

March 5, 2008

Mr. Steve DeMars
Pennsylvania Department of Environmental Protection
Environmental Cleanup Program
South Central Office
909 Elmerton Avenue
Harrisburg, PA 17110-8200

**Subject: Dual Phase Extraction Pilot Test Report
J.C. Cleaners
RD 1 (State Route 22), Box 7585, Gettysburg, Pennsylvania 17028
PADEP IRRSC-5-113**

Dear Mr. DeMars,

Earth Tech, Inc. (Earth Tech) is pleased to present this Dual Phase Extraction (DPE) Pilot Test Report (Report) for the J.C. Cleaners (Site) to the Pennsylvania Department of Environmental Protection (Department). The purpose of the DPE Pilot Test was to evaluate the utilization of DPE technology as a means of enhancing the mass recovery of residual contaminants.

Environmental History

The Site is an active dry cleaning facility located in Gettysburg, Pennsylvania. Previous dry cleaning activities at the Site have contaminated local groundwater with tetrachloroethene (PCE), trichloroethene (TCE), cis-1,2-dichloroethene (cis-DCE), and vinyl chloride (VC). Subsequent Site activities included installation of groundwater monitoring wells and startup of a groundwater treatment system and soil vapor extraction (SVE) unit. The SVE system had been shut down in 2000 because vapors were no longer drawn from the subsurface soils. The Department requested a re-start of the system in 2003 after it was re-plumbed. The SVE system was restarted in October of 2003; however, due to the high water table at approximately 4 feet below ground surface (bgs), the system drew in water. The Department agreed that the SVE system should remain shut down until the groundwater level subsides.

Following Earth Tech's involvement with the Site and in response to the Department's case manager and section chief suggestion, Earth Tech proposed the evaluation of Site conditions and appropriate technology to develop a recommendation to address potential source areas with the goal of eventual Site closure. Possible technologies will include soil vapor extraction (utilizing shallow groundwater draw-down), DPE, and in-situ anaerobic reductive dechlorination. Based upon evaluation of Site conditions and interaction with the Department's case manager, DPE was chosen as the best technology for the pilot test.

Health and Safety

Earth Tech personnel adhered to appropriate U.S. Environmental Protection Agency (USEPA) Standard Operating Safety Guidelines, and Occupational Safety and Health Administration (OSHA) Health and Safety Practices (29 CFR Part 1910) during onsite activities. All work was conducted in Level D personal protective equipment (PPE); proper respiratory protection and additional protective clothing were available if Site conditions warranted an upgrade to Level C protection. In addition, all field activities were completed following the guidelines of Chapter 245 (245.311 and 245.312) and Act 2.

A copy of the Site-specific Health and Safety Plan (HASP) was available onsite at all times. The HASP outlines safety and emergency response procedures, and includes a list of local emergency service telephone numbers and locations. A copy of the HASP is available from Earth Tech upon request.

DPE Test Background

The primary purpose of the DPE test was to evaluate the utilization of DPE technology as a means of enhancing the mass recovery of residual contaminants. The DPE test was also conducted to assess the effectiveness of applying a vacuum to gain hydraulic control and quantify the amount of water anticipated to be produced by the proposed extraction wells at the Site. Based on the information collected during previous investigations at the Site, the DPE Test focused on using existing wells at the Site. Monitoring wells SW-2 and SW-6 were utilized for the test, as these wells have historically exhibited the highest contaminant concentrations of the Site wells.

DPE involves the simultaneous recovery of vapors and groundwater under high vacuum conditions. The advantage of high vacuum DPE is that the applied vacuum can increase the groundwater recovery rate in low permeability soils and thereby maximize the mass removal rate of contaminants in dissolved and volatilized phases, including potential free phase product. Another advantage of DPE is the creation of secondary permeability in the formation. As groundwater and air are forced through the overburden pore spaces, additional flow channels/zones are created. Over time, the movement of groundwater through the tight soils becomes channelized. Because of this channelization, significant dewatering of the area around the extraction well also typically occurs, leading to the physical drying of the tight soils. As the soils dry, soil pore spaces become more interconnected and partings in the soil structure are expanded and/or created under the high vacuum, laterally and vertically extending the radial influence around the extraction well. In addition to the physical contaminant removal that is afforded by the DPE technology, oxygen levels are inherently increased in the zone of contamination as clean air replaces the contaminated air that is removed.

DPE testing was conducted using an Earth Tech trailer-mounted high vacuum test unit equipped with a liquid ring vacuum pump (LRVP) that can provide a maximum air flow rate of 140 cubic feet per minute at a maximum vacuum of 28 inches mercury (Hg). The LRVP was well-suited for

sites such as this with tighter soil conditions where higher vacuums and lower air-flow rates are expected.

Water and air drawn from the point of extraction was separated in a knockout tank that was equipped with an auto drain system. The water phase was directed off of the trailer into the onsite system for treatment prior to discharge. Air from the knockout tank was passed through a granular activated carbon (GAC) drum prior to discharge to the atmosphere.

Vapor Monitoring Point Installation

Prior to test startup, Earth Tech installed five (5) Vapor Monitoring Points (VMPs) at the Site. The VMPs were utilized to monitor the performance of the DPE system as detailed below. The VMP locations are presented on Figure 1 in Attachment A. Copies of the Drilling Logs are presented in Attachment B.

The borehole was drilled using conventional hollow stem auger techniques, and then one point was constructed within each borehole. The VMP was constructed of 1-inch diameter, threaded, flush-joint, schedule 40 PVC riser to grade and well screen with a slot width of 0.020 inches, approximately five (5) feet in length. A sand filter pack of appropriate grain size was placed in the annulus from the bottom of the borehole to approximately six (6) inches above the screened interval. Hydrated bentonite was used to seal the annulus above the filter pack to the base of the flush-mount. The monitoring point was secured with a flush-mounted manhole to prevent unauthorized entry.

Soil/rock cuttings and liquids generated during the drilling activities were managed in a manner consistent with Department protocols. Five drums of non-hazardous cuttings were generated during the drilling for sample point installation. One composite sample was collected for waste characterization from the drums used to containerize soil during drilling. This sample was analyzed for ignitability, pH, percent moisture, BTEX (8021), PCBs (8082), TPH (5030/8015; purge/trap, and solvent extraction, and 418.1), and TCLP metals (1311 for RCRA metals). Earth Tech is currently scheduling disposal of the soil/rock cuttings.

DPE Test Procedure

DPE pilot testing was implemented on the identified extraction points (SW-2 and SW-6) to evaluate the potential for dewatering and contaminant removal using vacuum methods. Each of the wells was tested for a duration of approximately 8 hours. Influence monitoring was performed using the newly installed VMPs installed during the previous tasks listed above as well as four existing groundwater monitoring wells (SW-4 through SW-7).

During each phase of pilot testing, Earth Tech measured the vacuum levels, VOC concentrations in air, water recovery from the extraction point and vacuum levels at monitoring points at regular intervals. Tables of the data are included in Attachment C. The monitoring points were used to determine the effective radius of vacuum influence from the extraction point. Extraction point air

flow rates of the discharge airstream were also measured during each test. Earth Tech used a photoionization detector (PID) to monitor vapors drawn from each extraction point.

A total of three (3) air samples were collected while testing at each extraction point for off-site laboratory analysis as part of this work effort (pre; midpoint and end). The air samples were analyzed by method TO-15 for the contaminants stated in the task above.

Analytical Results

The results of the laboratory analyses conducted on the pilot test influent samples are presented in Table 1 in Attachment C. DPE Pilot Test Field Measurements for each extraction test are presented on Tables 2 and 3 along with PID monitoring results. The air samples were shipped to Lancaster Laboratories Inc. (LLI) and analyzed for solvents using method TO-15. The DPE test Analytical Reports and Chain of Custody Form are presented in Attachment D.

The results of the air sampling indicate that well MW-6 exhibited the highest contaminant concentrations. Of the concentrations, the highest occurred at either the mid-point or the end-point samples. TCE was detected at a maximum concentration of 29 ppb (SW-2, mid-point) and 190 ppb (SW-6, end-point), PCE was detected at a maximum of 38 ppb (SW-2, start) and 560 ppb (SW-6, end-point), 1,2-DCE was detected at a maximum of 300 ppb (MW-2, end-point) and 1,000 ppb (SW-6, end-point), and VC was detected at a maximum concentration of 71 ppb (SW-2, end-point) and 300 ppb (SW-6, mid-point).

Flow Rate and Vacuum Levels

During the two short-term DPE tests, the highest air flow rate was achieved while extracting from monitoring well SW-2 (rates ranged from a high of 99 SCFM at startup to a low of 20 SCFM mid-test at 25.5 inches Hg vacuum). Monitoring well SW-6 produced a constant air flow rate of 28 SCFM at 22.5 inches Hg vacuum. The PID readings measured during the short term DPE tests ranged from 0 parts per million (ppm) to 2.9. The flow rates and vacuum measurements for the DPE tests are included on Tables 2 and 3 in Attachment C.

Radial Vacuum Influence

During the first test the vacuum level was initially measured at the extraction well (MW-6) and at the vacuum influence observation points including wells VMP-1 through VMP-5, SW-2, SW-4, SW-5, and SW-7. Following the test startup, vacuum levels were regularly monitored using Dwyer Magnehelic Differential Pressure Gauges in order to monitor the induced vacuum at observation. The maximum measured vacuum at the extraction well was 25.5 inches Hg. The results of the vacuum influence monitoring for the test at SW-6 are included on Table 4.

The maximum vacuum influence observed during the test was 0.48 inches of water at SW-7 located 97 feet from SW-6. Vacuum influences were also recorded in the remaining wells with the exception of VMP-2 and VMP-4. Based on these results, the radius of influence at this part of the site cannot be determined, but it appears that the subsurface is heterogeneous with a

preferred directional influence indicated in the fractured bedrock with a component of influence 97 feet in the direction of the SW-7.

During the second test the vacuum level was initially measured at the extraction well (SW-2) and at the vacuum influence observation points including wells VMP-1 through VMP-5 and SW-4 through SW-7. Following the test startup, the vacuum level was regularly observed and recorded in order to monitor the induced vacuum at the observation wells that resulted from extraction and the vacuum applied to the extraction well. The maximum measured vacuum at the extraction well was 22.5 inches Hg. The results of the vacuum influence monitoring for the test at SW-2 are included on Table 5.

The maximum vacuum influence observed during the test was 1.2 inches of water at SW-6 located 93 feet from SW-2. Vacuum influences were also recorded in the remaining wells with the exception of VMP-1 and VMP-3 through VMP-5. As with the first test, based on these results, the radius of influence at this part of the site cannot be determined, but it appears that the subsurface is heterogeneous with a preferred directional influence indicated in the fractured bedrock with a component of influence 93 feet in the direction of MW-6.

Mass Removal Calculations

Following completion of the pilot test and review of the laboratory analytical data, a calculation of the mass removal of contaminants was performed. A copy of the tables is included in Attachment C. The results indicate that a total of 0.0444 lbs of contaminants were removed during the performance of the pilot test.

Conclusions

In general, the pilot test demonstrated that DPE technology is not the optimal technology for the removal of contamination at the site. Due to the very tight soil conditions the only viable influence in the subsurface is through fracture flow in the bedrock. The laboratory results from the air samples and vacuum influence tests demonstrate that the DPE system was not able to remove substantial concentrations of solvents for the duration of the DPE tests.

The next step in remediation of the JC Cleaners site is the completion of further investigation and delineation of the source area while continuing the extraction and treatment of contaminated groundwater. Earth Tech would recommend the following approach:

- Perform an initial screening level vapor assessment beneath the on-site building(s). This can be done relatively quickly and inexpensively using small bore hammer drill and a PID meter, and would be used to guide additional soil characterization and/or vapor sampling.
- Perform a review of available records to determine the layout and routing of sanitary/storm sewer lines in the vicinity of the site buildings, which may have acted as a potential source for the contamination from the facility. This information will also be used to guide subsequent sampling.

- Perform direct push (Geoprobe™ or equivalent) soil sampling and vapor monitoring point installation and sampling to characterize residual contamination at/near the suspected source area, and at building(s) potentially impacted by the identified source(s).
- Evaluate which further remediation measures (beyond the current pump/treat technology) may be effective in shortening the time frame required for complete remediation. These measures would be required to comport with the existing use of the deeper aquifer to the west (municipal well SW-6), as well as the existing remedial measures being implemented at other nearby contaminated site(s).

If you have any questions or comments, please feel free to contact us at (717) 796-8012 or (717) 796-8010, respectively.

Sincerely,

Earth Tech, Inc.

Donald E. Wandling
Project Manager

Thomas L. McMonagle, P.G.
Program Manager

DEW/mm

Attachments

"By affixing my seal to this report, I am certifying that the information is true and correct. I further certify I am licensed to practice in the Commonwealth of Pennsylvania and that it is within my professional expertise to verify the correctness of the information."

Attachment A

Figures

Attachment B

Drilling Logs

Attachment C

Tables

Attachment D

Analytical Data