1925 Third Avenue Liquid Permaganate Treatment of Residual Subsurface PCE and TCE

Washington State Department of Ecology
Site ID 22254391

1925 Third LLC

December 2007

Parametrix

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Prepared for

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CERTIFICATION

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

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ACRONYMS

AS/SVE	air sparging/soil vapor extraction
COCs	chemicals of concern
ISCO	In Situ Chemical Oxidation
MTCA	Model Toxics Control Act
PCE	perchloroethylene
Site	1925 Third Avenue Site
TCE	Trichloroethylene

1. INTRODUCTION

This report has been prepared to present a strategy to remove lingering groundwater contamination at the 1925 Third Avenue Site (Site) in Seattle, Washington (Figure 1-1). The Site is the former location of the Barg French Dry Cleaning business, and has been under remediation since 2005 to fulfill the requirements of the Model Toxics Control Act (MTCA) (WAC 173-340-400) and the Prospective Purchaser Consent Decree executed on January 15, 2004. This report includes the following information:

- General project background information.
- Cleanup and performance goals.
- Description of the current system, and a summary of system performance.
- Description of in situ chemical oxidation treatment.
- Recommendations for use of chemical oxidation at the site, and cost estimate.
- A general description of compliance monitoring.

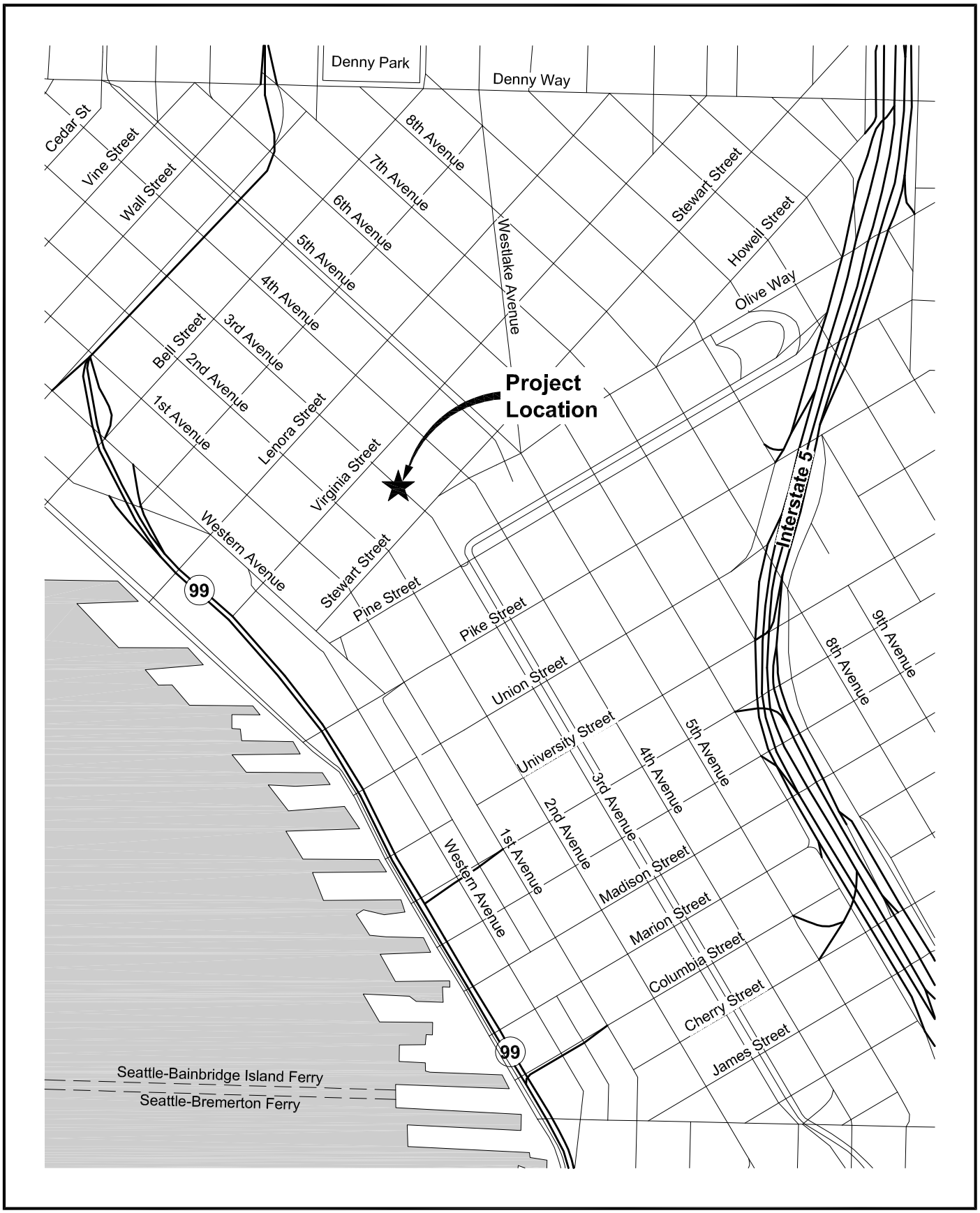

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Figure 1-1
1925 Third, LLC
Site Vicinity Map
Liquid Permanganate Treatment

2. BACKGROUND

2.1 SITE LOCATION AND BACKGROUND

The former Barg French Dry Cleaning business was located at 1925 Third Avenue, Seattle, Washing ton, in a structure originally known as the Heiden Building that was erected in 1914. The building is a three-story structure without a basement, comprised of brick and masonry walls supported on conventional shallow concrete spread footings. The northwestern third of the ground floor was occupied by the dry cleaning operation from 1951 to 2000. The remainder of the ground floor formerly housed a book store. The second and third floors have been used as commercial business spaces. Currently the second floor is occupied, but the ground floor is vacant. The building is bounded by Third Avenue to the northeast, a six story office building to the southeast, a paved alley to the southwest, and a two-story parking structure to the northwest.

2.2 GEOLOGIC AND HYDROGEOLOGIC CONDITIONS

Groundwater beneath the site that has been impacted by perchloroethylene (PCE) occurs in a shallow perched water-bearing zone within 20 feet of ground surface. Geologic data from the site and nearby properties indicate that the perched groundwater is laterally discontinuous, low yielding (less than 0.5 gpm), not a current or potential source of drinking water, and separated from potential drinking water aquifers by a well-documented confining unit consisting of dense silt and clay.

2.3 IDENTIFIED CHEMICALS OF CONCERN

A limited Phase II site assessment conducted in 1999 detected the presence of PCE, a dry cleaning solvent, in shallow soil beneath the floor of the dry cleaning space. Investigations completed from 1999 through 2001 included installation of more than 30 subsurface explorations consisting of soil probes, soil vapor extraction points, and monitoring wells.

PCE was the principal component of the dry cleaning fluids released at the site and best represents the impacts of the dry cleaning fluid release on the environment at the site. Trichloroethylene (TCE) is a degradation product of PCE and was also detected at the site. PCE and TCE behave similarly in the environment and are remediated using the same technologies. PCE and TCE are the main chemicals of concern (COCs) at the Site.

In March 2005 a groundwater air sparging/soil vapor extraction (AS/SVE) system was installed and started at the site to remove PCE and TCE from soil and groundwater beneath the ground floor of the building. Full details of the site background and cleanup objectives can be found in the Engineering Design Report (Parametrix 2005a) and the As-Built Report (Parametrix 2005b). The Engineering Design Report also provides the original plans and specifications for the groundwater AS/SVE system, as well as pilot testing results. The As-Built Report provides site schematics and start-up information and test results.

Performance monitoring has occurred at the Site in accordance with Washington State Department of Ecology (Ecology) regulations, and with the Parametrix Operation and Maintenance Plan (Parametrix 2006). Table 2-1 presents a summary of quarterly monitoring results for groundwater at the site.

Table 2-1. Groundwater Sampling Results, 1925 Third Avenue, Through June 2007

Site Cleanup Levels	PCE	196 µg/L				
	TCE	247µg/L				
			Soil Vapor Extraction Well Number			
		SVE-1	**SVE-2**	**SVE-5**	**SVE-6**	**SVE-7**
Groundwater Sampling Results by Date		µg/L	µg/L	µg/L	µg/L	µg/L
January 2001 (before system start)	PCE	6.0	2,900	4,200	220	950
April 7, 2006	PCE	3.8	490	320	140	100
	TCE	<0.2	37	<2.0	<2.0	2.5
June-July 2006	PCE	2.8	31	12	31	68
	TCE	<0.2	3.8	<0.2	<0.2	1.8
October 2, 2006	PCE	3.5	440	230	210	93
	TCE	<0.2	39	<1.0	<1.0	1.5
March 8, 2007	PCE	3.7	140	160	130	57
	TCE	<0.2	16	<1.0	<1.0	13
June 4, 2007	PCE	7.5	430	190	130	330
	TCE	<0.2	52	<1.0	<1.0	4.4
Percentage Reduction of PCE Since Jan. 2001		97%	85%	95%	41%	65%

Exceeds Cleanup Level

As the results show, in March 2007, groundwater samples collected at the site indicated that concentrations of PCE and TCE, were below the site clean up levels of 196 micrograms per liter (ug/L) and 247 ug/L respectively. The system was turned off in March, and was sampled again in June 2007. Sample results from the June sampling are located in Appendix A. During that period of time, the concentration of PCE increased to a concentration just above the site cleanup level. This "rebound" effect is commonly observed at PCE cleanup sites, and is caused by residual PCE (in the soils above the water table) desorbing back into the groundwater, as the water table rises and falls seasonally. The air sparging / vapor extraction system has removed a significant amount of PCE and TCE mass; however, redistribution of the remaining PCE in the soils and adjacent water table is continuing to cause results above the site cleanup levels.

3. IN SITU CHEMICAL OXIDATION

The pattern of rebound was evident in the last two successive cycles of system operations, sampling event with no cleanup level exceedances, then followup sampling event with exceedances. In order to improve the remediation system effectiveness and potentially decrease the time frame for cleanup, Parametrix evaluated In Situ Chemical Oxidation (ISCO) as an enhanced remedial option.

3.1 DESCRIPTION

ISCO involves injecting a chemical oxidant into the shallow aquifer and chemically degrading contaminants in groundwater into innocuous compounds (carbon dioxide and water). Contaminant concentration, general chemistry parameters, and environmental indicators are monitored prior to and following injection to assess the degradation process. The residual PCE in soil and groundwater would be treated using liquid permanganate. Treatment using permanganate is based on the following chemical reaction:

$$2NaMnO_4 + C_2HCl_3 \rightarrow 2CO_2 + 2MnO_2 + 2Na^+ + H^+ + 3Cl^- \quad \text{(Equation 1)}$$

A different oxidant or a combination of oxidants could be selected during the design phase based on the results of treatability testing. An ISCO bench-scale treatability test would be conducted to help refine the full-scale injection approach.

3.2 APPLICATION

Liquid permanganate would be injected into selected existing SVE wells that are currently part of the AS/SVE system. These wells are screened through the entire groundwater interval, and are adequately spaced provide the required coverage to treat the residual PCE and TCE plume. Well packers will be used during the injection to ensure that the permanganate is being injected at the correct depths to target the subsurface contamination.

Due to the low residual concentrations of PCE and TCE at the site, it is predicted that only one injection will be required to achieve the site cleanup levels. Sampling will occur quarterly after the injection monitor progress.

Prior to injecting the sodium permanganate, a pilot scale study will be performed, where 200-gallons of water will be injected into two of the SVE wells to confirm the hydraulic conductivity at the site. The two wells will be based on observed recovery rates from the quarterly monitoring. The pilot scale testing will focus on the SVE well that have the slowest and fastest recovery rates.

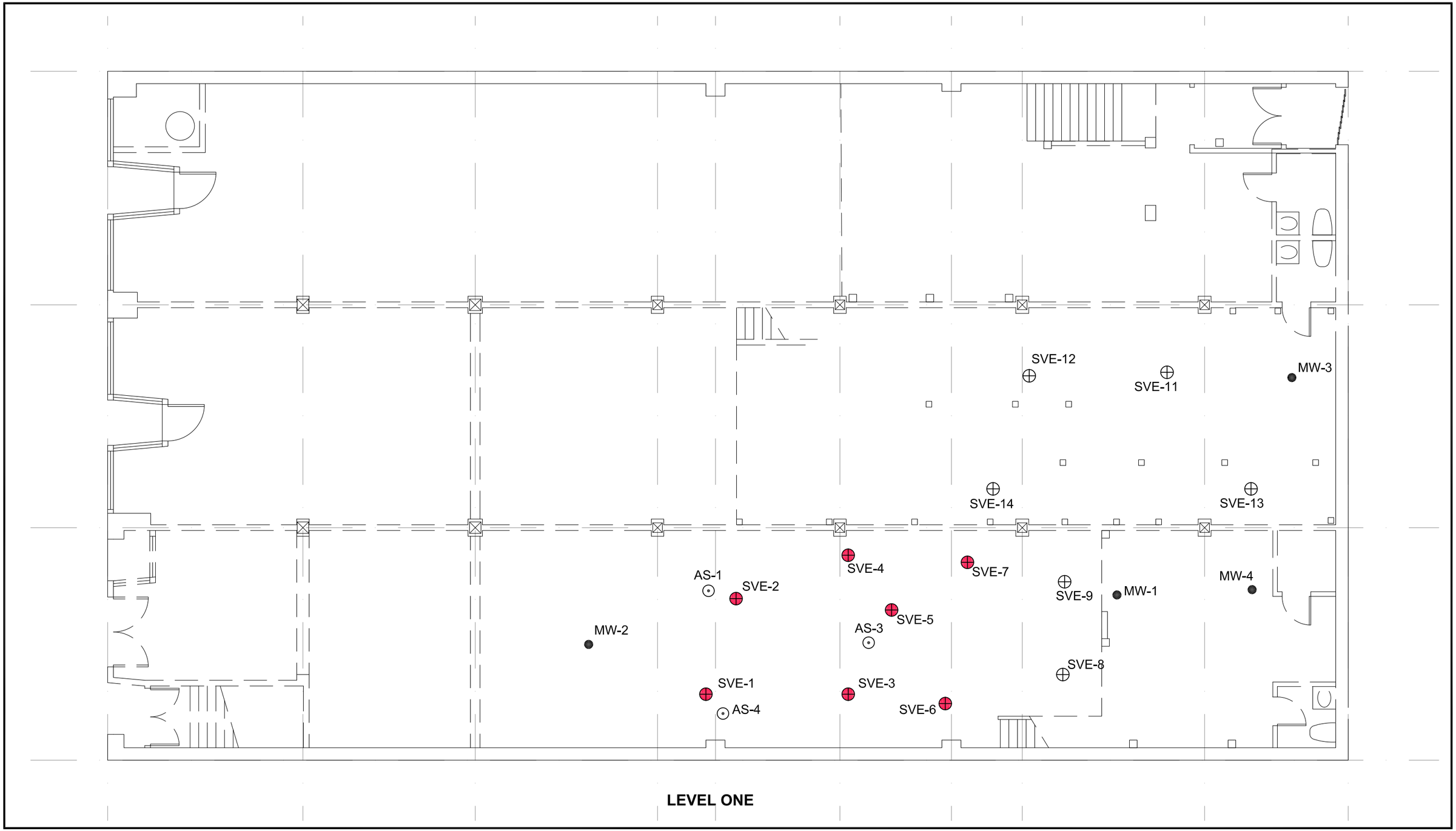
For the full scale injection 200-gallons of 4% sodium permanganate solution will be injected into eight SVE wells. The injection will take approximately 3 days to complete. A preliminary map showing the injection locations is shown on Figure 3-1.

3.3 MONITORING

The probes and wells to be monitored during and after the pilot scale injection are also shown on Figure 3-1. These monitoring locations were selected to allow sampling of groundwater at locations away from the injection wells, to provide data representative of changes in PCE in

the shallow groundwater system. The preliminary injection and monitoring schedule are summarized in Table 3-1.

The monitoring data will be plotted on time-series graphs and compared to site cleanup levels. A technical memorandum summarizing the methods, results, and recommendations regarding the pilot study will be submitted to 1925 Third LLC and the Department of Ecology.



LEVEL ONE

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LEGEND

MW- # MONITORING WELLS

SVE- # PROPOSED SOIL VAPOR EXTRACTION WELL FOR SODIUM PERMAGANATE INJECTION

AS-# AIR SPARING WELL

SVE- # SOIL VAPOR EXTRACTION WELLS

Figure 3-1
1925 Third, LLC
SVE Well Locations
Liquid Permaganate Treatment

4. REFERENCES

Parametrix, Inc. 2005a. Soil and Groundwater Remediation System Engineering Design Report for the Third Avenue Site. Parametrix, Sumner, Washington. January 2005.

Parametrix, Inc. 2005b. As-Built Report for the Soil and Groundwater Remediation System for the Third Avenue Site. Parametrix, Sumner, Washington. July 2005.

Parametrix, Inc. 2006. Operations and Maintenance Plan for the Third Avenue Site. Parametrix, Bremerton, Washington. April 2006.

APPENDIX A

Groundwater Monitoring Results