



Shelton Laundry and Cleaners September 2004 and April 2005 Groundwater Monitoring Results

Abstract

Groundwater samples for volatile organic analysis were collected from two shallow and two deep monitoring wells during September 2004 and April 2005 at Shelton Laundry and Cleaners in Shelton, Washington. Samples were collected to monitor concentrations and distribution of tetrachloroethylene (PCE). PCE contamination of the shallow groundwater was discovered in 1997 during an environmental site assessment of a nearby property. The source of contamination was assumed to be a spill that occurred in 1993 at the dry cleaning facility occupied by Shelton Laundry and Cleaners.

Monitoring of four shallow wells installed in 1998 detected PCE contamination in well 4W, located where the spill was reported to have occurred, with concentrations ranging from 280 ug/L in July 1998 to 25 ug/L in September 2000. In 2002, four additional deeper wells were installed. Results from the 2002 monitoring indicated that PCE contamination occurred at well 4W with an average concentration of 13 ug/L. PCE was not detected in the four deep wells.

Results from the September 2004 and April 2005 monitoring concur with previous results. PCE was detected in well 4W with concentrations of 9.9 to 20 ug/L. Trichloroethylene and cis-1,2-dichloroethylene also were detected in well 4W but at concentrations near or below the practical quantitation limit of 1 ug/L. PCE was not detected in the two deeper wells.

Although contaminant concentrations have decreased since 1998, PCE concentrations in well 4W exceeded the Model Toxic Control Act cleanup standard of 5.0 ug/L. Because PCE concentrations continue to exceed the cleanup standard in well 4W, a remedial action was implemented at this well in June 2005. Groundwater monitoring will continue on a quarterly basis for the next year to determine if the remediation has been effective.

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Background

Tetrachloroethylene (PCE) contamination of the shallow groundwater was discovered in 1997 during an environmental site assessment/subsurface investigation (Building Analytics, 1997) of a property in Shelton, Washington (Figure 1). PCE was detected at a concentration of 130 ug/L in groundwater collected from a shallow boring. The Model Toxic Control Act (MTCA) cleanup level for PCE in groundwater is 5 ug/L.

The Washington State Department of Ecology (Ecology) was notified of the contamination when it received copies of the Environmental Site Assessment Reports in June 1997. Based on these reports, Shelton Laundry and Cleaners was listed on Ecology's *Confirmed and Suspected Contaminated Sites List* in December 1997, and ranked under the Washington Ranking System.

The most likely source of the contamination was identified as the dry cleaning facility occupied by Shelton Laundry and Cleaners which is located adjacent to the property where the site assessment was conducted. A commercial laundry and dry cleaning facility has been in operation at this site since 1935. In 1993, a new dry cleaning machine was installed. As the old cleaning machine was removed, an unknown quantity of dry cleaning solvent, assumed to be PCE, was reportedly spilled and infiltrated through the broken asphalt in the alley behind the building. This spill event is assumed to be the source of groundwater contamination.

Several investigations were conducted at the Shelton Laundry and Cleaners site during 1997 and 1998. During these investigations, several shallow borings were drilled to collect both soil and groundwater samples. In July 1998, four shallow (15 feet deep) monitoring wells were installed. Groundwater was sampled from these wells four times between July 1998 and September 2000. PCE contamination was primarily detected in well 4W located where the spill was reported to have occurred, with concentrations ranging from 280 ug/L (July 1998) to 25 ug/L (September 2000).

Ecology conducted an investigation in 2002 to determine the current concentration and distribution of PCE. As part of the investigation, four additional wells (MW-5 through MW-8) were installed to gain a better understanding of contaminant concentrations at deeper depths. Three of the wells were installed to a depth of 45 feet beside existing shallow wells. The fourth well was installed to a depth of 60 feet downgradient of the site. PCE was not detected in any of the deeper wells during the 2002 monitoring (Marti, 2003).

Well logs from the deeper monitoring wells indicate that the project area is covered with up to two feet of fill and pavement material, which is underlain by an undetermined thickness of sandy gravel with some sand interbeds. The depth to the water table ranged from about four to six feet over the 1997 – 2005 study period. The sandy gravel in which all eight monitoring wells are screened is part of the Vashon recessional outwash deposits which underlay the western outwash plain between Shelton and the Skokomish Valley to the north. Deeper production well logs near the site indicate that the recessional deposits can attain a thickness of more than 100 feet in the area of Oakland Bay. Regionally, groundwater flow is described as being southward in the loose sand and gravel toward the Shelton Valley and Oakland Bay (Molenaar and Noble, 1970).

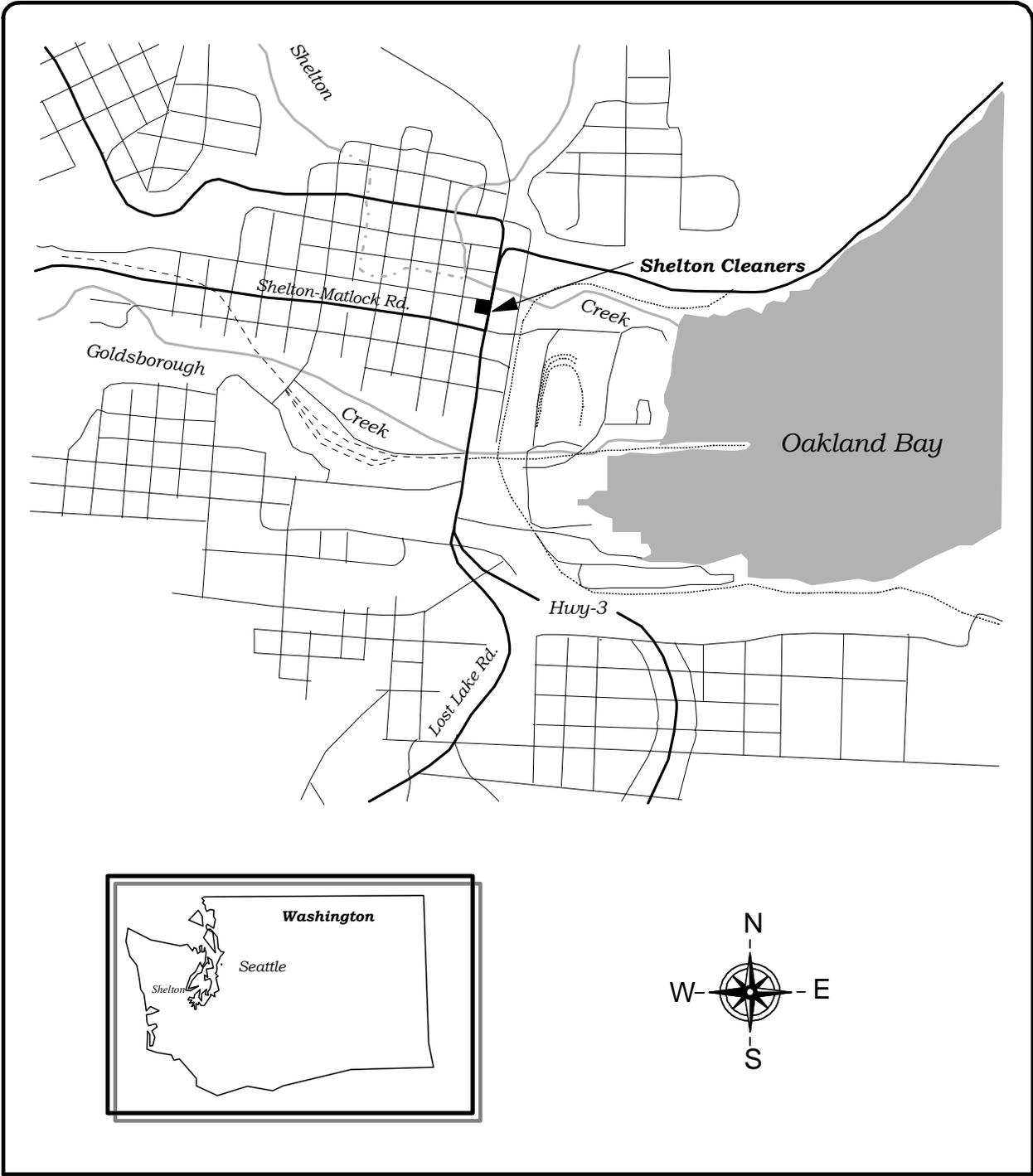


Figure 1: Shelton Laundry & Cleaners Site Location

Methods

Groundwater Sampling

Groundwater samples for volatile organic analysis (VOAs) were collected in September 2004 and April 2005 from two shallow and two deep monitoring wells to monitor concentrations and distribution of PCE (Figure 2).

The two shallow wells installed in 1998 (4W and 7W) were constructed of 1-inch diameter PVC to a depth of about 15 feet with 10-foot screens. The two deep wells (MW-5 and MW-6) were constructed of 2-inch diameter PVC to a depth of about 45 feet, with the screened interval from 35-45 feet below ground surface (bgs).

Static water levels were measured in all wells using a Solinst water level meter with a ¼-inch diameter probe prior to well purging and sampling. Measurements were recorded to 0.01 foot and are accurate to 0.03 foot. The probe was rinsed with deionized water between measurements. Wells were purged through a continuous flow cell until pH, specific conductivity, and temperature readings stabilized. Purge water from all the wells was collected and stored on-site in a 55-gallon drum. The purge water was transported and disposed of in accordance with Washington State Dangerous Waste Regulations (Chapter 173-340 WAC).

Monitoring wells MW-5 and MW-6 were purged and sampled using a stainless steel submersible pump, with a pump rate of less than 1-liter/minute. At the completion of purging, samples were collected from the wells directly from the dedicated pump discharge tubing into laboratory supplied containers. The pump was decontaminated between each well by circulating laboratory grade detergent/water through the pump followed by a clean water rinse, with each cycle lasting five minutes.

Because of their small diameter (1 inch), wells 4W and 7W were purged and sampled with a peristaltic pump. Although studies have shown that there can be a loss of volatile analytes in samples collected with suction lift devices such as a peristaltic pump, in some situations the loss may be small if the sample lift is small and a slow pump rate is used in conjunction with less sorptive tubing material (Parker, 1994). To minimize the loss of volatile analytes in wells 4W and 7W, dedicated polyethylene tubing was used in each well and pumped at a rate of less than 1-liter/minute. The sample lift was less than six feet. At the completion of purging, the polyethylene tubing was disconnected from the pump, plugged, and removed from the well. Water collected in the tubing was allowed to drain into pre-cleaned sample vials.

VOA samples were collected free of headspace in three 40-mL glass vials with Teflon-lined septa lids and preserved with 1:1 hydrochloric acid. Upon sample collection and proper labeling, all samples were stored in an ice-filled cooler. Samples were transported to Ecology's Operation Center in Lacey. Samples were kept in the walk-in cooler until picked up by the courier to the Ecology/EPA Manchester Environmental Laboratory in Manchester, Washington. Chain-of-custody procedures were followed according to Manchester Environmental Laboratory protocol (Ecology, 2003).

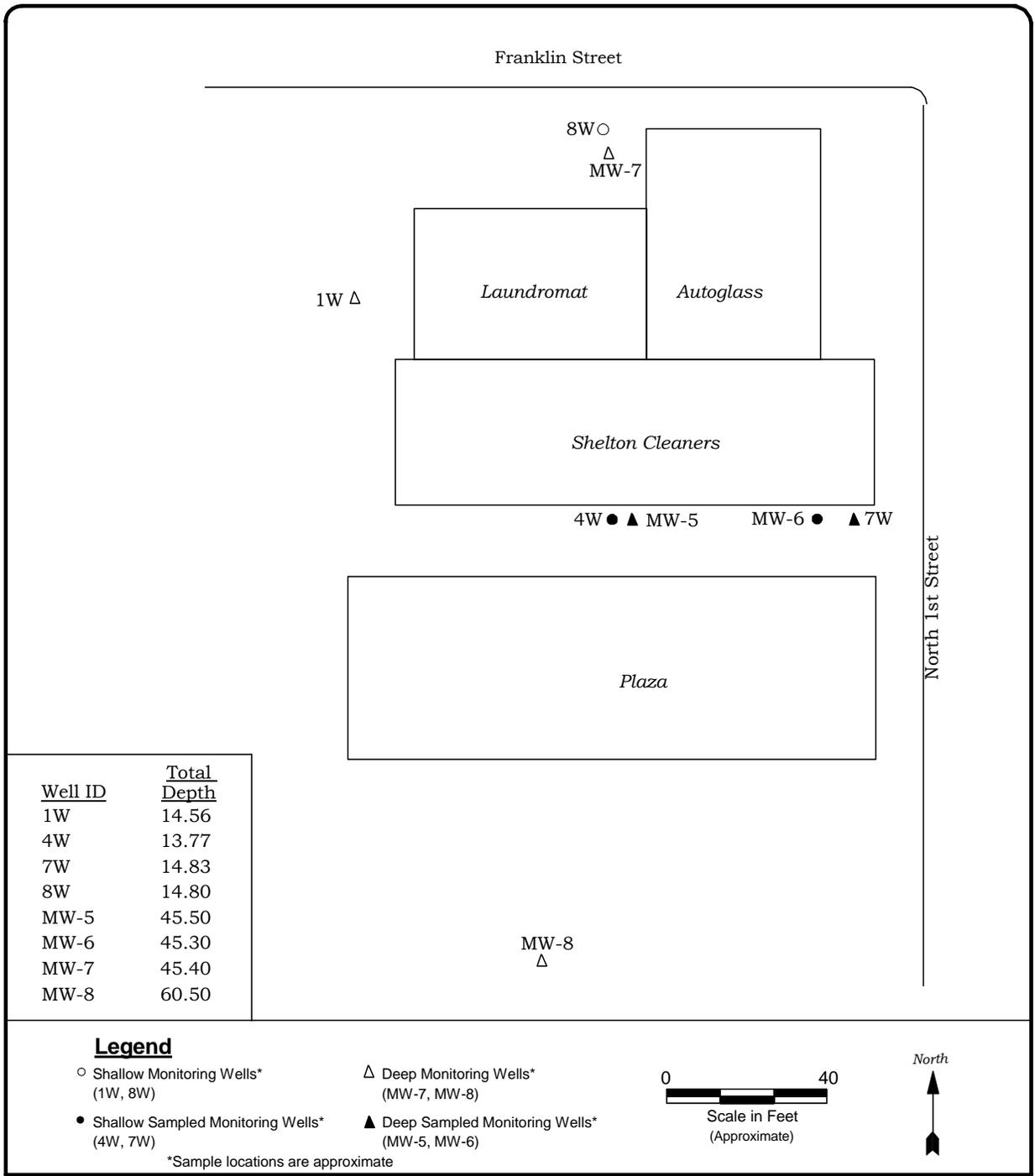


Figure 2: Shelton Laundry & Cleaners Sample Locations

Analysis

Analytes, analytical methods, and detection limits for both field and laboratory parameters are listed in Table 1. All groundwater samples were analyzed for volatile organics.

Table 1: Field and Laboratory Methods

Analytes	Method	Reference	Reporting Limit
<i>Field</i>			
Water Level	Solinst Water Level Meter	NA	0.03 feet
pH	Orion 25A Field Meter	NA	0.1 std. units
Temperature	YSI 3510 Temperature Probe	NA	0.1 °C
Specific Conductance	YSI 3520 Conductivity Cell	NA	10 umhos/cm
<i>Laboratory</i>			
VOAs	EPA SW-846 Method 8260B	U.S. EPA 1996	1-5 ug/L

In general, the quality of the data is acceptable. Quality control samples collected in the field consisted of blind duplicate samples, which were obtained from well 4W during both rounds of sampling. The numeric comparison of duplicate results is expressed as the relative percent difference (RPD). The RPD for PCE was 6% in September 2004 and 36% in April 2005. Due to the high RPD for the April results, average concentrations of the duplicate samples for PCE will be used in the remainder of this report.

In addition to field quality control samples, duplicate matrix spikes and surrogate compound recoveries were performed in the laboratory. Overall, matrix spikes and surrogate recoveries were within acceptable limits.

Quality assurance case narratives and laboratory reporting sheets, with the complete list of volatile organics analyzed, are available upon request.

Results

Field Observations

Total depth and depth-to-water of each monitoring well were determined before sampling began. Temperature, pH, and specific conductivity readings measured at the time of sampling are listed in Table 2.

Table 2: Summary of Field Parameter Results for September 2004 and April 2005

Monitoring Well	Total Depth (feet) ¹	Depth to Water (feet) ¹		Temperature (°C)		pH (standard units)		Specific Conductivity (umhos/cm)		Purge Volume (gallons)	
		9/04	4/05	9/04	4/05	9/04	4/05	9/04	4/05	9/04	4/05
<i>Shallow</i>											
1W	14.56	5.16	4.50	--	--	--	--	--	--	--	--
4W	13.77	5.12	4.47	14.4	11.0	6.7	6.9	219	214	3	3
7W	14.83	4.75	4.11	12.6	10.9	6.7	7.0	213	212	5	5
8W	14.80	4.41	3.78	--	--	--	--	--	--	--	--
<i>Deep</i>											
MW-5	45.5	5.12	4.45	13.6	11.3	6.9	7.1	215	211	10	10
MW-6	45.3	4.75	4.10	12.0	11.0	7.0	6.9	216	217	15	16
MW-7	45.4	4.52	3.85	--	--	--	--	--	--	--	--
MW-8	60.5	5.72	--	--	--	--	--	--	--	--	--

¹ Measured from top of PVC casing.

-- Not sampled

Completion depths for the eight monitoring wells ranged from 13.77 to 60.5 feet with depth-to-water ranging from 3.78 to 5.72 feet below the measuring point. Overall, water levels fluctuated less than one-foot during the monitoring period. Hydrographs showing water-level elevations for each well from May 2002 to April 2005 are in Figure 3. Data for the hydrographs are presented in Appendix A. The hydrographs show that the seasonal fluctuation is small throughout the year, less than one foot, and the groundwater gradient is fairly flat.

A typical groundwater flow pattern for the site is shown in Figure 4. This figure is based on water levels measured on September 2004. The location of the water-table contours was determined using a kriging algorithm in the Surfer software program. The groundwater flow direction is approximately perpendicular to the contours. The overall flow direction appears to be southward, which corresponds to the regional flow direction with flow toward the southwest and southeast.

Field parameters were within expected ranges for the sampled monitoring wells. Groundwater temperatures ranged from 10.9°C to 14.4°C. The pH of groundwater ranged from 6.7 to 7.1, and the specific conductivity measurements ranged from 211 to 219 umhos/cm.

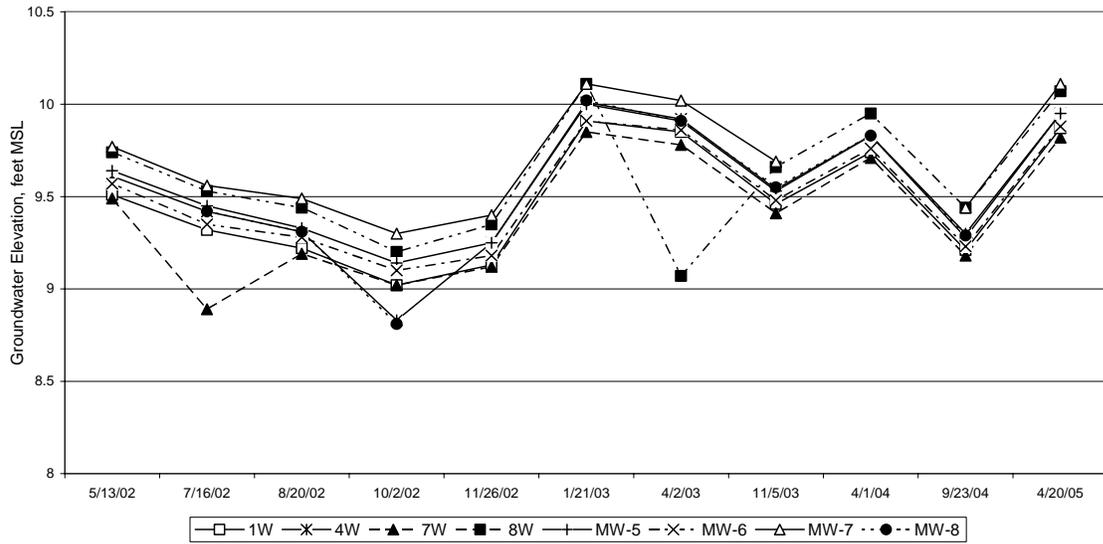


Figure 3: Shelton Laundry and Cleaners - Hydrographs, May 2002 to April 2005

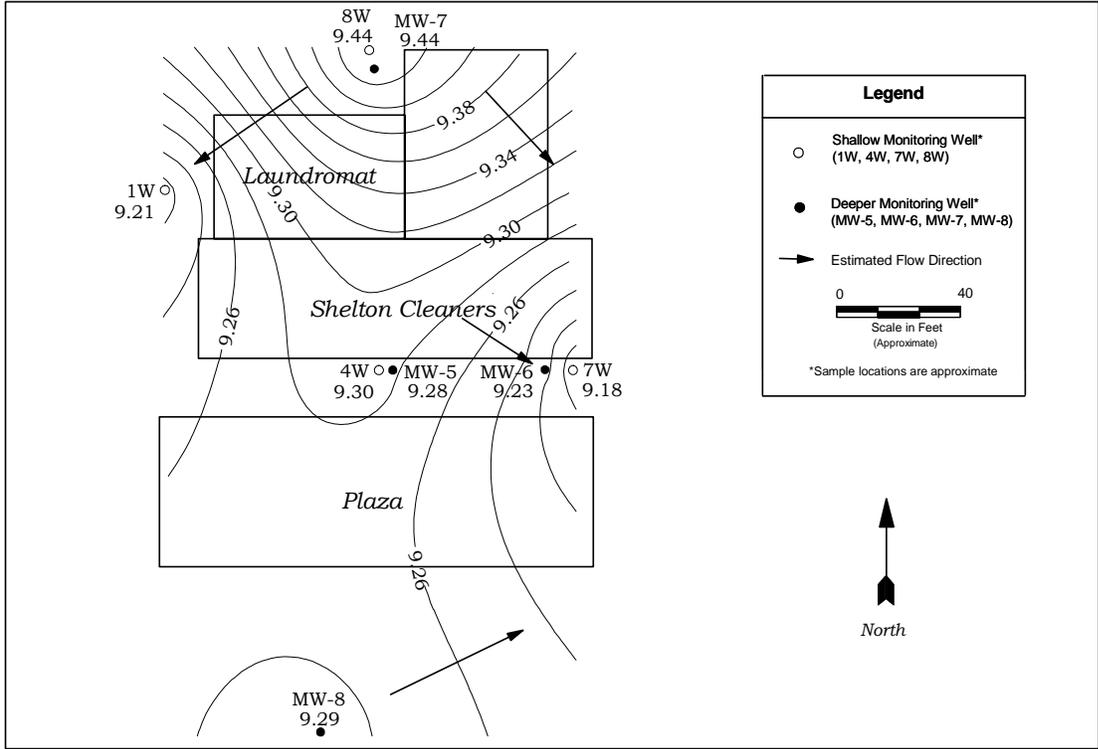


Figure 4: Shelton Laundry and Cleaners - Water Table Elevation, September 2004

Analytical Results

Analytical results for volatile organics (VOAs) are summarized in Table 3. For comparison, a summary of historical data for this project is presented in Appendix B.

Table 3: Summary of Analytical Results (ug/L) for September 2004 and April 2005

Well	Tetrachloroethylene (PCE)		Trichloroethylene (TCE)		Cis-1,2-Dichloroethylene (DCE)	
	9/04	4/05	9/04	4/05	9/04	4/05
4W	9.9	20*	1.4	2.3	0.47 J	0.83 J
7W	0.47 J	0.15 J	0.26 J	1 U	1 U	1 U
MW-5	1 U	1 U	1 U	1 U	1 U	1 U
MW-6	1 U	1 U	1 U	1 U	1 U	1 U

* – Average concentration of duplicate samples.

U – Analyte was not detected at or above the reported value.

J – Analyte was positively identified. The associated numerical result is an estimate.

Bold – Analyte was detected.

PCE, trichloroethylene (TCE), and cis-1,2-dichloroethylene (DCE) were detected in well 4W during both rounds of sampling. PCE concentrations in this well ranged from 9.9 to an average of 20 ug/L. TCE and DCE concentrations in well 4W were near or below the practical quantitation limit of 1 ug/L. PCE and TCE were also detected in well 7W at estimated concentrations of 0.47 and 0.15 ug/L for PCE, and 0.26 ug/L for TCE. Low concentrations of PCE have been detected in this well in the past. PCE, TCE, and DCE have not been detected in the four deep wells since they were installed in July 2002.

Conclusions

PCE concentrations have decreased in the two wells where PCE has been detected since the groundwater contamination was discovered in May 1997. During May 1997, the PCE concentration from a temporary boring in the vicinity of well 4W was reported as 130 ppb. PCE concentrations in well 4W have decreased from 280 ppb in July 1998 to an average of 15 ppb in 2005.

Although contaminant concentrations have decreased since 1998, PCE concentrations detected in well 4W during September 2004 and April 2005 continue to exceed the Model Toxic Control Act (MTCA) cleanup standard of 5.0 ug/L. TCE and DCE, typically associated with the breakdown of PCE, were detected in well 4W at concentrations below their respective cleanup standards of 5 ug/L.

Results of this study indicate that the Shelton site continues to be impacted in the area of well 4W but not at the other seven sampling locations. Because PCE concentrations continue to exceed MTCA cleanup standards in well 4W, a remedial action was implemented at this well in June 2005. Groundwater monitoring will continue on a quarterly basis for the next year to determine if the remediation has been effective.

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Appendix A. Hydrograph Data

Table A-1. Groundwater Elevations (feet above mean sea level), May 2002 to April 2005

Well ID	1W	4W	7W	8W	MW-5	MW-6	MW-7	MW-8
5/13/02	9.51	9.61	9.49	9.74	9.64	9.57	9.77	--
7/16/02	9.32	9.42	8.89	9.53	9.45	9.35	9.56	9.42
8/20/02	9.22	9.31	9.19	9.44	9.33	9.28	9.49	9.31
10/2/02	9.02	8.83	9.02	9.2	9.14	9.1	9.3	8.81
11/26/02	9.13	9.25	9.12	9.35	9.25	9.18	9.5	--
1/21/03	9.91	10.01	9.85	10.11	10	9.91	10.11	10.02
4/2/03	9.85	9.92	9.78	9.07	9.91	9.86	10.02	9.91
11/5/03	9.46	9.54	9.41	9.66	9.53	9.48	9.69	9.55
4/1/04	9.74	9.83	9.71	9.95	9.83	9.76	--	9.83
9/23/04	9.21	9.3	9.18	9.44	9.28	9.23	9.44	9.29
4/20/05	9.87	9.95	9.82	10.07	9.95	9.88	10.11	--

Depth-to-water measured from top of PVC casing.

-- Not measured

Appendix B. Historical Data

Table B-1. PCE, TCE, and DCE Results (ug/L) from May 1997 to April 2005

Well ID	Building Analytics	AA Enviro Assessment	GeoEngineers			
	5/21/97	3/3/98	7/24/98	11/18/98	7/12/99	9/6/00
1W						
PCE	--	--	<1.0	<1.0	<1.0	NS
TCE	--	--	<1.0	<1.0	<1.0	NS
4W						
PCE	130¹	1510²	280	130	39	25
TCE	NR	NR	4.7	<1.0	<1.0	<1.0
DCE	NR	NR	33	<1.0	<1.0	<1.0
7W						
PCE	--	--	4.3	3	<1.0	1.2
TCE	--	--	<1.0	<1.0	<1.0	<1.0
DCE	--	--	6.4	<1.0	<1.0	<1.0
8W						
PCE	--	--	<1.0	<1.0	<1.0	NS
TCE	--	--	<1.0	<1.0	<1.0	NS

PCE = tetrachloroethylene

TCE = trichloroethylene

DCE = cis-1,2-dichloroethylene

NS = not sampled

NR = not reported

<1.0 = Analyte was not detected at a concentration above the value shown.

U = Analyte was not detected at or above the reported value.

J = Analyte was positively identified. The associated numerical result is an estimate.

UJ = Analyte was not detected at or above the reported estimated result.

¹ = Concentration reported by Building Analytics is in approximate location of well 4W.

² = Concentration reported by AA Environ Assessment is in approximate location of well 4W.

* = Average concentration of duplicate samples.

Bold = Analyte was detected.

Table B-1 continued. PCE, TCE, and DCE Results (ug/L) from May 1997 to April 2005

Well ID	Ecology							
	7/17/02	10/3/02	1/22/03	4/3/03	11/5/03	4/1/04	9/23/04	4/20/05
1W								
PCE	1 U	1 U	1 U	1 U	--	--	--	--
TCE	1 U	2 U	1 U	1 U	--	--	--	--
4W								
PCE	9.3	15	17	12	15	26*	9.9	20*
TCE	0.84 J	1.9 J	0.25 J	1.3	2	2.8*	1.4	2.3
DCE	0.26 J	0.64 J	0.31 J	0.49 J	0.60 J	1.4	0.47 J	0.83 J
7W								
PCE	1 U	0.19 J	1 U	1 U	1 U	1.7	0.47 J	0.15 J
TCE	1 U	2 U	1 U	1 U	1 U	1 U	0.26 J	1 U
DCE	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
8W								
PCE	1 U	1 U	1 U	1 U	--	--	--	--
TCE	1 U	2 U	1 U	1 U	--	--	--	--
MW-5								
PCE	1 U	1 U	1 U	1 U	1 U	1 UJ	1 U	1 U
TCE	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-6								
PCE	1 U	1 U	1 U	1 U	1 U	1 UJ	1 U	1 U
TCE	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-7								
PCE	1 U	1 U	1 U	1 U	--	--	--	--
TCE	1 U	2 U	1 U	1 U	--	--	--	--
MW-8								
PCE	1 U	1 U	1 U	1 U	--	--	--	--
TCE	1 U	2 U	1 U	1 U	--	--	--	--

PCE = tetrachloroethylene

TCE = trichloroethylene

DCE = cis-1,2-dichloroethylene

-- = Not sampled

U = Analyte was not detected at or above the reported value.

J = Analyte was positively identified. The associated numerical result is an estimate.

UJ = Analyte was not detected at or above the reported estimated result.

* = Average concentration of duplicate samples.

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