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T E C H N I C A L M E M O R A N D U M

TO: Eugene Freedman
Washington State Department of Ecology

DATE: March 17, 2014

FROM: Thomas Cammarata
SoundEarth Strategies, Inc.

SUBJECT: Addendum to 700 Dexter Draft Cleanup Action Plan

SoundEarth Strategies, Inc. (SoundEarth) has prepared this Technical Memorandum as an addendum to the draft Cleanup Action Plan (CAP) for the 700 Dexter property located at 700 Dexter Avenue North in Seattle, Washington (the Property), on behalf of Frontier Environmental Management, LLC. The CAP was prepared by SoundEarth and dated January 31, 2014. SoundEarth submitted the CAP to the Washington State Department of Ecology (Ecology) on January 31, 2014. The purpose of this Technical Memorandum is to address the outstanding issues related to approval of the CAP by Ecology and to support the issuance of a No Further Action Likely Letter for the Site. The Site is defined by the known extent of contamination in the environmental media of concern which contains petroleum hydrocarbons and chlorinated solvents beneath the Property and portions of the south- and east-adjoining properties, as well as beneath the rights of way in 8th, 9th, and Westlake Avenues North and beneath Valley, Roy, and Broad Streets. The topics discussed in this Technical Memorandum were prepared in consultation with Ecology through email correspondence and at a meeting at Ecology's Northwest Regional Office on February 27, 2014.

The topics and the issues which are addressed in this Technical Memorandum are as follows:

- On-Property Mass Removal
- On-Property Pre-Electric Resistive Heating/Soil Vapor Extraction Treatment of Contaminant Mass
- Extent of Contaminated Groundwater Plume
- Degree of Contamination
- Procedures for Evaluation of Plume Stability
- Downgradient Dewatering Activities at Block 43
- Decay Rates and Restoration Time Frame
- Edible Oil Substrate Induced Degradation of Chlorinated Solvents
- Edible Oil Substrate Treatment Case Studies
- Off-Property Treatment
- Compliance Monitoring and Triggers for Off-Property Treatment

- Remedy for On-Property and Off-Property Petroleum Hydrocarbons
- On-Property Vapor Mitigation

Please refer to the CAP dated January 31, 2014, for a detailed discussion of the Site history, hydrogeology, conceptual site model, and the proposed remedial action. A discussion of each Technical Memorandum topic is presented below.

ON-PROPERTY MASS REMOVAL

The Electric Resistive Heating/Soil Vapor Extraction (ERH/SVE) system was used to remediate high concentrations of tetrachloroethylene (PCE), trichloroethylene (TCE), cis-1,2-dichloroethene (cis-1,2-DCE) and trans-1,2-decholorethene (trans-1,2-DCE), and vinyl chloride (VC) in soil and groundwater beneath the Property. The CAP presents a detailed discussion of the concentrations and distribution of on-Property chlorinated solvents and the ERH/SVE system remedial design.

The ERH/SVE system operated at the Property from approximately August to December 2014. During the treatment period approximately 12,000 pounds (5,443 kilogram [kg]) of chlorinated solvents as volatile organics were removed the subsurface. Attachment A presents a graph that shows the mass of chlorinated solvents removed, the average site temperature, and removal rate during the course of treatment. The graph shows that at a design soil temperature of approximately 100 degrees Celsius the mass of chlorinated solvent removed from the Property reached asymptotic state of approximately 12,000 pounds (5,443 kg), meaning the ERH/SVE system reached its limit of mass removal because a majority of the original mass was removed. This conclusion is also supported by the fact that the removal rate substantially decreased at the asymptotic state.

Further mass reduction on the Property will occur from planned injections of edible oil substrate (EOS) into the shallow, intermediate, and deep treatment zones to treat the residual chlorinated volatile organic compounds (CVOCs) in groundwater using in situ reductive dechlorination. Injection wells will be installed across the Property for source zone treatment and as barrier treatment walls along the eastern and southern Property boundaries for the purpose of injecting EOS to treat the residual solvent plume. The CAP presents a detailed discussion of the EOS remedial design.

ON-PROPERTY PRE-ERH/SVE TREATMENT OF CONTAMINANT MASS

The ERH/SVE system was designed to reduce PCE concentrations to below 14 milligrams per kilogram (mg/kg) in the vadose zone soil to allow for the disposal of the soil at a nonhazardous Subtitle D landfill. In addition to remediating the source area soil and groundwater, the ERH/SVE system is intended to reduce PCE concentrations in the groundwater treatment zone to less than 5,000 micrograms per liter (µg/L), which will be followed by EOS injection, and will expedite the restoration of groundwater quality beneath the Property and the Site.

Prior to treatment with ERH/SVE, SoundEarth estimated the total mass solvent within the treatment area (Figures 1 through 5). A 10-foot by 10-foot grid system and irregular-shaped areas within the grid were used to define areas with concentration ranges of total chlorinated solvents (CVOCs; PCE, TCE, total 1,2-DCE, and VC) as normalized to PCE based on the most recent soil and groundwater sample analytical results for the Property as presented in the CAP. Using these concentration ranges and grid

system volumes, the total mass of PCE was estimated as follows (note: all formulas used in calculations are in italics).

Normalization of PCE in Soil and Groundwater

The concentrations of TCE, cis-1,2-DCE, and VC in soil were normalized to PCE using the following method:

- The concentration of each CVOC was divided by its molar mass to convert the CVOC into a molar concentration as follows:
  - For example:
    - Concentration of TCE in a soil sample = 0.015 mg/kg.
    - Molar mass of TCE = 131.389 milligrams per millimole (mg/mmol).
  - *Molar concentration of TCE in soil = 0.015/131.389 = 0.0001 millimoles per kilograms (mmol/kg).*
  - For example:
    - Concentration of TCE in a water sample = 0.015 milligrams per liter.
    - Molar mass of TCE = 131.389 mg/mmol.
  - *Molar concentration of TCE in water = 0.015/131.389 = 0.0001 mmol* per liter*1 liter of water weighs 1 kilogram).*
- The individual CVOC molar masses of each sample were summed to calculate the total molar concentration of CVOCs.
  - For example: Sample taken at 10 feet below ground surface (bgs) (3.1 meters) in DB13 has the following molar masses of each CVOC:
    - PCE: 0.0007 mmol/kg
    - TCE: 0.0001 mmol/kg
    - cis-1,2-DCE: 0.0003 mmol/kg
    - trans-1,2-DCE: 0.0003 mmol/kg
    - VC: 0.0004 mmol/kg
  - The sum of these molar masses is **0.0018 mmol/kg**.
- These total molar concentrations of CVOCs for each sample were multiplied by the molar mass of PCE to normalize concentrations of total CVOCs to PCE (PCE normalized).
  - For example:
    - The above sample that has a molar mass of 0.0018 mmol/kg.
    - The molar mass of PCE is 165.834 mg/mmol.
  - *The PCE normalized concentration of the given sample is 0.0018/165.834 = 0.2908 mg/kg.*

Mass Estimation of Normalized PCE in Soil within the Treatment Area

Using these PCE normalized concentrations, isoconcentration maps were drawn to estimate the surface area by PCE normalized concentration ranges (Figures 1 through 5). The estimated total mass for PCE normalized for the treatment area includes mass as dense nonaqueous-phase liquid (DNAPL) from suspected source areas, and mass from adsorbed-phase soil and dissolved-phase groundwater with concentrations of total CVOCs. It is assumed the mass of total CVOCs in soil vapor is negligible; therefore, the mass of total CVOCs in soil vapor was excluded from the estimate of total mass.

To determine mass in soil:

- The treatment depth was divided into four 10-foot elevation segments (e.g., 40 to 30 feet North American Vertical Datum 1988 (NAVD88).
- Each 10-foot elevation segment was multiplied by the designated surface areas of the respective concentration ranges of PCE normalized depicted on Figures 1 through 5. The surface areas were determined using AutoCAD software.
  - For example:
    - From 40 to 30 feet NVAD88 the concentration of 95 mg/kg had an AutoCAD determined area of 1,695 square feet (157 meters squared).
    - The depth is 10 feet; 3.1 meters.
    - *Volume = 10 x 1,695 = 16,950 cubic feet (3.1* x *157 = 480 meters cubed).*
- Averages of the lowest and highest concentrations were used to determine the concentration for that area of interest.
  - For example:
    - A concentration range of 90 to 100 mg/kg would have an average concentration of 95 mg/kg.
- The mass of all the soil with and without concentrations of PCE and its decay products was determined by taking the volume and multiplying it by the bulk density of soil (125.9 pounds per cubic foot or 57.1 kg).
  - For example:
    - The volume for an average concentration of 95 mg/kg was 16,950 cubic feet (480 meters cubed).
    - The bulk density of soil is 125.9 pounds per cubic feet (2,017.7 kg per meter cubed).
    - *Soil Mass = 16,950 x 125.9 = 2,134,005 pounds (967,967.6 kg).*
- To determine the mass of PCE within this soil mass the average concentration of PCE was divided by 10^6 to convert mg/kg to kilograms per kilogram (kg/kg), making the concentration unitless. The concentration was then multiplied by the total soil mass.
  - For example:
    - *Average PCE concentration of 95 mg/kg / 10^6 = 0.000095 kg/kg.*

- As previously shown the soil mass of this concentration is 2,134,005 pounds (967,967.6 kg).
- *PCE Mass = 0.000095 x 2,134,005 = 203 pounds or 0.000095 x 967,967.6 = 92 kg.*

Mass Estimation of Normalized PCE in Groundwater within the Treatment Area

The mass of normalized PCE in groundwater was determinate as follows:

- The treatment depth was treated as a continuous volume from 10 to 40 feet bgs because this extent is considered a single water-bearing zone.
- To determine volume, the 30-foot elevation segment was multiplied by the designated surface areas of the respective concentration ranges of PCE normalized depicted on Figures 1 through 5. (Surface areas were determined using AutoCAD software.)
  - For example:
    - The average concentration of 75,000 µg/L had an AutoCAD determined area of 4,399 square feet (408.7 meters squared).
    - The depth is 30 feet (9.14 meters).
    - *Volume = 30 x 4,399 = 131,970 cubic feet (9.14* x *408.7 = 3,735 meters cubed).*
- AutoCAD determine the surface area between two concentrations, therefore an average of the lower and higher concentration was used to determine as the concentration for that area.
  - For example:
    - A concentration range of 50,000 to 100,000 µg/L would have an average concentration of 75,000 µg/L.
- Due to the presence of soil, the entire volume was not water. It was assumed that the effective porosity was 0.3, meaning that 30 percent of the volume was pores within the soil that water could fill. Therefore, 0.3 was multiplied by the volume to determine the volume of water.
  - For example:
    - *A volume of 131,970 cubic feet and a porosity of 0.3 produce a water volume of 39,591 cubic feet (3,735 meters cubed x 0.3 = 1,120.5 meters cubed).*
- The mass of all the water with and without concentrations of PCE and its decay compounds was determined by taking the volume of water and multiplying it by the bulk density of water (62.4 pounds per cubic foot or 1,000 kg per meter cubed).
  - For example:
    - The volume for the average concentration of 75,000 µg/L was 39,591 cubic feet (1,120.5 meters cubed).
    - The bulk density of soil is 62.4 pounds per cubic feet (1,000 kg per meters cubed).
    - *Water Mass = 35,591 x 62.4 = 2,470,478 pounds (1,120,589 kg).*

- To determine how much of this mass was PCE, the average concentration of PCE was divided by 10^9 to convert µg/L to liters per liter (L/L), making the concentration unitless. (The conversion of kilograms to liters is a 1 to 1 conversion because 1 liter of water weighs 1 kilogram.) The concentration is then multiplied by the total water mass.
  - For example:
    - Average PCE concentration of 75,000 µg/L / 10^9 = 0.000075 L/L.
    - The water mass of this concentration is 2,470,478 pounds (1,120,589 kg).
    - *PCE Mass = 0.000075 x 2,470,478= 185 pounds (84 kg).*

Using these approaches and parameters, the estimated total mass of PCE normalized within the treatment area in soil is 4,052 pounds (1,838 kg) and in groundwater is 1,161 pounds (527 kg). The mass calculations are presented in Attachment B.

DNAPL in Treatment Area

Residual DNAPL as PCE was observed in sludge located in a sump at the Property (Sump No. 4; see the CAP) and was sampled. The sump contained a PCE concentration of 85,000 mg/kg. In addition, analytical results from soil and groundwater samples indicated that historical releases of PCE had likely occurred near the southern sewer line and trenches near and between Sumps No. 2, No. 4, and No. 8. Therefore, it is anticipated that a significant quantity of mass exists as DNAPL beneath the Property, but the exact quantity will not be known until final removal rates are established post-ERH/SVE treatment.

Total On-Property Mass of PCE within Treatment Area

Based in the analysis presented above, the total mass of PCE normalized within the treatment area is estimated to be 12,422 pounds (5,635 kg). This was determined by taking the mass in soil (4,052 pounds; 1,838 kg), the mass in groundwater (1,161 pounds; 527 kg), and assuming a large residual DNAPL estimate of 7,209 pounds (4,052 + 1,161 + 7,209 = 12,422 pounds) or 3,270 kg (1,838 + 527 + 3,270 = 5,635 kg). The concentration ranges of PCE normalized for soil and groundwater in the treatment area are presented in Attachment B. In addition, Attachment B presents the calculated surface area for each elevation segment, volume, and mass corresponding to the average concentration range of PCE normalized in soil and groundwater.

Mass of PCE Remaining in the Groundwater at the Property after ERH/SVE Treatment

Prior to treatment with EOS, SoundEarth will estimate the mass of normalized PCE remaining in the groundwater at the Property. Based on our professional experience, we anticipate the concentrations of PCE and decay products remaining in the groundwater after treatment with ERH/SVE at less 5,000 µg/L. This is the concentration that EOS has been shown to effectively reduce the concentrations of CVOCs in groundwater to less than their applicable cleanup levels. There are numerous case studies that show that EOS creates conditions which substantially reduce high concentrations of chlorinated solvents in groundwater to below regulatory cleanup levels that are protective of human health the environment (ITRC 2007).

EXTENT OF CONTAMINATED GROUNDWATER PLUME

Results from the recent remedial investigation at the Site show that the chlorinated solvent groundwater plume in the shallow water-bearing zone extends to the alley between 8th and 9th Avenues North, and in the intermediate water-bearing zone the plume extends laterally from the Property north of Valley Street, south to Mercer Street, and east to 9th Avenue North (Figures 6 through 9). The lateral extent of the plume in the intermediate water-bearing zone is demonstrated by the presence of chlorinated solvents (PCE and its decay products) in groundwater at monitoring well MW114 located just south of Roy Street, at monitoring well MW127 located north of the intersection of Valley Street and 8th Avenue North, and at monitoring well MW119 located proximate to 9th Avenue North (Figures 6 through 9).

The extent of the chlorinated solvent groundwater plume at the Site is primarily the result of advective and dispersive transport mechanisms as demonstrated by the presence of chlorinated solvents in the groundwater at monitoring wells MW114 and MW127, and is influenced by dewatering activities on a vicinity property (Vulcan Block 43), as demonstrated by the presence of chlorinated solvents in groundwater at monitoring well MW119. Based on the estimated biological decay rates presented in the CAP and the geochemistry of the groundwater in the intermediate water-bearing zone, there are sufficient lines of evidence that show the groundwater conditions have the effective capacity to degrade the mass of contamination in the intermediate water-bearing zone within a reasonable restoration time frame. Recent treatment of soil and groundwater at the Property using ERH destroyed the major source of CVOCs, and the planned treatment of groundwater at the Property with EOS will remove the residual source migration from the off-Property chlorinated solvent groundwater plume and reduce the restoration time frame currently presented in the CAP.

DEGREE OF CONTAMINATION

The estimated masses of PCE, TCE, total 1,2-DCE, and VC in the groundwater in the intermediate water-bearing zone were calculated based on the surface area of the solvent plume, groundwater volume, and the average mass of each contaminant in groundwater. The masses were calculated using pre-thermal treatment groundwater results from the Property and analytical results for groundwater samples collected in December 2013 and January 2014 downgradient of the Property. Therefore, the results are extremely conservative because of the inclusion of pre-thermal treatment groundwater results. The mass calculations presented are in Attachment C.

The masses in the intermediate water-bearing zone will be further reduced after on-Property treatment with EOS. Based on the estimated biological decay rates presented in the CAP and the geochemistry of the groundwater in the intermediate water-bearing zone, there are sufficient lines of evidence that the groundwater conditions have the effective capacity to degrade the mass of contamination in the intermediate water-bearing zone within a reasonable restoration time frame.

PROCEDURES FOR EVALUATION OF PLUME STABILITY

Results from the recent remedial investigation at the Site show that the chlorinated solvent groundwater plume (the plume) in the shallow water-bearing zone extends to the alley between 8th Avenue North and 9th Avenue North, and in the intermediate water-bearing zone the plume extends laterally from the Property north of Valley Street, south to Mercer Street, and east to 9th Avenue North.

The lateral extent of the plume in the intermediate water-bearing zone is demonstrated by the presence of chlorinated solvents in groundwater at monitoring well MW114 located just south of Roy Street, at monitoring well MW127 located north of the intersection of Valley Street and 8th Avenue North, and at monitoring well MW119 located proximate to 9th Avenue North. Maps showing the extent of the plume for PCE, TCE, cis-1,2-DCE, and VC are shown on Figures 6 through 9.

During the course of the cleanup action at the Site, which includes treatment of on-Property contaminated soil and groundwater using ERH and using enhanced reductive dechlorination (ERD) technology, groundwater compliance monitoring will be conducted to evaluate the stability of the PCE, TCE, total 1,2-DCE, and VC plumes. Stability of the plumes will be evaluated after one, three, and five years of compliance monitoring. Compliance monitoring wells will include:

- Intermediate Water-Bearing Zone: MW107, MW108, MW109, MW110, MW111, MW112, MW114, MW115, MW116, MW117, MW118, MW119, MW120, MW127, and MW128
- Deep Water-Bearing Zone: MW102, MW103, MW104, MW105, MW106, MW113, and MW122

Based on analytical results from the compliance monitoring wells stability of the plume for all the chemicals of concern (COCs) will be evaluated. The stability of the plume will be evaluated in general accordance with the draft *Guidance on Remediation of Petroleum-Contaminated Ground Water by Natural Attenuation* prepared by Ecology (2005). Plume stability will be evaluated using one or both of the following methods:

- Graphical Linear Regression
- Non-Parametric Statistical Analyses (Man-Kendall or Mann-Whitney tests)

Results from these analyses will be used to determine if the plumes are expanding, stable, or shrinking, based on threshold criterion for these conditions presented in Ecology 2005. If the plumes for any of the CVOCs are found to be expanding based on statistical analysis, this may trigger the need for off-Property treatment of plumes areas using ERD.

DOWNGRADIENT DEWATERING ACTIVITIES AT BLOCK 43

As discussed in the CAP, significant changes in groundwater flow direction and shape of the potentiometric surface for the intermediate water-bearing zone have occurred over the last 4 months as the result of dewatering activity at Block 43 located downgradient of the Property. In addition, as a result of construction dewatering, low concentrations of chlorinated solvents have been detected in groundwater at monitoring well MW119 located upgradient and proximate to Block 43 (Figure 9). Chlorinated solvents previously were not detected in the groundwater at monitoring well MW119, and their recent presence is the result of dewatering activity at Block 43. Based on limited information provided to SoundEarth by the owner of Block 43, dewatering began in fall 2013 and will continue for up to 10 more months. The owner of Block 43 reports a pumping rate of 300 gallons per minute. Groundwater from the dewatering activities is treated prior to discharge to Lake Union under Ecology permit requirements.

SoundEarth evaluated the impacts of dewatering on the contaminated groundwater plume at the Site by calculating the differential between the groundwater elevations in March 2013, prior to the start of

dewatering, and in January 2014. The results of the analysis, which are shown on the attached Figure 10, show a shift in the direction of groundwater flow toward Block 43 and a long, linear depression in the groundwater potentiometric surface starting upgradient of monitoring well MW119 and including Block 43. Changes in seepage velocities prior to dewatering activities (March 2013) and during dewatering activities (January 2014) are shown on attached Figures 11 and 12, respectively. These figures clearly show that dewatering activities have changed the seepage velocities, the direction of groundwater flow, and the potentiometric surface of the groundwater upgradient and proximate to monitoring well MW119. These changes in the groundwater hydraulics at the Site have contributed to the recent discovery of chlorinated solvents in the groundwater at monitoring well MW119.

DECAY RATES AND RESTORATION TIME FRAME

The decay rates for PCE and its daughter products in the intermediate water-bearing zone were calculated assuming a first order decay rate. The effects of advection, dispersion, and absorption on the biological decay rates were removed by normalizing the concentrations of PCE and its daughter products to a conservative tracer, in this case, chloride (EPA 1998). The data was normalized by dividing the concentration of the tracer at the source (or between points measured downgradient of the source), by the concentration of the tracer at a downgradient location. The measured concentration of the contaminant at the downgradient location is then multiplied by the dilution of the tracer. The decay rates for the shallow and deep water-bearing zones were not determined due to insufficient data for those water-bearing zones. Attachments D presents the methodology used to calculate the first order biological decay rate for PCE, TCE, total 1,2-DCE, and VC.

Analytical results for two sets of flow lines were used to determine the decay rates in the intermediate zone (Attachments D-1 and D-2). They included the following:

- Flow Line 1: MW107, MW109, MW108, and MW116
- Flow Line 2: MW107, MW110, and MW115

The flow lines were selected based the direction of groundwater flow in the intermediate water-bearing zone in March 2013 and January 2014 and the extent of the chlorinated solvent plume. A regression analysis was performed on the normalized analytical results and the travel time between two points. The slope of linear regression is the decay rate. The travel time (distance/contaminant velocity) was calculated using following parameters:

- Site-specific intermediate water-bearing zone seepage velocity of 0.61 feet per day (SoundEarth 2013a) or 0.186 meters per day.
- Hydraulic gradient of 0.024 (SoundEarth 2014).
- Soil partition coefficients from Ecology's CLARC database: PCE 2.70E+02 milliliters per gram (mL/g); TCE 9.40E+01 mL/g; total DCE 3.890E+01 mL/g; and VC 1.90E+01 mL/g.
- Fraction of organic carbon of 0.001.
- Bulk density of 1.7 grams per meter cubed (assumption based on of a mixture of silt, sand, and gravel in the intermediate water-bearing zone).

- Effective porosity of 0.3 (assumption based on a mixture of silt, sand, and gravel in the intermediate water-bearing zone).

The linear regression analysis for PCE and its daughter products is presented in Attachment D-3 to D-10. Decay rates and the associated correlation coefficients for PCE and its daughter products are presented in the following table.

First Order Decay Rates for PCE, TCE, 1,2-DCE, and VC

Contaminant	Decay Rate/Year (Flow Line 1)	Linear Regression Correlation Coefficient (R^2)	Decay Rate/Year (Flow Line 2)	Linear Regression Correlation Coefficient (R^2)
PCE	0.199	0.784	3.95	0.807
TCE	0.127	0.882	2.84	0.730
1,2-DCE (total)	3.28	0.593	3.79	0.640
VC	0.405	0.893	1.81	0.526

NOTES:
1,2-DCE = total DCE
PCE = tetrachloroethylene
R^2 = correlation coefficient
TCE = trichloroethylene
VC = vinyl chloride

Based on the results presented above, the average first order biological decay rates for PCE, TCE, total 1,2-DCE, and VC in the intermediate water-bearing zone are 2.07/year, 1.48/year, 3.35/year, and 1.11/year, respectively. Correlation coefficients for the analytes indicate that good regression relationships exist within the data set. The validity of the Site-specific decays rate is also supported in the literature (EPA 1998).

The average decay rates for PCE, TCE, total 1,2-DCE, and VC presented above can be interpreted as the percent of mass of the chemical that will biologically degrade in the groundwater each year. For example, a decay rate of 2.07/year for PCE can be interpreted as 20.7 percent of the PCE mass will degrade in each year. The current conservative estimate of the PCE mass in the intermediate water-bearing zone is 8,913 pounds (4,043 kg) (see Degree of Contamination above). Therefore, in one year, the mass of PCE will decrease in the intermediate water-bearing zone to approximately 7,017 pounds (3,183 kg).

These results, in conjunction with other lines of evidence, support the conclusion that the intermediate water-bearing zone is capable of intrinsic bioremediation of chlorinated solvents and the rates of decay are sufficient to remove sufficient mass over time to achieve Site-specific cleanup standards in a reasonable restoration time frame. The concentrations for PCE, TCE, total 1,2-DCE, and VC in the groundwater at downgradient monitoring wells MW115 and MW116 (fourth quarter 2013) support the conclusion that these contaminants are attenuating downgradient of the source area, that the boundary of the plume is located proximate to 9th Avenue North, and that concentrations of PCE, TCE, total 1,2-

DCE, and VC at the downgradient edge of the plume are in compliance with applicable cleanup standards.

Based on average decay rates, the restoration time frame (RTF) for each monitoring well downgradient of the source well (MW107) along each of the flow lines was calculated (Attachment D-11). The RTF was calculated as follows:

$$t = Rx/V_{gw} * SQRT(1+4\alpha_x\lambda R/V_{gw})$$

NOTES:
t = time to restoration
x = distance along the flow line
R = retardation factor
V_{gw} = seepage velocity
SQRT = square root
α_x = longitudinal dispersivity
λ = first Order decay rate

The assumptions used to calculate RTFs included longitudinal dispersivity equal to 0.1 x distances to the receptor/well and steady-state condition for the plume (Ecology 2005).

Restoration Time Frames for PCE, TCE, 1,2-DCE, and VC

Contaminant	Monitoring Well	RTFs in Years (Flow Line 1)	Monitoring Well	RTFs in Years (Flow Line 2)
PCE	MW109/MW108/MW116	0.906/1.07/1.42	MW110/MW115	0.941/1.34
TCE	MW109/MW108/MW116	0.982/1.17/1.58	MW110/MW115	1.02/1.48
1,2-DCE (total)	MW109/MW108/MW116	0.788/0.912/1.19	MW110/MW115	0.816/1.13
VC	MW109/MW108/MW116	1.04/1.25/1.71	MW110/MW115	1.08/1.60

NOTES:
1,2-DCE = total DCE
PCE = tetrachloroethylene
RTF = restoration time frame
TCE = trichloroethylene
VC = vinyl chloride

The RTFs presented above define the approximate time required to reach one-half the steady-state concentration at a given receptor location (Ecology 2005). The time required to reach the applicable cleanup level for each chemical at wells along the flow line were then calculated and summed to obtain the total RTFs for all the COCs. Assuming the source area has been removed at the Property (i.e., treatment heating and enhanced biological decay), the estimated RTF required to achieve applicable cleanup levels for all the COCs throughout the Site is estimated to range from approximately 11 to 17 years. The RTFs are most likely conservative given the fact that the biological decay rates used to calculate the RTFs do not include decay resulting from advection, dispersion, and adsorption.

Attachments D-12 and D-13 presents the methodology used to calculate the RTFs for PCE, TCE, total 1,2-DCE, and VC for Flow Line 1 and Flow Line 2.

EOS INDUCED DEGRADATION OF CHLORINATED SOLVENTS

Treatment of the shallow zone soil and groundwater beneath the Property with ERH/SVE in the shallow zone will reduce initial PCE concentrations in groundwater to approximately 5,000 µg/L. The EOS will be injected in the shallow and intermediate zones and will act as a carbon source to deplete dissolved oxygen present in the aquifer, generate free hydrogen, and sustain a robust anaerobic microbial population that is capable of degrading PCE and its decay products in a reasonable restoration time frame. A detailed discussion of the EOS treatment at the Property is presented in the CAP.

During ERD the chlorine atoms within the solvent molecules are replaced by hydrogen one by one. As such, one mole of PCE is reduced to one mole of TCE, which is reduced to one mole of cis-1,2-DCE, which is reduced to one mole of VC, which is reduced to one mole of ethene as a detoxified final degradation product. Although the degradation of CVOCs is sequential, it does not mean that each step happens at the same time for every mole of PCE. The degradation pathway is parallel, so as the next mole of PCE is degrading to TCE, the previous mole of TCE is simultaneously degrading to total 1,2-DCE. In other words, ERD with EOS may lead to a short term spike in the concentrations of TCE, 1,2-DCE and VC; however, with the eventual degradation of PCE molecules, EOS enhanced and intrinsic bioremediation in the groundwater at the Site will result in substantial reduction in the concentration of PCE and decay products.

Attachment E-1 presents a chart for a property in Seattle with an initial source groundwater concentration of 4,500 µg/L PCE. Attachment E-1 (Chart E-1) depicts changes in the concentration of PCE and its decay products with time in the source area as a result of treatment with EOS. Decay rates were calculated based on changes in the concentration of each analyte with time. The chart - shows that although concentrations of some decay products initially increase the overall molar mass of the CVOCs decrease with time. These results suggest that EOS-enhanced decay in conjunction with intrinsic first order biological decay at the Site will result in a restoration time less than 11 to 17 years predicted for groundwater at the Site prior to the implementation of ERD technology.

Based on post EOS groundwater compliance monitoring results (years 1, 3, and 5), a chart similar to Chart E-1 will be prepared for the Site, an example of which is shown in Attachment E-2 (Chart E-2) The x-axis of Chart E-2 shows a 17 years duration of time (i.e., the maximum predicted restoration time frame for groundwater at the Site). The chart also shows the Washington State Model Toxics Control Act Method A cleanup level for VC (0.2 µg/L) parallel to the x-axis of the chart. Should over the duration of the compliance monitoring period, at years 1, 3, and 5, the concentration of VC rise above or is predicted not to reach the cleanup level by the maximum RTF of 17 years, additional EOS injections events will be considered in consultation with Ecology.

EOS TREATMENT CASE STUDIES

Two recent SoundEarth projects where EOS was injected to treat a PCE groundwater plume are presented in Attachment F. 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 as a result of injecting EOS. These case studies

provide evidence that the EOS remedy planned for the Property will enhance the degradation of CVOCs in the groundwater at the Site. A summary for each project is provided below. Charts and figures referenced herein are provided in Attachment F.

The Ballard Property was injected with edible oil in March 2010. Approximately 12,000 gallons of a 5-percent EOS solution were injected into 23 injection points over 2 days. The initial baseline concentration of PCE in groundwater was 590 µg/L and 240 µg/L in wells IW01 and IW02, respectively. Over a 2-year period, the concentrations decreased to 1.3 µg/L and 2.2 µg/L in IW01 and IW02, respectively (Charts 1 and 2 in Attachment E). The supporting information for this case study, including site layout, groundwater flow direction, and groundwater laboratory analytical data, is included in Attachment F.

Multiple injection events were conducted at the Capitol Hill Property between 2008 and 2011. During the initial event, approximately 11,000 gallons of 5 percent EOS solution were injected into 30 points over 4 days. The second and third injections were targeted toward specific wells, with 200 gallons injected at one point and 700 gallons injected into four points. The fourth injection event applied a higher concentration of EOS solution (18 percent), 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 µg/L and 2,000 µg/L in wells MW108 and KMW1, respectively, to <0.5 µg/L (Charts 3 and 4 in Attachment E). The concentrations of cis-1,2-DCE and VC at both sites have increased over time, which suggests that reductive dechlorination processes have accelerated because of the EOS injection events. The concentrations of cis-1,2-DCE and VC will decrease over time as a result of the enhanced anaerobic environment generated by injecting EOS and increasing the microbial populations that will continue to break down the chlorinated compounds. The supporting information for this case study, including site layout, groundwater flow direction, and groundwater laboratory analytical data, is included in Attachment E.

OFF-PROPERTY TREATMENT

Off-Property injection points will be installed in order to inject carbon-substrate into the shallow and intermediate water-bearing zones if conditions at the Site warrant additional treatment. Based on our current understanding of Site conditions, Figures 13 through 15 show the proposed network of off-Property injection wells in plan view and cross section. The off-Property injections wells will be placed on a north-south spacing of 20 feet (6.1 meters) and on north-south transects in 8th Avenue and in the alley between 8th and 9th Avenues North (Figures 13 through 15). Additional injection wells will be installed proximate to monitoring well MW114 at Mercer Street (Figures 13 through 15) The placement of the off-Property injection wells is designed to provide a barrier to the expansion of the chlorinated groundwater plume by advective and dispersive mechanisms and/or the effects of the dewatering activity at Block 43.The location of the injection wells is dynamic and can be adjusted based on conditions at the time injections wells are installed (based on analytical results from 1, 3, and 5 years of compliance monitoring). Any changes to the location of the injection wells within the network currently proposed in the CAP will be done in consultation with Ecology. The exact spacing and placement of the injection wells within the network is contingent on site conditions, access restrictions, and protection requirements for future use.

COMPLIANCE MONITORING AND TRIGGERS FOR OFF-PROPERTY TREATMENT

As presented in the CAP, numerous trigger conditions may lead to the implementation of off-Property treatment of the chlorinated solvent groundwater plume with EOS. Figures 13 through 15 show the current design for the off-Property injection well network. Groundwater compliance monitoring for the Site includes 2 years of quarterly groundwater monitoring, 2 years of semiannual groundwater monitoring, and 1 year of annual monitoring. Periodic analysis of these groundwater analytical results for plume stability and restoration time frame will be conducted in the 1st, 3rd, and 5th years of compliance monitoring.

The distribution of the injection wells within the network presented in the CAP is based on SoundEarth's current understanding of the extent of the contaminated groundwater plume in the shallow and intermediate water-bearing zones (Figures 13 through 15). The location of the injection wells is flexible and can be adjusted based on evoking conditions (e.g., groundwater flow direction changes in the shape of the chlorinated solvent plume) at the time the injection wells are installed. Any changes to the location of the injection wells within the network currently proposed in the CAP will be done in consultation with Ecology during the periodic analysis (years 1, 3, and 5). The trigger conditions used to implement off-Property injections of EOS are as follows:

- The chlorinated solvent groundwater plume is expanding and/or the restoration time frame exceeds that currently proposed in the CAP based on 1 year of quarterly groundwater monitoring results. The time series analysis and the reanalysis of the restoration time frame will be based on analytical results for groundwater samples collected from the following compliance monitoring well network:
  - Intermediate Water-Bearing Zone: MW107, MW108, MW109, MW110, MW111, MW112, MW114, MW115, MW116, MW117, MW118, MW119, MW120, and MW128
  - Deep Water-Bearing Zone: MW102, MW103, MW104, MW105, MW106, MW113, and MW122

- The contaminated groundwater plume is expanding and/or the restoration time frame exceeds that currently present in the CAP after 3 and 5 years of groundwater monitoring results. The time series analysis and the reanalysis of the restoration time frame will be based on analytical results from the following compliance monitoring well network:
  - Intermediate Water-Bearing Zone: MW107, MW108, MW109, MW110, MW111, MW112, MW114, MW115, MW116, MW117, MW118, MW119, MW120, and MW128
  - Deep Water-Bearing Zone: MW102, MW103, MW104, MW105, MW106, MW113, and MW122

Plume stability and restoration time frame will be evaluated in accordance with Ecology 2005 guidance.

REMEDY FOR ON-PROPERTY AND OFF-PROPERTY PETROLEUM HYDROCARBONS

Concentrations of petroleum hydrocarbons exceed their respective cleanup levels in soil and groundwater samples collected on the northern portion of the Property and within the 8th Avenue North right-of-way. The highest concentrations of petroleum hydrocarbons in soil at the northern portion of

the Property are 260 mg/kg gasoline-range petroleum hydrocarbon (GRPH) and 0.059 mg/kg benzene at a depth of 10 feet bgs (3.1 meters). The petroleum contamination is attributed to the historical operation of refueling facilities on the Property and on the east-adjoining properties. The petroleum hydrocarbon contamination appears vertically limited to the shallow and intermediate water-bearing zones. The lateral distribution of petroleum contamination in soil and groundwater is bound to the west by monitoring well W-MW-04, to the north by monitoring wells MW125 and MW-9, to the east by monitoring well MW121, and to the south by monitoring well W-MW-02. Figures 16 and 17 show the extent of petroleum hydrocarbons on-Property and off-Property in soil and groundwater.

On-Property petroleum-contaminated soil will be excavated from the surface to 10 feet bgs (3.1 meters bgs) during redevelopment of the Property. At the completion of the redevelopment, a 1-year quarterly groundwater monitoring program will be implemented for petroleum hydrocarbons using compliance monitoring wells MW-5 and MW121. Groundwater samples will analyzed for GRPH, diesel-range petroleum hydrocarbons and benzene, toluene, ethylbenzene, and total xylenes. Analytical results will be analyzed for restoration time and plume stability in accordance with Ecology 2005. If after 1 year of quarterly groundwater monitoring the petroleum hydrocarbon plume is expanding, a remedy will be implemented to treat the petroleum-contaminated groundwater. Remedies may include an air sparging curtain and/or injections of strong oxidizers into the groundwater to degrade the petroleum hydrocarbons. The remedy will be implemented in consultation with Ecology.

ON-PROPERTY VAPOR MITIGATION

The proposed development at the Property includes one level of subgrade parking to a depth of 10 feet bgs (3.1 meters bgs). Residual solvent contamination that may remain in the soil and/or groundwater beneath the Property at the time of redevelopment will be evaluated to assess its impact on indoor air quality for the new development. Indoor air quality will be evaluated in accordance the draft *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remediation* prepared by Ecology (2009). For example, the evaluation may include comparing residual concentrations of chlorinated solvents in the groundwater to generic groundwater vapor intrusion screen levels (SL), as presented in Ecology 2009. If concentrations of solvents in the groundwater exceed the SLs, a more comprehensive analysis of the indoor air quality can be conducted using the Johnson and Ettinger Model for Subsurface Vapor Intrusion into Buildings (J&E Model; EPA 2013). The J&E Model is a simplified model to evaluate the vapor intrusion pathway into buildings. If results from the J&E Model indicate that residual concentrations of soil and/or groundwater beneath the subgrade parking garage pose a risk to indoor air quality, mitigation measures can be implemented. The mitigation measures may include a vapor barrier beneath the sub-slab of the parking garage, a passive system to extract vapors from beneath the sub-slab of the parking garage, or extraction of vapors using a sub-slab depressurization system installed beneath the sub-slab. SoundEarth is currently preparing a Technical Memorandum for the developer of the Property that summaries the Washington State vapor intrusion assessment protocols and vapor mitigation alternatives for protecting indoor air quality.

REFERENCES

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_____. 2013. *EPA On-line Tools for Site Assessment Calculation: Screening Level Implementation of the Johnson and Ettinger Vapor Intrusion Model with Two Variable/Uncertain Parameters (source depth, moisture content)*. <http://www.epa.gov/athens/learn2model/part-two/onsite/JnE_lite_forward.html>

Washington State Department of Ecology (Ecology). 2005. *Draft Guidance on Remediation of Petroleum-Contaminated Ground Water by Natural Attenuation*. February 1.

_____. 2009. *Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action*. Publication No. 09-09-47. (Draft) October.

Attachments: Figure 1, Soil Ranges of Normalized PCE Concentrations from 0–10'
Figure 2, Soil Ranges of Normalized PCE Concentrations from 10–20'
Figure 3, Soil Ranges of Normalized PCE Concentrations from 20–30'
Figure 4, Soil Ranges of Normalized PCE Concentrations from 30–40'
Figure 5, Groundwater Ranges of Normalized PCE Concentrations from 10–40'
Figure 6, PCE Isocontours in Intermediate Water-Bearing Zone
Figure7, TCE Isocontours in Intermediate Water-Bearing Zone
Figure 8, Cis 1,2-DCE Isocontours in Intermediate Water-Bearing Zone
Figure 9, VC Isocontours in Intermediate Water-Bearing Zone
Figure 10, Difference in Groundwater Elevations before (March 29, 2013) and during (January 6, 2014) Dewatering Activities
Figure 11, Groundwater Contour Map, Intermediate "A" Water-Bearing Zone (March 29, 2013)
Figure 12, Groundwater Contour Map, Intermediate Water-Bearing Zone (January 6, 2014)
Figure 13, Cleanup Action Plan, Shallow Treatment Zone, In Situ Reductive Dechlorination
Figure 14, Cleanup Action Plan, Intermediate Treatment Zone, In Situ Reductive Dechlorination
Figure 15, Cleanup Action Plan, Cross Section, In Situ Reductive Dechlorination
Figure 16, Petroleum Hydrocarbon Concentrations in Soil
Figure 17, Petroleum Hydrocarbon Concentrations in Groundwater
A, Cumulative Mass Removal vs. Average Treatment Area Temperatures
B, Surface Area, Volume, and Estimated Mass of Normalized PCE within the On-Property Treatment Area
C, Estimated Mass of Chemicals of Concern in Intermediate Water-bearing Zone
D, Decay Rate and Restoration Time Frame Calculations
E, Edible Oil Substrate Decay Graph
F, Edible Oil Substrate Treatment Case Studies

TJC:dnm/amr

FIGURES

3/17/2014

P:\0797 FRONTIER ENV MGMT\700 DEXTER\TECHNICAL\CAD\2014 TM\CAP FIGURES\0797-001_2014CAP_PCE_SD1.F.DWG

VALLEY STREET

DEXTER AVENUE NORTH

8TH AVENUE NORTH

ROY STREET

N

LEGEND

P-08/ W-MW-04	ANGLED MONITORING WELL
R-MW1	SHALLOW WATER BEARING ZONE WELL
G-MW1	INTERMEDIATE "A" WATER-BEARING ZONE WELL
P-07/ W-MW-03	INTERMEDIATE "B" WATER-BEARING ZONE WELL
B102/ MW102	DEEP OUTWASH AQUIFER WELL
R-MW4	DECOMMISSIONED MONITORING WELL
DB14	SOIL BORING
	PROPERTY BOUNDARY
	PARCEL BOUNDARY
PCE	TETRACHLOROETHYLENE
mg/kg	MILLIGRAMS PER KILOGRAM
MTCA	WASHINGTON STATE MODEL TOXICS CONTROL ACT
CVOC	CHLORINATED VOLATILE ORGANIC COMPOUNDS

CONCENTRATION OF TOTAL CVOCs NORMALIZED AS PCE IN mg/kg

- >100
- 90-100
- 30-40
- 20-30
- 10-20
- 1-10
- 0.5-1
- 0.05-0.5
- <0.05

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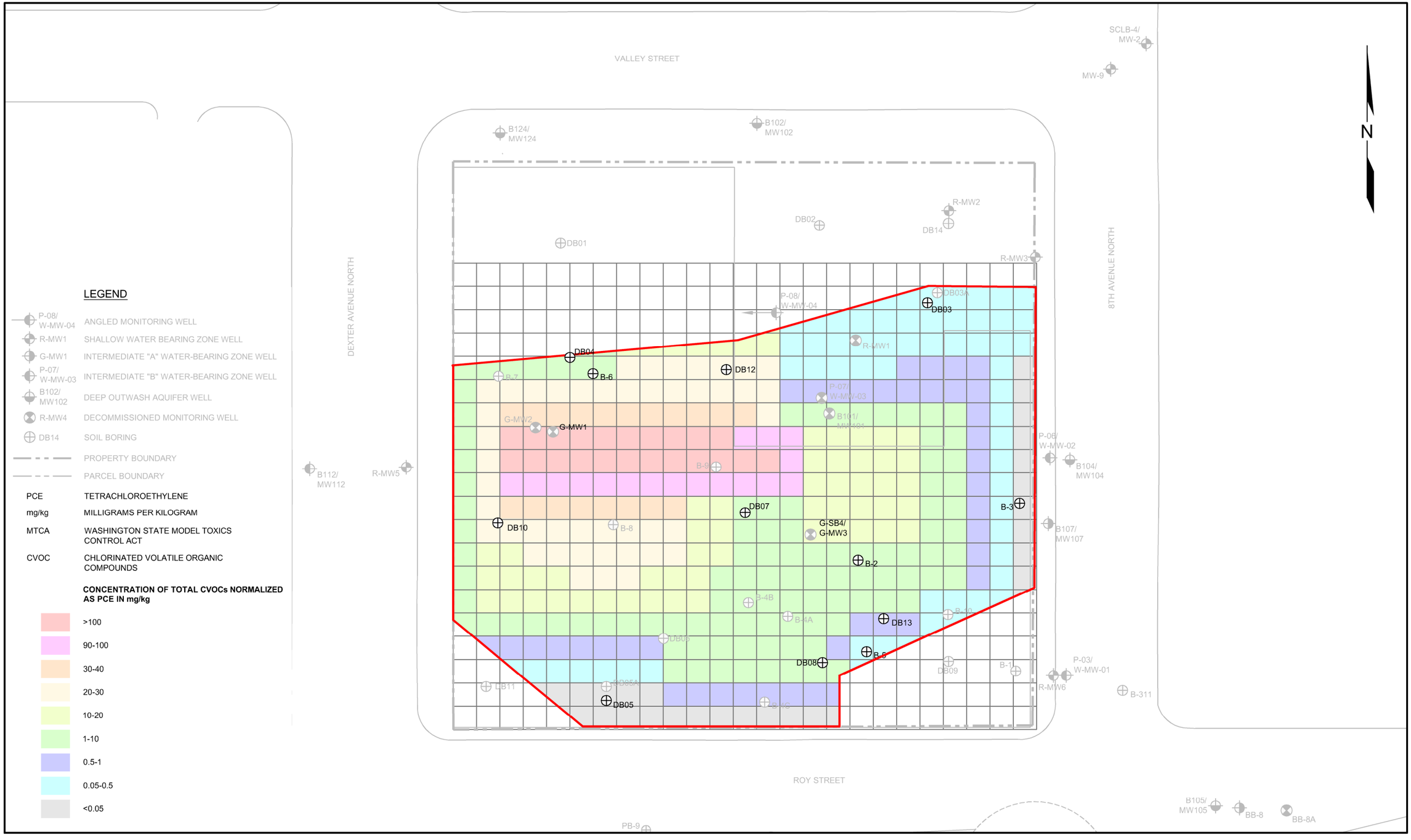
PROJECT NAME: 700 DEXTER
PROJECT NUMBER: 0797-001
STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 20 40 80
APPROXIMATE SCALE IN FEET

FIGURE 1
SOIL RANGES OF NORMALIZED PCE CONCENTRATIONS FROM 0-10'



LEGEND

P-08/ W-MW-04	ANGLED MONITORING WELL
R-MW1	SHALLOW WATER BEARING ZONE WELL
G-MW1	INTERMEDIATE "A" WATER-BEARING ZONE WELL
P-07/ W-MW-03	INTERMEDIATE "B" WATER-BEARING ZONE WELL
B102/ MW102	DEEP OUTWASH AQUIFER WELL
R-MW4	DECOMMISSIONED MONITORING WELL
DB14	SOIL BORING
	PROPERTY BOUNDARY
	PARCEL BOUNDARY
PCE	TETRACHLOROETHYLENE
mg/kg	MILLIGRAMS PER KILOGRAM
MTCA	WASHINGTON STATE MODEL TOXICS CONTROL ACT
CVOC	CHLORINATED VOLATILE ORGANIC COMPOUNDS

CONCENTRATION OF TOTAL CVOCs NORMALIZED AS PCE IN mg/kg

- >100
- 90-100
- 30-40
- 20-30
- 10-20
- 1-10
- 0.5-1
- 0.05-0.5
- <0.05

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CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 20 40 80
APPROXIMATE SCALE IN FEET

FIGURE 2
SOIL RANGES OF NORMALIZED PCE CONCENTRATIONS FROM 10-20'

P:\0797 FRONTIER ENV MGMT\700 DEXTER\TECHNICAL\CAD\2014 TM\CAP FIGURES\0797-001 2014CAP PCE SD2 F.DWG 3/5/2014

3/17/2014

P:\0797 FRONTIER ENV MGMT\700 DEXTER\TECHNICAL\CAD\2014 TM\CAP FIGURES\0797-001 2014CAP PCE SD4 F.DWG

VALLEY STREET

DEXTER AVENUE NORTH

8TH AVENUE NORTH

ROY STREET

N

LEGEND

P-08/ W-MW-04	ANGLED MONITORING WELL
R-MW1	SHALLOW WATER BEARING ZONE WELL
G-MW1	INTERMEDIATE "A" WATER-BEARING ZONE WELL
P-07/ W-MW-03	INTERMEDIATE "B" WATER-BEARING ZONE WELL
B102/ MW102	DEEP OUTWASH AQUIFER WELL
R-MW4	DECOMMISSIONED MONITORING WELL
DB14	SOIL BORING
	PROPERTY BOUNDARY
	PARCEL BOUNDARY
PCE	TETRACHLOROETHYLENE
mg/kg	MILLIGRAMS PER KILOGRAM
MTCA	WASHINGTON STATE MODEL TOXICS CONTROL ACT
CVOC	CHLORINATED VOLATILE ORGANIC COMPOUNDS

CONCENTRATION OF TOTAL CVOCs NORMALIZED AS PCE IN mg/kg

- >100
- 90-100
- 30-40
- 20-30
- 10-20
- 1-10
- 0.5-1
- 0.05-0.5
- <0.05

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STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 20 40 80
APPROXIMATE SCALE IN FEET

FIGURE 4
SOIL RANGES OF NORMALIZED PCE CONCENTRATIONS FROM 30-40'

3/17/2014

P:\0797 FRONTIER ENV MGMT\700 DEXTER\TECHNICAL\CAD\2014 TM\CAP FIGURES\0797-001 2014CAP PCE SD3 F.DWG

VALLEY STREET

DEXTER AVENUE NORTH

8TH AVENUE NORTH

ROY STREET

B124/ MW124

B102/ MW102

SCLB-4/ MW-2

MW-9

R-MW2

DB14

DB02

DB01

R-MW3

DB03A

DB03

P-08/ W-MW-04

R-MW1

DB04

DB12

B-7

B-6

P-07/ W-MW-03

B101/ MW101

G-MW2

G-MW1

P-06/ W-MW-02

B104/ MW104

B112/ MW112

R-MW5

B-9

DB07

B-3

DB10

B-8

G-SB4/ G-MW3

B107/ MW107

B-2

B-4B

B-4A

LB13

B-5

DB06

DB08

B-1

P-03/ W-MW-01

DB09

R-MW6

B-311

LB11

DB05A

DB05

B-4C

B105/ MW105

BB-8

BB-8A

PB-9

LEGEND

P-08/ W-MW-04	ANGLED MONITORING WELL
R-MW1	SHALLOW WATER BEARING ZONE WELL
G-MW1	INTERMEDIATE "A" WATER-BEARING ZONE WELL
P-07/ W-MW-03	INTERMEDIATE "B" WATER-BEARING ZONE WELL
B102/ MW102	DEEP OUTWASH AQUIFER WELL
R-MW4	DECOMMISSIONED MONITORING WELL
DB14	SOIL BORING
	PROPERTY BOUNDARY
	PARCEL BOUNDARY
PCE	TETRACHLOROETHYLENE
mg/kg	MILLIGRAMS PER KILOGRAM
MTCA	WASHINGTON STATE MODEL TOXICS CONTROL ACT
CVOC	CHLORINATED VOLATILE ORGANIC COMPOUNDS

CONCENTRATION OF TOTAL CVOCs NORMALIZED AS PCE IN mg/kg

- >100
- 90-100
- 30-40
- 20-30
- 10-20
- 1-10
- 0.5-1
- 0.05-0.5
- <0.05

N

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CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 20 40 80
APPROXIMATE SCALE IN FEET

FIGURE 3
SOIL RANGES OF NORMALIZED PCE CONCENTRATIONS FROM 20-30'

3/17/2014

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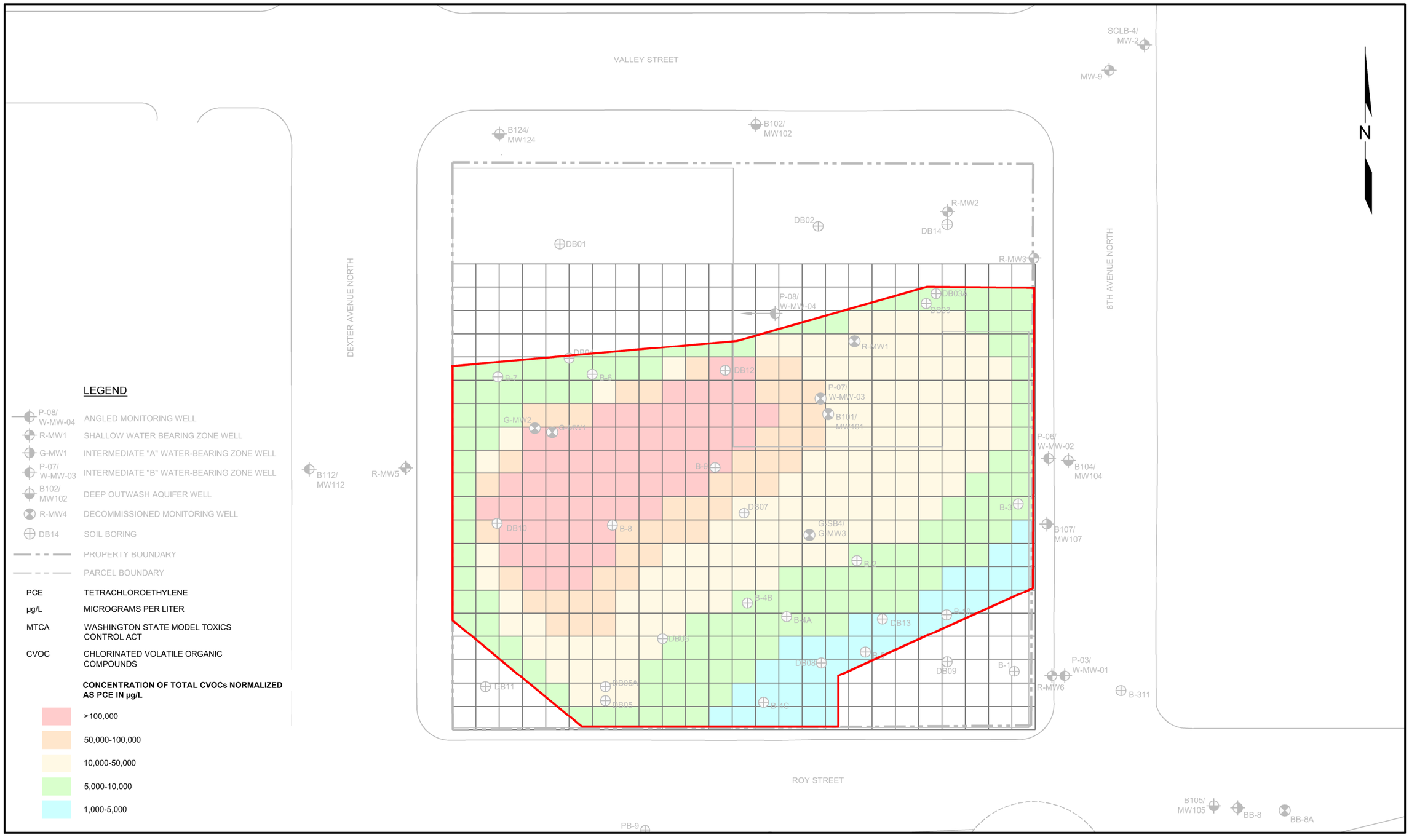

LEGEND

P-08/ W-MW-04	ANGLED MONITORING WELL
R-MW1	SHALLOW WATER BEARING ZONE WELL
G-MW1	INTERMEDIATE "A" WATER-BEARING ZONE WELL
P-07/ W-MW-03	INTERMEDIATE "B" WATER-BEARING ZONE WELL
B102/ MW102	DEEP OUTWASH AQUIFER WELL
R-MW4	DECOMMISSIONED MONITORING WELL
DB14	SOIL BORING
	PROPERTY BOUNDARY
	PARCEL BOUNDARY

PCE	TETRACHLOROETHYLENE
µg/L	MICROGRAMS PER LITER
MTCA	WASHINGTON STATE MODEL TOXICS CONTROL ACT
CVOC	CHLORINATED VOLATILE ORGANIC COMPOUNDS

CONCENTRATION OF TOTAL CVOCs NORMALIZED AS PCE IN µg/L

- >100,000
- 50,000-100,000
- 10,000-50,000
- 5,000-10,000
- 1,000-5,000

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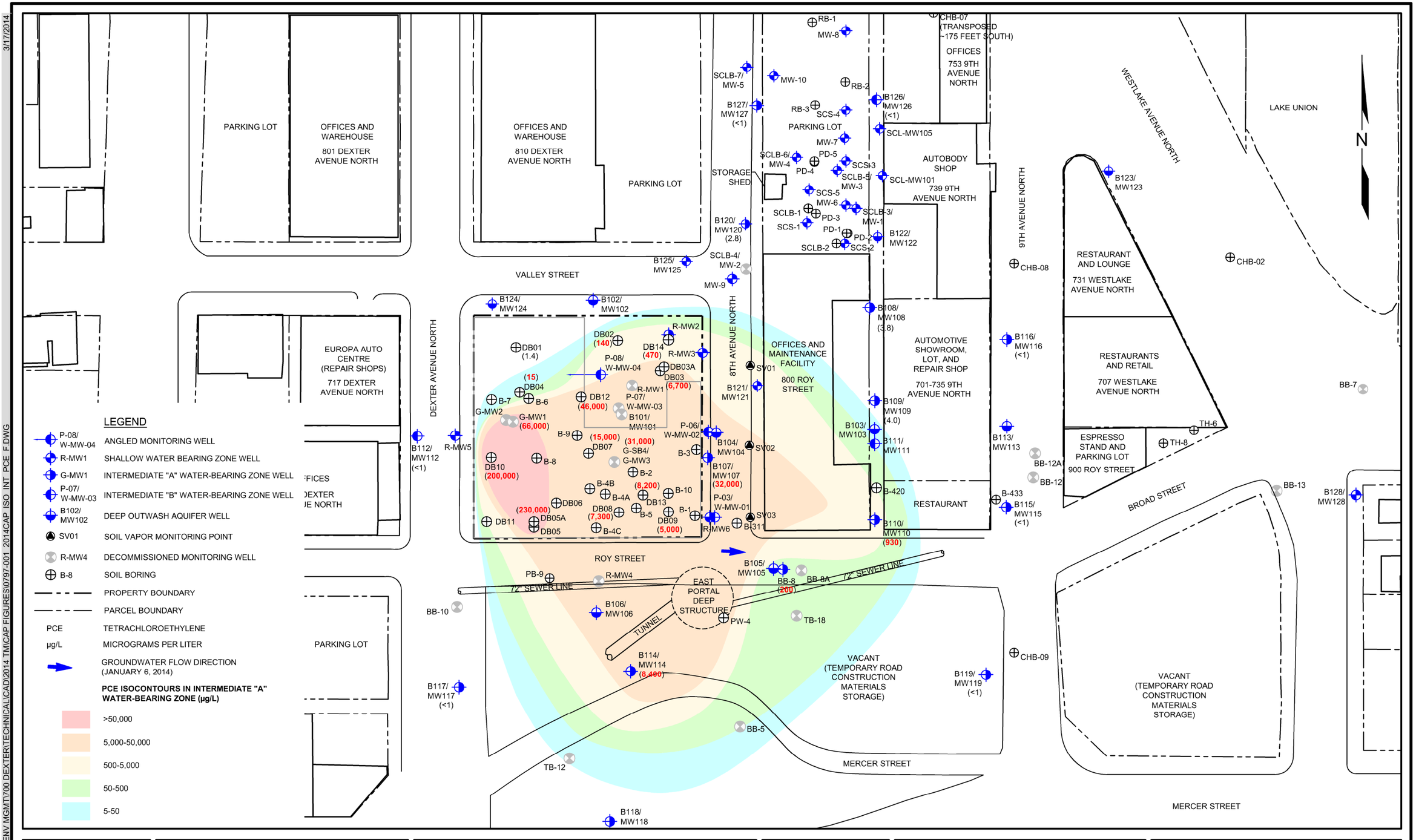
PROJECT NAME: 700 DEXTER
PROJECT NUMBER: 0797-001
STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 20 40 80
APPROXIMATE SCALE IN FEET

FIGURE 5
GROUNDWATER RANGES OF NORMALIZED PCE CONCENTRATIONS FROM 10-40'



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CAD FILE: 0797-001_2014CAP_ISO_INT_PCE

PROJECT NAME: 700 DEXTER PROPERTY
PROJECT NUMBER: 0797-001
STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 25 50 100 200
APPROXIMATE SCALE IN FEET

FIGURE 6
PCE ISOCONTOURS IN INTERMEDIATE WATER-BEARING ZONE

P:\0797 FRONTIER ENV MGMT\700 DEXTER\TECHNICAL\CAD\2014 TM\CAP FIGURES\0797-001_2014CAP_ISO_INT_PCE_F.DWG 3/17/2014

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3/17/2014

P:\0797 FRONTIER ENV MGMT\700 DEXTER\TECHNICAL\CAD\2014 TMCAP FIGURES\0797-001 2014CAP ISO INT TCE F.DWG

PARKING LOT

OFFICES AND WAREHOUSE
801 DEXTER AVENUE NORTH

OFFICES AND WAREHOUSE
810 DEXTER AVENUE NORTH

PARKING LOT

VALLEY STREET

EUROPA AUTO CENTRE (REPAIR SHOPS)
717 DEXTER AVENUE NORTH

DEXTER AVENUE NORTH

8TH AVENUE NORTH

OFFICES AND MAINTENANCE FACILITY
800 ROY STREET

STORAGE SHED

PARKING LOT

AUTOBODY SHOP
739 9TH AVENUE NORTH

AUTOMOTIVE SHOWROOM, LOT, AND REPAIR SHOP
701-735 9TH AVENUE NORTH

OFFICES
753 9TH AVENUE NORTH

9TH AVENUE NORTH

WESTLAKE AVENUE NORTH

LAKE UNION

RESTAURANT AND LOUNGE
731 WESTLAKE AVENUE NORTH

RESTAURANTS AND RETAIL
707 WESTLAKE AVENUE NORTH

ESPRESSO STAND AND PARKING LOT
900 ROY STREET

RESTAURANT

ROY STREET

BROAD STREET

MERCER STREET

PARKING LOT

VACANT (TEMPORARY ROAD CONSTRUCTION MATERIALS STORAGE)

VACANT (TEMPORARY ROAD CONSTRUCTION MATERIALS STORAGE)

MERCER STREET

EAST PORTAL DEEP STRUCTURE

TUNNEL

72" SEWER LINE

72" SEWER LINE

N

LEGEND

- P-08/ W-MW-04 — ANGLED MONITORING WELL
- R-MW1 — SHALLOW WATER BEARING ZONE WELL
- G-MW1 — INTERMEDIATE "A" WATER-BEARING ZONE WELL
- P-07/ W-MW-03 — INTERMEDIATE "B" WATER-BEARING ZONE WELL
- B102/ MW102 — DEEP OUTWASH AQUIFER WELL
- SV01 — SOIL VAPOR MONITORING POINT
- R-MW4 — DECOMMISSIONED MONITORING WELL
- B-8 — SOIL BORING
- PROPERTY BOUNDARY
- PARCEL BOUNDARY
- TCE — TRICHLOROETHYLENE
- µg/L — MICROGRAMS PER LITER
- GROUNDWATER FLOW DIRECTION (JANUARY 6, 2014)

TCE ISOCONTOURS IN INTERMEDIATE "A" WATER-BEARING ZONE (µg/L)

- >1,000
- 100-1,000
- 5-100

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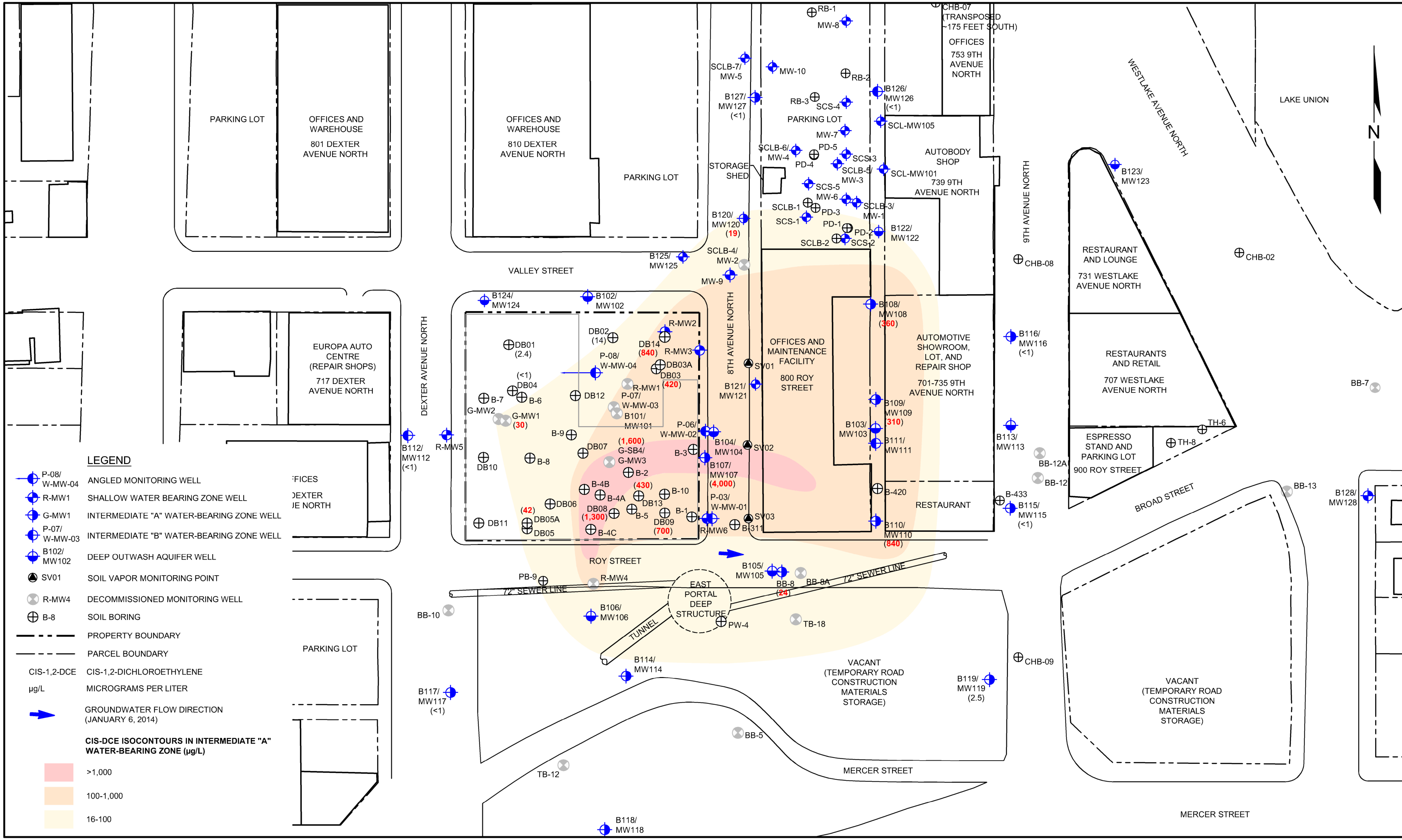
PROJECT NAME: 700 DEXTER PROPERTY
PROJECT NUMBER: 0797-001
STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 25 50 100 200
APPROXIMATE SCALE IN FEET

FIGURE 7
TCE ISOCONTOURS IN INTERMEDIATE WATER-BEARING ZONE



P:\0797 FRONTIER ENV MGMT\700 DEXTER\TECHNICAL\CAD\2014 TM\CAP FIGURES\0797-001_2014CAP_ISO_INT_CIS.DWG 3/17/2014

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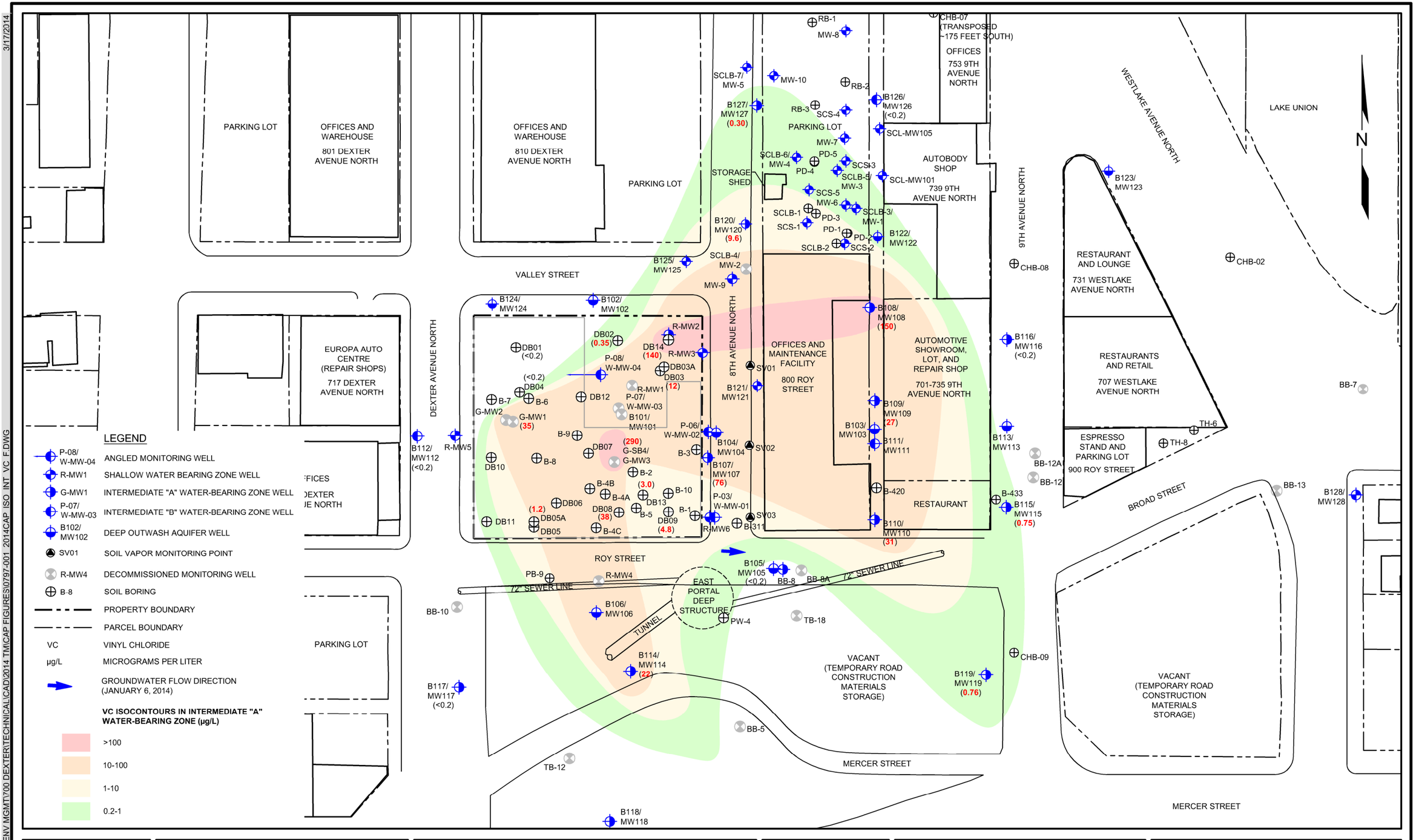
CAD FILE: 0797-001_2014CAP_ISO_INT_CIS

PROJECT NAME: 700 DEXTER PROPERTY
PROJECT NUMBER: 0797-001
STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 25 50 100 200
APPROXIMATE SCALE IN FEET

FIGURE 8
CIS-1,2-DCE ISOCONTOURS IN INTERMEDIATE WATER-BEARING ZONE



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DATE: 01/15/14
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CAD FILE: 0797-001_2014CAP_ISO_INT_VC

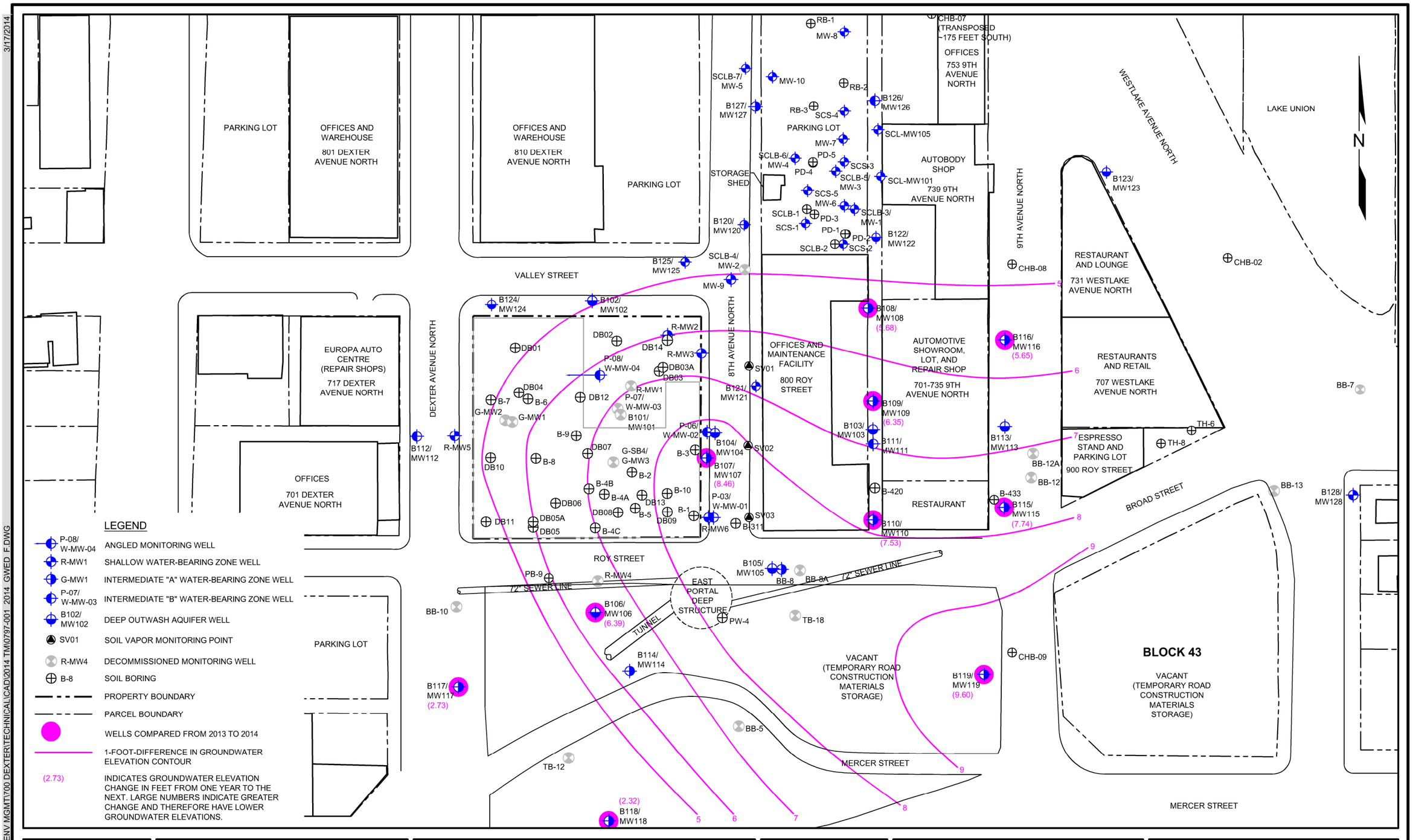
PROJECT NAME: 700 DEXTER PROPERTY
PROJECT NUMBER: 0797-001
STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 25 50 100 200
APPROXIMATE SCALE IN FEET

FIGURE 9
VC ISOCONTOURS IN INTERMEDIATE WATER-BEARING ZONE

P:\0797 FRONTIER ENV MGMT\700 DEXTER\TECHNICAL\CAD\2014 TMCAP FIGURES\0797-001_2014CAP_ISO_INT_VC.DWG 3/17/2014



LEGEND

P-08/ W-MW-04	ANGLED MONITORING WELL
R-MW1	SHALLOW WATER-BEARING ZONE WELL
G-MW1	INTERMEDIATE "A" WATER-BEARING ZONE WELL
P-07/ W-MW-03	INTERMEDIATE "B" WATER-BEARING ZONE WELL
B102/ MW102	DEEP OUTWASH AQUIFER WELL
SV01	SOIL VAPOR MONITORING POINT
R-MW4	DECOMMISSIONED MONITORING WELL
B-8	SOIL BORING
	PROPERTY BOUNDARY
	PARCEL BOUNDARY
	WELLS COMPARED FROM 2013 TO 2014
	1-FOOT-DIFFERENCE IN GROUNDWATER ELEVATION CONTOUR
(2.73)	INDICATES GROUNDWATER ELEVATION CHANGE IN FEET FROM ONE YEAR TO THE NEXT. LARGE NUMBERS INDICATE GREATER CHANGE AND THEREFORE HAVE LOWER GROUNDWATER ELEVATIONS.

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PROJECT NAME: 700 DEXTER PROPERTY
PROJECT NUMBER: 0797-001
STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 25 50 100 200
APPROXIMATE SCALE IN FEET

FIGURE 10
DIFFERENCE IN GROUNDWATER ELEVATIONS BEFORE (MARCH 29, 2013) AND DURING (JANUARY 6, 2014) DEWATERING ACTIVITIES

3/17/2014
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PARKING LOT

VALLEY STREET

739 9TH AVENUE NORTH

9TH AVENUE NORTH

RESTAURANT AND LOUNGE

731 WESTLAKE AVENUE NORTH

RESTAURANTS AND RETAIL

707 WESTLAKE AVENUE NORTH

ESPRESSO STAND AND PARKING LOT

900 ROY STREET

EUROPA AUTO CENTRE (REPAIR SHOPS)

717 DEXTER AVENUE NORTH

OFFICES

701 DEXTER AVENUE NORTH

DEXTER AVENUE NORTH

OFFICES AND MAINTENANCE FACILITY

800 ROY STREET

AUTOMOTIVE SHOWROOM, LOT, AND REPAIR SHOP

701-735 9TH AVENUE NORTH

RESTAURANT

ROY STREET

72" SEWER LINE

72" SEWER LINE

EAST PORTAL DEEP STRUCTURE

TUNNEL

PARKING LOT

BROAD STREET

VACANT (TEMPORARY ROAD CONSTRUCTION MATERIALS STORAGE)

VACANT (TEMPORARY ROAD CONSTRUCTION MATERIALS STORAGE)

B102/ MW102

B104/ MW104

B105/ MW105

B106/ MW106

B107/ MW107 (25.54')

B108/ MW108 (17.02')

B109/ MW109 (16.58')

B110/ MW110 (16.72')

B111/ MW111

B112/ MW112

B113/ MW113

B114/ MW114 (26.30')

B115/ MW115 (15.80')

B116/ MW116 (16.71')

B117/ MW117 (29.09')

B118/ MW118 (25.42')

B119/ MW119 (14.83')

G-MW1 (28.90')

G-MW2

G-SB4/ G-MW3 (28.41')

R-MW1

R-MW2

R-MW5

MW3

MW6

MW9

P-03/ W-MW-01

P-06/ W-MW-02

P-07/ W-MW-03

P-08/ W-MW-04

B-8

N

BLOCK 43

VACANT (TEMPORARY ROAD CONSTRUCTION MATERIALS STORAGE)

LEGEND

- P-08/ W-MW-04 — ANGLED MONITORING WELL
- R-MW1 — SHALLOW WATER-BEARING ZONE WELL
- G-MW1 — INTERMEDIATE "A" WATER-BEARING ZONE WELL
- P-07/ W-MW-03 — INTERMEDIATE "B" WATER-BEARING ZONE WELL
- B102/ MW102 — DEEP OUTWASH AQUIFER WELL
- PROPERTY BOUNDARY
- PARCEL BOUNDARY
- (29.09') — GROUNDWATER SURFACE ELEVATION
- 1-FOOT-INTERVAL CONTOUR LINE, DASHED WHERE INFERRED
- GROUNDWATER FLOW DIRECTION (MARCH 29, 2013)
- WELLS USED TO CALCULATE SEEPAGE VELOCITY
- SEEPAGE VELOCITY VECTOR

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PROJECT NAME: 700 DEXTER PROPERTY
PROJECT NUMBER: 0797-001
STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 40 80 160
APPROXIMATE SCALE IN FEET

FIGURE 11
GROUNDWATER CONTOUR MAP
INTERMEDIATE "A" WATER-BEARING ZONE
(MARCH 29, 2013)

P:\0797 FRONTIER ENV MGMT\700 DEXTER\TECHNICAL\CAD\2014 TM\0797-001_2014_CM_B_F.DWG

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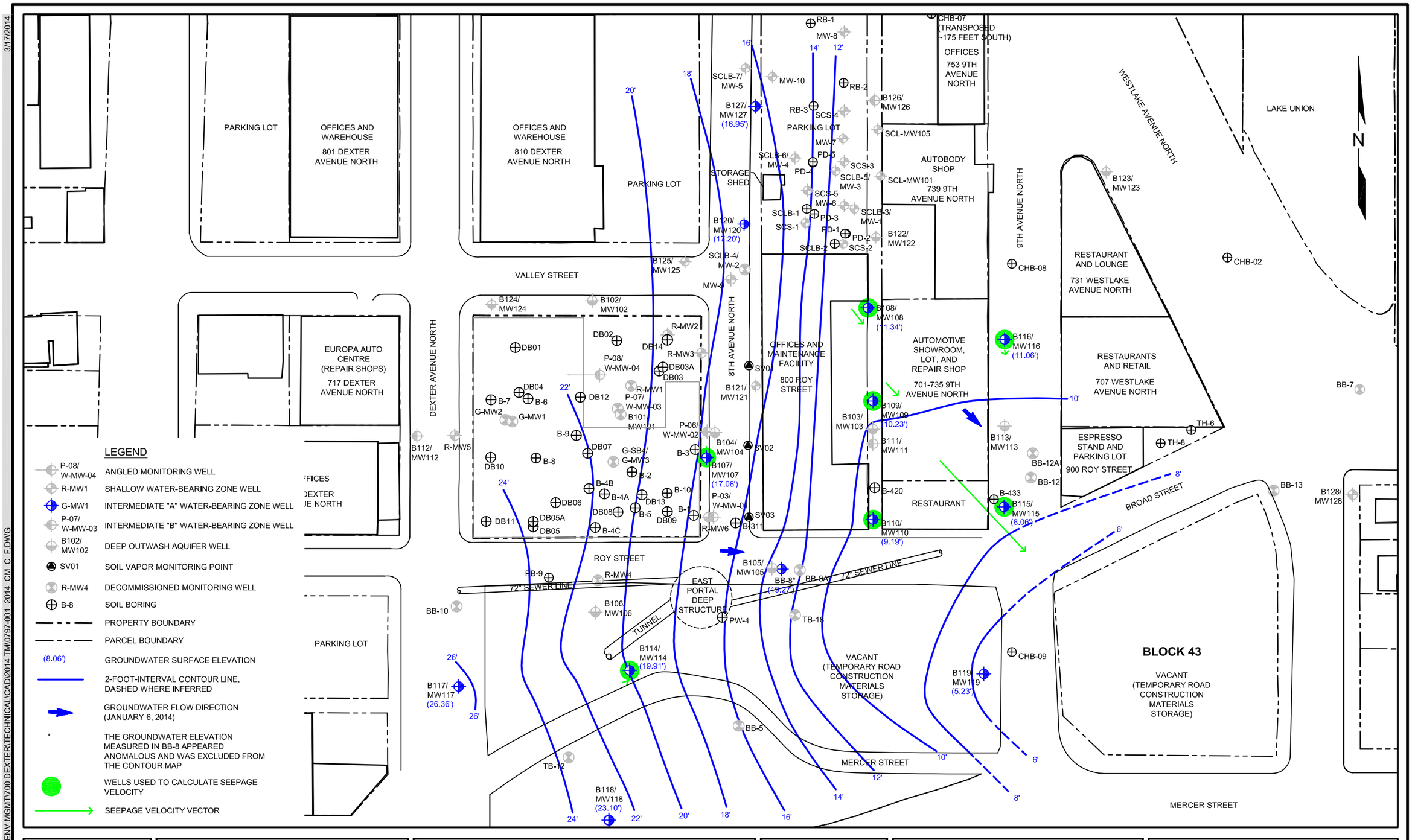

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CHECKED BY: CCC
CAD FILE: 0797-001_2014_CM_C

PROJECT NAME: 700 DEXTER PROPERTY
PROJECT NUMBER: 0797-001
STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 25 50 100 200
APPROXIMATE SCALE IN FEET

FIGURE 12
GROUNDWATER CONTOUR MAP
INTERMEDIATE WATER-BEARING ZONE
(JANUARY 6, 2014)

3/17/2014
P:\0797 FRONTIER ENV MGMT\700 DEXTER\TECHNICAL\CAD\2014 TM\0797-001 2014 CM C F.DWG
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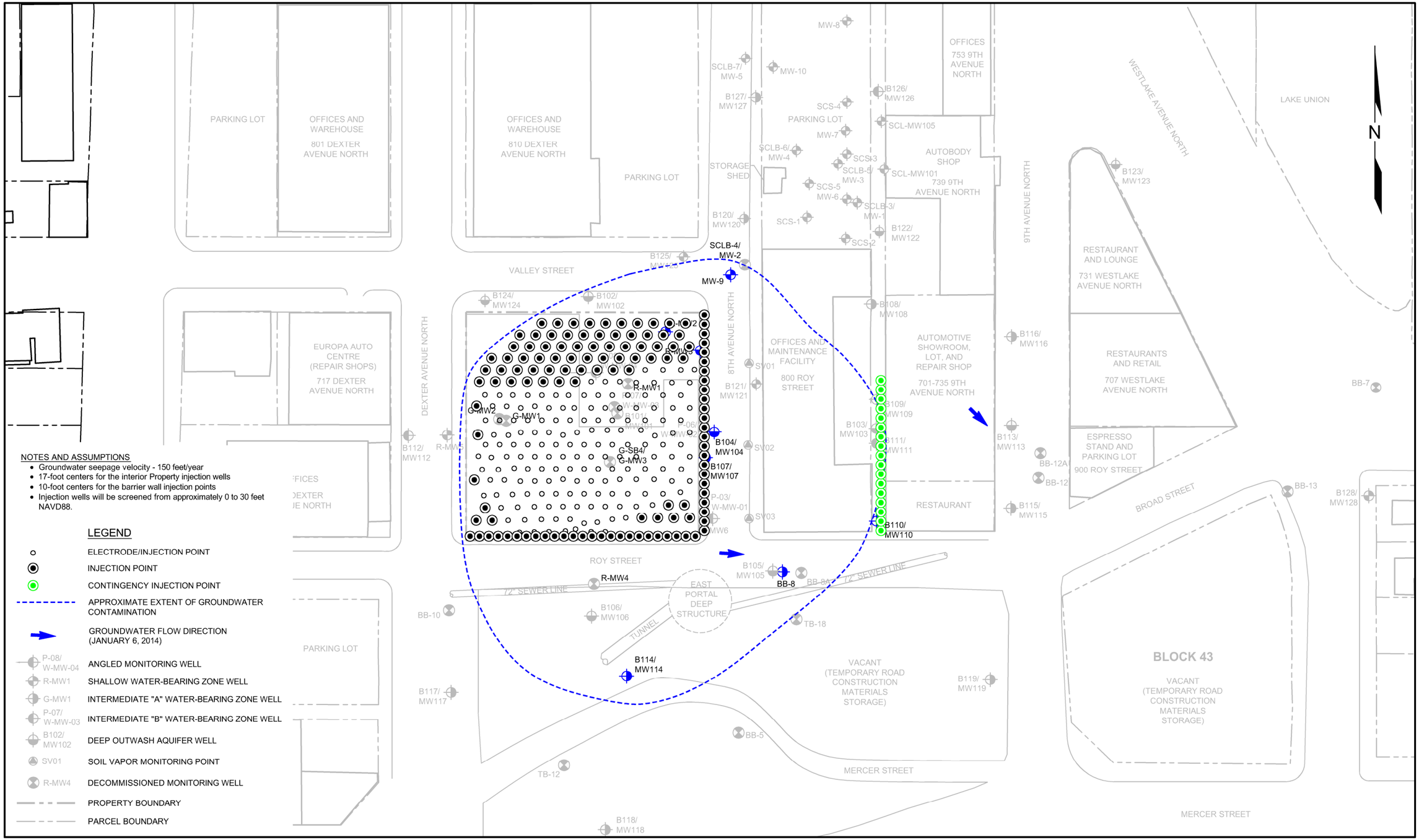

NOTES AND ASSUMPTIONS

- Groundwater seepage velocity - 150 feet/year
- 17-foot centers for the interior Property injection wells
- 10-foot centers for the barrier wall injection points
- Injection wells will be screened from approximately 0 to 30 feet NAVD88.

LEGEND

- ELECTRODE/INJECTION POINT
- INJECTION POINT
- CONTINGENCY INJECTION POINT
- APPROXIMATE EXTENT OF GROUNDWATER CONTAMINATION
- GROUNDWATER FLOW DIRECTION (JANUARY 6, 2014)
- P-08/ W-MW-04 — ANGLED MONITORING WELL
- R-MW1 — SHALLOW WATER-BEARING ZONE WELL
- G-MW1 — INTERMEDIATE "A" WATER-BEARING ZONE WELL
- P-07/ W-MW-03 — INTERMEDIATE "B" WATER-BEARING ZONE WELL
- B102/ MW102 — DEEP OUTWASH AQUIFER WELL
- SV01 — SOIL VAPOR MONITORING POINT
- R-MW4 — DECOMMISSIONED MONITORING WELL
- PROPERTY BOUNDARY
- PARCEL BOUNDARY

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CAD FILE: 0797-001_2014CAP_CA1_A

PROJECT NAME: 700 DEXTER PROPERTY
PROJECT NUMBER: 0797-001
STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 25 50 100 200
APPROXIMATE SCALE IN FEET

FIGURE 13
CLEANUP ACTION PLAN
SHALLOW TREATMENT ZONE
IN SITU REDUCTIVE DECHLORINATION

P:\0797 FRONTIER ENV MGMT\700 DEXTER\TECHNICAL\CAD\2014 TM\0797-001 2014CAP CA1 A F.DWG

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NOTES AND ASSUMPTIONS
- Groundwater seepage velocity - 25 feet/year
- 20-foot centers for the North-South injection well transects
- 75-foot spacing being transect lines
- 10-foot centers for the barrier wall injection points
- Injection wells will be screened from approximately 0 to -40 feet NAVD88.

LEGEND

- INJECTION POINT
- CONTINGENCY INJECTION POINT
- APPROXIMATE EXTENT OF GROUNDWATER CONTAMINATION
- GROUNDWATER FLOW DIRECTION (JANUARY 6, 2014)
- P-08/ W-MW-04 — ANGLED MONITORING WELL
- R-MW1 — SHALLOW WATER-BEARING ZONE WELL
- G-MW1 — INTERMEDIATE "A" WATER-BEARING ZONE WELL
- P-07/ W-MW-03 — INTERMEDIATE "B" WATER-BEARING ZONE WELL
- B102/ MW102 — DEEP OUTWASH AQUIFER WELL
- SV01 — SOIL VAPOR MONITORING POINT
- R-MW4 — DECOMMISSIONED MONITORING WELL
- PROPERTY BOUNDARY
- PARCEL BOUNDARY

PARKING LOT
OFFICES AND WAREHOUSE
801 DEXTER AVENUE NORTH
OFFICES AND WAREHOUSE
810 DEXTER AVENUE NORTH
PARKING LOT
STORAGE SHED
EUROPA AUTO CENTRE (REPAIR SHOPS)
717 DEXTER AVENUE NORTH
DEXTER AVENUE NORTH
VALLEY STREET
8TH AVENUE NORTH
OFFICES AND MAINTENANCE FACILITY
800 ROY STREET
OFFICES
753 9TH AVENUE NORTH
PARKING LOT
AUTOBODY SHOP
739 9TH AVENUE NORTH
AUTOMOTIVE SHOWROOM, LOT, AND REPAIR SHOP
701-735 9TH AVENUE NORTH
9TH AVENUE NORTH
WESTLAKE AVENUE NORTH
LAKE UNION
RESTAURANT AND LOUNGE
731 WESTLAKE AVENUE NORTH
RESTAURANTS AND RETAIL
707 WESTLAKE AVENUE NORTH
ESPRESSO STAND AND PARKING LOT
900 ROY STREET
BROAD STREET
BLOCK 43
VACANT (TEMPORARY ROAD CONSTRUCTION MATERIALS STORAGE)
ROY STREET
MERCER STREET
72" SEWER LINE
EAST PORTAL DEEP STRUCTURE
TUNNEL
RESTAURANT
PARKING LOT

P-08/ W-MW-04
P-07/ W-MW-03
P-06/ W-MW-02
P-03/ W-MW-01
B104/ MW104
B108/ W108
B109/ MW109
B111/ MW111
B110/ MW110
B113/ MW113
B115/ MW115
B116/ MW116
B123/ MW123
B124/ MW124
B125/ MW125
B120/ MW120
B121/ MW121
B102/ MW102
B101/ MW101
B103/ MW103
B105/ MW105
B106/ MW106
B107/ MW107
B112/ MW112
B114/ MW114
B117/ MW117
B118/ MW118
B119/ MW119
B126/ MW126
B127/ MW127
B128/ MW128
SCLB-7/ MW-5
SCLB-6/ MW-4
SCLB-5/ MW-7
SCLB-4/ MW-2
SCLB-3/ MW-3
SCLB-2/ MW-1
SCLB-1/ MW-8
SCS-1
SCS-2
SCS-3
SCS-4
SCS-5
SCS-6
SCL-MW101
SCL-MW105
MW-8
MW-10
MW-9
R-MW1
R-MW2
R-MW3
R-MW4
R-MW5
G-MW1
G-MW2
G-MW3
G-SE4/ G-MW3
MW1
MW6
SV01
SV02
SV03
BB-5
BB-7
BB-8
BB-8A
BB-10
BB-12
BB-12A
BB-13
TB-12
TB-18

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DATE: 01/15/14
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CAD FILE: 0797-001_2014CAP_CA1_B

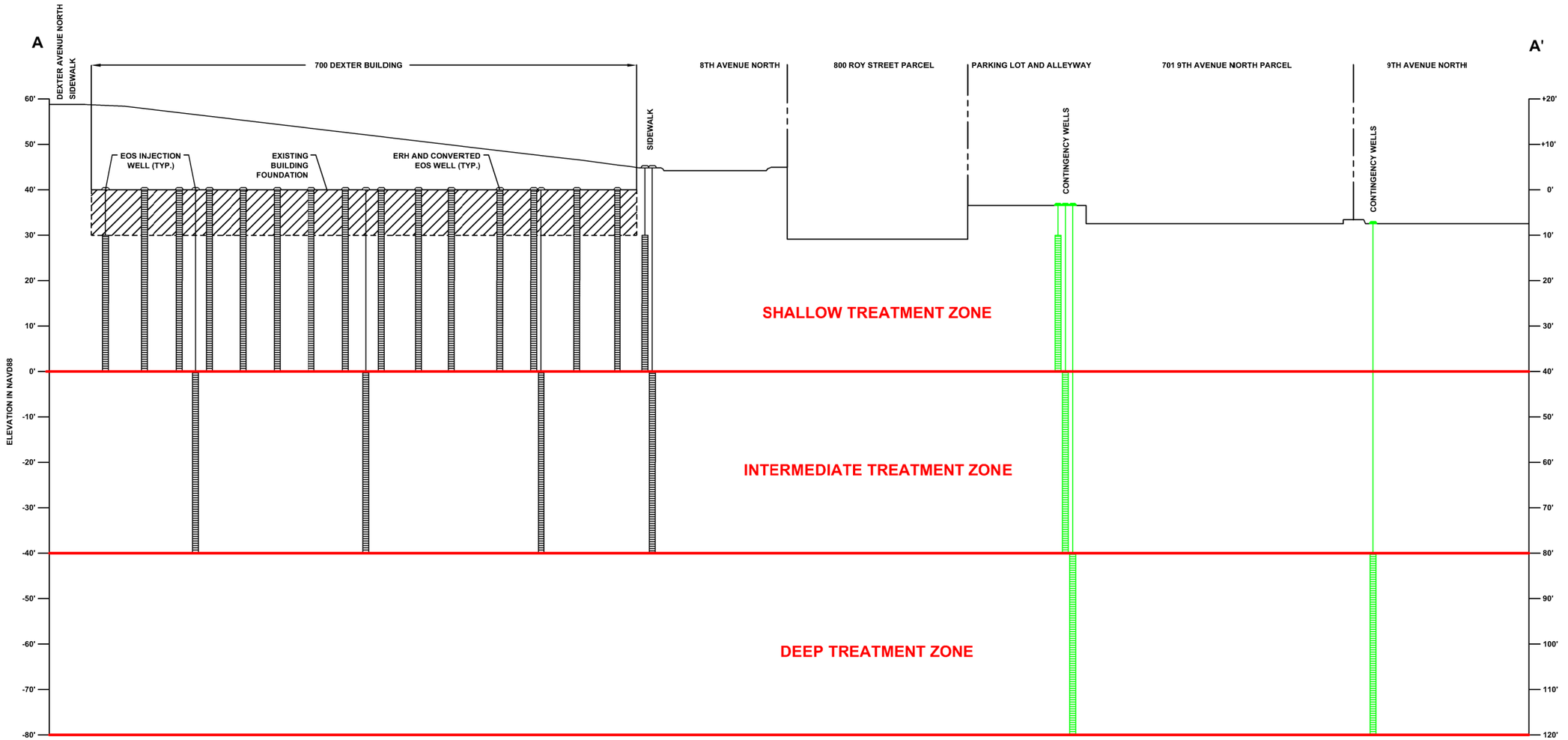
PROJECT NAME: 700 DEXTER PROPERTY
PROJECT NUMBER: 0797-001
STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

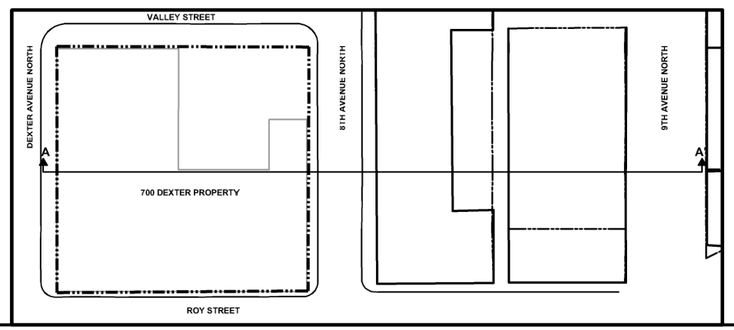
REGION:

0 25 50 100 200
APPROXIMATE SCALE IN FEET

FIGURE 14
CLEANUP ACTION PLAN
INTERMEDIATE TREATMENT ZONE
IN SITU REDUCTIVE DECHLORINATION

P:\0797 FRONTIER ENV MGMT\700 DEXTER\TECHNICAL\CAD\2014 TM\0797-001_2014CAP_CA1_B_F.DWG





LEGEND

	PROPOSED EXCAVATION AREA
ERH	ELECTRICAL RESISTANCE HEATING
EOS	EDIBLE OIL SUBSTRATE

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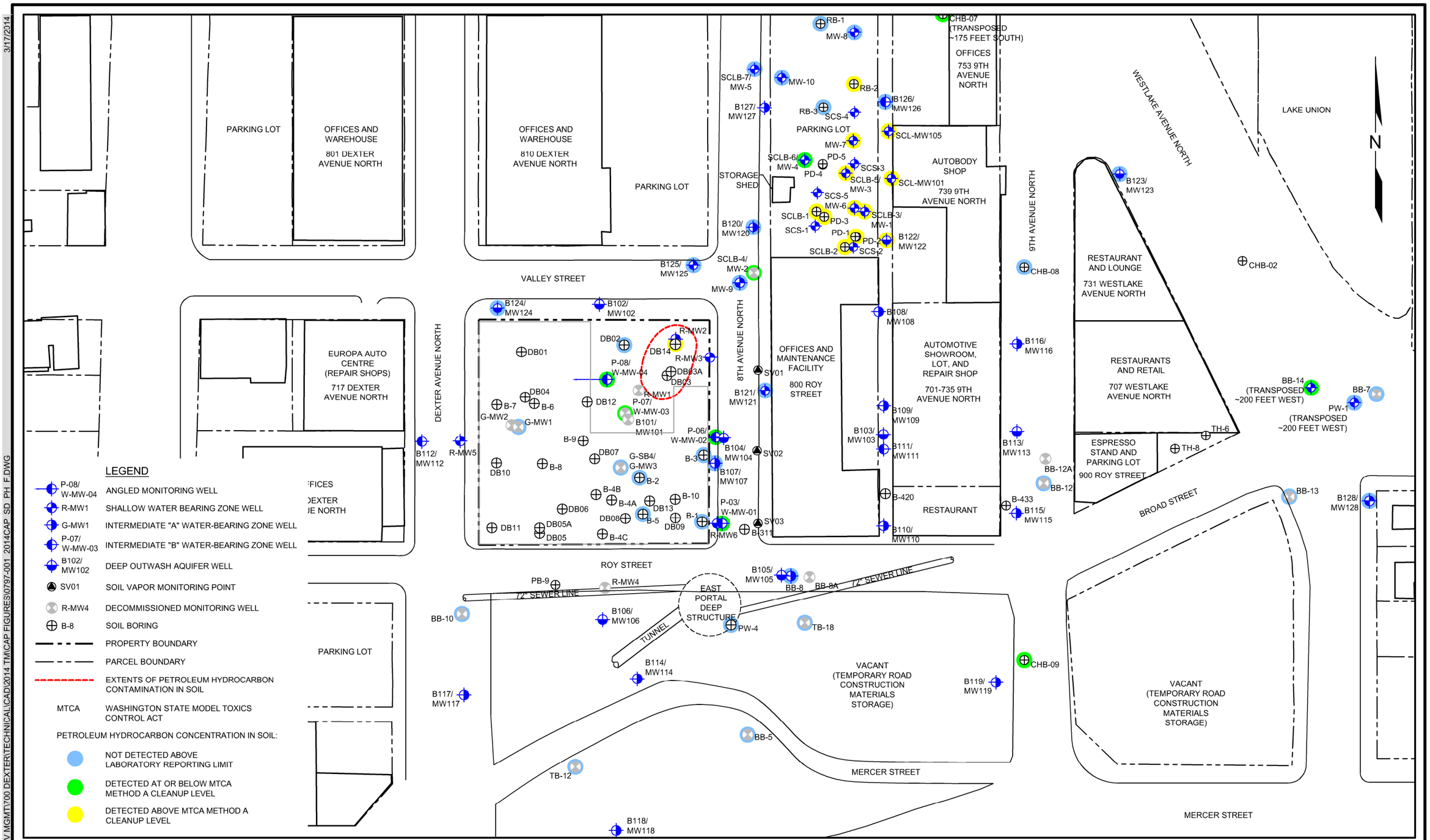
CAD FILE: 0797-001_2014CAP_CA1_XAA

PROJECT NAME: 700 DEXTER PROPERTY
PROJECT NUMBER: 0797-001
STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 25 50 100
APPROXIMATE HORIZONTAL SCALE IN FEET

FIGURE 15
CLEANUP ACTION PLAN
CROSS SECTION
IN SITU REDUCTIVE DECHLORINATION



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DATE: 01/15/14
DRAWN BY: BLR/JQC/NAC
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CAD FILE: 0797-001_2014CAP_SD_PH

PROJECT NAME: 700 DEXTER PROPERTY
PROJECT NUMBER: 0797-001
STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 25 50 100 200
APPROXIMATE SCALE IN FEET

FIGURE 16
PETROLEUM HYDROCARBON CONCENTRATIONS IN SOIL

3/17/2014
P:\0797 FRONTIER ENV MGMT\700 DEXTER\TECHNICAL\CAD\2014 TM\CAP FIGURES\0797-001 2014CAP SD PH F.DWG
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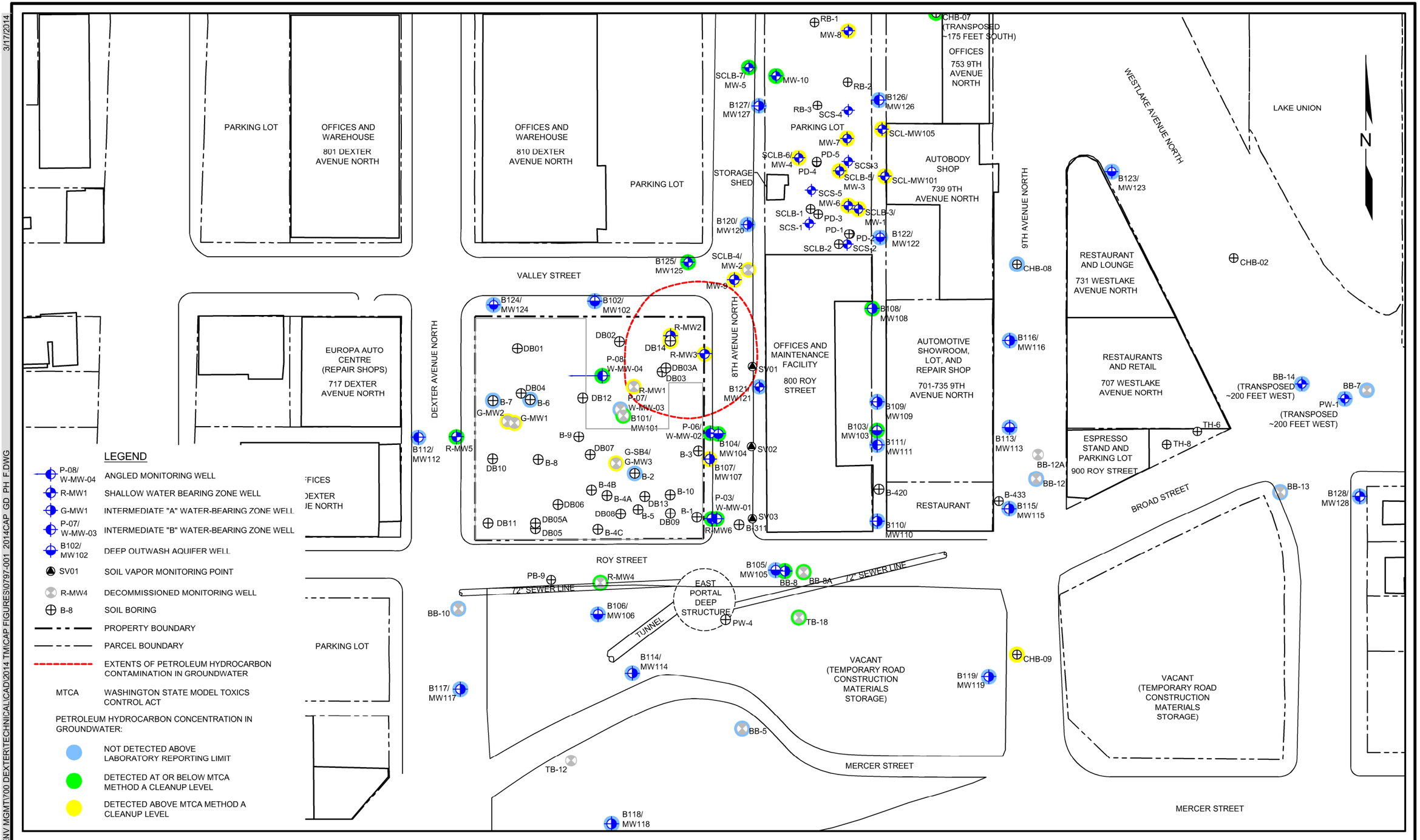

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PROJECT NAME: 700 DEXTER PROPERTY
PROJECT NUMBER: 0797-001
STREET ADDRESS: 700 DEXTER AVENUE NORTH
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 25 50 100 200
APPROXIMATE SCALE IN FEET

FIGURE 17
PETROLEUM HYDROCARBON CONCENTRATIONS IN GROUNDWATER

3/17/2014
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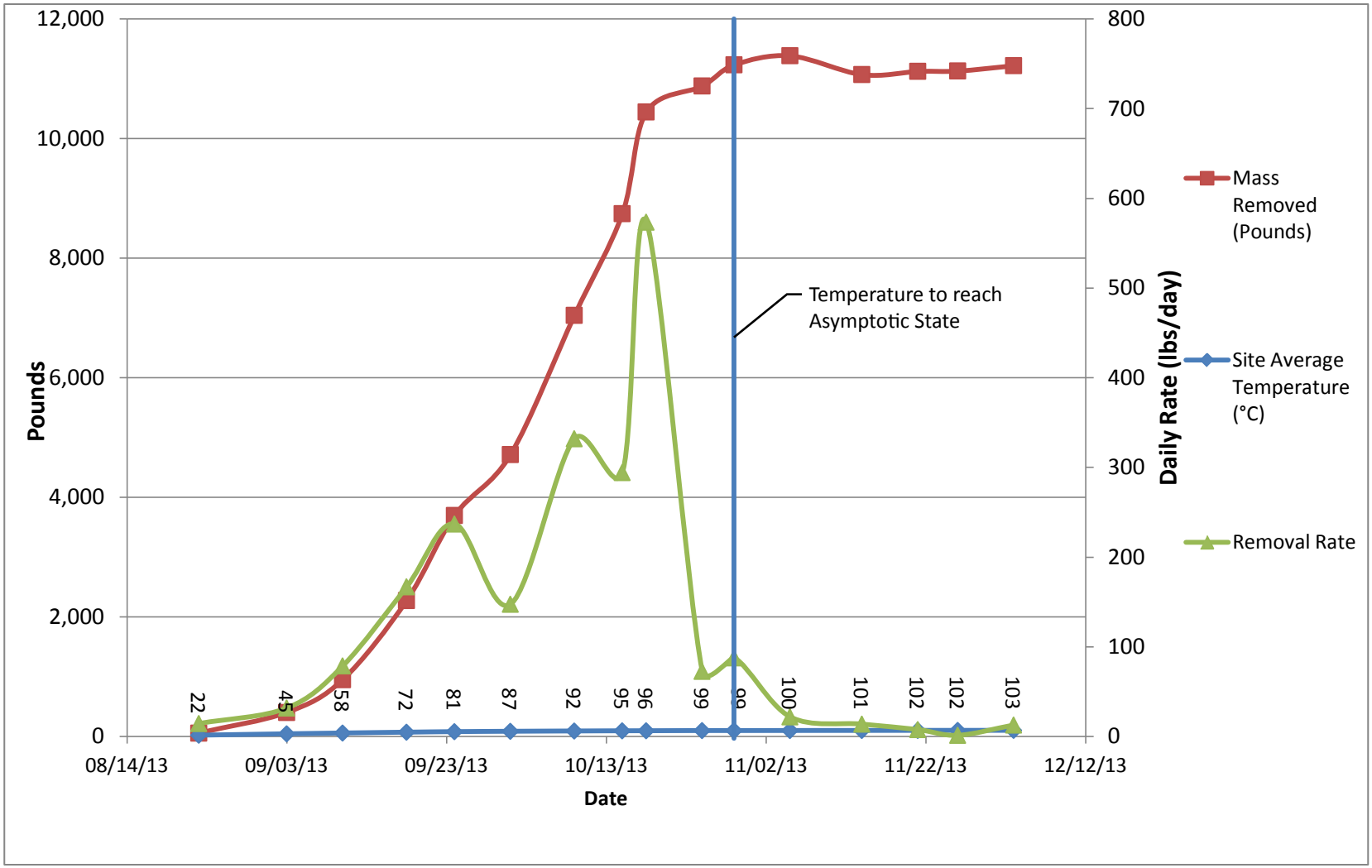
ATTACHMENT A
CUMULATIVE MASS REMOVAL VS.
AVERAGE TREATMENT AREA TEMPERATURES



Cumulative Mass Removed vs. Average Treatment Area Temperatures

ATTACHMENT B
SURFACE AREA, VOLUME, AND ESTIMATED MASS OF NORMALIZED PCE WITHIN THE ON-PROPERTY TREATMENT AREA

SoundEarth Strategies

Table 1
Surface Area, Volume, and Estimated Mass of Normalized PCE in Soil
within On-Property Treatment Area
700 Dexter Property
700 Dexter Avenue North
Seattle, Washington

Elevation segment 0 to 10 feet below ground surface (40 to 30 feet mean sea level)						
Concentration Range[1] (milligrams/kilogram)	**Average PCE Concentration[2]** (milligrams/kilogram)	**Surface Area[1]** (square feet)	**Volume[3]** (cubic feet)	**Soil Mass[4]** (pounds)	**PCE Mass[5]** (pounds)	**PCE Mass[5]** (kilograms)
>100 (100 to 300)	200	1,000	10,000	1,259,000	252	114.2144656
90 to 100	95.0	1,695	16,950	2,134,005	203	91.95692162
30 to 40	35.0	0	0	0	0	0
20 to 30	25.0	0	0	0	0	0
10 to 20	15.0	2,899	28,990	3,649,841	55	24.83308018
1 to 10	4.50	6,169	61,690	7,766,771	35	15.85325336
0.5 to 1	0.750	15,500	155,000	19,514,500	15	6.638715813
0.05 to 0.5	0.275	5,064	50,640	6,375,576	2	0.795275324
<0.05 (0.00)	0.000	5,616	56,160	7,070,544	0	0
Totals		**37,943**	**379,430**	**47,770,237**	**561**	**254**

Elevation segment 10 to 20 feet below ground surface (30 to 20 feet mean sea level)						
Concentration Range[1] (milligrams/kilogram)	**Average PCE Concentration[2]** (milligrams/kilogram)	**Surface Area[1]** (square feet)	**Volume[3]** (cubic feet)	**Soil Mass[4]** (pounds)	**PCE Mass[5]** (pounds)	**PCE Mass[5]** (kilograms)
>100 (100 to 300)	200	2,200	22,000	2,769,800	554	251.2718243
90 to 100	95.0	1,700	17,000	2,140,300	203	92.22818097
30 to 40	35.0	1,900	19,000	2,392,100	84	37.97630981
20 to 30	25.0	4,500	45,000	5,665,500	142	64.2456369
10 to 20	15.0	5,414	54,140	6,816,226	102	46.37678376
1 to 10	4.50	10,186	101,860	12,824,174	58	26.1762423
0.5 to 1	0.750	4,008	40,080	5,046,072	4	1.716643418
0.05 to 0.5	0.275	5,572	55,720	7,015,148	2	0.875054128
<0.05 (0.00)	0.000	2,463	24,630	3,100,917	0	0
Totals		**37,943**	**379,430**	**47,770,237**	**1,148**	**521**

Elevation segment 20 to 30 feet below ground surface (20 to 10 feet mean sea level)						
Concentration Range[1] (milligrams/kilogram)	**Average PCE Concentration[2]** (milligrams/kilogram)	**Surface Area[1]** (square feet)	**Volume[3]** (cubic feet)	**Soil Mass[4]** (pounds)	**PCE Mass[5]** (pounds)	**PCE Mass[5]** (kilograms)
>100 (100 to 300)	200	1,600	16,000	2,014,400	403	182.743145
90 to 100	95.0	700	7,000	881,300	84	37.97630981
30 to 40	35.0	2,200	22,000	2,769,800	97	43.97256926
20 to 30	25.0	9,000	90,000	11,331,000	283	128.4912738
10 to 20	15.0	8,100	81,000	10,197,900	153	69.38528785
1 to 10	4.50	15,120	151,200	19,036,080	86	38.8557612
0.5 to 1	0.750	781	7,810	983,279	1	0.334505616
0.05 to 0.5	0.275	442	4,420	556,478	0	0.069413841
<0.05 (0.00)	0.000	0	0	0	0	0
Totals		**37,943**	**379,430**	**47,770,237**	**1,106**	**502**

Elevation segment 30 to 40 feet below ground surface (10 to 0 feet mean sea level)						
Concentration Range[1] (milligrams/kilogram)	**Average PCE Concentration[2]**(milligrams/kilogram)	**Surface Area[1]** (square feet)	**Volume[3]** (cubic feet)	**Soil Mass[4]** (pounds)	**PCE Mass[5]** (pounds)	**PCE Mass[5]** (kilograms)
>100 (100 to 300)	200	900	9,000	1,133,100	227	102.793019
90 to 100	95.0	700	7,000	881,300	84	37.97630981
30 to 40	35.0	11,600	116,000	14,604,400	511	231.8553652
20 to 30	25.0	5,956	59,560	7,498,604	187	85.03266964
10 to 20	15.0	9,702	97,020	12,214,818	183	83.10815589
1 to 10	4.50	7,761	77,610	9,771,099	44	19.94441552
0.5 to 1	0.750	691	6,910	869,969	1	0.295958234
0.05 to 0.5	0.275	633	6,330	796,947	0	0.099409415
<0.05 (0.00)	0.000	0	0	0	0	0
Totals		**37,943**	**379,430**	**47,770,237**	**1,237**	**561**
Total PCE Mass in Soil (pounds)					**4,052**	**1,838**

NOTES:

[1]Concentration Range and surface areas correspond with Figures 39 through 42.

[2]Average concentration for concentration range. It is assumed that >100 milligrams per kilogram is between 100 and 300 mg/kg or 2 * 100 mg/kg.

[3]Volume = Surface Area * 10 foot elevation segment.

[4]Soil mass = volume * bulk soil density (125.9 pounds per cubic feet).

[5]PCE Mass (total CVOCS as PCE) = average PCE concentration as a percentage ((PCE in mg/kg)/10^6) * soil mass.

CVOC = chlorinated volatile organic compound

mg/kg = milligrams per kilogram

PCE = tetrachloroethylene

SoundEarth Strategies

Table 2
Surface Area, Volume, and Estimated Mass of Normalized PCE in Groundwater
within On-Property Treatment Area
700 Dexter Property
700 Dexter Avenue North
Seattle, Washington

Elevation segment 10 to 40 feet below ground surface (30 to 0 feet mean sea level)						
Concentration Range[1] (micrograms/liter)	**Average PCE Concentration[2]** (micrograms/liter)	**Surface Area[1]** (square feet)	**Volume[3]** (cubic feet)	**Groundwater Volume[4]** (cubic feet)	**Groundwater Mass[5]** (pounds)	**PCE Mass[6]** (pounds)
>100,000 (100,000 to 300,000)	200,000	6,300	189,000	56,700	3,538,080	708
50,000 to 100,000	75,000	4,399	131,970	39,591	2,470,478	185
10,000 to 50,000	30,000	12,940	388,200	116,460	7,267,104	218
5,000 to 10,000	7,500	10,330	309,900	92,970	5,801,328	44
1,000 to 5,000	3,000	3,974	119,220	35,766	2,231,798	7
Totals		**37,943**	**1,138,290**	**341,487**	**21,308,789**	**1,161**
Total PCE Mass in Groundwater						**1,161**

NOTES:

[1]Concentration Range and surface areas correspond with Figure 43.

[2]Average concentration for concentration range. It is assumed that >100,000 ug/L is between 100,000 and 300,000 µg/L or 2 * 100,000 µg/L, which is equal to the solubility limit of 200,000 µg/L for PCE.

[3]Volume = Surface Area * 10 foot elevation segment.

[4]Groundwater volume = volume * porosity (0.3).

[5]Groundwater mass = volume * water density (62.4 pounds per cubic feet or).

[6]PCE Mass (total CVOCS as PCE) = average PCE concentration as a percentage ((PCE in ug/L)/10^9) * groundwater mass.

µg/L = micrograms per liter

CVOC = chlorinated volatile organic compound

PCE = tetrachloroethylene

ATTACHMENT C
ESTIMATED MASS OF CHEMICALS OF CONCERN IN INTERMEDIATE WATER-BEARING ZONE

Table 1
Estimated Mass of Chemicals of Concern in Groundwater
700 Dexter Property
700 Dexter Avenue North
Seattle, Washington

Concentration Ranges correspond with Figures 21 through 24 of SoundEarth, 2014, CAP.
Surface Areas were based on the concentration range figures and determined using AutoCAD.
Average concentration for concentration range are based on the assumption that the concentration distribution is log normal.

Eq 1. $V = SA * T$ ***Eq 2. $GV = V * \varphi$*** ***Eq 3. $GM = GV * \rho$***

Eq 4. PCE Mass = $(C_p / 10^9) * GM$

V = Volume
A = Surface Area
T = Aquifer thickness (65 feet)
GV = Groundwater Volume
ϕ = porosity (0.3)
GM = Groundwater mass
ρ = water density (62.4 pounds per cubic feet)
C_p = Average Concentration
10^9 = conversion of micrograms per liter to kilograms per liter kilogram per liter

PCE Mass in Groundwater in the Intermediate Water-Bearing Zone

Concentration Range (micrograms/liter)	Average PCE Concentration (micrograms/liter)	Surface Area (square feet)	Volume[1] (cubic feet)	Groundwater Volume[2] (cubic feet)	Groundwater Mass[3] (pounds)	PCE Mass[4] (pounds)
>50,000	50,000	7,179	466,635	139,991	29,118,024	1,456
5,000 to 50,0000	22,500	75,642	4,916,730	1,475,019	306,803,952	6,903
500 to 5,000	2,500	49,220	3,199,300	959,790	199,636,320	499
50 to 500	250	49,485	3,216,525	964,958	200,711,160	50
5 to 50	25	37,679	2,449,135	734,741	152,826,024	4
1 to 5	3	71,868	4,671,420	1,401,426	291,496,608	1
Totals		**291,073**	**18,919,745**	**5,675,924**	**1,180,592,088**	**8,913**

Total PCE Mass in Groundwater (pounds)	**8,913**

TCE Mass in Groundwater in the Intermediate Water-Bearing Zone

Concentration Range (micrograms/liter)	Average TCE Concentration (micrograms/liter)	Surface Area (square feet)	Volume[1] (cubic feet)	Groundwater Volume[2] (cubic feet)	Groundwater Mass[3] (pounds)	TCE Mass[4] (pounds)
>1,000	1,000	6,300	409,500	122,850	25,552,800	26
100 to 1,000	500	4,399	285,935	85,781	17,842,344	9
10 to 100	50	12,940	841,100	252,330	52,484,640	3
1 to 10	5	10,330	671,450	201,435	41,898,480	0
Totals		**33,969**	**2,207,985**	**662,396**	**137,778,264**	**37**

Total TCE Mass in Groundwater (pounds)	**37**

Cis-DCE Mass in Groundwater in the Intermediate Water-Bearing Zone

Concentration Range (micrograms/liter)	Average cis-DCE Concentration (micrograms/liter)	Surface Area (square feet)	Volume[1] (cubic feet)	Groundwater Volume[2] (cubic feet)	Groundwater Mass[3] (pounds)	cis-DCE Mass[4] (pounds)
>1,000	1,000	37,446	2,433,990	730,197	151,880,976	152
100 to 1,000	500	59,304	3,854,760	1,156,428	240,537,024	120
10 to 100	50	86,972	5,653,180	1,695,954	352,758,432	18
1 to 10	5	78,056	5,073,640	1,522,092	316,595,136	2
Totals		**261,778**	**17,015,570**	**5,104,671**	**1,061,771,568**	**291**

Total cis-DCE Mass in Groundwater (pounds)	**291**

Vinyl Chloride Mass in Groundwater in the Intermediate Water-Bearing Zone

Concentration Range (micrograms/liter)	Average Vinyl Chloride Concentration (micrograms/liter)	Surface Area (square feet)	Volume[1] (cubic feet)	Groundwater Volume[2] (cubic feet)	Groundwater Mass[3] (pounds)	Vinyl Chloride Mass[4] (pounds)
>100	100	11,454	744,510	223,353	46,457,424	5
10 to 100	50	109,058	7,088,770	2,126,631	442,339,248	22
1 to 10	5	62,182	4,041,830	1,212,549	252,210,192	1
0.2 to 1	1	82,854	5,385,510	1,615,653	336,055,824	0
Totals		**265,548**	**17,260,620**	**5,178,186**	**1,077,062,688**	**28**

Total Vinyl Chloride Mass in Groundwater (pounds)	**28**

Notes:
[1] Eq 1.
[2] Eq 2
[3] Eq 3.
[4] Eq 4.
Assuming an intermediate water bearing zone thickness of 65 feet.
ug/L = micrograms per liter
PCE = tetrachloroethene
TCE = trichloroethene
cis-DCE = cis-1, 2 Dichloroethane

ATTACHMENT D
DECAY RATE AND RESTORATION TIME FRAME CALCULATIONS

D-1

Flow Line 1 Biological Decay Rates Calculations

700 Dexter

Normalizatin of Using Inorganic Tracer

Tracer: Chloride

Assumption Chloride concentrations 10 percent to total source chloride concentration: (y/n)

Calculated cell

Lab Data

Eq 1. [CL] = 0.86 [PCE] + 0.81 [TCE] + 0.73 [DCE] + 0.57[VC]

Eq 2. $C_{B,\,corr} = C_A e^{-\lambda t}$ ***Eq 3.*** $C_{B,\,corr} = C_A (T_A/T_B)$

$C_{B,\,corr}$ = tracer corrected concentrations

C_A = original Results

^ = lamda

e = expotent

t = time

T_A = Tracer concentration Point A (upgradient fo Point B)

T_B = Trace concentration at Point B (downgradient of point A)

Compounds **Sample Locations**

	MW107	MW109	MW108	MW116										
	Distance from Source (in Feet)													
	0	190	240	360										
	Concentrations in mg/L													
PCE	32	0.004	0.0038	0.0005										
TCE	2.4	0.018	0.0046	0.0005										
Total DCE	4.03	0.31	0.396	0.0005										
VC	0.076	0.027	0.15	0.0001										
Total Organic Chloride	32.5	0.3	0.38	0.00	0.0	0	0	0	0	0	0	0	0	0
Chloride	70.8	16.1	25.8	26.2										
Tracer (Total Chloride plus Chlorine)	103.25	16.36	26.18	26.20	0.00	0	0	0	0	0	0	0	0	0
Corrected PCE	32	0.025652	0.014986	0.00197	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Corrected TCE	2.40	0.11	0.02	0.001970	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Corrected DCE	4.03	1.96	1.56	0.001970	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Corrected VC	0.08	0.17	0.59	0.000394	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
TCE Decay Rate/yr	#DIV/0!	-2.33	-2.96	-2.87	#DIV/0!									
travel time (years)	0	1.31	1.65	2.48	0.00									

Eq 4. Vx = k * dh/dl/ǿ
Eq 5. R = 1+ [(Koc * foc * soil bulk density)/ǿ]
Eq 6. Vc = Vx/R
Eq 7. t = x/Vc

	Data
V_c = contaminant velocity (ft/day)	0.398
x = distance betweeen two points (ft)	240
t = time (years)	1.65
V_x = speepage velocity (ft/day)	0.61
k - hydraulic conductivity (ft/day)	0.5
dh/dl = gradient (demensionless)	0.024
ǿ = effective porosity	0.3
R = Retardation Factor	1.5
foc - fraction of organic carbon	0.001
Koc = soil partiting coefficient (ml/g)	94 tce
Bulk Density (g/cm3)	1.7

Koc	PCE	2.70E+02 ml/g	Source: CLARC Dec 2013
Koc	TCE	9.40E+01 ml/g	Source: CLARC Dec 2013
Koc	DCE	3.80E+01 ml/g	Source: CLARC Dec 2013
Koc	VC	1.90E+01 ml/g	Source: CLARC Dec 2013

In the absence of site specific data, assume a bulk density of 1.7 gm/cm3

In the absence of site specific data, assume an effective porosity of 0.3

For the intermediate zone used a site specific arithmatic average for K of 0.5 ft/day

In the absence of site specific organic carbon, assumes a foc of 0.001

Flow Line 2 Biological Decay Rate Calculations
700 Dexter Project

Normalizatin of Using Inorganic Tracer
Tracer: Chloride
Assumption Chloride concentrations 10 percent to total source chloride concentration: (y/n)

Calculated cell
Lab Data

Eq 1. [CL] = 0.86 [PCE] + 0.81 [TCE] + 0.73 [DCE] + 0.57[VC]

Eq 2. $C_{B,\,corr} = C_A\, e^{-\lambda t}$ ***Eq 3.*** $C_{B,\,corr} = C_A\,(T_A/T_B)$

$C_{B,\,corr}$ = tracer corrected concentrations
C_A = original Results
^ = lamda
e = expotent
t = time
T_A = Tracer concentration Point A (upgradient fo Point B)
T_B = Trace concentration at Point B (downgradient of point A)

Compounds **Sample Locations**

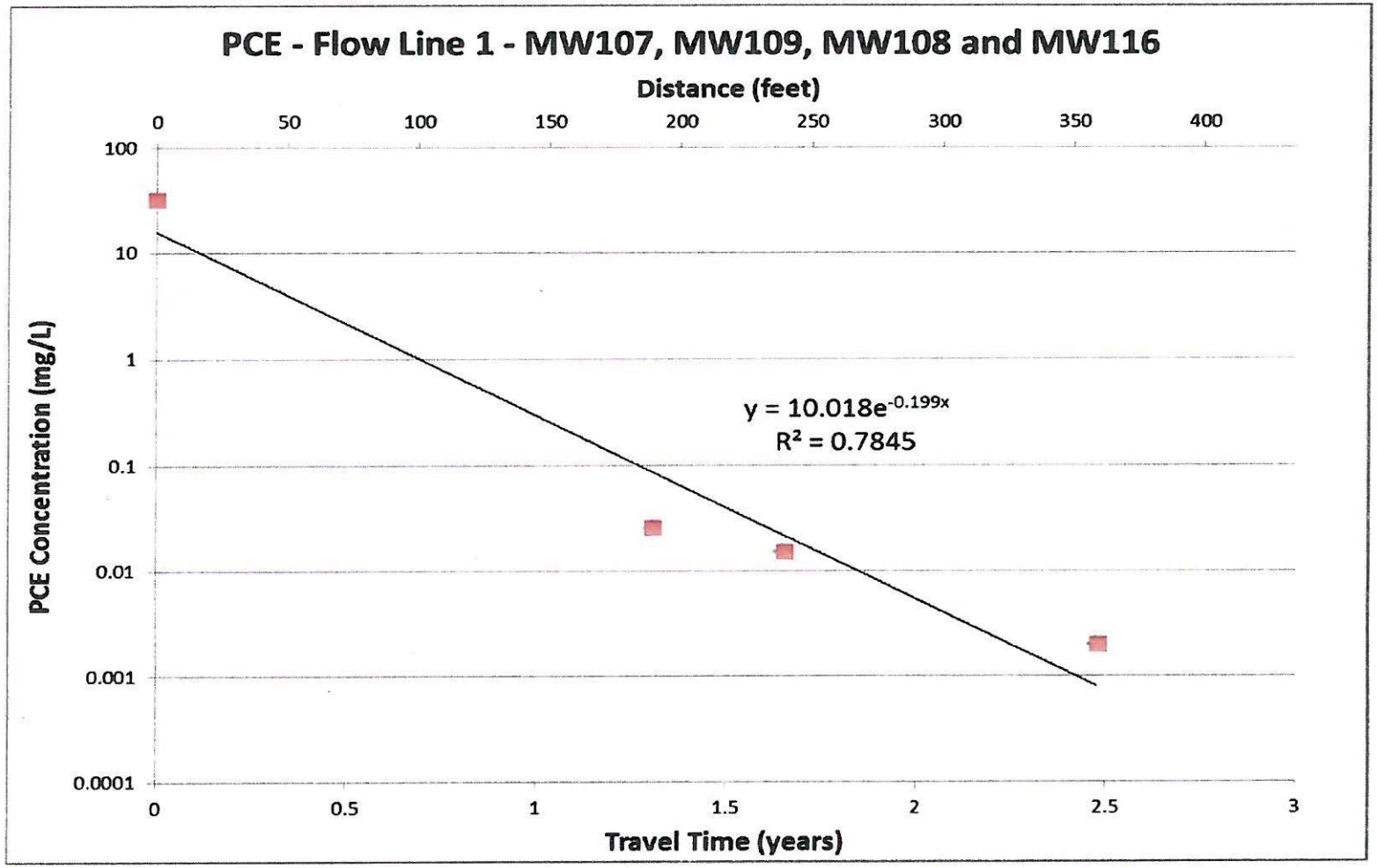
	MW107	MW110	MW115											
	Distance from Source (in Feet)													
	0	200	330											
	Concentrations in mg/L													
PCE	32	0.93	0.0005											
TCE	2.4	0.24	0.0005											
Total DCE	4.03	0.843	0.0005											
VC	0.076	0.031	0.00075											
Total Organic Chloride	32.5	1.6	0.00	0.00	0.0	0	0	0	0	0	0	0	0	0
Chloride	70.8	20.4	22.1											
Tracer (Total Chloride plus Chlorine)	103.25	22.03	22.10	0.00	0.00	0	0	0	0	0	0	0	0	0
Corrected PCE	32	4.707014	0.002336	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Corrected TCE	2.40	1.12	0.00234	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Corrected DCE	4.03	3.95	0.00234	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Corrected VC	0.08	0.15	0.00350	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
TCE Decay Rate/yr	#DIV/0!	-0.55	-3.05	#DIV/0!	#DIV/0!									
travel time (years)	0	1.38	2.27	0.00	0.00									

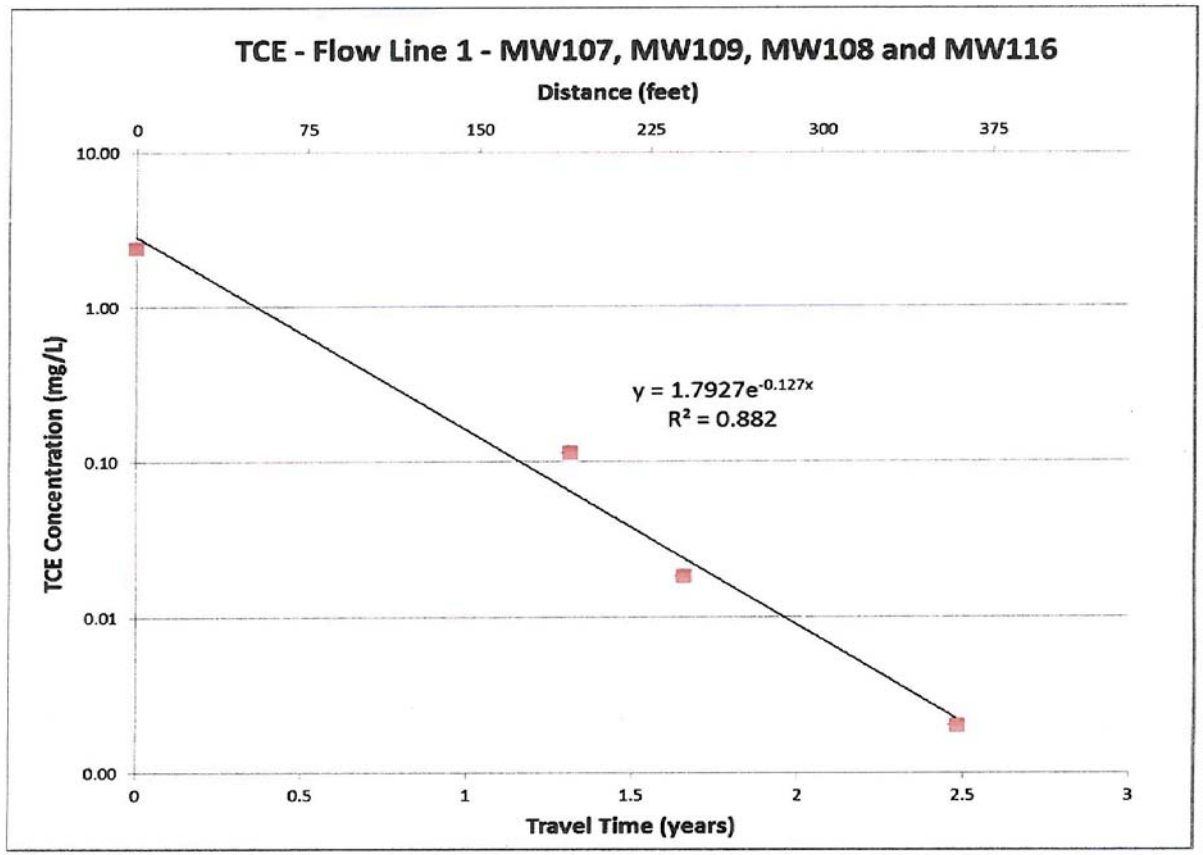
Eq 4. Vx = k * dh/dl/ǿ
Eq 5. R = 1+ [(Koc * foc * soil bulk density)/ǿ]
Eq 6. Vc = Vx/R
Eq 7. t = x/Vc

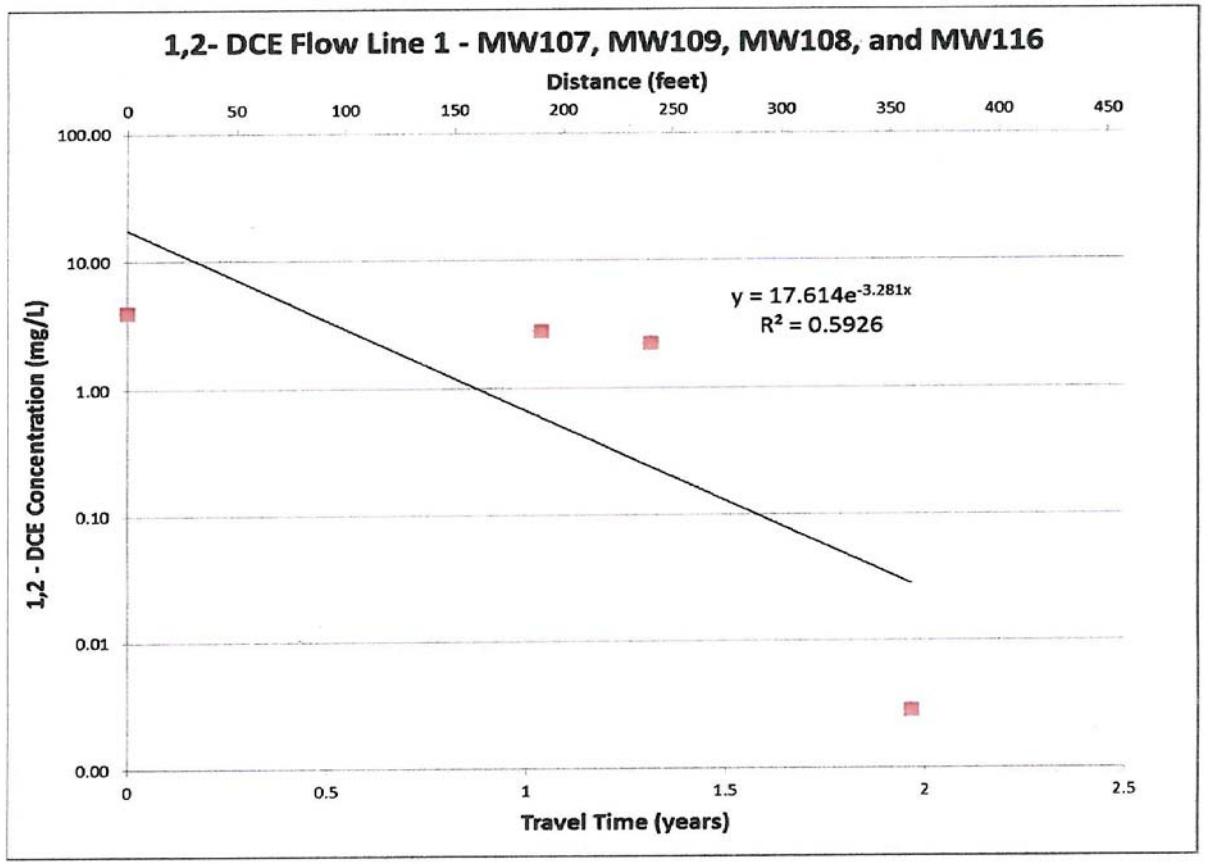
	Data
V_c = contaminant velocity (ft/day)	0.398
x = distance betweeen two points (ft)	330
t = time (years)	2.27
V_x = speepage velocity (ft/day)	0.61
k - hydraulic conductivity (ft/day)	0.5
dh/dl = gradient (demensionless)	0.024
ǿ = effective porosity	0.3
R = Retardation Factor	1.5
foc - fraction of organic carbon	0.001
Koc = soil partiting coefficient (ml/g)	94 tce
Bulk Density (g/cm3)	1.7

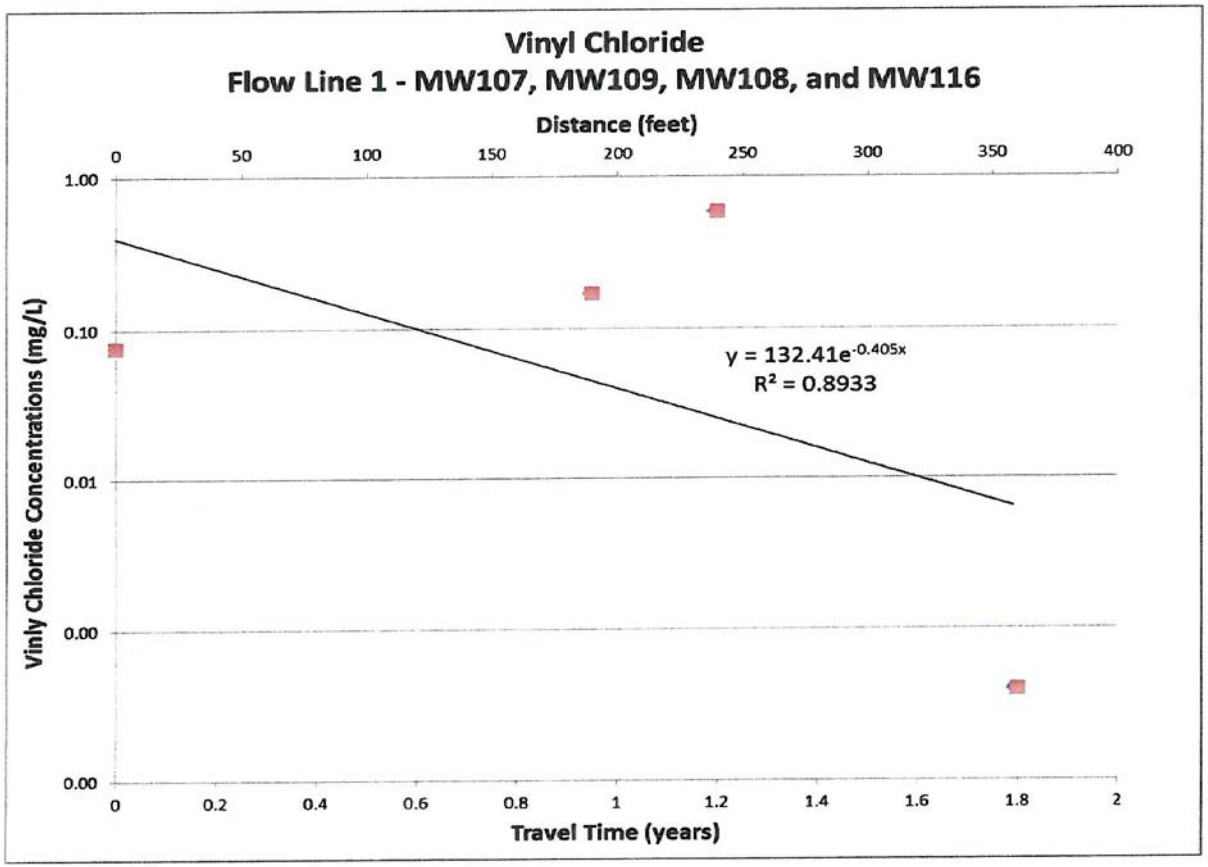
Koc	PCE	2.70E+02 ml/g	Source: CLARC Dec 2013
Koc	TCE	9.40E+01 ml/g	Source: CLARC Dec 2013
Koc	DCE	3.80E+01 ml/g	Source: CLARC Dec 2013
Koc	VC	1.90E+01 ml/g	Source: CLARC Dec 2013

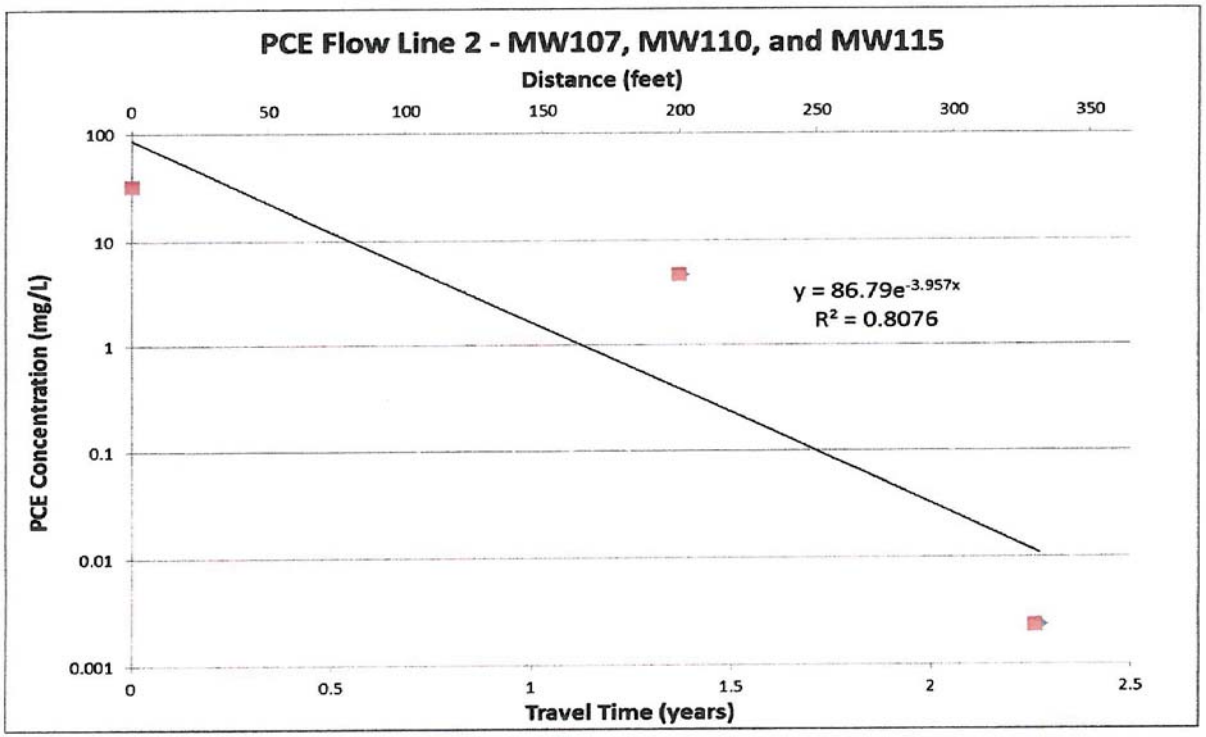
In the absence of site specific data, assume a bulk density of 1.7 gm/cm3
In the absence of site specific data, assume an effective porosity of 0.3
For the intermediate zone used a site specific arithmatic average for K of 0.5 ft/day
In the absence of site specific organic carbon, assumes a foc of 0.001

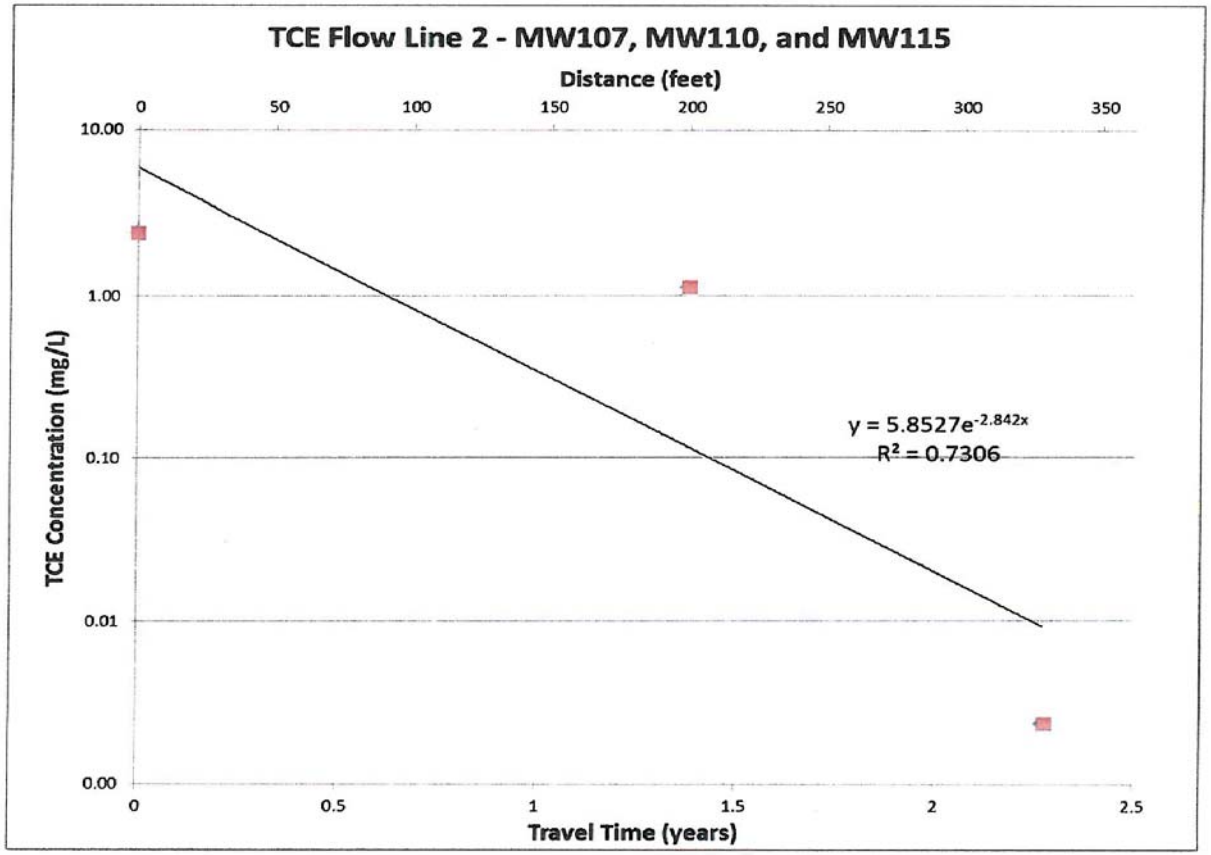

PCE - Flow Line 1 - MW107, MW109, MW108 and MW116
Distance (feet)
0
50
100
150
200
250
300
350
400
PCE Concentration (mg/L)
100
10
1
0.1
0.01
0.001
0.0001
y = 10.018e-0.199x
R² = 0.7845
0
0.5
1
1.5
2
2.5
3
Travel Time (years)

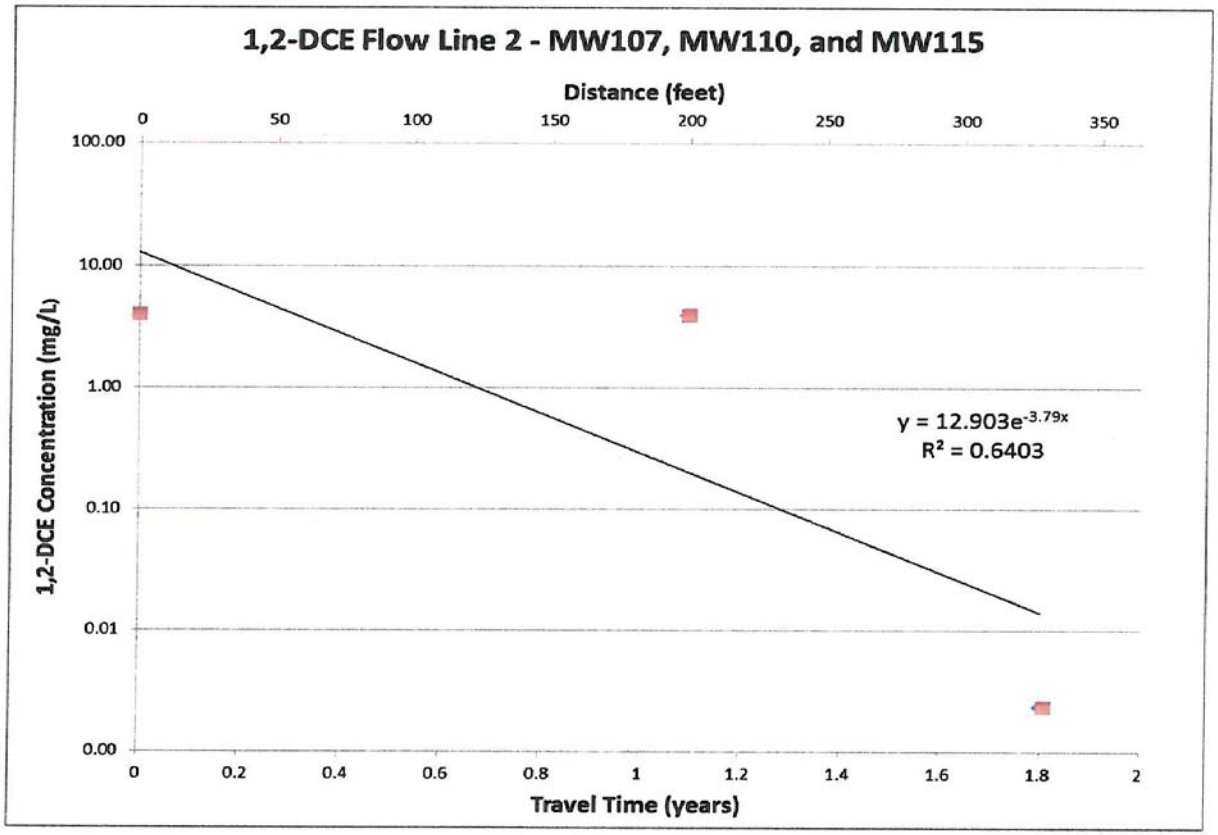

TCE - Flow Line 1 - MW107, MW109, MW108 and MW116
Distance (feet)
0
75
150
225
300
375
10.00
1.00
0.10
0.01
0.00
TCE Concentration (mg/L)
y = 1.7927e-0.127x
R² = 0.882
0
0.5
1
1.5
2
2.5
3
Travel Time (years)

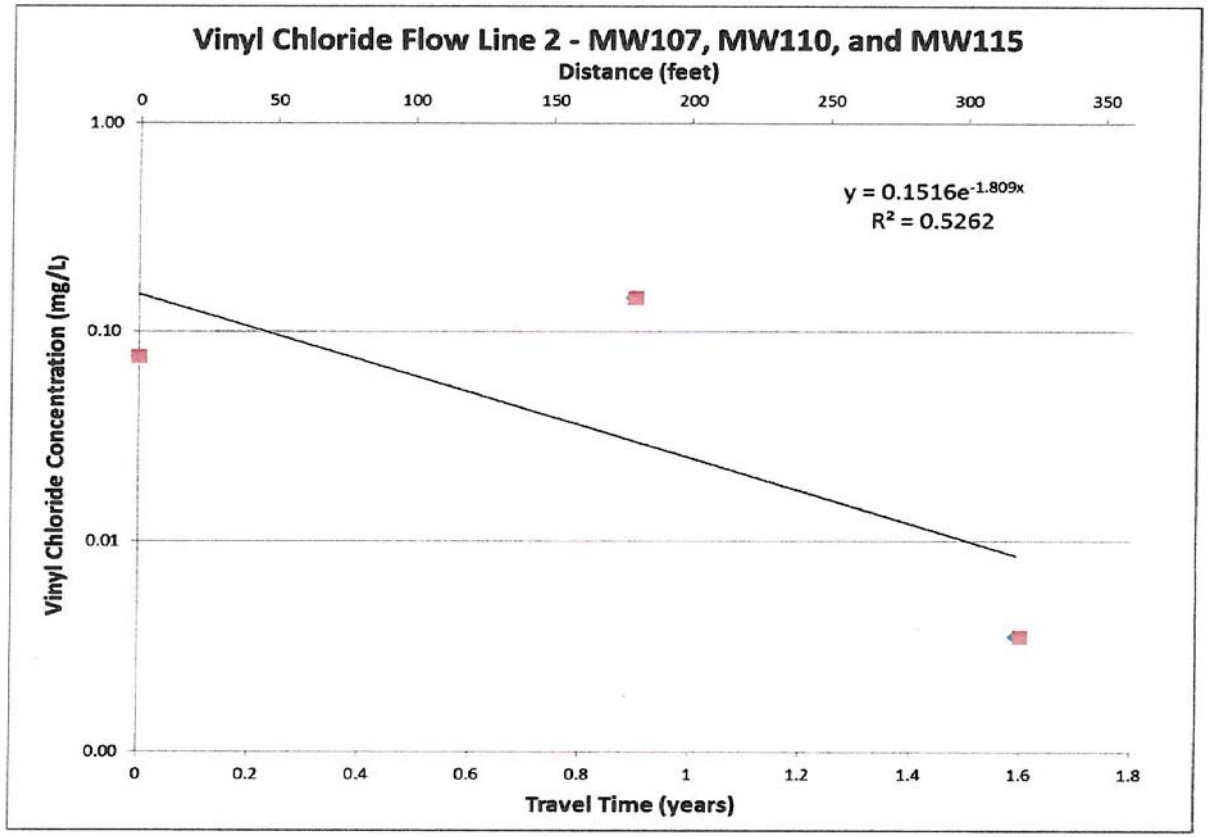

1,2- DCE Flow Line 1 - MW107, MW109, MW108, and MW116
Distance (feet)
0
50
100
150
200
250
300
350
400
450
100.00
10.00
1.00
0.10
0.01
0.00
1,2 - DCE Concentration (mg/L)
y = 17.614e-3.281x
R² = 0.5926
0
0.5
1
1.5
2
2.5
Travel Time (years)


Vinyl Chloride
Flow Line 1 - MW107, MW109, MW108, and MW116
Distance (feet)
0
50
100
150
200
250
300
350
400
1.00
0.10
0.01
0.00
0.00
Vinly Chloride Concentrations (mg/L)
y = 132.41e-0.405x
R² = 0.8933
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Travel Time (years)


PCE Flow Line 2 - MW107, MW110, and MW115
Distance (feet)
0
50
100
150
200
250
300
350
100
10
1
0.1
0.01
0.001
PCE Concentration (mg/L)
y = 86.79e-3.957x
R² = 0.8076
0
0.5
1
1.5
2
2.5
Travel Time (years)


TCE Flow Line 2 - MW107, MW110, and MW115
Distance (feet)
0
50
100
150
200
250
300
350
10.00
1.00
0.10
0.01
0.00
TCE Concentration (mg/L)
y = 5.8527e-2.842x
R² = 0.7306
0
0.5
1
1.5
2
2.5
Travel Time (years)


1,2-DCE Flow Line 2 - MW107, MW110, and MW115
Distance (feet)
0
50
100
150
200
250
300
350
100.00
10.00
1.00
0.10
0.01
0.00
1,2-DCE Concentration (mg/L)
y = 12.903e-3.79x
R² = 0.6403
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Travel Time (years)


Vinyl Chloride Flow Line 2 - MW107, MW110, and MW115
Distance (feet)
0
50
100
150
200
250
300
350
1.00
0.10
0.01
0.00
y = 0.1516e-1.809x
R² = 0.5262
Vinyl Chloride Concentration (mg/L)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
Travel Time (years)

Restoration Time Frame Calculations
700 Dexter

		Input
Restoration Time Frame (RTF)		
Distance down the Flow Line	360	feet
Retradation Factor	1.5	
Seepage Velocity	222.65	ft/yr
Decay Rate	1.11	1/yr
Alpha Dispersivity	36	0.1 (Lp)
Restoration Time	1.709964	Years

$$t = Rx/V_{gw} * SQRT(1+4\alpha_x\lambda R/V_{gw})$$

t = Time to restoration
x = Distance along the flow line
R = Retardation factor
V_{gw} = Seepage velocity
SQRT = Square root
α_x = Longitudinal dispersivity
λ = First Order decay rate
The assumptions used to calculate RTFs included longitudinal dispersivity equal to 0.1 x distances to the receptor/well and steady-state condition for the plume (Ecology 2005).

Flow Line 1

Restration Time Frame - PCE	RTF	
MW109	190	0.906 yrs
MW108	240	1.07 yrs
MW116	360	1.42 yrs

Restration Time Frame - TCE	RTF	
MW109	190	0.982 yrs
MW108	240	1.17 yrs
MW116	360	1.58 yrs

Restration Time Frame -DCE	RTF	
MW109	190	0.788 yrs
MW108	240	0.912 yrs
MW116	360	1.19 yrs

Restration Time Frame - VC	RTF	
MW109	190	1.04 yrs
MW108	240	1.25 yrs
MW116	360	1.71 yrs

Flow Line 2

Restration Time Frame - PCE	RTF	
MW110	200	0.941 yrs
MW115	330	1.34 yrs

Restration Time Frame - TCE	RTF	
MW110	200	1.02 yrs
MW115	330	1.48 yrs

Restration Time Frame -DCE	RTF	
MW110	200	0.816 yrs
MW115	330	1.13 yrs

Restration Time Frame - VC	RTF	
MW110	200	1.08 yrs
MW115	330	1.60 yrs

Restoration Time Frame Calculations
Flowline 1
700 Dexter

PCE Flow Line 1	MW107			Cleanup Level
Concentration (c)	32000	13	years (t) to reach less than:	5 (concentration)
λ Decary Rate Constant (years)	0.5	11.999	years (y) with RTF to reach less than:	5 (concentration)
RTF Constant (years)	0.923			
TCE Flow Line 1	MW107			Cleanup Level
Concentration (c)	2400	9	years (t) to reach less than:	5 (concentration)
λ Decary Rate Constant (years)	0.5	9	years (y) with RTF to reach less than:	5 (concentration)
RTF Constant (years)	1			
DCE Flow Line 1	MW107			Cleanup Level
Concentration (c)	4000	10	years (t) to reach less than:	16 (concentration)
λ Decary Rate Constant (years)	0.5	8.02	years (y) with RTF to reach less than:	16 (concentration)
RTF Constant (years)	0.802			
VC Flow Line 1	MW107			Cleanup Level
Concentration (c)	76	4	years (t) to reach less than:	0.2 (concentration)
λ Decary Rate Constant (years)	0.5	4.24	years (y) with RTF to reach less than:	0.2 (concentration)
RTF Constant (years)	1.06			
TCE Flow Line 1	MW107			Cleanup Level
Concentration (c)	18	2	years (t) to reach less than:	5 (concentration)
λ Decary Rate Constant (years)	0.5	1.964	years (y) with RTF to reach less than:	5 (concentration)
RTF Constant (years)	0.982			
DCE Flow Line 1	MW109			Cleanup Level
Concentration (c)	310	6	years (t) to reach less than:	16 (concentration)
λ Decary Rate Constant (years)	0.5	4.728	years (y) with RTF to reach less than:	16 (concentration)
RTF Constant (years)	0.788			
DCE Flow Line 1	MW108			Cleanup Level
Concentration (c)	363	7	years (t) to reach less than:	16 (concentration)
λ Decary Rate Constant (years)	0.5	6.384	years (y) with RTF to reach less than:	16 (concentration)
RTF Constant (years)	0.912			
VC Flow Line 1	MW109			Cleanup Level
Concentration (c)	27	3	years (t) to reach less than:	0.2 (concentration)
λ Decary Rate Constant (years)	0.5	3.12	years (y) with RTF to reach less than:	0.2 (concentration)
RTF Constant (years)	1.04			
VC Flow Line 1	MW108			Cleanup Level
Concentration (c)	150	5	years (t) to reach less than:	0.2 (concentration)
λ Decary Rate Constant (years)	0.5	6.25	years (y) with RTF to reach less than:	0.2 (concentration)
RTF Constant (years)	1.25			

Calculated value
Input value

$y = RTF^* t$

y= years to achieve cleanup level goal
RTF= contstant (years)
t= time (years)
Assumptions:
The assumptions used to calculate RTFs included longitudinal dispersivity equal to 0.1 x distances to the receptor/well and steady-state condition for the plume (Ecology 2005).

$t= (c_1 *\lambda)+(c_2 *\lambda)+(c_3 *\lambda)...$

t= time (years)
c= concentration
λ = decay rate (concentration degrades by half per year)
Assumptions:
t is calculated if c is greater than the cleanup level and where (c*λ)=1.

Restoration Time Frame Calculations
Flowline 2
700 Dexter

TCE Flow Line 2	MW110		Cleanup Level	
Concentration (c)	240	6 years (t) to reach less than:	5	(concentration)
λ Decary Rate Constant (years)	0.5	6.12 years (y) with RTF to reach less than:	5	(concentration)
RTF Constant (years)	1.02			
DCE Flow Line 2	MW110		Cleanup Level	
Concentration (c)	843	8 years (t) to reach less than:	16	(concentration)
λ Decary Rate Constant (years)	0.5	6.528 years (y) with RTF to reach less than:	16	(concentration)
RTF Constant (years)	0.816			
VC Flow Line 2	MW110		Cleanup Level	
Concentration (c)	31	3 years (t) to reach less than:	0.2	(concentration)
λ Decary Rate Constant (years)	0.5	2.736 years (y) with RTF to reach less than:	0.2	(concentration)
RTF Constant (years)	0.912			
VC Flow Line 2	MW115		Cleanup Level	
Concentration (c)	0.75	0 years (t) to reach less than:	0.2	(concentration)
λ Decary Rate Constant (years)	0.5	0 years (y) with RTF to reach less than:	0.2	(concentration)
RTF Constant (years)	1.6			
VC Flow Line 1	MW108		Cleanup Level	
Concentration	150	5 years (t) to reach less than:	0.2	(concentration)
Constant (years)	0.5	6.25 years (y) with RTF to reach less than:	0.2	(concentration)
RTF Constant (years)	1.25			

Calculated value
Input value

$y = RTF^* t$

y= years to achieve cleanup level goal
RTF= contstant (years)
t= time (years)
Assumptions:
The assumptions used to calculate RTFs included longitudinal dispersivity equal to 0.1 x distances to the receptor/well and steady-state condition for the plume (Ecology 2005).

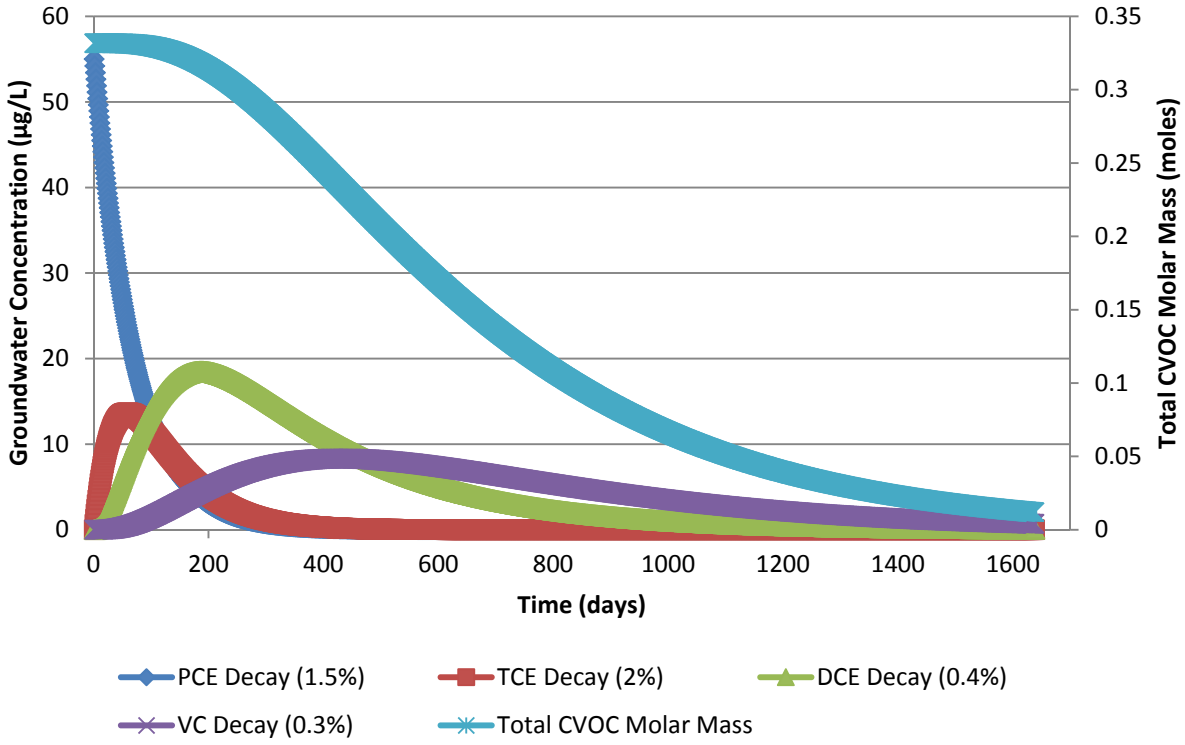
$t= (c_1 *\lambda)+(c_2 *\lambda)+(c_3 *\lambda)...$

t= time (years)
c= concentration
λ = decay rate (concentration degrades by half per year)
Assumptions:
t is calculated if c is greater than the cleanup level and where (c*λ)=1

ATTACHMENT E
CVOC DEGRADATION OVER TIME, POST-EOS INJECTIONS

SoundEarth Strategies

Chart E-1
CVOC Degradation Over Time, Post-EOS Injections



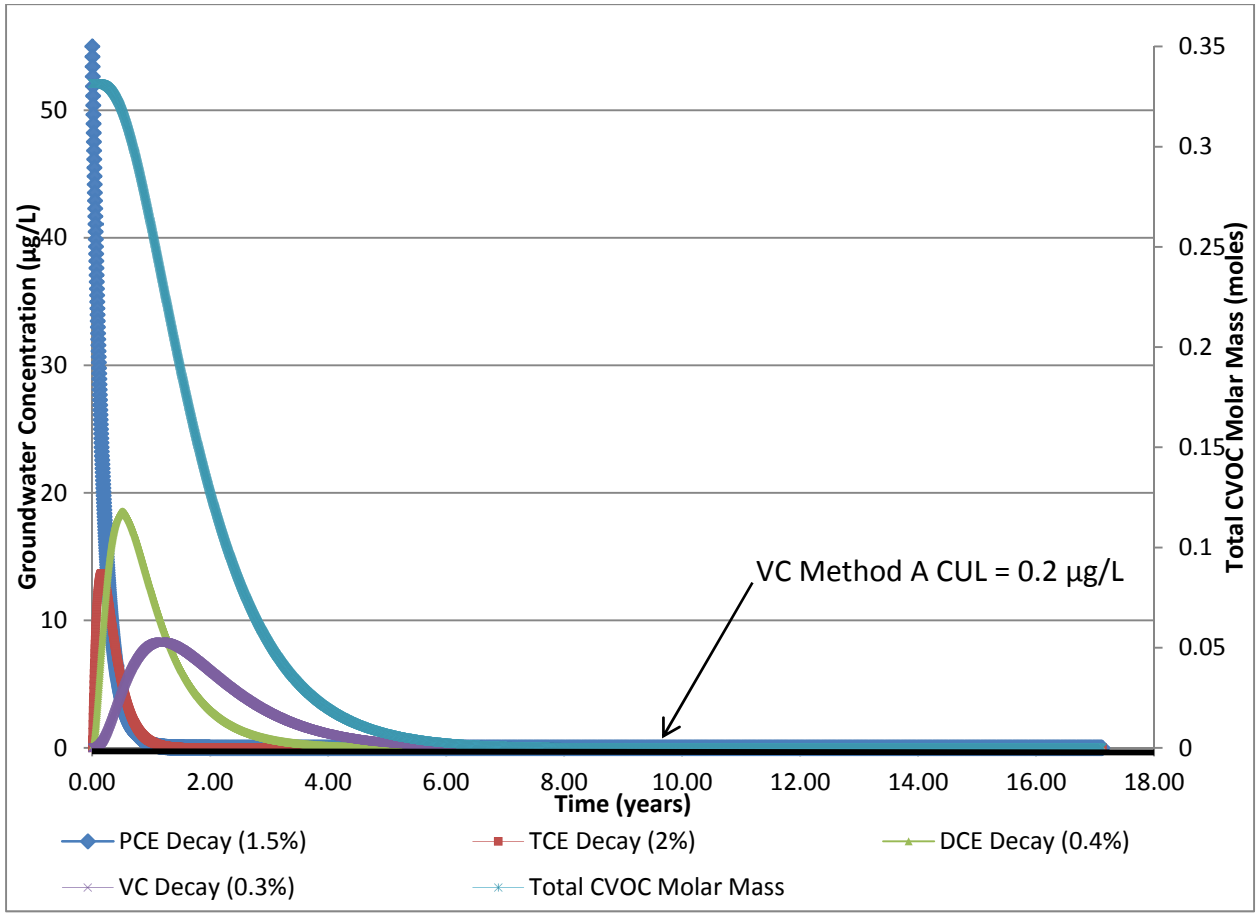
Empirical data demonstrating the degradation of chlorinated solvents at a site in Seattle result from treatment of the groundwater with EOS. The initial PCE concentration in the groundwater was 4,300 µg/L with no source removal. Similar results can be expected for the 700 Dexter Property after treatment with EOS.

NOTES:
Decay represents 1st order decay rate in percent mass degraded per day
EOS = Edible Oil Substrate

Chart E-2

Site Conceptual Model for CVOC Degradation

Over Time, Post-EOS Injections



Empirical data demonstrating the degradation of chlorinated solvents at a site in Seattle result from treatment of the groundwater with EOS. The initial PCE concentration in the groundwater was 4,300 µg/L with no source removal. Similar results can be expected for the 700 Dexter Property after treatment with EOS.

NOTES:

Decay represents 1st order decay rate in percent mass degraded per day

EOS = Edible Oil Substrate

ATTACHMENT F
EDIBLE OIL SUBSTRATE TREATMENT CASE STUDIES

Appendix E
Table 1
Case Study: Ballard Property
Summary of Groundwater Analytical Data
Troy Laundry Property
307 Fairview Avenue North
Seattle, Washington

Well ID	Sample Date	Depth to Water[1] (feet)	Groundwater Elevation[2] (feet)	Chlorinated Volatile Organic Compounds[3] (micrograms per liter)										
				PCE	TCE	1,1,1-Trichloroethane	EDC	cis-1,2-DCE	1,1-Dichloroethane	trans-1,2-DCE	Methylene chloride	1,1-Dichloroethene	Chloroethane	Vinyl chloride
MW01	10/03/08	14.02	85.98	1.6	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
TOC Elevation	04/20/09	13.15	86.85	**8.8**	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
100 feet	07/23/09	13.76	86.24	**9.7**	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	05/04/10	11.39	88.61	2.0	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	08/05/10	12.54	87.46	2.6	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	11/02/10	12.99	87.01	2.2	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	02/02/11	12.11	87.89	1.7	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	06/01/11	12.89	87.11	--	--	--	--	--	--	--	--	--	--	--
	08/11/11	13.81	86.19	--	--	--	--	--	--	--	--	--	--	--
	11/10/11	13.79	86.21	--	--	--	--	--	--	--	--	--	--	--
	02/03/12	12.73	87.27	--	--	--	--	--	--	--	--	--	--	--
MW02	10/03/08	14.57	86.91	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
TOC Elevation	04/20/09	13.85	87.63	1.4	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
101.48 feet	07/23/09	14.40	87.08	--	--	--	--	--	--	--	--	--	--	--
	05/04/10	12.35	89.13	1.3	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	08/05/10	13.90	87.58	2.1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	11/02/10	13.87	87.61	1.4	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	02/02/11	13.03	88.45	1.3	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	06/01/11	13.43	88.05	--	--	--	--	--	--	--	--	--	--	--
	08/11/11	14.14	87.34	--	--	--	--	--	--	--	--	--	--	--
	11/10/11	14.35	87.13	--	--	--	--	--	--	--	--	--	--	--
	02/03/12	13.42	88.06	--	--	--	--	--	--	--	--	--	--	--
MW03	10/03/08	13.07	89.82	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
TOC Elevation	04/20/09	11.75	91.14	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
102.89 feet	07/23/09	12.66	90.23	--	--	--	--	--	--	--	--	--	--	--
	05/04/10	10.84	92.05	--	--	--	--	--	--	--	--	--	--	--
	08/05/10	12.05	90.84	--	--	--	--	--	--	--	--	--	--	--
	11/02/10	12.07	90.82	--	--	--	--	--	--	--	--	--	--	--
	02/02/11	10.72	92.17	--	--	--	--	--	--	--	--	--	--	--
	06/01/11	11.18	91.71	--	--	--	--	--	--	--	--	--	--	--
	08/11/11	12.27	90.62	--	--	--	--	--	--	--	--	--	--	--
	11/10/11	12.79	90.10	--	--	--	--	--	--	--	--	--	--	--
	02/03/12	11.44	91.45	--	--	--	--	--	--	--	--	--	--	--
MW04	10/03/08	12.32	87.34	**86**	**18**	<1	<1	13	<1	<1	<5	<1	<1	<0.2
TOC Elevation	04/20/09	10.74	88.92	**510**	**56**	<1	<1	4.8	<1	<1	<5	<1	<1	<0.2
99.66 feet	07/23/09	11.61	88.05	--	--	--	--	--	--	--	--	--	--	--
	05/04/10	9.60	90.06	**110**	2.7	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	08/05/10	10.47	89.19	**130**	**5.5**	<1	<1	1.1	<1	<1	<5	<1	<1	<0.2
	11/02/10	11.16	88.50	**76**	**7.0**	<1	<1	2.7	<1	<1	<5	<1	<1	<0.2
	02/02/11	9.10	90.56	**56**	2.0	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	06/01/11	9.65	90.01	**27**	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	08/12/11	10.84	88.82	**27**	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2[pr]
	11/10/11	11.76	87.90	**36**	1.4	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	02/03/12	10.29	89.37	**33**	3.2	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
MW05	10/03/08	14.03	87.93	1.1	<1	<1	<1	1.3	<1	<1	<5	<1	<1	<0.2
TOC Elevation	04/20/09	13.00	88.96	2.0	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
101.96 feet	07/23/09	13.86	88.10	--	--	--	--	--	--	--	--	--	--	--
	05/04/10	--	--	--	--	--	--	--	--	--	--	--	--	--
	08/05/10	--	--	--	--	--	--	--	--	--	--	--	--	--
	11/02/10	--	--	--	--	--	--	--	--	--	--	--	--	--
	02/02/11	--	--	--	--	--	--	--	--	--	--	--	--	--
	06/01/11	--	--	--	--	--	--	--	--	--	--	--	--	--
	08/11/11	--	--	--	--	--	--	--	--	--	--	--	--	--
	11/10/11	13.69	88.27	1.1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	02/03/12	--	--	--	--	--	--	--	--	--	--	--	--	--
MTCA Cleanup Levels for Groundwater				**5[a]**	**5[a]**	**200[a]**	**5[a]**	**80[b]**	**NE**	**NE**	**5[a]**	**NE**	**NE**	**0.2[a]**

Appendix E
Table 1
Case Study: Ballard Property
Summary of Groundwater Analytical Data
Troy Laundry Property
307 Fairview Avenue North
Seattle, Washington

Well ID	Sample Date	Depth to Water[1] (feet)	Groundwater Elevation[2] (feet)	Chlorinated Volatile Organic Compounds[3] (micrograms per liter)										
				PCE	TCE	1,1,1-Trichloroethane	EDC	cis-1,2-DCE	1,1-Dichloroethane	trans-1,2-DCE	Methylene chloride	1,1-Dichloroethene	Chloroethane	Vinyl chloride
MW06	05/07/09	11.10	88.98	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
TOC Elevation	07/23/09	11.89	88.19	--	--	--	--	--	--	--	--	--	--	--
100.08 feet	05/04/10	10.14	89.94	--	--	--	--	--	--	--	--	--	--	--
	08/05/10	10.87	89.21	--	--	--	--	--	--	--	--	--	--	--
	11/02/10	--	--	--	--	--	--	--	40942.00	--	--	--	--	--
	02/02/11	9.48	90.60	--	--	--	--	--	--	--	--	--	--	--
	06/01/11	10.01	90.07	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	08/11/11	11.27	88.81	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2[pr]
	11/10/11	12.54	87.54	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	02/03/12	10.82	89.26	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
MW07	05/07/09	11.79	87.66	1,100	230	<1	<1	260	<1	1.9	<5	<1	<1	<0.2
TOC Elevation	07/23/09	12.69	86.76	540	100	<1	<1	99	<1	<1	<5	<1	<1	<0.2
99.45 feet	05/04/10	10.49	88.96	110	130	<1	<1	120	<1	1.3	<5	1.1	<1	15
	08/05/10	11.44	88.01	150	110	<1	<1	54	<1	<1	<5	<1	<1[ca]	1.9[ca]
	11/03/10	12.02	87.43	190	69	<1	<1	39	<1	<1	<5	<1	<1	2.0[ca]
	02/02/11	10.33	89.12	370	90	<1	<1	74	<1	<1	<5	<1	<1	3.0
	06/01/11	10.77	88.68	360	82	<1	<1	70	<1	<1	<5	<1	<1	1.4
	08/12/11	11.92	87.53	190	130	<1	<1	250	<1	<1	<5	<1	<1	1.2[pr]
	11/10/11	13.72	85.73	10	<1	<1	<1	390	<1	<1	<5	<1	<1	2.2
	02/03/12	11.30	88.15	4.9	1.6	<1	<1	400	<1	<1	<5	<1	<1	3.5
MW08	05/07/09	12.24	86.70	45	3.3	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
TOC Elevation	07/23/09	12.97	85.97	48	3.3	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
98.94 feet	05/04/10	10.45	88.49	4.1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	08/05/10	11.73	87.21	4.3	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	11/03/10	12.03	86.91	2.7	<1	<1	<1	12	<1	<1	<5	<1	<1	<0.2
	02/02/11	10.88	88.06	<1	<1	<1	<1	5.6	<1	<1	<5	<1	<1	<0.2
	06/01/11	11.35	87.59	--	--	--	--	--	--	--	--	--	--	--
	08/12/11	12.36	86.58	--	--	--	--	--	--	--	--	--	--	--
	11/10/11	12.86	86.08	--	--	--	--	--	--	--	--	--	--	--
	02/03/12	11.66	87.28	--	--	--	--	--	--	--	--	--	--	--
MW09	06/24/09	11.01	89.28	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
TOC Elevation	07/23/09	11.54	88.75	--	--	--	--	--	--	--	--	--	--	--
100.29 feet	05/04/10	9.55	90.74	3.2	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	08/05/10	10.48	89.81	4.0	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	11/02/10	11.22	89.07	2.3	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	02/02/11	9.01	91.28	2.3	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	06/01/11	9.63	90.66	--	--	--	--	--	--	--	--	--	--	--
	08/11/11	10.84	89.45	--	--	--	--	--	--	--	--	--	--	--
	11/10/11	11.82	88.47	--	--	--	--	--	--	--	--	--	--	--
	02/03/12	10.18	90.11	--	--	--	--	--	--	--	--	--	--	--
MW10 - Deep Well	06/24/09	16.30	83.16	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
TOC Elevation	07/23/09	16.50	82.96	--	--	--	--	--	--	--	--	--	--	--
99.46 feet	05/04/10	15.13	84.33	--	--	--	--	--	--	--	--	--	--	--
	08/05/10	15.87	83.59	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	11/03/10	16.27	83.19	<1	<1	<1	<1	<1	<1	<1	5.1[lc]	<1	<1	<0.2
	02/02/11	14.97	84.49	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	06/01/11	15.19	84.27	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	08/11/11	16.12	83.34	--	--	--	--	--	--	--	--	--	--	--
	11/10/11	16.88	82.58	--	--	--	--	--	--	--	--	--	--	--
	02/03/12	16.42	83.04	--	--	--	--	--	--	--	--	--	--	--
MTCA Cleanup Levels for Groundwater				**5[a]**	**5[a]**	**200[a]**	**5[a]**	**80[b]**	**NE**	**NE**	**5[a]**	**NE**	**NE**	**0.2[a]**

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Table 1
Case Study: Ballard Property
Summary of Groundwater Analytical Data
Troy Laundry Property
307 Fairview Avenue North
Seattle, Washington

Well ID	Sample Date	Depth to Water[1] (feet)	Groundwater Elevation[2] (feet)	Chlorinated Volatile Organic Compounds[3] (micrograms per liter)										
				PCE	TCE	1,1,1-Trichloroethane	EDC	cis-1,2-DCE	1,1-Dichloroethane	trans-1,2-DCE	Methylene chloride	1,1-Dichloroethene	Chloroethane	Vinyl chloride
MW11	06/24/09	11.35	85.23	430	70	<1	<1	68	<1	1.2	<5	<1	<1	<0.2
TOC Elevation	07/23/09	11.65	84.93	320	68	<1	<1	69	<1	1.2	<5	<1	<1	<0.2
96.58 feet	05/04/10	8.95	87.63	89	32	<1	<1	37	<1	1.2	<5	<1	<1	3.3
	08/05/10	10.44	86.14	140	42	<1	<1	34	<1	<1	<5	<1	<1	<0.2
	11/02/10	10.58	86.00	250	45	<1	<1	26	<1	<1	<5	<1	<1	0.59[ca]
	02/02/11	9.96	86.62	11	<1	<1	<1	350	<1	<1	<5	<1	<1	3.2
	06/01/11	10.37	86.21	2.5	<1	<1	<1	410	<1	<1	<5	<1	<1	2.6
	08/11/11	11.36	85.22	<1	<1	<1	<1	510	<1	<1	<5	<1	<1	2.2[pr]
	11/10/11	11.74	84.84	1.1	<1	<1	<1	760	<1	<1	<5	<1	<1	2.5
	02/03/12	10.33	86.25	<1	<1	<1	<1	510	<1	<1	<5	<1	<1	2.9
MW12	11/16/09	11.40	87.16	36	1.7	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
TOC Elevation	05/04/10	10.20	88.36	41	1.5	<1	<1	<1	<1	1.2	<5	<1	<1	<0.2
98.56 feet	08/05/10	11.55	87.01	39	1.8	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	11/02/10	11.73	86.83	71	3.8	<1	<1	1.2	<1	<1	<5	<1	<1	<0.2
	02/02/11	10.74	87.82	38	1.2	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	06/01/11	11.12	87.44	38	1.8	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	08/12/11	12.09	86.47	60	3.4	<1	<1	<1	<1	<1	<5	<1	<1	<0.2[pr]
	11/10/11	12.50	86.06	73	4.2	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	02/03/12	11.25	87.31	50	2.6	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
MW13	02/02/11	11.44	84.84	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
TOC Elevation	06/01/11	11.70	84.58	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
96.28 feet	08/11/11	12.46	83.82	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2[pr]
	11/10/11	12.77	83.51	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	02/03/12	11.66	84.62	--	--	--	--	--	--	--	--	--	--	--
MW14	02/02/11	14.42	81.01	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
TOC Elevation	06/01/11	14.42	81.01	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
95.43 feet	08/11/11	14.85	80.58	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2[pr]
	11/10/11	15.06	80.37	<1	<1	<1	<1	<1	<1	<1	<5	<1	<1	<0.2
	02/03/12	14.36	81.07	--	--	--	--	--	--	--	--	--	--	--
MW15	06/01/11	12.93	82.39	15	4.2	<1	<1	3.8	<1	<1	<5	<1	<1	<0.2
TOC Elevation	08/11/11	13.42	81.90	14	3.5	<1	<1	2.7	<1	<1	<5	<1	<1	<0.2[pr]
95.32 feet	11/10/11	13.72	81.60	17	4.2	<1	<1	2.3	<1	<1	<5	<1	<1	<0.2
	02/03/12	11.96	83.36	12	3.1	<1	<1	1.5	<1	<1	<5	<1	<1	<0.2
IW01	11/16/09	11.52	85.02	590	140	<1	<1	160	<1	2.0	<5	<1	<1	<0.2
TOC Elevation	05/04/10	9.26	87.28	130	53	<1	<1	75	<1	<1	<5	<1	<1	9.7
96.54 feet	08/05/10	10.55	85.99	130	39	<1	<1	77	<1	<1	<5	<1	<1	0.96
	11/02/10	10.87	85.67	9.9	1.3	<1	<1	360	<1	<1	<5	<1	<1	3.5[ca]
	02/02/11	10.07	86.47	6.0	1.9	<1	<1	180	<1	<1	<5	<1	<1	2.3
	06/01/11	10.50	86.04	9.7	2.2	<1	<1	360	<1	<1	<5	<1	<1	0.96
	08/11/11	11.55	84.99	1.3	<1	<1	<1	280	<1	<1	<5	<1	<1	1.9[pr]
	11/10/11	11.93	84.61	<1	<1	<1	<1	250	<1	<1	<5	<1	<1	1.5[j]
	02/03/12	10.58	85.96	47	25	<1	<1	420	<1	<1	<5	<1	<1	1.3
IW02	11/16/09	13.79	85.81	240	54	<1	<1	48	<1	<1	<5	<1	<1	<0.2
TOC Elevation	05/04/10	11.70	87.90	2.5	32	<1	<1	34	<1	<1	<5	<1	<1	3.2
99.60 feet	08/05/10	11.51	88.09	7.3	38	<1	<1	45	<1	<1	5.7[lc]	<1	<1	1.4
	11/02/10	12.12	87.48	14	31	<1	<1	34	<1	<1	6.5[lc]	<1	<1	0.93[ca]
	02/02/11	10.34	89.26	27	38	<1	<1	54	<1	<1	<5	<1	<1	1.3
	06/01/11	10.80	88.80	6.2	2.2	<1	<1	220	<1	<1	<5	<1	<1	2.2
	08/12/11	11.99	87.61	2.2	<1	<1	<1	150	<1	<1	<5	<1	<1	1.4[pr]
	11/10/11	12.85	86.75	1.1	<1	<1	<1	140	<1	<1	<5	<1	<1	1.5
	02/03/12	11.43	88.17	<1	<1	<1	<1	190	<1	<1	<5	<1	<1	2.1
MTCA Cleanup Levels for Groundwater				5[a]	5[a]	200[a]	5[a]	80[b]	NE	NE	5[a]	NE	NE	0.2[a]

NOTES:

Red denotes concentration exceeding MTCA Method A or B cleanup level for groundwater.

Samples analyzed by Friedman & Bruya, Inc., of Seattle, Washington.

[1]Depth to groundwater as measured from a fixed spot on the well casing rim.

[2]Elevations measured relative to a temporary benchmark with an assumed elevation of 100.00 feet.

[3]Analyzed by U.S. Environmental Protection Agency Method 8260B or 8260C.

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

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

Laboratory Notes:

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

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

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

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

-- = not analyzed/not measured

< = not detected at concentrations exceeding the laboratory reporting limit

cis-1,2-DCE = cis-1,2-dichloroethene

CLARC = Cleanup Levels and Risk Calculations

EDC = 1,2-dichloroethane

MTCA = Washington State Model Toxics Control Act

NE = not established

PCE = tetrachloroethene

TCE = trichloroethene

TOC = top of casing

trans-1,2-DCE = trans-1,2-dichloroethene

SoundEarth Strategies

Chart 1
Case Study: Ballard Property
Chlorinated Compounds in Groundwater for IW01
Troy Laundry Property
307 Fairview Avenue North
Seattle, Washington

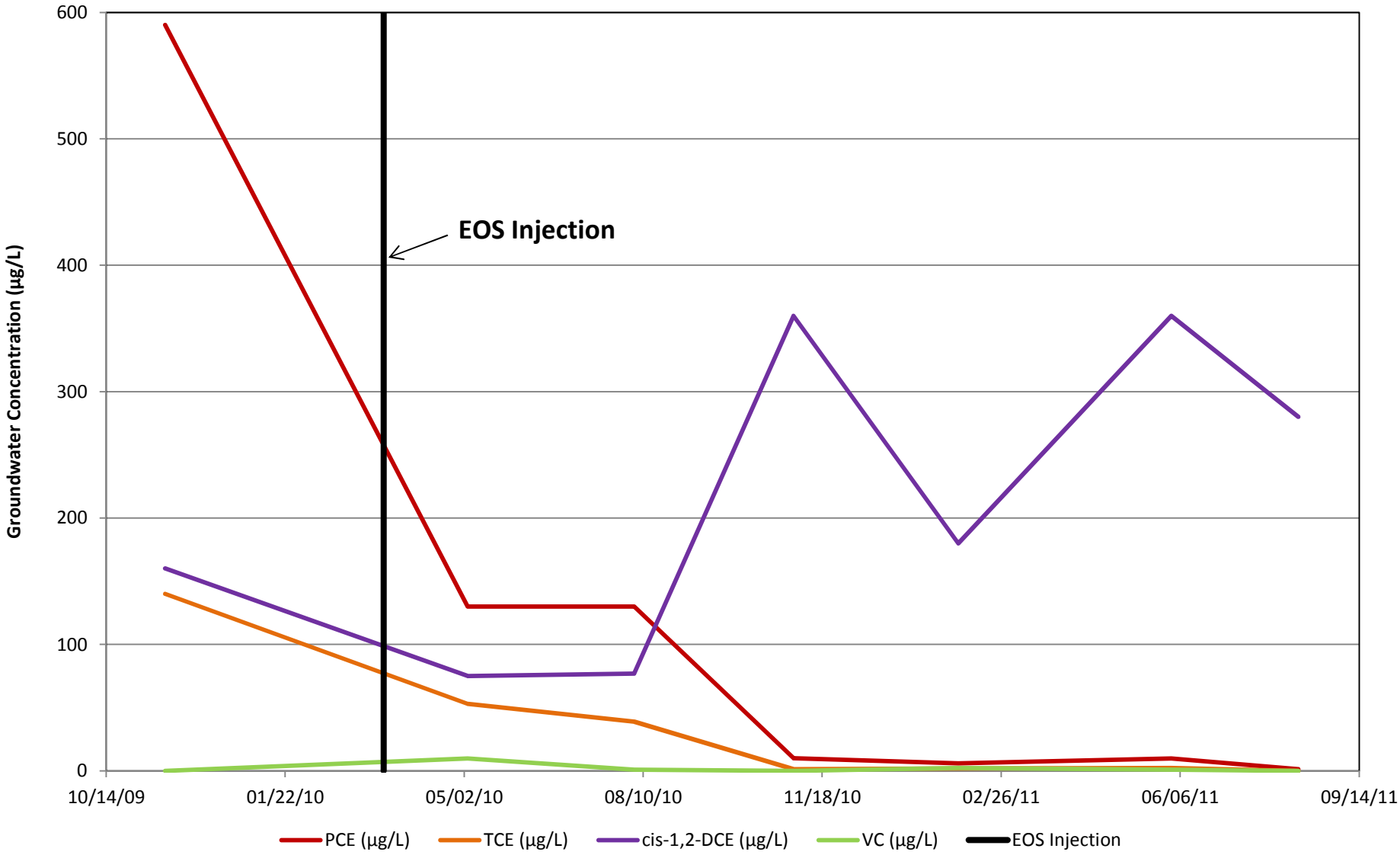
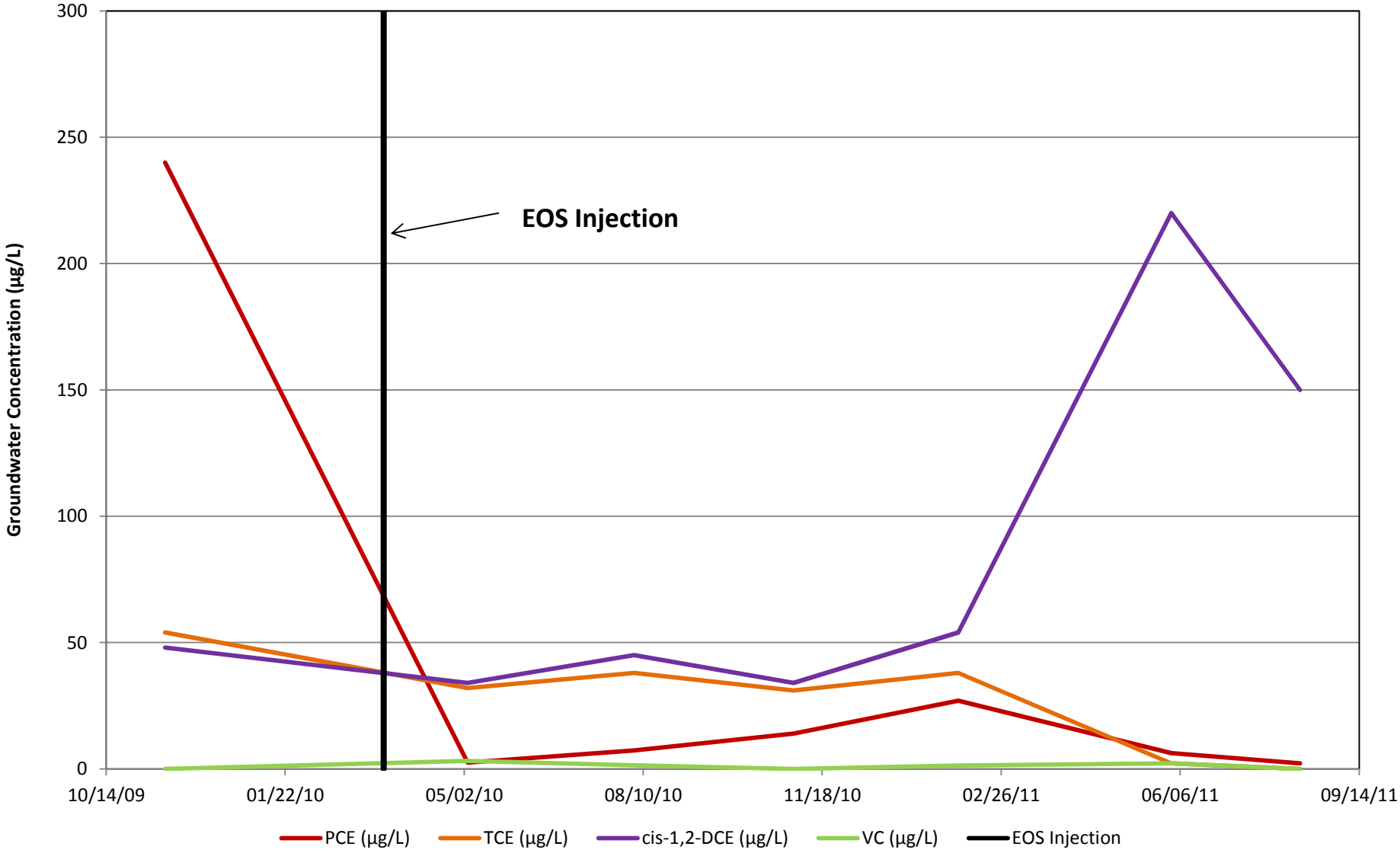


Chart 2
Case Study: Ballard Property
Chlorinated Compounds in Groundwater for IW02
Troy Laundry Property
307 Fairview Avenue North
Seattle, Washington



Appendix E
Table 2
Case Study: Capitol Hill Property
Summary of Groundwater Analytical Results
Troy Laundry Property
307 Fairview Avenue North
Seattle, Washington

Sample Location	Date Sampled	Depth to Groundwater (feet)	Groundwater Elevation (feet)	Sampled By	Analytical Results (micrograms per liter) [1] PCE	TCE	cis 1,2-Dichloroethene	Vinyl Chloride
Reconnaissance Groundwater Samples								
KGP-2	04/26/06	--	--	Kane	**1,200**	**110**	**92**	**1.1**
KGP-4	04/26/06	--	--	Kane	1.3	<1	5.4	**0.8**
Piezometers								
GB-1	04/25/06	--	--	Kane	**3,600**	**73**	29	<0.2
	03/28/08	19.50	--	SoundEarth	--	--	--	--
	04/15/08	19.41	--		**4,500**	**80**	49	**2.2**
	08/07/08	20.54	--		**3,700**	**65**	38	**2.3**
	02/06/09	--	--	SoundEarth	**670**	**35**	30	<2
	05/01/09	18.98	--		**810**	**1,500**	42	<2
	08/11/09	19.94	--		**18**	**3,100**	**560**	**8.2**
	11/13/09	20.88	--		**14**	**85**	**4,500**	**45**
	02/10/10	17.56	--		**45**	**77**	**2,900**	**17**
	05/17/10	18.33	--		**140**	**660**	**1,800**	**8.4**
	08/20/10	19.43	--		**130**	**450**	**1,500**	**6**
	11/19/10	19.31	--		**210**	**450**	**1,300**	**6.7**
	03/08/11	16.95	--		**260**	**210**	**450**	**15**
	Decommissioned April 2011							
GB-2	04/25/06	--	--	Kane	<10	<1	<1	<0.2
GB-3	04/25/06	--	--	Kane	<10	<1	<1	<0.2
Monitoring Wells								
KMW-1	04/25/06	--	--	Kane	**2,000**	**1,300**	**910**	**83**
TOC: 342.16 feet	03/28/08	18.85	323.31	SoundEarth	--	--	--	--
	04/15/08	--	--		**270**	**84**	**220**	**9.6**
	07/01/08	19.67	322.49		--	--	--	--
	08/07/08	19.98	322.18		**200**	**64**	**190**	**4.3**
	02/05/09	--	--	SoundEarth	**80**	**69**	**110**	**8.7**
	05/01/09	15.81	326.35		**33**	**260**	69	**4.9**
	08/11/09	16.47	325.69		**8.4**	**12**	**430**	**11**
	11/13/09	18.89	323.27		2.2	2.1	**370**	**4.8**
	02/10/10	14.88	327.28		1.9	3.5	**280**	**2.3**
	05/17/10	13.53	328.63		1.3	<1	**300**	**2.3**
	08/19/10	16.67	325.49		<1	1.1	**180**	**2.0**
	11/18/10	18.33	323.83		<1	3.5	**360**	**4.9**
	03/08/11	15.29	326.87		4.1	**32**	**340**	**12**
	06/08/11	15.62	326.54		<5 j	**87**	**320**	**19**
	09/26/11	18.53	323.63		<5 j	**120**	**300**	**91**
	12/08/11	19.07	323.09		3.4	**63**	**160**	**49**
KMW-2	04/25/06	--	--	Kane	<1	<1	<1	<0.2
TOC: 343.83 feet	03/28/08	20.36	323.47	SoundEarth	--	--	--	--
	07/01/08	21.18	322.65		--	--	--	--
	05/01/09	20.39	323.44	SoundEarth	--	--	--	--
	08/11/09	21.25	322.58		--	--	--	--
	11/13/09	22.03	321.8		--	--	--	--
	02/10/10	19.53	324.3		--	--	--	--
	05/17/10	19.65	324.18		--	--	--	--
	08/19/10	20.63	323.2		--	--	--	--
	11/18/10	20.95	322.88		--	--	--	--
	03/08/11	18.44	325.39		--	--	--	--
	09/26/11	20.64	323.19		--	--	--	--
	12/08/11	21.21	322.62		<1	<1	<1	<0.2
KMW-3	04/25/06	--	--	Kane	<1	<1	<1	<0.2
TOC: 343.90 feet	03/28/08	20.22	323.68	SoundEarth	--	--	--	--
	07/01/08	21.04	322.86		--	--	--	--
	05/01/09	20.27	323.63	SoundEarth	--	--	--	--
	08/11/09	21.15	322.75		--	--	--	--
	11/13/09	22.00	321.9		--	--	--	--
	02/10/10	19.39	324.51		--	--	--	--
	05/17/10	19.53	324.37		--	--	--	--
	08/19/10	20.52	323.38		--	--	--	--
	11/18/10	20.95	322.95		--	--	--	--
	03/08/11	18.3	325.6		--	--	--	--
	09/26/11	20.51	323.39		--	--	--	--
	12/08/11	21.09	322.81		--	--	--	--
MTCA Cleanup Level for Groundwater					**5** [2]	**5** [2]	**80** [3]	**0.2** [2]

Appendix E
Table 2
Case Study: Capitol Hill Property
Summary of Groundwater Analytical Results
Troy Laundry Property
307 Fairview Avenue North
Seattle, Washington

Sample Location	Date Sampled	Depth to Groundwater (feet)	Groundwater Elevation (feet)	Sampled By	Analytical Results (micrograms per liter) [1]			
					PCE	TCE	cis 1,2-Dichloroethene	Vinyl Chloride
KMW-4	04/25/06	--	--	Kane	<1	<1	<1	<0.2
TOC: 341.44 feet	03/28/08	19.62	321.82	SoundEarth	--	--	--	--
	07/01/08	21.02	320.42		--	--	--	--
	05/01/09	18.55	322.89	SoundEarth	--	--	--	--
	08/11/09	21.01	320.43		--	--	--	--
	11/13/09	21.41	320.03		--	--	--	--
	02/10/10	18.83	322.61		1.9	--	--	**2.3**
	05/17/10	18.52	322.92		1.3	--	--	**2.3**
	08/19/10	20.46	320.98		<1	--	--	**2.0**
	11/18/10	19.69	321.75		<1	--	--	**4.9**
	03/08/11	15.79	325.65		<1	<1	<1	<0.2
	06/08/11	16.80	324.64		<1	<1	<1	<0.2
	09/26/11	21.06	320.38		<1	<1	<1	<0.2
	12/08/11	21.05	320.39		<1	<1	<1	<0.2
MW-101	06/16/06	--	--	SoundEarth	**1,400**	**18**	5.1	<0.2
TOC: 341.60 feet	10/12/07	20.76	320.84		--	--	--	--
	03/28/08	--	--		--	--	--	--
	08/07/08	20.54	321.06		**650**	**6.2**	<1	<0.2
	11/06/08	--	--	SoundEarth	**22**	<1	<1	<0.2
	02/05/09	--	--		<1	<1	**85**	**2.1**
	05/01/09	19.04	322.56		2.1	2.2	**97**	**2.5**
	08/10/09	20.19	321.41		1.5	<1	**96**	**18**
	11/13/09	20.2	321.4		<1	<1	15	**29**
	02/10/10	17.17	324.43		2.2	2.3	57	**41**
	05/17/10	18.05	323.55		<1	<1	14	**79**
	08/20/10	19.55	322.05		<1	<1	2.4	**27**
	11/19/10	19.14	322.46		<1	<1	1.7	**30**
	03/08/11	15.78	325.82		<1	<1	21	**100**
	06/08/11	17.10	324.5		<1	<1	8.8	**49**
	09/26/11	19.83	321.77		<1	<1	1.5	**23**
	12/08/11	20.02	321.58		<1	<1	1.4	**8.9**
MW-102	06/16/06	--	--	SoundEarth	**1,100**	**23**	37	**3.7**
TOC: 340.95 feet	10/12/07	20.90	320.05		--	--	--	--
	01/11/08	--	--		**770**	**29**	33	**3**
	03/28/08	19.85	321.10		--	--	--	--
	04/15/08	--	--		**1,100**	**25**	35	**1.9**
	07/01/08	19.50	321.45		--	--	--	--
	08/07/08	20.71	320.24		**720**	**18**	26	**0.88**
	05/01/09	19.87	321.08	SoundEarth	**210**	<100	<100	<20
	08/10/09	20.6	320.35		--	--	--	--
	11/13/09	20.92	320.03		**110**	1.8	1.3	<0.2
	02/10/10	19.09	321.86		**1,300**	**59**	55	**5.0**
	05/17/10	19.26	321.69		**22**	**5.5**	69	**6.2**
	08/20/10	20.03	320.92		3.7	**230**	**120**	**7.5**
	11/18/10	20.26	320.69		2.9	**500**	**150**	**9.6**
	03/08/11	18.24	322.71		1.3	**71**	**1,700**	**31**
	06/08/11	19.35	321.60		<1	**6.0**	**1,500**	**27**
	09/26/11	20.34	321.61		<1	1.1	3.1	**36**
	12/08/11	20.50	321.45		<1	1.0	2.2	**13**
MW-103	06/16/06	--	--	SoundEarth	**20**	<1	<1	<0.2
TOC: 340.81 feet	04/15/08	--	--		**27**	<1	<1	<0.2
	03/28/08	19.40	321.41		--	--	--	--
	07/01/08	21.38	319.43		--	--	--	--
	08/07/08	20.75	320.06		**24**	<1	<1	<0.2
	11/06/08	--	--	SoundEarth	**27**	<1	<1	<0.2
	02/05/09	--	--		**19**	<1	<1	<0.2
	05/01/09	18.70	322.11		**15**	<1	<1	<0.2
	08/10/09	20.37	320.44		**19**	<1	<1	<0.2
	11/13/09	20.92	319.89		**34**	<1	<1	<0.2
	02/10/10	17.19	323.62		**35**	<1	<1	<0.2
	05/17/10	18.31	322.50		**44**	<1	<1	<0.2
	08/20/10	19.83	320.98		**25**	<1	<1	<0.2
	11/19/10	21.5	319.31		**22**	<1	<1	<0.2
	03/08/11	15.72	325.09		**50**	<1	<1	<0.2
	06/08/11	16.59	324.22		**53**	<1	<1	<0.2
	09/26/11	20.28	320.53		**36**	<1	<1	<0.2
	12/08/11	20.28	320.53		**35**	<1	<1	<0.2
MTCA Cleanup Level for Groundwater					**5** [2]	**5** [2]	**80** [3]	**0.2** [2]

Appendix E
Table 2
Case Study: Capitol Hill Property
Summary of Groundwater Analytical Results
Troy Laundry Property
307 Fairview Avenue North
Seattle, Washington

Sample Location	Date Sampled	Depth to Groundwater (feet)	Groundwater Elevation (feet)	Sampled By	Analytical Results (micrograms per liter) [1]			
					PCE	TCE	cis 1,2-Dichloroethene	Vinyl Chloride
MW-104	08/17/06	--	--		<1	<1	<1	<0.2
TOC: 339.40 feet	10/12/07	22.76	316.64		--	--	--	--
	01/11/08	--	--		**6.7**	<1	<1	<0.2
	03/28/08	22.36	317.04	SoundEarth	--	--	--	--
	04/08/08	--	--		**5.6**	<1	<1	<0.2
	07/01/08	22.59	316.81		--	--	--	--
	08/07/08	22.66	316.74		4.3	<1	<1	<0.2
	11/06/08	--	--		**6.0**	<1	<1	<0.2
	05/01/09	22.37	317.03		--	--	--	--
	08/10/09	22.67	316.73		--	--	--	--
	11/13/09	22.61	316.79		<1	<1	<1	<0.2
	02/11/10	21.85	317.55		1.7	<1	<1	<0.2
	05/17/10	22.07	317.33	SoundEarth	--	--	--	--
	08/20/10	22.46	316.94		--	--	--	--
	11/19/10	--	--		--	--	--	--
	03/08/11	--	--		--	--	--	--
	06/08/11	21.77	317.63		**11**	<1	<1	<0.2
	09/26/11	22.61	316.79		**9.4**	<1	<1	<0.2
	12/08/11	22.23	317.17		**10**	<1	<1	<0.2
MW-105	03/28/08	20.25	321.33		--	--	--	--
TOC: 341.58 feet	04/08/08	--	--	SoundEarth	3.7	<1	2.1	<0.2
	04/15/08	--	--		4.4	<1	2.1	**0.21**
	07/01/08	20.88	320.7		--	--	--	--
	08/07/08	21.12	320.46	SoundEarth	3.7	<1	1.5	<0.2
	11/06/08	--	--		4.5	<1	1.5	**0.23**
	02/05/09	--	--		**5.5**	<1	1.5	<0.2
	05/01/09	20.24	321.34		**6.8**	<1	1.7	**0.22**
	08/10/09	20.97	320.61		**8.2**	<1	1.6	**0.37**
	11/13/09	21.5	320.08		**9.1**	<1	2.2	**0.32**
	02/10/10	19.49	322.09		**11.0**	<1	1.8	**0.41**
	05/17/10	19.62	321.96	SoundEarth	**14.0**	<1	2.2	**0.43**
	08/20/10	20.46	321.12		**9.2**	<1	1.9	<0.2
	11/18/10	20.62	320.96		**15**	<1	15	**0.61**
	03/08/11	18.62	322.96		**8.3**	<1	39	**0.41**
	06/08/11	18.85	322.73		**11**	1.2	74	**0.79**
	09/26/11	20.49	321.09		**11**	1.5	**100**	**1.4**
	12/08/11	20.73	320.85		**9.8**	1.1	**88**	**0.33**
MW-106	04/08/08	--	--		**7.9**	<1	<1	<0.2
TOC: 340.72 feet	04/15/08	--	--	SoundEarth	**7.3**	<1	<1	<0.2
	07/01/08	20.41	320.31		--	--	--	--
	08/07/08	20.72	320		4.0	<1	<1	<0.2
	11/06/08	--	--		4.4	<1	<1	<0.2
	05/01/09	19.50	321.22		--	--	--	--
	08/10/09	20.51	320.21		--	--	--	--
	11/13/09	20.99	319.73		--	--	--	--
	02/11/10	18.59	322.13		2.3	<1	<1	<0.2
	05/17/10	19.06	321.66	SoundEarth	--	--	--	--
	08/20/10	20.00	320.72		--	--	--	--
	11/18/10	20.02	320.7		--	--	--	--
	03/08/11	17.79	322.93		--	--	--	--
	06/08/11	18.10	322.62		**7.9**	<1	<1	<0.2
	09/26/11	20.26	320.46		2.1	<1	<1	<0.2
	12/08/11	20.42	320.30		2.5	<1	<1	<0.2
MW-107	04/08/08	--	--		**400**	**16**	30	<0.2
TOC: 340.05 feet	04/15/08	--	--	SoundEarth	**650**	**21**	44	**0.27**
	07/01/08	23.01	317.04		--	--	--	--
	08/07/08	23.07	316.98		**380**	**17**	35	<0.2
	11/06/08	--	--		**1,100**	**20**	43	<0.2
	02/05/09	--	--		**230**	**11**	23	<0.2
	05/01/09	22.71	317.34		**400**	**17**	32	**0.34**
	08/11/09	22.96	317.09		**480**	**20**	38	**1.0**
	11/13/09	23.12	316.93		**480**	**25**	44	**1.0**
	02/10/10	22.45	317.6	SoundEarth	**100**	3.7	6.3	<0.2
	05/17/10	22.51	317.54		<1	<1	<1	<0.2
	08/19/10	27.70	312.35		<1	<1	<1	<0.2
	11/18/10	22.85	317.20		1.6	<1	<1	<0.2
	03/08/11	21.46	318.59		<1	<1	<1	<0.2
	09/26/11	22.88	317.17		<1	<1	<1	<0.2
	12/08/11	22.97	317.08		2.3	1.7	<1	<0.2
MTCA Cleanup Level for Groundwater					**5** [2]	**5** [2]	**80** [3]	**0.2** [2]

Appendix E
Table 2
Case Study: Capitol Hill Property
Summary of Groundwater Analytical Results
Troy Laundry Property
307 Fairview Avenue North
Seattle, Washington

Sample Location	Date Sampled	Depth to Groundwater (feet)	Groundwater Elevation (feet)	Sampled By	Analytical Results (micrograms per liter) [1]			
					PCE	TCE	cis 1,2-Dichloroethene	Vinyl Chloride
MW-108	04/08/08	--	--	SoundEarth	**7,300**	**320**	**170**	**13**
TOC: 342.06 feet	04/15/08	--	--		**5,600**	**250**	**150**	**18**
	07/01/08	19.79	322.27		--	--	--	--
	08/07/08	20.03	322.03		**3,400**	**220**	**190**	**18**
	11/06/08	--	--	SoundEarth	**2,900**	**170**	**140**	**8.5**
	02/05/09	--	--		**4,300**	**300**	**240**	**23**
	05/01/09	18.62	323.44		**780**	**190**	**130**	**14**
	08/11/09	19.72	322.34		**11**	4.0	**3,300**	**39**
	11/13/09	20.61	321.45		**13**	**14**	**3,600**	**44**
	02/10/10	17.44	324.62		**7.3**	<5	**3,700**	**42**
	05/17/10	17.73	324.33		<1	**8.1**	**1,100**	**52**
	08/20/10	19.08	322.98		1.6	2.0	**2,700**	**49**
	11/19/10	19.42	322.64		1.4	<1	**4,700**	**52**
	03/08/11	15.88	326.18		1	**6**	**570**	**22**
	06/08/11	17.02	325.04		<1	<1	**450**	**520**
	09/26/11	20.01	322.05		<5j	<5j	39	**280**
	12/08/11	19.46	322.60		<1	<1	21	**150**
KMW-1D	04/25/06	--	--	Kane	**22**	<1	<1	<0.2
TOC: 342.93 feet	05/15/06	--	--		**5.6**	--	--	--
	05/25/06	--	--		4.3	--	--	--
	03/28/08	19.50	323.43	SoundEarth	--	--	--	--
	07/01/08	20.28	322.65		--	--	--	--
	10/06/08	--	--		1.6	<1	<1	<0.2
	Decommissioned April 2011							
MW-108D	05/01/09	18.60	--	SoundEarth	<1	<1	<1	<0.2
	08/10/09	19.46	--		<1	<1	<1	<0.2
	06/08/11	16.74	--		<1	<1	<1	<0.2
	12/08/11	19.36	--		--	--	--	--
MW-109	04/15/08			SoundEarth	1.2	<1	<1	<0.2
TOC: 340.10 feet	07/01/08	13.2	326.9		--	--	--	--
	08/07/08	16.75	323.35		<1	<1	<1	<0.2
	02/11/10	--	--		--	--	--	--
	09/26/11	14.77	325.33	SoundEarth	--	--	--	--
	12/08/11	16.14	323.96		--	--	--	--
MW-110	04/15/08	--	--	SoundEarth	1.1	<1	<1	**1.3**
TOC: 342.88 feet	07/01/08	20.36	322.52		--	--	--	--
	08/07/08	20.65	322.23		<1	<1	2.3	<0.2
	11/06/08	--	--	SoundEarth	<1	<1	3.4	**1.1**
	02/05/09	--	--		<1	<1	4.1	**1.6**
	05/01/09	19.55	323.33		<1	<1	4.1	**0.30**
	08/10/09	20.43	322.45		<1	<1	3.5	**0.64**
	11/13/09	21.2	321.68		<1	<1	3.2	<0.2
	02/10/10	18.69	324.19		<1	<1	4.9	**1.2**
	05/17/10	18.82	324.06		<1	<1	4.8	**0.24**
	08/19/10	19.83	323.05		<1	<1	5.1	**0.81**
	11/19/10	20.12	322.76		--	--	--	--
	03/08/11	17.63	325.25		<1	<1	6.2	**1.1**
	06/08/11	17.69	325.19		<1	<1	4.1	<0.2
	09/26/11	19.85	323.03		<1	<1	4.9	**0.70**
	12/08/11	20.33	322.55		<1	<1	5.1	**0.80**
MW-111	05/05/08	--	--	SoundEarth	<1	<1	<1	<0.2
	07/01/08	21.79	--		--	--	--	--
	12/08/11	21.73	--	SoundEarth	<1	<1	<1	<0.2
RW01	10/06/08	--	--	SoundEarth	<1	<1	<1	<0.2
	02/11/10	21.95	--	SoundEarth	<1	<1	<1	<0.2
	05/17/10	22.13	--		<1	<1	<1	<0.2
	08/19/10	22.31	--		<1	<1	<1	<0.2
	11/19/10	--	--		--	--	--	--
	03/08/11	21.73	--		--	--	--	--
	06/08/11	21.90	--		<1	<1	<1	<0.2
	09/26/11	22.56	--		<1	<1	<1	<0.2
	12/08/11	22.36			<1	<1	<1	<0.2
MTCA Cleanup Level for Groundwater					**5** [2]	**5** [2]	**80** [3]	**0.2** [2]

Appendix E
Table 2
Case Study: Capitol Hill Property
Summary of Groundwater Analytical Results
Troy Laundry Property
307 Fairview Avenue North
Seattle, Washington

Sample Location	Date Sampled	Depth to Groundwater (feet)	Groundwater Elevation (feet)	Sampled By	Analytical Results (micrograms per liter) [1]			
					PCE	TCE	cis 1,2-Dichloroethene	Vinyl Chloride
RW02	10/06/08	--	--	SoundEarth	<1	<1	<1	<0.2
	02/11/10	22.12	--	SoundEarth	**40**	1.2	<1	<0.2
	05/17/10	22.28	--		**39**	1.2	1.2	<0.2
	08/20/10	22.64	--		**40**	1.2	1.3	<0.2
	11/19/10	22.64	--		**42**	1.2	1.4	<0.2
	03/08/11	21.89	--		**45**	1.4	2.5	<0.2
	06/08/11	22.03	--		**45**	1.6	2.9	<0.2
	09/26/11	22.78	--		**59**	2.0	4.1	<0.2
	12/08/11	22.74			**55**	1.7	3.7	<0.2
RW03	10/06/08	--	--	SoundEarth	**19**	<1	<1	<0.2
	02/11/10	21.68	--	SoundEarth	**18**	<1	<1	<0.2
	05/17/10	21.8	--		**15**	<1	<1	<0.2
	08/20/10	22.09	--		**13**	<1	<1	<0.2
	11/19/10	22.03	--		**16**	<1	<1	<0.2
	03/08/11	21.51	--		**11**	<1	<1	<0.2
	06/08/11	21.62	--		**11**	<1	<1	<0.2
	09/26/11	22.23	--		**13**	<1	<1	<0.2
	12/08/11	22.07			**13**	<1	<1	<0.2
RW04	10/06/08	--	--	SoundEarth	**170**	**7.3**	19	**0.29**
	02/11/10	22.26	--	SoundEarth	**6.7**	<1	<1	<0.2
	05/17/10	22.37	--		2.1	<1	<1	<0.2
	08/20/10	22.73	--		1.3	<1	<1	<0.2
	11/18/10	23.02	--		2.1	<1	<1	<0.2
	03/08/11	20.53	--		<1	<1	<1	<0.2
	12/08/11	23.18			<1	<1	70	**0.53**
Safeway Submersible Sump								
Safeway Sump	3/30/10	--	--	SoundEarth	**15**	<1	<1	<0.2
	12/09/11	--	--		4.5	<1	<1	<0.2
MTCA Cleanup Level for Groundwater					**5** [2]	**5** [2]	**80** [3]	**0.2** [2]

NOTES:

Red denotes concentration exceeding the MTCA Method A cleanup level.

Gray shaded rows indicate baseline groundwater analytical data sampled prior to remedial action.

[1]Analyzed by U.S. Environmental Protection Agency Method 82608.

[2]MTCA Cleanup Regulation, Method A Cleanup Levels for Groundwater, Chapter 173-340 of the Washington Administrative Code (revisedNovember 2007).

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

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

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

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

-- = not analyzed/not measured

< = concentration not detected above laboratory reporting limit

CLARC = Cleanup Levels and Risk Calculation

EPA = U.S. Environmental Protection Agency

Kane = Kane Environmental Inc.

MTCA = Washington State Model Toxics Control Act

PCE = tetrachloroethylene

SoundEarth = SoundEarth Strategies Inc. (formerly Sound Environmental Strategies Corporation)

TCE = trichloroethylene

SoundEarth Strategies

Chart 3
Case Study: Capitol Hill Property
Chlorinated Compounds in Groundwater for MW108
Troy Laundry Property
307 Fairview Avenue North
Seattle, Washington

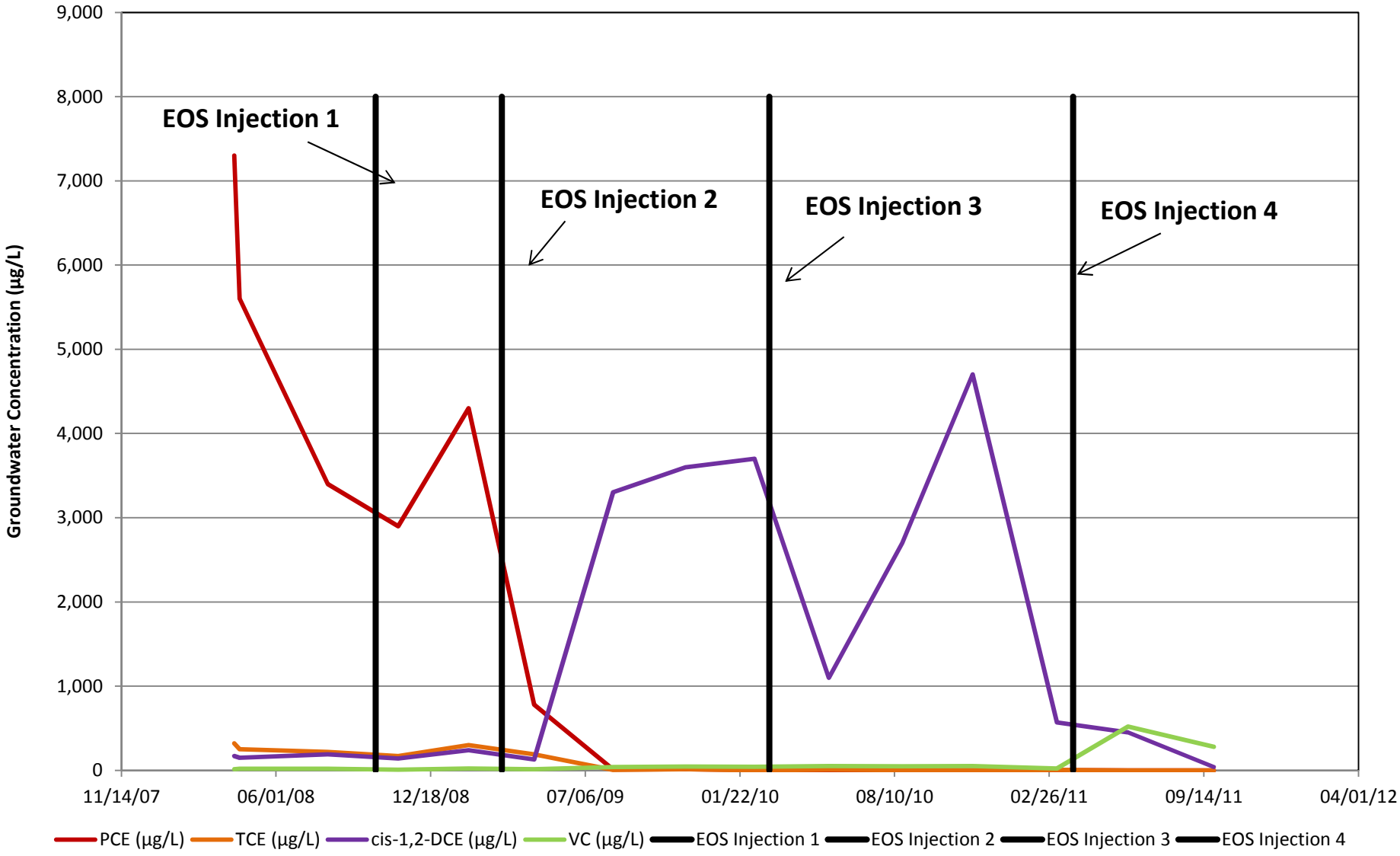
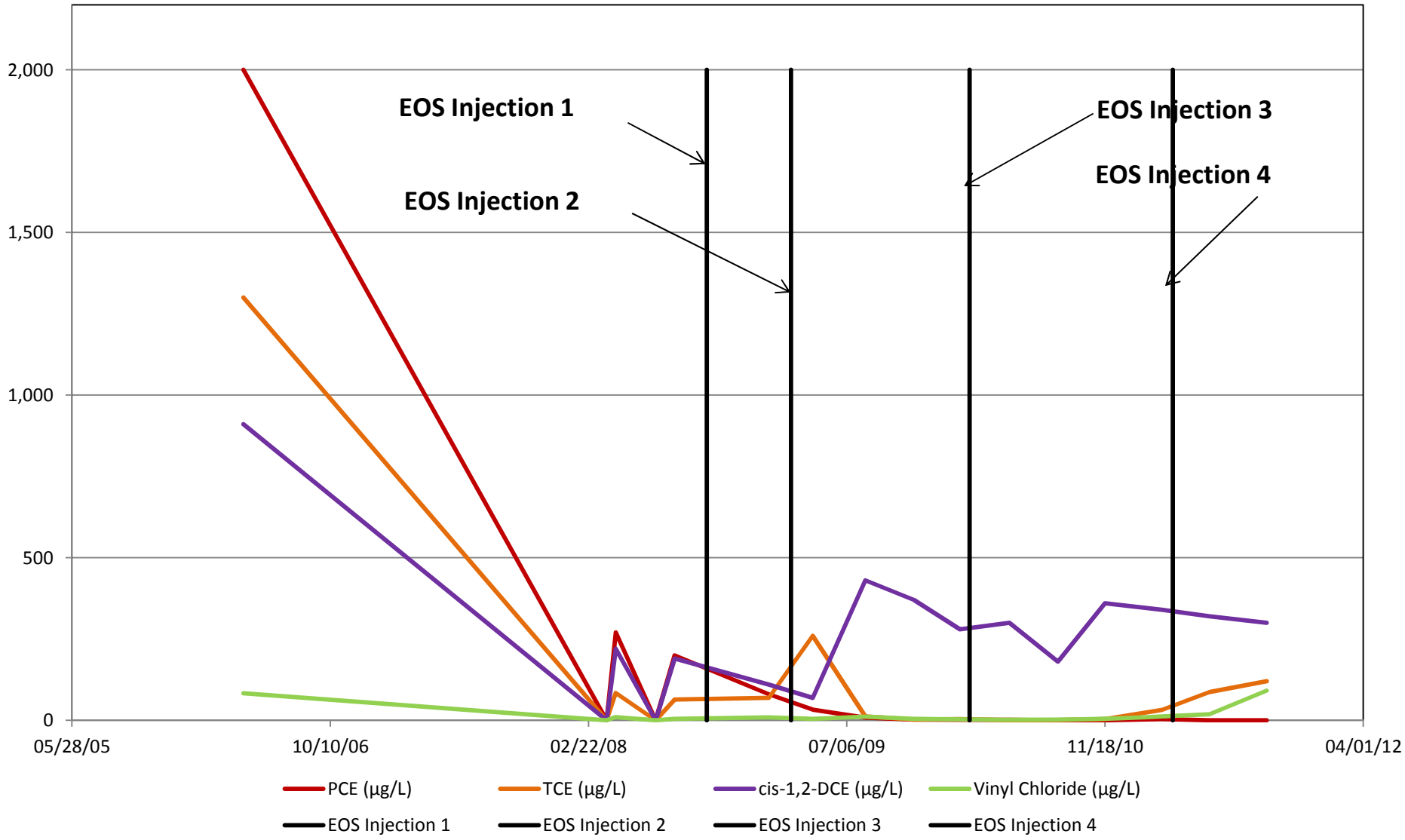


Chart 4
Case Study: Capitol Hill Property
Chlorinated Compounds in Groundwater for KMW1
Troy Laundry Property
307 Fairview Avenue North
Seattle, Washington



LEGEND

- CATCH BASIN
- MAN HOLE
- 2040 — ADDRESSES
- MW-104 — MONITORING WELL
- KMW-1 — MONITORING WELL (KANE ENVIRONMENTAL, 2006)
- MW-112 — PROPOSED SHALLOW MONITORING WELL
- PROPOSED SITE POINT OF COMPLIANCE WELL
- RW04 — REMEDIATION WELL
- GB-1 — PIEZOMETER (GEOENGINEERS, 2004)
- KMW-1D — DECOMMISSIONED MONITORING WELL
- KGP-4 — GEOPROBE BORING (KANE ENVIRONMENTAL, 2006)

LIMIT	PCE	VC
MTCA A	5	0.2

- PROPERTY BOUNDARY
- PARCEL BOUNDARY
- FORMER SITE FEATURES
- SEWER DRAIN
- STORM DRAIN
- GAS LINE
- OVERHEAD POWER LINE
- BURIED ELECTRIC LINE
- FIBER OPTIC LINE
- SEWER LINE MIGRATION PATHWAY
- RED — DENOTES CONCENTRATION EXCEEDS MTCA METHOD A CLEANUP LEVEL
- MTCA A — WASHINGTON STATE MODEL TOXICS CONTROL ACT METHOD A
- PCE — TETRACHLOROETHYLENE
- VC — VINYL CHLORIDE

RESULTS ARE IN MICROGRAMS PER LITER

N

KMW-4	PCE	VC
05/17/10	1.3	2.3
08/19/10	<1	2.0
11/19/10	<1	4.9
03/08/11	<1	<0.2
06/08/11	<1	<0.2
9/26/2011	<1	<0.2
12/08/11	<1	<0.2

MW-103	PCE	VC
02/10/10	35	<0.2
05/17/10	44	<0.2
08/20/10	25	<0.2
11/19/10	22	<0.2
03/08/11	50	<0.2
06/08/11	53	<0.2
09/26/11	36	<0.2
12/08/11	35	<0.2

MW-106	PCE	VC
11/06/08	4.4	<0.2
02/11/10	2.3	<0.2
06/08/11	7.9	<0.2
09/26/11	2.1	<0.2
12/08/11	2.5	<0.2

MW-109	PCE	VC
10/06/08	1.2	<0.2
02/11/10	<1	<0.2

GB-1	PCE	VC
02/10/10	45	17
05/17/10	140	8.4
08/20/10	130	6.0
11/19/10	210	6.7
03/08/11	260	15.0

RW04	PCE	VC
02/11/10	6.7	<0.2
05/17/10	2.1	<0.2
08/20/10	1.3	<0.2
11/18/10	2.1	<0.2
03/08/11	<1	<0.2
12/08/11	<1	0.53

RW01	PCE	VC
02/11/10	<1	<0.2
05/17/10	<1	<0.2
08/19/10	<1	<0.2
06/08/11	<1	<0.2
09/26/11	<1	<0.2
12/08/11	<1	<0.2

MW-108D	PCE	VC
05/01/09	<1	<0.2
08/10/09	<1	<0.2
06/08/11	<1	<0.2

MW-101	PCE	VC
02/10/10	2.2	41
05/17/10	<1	79
08/20/10	<1	27
11/19/10	<1	30
03/08/11	<1	100
06/08/11	<1	49
09/26/11	<1	23
12/08/11	<1	8.9

KMW-1D	PCE	VC
10/06/08	1.6	<0.2

KMW-1	PCE	VC
05/17/10	1.3	2.3
08/19/10	<1	2.0
11/18/10	<1	4.9
03/08/11	4.1	12
06/08/11	<5	19
9/26/2011	<5	91
12/08/11	3.4	49

MW-102	PCE	VC
02/10/10	1,300	5
05/17/10	22	6.2
08/20/10	3.7	7.5
11/18/10	2.9	9.6
03/08/11	<1	31
06/08/11	<1	27
09/26/11	<1	36
12/08/11	<1	13

MW-107	PCE	VC
02/10/10	100.0	<0.2
05/17/10	<1	<0.2
08/19/10	<1	<0.2
11/18/10	1.6	<0.2
03/08/11	<1	<0.2
09/26/11	<1	<0.2
12/08/11	2.3	<0.2

SUMP	PCE	VC
03/30/10	15	<0.2
12/09/11	4.5	<0.2

MW-111	PCE	VC
12/08/11	<1	<0.2

RW03	PCE	VC
02/11/10	18	<0.2
05/17/10	15	<0.2
08/20/10	13	<0.2
11/19/10	16	<0.2
3/8/2011	11	<0.2
06/08/11	11	<0.2
09/26/11	13	<0.2
12/08/11	13	<0.2

MW-110	PCE	VC
11/13/09	<1	<0.2
02/10/10	<1	1.2
05/17/10	<1	0.24
08/19/10	<1	0.81
03/08/11	<1	1.10
06/08/11	<1	<0.2
09/26/11	<1	0.70
12/08/11	<1	0.80

MW-108	PCE	VC
02/10/10	7.3	42
05/17/10	<1	52
08/20/10	1.6	49
11/19/10	1.4	52
03/08/11	1	22
06/08/11	<1	520
09/26/11	<5	280
12/08/11	<1	150

MW-105	PCE	VC
02/10/10	11.0	0.41
05/17/10	14.0	0.43
08/20/10	9.2	<0.02
11/18/10	15	0.61
3/8/2011	8.3	0.41
06/08/11	11	0.79
09/26/11	11	1.4
12/08/11	9.8	0.33

RW02	PCE	VC
02/11/10	40	<0.2
05/17/10	39	<0.2
08/20/10	40	<0.2
11/19/10	42	<0.2
3/8/2011	45	<0.2
06/08/11	45	<0.2
09/26/11	59	<0.2
12/08/11	55	<0.2

MW-104	PCE	VC
11/13/09	<1	<0.2
02/11/10	1.7	<0.2
06/08/11	11	<0.2
09/26/11	9	<0.2
12/08/11	10	<0.2

KMW-2	PCE	VC
12/08/11	<1	<0.2

2100 — MIXED USE: GROCERY (SAFEWAY) AND RESIDENTIAL APARTMENTS

2023 — 1720 FORMER LAUNDROMAT AND DRY CLEANING FACILITY (1969-1988)

2030 2032 — 2034 (FORMER DRY CLEANERS) 2036 — 2201 — FORMER SHOE CLEANING AND DYEING

SAFEWAY SUBMERSIBLE SUMP PUMP

VACATED ALLEY; UST; PARKING; SIDEWALK; KMW-4; GB-3; MW-103; MW-106; MW-109; MW-112; GB-1; KMW-1D; KGP-4; KGP-2; KMW-1; MW-108D; MW-101; MW-108; RW01; RW04; MW-102; MW-105; RW02; RW03; MW-107; MW-111; GB-2; KMW-2; MW-110; MW-104

0 45 90
APPROXIMATE SCALE IN FEET

SoundEarth Strategies
WWW.SOUNDEARTHINC.COM

DATE: 12/2/11
DRAWN BY: BLR/NAC
CHECKED BY: SKB
CAD FILE:

PROJECT NAME: CAPITOL HILL PROPERTY
PROJECT NUMBER:
STREET ADDRESS:
CITY, STATE: SEATTLE, WASHINGTON

REGION:

FIGURE 1
CAPITOL HILL PROPERTY
GROUNDWATER ANALYTICAL RESULTS

6/15/2012

P:\10566 FORMER OLYMPIA DRY CLEANERS\DELIVERABLES\2011 DRAFT FEASIBILITY STUDY REPORT\2012 RESPONSE TO ECOLOGY\CAP HILL CONTOUR MAP.DWG

LEGEND

- CATCH BASIN
- MAN HOLE
- 2040 ADDRESSES
- SVE-3 SOIL VAPOR EXTRACTION WELL
- MW-104 MONITORING WELL
- KMW-1 MONITORING WELL (KANE ENVIRONMENTAL, 2006)
- RW04 REMEDIATION WELL
- KMW-1D DECOMMISSIONED MONITORING WELL
- SGP-03 SOIL BORING
- SB-1 SOIL BORING
- KGP-1 GEOPROBE BORING (KANE ENVIRONMENTAL, 2006)
- GB-1 PIEZOMETER (GEOENGINEERS, 2004)
- B-5 SOIL BORING
- B-2 SOIL BORING (RILEY GROUP, 1998)
- B113 SOIL BORING
- TP01 TEST PITS
- PROPERTY BOUNDARY
- PARCEL BOUNDARY
- CONCRETE CONDUIT CONTAINING VARIOUS UTILITIES
- FORMER SITE FEATURES
- SS SEWER DRAIN
- SD STORM DRAIN
- GAS GAS LINE
- OHP OVERHEAD POWER LINE
- E BURIED ELECTRIC LINE
- FB FIBER OPTIC LINE
- 1-FOOT-INTERVAL GROUNDWATER CONTOUR (DECEMBER 8, 2011)
- GROUNDWATER FLOW DIRECTION (DECEMBER 8, 2011)

N

RESIDENTIAL UST 300 GALLONS (DECOMMISSIONED)

1,000 GALLON HEATING OIL UST (DECOMMISSIONED)

1,500 GALLON BUNKER OIL UST (DECOMMISSIONED)

VACATED ALLEY

ALLEY

PARKING

SIDEWALK

DECK

2100

2051

2040

2038

2036

2034

2030 2032

2026 2028

2024 1/2

2023

2020

2018

2015

2201

1806

1802

(FORMER DRY CLEANERS)

PRESENT MIXED USE: GROCERY (SAFEWAY) AND RESIDENTIAL APARTMENTS

FORMER SHOE CLEANING/ DYEING

SAFEWAY SUBMERSIBLE SUMP PUMP

1720
FORMER LAUNDROMAT AND DRY CLEANING FACILITY
(1969-1988)

FORMER BUILDING LAYOUT

FORMER DRY CLEANING AREA

NOTE: SOME LOCATIONS ARE APPROXIMATE

SoundEarth Strategies WWW.SOUNDEARTHINC.COM	DATE: 11/30/11 DRAWN BY: NAC CHECKED BY: SKB CAD FILE: 0521-001-07_XSLOC
PROJECT NAME: CAPITOL HILL PROPERTY PROJECT NUMBER: STREET ADDRESS: CITY, STATE: SEATTLE, WASHINGTON	REGION:
0 25 50 100 APPROXIMATE SCALE IN FEET	**FIGURE 2** CAPITOL HILL PROPERTY GROUNDWATER CONTOUR MAP

SOUNDEARTHINC.COM

6/13/2012

P:\0566 FORMER OLYMPIA DRY CLEANERS\DELIVERABLES\2011 DRAFT FEASIBILITY STUDY REPORT\2012 RESPONSE TO ECOLOGY\CAP HILL INJECTION LOCS.DWG

LEGEND

- CATCH BASIN
- MAN HOLE
- 2040 ADDRESSES
- MW-104 MONITORING WELL
- KMW-1 MONITORING WELL (KANE ENVIRONMENTAL, 2006)
- RW04 REMEDIATION WELL
- GB-1 PIEZOMETER (GEOENGINEERS, 2004)
- KMW-1D DECOMMISSIONED MONITORING WELL
- PROPERTY BOUNDARY
- PARCEL BOUNDARY
- FORMER SITE FEATURES
- SS SEWER DRAIN
- SD STORM DRAIN
- GAS GAS LINE
- OHP OVERHEAD POWER LINE
- E BURIED ELECTRIC LINE
- FO FIBER OPTIC LINE
- BOUNDARY OF SOURCE SOIL AREA
- BOUNDARY OF PROPOSED LARGE AREA EXCAVATION
- EOS INJECTION WELL OCTOBER 2008
- MARCH 2009
- MARCH 2010
- MARCH 2011
- POTASSIUM PERMANGANATE INJECTION WELL 2008

N

PRESENT MIXED USE: GROCERY (SAFEWAY) AND RESIDENTIAL APARTMENTS

FORMER SHOE CLEANING AND DYEING

1720 FORMER LAUNDROMAT AND DRY CLEANING FACILITY (1969-1988)

VACATED ALLEY

PARKING

SIDEWALK

DECK

2023 2040 2038 2030 2032 2034 (FORMER DRY CLEANERS) 2036 2028 2026 2201

KMW-4 MW-103 MW-106 MW-109 MW-108D MW-108 MW-101 MW-102 MW-107 MW-105 MW-110 MW-104 GB-2 RW01 RW04 RW02 RW03

IP19 IP20 IP30 IP27 IP08 IP29 IP07 IP28 IP26 IP05 IP24 IP25 SVE-1 IP06 IP23 GB-1 IP05 IP07 SVE-2 IP22 IP04 KMW-1D IP03 IP09 IP06 IP21 SVE-3 IP02 IP17 IP05 IP16 IP15 IP01 IP10 IP13 IP11 IP04 IP14 IP02 IP01 IP08 IP03 IP12 IP18 KMW-1

SoundEarth Strategies
WWW.SOUNDEARTHINC.COM

DATE: 05/11/11
DRAWN BY: JQC/BLR
CHECKED BY: SKB
CAD FILE:

PROJECT NAME: CAPITOL HILL PROPERTY
PROJECT NUMBER:
STREET ADDRESS:
CITY, STATE: SEATTLE, WASHINGTON

REGION:

0 15 30 60
APPROXIMATE SCALE IN FEET

FIGURE 3
CAPITOL HILL PROPERTY
INJECTION WELL LOCATIONS

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