Cost and Performance Summary Report
Soil Vapor Extraction, Pump and Treat, and In Situ Chemical Oxidation at
Dry Clean USA No. 11502, Orlando, Florida
August 2007

Summary Information [Refs. 1, 3, 4, 7, 8, 9, 10, 12, 13, and 14]

Dry Clean USA No. 11502 is a former dry cleaning facility that operated from 1988 to 1998 in Orlando, Florida. The site is located in a shopping center in a mixed retail commercial/ residential setting. A second dry cleaning operation was located in the same shopping center 65 feet east of the Dry Clean USA facility and operated from 1957 to 1988. Three public water supply wells are located within a 1-mile radius of the site. The shopping center was served by a septic system until the early 1970s.

Early site investigations conducted in 1993 and 1994 indicated chlorinated solvents, particularly tetrachloroethene (PCE), to be the main contaminant at the site. A contaminated groundwater plume extended from under the Dry Clean USA facility to southeast of the facility. The area of the plume was estimated at 70,000 square feet (ft^2). PCE was detected at a maximum concentration of 27,300 micrograms per liter (µg/L) in groundwater, indicating the possible presence of dense nonaqueous phase liquid (DNAPL). PCE-contaminated groundwater was primarily observed in the upper portion of the surficial aquifer, above a depth of approximately 30 feet below ground surface (bgs). Contamination below this depth was primarily caused by chlorinated solvents such as 1,1-dichloroethane (DCA), 1,1-dichloroethene (DCE), and vinyl chloride. The 1,1-DCE concentration (as high as 700 µg/L), that persists at the site, indicates migration off site, and is not believed to be related to either of the dry cleaners that operated at the site. The plume was approximately 800 by 300 ft^2. Composite soil samples were collected from beneath the floor of the Dry Clean USA building immediately north of the dry cleaning machine. The 0 to 3 feet bgs composite sample contained PCE at concentrations up to 3.9 milligrams per kilogram (mg/kg). The contaminated soil appeared to extend to a depth of 6 to 9 feet bgs.

Detailed site investigations began in April 1997 to more accurately define the source discharge at the facility and to assess the horizontal and vertical extent of chlorinated solvents in the subsurface. These investigations indicated that an area of elevated concentrations of chlorinated solvents existed in the soil and groundwater, extending approximately 300 feet east-southeast of the Dry Clean USA facility. The presumed source of the PCE was a relatively large or long-term discharge of solvents from the facility, based on the areal extent and concentration of the contaminated groundwater at the site. Two possible source areas were identified: (1) the Dry Clean USA building, and the septic drain lines from the second dry cleaner that had operated east of the Dry Clean USA facility until 1988. No details were available about decommissioning the septic drain lines.

Soil vapor extraction (SVE) was chosen to remediate the contaminated soil at the site after a successful pilot test that was conducted in April 1998. Pump and treat (P&T) using an aboveground air stripper was selected to contain the contaminant plume and remediate the

groundwater. The SVE system operated from April 1999 to December 2000, and the P&T system operated until November 2002. Monitored natural attenuation (MNA) was the remedy at the site after the P&T system was deactivated. In July 2004, increased concentrations of PCE were detected in samples from one source area well MW005. In situ chemical oxidation (ISCO) using hydrogen peroxide was implemented to treat PCE in the vicinity of well MW005 to expedite remediation of this hot spot.

The cleanup goals for the volatile organic compounds (VOCs) found at the site were the Florida Department of Environmental Protection (FDEP)'s cleanup target levels (CTL), which were the same as the Florida State maximum contaminant levels (MCL). PCE was the only contaminant detected in soil at the Dry Clean USA site. The FDEP CTL for PCE in soil was 30 micrograms per kilogram (µg/kg).

Florida Department of Environmental Protection (FDEP) Facility ID:	489502184
Type of Action:	Remedial
Lead:	Bureau of Waste Cleanup (as part of FDEP's Dry Cleaning Solvent Cleanup Program)
Oversight:	FDEP

Timeline [Refs. 1, 2, 3, 4, 9, 10, and 14]

Dates	Activities
April 9, 1998	SVE pilot test
October 5 to 23, 1998	SVE system installation, including piping and groundwater effluent plumbing
January to March 1999	On-site SVE equipment installation
April 26, 1999	SVE equipment shakedown
April 28, 1999	SVE and P&T systems startup
December 1, 2000	SVE system shutdown
January 2001	P&T system deactivated
March to November 2002	P&T system reactivated
December 2003 to July 2004	Quarterly MNA monitoring
October 4 to 5, 2005	ISCO — Injection of hydrogen peroxide
October 6, 2005	Post-hydrogen peroxide injection sampling
January, April, July, and October 2006	Quarterly monitoring

Factors That Affected Technology Cost or Performance [Refs. 1, 7, 8, and 14]

The groundwater in the upper and lower portions of the surficial aquifer at the site appeared to flow generally toward the east-southeast across the site. The water table was found at approximately 12 feet bgs.

Listed below are the key matrix characteristics relevant to SVE and ISCO and the values measured for each during site characterization.

Matrix Characteristics

Parameter	Value
Soil Classification	• To 47 feet bgs - Slightly silty, fine to medium-grained quartz sands, surface; • 47 to 53 feet bgs - Slightly sandy clay; • 53 to 83 feet bgs - Fine to medium-grained sand interbedded with clayey sand; • 83 to 89 feet bgs - Sandy, clayey, silt; • 89 to 93 feet bgs - Fine to coarse-grained sand with shell fragments; • 93 to 94 feet bgs - Hard phosphatic limestone.
Clay Content and Particle Size Distribution	• Surficial zone (8 to 47 feet bgs): fine to medium-grained quartz sands. • Intermediate zone (47 to 93 feet bgs): Fine to coarse-grained sand interbedded with clayey sand and clayey silt.
Deepest Significant Groundwater Contamination	68 feet bgs
Presence of NAPLs	PCE DNAPL present (based on 1 percent rule)
Hydraulic Conductivity	Surficial zone: 1.4 to 2.4 feet/day Intermediate zone: 47 to 93 feet/day
pH	4.9 to 6.7
Oxidation-Reduction Potential	Generally positive, ranged from 128 to 398.6 millivolts
Dissolved Oxygen	Ranged from 0.2 to 8.4 milligrams per liter (mg/L); was generally greater than 1.0 mg/L

Treatment Technology Description [Refs. 1, 2, 3, 4, 5, 7, 8, 10, and 14]

SVE and P&T

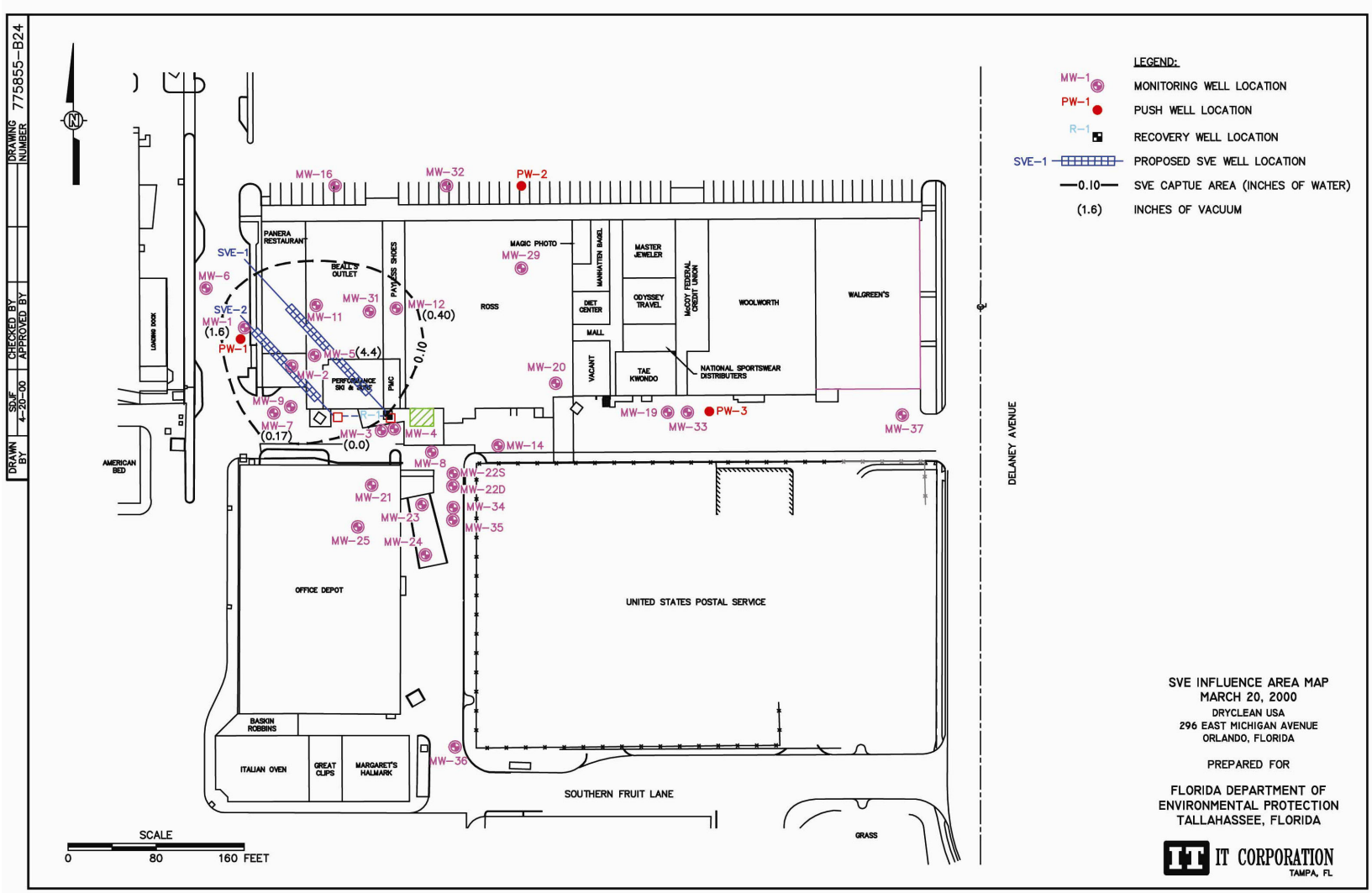
A pilot test of SVE conducted at the site on April 9, 1998, indicated that the permeability of the soil was sufficient for the technology to be applied. The full-scale SVE system consisted of two horizontal vapor extraction wells, a positive-displacement blower, a condensate tank, a vapor-phase granular activated carbon (GAC) treatment vessel, and an infiltration gallery. The system was designed to remediate an area of contaminated soil primarily located under and in the rear of the Dry Clean USA building.

Based on the estimated vapor-phase capture zone from the SVE modeling, the two horizontal vapor extraction wells were installed parallel to each other in a line extending from the west to the east side of the dry cleaning facility. The wells ranged in depth from approximately 130 to 200 feet, with a screened interval of 80 to 100 feet, and were 40 feet apart. The radius of influence of each SVE extraction well was expected to be 24 feet. A total of 400 standard cubic feet per minute (scfm) of air (200 scfm from each) was expected to be extracted from the wells, producing a total horizontal influence of 98 feet. This flow rate was expected to remain constant during operation of the system. The effluent flowed through a particulate filter and a 120-gallon condensate removal tank before it entered the blower. Water from the SVE condensate tank was pumped to the air stripper via a transfer pump. The off gas from the SVE system was originally treated using a 1,000-pound vapor-phase GAC unit. The effluent from the GAC unit was vented to the atmosphere. The treated water was pumped to an infiltration gallery west of the shopping center. Figure 1 shows the layout of the SVE system, as well as locations of the monitoring and recovery wells.

Before SVE system startup, 13 designated monitoring wells were sampled in March 1999 to obtain baseline contaminant concentrations. These wells included MW003, MW005 to MW007, MW012, MW019, MW022S, MW024, MW032, and MW034 to MW037. Ten new monitoring wells were added in the first year of SVE system operation (April 1999 to March 2000), including MW002, MW008, MW011, MW014, MW016, MW020, MW021, MW022D, MW023, and MW025. In the second year of SVE system operation (April 2000 to March 2001), the designated monitoring wells included new wells MW001, MW002, and MW033, in addition to other monitoring wells used in the first year. An additional monitoring well, MW029, was sampled during post-active remediation monitoring conducted after April 2001.

The P&T system consisted of one groundwater recovery well, a submersible pump, an influent tank, a feed pump, an air stripper system, and an on-site infiltration gallery. The recovery well was 6 inches in diameter and was screened at 5 to 25 feet bgs. Air stripping was selected to treat the recovered groundwater. The design pumping rate was 7 to 10 gallons per minute (gpm). Operating pumping rate was 10 to 12 gpm. The off gas from the air stripper was expected to meet air discharge requirements of 5.5 pounds per day and was not treated.

Figure 1: SVE System Layout and Monitoring and Recovery Well Locations at the Dry Clean USA No. 11502 Site [Ref. 3]



ISCO

Existing monitoring well MW005 was used for injecting the oxidant, and a new well (MW038) was installed for monitoring purposes using direct-push technology approximately 3 feet north of well MW005. The treatment zone included the upper 5 feet of the surficial aquifer and extended a distance of 7.5 feet in a radial direction from well MW005. This generated a treatment area of 177 ft^2 and a treatment volume of 708 cubic feet (based on an estimated treatment thickness of 4 feet).

Before the hydrogen peroxide was injected, baseline groundwater samples were collected from wells MW038 (monitoring), MW005 (injection), MW006 (upgradient), and MW014 (downgradient). The first batch of hydrogen peroxide was transferred to injection well MW005 using an in-line pump at a rate of 9 gpm with no back pressure (as indicated by the pressure gauge). The rate proposed in the modified remedial action plan was 2 to 5 gpm. Therefore, the injection rate was reduced and maintained at 2.7 gpm for the second batch of injection. Overall, 1,057 gallons of 1 percent hydrogen peroxide was injected into the treatment zone over a 2-day period from October 4 to 5, 2005.

When the injection event had been completed, dissolved oxygen and temperature were recorded in wells MW038 and well MW005 each hour for a minimum of 8 hours. Quarterly monitoring was conducted at the site for 12 months (January, May, July, and October 2006) after ISCO treatment. Figure 2 shows the layout of the ISCO injection system in the source area around well MW005.

Operating Parameters [Refs. 1, 2, 7, 8, and 14]

Listed below are the key operating parameters for SVE and ISCO and the values measured for each parameter.

Parameter	Value
Soil Vapor Extraction	
Air Flow Rate	220 to 270 scfm at 20 inches of water column at the wellheads
Operating Pressure/Vacuum	400 to 460 scfm at 19 to 20 inches of water column at the SVE blower
Pump and Treat	
Pumping Rate	10 to 12 gpm (operational)
pH	5.87
In Situ Chemical Oxidation	
pH	5.87
Pumping Rate	• Initial injection rate for first batch injection was approximately 9 gpm with no back pressure; later reduced to approximately 5 gpm. • Second batch of peroxide mix allowed to drain by gravity at a flow rate of approximately 2.7 gpm; rate maintained for the duration of the second batch injection.

Parameter	Value
Additives and Dosage	One percent hydrogen peroxide; 1,057 gallons
Microbial Activity	Not monitored
Injection Rates	2.7 to 9 gpm

Performance Information [Refs. 1, 3, 4, 5, 6, 7, 8, 11, and 14]

The goal of the remediation effort was to minimize migration of the plume of VOCs in groundwater by reducing the concentrations of PCE in the source area beneath the foundation of the dry cleaning facility, and to achieve the CTL for PCE in groundwater. The goal also included remediation of the contaminated groundwater plume in the upper portion of the surficial aquifer, where PCE concentrations exceeded 100 µg/L. Outside of the 100 µg/L plume, groundwater samples were collected on a quarterly basis to evaluate MNA of the dissolved plume in the lower surficial and intermediate aquifers and the downgradient portions of the dissolved plume. The goal for remediation system for PCE-contaminated soil was to achieve the CTL.

FDEP set a CTL for PCE in groundwater as 3 µg/L, which was also the same as the Florida MCL. The federal MCL for PCE is 5 µg/L. The FDEP CTL for PCE in soil was 30 µg/kg. Table 1 shows the CTLs for various VOCs in groundwater and soil at the Dry Clean USA site. Note that PCE was the only contaminant detected in soil at the Dry Clean USA site.

Table 1: FDEP Cleanup Target Levels in Groundwater and Soil at Dry Clean USA No. 11502 [Refs. 11, 14, and 16]

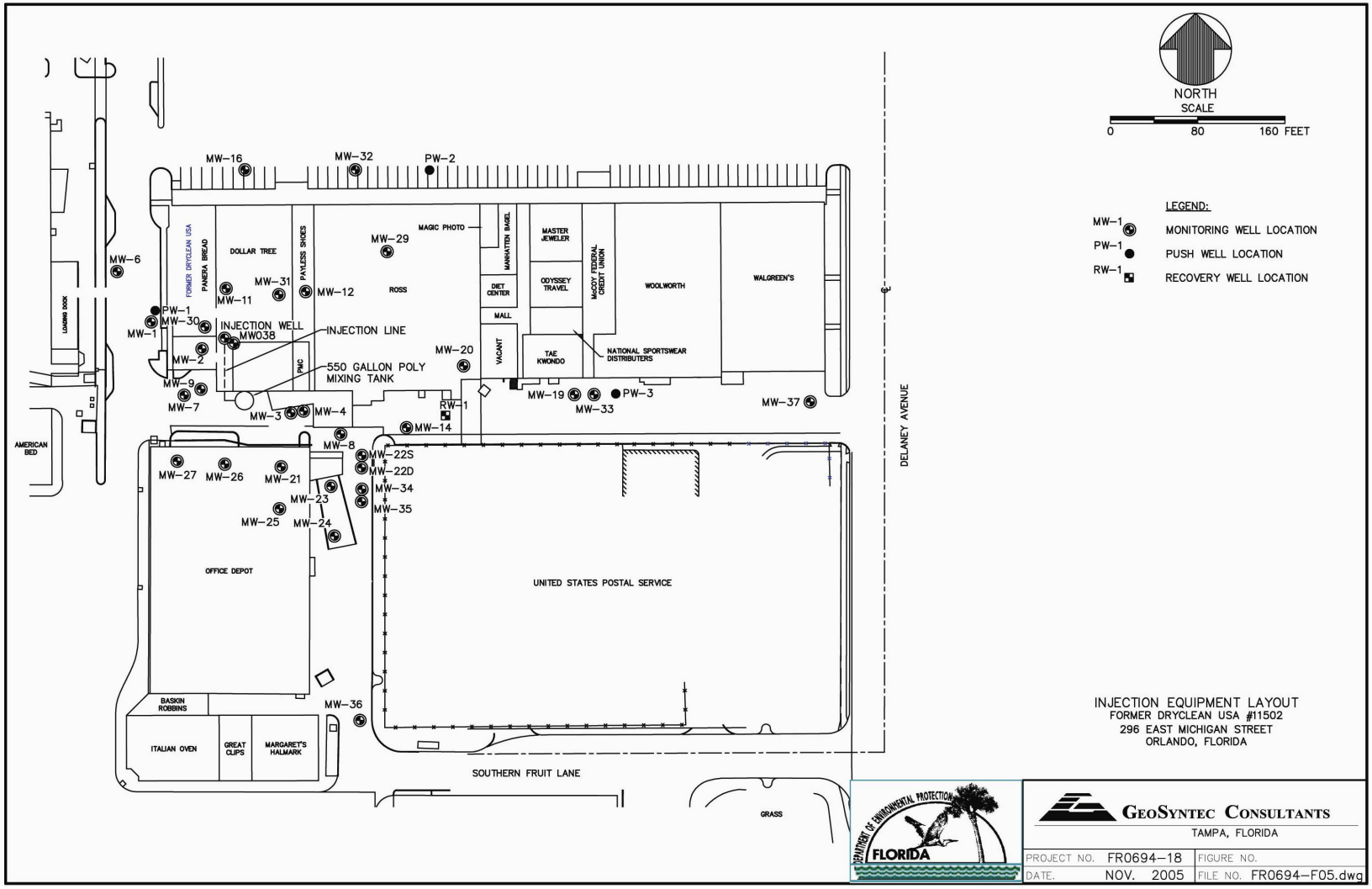
Chemicals of Concern	Groundwater (based on Florida MCL) (µg/L)	Soil (based on leachability) (µg/kg)
PCE	3	30
TCE	3	30
Cis-1,2-DCE	70	400
Trans-1,2-DCE	100	700
Vinyl chloride	1	7

Note: MCL – Maximum Contaminant Level

SVE and P&T

The SVE system operated at the site from April 28, 1999, to December 2000, and soil vapor samples were collected from the system discharge and analyzed to evaluate the performance of the SVE system. The P&T system operated from April 1999 to January 2001.

Figure 2: Chemical Oxidation Well Layout at the Dry Clean USA No. 11502 Site [Ref. 8]



Year 1 of Operation (April 1999 to March 2000)

The SVE system met design performance specifications at the end of the first year of operation in March 2000. As indicated in Figure 1, the radius of influence of the SVE system was found to be adequate to capture the PCE contamination in the area. Vacuum readings, collected quarterly from selected monitoring wells, confirmed that the radius of influence at the site was adequate. The mass recovery of the SVE system during the first year of operation was estimated at 5.1 pounds, nearly equal to the original design estimate of 5.2 pounds. Since the mass recovery rate for PCE found to be lower than the air emission standard within a few months of SVE operation, the vapor-phase GAC treatment for SVE off gas was shut down on October 14, 1999. No detectable PCE concentration were found in groundwater samples from monitoring wells MW002, MW005, MW006, MW007, MW021, MW022D, and MW037 at the end of the first year of SVE system operation. However, groundwater samples from wells MW003, MW008, MW012, MW014, MW022S, and MW023 contained PCE at concentrations above the CTL.

In its first year of operation, the P&T system recovered and treated a total of 2.56 million gallons of PCE-contaminated groundwater; the estimated mass recovery for PCE was 2.9 pounds. As seen in Table 2, influent concentrations at the recovery well, RW001, indicated a continued reduction in PCE concentration. The influent PCE concentration was measured at 85.6 µg/L at the end of the first year in March 2000, compared with 160 µg/L in first-quarter sampling conducted in June 1999.

Table 2: Influent PCE Concentration at Recovery Well, RW001 at Dry Clean USA No. 11502 Site [Ref. 11]

Date sampled	PCE concentration (µg/L)
April 28, 1999	**130**
May 26, 1999	**100**
June 23, 1999	**160**
August 30, 1999	**165**
December 8, 1999	**170**
March 20, 2000	**85.6**
July 17, 2000	**27**
September 28, 2000	**11**
December 20, 2000	**6.5**
July 16, 2001	**4.6**
October 1, 2001	**5.6**
September 10, 2002	1.1
December 10, 2003	BDL
March 18, 2004	1.4
July 22, 2004	BDL

Note: BDL – Below Detection Limit; values shown in **bold** are above the FDEP CTL

Year 2 of Operation (April 2000 to March 2001)

In the second year of operation, both the SVE and P&T systems did not operate for most of the first quarter (between May and July 2000) so that equipment that was damaged in a power overload could be repaired.

The SVE system continued to operate into the third quarter of the second year (November 2000 to January 2001) until soil sampling results from November 2000 indicated that the PCE concentration in soil was below the cleanup goal of 30 µg/kg. FDEP approved a recommendation to discontinue soil remediation, and the SVE system was shut down and decommissioned on December 1, 2000. In its second year of operation, the SVE system recovered an estimated 9.8 pounds of total VOCs. Groundwater monitoring continued through the end of year 2. In April 2001, at the end of the second year since the start of active remediation, the concentration of PCE was below the CTL in groundwater samples from monitoring wells MW016, MW022S, MW023, MW036, and MW037, and no detectable PCE concentration was found in monitoring wells MW001, MW003, MW006, and MW011. However, groundwater samples from monitoring wells MW008, MW014, and MW024 contained PCE at levels above the CTL.

Approximately 2.1 million gallons of contaminated groundwater were treated during the second year of P&T system operation. As seen in Table 2, the PCE influent concentration reported at well RW001 ranged from 27 µg/L in the first quarter (July 17, 2000) to 6.5 µg/L in the third quarter (December 20, 2000). The P&T system was deactivated during the fourth quarter of the second year (on January 17, 2001) at the request of FDEP to assess contaminant concentrations under natural groundwater flow conditions. Quarterly groundwater monitoring was continued to assess the impact of deactivating the P&T system.

Post-Active Remediation Monitoring and Monitored Natural Attenuation (April 2001 to July 2004)

The CTL of 3 µg/L for PCE contamination in groundwater had not been met in all monitoring wells when the SVE and P&T systems were shut down. Therefore, quarterly post-active remediation monitoring commenced from April 2001 and continued until March 2002. As seen in Table 2, the October 2001 influent sample from well RW001 indicated a concentration of PCE that exceeded the CTL (5.6 µg/L). The PCE concentration was higher than the CTL at a former source area well MW011 (4.9 µg/L) and at MW029 (6.1 µg/L) in the March 2002 sampling event. These results indicated a possible rebound of the PCE level in certain locations. Therefore, the P&T system was restarted in February 2002, before the March 2002 sampling event, to lower the concentration of PCE to below the CTL. The P&T system continued to operate until November 2002. As seen in Table 3, the September 2003 sampling event at the same two wells indicated that PCE concentrations in groundwater were below the CTL.

MNA groundwater monitoring was conducted on a quarterly basis from December 2003 until July 2004. In July 2004, as seen in Table 2, the influent PCE concentration at well RW001 was lower than the CTL, indicating that re-starting the P&T system had succeeded in lowering the concentration of PCE in that area; however the concentration of PCE in well MW005, a source

area well, exceeded the CTL (6.5 µg/L). Elevated groundwater levels near well MW005 were thought to be responsible for the increasing levels of PCE, possibly because residual PCE leached from soil. Figure 3 shows the possible relation between groundwater elevation and PCE concentration at well MW005. The absence of PCE degradation products and geochemical conditions such as a positive oxidation-reduction potential (183.9), low pH (5.7), and elevated dissolved oxygen concentration (5.2 milligrams per liter [mg/L]) indicated that conditions at MW005 were not favorable for reductive dechlorination of the PCE that persisted in this area. Hence, a targeted application of ISCO using 1 percent hydrogen peroxide was considered to treat the area near well MW005 to expedite closure of the site.

ISCO

On October 4 and 5, 2005, 1,057 gallons of 1 percent hydrogen peroxide was injected into former source area well MW005. During the injection process, pH readings were continuously collected from well MW005 to monitor the effects of peroxide injection on groundwater. The initial pH at well MW005 was 7.32; the pH was reported to be 5.87 when the injection system was shut down. A post-injection groundwater sample was collected from well MW005 on October 6, 2005. This groundwater sample indicated that the concentration of PCE in well MW005 was below detection limits (see Table 3).

Post Remediation Monitoring and Site Closure

PCE in groundwater was monitored after the ISCO treatment in groundwater. PCE concentrations in groundwater continued to meet the CTL for four consecutive quarterly monitoring events from January to October 2006 (see Table 3). As a result, the site met the no further action criteria. A Site Rehabilitation Completion Order was issued for this site on February 16, 2007.

Performance Data Quality [Ref. 1]

No exceptions to established quality assurance/quality control (QA/QC) procedures were noted in the available references.

Cost Information [Refs. 1 and 15]

The following costs were incurred to implement SVE, P&T, and ISCO at the Dry Clean USA No. 11502 site.

Cost for assessment	$97,700
Cost for design and implementation	$221,445 (SVE and P&T Systems) $28,405 (ISCO)
Operation and maintenance (O&M) costs	$121,143
Monitoring costs	$26,614
Site restoration costs	$7,000
Total cost	$502,307

Figure 3: PCE Concentration and Groundwater Elevation Over Time at Well MW005 [Ref. 7]

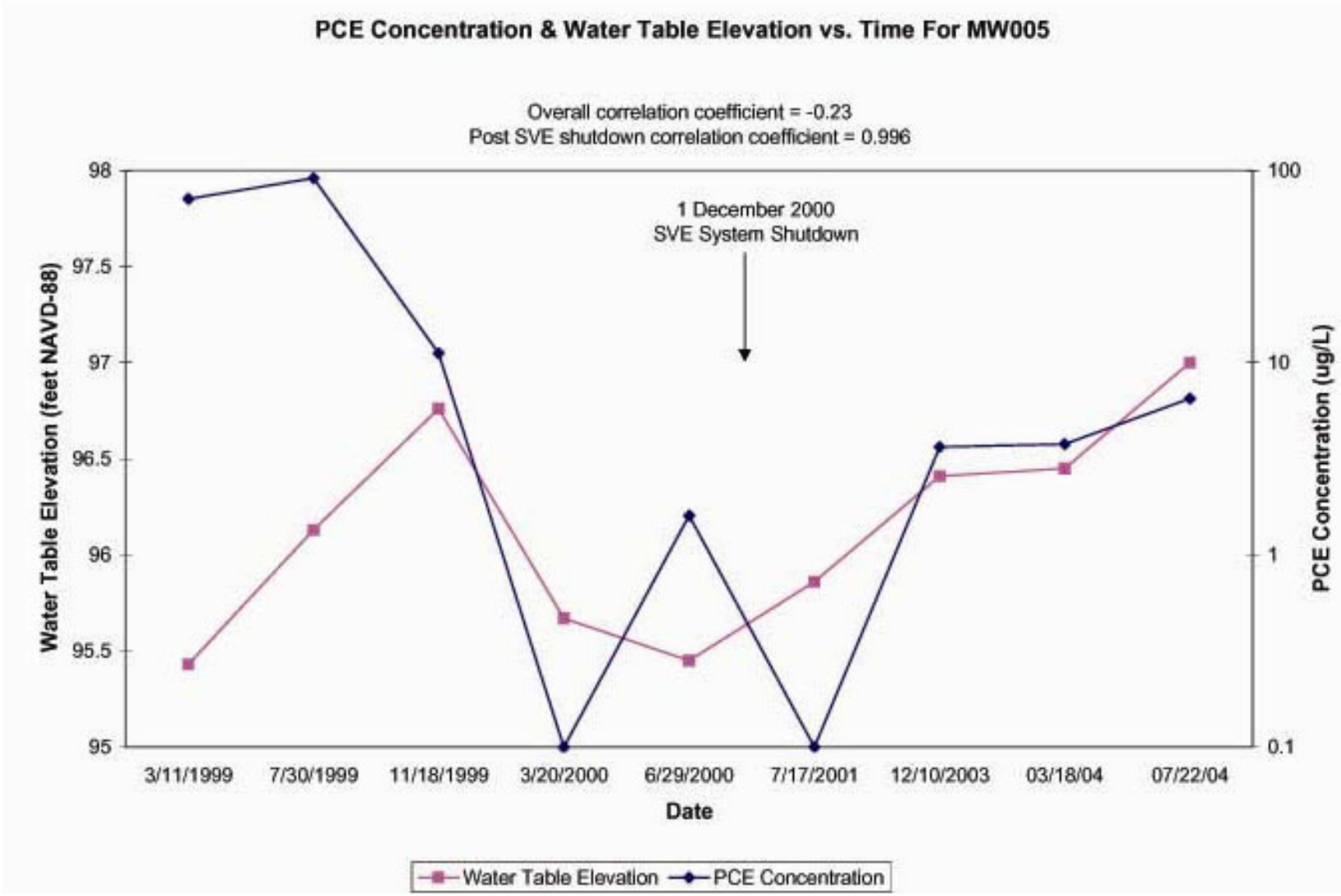


Table 3: Concentration of PCE in Select Monitoring Wells at the Dry Clean USA No. 11502 Site [Refs. 3, 4, 8, 11, and 14]

Monitoring Well (MW)	PCE Concentration (µg/L)																						
	Feb 97	Mar 99	Jul 99	Nov 99	Mar 00	Jun 00	Sep 00	Oct 00	Dec 00	Apr 01	Jul 01	Oct 01	Mar 02	Mar 03	Sep 03	Dec 03	Mar 04	Jul 04	Oct 05	Jan 06	May 06	Jul 06	Oct 06
MW001	**35.1**	NS	NS	NS	NS	NS	NS	BDL	BDL	BDL	NS	BDL	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW002	**535**	NS	NS	NS	BDL	NS	NS	BDL	BDL	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW003	**705**	**120**	**28.5**	**4.0**	**5.4**	**5.6**	NS	**4.5**	BDL	BDL	NS	BDL	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW005	**2380**	**71.2**	**91.2**	**11.2**	BDL	1.6	NS	NS	NS	NS	BDL	NS	NS	NS	NS	**3.6**	**3.8**	**6.5**	BDL	2	2.7	3	1.7
MW006	BDL	BDL	BDL	BDL	BDL	**3.4**	NS	BDL	BDL	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW007	BDL	BDL	BDL	BDL	BDL	BDL	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW008	**500**	NS	NS	NS	**9.6**	BDL	BDL	NS	1.7	**3.6**	2.1	**4.4**	BDL	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW011	**285**	NS	NS	**7.7**	NS	NS	BDL	NS	BDL	NS	1.2	2.9	**4.9**	**4.0**	1.8	NS	NS	NS	NS	NS	NS	NS	NS
MW012	**8.1**	**46.9**	**49.6**	**12.6**	**13.5**	**17.1**	1.8	NS	1.8	NS	BDL	1.0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW014	**120**	NS	NS	NS	**52.1**	**4.2**	NS	**6.5**	**4.6**	**3.7**	BDL	**3.8**	1.3	NS	NS	1.8	1.4	NS	NS	NS	NS	NS	NS
MW016	2.4	NS	NS	NS	NS	NS	BDL	NS	BDL	1.1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW020	**19.9**	NS	NS	1.5	NS	NS	NS	**9.0**	NS	NS	**5.4**	2.8	2.0	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW021	**63**	NS	NS	NS	BDL	BDL	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW022S	**115**	**575**	**405**	**16.2**	**10.6**	**5.5**	NS	2.8	3.0	2.8	BDL	BDL	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW022D	**22.6**	NS	NS	BDL	BDL	BDL	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW023	**410**	NS	NS	**29.8**	**15.9**	**3.4**	**4.0**	NS	**9.3**	2.4	NS	2.1	BDL	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW024	**27.5**	**5.2**	**9.7**	2.8	NS	NS	**7.0**	NS	**14.0**	**3.8**	**3.8**	1.6	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW029	BDL	NS	NS	NS	NS	NS	NS	NS	NS	NS	**5.7**	NS	**6.1**	**4.3**	BDL	NS	NS	NS	NS	NS	NS	NS	NS
MW036	NS	2.1	**5.3**	2.8	NS	NS	2.9	NS	2.4	1.3	BDL	1.8	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
MW037	NS	BDL	**3.7**	BDL	BDL	**5.4**	1.0	NS	2.5	2.7	2.3	BDL	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Note: NS – Not sampled; BDL – Below Detection Limit; Bolded values are above the FDEP CTL

Observations and Lessons Learned [Refs. 1 and 14]

1. Given the depth to groundwater at the site, installation of vertical SVE wells would likely have been feasible. Horizontal SVE wells did not appear to be as effective as vertical wells for this application.

2. Since the highest contaminant concentrations were often identified in groundwater samples collected at the top of the water table in the contaminant source area (well MW005, in this case), it appears important to ensure that shallow source zones be addressed by the remedial system.

3. The injection of a low concentration of hydrogen peroxide in the upper portion of the surficial aquifer and the capillary fringe was successful in polishing the low remaining concentrations of PCE contamination in groundwater, supporting site closure.

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