



Lakewood Plaza Cleaners/Ponders Corner Groundwater Monitoring Results, June 2017: Data Summary Report

Abstract

This data summary report is one in a series describing results of long-term groundwater monitoring at the former Lakewood Plaza Cleaners/Ponders Corner site south of Tacoma. The Washington State Department of Ecology (Ecology) began collecting groundwater data at the site in the early 1990s as part of its responsibilities for operation and maintenance of the site remedial actions. Operation of the nearby Lakewood Water District municipal supply wells H1 and H2 with wellhead treatment systems continues to be the remedial option identified in the EPA Record of Decision. The monitoring goal is to evaluate the effectiveness of wells H1 and H2 to contain and remove groundwater contaminated by improper waste management practices at the former cleaners.

This report describes water quality results for groundwater samples collected in June 2017 from eight project monitoring wells and Lakewood Water District municipal well H1.

Among the key findings:

- Tetrachloroethene (PCE) concentrations in monitoring wells MW-20B and MW-16A still do not meet the project cleanup level of 5 ug/L, with estimated concentrations of 174 ug/L and 82 ug/L respectively.
- Samples collected from municipal well H1 prior to treatment had an estimated PCE concentration of 3 ug/L, which is below the project cleanup level.
- Trichloroethene was also detected in wells MW-20B (2.9 ug/L) and MW-16A (0.82 ug/L) at concentrations below the cleanup level of 5 ug/L.

The use of municipal wells H1 and H2 to contain, remove, and treat contaminated groundwater associated with the Lakewood Plaza Cleaners/Ponders Corner site continues, since the cleanup goals have not been achieved. Based on recommendations of the last 5-year review (USACE, 2012), the Environmental Protection Agency (EPA) conducted a study (EPA, 2017) to reevaluate the treatment remedy. EPA determined that although production wells H1 and H2 are not pumped continuously, current operation of the wells appears to provide the protectiveness of the selected remedy. Since the cleanup goals have not been achieved, EPA and Ecology need to determine what additional actions are needed to achieve site cleanup.

Publication Information

This report is available on the Department of Ecology's website at <https://fortress.wa.gov/ecy/publications/SummaryPages/1803012.html>

Data and associated annual monitoring reports for this project are available at Ecology's Environmental Information Management (EIM) website [EIM Database](#).
Search Study ID: LAKEWOOD.

Ecology's Activity Tracker Code for this study is 99-001.

Water Resource Inventory Area (WRIA) and 8-digit Hydrologic Unit Code (HUC) numbers for the study area:

- WRIA: 12 - Chambers/Clover
- HUC number: 17110019

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Background

In 1981, the U.S. Environmental Protection Agency (EPA) confirmed that Lakewood Water District production wells H1 and H2 were contaminated with volatile organic compounds: tetrachloroethene (PCE), trichloroethene (TCE), and cis-1,2-dichloroethene (cis-1,2-DCE). Lakewood is south of Tacoma in Pierce County, Washington. The source of the contamination was identified as the former Lakewood Plaza Cleaners, a nearby dry cleaning and laundry facility (EPA, 1983). The contamination resulted from the dumping of PCE into on-site septic tanks and the disposal of dry cleaning sludge on the ground surface. The Lakewood Plaza Cleaners site was added to the National Priorities List (NPL) in 1982 under the site name: Lakewood/Ponders Corner. The site is currently occupied by Rainier Lighting and Electric Supply.

EPA began remedial activities at the site in 1983. Remediation included the installation and operation of groundwater air-strippers at Lakewood Water District wells H1 and H2, which are located approximately 800 feet southwest of the contaminant source area (Figure 1). Contaminated soils and sludge were also removed from the source area, and a small portion of the contaminated septic field soils were treated with vapor extraction. Soil remediation was completed in 1993. The soils unit of the site was removed from the NPL in 1996 (EPA, 1996). Treatment of the contaminated groundwater extracted by wells H1 and H2 continues, since groundwater cleanup levels for PCE of 5 ug/L have not been achieved.

Although the Washington State Department of Ecology's (Ecology's) responsibilities for operation and maintenance of the remedial actions did not begin until 1997, Ecology began semi-annual groundwater compliance monitoring at the site in 1991. The objective of the sampling was to collect data on groundwater quality in order to evaluate the effectiveness of Lakewood water supply wells H1 and H2 to contain, remove, and treat the groundwater contaminated by Plaza Cleaners.

Groundwater monitoring has been modified over the years to focus primarily on wells in the immediate vicinity of the former Plaza Cleaners. Currently there are eight monitoring wells and the two production wells (H1 and H2) in the monitoring program (Figure 1). Of the eight monitoring wells, one is screened in the Steilacoom Gravel unit (LPMW-2), one in the Vashon Till (MW-20B), and the remainder in the Advance Outwash deposits (MW-16A, MW-19A, MW-20A, MW-31, MW-32, MW-33).

The two shallow wells screened in the Steilacoom Gravel and Vashon Till units are located near the contaminant source area. The Steilacoom Gravel is composed of permeable Vashon recessional sand and gravel deposits. This unit typically ranges from about 0 to 30 feet below ground surface (bgs). The Steilacoom gravels, which are typically unsaturated, contain an area of perched groundwater in the immediate vicinity of the former Plaza Cleaners and near wells H1 and H2 (EPA, 1985a). The underlying Vashon Till consists of semi-confining silt and clay-rich layers that contain lenses of clean gravel. This unit, which is highly variable in thickness, typically ranges from about 30 to 75 feet bgs. At least one gravel lens is reported to be present beneath the former Plaza Cleaners site and appears to be large in its lateral extent. This permeable interval appears to be hydraulically interconnected with the Steilacoom gravels (EPA, 1985b).

The rest of the wells are screened in the highly permeable sands and gravels of the deeper Advance Outwash deposits, the primary water supply aquifer for the area. This unit is typically 75 to 110 feet bgs. Regional groundwater flow in the Advance Outwash is generally to the west-northwest toward Gravelly Lake. When production wells H1 and H2 are pumping, they create a capture zone influencing groundwater flow directions in the area. The horizontal hydraulic conductivities for this unit vary from 400 to 2000 feet per day. Linear flow velocities range from 2.7 to 100 ft/day (USACE, 2012).

Groundwater monitoring has been conducted at this site since 1985. In accordance with EPA policy and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA § 121(42 U.S.C. Section 9621) and the National Contingency Plan (NCP), five-year reviews are required on projects, as long as cleanup goals have not been achieved. Five 5-year reviews for the Lakewood Plaza Cleaners/Ponders Corner site have been completed. EPA conducted five-year reviews in 1992, 1997 and 2007. Ecology conducted a five-year review in 2002. The 2012 five-year review was conducted by the U.S. Army Corps of Engineers (USACE) for EPA. The 2012 five-year review concluded that the current remedy was not performing as expected or providing long-term protectiveness towards attaining the groundwater cleanup goals. The review acknowledged that the continuing migration of contaminants from the lower permeability till unit is the likely cause for ongoing impacts to groundwater in the advance outwash deposits. This represents one of the major physical factors preventing the attainment of groundwater cleanup levels throughout the plume in a reasonable timeframe (USACE, 2012).

In response to the findings of the last five-year review, EPA conducted a groundwater sampling and hydraulic monitoring study in 2016. The objective was to assess the current protectiveness of the on-going remedy at the site, specifically when well H1 and H2 are operating in a non-continuous manner. The EPA study involved the collection of groundwater quality and hydraulic data from April to November 2016 (EPA, 2017). The study concluded that although Lakewood Water District production wells H1 and H2 are not pumped continuously, the current operation of the wells appears to provide the protectiveness of the selected remedy.

Because the cleanup goals have not been achieved at the Lakewood Plaza Cleaners/Ponders Corner site, remediation and monitoring of the groundwater is ongoing under a long-term response action.

Data collected by Ecology, and the associated monitoring reports for this project, are available at Ecology's Environmental Information Management (EIM) website [EIM Database](#). Search Study ID: LAKEWOOD.

Methods and Results

In June 2017, Ecology collected groundwater samples from the two shallow (LPMW-2, MW-20B) and seven deep (MW-16A, MW-19A, MW-20A, MW-31, MW-32, MW-33, H1) wells in order to evaluate volatile organics in groundwater at the Lakewood Plaza Cleaners/Ponders Corner site.

Ecology sampled all monitoring wells in accordance with Ecology’s SOP EAP078 (Marti, 2014a). Monitoring wells MW-16A and MW-20A were purged and sampled, using dedicated bladder pumps. Wells LPMW-2, MW-19A, MW-20B, MW-31, MW-32, and MW-33 were purged and sampled with a stainless-steel submersible pump. Municipal well H1 was operating at the time of the June sampling. The sample for well H1 was collected from a tap before any water treatment, in accordance with Ecology’s SOP EAP077 (Marti, 2014b).

Groundwater samples were submitted for analysis of volatile organic compounds (VOCs). Analytical results for VOCs of concern (PCE, TCE, cis-1,2-DCE, and vinyl chloride) for the June 2017 sampling event are presented in Table 1 and Figure 1.

Quality control samples collected in the field consisted of a blind field duplicate collected from well MW-16A. The relative percent difference (RPD) for the June data ranged from 1% to 17%. The duplicate data meet the laboratory data quality objective (DQO) of 30% for this analysis. PCE results are reported as estimates when the associated lab blank exceeded the control limit. Results reported below the method reporting limit (1 ug/L) are automatically qualified as estimates. The laboratory data quality control and quality assurance results indicate that the analytical performance was good and the results are usable as qualified.

Table 1: Sample Results for Lakewood Plaza Cleaners/Ponders Corner, June 2017.

Well ID	Field Measurements						Laboratory Analysis			
	Well Depth (feet)	Ground Water Elevation (feet)	pH (Std. Units)	SC (uS/cm)	DO (mg/L)	ORP (mV)	PCE	TCE	Cis-1,2 DCE	Vinyl Chloride
	TOC						<i>Project Cleanup Levels</i>			
							5 ug/L	5 ug/L	70 ug/L	0.2 ug/L
Shallow Wells										
LPMW-2	29	257.09	6.5	324	1.7	48	5.7	1 U	1 U	1 U
MW-20B	50.4	253.32	6.5	299	5.2	111	174 J	2.9	4.5	1 UJ
Deep Wells										
MW-16A	109	249.52	7.9	258	6.7	46	82 J	0.82 J	1.3	1 UJ
MW-16A (dup)	--	--	--	--	--	--	69	0.83 J	1.4	1 UJ
MW-19A	97.5	257.66	6.7	202	7.2	84	1 U	1 U	1 U	1 U
MW-20A	97.3	252.41	7.4	241	5.6	66	1 U	1 U	1 U	1 UJ
MW-31	91.22	245.5	6.6	196	9.1	85	0.7 J	1 U	1 U	1 U
MW-32	114.48	244.56	6.9	207	6.4	58	1.4	1 U	1 U	1 U
MW-33	99.3	250.05	6.9	230	3.5	84	1 U	1 U	1 U	1 UJ
H1	110	--	--	--	--	--	3 J	1 U	1 U	1 UJ

TOC: Top of Casing

SC: Specific Conductance

DO: Dissolved Oxygen

ORP: Oxidation Reduction Potential

Bold: Analyte was detected.

Shade: Values are greater than project cleanup levels.

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

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

Monitoring wells MW-20B and MW-16A continue to have PCE concentrations that far exceed the cleanup level of 5 ug/L.

Samples collected from municipal wells H1 and H2 before treatment continue to have low concentrations of PCE (Tables 1 and 2).

PCE concentrations in well LPMW-2 also continue to be detected near the cleanup level (Tables 1 and 2). This well is located near the former septic system of Plaza Cleaners, which was identified as a source of the contamination (Figure 1).

Vinyl chloride was not detected in any of the sampled wells. Although the reporting limit was 1 ug/L, the method detection limit for the June 2017 analysis was 0.04 ug/L. Vinyl chloride has not been detected in any of the samples collected by Ecology since taking over the monitoring in 1991.

Long-term VOC data for wells monitored during the Lakewood Plaza Cleaners/Ponders Corner project are presented in Table 2. Figure 2 shows PCE concentration data for wells MW-16A and MW-20B for the same time period.

Discussion and Conclusions

Concentrations of PCE in groundwater have generally decreased from their 1980s levels with the implementation of remedial activities at the Lakewood Plaza Cleaners/Ponders Corner site. However, concentrations still do not meet the project groundwater cleanup goal of 5 ug/L. Since Ecology began sampling in 1991, groundwater PCE concentrations have varied over time. Concentrations in well MW-20B fluctuate seasonally but continue to be far above the cleanup level (Figure 2). PCE concentrations in well MW-16A also continue to exceed the cleanup level (Figure 2). Statistical trend analysis was performed on the PCE data from wells MW-20B and MW-16A. ProUCL Software was used to apply the Mann-Kendall trend test on the 1991 through 2017 time-series data. The trend analysis suggests that PCE concentrations in well MW-20B are decreasing, while in well MW-16A they are increasing. The increasing trend in well MW-16A is attributed to the likely downward migration of contaminants from the Vashon Till to the Advance Outwash.

This supports the conceptual site model that contaminants migrate from the lower permeability till to the more permeable outwash. Once in the outwash, the contaminants move in the capture zone towards pumping wells H1 and H2. EPA's 2016 study also appears to support this model (EPA, 2017).

The use of municipal wells H1 and H2 to remove and treat contaminated groundwater associated with the Lakewood Plaza Cleaners/Ponders Corner needs to continue, since the cleanup goals have not been achieved.

Recommendations

EPA recommended, and Ecology is in agreement, that since the cleanup goals throughout the contaminant plume have not been achieved, the current remedial activities should be evaluated. The first three recommendations in this report were made in the 2012 five-year review to evaluate the current remedial activities (USACE, 2012):

1. **Determine the capture zone in the Advance Outwash for wells H1 and H2 at the current pumping rates.** In 2012, it was reported that wells H1 and H2 operated on an alternate six-month rotation with seasonal flow variations. Since only one well operates at a time, it was concluded that a weak hydraulic control of the groundwater in the Advance Outwash and Vashon Till aquifers may result.

In 2016, EPA conducted a groundwater sampling and hydraulic monitoring study to address this issue. Determining the horizontal and vertical groundwater flow direction was a primary objective in order to provide insights on how the change in the production well pumping may have affected the protectiveness of the sites remedy. The EPA study seems to concur that hydraulic capture of the contaminated groundwater is not being maintained at all times because both wells are not pumped in a continuous manner. However, this does not appear to be impacting groundwater quality downgradient of the most contaminated wells. Groundwater to the north and west of well MW-16A continues to have PCE concentrations below the cleanup level.

The EPA study also used paired wells MW-20A and MW-20B to evaluate the vertical hydraulic gradient. The original conceptual model showed a downward vertical hydraulic gradient from the till to the advance outwash deposits. Water level data over the course of the project and in 2016 have shown the vertical flow reverses seasonally, from a downward gradient at the end of the wet season to an upward gradient at the end of the dry season.

2. **Update characterization of groundwater flow directions and extent of the contaminant plume in the Steilacoom Gravel and Vashon Till.** There is still insufficient groundwater data to assess either of these issues, since there is only one well in each unit in the current monitoring program. All other wells in these units have either been decommissioned or lost over the course of the project.
3. **Evaluate the restoration timeframe for the aquifer and alternatives to accelerate the restoration if necessary.** The estimated aquifer restoration timeframe has ranged from a minimum of 10 years to greater than 100 years (USACE), 2012). The shorter timeframe was apparently based on both production wells operating simultaneously and continuously. As of 2017, wells H1 and H2 have been used for 33 years to treat the contaminated groundwater. The variable pumping rates and continued leaching of PCE from the Vashon Till may be contributing to the increased length of time to achieve the cleanup goals. Additional treatment options for the source area (Steilacoom Gravel and Vashon Till) should be evaluated to determine if the restoration of the aquifer can be accelerated.

4. Since Ecology began groundwater compliance monitoring in 1991, the monitoring program has been modified over the years to focus primarily on wells in the immediate vicinity of the former Plaza Cleaners. Currently there are eight monitoring wells and the two production wells in the monitoring program. It is recommended that Ecology continue monitoring the primary wells (MW-16A, MW-20A, MW-20B, LPMW-2 and H1/H2) on an 18-month monitoring cycle to capture seasonal variation in the contaminant concentrations. Monitoring of the remaining wells on a 3-year (MW-33) and 5-year (MW-19A, MW-31, MW-32) cycle should continue to be sufficient to meet the project goals.
5. EPA installed two wells for the 2016 study. The wells were placed hydraulically downgradient of wells MW-16A and MW-20B based on the regional groundwater flow direction. These wells should be added to the monitoring program on a 3-year (MW-28R) and 5-year (MW-41R) rotation.
6. EPA recommends the installation of a new well west of well MW-16A. A downgradient or boundary well does not exist in the outwash deposits at this location. It is recommended that the well be installed to the same depth as MW-16A (105 to 115 feet bgs). Project well MW-21 had been located in this area until it was decommissioned in 1996. The reported well depth was 93 feet. PCE concentrations were approximately 2 ug/L when the well was sampled from 1991 thru 1994.

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Figures

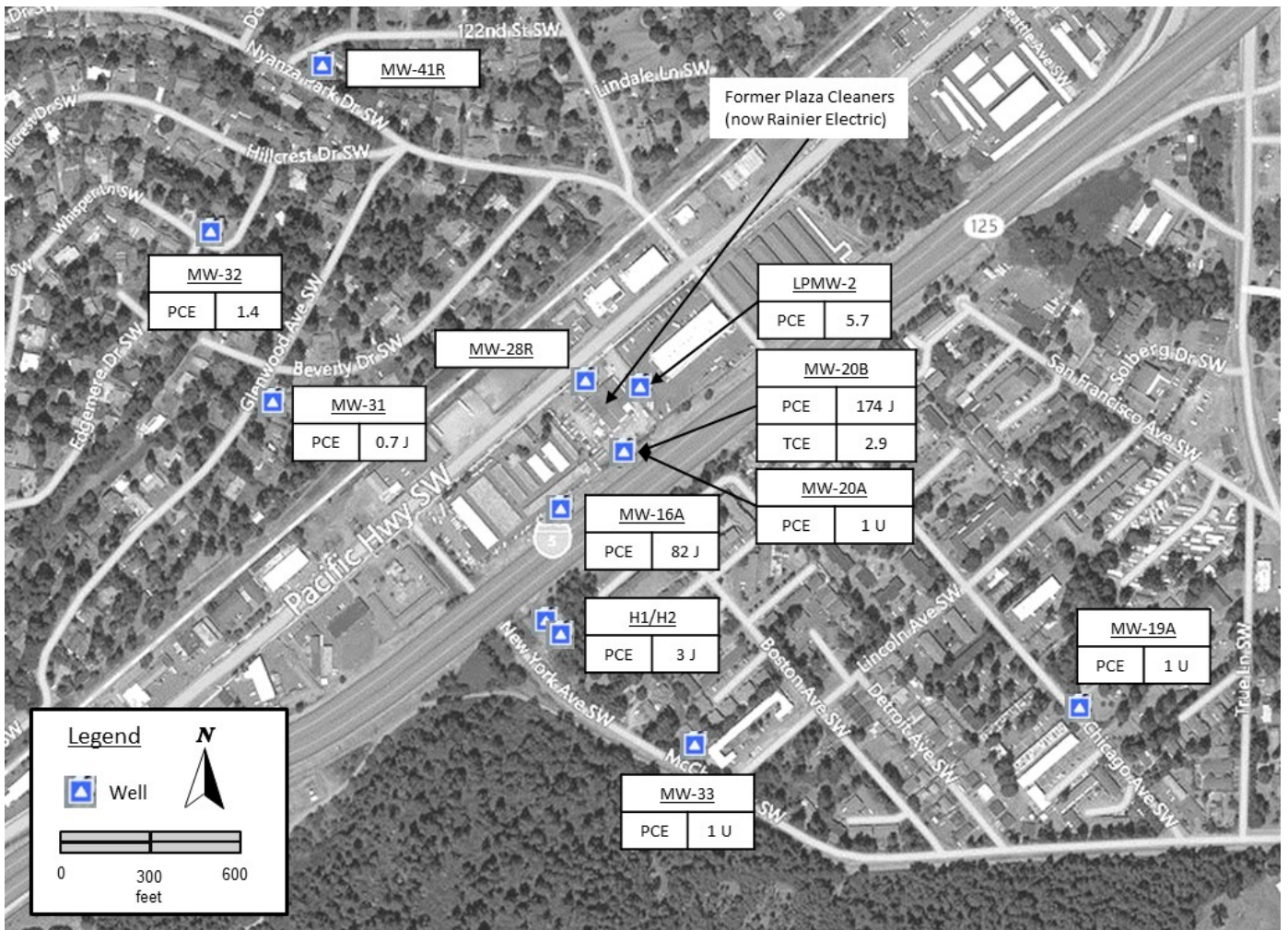


Figure 1. Lakewood Plaza Cleaners Sampling Locations and Results (ug/L), June 2017.

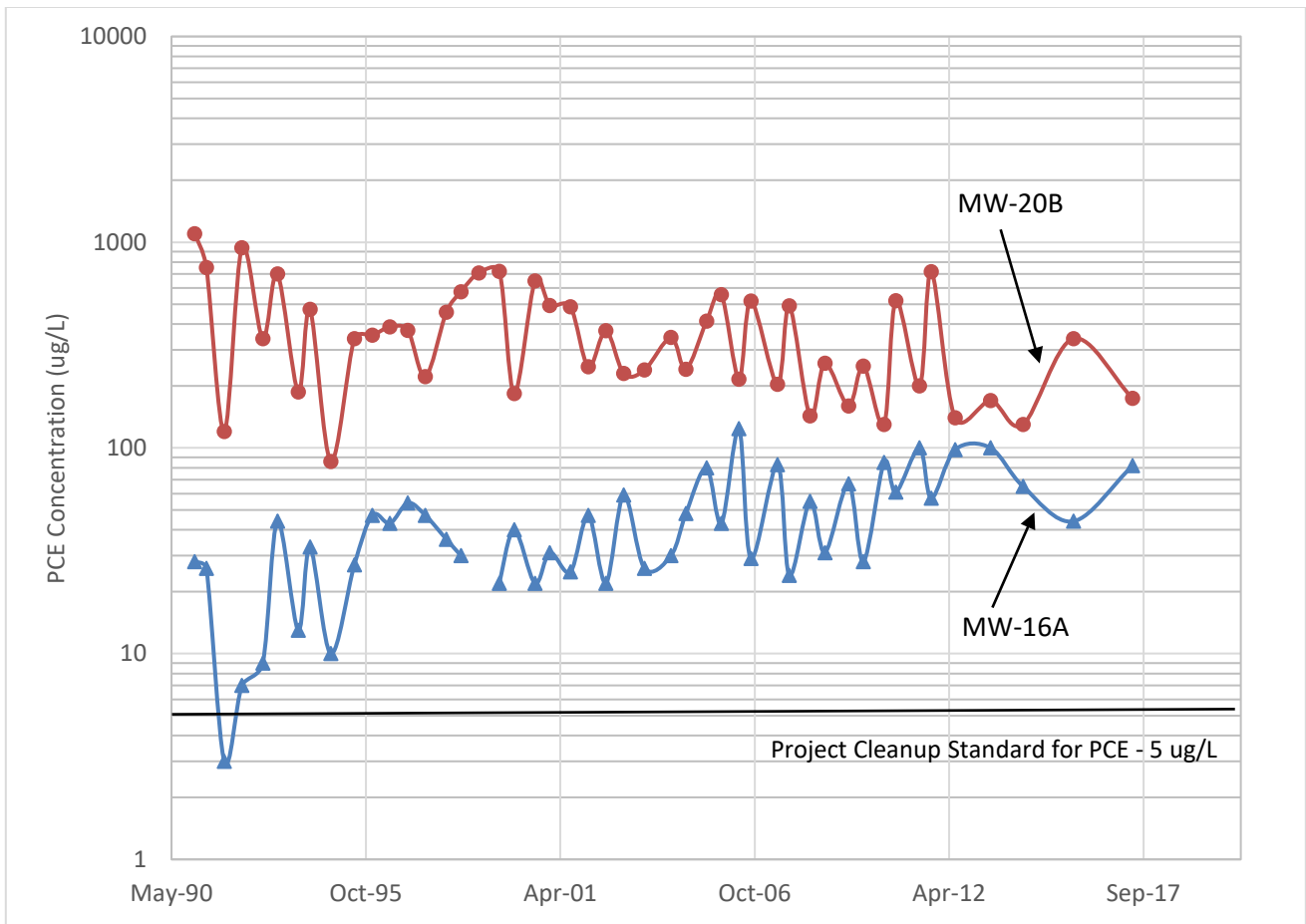


Figure 2. PCE Concentrations for Wells MW-16A and MW-20B, January 1991 to June 2017.

Tables

Table 2. Summary of Sample Results (ug/L) from January 1991 to June 2017.

Date	MW-16A				MW-20A				MW-20B			
	PCE	TCE	Cis-DCE	VC	PCE	TCE	Cis-DCE	VC	PCE	TCE	Cis-DCE	VC
1/1991	28	1 J	2.4 J	1 U	1 U	1 U	1 U	1 U	1100	18	33	1 U
5/1991	26	0.6 J	2	1 U	0.4 J	1 U	1 U	1 U	752	16	30	1 U
11/1991	2.7 J	1 U	0.6 J	1 U	0.4 NJ	1 U	1 U	1 U	120	2.6 J	6.7	1 U
5/1992	7	1 U	1	1 U	0.5 J	1 U	1 U	1 U	940	13	32	1 U
12/1992	9 J	0.3 J	0.8 J	1 UJ	0.8 J	1 UJ	1 UJ	1 UJ	340 J	14 J	20 J	5 UJ
5/1993	44	10 U	2 J	10 U	10 U	10 U	10 U	10 U	700	12	21	10 U
12/1993	13	0.3 J	0.7 J	1 U	0.3 J	1 U	1 U	1 U	187	50 U	8.2 J	50 U
4/1994	33	0.6	1.4	1 U	0.4	0.2 U	0.2 U	1 U	472	8.6 J	12.6	50 U
11/1994	9.7	0.3 J	0.5 J	1 U	0.3 J	1 U	1 U	1 U	86	50 U	3 J	50 U
7/1995	27	0.5 J	0.8 J	1 U	0.4 J	1 U	1 U	1 U	340	8.4	17	1 U
1/1996	47 E	0.8 J	1.5	2 U	0.2 J	1 U	1 U	2 U	353	7.2	15	2 U
7/1996	43	0.7 J	1.9	1 U	0.4 J	1 U	1 U	1 U	387	7.6	15	1 U
1/1997	54	1.1	3.1	1 U	0.4 J	1 U	1 U	1 U	373	100 U	6.4 J	100 U
7/1997	47	0.7 J	2.5	1 U	0.3 J	1 U	2 U	1 U	222	4	6.4	1 U
2/1998	36	0.7 J	2 J	5 U	0.4 J	1 U	1 U	1 U	456	7 J	12	10 U
7/1998	30	1 U	1.5	1 U	0.6 J	1 U	1 U	1 U	575	10	23	1 U
1/1999	--	--	--	--	1 U	2 U	1 U	1 U	708	5.2	12	1 U
8/1999	22	0.4 J	1.1	1 U	0.8 J	2 U	1 U	1 U	722	8.4 J	16 J	1 U
1/2000	40	0.7 J	1.9	1 U	0.2 NJ	2 U	1 U	1 U	184	6	13	1 U
8/2000	22	0.3 J	0.7	1 U	0.1 J	2 U	1 U	1 U	648	200 U	100 U	100 U
1/2001	31	0.4 J	1	1 U	0.2 J	1 U	1 U	1 U	493	6.6 J	12	10 U
8/2001	25	0.3 J	0.7 J	1 U	1 U	2 U	1 U	1 U	486	8.2	18	100 U
2/2002	47	0.8 J	2.3	1 UJ	--	--	--	--	248	200 U	100 U	100 UJ
8/2002	22	0.3 J	0.8 J	1 U	--	--	--	--	371	8.5	16	1 U
2/2003	59 J	0.2 J	2.4	1 U	1 U	1 U	1 U	1 U	230	100 U	100 U	100 U
9/2003	26	0.3 J	0.5 J	5 U	0.1 J	1 U	1 U	5 U	239	5.4 J	12	50 U
6/2004	30	0.4 J	0.8 J	1 U	0.2 J	1 U	1 U	1 U	344	6.5 J	15	10 U
11/2004	48	1 U	1.4	5 U	0.3 J	1 U	1 U	5 U	241	6.7	13	5 U
6/2005	80	1.3	2.8	5 U	1 U	1 U	1 U	2 U	413	6.6	12	5 U
11/2005	43	0.7 J	1 J	2 U	1 U	1 U	1 U	2 U	555	6.4	11	2 U
5/2006	124	1.8	4.6	5 U	1 U	1 U	1 U	5 U	216	4.2	6.6	5 U
9/2006	29	0.3 J	0.5 J	2 U	1 U	1 U	1 U	2 U	518	5.6	11	2 U
6/2007	83	1.2	2.5	2 U	2 U	2 U	2 U	2 U	204	4.4	7.8	2 U
10/2007	24	1 U	0.6 J	2 U	2 U	1 U	1 U	2 U	491	7.5	15	2 U
5/2008	55	1.2	2.8	1 U	1 U	1 U	1 U	1 U	143	5.5	12	1 U
10/2008	31	0.5 J	0.6 J	1 U	1 U	1 U	1 U	1 U	258	4.5	9	1 U
6/2009	67	0.9 J	2.2	1 U	1 U	1 U	1 U	1 U	160	4.1	7.4	1 U
11/2009	28	0.5 J	0.8 J	1 U	0.6 J	1 U	1 U	1 U	250	4.7	9.6	1 U
6/2010	85	1.3	1.6	1 U	1 U	1 U	1 U	1 U	130	3.7	6.3	1 U
10/2010	61	0.9 J	1.2	1 U	2 U	1 U	1 U	1 U	520	5.8	10	1 U

Date	MW-16A				MW-20A				MW-20B			
	PCE	TCE	Cis-DCE	VC	PCE	TCE	Cis-DCE	VC	PCE	TCE	Cis-DCE	VC
6/2011	100	1.4	1.6	1 UJ	1 U	1 U	1 U	1 UJ	200	3.5	5.6	1 UJ
10/2011	57	0.8 J	1	2 U	1 U	1 U	1 U	2 U	720	4.8	7.9	2 U
6/2012	98	1.3	2.4	1 U	1 U	1 U	1 U	1 U	140	3.3	5.7	1 U
6/2013	100	1.3	2.6	1 U	1 U	1 U	1 U	1 U	170	3.9	7	1 U
5/2014	65	1.1	1.3	1 U	1 U	1 U	1 U	1 U	130	2.1	3	1 U
10/2015	44	0.5 J	0.6 J	1 U	0.2 J	1 U	1 U	1 U	340	5.4	12	1 U
6/2017	82 J	0.82 J	1.3	1 UJ	1 U	1 U	1 U	1 UJ	174 J	2.9	4.5	1 UJ
MTCA CL	5	5	70	0.2	5	5	70	0.2	5	5	70	0.2

Table 2. Continued.

Date	MW-27				H1/H2				LPMW-2			
	PCE	TCE	Cis-DCE	VC	PCE	TCE	Cis-DCE	VC	PCE	TCE	Cis-DCE	VC
1/1991	1 U	1 U	1 U	1 U	--	--	--	--	--	--	--	--
5/1991	1 U	1 U	1 U	1 U	--	--	--	--	--	--	--	--
11/1991	1 U	1 U	1 U	1 U	--	--	--	--	--	--	--	--
5/1992	1 U	1 U	1 U	1 U	--	--	--	--	--	--	--	--
12/1992	1 UJ	1 UJ	1 UJ	1 UJ	--	--	--	--	--	--	--	--
5/1993	10 U	10 U	10 U	10 U	--	--	--	--	--	--	--	--
12/1993	1 U	1 U	1 U	1 U	--	--	--	--	--	--	--	--
4/1994	0.2 U	0.2 U	0.2 U	1 U	--	--	--	--	--	--	--	--
11/1994	1 U	1 U	1 U	1 U	--	--	--	--	--	--	--	--
7/1995	1 U	1 U	1 U	1 U	9	0.3 J	1 U	1 U	--	--	--	--
1/1996	1 U	1 U	1 U	2 U	8.4	0.2 J	0.2 J	2 U	--	--	--	--
7/1996	1 U	1 U	1 U	1 U	0.1 J	1 U	1 U	1 U	--	--	--	--
1/1997	1 U	1 U	1 U	1 U	18	0.4 J	0.4 J	1 U	--	--	--	--
7/1997	1 U	1 U	1 U	1 U	8.8	0.3 J	0.6 J	1 U	--	--	--	--
2/1998	1 U	1 U	1 U	1 U	11	0.4 J	0.3 J	1 U	--	--	--	--
7/1998	0.05 J	1 U	1 U	1 U	9.8	1 U	0.1 J	1 U	--	--	--	--
1/1999	1 U	2 U	1 U	1 U	1.5	1 U	1 U	1 U	--	--	--	--
8/1999	1 U	2 U	1 U	1 U	5.2	0.2 J	1 U	1 U	--	--	--	--
1/2000	1 U	2 U	1 U	1 U	10	2 U	1 U	1 U	--	--	--	--
8/2000	1 U	2 U	1 U	1 U	8.7	0.03 J	1 U	1 U	--	--	--	--
1/2001	1 U	1 U	1 U	1 U	11	0.2 J	1 U	1 U	--	--	--	--
8/2001	1 U	2 U	1 U	1 U	6.8	0.2 J	1 U	1 U	--	--	--	--
2/2002	1 U	2 U	1 U	1 UJ	12	0.2 J	0.2 J	1 UJ	--	--	--	--
8/2002	1 U	2 U	1 U	1 U	6.1	1 U	1 U	1 U	--	--	--	--
2/2003	1 U	1 U	1 U	1 U	1.3	1 U	1 U	1 U	--	--	--	--
9/2003	1 U	1 U	1 U	5 U	6.4	0.2 NJ	1 U	5 U	--	--	--	--
6/2004	1 U	1 U	1 U	1 U	7.9	0.2 J	0.1 J	1 U	--	--	--	--
11/2004	1 U	1 U	1 U	5 U	2.6	1 U	1 U	5 U	--	--	--	--
6/2005	1 U	1 U	1 U	2 U	14	0.3 J	1 U	2 U	--	--	--	--
11/2005	1 U	1 U	1 U	2 U	6.4	1 U	1 U	2 U	--	--	--	--
5/2006	1 U	1 U	1 U	5 U	7.3	0.2 J	1 U	5 U	9.9	1 U	1 U	5 U
9/2006	1 U	1 U	1 U	2 U	4.8	1 U	1 U	2 U	--	--	--	--
6/2007	2 U	2 U	2 U	2 U	5.2	2 U	2 U	2 U	4.8	1 U	1 U	2 U
10/2007	2 U	1 U	1 U	2 U	3.8	1 U	1 U	2 U	--	--	--	--
5/2008	1 U	1 U	1 U	1 U	9.6	1 U	1 U	1 U	2.5	1 U	1 U	1 U
10/2008	1 U	1 U	1 U	1 U	5.1	1 U	1 U	1 U	--	--	--	--
6/2009	1 U	1 U	1 U	1 U	6.8	1 U	1 U	1 U	4.1	1 U	1 U	1 U
11/2009	1 U	1 U	1 U	1 U	--	--	--	--	11	1 U	1 U	1 U
6/2010	1 U	1 U	1 U	1 U	4.3	1 U	1 U	1 U	4.4	1 U	1 U	1 U
10/2010	--	--	--	--	--	--	--	--	5	1 U	1 U	1 U
6/2011	1 U	1 U	1 U	1 UJ	5.9	1 U	1 U	1 UJ	3.2	1 U	1 U	1 UJ

Date	MW-27				H1/H2				LPMW-2			
	PCE	TCE	Cis-DCE	VC	PCE	TCE	Cis-DCE	VC	PCE	TCE	Cis-DCE	VC
10/2011	1 U	1 U	1 U	2 U	1.4	1 U	1 U	2 U	--	--	--	--
6/2012	Well Decommissioned				5.2	1 U	1 U	1 U	2.4	1 U	1 U	1 U
6/2013					4.9	1 U	1 U	1 U	2.2	1 U	1 U	1 U
5/2014					2.9	1 U	1 U	1 U	2.7	1 U	1 U	1 U
10/2015					1.8	0.2 J	1 U	1 U	--	--	--	--
6/2017					3 J	1 U	1 U	1 U J	5.7	1 U	1 U	1 U
MTCA CL	5	5	70	0.2	5	5	70	0.2	5	5	70	0.2

Table 2. Continued.

Date	MW-19A				MW-31				MW-33			
	PCE	TCE	Cis-DCE	VC	PCE	TCE	Cis-DCE	VC	PCE	TCE	Cis-DCE	VC
1/1991	--	--	--	--	1 J	1 U	1.9 J	1 U	--	--	--	--
5/1991	--	--	--	--	0.6 J	1 U	2	1 U	--	--	--	--
11/1991	1 U	0.5 NJ	1 U	1 U	0.9 NJ	1 U	2.2 J	1 U	--	--	--	--
5/1992	--	--	--	--	0.8 J	1 U	1	1 U	--	--	--	--
12/1992	1 UJ	1 UJ	1 UJ	1 UJ	0.5 J	1 UJ	0.9 J	1 UJ	--	--	--	--
5/1993	--	--	--	--	10 U	10 U	10 U	10 U	--	--	--	--
12/1993	1 U	0.4 J	1 U	1 U	0.8 J	1 U	1.2 J	1 U	--	--	--	--
4/1994	0.2 U	0.5	0.2 U	1 U	0.7	0.2 U	1	1 U	--	--	--	--
11/1994	--	--	--	--	0.8 J	1 U	1	1 U	--	--	--	--
7/1995	1 U	0.4 J	1 U	1 U	0.6 J	1 U	0.5 J	1 U	1 U	1 U	1 U	1 U
1/1996	--	--	--	--	0.6 J	1 U	0.7 J	2 U	--	--	--	--
7/1996	--	--	--	--	--	--	--	--	1 U	1 U	1 U	1 U
7/1997	1 U	0.3 J	2 U	1 U	0.9 J	1 U	0.9 J	1 U	1 U	1 U	2 U	1 U
7/1998	--	--	--	--	--	--	--	--	1 U	1 U	1 U	1 U
8/1999	1 U	0.4 J	1 U	1 U	0.9 J	2 U	0.4 J	1 U	1 U	2 U	1 U	1 U
8/2000	--	--	--	--	--	--	--	--	1 U	2 U	1 U	1 U
8/2001	1 U	0.3 J	1 U	1 U	0.4 J	2 U	0.3 J	1 U	1 U	2 U	1 U	1 U
8/2002	--	--	--	--	--	--	--	--	1 U	1 U	1 U	1 U
9/2003	1 U	0.4 NJ	1 U	5 U	0.5 J	1 U	0.1 NJ	5 U	1 U	1 U	1 U	5 U
6/2004	--	--	--	--	--	--	--	--	--	--	--	--
6/2005	1 U	0.6 J	1 U	2 U	0.5 J	1 U	1 U	2 U	1 U	1 U	1 U	2 U
5/2006	--	--	--	--	--	--	--	--	1 U	1 U	1 U	5 U
6/2007	2 U	1.2 J	2 U	2 U	1.6 J	2 U	2 U	2 U	2 U	2 U	2 U	2 U
5/2008	--	--	--	--	--	--	--	--	1 U	1 U	1 U	1 U
6/2009	1 U	1 U	1 U	1 U	--	--	--	--	1 U	1 U	1 U	1 U
6/2010	--	--	--	--	--	--	--	--	1 U	1 U	1 U	1 U
6/2011	--	--	--	--	--	--	--	--	--	--	--	--
10/2011	1 U	0.4 J	1 U	2 U	0.7 J	1 U	1 U	2 U	1 U	1 U	1 U	2 U
6/2013	--	--	--	--	--	--	--	--	1 U	1 U	1 U	1 U
10/2015	--	--	--	--	--	--	--	--	1 U	0.2 J	1 U	1 U
6/2017	1 U	1 U	1 U	1 U	0.7 J	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ
MTCA CL	5	5	70	0.2	5	5	70	0.2	5	5	70	0.2

Table 2. Continued.

Date	MW-32				MW-40				MW-41			
	PCE	TCE	Cis-DCE	VC	PCE	TCE	Cis-DCE	VC	PCE	TCE	Cis-DCE	VC
1/1991	1 J	1 U	1.1 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
5/1991	1	1 U	2	1 U	--	--	--	--	1 U	1 U	1 U	1 U
11/1991	0.6 NJ	1 U	0.6 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
5/1992	0.7 J	1 U	1	1 U	--	--	--	--	1 U	1 U	1 U	1 U
12/1992	0.7 J	1 UJ	0.5 J	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ
5/1993	10 U	10 U	10 U	10 U	--	--	--	--	10 U	10 U	10 U	10 U
12/1993	0.7 J	1 U	0.6 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
4/1994	0.7	0.2 U	0.6	1 U	0.2 U	0.2 U	0.2 U	1 U	0.2 U	0.2 U	0.2 U	1 U
11/1994	0.6 J	1 U	0.5 J	1 U	--	--	--	--	--	--	--	--
7/1995	0.7 J	1 U	0.5 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
1/1996	0.8 J	1 U	0.6 J	2 U	--	--	--	--	1 U	1 U	1 U	2 U
7/1996	--	--	--	--	--	--	--	--	--	--	--	--
8/2000	0.8 J	2 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	2 U	1 U	1 U
6/2005	1.4	1 U	1 U	2 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	2 U
6/2010	1.8	1 U	1 U	1 U	--	--	--	--	1 U	1 U	1 U	1 U
10/2011	--	--	--	--	1 U	1 U	1 U	2 U	--	--	--	--
6/2012					Well Decommissioned				Well Decommissioned			
6/2017	1.4	1 U	1 U	1 U	Well Decommissioned				Well Decommissioned			
MTCA CL	5	5	70	0.2	5	5	70	0.2	5	5	70	0.2

U: The analyte was not detected at or above the reported result.

J: The analyte was positively identified. The associated numerical result is an estimate.

UJ: The analyte was not detected at or above the reported estimated result.

NJ: The analyte has been tentatively identified. The associated numerical result is an estimate.

E: The concentration of the associated value exceeds the known calibration range.

-- Not Sampled

MTCA CL: Model Toxics Control Act Cleanup Level

Bold: The analyte was positively identified.

Shade: Values are greater than project cleanup levels.