Interim Action Work Plan
Bothell Landing Site
Revision No. 2

City of Bothell™

April 2010

Parametrix

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Interim Action Work Plan
Bothell Landing Site
Revision No. 2

Prepared for

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CITATION

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CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.

3/14/10

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Checked by David Dinkuhn, PE

Approved by Kenneth T. Fellows, PE

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ACRONYMS AND ABBREVIATIONS

ARAR	applicable relevant and appropriate requirement
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CFR	Code of Federal Regulations
City	City of Bothell
COPC	contaminant of potential concern
cy	cubic yards
DCA	dichloroethane
DCE	dichloroethene
Ecology	Washington State Department of Ecology
EPH	Extractable Petroleum Hydrocarbons
HVOC	halogenated volatile organic compound
IA	interim action
IAWP	Interim Action Work Plan
MNA	monitored natural attenuation
MTCA	Model Toxics Control Act
ORC™	oxygen release compound
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
PCE	tetrachloroethylene
RAO	remedial action objective
RI/FS	remedial investigation/feasibility study
Site	Bothell Landing site
SR	State Route
SVOC	semi-volatile organic compound
TCE	trichloroethylene
UST	underground storage tank
VC	vinyl chloride
VPH	Volatile Petroleum Hydrocarbons
WAC	Washington Administrative Code

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1. INTRODUCTION

This Interim Action Work Plan (IAWP) has been prepared for the Bothell Landing site (Site) located in Bothell, Washington (Figure 1-1). The IAWP is being conducted under Agreed Order DE 6294, 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 action(s).

The City currently owns the Site, a portion of which will accommodate the realignment of State Route (SR) 522, which is scheduled for construction in summer 2010. The interim action (IA) will be implemented during the construction window of the roadway realignment project. Remnant portions of the property will be redeveloped as part of the City's overall Downtown Revitalization Plan. In general, cleanup approaches discussed in this document will address anticipated future property uses as envisioned in the Downtown Revitalization Plan. Figure 1.1 from the Bothell Downtown Subarea Plan is provided in Appendix A for reference. The figure shows proposed future land uses in the vicinity of the Site.

1.1 PURPOSE

This IAWP was completed per 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 IAWP is to present a general conceptual-level description of an interim action developed to address petroleum hydrocarbon-contaminated soil and groundwater associated with contamination attributed to former gas stations at the site. These contaminated media are described in detail in the draft RI/FS submitted by the City (Parametrix 2009). Any additional cleanup action that may be required at the Site will be addressed as an additional interim action and/or as a final cleanup action after the RI/FS is completed (see Section 2.2.3). The IAWP was developed using information obtained during Site investigations that began in 2007 and are ongoing. This IAWP 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 brief summary of the other cleanup alternatives evaluated in the draft RI/FS.
- A description of the proposed interim action and a summary of the rationale used for selecting the proposed alternative.
- A schedule for implementation of the interim action.

This IAWP also includes the Compliance Monitoring Plan (including a Sampling and Analysis Plan/Quality Assurance Project Plan) (Appendix B), which will be used during completion of interim action at the Site. The Health and Safety Plan (submitted under separate cover) guidelines will also be followed.

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2. SITE CONDITIONS

This section summarizes the Site history and the human health and environmental concerns.

2.1 SITE HISTORY

The approximately 2.8-acre Site is located at 18120, 18126, and 18132 Bothell Way, and 10001 Woodinville Drive, Bothell, Washington (Tax Parcel Nos. 9457200015 and 9457200020). The Site currently contains two single-story restaurants in the northeast and northwest corners of the property and two multi-tenant retail and office buildings in the southern portion of the Site. The remainder of the Site is covered with asphalt-paved parking and landscaping (Figure 2-1).

Two service stations were reportedly located on the northeastern quadrant of the Site from the 1930s to the 1970s along with mixed commercial activity (ECOSS 2008; HWA 2007). The stations were demolished in the 1970s. The underground storage tanks (USTs) associated with the stations were removed during the 1970s reconstruction (HWA 2007) and in 1998 when the City purchased the north-central portion of the Site at 10001 Woodinville Way as part of a roadway widening and Rotunda Park project. Various Site soil and groundwater investigations have taken place since 1998. For a more detailed discussion of the Site history, physical characteristics, and previous investigations please see the draft RI/FS (Parametrix 2009). The IA implemented at the site will remediate the soil and groundwater affected by the release of petroleum hydrocarbons from the former service stations in the northeastern portion of the property.

2.2 HUMAN HEALTH AND ENVIRONMENTAL CONCERNS

The following sections include a discussion of the nature and extent of Site contamination to be addressed by the proposed interim action, a summary of the Site contaminants of potential concern (COPCs), and an assessment of risk.

2.2.1 Soil

This section summarizes the nature and extent of soil contaminated with COPCs that will be addressed by the proposed interim action.

2.2.1.1 Petroleum Hydrocarbons (including BTEX)

Petroleum releases in the vicinity of the historical gas stations and USTs have been well documented (Parametrix 2009). The estimated horizontal extent of petroleum-contaminated soil is shown on Figure 5-1. Also shown are the approximate locations of the former gas stations (Riley Group 2007; ECOSS 2008).

The historical and recent sampling results indicate that soils within the contaminated soil footprint contain gasoline; diesel; motor oil; benzene, toluene, ethylbenzene, and total xylenes (BTEX); and semi-volatile organic compounds (SVOCs), including naphthalenes at concentrations above the cleanup levels. Soil samples containing contaminants above the cleanup levels have been collected from depths ranging from 6 to 12 feet below ground surface (bgs). These depths of both observed and measured soil contamination are consistent with a “smear zone” in which soils within the range of annual water table fluctuations are contaminated by floating petroleum.

Monitoring wells have been installed to investigate potential impacts from petroleum migrating from the Hertz Rental Property to the west of the Site. Gasoline-, diesel-, and oil-range petroleum hydrocarbons were detected in the soil samples from the monitoring well borings but at concentrations below the screening criteria. The extent of potential petroleum contamination in soil has not been delineated on the Hertz Rental Property but it appears to be limited.

2.2.1.2 Metals

Limited sampling for metals has been conducted during previous investigations. Historically, some soil samples were analyzed for MTCA metals, which include arsenic, cadmium, chromium, lead, and mercury.

Barium and/or lead were detected above ecological indicator concentrations in soil samples collected from borings near the center of the Site at depths of 6 feet bgs each. These borings are located within the footprint of the future SR 522 alignment; therefore, paving to be completed following the interim action will eliminate the ecological receptor pathway. An apparent specific source for the barium and lead has not been identified. No other metals were detected in soil at concentrations above the ecological indicator concentrations. Evaluation of the lead and barium concentrations will be included in detailed terrestrial ecological evaluation to be performed as part of the ongoing RI activities for the Site, as well as in the final development of cleanup standards in the final RI/FS.

2.2.2 Groundwater

This section summarizes the nature and extent of groundwater contaminated with COPCs that will be addressed by the proposed interim action.

2.2.2.1 Petroleum Hydrocarbons (including BTEX)

Historical groundwater samples collected from Site wells have primarily been analyzed for petroleum hydrocarbons. During the RI, one constituent (benzene) was detected above the cleanup levels in a single well (MW-3). This is consistent with the historical data because MW-3 is located within the petroleum-contaminated soil footprint. The approximate area of petroleum-contaminated groundwater as estimated by HWA in 2007 is shown in Figure 5-1. Monitoring wells have been installed to investigate potential impacts from petroleum migrating from the Hertz Rental Property to the west of the Site. Specifically, gasoline- and oil-range petroleum hydrocarbons were detected in groundwater above MTCA A cleanup levels in soil probe HZ-B7 and non-aqueous phase liquid was observed during groundwater sampling in this boring (HWA 2008). HZ-B7 was advanced at the same approximate location as HZ-MW-10 shown on Figure 5-1. Note that wells BL-MW-6, HZ-MW-12, and HZ-MW-13 were installed during the RI to investigate groundwater in this area. No petroleum constituents were detected in any of the wells at the time (Parametrix 2009). An exception is a gasoline detection in HZ-MW-13 at a concentration well below the MTCA Method A cleanup level. Further investigation of groundwater impacts might be needed in this area for the final RI/FS for the Bothell landing site.

2.2.2.2 HVOCs

Groundwater contaminated with halogenated volatile organic compounds (HVOCs) from upgradient sources also represents a contaminant source. The contaminant source(s) cannot currently be attributed to a specific location but likely include two known current and former dry cleaning businesses that are located upgradient (north) from the property.

Historical groundwater samples collected from Site wells were analyzed for HVOCs. Historical results indicate that the source(s) of the HVOCs are located in the upgradient direction. In addition to the on-site wells, three upgradient wells have been sampled. Tetrachloroethylene (PCE), trichloroethylene (TCE), 1,2-dichloroethane (1,2-DCA), vinyl chloride (VC), 1,1-dichloroethene (1,1-DCE), and cis-1,2-dichloroethene (1,2-DCE) were detected in several wells. Only VC was detected at a concentration exceeding MTCA A cleanup levels in an on-site well (MW-3). The upgradient wells contained both PCE and VC at concentrations exceeding MTCA A cleanup levels.

Concentrations of HVOCs in groundwater appear to be more extensive to the north and east with the highest concentration of PCE observed approximately 100 feet upgradient of the Site. Generally, concentrations of PCE decrease towards the south.

Groundwater samples have been collected from differing depths within site wells to assess for vertical concentration gradients. Although only 1,2-DCA, cis-1,2-DCE, and chloroform were detected in the samples, a trend of increasing concentration with depth exists.

2.2.3 Summary of Contaminants of Potential Concern

Based on the draft RI/FS (Parametrix 2009), the COPCs for soil to be addressed by the proposed interim remedial action include:

- Total petroleum hydrocarbons (gasoline-, diesel-, and lube oil-range)
- Aromatic hydrocarbons (BTEX)
- Polycyclic aromatic hydrocarbons (PAHs; including naphthalenes)
- Metals (potentially, associated with waste oil)
- Polychlorinated biphenyls (PCBs; potentially, associated with waste oil)
- HVOCs.

For groundwater, COPCs include:

- Total petroleum hydrocarbons
- Volatile aromatic hydrocarbons (VOCs; including BTEX and HVOCs from upgradient sources)
- PAHs (potentially)
- Metals (potentially)

Characterization and remediation of the HVOCs in groundwater, including its source(s) will be addressed in the RI/FS.

2.2.4 Assessment of Risk

Potential exposure pathways developed under the draft RI/FS (Parametrix 2009) for the COPCs include the following:

- Current/future indoor retail worker:
  - Inhalation of vapors from the subsurface (groundwater and soil) in indoor air
  - Incidental soil ingestion and dermal contact
  - Direct ingestion of contaminated groundwater used as drinking water
- 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 groundwater in a trench or excavation

- Current/future resident or Site visitor (adult and child):
  - Inhalation of vapors from the subsurface (groundwater and soil) in indoor air
  - Incidental soil ingestion and dermal contact
  - Direct ingestion of contaminated groundwater used as drinking water
- 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 groundwater in a burrow
  - Potential groundwater to surface water (Sammamish River) pathway

Exposure to contaminants could occur via the complete exposure pathways described above. Based on the nature of the Site and the extent of contamination, current risks appear limited. The likely greatest potential risk to human receptors is inhalation of contaminant vapors in the workplace. Note, however, that only one of the occupied buildings on the Site is underlain (partially) by contaminated soil and groundwater with the potential to cause vapor intrusion. The second most likely exposure risk is to construction workers during soil-disturbing activities. Ecological receptors have limited risk of exposure because the majority of the Site contains buildings or pavement. However, this risk increases under the future development scenario under which approximately the southern third of the Site may become park space (see Figure 1.1 in Appendix A).

3. APPLICABLE STATE AND FEDERAL LAWS

This section discusses the applicable state and federal laws for the interim action including applicable or relevant and appropriate requirements (ARARs), cleanup standards, and remedial action objectives.

3.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Cleanup actions under MTCA (WAC 173-340-710) require the identification of all ARARs. Potential ARARs were identified for each medium of concern in the draft RI/FS (Parametrix 2009). The applicable state and federal laws specific to the selected IA are shown in Table 3-1.

3.2 REMEDIATION LEVELS

Based on the COPCs developed within the draft RI/FS, a list of specific hazardous substances and their associated remediation levels was developed. Selected remediation levels are listed below and are also provided for each individual COPC in Table 3-2.

The following remediation levels were selected for soil:

- MTCA Method A Soil Cleanup Levels for Unrestricted Land Use (WAC 173-340, Table 740-1)

MTCA Method A cleanup standards are appropriate for soil because they are protective of human health and groundwater. Terrestrial ecological receptors will be protected under the future property development scenario, which includes the placement of pavement, buildings, and associated hardscape over the entire IA footprint (refer to Figure 1-1 in Appendix A). The placement of these types of soil covers qualifies the IA area for an exclusion from a terrestrial ecological evaluation under WAC 173-340-7491(1)(b). It is acknowledged that an institutional control is required for this exclusion.

During the interim action, soil samples will be analyzed for EPH/VPH fractions (Extractable Petroleum Hydrocarbons and Volatile Petroleum Hydrocarbons, respectively) to evaluate Method B cleanup levels vis-à-vis the selected remediation levels and remediation conditions in the field.

For groundwater, the following remediation levels were selected:

- MTCA Method A Cleanup Levels for Groundwater (WAC 173-340, Table 720-1).

3.3 REMEDIAL ACTION OBJECTIVES

The following remedial action objectives (RAOs) have been established for the IA:

- Achieve MTCA Method A (and possibly Method B) soil and groundwater cleanup levels at the point of compliance, thus reducing or eliminating human exposure through direct contact and inhalation of vapors.
- Use permanent solutions to the maximum extent practicable (which includes consideration of cost-effectiveness).
- Verify the petroleum hydrocarbon-contaminated groundwater plume is stable or shrinking due to attenuation.
- Properly manage contaminated groundwater that may be generated during site development activities, and ensure that activities at the Site do not result in exposure to the contaminated groundwater that has migrated onto the Site.

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4. REMEDIAL ALTERNATIVES SUMMARY

In this section, remedial alternatives developed for the IA under the draft RI/FS (Parametrix 2009) are summarized. The draft RI/FS is still undergoing Ecology review and comment.

4.1 REMEDIAL ALTERNATIVE DEVELOPMENT

Three remedial alternatives to remediate petroleum-contaminated soil and groundwater were developed that meet the RAOs and MTCA requirements. Each alternative is summarized below.

4.1.1 Alternative 1 – Monitored Natural Attenuation

A monitored natural attenuation (MNA) alternative was developed to represent a cleanup approach involving a minimal level of effort and minimal (lower bound) costs. MNA consists of monitoring the Site groundwater plume over a long-term period (a monitoring period of 10 years was selected) to ascertain that natural attenuation is occurring. This alternative includes placement of a physical barrier over the Site's contaminated soils as part of new road construction and future redevelopment under the Downtown Bothell Subarea Plan. The capital costs for Alternative 1 total $25,000 and the operations and maintenance costs total $190,000 for a total alternative cost of $215,000.

4.1.2 Alternative 2 – In Situ Chemical Oxidation

An alternative based on in situ chemical oxidation was developed to represent an aggressive and innovative cleanup approach with a relatively high level of effort and upper bound costs.

Alternative 2 would be implemented as an in situ remedial technology for the Site prior to the construction of the realignment of SR 522. RegenOx™ by Regenesis is the product used as the basis for Alternative 2. A bench-scale treatability test would be conducted to help refine the full-scale treatment approach for Alternative 2. Alternative 2 would consist of mixing the RegenOx™ with the contaminated soil to a depth of 10 feet bgs using specialized soil mixing equipment. This depth corresponds with the anticipated average maximum depth of contamination. The area of contaminated soil to be treated is approximately 10,400 square feet. Confirmation soil samples would be collected concurrent with the mixing.

Residual groundwater contamination would be treated using in situ enhanced bioremediation. The specific in situ enhanced bioremediation technology selected for the Site involves mixing oxygen release compound (ORC™) with the soil at the same time as the RegenOx™.

Groundwater monitoring would be conducted quarterly for 1 year after the cleanup to assess groundwater conditions and verify that the contaminated groundwater plume is not expanding.

The capital costs for Alternative 2 total $970,000 and the operations and maintenance costs total $58,000 for a total alternative cost of $1,028,000.

4.1.3 Alternative 3 – Excavation and Off-Site Disposal

An alternative consisting of excavation and off-Site disposal was developed to represent a level of effort and costs anticipated to fall somewhere between Alternatives 1 and 2.

Approximately 3,370 cubic yards (cy) or 4,550 tons of contaminated soil would be excavated with heavy equipment to depths of up to 10 feet bgs. The soil quantities given represent a conservative estimate of the amount of contaminated soil present and are based on the historical and current sampling results for the Site. Soil that is confirmed to be contaminated would be trucked to a permitted landfill. Confirmation soil samples would be collected from the sidewalls and bottom of the excavation.

Residual groundwater contamination would be treated using ORC[TM] that is applied in slurry form with the soils used to backfill the excavation. ORC[TM] would only be applied to soils between the depths of 3 feet and 10 feet bgs (below the anticipated seasonal high groundwater elevation). The ORC application rate would be designed to treat the current extent of the petroleum plume.

Groundwater monitoring would be conducted quarterly for 1 year after the cleanup to assess groundwater conditions and verify that the contaminated groundwater plume is not expanding.

The capital costs for Alternative 3 total $831,000 and the operations and maintenance costs total $58,000 for a total alternative cost of $889,000.

4.2 REMEDIAL ALTERNATIVES COMPARISON

The three selected petroleum-contaminated soil and groundwater interim action alternatives were compared in accordance with MTCA regarding the following criteria:

- Each of the alternatives would be protective of human health and the environment through a combination of physical barriers, contaminant destruction or removal, and compliance monitoring.
- Alternatives 2 and 3 would be in compliance with cleanup standards in that MTCA A cleanup levels are expected to be met at the points of compliance for soil and groundwater. Alternative 1 would not meet this criterion.
- Each of the alternatives would be designed and implemented to meet the requirements of the ARARs.
- Each of the alternatives would conduct health and safety protection monitoring during implementation to ensure that the safety of workers, surrounding populations, and the environment are protected. Confirmation sampling performed for Alternatives 2 and 3 equate to the performance monitoring requirement and all alternatives include groundwater monitoring that would evaluate the long-term effectiveness of each alternative.

Table 4-1 summarizes the comparison of the alternatives. Effectiveness was evaluated in terms of protectiveness and ability to achieve the RAOs. The implementability of the alternatives depends on their technical feasibility, the availability of required resources, and administrative feasibility. Public concern reflects the anticipated level of adverse public reaction to each alternative. Costs were developed based on Engineer’s estimates and experience from past similar projects. Additional details appear in the draft RI/FS.

5. PROPOSED INTERIM ACTION

Excavation and removal of contaminated soil (Alternative 3) is the proposed alternative for the IA. This alternative includes excavating approximately 3,370 cy or 4,550 tons of contaminated soil with heavy equipment. Figure 5-1 shows an estimate of the footprint of the area of excavation. This footprint may change based on field screening conducted during the excavation activities. The actual extent of excavation will be based on the results of field screening and confirmation soil samples. The estimated volume of contaminated soil assumes that contaminated soils exist between the depths of 3 and 10 feet bgs within the contaminated soil footprint. Soils between the depths of 0 and 3 feet bgs are above the smear zone and are assumed to be clean (1,450 cy). Clean and contaminated soil would be segregated based on field screening and stockpiled separately for confirmation testing. Soil that is confirmed to be contaminated would be trucked to a permitted Subtitle D landfill. A possible candidate landfill is the Roosevelt Regional Landfill in Klickitat County. Confirmation soil samples would be collected from the sidewalls and bottom of the excavation. It is estimated that a total of about 35 excavation and stockpile samples would be collected and tested. Once the excavation is confirmed to be clean, it would be backfilled with a combination of clean stockpiled soil and imported structural fill. Proposed sample locations and the analytical testing program are provided in the Compliance Monitoring provided in Appendix B.

Excavation to a depth of 10 feet bgs will require excavation dewatering. The average depth of groundwater is approximately 6 feet bgs. Dewatering water would be treated to remove sediments and contaminants to meet treatment standards before being discharged to the sanitary sewer. Treatment standards would be specified in a disposal permit obtained from the utility owner.

Residual groundwater contamination will be treated using ORC™ that is applied in slurry form with the soils used to backfill the excavation at a dosing rate of 1.5 pounds per cubic yard. ORC™ would only be applied to soils below the anticipated seasonal high groundwater elevation.

Groundwater monitoring would be conducted quarterly for 1 year after the interim action to assess groundwater conditions and verify that the contaminated groundwater plume is not expanding. The appropriateness of further groundwater monitoring for the IA will be evaluated at that time. It is anticipated that removal of the contaminant source (the contaminated soil) and ORC™ application would result in a shrinking plume that would ultimately disappear. Three new monitoring wells and two existing wells will be used for monitoring (Figure 5-1).

Following the soil removal, residual groundwater concentrations may remain that present a potential risk for vapor intrusion. A vapor intrusion evaluation would be conducted for any occupied building constructed within 100 feet of the contaminated soil footprint or groundwater plume. If warranted, vapor intrusion mitigation measures will be designed into the new building(s).

This alternative is protective of human health and the environment, attains federal and state requirements that are applicable or relevant and appropriate, complies with anticipated cleanup standards, meets the threshold criteria, provides a high likelihood of achieving the RAOs within a reasonable restoration time frame, and meets the additional performance criteria. Furthermore, the risks discussed in Section 2.2.4 are mitigated under the proposed interim action because the action either removes the contaminants to levels that are protective to receptors or places engineering and administrative controls to prevent exposure.

It is recommended that the groundwater samples collected be analyzed for HVOCs during each of the four quarterly monitoring events to provide an ongoing assessment of concentration trends. These data would aid potential future planning efforts regarding cleanup of the upgradient HVOCs sources. In addition to monitoring for HVOCs, any future Site development activities should include the proper management and disposal of contaminated groundwater generated by construction activities.

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6. SCHEDULE

The proposed interim action is planned to be implemented during the construction window of the realignment of SR 522. Construction activities for the realignment of SR 522 are anticipated to begin during the second quarter of 2010 including the excavation, removal and disposal of contaminated soil and backfill in the remediation areas. The environmental remediation activities will commence within 90 days of the start of construction.

Groundwater monitoring in the area of the excavation will be conducted for a minimum of 1 year after the completion of the SR 522 realignment to verify the source of groundwater contamination has been removed and remediation levels for Site contamination have been met.

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7. REFERENCES

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

ECOSS (Environmental Coalition of South Seattle). 2008. City of Bothell Revenue Development Area, Report on Tax Parcel History through 1972. Prepared for King County Solid Waste Division. January 2008.

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FIGURES

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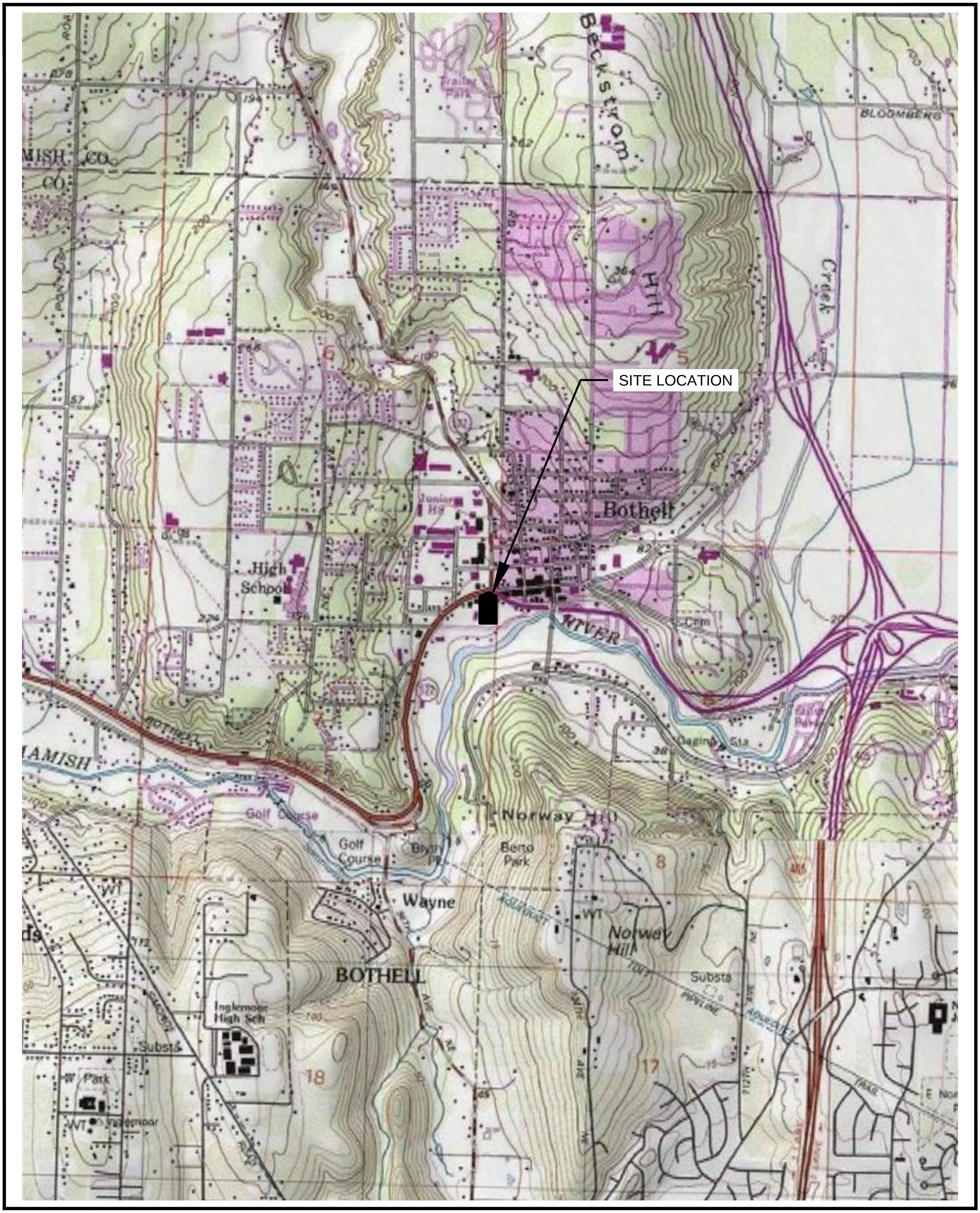

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Image Source: USGS Bothell Quadrangle 1981

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Figure 1-1
City of Bothell
Bothell Landing Site
Site Vicinity

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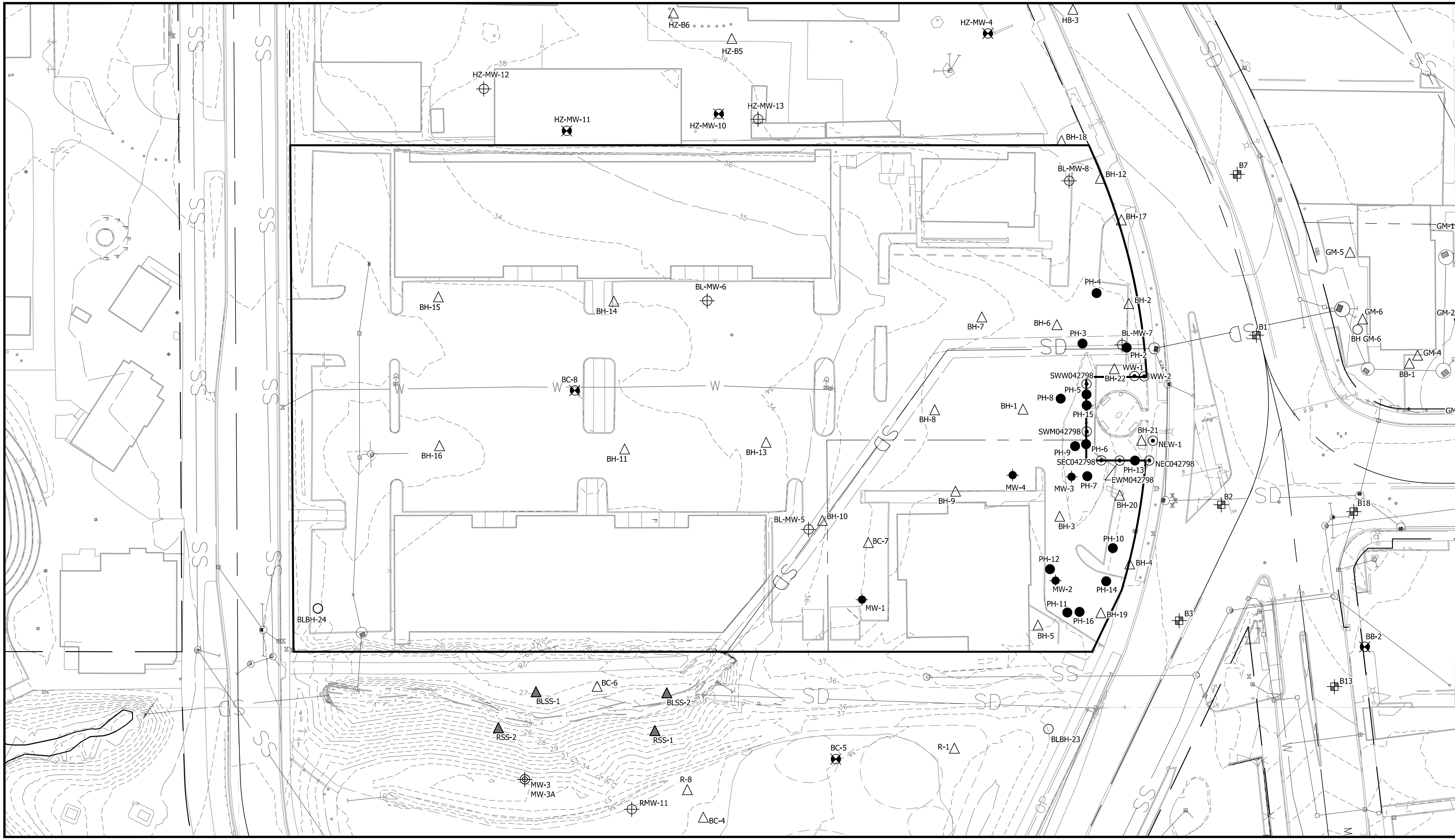

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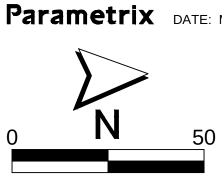

LEGEND

- 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
- PROPERTY BOUNDARY
- EXISTING BUILDING
- GTI 1992 FORMER WELL LOCATIONS

Figure 2-1
City of Bothell
Bothell Landing Site
Site Plan

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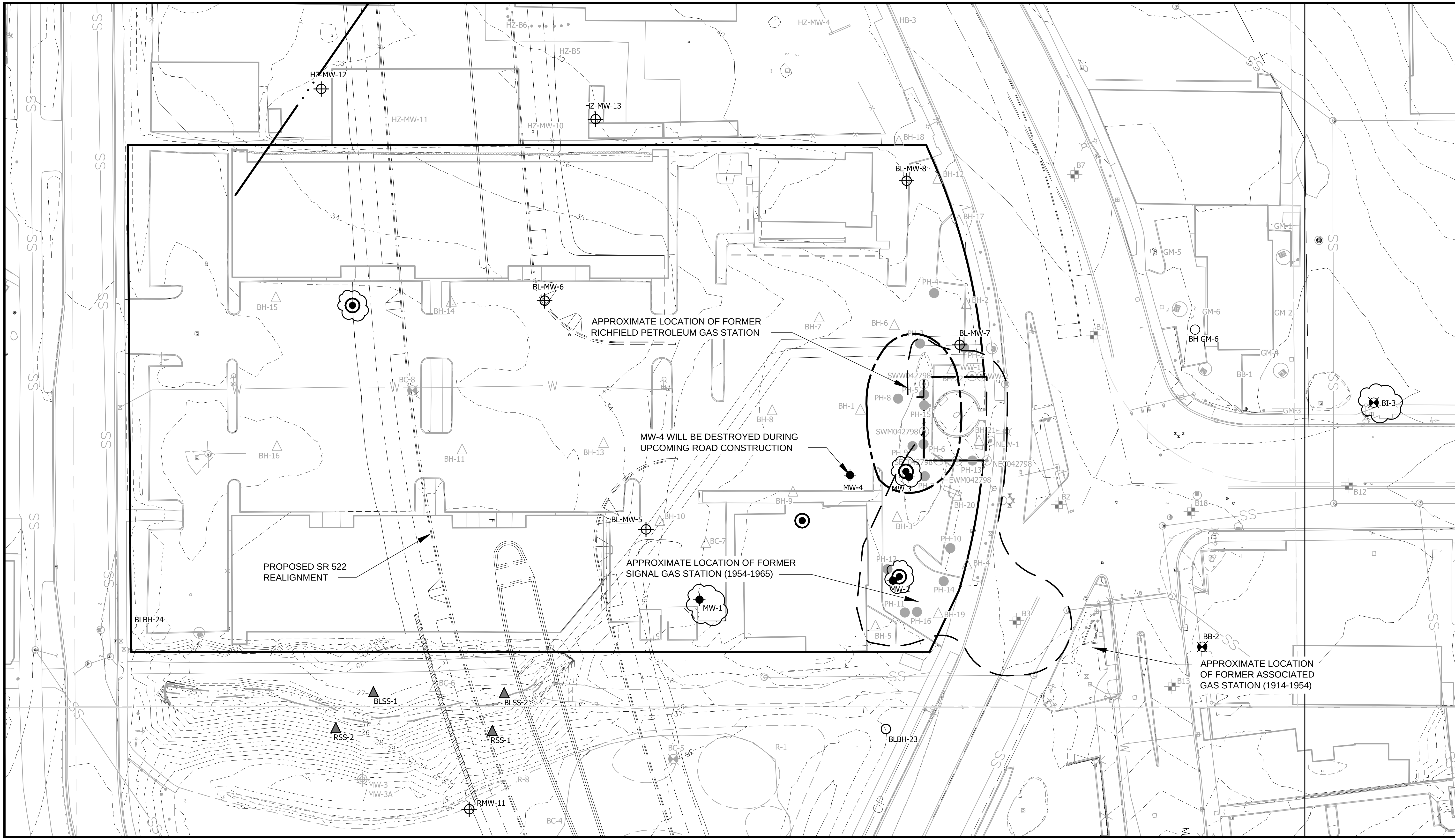

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LEGEND

- PSI 1998 CLOSURE SAMPLE LOCATIONS
- KLEINFELDER 1999 BORING LOCATIONS
- KLEINFELDER 1999 WELL LOCATIONS
- HWA 2007 PHASE II ESA BORINGS
- HWA 2007 PHASE II ESA 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
- GTI 1992 FORMER WELL LOCATIONS
- PROPOSED NEW MONITORING WELL
- MONITORING WELL TO BE USED FOR LONG TERM MONITORING
- PROPERTY BOUNDARY
- APPROXIMATE FOOTPRINT OF PETROLEUM CONTAMINATED SOIL TO BE ADDRESSED UNDER PROPOSED INTERIM ACTION
- APPROXIMATE PETROLEUM - IMPACTED GROUNDWATER PLUME TO BE ADDRESSED UNDER PROPOSED INTERIM ACTION

Figure 5-1
City of Bothell
Bothell Landing Site
Proposed Interim Remedial Action

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TABLES

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Table 3-1. Specific Applicable or Relevant and Appropriate Requirements (ARARs)

ARAR	Applicability
Soil	
Model Toxics Control Act (WAC 173-340-740, -747)	MTCA cleanup levels are applicable to Site soil.
Groundwater	
Model Toxics Control Act (WAC 173-340-720)	MTCA cleanup levels are applicable to Site groundwater.
Surface Water	
Model Toxics Control Act (WAC 173-340-730)	MTCA cleanup levels are applicable to the Site if remedial activities cause a release to surface water.
Air	
Washington Clean Air Act and Implementing Regulations (WAC 173-400; WAC 173-460; WAC 173-490)	Applicable for excavation activities.
Model Toxics Control Act (WAC 173-340-750)	MTCA cleanup levels are applicable to the Site if remedial activities cause a release to air.
Miscellaneous	
Protection of Wetlands, Executive Order 11990 (40 CFR Part 6, Appendix A)	This Act would be potentially applicable to remedial activities at the Site.
Native American Graves Protection and Repatriation Act (43 CFR Part 10)	This Act is applicable to remedial actions at the Site because it is possible that the disturbance of Native American materials could occur as a result of work in subsurface excavations at the Site. Such materials are not known to be present at the Site, but could be inadvertently uncovered during soil removal.
National Historic Preservation Act (36 CFR Parts 60, 63, and 800)	This Act is applicable to subsurface work at the Site. No such sites are known to be present in the area.
Washington Hazardous Waste Management Act (WAC 173-303)	This regulation is applicable to handling of contaminated media at the Site. The contamination policy allows contaminated media to be consolidated within the same area of a site without triggering Resource Conservation and Recovery Act or Washington dangerous waste regulations.
Department of Transportation of Hazardous Wastes (49 CFR 105 – 180)	Applicable to remedial activities that involve the off-site transportation of hazardous waste.
Washington Solid Waste Handling Standards (WAC 173-350)	These regulations are applicable to solid nonhazardous wastes and are relevant and appropriate to on-site remedial actions governing contaminated media management.
Washington Water Well Construction Act Regulations (WAC 173-160)	These regulations are applicable to the installation, operation, or closure of monitoring and treatment wells at the Site.

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Table 3-2. Remediation Levels

	Medium of Concern	
	Soil	Groundwater
Hazardous Substance	MTCA A[a] (mg/kg)	MTCA A[b] (ug/L)
Benzene	0.030	5
Toluene	7	1000
Ethylbenzene	6	700
Xylenes (total)	9	1000
Diesel	2,000	500
Motor Oil	2,000	500
Gasoline	30/100[c]	800/1000[d]
1-Methylnaphthalene	5	160[e]
2-Methylnaphthalene	5	160[e]
Benzo(a)pyrene	0.1[f]	0.1[f]
Arsenic	20	5
PCBs	1	-
Barium	-	-
Cadmium	2	5
Chromium	2,000[g]	50
Lead	250	15
Mercury	2	2
Selenium	-	-
Silver	-	-
Chromium	2,000[g]	50
Lead	250	15
Mercury	2	2
Selenium	-	-
Silver	-	-

mg/kg = milligrams per kilogram

PCBS: Polychlorinated biphenyls.

ug/l = micrograms per liter

[a] Model Toxics Control Act Method A Unrestricted Land Uses Table 740-1 (WAC 173-340-900). Remediation will achieve Method A levels. During interim action, excavation samples will be assessed using EPH/VPH analyses and MTCA three-phase worksheet in order to determine cleanup levels protective of direct contact and groundwater for any remaining soil contamination.

[b] Method A Cleanup levels for groundwater Table 720-1 (WAC 173-340-900)

[c] If benzene detected then 30 mg/kg, if no benzene then 100 mg/kg.

[d] If benzene detected then 800 ug/l, if no benzene then 1000 ug/l.

[e] Total value for naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene.

[f] Total using toxicity equivalency for all carcinogenic PAHs.

[g] Chromium III concentration

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Table 4-1. Detailed Alternatives Analysis

Alternative	Description	Effectiveness	Implementability	Public Concern	Estimated Cost
1. Monitored Natural Attenuation	Leave contamination in place. Monitor groundwater biannually for a minimum of 10 years.	Low	High	High	$215,000
2. In Situ Chemical Oxidation	Treat contamination in situ using soil mixing, chemical oxidation, and application of ORC™. Monitor groundwater quarterly for 1 year minimum.	Medium	Medium	Low	$1,028,000
3. Excavation and Off-Site Removal	Excavate and remove contaminated soils. Treat groundwater with application of ORC™ in backfill. Monitor groundwater quarterly for 1 year minimum.	High	High	Low	$890,000

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APPENDIX A

Bothell Downtown Subarea Plan (Figure 1.1)

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C. The Envisioned Future Downtown

This section provides an overview of the desired physical outcomes intended to result from implementing the combined regulations and planned public actions contained in this Plan.

The Downtown Subarea is composed of a multitude of privately held properties and miles of public rights-of-way under public ownership. The overarching purpose of the Downtown Plan is to orchestrate investment in changes made to this multiplicity of properties to produce greater value than any separate development could achieve, by providing a common purpose that all investors can rely upon, contribute to, and derive value from. This section describes the common purpose to which all investments shall be directed: a vision of the future that is sufficiently specific to provide a common purpose, yet broad enough to respond to opportunities and to the changes in the marketplace that will inevitably arise.

Note: The specific outcomes described and illustrated in this section are not part of the formal regulating code, and new development proposals will not be required to mimic the specific designs presented in the illustrations.

Fig. 1.1 A vision of potential future development in downtown Bothell showing one scenario focusing on redevelopment in the core area

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APPENDIX B

Compliance Monitoring Plan

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TECHNICAL MEMORANDUM

Date:	April 2, 2010
To:	Nduta Mbuthia, City of Bothell Project File
From:	Scott Elkind
Subject:	Bothell Landing Interim Action Compliance Monitoring Plan
cc:	Ken Fellow Steve Fuller David Dinkuhn
Project Number:	555-1647-019 (02/0212)
Project Name:	Bothell IAWP

INTRODUCTION

In conjunction with the realignment of State Route (SR) 522 and the southward extension of SR 527, the City of Bothell (City) is redeveloping the City's downtown core, which includes the Bothell Landing Commercial Center Site (Site). The Site is currently under Agreed Order (AO) No. 6294 with the Washington State Department of Ecology (Ecology) to perform a Remedial Investigation/ Feasibility Study (RI/FS), implement interim action(s), and develop a cleanup action plan (CAP) that will address known contamination, related to historical releases of hazardous substances at the site. Excavation of contaminated soils is to take place in compliance with the AO as an Interim Action (IA) for the remediation of petroleum-hydrocarbon-contaminated soils and groundwater at the site. The IA will be implemented during the construction window of the roadway realignment project. Remnant portions of the property will be redeveloped as part of the City's overall Downtown Revitalization Plan. At the current time, the IA for the Site is planned to consist of the following:

- Source removal by excavation of contaminated soils.
- Quarterly groundwater monitoring.

This Compliance Monitoring Plan (CMP) has been prepared in accordance with Washington Administrative Code (WAC) 173-340-410, Compliance Monitoring Requirements. The CMP will be used to:

- Ensure contaminated soil exceeding appropriate cleanup standards is removed during the IA through sampling of the excavation sidewalls and bottom.
- Ensure IA activities are conducted in a safe manner.
- Confirm the effectiveness of the IA through groundwater monitoring following completion of the IA.

There are three types of compliance monitoring: protection, performance, and confirmational monitoring. A description of each is presented in the following sections.

PROTECTION MONITORING

The purpose of protection monitoring is to confirm that human health is adequately protected during construction. Health and safety protocols, including monitoring requirements, are specified in the site-specific health and safety plan (HASP). The HASP has been completed as a separate document.

PERFORMANCE MONITORING

The purpose of performance monitoring is to confirm that the IA has attained appropriate cleanup standards. For the Site, this will include the collection of soil samples from the sidewalls and bottom of the excavation to confirm complete removal of contaminated soil during the IA and collection of soil stockpile samples to help determine proper disposal and/or re-use options. Sample collection procedures, required chemical analyses, and other requirements for performance monitoring are presented in the Compliance Monitoring Quality Assurance Project Plan (CMQAPP) included as Attachment 1 to this technical memorandum. The CMQAPP includes the appropriate cleanup levels necessary to assess soil quality and evaluate the need for continued excavation to achieve the necessary cleanup goals.

CONFIRMATIONAL MONITORING

The purpose of confirmational monitoring is to confirm the effectiveness of the soil IA. This will be accomplished by conducting four quarters of groundwater monitoring following completion of the soil IA. Groundwater purging and sample collection procedures, required chemical analyses, and other requirements for confirmational monitoring are presented in the CMQAPP included as Attachment 1 to this technical memorandum.

ATTACHMENT 1

Compliance Monitoring Quality Assurance Project Plan

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Compliance Monitoring Quality Assurance Project Plan Bothell Landing Site
Revision No. 2

Prepared for

City of Bothell
9654 NE 182nd Street
Bothell, WA 98011

Prepared by

Parametrix
411 108th Avenue NE, Suite 1800
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April 2010 | 555-1647-019 (02/0212)

CITATION

Parametrix. 2010. Compliance Monitoring Quality Assurance Project Plan. Bothell Landing Site. Revision No. 2. Prepared by Parametrix, Bellevue, Washington. April 2010.

CERTIFICATION

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned.

FOR

Prepared by Scott Elkind, PE

Checked by David Dinkuhn, PE

Approved by Kenneth T. Fellows, PE

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ACRONYMS AND ABBREVIATIONS

AO	Agreed Order
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, xylenes
CFR	Code of Federal Regulations
City	City of Bothell
CLP	Contract Laboratory Program
COPCs	contaminants of potential concern
CMQAPP	Compliance Monitoring Quality Assurance Project Plan
cy	cubic yard
DO	dissolved oxygen
DQIs	data quality indicators
DQOs	Data Quality Objectives
Ecology	Washington State Department of Ecology
EDD	electronic data deliverable
EIM	Environmental Information Management
EPA	U.S. Environmental Protection Agency
ESA	Environmental Site Assessment
gpm	gallon per minute
GPS	global positioning system
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HVOCs	halogenated volatile organic compounds
IA	Interim Action
IAWP	Interim Action Work Plan
ID	inside diameter
IDW	investigation derived waste
MS/MSD	matrix spike/matrix spike duplicate
MTCA	Model Toxics Contol Act
NTUs	nephelometric turbidity units
OD	outside diameter
ORC	oxygen releasing compound
ORP	oxidation-reduction potential
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls

ACRONYMS AND ABBREVIATIONS (CONTINUED)

PID	photoionization detector
PQL	practical quantitation limit
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RI/FS	Remedial Investigation/Feasibility Study
RPD	relative percent difference
Site	Bothell Landing Commercial Center Site
SOPs	standard operating procedures
SR	State Route
TBD	to be determined
USTs	underground storage tanks
VOCs	volatile organic compounds
WAC	Washington Administrative Code

1. INTRODUCTION

In conjunction with the realignment of State Route (SR) 522 and the southward extension of SR 527, the City of Bothell (City) is redeveloping the City's downtown core, which includes the Bothell Landing Commercial Center Site (site). The site, located in Bothell, Washington, (Figure 1-1) is under an Agreed Order (AO) Number DE 6294 between the City and the Washington State Department of Ecology (Ecology) to conduct a remedial investigation/feasibility study (RI/FS), implement interim action(s), and submit a cleanup plan to address known soil contamination related to historical releases of hazardous substances at the Site.

This Compliance Monitoring Quality Assurance Project Plan (CMQAPP) is incorporated within the Interim Action Work Plan (IAWP) for the site, and has been prepared to fulfill the requirements of the Agreed Order per Washington Administrative Code (WAC) 173-340-410(1)(b), Performance Monitoring, and WAC 173-340-410(1)(c), Confirmational Monitoring. This CMQAPP describes the sample collection procedures, analysis, and defines the Data Quality Objectives (DQOs) and criteria for the project. Parametrix prepared this CMQAPP 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)

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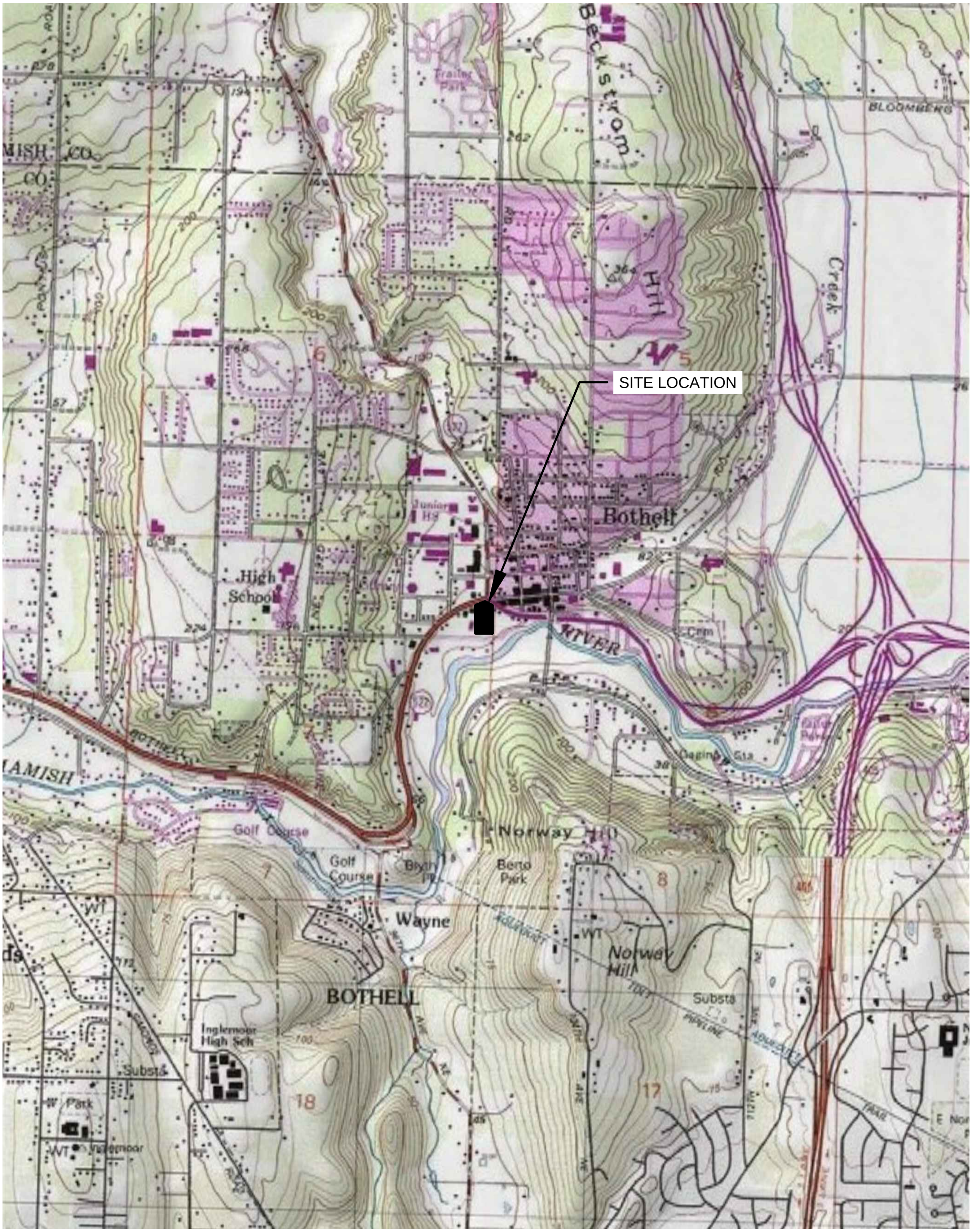

Parametrix DATE: Mar 31, 2010 FILE: BR1647019P02T0212_F-01-1

Image Source: USGS Bothell Quadrangle 1981

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SCALE IN FEET

Figure 1-1
City of Bothell
Bothell Landing Site
Site Vicinity

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2. 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 (Consultant Construction Manager or Environmental Consultant)	Coordinates with Contractor to obtain confirmational sampling during remedial construction; coordinates analytical laboratory testing of samples; prepares interim action reports.

2.2 PROBLEM DEFINITION/BACKGROUND

The site is an approximately 2.8-acre property and is located on the south side of the SR 527/SR 522 junction between the Sammamish River and downtown Bothell (Figure 2-1). Two single-story restaurants are located on the northern portion of the site, and two multi-tenant retail and office buildings are located on the southern portion of the site. The remainder of the site is covered by asphalt-paved parking and landscaping. The property was formerly the site of two gasoline service stations between the 1930s and 1970s. The stations were demolished during site redevelopment in the 1970s and the underground storage tanks (USTs) associated with the stations were reportedly removed at that time (HWA 2007). The site was the subject of several environmental investigations dating between 1998 and 2009 which included:

- UST Removal and Site Assessment performed by PSI in 1998 (PSI 1998).
- Phase I Environmental Site Assessment (ESA) performed by Riley Group in 2007 (Riley Group 2007).
- Phase II ESA performed by Kleinfelder in 1999 (Kleinfelder 1999a).
- Well installation and groundwater sampling report performed by Kleinfelder in 1999 (Kleinfelder 1999b).
- Annual groundwater monitoring and report performed by Kleinfelder in 2006 (Kleinfelder 2006).
- Phase II ESA performed by HWA in 2007 (HWA 2007).
- Remedial Investigation and Feasibility Study (RI/FS) performed by Parametrix in 2009 (Parametrix 2009).

Based on the RI/FS, the primary contaminants at the site are petroleum hydrocarbons. However, the following contaminants of potential concern (COPCs) may be present in soil based on site history:

- Total petroleum hydrocarbons (gasoline-, diesel-, and lube oil-range)
- Aromatic hydrocarbons (benzene, toluene, ethylbenzene, xylenes [BTEX])

- Polycyclic aromatic hydrocarbons (PAHs)
- Metals
- Polychlorinated biphenyls (PCBs)

For groundwater, COPCs include:

- Total petroleum hydrocarbons
- Aromatic hydrocarbon
- PAHs
- Metals
- Halogenated volatile organic compounds (HVOCs) (from off-site sources)

To satisfy the AO requirements, an IAWP was developed for the implementation of an Interim Action (IA) which will be performed to remediate COPCs which are present in soil and groundwater and which are originating from on-site sources.

This CMQAPP describes sample collection procedures and quality assurance and control methods to ensure representative data is collected during the IA.

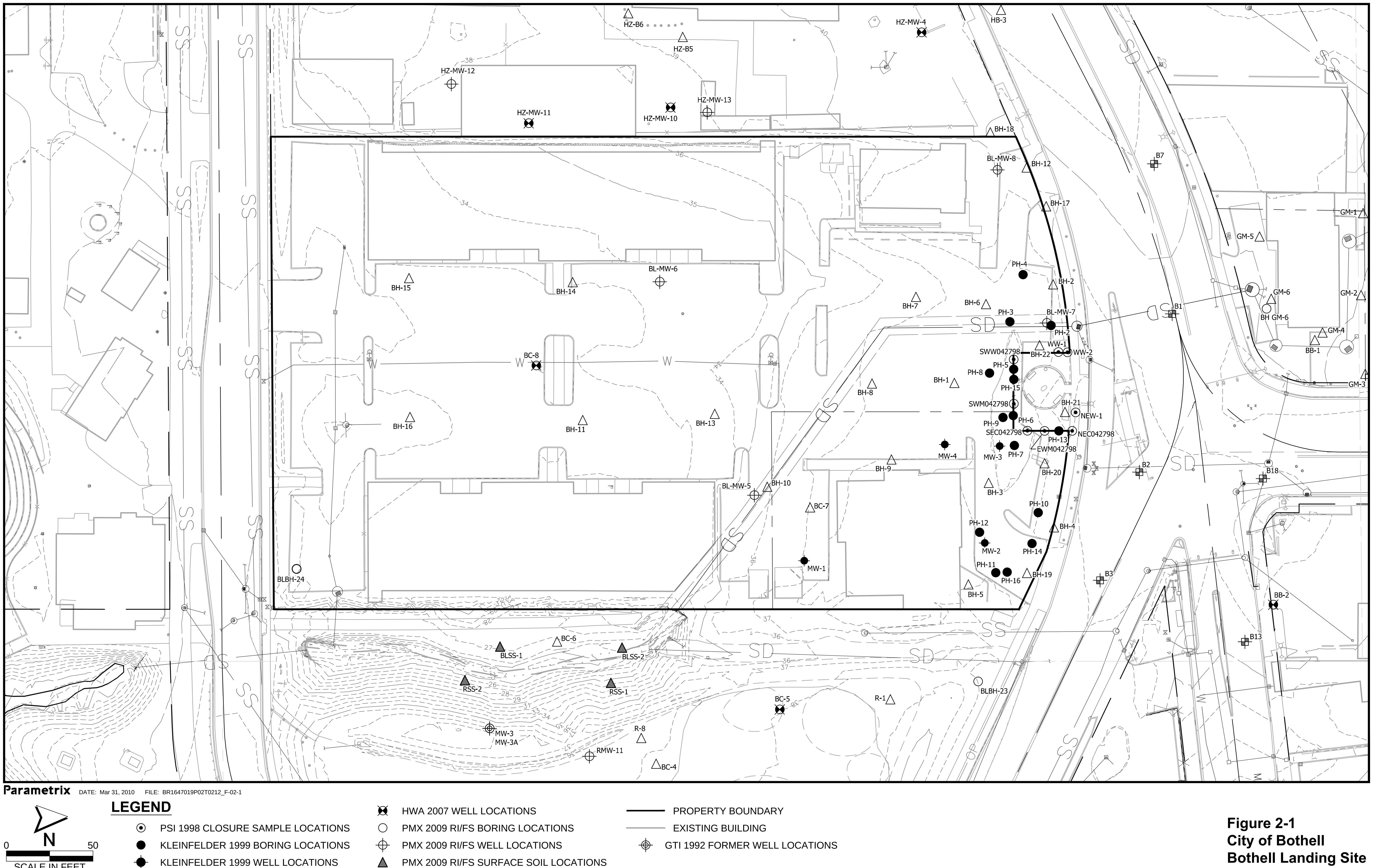
2.3 TASK DESCRIPTION

Based on the results of the RI/FS, the recommended alternative for soil cleanup was excavation and off-site disposal. At the current time, the IA is planned to consist of:

- Source removal by excavation in the area outlined in Figure 3-1.
- Residual groundwater contamination treatment by Oxygen Release Compound (ORC^{TM})
- Quarterly groundwater monitoring to assess groundwater quality following the interim action.

In source excavations, performance monitoring samples will be collected at the bottom and sidewalls of excavations to confirm that remediation levels have been met. Stockpiles will also be sampled to confirm and characterize contaminant levels for disposal purposes. Sample results will be compared to remediation levels provided in Section 3.

Confirmational monitoring will be completed by conducting four quarters of groundwater monitoring following completion of soil removal.



Parametrix DATE: Mar 31, 2010 FILE: BR1647019P02T0212_F-02-1

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
- PROPERTY BOUNDARY
- EXISTING BUILDING
- GTI 1992 FORMER WELL LOCATIONS

Figure 2-1
City of Bothell
Bothell Landing Site
Site Plan

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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	Was the contaminated soil within the footprint of the remediation area removed?
Identify the Goal of the Study	Does contamination still exist at the selected locations? Are the contaminant levels above applicable cleanup levels? 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 Model Toxics Control Act (MTCA) Method A (residential) cleanup levels.
Specify Performance or Acceptance Criteria	The tolerable limits of uncertainty regarding the cleanup of contamination at the subject properties will be based on exceedance or non-exceedance of MTCA A cleanup levels. Tolerable limits on analytical results are determined by the Quality Assurance/Quality Control (QA/QC) criteria defined in this CMQAPP.
Develop the Plan to Obtain Data	Presented in this CMQAPP.

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

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, such as groundwater monitoring, if needed.

Preliminary results will be communicated verbally as they become available.

3. SAMPLING PROCESS DESIGN

3.1 SAMPLING PROCESS DESIGN

A site-specific sampling approach has been developed to provide performance and confirmational sampling in support of the IA. The IA will target the area of significant petroleum contamination identified during the RI (Figure 3-1). The approach used for the IA will involve source removal by excavation, residual groundwater contamination treatment by ORC, followed by four quarters of groundwater monitoring to assess short-term groundwater quality following source removal.

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

Table 3-1. Sampling Approach

		COPCs (Soil and Groundwater)	
Area	**No. Locations**	**Soil**	**Groundwater**
Pot Hole Samples	6	EPH/VPH, gasoline, diesel, and heavy oil	N/A
Interim Action Footprint - Excavation Sidewalls	10[a]	Gasoline, diesel, and heavy oil, BTEX, PAHs, PCBs[b], HVOCs[b], and RCRA Metals	N/A
Interim Action Footprint - Excavation Bottom	5[a]		
Contaminated Soil Stockpile (3,370 cy estimated)	7[c]	Gasoline, diesel, and heavy oil, BTEX, PAHs, HVOCs, and RCRA Metals	N/A
Clean Soil Stockpile (1450 cy estimated)	10	Gasoline, diesel, and heavy oil, BTEX, PAHs, and RCRA Metals	N/A
Groundwater	5	N/A	Gasoline, diesel, & heavy oil, BTEX, PAHs, RCRA Metals[d], and VOCs

[a] Additional performance monitoring sampling may be required based on the results for the initial sampling round.
[b] Three sidewall locations and two bottom locations will be sampled and analyzed for PCBs and HVOCs.
[c] The actual number of stockpile samples required for disposal may change based on the acceptance requirement of the proposed disposal facility.
[d] Groundwater will be analyzed for total and dissolved metals.
BTEX: Benzene, toluene, ethylbenzene, and xylenes.
COPCs: Contaminants of potential concern.
Cy: Cubic yards.
EPH/VPH = extractable petroleum hydrocarbons/volatile petroleum hydrocarbons.
HVOCs: Halogenated volatile organic compounds.
N/A = not applicable.
PAHs: Polycyclic aromatic hydrocarbons.
PCBs: polychlorinated byphenyls.
RCRA: Resource Conservation and Recovery Act list metals (As, Ba, Cd, Cr, Pb, Hg, Se, Ag).
VOCs: Volatile organic compounds.

The objectives of the sampling are to confirm that all COPCs have met established remediation levels in soil, landfill disposal requirements are met for soil disposal, and to monitor groundwater conditions to determine whether the ORC™ treatment was effective. Details of the cleanup are provided in the following sections.

Flexibility will be incorporated into the field work so that modifications can be made in the field to refine the strategy. An example would be adjusting the location of samples based on field observations.

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.

3.1.1 Excavation and Soil Removal

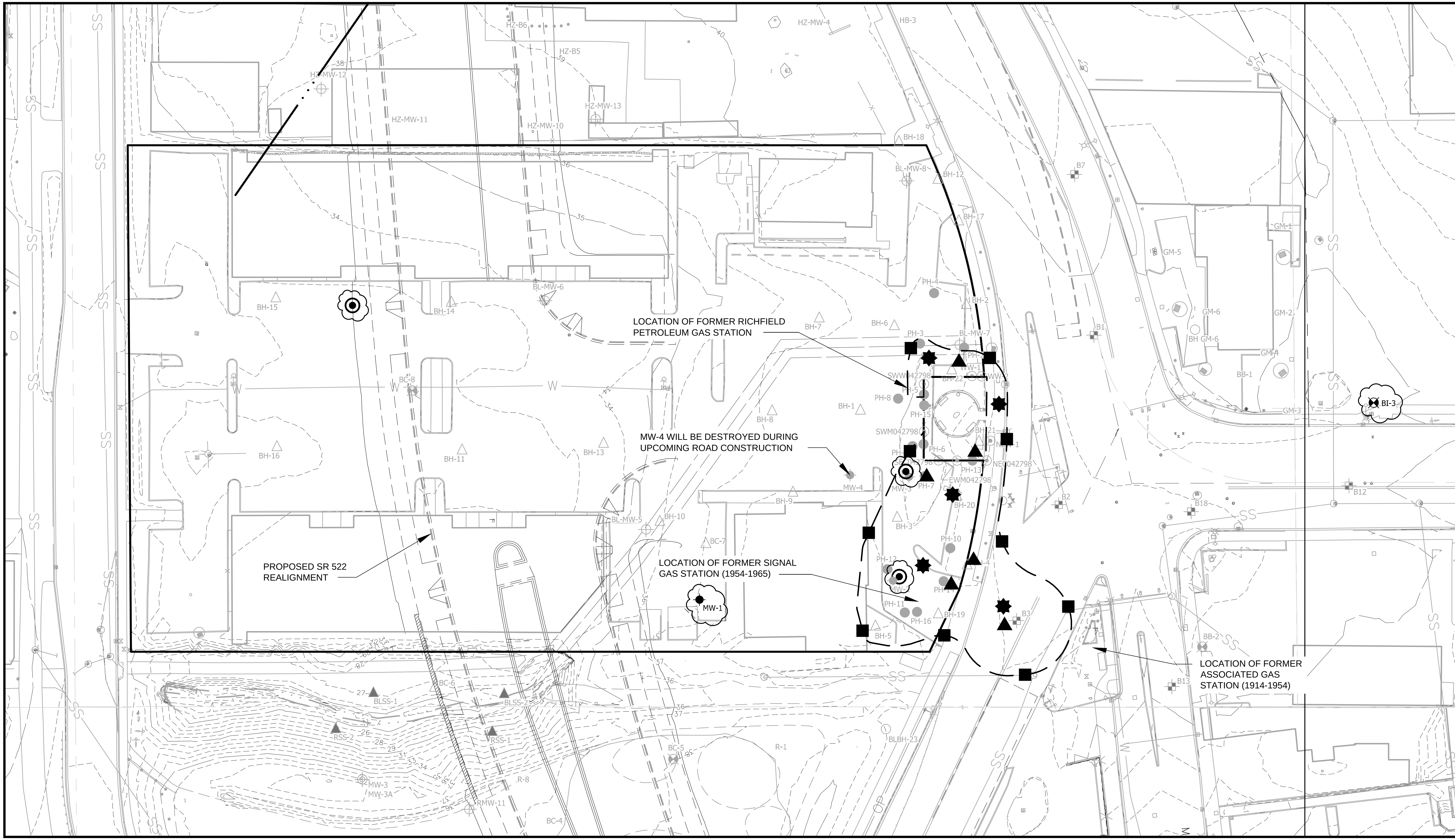
The concept for cleanup of source soils within the contaminated area (Figure 3-1) is to remove them by excavation. The extent of the excavation will be determined in the field by real-time observation and field screening. Once the apparent limit of contaminated soil is reached, the bottom and sidewalls of the excavation will be sampled to confirm removal. Both clean and contaminated soils will be stockpiled separately and sampled. Soils that are confirmed clean (by confirmation sampling following Ecology guidelines [Ecology 1995]) will be returned to the excavation as backfill. Contaminated soils will be transported to a permitted landfill. The remaining excavation will be backfilled with clean pit run. Removal of all contaminated soils will require excavation dewatering. Contaminated groundwater removed during dewatering will be treated to meet permit effluent standards and will be disposed of into the City's sanitary sewer system. Testing requirements for the treated water will be determined by the discharge permit to be obtained by the utility owner.

A description of these activities as well as the application of ORC™ and groundwater monitoring is provided below.

3.1.1.1 Contaminated Soil Removal

The following are the planned steps for contaminated soil removal:

- Prior to beginning excavation, collect soil samples for EPH/VPH analysis from pot holes excavated within in the contaminated soil footprint. Six soil samples for EPH/VPH analysis will be collected from the approximate locations shown on Figure 3-1. The samples will be analyzed on a two-day turnaround basis. A range of contaminated soils from moderately to highly contaminated will be targeted for sample collection. Field screening will be used to aid in sample selection. It is anticipated that the samples will be collected from near the groundwater table at an average depth of 6 feet bgs. The results of the EPH/VPH analyses will be input into Ecology's MTCATPH 11.1 spreadsheet model to determine TPH cleanup levels that are protective of direct contact and groundwater. All six samples will also be analyzed for gasoline, diesel, and heavy oil to provide additional information to be used in the evaluation. Protective concentrations derived using the model will be compared to the remediation levels established for the site. The results of the comparison will be reported in a brief technical memorandum that will be submitted to Ecology. At this time, an evaluation of the appropriateness of the remedial levels will be made in consultation with Ecology. Changes to the remedial levels will be established by agreement between the City and Ecology and will be implemented during the IA. The evaluation will be completed prior to the start of mass soil excavation activities on the Site.
- Excavate contaminated soils from the footprint shown on Figure 3-1. Field screen all excavated soils so that potentially clean and contaminated soils can be segregated and stockpiled separately. Conduct field screening using visual/olfactory methods and by headspace measurements, using a photoionization detector (PID).
- Excavate contaminated soils to limits defined by on-site field screening. Note that the contaminated soil footprint shown on Figure 3-1 is an estimate; the excavated footprint may change based on actual conditions encountered in the field. Determine the limits of the excavation using field screening and professional judgment. It is estimated that excavations as deep as 10 feet below ground surface (bgs) may be required.
- Conduct excavations during the dry summer months (May through September) so that the groundwater table is at the seasonal low. Plan excavations to occur as one of the initial steps in the grading phase of the road realignment.



Parametrix DATE: Apr 01, 2010 FILE: BR1647019P02T0212_F-03-1

N

0 50
SCALE IN FEET

LEGEND

- PSI 1998 CLOSURE SAMPLE LOCATIONS
- KLEINFELDER 1999 BORING LOCATIONS
- KLEINFELDER 1999 WELL LOCATIONS
- HWA 2007 PHASE II ESA BORINGS
- HWA 2007 PHASE II ESA 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
- GTI 1992 FORMER WELL LOCATIONS
- PROPOSED NEW MONITORING WELL
- MONITORING WELL TO BE USED FOR LONG TERM MONITORING
- PROPERTY BOUNDARY
- APPROXIMATE FOOTPRINT OF PETROLEUM CONTAMINATED SOIL TO BE ADDRESSED UNDER PROPOSED INTERIM ACTION
- PROPOSED SIDEWALL SAMPLE LOCATION
- PROPOSED BOTTOM OF EXCAVATION SAMPLE LOCATION
- PROPOSED EPH / VPH SAMPLE LOCATION

Figure 3-1
City of Bothell
Bothell Landing Site
Proposed Interim Remedial Action Sampling Locations

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- Collect confirmation soil samples from the base and sidewalls of the excavations. A total of 15 confirmation soil samples will be collected and analyzed for gasoline, BTEX, diesel, heavy oil, PAHs, RCRA metals and selected locations for HVOCs and PCBs. Proposed confirmation sample locations are shown on Figure 3-1. Samples are to be spaced 40 to 50 feet apart. Confirmation sample results will be compared to the remediation levels provided in Table 3-1 (as modified following the EPH/VPH evaluation if appropriate).
- Stockpile "contaminated" soil on plastic sheeting. Cover unworked stockpiles with sheeting at the end of each workday to prevent windblown dust migration and to prevent rainwater infiltration. It is anticipated that the soil will remain in the stockpiles for less than 30 days.
- Collect confirmation soil samples from both the clean and contaminated stockpiles. An estimated 1,450 cubic yards (cy) of clean soils and 3,370 cy of contaminated soils will be stockpiled. Based on this estimate, a total of 17 stockpile soil samples will be collected and analyzed for gasoline, BTEX, diesel, heavy oil, PAHs, and RCRA metals. Note that contaminated soil stockpile samples are not required to be analyzed for PAHs. TCLP samples will be analyzed based on the stockpile results and if required by the receiving landfill. Samples numbers may be reduced based on Ecology guidelines if stockpile volumes are less than estimated. Dispose of contaminated soil at a permitted landfill. At the current planning level, it is assumed that no soil will require disposal as hazardous waste.
- Restore site by backfilling using the stockpiled clean soil and imported pit run. Backfill using lifts no greater than 12 inches loose thickness. Compact backfilled soil to a density of at least 90 percent of the maximum value as determined by the Modified Proctor test. Perform a minimum of five density tests for each material type to confirm compaction.

3.1.2 Residual Plume Treatment

Mix 1.5 pounds per cy of ORC™ into backfilled soils located below the seasonal high groundwater table (approximately 3 feet bgs). This ratio was determined based on previous project experience. It is critical that the ORC is placed at sufficient depth so that it remains submerged beneath the groundwater table for most of the year. The ORC will slowly provide dissolved oxygen (DO) to the groundwater for about one year. The enhanced DO will encourage destruction of residual hydrocarbons in soil and groundwater by naturally-occurring aerobic bacteria in the soil. An estimated 4,050 pounds of ORC will be required.

3.1.3 Groundwater Monitoring

At the conclusion of the IA, four quarters of groundwater monitoring will be conducted using the five wells shown on Figure 3-1. Following these four events, the appropriateness of additional groundwater sampling events under the IA will be evaluated. Note that two of the wells proposed for sampling currently exist and that three new wells will be installed following completion of road construction. All groundwater samples collected will be analyzed for gasoline, diesel, heavy oil, volatile organic compounds (VOCs), PAHs, and RCRA metals (total and dissolved). VOCs sampling will allow for monitoring for the presence of halogenated VOCs from upgradient sources. Well installation and sampling shall be performed according to the procedures in Section 3.2.5.

3.1.4 Remediation Levels

As described in the RI/FS report (Parametrix 2009), the remediation levels listed in Table 3-2 are applicable under the IA.

Table 3-2. Remediation Levels

Hazardous Substance	Medium of Concern		
	Soil		Groundwater
	MTCA A [a] (mg/kg)	Background Concentration [b] (mg/kg)	MTCA A [c] (µg/L)
Benzene	0.030	-	5
Toluene	7	-	1,000
Ethylbenzene	6	-	700
Xylenes (total)	9	-	1,000
Tetrachloroethylene	0.05	-	5
Diesel	2,000	-	500
Motor Oil	2,000	-	500
Gasoline	30/100 [d]	-	800/1,000 [e]
1-Methylnaphthalene	5	-	160 [f]
2-Methylnaphthalene	5	-	160 [f]
Benzo(a)pyrene	0.1 [g]	-	0.1[g]
Arsenic	20	7	5
Barium	-	-	-
Cadmium	2	1	5
Chromium	2,000 [h]	48	50
Lead	250	17	15
Mercury	2	0.07	2
Selenium	-	-	-
Silver	-	-	-

mg/kg = milligrams per kilogram

µg/l = micrograms per liter

[a] Model Toxics Control Act Method A Unrestricted Land Uses Table 740-1 (WAC 173-340-900).

[b] Puget Sound concentrations from Table 1: Statewide & Regional 90th Percentile Values from Natural Background Soil Metals Concentrations in Washington State, Ecology Publication #94-115, October 1994.

[c] Method A Cleanup levels for groundwater Table 720-1 (WAC 173-340-900)

[d] If benzene detected then 30 mg/kg, if no benzene then 100 mg/kg.

[e] If benzene detected then 800 µg/l, if no benzene then 1,000 µg/l.

[f] Total value for naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene.

[g] Total using toxicity equivalency for all carcinogenic PAHs.

[h] Chromium III concentration

3.2 SAMPLING METHODS AND PROCEDURES

Descriptions of the specific sampling and laboratory methods for the project are presented in this section. The methods described are intended to supplement the SOPs provided in Appendix B. Sampling field forms are provided in Appendix A.

3.2.1 General Sampling Procedures

All soil samples will be placed into the appropriate sample containers using dedicated, disposable stainless steel or polyethylene spoons. All sample containers will be provided by the analytical laboratory. Bowls used during sample collection will be dedicated, disposable, and constructed of stainless steel, polyethylene, or aluminum. Samples for gasoline range organics (GRO) analyses will collected according to EPA Method 5035A (EPA 2004) as described in the soil sampling standard operating procedures. These samples will not be homogenized in the field.

Samples for non-volatiles analysis will be thoroughly homogenized before being placed in sample containers. Following sample collection, the location of all samples will be recorded using a handheld global positioning system (GPS) and sketched in the field logbook.

3.2.2 Summary of Sample Media, Numbers, and Analyses

Total numbers of samples to be collected are summarized by medium in Table 3-3. Numbers of samples include four consecutive quarters of groundwater monitoring.

Table 3-3. Summary of Sample Types, Analyses, and Number

Sample Medium	Analysis	No. Field Samples	No. Duplicate Samples	No. Trip Blanks	No. Rinsate Blanks	Total No.
Groundwater	Gasoline	16	4	4	4	28
	Diesel/Heavy Oil	16	4	-	4	24
	VOCs	16	4	4	4	28
	RCRA Metals	32	4	-	4	40
Soil[a]	Gasoline/BTEX	38	2	-	-	34
	EPH/VPH	6	-	-	-	6
	Diesel/Heavy Oil	38	2	-	-	34
	HVOCs[b]	5	1	-	-	6
	RCRA Metals	32	2	-	-	34
	PAHs	25	2	-	-	27
	PCBs[b]	5	1	-	-	6

[a] Includes confirmation samples and stockpile samples.

[b] Only selected 3 sidewalls and 2 bottom samples will be analyzed for HVOCs and PCBs.

BTEX: Benzene, toluene, ethylbenzene, and xylenes.
HVOCs: Halogenated organic compounds.
VOCs: volatile organic compounds.
PAHs: polycyclic aromatic hydrocarbons.
PCBs: polychlorinated biphenyls.
RCRA: Resource Conservation and Recovery Act.

3.2.3 Sample Containers, Preservation, and Holding Times

The following Table 3-4 provides a summary of potential sample analyses and specifications for containers, preservation, and holding times.

Table 3-4. Sample Containers, Preservation, and Holding Times

Analysis	Method	Matrix	Container	Preservation	Holding Time
Gasoline Range Organics/BTEX	NWTPH-Gx/5035A	Soil – 10g	2 – pre-weighed 40 mL vials (5 grams of sample per vial)	Cool to 4°C	48 hrs
		Groundwater	2 – 40 mL vials[a], zero headspace	HCL < pH 2 Cool to 4°C	14 days
Diesel and Heavy Range Organics	NWTPH-Dx	Soil	1 – 4 oz cwm	Cool to 4°C	14 days
		Groundwater	2 – 500 mL amber	HCL < pH 2 Cool to 4°C	14 days
EPH	EPH	Soil	1 – 4 oz cwm	Cool to 4°C	14 days
VPH	8021B	Soil	2 – pre-weighed 40 mL vials w/ stir-bar (5 grams of sample per vial)	Cool to 4°C	48 hrs
VOCs (HVOCs)	8260B	Soil	2 – pre-weighed vials w/stir-bar (5 grams of sample per vial)	Cool to 4°C	48 hrs
		Groundwater	3 – 40 mL vials[a], zero headspace	HCL < pH 2 Cool to 4°C	14 days
Metals	6010/7471A	Soil	1 - 4 oz cwm	Cool to 4°C	6 months
		Groundwater[b]	1 – 500 mL HDPE Dissolved samples field filtered through 0.45 µm filter	HNO_3 < pH 2 Cool to 4°C	6 months
PAHs	8270D SIM	Soil	1 – 4 oz cwm	Cool to 4°C	14 days
		Groundwater	2 – 1 L amber	Cool to 4°C	7 days
PCBs	8082	Soil	1 – 4 oz cwm	Cool to 4°C	14 days

[a] Teflon-lined silicon septum cap
[b] Groundwater will be analyzed for total and dissolved metals.

cwm: Clear, wide-mouth jar.
g: grams
EPH: Extractable petroleum hydrocarbons
HCl: Hydrochloric acid.
HDPE: High-density polyethylene.
mL: milliliter.
HNO_3: Nitric acid.
oz: ounce.
PAHs: polycyclic aromatic hydrocarbons
PCBs: Polychlorinated biphenyls.
µm: micron
VOCs: Volatile organic compounds.
VPH: Volatile petroleum hydrocarbons.

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 Monitoring Well Installation, Development, and Sampling

Monitoring wells will be installed by a licensed driller according to applicable Ecology regulations (Chapter 173-160 WAC). The monitoring wells will be constructed using 2-inch inside diameter (ID) polyvinyl chloride (PVC) casings fitted with 10-foot screens (with 0.01-inch or 0.02-inch slots). Well screens will be completed between the depths of 5 and 15 feet bgs. Completed well monuments will be flush-mounted; a 2-foot square concrete pad will be constructed around the monument as a surface seal.

Completed monitoring wells will be allowed to set for at least 24 hours before development to allow grout or bentonite chip seals to set. Development will be achieved by over-pumping at a flow rate of up to 1 gallon per minute (gpm) using an 5/8-inch outside diameter (OD) inertial lift pump fitted with a surge block. New polyethylene tubing shall be used for developing each well.

Water quality parameters (specific conductance, pH, temperature, and turbidity) will be measured during development. Development will be continued until the parameters stabilize as determined by the lack of appreciable change in measurement over several 3-minute monitoring periods or if a turbidity reading of 10 nephelometric turbidity units (NTUs) or less is attained. The 10 NTUs criterion is based on EPA sampling guidelines.

Groundwater sampling will be conducted no earlier than 24 hours following development to allow undisturbed water to enter the well column. Groundwater will be collected using a decontaminated, positive-displacement down-hole pump. New, disposable polyethylene tubing will be used at each sample location. For samples collected near the groundwater table, the sample pump will be lowered to 2-feet below the water surface.

Groundwater will be purged and sampled from the wells using low flow techniques. The measured purging and sampling flow rate shall be 0.5 liters per minute or less. Water quality parameters will be measured during sampling; purging shall be considered complete when the criteria shown in Table 3-5 are met over at least three 3-minute monitoring periods.

Table 3-5. Purging Stabilization Criteria

Parameter	Stabilization Criteria
pH	+\- 0.1 unit
Specific conductance	+\- 3%
Oxidation-reduction potential (ORP)	+\- 10 millivolts
Turbidity	+\- 10% (when greater that 10 NTUs)
Dissolved Oxygen	+\- 0.3 milligrams per liter

Filtered samples will be collected using a 0.45 micron filter placed in line with the sample tubing.

New well locations will be surveyed with an accuracy of +/- 1 foot horizontally and +/- 0.01 foot vertically.

3.2.6 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.

3.2.7 Investigation-Derived Waste

Investigation derived waste (IDW) from sampling activities will be containerized onsite in 55-gallon drums and staged onsite. A single composite sample from both water and soil will be collected for waste characterization. Disposal options for the IDW will be based on the analytical results of the IDW samples. Disposal shall be managed by the Owner's representative using a licensed waste disposal contractor.

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.

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 3-6.

Table 3-6. Sample Numbering Protocol

Site	BL = Bothell Landing
Matrix	SO = Soil GW = Groundwater TB = Trip blank water
Sampling Station	BLSW01 = Bothell Landing Sidewall Station 01 BLBT02 = Bothell Landing Bottom Station 02 BLMW09 = Bothell Landing Monitoring Well 09 (for continuity with past work, well identification will begin with 09) BLSP04 = Bothell Landing Stockpile Station 04
Sample Type/Sample Depth	0000 = Field sample collected at the surface 0000 = Trip blank water provided by the laboratory 1010 = Field duplicate collected at a depth of 1.0 feet 4115 = Rinsate sample collected following the collection of a sample at a depth of 11.5 feet.

Example:
BL-SO-SW01-0120 = Soil sample collected from the excavation sidewall station 01 at a depth of 12.0 feet.

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 groundwater. 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 3-7.

Table 3-7. Guidelines for Minimum QA/QC Samples for Field Sampling

	Field		
Media	**Field Duplicate**	**Trip Blank**	**Equipment Blank**
Soil and Groundwater	1 in 20	1 per cooler containing water VOCs and/or gasoline-range petroleum hydrocarbons samples	1 in 20 per equipment type, if reusable equipment is utilized

3.5.1.1 Field Duplicates

A minimum of one blind field duplicate will be analyzed per 20 samples. Field duplicates will be collected following field samples. Soil duplicates samples for non-volatiles analysis will be homogenized and split. Duplicate samples will be coded so the laboratory cannot discern which samples are field duplicates.

3.5.1.2 Trip Blanks

A trip blank shall accompany each cooler containing groundwater samples for gasoline and BTEX 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 VOCs, gasoline, and BTEX with the field samples.

3.5.1.3 Equipment/Rinsate Blanks

One equipment blank will be collected per 20 samples collected with non-disposable sampling equipment. Equipment blanks will be collected by capturing deionized water rinsed over (or through) sampling equipment after decontamination. Equipment blanks will be analyzed for the same constituents as the field samples.

3.5.2 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.

3.5.3 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. 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 that the CMQAPP 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 CMQAPP.
- 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 CMQAPP is not possible, the Manager will be consulted immediately. Any corrective action or field condition resulting in a major revision of the CMQAPP 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 CMQAPP, corrective action will follow the guidelines in SW-846 (EPA 1986). If analytical conditions do not conform to this CMQAPP, 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.

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5. 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 CMQAPP.

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:

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

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 FS 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. SCHEDULE

An estimated project schedule is provided below in Table 6-1. Note that the Contractor's schedule may vary as they will be working on multiple sites within the project vicinity.

Table 6-1. Schedule

Work Element	Commence/Implement By
Interim Action (Soil Excavation)	August , 2010
Install New Monitoring Wells	September 2010
1st Quarter Groundwater Sampling	September 30, 2010
2nd Quarter Groundwater Sampling	December 31, 2010
3rd Quarter Groundwater Sampling	March 30, 2011
4th Quarter Groundwater Sampling	June 30, 2011
Draft Interim Action Memorandum	August 15, 2011

Note: Groundwater monitoring memoranda will be submitted 6 weeks following completion of each groundwater monitoring event.

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