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REVISED DRAFT FEASIBILITY STUDY

Property:
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Prepared for:
Mrs. Katherine Burleson
1115 Bigelow Street Northeast
Olympia, Washington

Report Date:
February 26, 2013

DRAFT – ISSUED FOR ECOLOGY REVIEW

Revised Draft Feasibility Study

Prepared for:

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Former Olympia Dry Cleaners
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SoundEarth Strategies

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
µg/L	micrograms per liter
µg/m^3	micrograms/cubic meter
1,1-DCA	1,1-dichloroethane
1,2-DCA	1,2-dichloroethane
1,1-DCE	1,1-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane
AFCEE	Air Force Center for Environmental Excellence
Artesian Supply Well	private water supply well exhibiting artesian conditions, located along the west side of the Former Olympia Dry Cleaners Building
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CFR	Code of Federal Regulations
Cherry Street Q-Tip Trust Building	the building located on the western portion of the Cherry Street Q-Tip Trust Property.
Cherry Street Q-Tip Trust Property	Thurston County Assessor Parcel Number 78204000100 located at 1000 Cherry Street Southeast in Olympia, Washington; the property adjacent to the north of the Former Olympia Dry Cleaners Property
cm/sec	centimeters per second
COC	chemical of concern
cis-1,2-DCE	cis-1,2-dichloroethene
Dhc	*Dehalococcoides ethenogenes*
DPE	dual-phase extraction
DRPH	diesel-range petroleum hydrocarbon
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FAWP	Draft Revised Feasibility Analysis Work Plan
Former Olympia Dry Cleaners Building	a one-story, slab-on-grade building operating as a dry cleaning facility located on the western portion of the Former Olympia Dry Cleaners Property

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Former Olympia Dry Cleaners Property	the property located on Thurston County Assessor Parcel Numbers 782004000800 and 762004000700 located at 606 Union Avenue Southeast in Olympia, Washington
FS	feasibility study
FS Report	Feasibility Study Report
GRPH	gasoline-range petroleum hydrocarbon
HRC	hydrogen releasing compound
HVAC	heating, ventilation, and air conditioning
HVOC	halogenated volatile organic compound
JRW	JRW Bioremediation LLC
mg/L	milligrams per liter
MNA	monitored natural attenuation
MTCA	Washington State Model Toxics Control Act
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
North Alley	an unpaved alley approximately 6 feet in width that borders the north side of the Former Olympia Dry Cleaners Building
NWTPH	Northwest Total Petroleum Hydrocarbon (method)
O&M	operation and maintenance
ORP	oxidation-reduction potential
ORPH	oil-range petroleum hydrocarbon
PCE	tetrachloroethene
PGG	Pacific Groundwater Group
PRB	permeable reactive barrier
Qgof	latest Vashon fine-grained sediments
Qgos	latest Vashon recessional sand and minor silt (Tumwater Sand)
RAO	remedial action objective
RCW	Revised Code of Washington
RI	remedial investigation
RI Report	*Revised Draft Remedial Investigation Report*
ROI	radius of influence
ROW	right-of-way
Seep	a groundwater seep

ACRONYMS AND ABBREVIATIONS (CONTINUED)

SES	Sound Environmental Strategies Corporation
Site	the full lateral and vertical extent of contamination that has resulted from the operation of a dry cleaning facility on the Former Olympia Dry Cleaners Property
SoundEarth	SoundEarth Strategies, Inc., formerly known as Sound Environmental Strategies Corporation (SES)
Stemen	Stemen Environmental, Inc.
SVE	soil vapor extraction
TCE	trichloroethene
trans-1,2-DCE	trans-1,2-dichloroethene
USBR	U.S. Bureau of Reclamation
USC	United States Code
VOC	volatile organic compound
WAC	Washington Administrative Code
WSDNR	Washington State Department of Natural Resources

1.0 INTRODUCTION

SoundEarth Strategies, Inc. (SoundEarth), formerly known as Sound Environmental Strategies Corporation (SES), has prepared this Revised Draft Feasibility Study Report (FS Report) on behalf of Mrs. Katherine Burleson, owner of the Former Olympia Dry Cleaners property. This Revised Draft FS Report incorporates additional information requested by the Washington State Department of Ecology (Ecology) in their letter dated August 24, 2011 (Ecology 2011a), and email correspondence dated October 25 and 26, 2011 (SoundEarth 2011b; Ecology 2011b). The Former Olympia Dry Cleaners property is located on one parcel (Thurston County Assessor Parcel Number 78204000800) at 606 Union Avenue Southeast in Olympia, Washington (the Former Olympia Dry Cleaners Property), as shown on Figure 1. This Revised Draft FS Report was prepared for submittal to Ecology pursuant the Agreed Order Number DE00TCPHQ-1408, dated February 28, 2001.

SoundEarth conducted a remedial investigation (RI) to address data gaps identified following previous subsurface investigations and interim remedial actions conducted by others that had confirmed releases of the chemicals of concern (COCs) in exceedance of the preliminary cleanup levels, including tetrachloroethene (PCE) and its degradation compounds trichloroethene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE), and vinyl chloride (SES 2009). The releases of COCs resulted in the migration of contamination in soil, groundwater, and surface water. The suspected source of the COCs is associated with former dry cleaning operations and historical unreported spills outside of the building that occupies the Former Olympia Dry Cleaners Property (Figure 2). The previous investigations and interim remedial actions conducted at the Site are summarized in the *Revised Draft Remedial Investigation Report* (RI Report) prepared by SoundEarth in 2009.

According to the Ecology's *Guidelines for Property Cleanups Under the Voluntary Cleanup Program* dated July 2008, a site is defined by the nature and extent of contamination associated with one or more releases of hazardous substances prior to any cleanup of that contamination. As established in Chapter 173-340 of the Washington Administrative Code (WAC 173-340), the Site is defined by the full lateral and vertical extent of contamination that has resulted from the operation of a dry cleaning facility on the Former Olympia Dry Cleaners Property. Based on the information gathered to date, the Site extends beneath portions of the Former Olympia Dry Cleaners Property, the parcel located adjacent to the north, and the Cherry Street Southeast right-of-way (ROW).

1.1 DOCUMENT PURPOSE AND ORGANIZATION

The purpose of this Revised Draft FS Report is to develop and evaluate remedial alternatives for the Site and to select the most appropriate alternative based on the evaluation criteria as defined by the Washington State Model Toxics Control Act (MTCA) Statute and Regulation in WAC 173-340-350 through 173-340-390. According to MTCA, a cleanup action alternative must satisfy all of the following threshold criteria as specified in WAC 173-340-360(2):

- Protect human health and the environment.
- Comply with cleanup standards.
- Comply with applicable state and federal laws.
- Provide for compliance monitoring.

While these criteria represent the minimum standards for an acceptable cleanup action, WAC 173-340-360(2b) also recommends that the cleanup action alternative satisfy the following criteria:

- Use permanent solutions to the maximum extent practicable.
- Provide for a reasonable restoration time frame.
- Consider public concerns on the proposed cleanup action alternative.

This Revised Draft FS Report is organized into the following sections:

- **Section 2.0, Site Background.** This section provides a description of the Former Olympia Dry Cleaners Property and its history, and the geology and hydrology of the Site.
- **Section 3.0, Additional Remedial Investigation.** This section presents the results of the additional remedial investigation activities completed at the Site.
- **Section 4.0, Updated Conceptual Site Model.** This section includes a discussion of the confirmed and suspected source areas, COCs, affected media, fate of PCE in the environment, and transport mechanisms and exposure pathways.
- **Section 5.0, Remedial Alternatives Assessment.** This section provides preliminary cleanup standards, presents the results of the screening of remedial technologies, provides the comparative evaluation of cleanup action alternatives and disproportionate cost analysis, and presents the recommended cleanup action alternative.
- **Section 6.0, Bibliography.** This section lists references used to develop this document.
- **Section 7.0, Limitations.** This section presents the limitations associated with conducting the work reported herein and in preparing the Revised Draft FS Report.

2.0 SITE BACKGROUND

This section provides a summary of the Site and features, historical usage of the Former Olympia Dry Cleaners Property, the Site geology and hydrology, and previous investigations.

2.1 SITE DESCRIPTION

The Former Olympia Dry Cleaners Property occupies 7,623 square feet (0.18 acre) of land and is located on the northeast corner of the intersection of Union Avenue Southeast and Cherry Street Southeast in Olympia, Washington. Improvements to the Former Olympia Dry Cleaners Property include the one-story, slab-on-grade Former Olympia Dry Cleaners Building (2,584 square feet in area) and asphalt-paved areas, which serve as parking, along the west and south perimeters (Figure 2). A dry cleaning facility currently operates in the Former Olympia Dry Cleaners Building. An unpaved alley (the North Alley), approximately 6 feet in width, borders the north side of the Former Olympia Dry Cleaners Building.

The Site covers an approximate area of 3,700 square feet, based on the extent of PCE in affected media. In addition to the Former Olympia Dry Cleaners Property, the Site encompasses portions of the following parcels (Figure 3):

- One parcel (Thurston County Assessor Parcel Number 78204000700) located east of the Former Olympia Dry Cleaners Property is approximately 6,400 square feet in area and currently owned by Mrs. Katherine Burleson. The southern portion of this parcel is asphalt-paved and is a parking area, and the north portion of this parcel is unpaved and vegetated.

- One parcel (Thurston County Assessor Parcel Number 78204000100) located at 1000 Cherry Street Southeast, which is located north of the Former Olympia Dry Cleaners Property (Cherry Street Q-Tip Trust Property), across the North Alley, and is owned by the Cherry Street Q-Tip Trust. The western portion of this parcel is developed with a one-story building (Cherry Street Q-Tip Trust Building) that includes a basement beneath its northern portion. The building has historically been used as office space. The eastern and northern portions of this parcel are asphalt-paved and used as parking areas. The North Alley borders the south side of the building (Figure 2).

The locations of identified subsurface and overhead utilities at the Site are shown on Figure 2. Utility locations were identified based on public utility locates by the Northwest Utility Notification Center, private utility locates using electromagnetic and video methods, and field observations. Subsurface utilities identified on the Former Olympia Dry Cleaners Property include water, sanitary sewer, stormwater, natural gas, electric, and a private water supply well. Overhead utilities include electrical lines and telephone service. The private water supply well is located along the west side of the Former Olympia Dry Cleaners Building and exhibits artesian conditions (Artesian Supply Well on Figure 2). The Artesian Supply Well is not currently used as a potable water source on the Former Olympia Dry Cleaners Property.

2.2 HISTORICAL LAND USE

Mr. Frank Burleson purchased the Former Olympia Dry Cleaners Property in 1970. Prior to construction of the Former Olympia Dry Cleaners Building, imported fill was placed in the northern portion of the Former Olympia Dry Cleaner Property to bring the property to its present grade (Stemen 2005). Mr. Burleson operated a full-service dry cleaner business at the Site from 1970 to 1981. A dry cleaning machine that used PCE was installed in 1970 at the north-central portion of the Former Olympia Dry Cleaners Building, approximately 1 foot north of the existing dry cleaning machine (Figure 2).

Mr. Gaylor Bolton began leasing the Former Olympia Dry Cleaners Property from Mr. Burleson in 1981 and operated a full-service dry cleaner under the name Olympia Dry Cleaners. Mr. Bolton continued operating Olympia Dry Cleaners until 1995 (Stemen 2005). The cleaning methods and chemicals used during Mr. Bolton's operations are unknown. Mr. Howard McCullough leased the Former Olympia Dry Cleaners Property from 1996 to approximately 2002 and operated a clothes washing and pressing service under the name Howard's Cleaners. In addition, Mr. McCullough reportedly used the Former Olympia Dry Cleaners Property as a drop shop for dry cleaning services to be performed off the Former Olympia Dry Cleaners Property. Mr. McCullough reportedly did not operate the dry cleaning machine that was present in the Former Olympia Dry Cleaners Building (Stemen 2005).

Mr. Tony Anderson leased the Former Olympia Dry Cleaners Property in 2002 to operate a full-service dry cleaner under the name TMC Cleaners (Stemen 2005). In August 2004, Mr. Anderson reportedly discontinued use of PCE as the active dry cleaning agent on the Former Olympia Dry Cleaners Property and began using unspecified aliphatic hydrocarbons as part of his operations (Stemen 2005). The current dry cleaning machine was located approximately 1 foot south of the former dry cleaning machine (Figure 2). TCE was reportedly used as a stain remover in conjunction with the new dry cleaning process

(Stemen 2005). Mr. Anderson continued operating TMC Cleaners until approximately 2007. In 2007, Mr. McCullough began leasing the Former Olympia Dry Cleaners Property and operates a full-service dry cleaner called Howard's Cleaners. Howard's Cleaners uses the same dry cleaning machine used by TMC Cleaners.

2.3 PHYSICAL SETTING AND HYDROGEOLOGY

A summary of the Site physical setting and local geology and hydrology is provided below.

2.3.1 Physical Setting

The Site is located in Section 23, Township 18 South, Range 2 West in the City of Olympia, Thurston County, Washington (Figure 1). The approximate geographic coordinates for the Site are as follows: lat 47°2'22"N, long 122°53'39"W. The topography of the Site slopes downward toward the north. The slope is greater in the north-central and northwestern portions at the Former Olympia Dry Cleaners Property. Based on the survey performed during the RI, the ground surface elevation at the Site ranges from approximately 32 feet above mean sea level near Union Avenue Southeast down to approximately 26 feet above mean sea level near 10th Avenue Southeast.

2.3.2 Geology

The uppermost native soils in the local area consist of the Latest Vashon fine-grained sediments (Qgof) geologic unit (WSDNR 2003, PGG 2007). The Qgof unit consists predominantly of silt and clay with interbeds of silt, clay, clayey silt, and silty sand. These soil types generally have relatively low hydraulic conductivity ranges from 10^{-3} to 10^{-6} centimeters per second (Freeze and Cherry 1979). The maximum thickness of the Qgof unit in the region is approximately 95 feet (PGG 2007). Underlying the Qgof unit is a geologic unit referenced as the latest Vashon recessional sand and minor silt (Qgos). The Qgos unit consists predominantly of fine- to medium-grained sand with interbedded silt. These soil types generally have moderate hydraulic conductivity ranges from 10^{-1} to 10^{-5} centimeters per second (cm/sec; Freeze and Cherry 1979). The thickness of the Qgos unit may exceed 400 feet (PGG 2007).

2.3.3 Hydrology

The nearest surface water body to the Site is Capitol Lake, which is a freshwater lake located approximately 2,400 feet to the west (Figure 1). Regional groundwater reportedly flows toward Budd Inlet, which is a saltwater inlet located approximately 3,000 feet to the north (PGG 2007).

A shallow groundwater-bearing zone is observed in the native soils at the Site. The native soils consist of silt and clay, silty sand, and sandy silt from approximately 0 to 50 feet below ground surface (bgs). These soil types are characteristic of the Qgof unit, which is considered an aquitard based on its limited capacity to transmit groundwater (i.e., low hydraulic conductivity; PGG 2007). A groundwater seep (Seep) is located approximately 13 feet west of the southwest corner of the Cherry Street Q-Tip Trust Building (Figure 2). In addition, artesian conditions are observed in six monitoring wells (MW-07 through MW-09, MW-11, MW-12, and MW-14) and the Artesian Supply Well at the Site. The artesian conditions present are attributed to pressure applied by the Qgof unit that confines or partially confines groundwater in the underlying Qgos unit (PGG 2007).

3.0 ADDITIONAL REMEDIAL INVESTIGATION

On December 3, 2009, SoundEarth met with Ecology's case manager to discuss the results in the RI Report and the feasibility analysis of remedial technologies for the Site. During the meeting Ecology requested that additional remediation investigation work be performed to effectively evaluate remedial technologies for the Site. On August 25, 2010, Ecology approved the *Draft Revised Feasibility Analysis Work Plan* (FAWP) prepared by SoundEarth in 2010, and SoundEarth proceeded with the field activities. The FAWP included the additional assessment of groundwater quality, hydraulic conductivity of the shallow groundwater-bearing zone, and indoor air quality.

3.1 GROUNDWATER MONITORING

On September 8, 2010, SoundEarth collected and analyzed groundwater samples to assess groundwater quality conditions for PCE and its degradation breakdown compounds including TCE, trans-1,2-dichloroethene (trans-1,2-DCE), cis-1,2-DCE, 1,1,1-tricholoroethane (1,1,1-TCA), 1,1-dichloroethene (1,1-DCE), 1,1-dichloroethane (1,1-DCA), 1,2-dichloroethane (1,2-DCA), chloroethane, and vinyl chloride; for gasoline-, diesel-, and oil-range petroleum hydrocarbons (GRPH, DRPH, and ORPH, respectively); and for benzene, toluene, ethylbenzene, and total xylenes (BTEX); and to evaluate natural attenuation parameters and assess the microbial population within the dissolved-phase PCE plume.

3.1.1 Groundwater Quality

The existing network of groundwater monitoring wells includes MW-01, MW-03, MW-04, and MW-06 through MW-15 (Figure 2). The groundwater samples were collected using a bladder pump and low-flow groundwater sampling procedures as defined in the FAWP. In addition, SoundEarth measured the depth to groundwater for each monitoring well to calculate the groundwater elevations for the two water-bearing zones.

The groundwater samples collected were analyzed for halogenated volatile organic compounds (HVOCs) by U.S. Environmental Protection Agency (EPA) Method 8260C, for GRPH by Northwest Total Petroleum Hydrocarbons (NWTPH) Method NWTPH-Gx, DRPH and ORPH by NWTPH-Dx, and BTEX by EPA Method 8021B. A summary of the groundwater sample analytical data is provided in Tables 1 and 2 and shown on Figure 4. A copy of the groundwater laboratory analytical report is provided in Appendix A.

Analytical results for the groundwater samples collected in September 2010 indicated the following:

- Concentrations of PCE exceeded MTCA Method A cleanup level of 5 micrograms per liter (µg/L) in the groundwater samples collected from monitoring wells MW-10 and MW-15.
- Concentrations of TCE exceeded MTCA Method A cleanup level of 5 µg/L in the groundwater samples collected from monitoring wells MW-10 and MW-15.
- Concentrations of cis-1,2-DCE exceeded MTCA Method A cleanup level of 80 µg/L in the groundwater sample collected from monitoring well MW-09, MW-10, and MW-15.

- Concentrations of vinyl chloride exceeded MTCA Method A cleanup level of 0.2 µg/L in the groundwater samples collected from monitoring wells MW-09, MW-10, and MW-15.
- Concentrations of trans-1,2-DCE, 1,1-DCA, 1,1,1-TCA, 1,2-DCA and chloroethane did not exceed MTCA Method A cleanup levels in the groundwater samples analyzed.
- Concentration of GRPH exceeded MTCA Method A cleanup level of 1,000 µg/L in the groundwater sample collected from monitoring well MW-10.

A summary of the potentiometric surface for the existing monitoring wells at the Site are presented in Table 3 and shown on Figure 5. Five of the twelve monitoring wells installed in the shallow groundwater-bearing zone exhibited artesian conditions (MW-07 through MW-09, MW-11, and MW-14). The potentiometric surface contours indicate a groundwater flow direction to the north and west with an average lateral hydraulic gradient of 0.04 feet per foot. The potentiometric surface levels between monitoring wells MW-10 and MW-12 indicate an upward vertical hydraulic gradient of 0.15 feet per foot.

3.1.2 Natural Attenuation Parameters

Monitoring wells MW-03, MW-08, MW-10, MW-11, MW-13, and MW-14 were selected from the existing network of groundwater monitoring wells and sampled for natural attenuation parameters. The assessment of natural attenuation parameters was used to evaluate whether biodegradation is occurring and by what processes. The sample collection and analysis procedures were detailed in the FAWP.

The analysis of natural attenuation parameters included the following:

- Primary electron receptors, which are potential energy sources for naturally occurring bacteria capable of metabolizing PCE and its degradation breakdown products:
  - Dissolved oxygen (O^2)
  - Nitrate (NO_3^-)
  - Ferric Iron (Fe^{3+})
  - Sulfate (SO_4^-)
- Metabolic byproducts of biodegradation:
  - Manganese (Mn^{2+})
  - Ferrous iron (Fe^{2+})
  - Methane (CH_4)
  - Ethene (C_2H_4) and Ethane (C_2H_6)
- Additional parameters that were analyzed as indicators of the subsurface environment and potential biodegradation of PCE and its degradation breakdown products:
  - Oxidation-reduction potential (ORP)
  - Specific conductivity

- Turbidity
- Temperature
- pH

The selection of monitoring wells for analysis of natural attenuation parameters was based on their location relative to the dissolved-phase PCE groundwater plume and existing well network (Figure 6). Monitoring wells MW-03 and MW-08 are located upgradient of the dissolved-phase PCE plume, and are considered representative of background subsurface conditions. Monitoring wells MW-10 and MW-14 are representative of subsurface conditions within the dissolved-phase PCE plume. Monitoring well MW-10 is located in close proximity to the suspected primary source area. Monitoring wells MW-11 and MW-13 are located downgradient of the dissolved-phase PCE plume and are representative of subsurface conditions downgradient of the dissolved-phase plume. The additional parameters listed above were collected from the entire network of groundwater monitoring wells using a flow-through cell at the time of groundwater sample collection (Table 4).

The results for the monitored natural attenuation (MNA) parameters are provided in Table 4 and a summary of the results is provided below:

- The dissolved oxygen concentrations at monitoring wells MW-03 and MW-08 were 1.28 and 0.75 milligrams per liter (mg/L), respectively. These results indicate that the subsurface conditions upgradient of the dissolved-phase plume are trending toward aerobic conditions. Dissolved oxygen measurements at monitoring wells MW-09, MW-10, and MW-15 ranged from 0.01 to 0.25, which is indicative of anaerobic subsurface conditions. These three monitoring wells are located within or directly downgradient of the dissolved-phase PCE plume. The dissolved oxygen measurements at monitoring wells MW-14, MW-11, and MW-13 located further downgradient of the plume had measured concentrations ranging from 0.6 to 1.58, which is indicative of aerobic conditions. The dissolved oxygen measurements were evaluated along with the other natural attenuation parameters to evaluate whether the subsurface is predominantly aerobic or anaerobic, and whether oxygen is being used as an electron receptor.
- Nitrate concentrations collected from the six monitoring wells ranged from less than the laboratory practical quantitation limit of 0.1 to a concentration of 0.22 mg/L. A concentration of nitrate higher than 0.5 mg/L indicates that the subsurface may be under nitrate-reducing conditions and slightly anaerobic. The low concentrations of nitrate detected in the six wells analyzed indicate that nitrate is not a dominant electron receptor in the subsurface environment.
- Concentrations of manganese from the six monitoring wells ranged from 0.0 to 0.6 mg/L. Higher concentrations of manganese are an indicator that manganese ($Mn^{+4)}$ is being used as an electron receptor within the residual source area, and the subsurface environment is under manganese reducing conditions. Based on the concentrations of manganese observed from the six wells, it does not appear that manganese is a dominant electron receptor in the subsurface environment.

- Concentrations of ferric iron in background upgradient monitoring wells MW-03 and MW-08 were approximately an order of magnitude more than downgradient wells MW-10, MW-11, MW-13, and MW-14. In addition, the background concentrations of ferrous iron in the upgradient monitoring wells MW-03 and MW-08 were 2.9 and 4.4 mg/L, respectively. These sample concentrations were higher than the monitoring wells MW-10 and MW-14 located in or directly downgradient of the dissolved-phase PCE plume that ranged from 0.4 to 1.2 mg/L, respectively. The presence of ferrous iron is an indicator of whether ferric iron is being used as an electron receptor at the Site. In addition, the reduced concentrations of ferric iron in or directly downgradient of the plume area indicates ferrogenic conditions exist within the dissolved-phase plume.
- The concentrations of sulfate are greater than 1 mg/L and increase along the flow path from the background upgradient monitoring wells MW-03 and MW-08 through wells MW-10 and MW-14 located in or directly downgradient of the dissolved-phase PCE plume. This data indicates that sulfate reducing conditions exist within the dissolved-phase PCE plume. Therefore, sulfate appears to be utilized as an electron receptor.
- Concentrations of methane decrease along the flow path from the background upgradient monitoring wells MW-03 and MW-08 through wells MW-10, MW-11, MW-13, and MW-14. The presence of methane may be either an indicator of anaerobic biodegradation of existing naturally occurring carbon within the subsurface environment or the subsurface environment is under methanogenic redox conditions. The MNA parameter results indicate that the dominant redox conditions within the dissolved-phase PCE plume are under ferrogenic and sulfate reducing conditions, and are not under methanogenic conditions.
- Concentrations of ethene and ethane were below the laboratory practical quantitation limits. These compounds are typical daughter products of vinyl chloride. The presence of ethene and ethane indicates that the rate of biodegradation is high. Other breakdown pathways of vinyl chloride may exist such as complete mineralization. Therefore, the absence of the ethene and ethane does not indicate that degradation is not occurring of vinyl chloride; however, it is likely occurring through mineralization or at a reduced biodegradation rate.
- The ORP measured at the six monitoring wells ranged from -23.3 to -172.2 millivolts, which is within a range that typically is considered indicative of moderate to high anaerobic conditions, where ferrogenic and sulfate reducing conditions occur within the subsurface environment.
- The measured groundwater temperatures from the six monitoring wells ranged from 14.48 to 19.33 degrees Celsius (°C). Biodegradation processes occur at these temperatures, but typically are accelerated at higher temperatures approaching 20 °C or greater.
- The pH values ranged from 6.47 to 8.82 in the six monitoring wells analyzed for natural attenuation parameters. The pH of MW-10 within the source area was 7.59, well within the optimum pH range for microbial degradation of PCE. The optimal pH range for anaerobic microbial growth is 7 to 8, with a neutral pH conducive for the growth and proliferation of diverse microbial populations.

The natural attenuation parameters show that the shallow water-bearing zone is under anaerobic conditions, where ferrogenic to near sulfate reducing conditions occur within the dissolved-phase PCE plume. In addition, there is also evidence that anaerobic biodegradation from reductive dechlorination of PCE and its degradation compounds is occurring, based on the results of the natural attenuation parameters and empirical groundwater analytical results from the groundwater samples collected within the dissolved-phase PCE plume.

3.1.3 Microbial Population

Monitoring well MW-10 located within the dissolved-phase PCE plume was sampled to evaluate the microbial population. The sample was analyzed for *Dehalococcoides ethenogenes* (*Dhc*). The percent of *Dhc* in the microbial population was calculated by dividing the number of *Dhc 16S* ribonucleic acid gene copies by the total number of bacteria as estimated by the mass of deoxyribonucleic acid extracted from the sample. The sampling and analysis procedures were detailed in the FAWP. A copy of the certificate of analysis for the *Dhc* assay is provided in Appendix A of this Revised Draft FS Report.

The percent of *Dhc* in the microbial population ranged from 0.004 to 0.01 percent, based on the quantification of *Dhc* gene copies, the sample was estimated to contain 2×10^4 cells present per liter volume. These results indicate that the sample had moderate concentrations of *Dhc,* which may be associated with the breakdown of chlorinated compounds. It is possible to further increase *Dhc* concentrations by stimulating the microbes environment by the addition of an electron donor. The pH levels observed in wells MW-10 and MW-15 were 7.6 to 8.4, respectively, which are within the optimal pH range of 6.0 and 8.3 for dechlorination (Rowlands 2004).

3.2 SHALLOW GROUNDWATER-BEARING ZONE TESTING

On September 13, 2010, SoundEarth conducted a short-term pump test to calculate the hydraulic properties of the shallow groundwater-bearing zone in close proximity to the Seep. SoundEarth installed a total of five vented (gauged) In-Situ Level TROLL 700 pressure transducers into the pumping well MW-15 and the observation wells MW-09, MW-10, MW-12, and MW-13. These wells are installed within the shallow groundwater-bearing zone.

Prior to beginning the pump test, each transducer was synchronized to the same time using In-Situ Inc. 300 MHz RuggedReader Handheld PC. The transducers were programmed to collect pressure, temperature, and relative level depth of water data at 1-minute intervals. Pumping from well MW-15 began at 10:54 am and continued for 190 minutes at a constant pump rate of 2.8 gallons per minute. In addition, manual measurements were compiled and compared to electronic data collected by the transducers to look for anomalous data suggesting potential transducer malfunction, cable slippage, or other unexpected conditions. SoundEarth also measured relative water levels at the Seep, and monitoring well MW-12 and artesian supply well installed in the deep groundwater-bearing zone (Appendix B).

The analytical methods selected for the pump test analysis were the Theis Method (1935) unconfined aquifer approximation and Cooper-Jacob Method (1946) confined aquifer solutions. These analytical methods were chosen based on the anticipated hydraulic properties of the fill material within the former excavation where the Seep, pump well MW-15, and closest observation well MW-10 are located and observed pump test data measured. The assumptions underlying the two methods are summarized below.

Theis Method (unconfined aquifer approximation)

The Theis Method (1935) requires values of drawdown versus time at an observation well of a specified distance away from the pumping well, and the discharge rate for the pumping well. This solution assumes the following:

- Aquifer has infinite areal extent.
- Aquifer is homogeneous, isotropic and of uniform thickness.
- Pumping well is fully or partially penetrating.
- Flow to pumping well is horizontal when pumping well is fully penetrating.
- Aquifer is unconfined.
- Flow is unsteady.
- Water is released instantaneously from storage with decline of hydraulic head.
- Diameter of pumping well is very small so that storage in the well can be neglected.
- No delayed gravity response in aquifer.
- Low velocity is proportional to tangent of the hydraulic gradient instead of the sine (which is actually the case).
- Flow is horizontal and uniform in a vertical section through the axis of the well.
- Displacement is small relative to saturated thickness of aquifer.

Cooper-Jacob Method (confined water-bearing zone)

The Cooper-Jacob confined solution (1946) was developed based on a straight-line approximation of the Theis (1935) equation for unsteady flow to a fully penetrating well in a confined aquifer. The solution assumes a line source for the pumped well and therefore neglects wellbore storage. This solution assumes the following:

- Aquifer has infinite areal extent.
- Aquifer is homogeneous, isotropic, and of uniform thickness.
- Pumping well is fully penetrating.
- Flow to pumping well is horizontal.
- Aquifer is confined.
- Flow is unsteady.
- Water is released instantaneously from storage with decline of hydraulic head.
- Diameter of pumping well is very small so that storage in the well can be neglected.

- Values of u (a dimensionless time parameter) are small (i.e., the radial distance between pumping well and observation well [r] is small and time [t] is large).

The Cooper-Jacob straight-line method is a reasonable method to estimate transmissivity and associated hydraulic properties for an unconfined aquifer if the results are used in conjunction with other analytical methods (e.g., Theis Method) to interpret the hydraulic properties of a water-bearing zone and potential boundary conditions associated with changes in soil profile.

Aquifer Testing Analysis

The aquifer testing analysis software package AquiferWin32 version 3.26 was used to expedite the fitting of type-curves to the aquifer testing data. The water level data expressed as drawdown in the spreadsheet files were written to temporary files, and a data filter was applied to discard negative drawdown values. Then the files were used for analysis in AquiferWin32.

A review of the drawdown versus time plots for the pump and observation wells indicated that barometric pressure changes had a nominal effect on the observed hydraulic heads within the measured wells; therefore, the drawdown was not corrected for barometric affects since the applied corrections would likely have little influence on the interpretations of the hydraulic properties. No sizeable drawdown response was measured in observation wells MW-3, MW-09, and MW-13 during the pumping test most likely due to the distance from the pumping well MW-15, relative thin water-bearing zone, and associated duration of the pump test. In addition, the hydraulic head measurements in observation well MW-12 and the artesian supply well installed in the deep water-bearing zone increased slightly over time, indicating that water levels did not have enough time to equilibrate and the drawdown of the shallow water-bearing zone did not influence the hydraulic head of the deep water-bearing zone. SoundEarth did not analyze the drawdown response and/or water measurements collected from pump well MW-15, observation wells MW-03, MW-09, MW-13, and the artesian supply well, based on the observations described above.

The drawdown response was strong in observation well MW-10 located within the former excavation area and approximately 6.8 feet from pump well MW-15. A recovery of approximately 73 percent of the original value was observed in well MW-10. Full recovery did not occur due to duration time of the pump test field program. The results of the aquifer pump test analysis for observation well MW-10 and associated pumping well (MW-15) parameters are presented in Table 5. Data analysis plots for observation well MW-10 are provided in Appendix B.

The Cooper-Jacob analysis plots for observation well MW-10 indicate that a negative boundary condition was encountered at approximately 2,000 seconds or 33 minutes into the pumping test. The observed negative boundary is likely due to the change in soil profile and associated hydraulic properties from the more transmissive coarser soil material located within the former excavation area to the less transmissive finer regional imported soil that make up the shallow water-bearing zone. Slope 1 on the Cooper-Jacob analysis plot is indicative of the coarser soils within the former excavation area and Slope 2 on the Cooper-Jacob analysis plot is indicative of the finer soils surroundings the local area. The hydraulic properties of the shallow water-bearing zone will fall somewhere between the slopes charted on the Cooper-Jacob plot (Driscoll 1986). SoundEarth also charted three Theis analysis plots that included early and late time data collected during the pump test and late time data collected from the recovery portion of the test to confirm accuracy of analysis.

The arithmetic mean value of horizontal hydraulic conductivity calculated from five data analysis plots for observation well MW-10 is 6.77×10^{-3} centimeters and second. This hydraulic conductivity value is representative of the hydraulic characteristics within or in close proximity of the former excavation area. The hydraulic conductivity of the regional shallow water-bearing zone is most likely lower due to the finer soil profile observed within the existing well network at the Site.

The estimated range of storativity for the coarser soil material located within the former excavation is 6.05×10^{-3} to 8.37×10^{-3} and the finer soil material located outside the former excavation is 2.31×10^{-2} to 6.61×10^{-2}. The estimated intrinsic permeability of soils located within and/or in close proximity of the former excavation area is 6.90×10^{-8} centimeters squared (Table 5).

In addition, the total drawdown in the pump well MW-15 was approximately 2.55 feet. SoundEarth gauged the water level at the Seep located approximately 20 feet from the pump well MW-15. The water level at the Seep decreased approximately 5.63 inches or 0.47 feet during the pumping test indicating that there was good communication between the pumping at MW-15 and the Seep (Appendix B).

3.3 INDOOR AIR SAMPLING

On July 23, 2010, Mr. Teel with Ecology, Mr. Mayberry, the attorney representative for the Cherry Street Q-Tip Trust, and SoundEarth performed a site walk of the Cherry Street Q-Tip Trust Building to review the proposed locations for indoor air samples and perform a building survey for the property. A site walk and building survey were also performed at the Former Olympia Dry Cleaners Building. Mr. Burleson joined Mr. Teel and SoundEarth on the site walk. The results of the building surveys and response to Ecology's comments from the site walk were presented in the *Addendum No. 1 – Draft Vapor Sampling Work Plan* dated October 15, 2010. Ecology approved the work plan on October 28, 2010, which allowed SoundEarth to proceed with the indoor air sampling field program.

On December 3, 2010, SoundEarth collected sub-slab vapor sample from the Former Olympia Dry Cleaners Building Property and indoor and ambient air samples at the Cherry Street Q-Tip Trust Building Property. On June 16, 2011, SoundEarth collected a second sub-slab vapor sample from the Former Olympia Dry Cleaners Building Property due to the detection and interference of the leak detection gas, Freon, in the sub-slab sample collected on December 3, 2010. Indoor air and sub-slab vapor sampling was conducted in accordance with Ecology's draft *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action*, Review Draft dated October 2009 and select portions of the California Environmental Protection Agency, Department of Toxic Substance Control's February 2005 *Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air*.

3.3.1 Sub-slab Vapor Sampling

The sub-slab vapor sample and duplicate sample were located west of the existing dry cleaning machine in the Former Olympia Dry Cleaners Building (Figure 7). The sub-slab vapor samples collected were analyzed for HVOCs and BTEX by EPA Method TO-15. A summary of the sub-slab vapor analytical data from the June 16, 2011, sampling event is provided in Tables 6 and 7. The vapor analytical data from the December 3, 2010, is not presented in Tables 6 and 7 since the results were inconclusive due to a leak in the air sampling manifold. The high concentration of Freon in the sample and duplicate sample collected on December 3, 2010, resulted in the lab having to dilute the samples in order to avoid harming the laboratory equipment, and a low level analysis was not possible. A copy of the laboratory analytical report from both sampling events is provided in Appendix C.

As part of the sub-slab soil gas sampling, SoundEarth placed a shroud over the sample train. A leak detection tracer compound helium was applied to the sample train to determine whether indoor air was entering the sample canisters. Sub-slab soil gas sampling is prone to leaks, and it is common to detect the tracer compound (Ecology 2009). The leak detection compound was not detected in either sample. Analytical results for the sub-slab sample and duplicate sample indicate the following:

- Concentrations of PCE were detected in both the sample and duplicate sample at 880 and 870 micrograms per cubic meter ($\mu g/m^3$), respectively. These concentrations exceed Ecology's draft MTCA Method B soil gas screening level of 96 $\mu g/m^3$.
- Concentrations of TCE were detected in both the sample and duplicate sample at 66 $\mu g/m^3$. These concentrations exceed Ecology's draft MTCA Method B soil gas screening level of 3.7 $\mu g/m^3$.
- Concentrations of cis-1,2-DCE were detected in the samples collected; however, concentrations were below Ecology's draft MTCA Method B soil gas screening level of 160 $\mu g/m^3$.
- Concentrations of trans-1,2-DCE, 1,1-DCA, 1,1,1-TCA, 1,1-DCE, 1,2-DCA, chloroethane, and vinyl chloride from the samples collected were below the laboratory practical quantitation limit and the draft MTCA Method B soil gas screening level.

3.3.2 Indoor Air and Ambient Air Sampling

Four indoor air samples were collected from the Cherry Street Q-Tip Trust Building. One sample was collected along the south wall near the dissolved-phase plume, one sample was collected near the central portion of the building near the restrooms where floor penetrations were observed, one sample was collected within the dirt floor crawl space area on the basement level, and one sample was collected on the concrete floor basement near the west wall where piping penetrations were observed (Figure 7). An additional two ambient air samples were collected outside of the building. One ambient air sample was placed on the roof of the Cherry Street Q-Tip Trust Building at the heating, ventilation, and air conditioning (HVAC) intake and one ambient air sample was located southeast of the building based on the wind direction on the day of sampling, which was west to northwest (Figure 7).

The indoor and ambient air samples were analyzed for HVOCs and BTEX by EPA Method TO-15 low level. A summary of the indoor air analytical data is provided in Tables 8 and 9. A copy of the laboratory analytical report is provided in Appendix C.

Analytical results for the indoor and ambient air samples indicate the following:

- Concentrations of PCE were detected in the samples collected; however, concentrations were below Ecology's draft MTCA Method B cleanup level for indoor air of 9.6 µg/m^3. The ambient air samples had higher concentrations of PCE than the indoor air samples.
- Concentrations of TCE were below the laboratory practical quantitation limit in the samples collected. The laboratory quantitation limit was below the draft MTCA Method B cleanup level for indoor air of 0.37 µg/m^3.
- Concentrations of cis-1,2-DCE, trans-1,2-DCE, 1,1-DCA, 1,1,1-TCA, 1,1-DCE, chloroethane, and vinyl chloride were below the laboratory practical quantitation limit in the samples collected. The laboratory quantitation limit was below the draft MTCA Method B cleanup level for indoor air for these compounds.
- A concentration of 1,2-DCA was detected above the draft MTCA Method B cleanup level for indoor air of 0.096 µg/m^3 in ambient air sample VS-7, located near the HVAC intake, with a concentration of 0.20 µg/m^3. The other indoor and ambient air samples were below the cleanup level and below the laboratory quantitation limit.
- The highest benzene concentration was detected in the ambient air sample VS-7 located next to the HVAC intake at a concentration of 2.5 µg/m^3. Concentrations of benzene were detected above the draft MTCA Method B cleanup level for indoor air of 0.32 µg/m^3, in the four indoor air and two ambient air samples. Concentrations of benzene detected within the office building are attributed to the elevated concentrations detected at the HVAC intake.
- Concentrations of toluene, ethylbenzene, and total xylenes were detected in the air samples; however, the concentrations of these compounds were below their respective draft MTCA Method B cleanup levels.

In addition to the indoor air samples, SoundEarth collected barometric pressure data from two pressure sensors to document whether the building was under positive or negative pressure the day before and the day of indoor air sampling. One sensor was located inside the Cherry Street Q-Tip Trust Building and one sensor was positioned outside the building (Figure 7). A copy of the raw data from the barometric pressure sensors and a brief weather summary table are included in Appendix D. The data collected from the sensors indicates that the building was under a slight negative pressure compared to the ambient air pressure, and the barometric pressure was falling for the majority of the day during the sample collection period. Indoor air sample collection is considered representative of worst case conditions when a building is depressurized or has a lower indoor pressure when compared to outdoor air (Ecology 2009). Therefore, the results of the indoor air samples collected from the Cherry Street Q-Tip Trust Building during this event are representative of worst case conditions.

4.0 UPDATED CONCEPTUAL SITE MODEL

Based on the results of the additional remedial investigation activities, the conceptual site model was updated to represent current site conditions, confirmed and suspected source areas, affected media, contaminant transport, and exposure assessment.

4.1 CONFIRMED AND SUSPECTED SOURCE AREAS

The COCs for the Site include the chemical compounds that were detected in soil, groundwater, and/or surface water at concentrations exceeding the applicable MTCA cleanup levels. The COCs for the Site include PCE and its degradation compounds (Table 10). The suspected source of PCE is associated with former dry cleaning operations and historical unreported spills outside of the building that occupies the Former Olympia Dry Cleaners Property. In addition, concentrations of GRPH were detected in groundwater in MW-10, and ORPH concentrations exceeding the MTCA cleanup levels were detected in soil and groundwater in a limited area located near the northeast corner of the Former Olympia Dry Cleaners Building.

4.2 AFFECTED MEDIA

Soil, groundwater, and surface water are the media of concern at the Site. Indoor air has been retained as a medium of potential concern based on the concentrations of PCE in soil located beneath the southern portion of the Cherry Street Q-Tip Trust Building. Recent air monitoring resulted in detectable concentrations of PCE and benzene in the indoor air samples collected in the Cherry Street Q-Tip Trust Building. The benzene concentrations detected can be attributed to elevated concentrations detected in the ambient air (Table 9). The PCE concentrations were below the draft MTCA Method B cleanup level for indoor air; indoor air is not considered a potential media of concern based on the recent air monitoring performed.

4.3 CONTAMINANT FATE AND TRANSPORT

Provided below is a summary of the contaminant fate and transport model for the Site.

4.3.1 Transport Mechanisms Affecting Distribution of PCE in Subsurface

The lateral distribution of PCE concentrations in soil is likely a result of transport via direct contact from historical surface releases of PCE and transport over time via movement of dissolved-phase PCE in groundwater and sorptive capacity of the soil matrix.

Dissolved-phase PCE in groundwater will migrate with the horizontal and vertical groundwater gradients. The lateral groundwater flow direction is to the north and west (Figure 5). Concentrations of PCE in groundwater are typically highest in the source areas and decrease along the groundwater flow path as a result of dilution with unaffected groundwater. The vertical hydraulic gradient at the Site is upward based on the artesian conditions. The upward vertical hydraulic gradient significantly reduces the vertical migration of dissolved concentrations of PCE in groundwater with depth.

The transport of vapor-phase PCE in the subsurface is a result of volatilization of PCE released in confirmed and suspected source areas to the subsurface and dispersion through the unsaturated subsurface via natural mechanisms, such as barometric fluctuations.

4.3.2 Environmental Fate of PCE in Subsurface

Once PCE enters the subsurface, chemical attenuation processes, such as hydrolysis, direct mineralization, and reductive dehalogenation, may affect the PCE in soil and groundwater, resulting in a natural reduction or breakdown of the PCE into non-toxic compounds, such as ethene, ethane, chloride, and carbon dioxide. Biological attenuation processes, such as reductive dechlorination and cometabolic degradation, also may affect the reduction of PCE in soil and groundwater under conducive subsurface conditions. If biodegradation of PCE is occurring, the first line of evidence is the presence of degradation compounds that include TCE, cis-1,2-DCE, and vinyl chloride. The soil and groundwater analytical data confirm the presence of TCE, cis-1,2-DCE, and vinyl chloride at the Site, indicating that biological and/or other chemical attenuation processes are occurring at the Site. The vinyl chloride groundwater plume depicted on Figure 15 of the RI Report indicates that the source of PCE is degrading and the subsurface conditions are naturally reductive.

PCE is a volatile organic compound (VOC) and will volatilize into a gaseous state when released to an unsaturated subsurface environment (vadose zone). In areas of the Site where the ground surface does not have an impermeable cover, some PCE in its vapor-phase will escape to the atmosphere. Once in the atmosphere, the PCE will rapidly disperse and break down via photodegradation.

4.4 EXPOSURE ASSESSMENT

The two types of potential receptors at risk from exposure associated with the presence of PCE and its degradation compounds at the Site are human health risk and terrestrial ecological risk. The Site qualifies for Terrestrial Ecological Evaluation exclusion in accordance with WAC 173-340-7491 (SES 2009). Therefore, mitigating the potential human health risk associated with exposure to PCE and its degradation compounds in the affected media at the Site will be the primary objective of the cleanup action implemented. The preliminary exposure assessment conceptual site model is presented on Figure 8. This section presents the evaluation and conclusions pertaining to the exposure pathways and routes, and potential receptors at the Site.

4.4.1 Soil – Direct Contact Pathway

Direct contact of soil with concentrations of PCE and its degradation compounds above the applicable MTCA cleanup levels is limited to potential human receptors via dermal contact or ingestion. The standard point of compliance for the direct contact pathway for soil is 15 feet bgs for human receptors (e.g., construction worker), which represents a reasonable depth that could be accessed during normal redevelopment activities (WAC 173-340-740[6][d]).

Concentrations of PCE and its degradation compounds are present in unpaved shallow soil within 15 feet of the ground surface and located in the northwest corner of the Former Olympia Dry Cleaners Property and the North Alley. Temporary fencing has been placed around the northwest corner of the Former Olympia Dry Cleaners Property and on the western side of the North Alley to restrict access to these areas. Other portions of the Site where shallow soil is known to have detectable concentrations of PCE and its degradation compounds above the applicable MTCA cleanup levels are covered by Cherry Street Southeast and existing structures. The unpaved areas with concentrations of PCE in soil will require additional controls to mitigate this potential exposure pathway, such as permanent fencing or capping. In addition, future cleanup action or redevelopment in these areas of the Site could represent an exposure risk to a potential human receptor. Although the exposure risk of direct contact of soil has been minimized by access limitations via paved surfaces and/or temporary fencing, the direct contact pathway for soil is complete for construction workers until a cleanup action is implemented and/or institutional or engineering control measures are in place.

4.4.2 Vapor Pathway

The presence of PCE and its degradation compounds in shallow soil and/or groundwater has the potential to result in exposure via inhalation from vaporization to indoor and outdoor air. PCE contamination in soil and/or groundwater located within uncovered portions of the Site (e.g., North Alley, Seep) are unlikely to result in an exposure risk as a result of the vapors being dispersed, diluted, and/or degraded (via photodegradation) once in the atmosphere. The exposure risk posed by the vapor pathway in these areas of the Site is minimal, as is the probability that outdoor air concentrations of PCE and its degradation compounds would exceed applicable cleanup levels.

Portions of the Site where PCE contamination is located beneath buildings present the potential for vapor accumulation inside the buildings. Concentrations of PCE have been detected in indoor air samples collected from the Cherry Street Q-Tip Trust Building, but were below the draft MTCA Method B cleanup level for indoor air, and samples were collected during worst case conditions. The exposure risk posed by vapor pathway beneath buildings at the Site will be addressed in the selected cleanup action as warranted, including establishing cleanup standards and/or installing engineering controls. The vapor pathway is considered complete for construction workers until a cleanup action is implemented and/or institutional or engineering control measures are in place. The vapor pathway for the Cherry Street Q-Tip Trust Building is considered incomplete based on historical and recent indoor air sampling results. The vapor pathway for the Former Olympia Dry Cleaners Building cannot be ruled out at this time as a potential pathway as the current sub-slab vapor data were inconclusive.

4.4.3 Soil to Groundwater Pathway

Analytical results of groundwater samples collected at the Site indicate that contamination of groundwater via soil leaching appears to be complete. This pathway results in a source of contamination and associated potential exposure routes including surface water and drinking water through the groundwater media to potential receptors.

4.4.4 Groundwater to Surface Water Pathway

Analytical results of groundwater samples collected at the Site indicate the lateral and vertical extent of the dissolved-phase PCE plume is limited in area and thickness. Regional groundwater reportedly flows toward Budd Inlet, which is located approximately 3,000 feet to the north of the Site (PGG 2007). The groundwater to surface water pathway is considered incomplete for these surface water bodies, because the dissolved-phase PCE plume does not migrate to these surface water bodies.

Vertical leakage of groundwater through the backfill material in the soil excavation area and underlying Qgof geologic unit at the Site is to the result of the artesian conditions observed throughout the regional area. This vertical leakage formed the Seep and associated surface water located within the soil excavation area, approximately 13 feet west of the southwest corner of the Cherry Street Q-Tip Trust Building. Analytical results of surface water samples collected at the Seep indicate that contamination of surface water via vertical groundwater migration appears to be complete. The groundwater to surface water pathway in the vicinity of the Seep resulted in a source of contamination.

SoundEarth constructed a Seep Collection and Treatment System in February 2007 and modified the treatment system in December 2008. The purpose of the treatment system is to prevent the migration of surface water from the Seep to the eastern curb located along Cherry Street Southeast, and treat surface water with concentrations of PCE and its degradation compounds. The continuous operation of the treatment system prevents the migration of surface water from the Seep area. The treated surface water is discharged to the sanitary sewer in accordance with the LOTT Alliance discharge permit and is considered an incomplete pathway for surface water from the pretreatment activities. In addition, temporary fencing is placed around the Seep and associated surface water to prevent direct exposure until a cleanup action is completed at the Site to address the potential for direct contact exposure. Although the exposure risk of direct contact of surface water from the Seep has been minimized by operation of the treatment system and access limitations via temporary fencing, the groundwater to surface water pathway is complete for construction workers until a cleanup action is implemented and/or institutional or engineering control measures are in place.

4.4.5 Groundwater to Drinking Water Pathway

The potential exposure pathways for groundwater consist of direct exposure via dermal contact, ingestion, and/or inhalation of groundwater with concentrations of PCE and its degradation compounds. The shallow groundwater-bearing zone at the Site is located within the Qgof geologic unit, which is characterized as an aquitard (PGG 2007). Therefore, the shallow groundwater-bearing zone is not used as a drinking water source and does not represent a potable water resource as defined in WAC 173-340-720(2)(b)(i). The groundwater to drinking water pathway for the shallow groundwater-bearing zone is considered incomplete due to the shallow groundwater-bearing zone does not represent a potable water resource.

The Qgos geologic unit underlying the Qgof geologic unit may qualify as a future potential source of potable water. The analytical results from groundwater samples collected from monitoring well MW-12 and the Artesian Supply Well screened in the Qgos geologic unit indicate groundwater quality has not been affected by the historical releases of PCE to the subsurface at the Site. The Artesian Supply Well is not currently used as a potable water source at the Site. However, the Artesian Supply Well may present a potential risk for future exposure if used as a potable water source prior to completion of the cleanup action at the Site. Future cleanup action or redevelopment involving excavation in areas of groundwater with concentrations of PCE could represent an exposure risk. Therefore, the groundwater to drinking water pathway for the deeper groundwater-bearing zone is considered complete for construction and office workers, as well as residents.

Additional remedial action appears warranted to achieve regulatory closure for the Site. Factors that were considered during the evaluation of potential remedial alternatives included the COCs and their distribution in the subsurface, the affected media, potential exposure pathways, schedule, and cost.

5.0 REMEDIAL ALTERNATIVES ASSESSMENT

The purpose of this Revised Draft FS Report is to develop and evaluate cleanup action alternatives to facilitate selection of a final cleanup action at the Site in accordance with WAC 173-340-350(8). A feasibility study (FS) includes the development, screening, and evaluation process for numerous remedial alternatives. On December 3, 2009, SoundEarth met with Mr. Teel of Ecology to discuss the proposed remedial technologies to be evaluated for the Site allowing the feasibility analysis to focus on a limited number of likely feasible components and alternatives that are both implementable and capable of achieving the remediation objectives. Two additional remedial technologies have been included within this section at the request of Ecology (Ecology 2011a). The two additional remedial technologies evaluated herein include chemical oxidation and zero valent iron permeable reactive barrier (PRB) technologies. On February 27, 2012, SoundEarth and Ecology participated in a conference call to discuss Ecology's comments on the Revised Draft FS Report. As a result, SoundEarth provided additional bioremediation case study information and evaluated a chemical oxidation recirculation technology. On December 5, 2012 and January 16, 2013, SoundEarth and Ecology discussed Ecology's additional comments on the Revised Draft FS Report and the chemical oxidation recirculation technology. SoundEarth incorporated Ecology's comments in the revised section below. A list of the Ecology-approved remedial technologies to be evaluated is provided in Section 5.2.

The FS is used to screen cleanup action alternatives to eliminate alternatives that are not technically possible or the costs are disproportionate under WAC 173-340-360(3)(e), or alternatives that will substantially affect the future planned business operations at the Site. Based on the screening, the most advantageous remedial components were evaluated and are presented below, along with the recommended final cleanup action for the Site, in conformance with WAC 173-340-360 through WAC 173-340-390.

5.1 CLEANUP STANDARDS

The selected cleanup action alternative must comply with MTCA cleanup regulations specified in WAC 173-340 and with applicable federal and state laws. The preliminary cleanup levels and remedial action objectives for the Site are discussed in Sections 5.1.1 through 5.1.3 below. Ecology will be the lead agency for compliance, as specified under the Agreed Order Number DE00TCPHQ-1408, dated February 28, 2001.

5.1.1 Applicable or Relevant and Appropriate Requirements

Under WAC 173-340-350 and 173-340-710, applicable requirements include regulatory cleanup standards, standards of control, and other environmental requirements, criteria, or limitations established under state or federal law that specifically address a contaminant, remedial action, location, or other circumstances at a site.

MTCA defines relevant and appropriate requirements as follows:

> … those cleanup action standards, standards of control, and other human health and environmental requirements, criteria, or limitations established under state and federal law that, while not legally applicable to the hazardous substance, cleanup action, location, or other circumstances at a site, address problems or situations sufficiently similar to those encountered at the site. WAC 173-340-

710 through 173-340-760 identifies several requirements the department shall consider relevant and appropriate for establishing cleanup standards.

The criteria used to make this determination are presented in WAC 173-340-710(4)(a)-(i).

Remedial actions conducted under MTCA must comply with the substantive requirements of the applicable or relevant and appropriate requirements (ARARs) but are exempt from their procedural requirements (WAC 173-340-710[9]). Specifically, this exemption applies to state and local permitting requirements under the Washington State Water Pollution Control Act, Solid Waste Management Act, Hazardous Waste Management Act, Clean Air Act, State Fisheries Code, and Shoreline Management Act.

5.1.1.1 Screening of ARARs

ARARs were screened to assess their applicability to the Site. Only those that were deemed appropriate and applicable were retained as remedial action objectives (RAOs). The following list identifies the ARARs that may be applicable to the Site:

- MTCA, Chapter 70.105 of the Revised Code of Washington (RCW 70.105)
- State Environmental Policy Act (Chapter 43.21C of the Revised Code of Washington [RCW 43.21C])
- Clean Water Act (33 United States Code [USC] 1251 et seq.)
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 USC 9601 et seq. and Part 300 of Title 40 of the Code of Federal Regulations [40 CFR 300])
- Washington Dangerous Waste Regulations (WAC 173-303)
- Solid Waste Management Act (RCW 70.95; WAC 173-304 and 173-351)
- Water Quality Standards for Ground Waters of the State of Washington (RCW 90.48; WAC 173-200)
- Water Quality Standards for Surface Waters of the State of Washington (RCW 90.48 and 90.54; WAC 173-201A)
- Department of Transportation Hazardous Materials Regulations (40 CFR Parts 100 through 185)
- Washington State Water Well Construction Act (RCW 18.104; WAC 173-160)
- Underground Injection Control Registration (WAC 173-218)
- Occupational Safety and Health Standards (29 CFR 1910)
- Accreditation of Environmental Laboratories (WAC 173-50)
- City of Olympia and Thurston County regulations, codes, and standards

5.1.2 Development of Cleanup Standards

This section presents the preliminary cleanup standards for the Site. The cleanup levels proposed to meet the remedial action objectives for each media of concern are presented in Table 10.

5.1.3 Remedial Action Objectives

RAOs are administrative goals for a cleanup action that address the overall MTCA cleanup process. The purpose of establishing RAOs for a site is to provide remedial alternatives that protect human health and the environment (WAC 173-340-350). In addition, RAOs are designated to:

- Implement administrative principles for cleanup (WAC 173-340-130).
- Meet the requirements, procedures, and expectations for conducting an FS and developing cleanup action alternatives as discussed in WAC 173-340-350 through 173-340-370.
- Develop cleanup standards (WAC 173-340-700 through 173-340-760) and remedial alternatives that are protective of human health and the environment.

RAOs must include the following threshold requirements from Chapter 173-340 WAC:

- Protect human health and the environment.
- Comply with cleanup standards.
- Comply with applicable state and federal laws.
- Provide for compliance monitoring.

The RAOs for the Site are to mitigate risks to human health and the environment and to obtain a No Further Action determination from Ecology for the Site.

The final cleanup standards will be determined based on the selected cleanup action(s) approved by Ecology under Agreed Order Number DE00TCPHQ-1408 dated February 28, 2001. The final cleanup standards for the Site including cleanup levels, points of compliance, and remediation levels, if applicable, will be defined in the Cleanup Action Plan under a separate cover, in accordance with WAC 173-340-700.

5.2 IDENTIFICATION AND EVALUATION OF TECHNOLOGIES

The list of remedial technologies to be evaluated was approved by Ecology on October 26, 2011. The selected remedial technologies evaluated in this FS include the following:

- Bioremediation—Edible Oil Injection
- Bioremediation—Hydrogen-Releasing Compound
- Chemical Oxidation Injection
- Air Sparge with Soil Vapor Extraction (SVE)
- Dual-Phase Extraction (DPE)

- Zero Valent Iron PRB
- Excavation
- MNA
- Seep Control and Treatment

SoundEarth evaluated remedial alternatives for the Site with respect to the cleanup requirements set forth in MTCA. According to MTCA, a cleanup action alternative must satisfy the minimum threshold requirements for RAOs, as outlined in Section 5.1.3 above. WAC 173-340-360 (2)(b) also requires the cleanup action alternative to do the following:

- Use permanent solutions to the maximum extent practicable.
- Provide for a reasonable restoration time frame.
- Consider public concerns.

5.2.1 Remedial Technology Screening

A comprehensive list of remedial technologies, including technologies approved by Ecology, is presented in Table 11. The remedial alternatives were evaluated using the above criteria. Table 11 presents the results of the remedial component screening matrix. In addition to the screening matrix, each of the selected remedial technologies approved by Ecology is discussed in further detail below. The following Sections 5.2.1.1 through 5.2.1.9 were updated to incorporate additional information requested by Ecology in their letter dated August 24, 2011 (Ecology 2011a), and email correspondences dated October 25 and 26, 2011 (SoundEarth 2011b; Ecology 2011b).

5.2.1.1 Bioremediation—Edible Oil Injection

Bioremediation uses microorganisms to breakdown chlorinated compounds in soil and groundwater to nonhazardous compounds such as ethene or ethane. Anaerobic biodegradation is the breakdown of chemical compounds in the absence of oxygen. Edible oil is a nonhazardous vegetable oil that is injected into a contaminated plume to provide an energy source via carbon to stimulate the existing microorganisms and maintain an active population of microorganisms. The microorganisms break down the contaminants by using the chlorinated compounds as a carbon food source or cometabolizing the contaminants in the presence of another food source.

The detection of *Dhc* within the suspected source zone at the Site indicates that the microorganisms capable of degrading chlorinated compounds are present. The application of the edible oil will enhance the biological and chemical attenuation processes already occurring based on groundwater monitoring data for the Site presented in Section 3.1.

A commercial edible oil product SoundEarth would likely use is LactOil supplied by JRW Bioremediation LLC (JRW). The viscosity of LactOil is 25 centipoise and is 35 percent oil by weight (JRW 2011). The emulsion is mixed with water on site to create a 5 percent edible oil substrate solution before being injected through temporary injection points. The viscosity of edible oil is slightly more than water. The edible oil will adhere to the soil matrix and does not require direct contact with the COCs. The longevity and affinity for the soil matrix of this substrate will promote the anaerobic biodegradation that is already occurring at the Site. In addition, edible oil is considered a slow-releasing donor with a greater longevity in the subsurface when compared to sodium lactate (USBR 2006).

This technology is a feasible technology to be implemented at the Site and was retained for further evaluation based on the evidence of current degradation, the presence of microorganisms known to completely break down chlorinated compounds, the literature cited in this report, and the two case studies provided by SoundEarth discussed below.

5.2.1.2 Bioremediation—Hydrogen-Releasing Compound

A hydrogen-releasing compound (HRC) is delivered to the contaminated plume via injection. HRC is a food-grade polylactate ester and is delivered as a viscous solid, which allows for the slow release of hydrogen to the injected water-bearing zone and microorganisms to accelerate the degradation process. The case studies provided on the Regenesis website indicate that HRC is effective at reducing concentrations of PCE and TCE and augmenting reductive dechlorination. Bioremediation is a feasible technology for this Site based on the existing data presented in Section 5.2.1.1; however, HRC was not retained for further evaluation, based on its initial solubility of sodium lactate. HRC supplies sodium lactate to enhance the existing microorganism population, but does not allow for a controlled slow release for receptors directly downgradient. In addition, the rapid release of sodium lactate to the subsurface environment will require multiple injection events over the course of the cleanup action, which will make it difficult without a slow-releasing donor like edible oil to enhance the subsurface environment conditions that produce strong microorganism populations.

5.2.1.3 Chemical Oxidation Injection

Chemical oxidation compounds commonly used for the treatment of chlorinated compounds include permanganate, persulfate, and Fenton's reagent. These chemical oxidation compounds can effectively break the carbon-to-carbon double bond and facilitate the full breakdown of chlorinated compounds to nonhazardous compounds when in direct contact.

Permanganate is one of the more commonly used chemical oxidants to treat chlorinated compounds. Permanganate is highly stable in the subsurface due to its relative long half-life and is a cheaper chemical oxidant than persulfate and Fenton's reagent. Persulfate is a strong chemical oxidant, but persulfate has a shorter half-life than permanganate. Fenton's reagent is a rapid chemical reaction compound with a very short half-life that results in limited travel distances when injected. Fenton's reagent also produces a significant amount of gas and heat, which represent a health and safety hazard for workers.

The chemical oxidant can be delivered to the subsurface by batch injections or recirculation systems. The batch injection is common because it involves the use of temporary push borings to deliver the oxidant. The recirculation system involves more aboveground infrastructure and operation and maintenance (O&M) of the system. Both the batch injections and recirculation systems are evaluated in further detail below in Section 5.4.

This technology using permanganate as a chemical oxidant was retained for further evaluation based on the ability to breakdown COCs in affected media at the Site. No further evaluation of persulfate or Fenton's reagent as a chemical oxidant was retained.

5.2.1.4 Air Sparge with Soil Vapor Extraction

Air sparging combined with SVE is a proven technology for the remediation of VOCs. Air sparging involves the injection of air into the contaminated aquifer at an effective depth to cause both horizontal and vertical air to traverse through the soil column, creating an underground air stripping mechanism removing volatile and semivolatile organic contaminants. The injected air effectively transports the stripped contaminants into the unsaturated zone where they can be captured and removed by the SVE system. In addition, air sparging significantly increases the dissolved oxygen concentrations in saturated and vadose zone soil, promoting the growth of aerobic microorganisms and enhancing biodegradation.

The groundwater beneath the Site is shallow, and several wells exhibit artesian conditions. Air sparging mounds the groundwater near the sparge well, increasing groundwater elevations and potentially causing the migration of the plume, or results in impacted groundwater breaching the ground surface due to shallow groundwater elevations (Miller 1996). SVE is not implementable because there are little to no vadose zone soils at the Site and extensive dewatering would be necessary to apply a vacuum to the subsurface, which is cost prohibitive. Without being able to capture the vapors created by air sparging there is the potential to volatilize contaminants beneath buildings slabs and into indoor air, which poses a risk to commercial workers (Miller 1996). In addition, the existing groundwater quality data indicate that subsurface conditions are anaerobic and conducive for reductive dechlorination. This technology is not implementable based on the existing subsurface conditions and was not retained for further evaluation.

5.2.1.5 Dual-Phase Extraction

DPE is a proven technology for the remediation of VOCs in soil and groundwater. A DPE remediation system consists of a down well pump that would recover groundwater and the application of a vacuum to the exposed soil column for the recovery of VOCs from the soil. The extraction of groundwater reduces the mass of the dissolved-phase contaminants and reduces the mobility of the contaminant plume by hydraulic containment. Groundwater extraction can be effective for low to high permeability soils (EPA 1999). The vapor extraction component removes mass from the semi-saturated and unsaturated soil zones by volatilizing the contaminant and capturing the mass in the vapor-phase for ex situ treatment or discharge. The vapor extraction component is best applied when the surface is capped, soils have a low to moderate permeability, and a moderate vacuum is applied (EPA 1999).

EPA 1999 presents three case studies with successful results from the implementation of DPE at the removal of chlorinated VOCs from soil and groundwater. This technology is a feasible technology to implement at the Site and was retained for further evaluation.

5.2.1.6 Zero Valent Iron Permeable Reactive Barrier

A PRB is an in situ method for treating contaminated groundwater. Groundwater flows through a barrier wall containing a reactive mixture of zero valent iron and soil matrix. The zero valent iron acts as a catalyst to break down the chlorinated compounds dissolved in the groundwater.

This technology was retained for further evaluation for a passive treatment of the dissolved-phase plume. Although this remedial technology may successfully remediate the COCs in groundwater, it does not address the source soil material.

5.2.1.7 Excavation

Excavation of source material is a proven technology for the removal of contaminants from the subsurface. This technology removes the source material in soil and effectively eliminates the soil-to-groundwater pathway, but will not affect the dissolved-phase plume emanating from the source area. This technology was implemented previously and reached the maximum practical limits of excavation without shoring.

This technology was selected for further evaluation but will include shoring, excavation into the ROW and the evaluation of demolishing the Former Olympia Dry Cleaners Building to remove impacted soil.

5.2.1.8 Monitored Natural Attenuation

This technology was retained as a component of each remedial alternative for final polishing after the alternative has been implemented. MNA parameters will be evaluated as part of the groundwater quality assessment following the cleanup action.

5.2.1.9 Seep Control and Treatment

As part of the feasibility analysis seep control methods, such as permeation grouting and capping, were evaluated. Permeation grouting techniques are typically limited to soils containing sand- and gravel-size particles only. As referenced above in Section 2.3.2, the uppermost native soils in the local area consist of the Qgof geologic unit, which consists predominantly of silt and clay with interbeds of silt, clay, clayey silt, and silty sand. These soil types generally have relatively low hydraulic conductivity ranges from 10^{-3} to 10^{-6} cm/sec (Freeze and Cherry 1979). In general, soils with permeabilities between 10^{-3} and 10^{-4} cm/sec are marginally groutable, and soils with permeabilities lower than 10^{-5} cm/sec are ungroutable (Powers et al. 2007). The permeability of the soil is significantly influenced by the amount of fines present, and clayey fines reduce the groutability of soils more so than silty fines (Powers et al. 2007). Based on the existing subsurface conditions, permeation grouting was not retained as a potential solution to the Seep.

Depth to groundwater is shallow within the area of the Seep; however, after the previous interim remedial excavation, the Seep area was left at a lower grade than the surrounding area. This area will be brought back up to grade and capped. Capping of the Seep was retained for further evaluation as a component of each of the alternatives discussed below.

5.2.2 Cleanup Action Alternatives Selected for Further Evaluation

Based on the results presented in Table 11 and a review of case studies, the following technologies were selected for further evaluation:

- Cleanup Action Alternative 1, Bioremediation—Edible Oil Injection
- Cleanup Action Alternative 2, Chemical Oxidation—Permanganate Injection
- Cleanup Action Alternative 3, Chemical Oxidation— Recirculation System
- Cleanup Action Alternative 4, DPE
- Cleanup Action Alternative 5, Permeable Reactive Barrier

- Cleanup Action Alternative 6, Excavation with Shoring
  - Scenario 6A, Limited Excavation
  - Scenario 6B, Extensive Excavation

In addition, MNA and capping of the Seep were selected as components for each of the cleanup action alternatives for further evaluation.

5.3 ALTERNATIVE EVALUATION PROCESS

This section presents the evaluation of potentially feasible cleanup action alternatives with respect to the RAOs established for the Site. Remedial components were identified per the requirements set forth in MTCA under WAC 173-340-350(8)(b) and the focused screening of potential remedial components using the requirements and procedures for selecting cleanup actions as set forth in MTCA under WAC 173-340-360(2)(a)(b). The criteria used by SoundEarth to evaluate and compare applicable cleanup action alternatives when conducting the disproportionate cost analysis were derived from WAC 173-340-360(3)(f) and include the following:

- **Protectiveness.** The overall protectiveness of human health and the environment, including the degree to which existing risks are reduced, the time required to reduce risk at the facility and attain cleanup standards, the Site risks resulting from implementing the alternative, and improvement of overall environmental quality of the Site.
- **Permanence.** The degree to which the alternative permanently reduces the toxicity, mobility, or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated during the treatment process.
- **Cost.** The cost to implement the alternative, including the cost of construction, the net present value of long-term costs, and Ecology oversight costs. Long-term costs that were considered include those associated with O&M, monitoring, equipment replacement, reporting, and maintaining institutional controls.
- **Effectiveness over the Long Term.** The degree of certainty that the alternative will be successful, the reliability of the alternative during the period of time over which hazardous substances are expected to remain on the Site, and the magnitude of residual risk associated with the contaminated soil and/or groundwater components. The following types of cleanup action components, presented in descending order, may be used as a guide when assessing the relative degree of long-term effectiveness of the chosen alternative:
  - Reuse or recycling.
  - Destruction or detoxification.
  - Immobilization or solidification.
  - On-Property or off-Property disposal in an engineered, lined, and monitored facility.
  - On-Property isolation or containment with attendant engineering controls.
  - Institutional controls and monitoring.

- **Management of Short-Term Risks.** The risk to human health and the environment associated with the alternative during its construction and implementation, and the effectiveness of measures that will be taken to manage such risks.
- **Technical and Administrative Implementability.** The ability to implement the alternative; includes consideration of the technical feasibility of the alternative, administrative and regulatory requirements, permitting, scheduling, size, complexity, monitoring requirements, access for construction operations and monitoring, and integration with the future development plans for the Property.
- **Consideration of Public Concerns.** The consideration of community concerns regarding the alternative and, if there are concerns, the extent to which the alternative addresses those concerns. This process includes concerns from individuals, community groups, local governments, federal and state agencies, or any other organization that may have an interest in or knowledge of the Site.

5.4 FOCUSED EVALUATION OF TREATMENT ALTERNATIVES

The focused evaluation of cleanup action alternatives considered the practicable remedial components confirmed to be effective at treating COCs in the affected media of concern. SoundEarth also considered whether Site-specific constraints would preclude the application of a remedial component due to the creation of a greater risk to human health and/or the environment, or that such constraints could result in the remedial technology being technically or administratively infeasible to implement or substantial costs without proportional benefit. A detailed description of the six alternatives that were retained for additional consideration is provided below.

5.4.1 Cleanup Action Alternative 1, Bioremediation—Edible Oil Injection

Cleanup Action Alternative 1 will involve the injection of edible oil into the subsurface to provide a substrate as a food source for the existing microbial population and to promote the bioremediation of COCs present within the suspected source area and dissolved-phase plume. Figure 9 provides a conceptual illustration of how this cleanup action alternative might be implemented.

Based on SoundEarth's experience for the last 5 years, biological processes can work better in lower permeability water-bearing zones than chemical oxidation processes for chlorinated compound sites. The primary reason biological processes work better is due to the multiplication of bio-organisms versus the chemical dilution that occurs to the chemical oxidation components. The low permeability of the shallow water-bearing zone can be overcome by creating preferential pathways within the treatment zone by fracturing the soil matrix. This injection method could allow for better distribution of the edible oil if the soil matrix will not allow for a low-pressure injection due to the low permeability. However, Ecology currently prefers that a low-pressure injection method be applied if this cleanup action alternative is selected.

The current groundwater conditions at the Site have a pH range from 6.3 to 8.8, groundwater temperature of 14 to 19 degrees °C, and concentrations of dissolved oxygen from 0.75 to 1.3 mg/L (Table 4). As part of the performance monitoring, SoundEarth will monitor the groundwater conditions within the treatment zone for pH, temperature, and dissolved oxygen.

These groundwater parameters may affect the existing microorganism population's ability to grow at an accelerated rate. The performance monitoring will allow SoundEarth to determine whether or not any pH buffering is required. Although a groundwater temperature of 20 °C is ideal, multiple sites in Washington State having the same temperature range as the Site have shown excellent PCE reductions when edible oil has been applied. The introduction of edible oil will limit the amount of oxygen introduced during the injection process and will drive the water-bearing zone to be anaerobic. The available carbon in edible oil is extremely high, which leads the naturally occurring bacteria to use up all the available oxygen.

As part of the evaluation of this cleanup action alternative, two recent SoundEarth projects, where edible oil was injected to treat a PCE plume, were assessed. The two projects are located in Seattle, Washington, and are referred to as the Ballard Property and the Capitol Hill Property. Both of these projects have shown significant reductions in concentrations of PCE in groundwater. A summary for each project is provided below.

The Ballard Property was injected with edible oil in March 2010. Approximately 12,000 gallons of 5 percent edible oil solution was injected into 23 injection points for 2 days. The initial baseline concentration of PCE in groundwater was 590 and 240 µg/L in wells IW01 and IW02, respectively. Over a 2-year period, the concentration decreased to 1.3 and 2.2 µg/L in IW01 and IW02, respectively (Charts 1 and 2).

The Capitol Hill Property had multiple injection events from 2008 to 2011. The initial event injected approximately 11,000 gallons of 5 percent edible oil solution into 30 points for 4 days. The second and third injections were targeted for specific wells, with 200 gallons injected at 1 point and 700 gallons injected into 4 points. The fourth injection event had a higher concentration of edible oil, 18 percent solution, and approximately 3,600 gallons were injected into 14 points. PCE concentrations in samples collected from groundwater monitoring wells dropped from a high of 7,300 and 2,000 µg/L in wells MW108 and KMW1, respectively, to <0.5 µg/L (Charts 3 and 4). The concentrations of cis-1,2-DCE and vinyl chloride at both sites have increased over time. These results indicate that reductive dechlorination processes have accelerated due to the edible oil injection events. The concentrations of cis-1,2-DCE and vinyl chloride will decrease over time due to the enhanced subsurface environment from the injected edible oil and the microorganism population growth that will continue to break down the chlorinated compounds.

The Cleanup Action Alternative 1 preliminary field program, work components, and processes are described below. An emulsified edible oil is formulated with biodegradable vegetable oil that provides a food source for the microorganisms and stimulates biodegradation activity. Edible oil would be injected into the subsurface through either permanent injection wells or temporary injection points using a common and readily available drilling or direct-push technique. The edible oil injection would target the COCs within the saturated zone. In addition, the thin vadose zone soil layer would be treated by mounding the edible oil solution into the vadose zone. The PCE would be sequestered into the edible oil and then would be anaerobically biodegraded.

The edible oil would be injected at a low pressure into approximately up to 250 injection points assuming a radius of influence (ROI) of 2.5 feet. The Air Force Center for Environmental Excellence (AFCEE) 2004 document recommends a groundwater velocity of 5 feet per day and the estimated groundwater velocity at the Site is 3.2 feet per day (Table 5; AFCEE 2004). This groundwater flow velocity is near the low range, and it is possible that the injection points may require closer spacing than 5-foot on center. The injection spacing would be based on performance monitoring of total organic carbon and mounding in the field. If there was daylighting during the injection process, further injection would be discontinued at that location. In addition, to ensure that oily groundwater was not introduced to the nearby storm drain, a lower injection pressure would be used near the storm drain and curbs.

Injection into the wells would permeate the upper 10 feet of the water-bearing zone with the edible oil substrate. Up to 2,500 gallons of injectate would be injected into each well. Injections would be accomplished using a portable injection system that was skid-mounted and transported in a pickup truck. SoundEarth anticipates the first low pressure injection program would entail one injection event over a 50- to 60-day period, depending on how readily the formation accepts the injectate. A second injection event, approximately a third of the size of the initial injection program and bioaugmentation, would be incorporated under this cleanup action alternative as a contingency.

The feasibility of implementing this technology depends on the permeability of subsurface soil conditions and the available time frame allowed for achieving the RAOs. The existing reductive conditions and presence of *Dhc* would lead to the successful implementation of this technology. *Dhc* is a specific strain of bacteria that is known to degrade vinyl chloride to ethane. The assessment of the microbial population indicated that moderate concentrations of *Dhc* are present within the dissolved-phase plume. *Dhc* has been found in about 85 percent of the sites that have implemented the edible oil technology. If *Dhc* was not present, a number of vendors sell bioaugmentation slurries that could be used to develop *Dhc* at the Site. Performance monitoring during and after the injection would provide indicators as to whether or not bioaugmentation is necessary. If the process seems to be stalling at 1,2-DCE or vinyl chloride over a 1- to 2-year period, *Dhc* analysis would be completed again to further determine the need for bioaugmentation.

Key assumptions for this cleanup action alternative include the following:

- A single well point injection test will be performed to estimate design parameters before full-scale implementation. Baseline parameters including total organic carbon, pH, and metals will be collected. The injection pressure, mounding, and pH in the injection well and adjacent monitoring wells will be monitored.
- The approximate 250 injection points will be adequate to deliver the injectate. The total amount of injection points may vary based on subsurface conditions and unknown subsurface obstacles.
- Performance monitoring will include monitoring groundwater for total organic carbon, mounding, pH, MNA parameters, soil gas, sub-slab vapor, and monitoring of any seepage into the street for metals (arsenic, nickel, copper, manganese). A baseline monitoring event will be completed to establish performance monitoring parameters before implementing the edible oil injection. The performance monitoring parameters will be further discussed in the draft Cleanup Action Plan.
- A 1-day geoprobe event will be completed as part of the compliance monitoring.

- A monitoring well will be installed on the Cherry Street Q-Tip Trust Property and be incorporated into the existing monitoring well network for compliance monitoring.
- The volume of edible oil required will be calculated using a mass balance model supplied by the vendor and will be further discussed in the draft Cleanup Action Plan.
- The existing microbial population will not require augmentation. It is possible, based on additional testing, that the treatment zone may require bioaugmentation. The necessity for bioaugmentation will be determined by performance monitoring once the edible oil is introduced. Bioaugmentation will be implemented during a second injection event if necessary.
- One low-pressure injection event will take place over a 50- to 60-day period. A second smaller scale injection event will be included as a contingency. The duration of each injection event may vary. The number of events is relatively unimportant; it is the overall volume of the edible oil to be injected that is the driving force. The injection will be implemented using direct push, not permanent monitoring points.
- Five years of post-injection groundwater monitoring data will indicate that concentrations of COCs are below the MTCA cleanup levels for groundwater.
- A temporary oil/water separator will be required to remove any edible oil that is captured by the current seep collection system and will be disposed of properly.
- The entire treatment area, approximately 4,300 square feet, will be capped before implementation.
- Access will be provided by the Cherry Street Q-Tip Trust to install the groundwater monitoring well, pave the alley on the south side of the building, and portions of the remediation treatment area for the installation of the injection points.
- Site restoration activities will include matching the grade in the Seep area to the surrounding grade and replacing the sidewalk section that is missing south of the Cherry Street Q-Tip Trust Building and north of the Former Olympia Dry Cleaners Building.
- The Seep area will be brought up to grade and capped.
- The life cycle for this alternative will be assumed to be 5 years for the purpose of estimating the present worth cost. This duration should not be construed as a guaranteed remediation time frame.

The present worth cost estimate to implement Cleanup Action Alternative 1, assuming a real discount rate of 0.9 percent and a life cycle of 5 years, is approximately $1,033,000 (Table 12).

5.4.2 Cleanup Action Alternative 2, Chemical Oxidation—Permanganate Injection

Cleanup Action Alternative 2 will involve the injection of sodium permanganate into the subsurface to oxidize the contaminants in the suspected source and the dissolved-phase plume. Figure 10 provides an illustration of the conceptual implementation of this cleanup action alternative.

Chemical oxidation using permanganate provides a rapid treatment time of COCs in soil and groundwater. Chemical oxidation requires direct contact with the contaminant, and a high density injection grid is necessary for adequate contact with the affected media. It is difficult to control the distribution and chemical reactions of the oxidant in the subsurface. There can be fouling as the oxidant comes into contact with the soil matrix, such as the formation of manganese oxides, which can further inhibit the distribution of the oxidant to the targeted COCs. The capital costs associated with chemical oxidation when compared to bioremediation technologies are higher if high pressure injections are applied.

The distribution of the chemical oxidant within the source area and/or plume is dependent on the permeability of the soil matrix. The intrinsic permeability for the uppermost soil matrix from 0 to 12 feet bgs within and in close proximity to the former excavation area is approximately 6.90×10^{-8} centimeters squared (Table 5). This estimated intrinsic permeability is considered low to moderate. The intrinsic permeability for the finer soil material located regionally and at the same depths is likely lower, ranging from 1×10^{-9} to 1×10^{-11} centimeters squared. The low to moderate permeable soil may make it difficult to distribute the chemical oxidant and achieve direct contact with the affected media. Higher injection pressures can be used to fracture low permeability soil; however, the oxidant can extend farther than anticipated and potentially daylight in unexpected locations. Strong oxidants are hazardous if they daylight, and site controls are important when injecting powerful chemical oxidants because they pose a threat to the average person who may encounter chemicals that have daylighted outside the controlled treatment zone.

The Cleanup Action Alternative 2 preliminary field program, work components, and processes are described herein below. Sodium permanganate would be injected into the subsurface through temporary injection points using a direct-push drilling technique. The permanganate would target the COCs within the affected media. The thin vadose zone would be treated by mounding the chemical oxidant within the treatment area. The permanganate would oxidize the COCs it comes in direct contact with during the injection program.

The oxidant would be injected into approximately 360 injection points for adequate distribution in the subsurface and contact with the affected media. Approximately 135,000 pounds of chemical oxidant would be required to treat the affected media. This estimate is based on soil oxidant demand analyses completed at other sites in the Seattle area that ranged from 0.2 to 4 percent. To be conservative, a soil oxidant demand of 4 percent would be used for the treatment area. The injections would be accomplished using a portable injection system that would be skid-mounted and transported in a pickup truck. SoundEarth anticipates the injection program would entail one injection event over a 50- to 60-day period.

The feasibility of implementing this technology depends on direct contact between the oxidant and affected media and how well the oxidant is distributed in the subsurface. Monitoring during the injection program would be required to minimize the potential of the chemical daylighting and determine the lateral extent of the oxidant in the subsurface. The distribution of the chemical oxidant would be monitored by the detection of the purple color of the permanganate in monitoring wells, mounding of the groundwater table, and monitoring dissolved oxygen concentrations with a field meter.

Key assumptions for this cleanup action include the following:

- A single well injection test will be performed to estimate design parameters before full-scale implementation. Baseline parameters including dissolved oxygen and the natural and soil oxidant demand will be collected.
- The approximate 360 injection points will be adequate to deliver the chemical oxidant. The total amount of injection points may vary based on subsurface conditions and unknown subsurface obstacles.
- The estimated soil oxidant demand estimate will be conservative enough to provide adequate oxidant required to oxidize the COCs.
- One injection event will be performed over a 50- to 60-day period.
- Performance monitoring will include monitoring groundwater for permanganate in monitoring wells, mounding, dissolved oxygen, monitoring the Seep for any signs of permanganate, soil gas monitoring, and sub-slab vapor monitoring. A baseline monitoring event will be completed to establish performance monitoring parameters before implementing the chemical injection.
- A 1-day geoprobe event will be completed as part of the compliance monitoring.
- A monitoring well will be installed on the Cherry Street Q-Tip Trust Property and will be incorporated into the existing monitoring well network for compliance monitoring.
- Five years of post-injection groundwater monitoring data will indicate that concentrations of COCs are below the MTCA cleanup levels for groundwater.
- The existing Seep pump and batch treatment system will be utilized in case the permanganate daylights into the Seep area to capture the oxidant prior to entering the stormwater system.
- The entire treatment area, 4,300 square feet, will be capped.
- Access will be provided by the Cherry Street Q-Tip Trust to install the groundwater monitoring well, pave the alley on the south side of the building, and portions of the remediation treatment area and for the installation of the injection wells.
- Site restoration activities will include matching the grade in the Seep area to the surrounding grade and replacing the sidewalk section that is missing south of the Cherry Street Q-Tip Trust Building and north of the Former Olympia Dry Cleaners Building.
- The Seep area will be brought up to grade and capped.
- The life cycle for this alternative is assumed to be 5 years for the purpose of estimating the present worth cost. This duration should not be construed as a guaranteed remediation time frame.

The present worth cost estimate to implement Cleanup Action Alternative 2, assuming a real discount rate of 0.9 percent and a life cycle of 5 years, is approximately $1,116,000 (Table 13).

5.4.3 Cleanup Action Alternative 3, Chemical Oxidation–Recirculation System

Cleanup Action Alternative 3 will involve the injection and recirculation of sodium permanganate in the subsurface to oxidize the contaminants in the suspected source and the dissolved-phase plume. Figures 11A and 11B provide an illustration of the conceptual implementation of this cleanup action alternative.

Cleanup Action Alternative 3 differs from Cleanup Action Alternative 2 above in that it will involve the recirculation of the injected sodium permanganate instead of a batch injection. The advantages associated with the recirculation system include better oxidant site control within the treatment area and enhancing the natural groundwater gradient to increase the radius of influence from the injection points and more flexibility to focus treatment based on performance monitoring results. One disadvantage of this alternative is that the recirculation system requires aboveground infrastructure for the injection, extraction, and amending the groundwater before reinjection.

The Cleanup Action Alternative 3 preliminary field program, work components, and processes are described below. Sodium permanganate would be injected into the subsurface through permanent vertical and horizontal wells. The vertical wells would be used as an injection or extraction well, which would provide the flexibility for continual optimization of the recirculation system. Figures 11A and 11B show the two possible configurations for the recirculation system. If this cleanup action alternative is the selected remedy, the full design details would be presented under the draft Cleanup Action Plan.

The oxidant would be injected into 5 to 6 of the 11 vertical wells and 1 horizontal well, and extracted from the other 5 to 6 extraction wells for adequate distribution of the chemical oxidant in the subsurface. Approximately 21,350 pounds of chemical oxidant would be required for the treatment area. The recirculation system would operate continuously for 2 years. The permanganate injections would be pulsed based on performance monitoring data.

The feasibility of implementing this technology depends on direct contact between the oxidant and affected media and how well the oxidant is distributed in the subsurface. Monitoring during the injection program would be required to minimize the potential of the chemical daylighting and determine the lateral extent of the oxidant in the subsurface. The distribution of the chemical oxidant would be monitored by the detection of the purple color of the permanganate in monitoring wells, mounding of the groundwater table, and monitoring dissolved oxygen concentrations with a field meter. If the permanganate concentration exceeds 100 mg/L in the observation and extraction wells or system aboveground storage tanks, then permanganate injections in that area would cease.

Key assumptions for this cleanup action include the following:

- A single well injection test will be performed to estimate design parameters before full-scale implementation. Baseline parameters, including dissolved oxygen and the natural and soil oxidant demand, will be collected.
- The installation of nine permanent remediation wells will be installed, and existing monitoring wells MW-09 and MW-15 and existing horizontal well will be converted into remediation wells.

- Two additional monitoring wells will be included as a contingency in the event that additional wells are warranted for performance monitoring.
- An ROI of 8 feet will be estimated for the remediation wells when used as extraction points based on the observations between the existing horizontal remediation well and pumping well MW-15 during the pump test.
- The remediation wells will be utilized as either injection or extraction points to circulate the chemical oxidant through the subsurface to maximize contact with the COCs.
- An underground injection control registration will be approved for the reinjection of treated groundwater extracted during system operations.
- Performance monitoring will include monitoring groundwater for permanganate in monitoring wells, mounding, and dissolved oxygen, the Seep for any signs of permanganate, soil gas, and sub-slab vapor. A baseline monitoring event will be completed to establish performance monitoring parameters before implementing the chemical injection.
- A 1-day geoprobe event will be completed as part of the compliance monitoring.
- A monitoring well will be installed on the Cherry Street Q-Tip Trust Property and will be incorporated into the existing monitoring well network for performance monitoring.
- The groundwater recirculation system will operate for 2 years.
- Five years of post-injection groundwater monitoring data that will indicate that concentrations of COCs are below the MTCA cleanup levels for groundwater.
- The entire treatment area of 4,300 square feet will be capped.
- Access will be provided by the Cherry Street Q-Tip Trust to install the groundwater monitoring well, pave the alley on the south side of the building, and portions of the remediation treatment area and for the installation and operation of the remediation wells.
- Site restoration activities will include matching the grade in the Seep area to the surrounding grade and replacing the sidewalk section that is missing south of the Cherry Street Q-Tip Trust Building and north of the Former Olympia Dry Cleaners Building.
- The Seep area will be brought up to grade and capped.

The present worth cost estimate to implement Cleanup Action Alternative 3, assuming a real discount rate of 0.9 percent and a life cycle of 5 years, is approximately $737,000 (Table 14).

5.4.4 Cleanup Action Alternative 4, Dual-Phase Extraction

Cleanup Action Alternative 4 involves the installation of a DPE remediation system to reduce concentrations of COCs in soil and groundwater to below cleanup levels. The treatment area would be capped with asphalt to minimize surface water infiltration. Figure 12 provides a conceptual illustration of how this cleanup action alternative might be implemented.

Implementation of DPE involves the installation of vertical wells within the shallow water-bearing zone of contamination. A pump would be placed into the wells to extract groundwater and expose the soil column where a vacuum was applied to induce the flow of air and enhance the recovery of VOCs from the soil.

Based on the aquifer drawdown test completed in MW-15, an approximate ROI of 10 feet is estimated for each DPE well. The assumed extraction ROI is a relatively conservative estimate for dewatering a shallow water-bearing zone that consists of silty sand and sandy silt material. It is estimated that eight DPE wells would be necessary to address the dissolved-phase groundwater plume. The DPE wells would be screened from 3 to 10 feet bgs within the shallow water-bearing zone. The existing network of monitoring wells would not be incorporated into the DPE remediation system and would act as compliance points for post-remediation monitoring. Additional DPE wells would be installed within the shallow water-bearing zone based on observed performance monitoring if the extraction goals to expose the soil column within the treatment zone was not achieved.

The DPE remediation system would be designed to effectively target COCs in both the saturated and unsaturated zones. During the operation of the remediation system, recovered groundwater would be treated before discharge to the sanitary sewer and would be sampled and analyzed according to permit conditions; vapors from the system would be monitored monthly to assess the effectiveness and progress of the system. Confirmation soil samples would be used to demonstrate that the remediation objectives were attained at the presumed conclusion of remediation. The compliance monitoring plan would be finalized in the draft Cleanup Action Plan.

Key assumptions for this cleanup action include the following:

- Subsurface geology will be favorable for successful implementation of this technology.
- Access will be provided by the Cherry Street Q-Tip Trust to install the groundwater monitoring well, pave the alley on the south side of the building, and portions of the remediation treatment area and for the installation of the DPE wells.
- Based on the aquifer drawdown test, the maximum ROI for the DPE remediation wells is estimated at 10 feet. An ROI of 10 feet is considered conservative for the shallow water-bearing zone. Additional DPE wells will be installed, if necessary, to achieve the design objectives.
- The remediation area will be paved to limit surface water infiltration to maximize the drawdown of each pumping well.
- The wells will be screened within the shallow water-bearing zone and care will be taken to avoid screening across and into the artesian aquifer.
- Permit analysis and application will be obtained for the discharge of recovered groundwater to the sanitary sewer and vapors to ambient air. The recovered groundwater will be treated with a tray stripper before discharge to the sanitary

sewer. The emissions from the extracted soil vapors and those generated by the tray stripper will be modeled to determine whether a air discharge permit from Olympic Region Clean Air Agency and/or pretreatment of the vapor generated will be necessary.

- Compliance monitoring will include sub-slab vapor monitoring and a 1-day geoprobe event. The compliance monitoring parameters will be further discussed in the Cleanup Action Plan.
- A monitoring well will be installed on the Cherry Street Q-Tip Trust Property and will be incorporated into the existing monitoring well network for compliance monitoring.
- Site restoration activities will include matching the grade in the Seep area to the surrounding grade and replacing the sidewalk section that is missing south of the Cherry Street Q-Tip Trust Building and north of the Former Olympia Dry Cleaners Building.
- The Seep area will be brought up to grade and capped.
- The life cycle for this alternative is assumed to be 15 years for the purpose of estimating the present worth cost. This duration should not be construed as a guaranteed remediation time frame.

The present worth cost estimate to implement Cleanup Action Alternative 4, assuming a real discount rate of 0.9 percent and a life cycle of 15 years, is approximately $2,305,000 (Table 15).

5.4.5 Cleanup Action Alternative 5, Permeable Reactive Barrier

Cleanup Action Alternative 5 will involve the installation of a PRB to intercept contaminated groundwater coming from the Site. As groundwater flows through the reactive material in the barrier, zero valent iron, it acts as a catalyst to break down the COCs. This is a passive treatment technology for dissolved-phase COCs. Figure 13 provides a conceptual illustration of the extent of the PRB.

An excavation contractor would be used to remove soil from the proposed PRB footprint and down to approximately 10 feet. Care would be taken to key the barrier into the semi-confining layer at approximately 10 feet bgs across the treatment area. The excavated material would be field screened and segregated for proper characterization and off-Site disposal. A mixture of sand and iron fillings would be mixed on the Site and backfilled into the PRB footprint. The material would be mixed on the Site before placement in the trench.

Trench boxes would be required for the excavation of soil below the groundwater table and adjacent to the ROWs. The estimated mass of soil to be removed is 350 tons.

Key assumptions for this cleanup action include the following:

- The location of the PRB is limited due to the existing Site features, including the Cherry Street Q-Tip Trust Building, overhead and underground utilities, and ROW improvements. It is assumed that the entire dissolved-phase plume can be captured.

- The PRB will be successfully keyed into the semi-confining layer. This is an important assumption for this technology. The semi-confining layer ensures that the groundwater will preferentially flow through the permeable material in the barrier.
- The semi-confining layer will not be breached. This is another key assumption because if the semi-confining layer is breached, there is the potential for a large volume of clean groundwater from the lower, artesian aquifer that was otherwise clean to become contaminated by passing through the contaminated shallow water-bearing zone. The vertical hydraulic gradient could overcome the PRB design and may require additional engineering to control the excess water using a pump and treat system.
- This alternative does not include costs for a backup pump and treat system, if required.
- Trench boxes will be used for the excavation of soil and placement of the sand and iron mixture.
- The mass estimated as clean overburden and contaminated soil will depend on subsurface conditions encountered.
- No treatment of source zone soils is assumed.
- Compliance monitoring will include a sub-slab vapor monitoring event and groundwater monitoring. The compliance monitoring parameters will be further discussed in the Cleanup Action Plan.
- A monitoring well will be installed on the Cherry Street Q-Tip Trust Property and will be incorporate into the existing monitoring well network for performance monitoring. Access will be provided by the Cherry Street Q-Tip Trust to install the groundwater monitoring well.
- Quarterly groundwater monitoring for 10 years is assumed.

The present worth cost estimate to implement Cleanup Action Alternative 5, assuming a real discount rate of 0.9 percent and a life cycle of 10 years, is $1,150,000 (Table 16).

5.4.6 Cleanup Action Alternative 6, Excavation with Shoring

Provided below are two excavation scenarios.

5.4.6.1 Excavation, Scenario 6A—Limited Excavation with Shoring

Excavation is the most definitive method for removal of the remaining impacted soil provided there is access to the material and it can be done without damage to existing buildings or the public ROW. A limited excavation would include the removal of accessible soil contamination outside the building footprints, temporary bypassing of existing utilities, and excavation within the public ROW. Contaminated soil would be characterized for proper off-Site disposal. Clean structural fill would be imported and compacted to restore the Site to its original grade. A shoring system would be required along the ROWs to the west of the Site and along the northern and southern portion of the excavation near the existing buildings foundation. Impacts to both of the operating businesses would be anticipated based on road lane closures, noise from excavation equipment, and shoring installation. Figure 14 provides a conceptual illustration of how this alternative would be implemented.

Limits of the soil excavation would extend to 10 feet bgs across the Site and care would be taken to not compromise the semi-confining material at the base of the excavation. Shoring would be required because of excavation of contaminated soil below the groundwater table and the close proximity to the ROWs and existing buildings. The estimated mass of soil to be excavated would be approximately 2,000 tons.

During excavation activities, compliance soil sampling would be performed to evaluate disposal options for the material being hauled off the Site and to document that the specified cleanup levels were attained where accessible.

Key assumptions for this cleanup action include the following:

- Shoring will consist of soldier piles and wood lagging. It is estimated that approximately 2,500 exposed square feet of shoring will be required.
- The mass of imported fill will be equivalent to the contaminated and clean overburden soil mass hauled off the Site (2,000 tons).
- The utilities will be rerouted before excavation and replaced when the excavation is completed. It is assumed that the subsurface utilities at the Site are not considered migration pathways for contaminated groundwater.
- A minimum of 40 compliance soil samples will be required to confirm that contaminated soil had been removed from the Site.
- Loss of rent/revenue during the excavation will not exceed the cost of construction.
- Access will be provided by the Cherry Street Q-Tip Trust to install the groundwater monitoring well, shoring installation, and limits of excavation.
- Shoring near existing building foundation will be less expensive than demolition and replacement.
- Compliance monitoring will include a sub-slab vapor monitoring event and groundwater monitoring. The compliance monitoring parameters will be further discussed in the Cleanup Action Plan.
- A monitoring well will be installed on the Cherry Street Q-Tip Trust Property and will be incorporated into the existing monitoring well network for compliance monitoring.
- Natural attenuation will remediate the residual contamination that may be left in place because of inaccessibility beneath the existing buildings.
- The Seep area will be brought up to grade and capped.
- Quarterly groundwater monitoring for 3 years is assumed.

The present worth cost estimate to implement Cleanup Action Alternative 6A, assuming a real discount rate of 0.9 percent and a life cycle of 3 years, is approximately $1,633,000 (Table 17).

5.4.6.2 Excavation, Scenario 6B—Extensive Excavation with Shoring

An extensive excavation would include the removal of accessible soil contamination outside the building footprint of the Cherry Street Q-Tip Trust Building, demolition of the Former Olympia Dry Cleaners Building, temporary bypassing of existing utilities, and excavation within the public ROW. Contaminated soil would be characterized for proper off-Site disposal. Clean structural fill would be imported and compacted to restore the Site to its original grade. A shoring system would be required along the ROWs to the west of the Site, along the northern portion of the excavation near the existing building foundation and the southern limits of excavation. Impacts to the Cherry Street Q-Tip Trust Building business operations would be anticipated based on road lane closures, noise from excavation equipment, and shoring installation. The Former Olympia Dry Cleaner Building's tenant would have to be relocated, and the property owner would lose approximately $2,500 per month in revenue. Figure 15 provides a conceptual illustration of how this alternative would be implemented.

Limits of the soil excavation would extend to 10 feet bgs across the Site, and care would be taken to not compromise the semi-confining material at the base of the excavation. Shoring would be required because of excavation of contaminated soil below the groundwater table and the close proximity to the ROWs and existing buildings. The estimated mass of soil to be excavated would be approximately 3,000 tons.

During excavation activities, compliance soil sampling would be performed to evaluate disposal options for the material being hauled off the Site and to document that the specified cleanup levels were attained where accessible.

Key assumptions for this cleanup action include the following:

- The Former Olympia Dry Cleaners Building will be demolished.
- Shoring will consist of soldier piles and wood lagging. It is estimated that approximately 3,500 exposed square feet of shoring will be required.
- The mass of imported fill will be equivalent to the contaminated and clean overburden soil mass hauled off the Site (3,000 tons).
- The utilities will be rerouted before excavation and replaced when the excavation is completed. It is assumed that the subsurface utilities at the Site are not considered migration pathways for contaminated groundwater.
- A minimum of 60 compliance soil samples will be required to confirm that contaminated soil had been removed from the Site.
- Loss of rent/revenue during the excavation will not exceed the cost of construction.
- Access will be provided by the Cherry Street Q-Tip Trust for shoring installation and limits of excavation. It is assumed that the Cherry Street Q-Tip Trust tenant will not request compensation based on impacts to business operations.
- Shoring near existing Cherry Street Q-Tip Building foundation will be less expensive than demolition and replacement.
- A monitoring well will be installed on the Cherry Street Q-Tip Trust Property and will be incorporated into the existing monitoring well network for compliance

monitoring. Access will be provided by the Cherry Street Q-Tip Trust to install the groundwater monitoring well.

- Natural attenuation will remediate the residual contamination that may be left in place because of inaccessibility beneath the existing building to the north.
- The Seep area will be brought up to grade and capped.
- Quarterly groundwater monitoring for 3 years is assumed.

The present worth cost estimate to implement Cleanup Action Alternative 6B, assuming a real discount rate of 0.9 percent and a life cycle of 3 years, is approximately $2,533,000 (Table 18).

5.5 COMPARISON OF ALTERNATIVES

A summary of the evaluation of the cleanup action alternatives using the MTCA evaluation criteria (WAC 173-340-360[3][f]) is presented in Table 19.

- **Protectiveness.** All of the cleanup action alternatives provide a measure of protectiveness for human health and environment. Cleanup Action Alternative 6 exhibits a greater degree of protectiveness than Cleanup Action Alternatives 1 through 5 due to the permanent removal and disposal of the contaminated media. Cleanup Action Alternatives 1 through 3 rely on an in situ technique to biodegrade or oxidize the COCs, and Cleanup Action Alternative 4 physically removes the COCs from the saturated and unsaturated soil. Cleanup Action Alternative 5 is a passive technology that treats groundwater, but does not address the COCs in soil. The main difference in the degree of protectiveness is that Cleanup Action Alternative 6 physically removes the impacted material and Cleanup Action Alternatives 1 through 5 rely on in situ techniques to address COCs.
- **Permanence.** All cleanup action alternatives provide a permanent solution in the reduction of toxicity, mobility, and volume of COCs through either biological or physical means. Cleanup Action Alternative 6 would achieve the cleanup levels in soil more quickly than Cleanup Action Alternatives 1 through 4; however, it does not address the remaining dissolved-phase groundwater plume. Cleanup Action Alternatives 1 through 4 address soil and groundwater contamination, but require a longer period of time. Cleanup Action Alternative 5 has the lowest score because it only addresses groundwater contamination. Cleanup Action Alternative 6 scores the highest because it involves the physical removal of the contaminate source than Alternatives 1 through 5.
- **Effectiveness over the Long Term.** The long-term effectiveness of Cleanup Action Alternatives 1 through 4 would be slightly less than that of Cleanup Action Alternative 6. Cleanup Action Alternatives 1 through 4 score lower than Cleanup Action Alternative 5 due to uncertainties in the subsurface conditions beneath the Site. There is the possibility that preferential pathways exist but are difficult to characterize. Cleanup Action Alternative 5 scores the lowest of the alternatives because it does not affect the source material in soil. Cleanup Action Alternative 6 would include the most effective of alternatives because it includes the physical removal of more contaminated source material.
- **Management of Short-Term Risks.** The short-term risks are significantly higher for Cleanup Action Alternative 6 compared to the in situ techniques of Cleanup Action Alternatives 1

through 3. Cleanup Action Alternative 6 involves shoring of building foundations and the public ROW, excavation, transportation, and handling of hazardous materials. Cleanup Action Alternatives 4 and 5 also present short-term risks associated with the use of heavy equipment and excavation of limited quantities of soil during the installation of the DPE system or PRB.

- **Technical and Administrative Implementability.** Cleanup Action Alternatives 1 and 3 score high because they are the most readily implementable technologies. Cleanup Action Alternative 1 involves the installation of temporary injection locations and generates little waste. Cleanup Action Alternative 2 requires the installation of nine permanent injection points and basic manifold piping for the recirculation system. Cleanup Action Alternative 6 has the lowest score due to the complexity of shoring one or both of the buildings, the ROW, and rerouting utilities. All of the cleanup action alternatives involve permitting, but Cleanup Action Alternative 6 would have extensive engineering and geotechnical design activities. All cleanup action alternatives depend on access from the adjacent property owner for successful implementation.

5.6 DISPROPORTIONATE COST ANALYSIS

Costs are considered disproportionate to benefits if the incremental costs of one alternative versus a less expensive alternative exceed the incremental degree of benefit achieved by the more expensive alternative. The following is a description of the factors that were used to estimate the cost of the six alternatives discussed above.

5.6.1 Cleanup Action Alternative Cost Estimating

- **Capital Costs.** These costs include expenditures for equipment, labor, and material necessary to install a remedial action. Indirect costs may be incurred for engineering, financial, or other services not directly involved with installation of remedial alternatives but necessary for completion of this activity.
- **Operation and Maintenance Costs.** These costs are post-construction costs necessary to provide effective implementation of the alternative. Such costs may include, but are not limited to, the following: operating labor; maintenance materials and labor; disposal of residues; and administrative, insurance, and licensing costs.
- **Monitoring Costs.** These costs are incurred from monitoring activities associated with remedial activities. Cost items may include sampling labor, laboratory, analyses, and report preparation.
- **Present Worth Analysis.** Present worth analysis provides a method of evaluating and comparing costs that occur over different time periods by discounting all future expenditures to the present year. The present worth cost or value represents the amount of money which, if invested in year 0 and disbursed as needed, would be sufficient to cover all costs associated with a remedial alternative. The assumptions necessary to derive a present worth cost are inflation rate, discount rate, and period of performance. A discount rate, which is similar to an interest rate, is used to account for the time value of money. EPA policy on the use of discount rates for RI/FS cost analyses is stated in the preamble to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) published at the Federal Register (55

FR 8722) and in Office of Solid Waste and Emergency Response Directive 9355.3-20 titled Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis (EPA 1993). Based on the NCP and this directive, a discount rate of 0.9 percent is recommended in developing present value cost estimates for remedial action alternatives during the FS. This specified rate of 0.9 percent represents a "real" discount rate in that it approximates the marginal pretax rate of return on an average investment in the private sector in recent years and has been adjusted to eliminate the effect of expected inflation. For this Revised Draft FS Report, a more conservative real discount rate was selected based on the December 2011 revisions to Appendix C of the OMB Circular A-94. The real discount rates used to estimate the present worth of annual operating costs are based on the estimated restoration time frame (life cycle) for each alternative and are extrapolated from the referenced OMB Circular, which is published annually.

- Because it is assumed that all capital costs are incurred in year 0, the present worth analysis is performed only on annual O&M and groundwater monitoring costs. The total present worth for a given alternative is equal to the sum of the capital costs and the present worth of annual O&M and monitoring costs over the anticipated life cycle of the alternative.
- Using these criteria, and relying on the assumptions outlined in Section 5.4, the present worth costs of Cleanup Action Alternatives 1 through 6 are as follows:
  - Cleanup Action Alternative 1, $1,033,000 (Table 12)
  - Cleanup Action Alternative 2, $1,116,000 (Table 13)
  - Cleanup Action Alternative 3, $737,000 (Table 14)
  - Cleanup Action Alternative 4, $2,305,000 (Table 15)
  - Cleanup Action Alternative 5, $1,150,000 (Table 16)
  - Cleanup Action Alternative 6A, $1,633,000 (Table 17)
  - Cleanup Action Alternative 6B, $2,533,000 (Table 18)
- As indicated above, the cost of Cleanup Action Alternative 3 is much less than that of Cleanup Action Alternatives 1, 2, 4, 5, and 6. Chart 5 plots the relative cost and ranking scores and Chart 6 plots the cost–to-benefit ratios for the three alternatives in order to illustrate the relative cost and benefits afforded by each alternative. The charts clearly demonstrate that Cleanup Action Alternative 3 ranks the highest using the evaluation criteria and is the lowest cost alternative; therefore, it exhibits the lowest cost-to-benefit ratio.

5.7 RECOMMENDED CLEANUP ACTION ALTERNATIVE

After performing the comparative analysis and ranking of alternatives in accordance with the MTCA evaluation criteria, Cleanup Action Alternative 3 is a reasonable technology to select for the remediation of the Site. Cleanup Action Alternative 3 is the recommended alternative, and the application of in situ chemical oxidation is a proven technology for the remediation of the COCs. This cleanup action alternative includes capping of the Seep and MNA. Cleanup Action Alternative 3 meets the threshold requirements for cleanup actions set forth in WAC 173-340-360(3) and WAC 173-340-370. Cleanup Action Alternative 3 is protective of human health and the environment, is more easily implemented than competing alternatives, and provides a permanent solution for reducing concentrations of COCs at the Site. The cost to implement Cleanup Action Alternative 3 is less than competing alternatives and exhibits a low cost to benefit ratio compared to the competing alternatives. Based on SoundEarth's past experience, using chemical oxidation processes to treat chlorinated compound sites has been successful.

Details concerning the implementation of the recommended cleanup action alternative and the decision process used to evaluate whether modifications to the selected approach are warranted will be provided in the draft Cleanup Action Plan. The draft Cleanup Action Plan will discuss the methods and analyses associated with the single well point injection test, baseline monitoring event and performance monitoring for permanganate in monitoring wells, dissolved oxygen levels, mounding in monitoring wells, and the presence of permanganate in the Seep, as well as the mass balance calculation for the volume of sodium permanganate to be applied and the injection point ROI.

6.0 BIBLIOGRAPHY

Air Force Center for Environmental Excellence (AFCEE). 2004. *Principles and Practices of Enhanced Anaerobic Bioremediation of Chlorinated Solvents.* August.

California Environmental Protection Agency. 2005*. Guidance for Evaluation and Mitigation of Subsurface Vapor intrusion to Indoor Air*. February 7.

Driscoll, Fletcher G. 1986. *Groundwater and Wells*. U.S. Filter/Johnson Screens, St Paul, MN.

Freeze, Allan and John A. Cherry (Freeze and Cherry). 1979. *Groundwater*. Prentice-Hall, Inc., Englewood, Cliffs, NJ.

JRW Bioremediation LLC. (2011) LactOil Soy Microemulsion. <http://www.jrwbioremediation.com /lactoil.html>. (Reviewed November 8, 2011).

Miller, Ralinda. 1996. *Air Sparging*. October.

Pacific Groundwater Group (PGG). 2007. *Letter Regarding Deep Aquifer Hydrogeology, Cascade Pole Site, Olympia, Washington*. From Stephen Swope, PGG, to Don Bache, Port of Olympia. October 11.

Powers, J. Patrick, Arthur Corwin, Paul C. Schmall, Walter E. Kaeck (Powers et al.). 2007. *Construction Dewatering and Groundwater Control: New Methods and Applications*. John Wiley & Sons, Inc., Hoboken, NJ.

Rowlands. 2004. *Development of Optimal pH for Degradation of Chlorinated Solvents by the KB-1™ Anaerobic Bacterial Culture.* Unpublished report submitted to the Department of Biological Engineering, University of Guelph.

Sound Environmental Strategies Corporation (SES). 2009. *Revised Draft Remedial Investigation Report, Former Olympia Dry Cleaners, 606 Union Avenue Southeast, Olympia, Washington*. October 9.

SoundEarth Strategies, Inc. (SoundEarth). 2010a. *Draft Revised Feasibility Analysis Work Plan, Former Olympia Dry Cleaners, 606 Union Avenue Southeast, Olympia, Washington*. July 9.

________. 2010b. *Addendum No. 1 Draft Vapor Sampling Work Plan*. October 15.

________. 2011a. Letter Regarding Response to Ecology's Comments. From Timothy Brown, SoundEarth, Senior Hydrogeologist. To Mr. Steve Teel of Washington State Department of Ecology. October 7.

_______. 2011b. Email Message Regarding Former Olympia Dry Cleaners Site. From Suzanne Stumpf, EIT, Associate Engineer. To Steve Teel, LHG/Site Manager at Washington State Department of Ecology. October 25.

Stemen Environmental, Inc. (Stemen). 2005. *Draft Remedial Investigations and Associated Interim Remedial/Corrective Actions Report, Former Olympia Dry Cleaners, 606 East Union Avenue, Olympia, Washington*. January 10.

Thurston County Assessor. 2009. Assessor Records for Parcel Numbers 78204000300, 78204000700, 78204000800, 78204000100, 78203900500, 78205600400, 78205500100, 78205500200, 78203700400, and 78203900400. Reviewed online at <http://www.co.thurston.wa.us/assessor/process-Aplus.html>. January 30.

U.S. Department of the Interior Bureau of Reclamation (USBR). 2006. *Final Report for the Enhanced Anaerobic Bioremediation Pilot Test, Bountiful/Woods Cross Superfund Site, Bountiful, Utah*. December.

U.S. Environmental Protection Agency (EPA). 1993. *Memorandum: Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis*. Office of Solid Waste and Emergency Response Directive No. 9355.3-20). Obtained online at <http://www.epa.gov/superfund/>.

________. 1999. *Multi-Phase Extraction: State-of-the-art Practice*. June.

Washington State Department of Ecology (Ecology). 2005. *Letter Regarding Draft Remedial Investigation and Associated Interim Remedial/Corrective Actions Report, Former Olympia Dry Cleaners, 606 East Union Avenue, Olympia, Washington, Agreed Order #DE00TCPHQ-1408*. From Robert Warren, Toxics Cleanup Program Unit Manager. To Steven C. Marshall. July 28.

________. 2008. *Guidelines for Property Cleanups under the Voluntary Cleanup Program. Toxics Cleanup Program.* Publication No. 08-09-044. July.

________. 2009. *Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action*. October.

________. 2011a. Ecology Review of the *Draft Feasibility Study Report, April 29, 2011*, Prepared by SoundEarth, Former Olympia Dry Cleaners, 606 East Union Avenue, Olympia, WA. Agreed Order DE 00TCPHQ-1408. From Mr. Steve Teel, Ecology, Site Manager/Hydrogeologist. To Ms. Suzanne Stumpf, SoundEarth. August 24.

________. 2011b. Email Message Regarding Former Olympia Dry Cleaners Site. From Steve Teel, LHG/Site Manager at Washington State Department of Ecology. To Suzanne Stumpf. October 26.

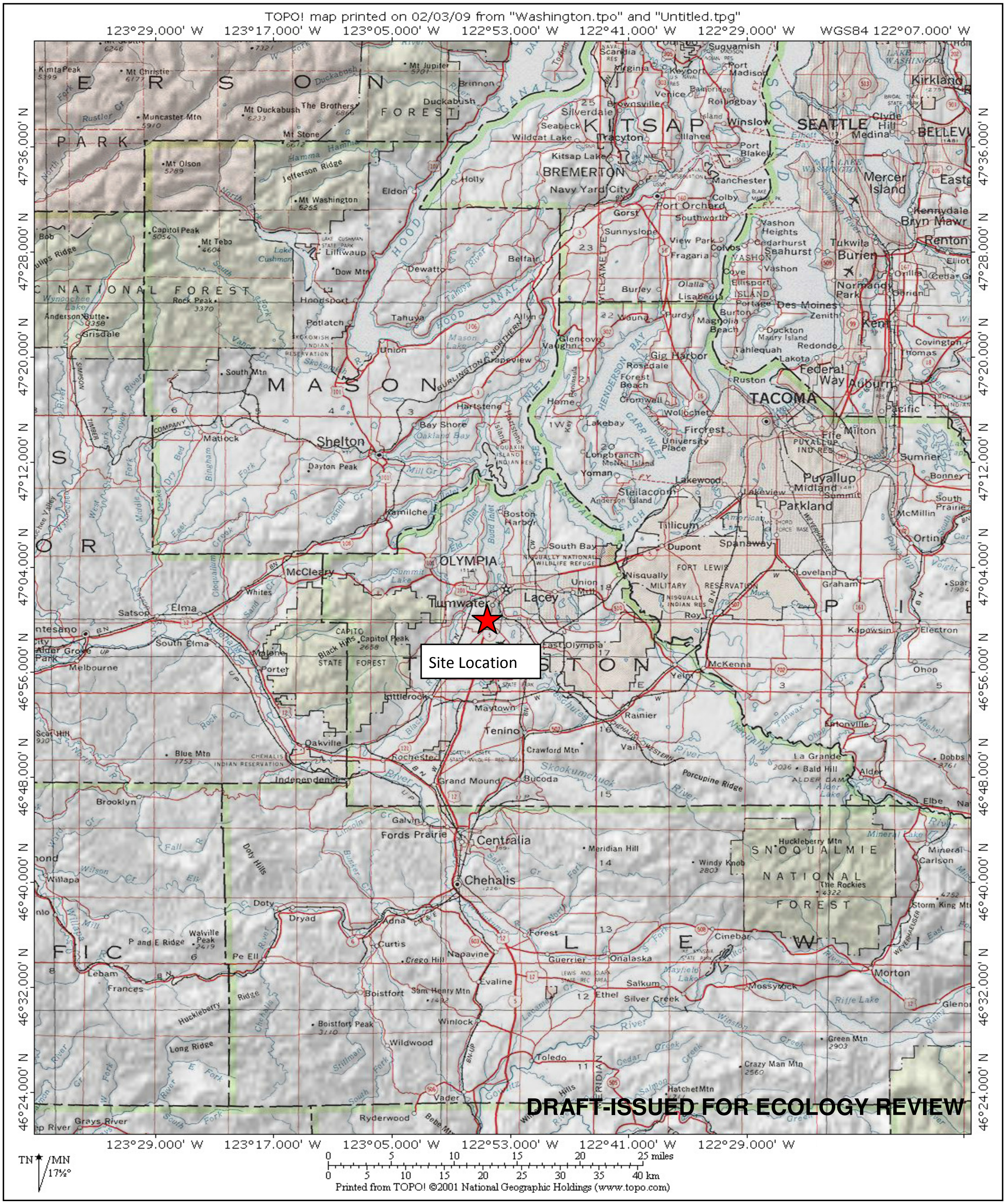
Washington State Department of Natural Resources (WSDNR). 2003. *Geologic Map of the Lacey 7.5-minute Quadrangle, Thurston County, Washington*.

7.0 LIMITATIONS

The services described in this report were performed consistent with generally accepted professional consulting principles and practices. No other warranty, expressed or implied, is made. These services were performed consistent with our agreement with our client. This report is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

Opinions and recommendations contained in this report apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this report.

FIGURES



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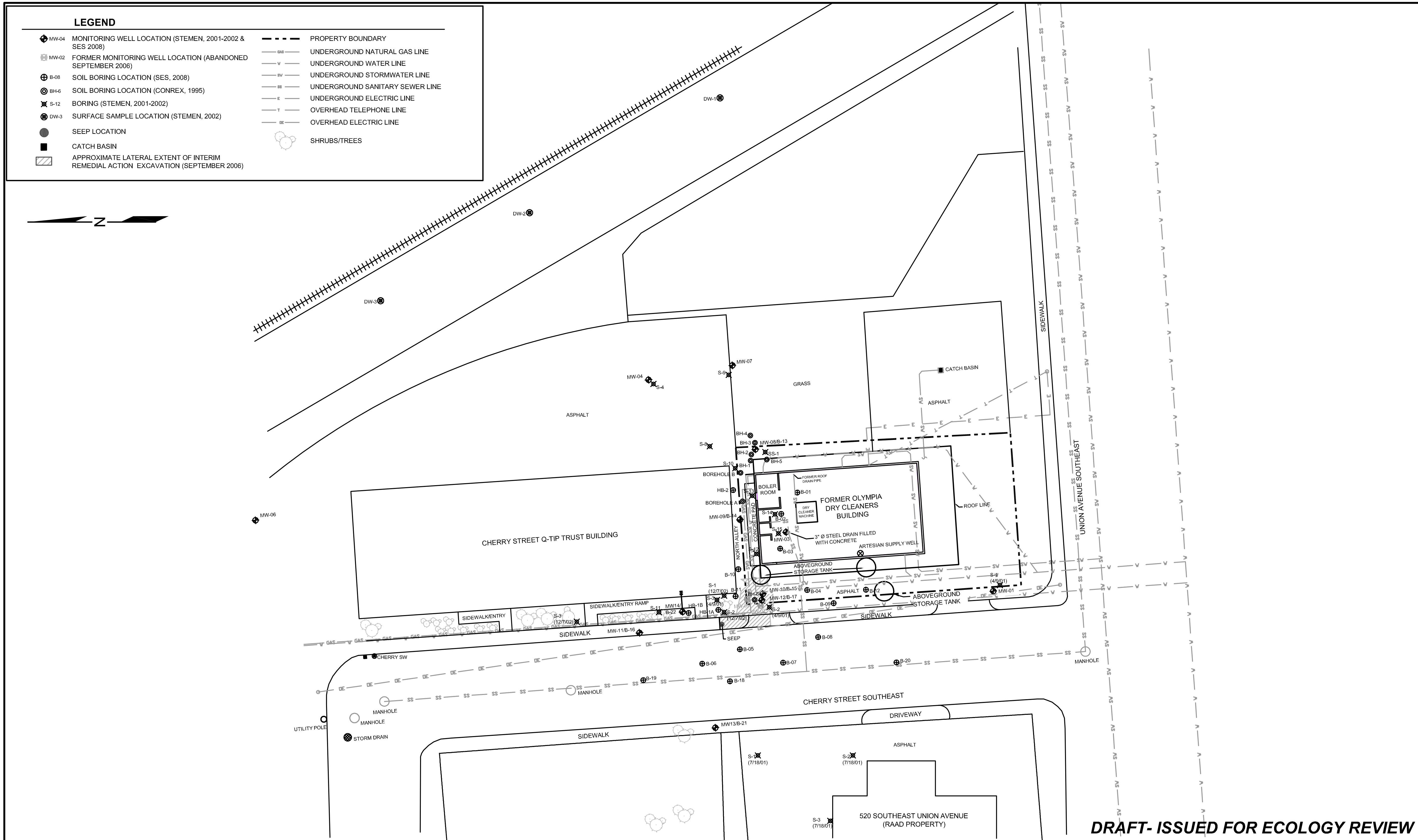
Date: February 3, 2011 Drawn By: NAC Chk By TSB Project No.: 0566-001 File ID: 0566-001_Fig1	Former Olympia Dry Cleaners 606 Union Avenue Southeast Olympia, Washington	**FIGURE 1** Site Location Map



DATE:	01/31/2011	PROJECT NAME:	FORMER OLYMPIA DRY CLEANERS
DRAWN BY:	NAC/BLR	SES PROJECT NUMBER:	0566-001-04
CHECKED BY:	SES/TB	STREET ADDRESS:	606 UNION AVE SOUTH EAST
CAD FILE:	0566-001_2011_SFM_2	CITY, STATE:	OLYMPIA, WASHINGTON

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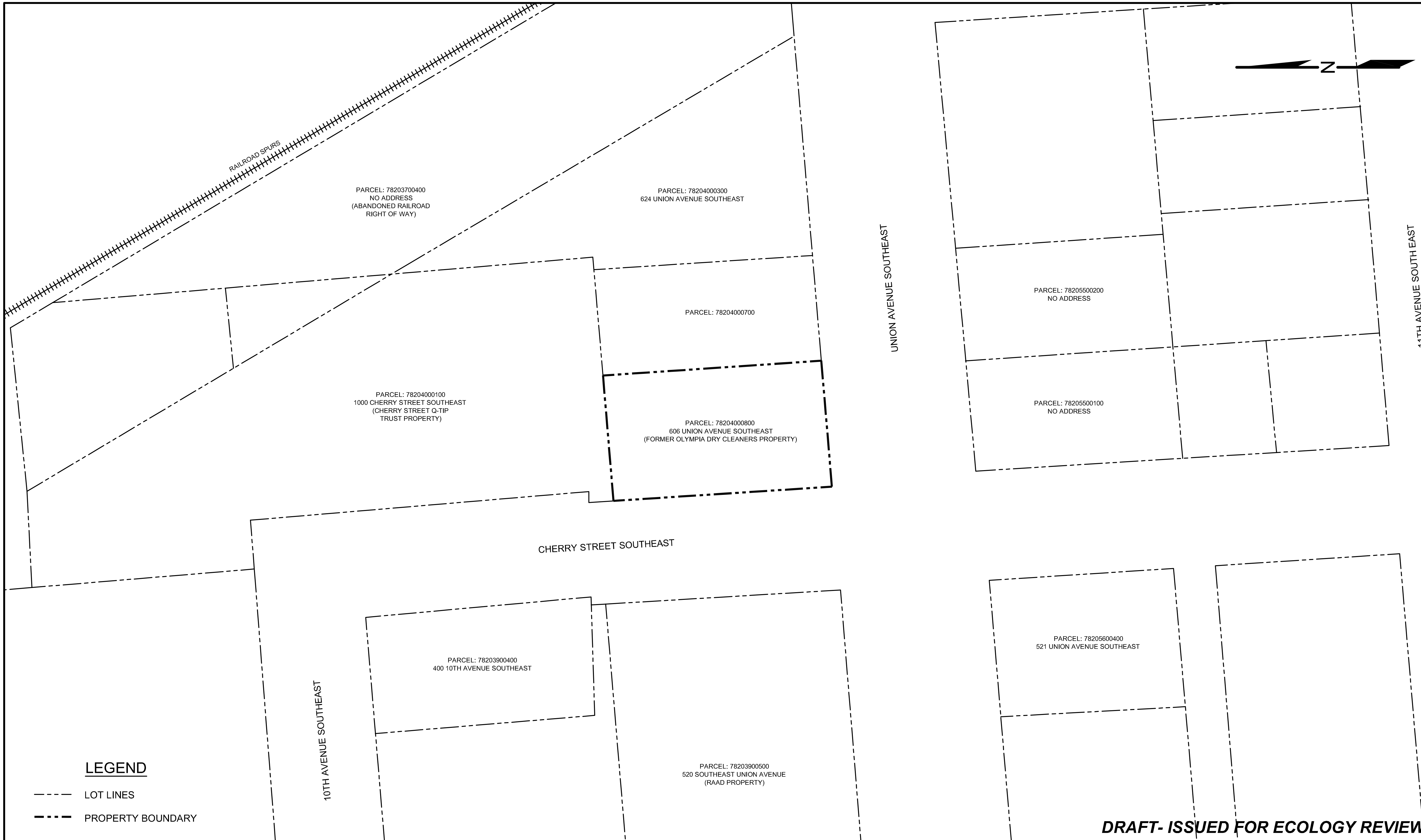
REGION:

0 10 20 40 80
APPROXIMATE SCALE IN FEET

FIGURE 2
SITE FEATURES MAP

P:\0566 Former Olympia Dry Cleaners\CAD\2011 FS Report\0566-001_2011_FS_SFM_2_DFER.dwg 01/19/2009



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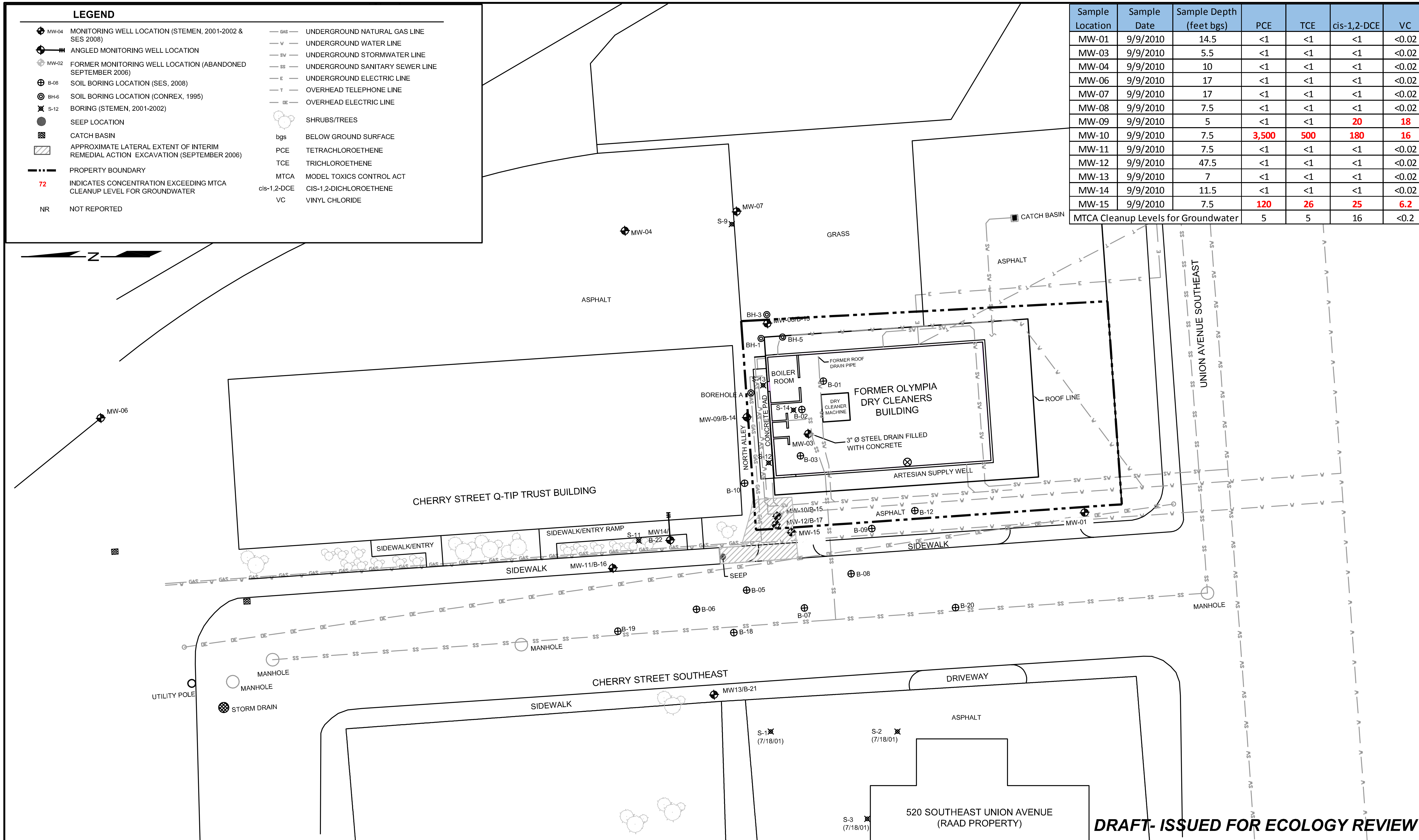
DATE: 01/24/11
DRAWN BY: NAC/JQC
CHECKED BY: SES/TSB
CAD FILE: 0566-001_2011_FS_SP_3

PROJECT NAME: FORMER OLYMPIA DRY CLEANERS
PROJECT NUMBER: 0566-001-04
STREET ADDRESS: 606 UNION AVENUE SOUTH EAST
CITY: OLYMPIA, WASHINGTON

REGION:

0 25 50 100
APPROXIMATE SCALE IN FEET

FIGURE 3
FORMER OLYMPIA DRY CLEANERS
AND SURROUNDING PROPERTIES



Sample Location	Sample Date	Sample Depth (feet bgs)	PCE	TCE	cis-1,2-DCE	VC
MW-01	9/9/2010	14.5	<1	<1	<1	<0.02
MW-03	9/9/2010	5.5	<1	<1	<1	<0.02
MW-04	9/9/2010	10	<1	<1	<1	<0.02
MW-06	9/9/2010	17	<1	<1	<1	<0.02
MW-07	9/9/2010	17	<1	<1	<1	<0.02
MW-08	9/9/2010	7.5	<1	<1	<1	<0.02
MW-09	9/9/2010	5	<1	<1	20	18
MW-10	9/9/2010	7.5	3,500	500	180	16
MW-11	9/9/2010	7.5	<1	<1	<1	<0.02
MW-12	9/9/2010	47.5	<1	<1	<1	<0.02
MW-13	9/9/2010	7	<1	<1	<1	<0.02
MW-14	9/9/2010	11.5	<1	<1	<1	<0.02
MW-15	9/9/2010	7.5	120	26	25	6.2
MTCA Cleanup Levels for Groundwater			5	5	16	<0.2

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DATE: 01/24/11
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CAD FILE: 0566-001_2011_FS_GD_4

PROJECT NAME: FORMER OLYMPIA DRY CLEANERS
PROJECT NUMBER: 0566-001-04
STREET ADDRESS: 606 UNION AVE SOUTH EAST
CITY, STATE: OLYMPIA, WASHINGTON

REGION:

0 15 30 60
APPROXIMATE SCALE IN FEET

FIGURE 4
GROUNDWATER ANALYTICAL RESULTS FOR SELECTED HVOCS

01/19/2009
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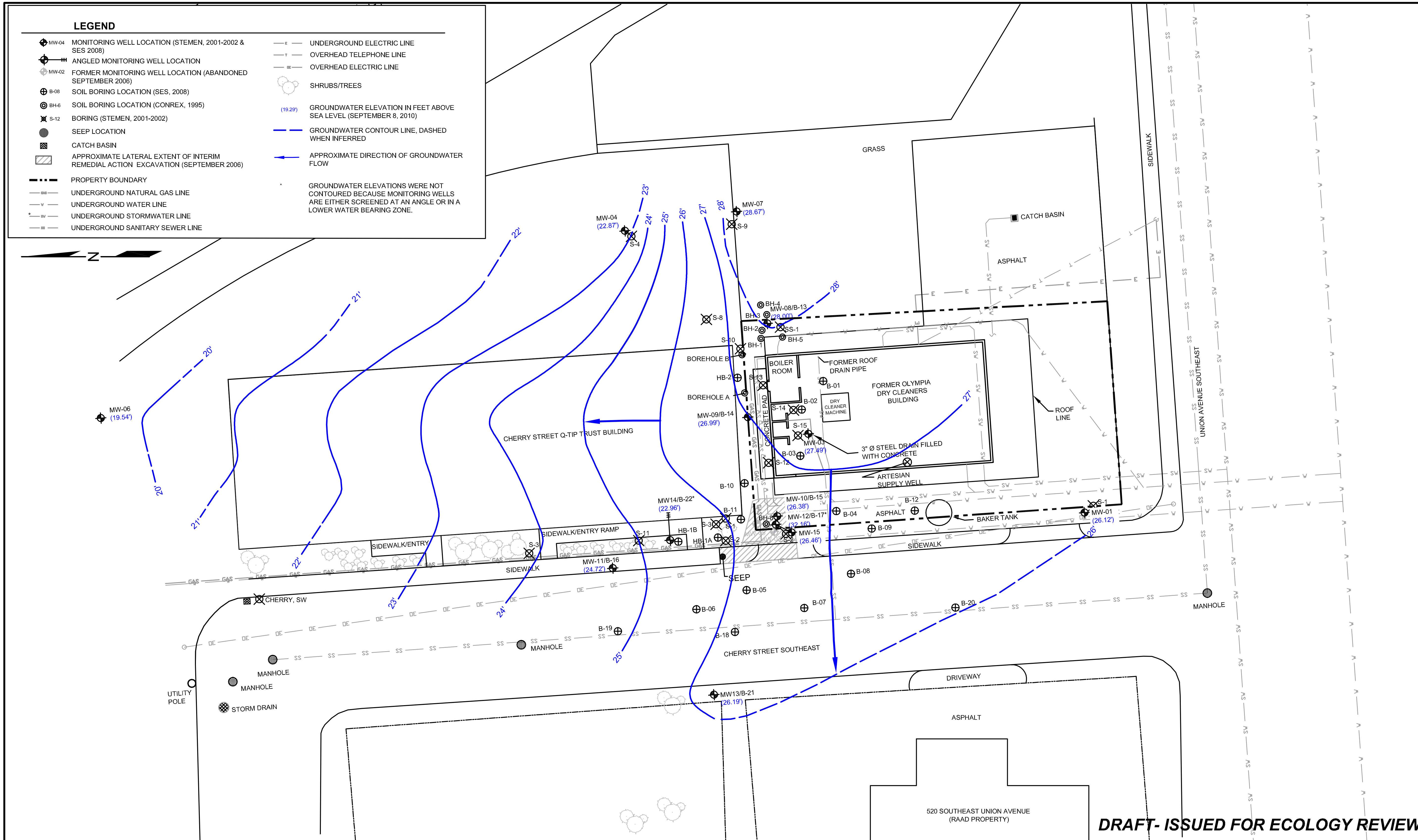

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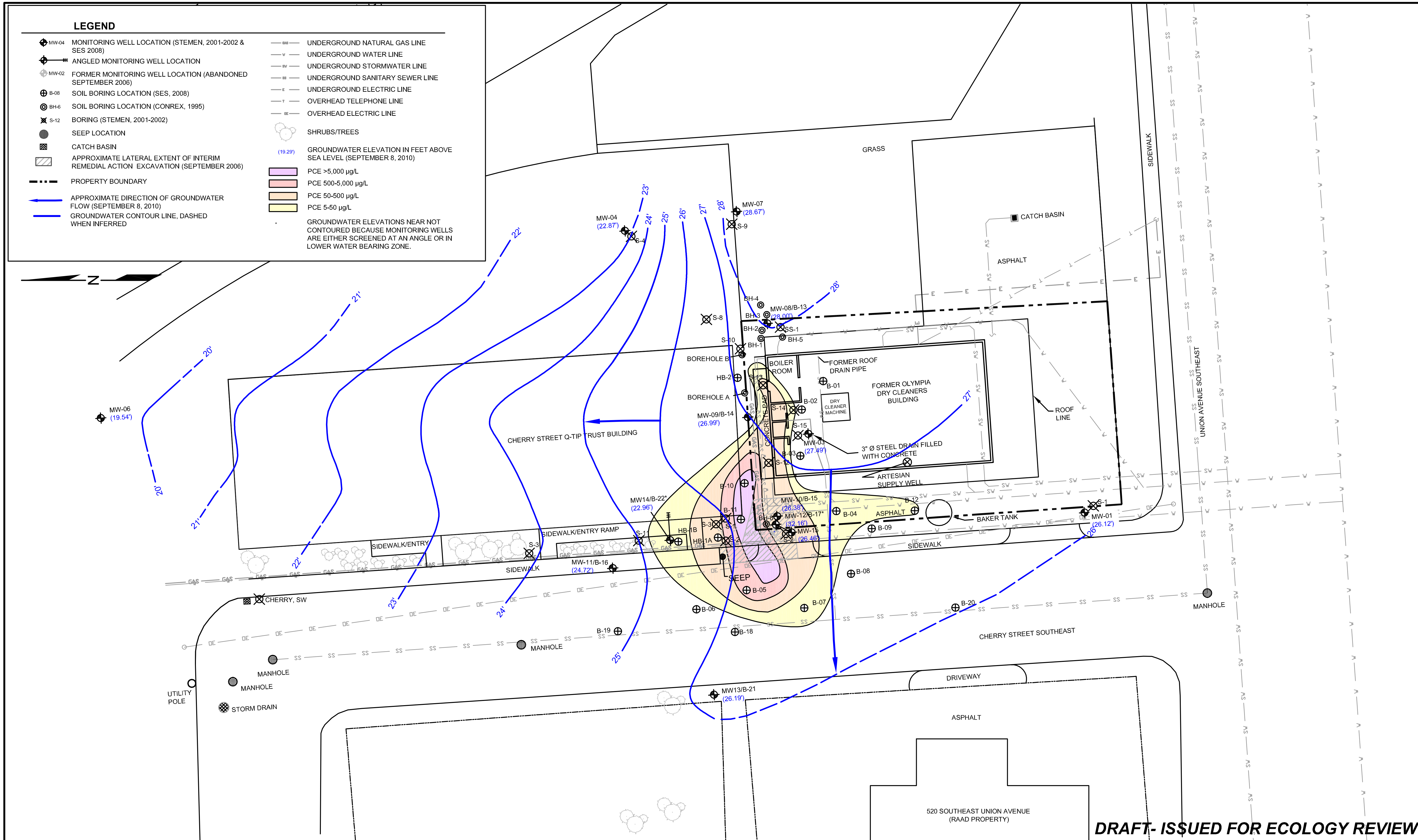
PROJECT NAME: FORMER OLYMPIA DRY CLEANERS
PROJECT NUMBER: 0566-001-04
STREET ADDRESS: 606 UNION AVE SOUTHEAST
CITY, STATE: OLYMPIA, WASHINGTON

REGION:

0 15 30 60
APPROXIMATE SCALE IN FEET

FIGURE 5
POTENTIOMETRIC SURFACE MAP
(SEPTEMBER 8, 2010)



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CAD FILE: 0566-001_2011_FS_GD_ISO_6

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PROJECT NUMBER: 0566-001-04
STREET ADDRESS: 606 UNION AVE SOUTH EAST
CITY, STATE: OLYMPIA, WASHINGTON

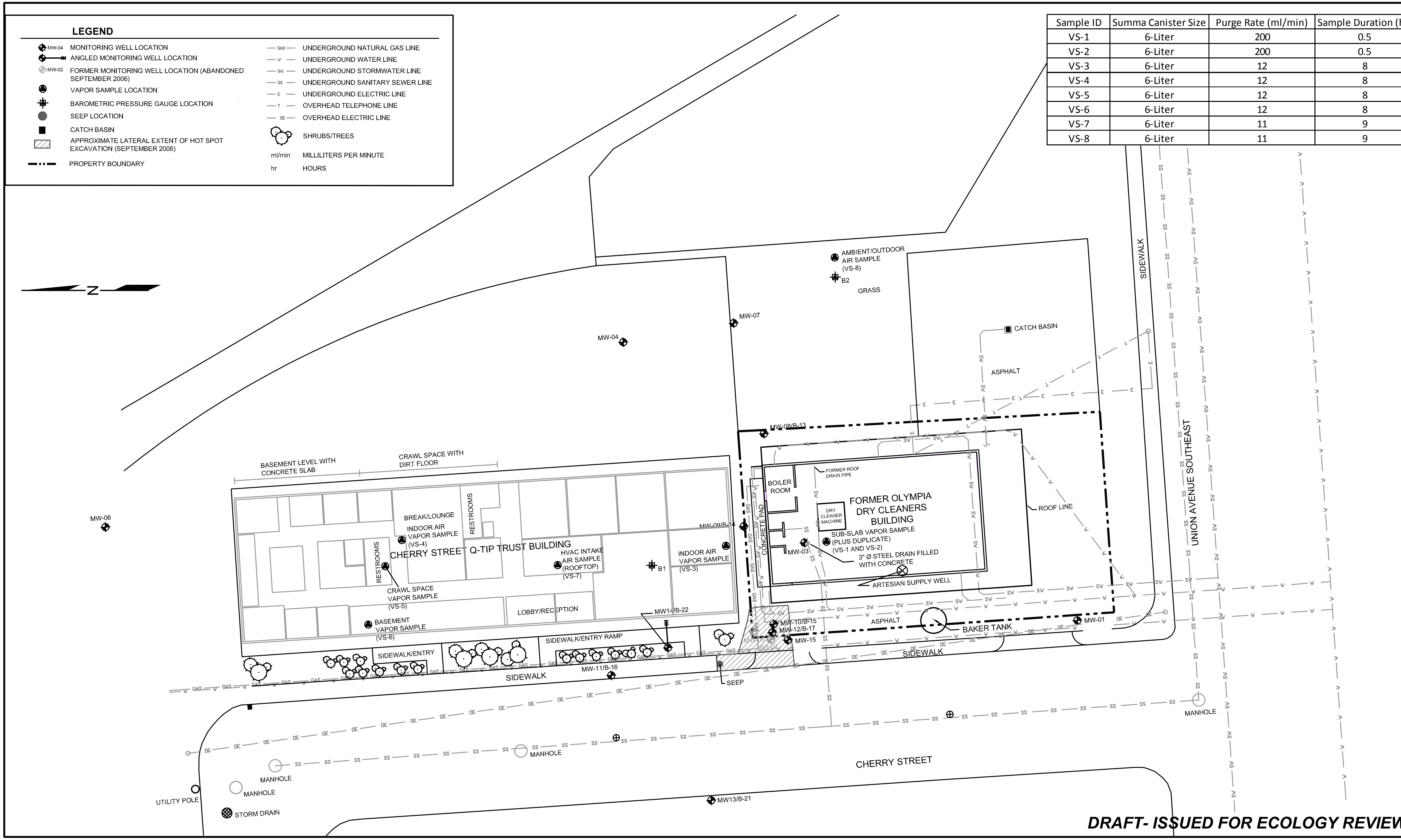
REGION:

0 15 30 60
APPROXIMATE SCALE IN FEET

FIGURE 6
PCE ISOCONCENTRATIONS IN GROUNDWATER (FROM 2009 REVISED RI)

P:\0566 Former Olympia Dry Cleaners\CAD\2011 FS Report\0566-001_2011_FS_GD_ISO_6_DFER.dwg 01/19/2009

Sample ID	Summa Canister Size	Purge Rate (ml/min)	Sample Duration (hr)
VS-1	6-Liter	200	0.5
VS-2	6-Liter	200	0.5
VS-3	6-Liter	12	8
VS-4	6-Liter	12	8
VS-5	6-Liter	12	8
VS-6	6-Liter	12	8
VS-7	6-Liter	11	9
VS-8	6-Liter	11	9



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CITY, STATE: OLYMPIA, WASHINGTON

REGION:

0 15 30 60
APPROXIMATE SCALE IN FEET

FIGURE 7
VAPOR SAMPLING LOCATIONS

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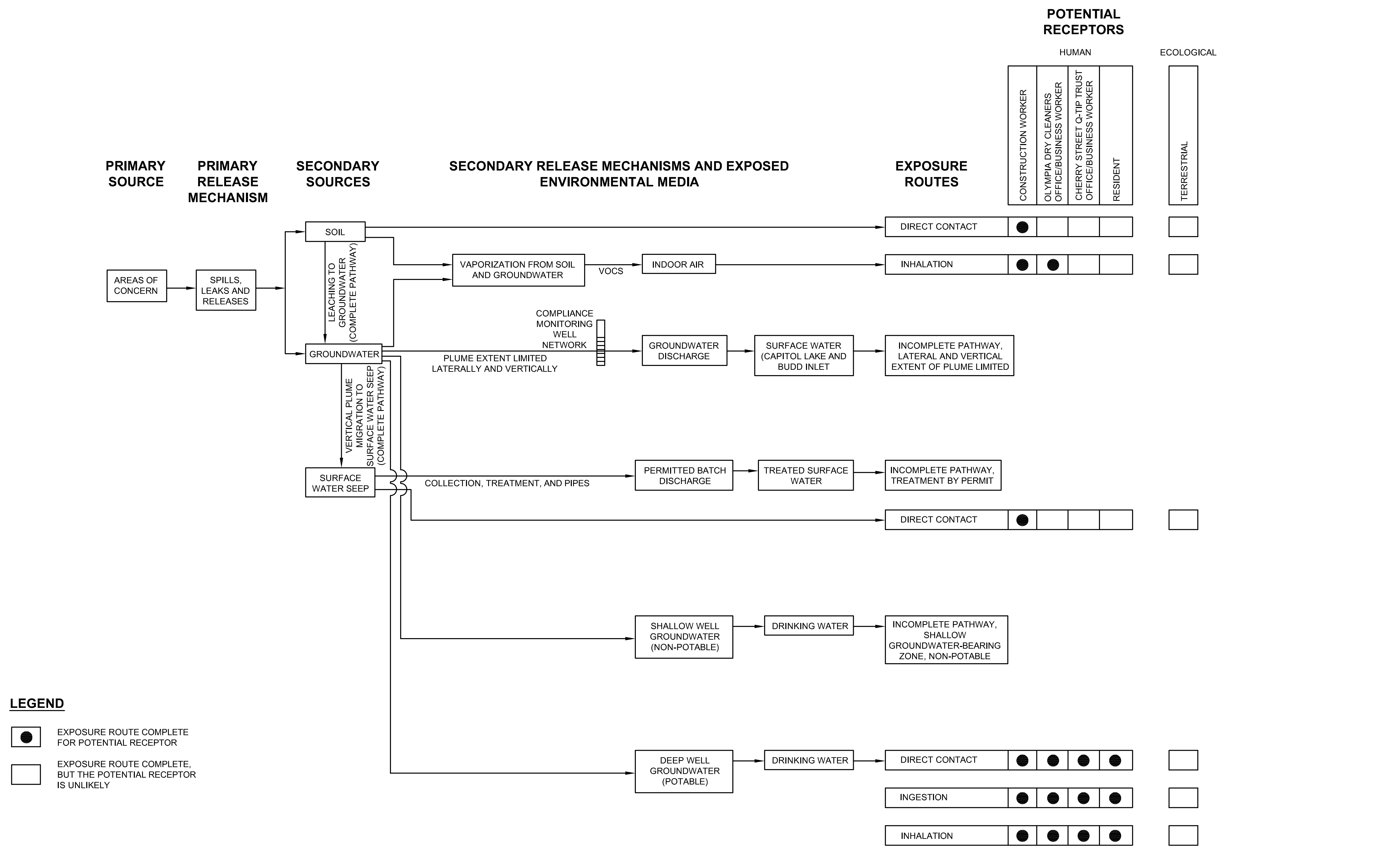
P:\0566 Former Olympia Dry Cleaners\CAD\2011 FS Report\0566-001_2011_FS_VSP_7_DFER.dwg

2/26/2013



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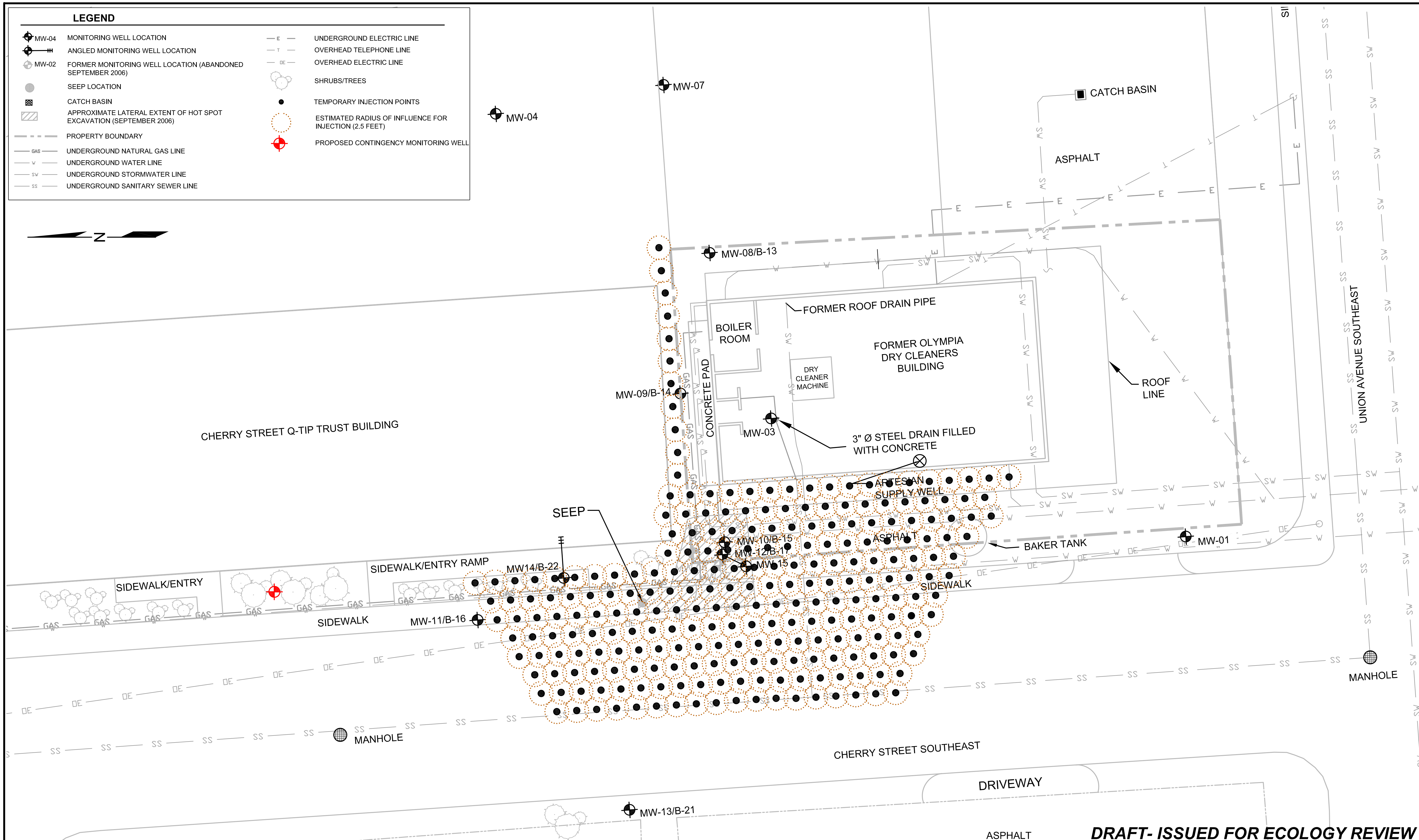
PROJECT NUMBER: 0566-001-04
STREET ADDRESS: 606 UNION AVENUE SOUTH EAST
CITY, STATE: OLYMPIA, WASHINGTON

REGION:

NOT TO SCALE

FIGURE 8
PRELIMINARY EXPOSURE ASSESSMENT
CONCEPTUAL SITE MODEL

P:\0566 FORMER OLYMPIA DRY CLEANERS\CAD\2011 FS REPORT\0566-001_2011_FS_CSM_8_DFER.DWG



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PROJECT NUMBER: 0566-001-04
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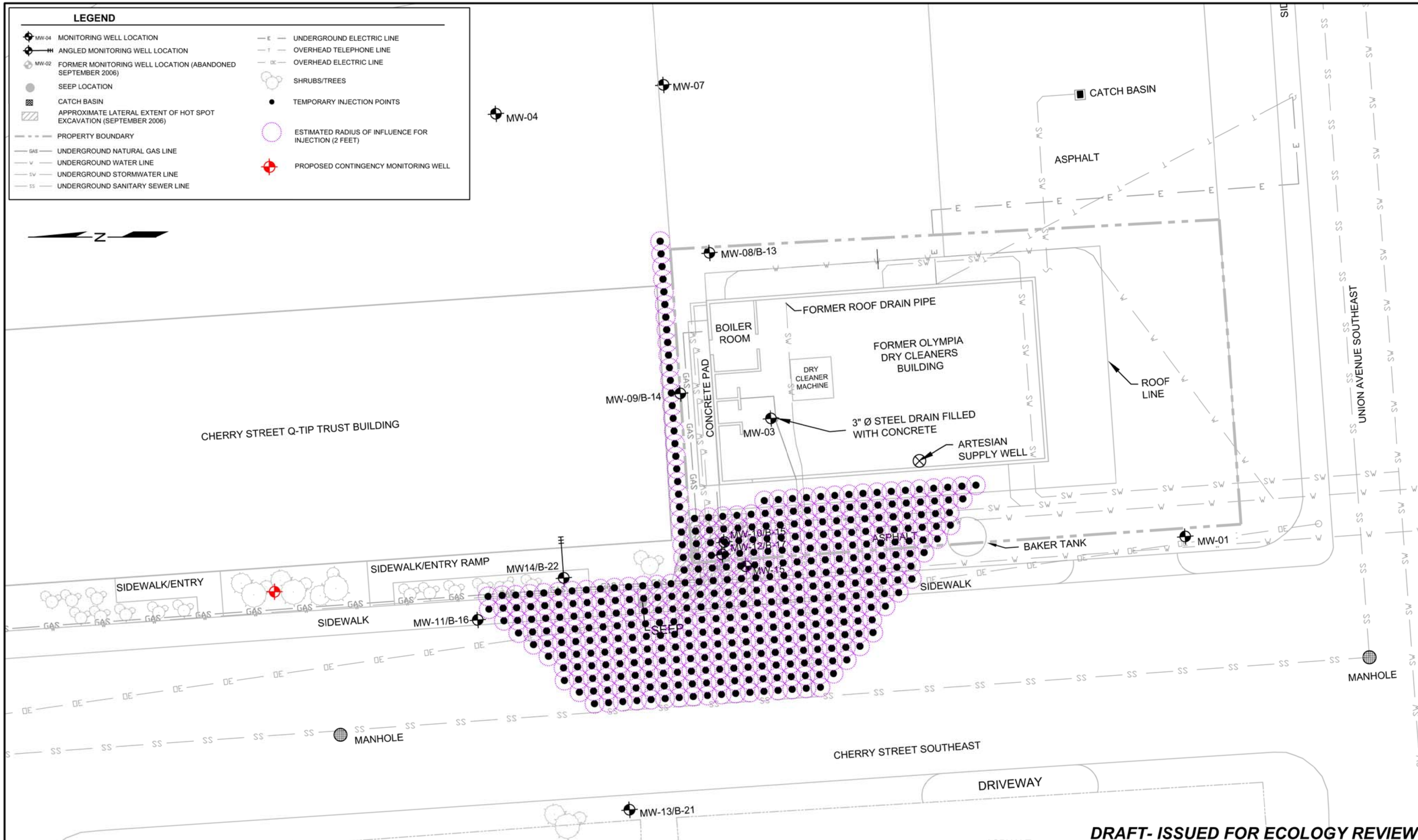
CITY, STATE: OLYMPIA, WASHINGTON

REGION:

0 10 20 40
APPROXIMATE SCALE IN FEET

FIGURE 9
CONCEPTUAL SITE PLAN
CLEANUP ACTION ALTERNATIVE 1
BIOREMEDIATION - EDIBLE OIL INJECTION



\\SOUND-FS\SES\CURRENT\PROJECTS\0566 FORMER OLYMPIA DRY CLEANERS\CAD\2011_FS REPORT\2013_REV FS\0566-001_2013_FS_CSP_ALT2_10_DFER.DWG 01/19/2009

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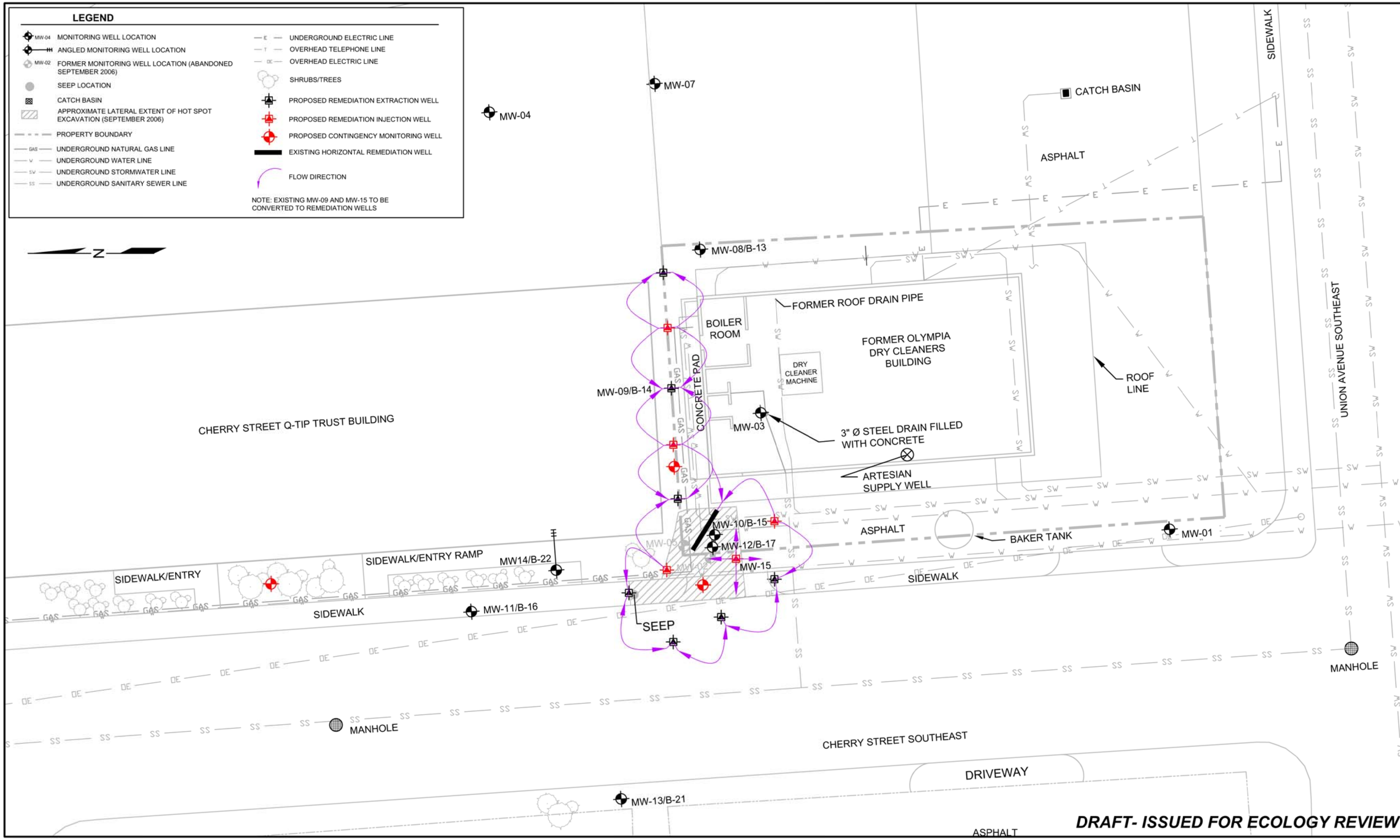
REGION:

0 10 20 40
APPROXIMATE SCALE IN FEET

FIGURE 10
CONCEPTUAL SITE PLAN
CLEANUP ACTION ALTERNATIVE 2
CHEMICAL OXIDATION - PERMANGANATE INJECTION



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CAD FILE:	0566-001_2013_FS_CSP_ALT3_11A

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FIGURE 11A
CONCEPTUAL SITE PLAN
CLEANUP ACTION ALTERNATIVE 3 CHEMICAL OXIDATION - RECIRCULATION SYSTEM - OPTION A

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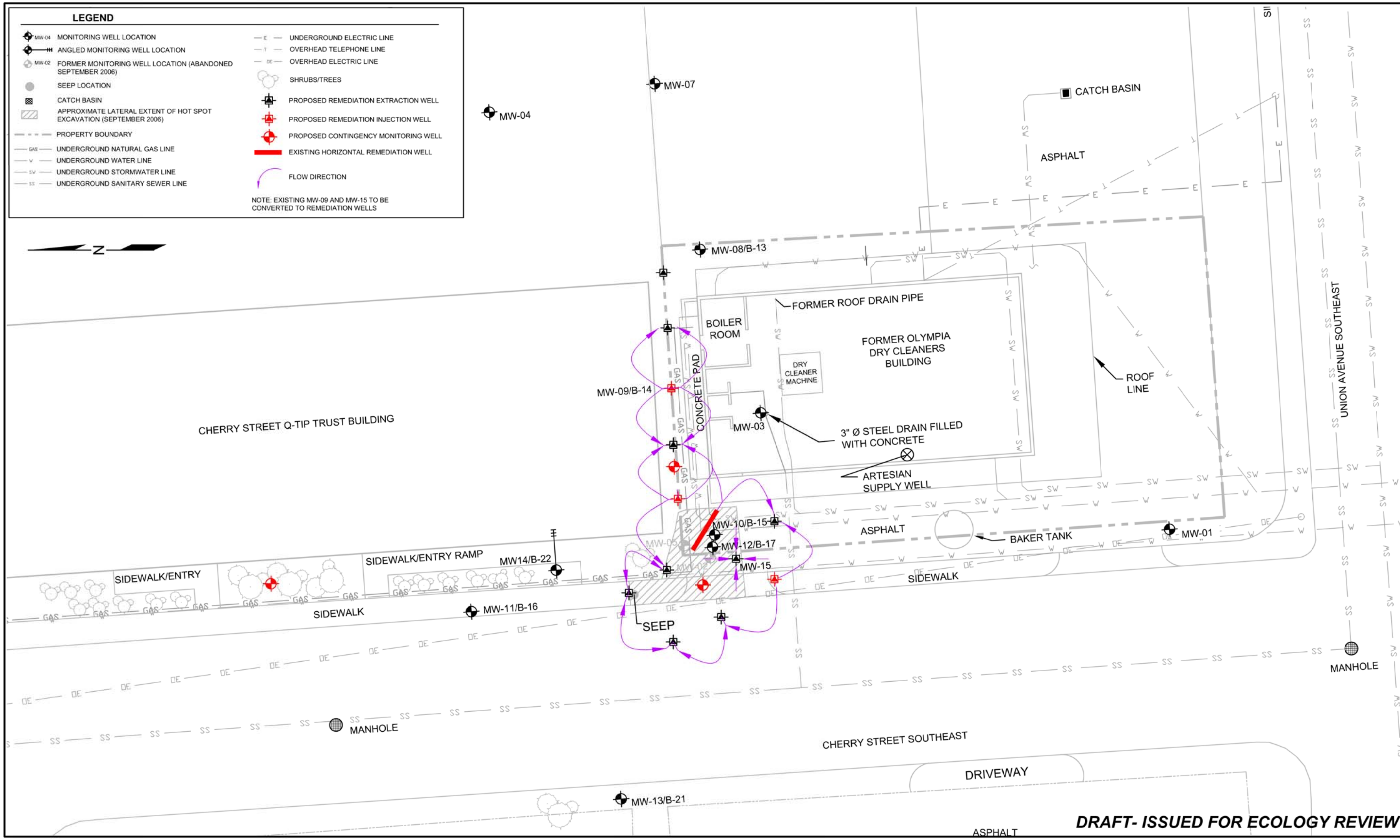

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DATE: 01/21/13
DRAWN BY: BLR
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CITY, STATE: OLYMPIA, WASHINGTON

REGION:

0 10 20 40
APPROXIMATE SCALE IN FEET

FIGURE 11B
CONCEPTUAL SITE PLAN
CLEANUP ACTION ALTERNATIVE 3 CHEMICAL OXIDATION - RECIRCULATION SYSTEM - OPTION B

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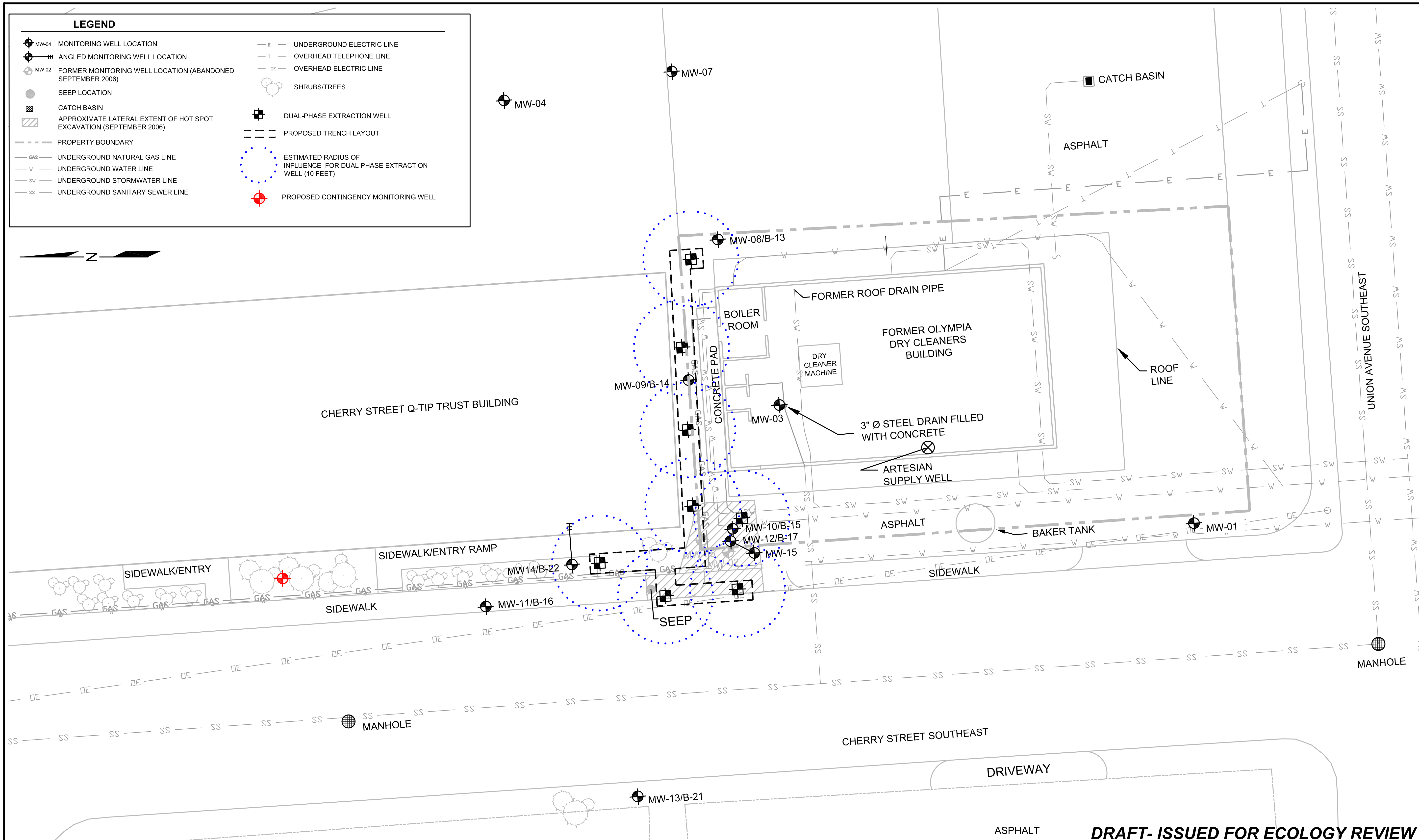

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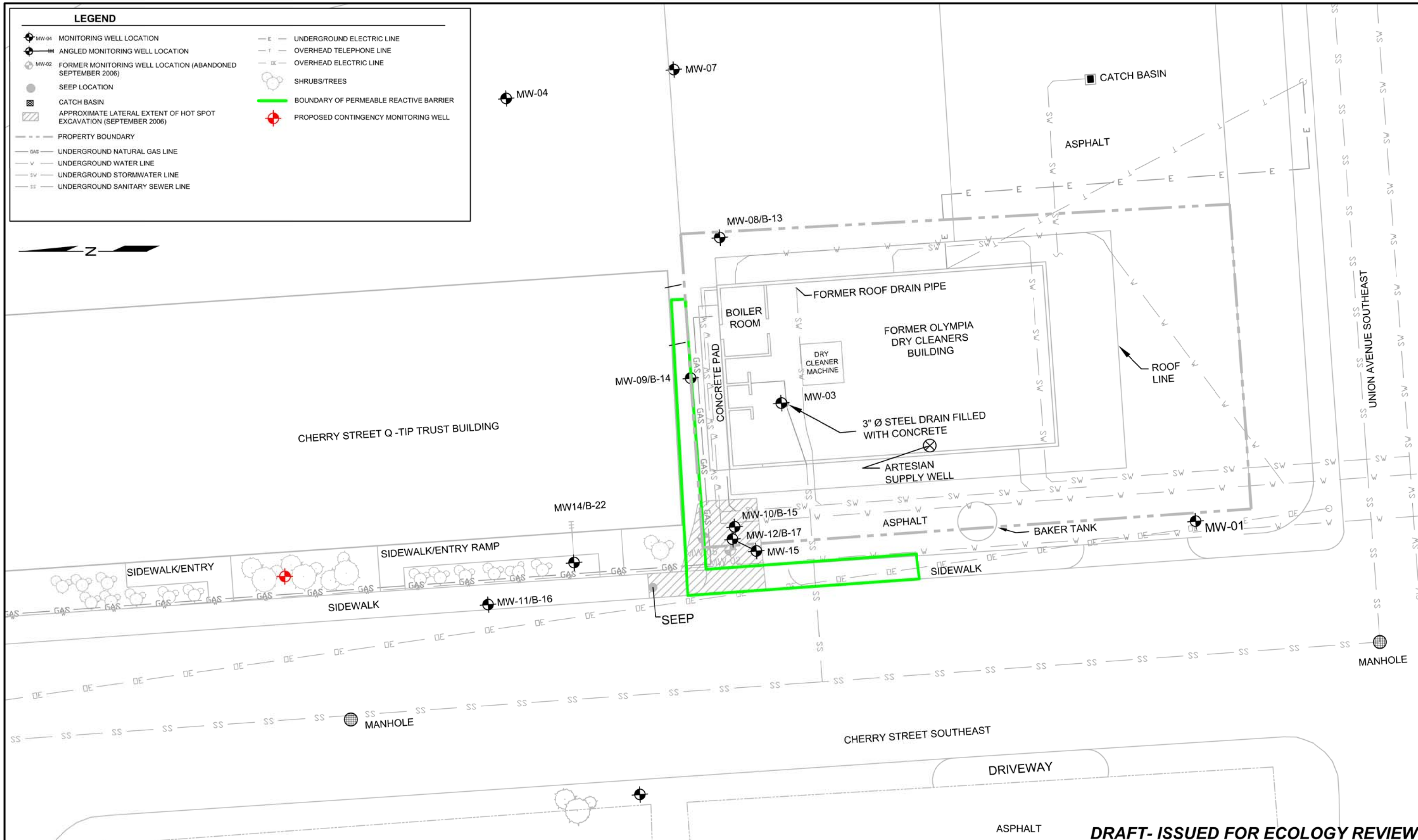
CITY, STATE: OLYMPIA, WASHINGTON

REGION:

0 10 20 40
APPROXIMATE SCALE IN FEET

FIGURE 12
CONCEPTUAL SITE PLAN
CLEANUP ACTION ALTERNATIVE 4
DUAL-PHASE EXTRACTION

\\sound-fs\sescurrentprojects\0566 Former Olympia Dry Cleaners\CAD\2011 FS Report\2013 Rev FS\0566-001_2013_FS_CSP_ALT4_12_DFER.dwg 01/19/2009



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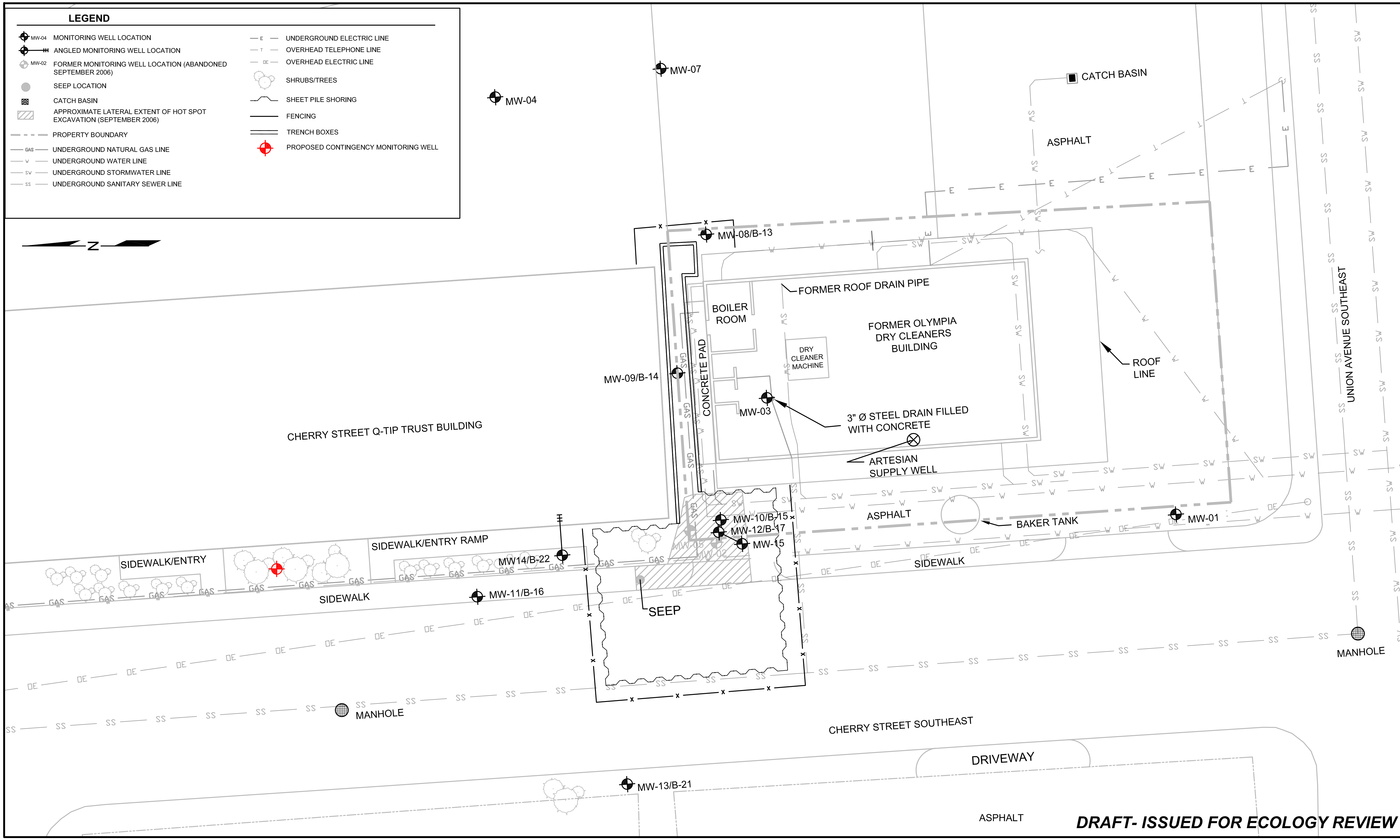
PROJECT NUMBER: 0566-001-04
STREET ADDRESS: 606 UNION AVE SOUTH EAST
CITY, STATE: OLYMPIA, WASHINGTON

REGION:

0 10 20 40
APPROXIMATE SCALE IN FEET

FIGURE 13
CONCEPTUAL SITE PLAN
CLEANUP ACTION ALTERNATIVE 5
PERMEABLE REACTIVE BARRIER



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CAD FILE: 0566-001_2013_FS_CSP_ALT6A_14

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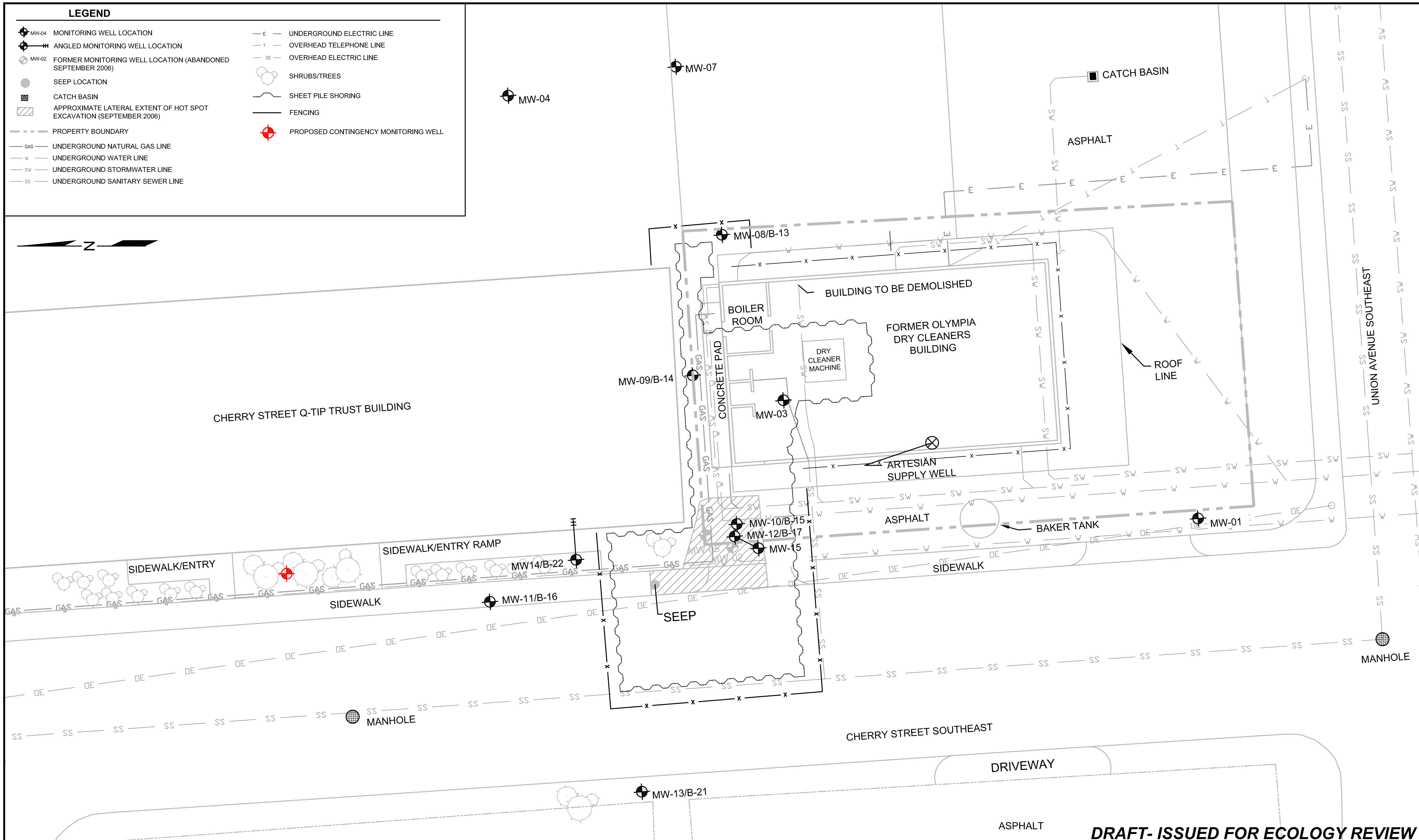
PROJECT NUMBER: 0566-001-04
STREET ADDRESS: 606 UNION AVE SOUTHEAST
CITY, STATE: OLYMPIA, WASHINGTON

REGION:

0 10 20 40
APPROXIMATE SCALE IN FEET

FIGURE 14
CONCEPTUAL SITE PLAN
CLEANUP ACTION ALTERNATIVE 6A
LIMITED EXCAVATION WITH SHORING

01/19/2009
\\sound-fs\sescurrentprojects\0566 Former Olympia Dry Cleaners\CAD\2011_FS Report\2013_Rev FS\0566-001_2013_FS_CSP_ALT6A_14_DFER.dwg



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CAD FILE:	0566-001_2013_FS_CSP_ALT6B_15

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PROJECT NUMBER:	0566-001-04
STREET ADDRESS:	606 UNION AVE SOUTHEAST
CITY, STATE:	OLYMPIA, WASHINGTON

REGION:

0 10 20 40
APPROXIMATE SCALE IN FEET

FIGURE 15
CONCEPTUAL SITE PLAN
CLEANUP ACTION ALTERNATIVE 6B
EXTENSIVE EXCAVATION WITH SHORING

TABLES

SoundEarth Strategies

Table 1
Groundwater Analytical Results for Selected HVOCs
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Well Location	Sampled By	Sample Identification	Sample Date	Sample Depth (feet bgs)	PCE	TCE	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethane	1,1,1-Trichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Chloroethane	Vinyl Chloride
					Analytical Results (micrograms per liter)									
MW-01	Stemen	MW-1	4/9/2001	NR	<1[a]	<1[a]	<1[a]	<1[a]	--	--	<1[a]	--	--	<5[a]
			10/1/2002		**5.7**[a]	<0.4[a]	<5[a]	<5[a]	--	--	<5[a]	--	--	<5[a]
			1/3/2003		<1[a]	<1[a]	<5[a]	<5[a]	--	--	<5[a]	--	--	<5[a]
			5/2/2003		<1[b]	<1[b]	<1[b]	<1[b]	--	--	<1[b]	--	--	<0.2[b]
			3/23/2004		<1[a]	<1[a]	<1[a]	<1[a]	--	--	<1[a]	--	--	<5[a]
			10/6/2005		ND	ND	ND	NA	--	--	NA	--	--	ND
	SoundEarth	MW01-20080813	8/13/2008	13	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<0.2[b]
		MW01-20100909	9/9/2010	14.5	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<0.2[c]
MW-02 (Decommissioned due to Interim Remedial Action)	Stemen	MW-2	4/9/2001	NR	**52,000**[a,c]	**6,000**[a]	**9,700**[a]	**196**[a]	--	--	<1[a]	--	--	**1,100**[a]
			10/1/2002		**50,000**[a]	**4,500**[a]	**3,900**[a]	100[a]	--	--	<5[a]	--	--	**1,300**[a]
			1/3/2003		**65**[a]	**34**[a]	**810**[a]	<5[a]	--	--	<5[a]	--	--	**170**[a]
			5/2/2003		**15,000**[b]	**2,200**[b]	**2,800**[b]	<1[b]	--	--	<1[b]	--	--	**790**[b]
			3/23/2004		<1[a]	<1[a]	<1[a]	<1[a]	--	--	<1[a]	--	--	<5[a]
			10/6/2005		**4,400**[a]	**1,600**[a]	**4,300**[a]	NA	--	--	NA	--	--	**2,900**[a]
MW-03	Stemen	MW-3-W	4/27/2001	NR	<1[a]	<1[a]	<1[a]	<1[a]	--	--	<1[a]	--	--	<5[a]
		MW-3	5/1/2001		4.4[a]	<1[a]	<1[a]	<1[a]	--	--	<1[a]	--	--	<5[a]
			10/1/2002		**31**[a]	3.6[a]	<5[a]	<5[a]	--	--	<5[a]	--	--	<5[a]
			1/3/2003		**12**[a]	<1[a]	<5[a]	<5[a]	--	--	<5[a]	--	--	<5[a]
			5/2/2003		<1[b]	<1[b]	<1[b]	<1[b]	--	--	<1[b]	--	--	<0.2[b]
			3/23/2004		<1[a]	<1[a]	<1[a]	<1[a]	--	--	<1[a]	--	--	<5[a]
			10/6/2005		ND	ND	ND	NA	--	--	NA	--	--	ND
	SoundEarth	MW03-20080813	8/13/2008	5	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<0.2[b]
		MW03-20100909	9/9/2010	5.5	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<0.2[c]
MW-04	Stemen	MW4	10/1/2002	NR	4.8[a]	**26**[a]	<5[a]	<5[a]	--	--	<5[a]	--	--	<5[a]
			1/3/2003		<1[a]	<1[a]	<5[a]	<5[a]	--	--	<5[a]	--	--	<5[a]
			5/2/2003		<1[b]	<1[b]	<1[b]	<1[b]	--	--	<1[b]	--	--	<0.2[b]
			3/23/2004		<1[a]	<1[a]	<1[a]	<1[a]	--	--	<1[a]	--	--	<5[a]
			10/6/2005		0.66	ND	ND	NA	--	--	NA	--	--	ND
	SoundEarth	MW04-20080813	8/13/2008	10	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<0.2[b]
		MW04-20100908	9/8/2010	10	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<0.2[c]
MTCA Cleanup Levels for Groundwater					**5**[e]	**5**[e]	**16**[f]	**160**[f]	**1,600**[g]	**200**[e]	**400**[f]	**5**[e]	**15**[f]	**0.2**[e]

SoundEarth Strategies

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Table 1
Groundwater Analytical Results for Selected HVOCs
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Well Location	Sampled By	Sample Identification	Sample Date	Sample Depth (feet bgs)	**Analytical Results** (micrograms per liter)									
					PCE	TCE	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethane	1,1,1-Trichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Chloroethane	Vinyl Chloride
MW-05 (Decommissioned due to Interim Remedial Action)	Stemen	MW5	10/1/2002	NR	2.9[a]	<0.4[a]	<5[a]	<5[a]	--	--	<5[a]	--	--	<5[a]
			1/3/2003		<1[a]	<1[a]	<5[a]	<5[a]	--	--	<5[a]	--	--	<5[a]
			5/2/2003		<1[b]	<1[b]	<1[b]	<1[b]	--	--	<1[b]	--	--	<0.2[b]
			3/23/2004		**120**[a]	**12**[a]	**990**[a]	13[a]	--	--	<1[a]	--	--	**380**[a]
			10/6/2005		0.77	ND	ND	NA	--	--	NA	--	--	ND
MW-06	Stemen	MW6	10/1/2002	NR	<0.4[a]	<0.4[a]	<5[a]	<5[a]	--	--	<5[a]	--	--	<5[a]
			1/3/2003		<1[a]	<1[a]	<5[a]	<5[a]	--	--	<5[a]	--	--	<5[a]
			5/2/2003		<1[b]	<1[b]	<1[b]	<1[b]	--	--	<1[b]	--	--	<0.2[b]
			3/23/2004		<1[a]	<1[a]	<1[a]	<1[a]	--	--	<1[a]	--	--	<5[a]
			10/6/2005		ND	ND	ND	NA	--	--	NA	--	--	ND
	SoundEarth	MW06-20080813	8/13/2008	14	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<0.2[b]
		MW06-20100908	9/8/2010	17	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<0.2[c]
MW-07	Stemen	MW7	10/1/2002	NR	<0.4[a]	<0.4[a]	<5[a]	<5[a]	--	--	<5[a]	--	--	<5[a]
		MW-7	1/3/2003		<1[a]	<1[a]	<5[a]	<5[a]	--	--	<5[a]	--	--	<5[a]
			5/2/2003		<1[b]	<1[b]	<1[b]	<1[b]	--	--	<1[b]	--	--	<0.2[b]
			3/23/2004		**4,700**[a]	<1[a]	<1[a]	<1[a]	--	--	<1[a]	--	--	<5[a]
			10/6/2005		ND	ND	ND	NA	--	--	NA	--	--	ND
	SoundEarth	MW07-20070319	3/19/2007		<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<0.2[b]
		MW07-20080813	8/13/2008	15	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<0.2[b]
		MW07-20100908	9/8/2010	17	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<0.2[c]
MW-08	SoundEarth	MW08-20080813	8/13/2008	7	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<0.2[b]
		MW08-20100908	9/8/2010	7.5	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<0.2[c]
MW-09	SoundEarth	MW09-20080813	8/13/2008	4	<1[b]	1.8[b]	14[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	**2.0**[b]
		MW09-20100909	9/9/2010	5	<1[c]	<1[c]	**20**[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	**18**[c]
MW-10	SoundEarth	MW10-20080813	8/13/2008	7	**360**[b]	**120**[b]	**250**[b]	1[b]	<1[b]	<1[b]	1.9[b]	<1[b]	<1[b]	**190**[b]
		MW10-20100909	9/9/2010	7.5	**3,500**[c]	**500**[c]	**180**[c]	1.5[c]	<1[c]	<1[c]	1.5[c]	<1[c]	<1[c]	**16**[c]
MW-11	SoundEarth	MW11-20080813	8/13/2008	8	<1[b]	<1[b]	<1[b]	<1[b]	--	--	<1[b]	--	<1[b]	<0.2[b]
		MW11-20100909	9/9/2010	7.5	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<0.2[c]
MW-12	SoundEarth	MW12-20080813	8/13/2008	47	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<1[b]	<0.2[b]
		MW12-20100909	9/9/2010	47.5	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<0.2[c]
MW-13	SoundEarth	MW13-20081112	11/12/2008	7	<1[b]	<1[b]	<1[b]	<1[b]	--	--	<1[b]	--	--	<0.2[b]
		MW13-20100908	9/8/2010	7	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<0.2[c]
MTCA Cleanup Levels for Groundwater					**5**[e]	**5**[e]	**16**[f]	**160**[f]	**1,600**[g]	**200**[e]	**400**[f]	**5**[e]	**15**[f]	**0.2**[e]

Table 1
Groundwater Analytical Results for Selected HVOCs
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Well Location	Sampled By	Sample Identification	Sample Date	Sample Depth (feet bgs)	**Analytical Results** (micrograms per liter)									
					PCE	TCE	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	1,1-Dichloroethane	1,1,1-Trichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Chloroethane	Vinyl Chloride
MW-14	SoundEarth	MW14-20081112	11/12/2008	11	**10**[b]	4.1[b]	7.7[b]	<1[b]	--	--	<1[b]	--	--	**0.73**[b]
		06-E09	9/19/2006	--	--	--	--	--	--	--	--	--	--	--
		MW14-20100909	9/9/2010	11.5	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<0.2[c]
MW-15	SoundEarth	MW15-20100909	9/9/2010	7.5	**120**[c]	**26**[c]	**25**	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	<1[c]	**6.2**[c]
Artesian Supply Well	CONREX	Artesian	5/26/1995	NR	<1[d]	<1[d]	<1[d]	<1[d]	--	--	<1[d]	--	--	NA
	SoundEarth	Supply Well-20070315	3/15/2007		<1[b]	<1[b]	<1[b]	<1[b]	--	--	<1[b]	--	--	<0.2[b]
		SW-20070328	3/28/2007		<1[b]	<1[b]	<1[b]	<1[b]	--	--	<1[b]	--	--	<0.2[b]
		Supply Well-20081021	10/21/2008		<1[b]	<1[b]	<1[b]	<1[b]	--	--	<1[b]	--	--	<0.2[b]
MTCA Cleanup Levels for Groundwater					**5**[e]	**5**[e]	**16**[f]	**160**[f]	**1,600**[g]	**200**[e]	**400**[f]	**5**[e]	**15**[f]	**0.2**[e]

NOTES:

Red denotes concentration exceeds MTCA cleanup level.
[a]Analyzed by EPA Method 8021B
[b]Analyzed by EPA Method 8260B.
[c]Analyzed by EPA Method 8260 C.
[d]Analyzed by EPA Modified Method 8010/8020.
[e]MTCA Cleanup Regulation, Method A Cleanup Levels for Groundwater, Chapter 173-340 of the Washington Administrative Code (revised November 2007).
[f]CLARC, Groundwater, Method B, Carcinogen, Standard Formula Value, CLARC website <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.
[g]CLARC, Groundwater, Method B, Non-Carcinogen, Standard Formula Value, CLARC website <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.

< = concentration not detected above the laboratory practical quantitation limit
-- = not sampled
bgs = below ground surface
CLARC = Cleanup Levels and Risk Calculations
CONREX = CONREX Inc.
EPA = U.S. Environmental Protection Agency
HVOCs = halogenated volatile organic compounds
MTCA = Washington State Model Toxics Control Act
NA = not available
ND = not detected above the laboratory PQL; PQL not available
NR = not reported
PCE = tetrachloroethene
SoundEarth = SoundEarth Strategies, Inc. (formerly known as Sound Environmental Strategies Corporation
Stemen = Stemen Environmental, Inc.
TCE = trichloroethene

SoundEarth Strategies

Table 2
Groundwater Analytical Results for Total Petroleum Hydrocarbons
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Well Location	Sampled By	Sample Identification	Sample Date	Sample Depth (feet bgs)	Analytical Results (µg/L) GRPH[1]	DRPH[2]	ORPH[2]	Benzene	Toluene	Ethylbenzene	Total Xylenes
MW-01	Stemen	MW-1	4/09/2001	NR	--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
		MW1	10/01/2002		--	--	--	<0.4[a]	<1[a]	<1[a]	<1[a]
		MW-1	1/3/2003		--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
			5/2/2003		--	--	--	<1[b]	<1[b]	<1[b]	<1[b]
			3/23/2004		--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
	SoundEarth	MW01-20100909	9/9/2010	14.5	<100	<50	<250	<1[a]	<1[a]	<1[a]	<3[a]
MW-02 (Decommissioned due to Interim Remedial Action)	Stemen	MW-2	4/09/2001	NR	--	<200[a]	<400[a]	<1[a]	10.7[a]	<1[a]	<1[a]
		MW2	10/01/2002		--	--	--	<0.4[a]	<1[a]	<1[a]	<1[a]
		MW-2	1/3/2003		--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
			5/2/2003		--	--	--	<1[b]	<1[b]	<1[b]	<1[b]
			3/23/2004		--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
MW-03	Stemen	MW-3-W	4/27/07	NR	--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
		MW-3	5/2/2001		--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
		MW3	10/01/2002		--	--	--	<0.4[a]	<1[a]	<1[a]	<1[a]
		MW-3	1/3/2003		--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
			5/2/2003		--	--	--	<1[b]	<1[b]	<1[b]	<1[b]
			3/23/2004		--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
	SoundEarth	MW03-20100909	9/9/2010	5.5	<100	<50	<250	<1[a]	<1[a]	<1[a]	<3[a]
MW-04	Stemen	MW4	10/01/2002	NR	--	--	--	<0.4[a]	<1[a]	<1[a]	<1[a]
		MW-4	1/3/2003		--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
			5/2/2003		--	--	--	<1[b]	<1[b]	<1[b]	<1[b]
			3/23/2004		---	--	--	<1[a]	<1[a]	<1[a]	<1[a]
	SoundEarth	MW04-20100908	9/8/2010	10	<100	<50	<250	<1[a]	<1[a]	<1[a]	<3[a]
MW-05 (Decommissioned due to Interim Remedial Action)	Stemen	MW5	10/01/2002	NR	--	--	--	<0.4[a]	<1[a]	<1[a]	<1[a]
		MW-5	1/3/2003		--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
			5/2/2003		--	--	--	<1[b]	<1[b]	<1[b]	<1[b]
			3/23/2004		--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
MTCA Cleanup Levels for Groundwater[3]					**1,000/800[c]**	**500**	**500**	**5**	**1,000**	**700**	**1,000**

Table 2
Groundwater Analytical Results for Total Petroleum Hydrocarbons
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Well Location	Sampled By	Sample Identification	Sample Date	Sample Depth (feet bgs)	Analytical Results (µg/L)						
					GRPH[1]	DRPH[2]	ORPH[2]	Benzene	Toluene	Ethylbenzene	Total Xylenes
MW-06	Stemen	MW6	10/01/2002	NR	--	--	--	<0.4[a]	<1[a]	<1[a]	<1[a]
		MW-6	1/3/2003		--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
			5/2/2003		--	--	--	<1[b]	<1[b]	<1[b]	<1[b]
			3/23/2004		--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
	SoundEarth	MW06-20100908	9/8/2010	17	<100	<50	<250	<1[a]	<1[a]	<1[a]	<3[a]
MW-07	Stemen	MW7	10/01/2002	NR	--	--	--	<0.4[a]	<1[a]	<1[a]	<1[a]
		MW-7	1/3/2003		--	--	--	<1[a]	<1[a]	<1[a]	<1[a]
			5/2/2003		--	--	--	<1[b]	<1[b]	<1[b]	<1[b]
			3/23/2004		--	--	--	<1[a]	2.0[a]	<1[a]	<1[a]
	SoundEarth	MW07-20100908	9/8/2010	17	<100	<50	<250	<1[a]	<1[a]	<1[a]	<3[a]
MW-08	SoundEarth	MW08-20100908	9/8/2010	7.5	<100	<50	<250	<1[a]	<1[a]	<1[a]	<3[a]
MW-09	SoundEarth	MW09-20100909	9/9/2010	5	<100	<50	<250	<1[a]	<1[a]	<1[a]	<3[a]
MW-10	SoundEarth	MW10-20100909	9/9/2010	7.5	**1,400**	<50	<250	<1[a]	<1[a]	<1[a]	<3[a]
MW-11	SoundEarth	MW11-20100909	9/9/2010	7.5	<100	<50	<250	<1[a]	<1[a]	<1[a]	18
MW-12	SoundEarth	MW12-20100909	9/9/2010	47.5	<100	<50	<250	<1[a]	<1[a]	<1[a]	<3[a]
MW-13	SoundEarth	MW13-20100908	9/8/2010	7	<100	<50	<250	<1[a]	<1[a]	<1[a]	<3[a]
MW-14	SoundEarth	MW14-20100909	9/9/2010	11.5	<100	<50	<250	<1[a]	<1[a]	<1[a]	<3[a]
MW-15	SoundEarth	MW15-20100909	9/9/2010	7.5	<100	<50	<250	<1[a]	<1[a]	<1[a]	<3[a]
Artesian Supply Well	CONREX	Artesian	5/26/1995	NR	--	<400[b]	<400[b]	<1[d]	<1[d]	<1[d]	<1[d]
MTCA Cleanup Levels for Groundwater[3]					**1,000/800[c]**	**500**	**500**	**5**	**1,000**	**700**	**1,000**

NOTES:

Red denotes concentration exceeds MTCA cleanup level.
[1]Analyzed by Method NWTPH-Gx.
[2]Analyzed by Method NWTPH-Dx.
[3]MTCA Cleanup Regulation, Method A Cleanup Levels for Groundwater, Chapter 173-340 of the Washington Administrative Code (revised November 2007).
[a]Analyzed by EPA Method 8021B.
[b]Analyzed by EPA Method 8260B.
[c]1,000 µg/L when benzene is not present and 800 µg/L when benzene is present.
[d]Analyzed by EPA Modified Method 8010/8020.

-- = not analyzed
< = concentration not detected above the laboratory practical quantitation limit
µg/L = micrograms per liter
bgs = below ground surface
CONREX = CONREX Inc.
DRPH = diesel-range petroleum hydrocarbons
EPA = U.S. Environmental Protection Agency
GRPH = gasoline-range petroleum hydrocarbons
MTCA = Washington State Model Toxics Control Act
NR = not reported
NWTPH = Northwest Total Petroleum Hydrocarbon
ORPH = oil-range petroleum hydrocarbons
SoundEarth = SoundEarth Strategies, Inc. (formerly known as Sound Environmental Strategies Corporation)
Stemen = Stemen Environmental, Inc.

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Table 3
Summary of Potentiometric Surface Data
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Well Location	Date Measured	Well Casing Diameter (inches)	Screen Interval (approximate feet below ground surface)	Top of Well Casing Elevation[1] (feet)	Temporary Well Casing Riser Length (feet)	Top of Temporary Well Casing Riser Elevation[2] (feet)	Depth to Groundwater[3] (feet below well casing)	Potentiometric Surface[4] (feet)
MW-01	08/13/08	1.00	8 to 18	31.44	--	--	6.14	25.30
	01/14/09	1.00	8 to 18	31.44	--	--	5.58	25.86
	09/08/10	1.00	8 to 18	31.44	--	--	5.32	26.12
MW-03	08/13/08	1.00	3 to 8	30.10	--	--	2.70	27.40
	01/14/09	1.00	3 to 8	30.10	--	--	2.84	27.26
	09/08/10	1.00	3 to 8	30.10	--	--	2.61	27.49
MW-04	08/13/08	1.00	5 to 15	26.03	--	--	1.33	24.70
	01/14/09	1.00	5 to 15	26.03	--	--	1.66	24.37
	09/08/10	1.00	5 to 15	26.03	--	--	3.16	22.87
MW-06	08/13/08	1.00	10 to 20	20.12	--	--	0.70	19.42
	01/14/09	1.00	10 to 20	20.12	--	--	0.83	19.29
	09/08/10	1.00	10 to 20	20.12	--	--	0.58	19.54
MW-07	08/13/08	1.00	12 to 22	29.82	--	--	0.64	29.18
	01/14/09	1.00	12 to 22	29.82	--	--	1.00	28.82
	09/08/10	1.00	12 to 22	29.82	--	--	1.15	28.67
MW-08	08/13/08	2.00	5 to 10	31.53	--	--	3.70	27.83
	01/14/09	2.00	5 to 10	31.53	--	--	3.80	27.73
	09/08/10	2.00	5 to 10	31.53	--	--	3.53	28.00
MW-09	08/13/08	2.00	3 to 6	30.56	--	--	3.78	26.78
	01/14/09	2.00	3 to 6	30.56	--	--	3.83	26.73
	09/08/10	2.00	3 to 6	30.56	--	--	3.57	26.99
MW-10	08/13/08	2.00	5 to 10	30.80	--	--	4.83	25.97
	01/14/09	2.00	5 to 10	30.80	--	--	4.61	26.19
	09/08/10	2.00	5 to 10	30.80	--	--	4.42	26.38
MW-11	08/13/08	2.00	5 to 10	24.66	5.13	29.79	5.30	24.49
	01/14/09	2.00	5 to 10	24.66	5.22	29.88	5.31	24.57
	09/08/10	2.00	5 to 10	24.66	5.125	29.785	5.07	24.72
MW-12	08/13/08	2.00	45 to 50	31.15	5.38	36.53	4.15	32.38
	01/14/09	2.00	45 to 50	31.15	5.38	36.53	4.51	32.02
	09/08/10	2.00	45 to 50	31.15	5.23	36.38	4.22	32.16
MW-13	11/12/08	2.00	4.5 to 9.5	26.38	--	--	0.20	26.18
	01/14/09	2.00	4.5 to 9.5	26.38	--	--	0.30	26.08
	09/08/10	2.00	4.5 to 9.5	26.38	--	--	0.187	26.19
MW-14[a]	11/12/08	2.00	9.3 to 14.3	26.00	5.35	31.35	3.47	22.86
	01/14/09	2.00	9.3 to 14.3	26.00	5.35	31.35	4.25	22.22
	09/08/10	2.00	9.3 to 14.3	26.00	4.98	30.98	2.98	22.96
MW-15	09/08/10	4.00	5 to 10	30.04	--	--	3.58	26.46

NOTES:

[1]Well top-of-casing elevations surveyed to mean sea level by ESM Consulting Engineers in August and November 2008. Monitoring wells MW-07 through MW-09, MW-13 and MW-15 are finished with polyvinyl chloride risers above ground surface.

[2]Top of temporary well casing riser elevation = top of well casing elevation + temporary well casing riser length.

[3]Depth to groundwater below the top of well casing or top of temporary well casing riser.

[4]Top of well casing elevation or top of temporary well casing riser elevation - depth to groundwater.

[a]Monitoring well installed at a 55 degree angle from ground surface. Potentiometric surface is approximated by multiplying the top of temporary well casing riser elevation - depth to groundwater by sin 55°.

-- = not applicable

Table 4
Summary of Groundwater Results for Monitored Natural Attenuation Parameters
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Well ID	Sample ID	Sample Date	Sampled By	Water Quality Meter	Dissolved Oxygen[1] (mg/L)	Nitrate[2] (mg/L)	Total Manganese[3] (mg/L)	Total Iron[4] (mg/L)	Ferrous Iron[5] (mg/L)	Ferric Iron[6] (mg/L)	Sulfate[2] (mg/L)	Methane[7] (mg/L)	Ethene[7] (mg/L)	Ethane[7] (mg/L)	ORP[1] (mV)	Specific Conductivity[1] (mS/cm)	Turbidity[1] (NTU)	Temperature[1] (ºC)	pH[1]
MW-01	MW01-20100909	09/09/10	SoundEarth	Hanna	1.14	--	--	--	--	--	--	--	--	--	-102.8	0.551	68.1	16.29	6.45
MW-03	MW03-20100909	09/09/10	SoundEarth	Hanna	1.28	<0.1	0.6	8.6	4.4	4.2	1.06	1.64	<0.005	<0.005	-96.4	0.661	47.2	19.33	6.47
MW-04	MW04-20100908	09/08/10	SoundEarth	Hanna	2.78	--	--	--	--	--	--	--	--	--	-127.5	0.283	>200	18.76	6.27
MW-06	MW06-20100908	09/08/10	SoundEarth	Hanna	1.82	--	--	--	--	--	--	--	--	--	-106.8	0.698	>200	17.22	6.33
MW-07	MW07-20100908	09/08/10	SoundEarth	Hanna	0.12	--	--	--	--	--	--	--	--	--	-264.4	0.151	>200	15.13	7.75
MW-08	MW08-20100908	09/08/10	SoundEarth	YSI	0.75	0.215	0.2	6.8	2.9	3.9	2.36	0.495	<0.005	<0.005	-119	0.283	109.2	15.07	8.24
MW-09	MW09-20100909	09/09/10	SoundEarth	YSI	0.2	--	--	--	--	--	--	--	--	--	-79.4	0.493	NM	15.86	7.14
MW-10	MW10-20100909	09/09/10	SoundEarth	YSI	0.25	0.183	0.3	1.1	0.4	0.7	5.40	0.136	<0.005	<0.005	-32.3	0.479	>200	16.24	7.59
MW-11	MW11-20100909	09/09/10	SoundEarth	Hanna	1.27	0.174	0.2	2.0	1.6	0.4	2.59	0.222	<0.005	<0.005	-149.8	0.184	10.9	15.62	7.03
MW-12	MW12-20100909	09/09/10	SoundEarth	Hanna	1.42	--	--	--	--	--	--	--	--	--	-176.2	0.338	14.7	14.77	8.11
MW-13	MW13-20100908	09/08/10	SoundEarth	YSI	0.60	<0.1	0.0	0.2	0.0	0.2	5.89	ND	<0.005	<0.005	-23.3	0.230	71.6	14.48	8.82
MW-14	MW14-20100909	09/09/10	SoundEarth	Hanna	1.58	<0.1	0.6	1.2	1.2	0.0	5.05	0.208	<0.005	<0.005	-172.2	0.178	22.8	16.06	7.21
MW-15	MW15-20100909	09/09/10	SoundEarth	YSI	0.01	--	--	--	--	--	--	--	--	--	12.8	0.412	132.8	15.68	8.47

NOTES:

[1]Parameter is measured in the field using water quality meter with flow-through cell. The reported value is the last reading prior to sampling groundwater.

[2]Analyzed by EPA Method 300.0 by Fremont Analytical of Seattle, Washington, unless otherwise noted.

[3]Analyzed in the field by SoundEarth personnel using a HachTotal Manganese kit, EPA Periodate Oxidation Method 8034, except where noted.

[4]Analyzed in the field by SoundEarth personnel using HachTotal Iron Kit, FerroVer Method 8008, except where noted.

[5]Analyzed in the field by SoundEarth personnel using HachFerrous Iron Kit, 1-10 Phenanthroline Method 8146, except where noted.

[6]Ferric iron concentration = total iron concentration - ferrous iron concentration.

[7]Analyzed by Method RSK-175 by Fremont Analytical Inc., of Seattle, Washington.

-- = not sampled

< = concentration not detected above the laboratory practical quantiation limit

> = greater than the detection limit of the water quality meter

°C = degrees Celsius

EPA = U.S. Environmental Protection Agency

mg/L = milligrams per liter

mS/cm = millisiemens per centimeter

mV = millivolts

ND = not detected

NM = not measured

NTU = Nephelometric Turbidity Units

ORP = oxidation-reduction potential

SoundEarth = SoundEarth Strategies, Inc. (formerly known as Sound Environmental Strategies Corporation)

SoundEarth Strategies

Table 5
Pump Test Results
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

Hydraulic Conductivity and Permeability Equations

$$K = T / b$$

K = Hydraulic Conductivity (L/t)
T = Transmissivity (L^2/t)
b = Saturated Thickness (L)

$$k_i = K * (\mu / \rho * g)$$

k_i = intrinsic permeability (L^2)
μ = water viscosity (M/L * t)
ρ = water density (M/L^3)
g = acceleration due to gravity (L/t^2)

Hydraulic Conductivity Calculation

Well ID	Well Type	Well Diameter (inches)	Borehole Diameter (inches)	Screened Interval (feet bgs)	Radial Distance to Pumping Well (feet)	Analytical Method	Aquifer Model / Data Type	T (ft^2/s)	b (ft)	K (ft/s)	K (cm/s)	Storativity (unitless)	Comments
MW-10	Observation	2	8.25	5-10	6.8	Cooper-Jacob (1946)	Confined / Pump	2.20E-03	5.30	4.15E-04	1.27E-02	6.05E-03	Original Slope (Slope 1), indicative of coarser imported soil (fill material) located within the 2006 excavation.
						Cooper-Jacob (1946)	Confined / Pump	5.98E-04	5.30	1.13E-04	3.44E-03	2.31E-02	Second Slope (Slope 2), indicative of finer regional imported soil (fill material) located outside of the 2006 excavation.
						Theis (1935)	Unconfined Approximation / Pump	1.73E-03	5.30	3.26E-04	9.93E-03	8.37E-03	Early Drawdown vs Time Data, indicative of coarser imported soil (fill material) located within the 2006 excavation.
						Theis (1935)	Unconfined Approximation / Pump	6.30E-04	5.30	1.19E-04	3.62E-03	2.33E-02	Later Drawdown vs Time Data, indicative of finer regional imported soil (fill material) located outside of the 2006 excavation.
						Theis (1935)	Unconfined Approximation / Recovery	7.28E-04	5.30	1.37E-04	4.19E-03	6.61E-02	Later Recovery vs Time Data, indicative of finer regional imported soil (fill material) located outside of the 2006 excavation.
									Arithmetic Mean	2.22E-04	6.77E-03	2.54E-02	The hydraulic properties of the unconfined water-bearing zone will fall somewhere in between the early and late observations (data) of the test.

Pumping Well Information

Well ID	Well Type	Well Diameter (inches)	Borehole Diameter (inches)	Screened Interval (feet bgs)	Pumping Rate (gpm)	Pumping Rate (ft^3/s)	Pumping Duration (minutes)
MW-15	Pumping	4	10.25	3-10.5	2.8	0.0062	190

Intrinsic Permeability Calculation

Well ID	K (cm/s)	μ / ρg (cm * s)	k_i (cm^2)
MW-10	6.77E-03	1.02E-05	6.90E-08

Assumption at 20 Celsius: μ / ρ * g = 1.02E-05 cm/s.

NOTES:
bgs = below ground surface
cm/s = centimeter per second
cm^2 = centimeter squared
ft = feet
ft/s = foot per second
ft^2/s = squared foot per second
ft^3/s = cubed foot per second
gpm = gallons per minute
s = seconds
t = time

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Table 6
Sub-Slab Vapor Analytical Results for Selected HVOCs
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Boring/Sample Location	Sample Location[1]	Sampled By	Sample Type	Sample Date	Dilution Factor[2]	Analytical Results[3] ($\mu g/m^3$)									
						PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCA	1,1,1-TCA	1,1-DCE	1,2-DCA	Chloroethane	Vinyl Chloride
VS-1	East of Dry Cleaning Machine	SoundEarth	Sub-slab Vapor	6/16/2011	11.5	**880**	**66**	5.8	<0.46	<0.93	<1.2	<0.46	<0.93	<1.5	<0.29
VS-2	East of Dry Cleaning Machine	SoundEarth	Sub-slab Vapor (Duplicate)	6/16/2011	8.1	**870**	**66**	5.6	<3.2	<0.65	<0.88	<0.32	<0.65	<1.1	<0.20
MTCA Method B Soil Gas Screening Levels[4]						**96**	**3.7**	**160**	**270**	**3,200**	**23,000**	**910**	**0.96**	**46,000**	**2.8**

NOTES:

Red denotes concentration exceeds MTCA cleanup level.

[1]Reference Figure 7, Vapor Sample Locations.

[2]Dilution Factor = Based on the final pressure of the sample canister and the required pressure applied for canister analysis.

[3]Analyzed by U.S. Environmental Protection Agency Method TO-15.

[4]MTCA Method B Soil Gas Screening Levels, Table B-1, Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State, October 2009 and updated in CLARC in September 2012.

$\mu g/m^3$ = microgram per cubic meter
< = concentration not detected above the laboratory practical quantitation limit
CLARC = Cleanup Levels and Risk Calculation
DCA = dichloroethane
DCE = dicholorethene
HVOC = halogenated volatile organic compound
MTCA = Washington State Model Toxics Control Act
PCE = tetrachloroethene
SoundEarth = SoundEarth Strategies, Inc.
TCA = trichloroethane
TCE = trichloroethene

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Table 7
Sub-Slab Vapor Analytical Results for BTEX
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Vapor Sample Identification	Sample Location[1]	Sampled By	Sample Type	Sample Date	Dilution Factor[2]	Analytical Results[3] (µg/m³)			
						Benzene	Toluene	Ethylbenzene	Total Xylenes
VS-1	East of Dry Cleaning Machine	SoundEarth	Sub-slab Vapor	6/16/2011	11.5	<1.8	350	<1.0	3.8
VS-2	East of Dry Cleaning Machine	SoundEarth	Sub-slab Vapor (Duplicate)	6/16/2011	8.1	<1.3	350	0.72	3.9
MTCA Method B Soil Gas Screening Levels[4]						**3.2**	**22,000**	**4,600**	**460**

NOTES:

[1]Reference Figure 7 - Vapor Sample Locations.

[2]Dilution Factor = Based on the final pressure of the sample canister and the required pressure applied for canister analysis.

[3]Analyzed by U.S. Environmental Protection Agency Method TO-15.

[4]MTCA Method B Soil Gas Screening Levels, Table B-1, Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State, October 2009.

µg/m³ = microgram per cubic meter

< = concentration not detected above the laboratory practical quantitation limit

BTEX = benzene, toluene, ethylbenzene, and total xylenes

MTCA = Washington State Model Toxics Control Act

SoundEarth = SoundEarth Strategies, Inc.

Table 8
Indoor and Ambient Air Vapor Analytical Results for Selected HVOCs
Cherry Street Q-Tip Trust Building
1000 Cherry Street Southeast
Olympia, Washington

Boring/ Sample Location	Sample Location[1]	Sampled By	Sample Type	Sample Date	Dilution Factor[2]	Analytical Results[3] (µg/m^3)									
						PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCA	1,1,1-TCA	1,1-DCE	1,2-DCA	Chloroethane	Vinyl Chloride
VS-3	South Office	SoundEarth	Indoor Air	12/3/2010	1.61	0.28	<0.17	<0.13	<0.64	<0.13	<0.18	<0.064	<0.13	<0.21	<0.041
VS-4	North Portion of Bldg	SoundEarth	Indoor Air	12/3/2010	1.58	0.27	<0.17	<0.12	<0.63	<0.13	<0.17	<0.063	<0.13	<0.21	<0.040
VS-5	Crawl Space	SoundEarth	Indoor Air	12/3/2010	1.68	0.27	<0.18	<0.13	<0.67	<0.14	<0.18	<0.067	<0.14	<0.22	<0.043
VS-6	Basement	SoundEarth	Indoor Air	12/3/2010	1.68	0.27	<0.18	<0.13	<0.67	<0.14	<0.18	<0.067	<0.14	<0.22	<0.043
VS-7	HVAC Intake-Roof	SoundEarth	Ambient Air	12/3/2010	1.64	0.35	<0.18	<0.13	<0.65	<0.13	<0.18	<0.065	**0.20**	<0.22	<0.042
VS-8	Southeast of Building	SoundEarth	Ambient Air	12/3/2010	1.49	0.36	<0.16	<0.12	<0.59	<0.12	<0.16	<0.059	<0.12	<0.20	<0.038
MTCA Method B Cleanup Levels for Indoor Air[4]						**9.6**	**0.37**	**16**	**27**	**320**	**2,300**	**91**	**0.096**	**4,600**	**0.28**

NOTES:

Red denotes concentration exceeds MTCA cleanup level.

[1]Reference Figure 7 - Vapor Sample Locations.

[2]Dilution Factor = Based on the final pressure of the sample canister and the required pressure applied for canister analysis.

[3]Analyzed by U.S. Environmental Protection Agency Modified TO-15 SIM Low Level Analysis.

[4]MTCA Method B Soil Gas Screening Levels, Table B-1, Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State, October 2009 and updated in CLARC in September 2012.

µg/m^3 = microgram per cubic meter

< = concentration not detected above the laboratory practical quantitation limit

DCA = dichloroethane

DCE = dicholorethene

HVAC = Heating, Ventilating, and Air Conditioning

HVOC = halogenated volatile organic compound

MTCA = Washington State Model Toxics Control Act

PCE = tetrachloroethene

SoundEarth = SoundEarth Strategies, Inc.

TCA = trichloroethane

TCE = trichloroethene

Table 9
Indoor and Ambient Air Vapor Analytical Results for BTEX
Cherry Street Q-Tip Trust Building
1000 Cherry Street Southeast
Olympia, Washington

Vapor Sample Identification	Sample Location[1]	Sampled By	Sample Type	Sample Date	Dilution Factor[2]	Analytical Results[3] (µg/m³)			
						Benzene	Toluene	Ethylbenzene	Total Xylenes
VS-3	South Office	SoundEarth	Indoor Air	12/3/2010	1.61	**1.6**	5.4	0.79	2.99
VS-4	North Portion of Building	SoundEarth	Indoor Air	12/3/2010	1.58	**1.7**	6.0	0.77	2.99
VS-5	Crawl Space	SoundEarth	Indoor Air	12/3/2010	1.68	**1.8**	4.5	0.58	2.22
VS-6	Basement	SoundEarth	Indoor Air	12/3/2010	1.68	**1.5**	5.2	0.68	2.6
VS-7	HVAC Intake-Roof	SoundEarth	Ambient Air	12/3/2010	1.64	**2.5**	5.3	1.3	7.0
VS-8	Southeast of Building	SoundEarth	Ambient Air	12/3/2010	1.49	**1.6**	4.9	0.60	2.62
MTCA Method B Cleanup Levels for Indoor Air[4]						**0.32**	**2,200**	**460**	**46**

NOTES:

Red denotes concentration exceeds MTCA cleanup level.

[1]Reference Figure 7 - Vapor Sample Locations.

[2]Dilution Factor = Based on the final pressure of the sample canister and the required pressure applied for canister analysis.

[3]Analyzed by U.S. Environmental Protection Agency Modified TO-15 SIM Low Level Analysis.

[4]MTCA Method B Indoor Air Cleanup Levels, Table B-1, Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State, October 2009.

µg/m³ = microgram per cubic meter

BTEX = benzene, toluene, ethylbenzene, and total xylenes

HVAC = Heating, Ventilating, and Air Conditioning

MTCA = Washington State Model Toxics Control Act

SoundEarth = SoundEarth Strategies, Inc.

SoundEarth Strategies

Table 10
Preliminary Cleanup Levels
Former Olympia Dry Cleaners Site
606 Union Avenue Southeast
Olympia, Washington

SOIL	
Chemicals of Concern	**Cleanup Levels (mg/kg)**
PCE	0.05[a]
TCE	0.03[a]
cis-1,2-Dichloroethene	160[b]
trans-1,2-Dichloroethene	1,600[b]
1,1-Dichloroethane	16,000[b]
1,1,1-Trichloroethane	2[a]
1,1-Dichloroethene	4,000[b]
1,2-Dichloroethane	11[c]
Chloroethane	NE
Vinyl Chloride	0.67[c]
Gasoline-Range Petroleum Hydrocarbons	30/100[a]
Diesel-Range Petroleum Hydrocarbons	2,000[a]
Oil-Range Petroleum Hydrocarbons	2,000[a]
Benzene	0.03[a]
Toluene	7[a]
Ethylbenzene	6[a]
Total Xylenes	9[a]
GROUNDWATER	
Chemicals of Concern	**Cleanup Levels (µg/L)**
PCE	5[d]
TCE	5[d]
cis-1,2-Dichloroethene	16[e]
trans-1,2-Dichloroethene	160[e]
1,1-Dichloroethane	1,600[e]
1,1,1-Trichloroethane	200[d]
1,1-Dichloroethene	400[e]
1,2-Dichloroethane	5[d]
Chloroethane	NE
Vinyl Chloride	0.2[d]
Gasoline-Range Petroleum Hydrocarbons	1,000/800[d]
Diesel-Range Petroleum Hydrocarbons	500[d]
Oil-Range Petroleum Hydrocarbons	500[d]
Benzene	5[d]
Toluene	1,000[d]
Ethylbenzene	700[d]
Total Xylenes	1,000[d]
SURFACE WATER	
Chemicals of Concern	**Cleanup Levels (µg/L)**
PCE	100[f]
TCE	13[f]
cis-1,2-Dichloroethene	NR
trans-1,2-Dichloroethene	33,000[g]
1,1-Dichloroethane	NR
1,1,1-Trichloroethane	930,000[g]
1,1-Dichloroethene	23,000[g]
1,2-Dichloroethane	59[f]
Chloroethane	NR
Vinyl Chloride	6,600[f]
Gasoline-Range Petroleum Hydrocarbons	1,000/800[d]
Diesel-Range Petroleum Hydrocarbons	500[d]
Oil-Range Petroleum Hydrocarbons	500[d]
Benzene	23[f]
Toluene	19,000[g]
Ethylbenzene	6,900[g]
Total Xylenes	1,000[d]

Table 10
Preliminary Cleanup Levels
Former Olympia Dry Cleaners Site
606 Union Avenue Southeast
Olympia, Washington

VAPOR (INDOOR AIR)	
Chemicals of Concern	**Cleanup Levels[1,2] ($\mu g/m^3$)**
PCE	9.6
TCE	0.37
cis-1,2-Dichloroethene	16
trans-1,2-Dichloroethene	27
1,1-Dichloroethane	320
1,1,1-Trichloroethane	2,300
1,1-Dichloroethene	91
1,2-Dichloroethane	0.096
Chloroethane	4,600
Vinyl Chloride	0.28
Benzene	0.32
Toluene	2,200
Ethylbenzene	460
Total Xylenes	46

NOTES:

[a]MTCA Method A Soil Cleanup Levels for Unrestricted Land Uses, Table 740-1 of Section 900 of Chapter 173-340 of the Washington Administrative Code, revised November 2007.

[b]CLARC, Soil, Method B Cleanup Levels, Non-Carcinogen, Standard Formula Value, Direct Contact (ingestion only), CLARC website <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.

[c]CLARC, Soil, Method B Cleanup Levels, Carcinogen, Standard Formula Value, Direct Contact (ingestion only), CLARC website <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.

[d]MTCA Method A Cleanup Levels for Ground Water, Table 720-1 of Section 900 of Chapter 173-340 of the Washington Administrative Code, revised November 2007.

[e]CLARC, Groundwater, Method B Cleanup Levels, Non-Carcinogen, Standard Formula Value, CLARC website <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.

[f]CLARC, Surface Water, Method B, Carcinogen, Standard Formula Value, CLARC website <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.

[g] CLARC, Surface Water, Method B, Non-Carcinogen, Standard Formula Value, CLARC website <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.

[1]MTCA Method B Indoor Air Cleanup Levels, Table B-1, Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State, October 2009. Most stringent cleanup level listed.

[2]MTCA Method B Indoor Air Cleanup Levels were updated based on a CLARC database search performed on 2/5/2013. If updated values were unavailable then the cleanup levels from Table B-1 were used.

µg/L = micrograms per liter
$\mu g/m^3$ = micrograms per meter cubed
CLARC = Cleanup Levels and Risk Calculation
mg/kg = milligrams per kilogram
MTCA = Washington State Model Toxics Control Act
NE = Researched, no data
NR = Not researched
PCE = tetrachloroethylene
TCE = trichloroethylene

Table 11
Remedial Component Screening Matrix
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Component Group	Component Options	Retained for Inclusion in Cleanup Action Alternatives?	Rationale for Inclusion or Exclusion
Passive Remediation			
	No Further Action	No	Excluded because it is not protective of human health or the environment.
	Monitored Natural Attenuation	Yes	Retained as a component of all cleanup action alternatives. Not retained for use as a sole administrative or engineering control.
	Containment Cap	Yes	Retained as a component of one or more cleanup action alternatives as an engineering control to seal the Seep.
	Environmental Covenant	No	Does not address groundwater contamination at the Site.
	Permeable Reactive Barrier	Yes	Technology is retained as an effective option treating COCs in groundwater downgradient of the Former Olympia Dry Cleaners Property.
In Situ Physical Treatment			
	SVE	No	Not retained because technology is not implementable based on Site-specific subsurface characteristics.
	Air Sparging	No	Not retained because technology is not implementable based on Site-specific subsurface characteristics.
	Surfactant Washing	No	Not retained as this technology has the potential to mobilize contaminants from the saturated zone beyond the Site boundary.
	Cosolvent Washing	No	Not retained as this technology has the potential to mobilize contaminants from the saturated zone beyond the Site boundary.
	Pump and Treat	Yes	Implemented alone, this component will not address soil contamination. Retained as a component of DPE.
	Dual-Phase Extraction	Yes	Retained and it is a proven technology to be effective for the remediation of the COCs in soil and groundwater.
In Situ Thermal			
	Resistive Thermal with SVE	No	Although these in situ thermal technologies generally satisfy the MTCA threshold and modifying evaluation criteria, none are retained because they are difficult to implement and not cost-competitive with other technologies when implemented at this scale. These technologies also present an increased short-term risk of injury during their installation and operation. Site-specific subsurface characteristics limit the effectiveness of SVE without a dewatering application.
	Conductive Thermal with SVE	No	
	Radio Frequency/Electromagnetic Thermal with SVE	No	
	Steam Injection with SVE and Groundwater Extraction	No	
	Hot Air Injection with SVE	No	
	Hot Water Injection with SVE and Groundwater Extraction	No	
Source Removal			
	Excavation without Shoring	No	Not retained because excavation without shoring is not feasible to implement based on the proximity of the adjacent buildings and rights-of-way.
	Excavation with Shoring		
	Sheet Pile Wall - Impervious Wall	Yes	Technology is retained as an impervious shoring option coupled with a dewatering component for excavation activities.
	Soldier Pile Wall - Non-Impervious Wall	No	Not retained due to the subsurface characteristics. The installation of soldier piles would compromise the semi-confining layer for the underlying artesian aquifer.

Table 11
Remedial Component Screening Matrix
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Component Group	Component Options	Retained for Inclusion in Cleanup Action Alternatives?	Rationale for Inclusion or Exclusion
Ex Situ Source Treatment			
	Surfactant Washing	No	Not retained because these components are not cost-competitive with other technologies at this scale and would result in another waste stream requiring disposal.
	Cosolvent Washing	No	
	Chemical Oxidation	No	
	Thermal Desorption	No	Not retained due to the shallow groundwater elevations the impacted soil is saturated.
	Landfill Disposal	Yes	This technology is retained because the excavated soil will be disposed of at a Subtitle C or contained-out Subtitle D landfill.
In Situ Chemical Oxidation			
	Heated Sodium Persulfate	No	These technologies are not retained because groundwater quality data indicate that the subsurface is anaerobic and favorable for reductive dechlorination, and chemical oxidation promotes aerobic conditions. Additionally, it is difficult to retain the chemical oxidant within the treatment zone and guaranteeing the capture of the chemical oxidant.
	Hydrogen Peroxide	No	
	Fenton's Reagent	No	
	RegenOx (Catalyzed Sodium Percarbonate)	No	
	Permanganate	Yes	This technology is retained because it is an effective treatment of COCs in soil and groundwater when delivered properly.
Containment/Immobilization			
	Bituminization	No	Not retained because these technologies reduce the mobility of hazardous substances but not their toxicity or volume. The technologies are typically implemented ex situ.
	Emulsified Asphalt	No	
	Modified Sulfur Cement	No	
	Polyethylene Extrusion	No	Not retained because this technology is not well developed.
	Pozzolan/Portland Cement	No	Not retained because the technology reduces the mobility of hazardous substances but not the toxicity or volume. The technology is typically implemented ex situ.
	Vitrification/Molten Glass	No	Not retained because it is not cost-competitive with our technologies in this group and is difficult to implement. This technology also presents an increased short-term risk of injury during installation and operation.
	Slurry Wall Containment	No	Not retained because these technologies reduce the mobility of hazardous substances but not their toxicity or volume. Additionally, these technologies are typically keyed into a confining layer and there is a risk associated with breaching the semi-confining layer with the underlying artesian aquifer conditions.
	Sheet Pile Wall Containment	No	
	Pump and Treat for Hydraulic Containment	Yes	Implemented alone, this component will not address soil contamination. Retained as a component of DPE.
Phytoremediation			
	Hydraulic Control	No	Not retained because implementation of these technologies is not compatible with the future land use at the Site, nor do these components result in a reasonable restoration time frame.
	Phyto-Degradation	No	
	Phyto-Volatilization	No	
	Phyto-Accumulation	No	
	Phyto-Stabilization	No	
	Enhanced Rhizosphere Biodegradation	No	

SoundEarth Strategies

Table 11
Remedial Component Screening Matrix
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Component Group	Component Options	Retained for Inclusion in Cleanup Action Alternatives?	Rationale for Inclusion or Exclusion
In Situ Bioremediation			
	Aerobic Bioremediation	No	Not retained because the groundwater quality indicates the subsurface is anaerobic and conducive for reductive dechlorination.
	Anaerobic Bioremediation	Yes	Retained as a technology because groundwater quality data indicates the subsurface is anaerobic and it will enhance bioremediation. A longer restoration time frame is anticipated because the Washington State Department of Ecology does not want to fracture the subsurface formation.

NOTES:
COC = chemical of concern
DPE - dual-phase extraction
MTCA = Washington State Model Toxics Control Act
SVE = soil vapor extraction

Table 12
Feasibility Level Cost Estimate
Cleanup Action Alternative 1
Bioremediation - Edible Oil Injection
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

CAPITAL COST ITEM	QTY	UNIT	UNIT PRICE	COST	TOTALS
Permitting (excludes labor)					
Traffic control and truck route haul plans	1	per permit	$ 4,000	$ 4,000	
Right-of-way permit fees	1	per permit	$ 2,000	$ 2,000	
Sidewalk and lane closure fees	1	per permit	$ 10,000	$ 10,000	
Utilities permit	1	per permit	$ 5,000	$ 5,000	
Geotechnical/Structural Engineering Support Services					
Geotechnical and Structural Design (Seep Seal)	1	ls	$ 10,000	$ 10,000	
Site Work					
Single Well Point Injection Test	1	ls	$ 22,500	$ 22,500	
First Injection Event					
Drilling Contractor	1	ls	$ 125,000	$ 125,000	
Edible oil injection	1	ls	$ 50,000	$ 50,000	
Contingency Monitoring Well Installation	1	ls	$ 8,500	$ 8,500	
Second Injection Event (Contingency)					
Drilling contractor	1	ls	$ 42,500	$ 42,500	
Edible oil injection	1	ls	$ 17,000	$ 17,000	
Bio augmentation	1	ls	$ 45,000	$ 45,000	
Geotechnical Oversight (Seep Seal)	1	ls	$ 10,000	$ 10,000	
Survey - baseline, weekly, conclusion of field work	1	ls	$ 5,000	$ 5,000	
Excavation Contractor (Seep Seal)					
Mobilization and site security	1	ls	$ 5,000	$ 5,000	
Temporary dewatering equipment/labor/disposal fees	1	ls	$ 5,000	$ 5,000	
Excavate, load and haul clean overburden	200	ton	$ 25	$ 5,000	
Excavate, load and haul contaminated soil	200	ton	$ 85	$ 17,000	
Import clean fill, compact, and fill	150	cy	$ 25	$ 3,750	
Import CDF for seep seal	100	cy	$ 95	$ 9,500	
Cap treatment area	500	sf	$ 12	$ 6,000	
Traffic Control					
Signage rental	20	day	$ 50	$ 1,000	
Flaggers	10	day	$ 800	$ 8,000	
Site Restoration					
Grade and repave sidewalks	1	ls	$ 15,000	$ 15,000	
Well Decommissioning	1	ls	$ 10,000	$ 10,000	
Subtotal				*$ 441,750*	
Labor and Other Direct Costs					
Professional Labor	1	ls	$ 169,949	$ 169,949	
Other Direct Costs (Reprographics, Courier Services)	1	ls	$ 936	$ 936	
Equipment (H&S equipment, soil sampling kits)	1	ls	$ 25,350	$ 25,350	
Analytical Costs	1	ls	$ 5,875	$ 5,875	
Subtotal				*$ 202,110*	
CONSTRUCTION SUBTOTAL					$ 643,860
Mobilization, Contingencies, and Demobilization					
Mobilization (1% of construction subtotal)				$ 6,439	
Bid (2% of construction subtotal)				$ 12,877	
Scope (15% of construction subtotal)				$ 96,579	
Cleanup and Demobilization (1% of construction subtotal)				$ 6,439	
Subtotal				*$ 122,333*	
CONSTRUCTION TOTAL					$ 766,193
Indirect Capital Costs					
Engineering Construction Services (8% of construction total)				$ 61,295	
Subtotal				*$ 61,295*	
TOTAL CAPITAL COST					**$ 827,489**

Table 12
Feasibility Level Cost Estimate
Cleanup Action Alternative 1
Bioremediation - Edible Oil Injection
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

O&M AND COMPLIANCE MONITORING COST ITEMS	ANNUAL COST[1]		Present Worth Cost of Annual O&M Real Discount Rate = 0.9%			
			n = 5 year			
Quarterly Groundwater Monitoring and Reporting (2 years)	$	45,000	$	88,799		
Present worth of Future MNA Quarterly Monitoring (Years 3-5)	$	27,000	$	79,564		
Compliance Monitoring						
Groundwater - TOC, pH, water levels (3 events)	$	6,000	$	5,946		
Soil Gas - 4 points (3 events)	$	10,000	$	9,911		
Building Sub-Slab - 1 point (2 events)	$	11,000	$	10,902		
Soil - 1 day geoprobe event	$	10,000	$	9,911		
TOTAL PRESENT WORTH O&M AND COMPLIANCE MONITORING COST					**$**	**205,033**
TOTAL PRESENT WORTH COST OF ALTERNATIVE 1					**$**	**1,033,000**

NOTES:

[1]Annual cost is 2012 year cost.

CDF = controlled density fill
cy = cubic yard
H&S = health and safety
ls = lump sum
MNA = monitored natural attenuation
n = number of years of operation and maintenance
O&M = operation and maintenance
QTY = quantity
sf = square feet
TOC = top of casing

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Table 13
Feasibility Level Cost Estimate
Cleanup Action Alternative 2
Chemical Oxidation - Permanganate Injection
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

CAPITAL COST ITEM	QTY	UNIT	UNIT PRICE	COST	TOTALS
Permitting (excludes labor)					
Traffic control and truck route haul plans	1	per permit	$ 4,000	$ 4,000	
Right-of-way permit fees	1	per permit	$ 2,000	$ 2,000	
Sidewalk and lane closure fees	1	per permit	$ 10,000	$ 10,000	
Utilities permit	1	per permit	$ 5,000	$ 5,000	
Geotechnical/Structural Engineering Support Services					
Geotechnical and Structural Design (Seep seal)	1	ls	$ 10,000	$ 10,000	
Site Work					
Single Well Point Injection Test	1	ls	$ 22,500	$ 22,500	
Injection Event					
Drilling Contractor	1	ls	$ 150,000	$ 150,000	
Permanganate	1	ls	$ 205,500	$ 205,500	
Contingency Monitoring Well Installation	1	ls	$ 8,500	$ 8,500	
Site Control	1	ls	$ 50,000	$ 50,000	
Geotechnical Oversight (Seep Seal)	1	ls	$ 10,000	$ 10,000	
Survey - baseline, weekly, conclusion of field work	1	ls	$ 5,000	$ 5,000	
Excavation Contractor (Seep Seal)					
Mobilization and Site Security	1	ls	$ 5,000	$ 5,000	
Temporary dewatering equipment/labor/disposal fees	1	ls	$ 5,000	$ 5,000	
Excavate, load and haul clean overburden	200	ton	$ 25	$ 5,000	
Excavate, load and haul contaminated soil	200	ton	$ 85	$ 17,000	
Import clean fill, compact, and fill	150	cy	$ 25	$ 3,750	
Import CDF for seep seal	100	cy	$ 95	$ 9,500	
Cap treatment area	500	sf	$ 12	$ 6,000	
Traffic Control					
Signage rental	20	day	$ 50	$ 1,000	
Flaggers	10	day	$ 800	$ 8,000	
Site Restoration					
Grade and repave sidewalks	1	ls	$ 15,000	$ 15,000	
Well Decommissioning	1	ls	$ 10,000	$ 10,000	
Subtotal				*$ 567,750*	
Labor and Other Direct Costs					
Professional Labor	1	ls	$ 121,730	$ 121,730	
Other Direct Costs (Reprographics, Courier Services)	1	ls	$ 720	$ 720	
Equipment (H&S equipment, soil sampling kits)	1	ls	$ 10,600	$ 10,600	
Analytical Costs	1	ls	$ 7,938	$ 7,938	
Subtotal				*$ 140,988*	
CONSTRUCTION SUBTOTAL					$ 708,738
Mobilization, Contingencies, and Demobilization					
Mobilization (1% of construction subtotal)				$ 7,087	
Bid (2% of construction subtotal)				$ 14,175	
Scope (15% of construction subtotal)				$ 106,311	
Cleanup and Demobilization (1% of construction subtotal)				$ 7,087	
Subtotal				*$ 134,660*	
CONSTRUCTION TOTAL					$ 843,399
Indirect Capital Costs					
Engineering Construction Services (8% of construction total)				$ 67,472	
Subtotal				*$ 67,472*	
TOTAL CAPITAL COST					**$ 910,871**

Table 13
Feasibility Level Cost Estimate
Cleanup Action Alternative 2
Chemical Oxidation - Permanganate Injection
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

O&M AND COMPLIANCE MONITORING COST ITEMS	ANNUAL COST[1]	Present Worth Cost of Annual O&M Real Discount Rate = 0.9%	
		n = 5 year	
Quarterly Groundwater Monitoring and Reporting (2 years)	$ 45,000	$ 88,799	
Present worth of Future MNA Quarterly Monitoring (Years 3-5)	$ 27,000	$ 79,564	
Compliance Monitoring			
Groundwater - TOC, pH, water levels (3 events)	$ 6,000	$ 5,946	
Soil Gas - 4 points (3 events)	$ 10,000	$ 9,911	
Building Sub-Slab - 1 point (2 events)	$ 11,000	$ 10,902	
Soil - 1 day geoprobe event	$ 10,000	$ 9,911	
TOTAL PRESENT WORTH O&M AND COMPLIANCE MONITORING COST			**$ 205,033**
TOTAL PRESENT WORTH COST OF ALTERNATIVE 2			**$ 1,116,000**

NOTES:

[1]Annual cost is 2012 year cost.

CDF = controlled density fill
cy = cubic yard
H&S = health and safety
ls = lump sum
MNA = monitored natural attenuation
n = number of years of operation and maintenance
O&M = operation and maintenance
QTY = quantity
sf = square feet
TOC = top of casing

Table 14
Feasibility Level Cost Estimate
Cleanup Action Alternative 3
Chemical Oxidation - Recirculation System
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

CAPITAL COST ITEM	QTY	UNIT	UNIT PRICE	COST	TOTALS
Permitting (excludes labor)					
Traffic Control and Truck Route Haul Plans	1	per permit	$ 4,000	$ 4,000	
Right-of-way Permit Fees	1	per permit	$ 2,000	$ 2,000	
Sidewalk and lane closure fees	1	per permit	$ 10,000	$ 10,000	
Utilities Permit	1	per permit	$ 5,000	$ 5,000	
Geotechnical/Structural Engineering Support Services					
Geotechnical and Structural Design (Seep Seal)	1	ls	$ 10,000	$ 10,000	
Site Work					
Single Well Point Injection Test	1	ls	$ 22,500	$ 22,500	
Drilling Contractor	1	ls	$ 37,000	$ 37,000	
Permanganate	1	ls	$ 32,000	$ 32,000	
Contingency Monitoring Well Installation	1	ls	$ 8,500	$ 8,500	
Recirculation system installation	1	ls	$ 60,000	$ 60,000	
Geotechnical oversight (Seep seal)	1	ls	$ 10,000	$ 10,000	
Survey - Baseline, Weekly, Conclusion of Field Work	1	ls	$ 5,000	$ 5,000	
Excavation Contractor (Seep Seal)					
Mobilization and site security	1	ls	$ 5,000	$ 5,000	
Temporary dewatering equipment/labor/disposal fees	1	ls	$ 5,000	$ 5,000	
Excavate, transport, and disposal clean overburden	200	ton	$ 25	$ 5,000	
Excavate, transport, and disposal contaminated soil	200	ton	$ 85	$ 17,000	
Import clean fill, compact, and fill	150	cy	$ 25	$ 3,750	
Import CDF for seep seal	100	cy	$ 95	$ 9,500	
Cap treatment area	500	sf	$ 12	$ 6,000	
Traffic Control					
Signage rental	10	day	$ 50	$ 500	
Flaggers	10	day	$ 800	$ 8,000	
Site Restoration					
Grade and repave sidewalks	1	ls	$ 15,000	$ 15,000	
Well Decommissioning	1	ls	$ 10,000	$ 10,000	
Subtotal				*$ 290,750*	
Labor and Other Direct Costs					
Professional Labor	1	ls	$ 48,000	$ 48,000	
Other Direct Costs (Reprographics, Courier Services)	1	ls	$ 720	$ 720	
Equipment (H&S equipment, soil sampling kits)	1	ls	$ 5,300	$ 5,300	
Analytical Costs	1	ls	$ 7,938	$ 7,938	
Subtotal				*$ 61,958*	
CONSTRUCTION SUBTOTAL					$ 352,708
Mobilization, Contingencies, and Demobilization					
Mobilization (1% of construction subtotal)				$ 3,527	
Bid (2% of construction subtotal)				$ 7,054	
Scope (15% of construction subtotal)				$ 52,906	
Cleanup and Demobilization (1% of construction subtotal)				$ 3,527	
Subtotal				*$ 67,015*	
CONSTRUCTION TOTAL					$ 419,723
Indirect Capital Costs					
Engineering Construction Services (8% of construction total)				$ 33,578	
Subtotal				*$ 33,578*	
TOTAL CAPITAL COST					**$ 453,301**

Table 14
Feasibility Level Cost Estimate
Cleanup Action Alternative 3
Chemical Oxidation - Recirculation System
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

O&M AND COMPLIANCE MONITORING COST ITEMS	ANNUAL COST[1]		Present Worth Cost of Annual O&M Real Discount Rate = 0.9%	
			n = 5 year	
O&M for Treatment system (2 years)	$	50,000	$	98,666
Quarterly Groundwater Monitoring and Reporting (2 years)	$	35,000	$	69,066
Present worth of Future MNA Quarterly Monitoring (Years 3-5)	$	27,000	$	79,564
Compliance Monitoring				
Groundwater - TOC, pH, water levels (3 events)	$	6,000	$	5,946
Soil Gas - 4 points (3 events)	$	10,000	$	9,911
Building Sub-Slab - 1 point (2 events)	$	11,000	$	10,902
Soil - 1 day geoprobe event	$	10,000	$	9,911
TOTAL PRESENT WORTH O&M AND COMPLIANCE MONITORING COST			**$**	**283,966**
TOTAL PRESENT WORTH COST OF ALTERNATIVE 3			**$**	**737,000**

NOTES:

[1]Annual cost is 2012 year cost.

CDF = controlled density fill
cy = cubic yard
H&S = health and safety
ls = lump sum
MNA = monitored natural attenuation
n = number of years of operation and maintenance
O&M = operation and maintenance
QTY = quantity
sf = square feet
TOC = top of casing

Table 15
Feasibility Level Cost Estimate
Cleanup Action Alternative 4
Dual-Phase Extraction
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

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CAPITAL COST ITEM	QTY	UNIT	UNIT PRICE	COST	TOTALS
Permitting (excludes labor)					
Right-of-way Permit Fees	1	per permit	$ 2,000	$ 2,000	
Sidewalk and lane closure fees	1	per permit	$ 10,000	$ 10,000	
ORCAA Permit Fees	1	per permit	$ 5,500	$ 5,500	
Wastewater Discharge Application Fees	1	per permit	$ 9,500	$ 9,500	
Site Work					
Site controls (fencing)	200	lf	$ 7.55	$ 1,510	
Site controls (signage)	20	sf	$ 29.50	$ 590	
Remediation well installation	8	ea	$ 4,000	$ 32,000	
Asphalt saw cutting	200	lf	$ 1.80	$ 360	
Asphalt removal	10	sy	$ 5.15	$ 52	
Excavate trenches	1	ls	$ 40,000	$ 40,000	
Hauling and disposal of unsuitable fill	240	ton	$ 35	$ 8,400	
Sand fill, dead or bank (not including compaction) under pipe, 6-inch thickness	25	cy	$ 23.00	$ 575	
Backfill for trenches, including compaction	155	cy	$ 44.45	$ 6,890	
Compact bedding in trench (excludes material)	141	cy	$ 4.96	$ 699	
PVC pipe, 3-inch schedule 40, installed - SVE and air supply line	400	lf	$ 18.66	$ 7,464	
PVC pipe, 1-inch schedule 40, installed - water discharge line	400	lf	$ 15.95	$ 6,380	
PVC pipe fittings (assume 35% of installed pipe costs)	1	ls	$ 4,845	$ 4,845	
Down-well pumps and associated controls	8	ea	$ 5,500	$ 44,000	
Well vaults, installed	8	ea	$ 1,000	$ 8,000	
Repave asphalt over trenches (4 inches thick)	80	sy	$ 55.00	$ 4,400	
Contingency Monitoring Well Installation	1	ls	$ 8,500	$ 8,500	
Site restoration	1	ls	$ 15,000	$ 15,000	
Well Decommissioning	1	ls	$ 10,000	$ 10,000	
Subtotal				*$ 226,665*	
Remediation Compound					
Remediation compound	1	ls	$ 12,000	$ 12,000	
Remedial skid with one positive displacement blower, knockout tank, instrumentation, telemetry	1	ls	$ 95,000	$ 95,000	
Electrical work - system master panel; breaker panel, wiring, lighting and controls	1	ls	$ 24,000	$ 24,000	
Subtotal				*$ 131,000*	
Post-Closure Activities					
Present Worth of Future On-Property Post-Closure Confirmation Soil Sampling and Regulatory NFA Correspondence (Assume $25,000 cost in 2012)	1	ls	$ 25,000	$ 25,000	
Present Worth of Future Off-Property Post-Closure Confirmation Soil Sampling with NFA Correspondence (Assume $40,000 cost in 2012)	1	ls	$ 40,000	$ 40,000	
Present Worth of Future Well and System Decommissioning Costs, Geotech Design/oversight for Seep Seal (Assume $95,000 cost in 2012)	1	ls	$ 95,000	$ 95,000	
Subtotal				*$ 160,000*	
CONSTRUCTION SUBTOTAL					$ 517,665
Mobilization, Contingencies, and Demobilization					
Mobilization (3% of construction subtotal)				$ 15,530	
Bid (10% of construction subtotal)				$ 51,767	
Scope (15% of construction subtotal)				$ 77,650	
Cleanup and Demobilization (3% of construction subtotal)				$ 15,530	
Subtotal				*$ 160,476*	
CONSTRUCTION TOTAL					$ 678,141
Indirect Capital Costs					
Engineering Design and Permitting (15% of construction total)				$ 101,721	
Engineering Construction Services (20% of construction total)				$ 135,628	
Subtotal				*$ 237,349*	
TOTAL CAPITAL COST					**$ 915,491**

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Table 15
Feasibility Level Cost Estimate
Cleanup Action Alternative 4
Dual-Phase Extraction
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

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O&M AND COMPLIANCE MONITORING COST ITEMS	ANNUAL COST	Present Worth of Annual O&M Costs — Real Discount Rate = 0.9%	
		n = 15 years	
Monthly DPE O&M Costs	$ 119,935	$ 1,142,063	
Quarterly DPE groundwater monitoring and reporting (assume 6 years)	$ 21,760	$ 126,545	
Present worth of Future MNA Annual Monitoring (Years 6 through 13)		$ 50,023	
Present worth of Future MNA Quarterly Monitoring (Years 14 and 15)		$ 50,100	
Compliance Monitoring			
Building Sub-Slab - 1 point (2 events)	$ 11,000	$ 10,902	
Soil - 1 day geoprobe event	$ 10,000	$ 9,911	
TOTAL PRESENT WORTH O&M AND COMPLIANCE MONITORING COST			**$ 1,390,000**
TOTAL PRESENT WORTH COST OF ALTERNATIVE 4			**$ 2,305,000**

NOTES:

[1]Annual cost is 2012 year cost.

cy = cubic yards
DPE = dual-phase extraction
ea = each
lf = linear feet
ls = lump sum
MNA = monitored natural attenuation
n = number of years of operation and maintenance
NFA = No Further Action
O&M = operation and maintenance
ORCAA = Olympic Region Clean Air Agency
QTY = quantity
sf = square feet
SVE = soil vapor extraction
sy = square yard

Table 16
Feasibility Level Cost Estimate
Cleanup Action Alternative 5
Permeable Reactive Barrier
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

CAPITAL COST ITEM	QTY	UNIT	UNIT PRICE	COST	TOTALS
Permitting (excludes labor)					
Traffic control and truck route haul plans	1	per permit	$ 4,000	$ 4,000	
Right-of-way permit fees	1	per permit	$ 2,000	$ 2,000	
Sidewalk and lane closure fees	1	per permit	$ 20,000	$ 20,000	
Utilities permit	1	per permit	$ 5,000	$ 5,000	
Geotechnical/Structural Engineering Support Services					
Geotechnical and Structural Design	1	ls	$ 10,000	$ 10,000	
Site Work					
Geotechnical Oversight	1	ls	$ 10,000	$ 10,000	
Excavation Contractor					
Mobilization and Site Security	1	ls	$ 15,000	$ 15,000	
Temporary dewatering equipment/labor/disposal fees	1	ls	$ 75,000	$ 75,000	
Trench Boxes	1	ls	$ 7,500	$ 7,500	
Excavate, load and haul clean overburden	120	ton	$ 25	$ 3,000	
Excavate, load and haul VOC Soils (contained out)	230	ton	$ 85	$ 19,550	
Contained Out Letter Prep	1	ls	$ 10,000	$ 10,000	
Mixing System	250	cy	$ 35	$ 8,750	
Sand Fill (75%)	200	cy	$ 30	$ 6,000	
Iron Fill (25%)	75	cy	$ 2,200	$ 165,000	
Traffic Control					
Signage rental	30	day	$ 50	$ 1,500	
Flaggers	20	day	$ 415	$ 8,300	
Well replacement/installation for quarterly groundwater monitoring	1	ea	$ 2,000	$ 2,000	
Contingency Monitoring Well Installation	1	ls	$ 8,500	$ 8,500	
Site Restoration					
Reconnect utilities	1	ls	$ 15,000	$ 15,000	
Well Decommissioning	1	ls	$ 10,000	$ 10,000	
Subtotal				*$ 406,100*	
Post-Closure Activities					
Present Worth of Future Off-Property Post-Closure Confirmation Soil Sampling with NFA Correspondence (Assume $25,000 cost in 2012) to be incurred in Year 11	1	ls	$ 25,000	$ 25,000	
Present Worth of Future Seep Control (no treatment)	1	ls	$ 10,000	$ 10,000	
Subtotal				*$ 35,000*	
Labor and Other Direct Costs					
Professional Labor	1	ls	$ 97,940	$ 97,940	
Other Direct Costs (Reprographics, Courier Services)	1	ls	$ 1,620	$ 1,620	
Equipment (H&S equipment, soil sampling kits)	1	ls	$ 37,000	$ 37,000	
Analytical Costs	1	ls	$ 10,419	$ 10,419	
Subtotal				*$ 146,979*	
CONSTRUCTION SUBTOTAL					$ 588,079
Mobilization, Contingencies, and Demobilization					
Mobilization (1% of construction subtotal)				$ 5,881	
Bid (2% of construction subtotal)				$ 11,762	
Scope (15% of construction subtotal)				$ 88,212	
Cleanup and Demobilization (1% of construction subtotal)				$ 5,881	
Subtotal				*$ 111,735*	
CONSTRUCTION TOTAL					$ 699,814
Indirect Capital Costs					
Engineering Construction Services (8% of construction total)				$ 55,985	
Subtotal				*$ 55,985*	
TOTAL CAPITAL COST					**$ 755,799**

Table 16
Feasibility Level Cost Estimate
Cleanup Action Alternative 5
Permeable Reactive Barrier
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

O&M AND COMPLIANCE MONITORING COST ITEMS	ANNUAL COST[1]		Present Worth Cost of Annual O&M Real Discount Rate = 0.9%			
			n = 10 years			
Quarterly Groundwater Monitoring and Reporting (7 years)	$	45,000	$	303,959		
Present worth of Future MNA Quarterly Monitoring (Years 8 through 10)	$	27,000	$	79,564		
Compliance Monitoring						
Performance Monitoring - Sub Slab (2 events)	$	11,000	$	10,902		
TOTAL PRESENT WORTH O&M AND COMPLIANCE MONITORING COST					**$**	**394,425**
TOTAL PRESENT WORTH COST OF ALTERNATIVE 5					**$**	**1,150,000**

NOTES:

[1]Annual cost is 2012 year cost.

cy = cubic yard
ea = each
H&S = health and safety
ls = lump sum
MNA = monitored natural attenuation
n = number of years of operation and maintenance
NFA = No Further Action
O&M = operation and maintenance
QTY = quantity
VOC = volatile organic compounds

Table 17
Feasibility Level Cost Estimate
Cleanup Action Alternative 6A
Limited Excavation with Shoring
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

Draft - Issued for Ecology Review

CAPITAL COST ITEM	QTY	UNIT	UNIT PRICE	COST	TOTALS
Permitting (excludes labor)					
Traffic control and truck route haul plans	1	per permit	$ 4,000	$ 4,000	
Right-of-way permit fees	1	per permit	$ 2,000	$ 2,000	
Sidewalk and lane closure fees	1	per permit	$ 20,000	$ 20,000	
Utilities permit	1	per permit	$ 5,000	$ 5,000	
Shoring and grading permit fees	1	per permit	$ 15,000	$ 15,000	
Geotechnical/Structural Engineering Support Services					
Geotechnical and Structural Design	1	ls	$ 35,000	$ 35,000	
Site Work					
Geotechnical Oversight	1	ls	$ 31,250	$ 31,250	
Shoring Contractor					
Install H-pile and lagging shoring	2,500	sf exposed	$ 85	$ 212,500	
Survey - baseline, weekly, conclusion of field work	1	ls	$ 25,000	$ 25,000	
Well abandonment within proposed excavation	3	ea	$ 2,000	$ 6,000	
Excavation Contractor					
Mobilization and Site Security	1	ls	$ 15,000	$ 15,000	
Temporary dewatering equipment/labor/disposal fees	1	ls	$ 190,000	$ 190,000	
Excavate, load and haul clean overburden	200	ton	$ 25	$ 5,000	
Excavate, load and haul VOC Soils (contained out)	2,000	ton	$ 85	$ 170,000	
Contained Out Letter Prep	1	ls	$ 10,000	$ 10,000	
Placement of an impermeable barrier at shoring faces	2,500	sf	$ 8	$ 20,000	
Import modified impermeable CDF	1,000	cy	$ 95	$ 95,000	
Traffic Control					
Signage rental	45	day	$ 50	$ 2,250	
Flaggers	20	day	$ 415	$ 8,300	
Well replacement/installation for quarterly groundwater monitoring	1	ea	$ 2,000	$ 2,000	
Contingency Monitoring Well Installation	1	ls	$ 8,500	$ 8,500	
Site Restoration					
Reconnect utilities	1	ls	$ 25,000	$ 25,000	
Well Decommissioning	1	ls	$ 10,000	$ 10,000	
Subtotal				*$ 916,800*	
Post-Closure Activities					
Present Worth of Future Off-Property Post-Closure Confirmation Soil Sampling with NFA Correspondence (Assume $25,000 cost in 2012) to be incurred in Year 11	1	ls	$ 35,000	$ 35,000	
Present Worth of Future Seep Treatment and Control	1	ls	$ 55,000	$ 55,000	
Subtotal				*$ 90,000*	
Labor and Other Direct Costs					
Professional Labor	1	ls	$ 170,159	$ 170,159	
Other Direct Costs (Reprographics, Courier Services)	1	ls	$ 1,620	$ 1,620	
Equipment (H&S equipment, soil sampling kits)	1	ls	$ 11,400	$ 11,400	
Analytical Costs	1	ls	$ 5,954	$ 5,954	
Subtotal				*$ 189,133*	
CONSTRUCTION SUBTOTAL					$ 1,195,933
Mobilization, Contingencies, and Demobilization					
Mobilization (1% of construction subtotal)				$ 11,959	
Bid (2% of construction subtotal)				$ 23,919	
Scope (15% of construction subtotal)				$ 179,390	
Cleanup and Demobilization (1% of construction subtotal)				$ 11,959	
Subtotal				*$ 227,227*	
CONSTRUCTION TOTAL					$ 1,423,160
Indirect Capital Costs					
Engineering Construction Services (8% of construction total)				$ 113,853	
Subtotal				*$ 113,853*	
TOTAL CAPITAL COST					**$ 1,537,013**

Table 17
Feasibility Level Cost Estimate
Cleanup Action Alternative 6A
Limited Excavation with Shoring
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

O&M AND COMPLIANCE MONITORING COST ITEMS	ANNUAL COST[1]		Present Worth Cost of Annual O&M Real Discount Rate = 0.9%			
			n = 3 years			
Quarterly Groundwater Monitoring and Reporting (1 year)	$	34,119	$	34,119		
Present worth of Future MNA Quarterly Monitoring (Years 2 and 3)			$	51,178		
Compliance Monitoring						
Building Sub-Slab - 1 point (2 events)	$	11,000	$	10,902		
TOTAL PRESENT WORTH O&M AND COMPLIANCE MONITORING COST					**$**	**96,199**
TOTAL PRESENT WORTH COST OF ALTERNATIVE 5A					**$**	**1,633,000**

NOTES:

[1]Annual cost is 2012 year cost.

CDF = controlled density fill
cy = cubic yard
ea = each
H&S = health and safety
ls = lump sum
MNA = monitored natural attenuation
n = number of years of operation and maintenance
NFA = No Further Action
O&M = operation and maintenance
QTY = quantity
sf = square feet
VOC = volatile organic compounds

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Table 18
Feasibility Level Cost Estimate
Cleanup Action Alternative 6B
Extensive Excavation with Shoring
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

CAPITAL COST ITEM	QTY	UNIT	UNIT PRICE	COST	TOTALS
Permitting (excludes labor)					
Traffic control and truck route haul plans	1	per permit	$ 4,000	$ 4,000	
Right-of-way permit fees	1	per permit	$ 2,000	$ 2,000	
Sidewalk and lane closure fees	1	per permit	$ 20,000	$ 20,000	
Utilities permit	1	per permit	$ 5,000	$ 5,000	
Shoring and grading permit fees	1	per permit	$ 20,000	$ 20,000	
Geotechnical/Structural Engineering Support Services					
Geotechnical and Structural Design	1	ls	$ 40,000	$ 40,000	
Site Work					
Geotechnical Oversight	1	ls	$ 62,500	$ 62,500	
Building Demo	2,500	sf	$ 25	$ 62,500	
Lost Revenue	12	mo	$ 2,500	$ 30,000	
Building Replacement	2,500	sf	$ 105	$ 262,500	
Shoring Contractor					
Install H-pile and lagging shoring	3,500	sf exposed	$ 85	$ 297,500	
Survey - baseline, weekly, conclusion of field work	1	ls	$ 25,000	$ 25,000	
Well abandonment within proposed excavation	10	ea	$ 2,000	$ 20,000	
Excavation Contractor					
Mobilization and Site Security	1	ls	$ 15,000	$ 15,000	
Temporary dewatering equipment/labor/disposal fees	1	ls	$ 250,000	$ 250,000	
Excavate, load, and haul clean overburden	400	ton	$ 25	$ 10,000	
Excavate, load, and haul VOC Soils (contained out)	3,000	ton	$ 85	$ 255,000	
Contained Out Letter Prep	1	ls	$ 10,000	$ 10,000	
Placement of an impermeable barrier at shoring faces	3,500	sf	$ 8	$ 28,000	
Import modified impermeable CDF	1,600	cy	$ 95	$ 152,000	
Traffic Control					
Signage rental	90	day	$ 50	$ 4,500	
Flaggers	40	day	$ 415	$ 16,600	
Well replacement/installation for quarterly groundwater monitoring	5	ea	$ 2,000	$ 10,000	
Contingency Monitoring Well Installation	1	ls	$ 8,500	$ 8,500	
Site Restoration					
Reconnect utilities	1	ls	$ 25,000	$ 25,000	
Well Decommissioning	1	ls	$ 10,000	$ 10,000	
Subtotal				$ 1,645,600	
Post-Closure Activities					
Present Worth of Future Off-Property Post Closure Confirmation Soil Sampling with NFA Correspondence (Assume $25,000 cost in 2012)	1	ls	$ 25,000	$ 25,000	
Present Worth of Future Seep Control (no treatment)	1	ls	$ 10,000	$ 10,000	
Subtotal				*$ 35,000*	
Labor and Other Direct Costs					
Professional Labor	1	ls	$ 193,438	$ 193,438	
Other Direct Costs (Reprographics, Courier Services)	1	ls	$ 1,620	$ 1,620	
Equipment (H&S equipment, soil sampling kits)	1	ls	$ 11,400	$ 11,400	
Analytical Costs	1	ls	$ 8,853	$ 8,853	
Subtotal				*$ 215,311*	
CONSTRUCTION SUBTOTAL					$ 1,895,911
Mobilization, Contingencies, and Demobilization					
Mobilization (1% of construction subtotal)				$ 18,959	
Bid (2% of construction subtotal)				$ 37,918	
Scope (15% of construction subtotal)				$ 284,387	
Cleanup and Demobilization (1% of construction subtotal)				$ 18,959	
Subtotal				*$ 360,223*	
CONSTRUCTION TOTAL					$ 2,256,135
Indirect Capital Costs					
Engineering Construction Services (8% of construction total)				$ 180,491	
Subtotal				*$ 180,491*	
TOTAL CAPITAL COST					**$ 2,436,625**

Table 18
Feasibility Level Cost Estimate
Cleanup Action Alternative 6B
Extensive Excavation with Shoring
Former Olympia Dry Cleaners
606 Union Ave Southeast
Olympia, Washington

O&M AND COMPLIANCE MONITORING COST ITEMS	ANNUAL COST[1]		Present Worth Cost of Annual O&M Real Discount Rate = 0.9%			
			n = 3 years			
Quarterly Groundwater Monitoring and Reporting (1 year)	$	34,119	$	34,119		
Present worth of Future MNA Quarterly Monitoring (Years 2 and 3)			$	51,178		
Compliance Monitoring						
Building Sub-Slab - 1 point (2 events)	$	11,000	$	10,902		
TOTAL PRESENT WORTH O&M AND COMPLIANCE MONITORING COST					**$**	**96,199**
TOTAL PRESENT WORTH COST OF ALTERNATIVE 6B					**$**	**2,533,000**

NOTE:
[1] Annual cost is 2012 year cost.

CDF = controlled density fill
cy = cubic yards
ea = each
H&S = health and safety
ls = lump sum
MNA = monitored natural attenuation
mo = months

n = number of years of operation and maintenance
NFA = No Further Action
O&M = operation and maintenance
QTY = quantity
sf = square feet
VOC = volatile organic compound

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Table 19
Remedial Alternatives Screening Summary
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Remedial Alternatives[1]	Remedial Details	Washington State Department of Ecology Evaluation Criteria/Relative Ranking (1 = Low 10 = High)						Ranking Score[2]
		Weighting Factors for Evaluation Criteria						
		20%	20%	20%	20%	20%	0%	
		Protectiveness	Permanence	Effectiveness over the Long Term	Management of Short-Term Risks	Technical and Administrative Implementability	Consideration of Public Concerns	
1. Bioremediation - Edible Oil Injection	Injection of Edible Oil Substrate to promote anaerobic biodegradation of the COCs in soil and groundwater. Cap and seal the seep.	7	8	7	6	8	N/A	**7.2**
2. Chemical Oxidation - Permanganate Injection	Injection of permanganate to oxidize the COCs in saturated soil and groundwater. Cap and seal the seep.	6	8	7	7	7	N/A	**7.0**
3. Chemical Oxidation - Recirculation System	Injection of permanganate to oxidize the COCs in saturated soil and groundwater. Cap and seal the seep.	6	8	7	8	8	N/A	**7.4**
4. Dual-Phase Extraction	Use of DPE to recover contaminated vapor and groundwater from beneath the Site. Place an asphalt cover over the treatment area to minimize surface water infiltration and short circuiting of vacuum influence. Cap and seal the seep.	7	6	6	6	7	N/A	**6.4**
5. Permeable Reactive Barrier	Installation of an iron wall barrier to treat COCs in groundwater migrating from source area.	6	4	3	7	4	N/A	**4.8**
6A. Limited Excavation with Shoring	Excavate the soil with concentrations of COCs in excess of their respective cleanup levels beneath the dry cleaner property and the adjacent ROW. Install shoring to protect adjacent ROWs during the excavation activities.	9	9	8	3	2	N/A	**6.2**
6B. Extensive Excavation with Shoring (Building Demolition)	Excavate the soil with concentrations of COCs in excess of their respective cleanup levels beneath the dry cleanup property and the adjacent ROW. Install shoring to protect adjacent ROWs during the excavation activities.	10	10	9	1	1	N/A	**6.2**

NOTES:

[1] Monitored natural attenuation of COCs is retained for all cleanup action alternatives.

[2] The ranking score for each alternative is the average of the weighted score for five of the six evaluation criteria. Consideration of Public Concerns is not included in the ranking score.

DPE = dual-phase extraction
COCs = chemicals of concern
N/A = not applicable
ROW = right-of-way

CHARTS

Chart 1
Case Study: Ballard Property
Chlorinated Compounds in Groundwater for IW01
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Draft - Issued for Ecology Review

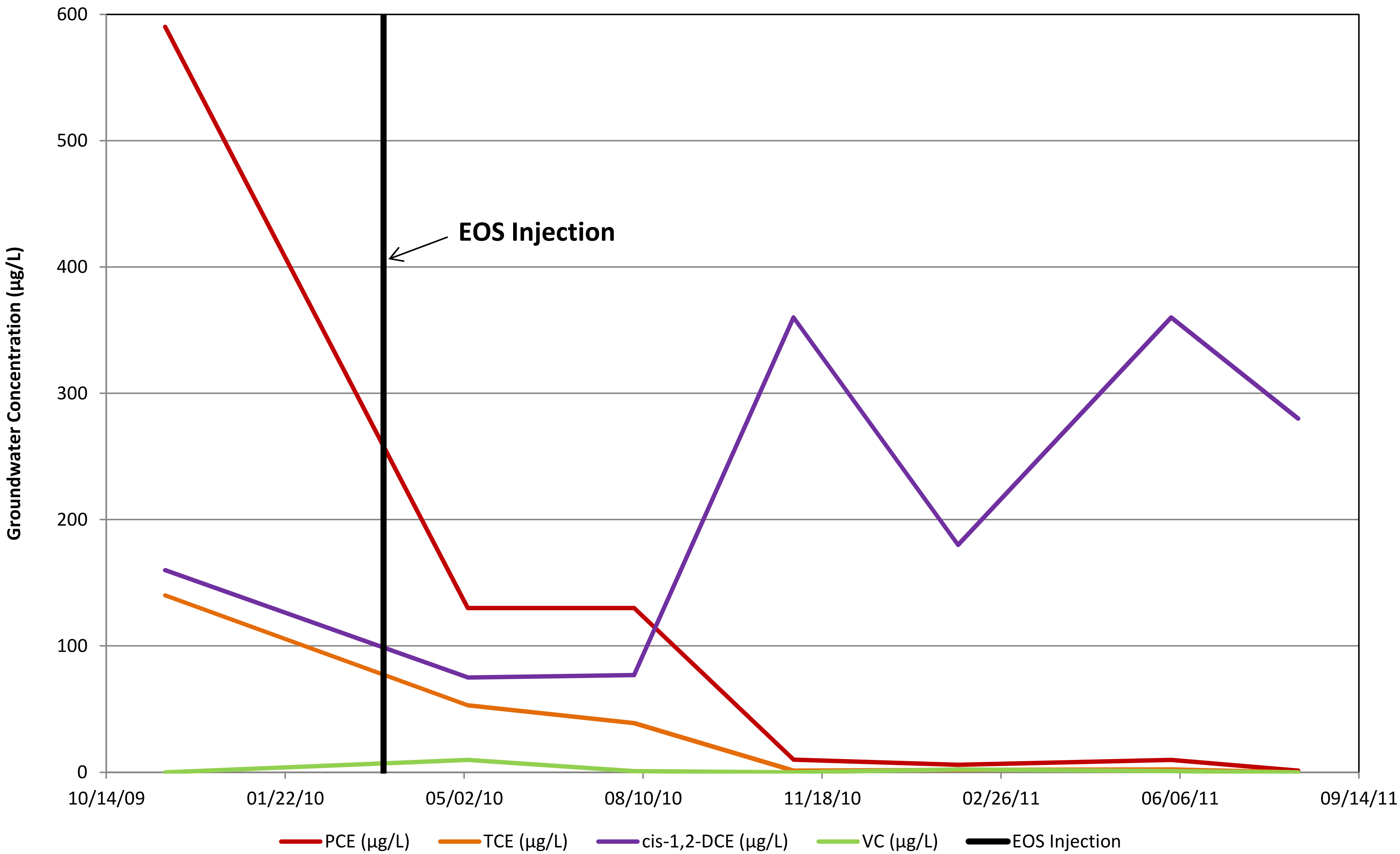

Chart 2
Case Study: Ballard Property
Chlorinated Compounds in Groundwater for IW02
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Draft - Issued for Ecology Review

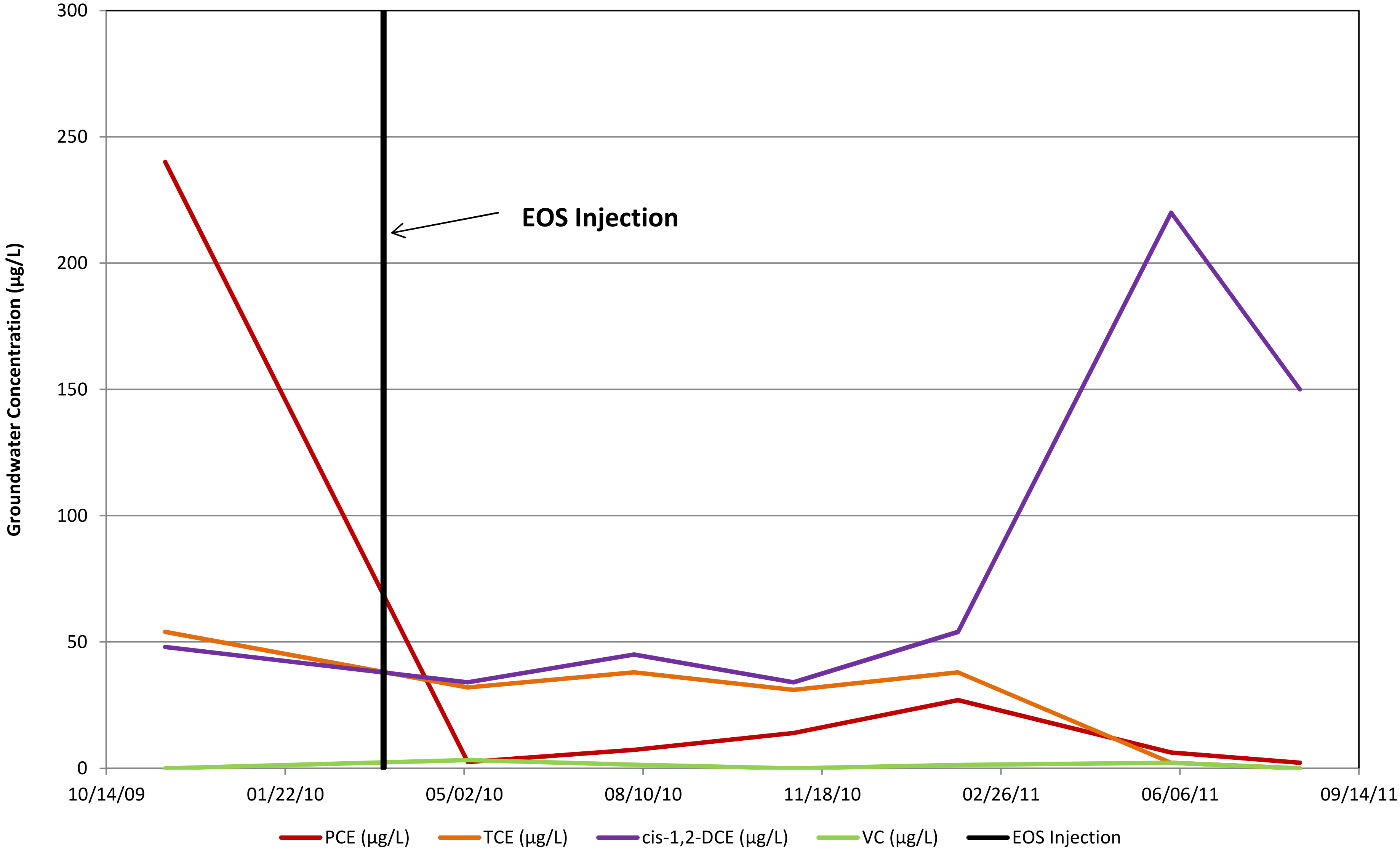

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Chart 3
Case Study: Capitol Hill Property
Chlorinated Compounds in Groundwater for MW108
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

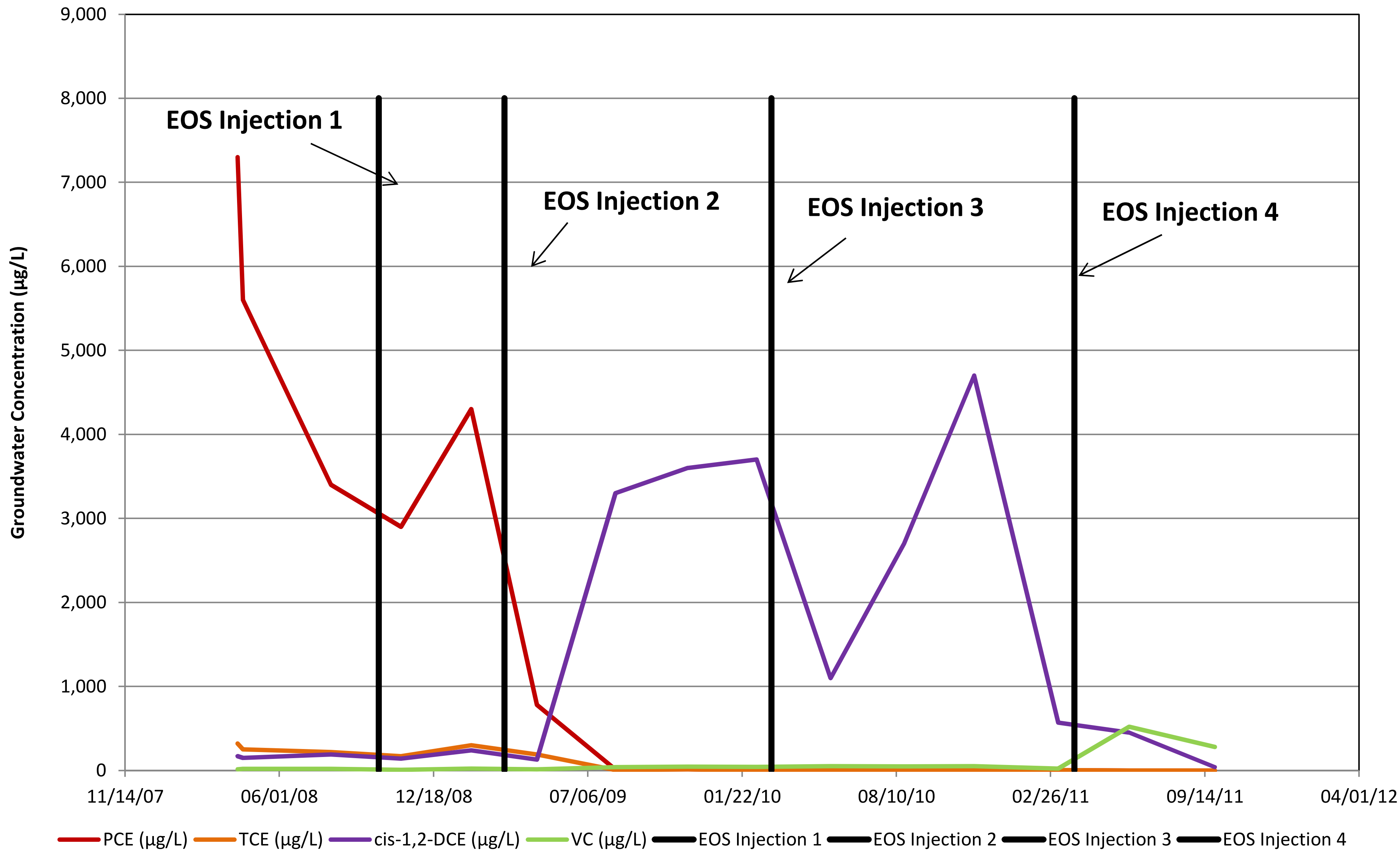

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Chart 4
Case Study: Capitol Hill Property
Chlorinated Compounds in Groundwater for KMW1
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

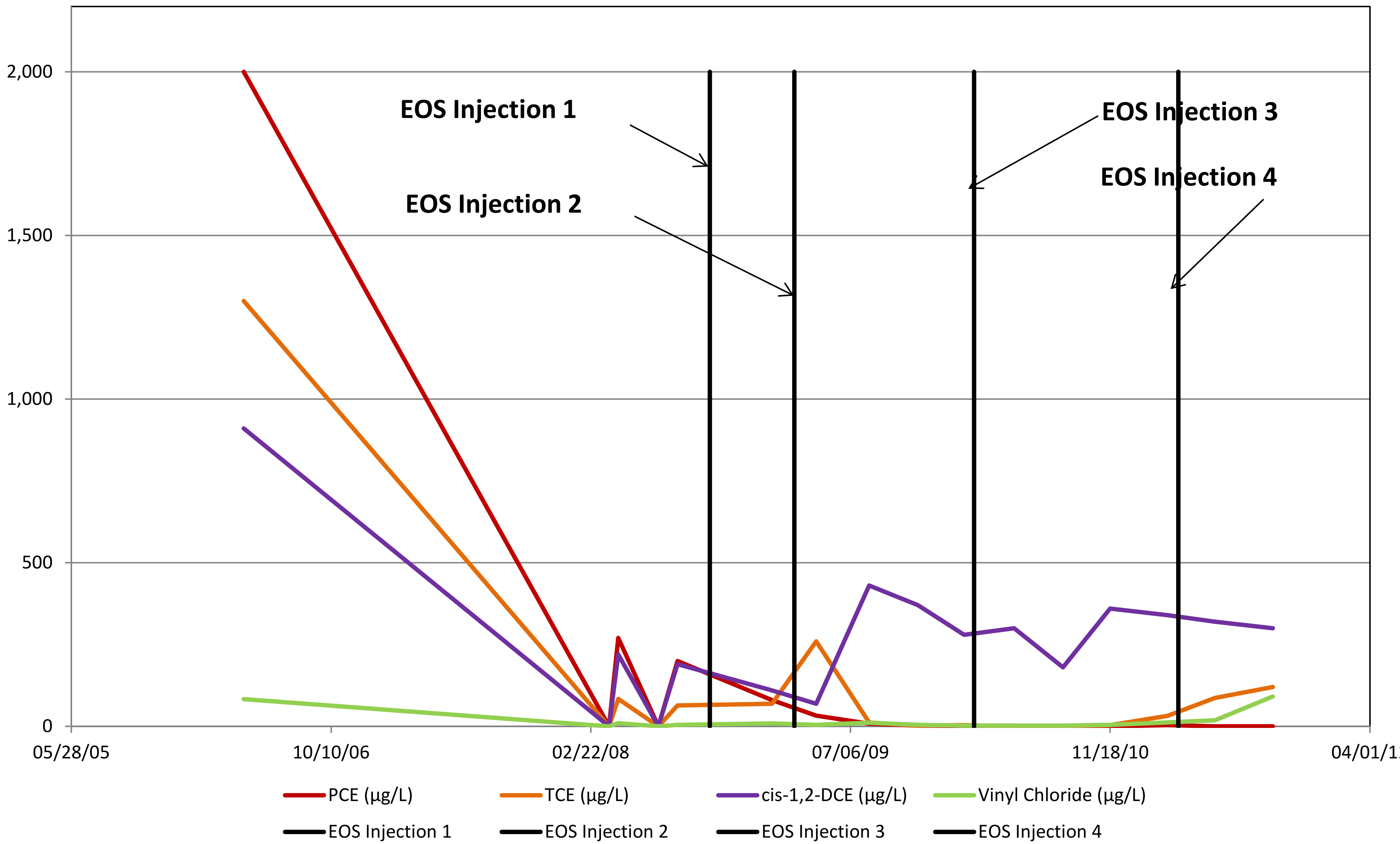


Chart 5
Cost and Relative Ranking of Cleanup Action Alternatives
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

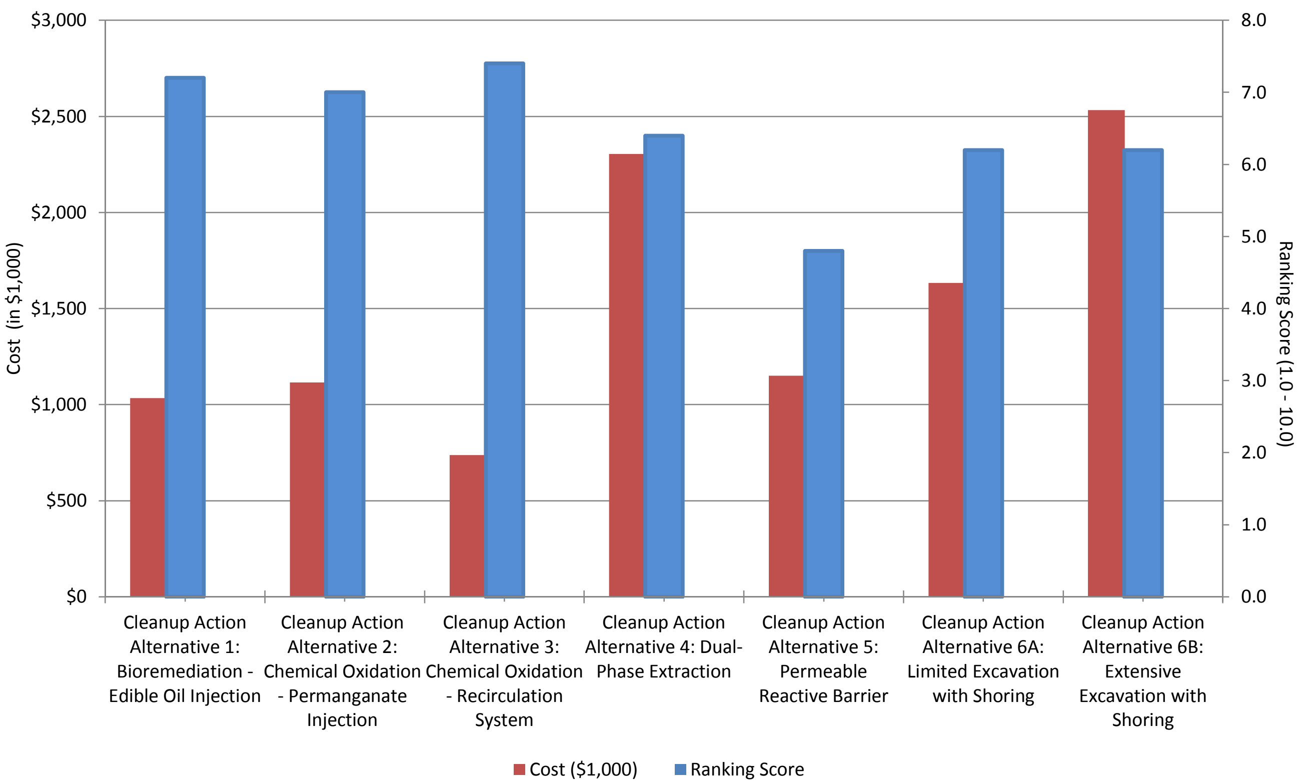
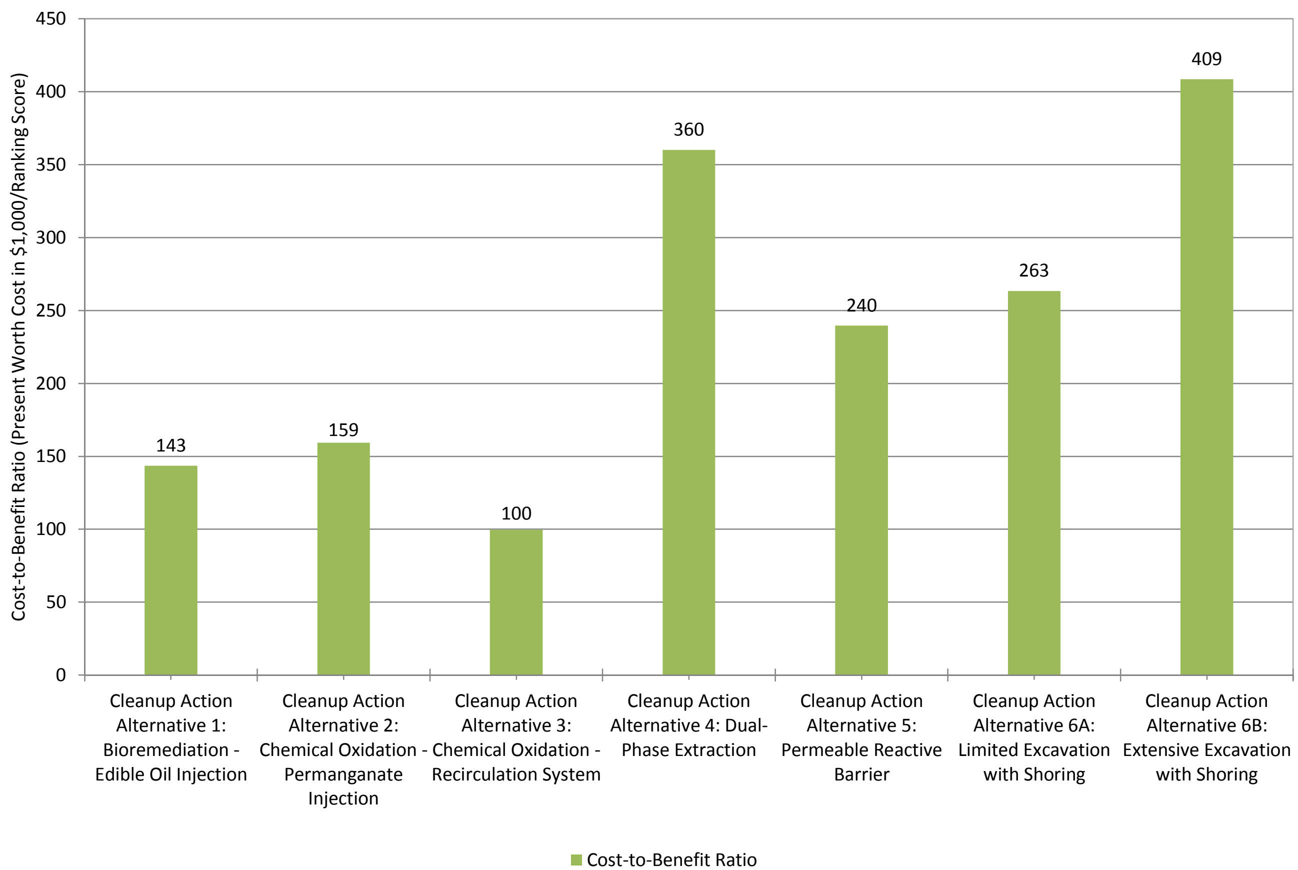


Chart 6
Cost-to-Benefit Ratio for Cleanup Action Alternatives
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington



APPENDIX A
GROUNDWATER LABORATORY ANALYTICAL REPORTS

Friedman & Bruya, Inc. #009082

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Charlene Morrow, M.S.
Yelena Aravkina, M.S.
Bradley T. Benson, B.S.
Kurt Johnson, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
TEL: (206) 285-8282
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e-mail: fbi@isomedia.com

September 21, 2010

Tim Brown, Project Manager
SoundEarth Strategies
2811 Fairview Ave. East, Suite 2000
Seattle, WA 98102

Dear Mr. Brown:

Included are the results from the testing of material submitted on September 10, 2010 from the SOU_0566-001-04_20100910, F&BI 009082 project. There are 28 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you should have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
c: Suzy Reilly
SOU0921R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on September 10, 2010 by Friedman & Bruya, Inc. from the Sound Environmental Strategies SOU_0566-001-04_20100910, F&BI 009082 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	Sound Environmental Strategies
009082-01	MW07-20100908
009082-02	MW08-20100908
009082-03	MW04-20100908
009082-04	MW13-20100908
009082-05	MW06-20100908
009082-06	MW01-20100909
009082-07	MW09-20100909
009082-08	MW03-20100909
009082-09	MW10-20100909
009082-10	MW11-20100909
009082-11	MW14-20100909
009082-12	MW12-20100909
009082-13	MW15-20100909
009082-14	MW99-20100909

Samples MW08-20100908, MW13-20100908, MW03-20100909, MW10-20100909, MW11-20100909, and MW14-20100909 were sent to Fremont for nitate, sulfate, and dissolved gasses analyses. The report is enclosed.

All quality control requirements were acceptable.

Date of Report: 09/21/10
Date Received: 09/10/10
Project: SOU_0566-001-04_20100910, F&BI 009082
Date Extracted: 09/13/10
Date Analyzed: 09/13/10 and 09/14/10

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING EPA METHOD 8021B AND NWTPH-Gx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 50-150)
MW07-20100908 009082-01	<1	<1	<1	<3	<100	129
MW08-20100908 009082-02	<1	<1	<1	<3	<100	129
MW04-20100908 009082-03	<1	<1	<1	<3	<100	129
MW13-20100908 009082-04	<1	<1	<1	<3	<100	125
MW06-20100908 009082-05	<1	<1	<1	<3	<100	125
MW01-20100909 009082-06	<1	<1	<1	<3	<100	126
MW09-20100909 009082-07	<1	<1	<1	<3	<100	127
MW03-20100909 009082-08	<1	<1	<1	<3	<100	125
MW10-20100909 009082-09	<1	<1	<1	<3	1,400	141
MW11-20100909 009082-10	<1	<1	<1	18	<100	132
MW14-20100909 009082-11	<1	<1	<1	<3	<100	124

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Date of Report: 09/21/10
Date Received: 09/10/10
Project: SOU_0566-001-04_20100910, F&BI 009082
Date Extracted: 09/13/10
Date Analyzed: 09/13/10 and 09/14/10

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES AND TPH AS GASOLINE USING EPA METHOD 8021B AND NWTPH-Gx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Benzene	Toluene	Ethyl Benzene	Total Xylenes	Gasoline Range	Surrogate (% Recovery) (Limit 50-150)
MW12-20100909 009082-12	<1	<1	<1	<3	<100	125
MW15-20100909 009082-13	<1	<1	<1	<3	<100	127
MW99-20100909 009082-14	<1	<1	<1	<3	1,500	140
Method Blank 00-1452 MB	<1	<1	<1	<3	<100	89

Date of Report: 09/21/10
Date Received: 09/10/10
Project: SOU_0566-001-04_20100910, F&BI 009082
Date Extracted: 09/15/10
Date Analyzed: 09/15/10 and 09/16/10

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL AND MOTOR OIL USING METHOD NWTPH-Dx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Diesel Range (C_{10}-C_{25})	Motor Oil Range (C_{25}-C_{36})	Surrogate (% Recovery) (Limit 50-150)
MW07-20100908 009082-01	<50	<250	82
MW08-20100908 009082-02	<50	<250	89
MW04-20100908 009082-03	<50	<250	85
MW13-20100908 009082-04	<50	<250	86
MW06-20100908 009082-05	<50	<250	94
MW01-20100909 009082-06	<50	<250	84
MW09-20100909 009082-07	<50	<250	87
MW03-20100909 009082-08	<50	<250	79
MW10-20100909 009082-09	<50	<250	84
MW11-20100909 009082-10	<50	<250	78
MW14-20100909 009082-11	<50	<250	102
MW12-20100909 009082-12	<50	<250	88

Date of Report: 09/21/10
Date Received: 09/10/10
Project: SOU_0566-001-04_20100910, F&BI 009082
Date Extracted: 09/15/10
Date Analyzed: 09/15/10 and 09/16/10

RESULTS FROM THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL AND MOTOR OIL USING METHOD NWTPH-Dx

Results Reported as ug/L (ppb)

Sample ID Laboratory ID	Diesel Range (C_{10}-C_{25})	Motor Oil Range (C_{25}-C_{36})	Surrogate (% Recovery) (Limit 50-150)
MW15-20100909 009082-13	<50	<250	93
MW99-20100909 009082-14	<50	<250	86
Method Blank 00-1450 MB	<50	<250	87

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW07-20100908	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/10/10	Lab ID:	009082-01
Date Analyzed:	09/11/10	Data File:	091027.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	103	63	127
Toluene-d8	99	60	129
4-Bromofluorobenzene	98	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	<0.2
Chloroethane	<1
1,1-Dichloroethene	<1
Methylene chloride	<5
trans-1,2-Dichloroethene	<1
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	<1
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	<1
Tetrachloroethene	<1

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW08-20100908	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/10/10	Lab ID:	009082-02
Date Analyzed:	09/11/10	Data File:	091028.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	104	63	127
Toluene-d8	100	60	129
4-Bromofluorobenzene	100	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	<0.2
Chloroethane	<1
1,1-Dichloroethene	<1
Methylene chloride	<5
trans-1,2-Dichloroethene	<1
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	<1
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	<1
Tetrachloroethene	<1

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW04-20100908	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/10/10	Lab ID:	009082-03
Date Analyzed:	09/11/10	Data File:	091029.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	105	63	127
Toluene-d8	100	60	129
4-Bromofluorobenzene	98	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	<0.2
Chloroethane	<1
1,1-Dichloroethene	<1
Methylene chloride	<5
trans-1,2-Dichloroethene	<1
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	<1
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	<1
Tetrachloroethene	<1

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW13-20100908	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/10/10	Lab ID:	009082-04
Date Analyzed:	09/11/10	Data File:	091030.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	103	63	127
Toluene-d8	99	60	129
4-Bromofluorobenzene	99	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	<0.2
Chloroethane	<1
1,1-Dichloroethene	<1
Methylene chloride	<5
trans-1,2-Dichloroethene	<1
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	<1
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	<1
Tetrachloroethene	<1

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW06-20100908	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/10/10	Lab ID:	009082-05
Date Analyzed:	09/11/10	Data File:	091031.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	105	63	127
Toluene-d8	100	60	129
4-Bromofluorobenzene	101	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	<0.2
Chloroethane	<1
1,1-Dichloroethene	<1
Methylene chloride	<5
trans-1,2-Dichloroethene	<1
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	<1
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	<1
Tetrachloroethene	<1

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW01-20100909	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/10/10	Lab ID:	009082-06
Date Analyzed:	09/11/10	Data File:	091035.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	105	63	127
Toluene-d8	100	60	129
4-Bromofluorobenzene	96	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	<0.2
Chloroethane	<1
1,1-Dichloroethene	<1
Methylene chloride	<5
trans-1,2-Dichloroethene	<1
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	<1
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	<1
Tetrachloroethene	<1

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW09-20100909	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/10/10	Lab ID:	009082-07
Date Analyzed:	09/11/10	Data File:	091036.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	107	63	127
Toluene-d8	101	60	129
4-Bromofluorobenzene	97	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	18
Chloroethane	<1
1,1-Dichloroethene	<1
Methylene chloride	<5
trans-1,2-Dichloroethene	<1
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	20
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	<1
Tetrachloroethene	<1

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW03-20100909	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/10/10	Lab ID:	009082-08
Date Analyzed:	09/11/10	Data File:	091037.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	105	63	127
Toluene-d8	101	60	129
4-Bromofluorobenzene	96	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	<0.2
Chloroethane	<1
1,1-Dichloroethene	<1
Methylene chloride	<5
trans-1,2-Dichloroethene	<1
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	<1
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	<1
Tetrachloroethene	<1

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW10-20100909	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/10/10	Lab ID:	009082-09
Date Analyzed:	09/11/10	Data File:	091038.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	104	63	127
Toluene-d8	101	60	129
4-Bromofluorobenzene	95	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	16
Chloroethane	<1
1,1-Dichloroethene	1.5
Methylene chloride	<5
trans-1,2-Dichloroethene	1.5
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	220 ve
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	510 ve
Tetrachloroethene	1,500 ve

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW10-20100909	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/13/10	Lab ID:	009082-09 1/100
Date Analyzed:	09/13/10	Data File:	091322.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	106	63	127
Toluene-d8	102	60	129
4-Bromofluorobenzene	93	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	<20
Chloroethane	<100
1,1-Dichloroethene	<100
Methylene chloride	<500
trans-1,2-Dichloroethene	<100
1,1-Dichloroethane	<100
cis-1,2-Dichloroethene	180
1,2-Dichloroethane (EDC)	<100
1,1,1-Trichloroethane	<100
Trichloroethene	500
Tetrachloroethene	3,500

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW11-20100909	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/13/10	Lab ID:	009082-10
Date Analyzed:	09/13/10	Data File:	091320.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	109	63	127
Toluene-d8	101	60	129
4-Bromofluorobenzene	91	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	<0.2
Chloroethane	<1
1,1-Dichloroethene	<1
Methylene chloride	<5
trans-1,2-Dichloroethene	<1
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	<1
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	<1
Tetrachloroethene	<1

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW14-20100909	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/13/10	Lab ID:	009082-11
Date Analyzed:	09/13/10	Data File:	091321.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	106	63	127
Toluene-d8	101	60	129
4-Bromofluorobenzene	92	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	<0.2
Chloroethane	<1
1,1-Dichloroethene	<1
Methylene chloride	<5
trans-1,2-Dichloroethene	<1
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	<1
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	<1
Tetrachloroethene	<1

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW12-20100909	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/10/10	Lab ID:	009082-12
Date Analyzed:	09/11/10	Data File:	091041.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	106	63	127
Toluene-d8	101	60	129
4-Bromofluorobenzene	99	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	<0.2
Chloroethane	<1
1,1-Dichloroethene	<1
Methylene chloride	<5
trans-1,2-Dichloroethene	<1
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	<1
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	<1
Tetrachloroethene	<1

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW15-20100909	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/10/10	Lab ID:	009082-13
Date Analyzed:	09/11/10	Data File:	091042.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	106	63	127
Toluene-d8	101	60	129
4-Bromofluorobenzene	101	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	6.2
Chloroethane	<1
1,1-Dichloroethene	<1
Methylene chloride	<5
trans-1,2-Dichloroethene	<1
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	25
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	26
Tetrachloroethene	120

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW99-20100909	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/10/10	Lab ID:	009082-14
Date Analyzed:	09/11/10	Data File:	091043.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	106	63	127
Toluene-d8	101	60	129
4-Bromofluorobenzene	97	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	17
Chloroethane	<1
1,1-Dichloroethene	1.4
Methylene chloride	<5
trans-1,2-Dichloroethene	1.6
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	250 ve
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	570 ve
Tetrachloroethene	1,400 ve

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	MW99-20100909	Client:	Sound Environmental Strategies
Date Received:	09/10/10	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/13/10	Lab ID:	009082-14 1/100
Date Analyzed:	09/13/10	Data File:	091323.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	105	63	127
Toluene-d8	100	60	129
4-Bromofluorobenzene	93	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	<20
Chloroethane	<100
1,1-Dichloroethene	<100
Methylene chloride	<500
trans-1,2-Dichloroethene	<100
1,1-Dichloroethane	<100
cis-1,2-Dichloroethene	190
1,2-Dichloroethane (EDC)	<100
1,1,1-Trichloroethane	<100
Trichloroethene	550
Tetrachloroethene	3,600

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	Method Blank	Client:	Sound Environmental Strategies
Date Received:	Not Applicable	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/10/10	Lab ID:	001439 mb
Date Analyzed:	09/10/10	Data File:	091014.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	102	63	127
Toluene-d8	99	60	129
4-Bromofluorobenzene	93	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	<0.2
Chloroethane	<1
1,1-Dichloroethene	<1
Methylene chloride	<5
trans-1,2-Dichloroethene	<1
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	<1
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	<1
Tetrachloroethene	<1

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	Method Blank	Client:	Sound Environmental Strategies
Date Received:	Not Applicable	Project:	SOU_0566-001-04_20100910, F&BI 009082
Date Extracted:	09/13/10	Lab ID:	001441 mb
Date Analyzed:	09/13/10	Data File:	091313.D
Matrix:	Water	Instrument:	GCMS4
Units:	ug/L (ppb)	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	106	63	127
Toluene-d8	100	60	129
4-Bromofluorobenzene	93	51	145

Compounds:	Concentration ug/L (ppb)
Vinyl chloride	<0.2
Chloroethane	<1
1,1-Dichloroethene	<1
Methylene chloride	<5
trans-1,2-Dichloroethene	<1
1,1-Dichloroethane	<1
cis-1,2-Dichloroethene	<1
1,2-Dichloroethane (EDC)	<1
1,1,1-Trichloroethane	<1
Trichloroethene	<1
Tetrachloroethene	<1

Date of Report: 09/21/10
Date Received: 09/10/10
Project: SOU_0566-001-04_20100910, F&BI 009082

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR BENZENE, TOLUENE, ETHYLBENZENE, XYLENES, AND TPH AS GASOLINE USING EPA METHOD 8021B AND NWTPH-Gx

Laboratory Code: 009082-05 (Duplicate)

Analyte	Reporting Units	Sample Result	Duplicate Result	Relative Percent Difference (Limit 20)
Benzene	ug/L (ppb)	<1	<1	nm
Toluene	ug/L (ppb)	<1	<1	nm
Ethylbenzene	ug/L (ppb)	<1	<1	nm
Xylenes	ug/L (ppb)	<3	<3	nm
Gasoline	ug/L (ppb)	<100	<100	nm

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Benzene	ug/L (ppb)	50	103	72-119
Toluene	ug/L (ppb)	50	110	71-113
Ethylbenzene	ug/L (ppb)	50	112	72-114
Xylenes	ug/L (ppb)	150	109	72-113
Gasoline	ug/L (ppb)	1,000	99	70-119

Date of Report: 09/21/10
Date Received: 09/10/10
Project: SOU_0566-001-04_20100910, F&BI 009082

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL EXTENDED USING METHOD NWTPH-Dx

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Diesel Extended	ug/L (ppb)	2,500	88	95	63-142	8

Date of Report: 09/21/10
Date Received: 09/10/10
Project: SOU_0566-001-04_20100910, F&BI 009082

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR VOLATILES BY EPA METHOD 8260C

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Vinyl chloride	ug/L (ppb)	50	110	110	50-154	0
Chloroethane	ug/L (ppb)	50	122	123	58-146	1
1,1-Dichloroethene	ug/L (ppb)	50	100	100	67-136	0
Methylene chloride	ug/L (ppb)	50	97	100	39-148	3
trans-1,2-Dichloroethene	ug/L (ppb)	50	103	101	68-128	2
1,1-Dichloroethane	ug/L (ppb)	50	98	96	79-121	2
cis-1,2-Dichloroethene	ug/L (ppb)	50	104	102	80-123	2
1,2-Dichloroethane (EDC)	ug/L (ppb)	50	99	97	73-132	2
1,1,1-Trichloroethane	ug/L (ppb)	50	101	101	83-130	0
Trichloroethene	ug/L (ppb)	50	106	104	80-120	2
Tetrachloroethene	ug/L (ppb)	50	112	110	76-121	2

Date of Report: 09/21/10
Date Received: 09/10/10
Project: SOU_0566-001-04_20100910, F&BI 009082

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF WATER SAMPLES FOR VOLATILES BY EPA METHOD 8260C

Laboratory Code: 009061-01 (Matrix Spike)

Analyte	Reporting Units	Spike Level	Sample Result	Percent Recovery MS	Acceptance Criteria
Vinyl chloride	ug/L (ppb)	50	<0.2	104	36-166
Chloroethane	ug/L (ppb)	50	<1	127	46-160
1,1-Dichloroethene	ug/L (ppb)	50	<1	104	60-136
Methylene chloride	ug/L (ppb)	50	<5	102	67-132
trans-1,2-Dichloroethene	ug/L (ppb)	50	<1	105	72-129
1,1-Dichloroethane	ug/L (ppb)	50	<1	101	70-128
cis-1,2-Dichloroethene	ug/L (ppb)	50	<1	103	71-127
1,2-Dichloroethane (EDC)	ug/L (ppb)	50	<1	108	69-133
1,1,1-Trichloroethane	ug/L (ppb)	50	<1	108	60-146
Trichloroethene	ug/L (ppb)	50	<1	106	66-135
Tetrachloroethene	ug/L (ppb)	50	<1	106	73-129

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Vinyl chloride	ug/L (ppb)	50	106	109	50-154	3
Chloroethane	ug/L (ppb)	50	117	121	58-146	3
1,1-Dichloroethene	ug/L (ppb)	50	107	106	67-136	1
Methylene chloride	ug/L (ppb)	50	117	117	39-148	0
trans-1,2-Dichloroethene	ug/L (ppb)	50	107	106	68-128	1
1,1-Dichloroethane	ug/L (ppb)	50	101	101	79-121	0
cis-1,2-Dichloroethene	ug/L (ppb)	50	104	104	80-123	0
1,2-Dichloroethane (EDC)	ug/L (ppb)	50	105	104	73-132	1
1,1,1-Trichloroethane	ug/L (ppb)	50	108	107	83-130	1
Trichloroethene	ug/L (ppb)	50	108	108	80-120	0
Tetrachloroethene	ug/L (ppb)	50	109	109	76-121	0

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

A1 – More than one compound of similar molecule structure was identified with equal probability.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for this range fell outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte indicated may be due to carryover from previous sample injections.

d - The sample was diluted. Detection limits may be raised due to dilution.

ds - The sample was diluted. Detection limits are raised due to dilution and surrogate recoveries may not be meaningful.

dv - Insufficient sample was available to achieve normal reporting limits and limits are raised accordingly.

fb - Analyte present in the blank and the sample.

fc – The compound is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. The variability is attributed to sample inhomogeneity.

ht - Analysis performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of normal control limits. Compounds in the sample matrix interfered with the quantitation of the analyte.

j – The result is below normal reporting limits. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The analyte result in the laboratory control sample is out of control limits. The reported concentration should be considered an estimate.

jr - The rpd result in laboratory control sample associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the compound indicated is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

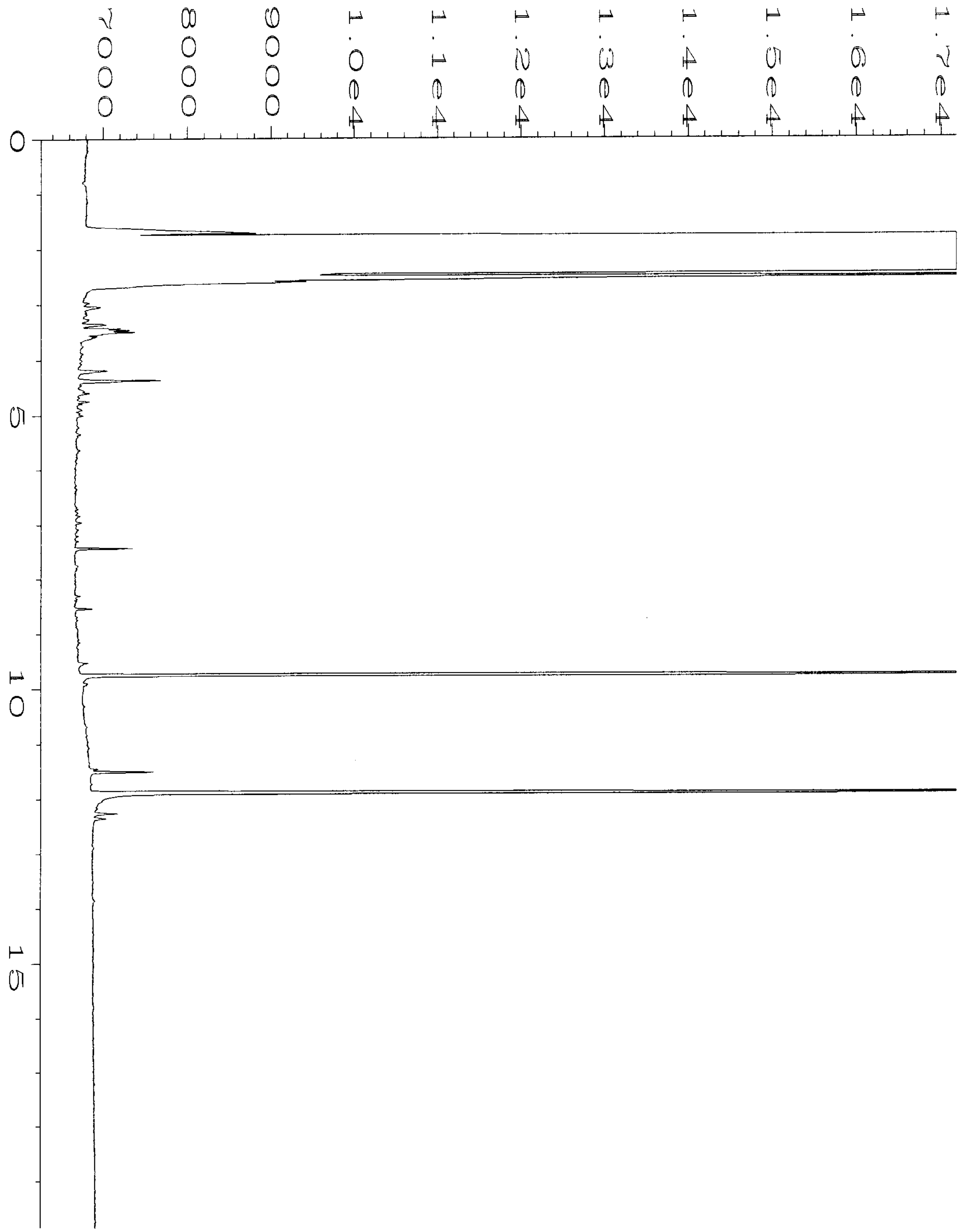
pc – The sample was received in a container not approved by the method. The value reported should be considered an estimate.

pr – The sample was received with incorrect preservation. The value reported should be considered an estimate.

ve - Estimated concentration calculated for an analyte response above the valid instrument calibration range. A dilution is required to obtain an accurate quantification of the analyte.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.



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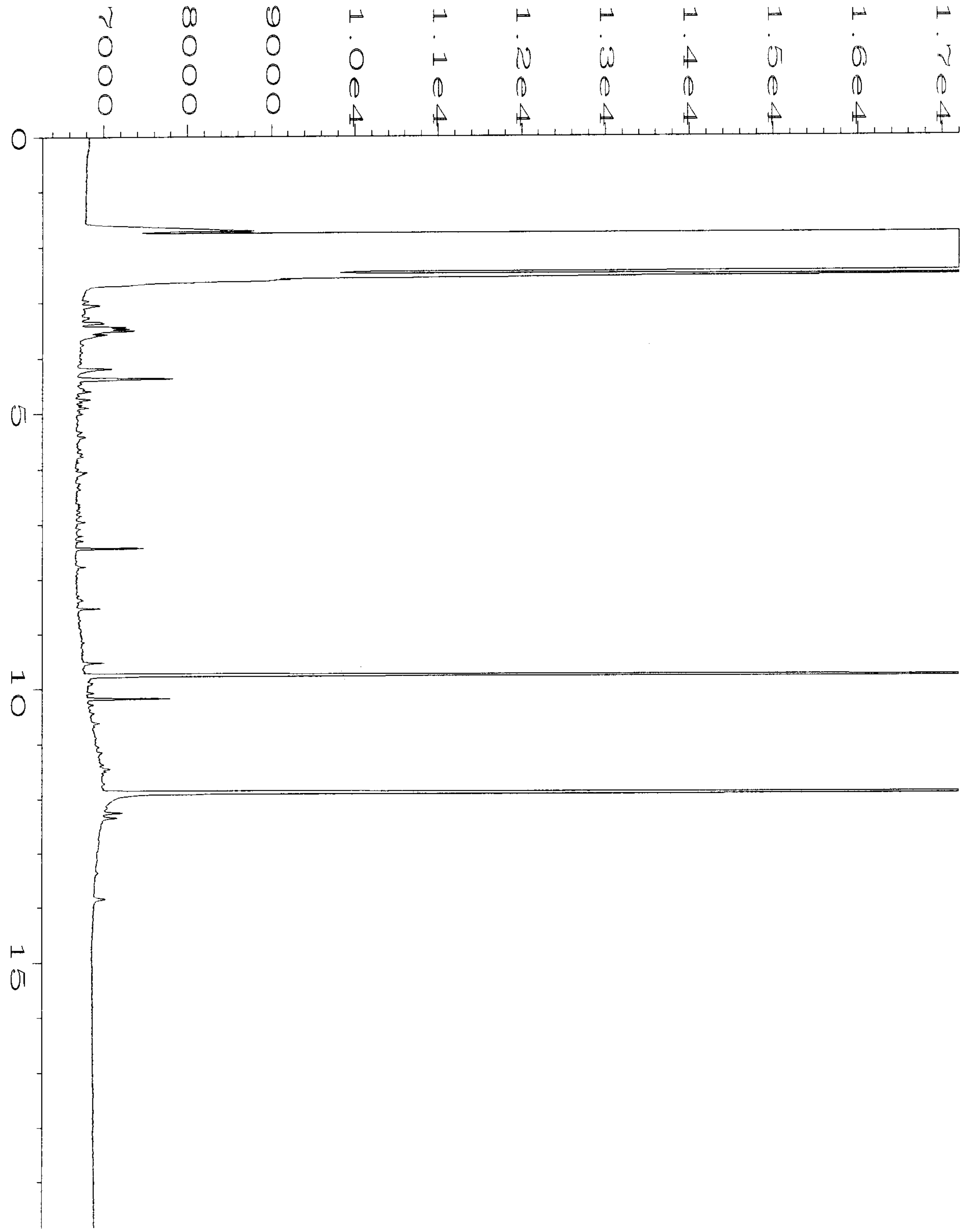
Operator	: ML	Page Number	: 1
Instrument	: GC1	Vial Number	: 32
Sample Name	: 009082-01	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 14
Acquired on	: 15 Sep 10 06:35 PM	Instrument Method	: TPHD.MTH
Report Created on	: 16 Sep 10 10:19 AM	Analysis Method	: TPHD.MTH



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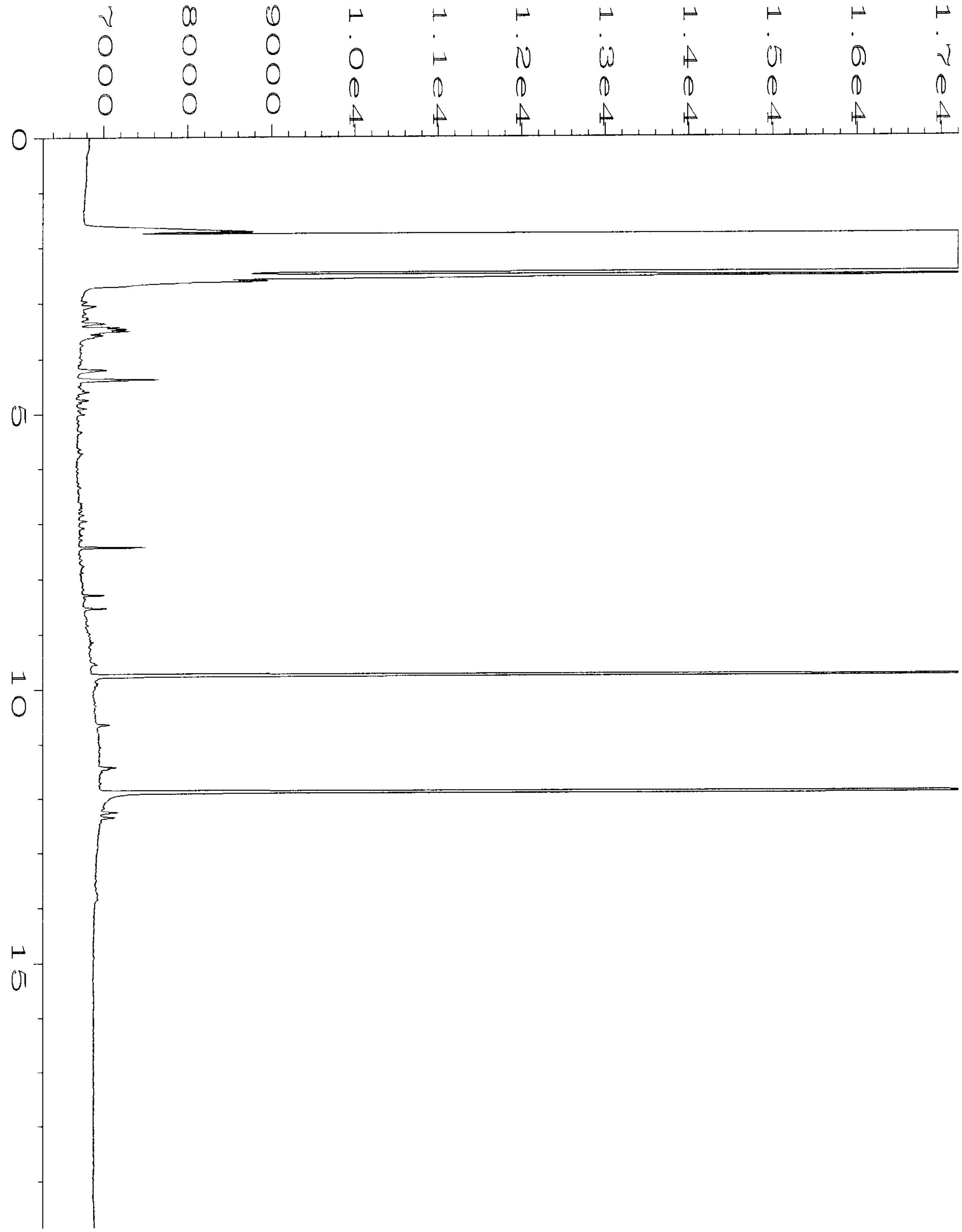
Operator	: ML		Page Number	: 1
Instrument	: GC1		Vial Number	: 33
Sample Name	: 009082-02		Injection Number	: 1
Run Time Bar Code:			Sequence Line	: 14
Acquired on	: 15 Sep 10	07:02 PM	Instrument Method:	TPHD.MTH
Report Created on:	16 Sep 10	10:19 AM	Analysis Method	: TPHD.MTH



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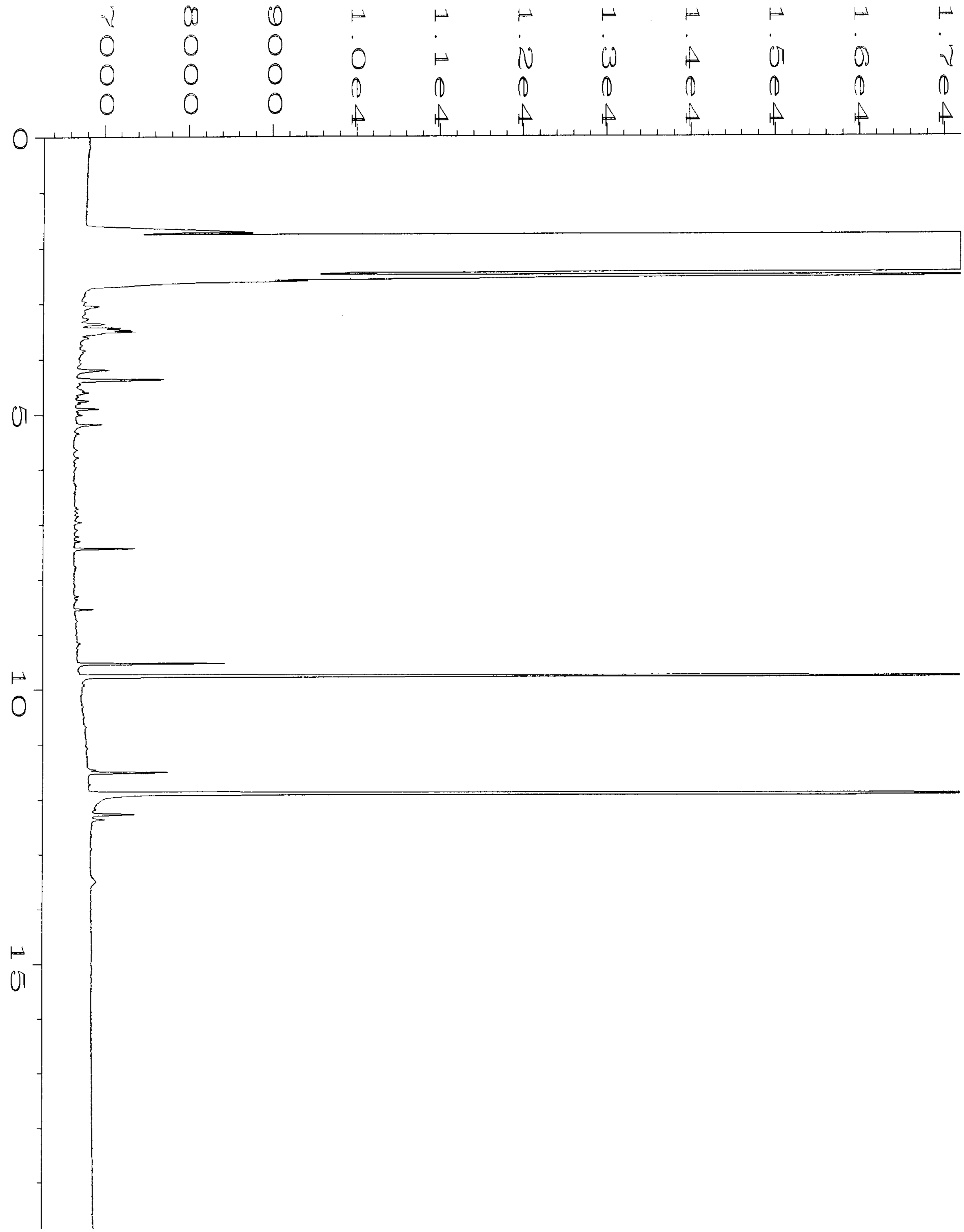
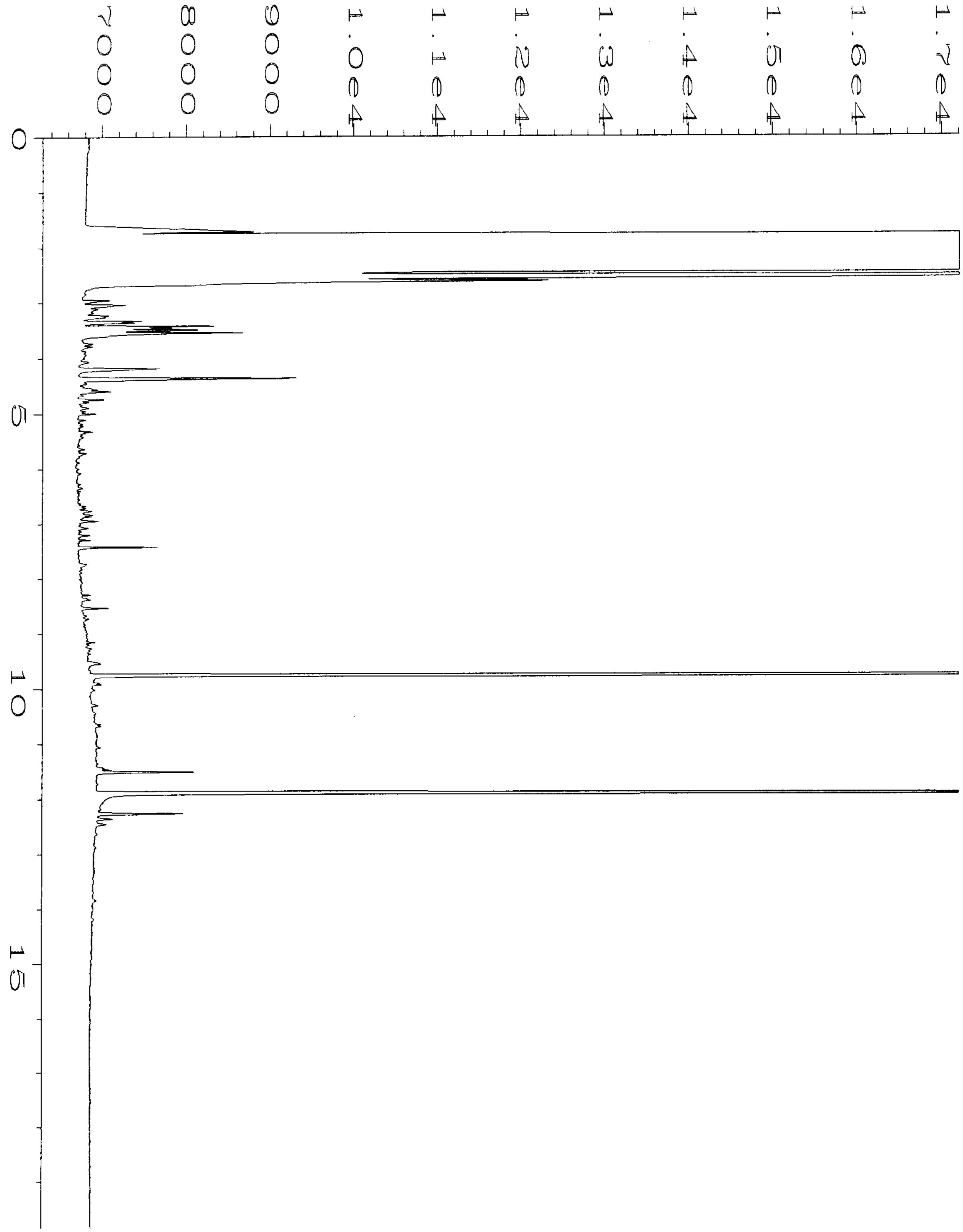
Operator : ML
Instrument : GC1
Sample Name : 009082-03
Run Time Bar Code:
Acquired on : 15 Sep 10 07:29 PM
Report Created on: 16 Sep 10 10:19 AM

Page Number : 1
Vial Number : 34
Injection Number : 1
Sequence Line : 14
Instrument Method: TPHD.MTH
Analysis Method : TPHD.MTH

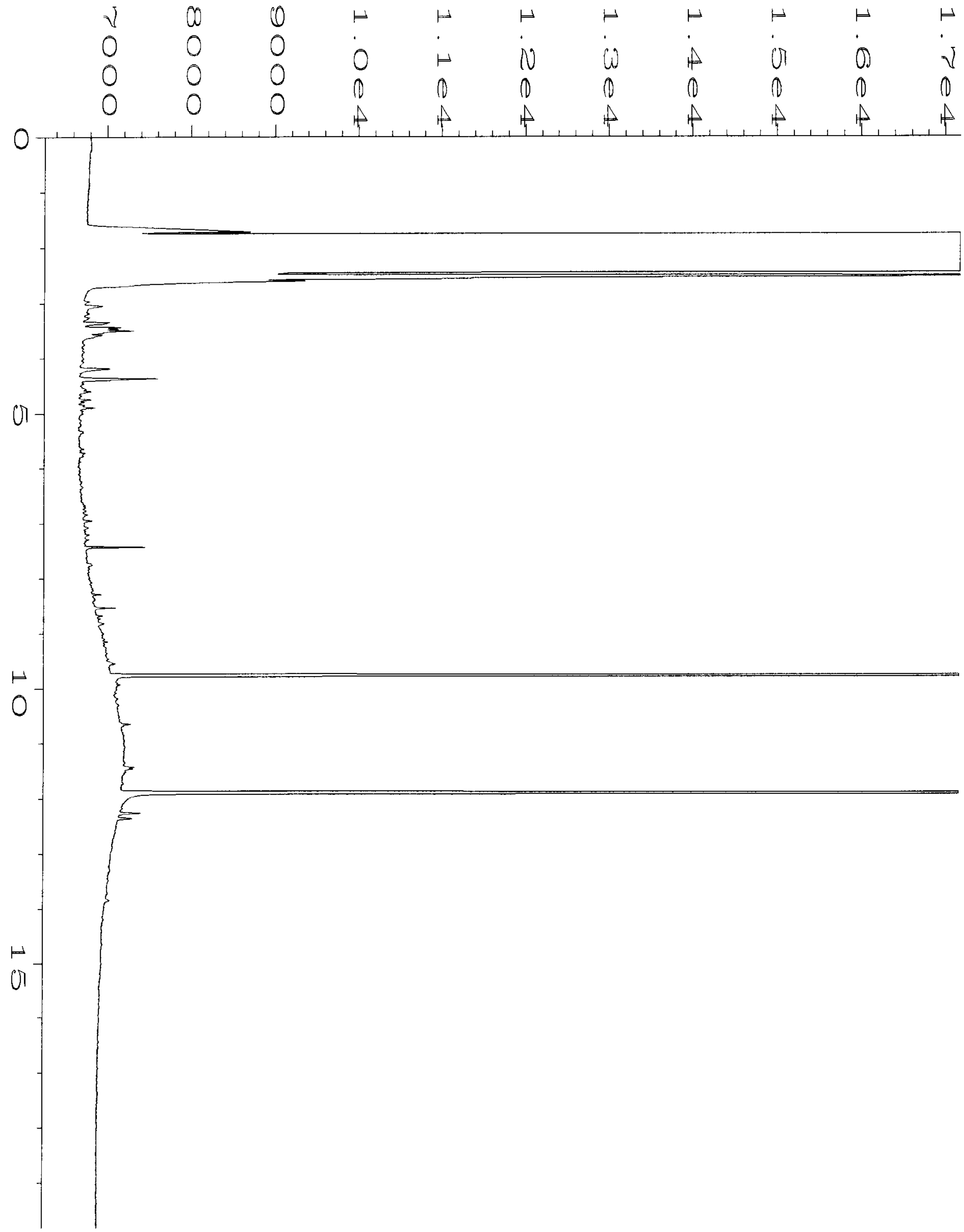


Data File Name : C:\HPCHEM\1\DATA\09-14-10\035F1401.D
Operator : ML
Instrument : GC1
Sample Name : 009082-04
Run Time Bar Code:
Acquired on : 15 Sep 10 07:55 PM
Report Created on: 16 Sep 10 10:19 AM

Page Number : 1
Vial Number : 35
Injection Number : 1
Sequence Line : 14
Instrument Method: TPHD.MTH
Analysis Method : TPHD.MTH



Data File Name	: C:\HPCHEM\1\DATA\09-14-10\036F1401.D		
Operator	: ML	Page Number	: 1
Instrument	: GC1	Vial Number	: 36
Sample Name	: 009082-05	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 14
Acquired on	: 15 Sep 10 08:22 PM	Instrument Method:	TPHD.MTH
Report Created on:	16 Sep 10 10:19 AM	Analysis Method	: TPHD.MTH



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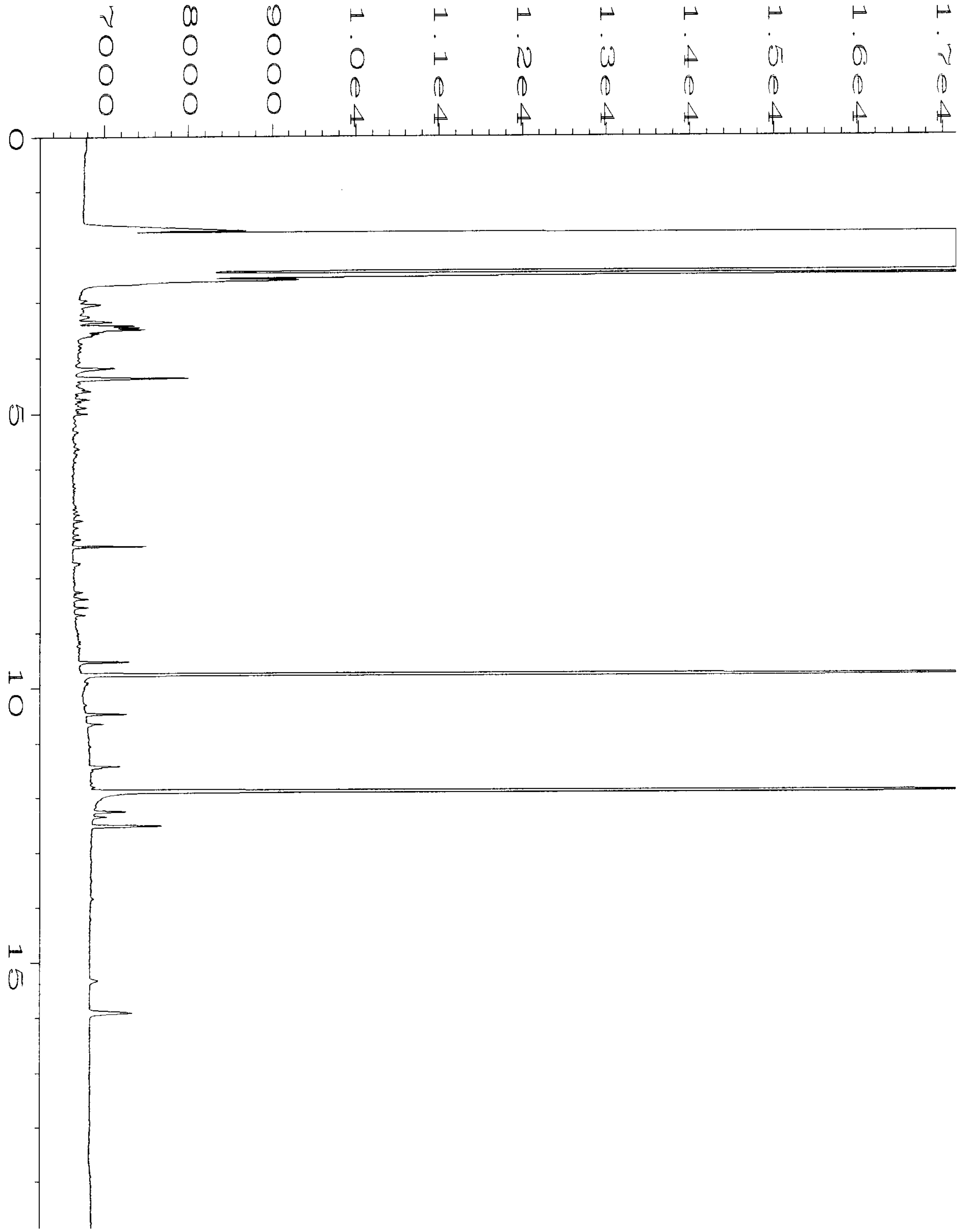
Operator : ML
Instrument : GC1
Sample Name : 009082-06
Run Time Bar Code:
Acquired on : 15 Sep 10 08:49 PM
Report Created on: 16 Sep 10 10:20 AM

Page Number : 1
Vial Number : 37
Injection Number : 1
Sequence Line : 14
Instrument Method: TPHD.MTH
Analysis Method : TPHD.MTH



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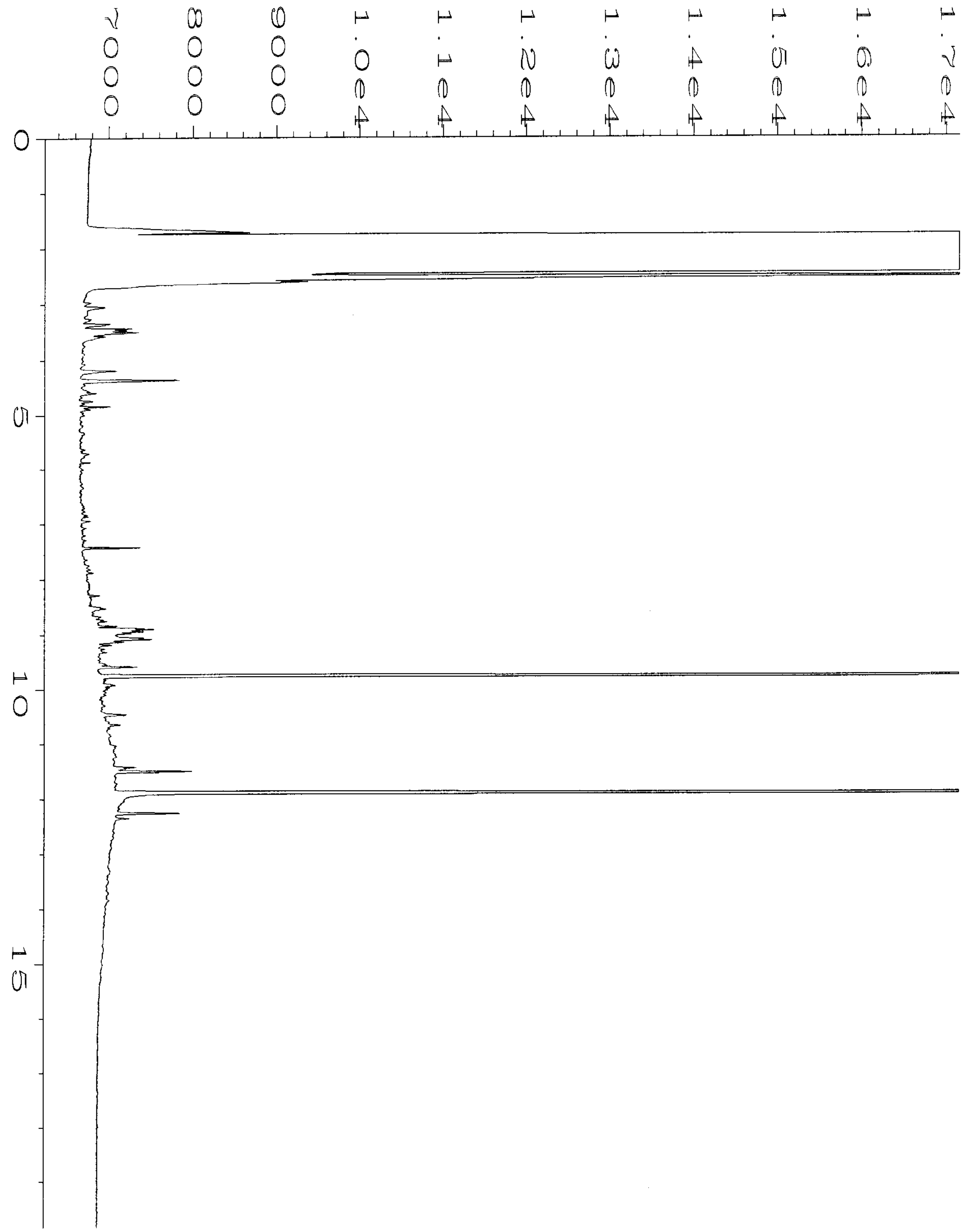
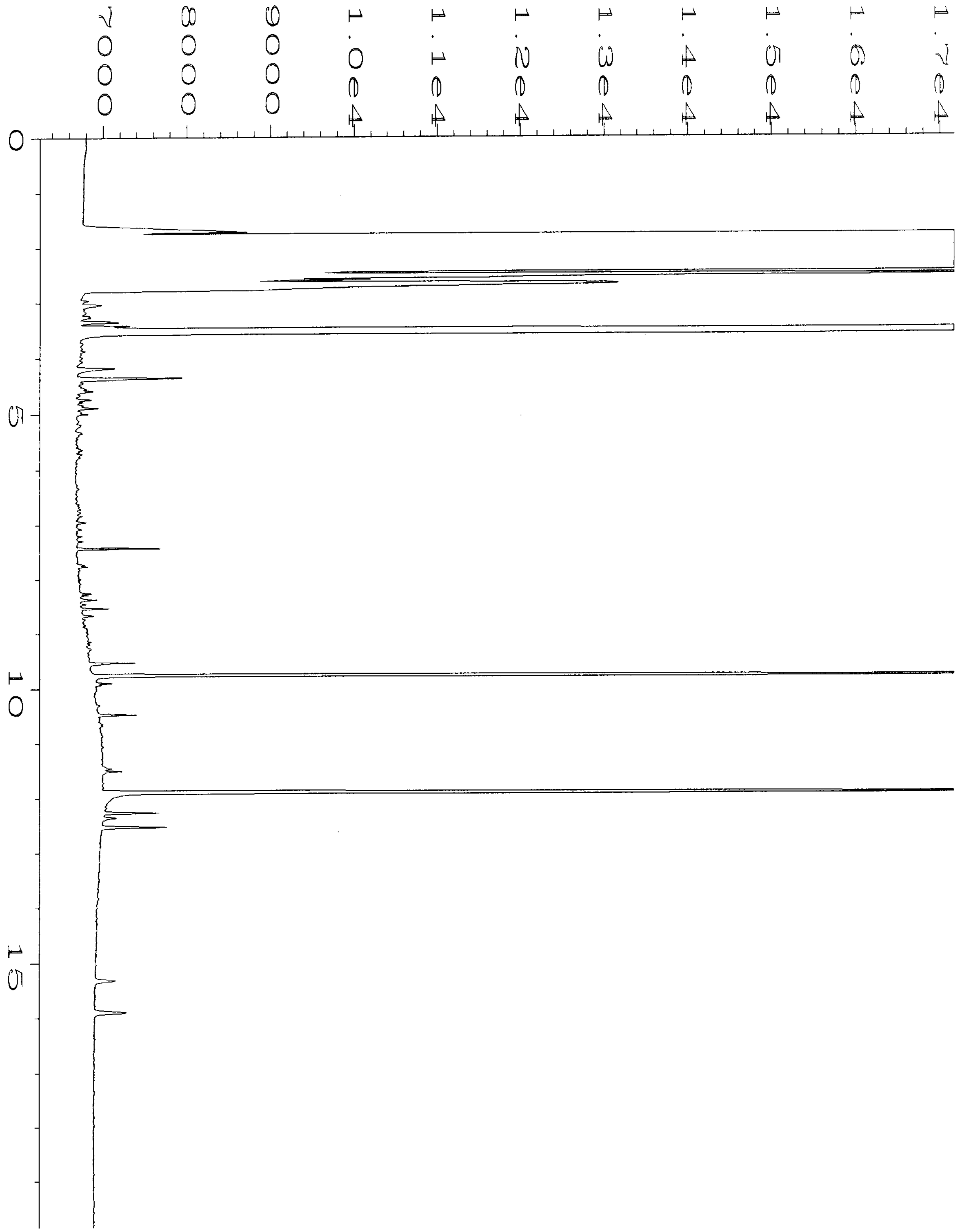
Operator : ML
Instrument : GC1
Sample Name : 009082-07
Run Time Bar Code:
Acquired on : 15 Sep 10 09:15 PM
Report Created on: 16 Sep 10 10:20 AM

Page Number : 1
Vial Number : 38
Injection Number : 1
Sequence Line : 14
Instrument Method: TPHD.MTH
Analysis Method : TPHD.MTH



Data File Name : C:\HPCHEM\1\DATA\09-14-10\039F1401.D

Operator	: ML	Page Number	: 1
Instrument	: GC1	Vial Number	: 39
Sample Name	: 009082-08	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 14
Acquired on	: 15 Sep 10 09:42 PM	Instrument Method:	TPHD.MTH
Report Created on:	16 Sep 10 10:20 AM	Analysis Method	: TPHD.MTH



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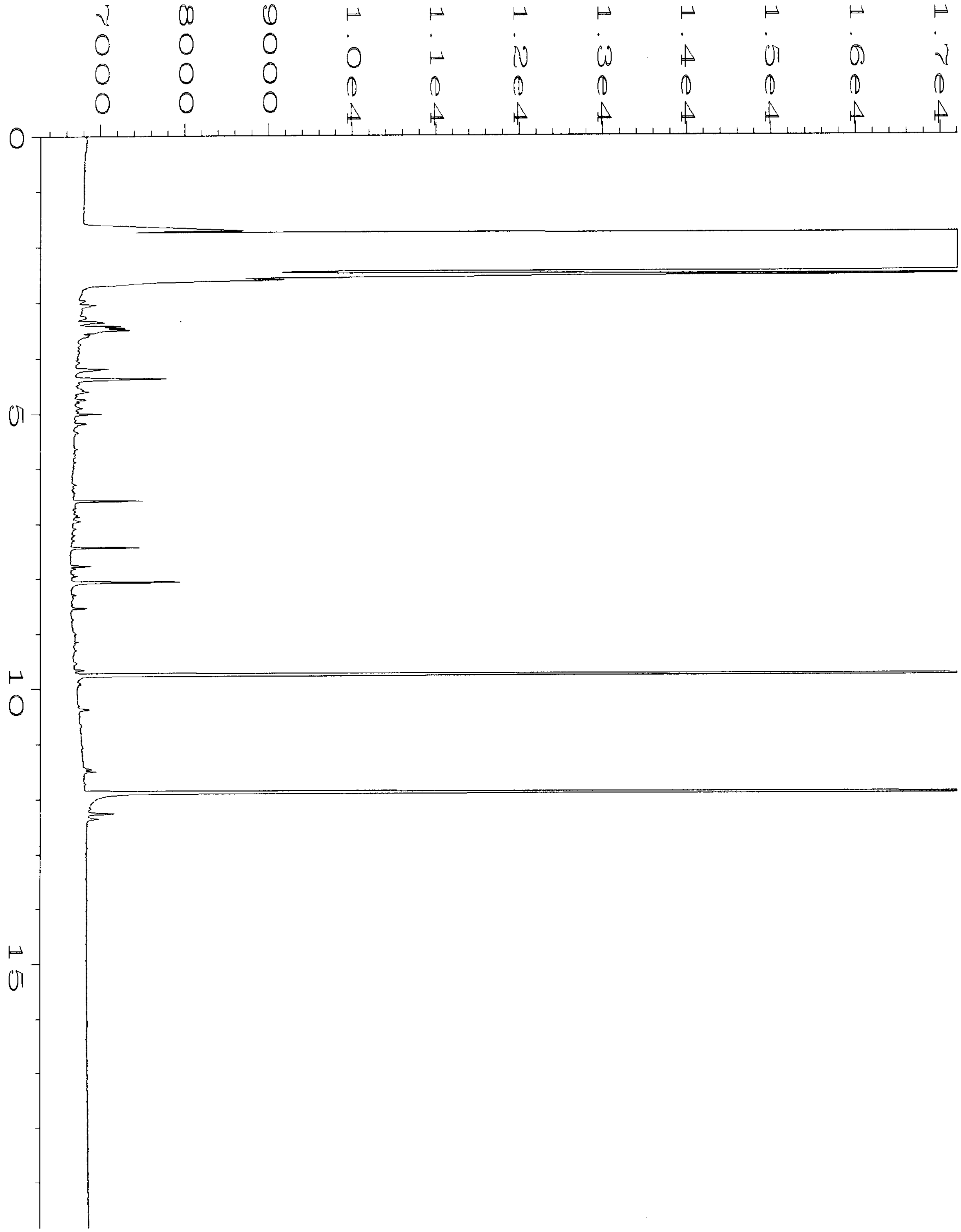
Operator	: ML	Page Number	: 1
Instrument	: GC1	Vial Number	: 40
Sample Name	: 009082-09	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 14
Acquired on	: 15 Sep 10 10:09 PM	Instrument Method:	TPHD.MTH
Report Created on:	16 Sep 10 10:20 AM	Analysis Method	: TPHD.MTH

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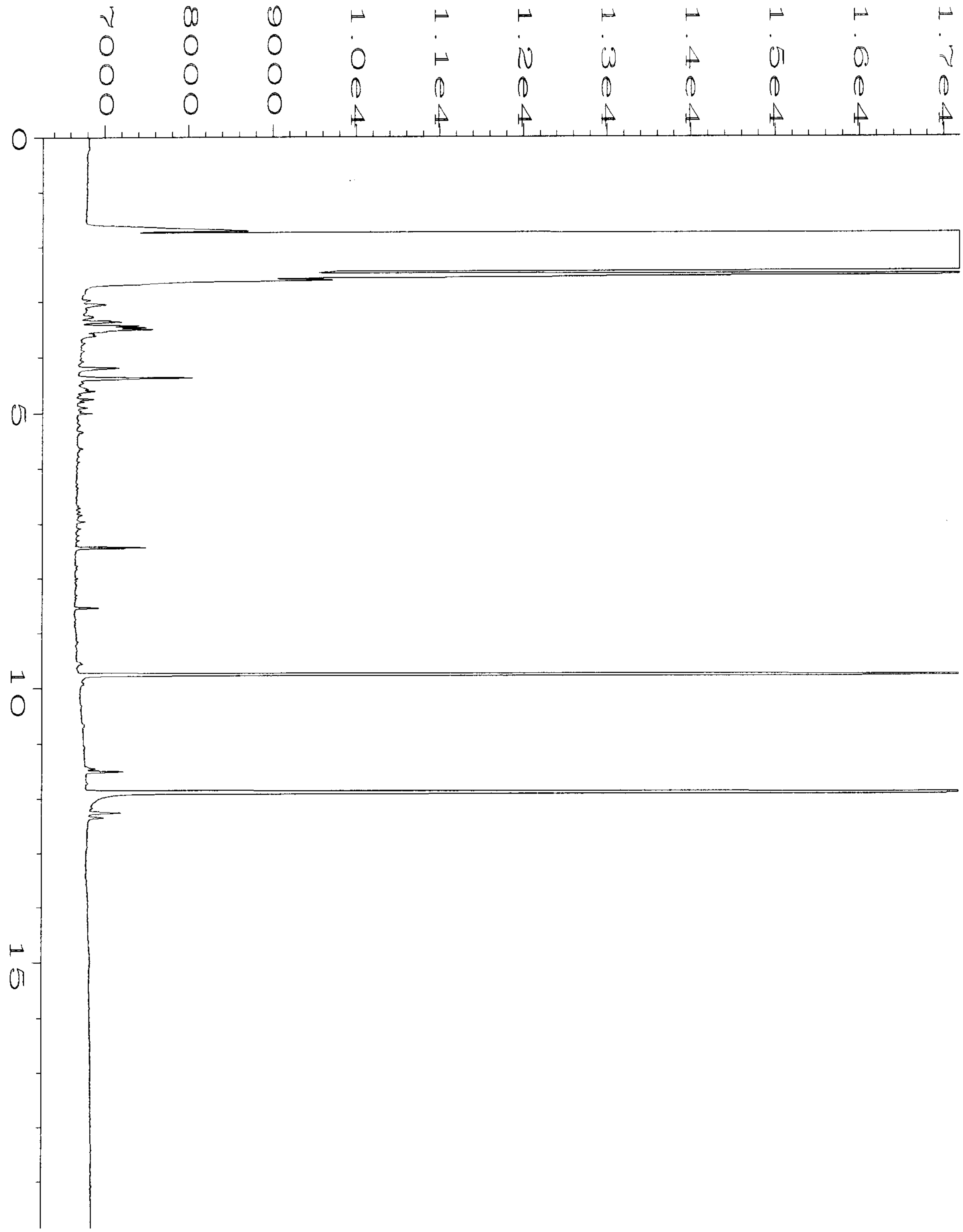
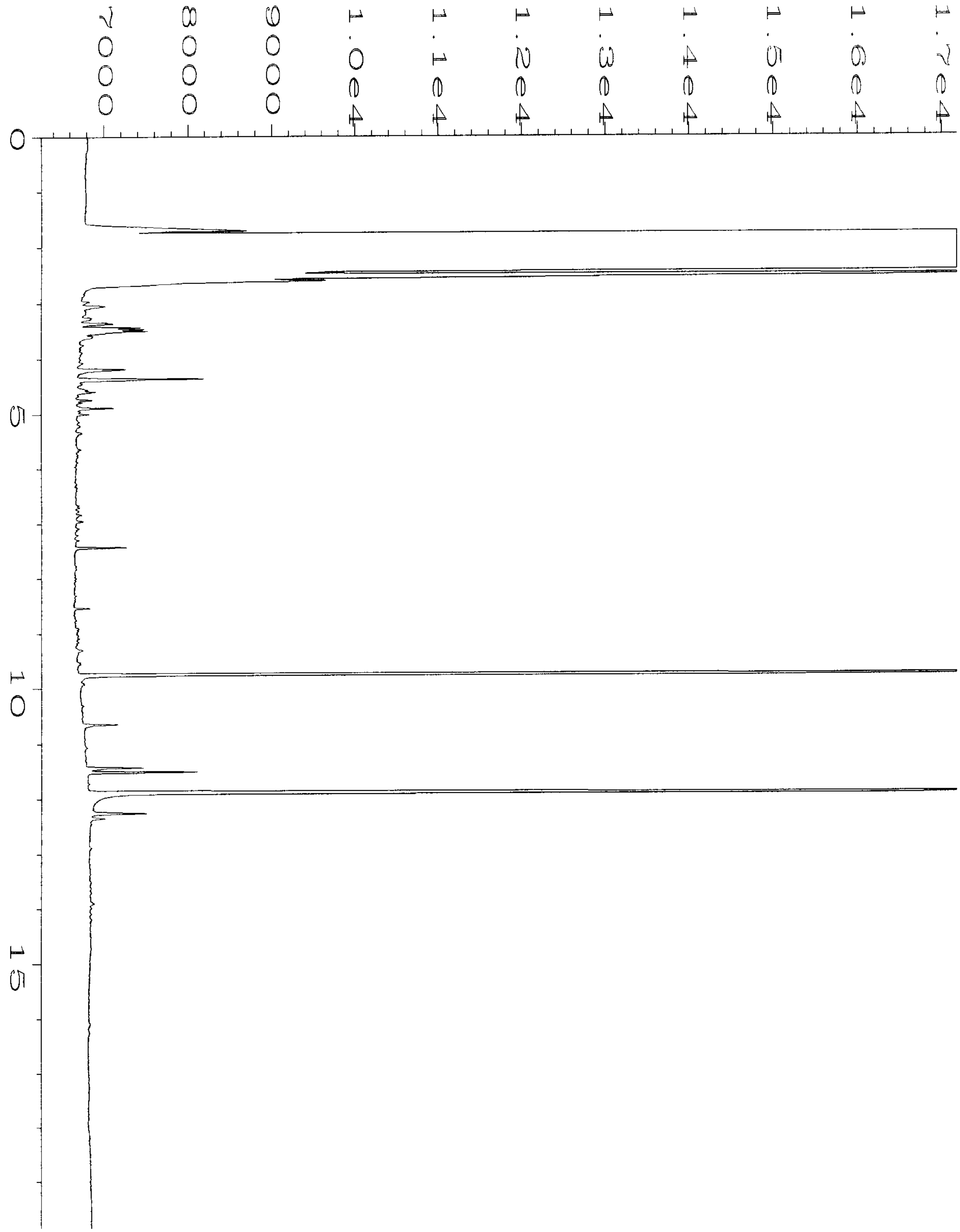
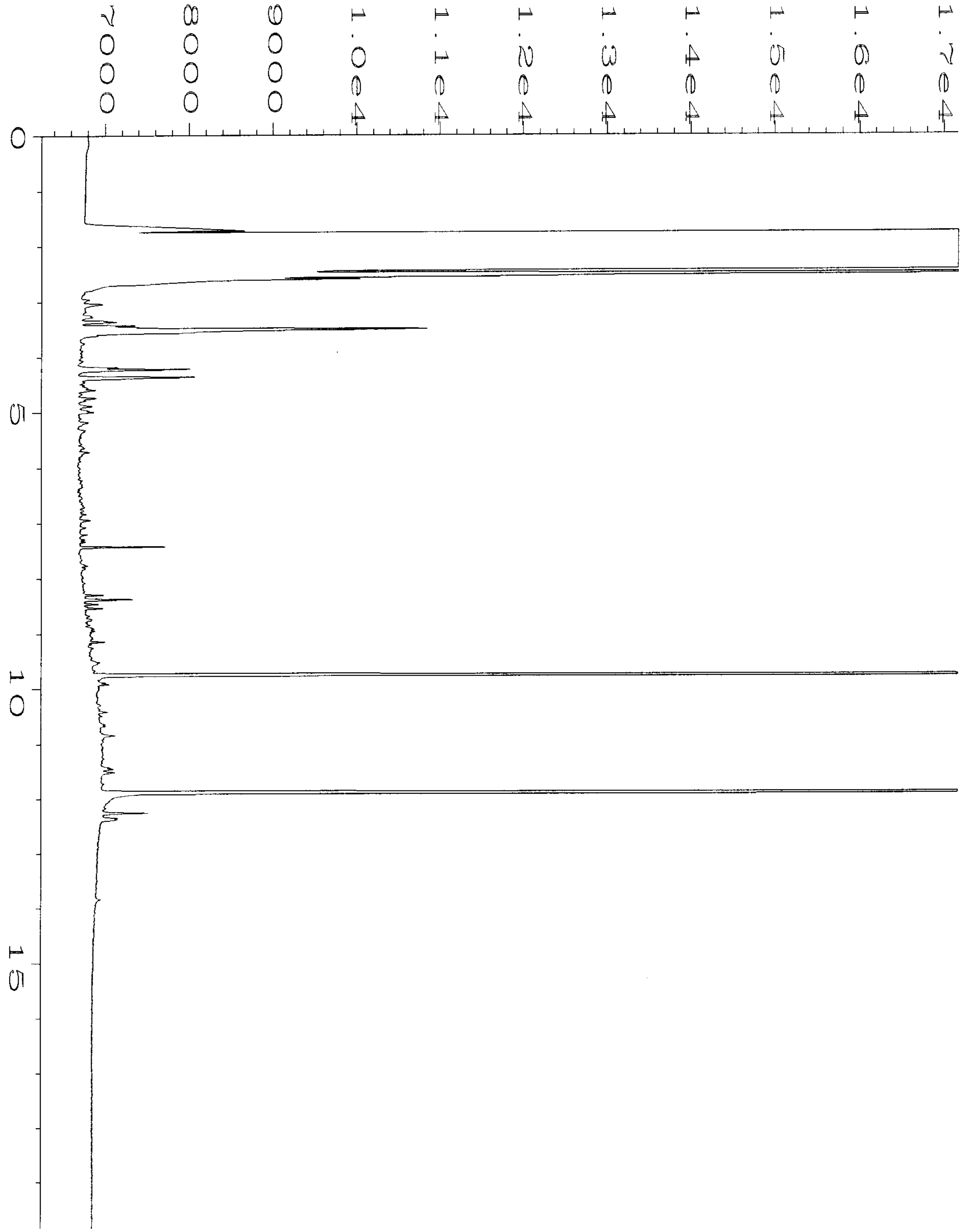
Operator          : ML                                Page Number       : 1
Instrument        : GC1                               Vial Number       : 41
Sample Name       : 009082-10                         Injection Number  : 1
Run Time Bar Code:                                    Sequence Line     : 16
Acquired on       : 15 Sep 10   11:29 PM              Instrument Method: TPHD.MTH
Report Created on: 16 Sep 10   10:20 AM               Analysis Method  : TPHD.MTH
```



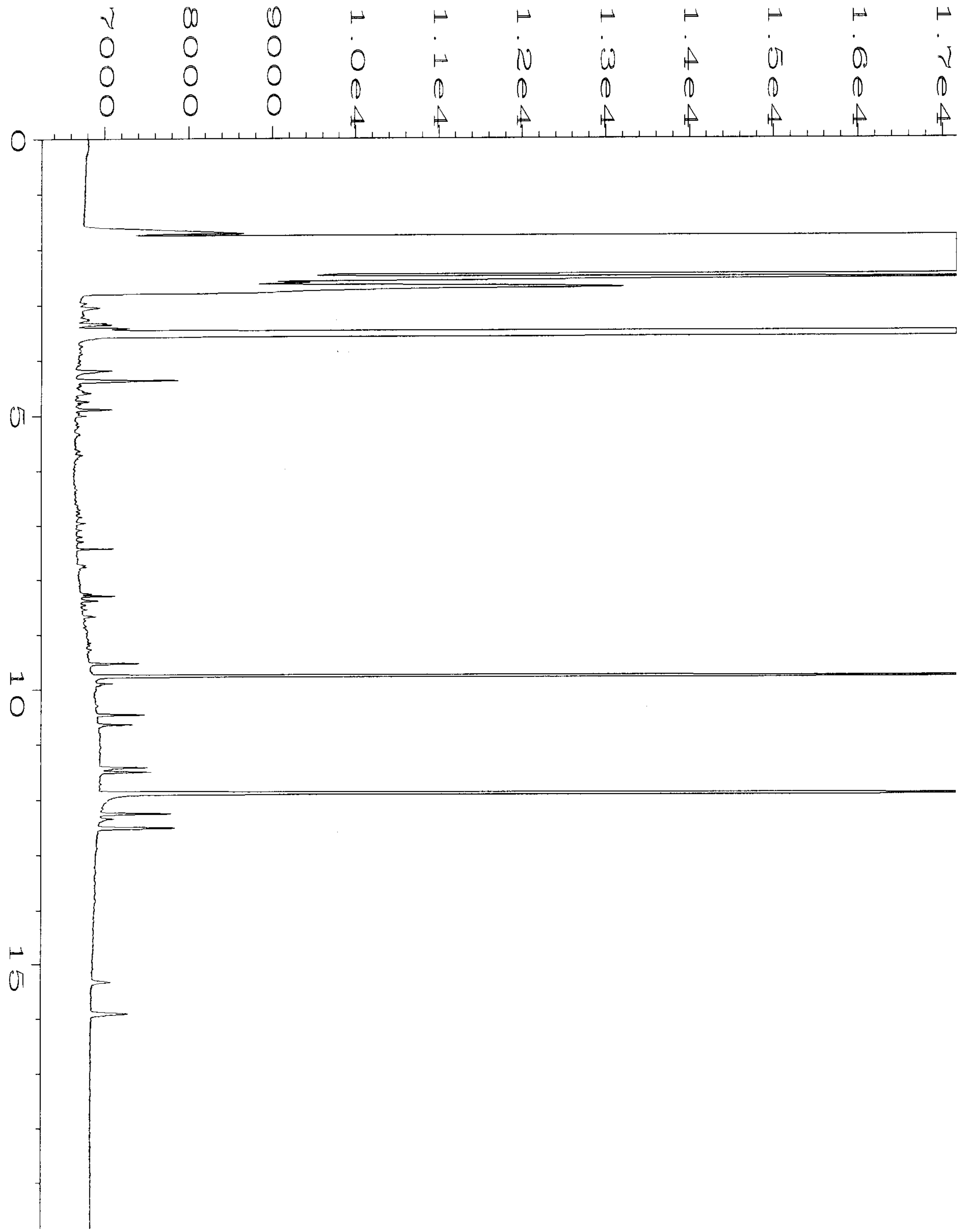
Data File Name	: C:\HPCHEM\1\DATA\09-14-10\042F1601.D			
Operator	: ML	Page Number	:	1
Instrument	: GC1	Vial Number	:	42
Sample Name	: 009082-11	Injection Number	:	1
Run Time Bar Code:		Sequence Line	:	16
Acquired on	: 15 Sep 10 11:55 PM	Instrument Method:		TPHD.MTH
Report Created on:	16 Sep 10 10:20 AM	Analysis Method	:	TPHD.MTH



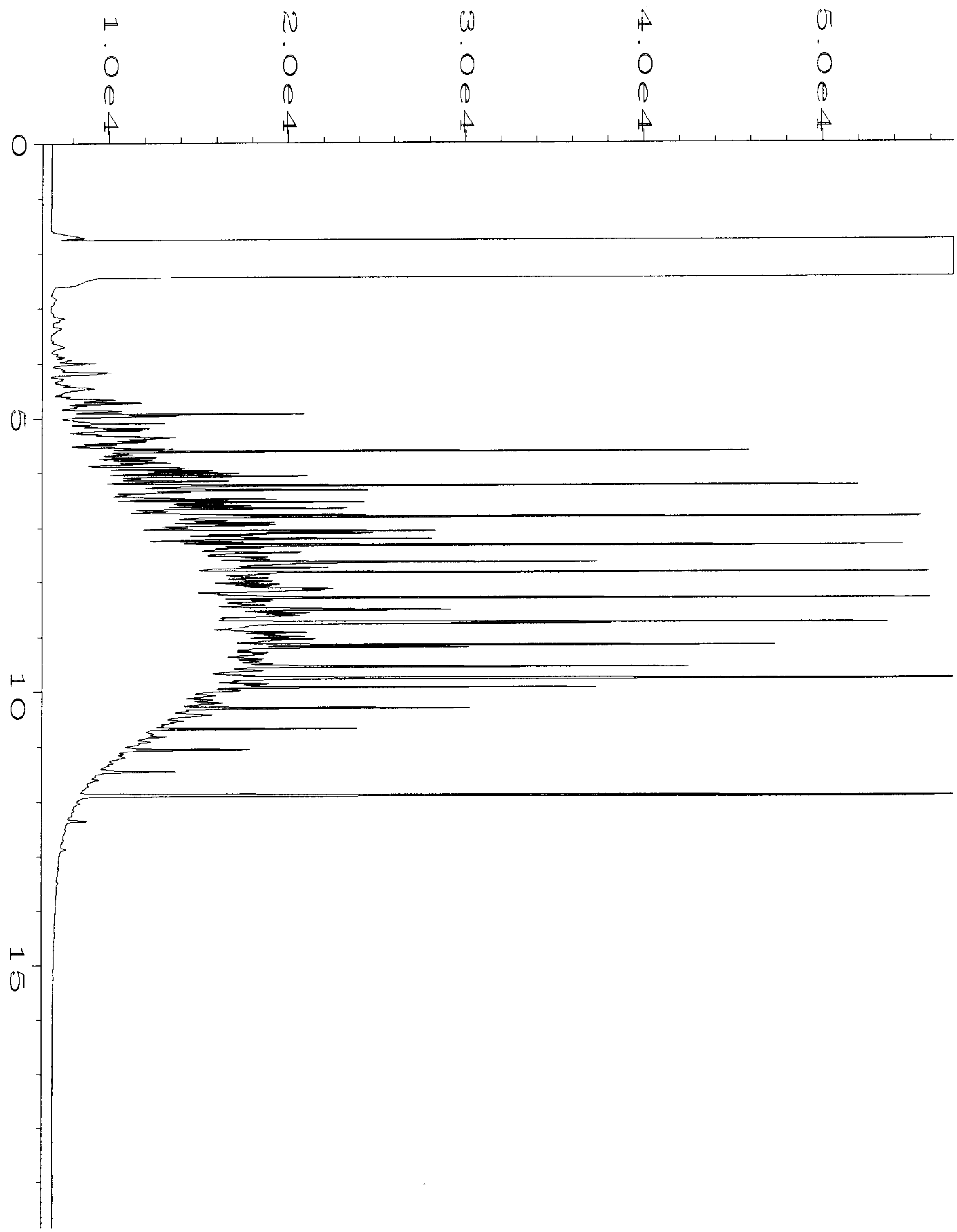
Data File Name	: C:\HPCHEM\1\DATA\09-14-10\043F1601.D		
Operator	: ML	Page Number	: 1
Instrument	: GC1	Vial Number	: 43
Sample Name	: 009082-12	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 16
Acquired on	: 16 Sep 10 00:22 AM	Instrument Method:	TPHD.MTH
Report Created on:	16 Sep 10 10:20 AM	Analysis Method	: TPHD.MTH



Data File Name	: C:\HPCHEM\1\DATA\09-14-10\044F1601.D		
Operator	: ML	Page Number	: 1
Instrument	: GC1	Vial Number	: 44
Sample Name	: 009082-13	Injection Number	: 1
Run Time Bar Code:		Sequence Line	: 16
Acquired on	: 16 Sep 10 00:48 AM	Instrument Method:	TPHD.MTH
Report Created on:	16 Sep 10 10:20 AM	Analysis Method	: TPHD.MTH

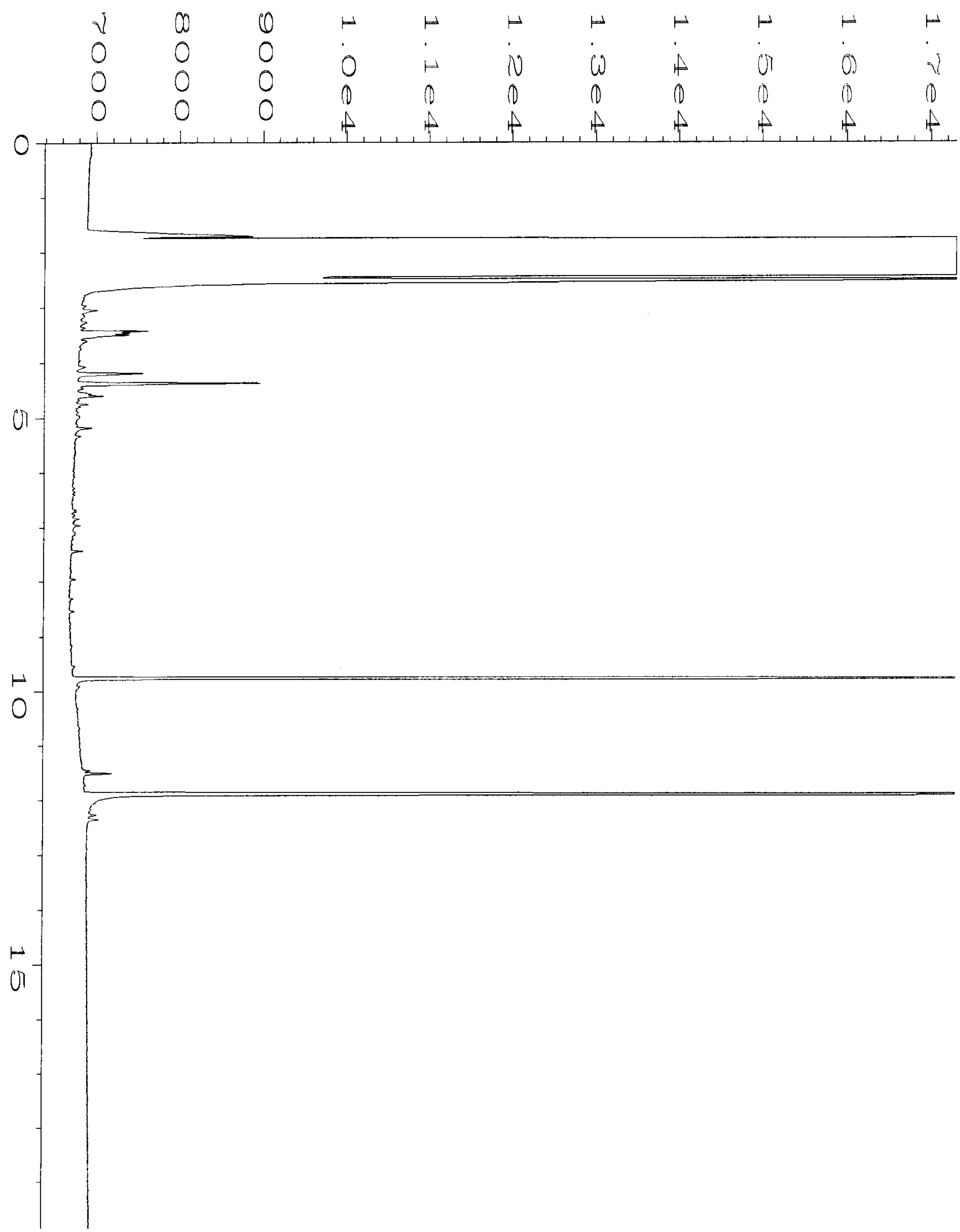


Data File Name	: C:\HPCHEM\1\DATA\09-14-10\045F1601.D			
Operator	: ML	Page Number	:	1
Instrument	: GC1	Vial Number	:	45
Sample Name	: 009082-14	Injection Number	:	1
Run Time Bar Code:		Sequence Line	:	16
Acquired on	: 16 Sep 10 01:15 AM	Instrument Method:		TPHD.MTH
Report Created on:	16 Sep 10 10:21 AM	Analysis Method	:	TPHD.MTH



Data File Name : C:\HPCHEM\1\DATA\09-14-10\003F1501.D
Operator : ML
Instrument : GC1
Sample Name : 32-197C 500 WADF
Run Time Bar Code:
Acquired on : 15 Sep 10 11:02 PM
Report Created on: 16 Sep 10 10:18 AM

Page Number : 1
Vial Number : 3
Injection Number : 1
Sequence Line : 15
Instrument Method: TPHD.MTH
Analysis Method : TPHD.MTH



Data File Name	: C:\HPCHEM\1\DATA\09-14-10\029F1401.D			
Operator	: ML	Page Number	:	1
Instrument	: GC1	Vial Number	:	29
Sample Name	: 00-1450 mb	Injection Number	:	1
Run Time Bar Code:		Sequence Line	:	14
Acquired on	: 15 Sep 10 05:15 PM	Instrument Method:		TPHD.MTH
Report Created on:	16 Sep 10 10:19 AM	Analysis Method	:	TPHD.MTH

2930 Westlake Ave N Suite 100
Seattle, WA 98109
T: (206) 352-3790
F: (206) 352-7178
info@fremontanalytical.com

Friedman and Bruya, Inc.
Attn: Michael Erdahl
3012 16th Ave W.
Seattle, WA 98119

RE: 009082
Fremont Project No: CHM100910-4

September 20th, 2010

Michael:

Enclosed are the analytical results for the ***009082*** water samples submitted to Fremont Analytical on September 10th, 2010.

Examination of these samples was conducted for the presence of the following:

- ***Dissolved Gases by RSK-175***
- ***Nitrate and Sulfate by EPA Method 300.0***

These applications were performed under Washington State Department of Ecology accreditation parameters. All appropriate Quality Assurance / Quality Control method parameters have been applied.

Please contact the laboratory if you should have any questions about the results.

Thank you for using Fremont Analytical!

Sincerely,

Michael Dee
Sr. Chemist / Principal
mikedee@fremontanalytical.com

2930 Westlake Ave . N., Suite 100
Seattle, WA 98109

T: 206.352.3790
F: 206-352-7178
email: info@fremontanalytical.com

Analysis of Dissolved Gases by RSK-175

Project: 009082
Client: Friedman and Bruya, Inc.
Client Project #: A-602
Lab Project #: CHM100910-4

RSK-175 (mg/L)	MRL	Method Blank	LCS	MW08-20100908	MW13-20100908	MW03-20100908
Date Extracted		9/13/10	9/13/10	9/13/10	9/13/10	9/13/10
Date Analyzed		9/13/10	9/13/10	9/13/10	9/13/10	9/13/10
Matrix				Water	Water	Water
Methane	0.005	nd	103%	**0.495**	nd	**1.64**
Ethane	0.005	nd	102%	nd	nd	nd
Ethene	0.005	nd	102%	nd	nd	nd

"nd" Indicates not detected at listed reporting limits
"int" Indicates that interference prevents determination
* Instrument Detection Limit
"J" Indicates estimated value
"MRL" Indicates Method Reporting Limit
"LCS" Indicates Laboratory Control Sample
"RPD" Indicates Relative Percent Difference

Acceptable RPD is determined to be less than 30%
Acceptable Recovery Limits:
LCS, LCSD = 80% to 120%
Spike Concentration = 100 PPMV

2930 Westlake Ave . N., Suite 100
Seattle, WA 98109

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Analysis of Dissolved Gases by RSK-175

Project: 009082
Client: Friedman and Bruya, Inc.
Client Project #: A-602
Lab Project #: CHM100910-4

RSK-175 (mg/L)	MRL	MW10-20100908	MW11-20100908	Duplicate MW11-20100908	RPD %
Date Extracted		9/13/10	9/13/10	9/13/10	
Date Analyzed		9/13/10	9/13/10	9/13/10	
Matrix		Water	Water	Water	
Methane	0.005	**0.136**	**0.222**	**0.171**	26%
Ethane	0.005	nd	nd	nd	
Ethene	0.005	nd	nd	nd	

"nd" Indicates not detected at listed reporting limits
"int" Indicates that interference prevents determination
* Instrument Detection Limit
"J" Indicates estimated value
"MRL" Indicates Method Reporting Limit
"LCS" Indicates Laboratory Control Sample
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Analysis of Dissolved Gases by RSK-175

Project: 009082
Client: Friedman and Bruya, Inc.
Client Project #: A-602
Lab Project #: CHM100910-4

RSK-175 (mg/L)	MRL	MW14-20100908
Date Extracted		9/13/10
Date Analyzed		9/13/10
Matrix		Water
Methane	0.005	**0.208**
Ethane	0.005	nd
Ethene	0.005	nd

"nd" Indicates not detected at listed reporting limits
"int" Indicates that interference prevents determination
* Instrument Detection Limit
"J" Indicates estimated value
"MRL" Indicates Method Reporting Limit
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Ion Chromatography by EPA Method 300.0

Project: 009082
Client: Friedman and Bruya, Inc.
Client Project #: A-602
Lab Project #: CHM100910-4

EPA Method 300.0 (mg/L)	**MRL**	**Method Blank**	**LCS**	**MW08-20100908**	**MW13-20100908**
Date Analyzed		9/10/10	9/10/10	9/10/10	9/10/10
Matrix				Water	Water
Nitrate (NO_3)	0.1	nd	107%	**0.215**	nd
Sulfate (SO_4)	0.1	nd	106%	**2.36**	**5.89**

"nd" Indicates no detection at the listed reporting limits
"int" Indicates that interference prevents determination
"J" Indicates estimated value
"MRL" Indicates Method Reporting Limit
"LCS" Indicates Laboratory Control Sample
"MS" Indicates Matrix Spike
"MSD" Indicates Matrix Spike Duplicate
"RPD" Indicates Relative Percent Difference

Acceptable RPD is determined to be less than 30%
Acceptable Recovery Limits:
LCS, LCSD, MS, MSD: 65% to 135%
Spike Concentrations:
NO_3 = 1.5 mg/L
SO_4 = 7.5 mg/L

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Ion Chromatography by EPA Method 300.0

Project: 009082
Client: Friedman and Bruya, Inc.
Client Project #: A-602
Lab Project #: CHM100910-4

EPA Method 300.0 (mg/L)	**MRL**	**MW03-20100908**	**MW10-20100908**	**MW11-20100908**
Date Analyzed		9/10/10	9/10/10	9/10/10
Matrix		Water	Water	Water
Nitrate (NO_3)	0.1	nd	**0.183**	**0.174**
Sulfate (SO_4)	0.1	**1.06**	**5.40**	**2.59**

"nd" Indicates no detection at the listed reporting limits
"int" Indicates that interference prevents determination
"J" Indicates estimated value
"MRL" Indicates Method Reporting Limit
"LCS" Indicates Laboratory Control Sample
"MS" Indicates Matrix Spike
"MSD" Indicates Matrix Spike Duplicate
"RPD" Indicates Relative Percent Difference

Acceptable RPD is determined to be less than 30%
Acceptable Recovery Limits:
LCS, LCSD, MS, MSD: 65% to 135%
Spike Concentrations:
NO_3 = 1.5 mg/L
SO_4 = 7.5 mg/L

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Ion Chromatography by EPA Method 300.0

Project: 009082
Client: Friedman and Bruya, Inc.
Client Project #: A-602
Lab Project #: CHM100910-4

EPA Method 300.0 (mg/L)	**MRL**	**MW14-20100908**	Duplicate **MW14-20100908**	**RPD %**
Date Analyzed		9/10/10	9/10/10	
Matrix		Water	Water	
Nitrate (NO_3)	0.1	nd	nd	
Sulfate (SO_4)	0.1	**5.05**	**5.07**	0.4%

"nd" Indicates no detection at the listed reporting limits
"int" Indicates that interference prevents determination
"J" Indicates estimated value
"MRL" Indicates Method Reporting Limit
"LCS" Indicates Laboratory Control Sample
"MS" Indicates Matrix Spike
"MSD" Indicates Matrix Spike Duplicate
"RPD" Indicates Relative Percent Difference

Acceptable RPD is determined to be less than 30%
Acceptable Recovery Limits:
LCS, LCSD, MS, MSD: 65% to 135%
Spike Concentrations:
NO_3 = 1.5 mg/L
SO_4 = 7.5 mg/L

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Ion Chromatography by EPA Method 300.0

Project: 009082
Client: Friedman and Bruya, Inc.
Client Project #: A-602
Lab Project #: CHM100910-4

		MS	MSD	
EPA Method 300.0 (mg/L)	**MRL**	**MW14-20100908**	**MW14-20100908**	**RPD %**
Date Analyzed		9/10/10	9/10/10	
Matrix		Water	Water	
Nitrate (NO_3)	0.1	112%	112%	0.2%
Sulfate (SO_4)	0.1	103%	103%	0.6%

"nd" Indicates no detection at the listed reporting limits
"int" Indicates that interference prevents determination
"J" Indicates estimated value
"MRL" Indicates Method Reporting Limit
"LCS" Indicates Laboratory Control Sample
"MS" Indicates Matrix Spike
"MSD" Indicates Matrix Spike Duplicate
"RPD" Indicates Relative Percent Difference

Acceptable RPD is determined to be less than 30%
Acceptable Recovery Limits:
LCS, LCSD, MS, MSD: 65% to 135%
Spike Concentrations:
NO_3 = 1.5 mg/L
SO_4 = 7.5 mg/L

SUBCONTRACT SAMPLE CHAIN OF CUSTODY

CHM100910-4

Page # 1 of 1

Send Report To Michael Erdahl

Company Friedman and Bruya, Inc.

Address 3012 16th Ave W

City, State, ZIP Seattle, WA 98119

Phone # (206) 285-8282 Fax # (206) 283-5044

SUBCONTRACTER

PROJECT NAME/NO.	PO #
009082	A-602

REMARKS

Please Email Results
merdahl@friedmanandbruya.com

TURNAROUND TIME
- [x] Standard (2 Weeks)
- [ ] RUSH
Rush charges authorized by:

SAMPLE DISPOSAL
- [ ] Dispose after 30 days
- [ ] Return samples
- [ ] Will call with instructions

Sample ID	Lab ID	Date Sampled	Time Sampled	Matrix	# of jars	Oil and Grease	EPH	VPH	Nitrate	Sulfate	Alkalinity	Dissolved Gasses				Notes
MW08-20100908		9/8/10	1430	W	3				X	X		X				
MW13-20100908		↓	1740	↓	↓				X	X		X				
MW03-20100909		9/9/10	1017	↓	↓				X	X		X				
MW10-20100909		↓	1140	↓	↓				X	X		X				
MW11-20100909		↓	1228	↓	↓				X	X		X				
MW14-20100909		↓	1353	↓	↓				X	X		X				

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by: [signature]	Michael Erdahl	Friedman & Bruya	9/10/10	9:00 Am
Received by: [signature]	Troy Zehr	F.A.	9/10/10	11:05
Relinquished by:				
Received by:				

009082

SAMPLE CHAIN OF CUSTODY

ME 09/10/10 V5/A05/B14

Send Report To Tim Brown & Suzy Reilly

Company SES

Address 2811 Fairview Ave E Ste 2000

City, State, ZIP Seattle, WA 98102

Phone # 206 306 1900 Fax # 206 306 1907

SAMPLERS (signature) [signature]

PROJECT NAME/NO. ODC 0566-001-04

PO #

REMARKS

Dissolved Gases = methane, ethene, & ethane

GEMS Y / N

TURNAROUND TIME
Standard (2 Weeks)
RUSH
Rush charges authorized by

SAMPLE DISPOSAL
X Dispose after 30 days
Return samples
Will call with instructions

Sample ID	Sample Location	Sample Depth	Lab ID	Date Sampled	Time Sampled	Matrix	# of jars	NWTPH-Dx	NWTPH-Gx	BTEX by 8021B	VOC's by 8260	Dissolved Gases EPA 8021A (~~SVOCs by 8270~~)	RCRA-8 Metals	cVOCs by 8260	Nitrate/sulfate EPA 300	Notes
MW07-20100908	MW07		01 A-G	9/8/10	1355	Water	7	X	X	X				X		
MW08-20100908	MW08		02 A-J	9/8/10	1430	water	10	X	X	X		X		X	X	
MW04-20100908	MW04		03 A-G	9/8/10	1542	water	7	X	X	X				X		
MW13-20100908	MW13		04 A-J	9/8/10	1740	water	10	X	X	X		X		X	X	
MW06-20100908	MW06		05 A-G	9/8/10	1811	water	7	X	X	X				X		
MW01-20100909	MW01		06 A-G	9/9/10	0919	water	7	X	X	X				X		
MW09-20100909	MW09		07 A-F	9/9/10	0945	water	7	X	X	X				X		
MW03-20100909	MW03		08 A-J	9/9/10	1017	water	10	X	X	X		X		X	X	
MW10-20100909	MW10		09 A-J	9/9/10	1140	water	10	X	X	X		X		X	X	
MW11-20100909	MW11		10 A-J	9/9/10	1228	water	10	X	X	X		X		X	X	
MW14-20100909	MW14		11 A-J	9/9/10	1353	water	10	X	X	X		X		X	X	
MW12-20100909	MW12		12 A-G	9/9/10	1555	water	7	X	X	X				X		
MW15-20100909	MW15		13 A-G	9/9/10	1630	water	7	X	X	X				X		

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

	SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:	[signature]	Pete Kingston	SES	9/10/10	0740
Received by:	[signature]	Nhan Phan	FeBI	9/10/10	V
Relinquished by:					
Received by:			Samples received at 3 °C		

009082

SAMPLE CHAIN OF CUSTODY ME 09/10/10 V5/A05/BT4

Send Report To Tim Brown Suzy Reilly

Company SES

Address 2811 Fairview Ave E. Ste 2000

City, State, ZIP Seattle, WA 98102

Phone # 206 306 1900 Fax # 206 306 1907

SAMPLERS (signature) [signature]

PROJECT NAME/NO. OPC 0566-001-04

PO #

REMARKS

GEMS Y / N

Page # 2 of 2

TURNAROUND TIME
X Standard (2 Weeks)
RUSH
Rush charges authorized by:

SAMPLE DISPOSAL
X Dispose after 30 days
Return samples
Will call with instructions

Sample ID	Sample Location	Sample Depth	Lab ID	Date Sampled	Time Sampled	Matrix	# of jars	NWTPH-Dx	NWTPH-Gx	BTEX by 8021B	VOC's by 8260	SVOC's by 8270	RCRA-8 Metals	cVOCs 8260		Notes
MW99-20100909	MW99		14 A-G	9/9/10	— PK	water	7	X	X	X				X		

PK 9/9/10

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by: [signature]	Pete Kingston	SES	9/10/10	0740
Received by: [signature]	Nhan Phan	FeBI	9/10/10	V
Relinquished by:				
Received by:		Samples received at 3 °C		

FORMS\COC\SESGEMSR1.DOC (Revision 1)

SiREM #S-1995

SiREM Site Recovery & Management
www.siremlab.com
130 Research Lane, Suite 2
Guelph, Ontario N1G 5G3
Phone (519) 822-2265
Fax (519) 822-3151

Certificate of Analysis: Quantitative Gene-Trac *Dehalococcoides* Assay

Customer: Suzy Reilly, Sound Earth Strategies
Project: Former Olympic Dry Cleaners
Customer Reference: 0566-001-04

SiREM Reference: S-1995
Report Issued: 23-Sept-10
Data Files: iQ5-DHC-QPCR-0664
DHC-QPCR-Check-gel-0471
MyiQ-DB-DHC-QPCR-0133

Table 1: Test Results

Customer Sample ID	SiREM Sample ID	Sample Collection Date	Sample Matrix	Percent Dhc [A]	*Dehalococcoides* Enumeration [B]
MW10-20100909	DHC-6451	9-Sep-10	Field Filter	0.004-0.01%	2×10^4/liter

Notes:

[A] Percent *Dehalococcoides* (Dhc) in microbial population. This value is calculated by dividing the number of Dhc 16S ribosomal ribonucleic acid (rRNA) gene copies by the total number of bacteria as estimated by the mass of DNA extracted from the sample. Range represents normal variation in Dhc enumeration.

[B] Based on quantification of Dhc 16S rRNA gene copies. Dhc are generally reported to contain one 16S rRNA gene copy per cell; therefore, this number is often interpreted to represent the number of Dhc cells present in the sample.

Analyst: Julie Pring
Julie Pring
Biotechnology Technologist

Approved: Ximena Druar
Ximena Druar, B.Sc.
Molecular Biology Coordinator

Table 2: Detailed Test Parameters, Gene-Trac Test Reference S-1995

Customer Sample ID	MW10-20100909
SiREM Sample ID	DHC-6451
Date Received	15-Sep-10
Sample Temperature	6 ˚C
Filtration Date	9-Sep-10
Volume Used for DNA Extraction	575 mL
DNA Extraction Date	16-Sep-10
DNA Concentration in Sample (extractable)	832 ng/L
PCR Amplifiable DNA	Detected
qPCR Date Analyzed	20-Sep-10
Laboratory Controls (see Table 3)	Passed
Comments	- -

Notes:

Refer to Table 3 for detailed results of controls.
ND = not detected
°C = degrees Celsius
PCR = polymerase chain reaction
qPCR = quantitative PCR
Dhc = *Dehalococcoides*
ng/L = nanograms per liter
mL = milliliters
DNA = Deoxyribonucleic acid

Table 3: Laboratory Controls, Gene-Trac Test Reference S-1995

Laboratory Control	Analysis Date	Control Description	Spiked Dhc 16S rRNA Gene Copies per Liter	Recovered Dhc 16S rRNA Gene Copies per Liter	Comments
Positive Control Low Concentration	20-Sep-10	qPCR with KB-1 genomic DNA (CSLD-0302)	3.6×10^{5}	2.1×10^{5}	- -
Positive Control High Concentration	20-Sep-10	qPCR with KB-1 genomic DNA (CSHD-0302)	2.9×10^{7}	2.0×10^{7}	- -
Negative Control	20-Sep-10	Tris Reagent Blank (TBD-0262)	0	ND	- -
DNA Extraction Blank	17-Sep-10	DNA extraction sterile water (FB-1267)	0	4.9×10^{2}	See Note 1

Notes:

Dhc = *Dehalococcoides*

DNA = Deoxyribonucleic acid

ND = not detected

qPCR = quantitative PCR

16S rRNA = 16S ribosomal ribonucleic acid

[1]Acceptable as test result for relevant sample is greater than 2 orders of magnitude above DNA Extraction Blank test result.

№ 2898

SiREM Site Recovery & Management
130 Research Lane, Suite 2 · Guelph, Ontario, Canada N1G 5G3 · Phone (519) 822-2265 or toll free 1-866-251-1747 Fax (519) 822-3151
www.siremlab.com

Chain-of-Custody Form

Page 1 of 1

Lab # S-1995

Project Name: Former Olympic Dry Cleaners	Project #: 0566-001-04
Project Manager: Suzy Reilly	
Email Address: sreilly@soundearthinc.com	
Company: Sound Earth Strategies	
Address: 2811 Fairview Avenue East Ste 2000	
Phone #: 206 306 1900	Fax #: 206 306 1907
Sampler's Signature: [signature]	Sampler's Printed Name: Suzy Reilly

Analysis

Preservative: 0 NA

Preservative Key
0. None
1. HCl
2. Other
3. Other

Customer Sample ID	Sampling Date	Sampling Time	Matrix	# of Containers	Gene-Trac Dhc	Gene-Trac VC	Gene-Trac Dhb									Other Information
MW10-20100909	9/9/10	1310	Filter	2	X											

PK 9/14/10

Sample Receipt	
Cooler Condition:	GOOD
Cooler Temperature:	6 °C
Custody Seals:	Yes ☐ No ☒

Billing Information
P.O. #: 0566-001-04
Bill To: Sound Earth Strategies
2811 Fairview Ave E
Seattle WA

Turnaround Time Requested
Normal ☒
Rush ☐

For Lab Use Only
2 Filters received
Proposal #:

	Relinquished By:	Received By:	Relinquished By:	Received By:	Relinquished By:	Received By:
Signature	[signature]	[signature]				
Printed Name	Pete Kingston	Julie Prins				
Firm	SES	SiREM				
Date/Time	9/14/10 / 1158	9/15/10				

Distribution: White - Return to Originator: Yellow - Lab Copy: Pink - Retained by Client

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Guelph, Ontario N1G 5G3
Phone: (519) 822-2265
Fax: (519) 822-3151
www.siremlab.com

Interpretation of Quantitative Gene-Trac *Dehalococcoides* Test Results

1) Background:

Dehalococcoides group organisms (*Dhc*) are the only known microorganisms capable of complete dechlorination of chloroethenes (i.e., tetrachloroethene, trichloroethene, *cis*-dichloroethene, vinyl chloride to non-toxic ethene. The detection of the *Dhc* 16S ribosomal ribonucleic acid (rRNA) gene has been correlated with the complete biological dechlorination of chlorinated ethenes to ethene at contaminated sites (Hendrickson et. al., 2002, *Applied and Environmental Microbiology*, 68: 485-495). The Quantitative Gene-Trac *Dehalococcoides* test is a quantitative polymerase chain reaction (PCR) test used to determine the concentration of the *Dhc* 16S rRNA gene in soil and groundwater samples.

2) Interpretation of Test Results:

The Quantitative Gene-Trac test reports two types of results, *"Dehalococcoides* 16S rRNA Gene Copies" is a raw value whereas **"**% *Dehalococcoides* in Microbial Population*"* is the raw value expressed as percentage of total microbial population. A detailed explanation of the two types of results is provided below.

a) *Dehalococcoides* 16S rRNA Gene Copies

This value is the direct number of *Dhc* 16S rRNA gene copies detected in the sample. Results may be reported either per liter (for groundwater) or per gram (for soil). This number is generally interpreted as equivalent to the number of viable *Dhc* present in the sample when certain reasonable assumptions are made, including that the DNA quantified belongs to viable *Dhc* (i.e., not from dead *Dhc*) and that each *Dhc* cell contains only one 16S rRNA gene. Guidelines for relating this value to observable dechlorination impacts for groundwater samples are provided below.

- **Values of 10^3 gene copies per liter or lower,** indicate the sample contains low concentrations of *Dhc* organisms which may indicate that site conditions are sub-optimal for high rates of dechlorination. Increases in *Dhc* concentrations at the site may be possible if conditions are modified (e.g., electron donor addition).

- **Values of 10^4-10^6 gene copies per liter,** indicates the sample contains moderate concentrations of *Dhc* which may, or may not, be associated with observable dechlorination impacts (i.e., ethene).

- **Values at or above 10^7 gene copies per liter,** indicate the samples contains high concentrations of *Dhc* which is often associated with high rates of dechlorination and the production of ethene. Test results exceeding 10^9 gene copies/liter are rarely observed.

b) % *Dehalococcoides* in Microbial Population (% *Dhc*)

This value presents the percentage of *Dhc* (% *Dhc*) relative to other microorganisms in the sample based on the formulas below. % *Dhc* is a measure of the predominance of *Dhc and,* in general, the higher this percentage the better.

$$\%\ Dhc = \frac{Number\ Dhc}{Number\ Dhc + Number\ other\ Bacteria}$$

Where:

$$Number\ other\ Bacteria = \frac{Total\ DNA\ in\ sample\ (ng) - DNA\ attributed\ to\ Dhc\ (ng)}{4.0\ x\ 10^{-6}\ ng\ DNA\ per\ bacterial\ cell}$$

The number of non-*Dhc* bacteria is estimated by assuming each non-*Dhc* bacterium contains 4.0 x 10^{-6} nanograms (ng) of DNA (Paul and Clark. 1996. *Soil Microbiology and Biochemistry*). Because the total mass of DNA in a sample is determined (by fluorometry) the total number of bacteria present can be estimated. For perspective, the % *Dhc* can range from very low fractions of percentages, in samples that have low numbers of *Dhc* and high numbers of other bacteria (incompletely colonized by *Dhc*), to greater than 50% in *Dhc* enriched cultures such as KB-1™ (fully colonized by *Dhc*).

In addition to determining the predominance of *Dhc*, this value is also used for interpretation of *Dhc* counts from different sampling locations or the same location over time, because it is normalized to total bacteria. In particular, the % *Dhc* value can be used to correct *Dhc* counts where samples are biased low due to non-representative sampling of biomass (bacteria). Example 1 below illustrates a scenario where the % *Dhc* value improves the interpretation of data where one sampling event was biased.

Example 1, use of % Dhc Value to interpret raw data

Example 1 presents results from monitoring well MW-1 sampled in April, May and June. Based on the raw *Dhc* counts alone (*Dehalococcoides* 16S rRNA Gene Copies) it might be assumed that the number of *Dhc* decreased 10-fold between April and May; however, based on the percentage of *Dhc* it is clear that the proportion of *Dhc* actually increased from April to May and that the low count is probably a case of sampling variability (biased low). The higher raw count and the higher percentage of *Dhc* in June confirms the trend of increasing *Dhc* concentrations over time.

Sample	***Dehalococcoides* 16S rRNA Gene Copies**	**% *Dhc***	**Interpretation Based on % *Dhc***
MW-1–April	1.0 x 10^5/Liter	0.1%	*Dhc* is a low proportion of total microbial population
MW-1–May	1.0 x 10^4/Liter	1%	*Dhc* predominance increased 10-fold from April, low count from low biomass sampled, non-biased sample would be [(1.0/0.1) x 1.0 x10^5] = 10^6 /Liter
MW-1 June	1.0 x 10^7/Liter	10%	*Dhc* predominance moderate and has increased 100-fold from April

3) Explanation of Notes

Quantitation limit: The quantitation limit of Gene-Trac test is 2,150 *Dhc* 16S rRNA gene copies per liter. Note, the specific quantitation limit for each test varies depending on the volume of sample used in the DNA extraction process. For example, if only a ½ liter of water was used the quantitation limit would increase two-fold to 4300 gene copies per liter. The specific quantitation limit is provided only where *Dhc* is not detected.

Value is an estimated quantity between the quantitation limit and detection limit: This is applicable in situations where *Dhc* DNA is detected above the detection limit, but below the quantitation limit, of the standard curve. In such cases an estimated value is provided which is based on extrapolation of the standard curve.

Sample inhibited testing: Each Quantitative Gene-Trac test includes a quantification of the amount of DNA extracted from the sample and a second test to determine if the extracted DNA is suitable for *Dhc* testing (PCR with a universal Bacteria primer). If a sample is determined to contain DNA and PCR with universal primers is negative, it suggests that the extracted DNA inhibited the PCR. Inhibition may be caused by compounds present in the original groundwater sample (e.g., humic acids). Where inhibition occurs there is an increased likelihood of false negatives since *Dhc* DNA, if present, may not be detected.

DNA not extracted from the sample: If DNA is not detected in the sample then "DNA not extracted from the sample" is reported. This is commonly due to samples that contain little or no biomass (bacteria). In some cases sampling may not capture bacteria (e.g., when attached bacteria are not dislodged from the aquifer matrix).

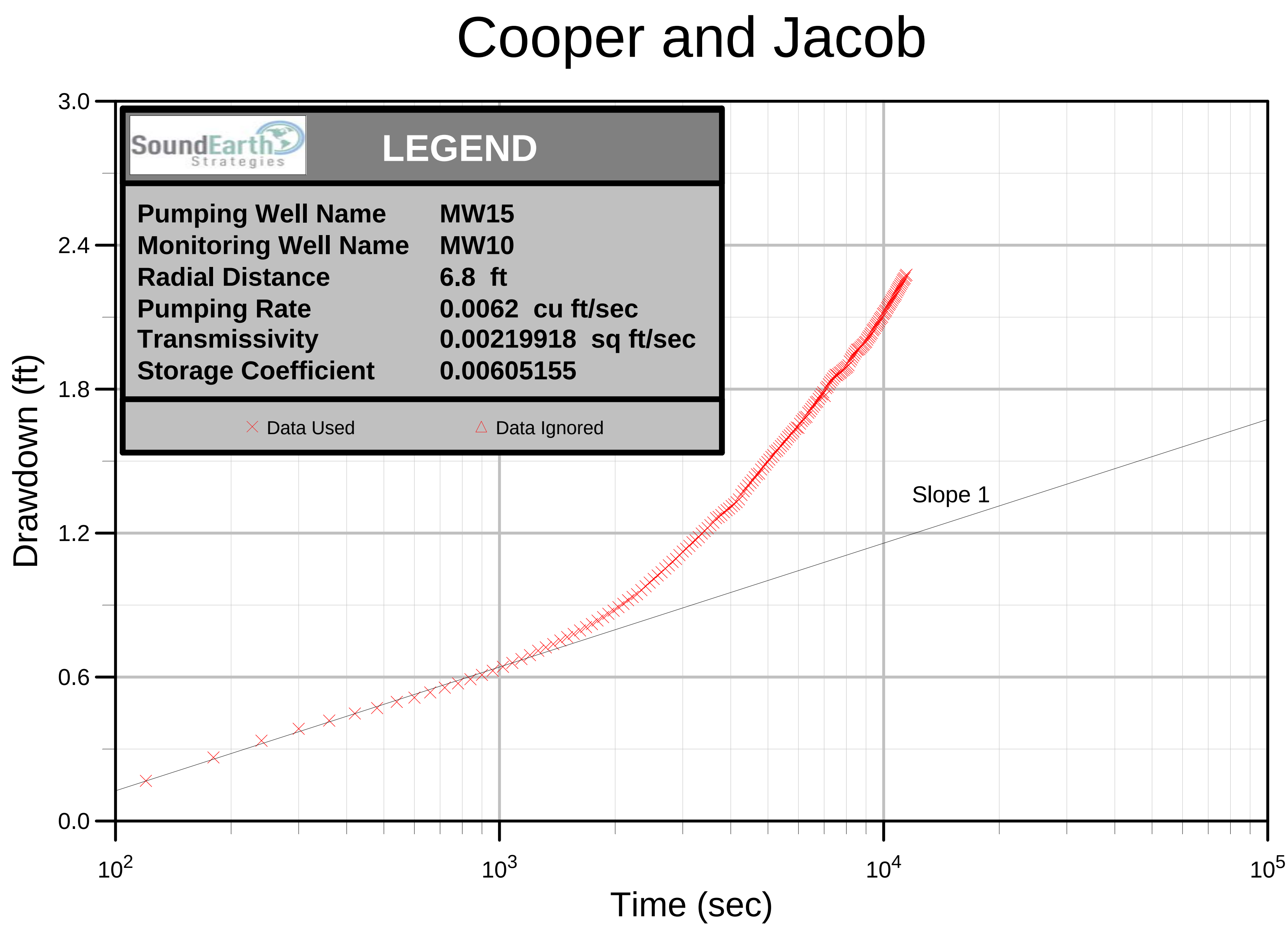
4) Converting Standard Gene-Trac to *Dhc* 16S rRNA Gene Copies/Liter

Quantitative Gene-Trac provides quantitative results in *Dhc* 16S rRNA Gene Copies/Liter, whereas standard Gene-Trac provides semi-quantitative results using a plus scale. Based on parallel analysis of standard versus Quantitative Gene-Trac estimates of the number of *Dhc* gene copies for each + score in the standard test were determined. Note, the conversion factors do not apply in all cases and are meant to be used as a rule of thumb for relating standard Gene-Trac results to Quantitative-Gene-Trac.

Estimated 16S rRNA Gene Copies/Liter for Standard Gene-Trac Intensity Scores

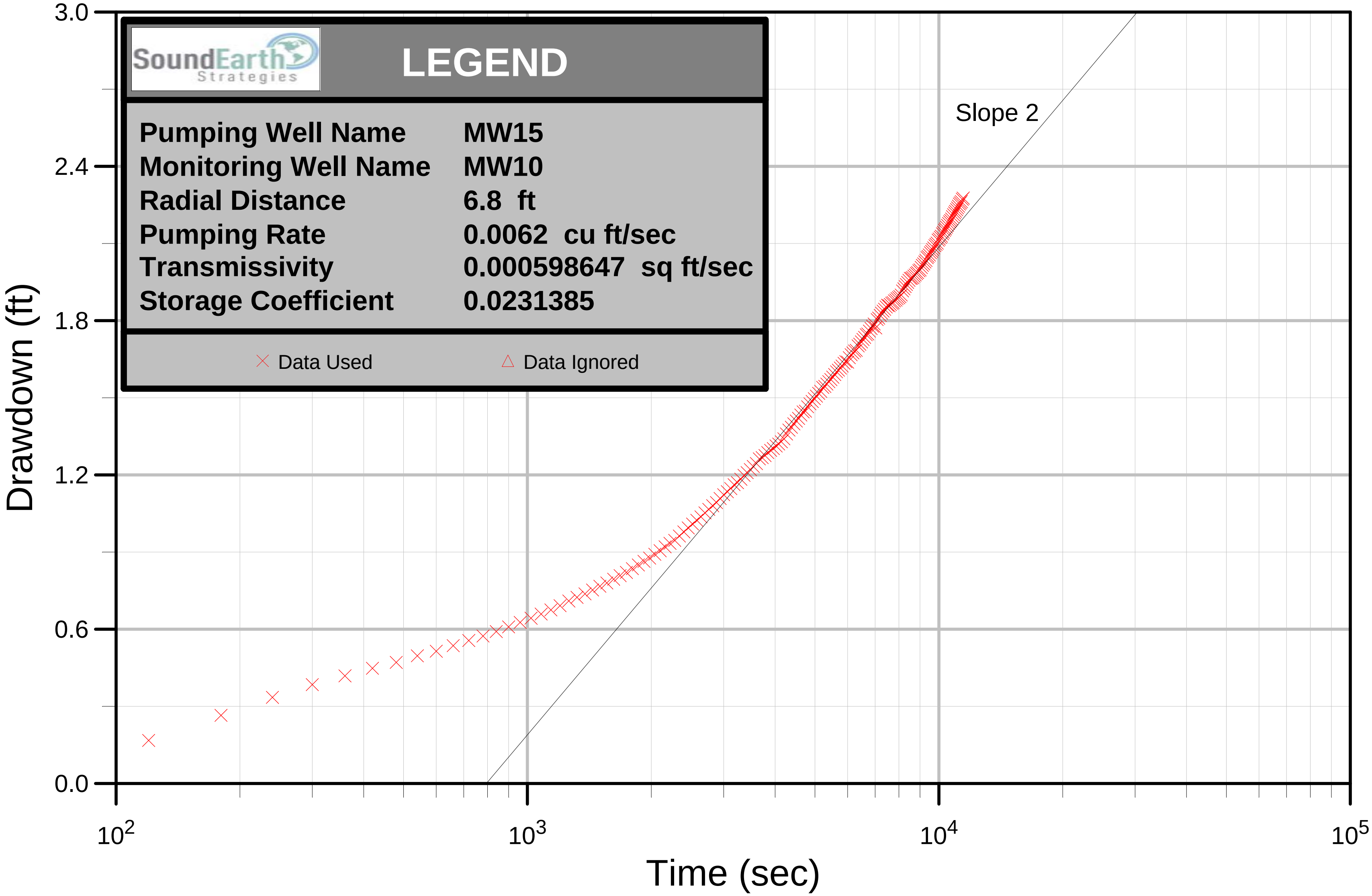
Standard Gene-Trac Intensity Score	Approximate Range of 16S rRNA Gene Copies/Liter
+	10^3-10^5
++	10^4-10^6
+++	10^5-10^7
++++	10^6-10^8

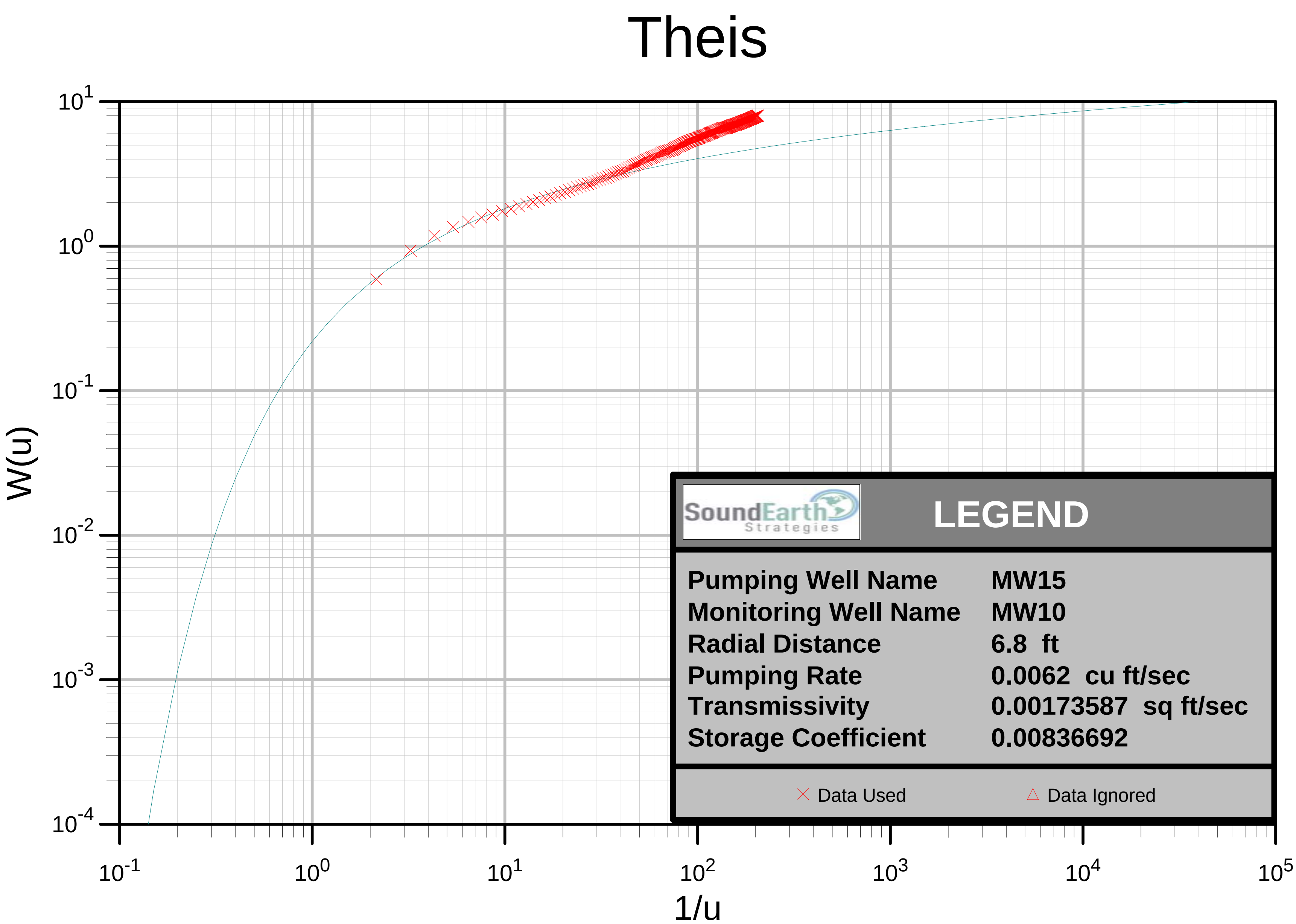
APPENDIX B
AQUIFER TEST



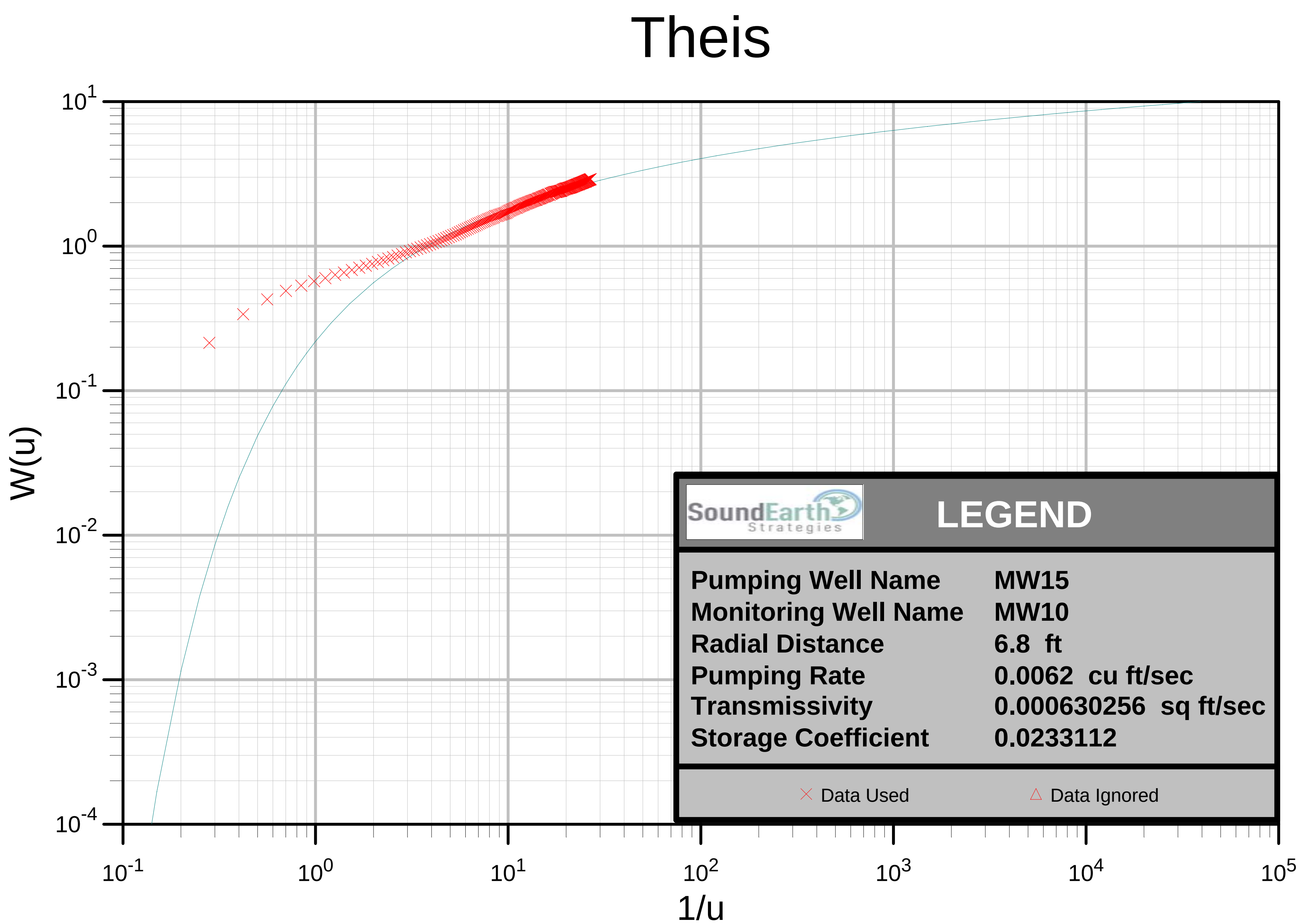
Cooper and Jacob
SoundEarth Strategies
LEGEND
Pumping Well Name MW15
Monitoring Well Name MW10
Radial Distance 6.8 ft
Pumping Rate 0.0062 cu ft/sec
Transmissivity 0.00219918 sq ft/sec
Storage Coefficient 0.00605155
Data Used
Data Ignored
Slope 1
Drawdown (ft)
3.0
2.4
1.8
1.2
0.6
0.0
10^2
10^3
10^4
10^5
Time (sec)

Cooper and Jacob

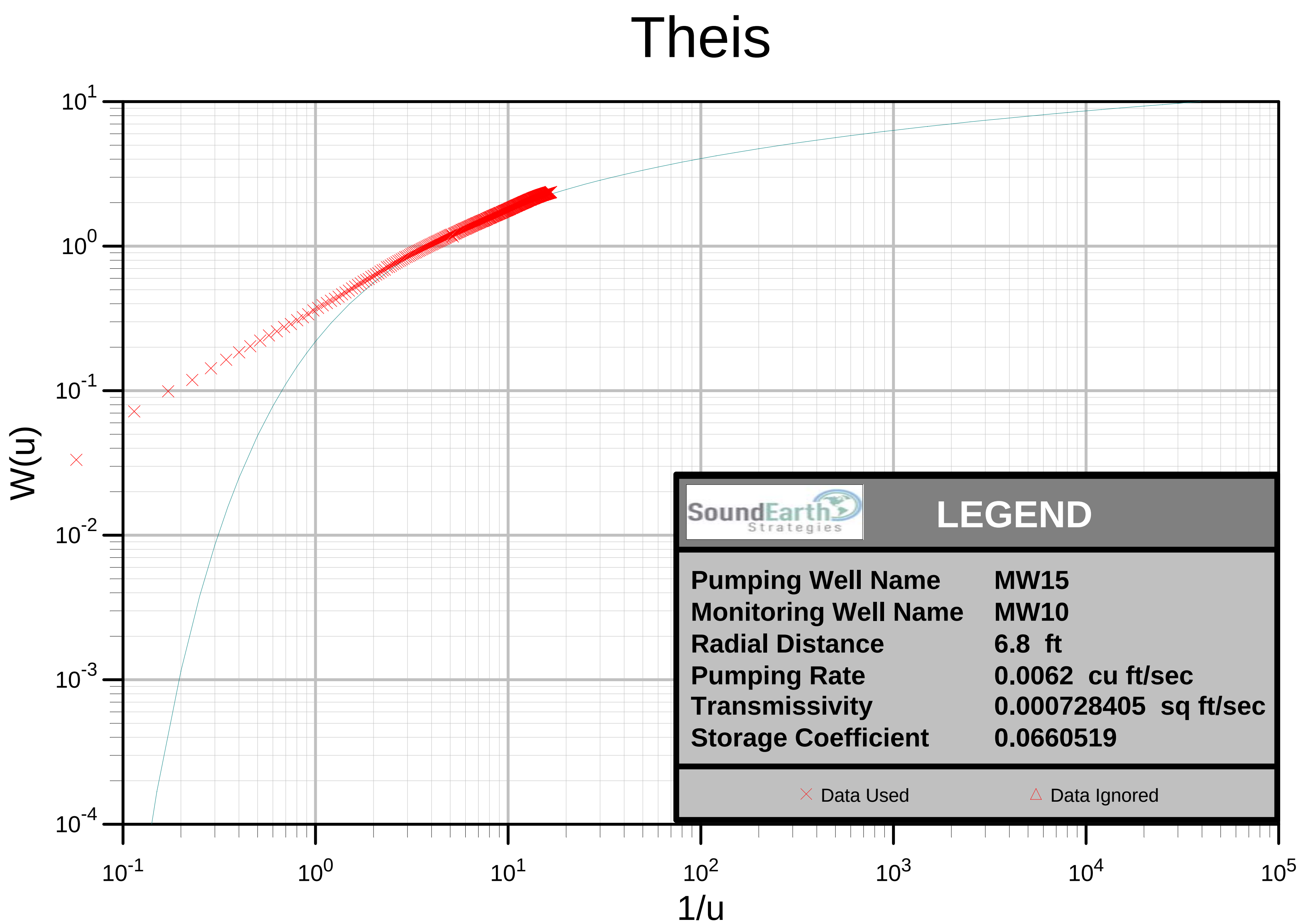




Theis
W(u)
1/u
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-1
10^0
10^1
10^2
10^3
10^4
10^5
SoundEarth Strategies
LEGEND
Pumping Well Name MW15
Monitoring Well Name MW10
Radial Distance 6.8 ft
Pumping Rate 0.0062 cu ft/sec
Transmissivity 0.00173587 sq ft/sec
Storage Coefficient 0.00836692
Data Used
Data Ignored



Theis
W(u)
1/u
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-1
10^0
10^1
10^2
10^3
10^4
10^5
SoundEarth Strategies
LEGEND
Pumping Well Name MW15
Monitoring Well Name MW10
Radial Distance 6.8 ft
Pumping Rate 0.0062 cu ft/sec
Transmissivity 0.000630256 sq ft/sec
Storage Coefficient 0.0233112
Data Used
Data Ignored


Theis
W(u)
1/u
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-1
10^0
10^1
10^2
10^3
10^4
10^5
SoundEarth Strategies
LEGEND
Pumping Well Name MW15
Monitoring Well Name MW10
Radial Distance 6.8 ft
Pumping Rate 0.0062 cu ft/sec
Transmissivity 0.000728405 sq ft/sec
Storage Coefficient 0.0660519
Data Used
Data Ignored

SoundEarth Strategies

Aquifer Test Data Collection Sheet
Former Olympia Dry Cleaners Site
606 Union Avenue Southeast
Olympia, Washington

Aquifer Test Data Collection Sheet

Site: Former Olympia Dry Cleaners **Field Personnel:** P. Kingston, S. Reilly, T. Brown **Equipment:** Flotec and four Level TROLL 700 (15 psi/g) and one Level TROLL 700 (30 psi/g)

Date	9/13/2010	Initial DTW (ft below TOC)	Total Depth (ft below TOC)	Initial Transducer Reading (PSI)	Time Pump On	Time Pump Off	Time Observations Stop	Flow Rate (gpm)	Total Volume Extracted (gallons)	Comments
Test Well	**MW15**	3.81	11.87	2.5	1054	1404	1902	2.8	538	bottom of transducer set at 9.8 ft below top of casing (TOC)
Observation Well	**MW03**	2.73	7.67	--	--	--	NA	--	--	no transducer; transducer diameter too large for 1-inch diameter observation well
Observation Well	**MW09**	3.86	9.55	1.9	--	--	1845	--	--	bottom of transducer set at 8.5 ft below TOC
Observation Well	**MW10**	4.67	12.25	2.7	--	--	1858	--	--	bottom of transducer set at 11 ft below TOC
Observation Well	**MW12**	3.97	58.73	20.3	--	--	1836	--	--	bottom of transducer set at 50 ft below TOC
Observation Well	**MW13**	0.65	9.56	3.4	--	--	1851	--	--	bottom of transducer set at 8.5 ft below TOC

	Depth to Water (ft)							**Ft Above Ground Surface**	**Yard Stick (inches)**	
Time	**Test Well: MW15**	**Obs Well: MW03**	**Obs Well: MW09**	**Obs Well: MW10**	**Obs Well: MW12**	**Obs Well: MW13**	**Obs Well: White Pipe 4-in**	**Obs Well: Artesian Well**	**Seep:**	**Other Observations** (i.e. pump frequency, water clarity, odor, pump performance, etc.)
1020	3.83	2.72	3.88	4.68	3.58	0.52	4.30	5.49	10.875	programmed start time for 1045; initial seep measurement was 10.875 inches notched poly tank where measurements were collected during the aquifer test
1055	4.15	--	--	--	--	--	--	--	--	
1056	4.40	--	--	--	--	--	--	--	--	
1058	4.48	2.70	3.89	5.10	3.42	0.52	4.76	5.48	10.875	
1059	4.51	--	--	--	--	--	--	--	--	
1101	4.54	--	--	--	--	--	--	--	--	
1102	4.58	--	--	--	--	--	--	--	--	
1103	4.56	--	--	--	--	--	--	--	--	
1104	4.60	--	--	--	--	--	--	--	--	
1106	4.63	2.74	3.88	5.25	3.38	--	4.90	5.54	10.875	

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Time	Test Well: MW15	Obs Well: MW03	Obs Well: MW09	Obs Well: MW10	Obs Well: MW12	Obs Well: MW13	Obs Well: White Pipe 4-in	Obs Well: Artesian Well	Seep:	Other Observations (i.e. pump frequency, water clarity, odor, pump performance, etc.)
1107	4.67	--	--	--	--	--	--	--	--	
1108	4.69	--	--	--	--	--	--	--	--	
1112	4.73	--	--	--	--	--	--	--	--	
1113	4.75	--	--	--	--	--	--	--	--	
1115	4.79	2.74	3.88	5.40	3.36	0.52	5.05	5.57	--	
1116	4.80	--	--	--	--	--	--	--	--	
1118	4.84	2.74	3.88	5.47	3.34	--	5.11	5.57	10.875	
1119	4.85	--	--	--	--	--	--	--	--	
1122	4.91	--	--	--	--	--	--	--	--	
1125	4.93	2.74	3.88	5.55	3.32	0.52	5.23	5.58	10.75	
1127	4.95	--	--	--	--	--	--	--	--	
1131	5.01	2.73	3.88	5.65	3.32	0.52	5.30	5.58	10.625	
1134	5.04	--	--	--	--	--	--	--	--	
1135	5.10	--	--	--	--	--	--	--	--	
1138	5.15	2.72	3.88	5.74	3.32	0.53	5.38	5.60	10.125	
1142	5.18	--	--	--	--	0.53	--	--	--	
1144	5.20	2.70	3.88	5.85	3.29		5.52	5.61	10	
1148	5.26	--	--	--	--	--	--	--	--	
1150	5.29	--	--	--	--	--	--	--	--	
1152	5.31	--	--	--	--	0.52	--	--	--	

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	Test Well: MW15	Obs Well: MW03	Obs Well: MW09	Obs Well: MW10	Obs Well: MW12	Obs Well: MW13	Obs Well: White Pipe 4-in	Obs Well: Artesian Well	Seep:	
1154	5.33	2.72	3.88	5.96	3.28	--	5.61	5.62	9.75	
1156	5.33	--	--	--	--	--	--	--	--	
1158	5.36	--	--	--	--	--	--	--	--	
1200	5.40	2.71	3.88	6.01	3.28	0.52	5.65	5.62	9.625	
1205	5.45	--	--	6.07	3.26	--	5.72	5.63	9.5	
1212	5.47	2.72	3.88	6.16	3.25	--	--	5.64	9.375	
1217	5.62	--	--	6.23	3.25	--	5.79	5.64	9.25	
1222	5.67	--	--	--	--	--	--	--	--	
1225	--	--	--	6.31	3.24	--	5.82	5.64	9	
1228	5.73	--	--	--	--	--	--	--	--	
1233	5.77	2.70	3.88	6.36	3.23	0.53	6.00	5.64	8.875	
1238	5.82	--	--	6.39	3.21	--	6.05	5.64	8.75	
1245	5.86	--	--	6.46	3.20	--	6.10	5.65	8.625	
1250	5.91	2.70	3.88	6.50	3.19	--	6.13	5.65	8.5	
1255	5.96	--	--	6.56	3.18	--	6.22	5.67	8.375	
1300	5.94	--	--	--	--	--	--	--	--	
1303	5.95	2.70	3.89	6.58	3.18	0.53	6.24	--	--	
1308	5.97	--	--	--	--	--	--	5.68	8.125	
1313	6.07	--	--	6.67	3.18	--	6.32	5.68	7.825	
1318	6.05	--	--	--	--	--	--	--	--	

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	Test Well: MW15	Obs Well: MW03	Obs Well: MW09	Obs Well: MW10	Obs Well: MW12	Obs Well: MW13	Obs Well: White Pipe 4-in	Obs Well: Artesian Well	Seep:	
1321	6.07	2.71	--	6.71	3.17	--	6.34	--	--	
1326	6.12	--	3.89	--	--	0.54	--	5.69	7.75	
1331	6.12	--	--	--	--	--	--	--	--	
1336	6.19	2.70	3.90	6.80	3.16	0.55	6.45	5.70	7.25	
1346	6.25	--	--	--	--	--	--	--	--	
1352	6.32	--	--	--	--	--	--	--	--	
1359	6.35	--	--	--	--	--	--	--	6.875	
1403	6.38	--	--	6.97	--	--	--	--	--	
1404	--	--	--	--	--	--	--	--	--	
1405	6.15	--	--	6.95	--	--	--	--	--	
1406	6.12	--	--	6.91	--	--	--	--	--	
1407	6.11	--	--	6.89	--	--	--	--	--	
1408	6.08	--	--	6.87	--	--	--	--	--	
1409	6.05	--	--	6.85	--	--	--	--	--	
1410	6.04	--	--	6.84	--	--	--	--	--	
1411	6.02	--	--	6.82	--	--	--	--	6.5	
1412	6.00	--	--	6.81	--	--	--	--	--	
1413	5.98	--	--	6.80	--	--	--	--	--	
1414	5.97	--	--	6.78	--	--	--	--	--	
1416	5.96	--	--	6.74	--	--	--	--	--	

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	Test Well: MW15	Obs Well: MW03	Obs Well: MW09	Obs Well: MW10	Obs Well: MW12	Obs Well: MW13	Obs Well: White Pipe 4-in	Obs Well: Artesian Well	Seep:	
1418	5.93	--	--	6.71	--	--	--	--	--	
1420	5.91	--	--	6.70	--	--	--	--	--	
1422	5.89	--	--	6.68	--	--	--	--	--	
1424	5.87	--	--	6.65	--	--	--	--	--	
1426	5.84	--	--	6.63	--	--	--	--	6.25	
1428	5.82	--	--	6.61	--	--	--	--	--	
1430	5.80	--	--	6.58	--	--	--	--	--	
1432	5.78	--	--	6.57	--	--	--	--	--	
1434	5.76	--	--	6.55	--	--	--	--	--	
1442	5.69	--	--	6.47	--	--	--	--	--	
1447	5.66	--	--	6.42	--	--	--	5.73	--	
1452	5.62	--	--	6.39	--	--	--	--	--	
1457	5.60	--	--	6.35	--	--	--	--	5.875	
1502	5.56	--	--	6.29	--	--	--	--	--	
1511	5.46	--	--	6.24	--	--	--	--	--	
1516	5.41	--	--	6.21	--	--	--	--	--	
1521	5.37	--	--	6.17	--	--	--	--	--	
1522	--	--	--	--	--	--	--	5.74	5.5	
1526	5.37	--	--	6.15	--	--	--	--	--	
1534	5.33	2.69	3.94	6.11	3.09	0.59	5.72	5.74	5.375	

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	Test Well: MW15	Obs Well: MW03	Obs Well: MW09	Obs Well: MW10	Obs Well: MW12	Obs Well: MW13	Obs Well: White Pipe 4-in	Obs Well: Artesian Well	Seep:	
1540	5.26	--	--	--	--	--	--	--	--	
1545	5.25	--	--	6.03	--	--	--	--	--	
1550	5.21	2.70	3.92	6.01	3.06	0.60	5.64	5.74	5.25	
1554	5.18	--	--	--	--	--	--	--	--	
1559	5.16	--	--	5.98	--	--	--	--	--	
1604	5.14	2.72	3.92	5.94	3.05	0.61	5.56	5.74	5.25	
1609	5.13	--	--	--	--	--	--	--	--	
1614	5.11	--	--	5.88	--	--	--	--	--	
1619	5.09	2.72	3.92	5.88	3.05	0.61	5.50	5.74	5.25	
1624	5.04	--	--	5.84	--	--	--	--	--	
1629	5.04	--	--	5.82	--	--	5.41	--	--	
1634	5.03	--	--	5.80	3.03	--	5.41	--	--	
1639	5.01	--	--	5.77	3.03	--	--	--	--	
1644	4.99	--	--	5.75	--	--	--	--	--	
1649	4.97	--	--	5.74	--	--	--	--	--	
1654	4.95	2.14	3.92	5.71	3.03	0.61	--	5.75	5.25	
1701	4.89	--	--	--	--	--	--	--	--	
1706	4.86	--	--	5.66	--	--	--	--	--	
1711	4.86	--	--	5.64	--	--	--	--	--	
1717	4.84	--	--	5.63	--	--	--	--	--	

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	Test Well: MW15	Obs Well: MW03	Obs Well: MW09	Obs Well: MW10	Obs Well: MW12	Obs Well: MW13	Obs Well: White Pipe 4-in	Obs Well: Artesian Well	Seep:	
1723	4.81	--	--	5.59	--	--	--	--	--	
1728	4.79	--	--	5.58	--	--	--	--	--	
1738	4.75	--	--	5.53	3.01	--	--	5.75	5.5	
1748	4.69	--	--	5.49	--	--	--	--	--	
1758	4.67	--	--	5.45	--	--	--	--	--	
1808	4.62	--	--	5.42	--	--	--	--	5.625	
1821	4.61	--	--	5.39	--	--	--	--	--	
1829	--	--	--	--	--	--	--	5.76	5.875	
1832	4.59	--	--	5.35	2.98	--	--	--	--	
1845	--	--	3.92	--	--	--	--	--	--	
1852	--	--	--	5.30	--	--	--	5.78	6	
1857	--	--	--	--	--	--	--	--	--	
1902	4.48	--	--	--	--	--	--	--	--	

Pumping Drawdown Data for MW-10

	Time (sec)	Drawdown (ft)
1	120	0.167879
2	180	0.265214
3	240	0.335418
4	300	0.38462
5	360	0.418716
6	420	0.448346
7	480	0.471251
8	540	0.496653
9	600	0.514868
10	660	0.536217
11	720	0.556332
12	780	0.57395
13	840	0.591439
14	900	0.609288
15	960	0.6269
16	1020	0.643146
17	1080	0.659271
18	1140	0.675273
19	1200	0.69181
20	1260	0.710023
21	1320	0.724239
22	1380	0.737687
23	1440	0.752623
24	1500	0.767145
25	1560	0.780113
26	1620	0.794512
27	1680	0.808556
28	1740	0.821231
29	1800	0.835685
30	1860	0.850024
31	1920	0.86419
32	1980	0.877281
33	2040	0.891741
34	2100	0.905898
35	2160	0.920717
36	2220	0.934346
37	2280	0.945829
38	2340	0.962961
39	2400	0.978606
40	2460	0.994146
41	2520	1.00949
42	2580	1.0239
43	2640	1.03722
44	2700	1.05257
45	2760	1.06614
46	2820	1.0806
47	2880	1.0928

	Time (sec)	Drawdown (ft)
48	2940	1.10857
49	3000	1.1232
50	3060	1.13517
51	3120	1.14742
52	3180	1.16212
53	3240	1.17028
54	3300	1.1839
55	3360	1.1989
56	3420	1.20931
57	3480	1.22139
58	3540	1.23305
59	3600	1.24465
60	3660	1.26263
61	3720	1.26798
62	3780	1.27596
63	3840	1.28702
64	3900	1.29571
65	3960	1.30273
66	4020	1.31333
67	4080	1.32029
68	4140	1.32933
69	4200	1.34082
70	4260	1.35963
71	4320	1.37468
72	4380	1.38563
73	4440	1.3992
74	4500	1.41008
75	4560	1.42032
76	4620	1.43335
77	4680	1.44502
78	4740	1.44805
79	4800	1.46549
80	4860	1.47686
81	4920	1.48626
82	4980	1.49685
83	5040	1.50673
84	5100	1.51756
85	5160	1.5257
86	5220	1.54053
87	5280	1.54499
88	5340	1.55368
89	5400	1.56308
90	5460	1.57118
91	5520	1.5807
92	5580	1.59068
93	5640	1.60129
94	5700	1.60777

	Time (sec)	Drawdown (ft)
95	5760	1.61646
96	5820	1.62354
97	5880	1.63425
98	5940	1.64068
99	6000	1.63877
100	6060	1.65603
101	6120	1.66758
102	6180	1.67489
103	6240	1.68209
104	6300	1.68495
105	6360	1.70233
106	6420	1.709
107	6480	1.71798
108	6540	1.72726
109	6600	1.73512
110	6660	1.74548
111	6720	1.74821
112	6780	1.7597
113	6840	1.76982
114	6900	1.77874
115	6960	1.78744
116	7020	1.77208
117	7080	1.8044
118	7140	1.81035
119	7200	1.82076
120	7260	1.82933
121	7320	1.83737
122	7380	1.84492
123	7440	1.85361
124	7500	1.86015
125	7560	1.8589
126	7620	1.86313
127	7680	1.86825
128	7740	1.87081
129	7800	1.87712
130	7860	1.88057
131	7920	1.88575
132	7980	1.88985
133	8040	1.89372
134	8100	1.89991
135	8160	1.91574
136	8220	1.92413
137	8280	1.93288
138	8340	1.94079
139	8400	1.94889
140	8460	1.95709
141	8520	1.96495

	Time (sec)	Drawdown (ft)
142	8580	1.96507
143	8640	1.96823
144	8700	1.97334
145	8760	1.97781
146	8820	1.98364
147	8880	1.98712
148	8940	1.99448
149	9000	1.99793
150	9060	2.00727
151	9120	2.01542
152	9180	2.02107
153	9240	2.02899
154	9300	2.03494
155	9360	2.04547
156	9420	2.05
157	9480	2.05577
158	9540	2.06405
159	9600	2.06981
160	9660	2.07613
161	9720	2.08326
162	9780	2.09195
163	9840	2.09714
164	9900	2.10226
165	9960	2.11344
166	10020	2.11773
167	10080	2.12421
168	10140	2.12867
169	10200	2.1382
170	10260	2.14379
171	10320	2.15176
172	10380	2.15671
173	10440	2.16373
174	10500	2.17069
175	10560	2.17849
176	10620	2.18498
177	10680	2.1898
178	10740	2.19587
179	10800	2.20497
180	10860	2.21205
181	10920	2.21937
182	10980	2.22539
183	11040	2.23212
184	11100	2.23854
185	11160	2.24562
186	11220	2.25389
187	11280	2.25818
188	11340	2.26342

	Time (sec)	Drawdown (ft)
189	11400	2.27205
190	11460	2.27686

Recovery Drawdown Data for MW-10

	Time (sec)	Drawdown (ft)
1	0	0
2	60	0.022556
3	120	0.048745
4	180	0.067196
5	240	0.080405
6	300	0.096949
7	360	0.111058
8	420	0.125102
9	480	0.137596
10	540	0.150752
11	600	0.163666
12	660	0.174675
13	720	0.186939
14	780	0.19646
15	840	0.208596
16	900	0.218709
17	960	0.229246
18	1020	0.244009
19	1080	0.253649
20	1140	0.264538
21	1200	0.274184
22	1260	0.284057
23	1320	0.293226
24	1380	0.302684
25	1440	0.314707
26	1500	0.323873
27	1560	0.334285
28	1620	0.345772
29	1680	0.356133
30	1740	0.365292
31	1800	0.374874
32	1860	0.385347
33	1920	0.394393
34	1980	0.401831
35	2040	0.413915
36	2100	0.422125
37	2160	0.433018
38	2220	0.440336
39	2280	0.451937
40	2340	0.461579
41	2400	0.466105
42	2460	0.485446
43	2520	0.488301
44	2580	0.497465
45	2640	0.508238
46	2700	0.515024
47	2760	0.523948

	Time (sec)	Drawdown (ft)
48	2820	0.534422
49	2880	0.540726
50	2940	0.548823
51	3000	0.557094
52	3060	0.568464
53	3120	0.572511
54	3180	0.579892
55	3240	0.587978
56	3300	0.596845
57	3360	0.604229
58	3420	0.61077
59	3480	0.61714
60	3540	0.625648
61	3600	0.631957
62	3660	0.639159
63	3720	0.647021
64	3780	0.654037
65	3840	0.659803
66	3900	0.666062
67	3960	0.674267
68	4020	0.680402
69	4080	0.687779
70	4140	0.69325
71	4200	0.699316
72	4260	0.706165
73	4320	0.714135
74	4380	0.719613
75	4440	0.726222
76	4500	0.732291
77	4560	0.737763
78	4620	0.743063
79	4680	0.750138
80	4740	0.756449
81	4800	0.76329
82	4860	0.766627
83	4920	0.774893
84	4980	0.78013
85	5040	0.787275
86	5100	0.792505
87	5160	0.799886
88	5220	0.805072
89	5280	0.810835
90	5340	0.815303
91	5400	0.792743
92	5460	0.82357
93	5520	0.828927
94	5580	0.832796

	Time (sec)	Drawdown (ft)
95	5640	0.841243
96	5700	0.845
97	5760	0.851066
98	5820	0.856542
99	5880	0.863201
100	5940	0.868504
101	6000	0.878441
102	6060	0.879276
103	6120	0.885228
104	6180	0.891598
105	6240	0.896004
106	6300	0.899691
107	6360	0.905167
108	6420	0.910223
109	6480	0.915704
110	6540	0.920345
111	6600	0.926355
112	6660	0.930285
113	6720	0.935105
114	6780	0.939096
115	6840	0.946356
116	6900	0.951711
117	6960	0.957064
118	7020	0.961829
119	7080	0.966951
120	7140	0.970344
121	7200	0.97706
122	7260	0.980511
123	7320	0.984505
124	7380	0.990134
125	7440	0.995337
126	7500	0.99805
127	7560	1.00557
128	7620	1.00826
129	7680	1.01239
130	7740	1.0173
131	7800	1.02236
132	7860	1.02772
133	7920	1.02974
134	7980	1.02974
135	8040	1.04087
136	8100	1.04617
137	8160	1.04813
138	8220	1.05551
139	8280	1.05992
140	8340	1.06498
141	8400	1.0701

	Time (sec)	Drawdown (ft)
142	8460	1.072
143	8520	1.0767
144	8580	1.08057
145	8640	1.0883
146	8700	1.09051
147	8760	1.09569
148	8820	1.0992
149	8880	1.10372
150	8940	1.10974
151	9000	1.11301
152	9060	1.11776
153	9120	1.12109
154	9180	1.12574
155	9240	1.12913
156	9300	1.13347
157	9360	1.13901
158	9420	1.14413
159	9480	1.14788
160	9540	1.15295
161	9600	1.14865
162	9660	1.15859
163	9720	1.16478
164	9780	1.16722
165	9840	1.17103
166	9900	1.17567
167	9960	1.18228
168	10020	1.18561
169	10080	1.19067
170	10140	1.19359
171	10200	1.19728
172	10260	1.2018
173	10320	1.20621
174	10380	1.2099
175	10440	1.21442
176	10500	1.21793
177	10560	1.22204
178	10620	1.22662
179	10680	1.23031
180	10740	1.23537
181	10800	1.23989
182	10860	1.244
183	10920	1.24948
184	10980	1.25156
185	11040	1.25561
186	11100	1.26048
187	11160	1.26441
188	11220	1.26888

	Time (sec)	Drawdown (ft)
189	11280	1.27334
190	11340	1.27786
191	11400	1.28137
192	11460	1.2859
193	11520	1.29084
194	11580	1.29411
195	11640	1.299
196	11700	1.30137
197	11760	1.30322
198	11820	1.30881
199	11880	1.31541
200	11940	1.31785
201	12000	1.32291
202	12060	1.32644
203	12120	1.32941
204	12180	1.33423
205	12240	1.33613
206	12300	1.34131
207	12360	1.34434
208	12420	1.34928
209	12480	1.35338
210	12540	1.35844
211	12600	1.36267
212	12660	1.366
213	12720	1.37029
214	12780	1.37107
215	12840	1.37671
216	12900	1.38029
217	12960	1.38511
218	13020	1.38684
219	13080	1.39142
220	13140	1.3938
221	13200	1.39957
222	13260	1.40278
223	13320	1.40546
224	13380	1.4126
225	13440	1.41362
226	13500	1.41629
227	13560	1.42147
228	13620	1.42433
229	13680	1.42855
230	13740	1.43046
231	13800	1.43403
232	13860	1.44003
233	13920	1.44159
234	13980	1.44665
235	14040	1.44968

	Time (sec)	Drawdown (ft)
236	14100	1.45218
237	14160	1.45486
238	14220	1.45939
239	14280	1.46313
240	14340	1.46563
241	14400	1.46967
242	14460	1.47188
243	14520	1.47622
244	14580	1.47807
245	14640	1.48116
246	14700	1.48545
247	14760	1.4882
248	14820	1.48926
249	14880	1.4958
250	14940	1.4986
251	15000	1.50152
252	15060	1.5033
253	15120	1.50729
254	15180	1.50908
255	15240	1.5136
256	15300	1.51592
257	15360	1.51783
258	15420	1.52014
259	15480	1.52395
260	15540	1.52604
261	15600	1.52919
262	15660	1.53163
263	15720	1.53377
264	15780	1.53645
265	15840	1.5405
266	15900	1.54175
267	15960	1.54526
268	16020	1.54729
269	16080	1.55109
270	16140	1.55424
271	16200	1.55454
272	16260	1.55692
273	16320	1.56002
274	16380	1.56168
275	16440	1.56556
276	16500	1.56742
277	16560	1.56781
278	16620	1.57133
279	16680	1.57323
280	16740	1.57579
281	16800	1.5793
282	16860	1.57983

	Time (sec)	Drawdown (ft)
283	16920	1.58228
284	16980	1.58567
285	17040	1.58651
286	17100	1.59007
287	17160	1.59174
288	17220	1.5923
289	17280	1.594
290	17340	1.59912
291	17400	1.60019
292	17460	1.6084
293	17520	1.60483

APPENDIX C
AIR LABORATORY ANALYTICAL REPORTS

Air Toxics Ltd. #1012179

12/22/2010
Ms. Suzanne Stumpf
Sound Environmental Strategies Corp
2811 Fairview Avenue East
Suite 2000
Seattle WA 98102

Project Name: ODC
Project #: 0566-001-04
Workorder #: 1012179

Dear Ms. Suzanne Stumpf

The following report includes the data for the above referenced project for sample(s) received on 12/8/2010 at Air Toxics Ltd.

The data and associated QC analyzed by Modified TO-15 are compliant with the project requirements or laboratory criteria with the exception of the deviations noted in the attached case narrative.

Thank you for choosing Air Toxics Ltd. for your air analysis needs. Air Toxics Ltd. is committed to providing accurate data of the highest quality. Please feel free to contact the Project Manager: Karen Lopez at 916-985-1000 if you have any questions regarding the data in this report.

Regards,

Karen Lopez

Karen Lopez
Project Manager

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630
(916) 985-1000 .FAX (916) 985-1020
Hours 6:30 A.M to 5:30 PST

Air Toxics LTD.
Laboratory Services Since 1989

WORK ORDER #: 1012179

Work Order Summary

CLIENT:	Ms. Suzanne Stumpf Sound Environmental Strategies Corp 2811 Fairview Avenue East Suite 2000 Seattle, WA 98102	**BILL TO:**	Ms. Suzanne Stumpf Sound Environmental Strategies Corp 2811 Fairview Avenue East Suite 2000 Seattle, WA 98102
PHONE:	206-306-1900	**P.O. #**	0566
FAX:	206-306-1907	**PROJECT #**	0566-001-04 ODC
DATE RECEIVED:	12/08/2010	**CONTACT:**	Karen Lopez
DATE COMPLETED:	12/22/2010		

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.	FINAL PRESSURE
01A	VS-3-20101203	Modified TO-15	5.0 "Hg	5 psi
01B	VS-3-20101203	Modified TO-15	5.0 "Hg	5 psi
02A	VS-6-20101203	Modified TO-15	6.0 "Hg	5 psi
02B	VS-6-20101203	Modified TO-15	6.0 "Hg	5 psi
03A	VS-7-20101203	Modified TO-15	5.5 "Hg	5 psi
03B	VS-7-20101203	Modified TO-15	5.5 "Hg	5 psi
04A	VS-4-20101203	Modified TO-15	4.5 "Hg	5 psi
04B	VS-4-20101203	Modified TO-15	4.5 "Hg	5 psi
05A	VS-5-20101203	Modified TO-15	6.0 "Hg	5 psi
05B	VS-5-20101203	Modified TO-15	6.0 "Hg	5 psi
06A	VS-8-20101203	Modified TO-15	3.0 "Hg	5 psi
06B	VS-8-20101203	Modified TO-15	3.0 "Hg	5 psi
07A	VS-1-20101203	Modified TO-15	5.0 "Hg	5 psi
08A	VS-2-20101203	Modified TO-15	2.0 "Hg	5 psi
09A	Lab Blank	Modified TO-15	NA	NA
09B	Lab Blank	Modified TO-15	NA	NA
09C	Lab Blank	Modified TO-15	NA	NA

Continued on next page

Air Toxics LTD.
Laboratory Services Since 1989

WORK ORDER #: 1012179

Work Order Summary

CLIENT:	Ms. Suzanne Stumpf Sound Environmental Strategies Corp 2811 Fairview Avenue East Suite 2000 Seattle, WA 98102	**BILL TO:**	Ms. Suzanne Stumpf Sound Environmental Strategies Corp 2811 Fairview Avenue East Suite 2000 Seattle, WA 98102
PHONE:	206-306-1900	**P.O. #**	0566
FAX:	206-306-1907	**PROJECT #**	0566-001-04 ODC
DATE RECEIVED:	12/08/2010	**CONTACT:**	Karen Lopez
DATE COMPLETED:	12/22/2010		

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.	FINAL PRESSURE
10A	CCV	Modified TO-15	NA	NA
10B	CCV	Modified TO-15	NA	NA
10C	CCV	Modified TO-15	NA	NA
11A	LCS	Modified TO-15	NA	NA
11AA	LCSD	Modified TO-15	NA	NA
11B	LCS	Modified TO-15	NA	NA
11BB	LCSD	Modified TO-15	NA	NA
11C	LCS	Modified TO-15	NA	NA
11CC	LCSD	Modified TO-15	NA	NA

CERTIFIED BY: Linda d. Freeman DATE: 12/22/10

Laboratory Director

Certfication numbers: CA NELAP - 02110CA, LA NELAP/LELAP- AI 30763,
NY NELAP - 11291, UT NELAP - 9166389892, AZ Licensure AZ0719
Name of Accrediting Agency: NELAP/Florida Department of Health, Scope of Application: Clean Air Act,
Accreditation number: E87680, Effective date: 07/01/09, Expiration date: 06/30/11
Air Toxics Ltd. certifies that the test results contained in this report meet all requirements of the NELAC standards

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630
(916) 985-1000 . (800) 985-5955 . FAX (916) 985-1020

LABORATORY NARRATIVE
Modified TO-15 Full Scan/SIM
Sound Environmental Strategies Corp
Workorder# 1012179

Eight 6 Liter Summa Canister (SIM Certified) samples were received on December 08, 2010. The laboratory performed analysis via modified EPA Method TO-15 using GC/MS in the Full Scan and SIM acquisition modes. The method involves concentrating up to 1.0 liters of air. The concentrated aliquot is then flash vaporized and swept through a water management system to remove water vapor. Following dehumidification, the sample passes directly into the GC/MS for analysis.

This workorder was independently validated prior to submittal using 'USEPA National Functional Guidelines' as generally applied to the analysis of volatile organic compounds in air. A rules-based, logic driven, independent validation engine was employed to assess completeness, evaluate pass/fail of relevant project quality control requirements and verification of all quantified amounts.

Method modifications taken to run these samples are summarized in the table below. Specific project requirements may over-ride the ATL modifications.

Requirement	***TO-15***	***ATL Modifications***
ICAL %RSD acceptance criteria	</=30% RSD with 2 compounds allowed out to < 40% RSD	For Full Scan: 30% RSD with 4 compounds allowed out to < 40% RSD For SIM: Project specific; default criteria is </=30% RSD with 10% of compounds allowed out to < 40% RSD
Daily Calibration	+- 30% Difference	For Full Scan: </= 30% Difference with four allowed out up to </=40%.; flag and narrate outliers For SIM: Project specific; default criteria is </= 30% Difference with 10% of compounds allowed out up to </=40%.; flag and narrate outliers
Blank and standards	Zero air	Nitrogen
Method Detection Limit	Follow 40CFR Pt.136 App. B	The MDL met all relevant requirements in Method TO-15 (statistical MDL less than the LOQ). The concentration of the spiked replicate may have exceeded 10X the calculated MDL in some cases

Receiving Notes

There were no receiving discrepancies.

Analytical Notes

The reported CCV for each daily batch may be derived from more than one analytical file due to the client's request for non-standard compounds.

Non-standard compounds may have different acceptance criteria than the standard TO-14A/TO-15 compound list as per contract or verbal agreement.

The results for each sample in this report were acquired from two separate data files originating from the same analytical run. The two data files have the same base file name and are differentiated with a "sim" extension on the SIM data file.

Samples VS-1-20101203 and VS-2-20101203 were transferred from SIM/Low Level analysis to full scan TO-15 due to high levels of target compounds.

Definition of Data Qualifying Flags

Eight qualifiers may have been used on the data analysis sheets and indicates as follows:

B - Compound present in laboratory blank greater than reporting limit (background subtraction not performed).

J - Estimated value.

E - Exceeds instrument calibration range.

S - Saturated peak.

Q - Exceeds quality control limits.

U - Compound analyzed for but not detected above the reporting limit.

UJ- Non-detected compound associated with low bias in the CCV

N - The identification is based on presumptive evidence.

File extensions may have been used on the data analysis sheets and indicates as follows:

a-File was requantified

b-File was quantified by a second column and detector

r1-File was requantified for the purpose of reissue

Laboratory Services Since 1989

Summary of Detected Compounds
MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

Client Sample ID: VS-3-20101203

Lab ID#: 1012179-01A

No Detections Were Found.

Client Sample ID: VS-3-20101203

Lab ID#: 1012179-01B

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Benzene	0.080	0.52	0.26	1.6
Toluene	0.032	1.4	0.12	5.4
Tetrachloroethene	0.032	0.042	0.22	0.28
Ethyl Benzene	0.032	0.18	0.14	0.79
m,p-Xylene	0.064	0.50	0.28	2.2
o-Xylene	0.032	0.18	0.14	0.79

Client Sample ID: VS-6-20101203

Lab ID#: 1012179-02A

No Detections Were Found.

Client Sample ID: VS-6-20101203

Lab ID#: 1012179-02B

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Benzene	0.084	0.46	0.27	1.5
Toluene	0.034	1.4	0.13	5.2
Tetrachloroethene	0.034	0.040	0.23	0.27
Ethyl Benzene	0.034	0.16	0.14	0.68
m,p-Xylene	0.067	0.44	0.29	1.9
o-Xylene	0.034	0.16	0.14	0.70

Client Sample ID: VS-7-20101203

Lab ID#: 1012179-03A

No Detections Were Found.

Summary of Detected Compounds
MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

Client Sample ID: VS-7-20101203

Lab ID#: 1012179-03B

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Benzene	0.082	0.77	0.26	2.5
1,2-Dichloroethane	0.033	0.048	0.13	0.20
Toluene	0.033	1.4	0.12	5.3
Tetrachloroethene	0.033	0.052	0.22	0.35
Ethyl Benzene	0.033	0.29	0.14	1.3
m,p-Xylene	0.066	1.2	0.28	5.0
o-Xylene	0.033	0.47	0.14	2.0

Client Sample ID: VS-4-20101203

Lab ID#: 1012179-04A

No Detections Were Found.

Client Sample ID: VS-4-20101203

Lab ID#: 1012179-04B

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Benzene	0.079	0.53	0.25	1.7
Toluene	0.032	1.6	0.12	6.0
Tetrachloroethene	0.032	0.040	0.21	0.27
Ethyl Benzene	0.032	0.18	0.14	0.77
m,p-Xylene	0.063	0.50	0.27	2.2
o-Xylene	0.032	0.18	0.14	0.79

Client Sample ID: VS-5-20101203

Lab ID#: 1012179-05A

No Detections Were Found.

Client Sample ID: VS-5-20101203

Lab ID#: 1012179-05B

Air Toxics LTD.
Laboratory Services Since 1989

Summary of Detected Compounds
MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

Client Sample ID: VS-5-20101203

Lab ID#: 1012179-05B

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Benzene	0.084	0.57	0.27	1.8
Toluene	0.034	1.2	0.13	4.5
Tetrachloroethene	0.034	0.040	0.23	0.27
Ethyl Benzene	0.034	0.13	0.14	0.58
m,p-Xylene	0.067	0.38	0.29	1.6
o-Xylene	0.034	0.14	0.14	0.62

Client Sample ID: VS-8-20101203

Lab ID#: 1012179-06A

No Detections Were Found.

Client Sample ID: VS-8-20101203

Lab ID#: 1012179-06B

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Benzene	0.074	0.50	0.24	1.6
Toluene	0.030	1.3	0.11	4.9
Tetrachloroethene	0.030	0.053	0.20	0.36
Ethyl Benzene	0.030	0.14	0.13	0.60
m,p-Xylene	0.060	0.44	0.26	1.9
o-Xylene	0.030	0.17	0.13	0.72

Client Sample ID: VS-1-20101203

Lab ID#: 1012179-07A

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1-Difluoroethane	320000	82000000 E	870000	220000000 E

Client Sample ID: VS-2-20101203

Lab ID#: 1012179-08A

Summary of Detected Compounds
MODIFIED EPA METHOD TO-15 GC/MS

Client Sample ID: VS-2-20101203

Lab ID#: 1012179-08A

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1-Difluoroethane	210000	77000000 E	560000	210000000 E

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: VS-3-20101203

Lab ID#: 1012179-01A

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122108**	**Date of Collection: 12/3/10 5:10:00 PM**
Dil. Factor:	**1.61**	**Date of Analysis: 12/21/10 01:46 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1-Difluoroethane	0.80	Not Detected	2.2	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	110	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	94	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: VS-3-20101203

Lab ID#: 1012179-01B

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122108sim**	**Date of Collection:**	**12/3/10 5:10:00 PM**
Dil. Factor:	**1.61**	**Date of Analysis:**	**12/21/10 01:46 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.016	Not Detected	0.041	Not Detected
1,1-Dichloroethene	0.016	Not Detected	0.064	Not Detected
1,1-Dichloroethane	0.032	Not Detected	0.13	Not Detected
cis-1,2-Dichloroethene	0.032	Not Detected	0.13	Not Detected
1,1,1-Trichloroethane	0.032	Not Detected	0.18	Not Detected
Benzene	0.080	0.52	0.26	1.6
1,2-Dichloroethane	0.032	Not Detected	0.13	Not Detected
Trichloroethene	0.032	Not Detected	0.17	Not Detected
Toluene	0.032	1.4	0.12	5.4
Tetrachloroethene	0.032	0.042	0.22	0.28
Ethyl Benzene	0.032	0.18	0.14	0.79
m,p-Xylene	0.064	0.50	0.28	2.2
o-Xylene	0.032	0.18	0.14	0.79
trans-1,2-Dichloroethene	0.16	Not Detected	0.64	Not Detected
Chloroethane	0.080	Not Detected	0.21	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	110	70-130
Toluene-d8	104	70-130
4-Bromofluorobenzene	94	70-130

Client Sample ID: VS-6-20101203

Lab ID#: 1012179-02A

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122109**	**Date of Collection:**	**12/3/10 4:52:00 PM**
Dil. Factor:	**1.68**	**Date of Analysis:**	**12/21/10 02:21 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1-Difluoroethane	0.84	Not Detected	2.3	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	110	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	92	70-130

Client Sample ID: VS-6-20101203

Lab ID#: 1012179-02B

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122109sim**	**Date of Collection:**	**12/3/10 4:52:00 PM**
Dil. Factor:	**1.68**	**Date of Analysis:**	**12/21/10 02:21 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.017	Not Detected	0.043	Not Detected
1,1-Dichloroethene	0.017	Not Detected	0.067	Not Detected
1,1-Dichloroethane	0.034	Not Detected	0.14	Not Detected
cis-1,2-Dichloroethene	0.034	Not Detected	0.13	Not Detected
1,1,1-Trichloroethane	0.034	Not Detected	0.18	Not Detected
Benzene	0.084	0.46	0.27	1.5
1,2-Dichloroethane	0.034	Not Detected	0.14	Not Detected
Trichloroethene	0.034	Not Detected	0.18	Not Detected
Toluene	0.034	1.4	0.13	5.2
Tetrachloroethene	0.034	0.040	0.23	0.27
Ethyl Benzene	0.034	0.16	0.14	0.68
m,p-Xylene	0.067	0.44	0.29	1.9
o-Xylene	0.034	0.16	0.14	0.70
trans-1,2-Dichloroethene	0.17	Not Detected	0.67	Not Detected
Chloroethane	0.084	Not Detected	0.22	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	110	70-130
Toluene-d8	104	70-130
4-Bromofluorobenzene	95	70-130

Air Toxics LTD. Laboratory Services Since 1989

Client Sample ID: VS-7-20101203

Lab ID#: 1012179-03A

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122110**	**Date of Collection: 12/3/10 5:17:00 PM**
Dil. Factor:	**1.64**	**Date of Analysis: 12/21/10 02:56 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1-Difluoroethane	0.82	Not Detected	2.2	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	106	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	90	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: VS-7-20101203

Lab ID#: 1012179-03B

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122110sim**	**Date of Collection:**	**12/3/10 5:17:00 PM**
Dil. Factor:	**1.64**	**Date of Analysis:**	**12/21/10 02:56 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.016	Not Detected	0.042	Not Detected
1,1-Dichloroethene	0.016	Not Detected	0.065	Not Detected
1,1-Dichloroethane	0.033	Not Detected	0.13	Not Detected
cis-1,2-Dichloroethene	0.033	Not Detected	0.13	Not Detected
1,1,1-Trichloroethane	0.033	Not Detected	0.18	Not Detected
Benzene	0.082	0.77	0.26	2.5
1,2-Dichloroethane	0.033	0.048	0.13	0.20
Trichloroethene	0.033	Not Detected	0.18	Not Detected
Toluene	0.033	1.4	0.12	5.3
Tetrachloroethene	0.033	0.052	0.22	0.35
Ethyl Benzene	0.033	0.29	0.14	1.3
m,p-Xylene	0.066	1.2	0.28	5.0
o-Xylene	0.033	0.47	0.14	2.0
trans-1,2-Dichloroethene	0.16	Not Detected	0.65	Not Detected
Chloroethane	0.082	Not Detected	0.22	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	110	70-130
Toluene-d8	102	70-130
4-Bromofluorobenzene	91	70-130

Client Sample ID: VS-4-20101203

Lab ID#: 1012179-04A

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122111**	**Date of Collection: 12/3/10 5:07:00 PM**
Dil. Factor:	**1.58**	**Date of Analysis: 12/21/10 03:46 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1-Difluoroethane	0.79	Not Detected	2.1	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	106	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	91	70-130

Laboratory Services Since 1989

Client Sample ID: VS-4-20101203

Lab ID#: 1012179-04B

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122111sim**	**Date of Collection:**	**12/3/10 5:07:00 PM**
Dil. Factor:	**1.58**	**Date of Analysis:**	**12/21/10 03:46 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.016	Not Detected	0.040	Not Detected
1,1-Dichloroethene	0.016	Not Detected	0.063	Not Detected
1,1-Dichloroethane	0.032	Not Detected	0.13	Not Detected
cis-1,2-Dichloroethene	0.032	Not Detected	0.12	Not Detected
1,1,1-Trichloroethane	0.032	Not Detected	0.17	Not Detected
Benzene	0.079	0.53	0.25	1.7
1,2-Dichloroethane	0.032	Not Detected	0.13	Not Detected
Trichloroethene	0.032	Not Detected	0.17	Not Detected
Toluene	0.032	1.6	0.12	6.0
Tetrachloroethene	0.032	0.040	0.21	0.27
Ethyl Benzene	0.032	0.18	0.14	0.77
m,p-Xylene	0.063	0.50	0.27	2.2
o-Xylene	0.032	0.18	0.14	0.79
trans-1,2-Dichloroethene	0.16	Not Detected	0.63	Not Detected
Chloroethane	0.079	Not Detected	0.21	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	110	70-130
Toluene-d8	104	70-130
4-Bromofluorobenzene	93	70-130

Client Sample ID: VS-5-20101203

Lab ID#: 1012179-05A

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122112**	**Date of Collection: 12/3/10 4:55:00 PM**
Dil. Factor:	**1.68**	**Date of Analysis: 12/21/10 04:38 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1-Difluoroethane	0.84	Not Detected	2.3	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	105	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	94	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: VS-5-20101203

Lab ID#: 1012179-05B

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122112sim**	**Date of Collection:**	**12/3/10 4:55:00 PM**
Dil. Factor:	**1.68**	**Date of Analysis:**	**12/21/10 04:38 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.017	Not Detected	0.043	Not Detected
1,1-Dichloroethene	0.017	Not Detected	0.067	Not Detected
1,1-Dichloroethane	0.034	Not Detected	0.14	Not Detected
cis-1,2-Dichloroethene	0.034	Not Detected	0.13	Not Detected
1,1,1-Trichloroethane	0.034	Not Detected	0.18	Not Detected
Benzene	0.084	0.57	0.27	1.8
1,2-Dichloroethane	0.034	Not Detected	0.14	Not Detected
Trichloroethene	0.034	Not Detected	0.18	Not Detected
Toluene	0.034	1.2	0.13	4.5
Tetrachloroethene	0.034	0.040	0.23	0.27
Ethyl Benzene	0.034	0.13	0.14	0.58
m,p-Xylene	0.067	0.38	0.29	1.6
o-Xylene	0.034	0.14	0.14	0.62
trans-1,2-Dichloroethene	0.17	Not Detected	0.67	Not Detected
Chloroethane	0.084	Not Detected	0.22	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	108	70-130
Toluene-d8	105	70-130
4-Bromofluorobenzene	94	70-130

Client Sample ID: VS-8-20101203

Lab ID#: 1012179-06A

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122113**	**Date of Collection: 12/3/10 5:22:00 PM**
Dil. Factor:	**1.49**	**Date of Analysis: 12/21/10 05:37 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1-Difluoroethane	0.74	Not Detected	2.0	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	106	70-130
Toluene-d8	104	70-130
4-Bromofluorobenzene	92	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: VS-8-20101203

Lab ID#: 1012179-06B

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122113sim**	**Date of Collection:**	**12/3/10 5:22:00 PM**
Dil. Factor:	**1.49**	**Date of Analysis:**	**12/21/10 05:37 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.015	Not Detected	0.038	Not Detected
1,1-Dichloroethene	0.015	Not Detected	0.059	Not Detected
1,1-Dichloroethane	0.030	Not Detected	0.12	Not Detected
cis-1,2-Dichloroethene	0.030	Not Detected	0.12	Not Detected
1,1,1-Trichloroethane	0.030	Not Detected	0.16	Not Detected
Benzene	0.074	0.50	0.24	1.6
1,2-Dichloroethane	0.030	Not Detected	0.12	Not Detected
Trichloroethene	0.030	Not Detected	0.16	Not Detected
Toluene	0.030	1.3	0.11	4.9
Tetrachloroethene	0.030	0.053	0.20	0.36
Ethyl Benzene	0.030	0.14	0.13	0.60
m,p-Xylene	0.060	0.44	0.26	1.9
o-Xylene	0.030	0.17	0.13	0.72
trans-1,2-Dichloroethene	0.15	Not Detected	0.59	Not Detected
Chloroethane	0.074	Not Detected	0.20	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	110	70-130
Toluene-d8	106	70-130
4-Bromofluorobenzene	94	70-130

Client Sample ID: VS-1-20101203

Lab ID#: 1012179-07A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**b122108**	**Date of Collection: 12/3/10 4:07:00 PM**
Dil. Factor:	**16100**	**Date of Analysis: 12/21/10 01:00 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	80000	Not Detected	200000	Not Detected
Chloroethane	80000	Not Detected	210000	Not Detected
1,1-Dichloroethene	80000	Not Detected	320000	Not Detected
trans-1,2-Dichloroethene	80000	Not Detected	320000	Not Detected
1,1-Dichloroethane	80000	Not Detected	320000	Not Detected
cis-1,2-Dichloroethene	80000	Not Detected	320000	Not Detected
1,1,1-Trichloroethane	80000	Not Detected	440000	Not Detected
Benzene	80000	Not Detected	260000	Not Detected
1,2-Dichloroethane	80000	Not Detected	320000	Not Detected
Trichloroethene	80000	Not Detected	430000	Not Detected
Toluene	80000	Not Detected	300000	Not Detected
Tetrachloroethene	80000	Not Detected	550000	Not Detected
Ethyl Benzene	80000	Not Detected	350000	Not Detected
m,p-Xylene	80000	Not Detected	350000	Not Detected
o-Xylene	80000	Not Detected	350000	Not Detected
1,1-Difluoroethane	320000	82000000 E	870000	220000000 E

E = Exceeds instrument calibration range.

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	106	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	102	70-130

Client Sample ID: VS-2-20101203

Lab ID#: 1012179-08A

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**b122107**	**Date of Collection: 12/3/10 4:07:00 PM**
Dil. Factor:	**10300**	**Date of Analysis: 12/21/10 12:13 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	52000	Not Detected	130000	Not Detected
Chloroethane	52000	Not Detected	140000	Not Detected
1,1-Dichloroethene	52000	Not Detected	200000	Not Detected
trans-1,2-Dichloroethene	52000	Not Detected	200000	Not Detected
1,1-Dichloroethane	52000	Not Detected	210000	Not Detected
cis-1,2-Dichloroethene	52000	Not Detected	200000	Not Detected
1,1,1-Trichloroethane	52000	Not Detected	280000	Not Detected
Benzene	52000	Not Detected	160000	Not Detected
1,2-Dichloroethane	52000	Not Detected	210000	Not Detected
Trichloroethene	52000	Not Detected	280000	Not Detected
Toluene	52000	Not Detected	190000	Not Detected
Tetrachloroethene	52000	Not Detected	350000	Not Detected
Ethyl Benzene	52000	Not Detected	220000	Not Detected
m,p-Xylene	52000	Not Detected	220000	Not Detected
o-Xylene	52000	Not Detected	220000	Not Detected
1,1-Difluoroethane	210000	77000000 E	560000	210000000 E

E = Exceeds instrument calibration range.

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	109	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	104	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: Lab Blank

Lab ID#: 1012179-09A

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122107a**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 12/21/10 12:55 PM**	

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
1,1-Difluoroethane	0.50	Not Detected	1.4	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	104	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	90	70-130

Client Sample ID: Lab Blank

Lab ID#: 1012179-09B

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122107sim**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 12/21/10 12:55 PM**	

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.010	Not Detected	0.026	Not Detected
1,1-Dichloroethene	0.010	Not Detected	0.040	Not Detected
1,1-Dichloroethane	0.020	Not Detected	0.081	Not Detected
cis-1,2-Dichloroethene	0.020	Not Detected	0.079	Not Detected
1,1,1-Trichloroethane	0.020	Not Detected	0.11	Not Detected
Benzene	0.050	Not Detected	0.16	Not Detected
1,2-Dichloroethane	0.020	Not Detected	0.081	Not Detected
Trichloroethene	0.020	Not Detected	0.11	Not Detected
Toluene	0.020	Not Detected	0.075	Not Detected
Tetrachloroethene	0.020	Not Detected	0.14	Not Detected
Ethyl Benzene	0.020	Not Detected	0.087	Not Detected
m,p-Xylene	0.040	Not Detected	0.17	Not Detected
o-Xylene	0.020	Not Detected	0.087	Not Detected
trans-1,2-Dichloroethene	0.10	Not Detected	0.40	Not Detected
Chloroethane	0.050	Not Detected	0.13	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	109	70-130
Toluene-d8	105	70-130
4-Bromofluorobenzene	92	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: Lab Blank

Lab ID#: 1012179-09C

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**b122106c**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 12/21/10 11:18 AM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	5.0	Not Detected	13	Not Detected
Chloroethane	5.0	Not Detected	13	Not Detected
1,1-Dichloroethene	5.0	Not Detected	20	Not Detected
trans-1,2-Dichloroethene	5.0	Not Detected	20	Not Detected
1,1-Dichloroethane	5.0	Not Detected	20	Not Detected
cis-1,2-Dichloroethene	5.0	Not Detected	20	Not Detected
1,1,1-Trichloroethane	5.0	Not Detected	27	Not Detected
Benzene	5.0	Not Detected	16	Not Detected
1,2-Dichloroethane	5.0	Not Detected	20	Not Detected
Trichloroethene	5.0	Not Detected	27	Not Detected
Toluene	5.0	Not Detected	19	Not Detected
Tetrachloroethene	5.0	Not Detected	34	Not Detected
Ethyl Benzene	5.0	Not Detected	22	Not Detected
m,p-Xylene	5.0	Not Detected	22	Not Detected
o-Xylene	5.0	Not Detected	22	Not Detected
1,1-Difluoroethane	20	Not Detected	54	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	105	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	102	70-130

Client Sample ID: CCV

Lab ID#: 1012179-10A

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122106**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 12/21/10 11:47 AM**

Compound	%Recovery
1,1-Difluoroethane	107

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	114	70-130
Toluene-d8	99	70-130
4-Bromofluorobenzene	89	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: CCV

Lab ID#: 1012179-10B

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122102sim**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 12/21/10 08:46 AM**

Compound	%Recovery
Vinyl Chloride	113
1,1-Dichloroethene	96
1,1-Dichloroethane	106
cis-1,2-Dichloroethene	91
1,1,1-Trichloroethane	94
Benzene	103
1,2-Dichloroethane	108
Trichloroethene	85
Toluene	98
Tetrachloroethene	88
Ethyl Benzene	93
m,p-Xylene	87
o-Xylene	90
trans-1,2-Dichloroethene	93
Chloroethane	118

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	114	70-130
Toluene-d8	107	70-130
4-Bromofluorobenzene	93	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: CCV

Lab ID#: 1012179-10C

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**b122102**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 12/21/10 09:04 AM**

Compound	%Recovery
Vinyl Chloride	116
Chloroethane	115
1,1-Dichloroethene	116
trans-1,2-Dichloroethene	113
1,1-Dichloroethane	114
cis-1,2-Dichloroethene	110
1,1,1-Trichloroethane	111
Benzene	112
1,2-Dichloroethane	115
Trichloroethene	113
Toluene	107
Tetrachloroethene	108
Ethyl Benzene	109
m,p-Xylene	107
o-Xylene	106
1,1-Difluoroethane	95

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	107	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	106	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: LCS

Lab ID#: 1012179-11A

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122104**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 12/21/10 10:22 AM**

Compound	%Recovery
1,1-Difluoroethane	Not Spiked

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	114	70-130
Toluene-d8	104	70-130
4-Bromofluorobenzene	92	70-130

Client Sample ID: LCSD

Lab ID#: 1012179-11AA

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122105**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 12/21/10 11:12 AM**

Compound	%Recovery
1,1-Difluoroethane	Not Spiked

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	117	70-130
Toluene-d8	103	70-130
4-Bromofluorobenzene	92	70-130

Client Sample ID: LCS

Lab ID#: 1012179-11B

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122104sim**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 12/21/10 10:22 AM**

Compound	%Recovery
Vinyl Chloride	109
1,1-Dichloroethene	91
1,1-Dichloroethane	96
cis-1,2-Dichloroethene	89
1,1,1-Trichloroethane	89
Benzene	94
1,2-Dichloroethane	100
Trichloroethene	80
Toluene	91
Tetrachloroethene	80
Ethyl Benzene	89
m,p-Xylene	82
o-Xylene	88
trans-1,2-Dichloroethene	89
Chloroethane	110

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	115	70-130
Toluene-d8	106	70-130
4-Bromofluorobenzene	94	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: LCSD

Lab ID#: 1012179-11BB

MODIFIED EPA METHOD TO-15 GC/MS SIM/FULL SCAN

File Name:	**a122105sim**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 12/21/10 11:12 AM**

Compound	%Recovery
Vinyl Chloride	104
1,1-Dichloroethene	93
1,1-Dichloroethane	98
cis-1,2-Dichloroethene	92
1,1,1-Trichloroethane	93
Benzene	93
1,2-Dichloroethane	100
Trichloroethene	80
Toluene	90
Tetrachloroethene	79
Ethyl Benzene	88
m,p-Xylene	82
o-Xylene	87
trans-1,2-Dichloroethene	92
Chloroethane	146 Q

Q = Exceeds Quality Control limits.

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	120	70-130
Toluene-d8	106	70-130
4-Bromofluorobenzene	94	70-130

Client Sample ID: LCS

Lab ID#: 1012179-11C

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**b122103**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 12/21/10 09:39 AM**

Compound	%Recovery
Vinyl Chloride	114
Chloroethane	115
1,1-Dichloroethene	118
trans-1,2-Dichloroethene	116
1,1-Dichloroethane	110
cis-1,2-Dichloroethene	113
1,1,1-Trichloroethane	114
Benzene	113
1,2-Dichloroethane	113
Trichloroethene	114
Toluene	113
Tetrachloroethene	108
Ethyl Benzene	116
m,p-Xylene	114
o-Xylene	114
1,1-Difluoroethane	Not Spiked

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	106	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	107	70-130

Client Sample ID: LCSD

Lab ID#: 1012179-11CC

MODIFIED EPA METHOD TO-15 GC/MS

File Name:	**b122104**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 12/21/10 10:08 AM**

Compound	%Recovery
Vinyl Chloride	113
Chloroethane	114
1,1-Dichloroethene	116
trans-1,2-Dichloroethene	113
1,1-Dichloroethane	107
cis-1,2-Dichloroethene	112
1,1,1-Trichloroethane	110
Benzene	110
1,2-Dichloroethane	108
Trichloroethene	110
Toluene	108
Tetrachloroethene	104
Ethyl Benzene	113
m,p-Xylene	110
o-Xylene	109
1,1-Difluoroethane	Not Spiked

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	106	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	107	70-130

Air Toxics Ltd. #1106421A

Air Toxics LTD.
Laboratory Services Since 1989

7/5/2011
Ms. Suzanne Stumpf
Sound Environmental Strategies Corp
2811 Fairview Avenue East
Suite 2000
Seattle WA 98102

Project Name: ODC
Project #: 0566-001-04
Workorder #: 1106421A

Dear Ms. Suzanne Stumpf

The following report includes the data for the above referenced project for sample(s) received on 6/20/2011 at Air Toxics Ltd.

The data and associated QC analyzed by Modified TO-15 SIM are compliant with the project requirements or laboratory criteria with the exception of the deviations noted in the attached case narrative.

Thank you for choosing Air Toxics Ltd. for your air analysis needs. Air Toxics Ltd. is committed to providing accurate data of the highest quality. Please feel free to contact the Project Manager: Kelly Buettner at 916-985-1000 if you have any questions regarding the data in this report.

Regards,

Kelly Buettner

Kelly Buettner
Project Manager

WORK ORDER #: 1106421A

Work Order Summary

CLIENT:	Ms. Suzanne Stumpf SoundEarth Strategies, Inc 2811 Fairview Avenue East Suite 2000 Seattle, WA 98102	**BILL TO:**	Ms. Suzanne Stumpf SoundEarth Strategies, Inc 2811 Fairview Avenue East Suite 2000 Seattle, WA 98102
PHONE:	206-306-1900	**P.O. #**	0566
FAX:	206-306-1907	**PROJECT #**	0566-001-04 ODC
DATE RECEIVED:	06/20/2011	**CONTACT:**	Kelly Buettner
DATE COMPLETED:	07/05/2011		

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.	FINAL PRESSURE
01A	VS-1-20110616	Modified TO-15 SIM	5.0 "Hg	5 psi
02A	VS-2-20110616	Modified TO-15 SIM	5.0 "Hg	5 psi
03A	Lab Blank	Modified TO-15 SIM	NA	NA
04A	CCV	Modified TO-15 SIM	NA	NA
05A	LCS	Modified TO-15 SIM	NA	NA
05AA	LCSD	Modified TO-15 SIM	NA	NA

CERTIFIED BY: Linda d. Freeman DATE: 07/05/11

Laboratory Director

Certfication numbers: CA NELAP - 02110CA, LA NELAP/LELAP- AI 30763,
NY NELAP - 11291, UT NELAP - 9166389892, AZ Licensure AZ0719
Name of Accrediting Agency: NELAP/Florida Department of Health, Scope of Application: Clean Air Act,
Accreditation number: E87680, Effective date: 07/01/09, Expiration date: 06/30/11
Air Toxics Ltd. certifies that the test results contained in this report meet all requirements of the NELAC standards

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630
(916) 985-1000 . (800) 985-5955 . FAX (916) 985-1020

LABORATORY NARRATIVE
Modified TO-15 SIM
Sound Environmental Strategies Corp
Workorder# 1106421A

Two 6 Liter Summa Canister (SIM Certified) samples were received on June 20, 2011. The laboratory performed analysis via modified EPA Method TO-15 using GC/MS in the SIM acquisition mode.

This workorder was independently validated prior to submittal using 'USEPA National Functional Guidelines' as generally applied to the analysis of volatile organic compounds in air. A rules-based, logic driven, independent validation engine was employed to assess completeness, evaluate pass/fail of relevant project quality control requirements and verification of all quantified amounts.

Method modifications taken to run these samples are summarized in the table below. Specific project requirements may over-ride the ATL modifications.

Requirement	***TO-15***	***ATL Modifications***
ICAL %RSD acceptance criteria	</=30% RSD with 2 compounds allowed out to < 40% RSD	Project specific; default criteria is </=30% RSD with 10% of compounds allowed out to < 40% RSD
Daily Calibration	+- 30% Difference	Project specific; default criteria is </= 30% Difference with 10% of compounds allowed out up to </=40%.; flag and narrate outliers
Blank and standards	Zero air	Nitrogen
Method Detection Limit	Follow 40CFR Pt.136 App. B	The MDL met all relevant requirements in Method TO-15 (statistical MDL less than the LOQ). The concentration of the spiked replicate may have exceeded 10X the calculated MDL in some cases

Receiving Notes

There were no receiving discrepancies.

Analytical Notes

Dilution was performed on samples VS-1-20110616 and VS-2-20110616 due to the presence of high level target species.

Definition of Data Qualifying Flags

Eight qualifiers may have been used on the data analysis sheets and indicates as follows:

B - Compound present in laboratory blank greater than reporting limit (background subtraction not performed).
J - Estimated value.
E - Exceeds instrument calibration range.
S - Saturated peak.
Q - Exceeds quality control limits.
U - Compound analyzed for but not detected above the reporting limit.
UJ- Non-detected compound associated with low bias in the CCV and/or LCS.

N - The identification is based on presumptive evidence.

File extensions may have been used on the data analysis sheets and indicates as follows:

a-File was requantified

b-File was quantified by a second column and detector

r1-File was requantified for the purpose of reissue

Air Toxics LTD.
Laboratory Services Since 1989

Summary of Detected Compounds
MODIFIED EPA METHOD TO-15 GC/MS SIM

Client Sample ID: VS-1-20110616

Lab ID#: 1106421A-01A

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
cis-1,2-Dichloroethene	0.23	1.4	0.91	5.8
Trichloroethene	0.23	12	1.2	66
Toluene	0.23	93	0.87	350
Tetrachloroethene	0.23	130	1.6	880
m,p-Xylene	0.46	0.56	2.0	2.4
o-Xylene	0.23	0.33	1.0	1.4

Client Sample ID: VS-2-20110616

Lab ID#: 1106421A-02A

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
cis-1,2-Dichloroethene	0.16	1.4	0.64	5.6
Trichloroethene	0.16	12	0.86	66
Toluene	0.16	93	0.61	350
Tetrachloroethene	0.16	130	1.1	870
Ethyl Benzene	0.16	0.17	0.70	0.72
m,p-Xylene	0.32	0.57	1.4	2.5
o-Xylene	0.16	0.33	0.70	1.4

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: VS-1-20110616

Lab ID#: 1106421A-01A

MODIFIED EPA METHOD TO-15 GC/MS SIM

File Name:	**e062209sim**	**Date of Collection:**	**6/16/11 6:16:00 PM**
Dil. Factor:	**11.5**	**Date of Analysis:**	**6/22/11 02:23 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.12	Not Detected	0.29	Not Detected
1,1-Dichloroethene	0.12	Not Detected	0.46	Not Detected
1,1-Dichloroethane	0.23	Not Detected	0.93	Not Detected
cis-1,2-Dichloroethene	0.23	1.4	0.91	5.8
1,1,1-Trichloroethane	0.23	Not Detected	1.2	Not Detected
Benzene	0.58	Not Detected	1.8	Not Detected
1,2-Dichloroethane	0.23	Not Detected	0.93	Not Detected
Trichloroethene	0.23	12	1.2	66
Toluene	0.23	93	0.87	350
Tetrachloroethene	0.23	130	1.6	880
Ethyl Benzene	0.23	Not Detected	1.0	Not Detected
m,p-Xylene	0.46	0.56	2.0	2.4
o-Xylene	0.23	0.33	1.0	1.4
trans-1,2-Dichloroethene	1.2	Not Detected	4.6	Not Detected
Chloroethane	0.58	Not Detected	1.5	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	103	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	101	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: VS-2-20110616

Lab ID#: 1106421A-02A

MODIFIED EPA METHOD TO-15 GC/MS SIM

File Name:	**e062210sim**	**Date of Collection: 6/16/11 6:16:00 PM**
Dil. Factor:	**8.05**	**Date of Analysis: 6/22/11 03:08 PM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.080	Not Detected	0.20	Not Detected
1,1-Dichloroethene	0.080	Not Detected	0.32	Not Detected
1,1-Dichloroethane	0.16	Not Detected	0.65	Not Detected
cis-1,2-Dichloroethene	0.16	1.4	0.64	5.6
1,1,1-Trichloroethane	0.16	Not Detected	0.88	Not Detected
Benzene	0.40	Not Detected	1.3	Not Detected
1,2-Dichloroethane	0.16	Not Detected	0.65	Not Detected
Trichloroethene	0.16	12	0.86	66
Toluene	0.16	93	0.61	350
Tetrachloroethene	0.16	130	1.1	870
Ethyl Benzene	0.16	0.17	0.70	0.72
m,p-Xylene	0.32	0.57	1.4	2.5
o-Xylene	0.16	0.33	0.70	1.4
trans-1,2-Dichloroethene	0.80	Not Detected	3.2	Not Detected
Chloroethane	0.40	Not Detected	1.1	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	103	70-130
Toluene-d8	100	70-130
4-Bromofluorobenzene	101	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: Lab Blank

Lab ID#: 1106421A-03A

MODIFIED EPA METHOD TO-15 GC/MS SIM

File Name:	**e062205sim**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis:**	**6/22/11 11:20 AM**

Compound	Rpt. Limit (ppbv)	Amount (ppbv)	Rpt. Limit (ug/m3)	Amount (ug/m3)
Vinyl Chloride	0.010	Not Detected	0.026	Not Detected
1,1-Dichloroethene	0.010	Not Detected	0.040	Not Detected
1,1-Dichloroethane	0.020	Not Detected	0.081	Not Detected
cis-1,2-Dichloroethene	0.020	Not Detected	0.079	Not Detected
1,1,1-Trichloroethane	0.020	Not Detected	0.11	Not Detected
Benzene	0.050	Not Detected	0.16	Not Detected
1,2-Dichloroethane	0.020	Not Detected	0.081	Not Detected
Trichloroethene	0.020	Not Detected	0.11	Not Detected
Toluene	0.020	Not Detected	0.075	Not Detected
Tetrachloroethene	0.020	Not Detected	0.14	Not Detected
Ethyl Benzene	0.020	Not Detected	0.087	Not Detected
m,p-Xylene	0.040	Not Detected	0.17	Not Detected
o-Xylene	0.020	Not Detected	0.087	Not Detected
trans-1,2-Dichloroethene	0.10	Not Detected	0.40	Not Detected
Chloroethane	0.050	Not Detected	0.13	Not Detected

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	104	70-130
Toluene-d8	99	70-130
4-Bromofluorobenzene	98	70-130

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: CCV

Lab ID#: 1106421A-04A

MODIFIED EPA METHOD TO-15 GC/MS SIM

File Name:	**e062202sim**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 6/22/11 08:42 AM**

Compound	%Recovery
Vinyl Chloride	76
1,1-Dichloroethene	73
1,1-Dichloroethane	76
cis-1,2-Dichloroethene	75
1,1,1-Trichloroethane	75
Benzene	73
1,2-Dichloroethane	77
Trichloroethene	70
Toluene	74
Tetrachloroethene	70
Ethyl Benzene	74
m,p-Xylene	71
o-Xylene	71
trans-1,2-Dichloroethene	74
Chloroethane	78

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	102	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	99	70-130

Client Sample ID: LCS

Lab ID#: 1106421A-05A

MODIFIED EPA METHOD TO-15 GC/MS SIM

File Name:	**e062203sim**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 6/22/11 09:24 AM**

Compound	%Recovery
Vinyl Chloride	94
1,1-Dichloroethene	97
1,1-Dichloroethane	96
cis-1,2-Dichloroethene	93
1,1,1-Trichloroethane	96
Benzene	91
1,2-Dichloroethane	97
Trichloroethene	88
Toluene	91
Tetrachloroethene	87
Ethyl Benzene	93
m,p-Xylene	89
o-Xylene	88
trans-1,2-Dichloroethene	103
Chloroethane	96

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	103	70-130
Toluene-d8	102	70-130
4-Bromofluorobenzene	99	70-130

Client Sample ID: LCSD

Lab ID#: 1106421A-05AA

MODIFIED EPA METHOD TO-15 GC/MS SIM

File Name:	**e062204sim**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 6/22/11 10:36 AM**

Compound	%Recovery
Vinyl Chloride	93
1,1-Dichloroethene	95
1,1-Dichloroethane	94
cis-1,2-Dichloroethene	91
1,1,1-Trichloroethane	94
Benzene	89
1,2-Dichloroethane	95
Trichloroethene	86
Toluene	89
Tetrachloroethene	86
Ethyl Benzene	90
m,p-Xylene	84
o-Xylene	83
trans-1,2-Dichloroethene	101
Chloroethane	95

Container Type: NA - Not Applicable

Surrogates	%Recovery	Method Limits
1,2-Dichloroethane-d4	103	70-130
Toluene-d8	101	70-130
4-Bromofluorobenzene	97	70-130

Air Toxics Ltd. #1106421B

6/24/2011
Ms. Suzanne Stumpf
Sound Environmental Strategies Corp
2811 Fairview Avenue East
Suite 2000
Seattle WA 98102

Project Name: ODC
Project #: 0566-001-04
Workorder #: 1106421B

Dear Ms. Suzanne Stumpf

The following report includes the data for the above referenced project for sample(s) received on 6/20/2011 at Air Toxics Ltd.

The data and associated QC analyzed by Modified ASTM D-1946 are compliant with the project requirements or laboratory criteria with the exception of the deviations noted in the attached case narrative.

Thank you for choosing Air Toxics Ltd. for your air analysis needs. Air Toxics Ltd. is committed to providing accurate data of the highest quality. Please feel free to contact the Project Manager: Kelly Buettner at 916-985-1000 if you have any questions regarding the data in this report.

Regards,

Kelly Buettner
Project Manager

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630
(916) 985-1000 .FAX (916) 985-1020
Hours 6:30 A.M to 5:30 PST

Air Toxics LTD.
Laboratory Services Since 1989

WORK ORDER #: 1106421B

Work Order Summary

CLIENT:	Ms. Suzanne Stumpf SoundEarth Strategies, Inc 2811 Fairview Avenue East Suite 2000 Seattle, WA 98102	**BILL TO:**	Ms. Suzanne Stumpf SoundEarth Strategies, Inc 2811 Fairview Avenue East Suite 2000 Seattle, WA 98102
PHONE:	206-306-1900	**P.O. #**	0566
FAX:	206-306-1907	**PROJECT #**	0566-001-04 ODC
DATE RECEIVED:	06/20/2011	**CONTACT:**	Kelly Buettner
DATE COMPLETED:	06/24/2011		

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.	FINAL PRESSURE
01A	VS-1-20110616	Modified ASTM D-1946	5.0 "Hg	5 psi
02A	VS-2-20110616	Modified ASTM D-1946	5.0 "Hg	5 psi
03A	Lab Blank	Modified ASTM D-1946	NA	NA
04A	LCS	Modified ASTM D-1946	NA	NA
04AA	LCSD	Modified ASTM D-1946	NA	NA

CERTIFIED BY: Linda L. Freeman DATE: 06/24/11

Laboratory Director

Certfication numbers: CA NELAP - 02110CA, LA NELAP/LELAP- AI 30763,
NY NELAP - 11291, UT NELAP - 9166389892, AZ Licensure AZ0719
Name of Accrediting Agency: NELAP/Florida Department of Health, Scope of Application: Clean Air Act,
Accreditation number: E87680, Effective date: 07/01/09, Expiration date: 06/30/11
Air Toxics Ltd. certifies that the test results contained in this report meet all requirements of the NELAC standards

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA - 95630
(916) 985-1000 . (800) 985-5955 . FAX (916) 985-1020

LABORATORY NARRATIVE
Modified ASTM D-1946
Sound Environmental Strategies Corp
Workorder# 1106421B

Two 6 Liter Summa Canister (SIM Certified) samples were received on June 20, 2011. The laboratory performed analysis via Modified ASTM Method D-1946 for Helium in air using GC/TCD. The method involves direct injection of 1.0 mL of sample.

Method modifications taken to run these samples are summarized in the table below. Specific project requirements may over-ride the ATL modifications.

Requirement	***ASTM D-1946***	***ATL Modifications***
Calibration	A single point calibration is performed using a reference standard closely matching the composition of the unknown.	A 3-point calibration curve is performed. Quantitation is based on a daily calibration standard which may or may not resemble the composition of the associated samples.
Reference Standard	The composition of any reference standard must be known to within 0.01 mol % for any component.	The standards used by ATL are blended to a >/= 95% accuracy.
Sample Injection Volume	Components whose concentrations are in excess of 5 % should not be analyzed by using sample volumes greater than 0.5 mL.	The sample container is connected directly to a fixed volume sample loop of 1.0 mL on the GC. Linear range is defined by the calibration curve. Bags are loaded by vacuum.
Normalization	Normalize the mole percent values by multiplying each value by 100 and dividing by the sum of the original values. The sum of the original values should not differ from 100% by more than 1.0%.	Results are not normalized. The sum of the reported values can differ from 100% by as much as 15%, either due to analytical variability or an unusual sample matrix.
Precision	Precision requirements established at each concentration level.	Duplicates should agree within 25% RPD for detections > 5 X's the RL.

Receiving Notes

There were no receiving discrepancies.

Analytical Notes

There were no analytical discrepancies.

Definition of Data Qualifying Flags

Seven qualifiers may have been used on the data analysis sheets and indicate as follows:
B - Compound present in laboratory blank greater than reporting limit.
J - Estimated value.
E - Exceeds instrument calibration range.
S - Saturated peak.
Q - Exceeds quality control limits.
U - Compound analyzed for but not detected above the detection limit.
M - Reported value may be biased due to apparent matrix interferences.
File extensions may have been used on the data analysis sheets and indicates as follows:
a-File was requantified
b-File was quantified by a second column and detector
r1-File was requantified for the purpose of reissue

Summary of Detected Compounds
NATURAL GAS ANALYSIS BY MODIFIED ASTM D-1946

Client Sample ID: VS-1-20110616

Lab ID#: 1106421B-01A

No Detections Were Found.

Client Sample ID: VS-2-20110616

Lab ID#: 1106421B-02A

No Detections Were Found.

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: VS-1-20110616

Lab ID#: 1106421B-01A

NATURAL GAS ANALYSIS BY MODIFIED ASTM D-1946

File Name:	**9062220b**	**Date of Collection: 6/16/11 6:16:00 PM**
Dil. Factor:	**1.61**	**Date of Analysis: 6/22/11 04:35 PM**

Compound	Rpt. Limit (%)	Amount (%)
Helium	0.080	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Client Sample ID: VS-2-20110616

Lab ID#: 1106421B-02A

NATURAL GAS ANALYSIS BY MODIFIED ASTM D-1946

File Name:	**9062221b**	**Date of Collection: 6/16/11 6:16:00 PM**
Dil. Factor:	**1.61**	**Date of Analysis: 6/22/11 04:58 PM**

Compound	Rpt. Limit (%)	Amount (%)
Helium	0.080	Not Detected

Container Type: 6 Liter Summa Canister (SIM Certified)

Air Toxics LTD.
Laboratory Services Since 1989

Client Sample ID: Lab Blank

Lab ID#: 1106421B-03A

NATURAL GAS ANALYSIS BY MODIFIED ASTM D-1946

File Name:	**9062203b**	**Date of Collection: NA**	
Dil. Factor:	**1.00**	**Date of Analysis: 6/22/11 09:03 AM**	

Compound	Rpt. Limit (%)	Amount (%)
Helium	0.050	Not Detected

Container Type: NA - Not Applicable

Client Sample ID: LCS

Lab ID#: 1106421B-04A

NATURAL GAS ANALYSIS BY MODIFIED ASTM D-1946

File Name:	**9062202**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 6/22/11 08:41 AM**

Compound	**%Recovery**
Helium	94

Container Type: NA - Not Applicable

Client Sample ID: LCSD

Lab ID#: 1106421B-04AA

NATURAL GAS ANALYSIS BY MODIFIED ASTM D-1946

File Name:	**9062228**	**Date of Collection: NA**
Dil. Factor:	**1.00**	**Date of Analysis: 6/22/11 07:48 PM**

Compound	%Recovery
Helium	94

Container Type: NA - Not Applicable

APPENDIX D
BAROMETRIC PRESSURE AND WEATHER STATION DATA

Table 1
Summary of Weather Data
for December 3, 2010
Former Olympia Dry Cleaners
606 Union Avenue Southeast
Olympia, Washington

Time	**Temperature** (°F)	**Dew Point** (°F)	**Barometric Pressure** (inches)	**Wind Direction**	**Wind Speed** (imiles per hour)	**Humidity** (%)	**Precipitation** (inches)	**Field Observations**
7:00	39.6	37.5	30.16	Calm	--	92	0.00	
7:30	38.9	37.0	30.17	Calm	--	93	0.00	
8:00	38.0	36.4	30.17	Calm	--	94	0.00	34 °F, calm wind with some gusts to the north-northwest
8:30	37.6	36.3	30.19	Calm	--	95	0.00	
9:00	38.0	37.0	30.20	Calm	--	96	0.00	
9:30	38.8	37.8	30.21	Calm	--	96	0.00	
10:00	39.6	38.3	30.22	Calm	--	95	0.00	Overcast, 39 °F, slight breeze to the east
10:30	40.3	39.0	30.23	Calm	2.0	95	0.00	Partly cloudy, 43 °F, wind 2 miles per hour to the north
11:00	41.1	39.2	30.22	East	3.0	93	0.00	
11:30	41.6	39.5	30.22	East	3.0	92	0.00	
12:00	43.3	39.4	30.21	Calm	--	86	0.00	
12:30	42.9	38.7	30.20	Northwest	3.0	85	0.00	
13:00	43.5	39.0	30.19	North-northwest	6.0	84	0.00	
13:30	43.8	39.3	30.19	North-northwest	5.0	85	0.00	
14:00	44.5	40.0	30.18	Northwest	4.0	85	0.00	46 °F, wind to the west-northwest
14:30	44.8	40.6	30.17	North	6.0	86	0.00	
15:00	44.9	40.1	30.17	North-northwest	4.0	83	0.00	
15:30	45.5	40.3	30.17	Northwest	5.0	82	0.00	
16:00	45.2	39.7	30.17	North-northwest	6.0	81	0.00	
16:30	44.5	39.7	30.17	Calm	--	83	0.00	
17:00	43.1	39.2	30.17	North	3.0	86	0.00	
17:30	42.3	39.0	30.17	North	3.0	88	0.00	
18:00	41.6	38.9	30.17	North	2.0	90	0.00	
18:30	41.1	38.7	30.17	Calm	--	91	0.00	
19:00	40.9	38.8	30.17	North	6.0	92	0.00	

NOTES:
-- = not applicable
% = percent
°F = degrees Fahrenheit
Field observation data was collected from weatherchannel.com