ENVIRONMENTAL PARTNERS INC

Cleanup Action Plan

Juanita Village Property
Kirkland, Washington

Prepared For:

Juanita Village L.L.C.
10843 N.E. 8th Street
Suite 200
Bellevue, WA 98004

April 21, 2000

Prepared By:

Environmental Partners, Inc.
10940 NE 33rd Place, Suite 110
Bellevue, Washington 98004
(425) 889-4747

John Kane
Project Manager

EPI Project Number: 29801.3

TABLE OF CONTENTS

List of Figures

TABLE OF CONTENTS

1.0 INTRODUCTION

This Cleanup Action Plan (CAP) describes the proposed remedial action at the Juanita Village property located in the Juanita Business District of Kirkland, Washington (Figure 1). The property includes a 1960s vintage shopping center proposed for redevelopment as a combined mixed-use commercial/residential property. A cleanup action will be completed as part of the redevelopment project. This CAP describes the property, the environmental conditions, identifies the remedial action objectives, and describes the appropriate cleanup standards selected under the Washington Department of Ecology (Ecology) Model Toxics Control Act (MTCA). It also describes the cleanup action and compliance monitoring that will be conducted at the site.

The following section presents a summary of the information required by the MTCA [WAC173-340-360 (10(a))]. The information in the CAP is based on the information provided in the Remedial Investigation/Feasibility Study and the results of the Density Driven Convection (DDC) well and Soil Vapor Extraction (SVE) Pilot Tests performed at the property from September through October 1999 (RI/FS; Environmental Partners, Inc. 1999). Remediation at the property will be conducted following the requirements established in the Prospective Purchaser Agreement (PPA) Consent Decree with Washington State Department of Ecology (Ecology) and the Washington State's Attorney General's Office (AG's Office).

1.1 Summary of Development Project

The planned Juanita Village development is a European-style pedestrian oriented village with shops, restaurants, boutiques and specialty markets surrounded by a diverse variety of housing including live/work lofts, town homes, studios, stacked flats. The project epitomizes the kind of "infilling" and brownfields redevelopment that is essential for the successful implementation of the State of Washington Growth Management Act (GMA) Ch. 36.70A. RCW.

1.2 Property Description

The property consists of 10 tax parcels located in the Juanita Business District of Kirkland, Washington. Figure 1 shows the vicinity map of the Juanita Village property. The northern one-third of the subject property is currently developed with a small strip mall, a drive-through bank, a stand alone Bank of America building, a vacant and former grocery store, concrete sidewalks and asphalt paving for parking. An automotive repair facility (Juanita Auto Clinic, former Texaco service station) is located on the east-central portion of the subject property. Trees and shrubs are present in the central and west-central portion of the property. A vacant unvegetated area is located on the southeastern portion of the subject property. The Juanita Village property is zoned for mixed use allowing office, retail and residential uses.

The nearest surface water bodies are Lake Washington, located approximately 600 feet to the south from the Juanita Village southern property boundary, and Juanita Creek located approximately 300 feet northwest of the Juanita Village northwestern property boundary.

The topography of the northern portion of the property is generally flat with a slight lowering in grade to the south-southwest. The central and southern portion of the property is also flat, but there is a distinct

change in grade between the southern edge of the northern asphalt parking lot and the central vegetated area. There is a small area of steep grade on the western and southern perimeters of the Juanita Auto Clinic (former Texaco service station) location and within a vegetated southern area.

The Juanita Village property is surrounded by retail, residential and office buildings to the north, small strip centers and commercial buildings to the east across 98th Avenue NE, and office buildings, condominiums, and Juanita Beach Park to the south across Juanita Drive NE. Play fields for the Juanita Beach Park, the German Retirement Home and commercial and residential structures are located directly west of the property across 97th Avenue NE.

1.3 Property History

The northern portion of the subject property was first developed commercially in approximately 1965-1966. The development included the currently vacant grocery store building, the one-story retail complex, the office building located north of the grocery store, and the present-day Bank of America building. A dry cleaning operation was present in the strip mall in the early 1970s, although the specific starting date of the dry cleaner's lease is unknown.

The east-central portion of the subject property currently occupied by the Juanita Auto Clinic (former Texaco service station) was developed in the late 1960s. Underground gasoline storage tanks associated with the former Texaco station were removed in 1984.

A former Chevron service station was located on the southeastern corner of the subject property starting in the mid-1950s. The Chevron service station's underground storage tanks were removed in 1993. Subsequent soil and ground water remediation was conducted following removal of the USTs.

1.4 Property Investigations

Previous investigations by Terra Associates, Inc. (Terra Associates) of Kirkland, Washington and Environmental Partners, Inc. were conducted at the subject property. Terra Associates conducted two environmental site assessments on portions of the Juanita Village property in April 1994 and July 1998. In 1998, Environmental Partners Inc. (EPI) also conducted additional site characterization activity in four phases: Limited Phase II (September 1998), Phase II Addendum 1 (September 1998), Phase II Addendum 2 (October 1998) and Phase II Addendum 3 (November 1998). The site characterization data from the Terra Associates investigations and EPI investigations are presented in the RI Report.

Concentrations of TPH-Diesel and Heavy oil were found above the MTCA Method A Soil Cleanup Level in one surface soil sample collected west of the Juanita Auto Clinic (former Texaco service station) in 1994 by Terra Associates. A concentration of TPH-Heavy Oil above the MTCA Method A Soil Cleanup Level was found in the soil sample collected at 2.5 feet below ground surface (bgs) at MW-2 on the Juanita Auto Clinic parcel. However, the soil sample collected immediately beneath the 2.5-foot sample at 5.0 feet bgs resulted in a non-detectable concentration of TPH-Heavy Oil. Additional soil sampling conducted by EPI in 1998 revealed concentrations of TPH-Gasoline above the MTCA Method A Soil Cleanup Level in the southeastern portion of the property, at the former Chevron service station.

Testing for benzene, toluene, ethylbenzene, xylenes, and other volatile organic compounds showed no detectable concentrations above the practical quantitation levels.

Additional soil sampling by EPI also confirmed the presence of PCE-impacted soil in the area of the former on-site dry cleaner with detectable concentrations of PCE but non-detectable concentrations of PCE associated substances including trichloroethane (TCE), 1,1- and 1,2-dichloroethane (1,1-DCE and 1,2-DCE), and vinyl chloride (VC) (see Figures 2 and 3). For the purposes of this Cleanup Action Plan, the term "associated substances" will refer to PCE associated substances including TCE, 1,1-DCE, 1,2-DCE and VC.

Ground water sampling by Terra Associates in 1994 resulted in concentrations of TPH-Heavy Oil above the MTCA Method A Ground Water Cleanup Levels in wells MW-101, MW-102 and MW-103. Terra Associates stated that these ground water results did not reflect motor oil concentrations in the ground water, but were the result of organic interference caused by the thick organic topsoil layer leaching into the shallow ground water. More recent sampling has not detected TPH in ground water. A Phase II investigation also conducted by Terra Associates in July 1998 revealed concentrations of PCE above the MTCA Method A Ground Water Cleanup Level upgradient and down-gradient from the on-site dry cleaner on the Juanita Village property. The PCE associated substances were not found above their applicable MTCA Ground Water Cleanup Levels during the Terra Associates Phase II. Additional ground water sampling by EPI confirmed the presence of PCE above the MTCA Method A Ground Water Cleanup Level off-site/up-gradient and off-site/downgradient of the Juanita Village property and also confirmed that PCE associated substances were generally not detected on-site or off-site. In a few instances PCE associated substances were detected in on-property ground water, but they were detected substantially below their respective MTCA Cleanup Levels.

Based on a review by Ecology of the results of these previous investigations, additional site characterization tasks were conducted in August 1999 to fill data gaps in the remedial investigation of the Juanita Village property. In addition, EPI conducted a ground water remediation pilot test using a density driven convection (DDC) well and performed a soil vapor extraction (SVE) pilot test to determine the feasibility of both technologies for remediating soil and ground water at the property.

The primary contaminant of concern in soil and ground water on the Juanita Village property is tetrachloroethene, also called perchloroethene (PCE), a common dry cleaning solvent. Two distinct plumes of PCE exist in groundwater at the Juanita Village property. The primary PCE ground water plume extends from underneath the former on-property dry cleaner in a south to southwesterly direction, across 97th Avenue and into Juanita Beach Park (currently owned and operated by King County). The down-gradient edge of the primary PCE plume is found near the center of the Juanita Park parking lot, north of Juanita Drive NE. A smaller PCE plume is found in the northeastern corner of the Juanita Village property. Analytical data results indicate that this up-gradient plume originates from an off-property dry cleaner formerly operating across 98th Avenue NE northeast of the Juanita Village property. Figure 4 shows the horizontal extent of both PCE plumes based on the results of the remedial investigation.

The two PCE plumes are primarily confined to the upper 10ft to 15ft of a single aquifer system. PCE has also been detected in two deep ground water wells on the Juanita Village property up to 8.4 ppb.

Results of the remedial investigation have indicated the PCE found in the deeper portion of the aquifer is originating from the upgradient, off-property source. Three DDC pilot test ground water monitoring well samples, collected in September and October 1999 from the two on-property deep wells downgradient from the on-property PCE source, resulted in non-detectable concentrations of PCE. The data results indicate that the PCE found in the deeper portion of the aquifer is limited within the Juanita Village property boundary. Ground water remediation of the upgradient, off-property source is expected to reduce concentrations of PCE found in the deeper portion of the aquifer in the northern portion of the Juanita Village property to concentrations below the MTCA Ground Water Cleanup Level.

PCE has also been found in soil directly below the former on-site dry cleaning location, in the northern portion of the drive-through bank teller area, and adjacent to the sewer line leading from the former on-site dry cleaner to the on-site main sewer. These three adjacent locations are considered the source area for the on-site PCE plume found in ground water defined by soil sampling during the remedial investigation. Analytical data supports a release mechanism indicating that PCE-containing waste water slowly leaked through small utility trenches located inside the dry cleaning building into the subsurface soil, then dissolved into the groundwater and subsequently transported down-gradient. A secondary release includes some PCE-containing wastewater draining into the on-site sanitary sewer system. As-built drawings obtained from the Northshore Utility District show that the dry cleaner was connected to a sewer line in 1968. Leaks in the sewer line may have caused some PCE containing wastewater to also migrate through the unsaturated soil column to the ground water surface.

Soil analytical data results do not support the theory that there may have been disposal of PCE in the septic drainfield located west of the dry cleaner. As-built records from the Northshore Utility District show that this drainfield was connected to the septic tank associated with the office building located west of the dry cleaner.

Ground water sampling results at the Juanita Auto Clinic (former Texaco service station) indicate petroleum hydrocarbons are present in ground water but at concentrations below the MTCA Method A Cleanup Level. Residual petroleum-impacted soil may be present within the footprint of the service station building.

Soil samples collected during the remedial investigation in the area of the former Chevron site revealed gasoline range petroleum hydrocarbons are still present at concentrations above cleanup levels. In addition, one ground water sample collected near the location of a reported former waste oil underground storage tank revealed a concentration of PCE slightly above the cleanup level. Some residual soil and ground water contamination may be present in isolated locations in this portion of the subject property. According to documentation available at Ecology's Northwest Regional Office, the majority of the petroleum-contaminated soil and ground water was removed during an underground storage tank decommissioning performed in 1993.

One soil sample was collected when ground water monitoring well EPI-MW-5 was drilled in Juanita Beach Park. No concentrations of PCE or associated substances were detected in this soil sample. There are no known sources of PCE down-gradient from the Juanita Village property. Furthermore, ground water levels in that area fluctuate only by approximately one to one and one-half feet during the year. For these reasons, no PCE soil contamination is believed to exist in Juanita Beach Park.

In summary, the known or potential areas of soil remediation on the Juanita Village property are the following:

- one waste oil and one heating oil underground storage tank associated with the Juanita Auto Clinic (former Texaco service station),
- soil at the Juanita Auto clinic and former Chevron service station containing concentrations of TPH above the MTCA Soil Cleanup Level,
- PCE-impacted soil beneath the on-site dry cleaner, along the sewer line south of the dry cleaner,
- potential TPH-impacted soil within the footprint of the Juanita Auto Clinic building due to the presence of a sump and underground hydraulic lift inside the building.

The extent of TPH-impacted soil was limited at MW-2 and EPI-18 because deeper soil samples collected at both locations revealed non-detectable concentrations of TPH. In both cases, the analytical laboratory practical quantitation limit (PQL) was lower than the MTCA Method A Soil Cleanup Level.

2.0 CLEANUP ACTION SELECTION

The findings of the remedial investigation were used to develop the cleanup alternatives for the Juanita Village property. The evaluation of the alternatives was presented in the Feasibility Study (FS by EPI, January 21, 2000). The FS proposed the cleanup standards and remedial action objectives (RAO), screened 22 remedial technologies, evaluated four cleanup action alternatives and identified a preferred cleanup action. The following sections describe the RAO, the four cleanup alternatives evaluated in the FS, and a detailed discussion of the preferred cleanup action alternative.

2.1 Remedial Action Objectives

Remedial action objectives define the overall goals of the remedial effort and act as benchmarks for comparative evaluation of each remedial alternative. The RAOs are specific to each of the contaminants and media affected at the Juanita Village site as follows:

PCE

1) On-property soil: Control and remove the potential for direct contact of PCE to humans and the environment from PCE contaminated soil, and associated substances, if identified, at concentrations above MTCA cleanup levels, and remediate soils to below the MTCA Cleanup Level, reducing the potential of PCE migration to ground water.
2) On-property ground water: Treat and restore the ground water to concentrations below the MTCA Ground Water Cleanup Level, and minimize the potential for exposure to humans and the environment.
3) Up-gradient ground water: Treat and minimize migration of PCE contamination above the MTCA Ground Water Cleanup Level onto the Juanita Village property originating from a former off-property up-gradient source.
4) Downgradient ground water: Treat and restore the ground water to PCE concentrations below the MTCA Ground Water Cleanup Level, and minimize the potential for exposure to humans and the environment.

Petroleum Hydrocarbon Impacted Soil

1) Excavate and treat, or recycle where practicable, off-site for soils containing petroleum hydrocarbons above MTCA Cleanup Levels.
2) Minimize the potential for direct exposure to humans and the environment and minimize migration of hydrocarbons to groundwater.

2.2 Alternatives Evaluated in Feasibility Study

The subsurface conditions, distribution of contaminants, and the remedial action objectives for the subject property were carefully considered. Four cleanup action alternatives were evaluated in the Feasibility Study for contaminated soil and ground water above their respective MTCA Cleanup Level. A brief summary of each alternative is provided below:

Alternative 1 - Excavation of Source Areas and Natural Attenuation of Ground Water with Capping, Institutional Controls and Long-Term Monitoring

This remedial alternative consists of excavating and removing the TPH-gasoline and PCE-containing soil and allowing natural attenuation mechanisms to address the ground water impacts at the site. This alternative includes capping the subject property with buildings, pavement, or a combination of the two.

The excavated TPH-gasoline contaminated soils would be transported to a licensed and permitted thermal desorption treatment facility. The goal of this excavation would be to remove TPH-gasoline contaminated soil at the property above the MTCA Method A Soil Cleanup Levels. If soils containing TPH-heavy oil were found, they would be sampled and analyzed using the methods described in Ecology's Interim TPH Policy. Soils with concentrations of TPH-heavy oil that are below the Method B cleanup level derived under the Interim TPH Policy would be left on-site, and any soils with concentrations above that level would be transported to a licensed and permitted thermal desorption treatment facility.

Excavated PCE-containing soil would be managed in two methods. PCE soils below the MTCA Soil Cleanup Level would be re-used on the property as fill material in a manner that isolates it from ground water and direct contact. Excavated PCE soil above the MTCA Soil Cleanup Level, if any, would be transported to a permitted hazardous waste landfill for disposal, or consolidated on-property, isolated from ground water and direct contact, following Ecology's Area of Contamination (AOC) policy with a restrictive covenant (Consent Decree, Exhibit F). Compliance with MTCA cleanup levels would be confirmed through performance sampling (see Compliance Monitoring). This portion of the remedial alternative would consist of excavation and off-property treatment and/or disposal, performance soil sampling and analysis of excavated areas, and backfilling of excavated areas.

This alternative assumes that by excavating the impacted soil, the source material for ground water PCE-impacts would be removed and contamination concentrations would slowly be reduced through natural attenuation both on and off-property. Ground water monitoring for up to 20 years would be necessary to demonstrate the attainment of ground water cleanup levels. It would be necessary to place institutional controls on the use of ground water at the subject property until such time that it could be demonstrated that ground water cleanup levels had been attained. Ground water monitoring would be needed to assure PCE contamination did not migrate down gradient nor migrate to the base of the water table and to prevent contact to humans, to surface water or the environment. The pathway to surface water would be monitored by placing wells in the Juanita Drive NE right-of-way.

Natural attenuation would provide mid- and long-term improvement for PCE-impacted ground water using chemical breakdown and degradation of PCE. Natural attenuation would require active ground water monitoring to estimate the rates of breakdown and degradation, and attainment of the MTCA Cleanup Levels. However, if it were the only remediation activity for the entire site, natural attenuation alone would not eliminate the potential for further off-property contaminant migration.

Alternative 2 - Excavation of Source Areas and In-Well Vapor Stripping (Density Driven Convection) with Soil Vapor Extraction

This remedial alternative consists of the following tasks:

1) Excavating TPH containing soils above the MTCA soil cleanup level, and recycling where practicable,
2) Soil vapor extraction of PCE from the unsaturated soil for on-property and up-gradient, off-property,
3) In-situ stripping of PCE from ground water on-property and if necessary, off-property,
4) If soils with PCE concentrations on-property are discovered above the MTCA cleanup level, then either a.) soils will be excavated and disposed off-site at a RCRA permitted landfill or b.) contained on-property under a restrictive covenant with prior approval from Ecology using Ecology's AOC and Contained-In policies.

Performance and confirmation sampling of soil and ground water will be conducted to monitor the achievement of cleanup levels. For a full discussion of Alternative 2, see the Selected Alternative in Section 3.0.

Alternative 3 - Excavation of Source Areas and In Situ Air Sparging with Soil Vapor Extraction

This remedial alternative consists of excavating and removing the TPH-gasoline contaminated soil and PCE-containing soil from the source areas of the site as well as in-situ air sparging of the ground water combined with soil vapor extraction to treat ground water contamination at the site.

The excavated TPH-gasoline contaminated soils would be transported to a licensed and permitted thermal desorption treatment facility. The goal of this excavation would be to remove TPH-gasoline contaminated soil at the property above the MTCA Soil Cleanup Levels. If soils containing TPH-heavy oil were found, they would be sampled and analyzed using the methods described in Ecology's Interim TPH Policy. Soils with concentrations of TPH-heavy oil that are below the MTCA Cleanup Level derived under the Interim TPH Policy would be left on-site, and any soils with concentrations above that level would be transported to a licensed and permitted thermal desorption treatment facility.

Excavated PCE-containing soil below the MTCA Soil Cleanup Levels would be re-used on the property as fill material in a manner that isolates it from ground water and direct contact. Excavated PCE-containing soil above the Soil Cleanup Levels, if any, would need to be transported to a permitted hazardous waste landfill for disposal or consolidated on-property isolated from ground water and direct contact and following Ecology's Area of Contamination (AOC) policy. Compliance with MTCA Cleanup Levels would be confirmed through performance sampling and analysis. This portion of the remedial alternative would consist of excavation and off-property treatment and/or disposal, performance soil sampling and analysis of excavated areas, and backfilling of excavated areas.

The PCE impacts to the ground water at the site would be addressed using in-situ air sparging combined with soil vapor extraction. Air sparging is the injection of compressed air at controlled pressures and volumes into water-saturated soils. Volatile Organic Compounds (VOCs) are stripped from the water as air channels are formed in the subsurface, and stripped contaminants are captured by

a vapor extraction system in the vadose zone. The contaminant vapors are captured in granular activated carbon units prior to discharge to the atmosphere.

This remedial alternative would treat the ground water and unsaturated zone in-situ. The subsurface at the site appears to be conducive to a wide area of influence from this technology. However, it is anticipated that, due to the large area and depth of the on-site impacted ground water, many sparge wells (50+) and a fairly extensive sub-grade piping system would be needed to cover the targeted treatment area. The restoration timeframe for the site using this remedial alternative is expected to be not less than three to four years, and possibly longer.

Ground water monitoring would be necessary to demonstrate the attainment of ground water cleanup levels on the Juanita Village property. Ground water monitoring would be needed to assure that the pathway to Lake Washington surface water is not completed by placing ground water monitoring wells in the Juanita Drive NE right-of-way.

Alternative 4 - Excavation of Source Areas and In Situ Six-Phase Heating™ (SPH) with Soil Vapor Extraction

This remedial alternative consists of excavating and removing the TPH-gasoline contaminated soil and PCE-containing soil from the source areas of the site and also involves in situ six-phase heating™ (SPH) with soil vapor extraction to treat soil and ground water.

The excavated TPH-gasoline contaminated soils would be transported to a licensed and permitted thermal desorption treatment facility. The goal of this excavation would be to remove TPH-gasoline contaminated soil at the property above the MTCA Soil Cleanup Levels. If soils containing TPH-heavy oil were found, they would be sampled and analyzed using the methods described in Ecology's Interim TPH Policy. Soils with concentrations of TPH-heavy oil that are below the MTCA Cleanup Level derived under the Interim TPH Policy would be left on-site, and any soils with concentrations above that level would be transported to a licensed and permitted thermal desorption treatment facility.

Excavated PCE-containing soil below the MTCA Soil Cleanup Levels would be re-used on the property as fill material in a manner that isolates it from ground water and direct contact. Excavated PCE-containing soil above the MTCA Soil Cleanup Levels, if any, would need to be transported to a permitted hazardous waste landfill for disposal or consolidated on-property isolated from ground water and direct contact and following Ecology's Area of Contamination (AOC) policy. Compliance with MTCA cleanup levels would be confirmed through performance sampling and analysis. This portion of the remedial alternative would consist of excavation and off-property treatment and/or disposal, performance soil sampling and analysis of excavated areas, and backfilling of excavated areas.

The PCE impacts to the ground water at the Juanita Village property would be addressed using in-situ SPH combined with conventional soil vapor extraction. SPH is a technology developed by Battelle Northwest Laboratories and promoted by Current Environmental Solutions (CES) and consists of resistively heating soil and ground water using electrodes installed in the subsurface. The heating of the soil and ground water create a source of steam which strips volatile contaminants from the subsurface.

The contaminants are then captured in the vadose zone by a soil vapor extraction system. Contaminated vapor is filtered through granular activated carbon units prior to atmospheric discharge. SPH technology is typically used in tight formations with low hydraulic conductivity. This technology is relatively complicated to install and operate to ensure the most efficient treatment, and may require additional steam condensate treatment systems and incur very high electrical costs. Ground water monitoring would be necessary to demonstrate the attainment of ground water cleanup levels on the Juanita Village property. Limited case studies show that the restoration timeframe for a site using this remedial alternative can be as low as 6 months; however, this remedial alternative would not be expected to treat the groundwater at the Juanita Village property in less than two to three years and could take longer. Ground water monitoring would be needed to assure that the pathway to Lake Washington surface water is not completed by placing ground water monitoring wells in the Juanita Drive NE right-of-way.

2.3 Selection of Cleanup Standards

The Juanita Village property will be used for residential and retail uses. Therefore, the cleanup standards for this property must be protective of these uses, and MTCA Methods A and B Cleanup Levels will be used.

Method A cleanup levels are designed for sites undergoing routine cleanup actions and for sites that involve relatively few hazardous substances (WAC 173-340-700(3)(a)). Method B cleanup levels apply to all sites, and are used unless one or more of the conditions for using Method A cleanup levels is demonstrated to exist, and the person conducting the cleanup action chooses to use Method A (WAC 173-340-705(1)).

For soils, Method B will be used as the Soil Cleanup Level for PCE since Method B may be used for all sites. Method A Soil Cleanup Levels or Ecology's Interim TPH policy will be used for petroleum hydrocarbons (TPH). Method A Cleanup Levels for TPH are frequently used because the formula in WAC 173-340-740 cannot be used to calculate a Method B cleanup level for this substance. Juanita Village does not anticipate finding any TPH-heavy oil contaminated soil at the Site. However, if it does, a Method B cleanup level will be calculated using Ecology's Interim TPH Policy.

For ground water, the conditions for using Method A cleanup levels are met at this site because numerical standards are available for all indicator hazardous substances in all media of concern (WAC 173-340-704(1)(b)). In addition, Method A cleanup levels for ground water are appropriate because only one hazardous substance, PCE, has been identified at the site in concentrations above cleanup levels. (WAC 173-340-700(3)(a)). Since the conditions for using Method A are met, and since Juanita Village has elected to use Method A levels for ground water, the MTCA Method A Ground Water Cleanup Levels will be used at this site. Ground water on the Juanita Village property is not used for drinking water. Drinking water is currently supplied and will continue to be supplied by the Northshore Utility District. No cleanup levels will be established for the PCE associated substances (TCE, 1,1-DCE, 1,2-DCE, VC). Although there have been a few isolated detectable concentrations of these substances, none of the detectable concentrations have approached their respective MTCA Cleanup Levels.

Table 1. Selected MTCA Cleanup Levels for Juanita Village Site Remediation

Media	Contaminant	Cleanup Level	Reference
Soil	TPH-Gasoline	100 ppm or Interim TPH Policy calculation	Method A or Interim TPH Policy
	PCE	19.6 ppm	Method B
	TPH-Diesel/ Heavy Oil	Interim TPH Policy calculation	Interim TPH Policy
Ground Water	TPH-Gasoline/ Diesel/Heavy Oil	1 ppm or Interim TPH Policy calculation	Method A or Interim TPH Policy
	PCE	5 ppb	Method A

2.4 Selection of Points of Compliance

The MTCA regulations, WAC 173-340-720(6), require that ground water cleanup levels be attained in all ground waters from the point of compliance to the outer boundary of the PCE plume. The point of compliance shall be established throughout the site from the uppermost level of the saturated zone extending vertically to the lowest most depth, which could potentially be affected (WAC 173-340-720 (6)).

The point of compliance for ground water that will meet the MTCA groundwater cleanup level is throughout the plume except for that portion that is up-gradient of 98th Avenue NE right-of-way. The point of compliance will be measured in deep and shallow monitoring wells; and specifically on-property at selected wells on-property and down gradient at 97th Avenue NE right-of-way and Juanita Drive NE right-of-way; and off-property from up-gradient, off-property source along 98th Avenue NE right-of-way and/or the northeastern portion of the property.

Compliance with ground water cleanup levels at the northeastern boundary of the Juanita Village property will be measured at RI-MW1D and a new shallow well to be installed adjacent to RI-MW1D. Compliance with ground water cleanup levels on the rest of the Juanita Village property will be measured in on-property shallow wells, such as EPI-MW-2, EPI-MW-4, MW-202, and MW-203 and deep wells RI-MW-2D and RI-MW-3D. In addition, Juanita Village will monitor 2 new shallow wells which are to be installed on the Juanita Drive NE City of Kirkland right-of-way. The natural attenuation model described in the Technical Memorandum (Attachment A to this CAP) predicts that cleanup levels will be met by the time or before the plume reaches the Juanita Drive NE right-of-way. By placing the compliance monitoring wells in this location, Juanita Village will be able to confirm that the proposed remediation and the combined processes of SVE, DDC and source removal in addition to natural attenuation will achieve MTCA Cleanup Levels and confirm the model prediction.

The point of compliance for soil is defined similarly in WAC 173-340-740 (6). Based on WAC 173-340-740 (6), the point of compliance for soil is throughout the Juanita Village property and will be met in each excavation with compliance monitoring in the on-property excavation bottom and sidewalls. The SVE remediation will be conducted as part of the soil remediation and the point of compliance monitoring will be conducted by monitoring SVE vapor recovery. Compliance with soil cleanup levels for PCE and TPH will be measured at the excavation margins (vertically and horizontally) from ground surface to a depth

of 15 feet, or to the depth of excavation if it is deeper than 15 feet bgs and above ground water elevation on the Juanita Village property. Cleanup of PCE-impacted soil upgradient of the Juanita Village property is not a requirement of this cleanup action plan.

These points of compliance for ground water and soil cleanup at the Juanita Village site will be specified in the Compliance Monitoring Plan during the engineering design phase.

3.0 SELECTED CLEANUP ACTION

Consistent with the MTCA, a comparative analysis of alternatives was performed in the FS and Alternative 2 is hereby selected as the preferred cleanup action for the Juanita Village property. Tasks of the preferred alternative are described below. The remedy selection is consistent with the MTCA in that it provides a permanent remedy in a reasonable timeframe, using preferred treatment technologies, and does not rely on institutional controls. Alternative 2 also greatly reduces environmental risk.

3.1 Description of Selected Cleanup Action

Alternative 2 - Excavation of Source Areas and In Situ In-Well Vapor Stripping (Density Driven Convection) with Soil Vapor Extraction.

Alternative 2 includes treatment for petroleum and PCE contaminated soils and treatment for PCE contaminated ground water. These cleanup action tasks will be implemented where soils and ground water occur and are above their respective MTCA Cleanup Level. These cleanup tasks are estimated to achieve the Cleanup Levels specified on Table 1 within a reasonable restoration timeframe of two to five years for ground water and a shorter time frame for soils.

Upon the effective date of the Consent Decree, Juanita Village L.L.C. will perform the following cleanup tasks according to the estimated schedule provided in Appendix D of the Consent Decree. A summary of the tasks for soil and groundwater cleanup and the order in which they will occur are provided below. These tasks may be implemented in a phased and sequential manner following the Model Toxics Control Act and coordinated with the proposed redevelopment of the Juanita Village property consistent with the Consent Decree.

The cleanup actions consist of the following tasks for soil and ground water above their respective MTCA Cleanup Level:

- Excavation and off-site treatment of petroleum contaminated soils using thermal desorption and/or recycling where practical for soils in the southeastern portion of the property, former Chevron service station and the central eastern area, Juanita Auto Clinic, (former Texaco service station);

- On-property, Soil Vapor Extraction (SVE) for in-situ treatment of PCE-contaminated soils in the central western area, around the former on-site dry cleaner and down gradient. Off-property, treatment along 98th Ave NE right-of-way resulting from a former off-site, up-gradient dry cleaner;

- In-situ Density Driven Convection (DDC) well treatment of PCE-contaminated ground water around the former on-site dry cleaner location and down gradient along 97th Avenue NE right-of-way. If necessary, south and down-gradient along Juanita Drive NE right-of-way; and if necessary, at the Juanita Village property northeast area and/or along 98th Ave NE right-of-way;

- If soils with concentrations of PCE above the MTCA Cleanup Level are discovered on the Juanita Village property, then Juanita Village will either excavate the soils with off-site disposal at a RCRA permitted landfill, or contain them on-site under a restrictive covenant with prior approval from Ecology using Ecology's Area of Contamination and Contained-In policies. If soils are below the

MTCA Cleanup Level then reuse of soils as subsurface fill is acceptable and would not require a Restrictive Covenant.

Compliance monitoring will be implemented to confirm site cleanup is complete and the Cleanup Levels have been achieved. Cleanup actions will be completed following compliance monitoring defined in the MTCA (WAC 173-340-410) and Ecology's statistical guidance (Ecology 1992 (92-54) *Ref Statistical Guidance for Site Managers*). Performance and confirmation monitoring for TPH, PCE and its associated substances, if identified, will be conducted for soil and ground water at the points of compliance.

3.2 Excavation, Off-Site Treatment and Recycling of TPH Contaminated Soil

The selected remedial alternative consists of excavating and removing soils containing total petroleum hydrocarbons-gasoline in concentrations above the MTCA Cleanup Levels. If soils containing TPH-heavy oil are found, they will be sampled and analyzed using the methods described in Ecology's Interim TPH Policy. Soils with concentrations of TPH-heavy oil that are below the Method B cleanup level derived under the Interim TPH Policy will be left on-property, and any soils with concentrations above that level will be transported to a licensed and permitted thermal desorption facility. Based on the analytical results provided in the RI Report for the Juanita Village property, TPH-gasoline-contaminated soil above the MTCA Method A Soil Cleanup Level will be excavated in the area of the former Chevron service station. TPH-contaminated soils above the MTCA Cleanup Level will be transported to a licensed and permitted thermal desorption treatment facility using U.S Department of Transportation approved shipping documentation, treated and recycled where practical.

Compliance with MTCA cleanup levels will be confirmed through performance sampling and analysis to ensure that soils with concentrations of TPH exceeding the Cleanup Levels, have been removed following Ecology's statistical guidance (Ecology 1992 (92-54) *Ref Statistical Guidance for Site Managers*; and Ecology 1991 (91-30) *Guidance for Remediation of Petroleum Contaminated Soils*). Confirmation soil sampling will be performed using MTCA Cleanup Levels and Ecology's Interim TPH Policy for impacted soils. Furthermore, confirmation soil sampling will also be performed on the sidewalls and bottom of the excavated areas to ensure that soils with concentrations above the Cleanup Levels have been removed.

3.3 Treatment and Management of PCE Contaminated Soils

Based on the analytical results of the soil sampling conducted on the Juanita Village property, PCE soil concentrations are expected to be below the MTCA Soil Cleanup Level. However, soil vapor extraction (SVE) will be conducted regardless prior to and during the DDC well ground water remediation to decrease the concentrations of the PCE-containing soil that may continue to act as a source of PCE to the ground water. SVE will also reduce the potential pathway of exposure to humans and the environment from PCE vapors. The SVE pilot test was performed at DDC-1 with monitoring points at MW-201, SVE-1, MW-203, and MW-202 (Figure B-1 in Attachment B). The location of the upper screen (vapor extraction screen) in well DDC-1 ranged from approximately 10 feet below ground surface (bgs) to approximately 18 feet bgs. The ground water level was at approximately 18 feet bgs in DDC-1.

The results of the SVE pilot test performed at DDC-1 are provided in Attachment B. When monitoring data from all points are considered, a best-fit linear regression through the data indicate an effective vacuum radius of influence of 85 feet at 0.10 inches of water at a flow rate of about 50 scfm.

A soil vapor extraction system will be installed to remediate PCE-containing soil at and around the perimeter of the former on-property dry cleaner. The SVE system is expected to operate for 2 to 3 months until the concentration of PCE vapor in the SVE system is at continuously low or non-detectable concentrations. The SVE wells will be directly connected to PVC pipe that will lead to a secured trailer located on, or adjacent to, the Juanita Village property. The recovered soil vapors will be treated via granular activated carbon units located inside the trailer prior to discharge to the atmosphere. See attached Puget Sound Clean Air Agency (PSCAA) substantive permit requirements (Attachment C); and see RCW 70.105D.090.

The number and location of SVE wells will be discussed in the engineering design report. Individual SVE wells may be intermittently shut-on and -off during the remediation activity based on engineering protocols to enhance the efficiency of the SVE remediation system. SVE operation procedures will be discussed in the engineering design report. The SVE system will be operated in accordance with the requirements of the PSCAA permit (see Attachment C).

Soil excavation will occur following SVE treatment for the PCE impacted soil in and around the source area, the former on-site dry cleaner. Performance monitoring soil sampling will be conducted prior to and during excavation in the PCE source area. The performance monitoring soil sampling will be used to confirm that all PCE contaminated soil has been excavated or remediated below the Cleanup Level. If soil is encountered during redevelopment excavation activity that contains PCE concentrations above detection limits, but below the Cleanup Level, then this soil may be re-used on the property as fill material in a manner that isolates it from ground water and direct contact.

An additional Ecology review and approval is required only if new PCE containing soils are discovered and are not cleaned up to the MTCA cleanup level for PCE and Juanita Village requests to store and isolate these PCE contaminated soils on-site. Should any of this PCE-containing soil be identified during remediation and should Juanita Village prefer to store and isolate these PCE contaminated soils on-site, then Juanita Village will submit a request to Ecology for an Area of Contamination (AOC) and Contained-In determination to enable the soil to remain at the property. The request for AOC and Contained-In determination must be made prior to excavation and prior to completing the cleanup. Should PCE contaminated soil above the MTCA cleanup level remain on-property using an AOC and Contained-In determination, then a restrictive covenant will be filed on the property or that portion of the property (see Consent Decree Exhibit F). On the other hand, Juanita Village may select to excavate this soil and dispose off-site at a RCRA permitted landfill.

Excavated soils containing PCE above the Method B Soil Cleanup Levels, if any, would either be a.) transported to, and disposed of at a RCRA permitted landfill (for example, the Waste Management facility in Arlington, Oregon), or b.) consolidated on the Juanita Village property in a manner that isolates soils from ground water and direct contact in which case a restrictive covenant would be required (Consent Decree, Exhibit F). If consolidated on-property, the soil would first undergo mechanical separation to segregate gravels from fines, which would reduce the amount of contaminated material that requires containment. The soil above the MTCA Method B Soil Cleanup Level would then be

consolidated on the Juanita Village property, underlain with a geotextile and covered with paving. This on-property placement of PCE-containing soil above the MTCA Soil Cleanup Level will be conducted consistent with Ecology's Area of Contamination (AOC) and Contained-In policies. If contaminated soil above the MTCA Soil Cleanup Level is consolidated and contained on-property, Juanita Village will record a restrictive covenant as provided in the Consent Decree, Exhibit F. To the extent redevelopment activity results in soil excavation in the area of the on-property dry cleaner, the potential for residual on-property PCE contamination is significantly reduced.

Two septic tanks and one pump tank were found on the Juanita Village property during the remedial investigation. One of the tanks is located at the Juanita Auto Clinic (former Texaco service station) and the second septic tank with the pump tank is located adjacent to the office building north of the former grocery store as located on Figure 2. The septic tanks and their contents will be removed during site cleanup activities and confirmation soil samples will be collected.

Should any currently unknown tanks be identified on property during excavation and cleanup activities, the tanks and their contents will be removed and confirmation soil samples will be collected.

3.4 Ground Water Remediation

The following table provides a summary of the location and number of DDC wells SVE wells for ground water remediation.

Table 2. Location and Number of Treatment Wells

	DDC Wells	SVE Wells
Juanita Village		
Existing	1	1
Proposed	8-10	8-10
Total	9-11	9-11
Up-Gradient Off-Property		
Existing	0	0
Proposed	0-2[(1)]	1-2[(1)]
Total	0-2	0-2
Down-Gradient Off-Property		
Existing	0	
Proposed	1-2[(2)]	0
Total	1-2	0

[(1)] Up to 2 SVE wells may be installed first to determine if SVE technology will cleanup ground water migrating onto the Juanita Village property from the up-gradient, off-site location. If SVE wells alone are successful, no DDC wells will be installed at this location.

[(2)] Up to 2 DDC wells may be installed on the Juanita Drive NE right-of-way if PCE concentrations in down-gradient off-site monitoring wells are above MTCA Method A ground water cleanup level.

Juanita Village Property PCE Plume

The PCE impacts to the ground water at the Juanita Village property will be remediated using a network of DDC wells placed on the Juanita Village property and located in the PCE plume. Ground water remediation activity will be started prior to or during the initial development activity on the Juanita Village property. See engineering sketch of DDC well in Attachment B.

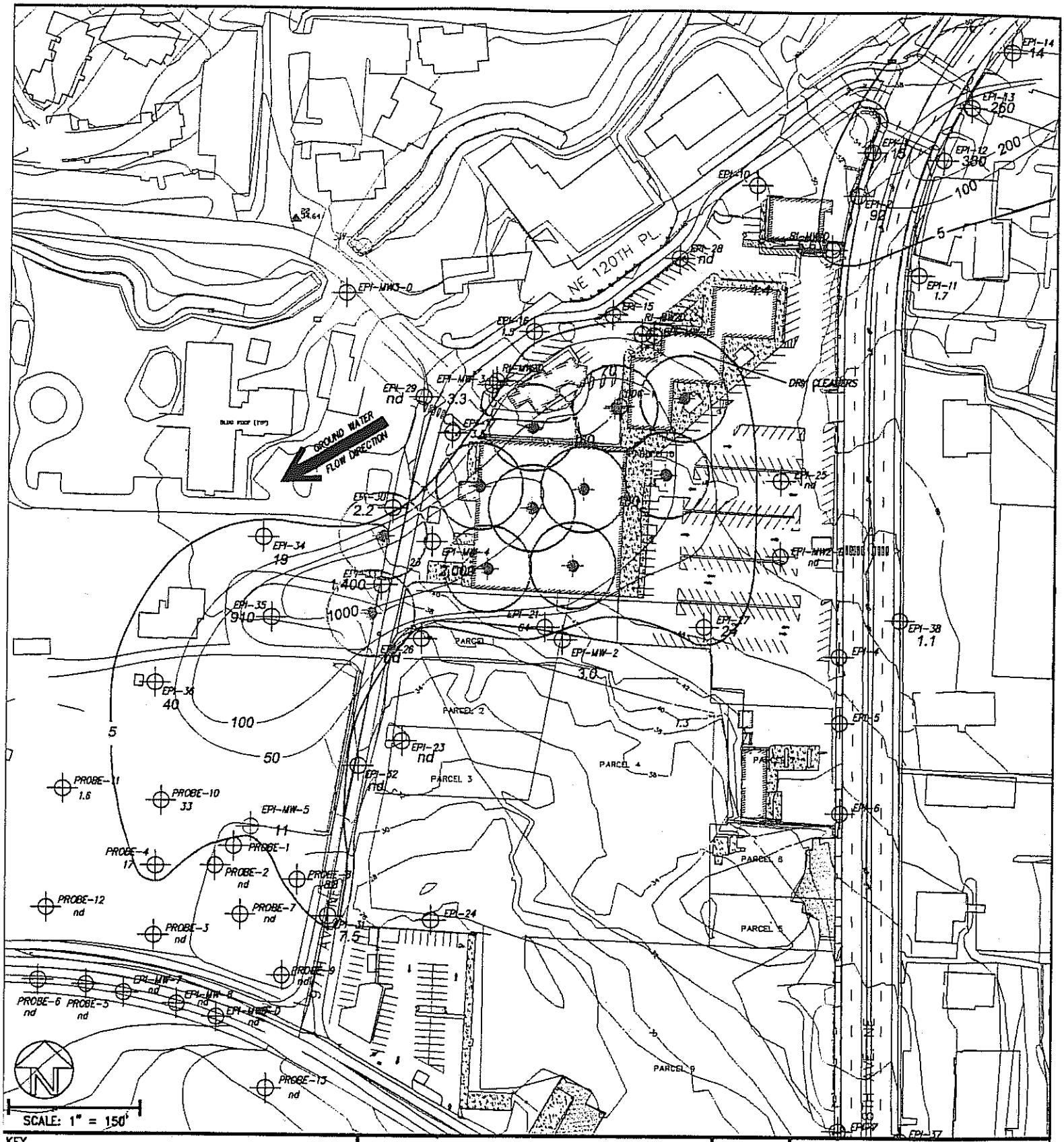
The DDC well pilot test results indicated that the saturated soils at the Juanita Village property are conducive to a maximum radius of influence of 50 feet for the DDC wells. The hydraulic data compiled during the DDC well Pilot Test indicate a measurable response out to a distance of about 70 feet from the treatment well (70-foot radius). The data indicate that the full-scale design should utilize well spacing at a distance no greater than 70 feet and the current conceptual design for DDC treatment well spacing is 50 feet on center. Analytical results of the DDC Pilot Test are provided in Attachment B of this CAP. The actual design specifications will be completed in the next step, during the engineering design for the Juanita Village property.

One DDC well was used to perform the pilot test and was installed within the PCE plume on the Juanita Village property. An estimated 9 to 10 additional DDC wells will be installed within the PCE plume on the Juanita Village property. Figure 5 shows a proposed conceptual plan for placement of the DDC wells on the Juanita Village property. The estimated restoration timeframe is within 2 to 5 years. Working in conjunction with cleanup activities, excavation and redevelopment preparations, some wells may be temporarily closed and/or relocated with prior approval from Ecology. The installation and operation of the DDC wells may also occur in a phased manner, instead of installing all of the DDC wells at the same time.

Two DDC wells will be placed near the former on site dry cleaners. The objective of these two wells will be to remediate contaminated groundwater originating at the source area. Currently, the highest PCE concentrations within the plume exist adjacent to the former grocery store near the downgradient western property boundary. Seven DDC wells will be placed downgradient of the on-property source area within the on-property plume. Two DDC wells will be placed along 97th Ave to treat ground water before it leaves the Juanita Village property. The radius of influence of these two DDC wells is expected to reach into the northeastern King County property across 97th Avenue NE. All of the DDC wells will be controlled from one or two secured trailers currently to be located adjacent to and west of the former on-property grocery store.

The DDC wells and cleanup remediation system will be detailed in the engineering design report. Individual DDC wells may be intermittently shut-on and -off during the remediation activity based on engineering protocols to enhance the efficiency of the ground water remediation system. DDC operation procedures will be discussed in more detail in the engineering design report.

Concentrations of PCE down-gradient and off-property from the Juanita Village property boundary will decrease as a result of the removal of PCE contaminated soil source area, SVE and DDC treatment of soil and ground water and through natural attenuation. The PCE plume currently extends to approximately 100 feet north of the Juanita Drive NE northern right-of-way. It is expected that the DDC wells on the Juanita Village property boundary will act to remove the source area and to cut off a significant fraction of the plume from further off-property migration. However, a portion of the off-



KEY

- EPI-MW-5 — EPI GROUND WATER MONITORING WELL
- TERRA GROUND WATER MONITORING WELL
- EPI-20 — EPI STRATAPROBE GROUND WATER SAMPLING LOCATION
- PCE CONCENTRATION CONTOUR
- PROPOSED DDC WELL

ENVIRONMENTAL PARTNERS INC

FIGURE 5

PROPOSED CONCEPTUAL PLAN FOR DDC WELLS PLACEMENT

PROJECT	29801.3		
PREPARED FOR	JUANITA VILLAGE, LLC		
LOCATION	JUANITA VILLAGE KIRKLAND, WASHINGTON		
SHEET	DRAWN BY	REVIEWED BY	DATE
1 of 1	EMK	JRK	04/21/00

property plume may be unaffected by these wells and may continue to migrate, and concentrations of PCE in the off-property down gradient plume are expected to be significantly reduced and reach the MTCA cleanup level due to upgradient treatment and through natural attenuation.

A technical memorandum (see Attachment A) provides a discussion of ground water natural attenuation processes for the off-property, down-gradient PCE-contaminated ground water. The technical memorandum estimates that without operating DDC wells downgradient from the Juanita Village property boundary, the down-gradient ground water will attain cleanup levels in a reasonable time period through natural attenuation. Natural attenuation will require active ground water monitoring of PCE and its associated substances, if identified, to confirm the effectiveness of the natural attenuation process and protection of nearby aquatic resources.

Up-Gradient Off-Property PCE Plume

A separate up-gradient, off-property source of PCE-contaminated ground water was identified at the northeastern portion of the Juanita Village property during the remedial investigation. Concentrations of PCE above the MTCA Method A Ground Water Cleanup Level have been found in ground water monitoring wells located on the northeastern portion of the Juanita Village property. A former off-property dry cleaning operation was identified upgradient of the Juanita Village property on the eastern side of 98th Avenue NE and appears to be the source of this up-gradient PCE plume. A request to the current owners for access to conduct ground water remediation on the former dry cleaning property was denied.

To cleanup and minimize additional migration of this upgradient PCE plume onto the Juanita Village property, the soils and if necessary the ground water will be treated. Initially SVE wells will be placed at the northeast-property boundary or in the City of Kirkland right-of-way along 98th Avenue NE. The purpose of these SVE wells will be to treat soil and minimize its potential to re-contaminate ground water on the Juanita Village property. Ground water monitoring wells will be located at the northeastern portion on the Juanita Village property and will be used to monitor the PCE concentrations flowing onto the property from the up-gradient, off-property source. If the SVE wells do not reduce PCE to a concentration below the Cleanup Level, DDC wells will be installed at the northeast-property boundary or in the City of Kirkland right-of-way along 98th Avenue NE. The estimated restoration timeframe is within 2 to 5 years. No soil will be excavated from the off-property former dry cleaning property. Inability to gain access and excavate off-property soil means that complete ground water remediation of the up-gradient, off-property parcel may not be possible.

4.0 COMPLIANCE MONITORING

Compliance monitoring is composed of three parts: Protection monitoring, Performance monitoring and Confirmation monitoring. Compliance monitoring will be conducted for both ground water and soil for all chemicals of concern, specifically TPH and PCE as listed on Table 1. at the specified points of compliance for each media. The number and location of wells and frequency of monitoring will be specified in the Compliance Monitoring Plan prepared during the next phase, the engineering design.

The soil and ground water monitoring will comply with MTCA's requirements for compliance monitoring (WAC 173-340-410). This subsection of the MTCA requires: protection monitoring to confirm that human health and the environment are adequately protected during the cleanup action activity; performance monitoring to confirm that the cleanup action has attained cleanup standards and; confirmational monitoring to confirm the effectiveness of the cleanup action after cleanup standards have been attained. The Compliance monitoring plan will be prepared prior to the start of the full-scale ground water remediation activity. Protection monitoring will be addressed in the Health and Safety Plan, also prepared during the engineering design phase. The performance and confirmational monitoring will be included with the engineering design report, the construction plans and specifications, and the operation and maintenance plan (WAC 173-340-400(4)(a), (b), and (c).

4.1 Protection Monitoring

Protection monitoring will be conducted to confirm that human health and the environment are being protected during implementation of the cleanup action. This information will be provided in a site specific Health and Safety Plan and will include appropriate soil and air monitoring, chemical and waste handling, decontamination and documentation procedures.

4.2 Performance Monitoring

Performance soil monitoring will be conducted during the soil excavation activity at the former Chevron service station location, the Juanita Auto clinic (former Texaco service station) and the former on-site dry cleaner location, and at any other area where soils are found to contain PCE and/or TPH exceeding the respective MTCA Cleanup Level as described in Section 3.1 Description of Selected Cleanup Action.

Initially, ground water samples will be analyzed for PCE and if identified, PCE associated substances and TPH. Following two ground water monitoring events, three indicator chemicals will be selected. The indicator chemicals will include PCE and if identified two associated substances and TPH. These selected indicator chemicals will be used for the remaining quarterly performance monitoring. The final round of performance monitoring will include PCE and associated substances and TPH. Performance and confirmational ground water sampling is described in more detail in the following section.

4.3 Confirmation Monitoring

Soil and ground water confirmation monitoring will be used to demonstrate the attainment of MTCA Cleanup Levels at the Juanita Village site following the MTCA (WAC 173-340-410 and Ecology's

statistical guidance (*Ecology 1992 (92-54) Statistical Guidance for Site Managers*). Confirmation monitoring may include performance monitoring along with confirmation monitoring results.

The monitoring wells used for ground water confirmation monitoring will be the existing wells located within the Juanita Village property in addition to wells along the public right-of-way. If monitoring wells are removed during Juanita Village development activities and are needed later to fulfill monitoring requirements during or following remediation, it is expected that some of these wells will be reinstalled at or near the same locations for practical purposes due to their location adjacent to utility corridors or other structures. The range of monitoring wells for up-gradient, on-property and down-gradient compliance PCE monitoring are provided in Table 3 below. The compliance monitoring wells will be specified in the Compliance Monitoring Plan during the engineering design task.

Table 3. Number of Compliance Monitoring Wells

Location	Status of Wells	Deep Wells	Shallow Wells
Up-Gradient in Juanita Village northeastern property or along 98th Avenue right-of-way	Existing	1	1
	Proposed	0-1	2
	Total	1-2	3
On-Property/PCE Source Area			
	Existing	2	4
	Proposed	0	0
	Total	2	4
Down-Gradient for On-Property Source including 97th Avenue NE			
	Existing	0	1
	Proposed	1-2	1-2
	Total	1-2	2-3
Down-Gradient at Juanita Drive NE right-of-way			
	Existing	0	0
	Proposed	1-2	2-3
	Total	1-2	2-3
Total Number of Wells		**5-8**	**11-13**

Juanita Village Property Monitoring

Performance and confirmation monitoring will be implemented beginning on a quarterly basis in wells within the Juanita Village property boundary, starting three months after the start of the implementation of the full-scale DDC well system and after baseline monitoring. Existing shallow ground water monitoring wells EPI-MW-2, EPI-MW-4, MW-202 and MW-203 and existing deep wells RI-MW-2D and RI-MW-3D will be used to evaluate the progress of the on-property PCE ground water remediation

activity. Individual DDC wells will be turned off when levels in each well show PCE below the MTCA Cleanup Level for PCE for two consecutive quarters, followed by confirmation monitoring.

Confirmation monitoring will begin with sampling selected wells for two additional consecutive quarters, resulting in a total of four consecutive quarters. After the fourth quarterly round of ground water sampling is completed and PCE concentrations have remained below the MTCA Cleanup Level for PCE, then monitoring and cleanup actions will be complete. The DDC wells will be closed following Ecology well abandonment guidelines pursuant to WAC 173-160-560.

Up-Gradient Off-Property PCE Source Monitoring

One or two deep monitoring wells in addition to three shallow wells will be located on the Juanita Village property at the northeastern property boundary and the 98th Avenue right-of-way, will be used to monitor the ground water from the up-gradient, off-property source. Ground water performance monitoring will be implemented on a quarterly basis, starting three months after implementation of the SVE, or SVE and DDC well system at the northeast corner of the Juanita Village property or in the City of Kirkland right-of-way and after baseline monitoring, to provide an ongoing assessment of ground water quality in the upper and deeper portions of the aquifer. SVE, or SVE and DDC well groundwater treatment of the off-property PCE source will stop when levels of PCE in the groundwater monitoring results are below the MTCA Cleanup Level for PCE for two consecutive quarters, followed by confirmation monitoring.

DDC wells will be turned off when levels in each well show PCE in groundwater is below the MTCA Cleanup Level for PCE for two consecutive quarters, followed by confirmation monitoring.

Confirmation monitoring will begin with sampling selected wells for two additional consecutive quarters, resulting in a total of four consecutive quarters. After the fourth quarterly round of ground water sampling is completed and PCE concentrations have remained below the MTCA Cleanup Level for PCE, then monitoring and cleanup actions will be complete. The DDC wells will be closed following Ecology well abandonment guidelines pursuant to WAC 173-160-560.

Down-Gradient Off-Property PCE Monitoring

One or two deep monitoring wells and two to three shallow ground water monitoring well will be placed in the 97th Avenue right-of-way and Juanita Drive NE right-of-way to monitor for migration of the southern edge of the PCE plume. Bi-annual ground water monitoring will occur for two years after the start of the DDC well remediation on the Juanita Village property.

Based on the proposed remediation in addition to natural attenuation, (see natural attenuation modeling in Attachment A) any concentrations of PCE in ground water that may migrate towards Lake Washington and Juanita Creek are expected to be very low and below the MTCA Ground Water Cleanup Level, and well below the Ambient Water Quality Criteria. In the event that the PCE plume reaches the right-of-way of Juanita Drive NE at concentrations above the MTCA Cleanup Level, then one or two DDC treatment wells will be placed along the Juanita Drive right-of-way. If necessary, the DDC wells will be installed and ground water will be remediated to PCE concentrations below the MTCA Ground Water Cleanup Level in the DDC wells. When PCE concentrations are below the MTCA Ground Water Cleanup Level in the DDC well(s) for two consecutive quarters, the DDC wells will be

turned off and confirmation monitoring will begin. Confirmation ground water monitoring will continue for two additional consecutive quarters and stop when PCE concentrations are below the MTCA Ground Water Cleanup Level for a total of four consecutive quarters. All ground water wells will be abandoned after ground water monitoring requirements are completed following Ecology ground water well abandonment procedures pursuant to WAC 173-160-560.

4.4 Compliance with MTCA Requirements

The preferred cleanup action complies with MTCA threshold requirements, including protection of human health and the environment, compliance with cleanup standards associated with a property cleanup, compliance with applicable state and federal laws, and provision for compliance monitoring. The selected cleanup alternative will protect human health and the environment through removal of the petroleum-contaminated soils, and through treatment of soils and groundwater containing PCE. Cleanup levels in Table 1 for soils and groundwater will be achieved throughout the Juanita Village property. The cleanup action will be constructed and operated in compliance with applicable federal, state, and local laws. Protection, performance, and confirmational monitoring programs will be implemented to confirm that the cleanup action adequately protects human health and the environment during and after construction, and that cleanup standards are met.

4.5 Compliance Monitoring Report

Soil and ground water compliance monitoring results will be summarized with QA/QC results, and will follow Ecology's statistical guidance. The report will include tables, comparison with MTCA Cleanup Levels for all points of compliance and statistical analyses. The report will include hard copy and electronic copy (see section 6.4 Reporting).

5.0 IMPLEMENTATION SCHEDULE

The cleanup tasks including SVE soil treatment and the DDC well ground water treatment on the Juanita Village property will begin in accordance with the Schedule with Scope of Work (Exhibit F). The Ecology Site Manager will be immediately notified of any remediation activity delays. Ground water treatment along Juanita Drive will only occur if PCE is detected in ground water monitoring wells at or above the MTCA Ground Water Cleanup Level for PCE. The SVE activity will start prior to the start of the DDC well ground water remediation system. TPH contaminated soil in the southern portion of the property will be excavated after approval of this Cleanup Action Plan during site remediation. Any excavation of PCE contaminated soil encountered during site redevelopment is scheduled to occur pursuant to the Schedule with Scope of Work.

5.1 Ground Water Monitoring Schedule

Performance monitoring will begin with ground water monitoring to establish baseline conditions and will be scheduled as the first task of the DDC well remedial activity and continue with subsequent quarterly sampling, except for the two wells down gradient at the Juanita Drive NE which will be monitored biannually for two years. DDC well groundwater treatment on Juanita Village property will stop when levels of PCE in groundwater sample results are below the MTCA Cleanup Level for PCE and if identified for associated substances and TPH for two consecutive quarters followed by compliance monitoring of two quarters, resulting in a total of four consecutive quarters. Performance monitoring will also be conducted for two consecutive quarters followed by compliance monitoring for two quarters up-gradient at 98th Avenue NE and down-gradient at 97th Avenue NE and Juanita Drive NE. Confirmational monitoring will cease when the PCE concentrations in ground water are below the MTCA Cleanup Level for two consecutive quarters followed by two consecutive quarters of performance monitoring below the cleanup level, resulting in a total of four consecutive quarters.

5.2 Certification of Attainment of Cleanup Levels

As provided in the Consent Decree, Juanita Village L.L.C. from time to time may ask Ecology to certify that portions of the property have attained cleanup levels. If the data show that cleanup levels have been met and Compliance Monitoring is complete in the selected portion(s) of the property, then a request may be submitted to Ecology for a certificate of completion letter for that portion(s) of the property. Ecology will provide a written response within sixty (60) days of the request.

6.0 REPORTING

6.1 Procedure

Unless otherwise specified by Ecology, all reports, plans, specifications, and similar information submitted shall meet the requirements outlined in MTCA (WAC 173-340-840). This includes submittal of three copies (three hard copies and one electronic copy) of the plan or report with a cover letter describing the submittal and specifying the desired Ecology action or response. In some circumstances, additional copies may be required to meet public participation and interagency coordination needs.

6.2 Monthly Reporting and Periodic Updates

Monthly progress reports (hard copy and electronic copy) will be submitted to Ecology for each month period after the start of the Cleanup Action as listed on the Schedule with Scope of Work (Consent Decree, Exhibit F). Monthly reporting will begin on the 10th day of the second month (40 days after the effective date of the Consent Decree. The monthly report will include a summary of all site activities for the prior four weeks, sampling and analytical results, estimated changes in work elements or schedule, a forecast for changes or deviations in work plan or schedule, and related site cleanup matters. Juanita Village may request that progress reports be submitted less frequently after the ground water treatment system has begun operating.

More frequent updates will be provided during times of significant site activity (e. g. building demolition combined with soil excavation activity). During the initial stages of implementation of the Cleanup Action, such as start up for excavation, SVE treatment, and DDC well operation, weekly site meetings will be scheduled or weekly electronic mail summaries will be forwarded to the Ecology project coordinator. Should a significant change in concentration level occur for PCE or associated substances if identified, Ecology will be notified.

6.3 Public Participation and Public Information Reporting

MTCA regulations require that public concerns regarding the proposed cleanup action be addressed. A public comment period for this document and associated documents is presented to give the public an opportunity to comment on the proposed cleanup. Public comments and concerns will be evaluated in determining whether any changes are warranted to this Cleanup Action Plan. A responsiveness summary will be prepared by Ecology to answer and address all comments received on this Cleanup Action Plan, the Prospective Purchaser Consent Decree, Public Participation Plan, and SEPA environmental checklist and SEPA-Determination of Non-Significance for the remediation. If substantial changes are recommended to the Cleanup Action Plan and associated documents, then Ecology will request a second public comment period.

6.4 Final Draft Report with Compliance Monitoring Report

Upon completion of site cleanup activities including final compliance monitoring results, a final draft report detailing site cleanup activities and compliance monitoring results will be submitted to Ecology.

6.5 Notice of Completion

Upon successful implementation of the CAP as determined by compliance monitoring, a Certificate of Completion letter will be issued by Ecology. The certificate will be requested from Ecology once compliance monitoring verifies:

- TPH is cleaned up at the point of compliance in the soils below the MTCA Cleanup Level;
- PCE is cleaned up at the point of compliance in the soils below the MTCA Cleanup Level;
- PCE is cleaned up at the point of compliance in the ground water below the MTCA Cleanup Level, and
- If discovered, the PCE associated substances are cleaned up at the point of compliance below their respective MTCA Cleanup Levels.

Following the issuance of the Certificate of Completion, Ecology will publish notice in the State Register pursuant to WAC 173-340-330(4).

7.0 JUSTIFICATION FOR SELECTING THE CLEANUP ACTION

The preferred Cleanup Action is intended to effectively and permanently protect human health and the environment at the Juanita Village site by:

- Removing the PCE-contaminated soil above the MTCA Cleanup Level such as in the area of the former on-site dry cleaner and associated sewer line;

- Removing petroleum hydrocarbon contaminated soils above the MTCA Cleanup Level such as in the area of the former Chevron service station and/or former Texaco service station;

- Removing the PCE vapor in soil to eliminate the potential exposure to human health and the environment in the area of the former on-site dry cleaner, associated sewer line ; and PCE vapors in soils from up-gradient, off-property dry cleaner in the northeast area of the property and along the 98th Avenue NE right-of-way;

- Managing the contaminated TPH and PCE-impacted soil during soil excavation activity in compliance with applicable regulatory requirements;

- Implementing ground water remedial activity to remediate PCE-containing ground water above the MTCA ground water cleanup level on the Juanita Village property, along 97th Avenue NE, if needed along 98th Ave NE, and Juanita Drive NE, and monitoring natural attenuation of the possible PCE-impacted ground water at the Juanita Drive NE right-of-way for the purposes of controlling and minimizing migration of a plume to Lake Washington; and

- If necessary, implementing ground water remedial activity along 98th Avenue NE right-of-way to prevent migration of PCE originating from the former, off-site dry cleaners which is currently migrating onto the Juanita Village property.

The risk of direct exposure to contaminated soil will be controlled by the removal, transport and treatment of petroleum contaminated soil, and in-situ treatment of PCE contaminated soil. PCE-containing soil will be treated in-situ using SVE. The resulting soil with concentrations below the MTCA Soil Cleanup Level for PCE will be reused on-site as fill material in a manner protective of ground water and direct contact. Soil with concentrations above the MTCA Soil Cleanup Level for PCE will be a.) consolidated on-property in a manner protective of ground water and direct contact following Ecology's AOC and Contained-In policies under a restrictive covenant or b.) transported to a RCRA permitted landfill facility. Ground water will be restored within a reasonable period using DDC treatment with SVE.

8.0 APPLICABLE STATE AND FEDERAL LAWS

The preferred cleanup alternative will comply with applicable state and federal laws and regulations including the MTCA, which is the primary regulation that establishes the requirements and standards for the cleanup action in the State of Washington. The alternative will also comply with applicable regulations regarding management of soil excavated, transported and treated at regulated and permitted facilities.

Cleanup standards developed under the MTCA must meet the statutory requirement of being at least as stringent as all applicable state and federal laws. The laws and regulations that were considered in the development of the cleanup action for the Juanita Village site are identified and evaluated in Table 4.

Table 4

POTENTIAL FEDERAL ARARs FOR THE JUANITA VILLAGE PROPERTY

POTENTIAL REQUIREMENTS	DETERMINATION OF APPLICABLE OR RELEVANT AND APPROPRIATE	COMMENTS
Clean Air Act of 1977, as amended Title 42 USC 7401, et seq.	Not Applicable	The Clean Air Act regulates emissions of hazardous pollutants to the air. Controls for emissions are implemented through federal, state, and local programs. Pursuant to the CAA, EPA has promulgated National Ambient Air Quality Standards, National Emissions Standards for Hazardous Air Pollutants, and New Source Performance Standards. The Clean Air Act is implemented in the State of Washington through the Washington Clean Air Act criteria, which are potential ARARs for the Juanita Village property.
Clean Water Act of 1977 Title 42 USC 1251	Not Applicable	The Clean Water Act establishes the guidelines and standard to control discharge of pollutants to waters of the U.S. No discharges to surface waters will occur during the remedial action, so this law is not applicable.
Water Quality Standards 40 CFR 131	Not Applicable	40 CFR 131 establishes the requirements and procedures for states to develop and adopt water quality standards based on federal water quality criteria that are at least as stringent as the federal standards. Washington State has received EPA approval and has adopted more stringent water quality criteria under WAC 173-201A. Since there will be no surface water discharges, this law is not applicable.
National Pollution Discharge Elimination System (NPDES) 40 CFR 122 to 125	Not Applicable	The NPDES program controls release of toxic pollutants through monitoring requirements and implementation of a best management practices program. The substantive requirements of the program would apply if discharge of treated wastewater were to occur as part of a remedial alternative. Since no discharge will occur, this law is not applicable.
Safe Drinking Water Act of 1974 Title 42 USC 300, et seq.	Not Applicable	MTCA requires that ground water cleanup levels be at least as stringent as maximum contaminant levels (MCLs), secondary maximum contaminant levels (SMCLs), and non carcinogen maximum contaminant level goals (MCLGs) established under the Safe Drinking Water Act where ground water is a current or future source of drinking water. Since ground water under the Juanita Village property is neither a current or future source of drinking water, these requirements are not applicable.
National Primary and Secondary Drinking Water Standards 40 CFR 141, 143		

Table 4

POTENTIAL FEDERAL ARARs FOR THE JUANITA VILLAGE PROPERTY

POTENTIAL REQUIREMENTS	DETERMINATION OF APPLICABLE OR RELEVANT AND APPROPRIATE	COMMENTS
Hazardous Materials Transportation Act 49 USC 1801, et seq.		
Hazardous Materials Regulation 49 CFR 171	Applicable	To transport hazardous materials on public roads, the materials must be properly classed, described, packaged, marked, labeled, and in condition for shipment. These requirements are applicable to offsite shipment of hazardous materials generated during remedial activities.
Hazardous Materials Tables, Hazardous Materials Communications Requirements, and Emergency Response Information Requirements 49 CFR 172	Applicable	These requirements also are applicable if hazardous waste is generated during remediation and is transported off-site. Tables are used to identify requirements for labeling, packaging, and transportation based on categories of waste types. Specific performance requirements are established for packaging.
Resource Conservation and Recovery Act Title 42 USC 6901 et seq.	Not Applicable	The Resource Conservation and Recovery Act (RCRA) consists of standards and criteria controlling the treatment, storage, and disposal of hazardous wastes. The EPA has granted the State of Washington the authority to implement RCRA through the Department of Ecology's Dangerous Waste Program (WAC 173-303). Therefore, the RCRA criteria that are potential ARARs for the Juanita Village property are not detailed here.

Table 4
POTENTIAL WASHINGTON STATE ARARs FOR THE JUANITA VILLAGE PROPERTY

POTENTIAL REQUIREMENTS	DETERMINATION OF APPLICABLE OR RELEVANT AND APPROPRIATE	COMMENTS
Dangerous Waste Regulations WAC 173 - 303		Dangerous Waste Regulations apply to all persons who handle dangerous wastes including (but not limited to) generators, transporters, owners, and operators of dangerous waste recycling, transfer, storage, treatment, and disposal facilities.
Designation of Waste WAC 173-303-070	Applicable	These requirements establish the methods and procedures to determine if solid waste requires management as dangerous wastes. The substantive requirements of this section may be applicable if remedial activities involve the generation of dangerous waste.
Requirements for Generators of Dangerous Waste WAC 173-303-170	Applicable	Substantive requirements for generators of dangerous waste established under this chapter may be applicable to remedial actions if dangerous wastes are generated.
Water Well Construction Chapter 18.104 RCW		
Minimum Standards for Construction and Maintenance of Water Wells WAC 173-160	Applicable	These requirements are applicable to remedial actions that include the design and construction of wells (resource protection wells) that may be used for groundwater extraction or monitoring at the Juanita Village property. Procedures are also specified for well abandonment or decommissioning.
Water Pollution Control/Water Resources Act Ch. 90.48 RCW/Ch. 90.54 RCW		
National Pollution Discharge Elimination System Permit Program WAC 173-220	Not Applicable for Remediation	Establishes a state permit program pursuant to the federal NPDES system. Substantive sections of the regulation may be applicable to remedial alternatives that involve discharges to surface waters. Discharges may include site run-off, spillage, leaks, sludge, or treated waste disposal. This cleanup will not involve any discharges to surface water, so these requirements are not applicable.

Table 4
POTENTIAL WASHINGTON STATE ARARs FOR THE JUANITA VILLAGE PROPERTY

Potential Requirements	Determination of Applicable or Relevant and Appropriate	Comments
Washington Clean Air Act Chapter 70.94 RCW and Chapter 43.21A RCW General Regulations for Air Pollution Sources WAC 173-400	Applicable	Substantive standards established for the control and prevention of air pollution under this regulation may be applicable to remedial actions at the Juanita Village property. The regulation requires that all sources of air contaminants meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. Puget Sound Clean Air Agency (PSCAA) substantive requirements will be met for the SVE remediation system on the Juanita village property.

9.0 REFERENCES

AGRA Earth & Environmental, Inc. Results of Downgradient Site Characterization BP Branded Service Station #11063, 9800 NE 116th Street, Kirkland, Washington, March 22, 1996.

Alisto Engineering Group. Table – Summary of Results of Groundwater Sampling, BP Oil Company Service Station No. 11063, 9800 NE 116th Street, Kirkland, Washington, June 1999.

Environmental Partners, Inc. Remedial Investigation Report, Juanita Village Property Kirkland, WA, December 22, 1999.

Environmental Partners, Inc. Feasibility Study Report, Juanita Village Property Kirkland, WA, December 27, 1999.

Marten & Brown, LLP. Kirkland/Juanita Village Site Clean-up Proposal, April 27, 1999.

Terra Associates, Inc. Level I Environmental Assessment, Juanita Market Place, 11849 – 98th Avenue NE, Kirkland, Washington February 24, 1994.

Terra Associates, Inc. Limited Level II Site Assessment, Proposed Market Place, 98th Avenue NE and Juanita Drive NE, Kirkland, WA, April 11, 1994.

Terra Associates, Inc. Geotechnical Report, Rite Aid Store, Juanita Shopping Center NE Juanita Drive and 98th Avenue NE, Kirkland, Washington December 2, 1997.

Terra Associates, Inc. Preliminary Report Environmental Sampling and Testing, Juanita Beach Development, Kirkland, WA, July 17, 1998.

Professional Service Industries, Inc. Environmental Site Assessment Phase I at the Juanita Bay Village Shopping Center, Kirkland, Washington, January 3, 1991.

Attachment A

ENVIRONMENTAL PARTNERS INC 10940 NE 33rd Place Suite 110 Bellevue, Washington 98004 ph 425.889.4747 fax 425.889.4755

TECHNICAL MEMORANDUM

DATE: January 21, 2000

TO: Washington Department of Ecology

FROM: John Kane
Environmental Partners, Inc. (EPI)

RE: Natural Attenuation Down-Gradient from the Juanita Village Property
EPI Project No. 29801.0

This technical memorandum discusses three processes of natural attenuation expected to occur off-site and down-gradient from the Juanita Village property, reductive dechlorination, hydrodynamic dispersion and dilution.

Hydrodynamic Dispersion and Dilution

Hydrodynamic dispersion is the process where a contaminant plume spreads out in directions that are longitudinal and transverse to the direction of the plume migration (EPA, 1998). Dispersion of a contaminant dilutes the concentrations of that contaminant and introduces the contaminant into portions of the aquifer where it can mix with more electron acceptors cross-gradient to the direction of ground water flow. Two different processes cause hydrodynamic dispersion: mechanical dispersion and molecular diffusion. Mechanical dispersion is the dominant mechanism for the off-site down gradient ground water from the Juanita Village property because molecular diffusion usually occurs at extremely low ground water velocities. Therefore, molecular diffusion will not be further discussed in this memorandum.

Even though the ground water is found in a continuous sand unit off-site from the Juanita Village property, heterogeneous features were found in the sand unit during the drilling of the off-site well MW-5. The sand ranged from fine to medium grain size with trace clay and gravels throughout the sand unit to a depth of 20 feet below ground surface (bgs). Even small changes in the sand can change hydraulic conductivity characteristics enough to produce significant variations in fluid and solute velocities and thus introduce dispersion (EPA, 1998). Continuous infiltration of rainwater on unpaved areas downgradient from Juanita Village property will also supplement the natural attenuation process through dilution. Based on the results of the ground water analytical data and sample locations collected down-gradient, longitudinal (horizontal) dispersion occurs downgradient from the Juanita Village property.

Figures 1 shows the results of first-order decay modeling using the U.S. EPA BIOCHLOR model and Figure 2 shows a first-order decay model calculated by EPI and Project Performance Corporation (PPC). The BIOCHLOR model included degradation, dispersion and not dilution in the calculations. The second model prediction, Figure 2, considers only first order decay degradation and not dispersion

and dilution. The model presented in Figure 1 used a more conservative half-life for tetrachloroethene (PCE) of 4 years and the model in Figure 2 used a half-life of 2 years. Both graphs show that the concentration of PCE will decrease to concentrations below the MTCA Method A Ground Water Level for PCE by the time the plume (1.4 ppm) reaches Juanita Drive NE. Furthermore, it should be noted that the source area used for both models (1.4 ppm) will be within the active treatment zone of the DDC wells that will be placed adjacent to 97th Avenue. Both modeling results do not take into account that the source area is treated. A detailed discussion of degradation of chlorinated compounds is provided below:

Observed Degradation of Chlorinated Compounds at the Juanita Village Property

The degradation of chlorinated solvents through reductive dechlorination is a naturally occurring process which has been studied and documented extensively in the last decade. This process has been demonstrated to be occurring at a wide variety of sites (U.S. EPA 1998). The rate constants for the degradation process are variable based on the site-specific conditions such as ground water velocity and subsurface soil types, but existing models using empirical site data can assist in predicting the reductive dechlorination rate. The expected steps of the degradation process for this site are the chain decay of Tetrachloroethene >Trichloroethene>Dichloroethene Vinyl Chloride>Ethene (PCE>TCE>DCE>vinyl chloride>ethene) as each chloride is stripped from the initial PCE molecule.

Evidence of Degradation Processes

U.S. EPA considers the use of natural attenuation when at least 2 out of 3 lines of evidence are found at a site:

1) Observed contaminant concentration reductions along the flow path down-gradient from the source,

2) Increase in source decay products, and

3) Field data to support biodegradation and derived decay rate.

The source area for the PCE-contaminated ground water on the Juanita Village property is the on-site dry cleaning location. The remedial investigation results revealed that the center of the contaminant mass is currently in the area of the former grocery store (EPI-MW-4, Figure 1 Draft Final CAP). Based on ground water sampling immediately down-gradient from the former grocery store, PCE concentrations are decreasing. Furthermore, concentrations of PCE decay products (Trichloroethene, cis-1, 2-Dichloroethene) were found in ground water at EPI-MW-4 and not in the up-gradient ground water wells. (The presence of *cis*-1, 2 DCE is a distinct marker of TCE degradation processes). Finally, ground water data results were used to determine the first-order decay rate for the BIOCHLOR model for the down-gradient PCE plume downgradient of the Juanita Village property boundary. All three EPA natural attenuation criteria are met for the ground water down-gradient from the Juanita Village property.

In addition, ground water field measurements support a natural attenuation approach. The groundwater conditions are a slightly reducing environment. Field measurements for dissolved oxygen and ferrous iron collected on the southern Juanita Drive NE right-of-way, approximately 75 feet from the historic

Lake Washington shoreline, indicate a slightly reducing environment (low dissolved oxygen levels (<2mg/L) and Fe [II] (>1.5 mg/L) down-gradient from the Juanita Village property. The field data results suggest more organic matter in the aquifer down-gradient of the Juanita Village property associated with the historic near-shore environment.

The rate of PCE concentration reduction from the source area (EPI-MW-4 for the down-gradient ground water) suggests that attenuation by processes other than dispersion alone (e.g. degradation) is occurring. Figure 1 shows modeling results using the U.S. EPA BIOCHLOR model comparing the concentration reductions that would occur with and without degradation along with field data from the site. Figure 2 shows the results of a first order decay of PCE prepared by EPI to confirm the BIOCHLOR model results.

Observed Degradation Rate

The modeling data in Figure 1 was generated using the BIOCHLOR model. The model assumes that the source area, a ground water sample collected at the western right-of-way on 97th Avenue NE (EPI-33), is maintained at a constant concentration of 1,400 ug/L (1.4 ppm) of PCE. This assumption is based on empirical data obtained from a Strataprobe ground water sample collected at EPI-33 on July 29, 1999.

The half-lives of individual compounds have been adjusted to represent a conservative estimate for the relative fractions of PCE and degradation byproducts. In this framework, the half-life of PCE the half-life of each decay product is the same (2 years). This provides a situation where the degradation byproducts are generated at a limited rate and are degraded essentially as fast as they are generated. The site monitoring data have included regular analysis for vinyl chloride (the decay product between DCE and ethene) and the analytical results have been below detection limits in all of the ground water sampling conducted for the Juanita Village remedial investigation and subsequent investigations.

The data presented in Figure 1 cannot be construed as the only representation of the attenuation processes. Other interpretations are certainly valid (e.g, more dispersion/less degradation, more degradation/less dispersion, different concentrations at the source location). However, the decay constant used to develop Figures 1 and 2 (PCE half-life of 2 years) is on the conservative end of the range of literature reported values. In addition, the potential future impacts of the plume discharge to the down gradient Lake Washington should be based on the total attenuation (combined degradation and dispersion).

The transport modeling provides a reasonable match to the field data from the site. The field data extends to Lake Washington, a distance of about 900 feet from the source area (EPI-33). The modeling estimates are extrapolating the trends from the data and any predictions contain substantial uncertainty. However, the furthermost down-gradient ground water sample result used in this model was 1.6 ppb, well below the MTCA Method A Ground Water Cleanup Level of 5 ppb. A non-detectable concentration value was not used in the model, maintaining a conservative estimation using the BIOCHLOR model.

Impacts on Plume Migration

Qualitative and quantitative data demonstrate that natural attenuation through reductive dechlorination is affecting the VOC plume migration at the Juanita Village property:

- Expected PCE degradation products of TCE and cis-1, 2 DCE are present at EPI-MW-4 directly upgradient from the King County Park property (the presence of cis-1, 2 DCE is a distinct marker of TCE degradation processes).

- Using a PCE half-life of 2 years and a travel time from the site to the downgradient discharge in the Lake Washington of 24 years, a total of 12 half-lives would occur for the degradation process. This would result in an estimated concentration reduction by a factor of 4096, i.e., $(1/2)^{12.}$, (reducing the concentration in half 12 times or 4,096 times smaller).

- Using a PCE half-life of 4 years and a travel time from the site to the downgradient discharge in the Lake Washington of 12 years, a total of 6 half-lives would occur for the degradation process. This would result in an estimated concentration reduction by a factor of 64, i.e., $(1/2)^{6.}$, (reducing the concentration in half 6 times or 64 times smaller).

- The travel time estimate is based on a distance of 900 ft and PCE travel velocity of 33 ft/year. This estimate is for degradation as the only attenuation process and does not include the additional effects from plume dispersion/dilution. Since the upgradient ground water will be remediated using an active remediation system (SVE and DDC wells) plume dispersion/dilution is expected to supplement the natural attenuation process for the down-gradient property.

Revised MTCA Currently Under Public Comment

A new section of the MTCA is currently proposed, WAC 173-340-370 *Expectations for cleanup action alternatives*. This new proposed section includes a discussion for using of natural attenuation, which may be appropriate at sites where:

(a) Source control has been conducted to the maximum extent practicable;
(b) Leaving contaminants on-site during the restoration time frame does not pose an unacceptable threat to human health or the environment;
(c) There is evidence that natural attenuation is occurring and will continue to occur at a reasonable rate at the site; and
(d) Appropriate monitoring requirements are adopted to ensure that the natural attenuation process is taking place and that human health and the environment are protected.

For this particular site, all four criteria are met. The source of the PCE is being excavated and the upgradient ground water is being actively remediated (DDC wells). Ground water is not currently being used as drinking or supply water and is expected not to be used during the restoration time frame because City water is used at King County Parks. Natural attenuation is occurring as shown by the ground water analytical data collected from EPI-MW-4, and down-gradient ground water monitoring will be included in the Cleanup Action Plan.

Summary of EPA Criteria Documents for PCE, TCE, DCE and Vinyl Chloride

Section 304 of the Clean Water Act requires the EPA to publish water quality criteria reflecting the latest scientific knowledge on all identifiable effects that chemicals in any body of water may have on human health and the aquatic environment. Pursuant to this requirement EPA, has published Ambient Water Quality Criteria (AWQC) documents for PCE, TCE, DCE and vinyl chloride. The relevant AWQC documents for PCE, TCE, DCE and vinyl chloride were published by the EPA in 1980 (EPA 1980a, 1980b, 1980c and 1980d). Under the MTCA (chapter 173-340-730 WAC), surface water cleanup standards are to be based on water quality standards for the State of Washington (Chapter 173-201 WAC) and water quality criteria published pursuant to Section 304 of the Clean Water Act.

All of these compounds are volatile and are expected to be rapidly eliminated from surface water through volatilization. The EPA criteria documents note that these compounds will be quickly transferred from aquatic systems to the atmosphere through volatilization and studies have shown that these compounds should not remain in an aquatic ecosystem under most natural conditions. Due to the relative solubility (150 mg/L for PCE, 1,100 mg/L for TCE, 2,500 mg/L for 1,2-DCE and 2,600 mg/L for vinyl chloride) of these compounds, they are not bioaccumulated to any significant degree. The half life of these organic compounds in biological tissues is less than one day.

Tetrachloroethene

The criteria document states that available data for PCE indicate that toxicity to freshwater aquatic life has been observed at concentrations as low as 5.3 mg/l. No data are available concerning chronic toxicity to sensitive freshwater aquatic life, but adverse behavior effects occur in one species at a concentration of 0.84 mg/l (840 ppb). The Lowest Observed Effects Limit (LOEL) is reported as 0.84 mg/l for freshwater species.

Trichloroethene

The criteria document states that available data for TCE indicate that toxicity to freshwater aquatic life has been observed at concentrations as low as 45 mg/l. No data are available concerning chronic toxicity to sensitive freshwater aquatic life but adverse behavior effects (not toxic effects) occur in one species at a concentration as low as 21.9 mg/l. The LOEL is reported as 21.9 mg/l for freshwater species.

Dichloroethene

The criteria document states that available data for DCE indicate that toxicity to freshwater aquatic life has been observed at concentrations as low as 11.6 mg/l. No definitive data are available concerning chronic toxicity to sensitive freshwater aquatic species. Most of the aquatic studies for DCE have been conducted with 1,1-DCE isomer. One study testing bluegills found the 96-hour LC_{50} for 1,1-DCE and 1,2-DCE to be 73.9 and 135 mg/l, respectively. The criteria document notes that the location of the chlorine atoms on the DCE molecule (1,1-DCE versus 1,2-DCE) does not affect the acute toxicity very much (for freshwater aquatic species).

Vinyl Chloride

The criteria document states that insufficient data exist for vinyl chloride toxicity to set criteria for aquatic species. One bacterial growth test indicated that vinyl chloride was not toxic (to bacteria) at concentrations up to 900 mg/L. Based on an estimated bio-concentration of vinyl chloride in fish, the

criteria document states that a concentration of 0.525 mg/L would be protective of human health based on exposure from fish consumption (at a risk level of 10^{-6}). It should be noted that vinyl chloride has not been detected above the laboratory detection limits in any of the ground water or soil samples collected during the Juanita Village remedial investigation and subsequent investigations. The applicable surface water criteria for PCE and its degradation products at this site are presented in Table 1. These same AWQC parameters are also listed in Ecology's CLARC II tables.

Table 1
Applicable Surface Water Criteria for Beneficial Use of Surface Water

Compound	Water quality criteria	Basis	Federal Register reference
TCE	21.9 mg/l	LOEL[1]	45 FR 79341
1,2 DCE	11.6 mg/l	LOEL[1]	45 FR 79332
PCE	0.840 mg/l	LOEL[1]	45 FR 79340
Vinyl Chloride	0.525 mg/l	Ambient criteria for human health fish consumption[2]	45 FR 79341

[1]EPA criteria documents use Lowest Observed Effects Limit (LOEL) for these compounds

[2]no LOEL exists for this compound

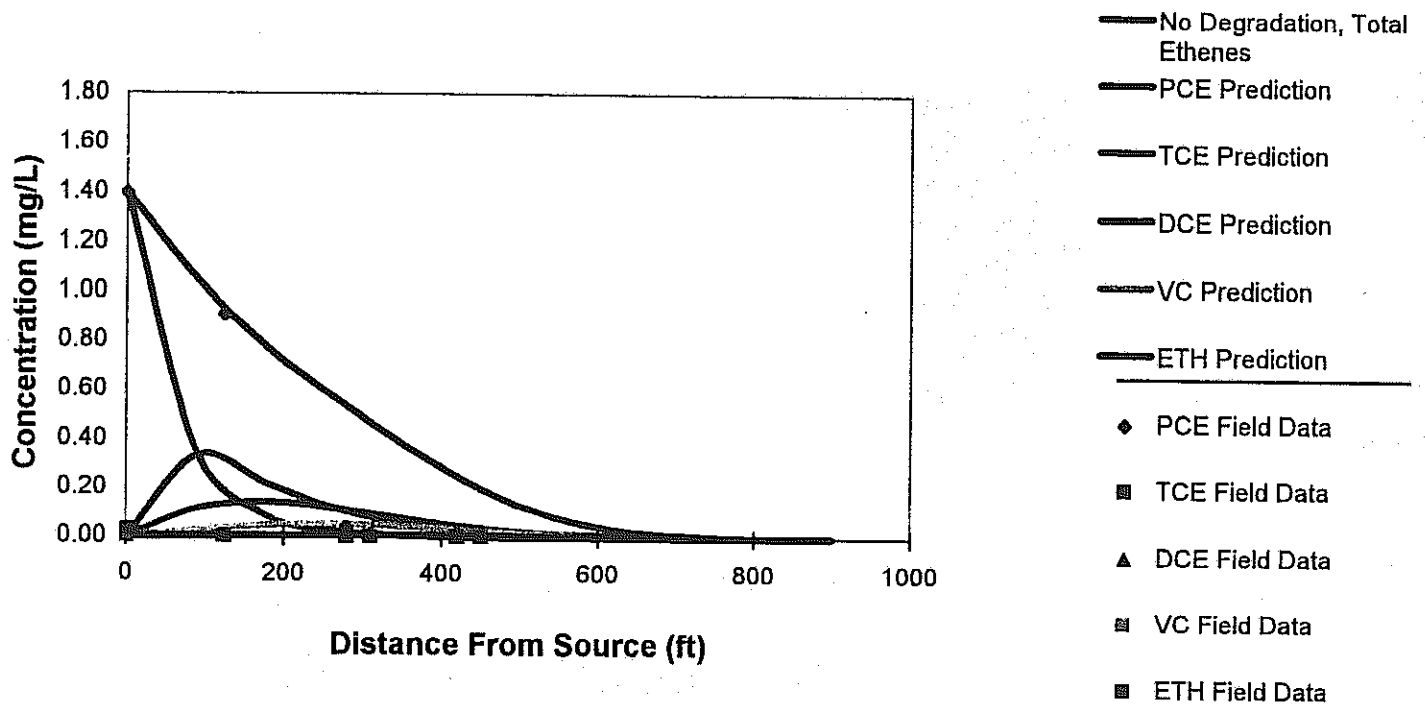
Conclusions

The results of the BIOCHLOR model and EPI's first order decay model, using measured field data as model input parameters, show that natural attenuation by degradation, dispersion and dilution of PCE is occurring off-site and downgradient from the Juanita Village property. Concentrations of PCE are expected to decrease to concentrations below the MTCA Method A Ground Water Cleanup Level by the time the plume reaches Juanita Drive NE.

Furthermore, concentrations of PCE are expected to remain below MTCA Method A Ground Water Cleanup Level and the Ambient Water Quality Criteria in Lake Washington and Juanita Creek. The upgradient active ground water remediation on the Juanita Village property will supplement the degradation process by significantly reducing the source of the PCE concentrations migrating down-gradient from the Juanita Village property. The placement of two DDC wells at the western Juanita Village property boundary will reach the northeast corner of the King County property where the highest PCE concentrations (1.4 ppm) was found during the remedial investigation. Continued infiltration of rainwater on unpaved areas downgradient from Juanita Village property will also supplement the dispersion/dilution natural attenuation process. A contingency plan has been included in the CAP including down-gradient ground water monitoring and the implementation of a DDC well remediation system, if necessary.

Figure 1

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE



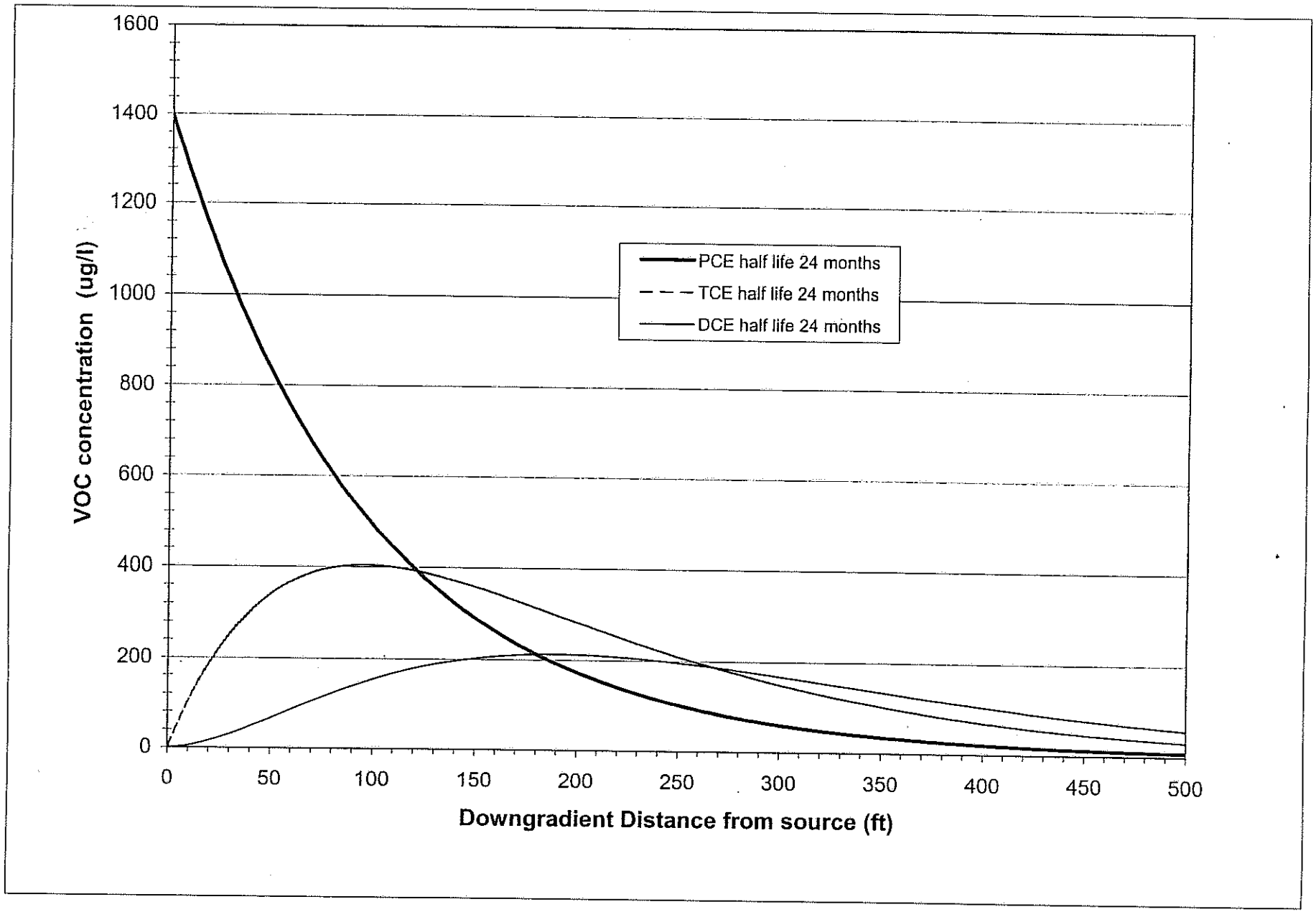
Log ⟺ Linear

Time:
10 Years

To Input

To Individual Compounds

Figure 2
Prediction of PCE and Degradation Byproducts With Estimated Decay Rates



Groundwater pore velocity 100 ft/yr
PCE retardation factor 3
PCE velocity 33 ft/yr

Juanita Village site

References

EPA 1998. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water, EPA Office of Research and Development, EPA/600/R-98/128

EPA 1980a. Ambient Water Quality Criteria for Trichloroethene, EPA Office of Water, Criteria and Standards Division, EPA 440/5-80-077

EPA 1980b. Ambient Water Quality Criteria for Dichloroethene, EPA Office of Water, Criteria and Standards Division, EPA 440/5-80-041

EPA 1980c. Ambient Water Quality Criteria for Vinyl Chloride, EPA Office of Water, Criteria and Standards Division, EPA 440/5-80-078

EPA 1980d. Ambient Water Quality Criteria for Tetrachloroethene, EPA Office of Water, Criteria and Standards Division, EPA 440/5-80-076

Attachment B

Environmental Partners Inc.

Vapor Extraction Pilot Test Data Sheet

Location: Juanita, Kirkland, WA Date: August 17, 1999 Personnel: Alex Jones (EPI)

Equipment: Kaiser Omega 7.5 hp Positive Displacement Blower

	Extraction Well							Observation Wells							
Well Name	DDC-1							MW-201		SVE-1		MW-203		MW-202	
Time (hh:mm after Start)	vacuum (" H20)	Flow (scfm)	Pipe Diameter (in)	Temp. (F)	RH (%)	PID Reading (ppmv)	Bag Sample (y/n)	vacuum (" H20)	Distance from Extraction (ft)	vacuum (" H20)	Distance from Extraction (ft)	vacuum (" H20)	Distance from Extraction (ft)	vacuum (" H20)	Distance from Extraction (ft)
0:00	0.0	0.0	2	--	--	--	n	0.00	12.8	0.00	25.2	0.00	68.5	0.00	79.5
0:00+	38.0	65	2	66	nm	nm	n	4.2		1.6		0.30		0.10	
00:05	41.0	56	2	66	nm	nm	n	4.2		1.8		0.52		0.48	
00:10	42.0	57	2	66	nm	nm	n	4.2		1.6		0.54		0.50	
00:15	42.0	55	2	63	nm	nm	n	4.2		1.6		0.52		0.50	
00:20	42.0	57	2	63	nm	nm	n	4.2		1.6		0.52		0.50	
00:25	42.0	50	2	63	nm	nm	n	4.2		1.6		0.52		0.50	
00:30	42.0	50	2	63	nm	nm	n	4.2		1.6		0.52		0.50	
00:40	42.0	50	2	62	nm	nm	n	4.2		1.6		0.54		0.50	
00:50	42.0	50	2	63	nm	nm	n	4.2		1.6		0.54		0.50	
01:00	41.0	50	2	63	nm	nm	n	4.3		1.6		0.54		0.52	
01:20	41.0	50	2	64	nm	43.8	n	4.3		1.6		0.53		0.50	
01:40	41.0	50	2	65	nm	nm	n	4.3		1.6		0.54		0.52	
02:00	41.0	50	2	67	nm	nm	n	nm		1.6		0.54		0.52	
02:20	40.0	50	2	68	nm	78.9	n	4.4		1.6		0.54		0.52	
02:40	40.0	50	2	68	nm	nm	n	4.4		1.6		0.54		0.52	
03:00	40.0	50	2	68	nm	131	y	4.4		1.6		0.54		0.52	

Figure 1
Vapor Extraction Pilot Test Data for DDC-1
Juanita Village, Kirkland, WA
EPI Project No. 29801.4

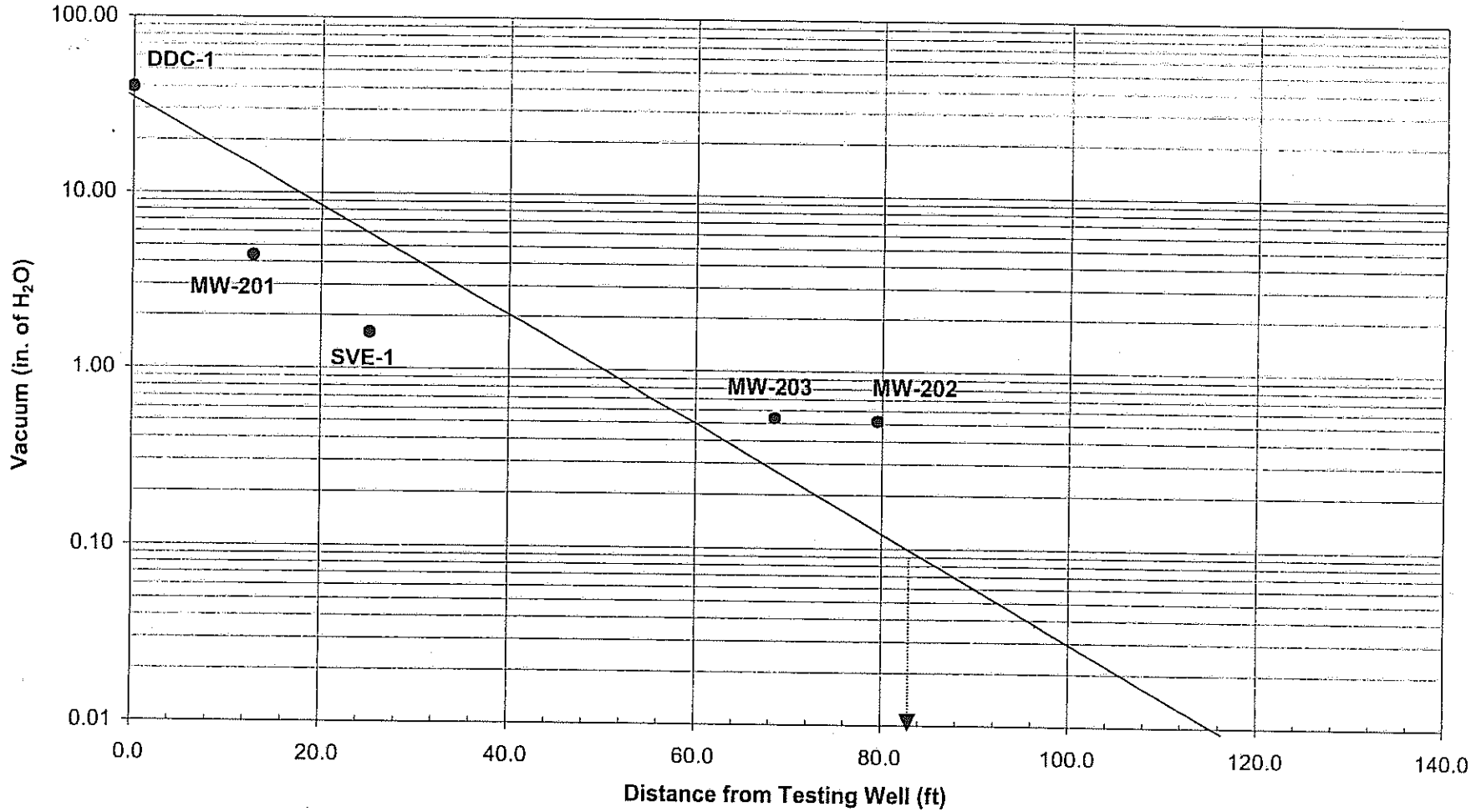


Table 1
DDC Well Pilot Test Parameters
Juanita Village Property, Kirkland, V

	Distance from DDC Well (ft.)	PCE Concentrations (ppb)					Dissolved Oxygen (mg/L)		Alkalinity (mg/L)			
		8/2/99	9/1/99**	9/10/99	10/1/99	10/15/99	9/10/99	10/1/99	8/2/99	9/1/99	9/10/99	1(
DDC-1 Influent	0	--	--	49	56	--	2.2	0.984	--	--	93	
DDC-1 Effluent	0	--	--	nd	nd	--	9.8	8.9	--	--	110	
MW-201	15	480	2200	1700	1200	--	5.9	6.30	55	--	57	
RI-SB-2*	50	--	--	--	--	800	--	--	--	--	--	
MW-202	70	70	200	74	170	--	5.6	4.6	--	--	74	
MW-203	78	160	150	160	170	--	4.30	2.7	--	--	65	
EPI-MW-3	145	3.3	--	3.3	2.7	--	3.5	2.7	--	--	59	
RI-MW-2D	72	nd	--	--	nd	--	--	1.5	--	--	--	
RI-MW-3D	145	8.4	--	nd	nd	--	0.60	1.2	--	--	130	

	Temperature (°F)				
	8/2/99	9/1/99	9/10/99	10/1/99	8/2
DDC-1 Influent	--	--	67	52.7	-
DDC-1 Effluent	--	--	68.20	58	-
MW-201	73.4 / 71.7 / 70.9	62.5 / 61.3 / 60.05	59.2 / 59.0 / 59.1 / 59.2	57.7 / 57.9 / 58.1	182 / 1(
RI-SB-2	--	--	--	--	-
MW-202	75.7 / 73.0 / 70.5	60.2 / 59.2 / 60.7	58.2 / 58.5 / 58.3	56.5 / 56.8 / 56.8	171 / 1(
MW-203	66.2 / 67.3 / 66.5	58.0 / 58.5 / 58.7	70.0 / 65.1 / 64.6 / 64.5	70.1 / 64.1 / 61.8	169 / 1(
EPI-MW-3	69.8 / 66.1 / 68.4	--	59.1 / 58.3 / 58.4	56.8 / 57.0 / 57.1	156 / 1(
RI-MW-2D	74.8 / 73.2 / 70.1	--	--	57.0 / 56.3 / 56.5	211 / 1(
RI-MW-3D	68.2 / 67.4 / 67.4	--	57.6 / 58.4 / 58.8	59.1 / 60.5 / 60.6	219 / 2(

Notes:

*Ground water grab sample collected at RI-SB-2 during RI soil sampling task using Strataprobe rig on 10/1

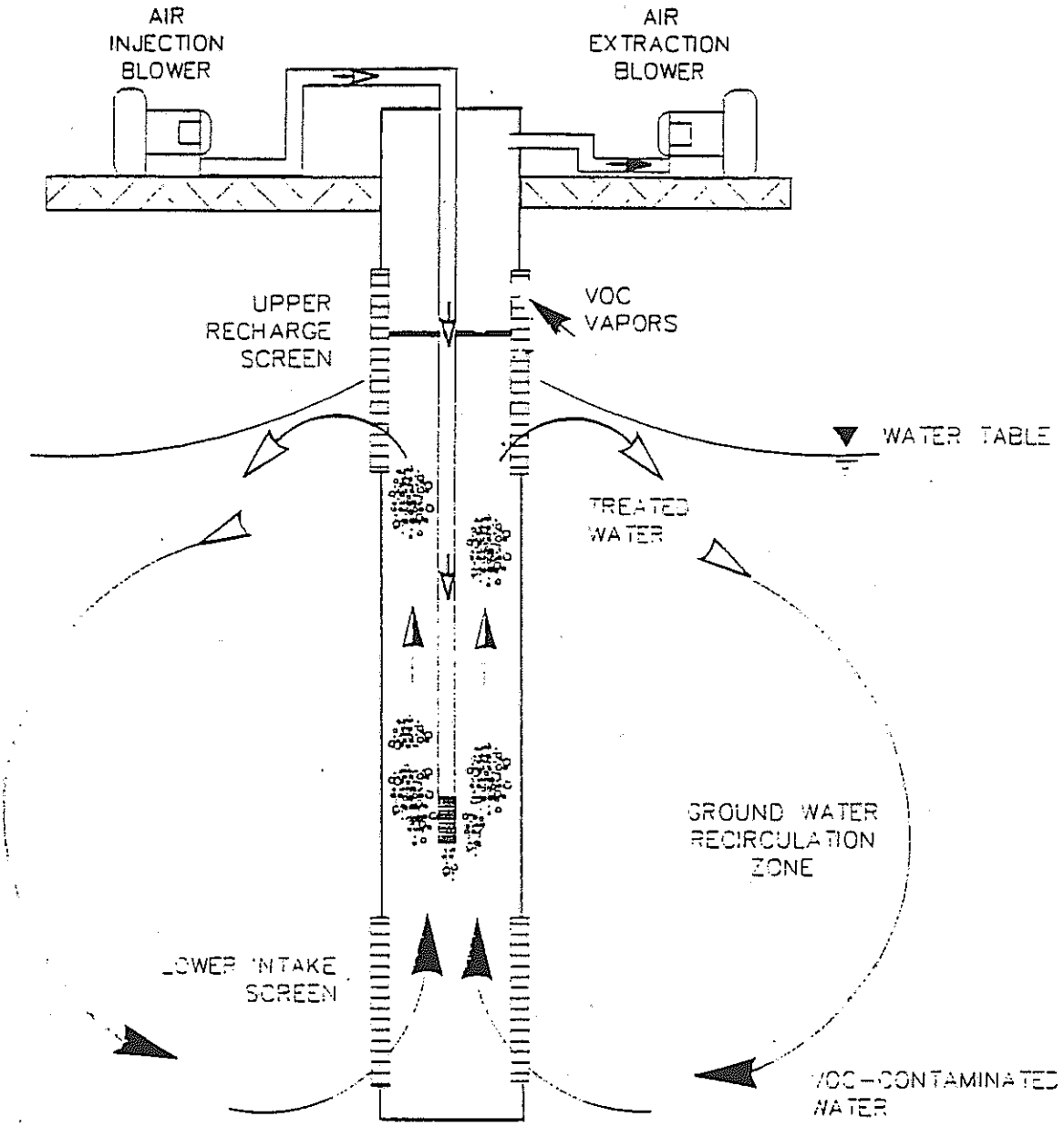
-- = Not Analyzed

Sampling dates in table denote sampling event range, some events occurred within 2-day timeframe.

Dissolved Oxygen background measurements collected in Novemebr 1998:

EPI-MW-8 - Upper portion of aquifer: 2.2 mg/L

EPI-MW-6 - Deeper portion of aquifer: 0.311 mg/L



TYPICAL LAYOUT OF EDDC IN-WELL STRIPPING IN A RECIRCULATING WELL

PROJECT PERFORMANCE CORPORATION
16035 SE 36th STREET BELLEVUE WA 98006

DRAWN BY:	REVIEWED BY:	DATE:	FILE NAME:	PPC PROJECT #:
TJM	—	—	DDCWELL.SKD	—

Attachment C

SUBSTANTIVE REQUIREMENTS OF STATE AND LOCAL LAWS REQUIRING PERMITS OR APPROVALS

Puget Sound Clean Air Agency Notice of Construction.

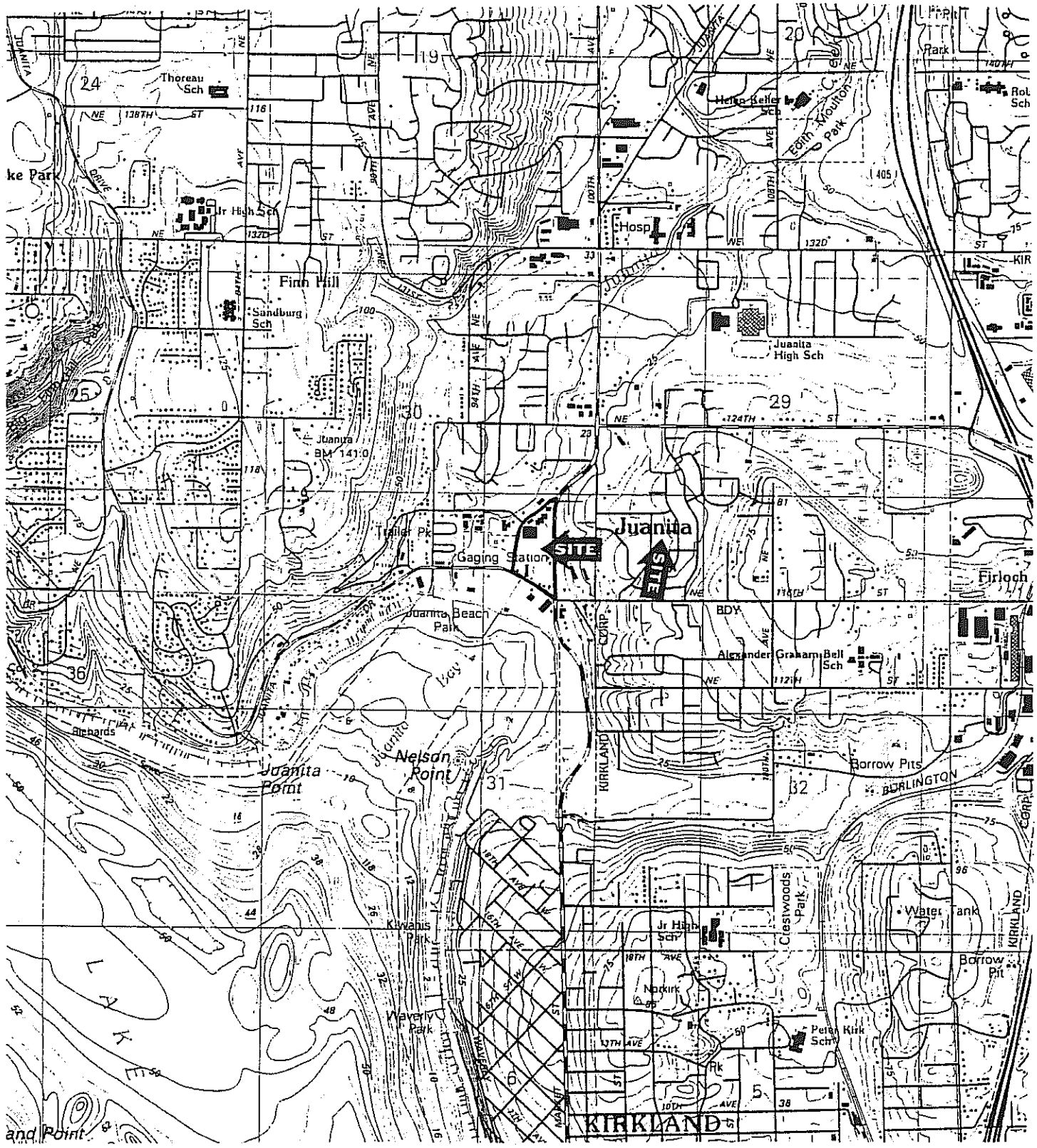
Requirements applicable to the Soil Vapor Extraction System, including a Vacuum Blower with emissions controlled by Vapor Carbon Vessels (in Series).

1. All emissions from the soil vapor extraction system (SVE) shall be vented through the multi-stage carbon adsorbers. Juanita Village shall perform monthly monitoring of the concentration of perchloroethylene (PCE) in the vapor (a) entering the first carbon adsorber, and (b) leaving the carbon adsorber preceding the last carbon adsorber.

2. Juanita Village shall not operate the SVE system if the concentration of PCE in the vapor leaving the carbon adsorber preceding the last carbon adsorber in the series exceeds 10 ppm.

3. If the most recent monitoring shows that the concentration of PCE in the vapor entering the first carbon adsorber is below 10 ppm for a period greater than 30 consecutive days, Juanita Village may remove the carbon adsorbers provided that Juanita Village monitors the uncontrolled emissions monthly to assure that the concentration remains below 10 ppm.

4. Juanita Village shall retain the monitoring records on site, make these records available to Puget Sound Clean Air Agency personnel upon request, and notify the Puget Sound Clean Air Agency at least 7 days prior to the removal of the carbon adsorbers and within 7 days when PCE concentrations in the uncontrolled emissions exceed 10 ppm.



KEY

SOURCE: USGS 7.5 MINUTE QUANDRANGLE (TOPOGRAPHIC)

BELLEVUE NORTH, WA
1982

N

SCALE: 1:24,000

ENVIRONMENTAL PARTNERS INC

FIGURE 1
GENERAL VICINITY MAP

PROJECT	29801.3		
PREPARED FOR	JUANITA VILLAGE LLC		
LOCATION	JUANITA VILLAGE KIRKLAND, WASHINGTON		
SHEET 1 of 1	DRAWN BY VRR	REVIEWED BY JRK	DATE 04/21/00