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Bioremediation Field Pilot Study
Status Report
Volume I

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DIVISION OF ENVIRONMENTAL REMEDIATION

Universal Instruments Corporation

Kirkwood, Broome County, New York

December 2002

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BLASLAND, BOUCK & LEE, INC.
engineers & scientists

REPORT

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1. Introduction

This Bioremediation Field Study Status Report has been prepared by Blasland, Bouck & Lee, Inc. (BBL) for the Universal Instruments Corporation (Universal Instruments) site in Kirkwood, Broome County, New York (Site Number 7-04-026). This Bioremediation Field Study Status Report is submitted as part of the Remedial Design (RD) Work Plan, which was submitted to the New York State Department of Environmental Conservation (NYSDEC) on June 20, 2001 in accordance with the executed Order on Consent between Universal Instruments and the NYSDEC, dated January 19, 2001. This Bioremediation Field Study Status Report presents an evaluation of the data collected to date in connection with the enhanced natural bioremediation of groundwater beneath the Universal Instruments site.

1.1 Purpose

The purpose of this report is to provide a detailed description of the work performed at the site in order to assess an enhanced natural bioremediation remedy for the degradation of volatile organic compounds (VOCs) in groundwater. Results of four groundwater monitoring and sampling events, a description of Hydrogen Release Compound (HRC™) and Oxygen Release Compound™ (ORC™) injection as part of the enhanced bioremediation field study, and baseline groundwater sampling of monitoring wells are presented.

The enhanced bioremediation field study was designed to assess the viability of a combination of HRC™ and ORC™ as a means to enhance the reductive dechlorination process. The purpose of the continuing enhanced bioremediation field study is to evaluate the effectiveness of HRC™ and ORC™ technology method for remediating the groundwater plume at the site.

The baseline groundwater sampling event was conducted to assess present conditions in the COC-affected saturated zone with respect to dissolved-phase COCs and bioremediation marker parameters in order to provide a basis for comparison to three subsequent groundwater sampling events post-dating the injection of HRC™.

An evaluation of the groundwater remediation method at the site was made to provide recommendations regarding modifications to the remediation method selected in the Record of Decision (ROD) (NYSDEC, 2000) and present proposals for implementation of alternative and supplemental remediation methods that will more effectively achieve the site cleanup goals stipulated in the ROD.

A RD Work Plan (BBL, 2001a) was prepared that contains a detailed description of the construction and implementation of the in-situ bioremediation field study, which included the following:

- the in-situ bioremediation field study design;
- the monitoring program to assess the effectiveness of the field study and the status of plume movement horizontally and vertically;
- the field study evaluation criteria; and
- the requirements for creating a contingency plan to implement hydraulic control promptly in case any element of the in-situ bioremediation field study fails to control migration of the plume.

The RD Work Plan stated that the field study would be implemented over a 6- to 12-month period to collect data needed to determine the feasibility of using this approach as the sole remedy for the impacted groundwater at the site.

The RD Work Plan was submitted to the NYSDEC in June 2001 (BBL, 2001a). The Groundwater Contingency Work Plan was submitted to NYSDEC in February 2002 (BBL, 2002).

The Bioremediation Field Study Status Report is divided into the following sections:

- Section 1 contains the introduction to the Status Report and describes the purpose of the field study and background information relevant to the evaluation of the field study.
- Section 2 contains a summary description of baseline and subsequent groundwater sampling event methods, and HRC™/ORC™ injection methods.
- Section 3 presents the results of the baseline groundwater sampling event.
- Section 4 presents the results of the injection of HRC™/ORC™ into groundwater.
- Section 5 presents the results the three subsequent groundwater sampling events.
- Section 6 contains a description of the groundwater remediation method selected in the ROD and describes a proposed modification to the groundwater remediation program.
- Section 7 contains the references used in this document.

1.2 Background

The former Dover Electronics facility is located at 29 Industrial Park Drive, Kirkwood, Broome County, New York. The facility is located on a site of approximately 9.58 acres in size. A site location map is shown on Figure 1, and Figure 2 is the site plan.

The property is situated in an industrial setting. Major plants in the area include; Truckstops of America Landfill (0.5 mile southeast), Frito Lay Plant (0.5 mile south), Universal Instruments (147 Industrial Park Drive, 0.5 mile east), Kason Industries (eastern property boundary), Consolidated Freightways (northern property boundary), and the newly developed Pilot Truck Stop to the south. Industrial properties surround the property on north, east, and west. The property consists of an industrial building with parking areas. The site currently serves as the corporate headquarters for Universal Instruments.

1.2.1 Site History

The facility was first constructed in 1973, with subsequent additions built in 1978, 1982, and 1984. It has been occupied by Universal Instruments and Dover Electronics. In 1993, Dover Electronics was renamed Dovatron, Inc. (Dovatron). In 1995, Dovatron transferred its title to the facility to Universal Instruments. In 1996, Dovatron changed its name to the DII Group. Later the DII Group sold to Flextronics International, Inc. and Universal Instruments became a wholly-owned subsidiary to Dover Corporation. The site currently serves as the corporate headquarters for Universal Instruments. The facility has reportedly been used for electronic circuit board manufacturing since 1973.

Previous circuit board manufacturing processes used tetrachloroethene (PCE) as a cleaning solvent. Originally, the virgin PCE was stored in 55-gallon drums at an outside drum storage area. During the initial facility expansion, a ramp to the east-side overhead door served as the entry point for PCE drums. As production increased and the facility was again expanded, virgin PCE was stored in a 3,000-gallon aboveground storage tank that has since been removed.

An aboveground 5,000-gallon waste PCE flux storage tank was also located on the site. In March 1992, a 10,000-gallon fuel oil tank was reportedly removed from the site, and in March 1993, the aboveground PCE system was dismantled. Two 480-gallon PCE tanks were reportedly dismantled and removed from the building interior at that time. Historical handling and use of PCE has resulted in its documented presence in the soil, stormwater, and groundwater at this site.

1.2.2 Site Geology and Hydrogeology

The site is immediately underlain by surficial soils that consist of various types of silty and gravelly loams that were reworked by cut and fill activities when site was developed. These surficial soils are derived from the underlying till deposits, a dense soil/sediment type of glacial depositional environment origin.

Below the surficial soils, weathered till is encountered. The weathered till (a slightly decomposed version of the unweathered till) consists of light brown to brown, poorly sorted silts and fine sands that contain varying minor amounts of clay and fine gravel. Cobbles are rarely present. The weathered till is dense and appears to be unstratified. Although fracturing has been reported in the weathered till (Shield, 2000), observations from recent soil borings and from a large cut bank across Colesville Road from the site suggest that such fracturing is not prevalent. The weathered till unit has a thickness that ranges from 10 to 25 feet. As with the surficial soils above, the weathered till appears to be restricted as a geologic unit to the area of the Universal Instruments property. It does not extend onto the Pilot Truck Stop property.

The unweathered till is the next geologic unit encountered beneath the site. The unweathered till consists primarily of brown to olive-gray, poorly sorted silts and fine sands. The unweathered till contains lenses of clay-rich sediment and sand and fine gravel rich lenses. The unweathered till is very dense and has less fracturing. Its thickness ranges from less than 20 feet at the southern part of the site to greater than 80 feet at the northern part of the site. The contact with the overlying weathered till appears to be a gradational boundary rather than a sharp one.

Across Industrial Park Drive, on the Pilot Truck Stop, surficial soils encountered are composed of imported fill materials consisting of loose to moderately dense, admixed silt, sand, gravel, angular rock fragments, and small brick and concrete debris. This fill layer varies in thickness from 2 feet to about 6 feet. Beneath the fill layer, is an organic rich silt layer, about 1 to 2 feet thick, that contains small plant and wood fragments. This layer has a probable wetland's marsh origin. Below the organic silt layer, till is encountered. The till extends to a depth that varies from 12 feet to 15 feet. Below the till, well-sorted, fine to medium-grained sands with some fine gravel are found. These sands were encountered in each pilot boring drilled for monitoring wells on the Pilot Truck Stop property and, therefore, appear to be laterally extensive. The sands contain thin layers and lenses of silt and clay.

The deepest layer encountered is a well-sorted, medium to coarse-grained sand unit that contains some fine gravel that was found at a depth of 50 feet below the ground surface at the MW-34 location on the Pilot Truck Stop. This layer extended to the approximate termination of the boring at a depth of 56 feet.

Bedrock has not been encountered during drilling operations at the site or at the Pilot Truck Stop. Bedrock is believed to start at a depth around 115 feet below the Universal building or approximately 80 feet below the Pilot Truck Stop (Shield, 2000).

Before and during the Pre-Design Phase for remedial action, BBL has continued to evaluate the groundwater data at the Kirkwood site. Emphasis has been placed on evaluating patterns of groundwater flow. After review of the more recent groundwater data collected since our June 20, 2001 letter to the NYSDEC, we believe that the conclusions drawn then are still valid. Those conclusions are summarized below:

- Two distinct water-bearing zones exist;

- Head differences within the first (uppermost) water-bearing zone vary, both spatially and temporally, with some well-pair locations having upward gradients and others downward gradients;
- There appears to be hydraulic communication between the two halves of the first water-bearing zone, but not any hydraulic communication with the deeper water-bearing zone; and
- Groundwater flow directions are to the southwest within the first water-bearing zone, but vary slightly between the upper and lower halves of this zone.

The bases for these conclusions are summarized below.

Water-Bearing Zones

Two distinct water-bearing zones exist. The first is within the glacial till and the second zone is a confined unit in glacial outwash deposits that we have named the confined deep zone.

The first water-bearing zone is a water table unit with a free water surface. This first water-bearing zone is approximately 30 feet thick. This zone is found within some fractured deposits of the weathered till and within the unweathered till that has an increase in sandy layers with depth and to the south. This appears to increase the overall hydraulic conductivity of the unit with depth and in the downgradient direction. The sandy lenses within the lower half of this zone indicate some hydraulic sorting, possibly from esker activity. There does not appear to be a distinct or sharp geologic or hydrologic demarcation between the upper and lower halves of this zone.

The deep confined zone is separated from the overlying first water-bearing zone by a 3 to 4-foot-thick silty clay unit. This deeper water-bearing unit consists of sand and gravel of glacial outwash origin. The hydraulic conductivity appears good, although the storativity data suggest the unit may be thin and have limited areal extent. There is a consistent upward vertical head difference of approximately 5 feet between this zone and the overlying first water-bearing zone.

Vertical Head Differences

Vertical head differences between the water levels in the five existing well pairs were observed. These head differences are present through out the database of historic groundwater level measurements. Typically, the head differences are consistent through time for the individual well pairs, but there are temporal exceptions. The vertical gradients observed in these well pairs is a micro-scale reflection of the bulk mass transport of groundwater through the entire saturated thickness of this uppermost water-bearing zone.

Groundwater Flow Directions

The groundwater gradient is similar between the two zones and the contour elevations only vary slightly in geographic position within the first water-bearing zone. This shows that this water-bearing zone functions as one hydrologic unit on a macro-scale.

The groundwater data within the upper half of the first water-bearing zone show that the groundwater flow direction is in a southwesterly direction with some minor variability. Groundwater data for water levels taken from monitoring wells MW-7A and MW-13 create an anomalous high area and are considered to be non-representative of area wide groundwater flow. The overall groundwater flow direction to the southwest is consistent with the migration pattern shown by the dissolved-phase chlorinated hydrocarbon plume.

Groundwater within the lower half of the first water-bearing zone appears to move in a consistent direction. Groundwater within the lower half moves to the west in the vicinity of the former flux tank, turning to the southwest near MW-24. The groundwater flow direction appears to be primarily southwest on the southeastern side of the facility building. The groundwater flow direction is southwest south of the building.

Aquifer tests were also performed using limited (in time and in observation points) pumping tests in monitoring wells MW-3, MW-12, MW13, MW-22, MW-25, and MW-34 to establish the approximate hydraulic conductivity, transmissivity, and permeability of the aquifer(s). Another goal of the pumping test was to assess potential hydraulic connections between clustered wells screened within the same aquifer or in different aquifers. The estimated hydraulic conductivities derived from the pump testing ranged from 10^{-3} to 10^{-6} cm/sec, indicating that there is variation in the hydrogeologic setting at the site. Hydraulic connections between the clustered well pairs were not observed.

1.2.3 Post-Feasibility Study Activities

In July 2000, the feasibility of in-situ groundwater treatment of chlorinated hydrocarbons was assessed. The use of hydrogen and oxygen releasing compounds that can accelerate the removal of dissolved constituents at the site and provide containment and control of the byproducts that are produced during the in-situ biodegradation process was proposed. As a result of the conference call on November 8, 2000, the NYSDEC agreed on the proposed in-situ bioremediation field testing program.

The groundwater remedy elements described in the Record of Decision (NYSDEC, 2000) are:

- replacement and re-routing of the stormwater piping system between the roof drains in the front of the building and CB-1537 outfall;
- evaluation of in-situ groundwater treatment in areas where the highest concentrations are present to accelerate groundwater cleanup (in-situ bioremediation field study);
- groundwater extraction and treatment for the impacted groundwater if in-situ bioremediation is not effective;

The NYSDEC and Universal Instruments have agreed that the remedial action of groundwater extraction and treatment will only be implemented should the in-situ bioremediation field study fail to demonstrate its effectiveness in attaining the remedial action objectives for the site.

2. Methods and Procedures

2.1 Baseline and Field Study Groundwater Monitoring and Sampling

An initial baseline groundwater sampling event was be conducted on all existing monitoring wells and on the newly installed monitoring points (a total of 48 groundwater sampling locations) to establish pre-HRC™/ORC™ injection conditions (Figure 2). This baseline groundwater sampling event was performed from September 19 through September 28, 2001 using the low-flow purging and sampling method. Samples collected from the newly installed wells MW-37 and MW-38, the newly installed monitoring points (MP-1 through MP-10D)[1] and all existing monitoring wells were analyzed for SSPL VOCs. Monitoring wells and points that were part of the field study sampling list (see below) were analyzed for selected inorganic parameters, and selected dissolved gases. An additional subset of groundwater samples that had been collected from 22 selected monitoring wells was analyzed for metabolic acids (byproducts derived from biodegradation of HRC™). The protocol for the low-flow purging method and equipment decontamination followed the requirements described in the *Quality Assurance Project Plan* and its attached *Field Sampling Plan*.

The analytical method used to test the groundwater samples for VOCs was USEPA Method 8260B following Contract Laboratory Protocol [CLP] Statement of Work [SOW], document OLM04.2, as modified by the NYSDEC Analytical Services Protocol (ASP) dated June 2000. The SSPL target VOCs for the site are: tetrachloroethene PCE; trichloroethene (TCE); 1,1,1-trichloroethane (1,1,1-TCA); 1,1-dichloroethene (1,1-DCE); cis-1,2-dichloroethene (1,2-DCE); total 1,2-DCE; 1,1-dichlorethane (1,1-DCA); and vinyl chloride. The selected inorganic parameters for bioremediation monitoring were nitrate, sulfate, sulfide, chloride, dissolved iron, dissolved manganese, and alkalinity. The dissolved gas target analytes were carbon dioxide, methane, ethane, and ethene. The selected metabolic acids chosen for analysis were acetic acid, butyric acid, lactic acid, propionic acid, and pyruvic acid. The inorganic parameters, dissolved gases, and metabolic acids were analyzed using various appropriate USEPA methods, SW-846 methods, and ASTM standard methods.

The monitoring well and monitoring point samples that were selected for metabolic acid analysis were: monitoring wells MW-2, MW-7A, MW-12, MW-13, MW-15, MW-24, MW-25, MW-28, MW-30 through MW-32, MW-34, MW-35, MW-37, and MW-38; and monitoring points MP-3D, MP-4, MP-5, MP-6S, MP-6D, MP-8S, and MP-8D. These particular wells were selected to provide lateral and vertical baseline coverage for areas inside and outside the plume, including fringe and plume interior locations.

Three bi-monthly groundwater monitoring and sampling events were conducted subsequent to the baseline event. These bi-monthly events occurred on December 3 through 6, 2001; January 28 through February 1, 2002; and April 1 through 5, 2002. The groundwater monitoring, sampling, and analytical methods used during the bi-monthly events were the same as those used during the baseline event. The bi-monthly events were conducted on the 29 selected monitoring wells and points specified in the RD Work Plan (BBL, 2001a). The selected monitoring wells and points are: MW-2, MW-7A, MW-12, MW-13, MW-15, MW-16, MW-24, MW-25, MW-28, MW-30 through MW-32, MW-34, MW-35, MW-37, MW-38, MP-1, MP-2, MP-3D, MP-4, MP-5, MP-6S, MP-6D, MP-7, MP-8S, MP-8D, MP-9, MP-10S, and MP-10D. SSPL VOC, inorganic parameter, dissolved gas, and metabolic acid analyses were performed on all the groundwater samples collected.

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[1] The new monitoring wells and points were installed between September 24 and October 11, 2002 as part of the bioremediation field study. These monitoring wells and monitoring points were installed to help assess the effectiveness of bioremediation by providing additional coverage of the saturated zone. The monitoring wells and monitoring points were installed as proposed in the Remedial Design Work Plan (BBL, 2001a) using direct push and mud-rotary methods. The locations of the new monitoring wells and monitoring points are shown on Figure 2. The geologic log for MW-37 is presented in Appendix A.

During all the groundwater monitoring events, water levels within the monitoring wells were measured with a Solinst water level meter equipped with a stainless steel probe and measuring tape graduated in engineering units to 0.01 foot. Groundwater depths and elevation data are presented in Tables 1 through 4.

During all the groundwater sampling events, the sampled monitoring wells and monitoring points were purged with bladder pumps and Teflon®-lined polyethylene tubing was used to pass groundwater from the pump to the surface (the tubing that was used has been dedicated for future use to each well that was sampled). Groundwater quality parameters (pH, dissolved oxygen, conductivity, temperature, turbidity, and oxygen reduction potential) were measured with an Horiba U-22 water quality instrument with flow-through cell. Groundwater quality data collected during well purging is contained in Appendices A through D (Volumes II through V).

2.2 HRC™/ ORC™ Injection

HRC™ was injected into the shallow saturated zone affected by the groundwater plume to begin the bioremediation field study, to enhance the reductive dechlorination process, thereby decreasing the concentration of dissolved-phase VOCs. The HRC™/ORC™ injection program was performed from October 8 through October 18, 2001.

The dosing requirement and total mass for the HRC™ and ORC™ was calculated by the manufacturer, Regenesis, as 5 pounds per foot and 4 pounds per foot, respectively. This calculation was based on the size of the test areas (approximately 1500 square feet each), a contaminated saturated thickness of 10 feet, representative PCE concentration of 1,200 micrograms per liter (μg/L), and an estimated groundwater velocity of 30 feet per year.

HRC™ with a viscosity of 20,000 centipoise can be injected at flow rates of 3 to 10 gallons per minute (gpm) at pressures ranging from 200 pounds per square inch gauge (psig) to 1,500 psig. ORC™ is usually injected as a 20% to 40% slurry mixture at a rate of 1 gpm to 5 gpm using grout pumps. The solids content of the slurry mixture is dependent upon the permeability of the soil into which it is injected. The acceptable injection pressures for ORC™ typically range from 100 psig to 500 psig.

HRC™ is used to enhance in-situ biodegradation rates for chlorinated hydrocarbons by fueling anaerobic reductive dechlorination processes. HRC™ is a sticky gel at room temperature and was pre-heated to a uniform consistency that produced a liquid that would flow freely. The HRC™ was pre-heated by placing the shipping containers in a heated water bath. The water in the bath was recirculated through a steam cleaner and kept at a temperature ranging between 115 degrees and 140 degrees Fahrenheit. The HRC™ temperature was approximately kept between approximately 90 to 95 degrees Fahrenheit.

ORC™, which provides oxygen to support the aerobic biodegradation of chlorinated hydrocarbons, such as DCE, and vinyl chloride was injected below the plume to address these reductive dechlorination products. Manufactured as a powder, ORC™ was mixed with water for slurry injection (50% solids) into the saturated zone.

Three testing areas were selected for HRC™ injection (Figure 3) for evaluation of the feasibility of in-situ bioremediation as a remedial method:

- on site near existing monitoring well MW-24;
- on site near existing monitoring well MW-7A; and
- off site near existing monitoring well MW-28.

The three HRC™ injection areas cover a large extent of the higher concentration areas of COC-affected groundwater.

In addition, an aerobic bio-barrier area in the 25- to 35-foot zone downgradient of the pilot study area for the treatment of PCE degradation byproducts, such as DCE and vinyl chloride was selected for injection of ORC™ (Figure 3). This bio-barrier is designed to cover the off-site treatment area plume edge to prevent further migration of PCE daughter products. The ORC™ barrier was designed to provide a minimum of a 100-day retention time for VOCs based on a conservative average groundwater flow velocity of 0.1 ft/day.

Direct push hydraulic equipment, air rotary drilling equipment, and slurry pumps were be used to deliver the reagents into the subsurface. The injection work was performed by Parratt Wolff, Inc. of East Syracuse, New York over a period of 9 working days. A total of 5,000 pounds of HRC™ was distributed at 5 lbs/ft within the treatment areas of the 100 plume area borings. A total of 1,200 pounds of ORC™ was injected at a rate of 3 to 12 lbs/ft along the barrier in 30 borings. HRC™ was applied at the site using a combination of air rotary drilling in upper parking lot at the Universal property) and direct push hydraulic equipment in the lower parking lot and on the Pilot Truck Stop site. Injection through a steel rod fitted with an inflatable packer was used within the open borehole where air-rotary drilling techniques were employed. ORC™ was injected at all locations using direct push hydraulic equipment.

3. Baseline Groundwater Monitoring And Sampling Results

Groundwater gauging and sampling was conducted on September 19 through September 28, 2001. The depth to water was gauged at each of the 35 groundwater monitoring wells and 13 monitoring points at the site. Groundwater samples were collected from all existing monitoring wells and monitoring points and analyzed for SSPL VOCs, inorganic bioremediation parameters, dissolved gas bioremediation parameters, and metabolic acids. During purging, groundwater was monitored through a flow cell for the field parameters pH, dissolved oxygen, conductivity, temperature, turbidity, and oxygen reduction potential.

3.1 Groundwater Flow Directions

The water level data was collected over the nine-day sampling period and is summarized in Table 1. Groundwater contours showing the hydraulic gradients and groundwater flow directions for the shallow and intermediate saturated zone within the glacial till are shown on Figures 4 and 5.

Figure 4 indicates that the groundwater within the upper shallow zone flows toward the southwest with a hydraulic gradient that ranges from 0.050 to 0.136 ft/ft. This gradient range is illustrative of the permeability change in the shallow zone as groundwater moves from the dense, silty and clayey till beneath the Universal property into the sandy silt and silty sand area found beneath the Pilot Truck Stop. Groundwater seepage velocities calculated for these two areas show a seepage velocity of 0.06 feet per day beneath the Universal property (area of well MW-7A) and a seepage velocity of 0.1 feet per day beneath the Pilot Truck Stop.

Figure 5 indicates that the groundwater within the intermediate zone flows toward the southwest, as well, with a very similar hydraulic gradient. There is some minor offset to the groundwater elevation contours between the two parts of the saturated zone. This is indicative of slight soil composition and aquifer heterogeneties between the upper and lower parts of the saturated till.

The groundwater flow directions and hydraulic gradients reported above and resulting from the water level measurements collected during this groundwater sampling event are consistent with groundwater elevation data previously reported by Shield Environmental in the RI Report (Shield Environmental, 2000).

3.2 Analytical and Field Parameter Results

A summary of the groundwater analytical results for SSPL VOCs is provided in Table 4. A PCE isoconcentration contour map for the shallow zone during September 2001 is presented on Figure 6. A PCE isoconcentration contour map for the intermediate zone during September 2001 is presented on Figure 7. Appendix B contains the chain of custody forms and the laboratory data reports. The complete laboratory data package is presented in Volume II.

After a review of the September groundwater quality data, the following observations were made.

- The shallow and intermediate parts of the saturated zone within the glacial till have similar groundwater geochemistry, which is further supporting evidence that they are indeed part of the same hydrologic water bearing unit (see Table 6 and Appendix B – Well Purging Sheets).

- The shallow and intermediate zones were observed to have predominantly negative moderate redox potentials. None of the monitoring wells or monitoring points exhibited a redox potential that indicated oxidizing or aerobic conditions. Overall, both shallow and intermediate zones show reducing conditions

(Figures 6 and 7). The most negative redox potentials were associated with higher VOC concentration areas of the plume that are not subject to recharge by oxygen rich surface water and with the former wetlands area beneath the Pilot Truck Stop. Redox potentials are found on the Well Purging Sheets contained within Appendix B.

- SSPL VOCs were detected within the most of the monitoring wells that previously had defined the groundwater plume. However, on the margins of the groundwater plume, some of the samples collected from plume fringe monitoring wells had sample results that were below the NYSDEC groundwater standard of 5 µg/L for PCE.
- The analytical results from the groundwater samples show the presence of all the major "daughter" products that result from the breakdown of PCE. The presence of "daughter products was most noticeable in samples from the plume fringe wells, where method detection limits were lower.
- The analytical results for the dissolved gases showed that methane was detected frequently at trace levels or higher. Three methane detections were well above trace concentrations. These methane detections came from plume fringe areas. Ethane was detected in three samples at trace concentrations. Ethene was not detected in any of the groundwater samples. Carbon dioxide was detected at concentrations that ranged from 10 mg/L to 630 mg/L (see Table 7).
- The selected metabolic acids were not detected, as anticipated, with two notable exceptions in the groundwater samples from monitoring points MP-6S (acetic acid) and MP-6D (acetic, butyric, lactic, and propionic acids) where the concentrations were well above what would be considered possible background levels (see Table 8). We believe the results from the two high results to be outliers or erroneous.

3.3 Discussion

Groundwater sample analytical VOC data sets for the site are available for at least half of the monitoring wells that extend back to November 1998. However, there are only two sets of analytical VOC data where most monitoring wells sampled during the September 2001 event are represented. These groundwater analytical data sets are for April 1999 and September 2001. Historical analytical VOC in groundwater data are summarized in Table 21.

A review of the historical VOC data indicates that the COC plume within the shallow and intermediate parts of the saturated zone within the glacial till has not expanded further downgradient in the last two years, nor has migration of COCs to the deeper groundwater zone occurred (see Figures 6 and 8, and 9 through 11). Comparison of groundwater sample results from plume fringe wells that are found in downgradient and sidegradient locations indicates a shrinking plume. VOCs that represent daughter breakdown products of the parent compounds (for PCE, TCE, and 1,1,1-TCA) are present.

The September 2001 groundwater sampling event[2] indicated that differing contaminant conditions existed within the dissolved-phase plume area from those documented at the completion of the RI phase. In summary the differing conditions observed to have occurred between early 1998 and September 2001 include:

- groundwater impacts related to dissolved-phase chlorinated COCs that were of lesser concentrations within both the shallow and deeper zones of the primary plume areas, as well as, in the adjoining lesser affected areas because of natural attenuation processes (biodegradation, adsorption, diffusion) and the elimination of new source mass;

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[2] For the September 2001 groundwater sampling event, newly installed monitoring wells/points MP-1 and MP-2 were dry. MW-18 had a hard obstruction inside the casing just below the measured water level. MP-7, MP-9, and MP-10S were very muddy and required additional development. Therefore, these wells/points were not sampled.

- the present configuration of the dissolved-phase groundwater plume shows that the total area affected has diminished as compared to the plume shape from two to three years ago, which indicates a shrinking plume resulting from the mass removal of COCs by natural attenuation;

- the detections of VOCs representing the degradation products of PCE along with reduction-oxidation potentials indicating reducing conditions, which support the conclusion that a favorable environment for in-situ, enhanced biodegradation of the dissolved-phase groundwater plume exists in the saturated subsurface.

3.4 Data Usability Summary Reports

The groundwater test data reported from the analytical laboratory was reviewed by Environmental Data Quality, Inc. (EDQI) of Exton, Pennsylvania. Six Data Usability Summary Reports (DUSRs) were prepared by EDQI for sample delivery groups (SDG) A2291, B2291, C2291, G2291, T2291, and Y2291. The DUSRs are presented in Appendix B. EDQI found the data to be useable for its intended purpose of groundwater monitoring and pilot test evaluation of enhanced in-situ bioremediation. The data evaluations are summarized below.

- The date deliverables were complete for all of the SDGs, with the exception of G2291, where the laboratory needed to supply a copy of a missing chain-of-custody.
- The chains of custody were complete and holding times were met for all analyses in all six SDGs.
- All criteria were met and no qualifiers were applied for instrument performance in all six SDGs.
- Initial and continuing calibrations criteria were met for SDGs C2291 and G2291. SDG A2291had the continuing calibration precision criterion exceeded for TCE. The TCE results for the groundwater samples collected from MP-6D, MP-6S, and MW-26 should be considered quantitative estimates. SDG B2291had the continuing calibration precision criterion exceeded for vinyl chloride, 1,1-DCE, trans-1,2-DCE, and TCE. These VOC results for the groundwater samples collected from MW-17, MW-25, MW-28, MW-32, MW-34, and MW-35 should be considered quantitative estimates. SDG T2291had the continuing calibration precision criterion exceeded for TCE. The TCE results for all the groundwater samples listed in this SDG (12) should be considered quantitative estimates. SDG Y2291had the continuing calibration precision criterion exceeded for TCE and PCE. The TCE results for the groundwater samples collected from MW-2, MW-5, MW-6, and MW-8 should be considered quantitative estimates. The PCE results for the groundwater samples collected from MW-5, MW-6, and MW-8 should be considered quantitative estimates.
- All criteria were met and no qualifiers were applied for laboratory and field blank analysis results, surrogate compounds, laboratory control sample/blank spike results, and internal standard performance in all six SDGs.
- All criteria were met and no qualifiers were applied for matrix spike and matrix spike duplicate analyses for five of the six SDGs. In SDG Y2291 the matrix spike and matrix spike duplicate recoveries from sample MW-2DL were below the acceptance limits for PCE. The positive result for PCE in the original sample should be considered a biased low quantitative estimate.
- All criteria were met and no qualifiers were applied for qualitative identification for five of the six SDGs. In SDG C2291 a positive result of 0.2 μg/L was reported for vinyl chloride from sample MP-8S. The mass spectrum for this compound did not match the reference spectrum included in the data package. This positive result is considered erroneous and was replaced by the quantitation limit for vinyl chloride.
- In each SDG some samples were re-analyzed at dilutions for VOCs. The re-analyses were performed because the responses for some VOCs exceeded the linear range of the GC/MS instrument. In SDG C2291 the TCE result for sample MP-4 should be considered a quantitative estimate because response for this

compound exceeded the linear range of the GC/MS instrument and the dilution analysis of this sample resulted in a response for TCE that was below detectable levels. In SDG T2291 sample MW-24 was initially analyzed at a 100-fold dilution because of suspected high levels of target compounds. This raised the quantitation limits for all other SSPL VOCs. Sample MW-24 was re-analyzed at a 167-fold dilution because the PCE response in the original analysis exceeded the linear range of the GC/MS instrument. The elevated quantitation limits should be noted when assessing the data from this sample. In SDG Y2291 the TCE result from sample MW-5 should be considered a quantitative estimate. The TCE response exceeded the linear range of the GC/MS instrument and the dilution analysis resulted in a TCE response below detectable levels. Also, in SDG Y2291 the PCE result for sample MW-8 should be considered a quantitative estimate because the PCE response exceeded the linear range of the GC/MS instrument. That laboratory did not re-analyze sample MW-8 at a dilution.

3.5 Conclusions

The lack of COC migration to the deepest groundwater zone (monitored by MW-34) shows that the groundwater plume has a defined vertical extent. Hydrogeologic cross-sections were prepared that show the groundwater plume as represented by the September 2001 data in relation to subsurface hydrogeology (Figures 9, 10, and 11). The lines of cross-section are shown on Figure 6. Similar groundwater geochemistry shows that the groundwater with the saturated part of the glacial till functions as one water-bearing unit. Slightly varying upward and downward vertical heads between the shallow and intermediate zones (coupled with the demonstrated hydrologic connection) represents advection within the saturated zone that has caused the dissolved VOCs to mix within the water-bearing unit as they migrated downgradient. The overall negative redox potential within the saturated groundwater zone and the presence of daughter breakdown products derived from the parent PCE indicates very favorable conditions for natural attenuation by reductive dechlorination within an anaerobic environment.

4. HRC™/ORC™ Injection Results

Injection of HRC™ and ORC™ was accomplished without major deviations from the procedures described within the RD Work Plan section for In-Situ Bioremdiation Field Study Design. The areas were the injection points were installed based on field conditions are shown on Figure 4. The amounts of HRC™ and ORC™ product injected at each location, the number and pattern of injection points, and observations made during the injection process are summarized below (see also Appendices C [Photographs]and D [Field Notes]).

4.1 Upper Parking Lot

Injection of HRC™ was performed in the MW-24 area within 20 injection points. The Field Study Design called for a grid pattern of 4 rows of 5 injection points each; however, the design grid partially overlaid the drainage swale from the outfall of Catch Basin CE-1547 and the drainage swale along Colesville Road. These areas were inaccessible to the air-rotary drill rig, which was needed to advance the injection points through the glacial till in this area. Therefore, the injection point pattern was modified with more points located within the upper parking lot paved area (see Figure 3). The injection point spacing was kept as close as possible to the prescribed 10 feet. The HRC™ product was injected through a steel rod that had an inflatable packer mounted. Approximately fifty pounds of HRC™ was injected into each point for a total of 1,000 pounds injected into the saturated zone in this location.

During injection point drilling using the air-rotary method, airflow pathways within both the unsaturated and saturated zones were observed connecting some of the injection points and monitoring wells. During drilling at a specific injection point location, water was observed being blown out of either monitoring well MW-24 or monitoring point MP-3D, or dust was observed being blown out of a previously completed injection point that had been backfilled. The air pressure during drilling was approximately 120 pounds per square inch.

Nearby connections to MW-24 were observed originating from one injection point located 10 feet south of the well and from one injection point 6 feet to the east. A further connection was observed originating from one injection point 20 feet to the east-northeast. In this specific case water and HRC™ product bubbled out of MW-24's wellhead. Some injection points drilled in the upper parking lot displayed connections to some other previously completed points. These connections were sporadic and limited to a maximum of 15 feet from the injection point being drilled. The pattern of airflow connections was not radial and in many instances existing injection points that were intervening between the airflow source and the observed connection point did not exhibit the slightest reaction. Overall, the pattern of airflow connections trended north-northeast to south-southwest and east-northeast to west-southwest. These observed airflow connections probably represent some vertical fracturing in the till possibly intersecting with sandier horizontal soil lenses.

4.2 Lower Parking Lot

Injection of HRC™ was performed in the MW-7A area within 30 injection points. The Field Study Design called for a grid pattern of 5 rows of 6 injection points each, however, the design grid was located on the steep slope that is found between the upper and lower parking lots. This area was inaccessible to any type of drill rig without construction of a horizontal pad. Therefore, the injection point pattern was modified with most points located within the lower parking lot paved area (see Figure 3). The injection point spacing was kept as close as possible to the prescribed 10 feet. The pattern was change to 4 rows with the rows containing 9, 8, 8, and 5 injection points from the top row to the bottom row. The injection points were installed by direct push (24 points) and air-rotary drilling (6 points) methods. The HRC™ product was injected through either the steel direct push rod or through the packer assembly. Fifty pounds of HRC™ was injected into each point for a total of 1,500 pounds injected into the saturated zone in this location.

The air rotary method was used at six locations for two reasons. First, the drilling rig and crew was available and second, at three locations very dense clays were encountered that actually bent the direct push rod when rod withdrawal was attempted. The dense clay lens was encountered to about 5 to 10 feet to the south and east of monitoring well MW-7A.

4.3 Pilot Truck Stop

Both HRC™ and ORC™ injection points were installed off site within the plume toe area, which is located beneath a portion of the Pilot Truck Stop property.

4.3.1 HRC™ Injection

Injection of HRC™ was performed in the MW-28 area within 50 injection points. The Field Study Design called for a grid pattern of 5 rows of 10 injection points each and this pattern was generally followed (see Figure 4). The HRC™ injection point grid was bent slightly to form an arc that was similar to the arc formed by the ORC™ barrier. This bending resulted in some injection points being slightly closer than 10 feet and others being slight further apart than 10 feet. The injection points were installed by direct push methods. The HRC™ product was injected through the steel direct push rod. Approximately fifty pounds of HRC™ was injected into each point for a total of 2,500 pounds injected into the saturated zone in this location.

The direct push method worked very easily at all injection point locations in this area.

4.3.2 ORC™ Injection

Injection of ORC™ was performed south and west of the MW-28 area within 30 injection points. The Field Study Design called for a 2 rows of 15 injection points each; however, because of a stormwater sewer line the 10-foot spacing was increased to 12 or 13 feet at some point locations (see Figure 4). The injection points were installed by direct push methods. The ORC™ product was injected as a slurry mixture through the steel direct push rod. The Field Study Design called for forty pounds of ORC™ to be injected into each point for a total of 2,500 pounds injected into the saturated zone to create the barrier. In the field the total ORC™ mass was distributed as 30 pounds in 22 holes, 60 pounds in 7 holes, and 120 pounds in one hole. The higher ORC™ mass injection points were located in the middle of the rear row and toward the end of the row facing the HRC™ injection area. The injection point with 120 pounds of ORC™ was located 50 feet from the north end of the forward row.

The direct push method worked very easily at all injection point locations in this area.

5. Field Study Groundwater Monitoring And Sampling Results

Groundwater monitoring wells in the injection areas have been monitored bimonthly since the HRC™/ORC™ injection. Post-injection groundwater monitoring events were conducted on December 3 through 6, 2001, January 28 through February 1, 2002, and April 1 through 5, 2002. Results of the post-injection groundwater monitoring events are presented in sections 5.1 through 5.3.

5.1 December 2001 Groundwater Monitoring and Sampling Event

5.1.1 Groundwater Flow Directions

The water level data was collected over the four-day sampling period and is summarized in Table 2. Groundwater contours showing the hydraulic gradients and groundwater flow directions for the shallow and intermediate saturated zone within the glacial till are shown on Figures 12 and 13. Figure 12 indicates that the groundwater within the upper shallow zone flows toward the southwest with a hydraulic gradient that ranges from 0.063 to 0.135 ft/ft. This gradient range is illustrative of the permeability change in the shallow zone as groundwater moves from the dense, silty and clayey till beneath the Universal property into the more sandy area found beneath the Pilot Truck Stop. Figure 13 indicates that the groundwater within the intermediate zone flows toward the southwest, as well, with a very similar hydraulic gradient. The minor offset to the groundwater elevation contours between the two parts of the saturated zone that was previously observed is still evident.

The groundwater flow directions and hydraulic gradients reported above and resulting from the water level measurements collected during this groundwater sampling event are consistent with groundwater elevation data previously reported by Shield Environmental in the RI Report (Shield Environmental, 2000) and as observed during the baseline groundwater monitoring and sampling event (see Section 3.1).

5.1.2 Analytical and Field Parameter Results

A summary of the groundwater analytical results for SSPL VOCs is provided in Table 9. A PCE isoconcentration contour map for the shallow zone during December 2001 is presented on Figure 14. A PCE isoconcentration contour map for the intermediate zone during December 2001 is presented on Figure 15. Appendix E contains the chain of custody forms and the laboratory data reports. The complete laboratory data package is presented in Volume III.

After a review of the December groundwater quality data, the following observations were made.

- The shallow and intermediate parts of the saturated zone within the glacial till have similar groundwater geochemistry as observed previously (see Table 10 and Appendix E – Well Purging Sheets).

- The shallow and intermediate zones were observed to have predominantly moderate negative redox potentials, which is consistent with the baseline data. None of the monitoring wells or monitoring points exhibited a redox potential that indicated oxidizing or aerobic conditions. Overall, both shallow and intermediate zones show reducing conditions. The most negative redox potentials were associated with lower VOC concentration areas of the plume, such as the plume fringe and plume center, that are not subject to recharge by oxygen rich surface water, and with the former wetlands area beneath the Pilot Truck Stop. Redox potential for December 2001 is found on the Well Purging Sheets contained in Appendix E.

- SSPL VOCs were detected within groundwater samples collected from monitoring wells within the boundaries of the delineated groundwater plume. On the margins of the groundwater plume samples collected from plume fringe monitoring wells had sample results that were just above or below the NYSDEC groundwater standard of 5 µg/L for PCE.

- The analytical results from the groundwater samples show the presence of all the major "daughter" products that result from the breakdown of PCE. The presence of "daughter" products was most noticeable in samples from the plume fringe wells, where method detection limits were lower.

- The analytical results for the dissolved gases showed that methane was detected frequently at trace levels or higher. One methane detection was well above trace concentration. Ethane was detected in seven samples at trace concentrations. Ethene was not detected in any of the groundwater samples. Carbon dioxide was detected at concentrations that ranged from 10 mg/L to 610 mg/L (see Table 11).

- The metabolic acids were not detected with one exception. The exception was the groundwater sample from monitoring point MP-8S, which had propionic acid detected at 6.8 mg/L (see Table 12).

5.2 January 2002 Groundwater Monitoring and Sampling Event

5.2.1 Groundwater Flow Directions

The water level data was collected over the five-day sampling period and is summarized in Table 3. Groundwater contours showing the hydraulic gradients and groundwater flow directions for the shallow and intermediate saturated zone within the glacial till are shown on Figures 16 and 17. Figure 16 indicates that the groundwater within the upper shallow zone flows toward the southwest with a hydraulic gradient that ranges from 0.044 to 0.143 ft/ft. This gradient range is illustrative of the permeability change in the shallow zone as groundwater moves from the dense, silty and clayey till beneath the Universal property into the more sandy area found beneath the Pilot Truck Stop. Figure 17 indicates that the groundwater within the intermediate zone flows toward the southwest, as well, with a very similar hydraulic gradient. The minor offset to the groundwater elevation contours between the two parts of the saturated zone remains in evidence.

The groundwater flow directions and hydraulic gradients reported for this groundwater sampling event were very consistent with the temporal data set from previously collected groundwater levels.

5.2.2 Analytical and Field Parameter Results

A summary of the groundwater analytical results for SSPL VOCs is provided in Table 13. A PCE isoconcentration contour map for the shallow zone during January 2002 is presented on Figure 18. A PCE isoconcentration contour map for the intermediate zone during January 2002 is presented on Figure 19. Appendix F contains the chain of custody forms and the laboratory data reports. The complete laboratory data package is presented in Volume IV.

After a review of the January groundwater quality data, the following observations were made.

- The shallow and intermediate parts of the saturated zone within the glacial till have similar groundwater geochemistry, which is further supporting evidence that they are indeed part of the same hydrologic water bearing unit (see Table 14 and Appendix F – Well Purging Sheets).

- As observed during the September and December 2001 groundwater monitoring, the shallow and intermediate zones had predominantly moderate negative redox potentials. None of the monitoring wells or monitoring points exhibited a redox potential that indicated oxidizing or aerobic conditions. Overall, both shallow and intermediate zones show reducing conditions. The most negative redox potentials were associated with lower VOC concentration areas of the plume, such as the plume fringe and plume center, that are not subject to recharge by oxygen rich surface water, and with the former wetlands area beneath the Pilot Truck Stop. Redox potential for January 2002 is found on the Well Purging Sheets in Appendix F.

- SSPL VOCs were detected within groundwater samples collected from monitoring wells within the boundaries of the delineated groundwater plume. On the margins of the groundwater plume samples collected from plume fringe monitoring wells had sample results that were just above or below the NYSDEC groundwater standard of 5 µg/L for PCE. Within the source area, a rise in PCE concentrations from the September and December sampling events was observed (the increase has been attributed to the HRC™ injection process, see Section 5.4 for a more detailed explanation).

- The analytical results from the groundwater samples show the presence of all the major "daughter" products that result from the breakdown of PCE. As before, the presence of "daughter" products was most noticeable in samples from the plume fringe wells, where method detection limits were lower.

- The analytical results for the dissolved gases showed that methane was detected in six samples at trace levels or higher. Two methane detections were well above trace concentrations. Ethane was detected in two samples slightly above trace concentrations. Ethene was not detected in any of the groundwater samples. Carbon dioxide was detected at concentrations that ranged from 38 mg/L to 670 mg/L (see Table 15).

- The metabolic acids were not detected with two exceptions. The exception were the groundwater samples from monitoring wells MW-28 and MW-31, which had lactic and propionic acids detected (see Table 16).

5.3 April 2002 Groundwater Monitoring and Sampling Event

5.3.1 Groundwater Flow Directions

The water level data was collected over the five-day sampling period and is summarized in Table 4. Groundwater contours showing the hydraulic gradients and groundwater flow directions for the shallow and intermediate saturated zone within the glacial till are shown on Figures 20 and 21. Figure 20 indicates that the groundwater within the upper shallow zone flows toward the southwest with a hydraulic gradient that ranges from 0.060 to 0.167 ft/ft. This gradient range is illustrative of the permeability change in the shallow zone as groundwater moves from the dense, silty and clayey till beneath the Universal property into the more sandy area found beneath the Pilot Truck Stop. Figure 21 indicates that the groundwater within the intermediate zone flows toward the southwest, as well, with a very similar hydraulic gradient. The minor offset to the groundwater elevation contours between the two parts of the saturated zone remains and is probably a permanent feature of the hydraulic system.

The groundwater flow directions and hydraulic gradients reported for this groundwater sampling event were very consistent with the temporal data set from previously collected groundwater levels.

5.3.2 Analytical and Field Parameter Results

A summary of the groundwater analytical results for SSPL VOCs is provided in Table 17. A PCE isoconcentration contour map for the shallow zone during April 2002 is presented on Figure 22. A PCE isoconcentration contour map for the intermediate zone during April 2002 is presented on Figure 23. Appendix G contains the chain of custody forms and the laboratory data reports. The complete laboratory data package is presented in Volume V.

After a review of the April groundwater quality data, the following observations were made.

- The shallow and intermediate parts of the saturated zone within the glacial till have similar groundwater geochemistry, which is further supporting evidence that they are indeed part of the same hydrologic water bearing unit (see Table 18 and Appendix G – Well Purging Sheets).

- As observed during the September and December 2001, and January 2002 groundwater monitoring, the shallow and intermediate zones had predominantly moderate negative redox potentials. None of the monitoring wells or monitoring points exhibited a redox potential that indicated oxidizing or aerobic conditions. Overall, both shallow and intermediate zones show reducing conditions. The most negative redox potentials were associated with lower VOC concentration areas of the plume, such as the plume fringe and plume center, that are not subject to recharge by oxygen rich surface water, and with the former wetlands area beneath the Pilot Truck Stop. Redox potential for April 2002 is found on the Well Purging Sheets contained in Appendix G.

- SSPL VOCs were detected within groundwater samples collected from monitoring wells within the boundaries of the delineated groundwater plume. On the margins of the groundwater plume samples collected from plume fringe monitoring wells had sample results that were just above or below the NYSDEC groundwater standard of 5 µg/L for PCE. Within the source area PCE concentrations did not appear to rise from the January 2002 sampling event, but the area covered by the 1,000 µg/L increased (the increase has been attributed to the HRC™ injection process, see Section 5.4 for a more detailed explanation). In contrast the toe of the plume appeared to have retreated slightly (see Figure 23).

- The analytical results from the groundwater samples show the presence of all the major "daughter" products that result from the breakdown of PCE. The presence of "daughter" products was most noticeable in samples from the plume fringe wells, where method detection limits were lower.

- The analytical results for the dissolved gases showed that methane was detected in 11 samples at trace levels or higher. One methane detection was above trace concentrations. Ethane and ethene were not detected in any of the groundwater samples. Carbon dioxide was detected at concentrations that ranged from 17 mg/L to 580 mg/L (see Table 19).

- The metabolic acids were not detected with two exceptions. The exception were the groundwater samples from monitoring wells MW-28 and MW-31, which had lactic and propionic acids detected (see Table 20).

5.4 Discussion

The field study data generated from the December 2001, January 2002, and April 2002 groundwater sampling events was compared to the historical data set and evaluated for evidence of bio-attenuation. Historical analytical VOC and inorganic parameter data are summarized in Tables 21 and 22.

The lines of evidence checked included the following:

1. Decreasing concentration trend for PCE

2. Increasing concentration trend for PCE daughter (breakdown) products

3. Increasing ratio of daughter products to PCE
4. Decreasing oxygen reduction potential (ORP) and or low ORP
5. Increasing alkalinity
6. Increasing methane, ethane, and ethene concentrations
7. Increasing dissolved carbon dioxide
8. Plume stability (no significant horizontal or vertical migration outside the starting boundaries)

The interpretation of each of these lines of evidence is as follows:

1. Decreasing PCE concentrations indicate mass removal from the system or mass transformation into daughter (breakdown) products
2. Increasing concentration trends of daughter products indicate mass transformation of PCE through biological and/or chemical degradation
3. Increasing the ratio of daughter products to PCE indicates that PCE is being degraded and that no new dissolved PCE mass is being added to groundwater or the degradation is occurring faster than dissolved PCE mass is added to groundwater
4. Decreasing ORP indicates that conditions are becoming more anaerobic and more favorable to reductive dechlorination of PCE, TCE, and the DCE compounds, and low ORP, below 150 millivolts, indicates conditions are optimal for reductive dechlorination
5. Increasing alkalinity indicates consumption of carbon dioxide by calcium or magnesium in the groundwater system (an indirect indication of increased carbon dioxide in groundwater)
6. Increasing methane, ethane, and ethene concentrations indicate the PCE degradation process is reaching its endpoint
7. Increasing carbon dioxide concentrations indicate that the PCE degradation process has gone to completion
8. Plume stability indicates that PCE mass is being degraded faster than migration processes are occurring

A review of the SSPL VOC data indicates that the COC plume within the shallow and intermediate parts of the saturated zone within the glacial till did not expanded further downgradient during the field study period, nor did migration of COCs to the deeper groundwater zone occur (see Figures 14 and 15, 18 and 19, and 22 and 23). Comparison of groundwater sample results from plume fringe wells that are found in downgradient and sidegradient locations indicates a shrinking plume. VOCs that represent daughter breakdown products of the parent compounds (for PCE, TCE, and DCE compounds) are present.

The three field study groundwater sampling events indicate that the lines of evidence for biodegradation of PCE in groundwater beneath the site are primarily positive. In summary the observed groundwater conditions from the field study data include:

- Decreasing PCE trends in some plume fringe areas, but increasing PCE trends at the source area and the "hotspot" beneath the Pilot Truck Stop;

- Increasing concentrations of PCE daughter products (where laboratory detection limits allow these products to be detected);

- Increasing ratios of daughter products to PCE, most dramatically seen in plume fringe well sample results (see Figures 28 through 39);

- A general decrease in ORP values through time, although an increase in ORP was observed in the toe of the groundwater plume;

- A general increase in alkalinity values within the plume;

- Sporadic detections of methane, ethane, and ethene;

- Elevated concentrations of carbon dioxide in some of the groundwater samples; and

- Plume dimensions that have remained steady.

The increasing concentration trend for PCE in the source area, directly downgradient of the source area, and at the "hotspot" beneath the Pilot Truck Stop corresponds to the areas where HRC was injected into the saturated zone. This observation resulted in inquires to the manufacturer of HRC, Regenesis, to check if this had occurred at other sites where HRC was injected in source areas. Regenesis provided information to BBL that indicates HRC injection can cause new contaminant mass to enter groundwater by desorbing contaminants from aquifer material and by freeing micro-droplets of contaminant from tight pore spaces. The desorption occurs through a surfactant effect and the release of separate phase contaminant results from vibration of aquifer soils generated by the injection process (see Appendix H for copies of case studies provided by Regenesis).

The increasing concentrations of daughter products and the increasing ratios of daughter products to PCE observed from the analytical data shows that PCE is undergoing degradation. The ORP values detected since September of 2001 show that overall groundwater conditions are naturally within the range where reductive dechlorination can occur and that in many areas of the plume ORP values are close to or in the optimal range for reductive dechlorination. Detections of the dissolved hydrocarbon gases (methane, ethane, and ethene) above background concentrations, increased alkalinity values, and elevated dissolved carbon dioxide also are positive indicators for biodegradation of PCE and its daughter products.

5.5 Data Usability Summary Reports

The groundwater test data reported from the analytical laboratory was reviewed by EDQI of Exton, Pennsylvania. Six DUSRs were prepared by EDQI, one each for SDGs J2291 and K2291 (December 2001) sampling event, P2291 and QQ2291 (January 2002 sampling event), and QX2291 and QY2291 (April 2002 sampling event). The DUSRs are presented in Appendices E, F, and G. EDQI found the data to be useable for its intended purpose of groundwater monitoring and pilot test evaluation of enhanced in-situ bioremediation of groundwater. The data evaluations are summarized below:

- The date deliverables were complete for all of the SDGs.
- The chains of custody were complete and holding times were met for all analyses in all six SDGs.

- All criteria were met and no qualifiers were applied for instrument performance in all six SDGs.
- Initial and continuing calibrations criteria were met for SDG K2291. These criteria were not met for all SSPL VOCs in the other SDGs. SDG J2291had the continuing calibration precision criterion exceeded for PCE. The PCE results for groundwater samples MP-4, MP-5, MW-2, MW-16, and MW-24 should be considered quantitative estimates. SDG P2291had the continuing calibration precision criterion exceeded for PCE. The PCE results for groundwater samples MP-2, MW-24, and DUP-1 should be considered quantitative estimates. SDG QQ2291had the continuing calibration precision criterion exceeded for PCE. The PCE results for groundwater samples MP-10S, MW-28, and MW-34 should be considered quantitative estimates. SDG QX2291had the continuing calibration precision criterion exceeded for TCE and PCE. No results were reported for TCE. The PCE results for the groundwater sample collected from MP-6S should be considered a quantitative estimate. SDG QY 2291 had the continuing calibration precision criterion exceeded for TCE and PCE. The TCE and PCE results for groundwater samples MP-7 and MP-9 should be considered quantitative estimates.
- Qualifiers were applied for positive laboratory and field blank analysis results in each of the six SDGs. In SDG J2291 sample results for trans-1,2-DCE (MW-13, MW-16, MW-24) and PCE (MP-6D, MW-15) were qualified as qualitatively invalid because of the presence of these compounds in the associated laboratory method blanks. In SDG K2291 sample results for PCE (MP-10D, MW-32, MW-34, MW-35) were qualified as qualitatively invalid because of the presence of these compounds in the associated laboratory method blanks. In SDG P2291 sample results for TCE (MP-14, MW-24) and PCE (MW-12) were qualified because as qualitatively invalid because of the presence of these compounds in the associated laboratory method blanks. In SDG QQ2291 sample results for TCE (MP-8D, MP-10S) and PCE (MP-8D) were qualified because as qualitatively invalid because of the presence of these compounds in the associated laboratory method blanks. In SDG QX2291 sample results for trans-1,2-DCE (DUP-1), TCE (MP-3D, MW-2, MW-12, MW-13, MW-15, MW-32), and PCE (MP-3D, MP-6D, MW-30, MW-32) were qualified because as qualitatively invalid because of the presence of these compounds in the associated laboratory method blanks. In SDG QY2291 sample results for trans-1,2-DCE (DUP-3, MP-8S, MW-31) and PCE (MP-8D, MW-10D) were qualified because as qualitatively invalid because of the presence of these compounds in the associated laboratory method blanks.
- All criteria were met and no qualifiers were applied for surrogate compounds, laboratory control sample/blank spike results, and internal standard performance in all six SDGs.
- All criteria were met and no qualifiers were applied for matrix spike and matrix spike duplicate analyses for five of the six SDGs. In SDG P2291 the matrix spike and matrix spike duplicate recoveries from sample MW-13 were below the acceptance limits for PCE. The positive result for PCE in the original sample should be considered a biased low quantitative estimate.
- Evaluation of field duplicates results in SDG J2291 indicated that the relative percent difference (RPD) for cis-1,2-DCE, TCE, and PCE between DUP-2 and sample MW-38 exceeded 20 percent. Within the same SDG, the RPD between the duplicate results (DUP-1) and the original sample (MW-13) were acceptable.
- All criteria were met and no qualifiers were applied for qualitative identification for five of the six SDGs. In SDG P2291 a positive result of 3 μg/L was reported for 1,1,1-TCE from sample MP-4. The mass spectrum for this compound did not match the reference spectrum included in the data package. This positive result is considered erroneous and was replaced by the quantitation limit for the compound.
- In each SDG some samples were re-analyzed at dilutions for VOCs. The re-analyses were performed because the responses for some VOCs exceeded the linear range of the GC/MS instrument. In SDG J2291 samples MW-25 and MW-38 were analyzed at initial dilutions because of suspected high levels of target compounds. The resulting elevated quantitation limits should be noted when assessing the data from these samples. Eleven other samples from this SDG were re-analyzed at various dilutions and the dilution results

are reported for the specified SSPL VOCs. In SDG K2291 samples MP-7, MP-9, and MW-37 were initially analyzed at dilution. The resulting elevated quantitation limits for all other SSPL VOCs should be noted when assessing the analytical results from these samples. In SDG P2291, six samples were analyzed at an initial dilution (DUP-2, MP-4, MP-5, MP-6S, MW-7A, and MW-38). The resulting elevated quantitation limits should be noted when assessing the data from these samples. Six other samples from SDG P2291 were re-analyzed at various dilutions and the dilution results are reported for the specified SSPL VOCs. In SDG QQ291, sample MP-8S was re-analyzed at a 6.2-fold dilution for PCE. The dilution result is reported. In SDG QX2291, sample MW-37 was initially analyzed at a dilution factor of 2.5. The resulting elevated quantitation limits for all SSPL VOCs should be noted when assessing the analytical results from this sample. Nine other samples from SDG QX2291 were re-analyzed at various dilutions and the dilution results are reported for the specified SSPL VOCs. In SDG QY2291 samples MP-8S, MW-25, and MW-28 were initially analyzed at dilution. The resulting elevated quantitation limits for all other SSPL VOCs should be noted when assessing the analytical results from these samples.

5.6 Conclusions

The continued lack of COC migration to the deepest groundwater zone (monitored by MW-34) shows that the groundwater plume is confined vertically. The SSPL VOC data collected during the field study period show that the plume geometry illustrated on the hydrogeologic cross-sections representing the September 2001 data in relation to subsurface hydrogeology (Figures 9, 10, and 11) is consistent and is a valid conceptual model. Similar groundwater geochemistry shows that the groundwater with the saturated part of the glacial till functions as one water-bearing unit. Continued slightly varying upward and downward vertical heads between the shallow and intermediate zones (coupled with the demonstrated hydrologic connection) shows advection within the saturated zone continues to mix the dissolved VOCs within the water-bearing unit as they migrate downgradient.

The limitation of the increasing concentrations of PCE to within the HRC injection areas coupled with the sporadic detections of the metabolic acids (HRC byproducts) clearly shows that the linear and advective transport of COCs in this groundwater system is very slow. This is a direct function of aquifers overall low hydraulic conductivity and the continuing natural attenuation at the plume edges.

The overall negative redox potential within the saturated groundwater zone, the presence of daughter breakdown products derived from the parent PCE, increased concentrations and ratios of the daughter products, and detections of methane, ethane, and ethene indicate not only very favorable conditions for natural attenuation by reductive dechlorination within an anaerobic environment, but strong evidence that the process of reductive dechlorination is actually taking place. Because PCE and the daughter products are being degraded effectively, the COC plume has become limited in areal extent to its present size and will begin to shrink when the COC degradation rates exceed the rate at which PCE desorbs from aquifer soils. Our interpretation of the available date indicates that plume shrinkage should occur once adsorbed PCE has been completed desorbed from aquifer soils.

As indicated by the pilot study to-date, the enhanced natural attenuation of PCE in groundwater at this site is a viable and effective means of groundwater remediation at this site.

6. Remedial Action Proposals

6.1 Groundwater Remedial Action

The remedial action for groundwater that was selected in the ROD is groundwater extraction and treatment. An evaluation of the supplemental in-situ groundwater treatment through enhanced bioremediation within the higher COC concentration areas of the groundwater plume was approved in the NYSDEC. This measure was approved to determine if this would be the solution to shorten the duration of the groundwater cleanup.

Enhanced in-situ bioremediation as approved in the ROD and described in the Remedial Design Work Plan (BBL, 2001a) was implemented and has undergone evaluation. The evaluation has been presented in the preceding sections of this Bio-Pilot Field Study Status Report.

As described in the Remedial Design Work Plan (BBL, 2001a), assessment of in-situ bioremediation as the sole remedy for treating the impacted groundwater at the site would be evaluated from the field study results according to the following performance evaluation criteria:

- decrease in PCE and TCE concentrations in monitoring wells located within the treatment zones and immediately downgradient;
- reduction of all COC concentrations in monitoring points downgradient of the ORC™ biobarrier to below SCGs;
- favorable reducing environment, indicated by Redox potential and specific electron acceptors;
- presence of gaseous products such as methane, ethane, and ethene; and
- stability of the dissolved-phase PCE plume after the treatment.

These performance criteria were based on the then current understanding of the site conditions and contaminant profiles.

This Bio-Pilot Field Study Status Report has clearly shown the reductive dechlorination of PCE and its daughter products is occurring. A favorable reducing environment, as shown by Redox potential, exists. The dissolved gas products from the final dechlorination of the COCs are present. The areal and vertical extents of the dissolved-phase PCE plume are stable. The reduction of COC concentrations in downgradient monitoring points to below SCGs is underway. The case studies provided by Regenesis indicate that once the new PCE mass added to the plume from the HRC injection process is assimilated decreasing PCE and TCE trends will become evident.

Based on the field study results to-date, in-situ enhanced bioremediation is performing well for groundwater remediation at the site. The data show that:

1. It will achieve the groundwater remediation objectives stipulated in the ROD more effectively (two prior groundwater extraction efforts [an interim remedy and a pilot program] have already demonstrated that groundwater extraction is not an effective approach within the source area at the site);
2. The subsurface environment is conducive to bioremediation of the COC plume, which was already occurring prior to our enhancement efforts;

3. The COC plume is stable and groundwater transport processes are extremely slow within the source area; and

4. A contingency plan has been approved to provide containment in the event that in-situ bioremediation ceases to be an effective remediation approach.

6.1.1 Enhanced Bioremediation Monitoring Program

A groundwater monitoring program was developed for the purpose of evaluating the performance of enhanced in-situ bioremediation of the groundwater plume. The groundwater monitoring program was detailed in the Remedial Design Work Plan and approved by the NYSDEC. As part of the groundwater monitoring program an initial round of groundwater sampling of COCs and bioremediation parameters was conducted prior to the installation of the HRC™ and ORC™ materials to establish the baseline conditions. This groundwater sampling event is discussed in this report in Sections 3.

Following the injection of the HRC™ and ORC™ materials, monitoring of selected wells was begun. Three bi-monthly groundwater sampling events were conducted to validate the effectiveness of the in-situ bioremediation. Periodic groundwater samples are taken from the following locations:

- an upgradient location to determine the background groundwater conditions;
- inside the treatment area;
- an appropriate distance downgradient of the treatment area to identify potential residence time requirements for complete biodegradation, the chemical flux, and biodegradation performance; and
- a downgradient compliance point to confirm that off-site migration is not occurring.

The monitoring program employed low-flow sampling techniques and included the measurement of the following field/laboratory parameters for the HRC™ treatment areas:

- all COCs (using USEPA Method 8260);
- bioremediation field redox parameters: pH, temperature, redox potential, dissolved oxygen;
- bioremediation laboratory redox parameters: nitrate, sulfate, sulfide, chloride, dissolved iron(II), dissolved manganese, and alkalinity;
- dissolved gas end-products: carbon dioxide, methane, ethane, and ethene; and
- metabolic acids products.

The ORC™ treatment area was monitored for field redox parameters, temperature, pH, and dissolved oxygen.

The analytical procedures used to analyze the COCs were consistent with the previously approved *Quality Assurance Project Plan* (QAPP) included in the *Remedial Investigation/Feasibility Study Work Plan* (Shield Environmental, 1998) for the site.

Based on our evaluation of the COC plume, we recommend that the above monitoring program be revised by reducing the monitoring frequency and dropping some of the analytical requirements. As discussed in the sections above, the plume is stable and COC transport mechanisms are slow. Given the effort required for each sampling event, the benefit of quarterly sampling versus semi-annual sampling is not apparent. We believe that at this point in time semi-annual monitoring will provide sufficient temporal coverage of changes to the COC plume.

We recommend that semi-annual sampling replace the quarterly frequency. We recommend that the metabolic acids be dropped because the information they provide at this point is duplicated by the other analytical parameters. We recommend that monitoring points MP-1 and MP-7 be dropped from the monitoring program. MP-1 has been dry since installation and it's casing apparently ends 2 to 3 feet above high groundwater levels. MP-7 is close to a number of other monitoring points and is providing redundant coverage.

We propose that dissolved gas (methane, ethane, ethene, and carbon dioxide) analysis be limited to monitoring wells MW-24 and MP-3D (MW-24 HRC Field Test Area), MP-4 and MP-6S (MW-7A HRC Field Test Area), and MP-7 and MP-8S (MW-25 HRC Field Test Area) because these are near the source areas and "hot spots". Outside of these areas, the SSPL VOC concentrations are low enough that the related concentrations of the dissolved gases will be typically to low to detect.

The changes described above are summarized in the table shown below.

TABLE - MONITORING PROGRAM FOR ORC™ AND HRC™ TREATMENT ZONES

Treatment Zone	Monitoring Wells	Sampling Frequency	Analysis Parameters
MW-24 (HRC™)	MP-1 (delete) MP-2 MP-3D MW-15 MW-24 MW-12 MW-13 MW-16	• Semi-Annual	• All COCs • Bioremediation Field Redox Parameters • Bioremediation Lab Redox Parameters
MW-7A (HRC™)	MW-2 MP-4 MP-5 MP-6S MP-6D MW-7A MW-38	• Semi-Annual	• All COCs • Bioremediation Field Redox Parameters • Bioremediation Lab Redox Parameters
MW-25 (HRC™)	MP-7 (delete) MP-8S MP-8D MW-25 MW-28 MW 34	• Semi-Annual	• All COCs • Bioremediation Field Redox Parameters • Bioremediation Lab Redox Parameters
Barrier (ORC™)	MP9 MP-10S MP-10D MW-30 MW-31 MW-32 MW-35 MW-37	• Semi-Annual	• All COCs • Bioremediation Field Redox Parameters • Bioremediation Lab Redox Parameters

We recommend that a baseline groundwater sampling event (limited to the analysis parameters in the table above) be performed in September 2002 for comparison to the original September 2001 baseline groundwater sampling event.

6.1.2 Groundwater Contingency Plan

A Groundwater Contingency Plan was submitted to the NYSDEC in February 2002 (BBL, 2002) as described in the RD Work Plan. The remedial action of groundwater by extraction and treatment as described in the Groundwater Contingency Plan will only be implemented in the event that the in-situ bioremediation of groundwater fails to demonstrate its effectiveness in attaining the remedial action objectives for the site.

7. References

Blasland, Bouck & Lee, Inc. July 2001a. *Remedial Design Work Plan.*

Blasland, Bouck & Lee, Inc. June 20 2001b. Letter to Mr. James A. Moras, P.E. of the New York State Department of Environmental Conservation (NYSDEC), regarding *Universal Instruments Corporation, Kirkwood, Broome County, New York, Dover Electronics Site (Site Number 7-04-026).*

Blasland, Bouck & Lee, Inc. February 2002. *Contingency Plan Groundwater Remedy.*

New York State Department of Environmental Conservation (NYSDEC). March 2000. *Record of Decision: Dover Electronics Site, Kirkwood (T), Broome County, Site Number 7-04-026.*

New York State Department of Environmental Conservation (NYSDEC). January 2001. *Order on Consent: Index #B7-0515-97-05.*

Shield Engineering Associates, Inc. July 2000. *Feasibility Study Report.*

Shield Environmental Associates, Inc. July 2000. *Remedial Investigation Report.*

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TABLE 1

GROUNDWATER ELEVATION DATA (SEPTEMBER 2001)
Former Dover Electronics Site
Kirkwood, New York

Monitoring Well	Top of Casing (ft.)	Date	Dissolved Oxygen (mg/L)	Depth to Water (ft)	Groundwater Elevation (ft)	Total Depth (ft)	Screened Interval (ft)	Water Bearing Unit
MW-2	863.28	9/21/2001	0	11.97	851.31	16.38	5-15	Shallow
MW-3	859.16	9/20/2001	0.04	8.1	851.06	14.21	5-15	Shallow
MW-5	864.68	9/21/2001	0	12.05	852.63	21.7	5-20	Shallow
MW-6	863.67	9/21/2001	0	3.28	860.39	34.61	15-35	Intermediate
MW-7A	882.74	9/20/2001	5.62	7.26	875.48	16.2	7-17	Shallow
MW-8	899.42	9/21/2001	6.35	29.27	870.15	59.11	30-60	Intermediate
MW-9	923.94	9/19/2001	1.45	47.95	875.99	59.73	30-60	Shallow
MW-11	918.87	9/19/2001	1.68	41.98	876.89	61.45	52-62	Intermediate
MW-12	912.31	9/18/2001	0	40.38	871.93	72.29	63-73	Intermediate
MW-13	912.14	9/20/2001	0.17	33.2	878.94	48.28	39-49	Shallow
MW-14	915.40	9/19/2001	0	41.43	873.97	72.08	62-72	Intermediate
MW-15	899.38	9/26/2001	0	31.57	867.81	45.76	36-46	Shallow
MW-16	878.87	9/20/2001	0	22.41	856.46	30.6	18-28	Shallow
MW-17	859.29	9/25/2001	0	15.31	843.98	20	8-18	Shallow
MW-18	860.71	9/26/2001		DRY	-	18	8-18	Shallow
MW-19	859.59	9/24/2001	0	15.59	844	18.94	8-18	Shallow
MW-20	858.94	9/26/2001	3	11.28	847.66	23.45	14-24	Shallow
MW-21	883.22	9/26/2001	0.89	26.33	856.89	40.39	31-41	Intermediate
MW-22	861.62	9/20/2001	0	6.7	854.92	21.33	17-22	Intermediate
MW-23	916.62	9/19/2001	0	40.73	875.89	49.72	40.5-50.5	Shallow
MW-24	907.66	9/20/2001	2.84	36.46	871.2	44.65	35-45	Shallow
MW-25	857.52	9/25/2001	0.28	14.37	843.15	39.81	34-39	Intermediate
MW-26	859.04	9/24/2001	1.1	15.63	843.41	28.03	22.5-27.5	Intermediate
MW-27	860.01	9/26/2001	0.83	14.68	845.33	26.67	16.5-26.5	Shallow
MW-28	859.09	9/25/2001	0.67	14.29	844.8	25.84	15-25	Shallow
MW-29	917.41	9/19/2001	3.36	43.49	873.92	49	39-49	Shallow
MW-30	862.75	9/26/2001	0.31	14.9	847.85	21.05	15-25	Shallow
MW-31	858.6	9/26/2001	0	14.58	844.02	24.1	13-23	Shallow
MW-32	861.18	9/25/2001	0	13.9	847.28	23.3	15.1-25.1	Shallow
MW-33	863.64	9/26/2001	0	14.82	848.82	22.47	15-25	Shallow
MW-34	857.14	9/25/2001	0	9.56	847.58	58.62	53-58	Deep
MW-35	857.14	9/25/2001	0.2	14.26	842.88	36.98	32-37	Intermediate
MW-36	857.19	9/26/2001	0	13.96	843.23	22.13	14-24	Shallow
MW-37	858.10	9/28/2001	1.31	15.32	842.78	36.52	31-36	Intermediate
MW-38	862.20	9/28/2001	5.05	9.12	853.08	25.27	20-25	Intermediate
MP-1	912.63	9/27/2001	-	39.78	872.85	41.48	31-41	Shallow
MP-2	911.00	9/27/2001	-	43.21	867.79	44.83	34-44	Shallow
MP-3D	910.59	9/28/2001	8.94	39.32	871.27	56.74	46-56	Intermediate
MP-4	883.65	9/27/2001	0.88	10.1	873.55	27.85	17-27	Shallow
MP-5	881.97	9/27/2001	3.2	12.89	869.08	24.74	14-24	Shallow
MP-6S	875.67	9/24/2001	0.75	13.44	862.23	24.78	14-24	Shallow
MP-6D	873.83	9/24/2001	0	9.33	864.5	49.61	39-49	Intermediate
MP-7	857.08	9/27/2001	8.96	13.83	843.25	18.07	8-18	Shallow
MP-8S	857.72	9/27/2001	10.42	14.5	847.3	23.61	13-23	Shallow
MP-8D	857.77	9/27/2001	1.41	12.84	844.93	54.75	44-54	Intermediate
MP-9	857.34	9/27/2001	-	13.88	843.46	17.39	7-17	Shallow
MP-10S	857.6	9/27/2001	-	-	-	20.58	10-20	Shallow
MP-10D	857.58	9/27/2001	0.61	14.3	843.28	56.21	46-56	Intermediate

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TABLE 2

GROUNDWATER ELEVATION DATA (DECEMBER 2001)

Former Dover Electronics Site
Kirkwood, New York

Monitoring Well	Top of Casing (ft.)	Date	Dissolved Oxygen (mg/L)	Depth to Water (ft)	Groundwater Elevation (ft)	Total Depth (ft)	Screened Interval (ft)	Water Bearing Unit
MW-2	863.28	12/3/2001	5.64	12.85	850.43	16.38	5-15	Shallow
MW-3	859.16	12/3/2001	NA	NA	-	14.21	5-15	Shallow
MW-5	864.68	12/3/2001	NA	NA	-	21.70	5-20	Shallow
MW-6	863.67	12/3/2001	NA	NA	-	34.61	15-35	Intermediate
MW-7A	882.74	12/3/2001	3.53	7.26	875.48	16.20	7-17	Shallow
MW-8	899.42	12/3/2001	NA	NA	-	59.11	30-60	Intermediate
MW-9	923.94	12/3/2001	NA	NA	-	59.73	30-60	Shallow
MW-11	918.87	12/3/2001	NA	NA	-	61.45	52-62	Intermediate
MW-12	912.31	12/3/2001	2.02	40.29	872.02	72.29	63-73	Intermediate
MW-13	912.14	12/3/2001	7.14	39.79	872.35	48.28	39-49	Shallow
MW-14	915.40	12/3/2001	NA	NA	-	72.08	62-72	Intermediate
MW-15	899.38	12/3/2001	0.83	31.81	867.57	45.76	36-46	Shallow
MW-16	878.87	12/3/2001	6.21	22.85	856.02	30.60	18-28	Shallow
MW-17	859.29	12/3/2001	NA	NA	-	20.00	8-18	Shallow
MW-18	860.71	12/3/2001	NA	14.69	-	18.00	8-18	Shallow
MW-19	859.59	12/3/2001	NA	15.47	844.12	18.94	8-18	Shallow
MW-20	858.94	12/3/2001	NA	11.60	847.34	23.45	14-24	Shallow
MW-21	883.22	12/3/2001	NA	NA	-	40.39	31-41	Intermediate
MW-22	861.62	12/3/2001	NA	NA	-	21.33	17-22	Intermediate
MW-23	916.62	12/3/2001	NA	NA	-	49.72	40.5-50.5	Shallow
MW-24	907.66	12/3/2001	6.62	37.75	869.91	44.65	35-45	Shallow
MW-25	857.52	12/3/2001	0.73	14.45	843.07	39.81	34-39	Intermediate
MW-26	859.04	12/3/2001	NA	15.42	843.62	28.03	22.5-27.5	Intermediate
MW-27	860.01	12/3/2001	NA	14.53	845.48	26.67	16.5-26.5	Shallow
MW-28	859.09	12/3/2001	1.45	14.29	844.80	25.84	15-25	Shallow
MW-29	917.41	12/3/2001	NA	NA	-	49.00	39-49	Shallow
MW-30	862.75	12/3/2001	8.99	15.11	847.64	21.05	15-25	Shallow
MW-31	858.6	12/3/2001	6.07	13.95	844.65	24.10	13-23	Shallow
MW-32	861.18	12/3/2001	6.56	14.40	846.78	23.30	15.1-25.1	Shallow
MW-33	863.64	12/3/2001	NA	15.07	848.57	22.47	15-25	Shallow
MW-34	857.14	12/3/2001	0.54	10.26	846.88	58.62	53-58	Deep
MW-35	857.14	12/3/2001	0	14.63	842.51	36.98	32-37	Intermediate
MW-36	857.19	12/3/2001	NA	14.39	842.80	22.13	14-24	Shallow
MW-37	857.88	12/3/2001	0.57	15.32	842.56	36.52	31-36	Intermediate
MW-38	862.51	12/3/2001	1.44	10.21	852.30	25.27	20-25	Intermediate
MP-1	912.26	12/3/2001	NA	39.70	872.56	41.48	30-40	Shallow
MP-2	910.82	12/3/2001	NA	39.19	871.63	44.83	34-44	Shallow
MP-3D	910.29	12/3/2001	6.12	39.45	870.84	56.74	46-56	Intermediate
MP-4	883.29	12/3/2001	11.24	8.27	875.02	27.85	17-27	Shallow
MP-5	881.8	12/3/2001	6.46	14.05	867.75	24.74	14-24	Shallow
MP-6S	875.37	12/3/2001	10.08	13.96	861.41	24.78	14-24	Shallow
MP-6D	873.65	12/3/2001	12.1	9.48	864.17	49.61	39-49	Intermediate
MP-7	856.84	12/3/2001	7.59	14.09	842.75	18.07	8-18	Shallow
MP-8S	857.53	12/3/2001	11.79	14.80	842.73	23.61	13-23	Shallow
MP-8D	857.32	12/3/2001	0.41	14.56	842.76	54.75	44-54	Intermediate
MP-9	857.26	12/3/2001	1.51	14.37	842.89	17.39	7-17	Shallow
MP-10S	857.36	12/3/2001	7.56	14.65	842.71	20.58	10-20	Shallow
MP-10D	857.37	12/3/2001	0.38	14.46	842.91	56.21	46-56	Intermediate

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TABLE 3

GROUNDWATER ELEVATION DATA (JANUARY 2002)
Former Dover Electronics Site
Kirkwood, New York

Monitoring Well	Top of Casing (ft.)	Date	Dissolved Oxygen (mg/L)	Depth to Water (ft)	Groundwater Elevation (ft)	Total Depth (ft)	Screened Interval (ft)	Water Bearing Unit
MW-2	863.28	1/28/2002	5.3	10.24	853.04	16.38	5-15	Shallow
MW-3	859.16	1/28/2002	NA	4.95	854.21	14.21	5-15	Shallow
MW-5	864.68	1/28/2002	NA	11.08	853.6	21.7	5-20	Shallow
MW-6	863.67	1/28/2002	NA	2.74	860.93	34.61	15-35	Intermediate
MW-7A	882.74	1/28/2002	6.0	7.11	875.63	16.2	7-17	Shallow
MW-8	899.42	1/28/2002	NA	29.13	870.29	59.11	30-60	Intermediate
MW-9	923.94	1/28/2002	NA	47.86	876.08	59.73	30-60	Shallow
MW-11	918.87	1/28/2002	NA	42.12	876.75	61.45	52-62	Intermediate
MW-12	912.31	1/28/2002	0	40.37	871.94	72.29	63-73	Intermediate
MW-13	912.14	1/28/2002	3.5	34.5	877.64	48.28	39-49	Shallow
MW-14	915.40	1/28/2002	NA	41.39	874.01	72.08	62-72	Intermediate
MW-15	899.38	1/28/2002	0	31.56	867.82	45.76	36-46	Shallow
MW-16	878.87	1/28/2002	0.70	20.89	857.98	30.6	18-28	Shallow
MW-17	859.29	1/28/2002	NA	14.39	844.9	20	8-18	Shallow
MW-18	860.71	1/28/2002	NA	13.87	-	18	8-18	Shallow
MW-19	859.59	1/28/2002	NA	14.71	844.88	18.94	8-18	Shallow
MW-20	858.94	1/28/2002	NA	11.3	847.64	23.45	14-24	Shallow
MW-21	883.22	1/28/2002	NA	24.98	858.24	40.39	31-41	Intermediate
MW-22	861.62	1/28/2002	NA	5.48	856.14	21.33	17-22	Intermediate
MW-23	916.62	1/28/2002	NA	41.41	875.21	49.72	40.5-50.5	Shallow
MW-24	907.66	1/28/2002	4.7	36.85	870.81	44.65	35-45	Shallow
MW-25	857.52	1/28/2002	0	13.61	843.91	39.81	34-39	Intermediate
MW-26	859.04	1/28/2002	NA	14.61	844.43	28.03	22.5-27.5	Intermediate
MW-27	860.01	1/28/2002	NA	14.21	845.80	26.67	16.5-26.5	Shallow
MW-28	859.09	1/28/2002	0	13.91	845.18	25.84	15-25	Shallow
MW-29	917.41	1/28/2002	NA	44.84	872.57	49	39-49	Shallow
MW-30	862.75	1/28/2002	7.2	14.41	848.34	21.05	15-25	Shallow
MW-31	858.6	1/28/2002	0.90	12.95	845.65	24.1	13-23	Shallow
MW-32	861.18	1/28/2002	9.5	13.95	847.23	23.3	15.1-25.1	Shallow
MW-33	863.64	1/28/2002	NA	14.12	849.52	22.47	15-25	Shallow
MW-34	857.14	1/28/2002	0.70	11.47	845.67	58.62	53-58	Deep
MW-35	857.14	1/28/2002	0.90	13.51	843.63	36.98	32-37	Intermediate
MW-36	857.19	1/28/2002	NA	13.8	843.39	22.13	14-24	Shallow
MW-37	858.10	1/28/2002	0.60	14.51	843.59	36.52	31-36	Intermediate
MW-38	862.20	1/28/2002	0	8.3	853.9	25.27	20-25	Intermediate
MP-1	912.63	1/28/2002	NA	39.53	873.1	41.48	31-41	Shallow
MP-2	911.00	1/28/2002	5.8	35.69	875.31	44.83	34-44	Shallow
MP-3D	910.59	1/28/2002	0	38.85	871.74	56.74	46-56	Intermediate
MP-4	883.65	1/28/2002	6.0	7.34	876.31	27.85	17-27	Shallow
MP-5	881.97	1/28/2002	7.2	7.6	874.37	24.74	14-24	Shallow
MP-6S	875.67	1/28/2002	0.4	13.09	862.58	24.78	14-24	Shallow
MP-6D	873.83	1/28/2002	0.7	8.45	865.38	49.61	39-49	Intermediate
MP-7	857.08	1/28/2002	0.2	13.07	844.01	18.07	8-18	Shallow
MP-8S	857.72	1/28/2002	17.8	14.07	843.65	23.61	13-23	Shallow
MP-8D	857.77	1/28/2002	0	13.77	844.00	54.75	44-54	Intermediate
MP-9	857.34	1/28/2002	0	13.52	843.82	17.39	7-17	Shallow
MP-10S	857.6	1/28/2002	0	13.86	843.74	20.58	10-20	Shallow
MP-10D	857.58	1/28/2002	0.4	13.76	843.82	56.21	46-56	Intermediate

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TABLE 4

GROUNDWATER ELEVATION DATA (APRIL 2002)
Former Dover Electronics Site
Kirkwood, New York

Monitoring Well	Top of Casing (ft.)	Date	Dissolved Oxygen (mg/L)	Depth to Water (ft)	Groundwater Elevation (ft)	Total Depth (ft)	Screened Interval (ft)	Water Bearing Unit
MW-2	863.28	4/1/2002	3	8.99	854.29	16.38	5-15	Shallow
MW-3	859.16	4/1/2002	NA	3.98	855.18	14.21	5-15	Shallow
MW-5	864.68	4/1/2002	NA	7.71	856.97	21.70	5-20	Shallow
MW-6	863.67	4/1/2002	NA	0.41	863.26	34.61	15-35	Intermediate
MW-7A	882.74	4/1/2002	7.9	4.46	878.28	16.20	7-17	Shallow
MW-8	899.42	4/1/2002	NA	27.86	871.56	59.11	30-60	Intermediate
MW-9	923.94	4/1/2002	NA	46.93	877.01	59.73	30-60	Shallow
MW-11	918.87	4/1/2002	NA	41.54	877.33	61.45	52-62	Intermediate
MW-12	912.31	4/1/2002	0	38.15	874.16	72.29	63-73	Intermediate
MW-13	912.14	4/1/2002	2.8	32.19	879.95	48.28	39-49	Shallow
MW-14	915.40	4/1/2002	NA	40.58	874.82	72.08	62-72	Intermediate
MW-15	899.38	4/1/2002	0.7	31.05	868.33	45.76	36-46	Shallow
MW-16	878.87	4/1/2002	0.04	18.86	860.01	30.60	18-28	Shallow
MW-17	859.29	4/1/2002	NA	12.44	846.85	20.00	8-18	Shallow
MW-18	860.71	4/1/2002	NA	DRY	-	18.00	8-18	Shallow
MW-19	859.59	4/1/2002	NA	13.12	846.47	18.94	8-18	Shallow
MW-20	858.94	4/1/2002	NA	10.31	848.63	23.45	14-24	Shallow
MW-21	883.22	4/1/2002	NA	22.35	860.87	40.39	31-41	Intermediate
MW-22	861.62	4/1/2002	NA	5.37	856.25	21.33	17-22	Intermediate
MW-23	916.62	4/1/2002	NA	41.21	875.41	49.72	40.5-50.5	Shallow
MW-24	907.66	4/1/2002	3.8	35.75	871.91	44.65	35-45	Shallow
MW-25	857.52	4/1/2002	1	11.86	845.66	39.81	34-39	Intermediate
MW-26	859.04	4/1/2002	NA	12.81	846.23	28.03	22.5-27.5	Intermediate
MW-27	860.01	4/1/2002	NA	12.29	847.72	26.67	16.5-26.5	Shallow
MW-28	859.09	4/1/2002	0.6	11.75	847.34	25.84	15-25	Shallow
MW-29	917.41	4/1/2002	NA	44.64	872.77	49.00	39-49	Shallow
MW-30	862.75	4/1/2002	0	12.96	849.79	21.05	15-25	Shallow
MW-31	858.6	4/1/2002	0	11.20	847.4	24.10	13-23	Shallow
MW-32	861.18	4/1/2002	13	11.92	849.26	23.30	15.1-25.1	Shallow
MW-33	863.64	4/1/2002	NA	12.33	851.31	22.47	15-25	Shallow
MW-34	857.14	4/1/2002	0	8.62	848.52	58.62	53-58	Deep
MW-35	857.14	4/1/2002	0	11.79	845.35	36.98	32-37	Intermediate
MW-36	857.19	4/1/2002	NA	NA	-	22.13	14-24	Shallow
MW-37	857.88	4/1/2002	20	12.70	845.18	36.52	31-36	Intermediate
MW-38	862.51	4/1/2002	6.7	4.46	858.05	25.27	20-25	Intermediate
MP-1	912.26	4/1/2002	NA	39.06	873.2	41.48	30-40	Shallow
MP-2	910.82	4/1/2002	2	36.02	874.8	44.83	34-44	Shallow
MP-3D	910.29	4/1/2002	0	37.94	872.35	56.74	46-56	Intermediate
MP-4	883.29	4/1/2002	5.3	6.47	876.82	27.85	17-27	Shallow
MP-5	881.8	4/1/2002	5.6	12.96	868.84	24.74	14-24	Shallow
MP-6S	875.37	4/1/2002	3.7	11.76	863.61	24.78	14-24	Shallow
MP-6D	873.65	4/1/2002	0	7.00	866.65	49.61	39-49	Intermediate
MP-7	856.84	4/1/2002	0	11.91	844.93	18.07	8-18	Shallow
MP-8S	857.53	4/1/2002	17	12.32	845.21	23.61	13-23	Shallow
MP-8D	857.32	4/1/2002	1	12.06	845.26	54.75	44-54	Intermediate
MP-9	857.26	4/1/2002	0	12.01	845.25	17.39	7-17	Shallow
MP-10S	857.36	4/1/2002	0	12.11	845.25	20.58	10-20	Shallow
MP-10D	857.37	4/1/2002	0	12.02	845.35	56.21	46-56	Intermediate

UNIVERSAL INSTRUMENTS CORPORATION

TABLE 5

SSPL GROUNDWATER ANALYTICAL RESULTS
SEPTEMBER 2001
Former Dover Electronics Site
Kirkwood, New York

Sample Location Sampling Date Laboratory ID	MW-2 9/21/2001 Y2291-3	MW-3 9/20/2001 T2291-10	MW-5 9/21/2001 Y2291-4	MW-6 9/21/2001 Y2291-1	MW-7A 9/20/2001 T2291-12	MW-8 9/21/2001 Y2291-2
Vinyl Chloride	< 1.8	< 0.5	< 0.5	< 0.5	< 130	< 0.5
1,1-Dichloroethene	< 1.8	< 0.5	< 0.5	< 0.5	< 130	< 0.5
trans-1,2-Dichloroethene	< 1.8	< 0.5	< 0.5	< 0.5	< 130	< 0.5
1,1-Dichloroethane	< 1.8	< 0.5	< 0.5	< 0.5	< 130	< 0.5
cis-1,2-Dichloroethene	1 JD	< 0.5	< 0.5	< 0.5	< 130	< 0.5
1,1,1-Trichloroethane	< 1.8	< 0.5	< 0.5	< 0.5	< 130	< 0.5
Trichloroethene	1 JD	< 0.5	< 0.5	< 0.5	< 130	< 0.5
Tetrachloroethene	22 D	11 D	12	< 0.5	3600	< 0.5

Sample Location Sampling Date Laboratory ID	MW-9 9/19/2001 T2291-1	MW-11 9/19/2001 T2291-4	MW-12 9/19/2001 T2291-6	MW-13 9/20/2001 T2291-9	MW-14 9/19/2001 T2291-2	MW-15 9/26/2001 C2291-72
Vinyl Chloride	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1-Dichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
trans-1,2-Dichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1-Dichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
cis-1,2-Dichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1,1-Trichloroethane	< 0.5	0.2 J	< 0.5	< 0.5	< 0.5	< 0.5
Trichloroethene	< 0.5	< 0.5	< 0.5	0.3 J	< 0.5	< 0.5
Tetrachloroethene	< 0.5	< 0.5	< 0.5	13	0.3 J	< 0.5

Sample Location Sampling Date Laboratory ID	MW-16 9/20/2001 T2291-7	MW-17 9/25/2001 B2291-1	MW-19 9/24/2001 A2291-2	MW-20 9/26/2001 C2291-6	MW-21 9/26/2001 C2291-8	MW-22 9/20/2001 T2291-11
Vinyl Chloride	< 0.5	< 0.5	< 4.2	< 0.5	< 0.5	< 0.5
1,1-Dichloroethene	< 0.5	< 0.5	< 4.2	< 0.5	< 0.5	< 0.5
trans-1,2-Dichloroethene	< 0.5	< 0.5	< 4.2	< 0.5	< 0.5	< 0.5
1,1-Dichloroethane	< 0.5	< 0.5	< 4.2	< 0.5	< 0.5	< 0.5
cis-1,2-Dichloroethene	< 0.5	< 0.5	20 D	< 0.5	< 0.5	< 0.5
1,1,1-Trichloroethane	< 0.5	< 0.5	< 4.2	< 0.5	< 0.5	< 0.5
Trichloroethene	< 0.5	< 0.5	20 D	< 0.5	< 0.5	< 0.5
Tetrachloroethene	2	3	88 D	8	< 0.5	< 0.5

NOTE:
All concentrations reported in micrograms per liter (µg/L).
D = Sample analyzed at a dilution factor greater than 1.
J = Reported concentration is less than the CRQL but greater than 0.

Table 5 continued...

Sample Location Sampling Date Laboratory ID	MW-23 9/19/2001 T2291-3	MW-24 9/20/2001 T2291-8	MW-25 9/25/2001 B2291-4	MW-26 9/24/2001 A2291-3	MW-27 9/26/2001 C2291-1	MW-28 9/25/2001 B2291-2
Vinyl Chloride	< 0.5	< 84	< 25	< 5	< 2.5	< 3.6
1,1-Dichloroethene	< 0.5	< 84	< 25	< 5	< 2.5	< 3.6
trans-1,2-Dichloroethene	< 0.5	< 84	< 25	< 5	< 2.5	< 3.6
1,1-Dichloroethane	< 0.5	< 84	< 25	< 5	< 2.5	< 3.6
cis-1,2-Dichloroethene	5	46 JD	< 25	< 5 D	6 D	3 JD
1,1,1-Trichloroethane	< 0.5	< 84	< 25	< 5	< 2.5	< 3.6
Trichloroethene	2	< 84	< 25	< 5 D	5 D	1 JD
Tetrachloroethene	0.3 J	2500 D	630 D	94 D	56 D	70 D

Sample Location Sampling Date Laboratory ID	MW-29 9/19/2001 T2291-5	MW-30 9/26/2001 C2291-5	MW-31 9/26/2001 C2291-2	MW-32 9/25/2001 B2291-6	MW-33 9/26/2001 C2291-3	MW-34 9/25/2001 B2291-3
Vinyl Chloride	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1-Dichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
trans-1,2-Dichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1-Dichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
cis-1,2-Dichloroethene	< 0.5	0.6	1	< 0.5	0.8	< 0.5
1,1,1-Trichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Trichloroethene	< 0.5	1	3	< 0.5	0.6	< 0.5
Tetrachloroethene	< 0.5	< 0.5	1	< 0.5	13	< 0.5

Sample Location Sampling Date Laboratory ID	MW-35 9/25/2001 B2291-5	MW-36 9/26/2001 C2291-4	MW-37 9/28/2001 G2291-2	MW-38 9/28/2001 G2291-1	MP-3D 9/28/2001 G2291-3	MP-4 9/27/2001 C2291-11
Vinyl Chloride	< 0.5	< 0.5	< 0.5	< 6.3	< 0.5	< 250
1,1-Dichloroethene	< 0.5	< 0.5	< 0.5	< 6.3	< 0.5	< 250
trans-1,2-Dichloroethene	< 0.5	< 0.5	< 0.5	< 6.3	< 0.5	< 250
1,1-Dichloroethane	< 0.5	< 0.5	< 0.5	< 6.3	< 0.5	< 250
cis-1,2-Dichloroethene	< 0.5	< 0.5	< 0.5	10 D	< 0.5	< 250
1,1,1-Trichloroethane	0.7	< 0.5	< 0.5	< 6.3	< 0.5	< 250
Trichloroethene	< 0.5	< 0.5	0.7	10 D	< 0.5	< 250
Tetrachloroethene	< 0.5	< 0.5	24	140 D	1	7700 D

Sample Location Sampling Date Laboratory ID	MP-5 9/27/2001 C2291-10	MP-6S 9/24/2001 A2291-4	MP-6D 9/24/2001 A2291-1	MP-8S 9/27/2001 C2291-12	MP-8D 9/27/2001 C2291-13	MP-10D 9/27/2001 C2291-14
Vinyl Chloride	< 50	< 5	< 0.5	< 6.3	< 0.5	< 0.5
1,1-Dichloroethene	< 50	< 5	< 0.5	< 6.3	< 0.5	< 0.5
trans-1,2-Dichloroethene	< 50	< 5	< 0.5	< 6.3	< 0.5	< 0.5
1,1-Dichloroethane	< 50	< 5	< 0.5	< 6.3	< 0.5	< 0.5
cis-1,2-Dichloroethene	< 50	< 5	< 0.5	6 JD	< 0.5	< 0.5
1,1,1-Trichloroethane	< 50	< 5	< 0.5	< 6.3	< 0.5	< 0.5
Trichloroethene	< 50	< 5	< 0.5	2 JD	< 0.5	< 0.5
Tetrachloroethene	1500 D	120 D	2	150 D	2	0.5

NOTE:
All concentrations reported in micrograms per liter (µg/L).
D = Sample analyzed at a dilution factor greater than 1.
J = Reported concentration is less than the CRQL but greater than 0.

Table 5 continued...

Sample Location Sampling Date Laboratory ID	TB-1 - B2291-7	TB-2 - C2291-9	TB-3 - C2291-15	TB-4 9/28/2001 G2291-6	EB092801 9/28/2001 G2291-5	FD092801 9/28/2001 G2291-4
Vinyl Chloride	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 6.3
1,1-Dichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 6.3
trans-1,2-Dichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 6.3
1,1-Dichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 6.3
cis-1,2-Dichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	9 D
1,1,1-Trichloroethane	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 6.3
Trichloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	9 D
Tetrachloroethene	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	140 D

NOTE:

All concentrations reported in micrograms per liter (µg/L).

D = Sample analyzed at a dilution factor greater than 1.

J = Reported concentration is less than the CRQL but greater than 0.

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TABLE 6

INORGANIC GROUNDWATER ANALYTICAL RESULTS
SEPTEMBER 2001
Former Dover Electronics Site
Kirkwood, New York

Sample Location	Laboratory ID	Alkalinity-Total	Chloride	Nitrate	Iron, Dissolved	Manganese, Dissolved	Sulfate	Sulfide
MW-9	01090460-01	130	496	1.02	0.134	0.355	16.5	-
MW-11	01090460-04	348	3.77	0.870	0.074	0.091	15.9	-
MW-12	01090460-06	128	242	0.870	0.020	3.71	9.22	-
MW-14	01090460-02	120	1,032	0.934	0.210	2.39	45.3	-
MW-15	01100081-13	150	13.8	0.901	0.569	0.318	9.78	< 2.0
MW-17	01100081-01	60	630	1.08	0.150	1.16	40	< 2.0
MW-20	01100081-12	210	293	0.974	0.085	0.012	9.67	< 2.0
MW-21	01100081-14	80	58.9	1.11	0.441	0.012	14.9	< 2.0
MW-23	01090460-03	228	5.62	0.816	1.25	1.07	1.97	-
MW-25	01100081-04	70	517	2.31	1.56	2.31	24.2	< 2.0
MW-27	01100081-07	150	317	0.886	3.23	1.32	35.1	< 2.0
MW-28	01100081-02	90	208	0.861	1.28	7.19	56.2	< 2.0
MW-29	01090460-05	170	3.26	0.816	4.56	1.18	34.0	-
MW-30	01100081-11	420	393	< 0.01	1.18	23.1	117	< 2.0
MW-31	01100081-08	130	847	0.810	0.054	1.71	38.5	< 2.0
MW-32	01100081-06	260	252	< 0.01	23.2	22.7	23.5	< 2.0
MW-33	01100081-09	90	637	< 0.01	0.546	0.099	16.1	< 2.0
MW-34	01100081-03	180	2.49	0.900	0.313	0.900	1.80	< 2.0
MW-35	01100081-05	80	548	1.49	0.093	0.015	32.3	< 2.0
MW-36	01100081-10	130	283	0.811	10.4	1.14	31.4	< 2.0
MW-37	01100081-24	180	328	2.09	1.38	1.96	33.1	< 2.0
MW-38	01100081-20	60	369	2.06	1.12	0.612	30.3	< 2.0
MP-3D	01100081-21	90	16.2	0.99	0.988	0.251	16.3	< 2.0
MP-4	01100081-16	80	223	1.89	2.18	1.46	24.6	< 2.0
MP-5	01100081-15	60	1,030	2.43	0.409	0.683	21.5	< 2.0
MP-8S	01100081-17	60	243	1.10	0.347	2.16	33.4	< 2.0
MP-8D	01100081-18	80	178	1.45	1.53	0.354	93.4	< 2.0
MP-10D	01100081-19	210	4.21	< 0.01	1.50	0.726	11.6	< 2.0
FD092801	01100081-22	50	376	2.09	0.880	0.620	30.4	< 2.0
EB092801	01100081-23	8	1.08	0.99	< 0.005	< 0.005	0.364	< 2.0

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TABLE 7

DISSOLVED GASES GROUNDWATER ANALYTICAL RESULTS
SEPTEMBER 2001
Former Dover Electronics Site
Kirkwood, New York

Sample Location	Laboratory ID	Methane	Ethane	Ethene	Carbon Dioxide
MW-2	NJAL-1930-03	<0.002	<0.004	<0.004	250
MW-3	NJAL-1909-10	<0.002	<0.004	<0.004	44
MW-5	NJAL-1930-04	<0.002	<0.004	<0.004	280
MW-6	NJAL-1930-01	0.004	<0.004	<0.004	30
MW-7A	NJAL-1909-12	0.005	<0.004	<0.004	120
MW-8	NJAL-1930-02	0.005	<0.004	<0.004	36
MW-9	NJAL-1909-01	0.002	< 0.004	< 0.004	84
MW-11	NJAL-1909-04	< 0.002	< 0.004	< 0.004	4.7
MW-12	NJAL-1909-06	0.005	< 0.004	< 0.004	48
MW-13	NJAL-1909-09	<0.002	<0.004	<0.004	25
MW-14	NJAL-1909-02	< 0.002	< 0.004	< 0.004	190
MW-15	NJAL-2002-07	0.007	<0.004	<0.004	110
MW-16	NJAL-1909-07	< 0.002	< 0.004	< 0.004	30
MW-20	NJAL-2002-06	0.007	<0.004	<0.004	69
MW-21	NJAL-2002-08	0.007	<0.004	<0.004	51
MW-22	NJAL-1909-11	0.004	<0.004	<0.004	46
MW-23	NJAL-1909-03	< 0.002	< 0.004	< 0.004	53
MW-24	NJAL-1909-08	<0.002	<0.004	<0.004	120
MW-27	NJAL-2002-01	0.009	<0.004	<0.004	240
MW-29	NJAL-1909-05	0.021	< 0.004	< 0.004	33
MW-30	NJAL-2002-05	0.006	<0.004	<0.004	630
MW-31	NJAL-2002-02	0.018	<0.004	<0.004	340
MW-33	NJAL-2002-03	0.008	<0.004	<0.004	180
MW-36	NJAL-2002-04	0.16	<0.004	<0.004	460
MW-37	NJAL-2002-18	0.05	0.005	<0.004	10
MW-38	NJAL-2002-14	<0.002	<0.004	<0.004	240
MP-3D	NJAL-2002-15	0.004	0.007	<0.004	44
MP-4	NJAL-2002-10	0.007	<0.004	<0.004	100
MP-5	NJAL-2002-09	<0.002	<0.004	<0.004	170
MP-8S	NJAL-2002-11	<0.002	<0.004	<0.004	260
MP-8D	NJAL-2002-12	0.009	<0.004	<0.004	37
MP-10D	NJAL-2002-13	0.006	<0.004	<0.004	35
FD092801	NJAL-2002-16	0.006	0.004	<0.004	290
EB092801	NJAL-2002-17	<0.002	<0.004	<0.004	41

All concentrations reported in mg/L.

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TABLE 8

METABOLIC ACIDS GROUNDWATER ANALYTICAL RESULTS
SEPTEMBER 2001
Former Dover Electronics Site
Kirkwood, New York

Sample Location	Laboratory ID	Pyruvic Acid	Lactic Acid	Acetic Acid	Propionic Acid	Butyric Acid
MW-2	11I0842-06	<0.1	<1..0	<1.0	<1.0	<1.0
MW-3	11I0842-04	<0.1	<1..0	<1.0	<1.0	<1.0
MW-7A	11I0842-03	<0.1	<1..0	<1.0	<1.0	<1.0
MW-15	11J0103-04	<0.1	<1..0	<1.0	<1.0	<1.0
MW-16	11I0842-02	<0.1	<1..0	<1.0	<1.0	<1.0
MW-19	11I0870-02	<0.1	<1..0	<1.0	<1.0	<1.0
MW-20	11J0103-03	<0.1	<1..0	<1.0	<1.0	<1.0
MW-22	11I0842-05	<0.1	<1..0	<1.0	<1.0	<1.0
MW-24	11I0842-07	<0.1	<1..0	<1.0	<1.0	<1.0
MW-25	11I0956-03	<0.1	<1..0	<1.0	<1.0	<1.0
MW-26	11I0870-01	<0.1	<1..0	<1.0	<1.0	<1.0
MW-27	11J0103-01	<0.1	<1..0	<1.0	<1.0	<1.0
MW-28	11I0956-01	<0.1	<1..0	<1.0	<1.0	<1.0
MW-29	11I0842-01	<0.1	<1..0	<1.0	<1.0	<1.0
MW-31	11J0103-02	<0.1	<1..0	<1.0	<1.0	<1.0
MW-34	11I0956-02	<0.1	<1..0	<1.0	<1.0	<1.0
MW-38	11J0103-10	<0.1	<1..0	<1.0	<1.0	<1.0
MP-3D	11J0103-11	<0.1	<1..0	<1.0	<1.0	<1.0
MP-4	11J0103-06	<0.1	<1..0	<1.0	<1.0	<1.0
MP-5	11J0103-05	<0.1	<1..0	<1.0	<1.0	<1.0
MP-6S	11I0870-03	<0.1	<1..0	5.5	<1.0	<1.0
MP-6D	11I0870-04	<0.1	12.1	13.1	6.3	6.2
MP-8S	11J0103-07	<0.1	<1..0	<1.0	<1.0	<1.0
MP-8D	11J0103-08	<0.1	<1..0	<1.0	<1.0	<1.0
MP-10D	11J0103-09	<0.1	<1..0	<1.0	<1.0	<1.0
FD092801	11J0103-12	<0.1	<1..0	<1.0	<1.0	<1.0
EB092801	11J0103-13	<0.1	<1..0	<1.0	<1.0	<1.0

All concentrations reported in mg/L.

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TABLE 9

SSPL GROUNDWATER ANALYTICAL RESULTS
DECEMBER 2001
Former Dover Electronics Site
Kirkwood, New York

Sample Location	MW-2	MW-7A	MW-12	MW-13	MW-15	MW-16
Sampling Date	12/4/2001	12/4/2001	12/3/2001	12/3/2001	12/3/2001	12/3/2001
Laboratory ID	J2291-8	J2291-13	J2291-3	J2291-4	J2291-5	J2291-6
Vinyl Chloride	<6	<160	<0.5	<0.5	<0.5	<3
1,1-Dichloroethene	<6	<160	<0.5	<0.5	<0.5	<3
trans-1,2-Dichloroethene	<6	<160	<0.5	0.04 JB	<0.5	<3
1,1-Dichloroethane	<6	<160	<0.5	<0.5	<0.5	<3
cis-1,2-Dichloroethene	5 DJ	<160	<0.5	0.06 JB	0.03 J	4 D
1,1,1-Trichloroethane	<6	<160	<0.5	<0.5	<0.5	<3
Trichloroethene	5 DJ	<160	<0.5	0.3 JB	<0.5	2 DJ
Tetrachloroethene	150 DB	6,000 DB	0.09 J	14	0.2 JB	92 DB

Sample Location	MW-24	MW-25	MW-28	MW-30	MW-31	MW-32
Sampling Date	12/3/2001	12/5/2001	12/5/2001	12/5/2001	12/5/2001	12/5/2001
Laboratory ID	J2291-7	J2291-18	J2291-19	J2291-20	K2291-1	K2291-3
Vinyl Chloride	<42	<25	<17	<0.5	<0.5	<0.5
1,1-Dichloroethene	<42	<25	<17	<0.5	<0.5	<0.5
trans-1,2-Dichloroethene	<42	<25	<17	0.03 J	<0.5	<0.5
1,1-Dichloroethane	<42	<25	<17	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	35 DJ	5 DJ	10 DJ	0.4 J	0.8	0.07 J
1,1,1-Trichloroethane	<42	<25	<17	<0.5	<0.5	<0.5
Trichloroethene	12 DJ	6 DJ	5 DJ	0.4 J	1	<0.5
Tetrachloroethene	1,600 DB	960 DB	440 DB	2 B	0.7 B	0.5 JB

Sample Location	MW-34	MW-35	MW-37	MW-38	MP-3D	MP-4
Sampling Date	12/5/2001	12/5/2001	12/5/2001	12/4/2001	12/3/2001	12/4/2001
Laboratory ID	K2291-4	K2291-5	K2291-6	J2291-15	J2291-1	J2291-9
Vinyl Chloride	<0.5	<0.5	<2	<10	<0.5	<25
1,1-Dichloroethene	<0.5	<0.5	<2	<10	<0.5	<25
trans-1,2-Dichloroethene	<0.5	<0.5	<2	<10	<0.5	<25
1,1-Dichloroethane	<0.5	<0.5	<2	<10	<0.5	<25
cis-1,2-Dichloroethene	<0.5	0.04 J	0.2 J	23 D	0.06 J	3 DJ
1,1,1-Trichloroethane	<0.5	0.4 J	<2	<10	<0.5	<25
Trichloroethene	<0.5	<0.5	0.9 J	21 D	0.03 J	4 DJ
Tetrachloroethene	0.05 JB	0.04 JB	43 B	330 DB	0.1 J	1,100 DB

NOTE:

All concentrations reported in micrograms per liter (µg/L).

D = Sample analyzed at a dilution factor greater than 1.

J = Reported concentration is less than the CRQL but greater than 0.

Table 9 continued...

Sample Location Sampling Date Laboratory ID	MP-5 12/4/2001 J2291-10	MP-6S 12/4/2001 J2291-12	MP-6D 12/4/2001 J2291-11	MP-7 12/6/2001 K2291-8	MP-8S 12/4/2001 J2291-17	MP-8D 12/4/2001 J2291-16
Vinyl Chloride	<13	<2	<0.5	<1	<0.5	<0.8
1,1-Dichloroethene	<13	<2	<0.5	<1	0.08 J	<0.8
trans-1,2-Dichloroethene	<13 J	<2	<0.5	<1	0.1 J	<0.8
1,1-Dichloroethane	<13	<2	<0.5	<1	<0.5	<0.8
cis-1,2-Dichloroethene	0.8 DJ	0.2 DJ	<0.5	2	2	0.3 DJ
1,1,1-Trichloroethane	410 BD	<2	<0.5	<1	<0.5	<0.8
Trichloroethene	0.2 J	<2	<0.5	0.5 J	1	0.6 DJ
Tetrachloroethene		37 DB	<0.5 B	25 B	10 B	26 DB

Sample Location Sampling Date Laboratory ID	MP-9 12/6/2001 K2291-9	MP-10D 12/6/2001 K2291-10	MP-10S 12/6/2001 K2291-11	DUP-1 12/3/2001 J2291-2	DUP-2 12/4/2001 J2291-14	DUP-3 12/5/2001 K2291-2
Vinyl Chloride	<0.8	<0.5	<0.5	<0.5	<25	<0.5
1,1-Dichloroethene	<0.8	<0.5	<0.5	<0.5	<25	<0.5
trans-1,2-Dichloroethene	0.05 J	<0.5	<0.5	<0.5	<25 J	<0.5
1,1-Dichloroethane	<0.8	<0.5	<0.5	<0.5	<25	<0.5
cis-1,2-Dichloroethene	2	<0.5	0.05 J	0.06 J	33 D	0.9
1,1,1-Trichloroethane	<0.8	<0.5	<0.5	<0.5	<25	<0.5
Trichloroethene	0.3 J	<0.5	<0.5	<0.2	33 D	1
Tetrachloroethene	18 B	0.07 JB	1 B	13	830 DB	0.7 B

Sample Location Sampling Date Laboratory ID	TB 12/5/2001 K2291-7	TB-2 12/6/2001 K2291-12
Vinyl Chloride	<0.5	<0.5
1,1-Dichloroethene	<0.5	<0.5
trans-1,2-Dichloroethene	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5
cis-1,2-Dichloroethene	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5
Trichloroethene	<0.5	<0.5
Tetrachloroethene	<0.5	<0.5

NOTE:
All concentrations reported in micrograms per liter (µg/L).
D = Sample analyzed at a dilution factor greater than 1.
J = Reported concentration is less than the CRQL but greater than 0.

UNIVERSAL INSTRUMENTS CORPORATION

TABLE 10

INORGANIC GROUNDWATER ANALYTICAL RESULTS
DECEMBER 2001
Former Dover Electronics Site
Kirkwood, New York

Sample Location	Laboratory ID	Alkalinity-Total	Chloride	Nitrate	Iron, Dissolved	Manganese, Dissolved	Sulfate	Sulfide
MW-2	01120088-01	76	299	3.69	0.186	2.03	39.6	< 2.0
MW-7	01120088-06	84	355	1.66	0.08	0.021	41.2	< 2.0
MW-12	01120045-03	112	215	0.061	0.924	3.47	13.2	<2.0
MW-13	01120045-04	216	1.14	0.317	1.53	0.167	20.4	<2.0
MW-15	01120045-05	180	16.2	0.139	2.46	0.493	9.57	<2.0
MW-16	01120045-06	128	134	0.17	0.413	1.830	10.6	<2.0
MW-24	01120045-07	72	242	<0.01	0.305	0.159	11.2	<2.0
MW-25	01120122-03	120	473	0.10	0.291	0.499	24.0	< 2.0
MW-28	01120122-04	46	438	0.91	0.811	7.19	33.0	< 2.0
MW-30	01120122-05	400	385	< 0.01	1.24	21.6	107	< 4.0
MW-31	01120122-06	180	638	< 0.01	0.109	1.31	36.3	< 2.0
MW-32	01120122-08	370	260	< 0.01	6.4	20.4	23.9	< 4.0
MW-34	01120122-09	260	1.2	< 0.01	0.425	0.377	1.6	< 2.0
MW-35	01120122-10	110	567	0.24	0.048	0.020	31.1	< 2.0
MW-37	01120122-11	190	436	1.04	1.30	0.913	36.1	< 2.0
MW-38	01120088-08	64	432	1.42	0.347	0.384	27.9	< 4.0
MP-3D	01120045-01	140	10.4	0.119	0.705	0.181	3.77	<2.0
MP-4	01120088-02	76	283	1.49	0.319	0.741	24.4	< 4.0
MP-5	01120088-03	40	1,420	1.73	0.286	0.496	18.0	< 4.0
MP-6S	01120088-05	128	338	0.91	0.087	0.883	11.3	< 4.0
MP-6D	01120088-04	148	3.67	0.32	2.33	1.95	6.1	< 4.0
MP-7	01120176-01	120	300	0.027	0.118	3.70	34.5	< 2.0
MP-8S	01120122-02	64	123	0.13	0.073	6.66	48.8	< 2.0
MP-8D	01120122-01	84	181	0.27	0.274	0.896	11.3	< 2.0
MP-9	01120176-02	110	176	0.06	0.114	0.465	31.9	10
MP-10S	01120176-04	200	122	0.015	0.077	1.59	33.3	< 2.0
MP-10D	01121076-03	270	1.38	< 0.01	0.01	0.548	1.26	< 2.0
DUP-1	01120045-02	200	1.11	0.326	1.15	0.161	20.1	<2.0
DUP-2	01120088-07	64	440	1.40	0.753	0.373	28.2	< 4.0
DUP-3	01120122-07	180	642	< 0.01	0.118	1.31	37.2	< 2.0

NOTE: All concentrations reported in milligrams per liter (mg/L).

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TABLE 11

DISSOLVED GASES GROUNDWATER ANALYTICAL RESULTS
DECEMBER 2001
Former Dover Electronics Site
Kirkwood, New York

Sample Location	Laboratory ID	Methane	Ethane	Ethene	Carbon Dioxide
MW-2	NJAL#2367-08	<0.002	<0.004	<0.004	270
MW-7A	NJAL#2367-13	0.006	0.008	<0.004	130
MW-12	NJAL#2367-03	0.007	< 0.004	< 0.004	76
MW-13	NJAL#2367-04	0.007	<0.004	<0.004	130
MW-15	NJAL#2367-05	<0.002	<0.004	<0.004	36
MW-16	NJAL#2367-06	< 0.002	< 0.004	< 0.004	84
MW-24	NJAL#2367-07	<0.002	<0.004	<0.004	140
MW-25	NJAL#2367-18	0.008	<0.004	<0.004	220
MW-28	NJAL#2367-19	0.007	0.007	<0.004	370
MW-30	NJAL#2367-20	<0.002	<0.004	<0.004	600
MW-31	NJAL#2367-21	0.3	0.003J	<0.004	290
MW-32	NJAL#2367-23	<0.002	<0.004	<0.004	570
MW-34	NJAL#2367-24	0.004	<0.004	<0.004	50
MW-35	NJAL#2367-25	0.005	<0.004	<0.004	220
MW-37	NJAL#2367-26	0.011	0.003J	<0.004	180
MW-38	NJAL#2367-15	0.006	<0.004	<0.004	280
MP-3D	NJAL#2367-01	0.007	<0.004	<0.004	60
MP-4	NJAL#2367-09	0.004	<0.004	<0.004	54
MP-5	NJAL#2367-10	<0.002	<0.004	<0.004	57
MP-6S	NJAL#2367-12	<0.002	<0.004	<0.004	10
MP-6D	NJAL#2367-11	0.007	<0.004	<0.004	50
MP-7	NJAL#2379-01	<0.002	<0.004	<0.004	600
MP-8S	NJAL#2367-17	0.007	0.003J	<0.004	270
MP-8D	NJAL#2367-16	0.008	0.004	<0.004	130
MP-9	NJAL#2379-02	0.006	<0.004	<0.004	470
MP-10S	NJAL#2379-04	0.008	<0.004	<0.004	610
MP-10D	NJAL#2379-03	0.007	0.003J	<0.004	42
DUP-1	NJAL#2367-02	0.006	<0.004	<0.004	54
DUP-2	NJAL#2367-14	0.006	0.004	<0.004	310
DUP-3	NJAL#2367-22	0.16	<0.004	<0.004	320
TB	NJAL#2367-27	<0.002	<0.004	<0.004	<2.0
TB-2	NJAL#2367-27	<0.002	<0.004	<0.004	<2.0

All concentrations reported in mg/L.

UNIVERSAL INSTRUMENTS CORPORATION

TABLE 12

METABOLIC ACIDS GROUNDWATER ANALYTICAL RESULTS
DECEMBER 2001
Former Dover Electronics Site
Kirkwood, New York

Sample Location	Laboratory ID	Pyruvic Acid	Lactic Acid	Acetic Acid	Propionic Acid	Butyric Acid
MW-2	11L0116-01	<0.1	<1.0	<1.0	<1.0	<1.0
MW-7A	11L0116-06	<0.1	<1.0	<1.0	<1.0	<1.0
MW-12	11L0057-02	<0.1	<1.0	<1.0	<1.0	<1.0
MW-13	11L0057-03	<0.1	<1.0	<1.0	<1.0	<1.0
MW-15	11L0057-04	<0.1	<1.0	<1.0	<1.0	<1.0
MW-24	11L0057-06	<0.1	<1.0	<1.0	<1.0	<1.0
MW-25	11L0207-03	<0.1	<1.0	<1.0	<1.0	<1.0
MW-28	11L0207-04	<0.1	<1.0	<1.0	<1.0	<1.0
MW-30	11L0207-05	<0.1	<1.0	<1.0	<1.0	<1.0
MW-31	11L0207-06	<0.1	<1.0	<1.0	<1.0	<1.0
MW-32	11L0207-08	<0.1	<1.0	<1.0	<1.0	<1.0
MW-34	11L0207-09	<0.1	<1.0	<1.0	<1.0	<1.0
MW-35	11L0207-10	<0.1	<1.0	<1.0	<1.0	<1.0
MW-37	11L0207-11	<0.1	<1.0	<1.0	<1.0	<1.0
MW-38	11L0116-08	<0.1	<1.0	<1.0	<1.0	<1.0
MP-3D	11L0057-01	<0.1	<1.0	<1.0	<1.0	<1.0
MP-4	11L0116-02	<0.1	<1.0	<1.0	<1.0	<1.0
MP-5	11L0116-03	<0.1	<1.0	<1.0	<1.0	<1.0
MP-6S	11L0116-05	<0.1	<1.0	<1.0	<1.0	<1.0
MP-6D	11L0116-04	<0.1	<1.0	<1.0	<1.0	<1.0
MP-7	11L0232-01	<0.1	<1.0	<1.0	<1.0	<1.0
MP-8S	11L0207-02	<0.1	<1.0	<1.0	6.8	<1.0
MP-8D	11L0207-01	<0.1	<1.0	<1.0	<1.0	<1.0
MP-9	11L0232-02	<0.1	<1.0	<1.0	<1.0	<1.0
MP-10S	11L0232-04	<0.1	<1.0	<1.0	<1.0	<1.0
MP-10D	11L0232-03	<0.1	<1.0	<1.0	<1.0	<1.0
DUP-1	11L0057-07	<0.1	<1.0	<1.0	<1.0	<1.0
DUP-2	11L0116-07	<0.1	<1.0	<1.0	<1.0	<1.0
DUP-3	11L0207-07	<0.1	<1.0	<1.0	<1.0	<1.0

All concentrations reported in mg/L.

UNIVERSAL INSTRUMENTS CORPORATION

TABLE 13

SSPL GROUNDWATER ANALYTICAL RESULTS
JANUARY 2002
Former Dover Electronics Site
Kirkwood, New York

Sample Location	MW-2	MW-7A	MW-12	MW-13	MW-15	MW-16
Sampling Date	1/29/2002	1/28/2002	1/28/2002	1/28/2002	1/28/2002	1/28/2002
Laboratory ID	P2291-14	P2291-9	P2291-3	P2291-1	P2291-7	P2291-8
Vinyl Chloride	<0.5	<84	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene	<0.5	<84	<0.5	<0.5	<0.5	<0.5
trans-1,2-Dichloroethene	<0.5	<84	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethane	<0.5	<84	<0.5	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	0.05 J	<84	<0.5	<0.5	<0.5	0.3 J
1,1,1-Trichloroethane	<0.5	<84	<0.5	<0.5	<0.5	<0.5
Trichloroethene	0.3 JB	<84	<0.5	<0.5	0.03 J	0.3 JB
Tetrachloroethene	10 B	3,900 DB	0.09 JB	13	<0.5	8 B

Sample Location	MW-24	MW-25	MW-28	MW-30	MW-31	MW-32
Sampling Date	1/28/2002	1/30/2002	1/30/2002	1/29/2002	1/31/2002	1/29/2002
Laboratory ID	P2291-6	QQ2291-3	QQ2291-2	P2291-20	QQ2291-11	P2291-18
Vinyl Chloride	<42	<6	<18	<0.5	0.07 J	<0.5
1,1-Dichloroethene	<42	<6	<18	<0.5	<0.5	<0.5
trans-1,2-Dichloroethene	<42	0.9 J	<18	<0.5	<0.5	<0.5
1,1-Dichloroethane	<42	<6	<18	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	31 J	10	8 J	0.5	1	0.2 J
1,1,1-Trichloroethane	<42	<6	<18	<0.5	<0.5	<0.5
Trichloroethene	12 JB	250 B	9 JB	0.7	2 B	<0.5
Tetrachloroethene	1,500	250 B	550	0.07 J	1 B	<0.5

Sample Location	MW-34	MW-35	MW-37	MW-38	MP-2	MP-3D
Sampling Date	1/30/2002	1/29/2002	1/29/2002	1/29/2002	1/28/2002	1/28/2002
Laboratory ID	QQ2291-1	P2291-17	P2291-19	P2291-15	P2291-4	P2291-5
Vinyl Chloride	<0.5	<0.5	<0.8	<8	<16	<0.5
1,1-Dichloroethene	<0.5	<0.5	<0.8	<8	<16	<0.5
trans-1,2-Dichloroethene	<0.5	<0.5	<0.8	<8	<16	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.8	<8	<16	<0.5
cis-1,2-Dichloroethene	<0.5	0.09 J	<0.8	19 D	22 D	<0.5
1,1,1-Trichloroethane	<0.5	0.8	<0.8	<8	<16	<0.5
Trichloroethene	<0.5	<0.5	1 B	28 DB	10 DJB	<0.5
Tetrachloroethene	<0.5	<0.5	30 B	400 DB	350 D	0.2 J

NOTE:

All concentrations reported in micrograms per liter (µg/L).

D = Sample analyzed at a dilution factor greater than 1.

J = Reported concentration is less than the CRQL but greater than 0.

Table 13 continued...

Sample Location Sampling Date Laboratory ID	MP-4 1/29/2002 P2291-11	MP-5 1/29/2002 P2291-10	MP-6S 1/29/2002 P2291-12	MP-6D 1/29/2002 P2291-13	MP-7 1/31/2002 QQ2291-9	MP-8S 1/30/2002 QQ2291-4
Vinyl Chloride	<310	<42	<31	<0.5	<0.5	<3
1,1-Dichloroethene	<310	<42	<31	<0.5	<0.5	<3 J
trans-1,2-Dichloroethene	<310	<42	<31	<0.5	<0.5	0.2 DJ
1,1-Dichloroethane	<310	<42	<31	<0.5	<0.5	<3
cis-1,2-Dichloroethene	<310	11 DJ	9 DJ	<0.5	<0.5	6 DJ
1,1,1-Trichloroethane	<310	<42	4 DJ	<0.5	<0.5	<3
Trichloroethene	47 DB	4 DJ	50 DJ	0.3 J	<0.5	3 DJB
Tetrachloroethene	9,300 DB	1,100 DB	890 DB	1 B	0.3 J	100 DB

Sample Location Sampling Date Laboratory ID	MP-8D 1/30/2002 QQ2291-5	MP-9 1/31/2002 QQ2291-10	MP-10D 1/30/2002 QQ2291-7	MP-10S 1/30/2002 QQ2291-6	DUP-1 1/28/2002 P2291-2	DUP-2 1/29/2002 P2291-16
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<13
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<13
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<13
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<13
cis-1,2-Dichloroethene	<0.5	0.7	<0.5	0.03 J	<0.5	20
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<13
Trichloroethene	0.03 JB	0.2 J	<0.5	0.03 JB	0.2 JB	30 B
Tetrachloroethene	0.3 JB	5	0.1 J	1	8	420 B

Sample Location Sampling Date Laboratory ID	DUP-3 1/31/2002 QQ2291-12	TB 1/30/2002 QQ2291-8	TB-2 1/31/2002 QQ2291-13
Vinyl Chloride	<0.5	<0.5	<0.5
1,1-Dichloroethene	0.07 J	<0.5	<0.5
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	1	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	<0.5
Trichloroethene	2	<0.5	<0.5
Tetrachloroethene	0.9	<0.5	<0.5

NOTE:

All concentrations reported in micrograms per liter (μg/L).

D = Sample analyzed at a dilution factor greater than 1.

J = Reported concentration is less than the CRQL but greater than 0.

UNIVERSAL INSTRUMENTS CORPORATION

TABLE 14

INORGANIC GROUNDWATER ANALYTICAL RESULTS
JANUARY 2002
Former Dover Electronics Site
Kirkwood, New York

Sample Location	Laboratory ID	Alkalinity-Total	Chloride	Iron, Dissolved	Manganese, Dissolved	Nitrate	Sulfate	Sulfide
MW-2	02010586-05	176	128	<0.005	<0.005	3.03	36.1	<2.0
MW-7A	02010563-09	128	450	<0.005	0.011	2.02	37.2	<2.0
MW-12	02010563-03	196	260	<0.005	2.91	<0.05	10.2	<2.0
MW-13	02010563-01	144	1.6	<0.005	0.005	0.480	31.1	<2.0
MW-15	02010563-07	148	34.1	<0.005	0.304	0.27	10.7	<2.0
MW-16	02010563-08	80	28.9	<0.005	1.370	0.06	8.2	<2.0
MW-24	02010563-06	68	260	<0.005	0.207	1.23	23.2	<2.0
MW-25	02010645-03	170	435	<0.005	11.3	0.35	20.3	<2.0
MW-28	02010645-02	250	622	9.9	10.2	<0.05	27.9	<2.0
MW-30	02010586-11	210	478	0.229	22.0	<0.05	118	<2.0
MW-31	02020025-03	170	592	0.02	1.1	0.05	37.5	<2.0
MW-32	02010586-09	250	311	6.40	20.2	<0.05	28.8	<2.0
MW-34	02010645-01	250	1.33	<0.005	0.348	<0.05	1.26	<2.0
MW-35	02010586-08	100	649	<0.005	0.034	0.35	34.3	<2.0
MW-37	02010586-10	200	577	<0.005	1.03	1.69	29.5	<2.0
MW-38	02010586-06	100	499	0.008	0.364	1.76	30.7	<2.0
MP-2	02010563-04	68	630	<0.005	0.575	0.89	28.1	<2.0
MP-3D	02010563-05	130	12.6	<0.005	0.126	0.18	3.7	<2.0
MP-4	02010586-02	56	404	<0.005	0.219	2.1	24.8	<2.0
MP-5	02010586-01	24	2,730	<0.005	0.381	2.25	19.3	<2.0
MP-6S	02010586-03	128	395	<0.005	0.143	1.48	14.4	<2.0
MP-6D	02010586-04	160	3.40	<0.005	2.18	0.43	5.7	<2.0
MP-7	02020025-01	360	1,244	0.351	1.82	<0.05	41.0	<2.0
MP-8S	02010645-04	160	279	<0.005	5.98	0.25	37.9	<2.0
MP-8D	02010645-05	220	1.91	<0.005	0.457	<0.05	1.7	<2.0
MP-9	02020025-02	140	910	4.03	3.36	<0.05	37.9	<2.0
MP-10S	02010645-06	180	288	0.068	2.41	<0.05	40.7	<2.0
MP-10D	02010645-07	220	<0.05	<0.005	0.538	2.35	1.3	<2.0
DUP-1	02010563-02	180	1.6	<0.005	0.052	0.46	31.9	<2.0
DUP-2	02010586-07	60	507	<0.005	0.342	1.79	31.0	<2.0
DUP-3	02020025-04	180	593	0.019	1.06	0.05	37.6	<2.0

NOTE: All concentrations reported in milligrams per liter (mg/L).

UNIVERSAL INSTRUMENTS CORPORATION

TABLE 15

DISSOLVED GASES GROUNDWATER ANALYTICAL RESULTS
JANUARY 2002
Former Dover Electronics Site
Kirkwood, New York

Sample Location	Laboratory ID	Methane	Ethane	Ethene	Carbon Dioxide
MW-2	NJAL#2660-14	<0.002	<0.004	<0.004	260
MW-7A	NJAL#2660-09	<0.002	<0.004	<0.004	150
MW-12	NJAL#2660-03	<0.002	<0.004	<0.004	100
MW-13	NJAL#2660-01	<0.002	<0.004	<0.004	95
MW-15	NJAL#2660-07	0.006	<0.004	<0.004	38
MW-16	NJAL#2660-08	0.006	<0.004	<0.004	83
MW-24	NJAL#2660-06	<0.002	<0.004	<0.004	180
MW-25	NJAL#2660-23	<0.002	<0.004	<0.004	170
MW-28	NJAL#2660-22	<0.002	<0.004	<0.004	270
MW-30	NJAL#2660-20	<0.002	<0.004	<0.004	590
MW-31	NJAL#2673-03	1.5J	0.026	<0.004	320
MW-32	NJAL#2660-18	<0.002	<0.004	<0.004	590
MW-34	NJAL#2660-21	0.003	<0.004	<0.004	70
MW-35	NJAL#2660-17	<0.002	<0.004	<0.004	170
MW-37	NJAL#2660-19	<0.002	<0.004	<0.004	240
MW-38	NJAL#2660-15	<0.002	<0.004	<0.004	360
MP-2	NJAL#2660-04	<0.002	<0.004	<0.004	98
MP-3D	NJAL#2660-05	<0.002	<0.004	<0.004	65
MP-4	NJAL#2660-11	<0.002	<0.004	<0.004	180
MP-5	NJAL#2660-10	<0.002	<0.004	<0.004	210
MP-6S	NJAL#2660-12	<0.002	<0.004	<0.004	120
MP-6D	NJAL#2660-13	<0.002	<0.004	<0.004	100
MP-7	NJAL#2673-01	0.005	<0.004	<0.004	39
MP-8S	NJAL#2660-24	<0.002	<0.004	<0.004	340
MP-8D	NJAL#2660-25	<0.002	<0.004	<0.004	100
MP-9	NJAL#2673-02	0.010	<0.004	<0.004	300
MP-10S	NJAL#2660-26	0.010	<0.004	<0.004	670
MP-10D	NJAL#2660-27	0.16	<0.004	<0.004	60
DUP-1	NJAL#2660-02	<0.002	<0.004	<0.004	49
DUP-2	NJAL#2660-16	<0.002	<0.004	<0.004	310
DUP-3	NJAL#2673-04	1.3J	0.022	<0.004	300
TB	NJAL#2660-28	<0.002	<0.004	<0.004	<2.0
TB-2	NJAL#2673-05	<0.002	<0.004	<0.004	<2.0

All concentrations reported in mg/L.

UNIVERSAL INSTRUMENTS CORPORATION

TABLE 16

METABOLIC ACIDS GROUNDWATER ANALYTICAL RESULTS
JANUARY 2002
Former Dover Electronics Site
Kirkwood, New York

Sample Location	Laboratory ID	Pyruvic Acid	Lactic Acid	Acetic Acid	Propionic Acid	Butyric Acid
MW-2	12A1032-05	<0.1	<1.0	<1.0	<1.0	<1.0
MW-7A	12A0986-09	<0.1	<1.0	<1.0	<1.0	<1.0
MW-12	12A0986-03	<0.1	<1.0	<1.0	<1.0	<1.0
MW-13	12A0986-01	<0.1	<1.0	<1.0	<1.0	<1.0
MW-15	12A0986-07	<0.1	<1.0	<1.0	<1.0	<1.0
MW-16	12A0986-08	<0.1	<1.0	<1.0	<1.0	<1.0
MW-24	12A0986-06	<0.1	<1.0	<1.0	<1.0	<1.0
MW-25	12B0035-07	<0.1	<1.0	<1.0	<1.0	<1.0
MW-28	12B0035-06	<0.1	6.0	<1.0	18.1	<1.0
MW-30	12A1032-11	<0.1	<1.0	<1.0	<1.0	<1.0
MW-31	12B0035-03	0.1	<1.0	<1.0	5.3	<1.0
MW-32	12A1032-09	<0.1	<1.0	<1.0	<1.0	<1.0
MW-34	12B0035-05	<0.1	<1.0	<1.0	<1.0	<1.0
MW-35	12A1032-08	<0.1	<1.0	<1.0	<1.0	<1.0
MW-37	12A1032-10	<0.1	<1.0	<1.0	<1.0	<1.0
MW-38	12A1032-06	<0.1	<1.0	<1.0	<1.0	<1.0
MP-2	12A0986-04	<0.1	<1.0	<1.0	<1.0	<1.0
MP-3D	12A0986-05	<0.1	<1.0	<1.0	<1.0	<1.0
MP-4	12A1032-02	<0.1	<1.0	<1.0	<1.0	<1.0
MP-5	12A1032-01	<0.1	<1.0	<1.0	<1.0	<1.0
MP-6S	12A1032-03	<0.1	<1.0	<1.0	<1.0	<1.0
MP-6D	12A1032-04	<0.1	<1.0	<1.0	<1.0	<1.0
MP-7	12B0035-01	<0.1	<1.0	<1.0	<1.0	<1.0
MP-8S	12B0035-08	<0.1	<1.0	<1.0	<1.0	<1.0
MP-8D	12B0035-09	<0.1	<1.0	<1.0	<1.0	<1.0
MP-9	12B0035-02	<0.1	<1.0	<1.0	<1.0	<1.0
MP-10S	12B0035-10	<0.1	<1.0	<1.0	<1.0	<1.0
MP-10D	12B0035-11	<0.1	<1.0	<1.0	<1.0	<1.0
DUP-1	12A0986-02	<0.1	<1.0	<1.0	<1.0	<1.0
DUP-2	12A1032-07	<0.1	<1.0	<1.0	<1.0	<1.0
DUP-3	12B0035-04	<0.1	<1.0	<1.0	8.2	<1.0

All concentrations reported in mg/L.

UNIVERSAL INSTRUMENTS CORPORATION

TABLE 17

SSPL GROUNDWATER ANALYTICAL RESULTS
APRIL 2002
Former Dover Electronics Site
Kirkwood, New York

Sample Location	MW-2	MW-7A	MW-12	MW-13	MW-15	MW-16
Sampling Date	4/3/2002	4/2/2002	4/2/2002	4/2/2002	4/2/2002	4/2/2002
Laboratory ID	QX2291-16	QX2291-8	QX2291-1	QX2291-2	QX2291-6	QX2291-10
Vinyl Chloride	<0.5	<170	<0.5	<0.5	<0.5	<6
1,1-Dichloroethene	<0.5	<170	<0.5	<0.5	<0.5	<6
trans-1,2-Dichloroethene	<0.5	<170	<0.5	<0.5	<0.5	<6
1,1-Dichloroethane	<0.5	<170	<0.5	<0.5	<0.5	<6
cis-1,2-Dichloroethene	<0.5	<170	<0.5	<0.5	0.08 J	6 DJ
1,1,1-Trichloroethane	<0.5	<170	<0.5	0.4 J	<0.5	<6
Trichloroethene	0.2 J	38 DJ	0.03 J	0.2 J	0.05 J	5 DJ
Tetrachloroethene	7	3,800 DJ	<0.5	8	0.2	180 D

Sample Location	MW-24	MW-25	MW-28	MW-30	MW-31	MW-32
Sampling Date	4/2/2002	4/4/2002	4/4/2002	4/3/2002	4/4/2002	4/3/2002
Laboratory ID	QX2291-3	QY2291-4	QY2291-3	QX2291-19	QY2291-6	QX2291-18
Vinyl Chloride	<63	<25	<31	<0.5	<0.5	<0.5
1,1-Dichloroethene	<63	<25	<31	<0.5	0.1 J	<0.5
trans-1,2-Dichloroethene	8 DJ	<25	<31	<0.5	0.03 J	<0.5
1,1-Dichloroethane	<63	<25	<31	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	610 DJ	4 J	17 J	0.5	1	0.1 J
1,1,1-Trichloroethane	<63	<25	<31	<0.5	<0.5	<0.5
Trichloroethene	40 DJ	13 J	12 J	0.6	2	0.07 J
Tetrachloroethene	1,600 D	670	930	0.06 J	1	0.4 J

Sample Location	MW-34	MW-35	MW-37	MW-38	MP-2	MP-3D
Sampling Date	4/4/2002	4/3/2002	4/3/2002	4/3/2002	4/2/2002	4/2/2002
Laboratory ID	QY2291-5	QX2291-17	QX2291-20	QX2291-14	QX2291-4	QX2291-5
Vinyl Chloride	<0.5	<0.5	<1	<8	<8	<0.5
1,1-Dichloroethene	<0.5	<0.5	<1	<8	<8	<0.5
trans-1,2-Dichloroethene	<0.5	<0.5	<1	<8 J	<8	<0.5
1,1-Dichloroethane	<0.5	<0.5	<1	<8	<8	<0.5
cis-1,2-Dichloroethene	<0.5	0.1 J	<1	18 D	9 D	<0.5
1,1,1-Trichloroethane	<0.5	0.9	<1	<8	<8	<0.5
Trichloroethene	<0.5	<0.5	1 J	21 D	4 DJ	0.03 J
Tetrachloroethene	0.2 J	<0.5	44	320 D	290 D	0.4 J

NOTE:

All concentrations reported in micrograms per liter (µg/L).

D = Sample analyzed at a dilution factor greater than 1.

J = Reported concentration is less than the CRQL but greater than 0.

Table 17 continued...

Sample Location Sampling Date Laboratory ID	MP-4 4/2/2002 QX2291-7	MP-5 4/2/2002 QX2291-9	MP-6S 4/3/2002 QX2291-12	MP-6D 4/3/2002 QX2291-13	MP-7 4/5/2002 QY2291-11	MP-8S 4/4/2002 QY2291-2
Vinyl Chloride	<250	<42	<84	<0.5	<0.5	<8
1,1-Dichloroethene	<250	<42	<84	<0.5	<0.5	<8
trans-1,2-Dichloroethene	<250	<42	<84	<0.5	<0.5	0.8 J
1,1-Dichloroethane	<250	<42	<84	<0.5	<0.5	<8
cis-1,2-Dichloroethene	13 DJ	130 D	100 D	<0.5	<0.5	12
1,1,1-Trichloroethane	<250	<42	<84	<0.5	<0.5	<8
Trichloroethene	82 DJ	100 D	39 DJ	<0.5	<0.5	7 J
Tetrachloroethene	7,500 D	1,300 D	2,100 D	0.6	0.2 J	260

Sample Location Sampling Date Laboratory ID	MP-8D 4/4/2002 QY2291-1	MP-9 4/5/2002 QY2291-12	MP-10D 4/4/2002 QY2291-7	MP-10S 4/4/2002 QY2291-8	DUP-1 4/2/2002 QX2291-11	DUP-2 4/3/2002 QX2291-15
Vinyl Chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<8
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<8
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<8
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<8
cis-1,2-Dichloroethene	<0.5	0.7	<0.5	0.06 J	<0.5	17
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	0.5	<8
Trichloroethene	0.04 J	0.1 J	0.04 J	<0.5	0.3 J	21 D
Tetrachloroethene	0.2 J	3	0.3 J	0.8	10	340 D

Sample Location Sampling Date Laboratory ID	DUP-3 4/4/2002 QY2291-10	TB 4/4/2002 QY2291-9	TB-1 4/5/2002 QY2291-13
Vinyl Chloride	<0.5	<0.5	<0.5
1,1-Dichloroethene	0.1 J	<0.5	<0.5
trans-1,2-Dichloroethene	0.04 J	<0.5	<0.5
1,1-Dichloroethane	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	1	<0.5	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	<0.5
Trichloroethene	2	<0.5	<0.5
Tetrachloroethene	1	<0.5	<0.5

NOTE:

All concentrations reported in micrograms per liter (µg/L).

D = Sample analyzed at a dilution factor greater than 1.

J = Reported concentration is less than the CRQL but greater than 0.

UNIVERSAL INSTRUMENTS CORPORATION

TABLE 18

INORGANIC GROUNDWATER ANALYTICAL RESULTS
APRIL 2002
Former Dover Electronics Site
Kirkwood, New York

Sample Location	Laboratory ID	Alkalinity-Total	Chloride	Nitrate	Iron, Dissolved	Manganese, Dissolved	Sulfate	Sulfide
MW-2	02040171-04	220	65.9	3.83	<0.005	<0.005	37.2	<2.0
MW-7A	02040098-08	60	628	1.93	0.011	0.007	32.6	<2.0
MW-12	02040098-01	80	253	<0.05	1.320	3.88	8.0	<2.0
MW-13	02040098-02	150	1.6	0.320	0.06	0.04	36.8	<2.0
MW-15	02040098-06	180	18.9	0.17	0.836	0.301	9.9	<2.0
MW-16	02040098-10	120	184	0.3	0.20	2.1	12.7	<2.0
MW-24	02040098-03	160	335	0.49	1.13	14.2	14.7	<2.0
MW-25	02040172-04	120	385	1.20	0.013	5.76	18.4	<2.0
MW-28	02040172-03	210	584	<0.05	14.2	21.9	9.7	<2.0
MW-30	02040171-08	490	509	<0.05	0.041	22.5	117	<2.0
MW-31	02040172-06	190	619	<0.05	0.021	1.31	30.8	<2.0
MW-32	02040171-07	270	324	<0.05	0.333	20.5	26.5	<2.0
MW-34	02040172-05	230	1.67	<0.05	0.035	0.367	1.1	<2.0
MW-35	02040171-06	110	606	0.26	0.031	0.018	31.7	<2.0
MW-37	02040171-09	130	496	1.31	0.06	0.634	22.7	<2.0
MW-38	02040171-03	120	308	1.15	0.041	0.723	25.4	<2.0
MP-2	02040098-04	30	531	0.72	0.336	0.188	26	<2.0
MP-3D	02040098-05	120	13	0.21	<0.005	0.106	3.6	<2.0
MP-4	02040098-07	30	459	1.71	0.016	0.155	24.8	<2.0
MP-5	02040098-09	60	1,580	1.86	0.431	1.06	16.5	<2.0
MP-6S	02040171-01	90	557	1.23	<0.005	0.061	17.0	<2.0
MP-6D	02040171-02	151	3.26	0.19	0.026	2.16	5.2	<2.0
MP-7	02040209-01	140	97	<0.05	0.014	0.25	18.0	<2.0
MP-8S	02040172-02	64	291	0.32	<0.005	0.642	32.8	<2.0
MP-8D	02040172-01	250	2.93	<0.05	0.005	0.469	1.63	<2.0
MP-9	02040209-02	140	313	<0.05	6.68	5.65	34.7	<2.0
MP-10S	02040172-08	130	219	<0.05	0.092	0.394	1.55	<2.0
MP-10D	02040172-07	240	7.43	<0.05	<0.005	0.536	1.03	<2.0
DUP-1	02040098-11	140	1.9	0.33	0.04	0.024	33	<2.0
DUP-2	02040171-05	100	322	1.20	0.095	0.616	26.5	<2.0
DUP-3	02040172-09	190	621	0.56	0.016	1.31	31.7	<2.0

NOTE: All concentrations reported in milligrams per liter (mg/L).

UNIVERSAL INSTRUMENTS CORPORATION

TABLE 19

DISSOLVED GASES GROUNDWATER ANALYTICAL RESULTS
APRIL 2002
Former Dover Electronics Site
Kirkwood, New York

Sample Location	Laboratory ID	Methane	Ethane	Ethene	Carbon Dioxide
MW-2	3044-16	<0.002	<0.004	<0.004	150
MW-7A	3044-08	<0.002	<0.004	<0.004	78
MW-12	3044-01	<0.002	<0.004	<0.004	26
MW-13	3044-02	<0.002	<0.004	<0.004	17
MW-15	3044-06	<0.002	<0.004	<0.004	22
MW-16	3044-10	0.003	<0.004	<0.004	26
MW-24	3044-03	<0.002	<0.004	<0.004	140
MW-25	3044-24	<0.002	<0.004	<0.004	110
MW-28	3044-23	0.002	<0.004	<0.004	200
MW-30	3044-19	0.002	<0.004	<0.004	530
MW-31	3044-26	<0.002	<0.004	<0.004	300
MW-32	3044-18	<0.002	<0.004	<0.004	500
MW-34	3044-25	<0.002	<0.004	<0.004	19
MW-35	3044-17	<0.002	<0.004	<0.004	140
MW-37	3044-20	<0.002	<0.004	<0.004	160
MW-38	3044-14	0.002	<0.004	<0.004	250
MP-2	3044-04	<0.002	<0.004	<0.004	110
MP-3D	3044-05	<0.002	<0.004	<0.004	28
MP-4	3044-07	0.004	<0.004	<0.004	120
MP-5	3044-09	<0.002	<0.004	<0.004	170
MP-6S	3044-12	0.002	<0.004	<0.004	81
MP-6D	3044-13	0.004	<0.004	<0.004	29
MP-7	3058-01	0.022	<0.004	<0.004	64
MP-8S	3044-22	0.002	<0.004	<0.004	410
MP-8D	3044-21	0.004	<0.004	<0.004	17
MP-9	3058-02	0.004	<0.004	<0.004	580
MP-10S	3044-28	0.004	<0.004	<0.004	120
MP-10D	3044-27	<0.002	<0.004	<0.004	18
DUP-1	3044-11	0.003	<0.004	<0.004	15
DUP-2	3044-15	0.008	<0.004	<0.004	250
DUP-3	3044-30	0.29J	<0.004	<0.004	300
TB	3058-03	<0.002	<0.004	<0.004	NA
TB-2	3044-29	<0.002	<0.004	<0.004	NA

All concentrations reported in mg/L.
NA Not Analyzed

UNIVERSAL INSTRUMENTS CORPORATION

TABLE 20

METABOLIC ACIDS GROUNDWATER ANALYTICAL RESULTS
APRIL 2002
Former Dover Electronics Site
Kirkwood, New York

Sample Location	Laboratory ID	Pyruvic Acid	Lactic Acid	Acetic Acid	Propionic Acid	Butyric Acid
MW-2	12D0207-05	<0.1	<1.0	<1.0	<1.0	<1.0
MW-7A	12D0140-08	<0.1	<1.0	<1.0	<1.0	<1.0
MW-12	12D0140-01	<0.1	<1.0	<1.0	<1.0	<1.0
MW-13	12D0140-02	<0.1	<1.0	<1.0	<1.0	<1.0
MW-15	12D0140-06	<0.1	<1.0	<1.0	<1.0	<1.0
MW-16	12D0140-10	<0.1	<1.0	<1.0	<1.0	<1.0
MW-24	12D0140-03	<0.1	<1.0	<1.0	<1.0	<1.0
MW-25	12D0293-04	<0.1	<1.0	<1.0	<1.0	<1.0
MW-28	12D0293-03	<0.1	6.0	<1.0	18.1	<1.0
MW-30	12D0207-08	<0.1	<1.0	<1.0	<1.0	<1.0
MW-31	12D0293-06	0.1	<1.0	<1.0	5.3	<1.0
MW-32	12D0207-07	<0.1	<1.0	<1.0	<1.0	<1.0
MW-34	12D0293-05	<0.1	<1.0	<1.0	<1.0	<1.0
MW-35	12D0207-06	<0.1	<1.0	<1.0	<1.0	<1.0
MW-37	12D0207-09	<0.1	<1.0	<1.0	<1.0	<1.0
MW-38	12D0207-03	<0.1	<1.0	<1.0	<1.0	<1.0
MP-2	12D0140-04	<0.1	<1.0	<1.0	<1.0	<1.0
MP-3D	12D0140-05	<0.1	<1.0	<1.0	<1.0	<1.0
MP-4	12D0140-07	<0.1	<1.0	<1.0	<1.0	<1.0
MP-5	12D0140-09	<0.1	<1.0	<1.0	<1.0	<1.0
MP-6S	12D0207-01	<0.1	<1.0	<1.0	<1.0	<1.0
MP-6D	12D0207-02	<0.1	<1.0	<1.0	<1.0	<1.0
MP-7	12D0310-01	<0.1	<1.0	<1.0	<1.0	<1.0
MP-8S	12D0293-02	<0.1	<1.0	<1.0	<1.0	<1.0
MP-8D	12D0293-01	<0.1	<1.0	<1.0	<1.0	<1.0
MP-9	12D0310-02	<0.1	<1.0	<1.0	<1.0	<1.0
MP-10S	12D0293-08	<0.1	<1.0	<1.0	<1.0	<1.0
MP-10D	12D0293-07	<0.1	<1.0	<1.0	<1.0	<1.0
DUP-1	12D0140-11	<0.1	<1.0	<1.0	<1.0	<1.0
DUP-2	12D0207-04	<0.1	<1.0	<1.0	<1.0	<1.0
DUP	12D0293-09	<0.1	<1.0	<1.0	8.2	<1.0

All concentrations reported in mg/L.

UNIVERSAL INSTRUMENTS CORPORATION

TABLE 21

HISTORICAL GROUNDWATER ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
Former Dover Electronics Site
Kirkwood, New York

Sample Location	Sampling Date	Method	PCE ug/L	TCE ug/L	1,2-DCE Total (ug/L)	Vinyl Chloride (ug/L)
MW-1	11/18/1998	TAL/TCL	170	11	21	8.1
MW-2	11/13/1998	SSPL	320	3.6J	4.4J	NA
	9/21/2001	SSPL	22	1J	1J	<1.8
	12/4/2001	SSPL	150	5	5	<6
	1/29/2002	SSPL	10	0.3J	0.05J	<0.5
	4/3/2002	SSPL	7	0.2J	<0.5	<0.5
	9/13/2002	SSPL	93E	6	5	<0.5
MW-3	11/12/1998	SSPL	200	<5	<5	ND
	9/20/2001	SSPL	11	<0.5	<0.5	<0.5
MW-5	9/13/2002	SSPL	110	3J	5	<2
	11/13/1998	SSPL	14	<5	<5	ND
	9/21/2001	SSPL	12	<0.5	<0.5	<0.5
	9/13/2002	SSPL	13B	0.2J	<0.5	<0.5
MW-6	11/11/1998	SSPL	<5	<5	<5	ND
	9/21/2001	SSPL	<0.5	<0.5	<0.5	<0.5
	9/13/2002	SSPL	0.2JB	<0.5	<0.5	<0.5
MW-7A	11/16/1998	SSPL	1,300	<5	<50	ND
	9/19/2001	SSPL	3,600	<130	<130	<130
	12/4/2001	SSPL	6,000	<160	<160	<160
	1/28/2002	SSPL	3,900	<84	<84	<84
	4/2/2002	SSPL	3,800	38J	<170	<170
	9/13/2002	SSPL	800E	4	<0.5	<0.5
MW-8	11/16/1998	SSPL	<5	<5	<5	ND
	9/21/2001	SSPL	<0.5	<0.5	<0.5	<0.5
	9/13/2002	SSPL	0E	<0.5	<0.5	<0.5
MW-9	11/18/1998	SSPL	<5	<5	<5	ND
	9/19/2001	SSPL	<0.5	<0.5	<0.5	<0.5
	9/13/2002	SSPL	0.07JB	<0.5	<0.5	<0.5
MW-11	11/13/1998	SSPL	<5	<5	<5	ND
	9/19/2001	SSPL	<0.5	<0.5	<0.5	<0.5
	9/13/2002	SSPL	0.1JB	<0.5	<0.5	<0.5
MW-12	11/17/1998	SSPL	<5	<5	<5	ND
	2/2/1999	SSPL	<5	<5	<5	ND
	9/19/2001	SSPL	<0.5	<0.5	<0.5	<0.5
	12/3/2001	SSPL	0.09J	<0.5	<0.5	<0.5
	1/28/2002	SSPL	0.09J	<0.5	<0.5	<0.5
	4/2/2002	SSPL	<0.5	0.03J	<0.5	<0.5
	9/13/2002	SSPL	0.2J	<0.5	<0.5	<0.5
MW-13	11/12/1998	SSPL	13	<5	<5	ND
	2/2/1999	SSPL	9.7	<5	<5	ND
	9/19/2001	SSPL	13	0.3J	<0.5	<0.5
	12/3/2001	SSPL	14	0.3J	0.06J	<0.5
	1/28/2002	SSPL	13	<0.5	<0.5	<0.5
	4/2/2002	SSPL	8	0.2J	<0.5	<0.5
	9/13/2002	SSPL	7	0.2J	<0.5	<0.5
MW-14	11/17/1998	SSPL	<5	<5	<5	ND
	9/19/2001	SSPL	0.3J	<0.5	<0.5	<0.5
	9/13/2002	SSPL	0.5J	<0.5	<0.5	<0.5
MW-15	2/4/1999	SSPL	<5	<5	<5	ND
	3/11/1999	SSPL	<5	<5	<5	ND
	9/26/2001	SSPL	<0.5	<0.5	<0.5	<0.5
	12/3/2001	SSPL	0.2J	<0.5	0.03J	<0.5
	1/28/2002	SSPL	<0.5	0.03J	<0.5	<0.5
	4/2/2002	SSPL	0.2	0.05J	0.08J	NA
	9/13/2002	SSPL	0.2J	0.5U	0.5U	0.5U
MW-16	11/12/1998	SSPL	570	11J	16J	NA
	2/1/1999	SSPL	470	15J	12J	NA
	9/19/2001	SSPL	2	<0.5	<0.5	<0.5
	12/3/2001	SSPL	92	2J	4	<3
	1/28/2002	SSPL	8	0.3J	0.3J	<0.5
	4/2/2002	SSPL	180	5J	6J	<6
	9/13/2002	SSPL	160E	7DJ	6	<0.5
MW-17	11/11/1998	SSPL	4.7J	<5	<5	ND
	2/4/1999	SSPL	3 J	<5	<5	ND
	9/25/2001	SSPL	3	<0.5	<0.5	<0.5
	9/13/2002	SSPL	3B	0.2J	0.08J	<0.5
MW-18	11/18/1998	SSPL	<5	<5	<5	ND
	2/3/1999	SSPL	2.7J	0.81 J	<5	ND
	3/10/1999	SSPL	2J	<5	<5	ND

Table 21 continued

MW-19	11/11/1998	SSPL	68	8.8	9	NA
	2/5/1999	SSPL	160	18	17	NA
	3/10/1999	SSPL	160	17	16	NA
	9/24/2001	SSPL	88	20	<4.2	<4.2
	9/13/2002	SSPL	11	4	4	<0.5
MW-20	11/10/1998	SSPL	9.3	<5	<5	ND
	2/4/1999	SSPL	12	<5	<5	ND
	3/15/1999	SSPL	63	1.3J	<5	ND
	9/26/2001	SSPL	8	<0.5	<0.5	<0.5
	9/13/2002	SSPL	4	0.1J	<0.5	<0.5
MW-21	2/1/1999	SSPL	<5	<5	<5	ND
	3/12/1999	SSPL	<5	<5	<5	ND
	9/26/2001	SSPL	<0.5	<0.5	<0.5	<0.5
	9/13/2002	SSPL	0.9J	<0.5	<0.5	<0.5
MW-22	11/13/1998	SSPL	<5	<5	<5	ND
	2/4/1999	SSPL	<5	<5	<5	ND
	9/19/2001	SSPL	<0.5	<0.5	<0.5	<0.5
	9/13/2002	SSPL	0.3J	<0.5	<0.3	<0.5
MW-23	11/18/1998	TAL/TCL	48	<50	<42	NA
	2/5/1999	SSPL	21	<5	<5	ND
	3/19/1999	SSPL	13	<5	<5	ND
	9/19/2001	SSPL	0.3J	2	5	<0.5
	9/13/2002	SSPL	2	2	0.3J	<0.5
MW-24	11/13/1998	SSPL	2,100	8.8J	<5	NA
	2/3/1999	SSPL	2,700	<100	24J	NA
	9/19/2001	SSPL	2,500	26J	46J	<84
	12/3/2001	SSPL	1,600	12J	35J	<42
	1/28/2002	SSPL	1,500	12J	31J	<42
	4/2/2002	SSPL	1,600	40J	610	<63
	9/13/2002	SSPL	300E	160E	550E	<0.5
MW-25	3/19/1999	SSPL	1,200	6.7J	20J	ND
	4/23/1999	SSPL	1,100	<50	<33	ND
	9/25/2001	SSPL	630	<25	<25	<25
	12/5/2001	SSPL	960	6J	5J	<25
	1/30/2002	SSPL	250	250	10	<6
	4/4/2002	SSPL	670	13J	4J	<25
MW-26	2/5/1999	SSPL	200	6J	<50	NA
	3/10/1999	SSPL	150	4.1J	8.9	NA
	9/24/2001	SSPL	94	5	5	<5
	9/13/2002	SSPL	11	1	0.9	<0.5
MW-27	2/3/1999	SSPL	73	2.5J	5.3	NA
	3/11/1999	SSPL	100	2.6J	<5	NA
	9/26/2001	SSPL	56	5	6	<2.5
	9/13/2002	SSPL	37E	15	11	<0.5
MW-28	2/3/1999	SSPL	1,200	10J	<5	NA
	3/17/1999	SSPL	< 5	10J	14J	NA
	9/25/2001	SSPL	70	1J	3J	<3.6
	12/5/2001	SSPL	440	5J	10J	<17
	1/30/2002	SSPL	550	9J	8J	<18
	4/4/2002	SSPL	930	12J	17J	<31
	9/13/2002	SSPL	53E	45E	82E	<0.5
MW-29	2/3/1999	SSPL	<5	<5	15J	ND
	3/12/1999	SSPL	<5	<5	< 5	ND
	9/19/2001	SSPL	<0.5	<0.5	<0.5	<0.5
	9/13/2002	SSPL	0.1J	<0.5	<0.5	<0.5
MW-30	3/19/1999	SSPL	<5	0.8 J	<5	ND
	4/23/1999	SSPL	<5	0.97 J	<5	ND
	9/26/2001	SSPL	<0.5	1	0.6	<0.5
	12/5/2001	SSPL	2	0.4J	0.4J	<0.5
	1/29/2002	SSPL	0.07J	0.7	0.5	<0.5
	04/02	0.06J	0.06J	0.6	0.5	<0.5
	9/13/2002	SSPL	0.1J	0.6	0.5	<0.5
MW-31	3/18/1999	SSPL	1.3J	1.9 J	<5	ND
	4/22/1999	SSPL	<5	1.4 J	<5	ND
	9/26/2001	SSPL	1	3	1	<0.5
	12/5/2001	SSPL	0.7	1	0.8	<0.5
	1/31/2002	SSPL	1	2	1	0.07J
	4/4/2002	SSPL	1	2	1	<0.5
	9/13/2002	SSPL	0.7	2	2	<0.5
MW-32	3/19/1999	SSPL	<5	<5	<5	ND
	4/22/1999	SSPL	<5	<5	<5	ND
	9/25/2001	SSPL	<0.5	<0.5	<0.5	<0.5
	12/5/2001	SSPL	0.5J	<0.5	0.07J	<0.5
	1/29/2002	SSPL	<0.5	<0.5	0.2J	<0.5
	4/3/2002	SSPL	0.4J	0.07J	0.1J	<0.5
	9/13/2002	SSPL	0.2J	0.03J	<0.5	<0.5
MW-33	3/18/1999	SSPL	37	1.1J	< 5	ND
	4/22/1999	SSPL	27	0.74J	< 5	ND
	9/26/2001	SSPL	13	0.6	0.8	<0.5
	9/13/2002	SSPL	6	0.8	0.2J	<0.05

Table 21 continued

MW-34	4/21/1999	SSPL	<5	<5	<5	ND
	9/25/2001	SSPL	<0.5	<0.5	<0.5	<0.5
	12/5/2001	SSPL	0.05J	<0.5	<0.5	<0.5
	1/30/2002	SSPL	<0.5	<0.5	<0.5	<0.5
	4/4/2002	SSPL	0.2J	<0.5	<0.5	<0.5
	9/13/2002	SSPL	0.2J	0.05J	<0.5	<0.5
MW-35	4/21/1999	SSPL	<5	<5	<5	ND
	9/25/2001	SSPL	<0.5	<0.5	<0.5	<0.5
	12/5/2001	SSPL	0.04J	<0.5	0.04J	<0.5
	1/29/2002	SSPL	<0.5	<0.5	0.09J	<0.5
	4/3/2002	SSPL	<0.5	<0.5	0.1J	<0.5
	9/13/2002	SSPL	0.08J	<0.5	<0.5	<0.5
MW-36	4/21/1999	SSPL	<5	<5	0.97 J	
	9/26/2001	SSPL	<0.5	<0.5	0.5	<0.5
	9/13/2002	SSPL	0.07J	<0.5	0.3J	<0.5
MW-37	9/28/2001	SSPL	24	0.7	<0.5	<0.5
	12/5/2001	SSPL	43	0.9J	0.2J	<2
	1/29/2002	SSPL	30	1	<0.8	<0.8
	4/3/2002	SSPL	44	1J	<1	<1
	9/13/2002	SSPL	16	0.8	0.07J	<0.05
MW-38	9/28/2001	SSPL	140	10	10	<6.3
	12/4/2001	SSPL	330	21	23	<10
	1/29/2002	SSPL	400	28	19	<8
	4/3/2002	SSPL	320	21	18	<8
	9/13/2002	SSPL	220E	32E	17	<0.05
MP-1	Dry					
MP-2	1/28/2002	SSPL	350	10J	22	<16
	4/2/2002	SSPL	290	4J	9	<8
	9/13/2002	SSPL	290D	4D	9D	<8
MP-3D	9/28/2001	SSPL	1	<0.5	<0.5	<0.5
	12/3/2001	SSPL	0.1J	0.03J	0.06J	<0.5
	1/28/2002	SSPL	0.2J	<0.5	<0.5	<0.5
	4/2/2002	SSPL	0.03J	<0.5	<0.5	<0.5
MP-4	9/27/2001	SSPL	7,700	<250	<250	<250
	12/4/2001	SSPL	1,100	4J	3J	<25
	1/29/2002	SSPL	9,300	47	<310	<310
	4/2/2002	SSPL	7,500	82J	13J	<250
	9/13/2002	SSPL	1,100E	7	2<0.5	
MP-5	9/27/2001	SSPL	1,500	<50	<50	<50
	12/4/2001	SSPL	410	0.8J	1J	<13
	1/29/2002	SSPL	1,100	4J	11J	<42
	4/2/2002	SSPL	1,300	100	130	<42
	9/13/2002	SSPL	480E	98E	110E	<0.5
MP-6S	9/24/2001	SSPL	120	<5	<5	<5
	12/4/2001	SSPL	37	<2	0.2J	<2
	1/29/2002	SSPL	890	50J	9J	<31
	4/3/2002	SSPL	2,100	39J	100	<84
	9/13/2002	SSPL	130E	6	15	<.05
MP-6D	9/24/2001	SSPL	2	<0.5	<0.5	<0.5
	12/4/2001	SSPL	<0.5	<0.5	<0.5	<0.5
	1/29/2002	SSPL	1	0.3J	<0.5	<0.5
	4/3/2002	SSPL	0.6	<0.5	<0.5	<0.5
	9/13/2002	SSPL	14B	0.06J	<0.5	<0.5
MP-7	12/6/2001	SSPL	25	0.5J	2	<1
	1/31/2002	SSPL	0.3J	<0.5	<0.5	<0.5
	4/5/2002	SSPL	0.2J	<0.5	<0.5	<0.5
	9/13/2002	SSPL	0.02J	<0.5	<0.5	<0.5
MP-8S	9/27/2001	SSPL	150	2J	6	0.2J
	12/4/2001	SSPL	10	1	2	<0.5
	1/30/2002	SSPL	100	3J	6J	<3
	4/4/2002	SSPL	260	7J	12	<8
	9/13/2002	SSPL	0.02J	<0.5	<0.5	<0.5
MP-8D	9/27/2001	SSPL	2	<0.5	<0.5	<0.5
	12/4/2001	SSPL	26	0.6J	0.3J	<0.8
	1/30/2002	SSPL	0.3J	0.03J	<0.5	<0.5
	4/4/2002	SSPL	0.2J	0.04J	<0.5	<0.5
	9/13/2002	SSPL	1	<0.5	<0.5	<0.5
MP-9	12/6/2001	SSPL	18	0.3J	2	<0.8
	1/31/2002	SSPL	5	0.2J	0.7	<0.5
	4/5/2002	SSPL	3	0.1J	0.7	<0.5
	9/13/2002	SSPL	3	0.1J	0.7	<0.5
MP-10S	12/6/2001	SSPL	1	<0.5	0.05J	<0.5
	1/30/2002	SSPL	1	0.03J	0.03J	<0.5
	4/4/2002	SSPL	0.8	<0.5	0.06J	<0.5
MP-10D	9/27/2001	SSPL	<0.5	<0.5	<0.5	<0.5
	12/6/2002	SSPL	0.07J	<0.5	<0.5	<0.5
	1/30/2002	SSPL	0.1J	<0.5	<0.5	<0.5
	4/4/2002	SSPL	0.3J	0.04J	<0.5	<0.5
	9/13/2002	SSPL	0.4J	<0.5	<0.5	<0.5

NOTES: J = Estimated result

NA = Not analyzed

UNIVERSAL INSTRUMENTS CORPORATION

TABLE 22

HISTORICAL GROUNDWATER ANALYTICAL RESULTS
INORGANIC PARAMETERS
Former Dover Electronics Site
Kirkwood, New York

Sample Location	Sampling Date	ORP	DO	Alkalinity-Total	Dissolved CO_2	Nitrate	Iron, Dissolved	Manganese, Dissolved	Sulfate
MW-2	11/13/1998	NA	NA	NA		8.3	NA	NA	30
	9/21/2001	170	0	NA	250	NA	NA	NA	NA
	12/4/2001	200	5.64	76	270	3.69	0.186	2.03	39.6
	1/30/2002	150	5.23	176	260	3.03	<0.005	<0.005	36.1
	4/1/2002	200	3	220	150	3.83	<0.005	<0.005	37.2
MW-7A	11/16/1998	86	1.92	NA		0.9	0	NA	62
	9/19/2001	170	5.6	NA	120	NA	NA	NA	NA
	12/4/2001	180	3.53	84	130	1.66	0.08	0.021	41.2
	1/30/2002	150	6.0	128	150	2.02	<0.005	0.011	37.2
	4/1/2002	190	7.9	60	78	1.93	0.011	0.007	32.6
MW-9	11/18/1998	NA	NA	NA		0.3	NA	NA	<20
	9/19/2001	140	1.44	130	84	1.02	0.134	0.355	16.5
MW-11	11/13/1998	123	1.11	NA		<0.1	0	NA	130
	9/19/2001	120	1.7	348	4.7	0.87	0.074	0.091	15.9
MW-12	11/17/1998	55	0.93	NA		<0.1	0	NA	13
	2/2/1999	NA	NA	NA		<0.1	NA	NA	25
	9/19/2001	90	0	128	48	0.87	0.02	3.71	9.22
	12/3/2001	60	2	112	76	0.061	0.924	3.47	13.2
	1/30/2002	80	0	196	100	<0.05	<0.005	2.91	10.2
	4/1/2002	80	0	80	26	<0.05	1.32	3.88	8.0
MW-13	2/2/1999	-46	0.37	NA		0.2	0	NA	31
	9/19/2001	60	0	NA	25	NA	NA	NA	NA
	12/3/2001	75	7.2	216	130	0.317	1.53	0.167	20.4
	1/30/2002	100	3.5	144		0.48	<0.005	0.005	31.1
	4/1/2002	175	2.8	150	17	0.32	0.06	0.04	36.8
MW-14	11/17/1998	135	1.07	NA		<0.1	0.5	NA	24
	9/19/2001	110	0	120	190	0.934	0.21	2.39	45.3
MW-15	2/4/1999	32	3.69	NA		0.5	0	NA	13
	3/11/1999	112	2.35	NA		0.4	0	NA	12
	9/26/2001	40	0	150	110	0.901	0.569	0.318	9.78
	12/3/2001	20	0.83	180	36	0.139	2.46	0.493	9.57
	1/30/2002	80	0	148		0.27	<0.005	0.304	10.7
	4/1/2002	130	0.7	180	22	0.17	0.836	0.301	9.9
MW-16	11/12/1998	171	2.37	NA		0.5	NA	NA	20
	2/1/1999	151	0.66	NA		0.9	0	NA	21
	12/3/2001	110	6.21	128	84	0.17	0.413	1.83	10.6
	1/30/2002	120	0.7	80		0.06	<0.005	1.37	8.2
	4/1/2002	150	0.04	120	26	0.3	0.2	2.1	12.7
MW-17	11/11/1998	NA	NA	NA		0.1	NA	NA	<20
	2/4/1999	222	4.56	NA		0.5	0	NA	29
	9/25/2001	110	0	60	NA	1.08	0.15	1.16	40
MW-20	11/10/1998	61	2.45	NA		0.2	0	NA	8
	2/4/1999	139	0.7	NA		0.3	0	NA	9
	3/15/1999	151	0.42	NA		0.5	0	NA	9
	9/26/2001	110	3	210	69	0.974	0.085	0.012	9.67
MW-21	2/1/1999	280	1.42	NA		0.4	0	NA	21
	3/12/1999	123	2.58	NA		0.4	0	NA	14
	9/26/2001	70	0.3	80	51	1.11	0.441	0.012	14.9

NOTES
NA = Not Analyzed
J = Estimated result

Table 22 continued

Sample Location	Sampling Date	ORP	DO	Alkalinity-Total	Dissolved CO_2	Nitrate	Iron, Dissolved	Manganese, Dissolved	Sulfate
MW-23	11/18/1998	NA	NA	NA		<0.1	NA	NA	53
	2/5/1999	NA	NA	NA		0.2	NA	NA	16
	3/19/1999	NA	NA	NA		0.3	NA	NA	7
	9/19/2001	-120	0	228	53	0.816	1.25	1.07	1.97
MW-24	11/13/1998	NA	NA	NA		1.6	NA	NA	<20
	2/3/1999	NA	NA	NA		1.6	NA	NA	29
	9/19/2001	190	2.57	NA	120	NA	NA	NA	NA
	12/3/2001	135	6.62	72	140	<0.01	0.305	0.159	11.2
	1/30/2002	150	4.7	68		1.23	<0.005	0.207	23.2
	4/1/2002	-21	3.8	160	140	0.49	1.13	14.2	14.7
MW-25	3/19/1999	162	2.75	NA		1.7	0	NA	24
	4/23/1999	211	1.58	NA		1.8	0	NA	26
	9/25/2001	210	0.3	70	NA	2.31	1.56	2.31	24.2
	12/5/2001	140	0.7	120	220	0.1	0.291	0.499	24
	4/1/2002	195	1	120	110	1.2	0.013	5.76	18.4
MW-27	2/3/1999	171	2.08	NA		0.8	0	NA	50
	3/11/1999	153	0.52	NA		1.2	0	NA	25
	9/26/2001	-150	0.8	150	240	0.886	3.23	1.32	35.1
MW-28	2/3/1999	160	1.05	NA		1.3	0	NA	27
	3/17/1999	176	1.03	NA		1	0.6	NA	29
	9/25/2001	140	0.7	90	NA	0.861	1.28	7.19	56.2
	12/5/2001	350	1.45	46	370	0.91	0.811	7.19	33
	1/30/2002	-61	0	250		<0.05	9.9	10.2	27.9
	4/4/2002	-200	0.6	210	200	<0.05	14.2	21.9	9.7
MW-29	2/3/1999	NA	NA	NA		<0.1	NA	NA	110
	3/12/1999	NA	NA	NA		<0.1	NA	NA	85
	9/19/2001	-90	3.4	170	33	0.816	4.56	1.18	34.0
MW-30	3/19/1999	NA	NA	NA		<0.1	NA	NA	120
	9/26/2001	-135	0.31	420	630	<0.01	1.18	23.1	117
	12/5/2001	70	9	400	600	<0.01	1.24	21.6	107
	1/30/2002	-60	7.21	210		<0.05	0.229	22	118
	4/1/2002	100	0	490	530	<0.05	0.041	22.5	117
MW-31	3/18/1999	110	0.36	NA		0.1	0	NA	44
	4/22/1999	233	0.07	NA		0.1	0	NA	36
	9/26/2001	80	0	130	340	0.81	0.054	1.71	38.5
	12/5/2001	130	6.1	180	290	<0.01	0.109	1.31	36.3
	1/30/2002	110	0.88	170		0.05	0.020	1.10	37.5
	4/1/2002	150	0	190	300	<0.05	0.021	1.31	30.8
MW-32	3/19/1999	-6	2.15	NA		<0.1	0	NA	39
	4/22/1999	182	0.28	NA		<0.1	0	NA	36
	9/25/2001	-30	0	260	NA	<0.01	23.2	22.7	23.5
	12/5/2001	20	6.6	370	570	<0.01	6.4	20.4	23.9
	1/30/2002	2	9.55	250		<0.05	6.4	20.2	28.8
	4/1/2002	94	13	270	500	<0.05	0.333	20.5	26.5
MW-33	3/18/1999	123	4.51	NA		<0.1	0	NA	37
	4/22/1999	190	0.44	NA		<0.1	0	NA	25
	9/26/2001	130	0	90	180	<0.01	0.546	0.099	16.1
MW-34	4/21/1999	72	0.05	NA		<0.1	0	NA	5
	9/25/2001	-20	0	180	NA	0.9	0.313	0.9	1.8
	12/5/2001	20	0.6	260	50	<0.01	0.425	0.377	1.6
	4/1/2002	180	0	230	19	<0.5	0.035	0.367	1.1
MW-35	4/21/1999	164	0.16	NA		0.6	0	NA	31
	9/25/2001	170	0.3	80	NA	1.49	0.093	0.015	32.3
	12/5/2001	270	0	110	220	0.24	0.048	0.02	31.1
	1/30/2002	100	0.9	100		0.35	<0.005	0.034	34.3
	4/1/2002	120	0	110	140	0.26	0.031	0.018	31.7

NOTES

NA = Not Analyzed

J = Estimated result

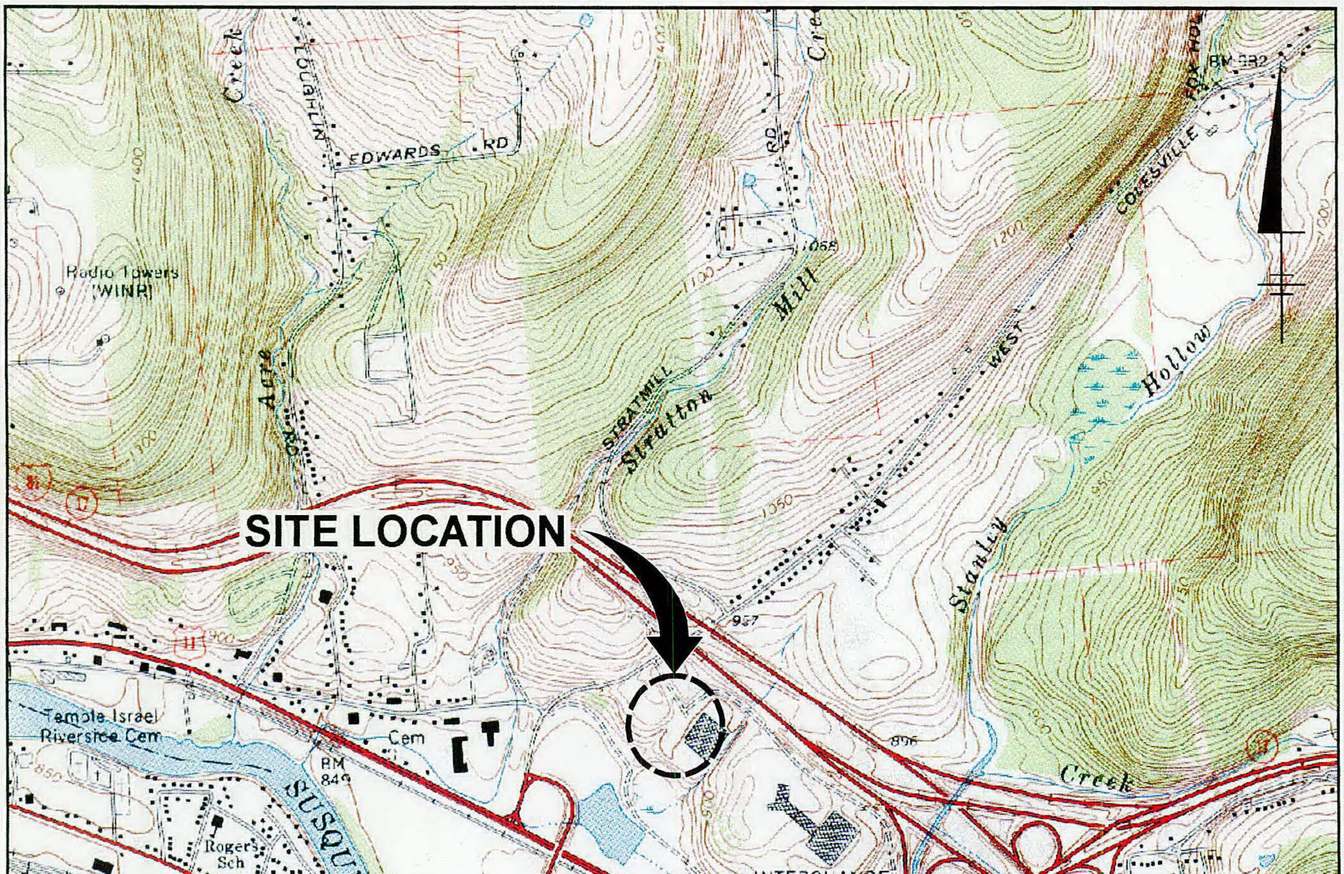
Table 22 continued

Sample Location	Sampling Date	ORP	DO	Alkalinity-Total		Nitrate	Iron, Dissolved	Manganese, Dissolved	Sulfate
MW-36	4/21/1999	167	0.07	NA		<0.1	0	NA	40
	9/26/2001	-70	0	130	460	0.811	10.4	1.14	31.4
MW-37	9/28/2001	12	1.3	180	10	2.09	1.38	1.96	33.1
	12/5/2001	70	0.6	190	180	1.04	1.3	0.913	36.1
	1/30/2002	120	1.6	200		1.69	<0.005	1.03	29.5
	4/1/2002	180	20	130	160	1.31	0.06	0.634	22.7
MW-38	9/28/2001	180	4.7	60	240	2.06	1.12	0.612	30.3
	12/4/2001	190	1.44	64	280	1.42	0.347	0.384	27.9
	1/30/2002	140	0	100		1.76	0.008	0.364	30.7
	4/1/2002	230	6.7	120	250	1.15	0.041	0.723	25.4
MP-2	1/30/2002	150	6	68		0.89	<0.005	0.575	28.1
	4/1/2002	150	2	30	110	0.72	0.336	0.188	26
MP-3D	9/28/2001	130	8.95	90	44	0.99	0.988	0.251	16.3
	12/3/2001	110	6.2	140	60	0.119	0.705	0.181	3.77
	1/30/2002	80	0	130		0.18	<0.005	0.136	3.7
	4/1/2002	135	0	120	28	0.21	<0.005	0.106	3.6
MP-4	9/27/2001	-65	0.8	80	100	1.89	2.18	1.46	24.6
	12/4/2001	100	11.2	76	54	1.49	0.319	0.741	24.4
	1/30/2002	150	6	56		2.1	<0.005	0.219	24.8
	4/1/2002	200	5.3	30	120	1.71	0.016	0.155	24.8
MP-5	9/27/2001	120	3.44	60	170	2.43	0.409	0.683	21.5
	12/4/2001	190	6.5	40	57	1.73	0.286	0.496	18
	1/30/2002	190	7.3	24		2.25	<0.005	0.381	19.3
	4/1/2002	160	5.6	60	170	1.86	0.431	1.06	16.5
MP-6S	9/24/2001	80	0.8	NA	NA	NA	NA	NA	NA
	12/4/2001	95	10.2	128	10	0.91	0.087	0.883	11.3
	1/30/2002	130	0.4	128		1.48	<0.005	0.143	14.4
	4/1/2002	220	3.7	90	81	1.23	<0.005	0.061	17.0
MP-6D	9/24/2001	-230	0	NA	NA	NA	NA	NA	NA
	12/4/2001	280	12	148	50	0.32	2.33	1.95	6.1
	1/30/2002	120	0.7	160		0.43	<0.005	2.18	5.7
	4/1/2002	170	0	151	29	0.19	0.026	2.16	5.2
MP-7	12/6/2001	160	7.6	120		0.027	0.118	3.7	34.5
	1/30/2002	-150	0.2	360		<0.05	0.351	1.82	41.0
	4/1/2002	-110	0	140	64	<0.05	0.014	0.248	18.0
MP-8S	9/27/2001	200	10.4	60	260	1.1	0.347	2.16	33.4
	12/4/2001	210	11.8	64	270	0.13	0.073	6.66	48.8
	1/30/2002	180	17	160		0.25	<0.005	5.98	37.9
	4/1/2002	250	17	64	410	0.32	<0.005	0.642	32.8
MP-8D	9/27/2001	42	1.4	80	37	1.45	1.53	0.354	93.4
	12/4/2001	-40	0.41	84	130	0.27	0.274	0.896	11.3
	1/30/2002	-40	0	220		<0.05	<0.005	0.457	1.7
	4/1/2002	100	1	250	17	<0.05	0.005	0.469	1.63
MP-9	12/6/2001	240	1.5	110	470	0.06	0.114	0.465	31.9
	1/30/2002	-20	0	140		<0.05	4.03	3.36	37.9
	4/1/2002	55	0	140	580	<0.05	6.68	5.65	34.7
MP-10S	12/6/2001	200	7.6	200	610	0.015	0.077	1.59	33.3
	1/30/2002	140	0	180		<0.05	0.068	2.41	40.7
	4/1/2002	70	0	130	120	<0.05	0.092	0.394	1.55
MP-10D	9/27/2001	60	0.4	210	35	<0.01	1.5	0.726	11.6
	12/6/2002	100	0.4	270	42	<0.01	0.01	0.548	1.26
	1/30/2002	70	0.4	220		2.35	<0.005	0.538	1.3
	4/1/2002	130	0	240	18	<0.05	<0.005	0.536	1.03

NOTES

NA = Not Analyzed

J = Estimated result



REFERENCE: Base Map Source USGS 7.5 Minute Quad. Series Binghamton East, New York, 1968, Photorevised 1976.

2000'　0　2000'

Approximate Scale: 1" = 2000'

AREA LOCATION

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK

LOCATION MAP

BBL BLASLAND, BOUCK & LEE, INC.
engineers & scientists

FIGURE
1

07/18/01 CRA-54-IY
05203003/05203n01.cdr

Figure 24
Oxygen Redutction Potential
Shallow Groundwater Unit

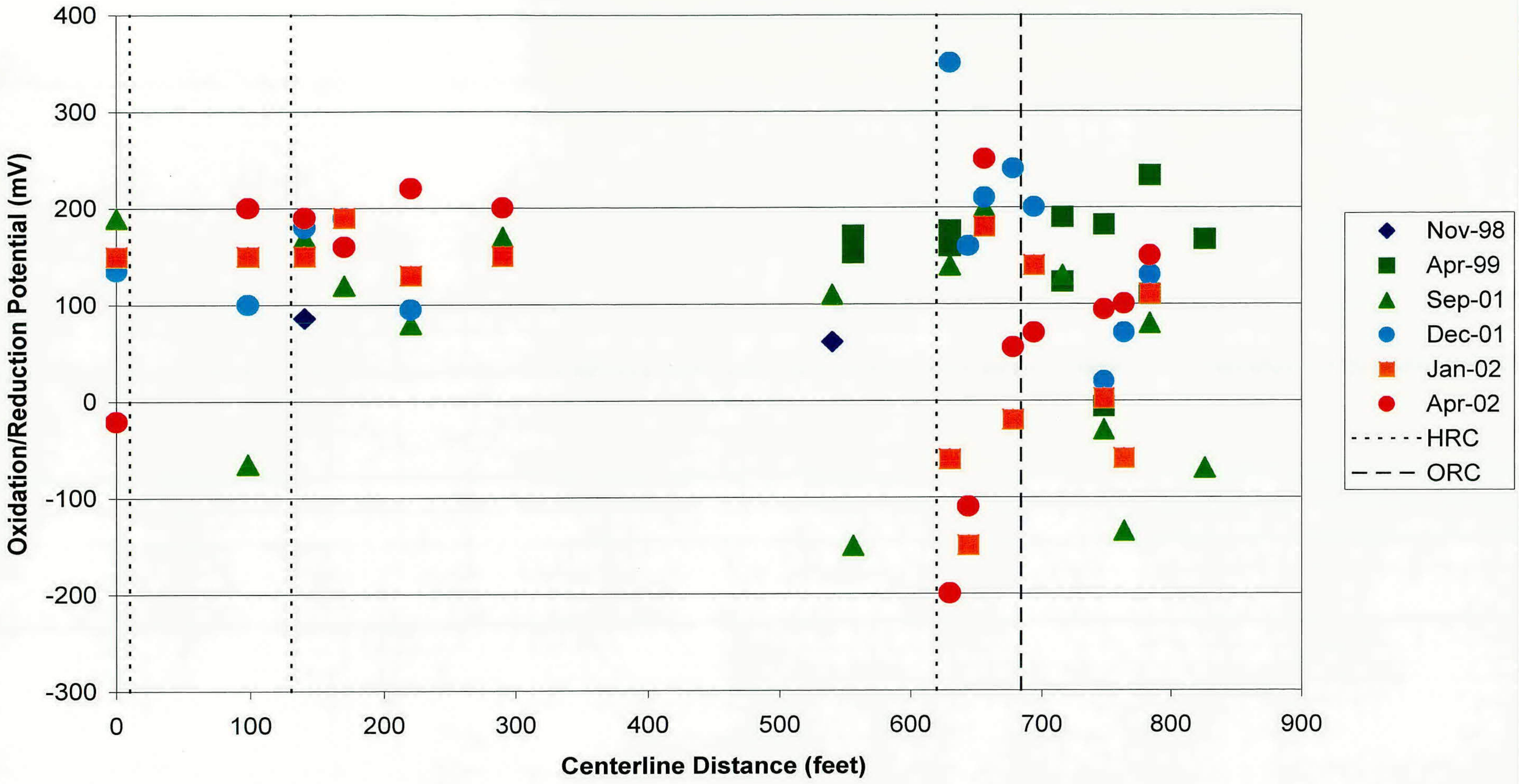


Figure 25
Alkalinity
Shallow Groundwater Unit

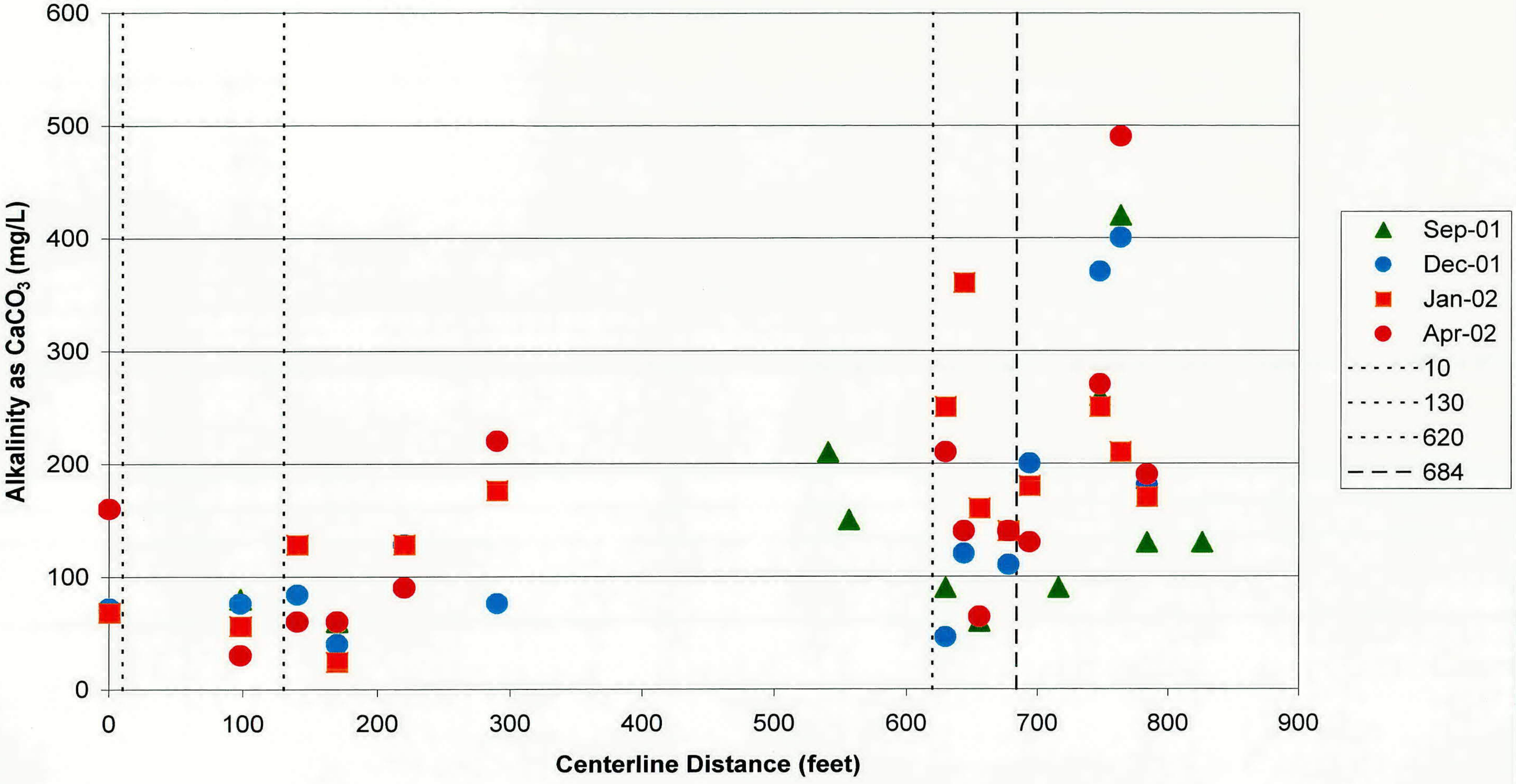
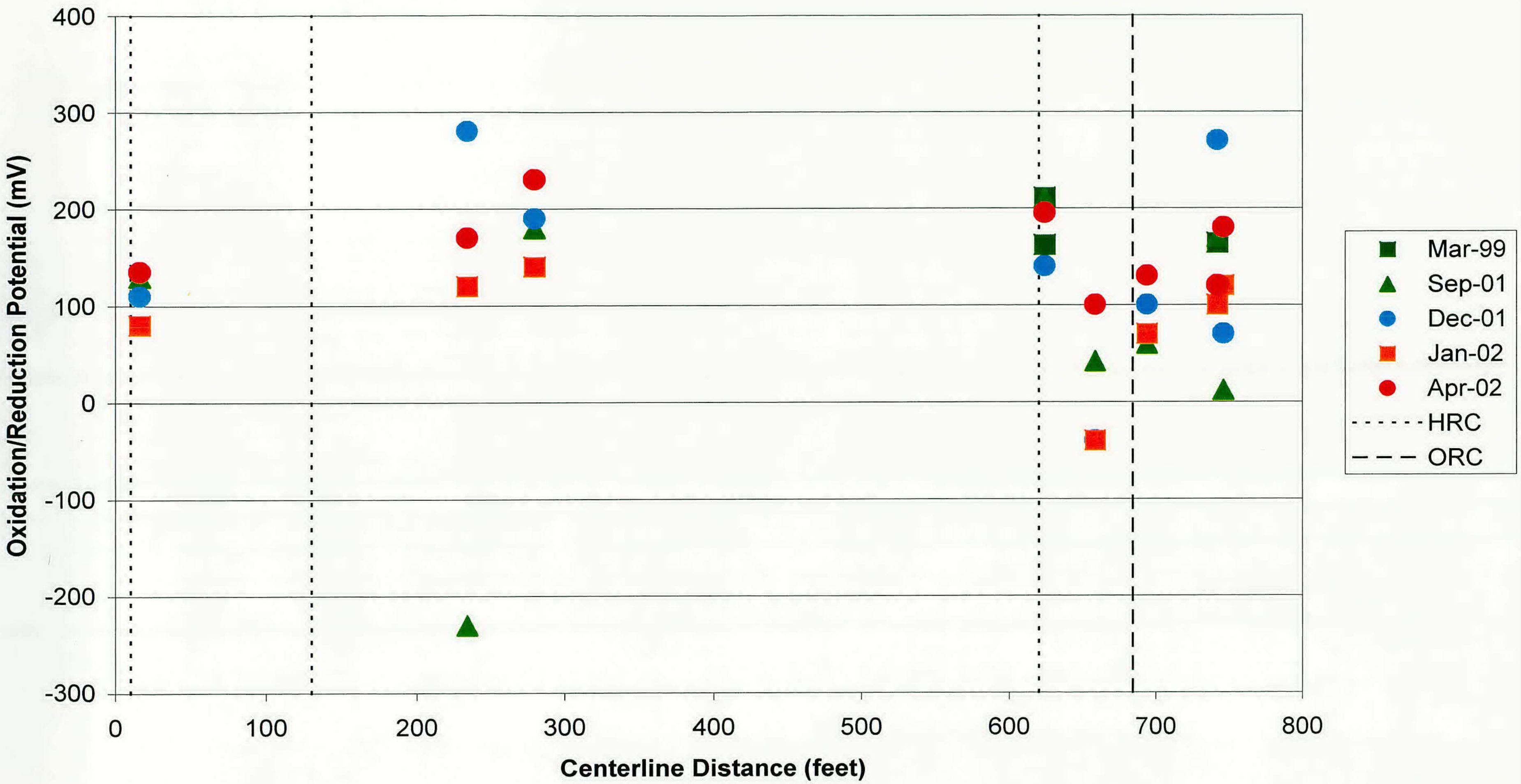


Figure 26
Oxygen Reduction Potential
Intermediate Groundwater Unit



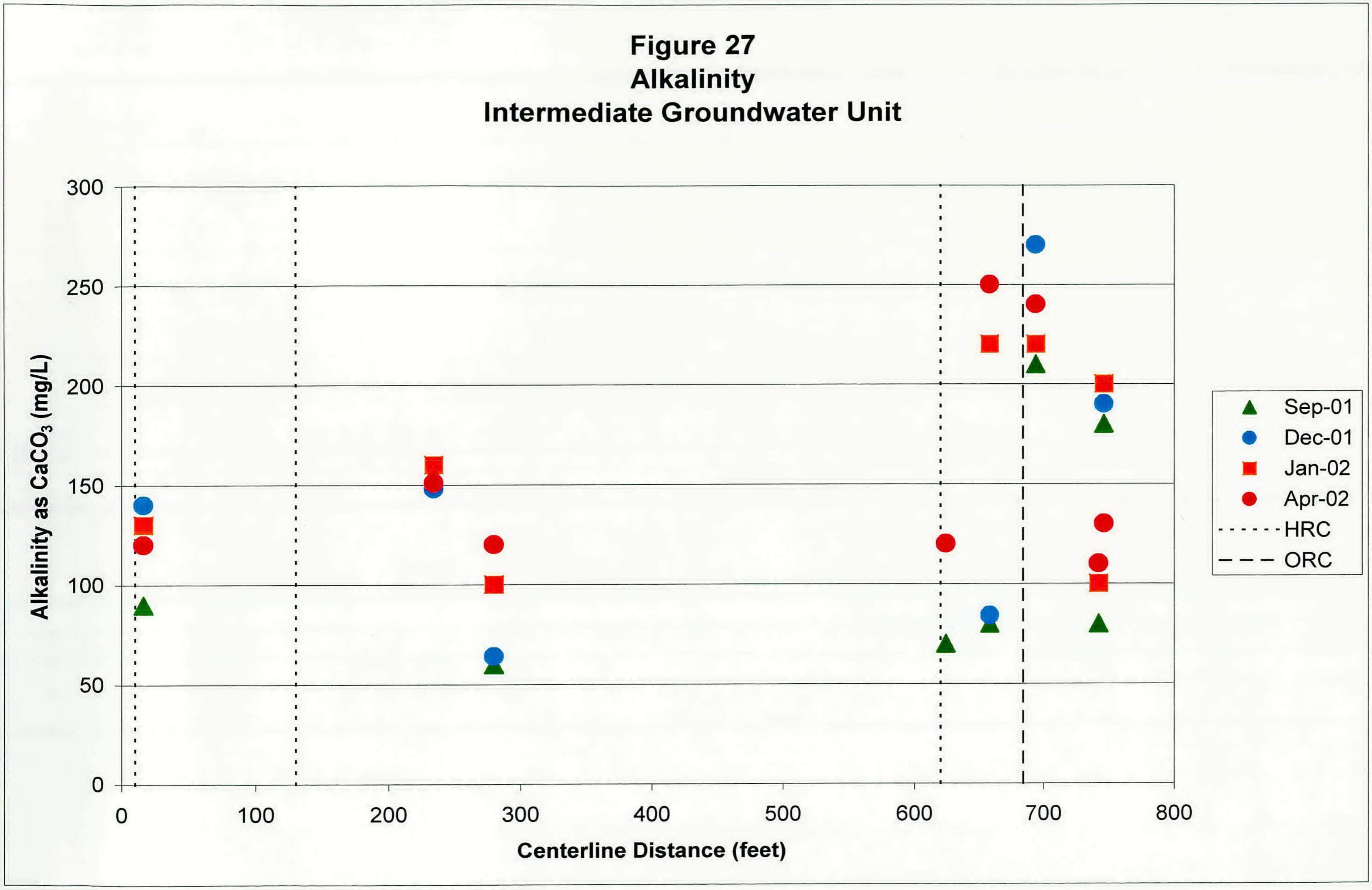


Figure 27
Alkalinity
Intermediate Groundwater Unit

Figure 28

MW-24 Bar Graph - PCE and Breakdown Products

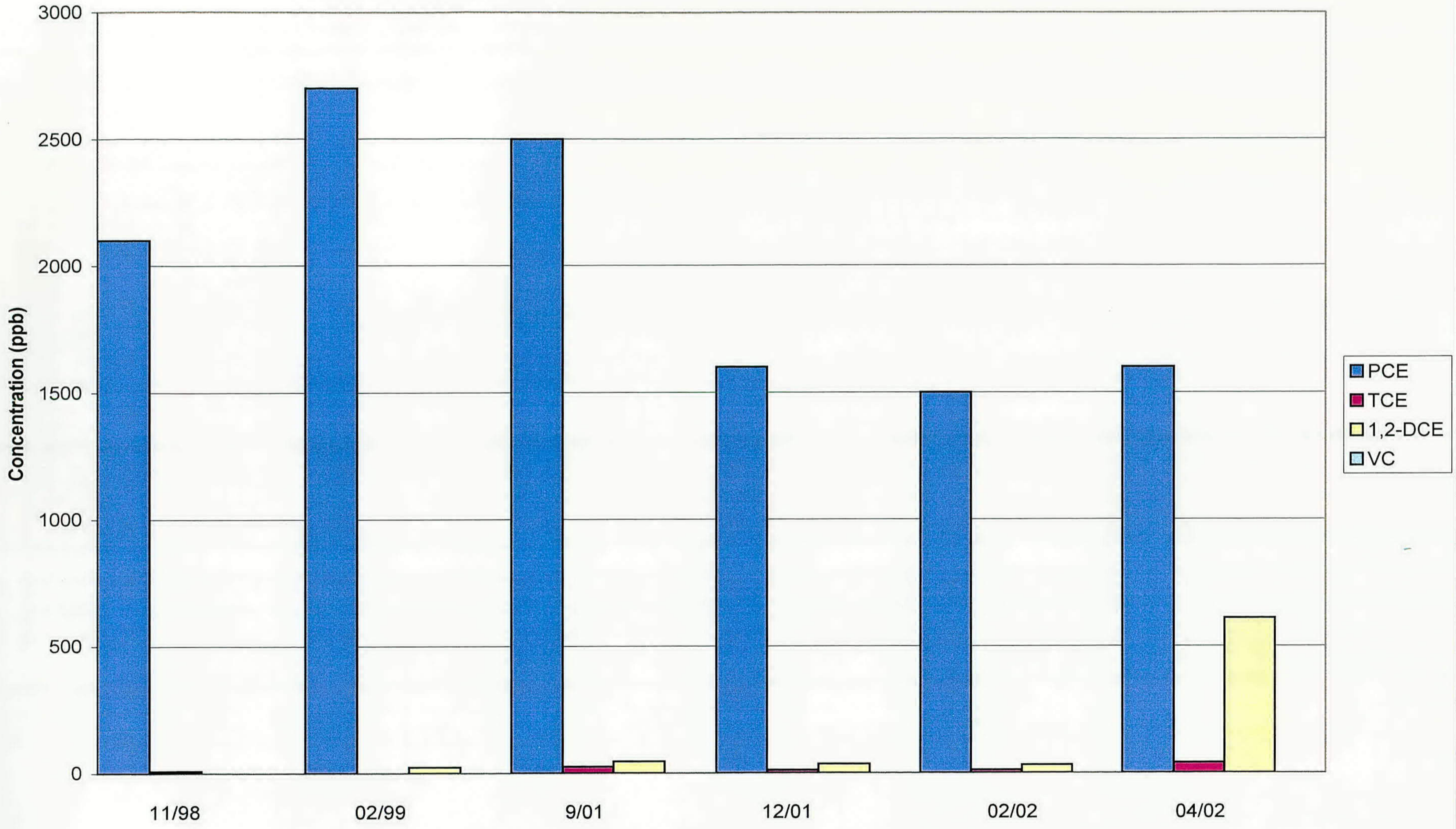
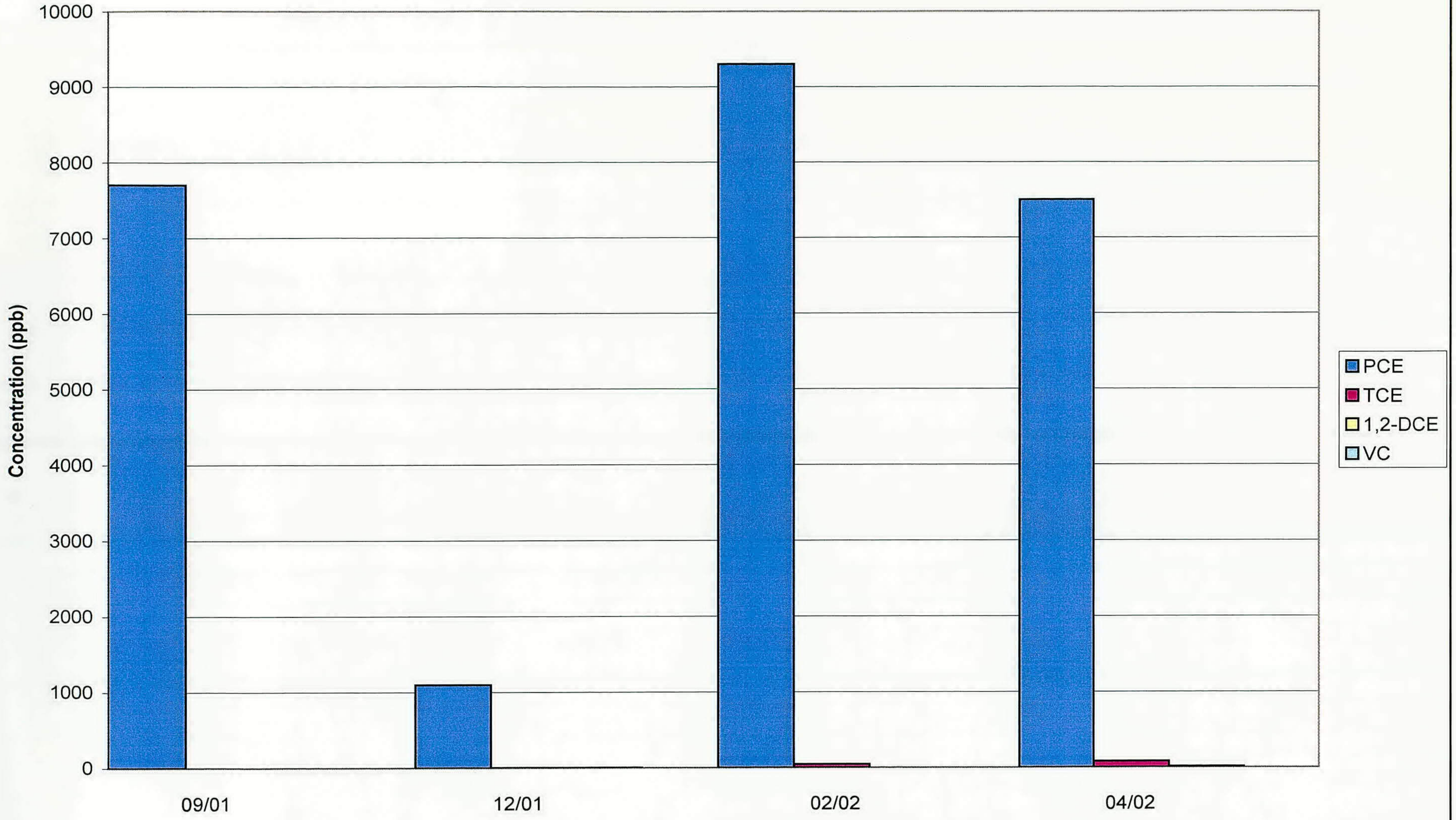


Figure 29
MP-4 Bar Graph - PCE and Breakdown Products



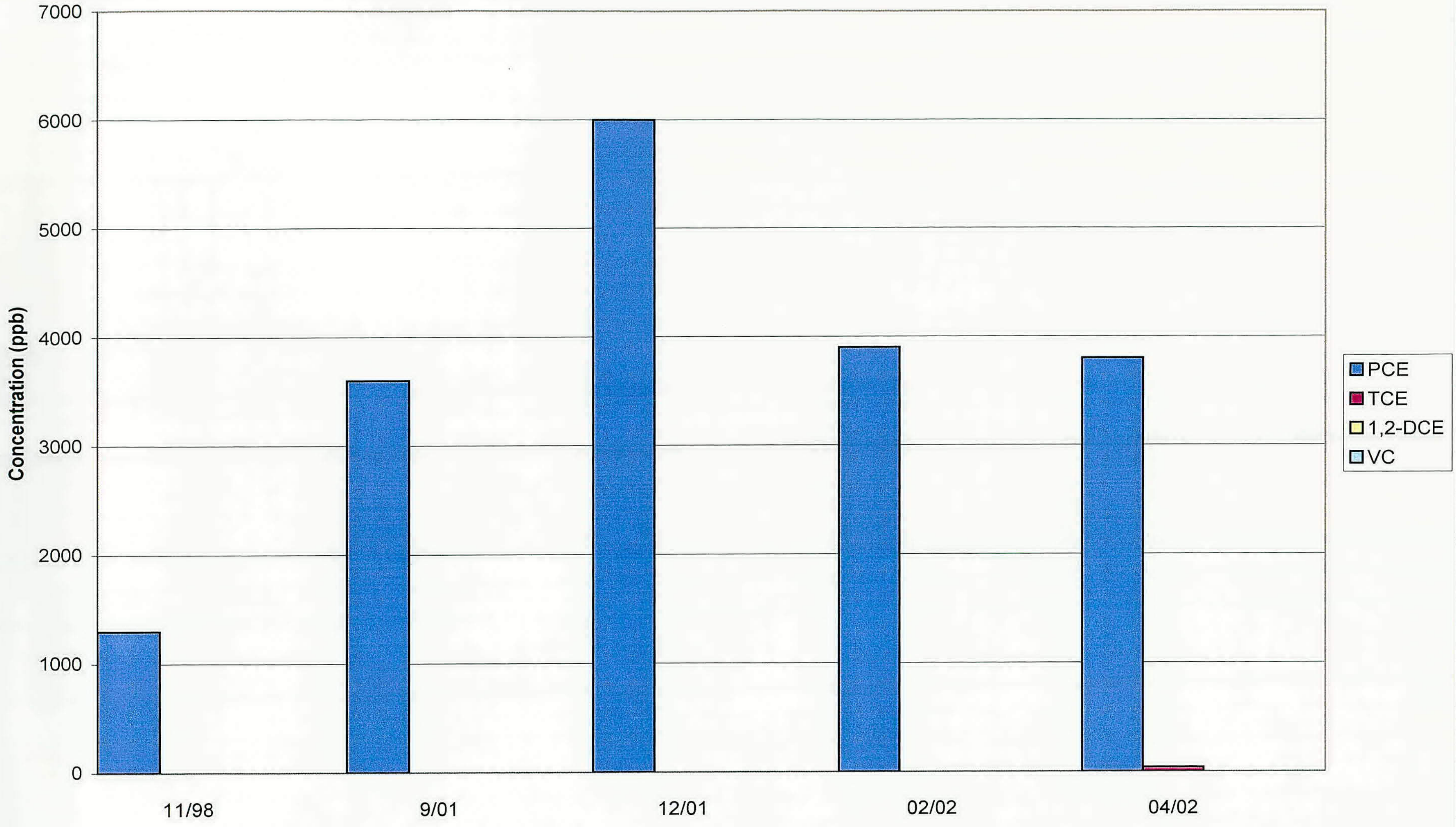


Figure 30
MW-7A Bar Graph - PCE and Breakdown Products

Figure 31
MP-5 Bar Graph - PCE and Breakdown Products

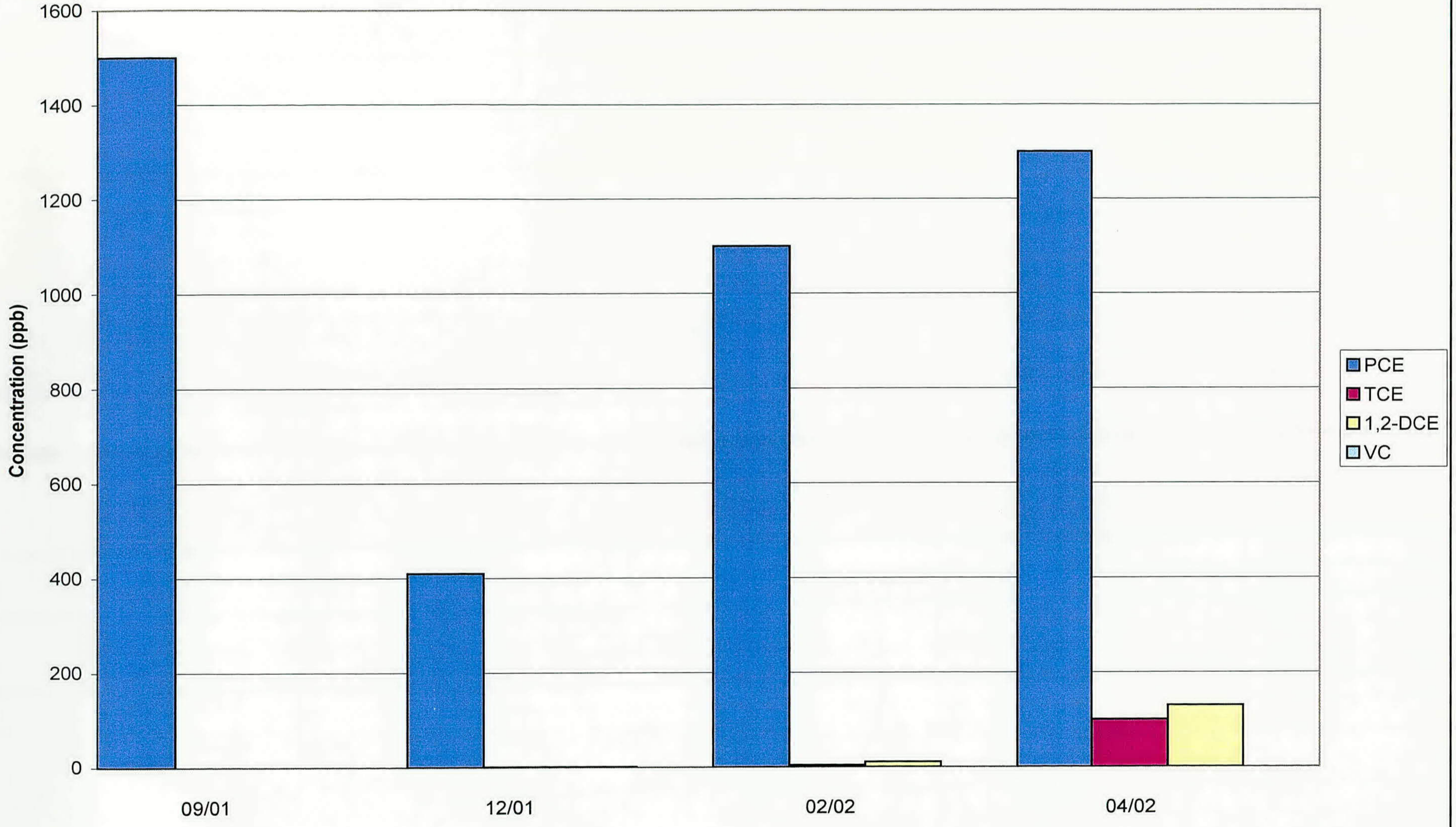


Figure 32
MP-6S Bar Graph - PCE Breakdown Products

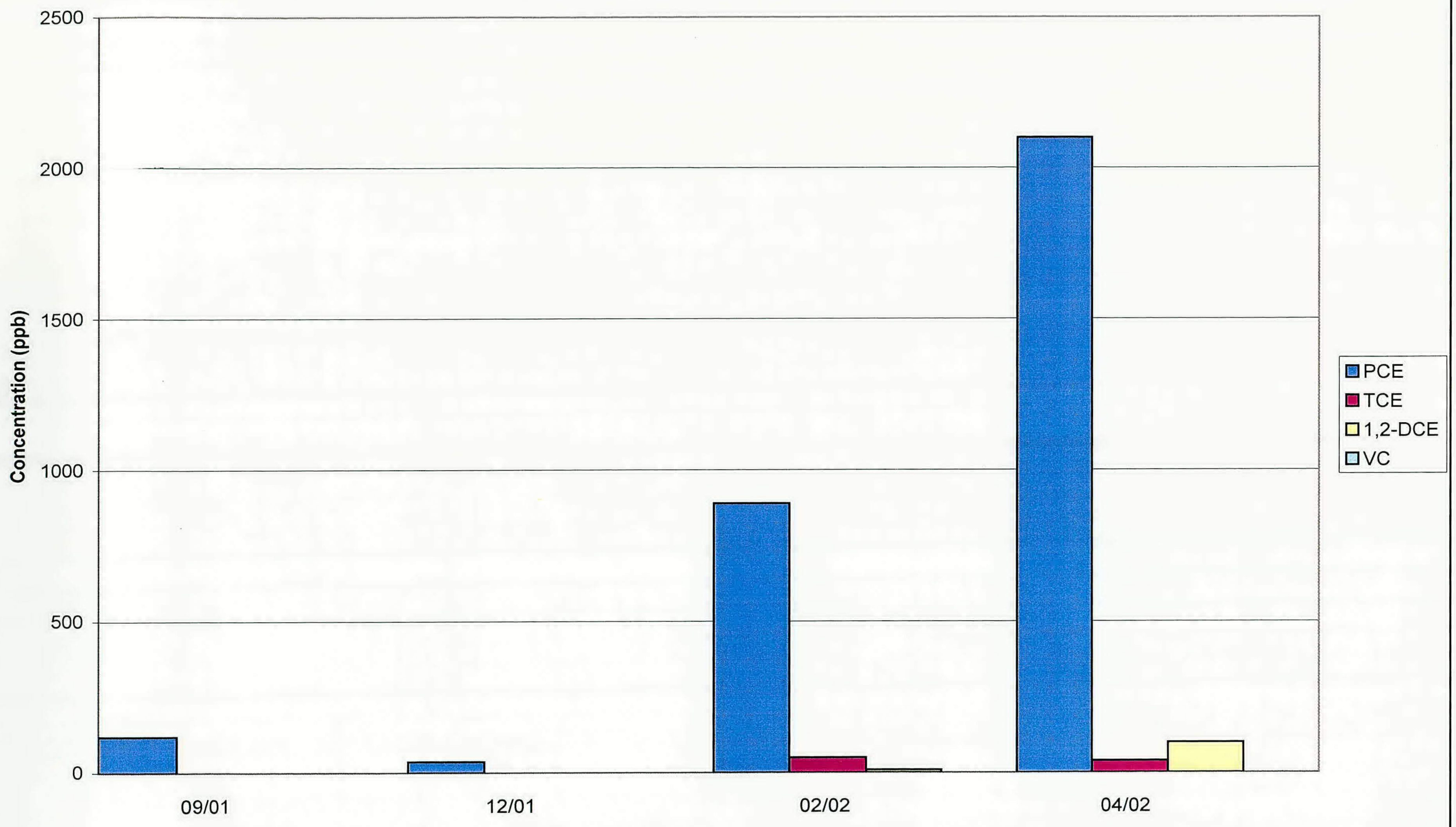
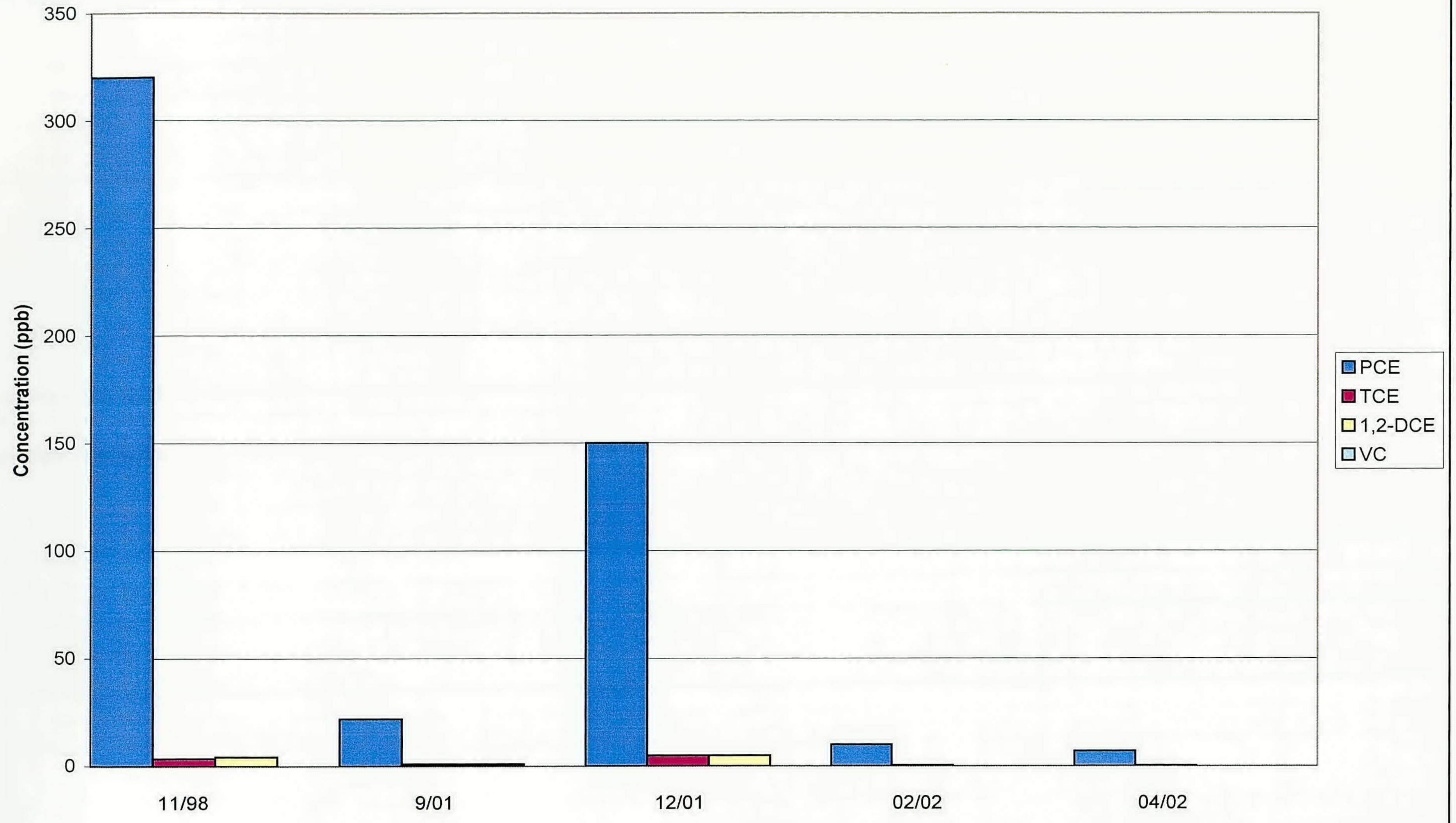


Figure 33
MW-2 Bar Graph - PCE and Breakdown Products



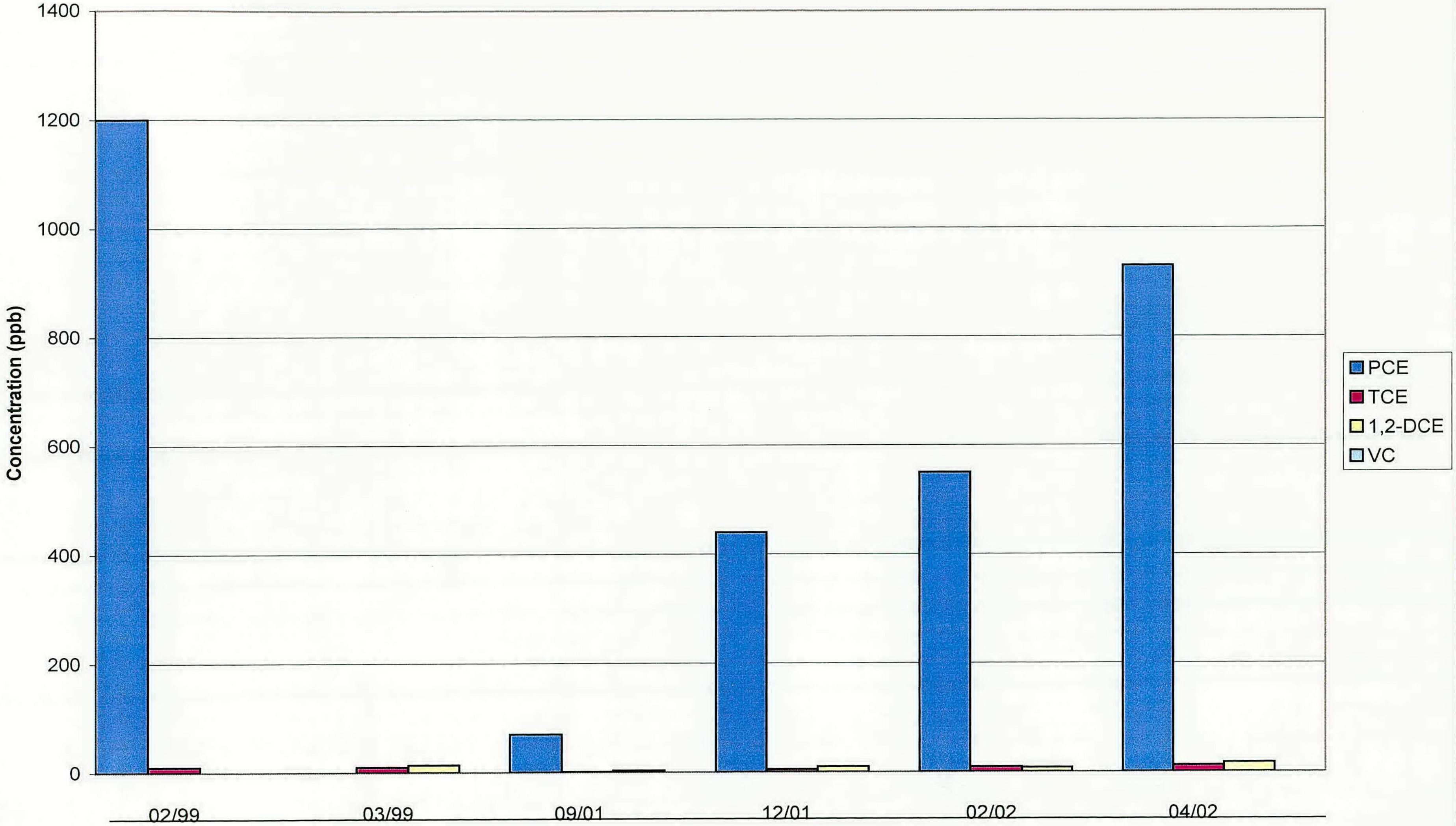


Figure 34
MW-28 Bar Graph - PCE and Breakdown Products

Figure 35
MP-8S Bar Graph - PCE and Breakdown Products

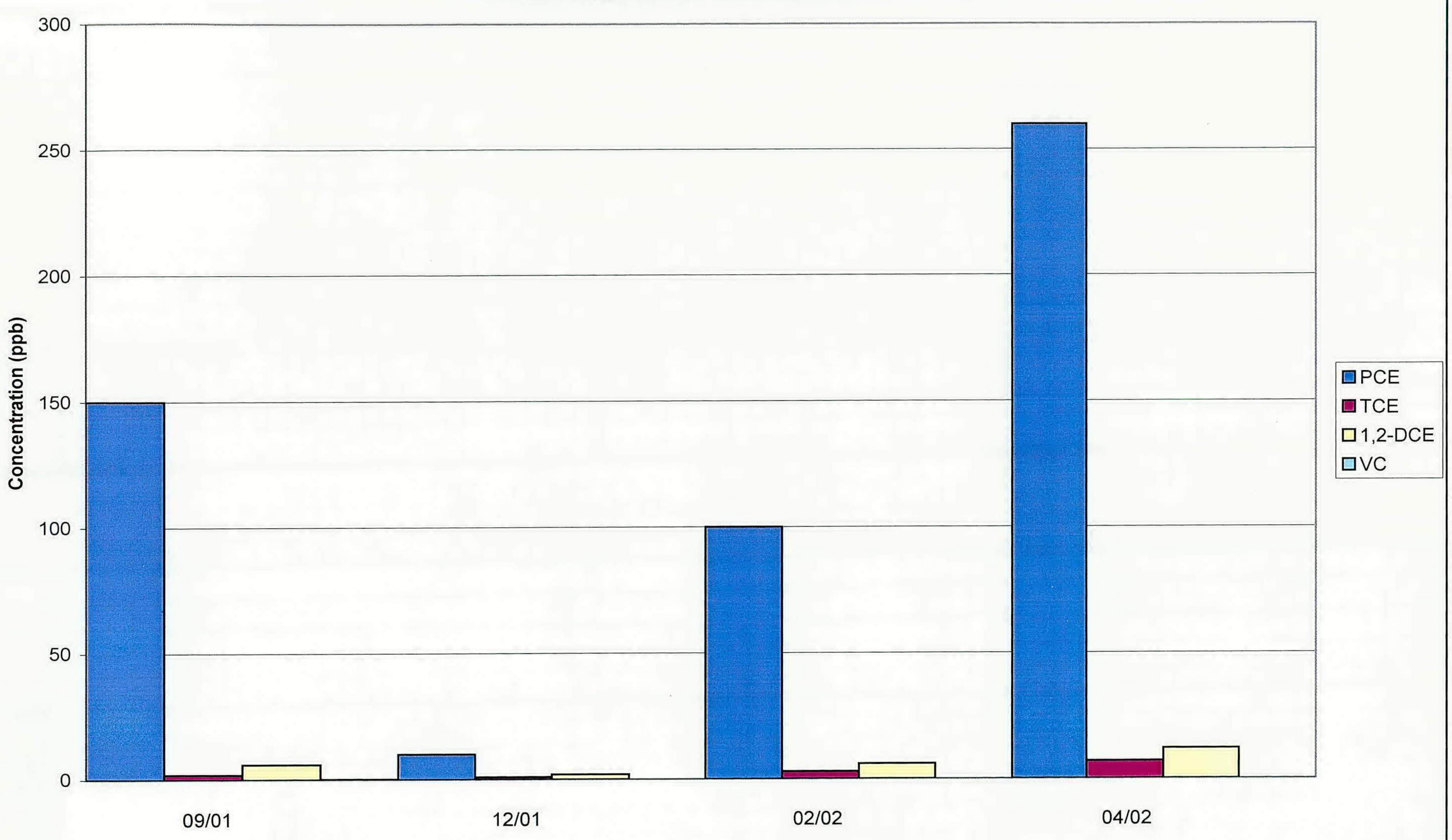
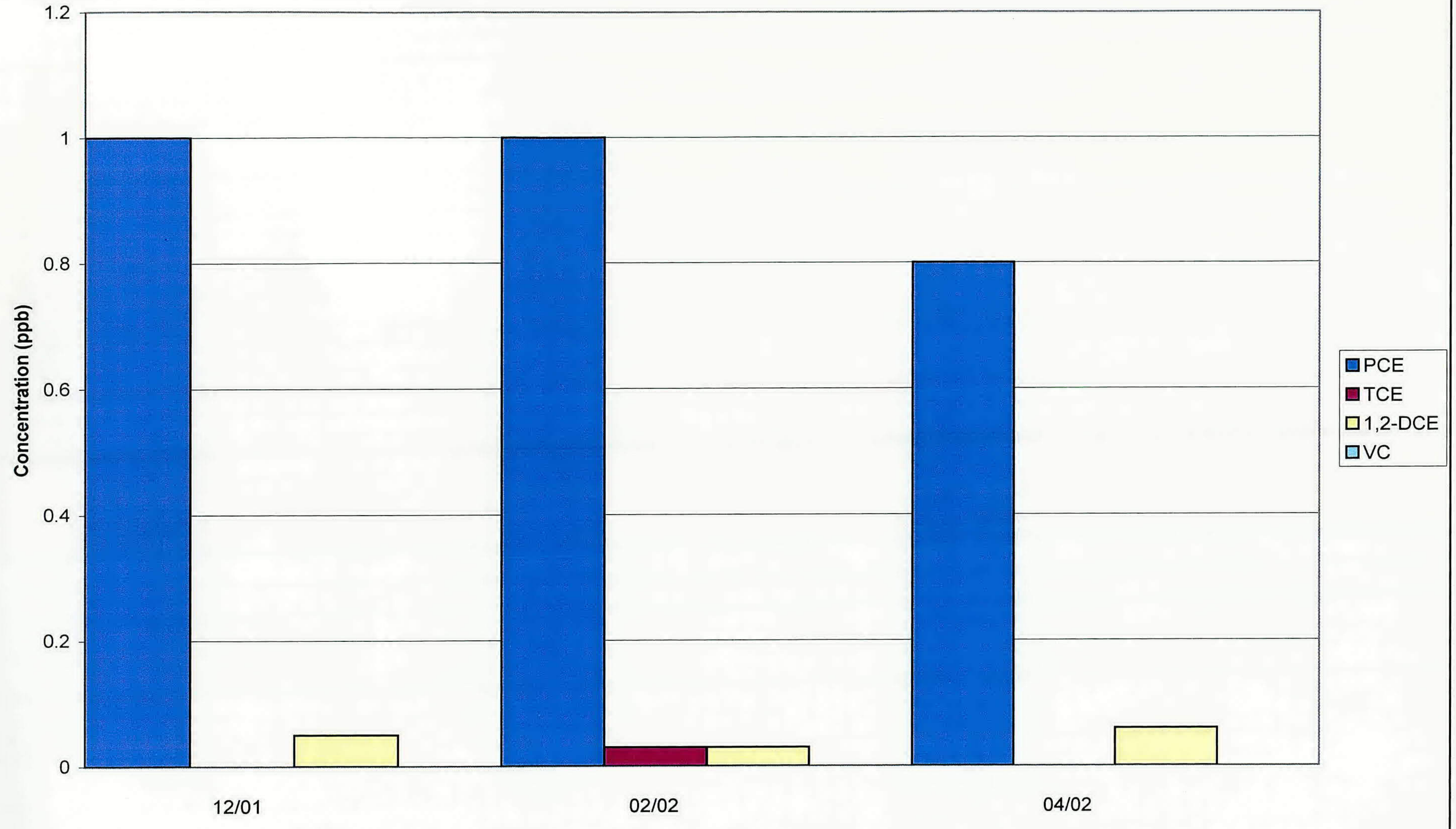


Figure 36
MP-10S Bar Graph PCE and Breakdown Products



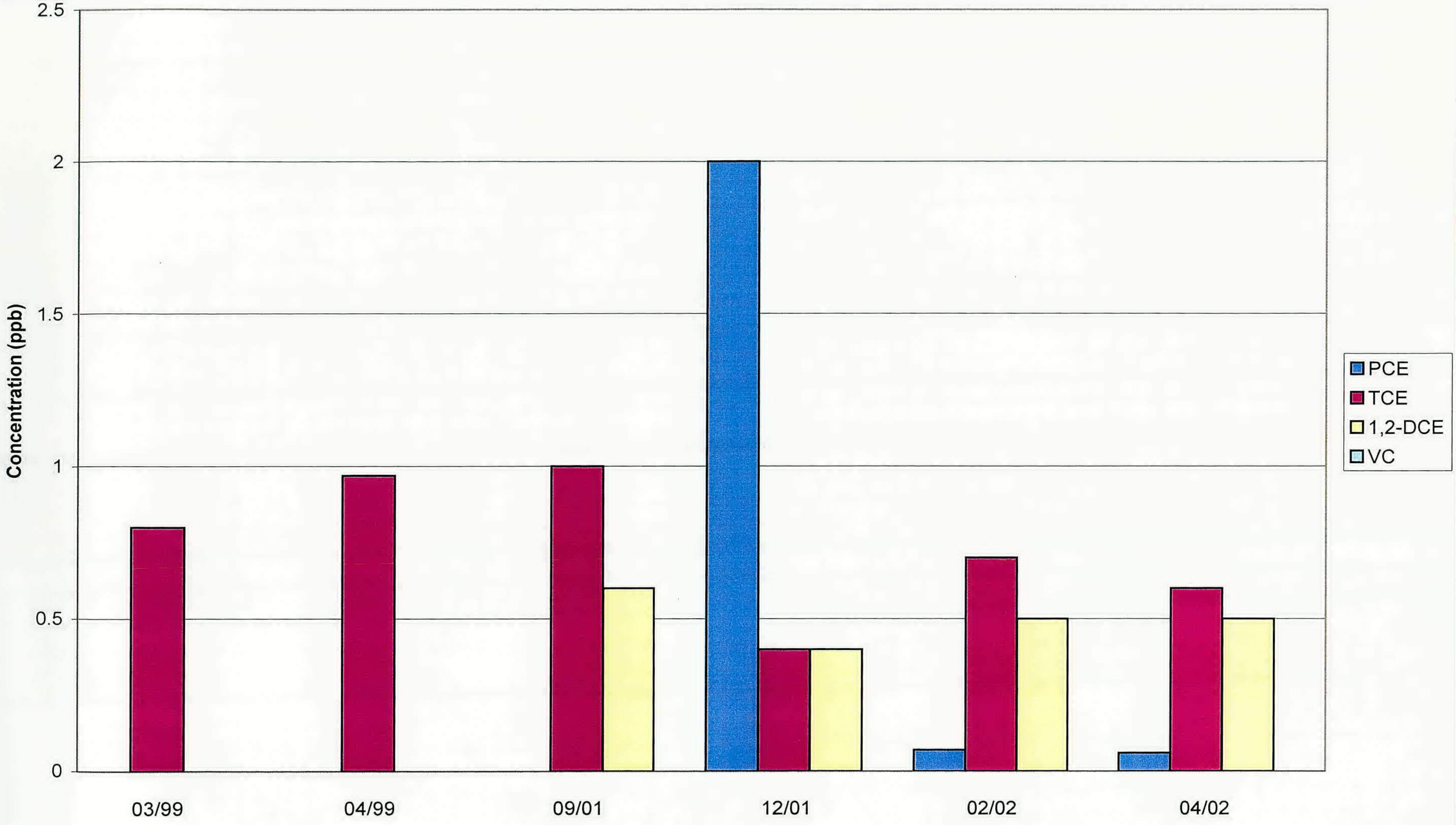


Figure 37
MW-30 Bar Graph - PCE and Breakdown Products

Figure 38
MW-31 Bar Graph - PCE and Breakdown Products

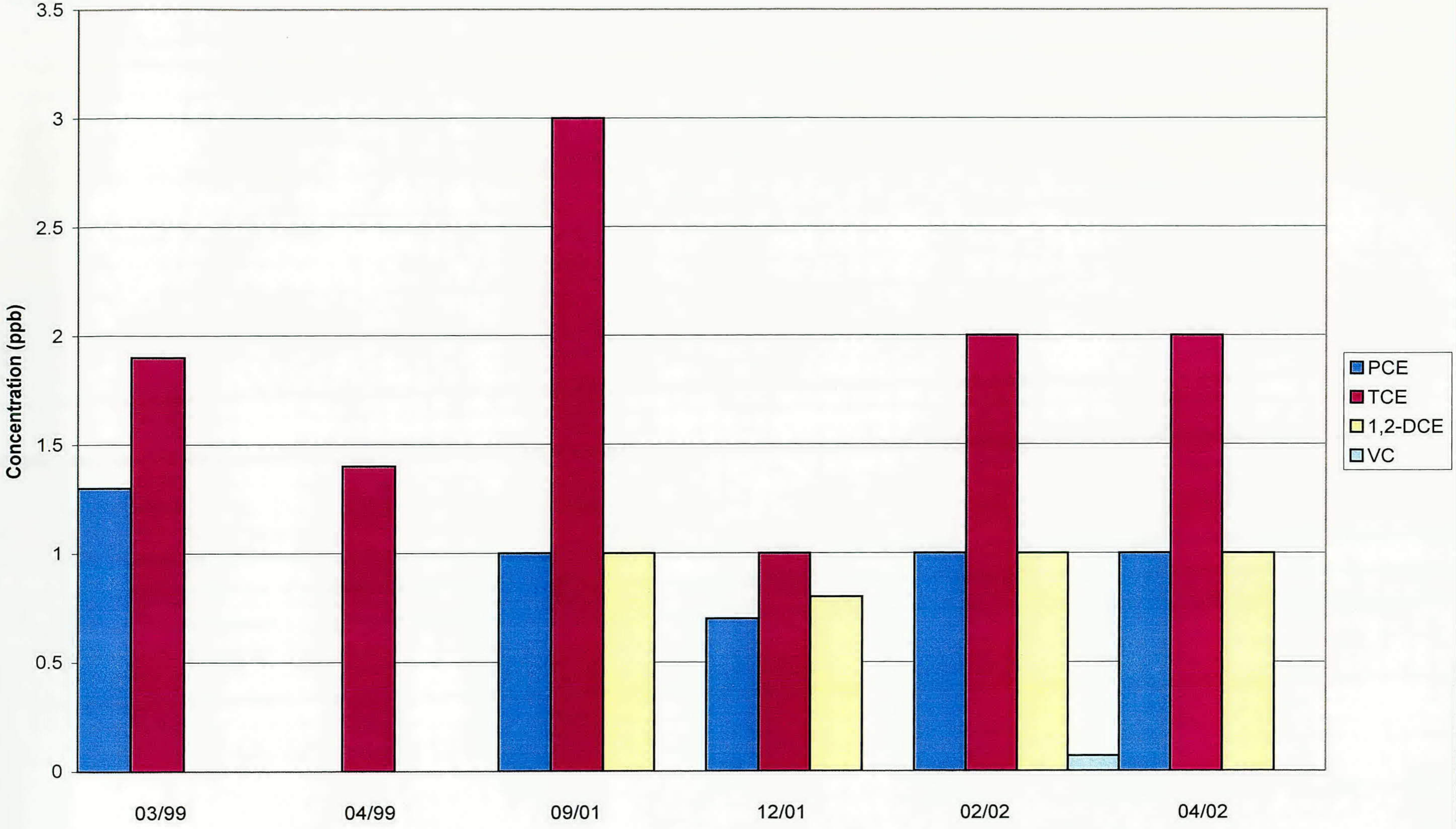
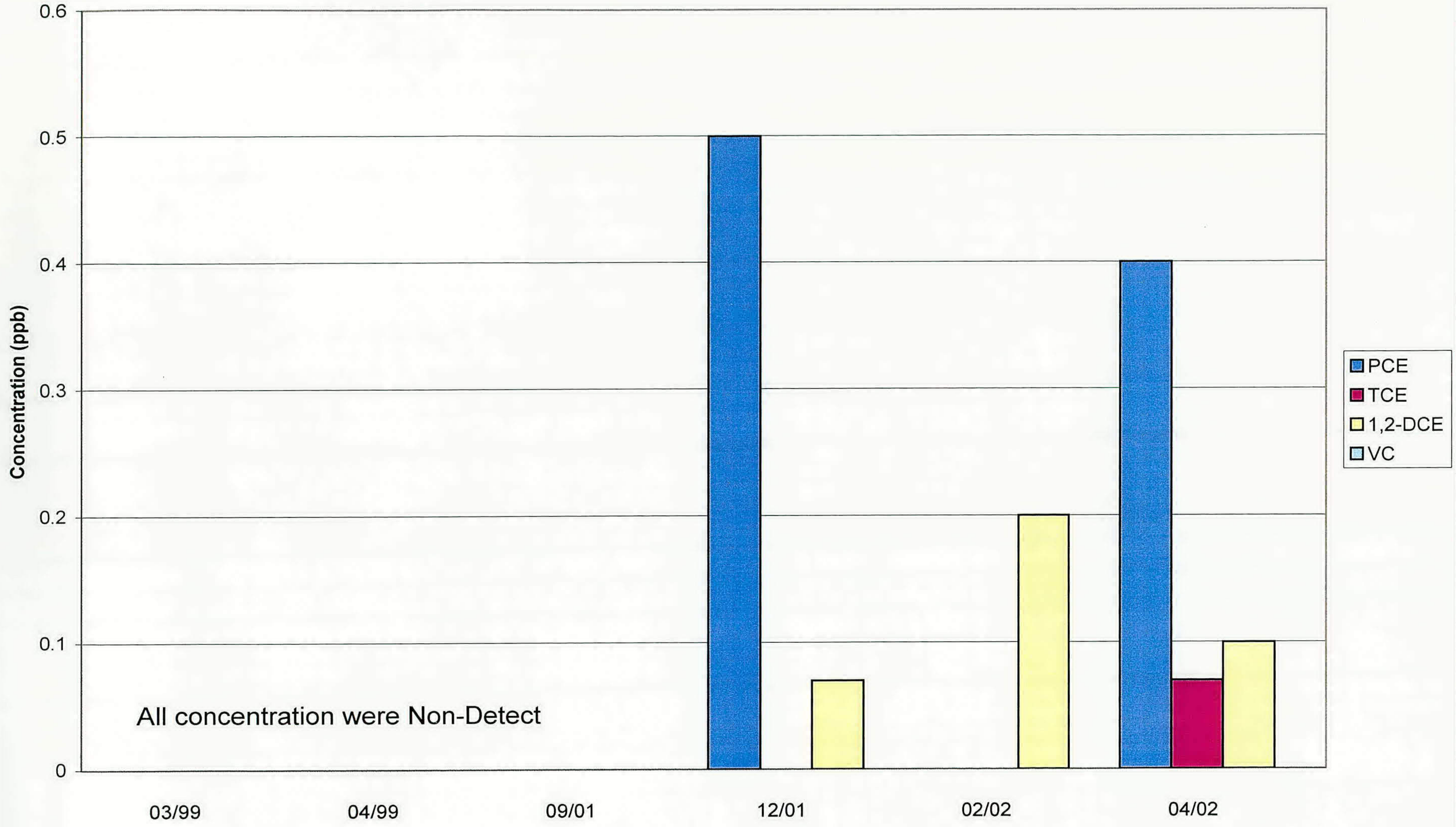


Figure 39
MW-32 Bar Graph - PCE and Breakdown Products



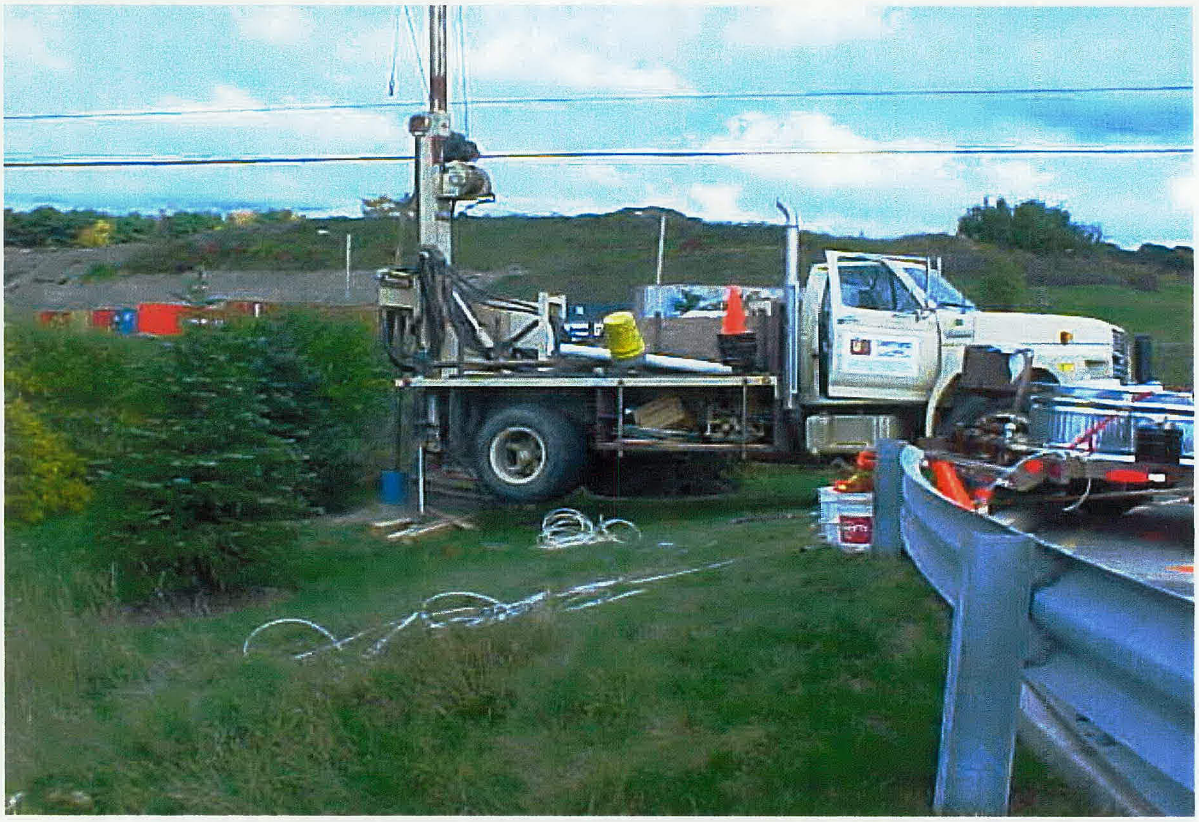
APPENDIX A

MONITORING WELL LOG

Client: Universal Instruments-Kirkwood, NY	Well ID: MW-37	**Blasland, Bouck & Lee, Inc.** **8 South River Rd.** **Cranbury, New Jersey 08512**
Project # : 05203.003	Sheet 1 of 1	

depth (feet)	**Moisture Content**	**PID (ppm)**	**Blow Count**	**Soil Classification**	**Remarks**
					Split spoon sampling from 25-40 ft. PID lamp out of service
24	wet		9	Brown gravel and fine silty sand	
26			10	Till, Brown gravel and fine silty sand	
28			4		
30	wet		7		
32			4	Till, pebbles, course to fine silty brown sand	
34	wet		39		
36			28	Till with course to fine brown silty sand	
38			26	Till with some clay.	
	wet				
40				40' END OF BOREHOLE	

APPENDIX C

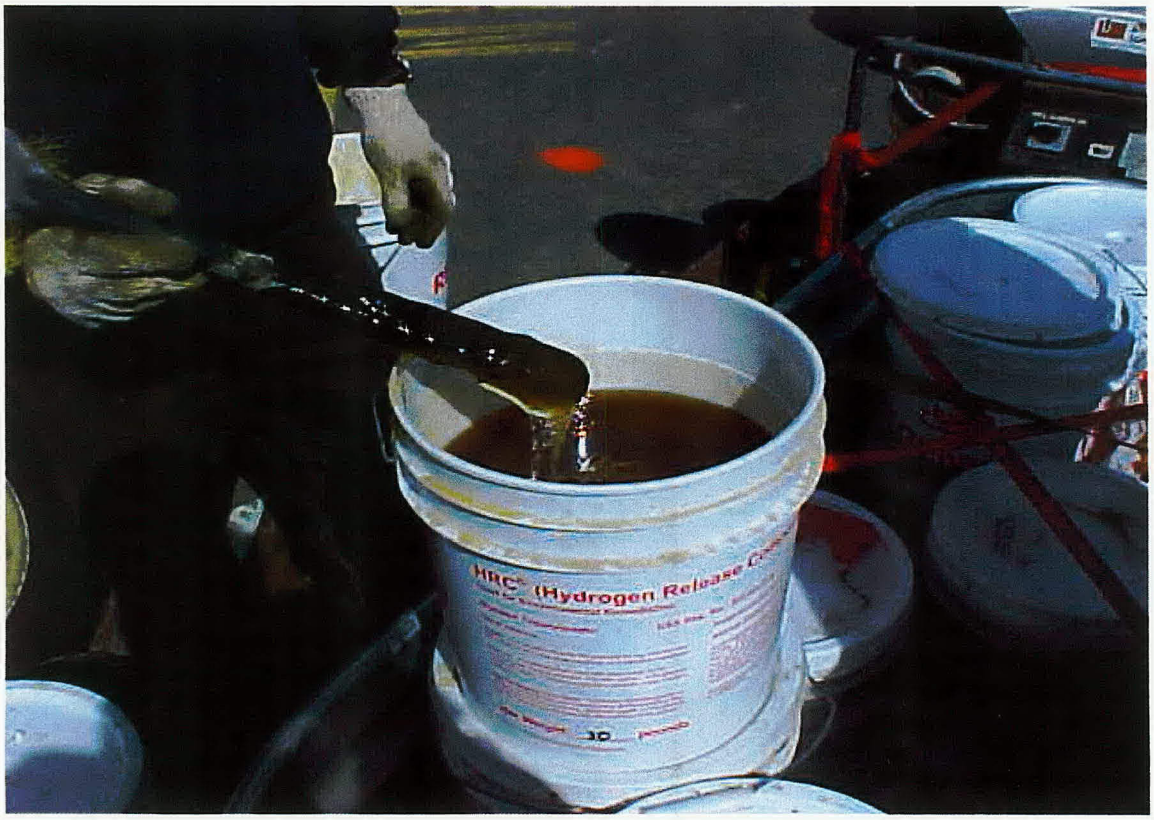


MW-24 Area – Installation of first HRC injection point

MW-24 Area – HRC injection at first point (Cylinder for packer inflation w/ inert gas)

Universal Instruments-Kirkwood North
Industrial Drive, Kirkwood, New York

MW-24 Area – HRC injection trailer (pump and hopper, glycerin rinse, and water bath



MW-24 Area – HRC heated for injection

Universal Instruments-Kirkwood North
Industrial Drive, Kirkwood, New York

MW-24 Area – Heated HRC being poured in pump hopper

MW-24 Area – HRC injection point installation

Universal Instruments-Kirkwood North
Industrial Drive, Kirkwood, New York

Pilot Truck Stop – HRC injection (Drill rig and trailer with pump, water bath and HRC)

MW-7A Area – Installation of injection points

Universal Instruments-Kirkwood North
Industrial Drive, Kirkwood, New York

MW-7A Area – HRC injection in progress

MW-7A Area – Trailer with generator, pressure washer, hot water bath for HRC

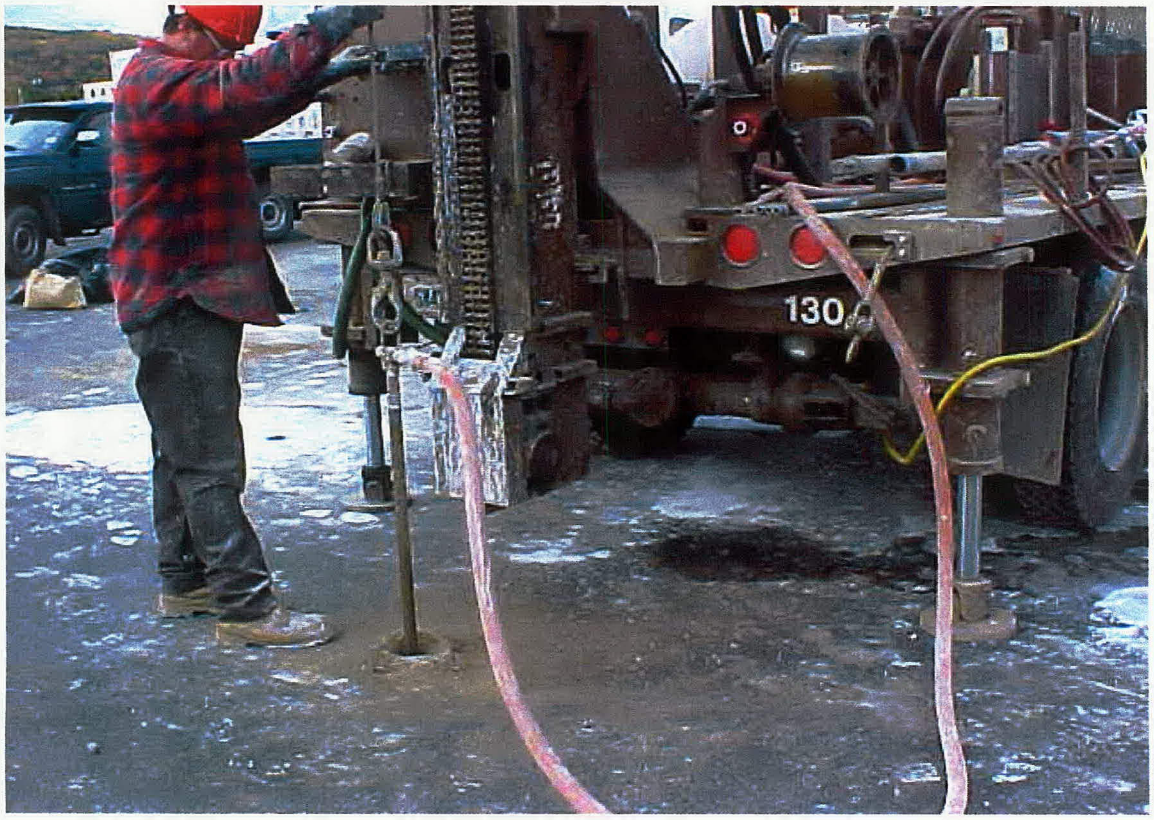
Universal Instruments-Kirkwood North
Industrial Drive, Kirkwood, New York

Pilot Truck Stop – ORC injection (Drill rig with pump and ORC bucket [blue])

Pilot Truck Stop – Mixing ORC for injection

Universal Instruments-Kirkwood North
Industrial Drive, Kirkwood, New York

Pilot Truck Stop – ORC injection (50% solids mix) in progress



Pilot Truck Stop – ORC injection in progress through direct push rods

Universal Instruments-Kirkwood North
Industrial Drive, Kirkwood, New York

APPENDIX D

SHEET 1

DATE

BY

PROJ. NO.

CHECKED BY

DATE

CALCS. BY

SUBJECT

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

+ 13 HRC

+ ~~8~~ 7 HRC
+ 13 ORC

~~[illegible]~~
+ 9 + 8 ORC

7 buckets left
+9 bkts

Start w/ 16 buckets of HRC

11 remaining

		INJECTION PTS COMPLETED		MATERIAL USED	
DATE	NOTES	HRC	ORC	HRC	ORC
10/8	Day Richmond, Barney, Dennis (Parratt Wolff) arrive Weather: cool, breezy ~55°F high, patchy clouds	~~2~~ 2 (MW-24)	—	~4 buckets	—
10/9	Joe & Jim of PW arrive to do ORC injection Steve Crook on site from PW to observe/ take photos. Dennis off site – replaced by Dave. Weather: frost in AM, breezy, ~55°F high, clear, afternoon clouds	3 (")	10	~4 1/3 buckets	10 buckets
~~10/10~~ 10/10	Weather: Clear, sun, projected 65°F high Pneumatic pump will not work for HRC injection → Will ~~move~~ have both rigs up at Area 1. Completed drilling/injection on grass area – will move onto parking lot to complete Area 1 injection. J. Marcus will visit 10/16. Mark Gialanella notified of top lot block off for next 4 days.	3 (")	20 (Done!)	~4 2/3 buckets	30 buckets
~~10/11~~ 10/11	Weather: cool AM (~50°F) w/ forecast up to 75°F Dry, sunny. 2 rigs in Area 1 on pavement. ~~4~~ 6 men today Hit water at 25' at pt #9. Losing ~~connection~~ pressure due to connection at 40' between points – will return w/ more augers tomorrow to seal off. XX Try geoprobe?? Cooler of fifteen 1-L poly ZnAc/NaOH jars arrived from Compuchem. ~~Will~~ Generated 1 drum of water/mud from pt. #9. M. Gialanella will be away Tues & Wed of next wk.	3		5 buckets	
10/12	Weather: cool AM (~50°F), breezy; forecast clouds & 65°F Inject at top of water table (~30') at pt #12. Will auger down 40' for remaining pts at MW24.	4		6 2/3	

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engineers & scientists

SUBJECT
PROJ. NO.
BY
DATE
SHEET

CALCS. BY ______ DATE ______

CHECKED BY ______ DATE ______

DATE	NOTES	INJ. POINTS COMPLETED		MATERIAL USED	
		HRC	ORC	HRC	ORC
10/15/01	WEATHER: CLOUDY/RAIN, CLEARING LATE A.M. ~ 55-60°F 4 1/2 POINTS IN MW-24 AREA. 2 RIGS, 2 CREWS (5 MEN) ON SITE, 4 1/3 BORINGS & (4) 55 GALLON DRUMS USED FOR CUTTINGS.	4 1/3	—	3 1/3 buckets	—
10/16/01	FOGGY 50°F. BEGIN MID DRIVEWAY (MW-7A) AREA. DTW (MW-7A) = 7.19'. ONE RIG STILL IN MW-24 AREA FINISHING LAST INJECTION POINT. PILOT AREA: DTW (MW-39) = 11.89'. JIM MOORES ON SITE @ 1045, PLEASED WITH OPERATION AT PILOT, POINTS ENTERING WITHOUT PROBLEM.	2 (MID DRIVE) 25 (PILOT)	— —	3 1/3 buckets 41 2/3 buckets	— —
10/17/01	RAINING 55-60°F. BEGIN AT PILOT. 4 TRUCK PARKING SPACES CONED OFF OVERNIGHT; SHOULD FINISH AREA TODAY. CHECK HRC INVENTORY: 41 2/3 BUCKETS TO FINISH 25 POINTS @ PILOT & 50 BUCKETS TO FINISH MID DRIVE (SHOULD REQUIRE 46 2/3 BUCKETS (28 POINTS).	25 (PILOT)	—	41 2/3 BUCKETS	—
10/18/01	SUNNY 50°F. MW 7A (MID DRIVE-WAY) AREA. HOLLOW STEM AUGER TO 10' (PAST TILE) AND DIRECT PUSH/HRC INJECT TO ~18'. NB; DRILLED THROUGH 1 1/4" - 1 1/2" GRAY PVC PIPE ALONG GRASS LINE. MARKED WITH GREEN METAL U-STAKE. MOVED LINE OF INJECTION POINTS ≈ 1' CLOSER TO ROAD, JUST OFF TRENCH/GUTTER IN GRASS. 12 INJECTIONS BEFORE LUNCH. 18 INJECTIONS AFTER LUNCH. ALL INJECTIONS COMPLETE.	28 (MW-7A)	—	46 2/3 BUCKETS	—

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SUBJECT HRC Inventory | PROJ. NO. | BY MY | DATE | SHEET

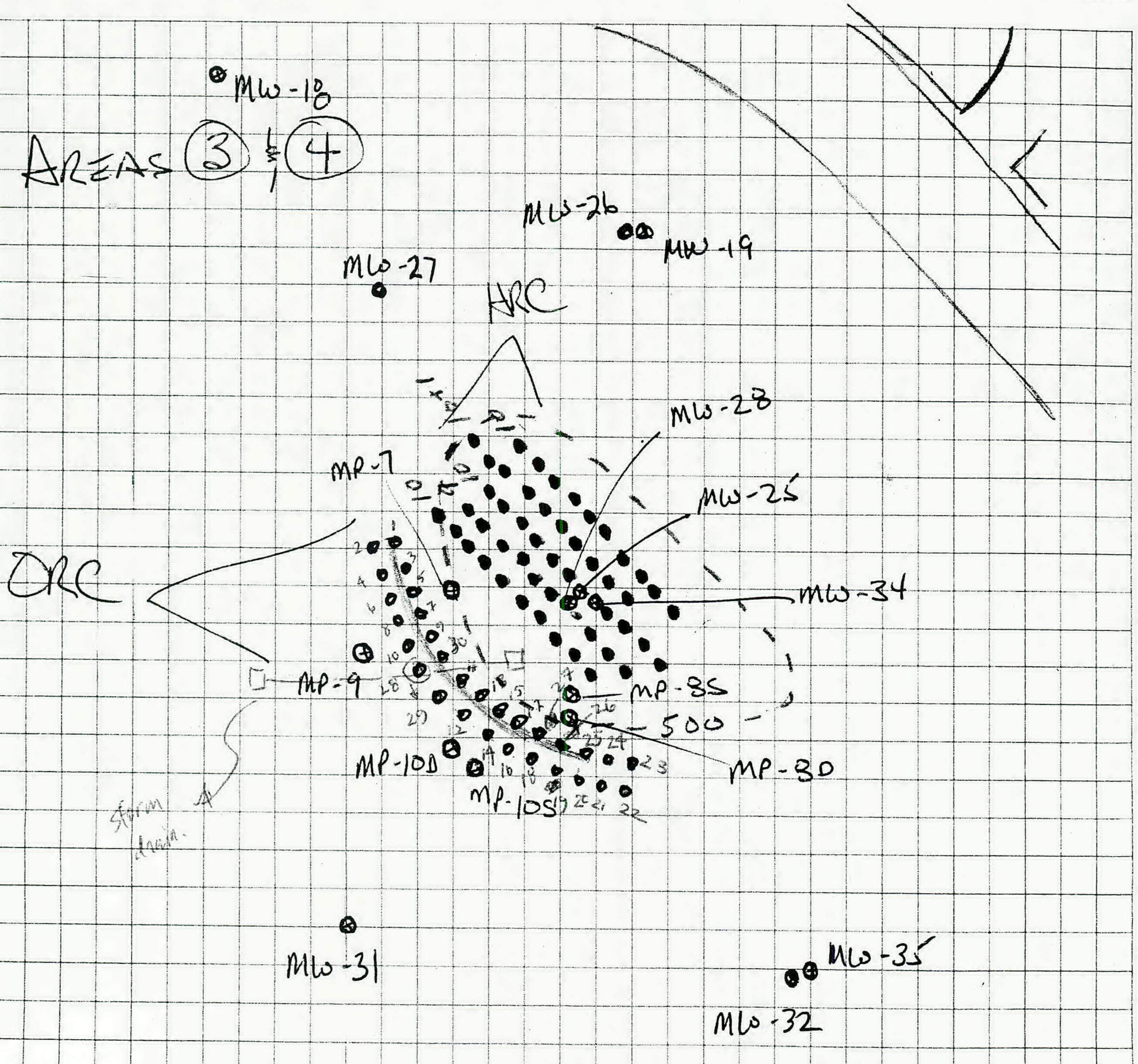
CALCS. BY ____________; DATE ____________ CHECKED BY ____________; DATE ____________

36 x 3 = 108
~~24~~ 24
6 6
138

		Total in Store Room	Amt Removed and transferred to trough	Total in Heating Trough	Amt used/injected
Start		167 buckets	—	—	—
10/8	Start	154	13	13	—
	end	—	—	~9	~4
10/9	start	147	7	16	—
	end	—	—	~11 2/3	~4 1/3
10/10	start	138	9	20 2/3	—
	end	—	—	16	4 2/3
10/11	Start	—	—	16	—
	end	—	—	11	5
10/12	start	—	—	11	—
	end	—	—	4 1/3	6 2/3
10/15	START	129	9	?	—
	END	119	10		8 1/3
10/17/01	START	50	—	41 2/3	—
	END	—	—		
10/18/01	START	50	50	—	50
	END	0	—	0	

SUBJECT	PROJ. NO.	BY	DATE	SHEET
HRC/ORC INJECTION	05203	GRA	10-05-01	2

CALCS. BY ______; DATE ______ CHECKED BY ______; DATE ______



1" = 60'

ORC Injection:

X #28 in line of storm drain

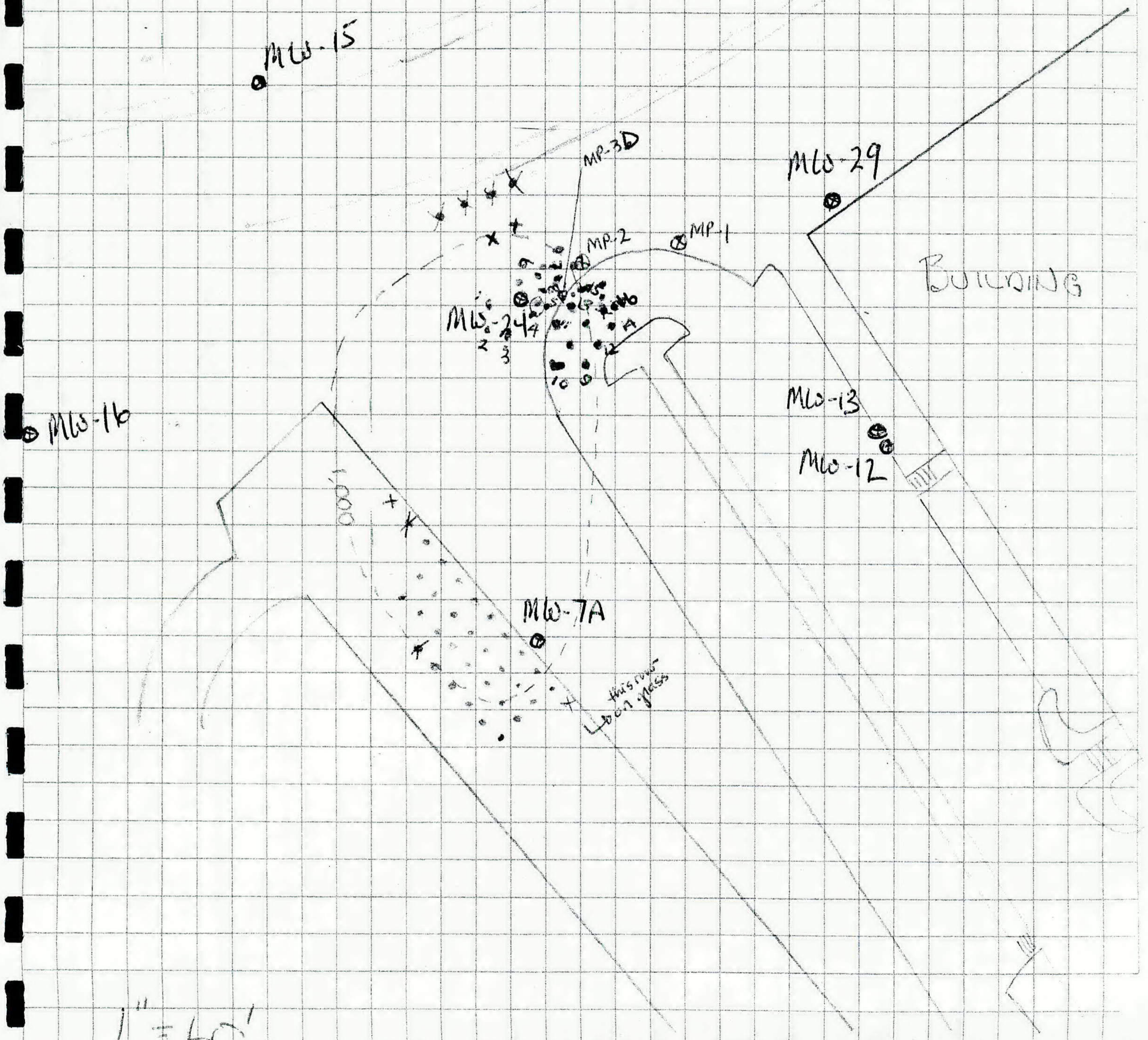
30×40=1200

660	# 1 - 22 :	30 lbs/hole
420	# 23-29 :	60 lbs/hole
120	# 30 :	120 lbs
1200	All injected at 50% solids	

SUBJECT HRC INJECTION	PROJ. NO. 05203	BY GRA	DATE 10-05-01	SHEET 1

CALCS. BY ____________; DATE ____________ CHECKED BY ____________; DATE ____________

AREAS ① & ②



1" = 60'

MP-2 is 5' north of inj. pt. #7.

. tricone drill bit
- 10' x 3" ϕ sections
- pull out
- air packer & 1"ϕ injection pipes

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

10/8/01

Injection Point No. : 1 .

Area Location: MW-24 (top)

~4' downhill from MW-24

30 lb/bucket

Total Depth of Injection Point: 45' .

Start Time: 1030 .

Finish Time: 1300.

10 lb/gal

Observations:

→ 5 gal per injection pt.

At ~40', bolts blown off of MW-24 cover.

MP-3D DTW: 37'

[✓ HRC]/ORC Injection

Start Time: 1405 .

Finish Time: 1415 .

Depth Interval HRC/ORC injected: 35' - 45' . Injected through packer at 35'.

Amount of HRC/ORC injected (pounds or gallons): 5 gal .

Back Pressure **Injection Pressure (PSI)**

Start: ______ .

Finish: ______ .

Injection Rate (pounds or gallons per minute)

Start: ______ .

Finish: ______ .

Observations:

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 2 **Area Location:** MW-24

Total Depth of Injection Point: 45' 10/8/01

Start Time: 1455 **Finish Time:** 1630

Observations:

HRC/ORC Injection [✓ HRC]

Start Time: 1730 **Finish Time:** 1740

Depth Interval HRC/ORC injected: 35'-45' from depth of 35'

Amount of HRC/ORC injected (pounds or gallons): 4 gal

Injection Pressure (PSI)

Start: 40 **Finish:** peaked at 95 psi 160 psi

Injection Rate (pounds or gallons per minute)

—

Start: **Finish:**

Observations:

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 3 . **Area Location:** MW-24 . 10/9

Total Depth of Injection Point: 45' .

Start Time: 0630 . **Finish Time:** .

Observations:

[✓ HRC]/ORC Injection

Start Time: . **Finish Time:** 0945 .

Depth Interval HRC/ORC injected: 35-45' .

Amount of HRC/ORC injected (pounds or gallons): 5 gal. .

Injection Pressure (PSI)

Start: . **Finish:** . peak at 120 psi.

Injection Rate (pounds or gallons per minute)

Start: . **Finish:** .

Observations:

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

10/9

Injection Point No. : 4 .
Area Location: MW-24 .

Total Depth of Injection Point: 45' .

Start Time: 1000 .
Finish Time: 1200 .

Observations:

Gravel layer encountered.
Air coming out of pt # 3 and MW-24 (~3' & ~2' away, respectively.)

HRC/ORC Injection

Start Time: 1230 .
Finish Time: 1240 .

Depth Interval HRC/ORC injected: 35-45' .

Amount of HRC/ORC injected (pounds or gallons): 5 gal .

Injection Pressure (PSI)

Start: .
Finish: .

Injection Rate (pounds or gallons per minute)

Start: .
Finish: .

Observations:

Filled up pts 1-3 w/ bentonite

10/9

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 5. **Area Location:** MW-24

Total Depth of Injection Point: 45'

Start Time: 1350. **Finish Time:** 1530.

Observations:

Water coming out of hole for bottom 10'

HRC/ORC Injection

Start Time: 1600 **Finish Time:** 1620

Depth Interval HRC/ORC injected: 35-45'

Amount of HRC/ORC injected (pounds or gallons): 5 gal.

Injection Pressure (PSI)

Start: 40 **Finish:** 120

Injection Rate (pounds or gallons per minute)

Start: **Finish:**

Observations:

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 6 . **Area Location:** MW-24 .

Total Depth of Injection Point: 45' .

Start Time: 0700 . **Finish Time:** 0930 .

Observations:

[✓ HRC]/ORC Injection

Start Time: 1000 . **Finish Time:** 1015 .

Depth Interval HRC/ORC injected: 35' -45' .

Amount of HRC/ORC injected (pounds or gallons): 5 gal. .

Injection Pressure (PSI)

Start: 20 . **Finish:** 120 .

Injection Rate (pounds or gallons per minute)

Start: . **Finish:** .

Observations:

10/10

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 7 **Area Location:** MW-24

3 ft S of MP-2 — cap left open to prevent pressure build-up.

Total Depth of Injection Point: 45'

Start Time: 1040 **Finish Time:** 1230

Observations:

HRC/ORC Injection

Start Time: 1300 **Finish Time:** 1330

Depth Interval HRC/ORC injected: ________

Amount of HRC/ORC injected (pounds or gallons): ________

Injection Pressure (PSI)

Start: ________ **Finish:** ________

Injection Rate (pounds or gallons per minute)

Start: ________ **Finish:** ________

Observations:

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 8 .
Area Location: MW-24 .
~~[illegible]~~ 3' north of [illegible]

Total Depth of Injection Point: ~~25'~~ 45'.

Start Time: 1400 .
Finish Time: ~~1600~~ .

Observations:

MW-24 DTW= 34.75'

Trouble getting down — turned out to be rock stuck in drill bit.

HRC/ORC Injection

Start Time: .
Finish Time: 1630 .

Depth Interval HRC/ORC injected: 35 -45 .

Amount of HRC/ORC injected (pounds or gallons): 5 gal. .

Injection Pressure (PSI)

Start: .
Finish: .

Injection Rate (pounds or gallons per minute)

Start: .
Finish: .

Observations:

10/11

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 9 .

Area Location: MW-24 - pavement

Total Depth of Injection Point: ~~50~~'47'.

Start Time: 0720 .

Finish Time: 1230.

Observations:

- Problem getting down at ~ 25' ⇒ poured water down casing. — mud blocking off air circulation around rods.
- 30' : circulate water & air.
- During Drilling of 9 & 10, water bubbling up seen at MW-24 and pt #3.

HRC/ORC Injection

Start Time: 1315 .

Finish Time: 1330 .

Depth Interval HRC/ORC injected: 35-45' .

Amount of HRC/ORC injected (pounds or gallons): 5 gal. .

Injection Pressure (PSI)

Start: .

Finish: .

Injection Rate (pounds or gallons per minute)

Start: .

Finish: .

Observations:

Unable to get packer down to 35'

Will Inject directly through 3"ϕ rods. (35-45') ~~and~~ as they are withdrawn

10/11

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 10 **.** **Area Location:** MW-24 **.**

Total Depth of Injection Point: 50' **.** (5 x 10' rods)

Start Time: 0950 **.** **Finish Time:** 1140 **.**

Observations:

Augured down to 20' to try to avoid same problem as pt #9

DTW MP-2 = 37.55' & rising. ~~Air~~ Positive pressure in well (can feel air coming out)

HRC/ORC Injection

Start Time: 1200 **.** **Finish Time:** 1210 **.**

Depth Interval HRC/ORC injected: 35' - 50' **.**

Amount of HRC/ORC injected (pounds or gallons): 5 gal **.**

Injection Pressure (PSI)

Start: 40 **.** **Finish:** 110. **.**

Injection Rate (pounds or gallons per minute)

Start: _____ **.** **Finish:** _____ **.**

Observations:

10/11

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 11 . **Area Location:** MW-24 .

Total Depth of Injection Point: 50' .

Start Time: 1230 . **Finish Time:** 1520 .

Observations: Augured down to 20'.
Poured water down casing to help air circulation.

HRC/ORC Injection

Start Time: ~~16~~ 1545. **Finish Time:** 1600 .

Depth Interval HRC/ORC injected: 5 gal . (50 lbs)

Amount of HRC/ORC injected (pounds or gallons): 40-50' .

Injection Pressure (PSI)

Start: 30 . **Finish:** 100 — (@ air compressor)

Injection Rate (pounds or gallons per minute)

Start: . **Finish:** .

Observations:

10/11
& 10/12

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 12 .　　**Area Location:** MW-24 .
near "T" of median

Total Depth of Injection Point: 40' .

10/12

Start Time: 1445 .　　**Finish Time:** 1700 .　　0630 – 0730
pause.

Water at 30'.

Observations:

Auger down to ~~20~~ 10 ft. ~~will drill tomorrow (10/12~~)

Losing pressure at 40' — connection w/ pt #9 (~6' away East) & MW-29 & pt #3 at 35'

Will return w/ more augers to complete drilling ~~w/ MW-24~~)

HRC/ORC Injection

Start Time: 0800 .　　**Finish Time:** 0815 .

Depth Interval HRC/ORC injected: 32 - 40' .

Amount of HRC/ORC injected (pounds or gallons): 5 gal .

Injection Pressure (PSI)

Start: 0 .　　**Finish:** 70 .

Injection Rate (pounds or gallons per minute)

Start: ______ .　　**Finish:** ______ .

Observations:

Packer put at 15' bgs.

10/11 - 10/12

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 13 . **Area Location:** MW-24 .

pavement southern edge along grass.
6-7' E ~~from~~ of MP-3D.

Total Depth of Injection Point: 50' .

Start Time: 1634 . **Finish Time:** 1700 .

pause: 0630 - 0945 (cleaned out drill bit, eqt, etc.)

Observations:

Augured down to 40' – will drill tomorrow (10/12)

Water encountered at 38'.

HRC/ORC Injection

Start Time: 1000 . **Finish Time:** 1015 .

Depth Interval HRC/ORC injected: 40 - 50' .

Amount of HRC/ORC injected (pounds or gallons): 5 gal. .

Injection Pressure (PSI)

Start: 10 . **Finish:** 10 .

Injection Rate (pounds or gallons per minute)

Start: ______ . **Finish:** ______ .

Observations:

10/12

10/15

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No.: 14 . **Area Location:** MW-24 .

along "T" of meridian

Total Depth of Injection Point: 50' .

Start Time: 0900 . **Finish Time:** 1200 . (w/ ½ hr lunch break)

Observations:

Auger down to 40'.

HRC/ORC Injection

Start Time: 1220 . **Finish Time:** 1225 .

Depth Interval HRC/ORC injected: 40 - 50' .

Amount of HRC/ORC injected (pounds or gallons): 5 gal .

Injection Pressure (PSI)

Start: 0 . **Finish:** 30 .

Injection Rate (pounds or gallons per minute)

Start: . **Finish:** .

Observations:

$14 \times \frac{5}{3} = \frac{70}{3}$

$= 23\frac{1}{3}$

[illegible]

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 15 . **Area Location:** MW-24 .

driveway Along grass edge
7-8 ft N of MP-3D-

Total Depth of Injection Point: 50' .

Start Time: 1100 . **Finish Time:** 1315 .

[illegible]

Observations: ½ hr lunch break

HRC/ORC Injection

Start Time: 1345 . **Finish Time:** 1400 .

Depth Interval HRC/ORC injected: 40-50 .

Amount of HRC/ORC injected (pounds or gallons): 5 gal. .

Injection Pressure (PSI)

Start: 10 . **Finish:** 25 .

60 psi w/ air compressor

Injection Rate (pounds or gallons per minute)

Start: . **Finish:** .

Observations:

10/12
10/15/0

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 1b . **Area Location:** MW-24 .

Total Depth of Injection Point: 50 .

Start Time: 1300 . **Finish Time:** 1045 .
10/15/01 0745 10/15/01

Observations:

Will complete drilling on 10/15 (Mon)
Auger down 40'
Point sealed with ≈ 4" blacktop patch

HRC/ORC Injection

Start Time: 0940 . **Finish Time:** 1010 .

Depth Interval HRC/ORC injected: 40-50 .

Amount of HRC/ORC injected (pounds or gallons): 5 gal. .

Injection Pressure (PSI)

Start: 10 . **Finish:** 25 .
60 w/ air compresser.

Injection Rate (pounds or gallons per minute)

Start: . **Finish:** .

Observations:

HRc

10/15

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 17 . **Area Location:** MW-24 .

Total Depth of Injection Point: 50 .

Start Time: 0845 . **Finish Time:** 1145 .

Observations:

"Blowout" @ nearby injection point

~~[illegible]~~

HRC/ORC Injection

Start Time: 1105 . **Finish Time:** 1130 .

Depth Interval HRC/ORC injected: 40-50 .

Amount of HRC/ORC injected (pounds or gallons): 5 gal .

Injection Pressure (PSI)

Start: 10 . **Finish:** 60 .

Injection Rate (pounds or gallons per minute) 5 gal/2 min

Start: . **Finish:** .

Observations:

Hor

10/15

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 18 . **Area Location:** MW-24 .

Total Depth of Injection Point: 50' .

Start Time: 1055 . **Finish Time:** 1530 .

Observations:

RIG MALFUNCTION (BROKEN HYDRAULIC LINE). STOP WORK 1145 / RESTART 1232
NOTICED AIR/HRC BUBBLES FROM MW-24 DURING DRILLING

HRC/ORC Injection

Start Time: 1445 . **Finish Time:** 1515 .

Depth Interval HRC/ORC injected: 40-50 .

Amount of HRC/ORC injected (pounds or gallons): 5 gal .

Injection Pressure (PSI)

Start: 20 . **Finish:** 40 .

Injection Rate (pounds or gallons per minute) 5 gal / 2 min

Start: . **Finish:** .

Observations:

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 19 .　　**Area Location:** MW-24 .

Total Depth of Injection Point: .

Start Time: 1200 .　　**Finish Time:** 1550 .

Observations:

1/2 hr. LUNCH

NOTICED AIR/HRC BUBBLES FROM MW-24 DURING DRILLING

HRC/ORC Injection

Start Time: 1505 .　　**Finish Time:** 1530 .

Depth Interval HRC/ORC injected: 40-50 .

Amount of HRC/ORC injected (pounds or gallons): 5 gal .

Injection Pressure (PSI)

Start: 30 .　　**Finish:** 80 .

Injection Rate (pounds or gallons per minute) 5 gal / 5 ~~3~~ min

Start: .　　**Finish:** .

Observations:

HRC

10/15
10/16

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 20 . **Area Location:** MW-24 .

Total Depth of Injection Point: 50' .

Start Time: 1605 . **Finish Time:** 1045 . 10/16/01
END OF DAY 1700 (20') START 10/16 0715

Observations:

HRC/ORC Injection

Start Time: 1010 . **Finish Time:** 1025 .

Depth Interval HRC/ORC injected: 40-50 .

Amount of HRC/ORC injected (pounds or gallons): 5 gal .

Injection Pressure (PSI)

Start: 6 . **Finish:** 120 .

Injection Rate (pounds or gallons per minute) 5 gal/2 min

Start: . **Finish:** .

Observations:

NO PROBLEMS, 10/16 ⇒ HAD TO WAIT FOR RIG WITH HRC PUMP.

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 1 .   **Area Location:** MW-7A .

Total Depth of Injection Point: 18' .

Start Time: 0730 .   **Finish Time:** 0830 .

Observations:

WORK CONFINED TO PARKING SPOTS. TRAFFIC CAN PASS NO PROBLEM. NOTIFIED MARK G. WRT WORK ON MID DRIVE AREA. WORK AREA CLEARLY CONED.

HRC/ORC Injection

Start Time: 0805 .   **Finish Time:** 0815 .

Depth Interval HRC/ORC injected: 8 - 18' .

Amount of HRC/ORC injected (pounds or gallons): 5 gal .

Injection Pressure (PSI)

Start: — .   **Finish:** — .   No pressure gauge on direct push rig

Injection Rate (pounds or gallons per minute) 5gal/5 min

Start: .   **Finish:** .

Observations:

Problems WITH HRC COAGULATING IN COLD LINES. LINES AND FITTINGS KEPT IN HOT WATER TO MINIMIZE LINE BLOCKING

10/16

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 2 . **Area Location:** MW-7A .

Total Depth of Injection Point: 18' .

Start Time: 0835 . **Finish Time:** 1010 .

Observations:

RE-DRILLED WITH AUGER TO 10'. DIRECT PUSH TO 18'

HRC/ORC Injection

Start Time: 0940 . **Finish Time:** 1000 .

10/18/01 1000 1020

Depth Interval HRC/ORC injected: 8-18' .

Amount of HRC/ORC injected (pounds or gallons): ≈ 3gal + 3gal (10/18/01)

Injection Pressure (PSI)

Start: — . **Finish:** — .

Injection Rate (pounds or gallons per minute)

Start: . **Finish:** .

Observations:

HRC PUMP SYSTEM UNDER HIGH PRESSURE. TWO FITTINGS BROKE DURING INJECTION ONLY ≈ 3 GAL HRC INJECTED. MUST RE-DESIGN DRILLING.

INJECTION COMPLETED 10/18/01

10/18

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 3 . **Area Location:** MW-7A .

Total Depth of Injection Point: .

Start Time: ~~0730~~ . **Finish Time:** .

Observations:

H.S. AUGER TO 10' (PAST TILL)

HRC/ORC Injection

Start Time: 1015 . **Finish Time:** .

Depth Interval HRC/ORC injected: .

Amount of HRC/ORC injected (pounds or gallons): .

Injection Pressure (PSI)

Start: . **Finish:** .

Injection Rate (pounds or gallons per minute)

Start: . **Finish:** .

Observations:

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 4 .   **Area Location:** MW-7A .

Total Depth of Injection Point: .

Start Time: 0730 .   **Finish Time:** .

Observations:

H.S. AUGER TO 10' (PAST TILL)

HRC/ORC Injection

Start Time: .   **Finish Time:** .

Depth Interval HRC/ORC injected: .

Amount of HRC/ORC injected (pounds or gallons): .

Injection Pressure (PSI)

Start: .   **Finish:** .

Injection Rate (pounds or gallons per minute)

Start: .   **Finish:** .

Observations:

All remaining MW-7A points were first H.S. auger to 10' and then direct pushed to 18'. HRC then injected. all 30 ~~[illegible]~~ injection points completed in 1 day (10/18/01)

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 1 .
Area Location: MW-28 PILOT .

Total Depth of Injection Point: .

Start Time: 11:10 .
Finish Time: 11:50 .

Observations:

HRC/ORC Injection

Start Time: — .
Finish Time: — .

Depth Interval HRC/ORC injected: 15-25' .

Amount of HRC/ORC injected (pounds or gallons): 5 gal .

Injection Pressure (PSI)

Start: — .
Finish: — .

Injection Rate (pounds or gallons per minute)

Start: — .
Finish: — .

Observations:
NO PROBLEMS

DTW (MW-34)
= 11.89

10/14

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 2 . **Area Location:** PILOT MW-28

Total Depth of Injection Point: 25' .

Start Time: 1150 . **Finish Time:** 1220.

Observations:

HRC/ORC Injection

Start Time: 1215 . **Finish Time:** 1220

Depth Interval HRC/ORC injected: 15-25 .

Amount of HRC/ORC injected (pounds or gallons): 5 gal .

Injection Pressure (PSI)

Start: — . **Finish:** — .

Injection Rate (pounds or gallons per minute)

Start: — . **Finish:** — .

Observations:

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 3 . **Area Location:** MW-28 .

Total Depth of Injection Point: 25 .

Start Time: 1220 . **Finish Time:** 1250 .

Observations:

HRC/ORC Injection

Start Time: 1245 . **Finish Time:** 1250 .

Depth Interval HRC/ORC injected: 15 - 25 .

Amount of HRC/ORC injected (pounds or gallons): 5 gal .

Injection Pressure (PSI)

Start: — . **Finish:** — .

Injection Rate (pounds or gallons per minute)

Start: — . **Finish:** — .

Observations:

10/16

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 4 . **Area Location:** MW-23 .

Total Depth of Injection Point: 25 .

Start Time: 1250 . **Finish Time:** 1310 .

Observations:

HRC/ORC Injection

Start Time: 1305 . **Finish Time:** 1310 .

Depth Interval HRC/ORC injected: 15-25 .

Amount of HRC/ORC injected (pounds or gallons): 5 gal .

Injection Pressure (PSI)

Start: ______ . **Finish:** ______ .

Injection Rate (pounds or gallons per minute)

Start: ______ . **Finish:** ______ .

Observations:

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 5.   **Area Location:** MW-28.

Total Depth of Injection Point: .

Start Time: 1305.   **Finish Time:** 1400.

Observations:

HRC/ORC Injection

Start Time: 1340.   **Finish Time:** 1350.

Depth Interval HRC/ORC injected: 15-25.

Amount of HRC/ORC injected (pounds or gallons): 5 gal.

Injection Pressure (PSI)

Start: —.   **Finish:** —.

Injection Rate (pounds or gallons per minute)

Start: —.   **Finish:** —.

Observations:

10/16

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 6 . **Area Location:** MW-28 .

Total Depth of Injection Point: .

Start Time: 1355 . **Finish Time:** 1415 .

Observations:

HRC/ORC Injection

Start Time: 1410 . **Finish Time:** 1415 .

Depth Interval HRC/ORC injected: 15 - 25 .

Amount of HRC/ORC injected (pounds or gallons): 5 gal .

Injection Pressure (PSI)

Start: — . **Finish:** — .

Injection Rate (pounds or gallons per minute)

Start: — . **Finish:** — .

Observations:

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 7 **Area Location:** MW-28

Total Depth of Injection Point: .

Start Time: 1105 **Finish Time:** .

Observations:

HRC/ORC Injection

Start Time: 1215 **Finish Time:** .

Depth Interval HRC/ORC injected: .

Amount of HRC/ORC injected (pounds or gallons): .

Injection Pressure (PSI)

Start: . **Finish:** .

Injection Rate (pounds or gallons per minute)

Start: . **Finish:** .

Observations:

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 8 **.** **Area Location:** MW 28 **.**

Total Depth of Injection Point: **.**

Start Time: 1415 **.** **Finish Time:** **.**

Observations:

HRC/ORC Injection

Start Time: **.** **Finish Time:** **.**

Depth Interval HRC/ORC injected: **.**

Amount of HRC/ORC injected (pounds or gallons): **.**

Injection Pressure (PSI)

Start: **.** **Finish:** **.**

Injection Rate (pounds or gallons per minute)

Start: **.** **Finish:** **.**

Observations:

No injection point logs for 9-50. 25 injection points completed 10/16 & 25 completed 10/17.

[illegible]/10

10/9

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 1 **Area Location:** ORC Barrier

Total Depth of Injection Point: 25'

Start Time: ________ **Finish Time:** ________ 15 min

Observations:

50% solids ORC mix slurry.

Hollow stem to 8'
Probe remaining depth

HRC/[✓ ORC] Injection

Start Time: ________ **Finish Time:** ________ 5 min.

Depth Interval HRC/ORC injected: 15-25'

Amount of HRC/ORC injected (pounds or gallons): 4 gal.

Injection Pressure (PSI)

Start: ________ **Finish:** ________

Injection Rate (pounds or gallons per minute)

Start: ________ **Finish:** ________

Observations:

1500 - pt #7

10/10 1100 pt #9 rocks at 8 ft. — Break for lunch.

10/10

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No.: 11 . **Area Location:** #4 ORC. Barrier

Total Depth of Injection Point: ______ .

Start Time: 0700 . **Finish Time:** ______ .

Observations:

HRC/[✓ ORC] Injection

Start Time: ______ . **Finish Time:** ______ .

Depth Interval HRC/ORC injected: ______ .

Amount of HRC/ORC injected (pounds or gallons): ______ .

Injection Pressure (PSI)

Start: ______ . **Finish:** ______ .

Injection Rate (pounds or gallons per minute)

Start: ______ . **Finish:** ______ .

Observations:

1100 #19

10/16

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 24 . **Area Location:** ORC Barrier. Area #4

Total Depth of Injection Point: ~~3~~25' .

Start Time: 1315 . **Finish Time:** 1330 .

(4' rods)

Observations:

HRC/[✓ ORC] Injection

Start Time: 1335 . **Finish Time:** 1345 .

Depth Interval HRC/ORC injected: 15-25 .

Amount of HRC/ORC injected (pounds or gallons): ________ .

Injection Pressure (PSI)

Start: ________ . **Finish:** ________ .

Injection Rate (pounds or gallons per minute)

Start: ________ . **Finish:** ________ .

Observations:

10/10

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 29 . **Area Location:** ORC .

Total Depth of Injection Point: 25' .

Start Time: 1535 . **Finish Time:** 1545 .

Observations:

HRC/ORC Injection

Start Time: 1545 . **Finish Time:** 1550 .

Depth Interval HRC/ORC injected: 15-25' .

Amount of HRC/ORC injected (pounds or gallons): ~40 lbs. .

Injection Pressure (PSI)

Start: n/a . **Finish:** .

Injection Rate (pounds or gallons per minute)

Start: . **Finish:** .

Observations:

HRC/ORC INJECTION LOG

DOVER/UNIVERSAL INSTRUMENTS SITE
Kirkwood, New York

Injection Point No. : 30 .   **Area Location:** ORC Barrier.

Total Depth of Injection Point: 25' .   (7 4' rods)

Start Time: 1000 .   **Finish Time:** 1605 .

Observations:

HRC/ORC Injection

Start Time: 1605 .   **Finish Time:** ~~1610~~ 1615 .

Depth Interval HRC/ORC injected: 15-25' .

Amount of HRC/ORC injected (pounds or gallons): ~~[illegible]~~ 120 lbs.

Injection Pressure (PSI)

Start: n/a .   **Finish:** .

Injection Rate (pounds or gallons per minute)

Start: .   **Finish:** .

Observations:

APPENDIX H

Hydrogen Release Compound HRC®

Using HRC to Treat Residual Sorbed DNAPL Contamination

General Background

While it is clear that bioremediation is effective against dissolved phase contamination, which is readily available for microbial consumption, there has been debate about how easily a sorbed contaminant can be treated. First, we offer the following definitions of different types of DNAPL contamination, which will facilitate discussion.

DNAPL Contamination

Hydrophobic Sorption

This is generally a very low level of contamination that sorbs to clean aquifer materials after they are exposed to a dissolved phase plume. Typically the soil will superficially adsorb a few multiples of the dissolved phase concentration unless there is a significant amount of organic matter in the system. Under these high organic conditions there may be as much as one to two order of magnitude increase over the dissolved phase concentration, but this is still a fairly low level of total mass and is clearly the exception rather than the rule. The hydrophobic sorption value in most cases is between 1x and 2x the dissolved phase concentration. In our standard HRC Applications Software (see www.regenesis.com) we consider this factor as a function of the K_{OC} (organic carbon). The software relies on published data sets for hydrophobic sorption under a various conditions with K_{OC} being a major factor.

Residual DNAPL

When pure solvent enters the aquifer it sinks – hence the term DNAPL for Dense Non-aqueous Phase Liquid. As a result the liquid tends to "finger" through the aquifer forming "stringers" as well as droplets in its wake. A small amount of residual mass is of far greater impact than even a very high 100x hydrophobic sorption value. What we have here is "free product" but it exists in small amounts as droplets in the macropores or "stringers" that connect through several pores. This is a main target for HRC, beyond the dissolved phase and hydrophobically sorbed contamination. It is also the kind of contamination that new evidence shows we can effectively remediate by actively stimulating reductive dechlorination.

Free Phase DNAPL

This is "free product", a palpable amount of material that is usually only manageable by excavation, pumping or some other intensive mechanical process. HRC is generally contraindicated in these settings – strictly from a stoichiometric perspective; there is just too much contaminant mass in free product for an affordable use of HRC. However, a final technology selection decision is still a function of the economic comparison to the next available solution for the problem as well as any special logistical constraints that would limit normal DNAPL removal operations.

In summary, at present we apply HRC without concern to all problems involving dissolved phase and hydrophobically sorbed contamination. The next challenge for us is to explore the limits of how we can affordably impact residual DNAPL and in rare instances the free phase contamination.

Treating Hydrophobically Sorbed and Residual Sorbed DNAPL

Why it Should Work

Microorganisms can accelerate sorbed contaminant removal by several mechanisms. Primarily, when microbes consume the "newly born" dissolved phase that is outside an actively desorbing source - they maintain a concentration gradient. In accordance with Fick's Law, the flux from the sorbed material will increase with the steepness of this gradient. Also, microbes may actively secrete "biosurfactants" which act like soap to facilitate desorbtion. Consequently, we have these two mechanisms for biological impact.

Experimental Evidence

Our work was modeled after the pioneering efforts of Dr. Joe Hughes at Rice University (Carr, C.S., Garg, S. and J.B. Hughes, 2000. The Effect of Dechlorinating Bacteria on the Longevity and Composition of PCE-Containing Non Aqueous Phase Liquids under Equilibrium Conditions. ES&T 34/6, 1088-1094).

In the studies we conducted we decided to focus on chlorinated solvents and the action of HRC on some or all of the phases we have discussed above. Three types of experiments were performed:

- The "Disappearing Drop Experiment"

A visible drop of TCE (about 0.5 grams) was placed in a flask. Water from a second flask containing soil and HRC was recirculated through the flask containing the pure TCE. The experimental set-up is shown in Figure 1. Figure 2 shows the results over 12 days in which the disappearance of the "free product" is clearly noted. The rate of removal is somewhat accelerated by the recirculation, which even though gentle is fast compared to typical aquifer flow. Still, even projecting these results out by a time factor of 10 to as high as 100, what is clearly illustrated is that small globules of DNAPL can be completely removed relatively quickly from the aquifer solely by microbial consumption

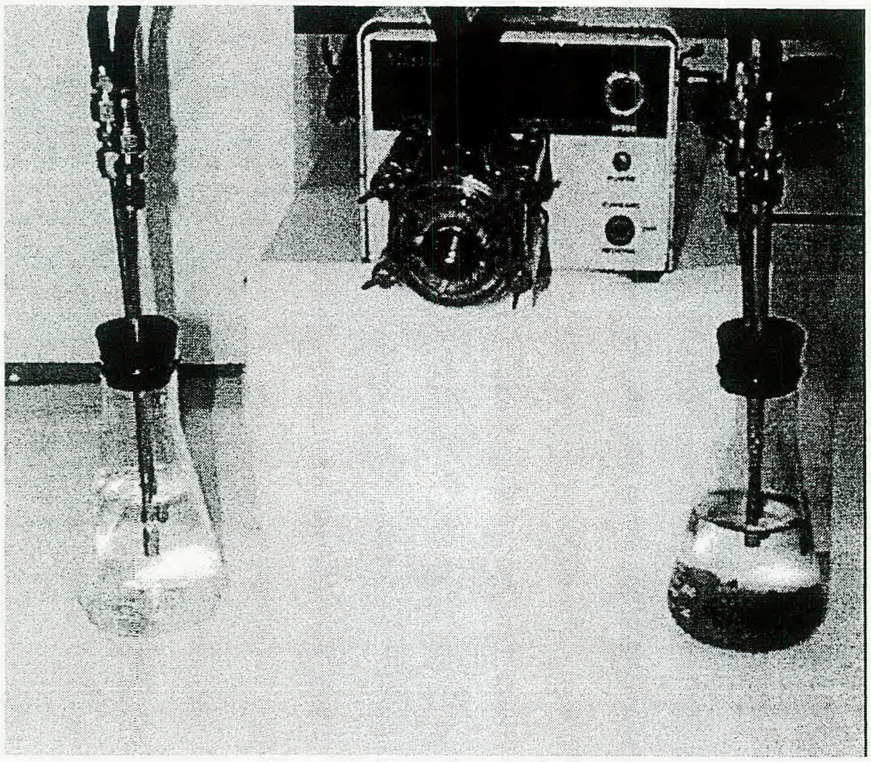
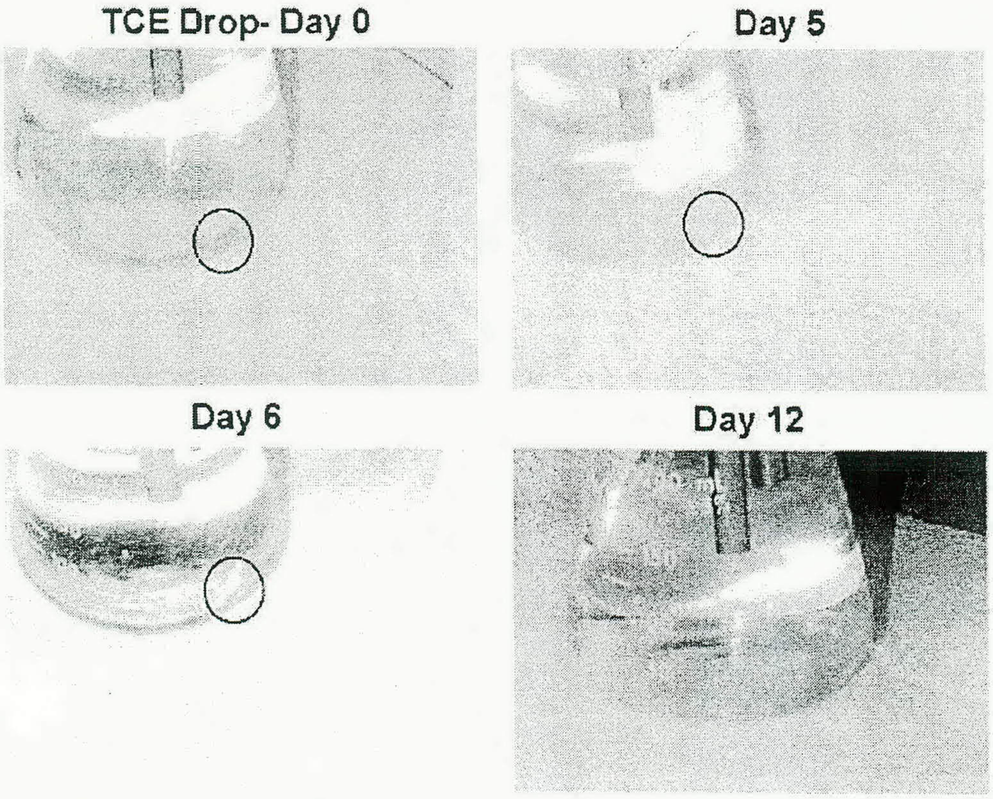


Figure 1. Experiment Set-Up



TCE Drop- Day 0

Day 5

Day 6

Day 12

Figure 2. Disappearing Drop Results from Baseline to Day 12

- The “Hughes Experiment”

In a simple version of the experiment carried out in the paper cited above, a column of acclimated, microbially active soil was flushed with water saturated with TCE (175 mg/L) until the soil was saturated with TCE and in equilibrium with the dissolved phase. HRC was added to the soil and the aqueous phase circulating through the system was analyzed on a regular basis. The results are shown in Figure 3 and essentially represent the action of HRC on the dissolved phase and the soil bound hydrophobically sorbed material that replenishes the dissolved phase in accordance with Fick’s Law.

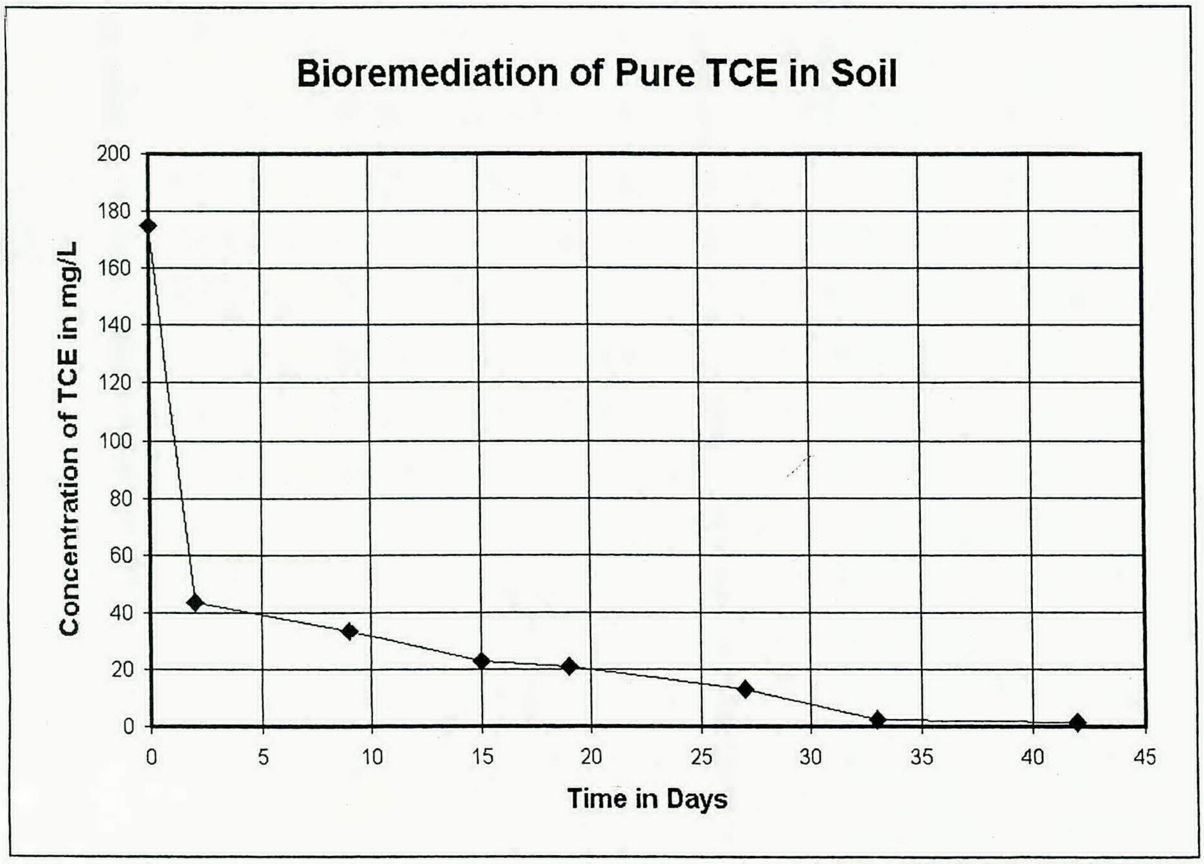


Figure 3. Hughes Experiment Results

- The “Modified Hughes Experiment” using higher initial DNAPL Mass

In this experiment replicate samples were created in which there was excess TCE. HRC was applied and the data was accumulated by complete analysis of a given set of tubes in a time series. In each test tube there was 10 grams of soil, 0.5 grams of TCE, 1.5 grams of HRC and 130 ml of distilled water. Figure 4 presents the change in total TCE mass in the system over time. Once again, what is clearly illustrated is that small globules of DNAPL can be completely removed relatively quickly from the aquifer solely by microbial consumption. Also, in contrast to the “Disappearing Drop” experiment, in which a moderate but artificially high flow was present, in this instance the system was completely static and still there was a vary rapid removal of residual source under the direction of microbial action.

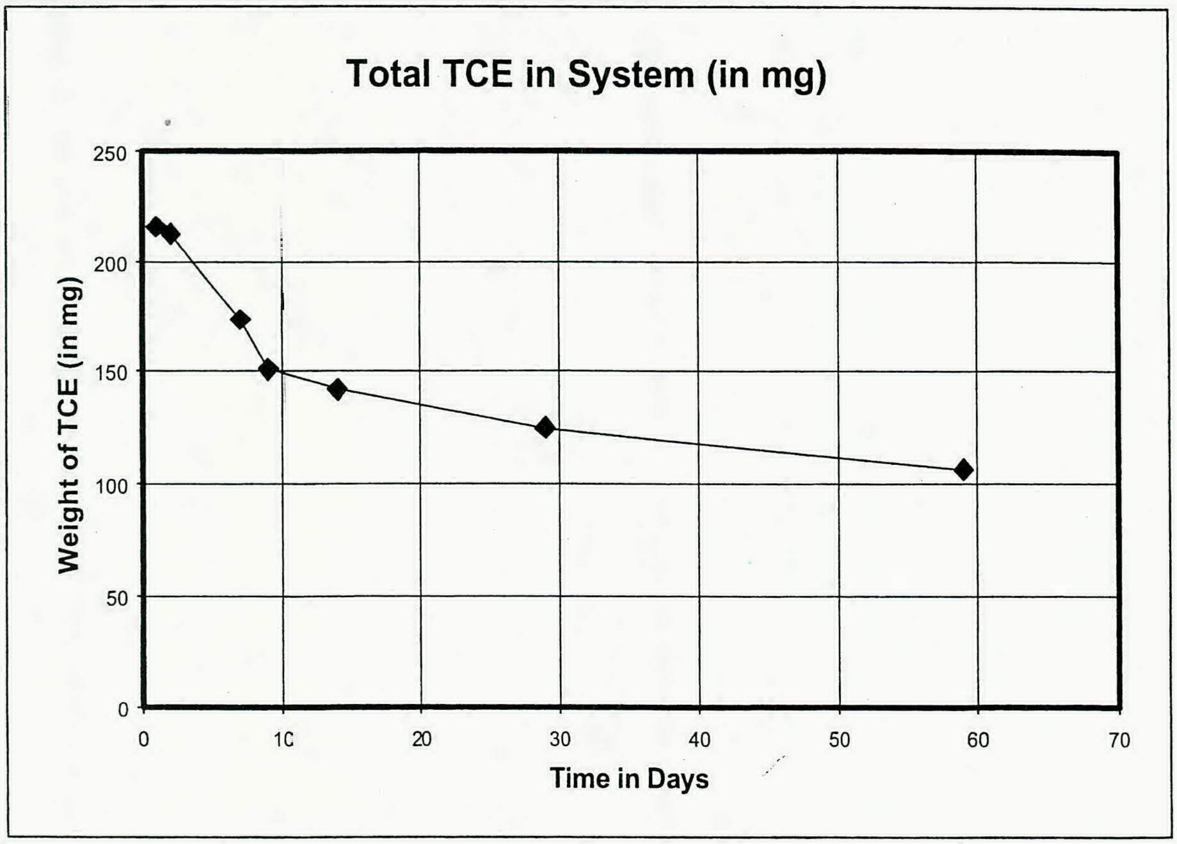


Figure 4. Results of the Modified Hughes Experiment

All of these experiments showed that the TCE was remediated very effectively. It was concluded that HRC can assist in the bioremediation of pure phase TCE either on or in soil whether in liquid form or adsorbed onto and into the soil.

Field Evidence

Proving that bioremediation accelerates desorption in the field is a daunting proposition due to the heterogeneity of the system, the costs and uncertainly involved. Still, Regenesis is examining some options and hopes to initiate such a project in the near future. In the meantime, there is some indirect evidence for bioremediation mediated in some of our field work to date.

If we consider a simple sequential dechlorination of TCE to the first daughter product DCE we can accumulate some indirect evidence for the desorption. Given that TCE degrades faster than DCE we can hypothesize that if desorption is occurring that we will see an excess of DCE in the system over time. So, as we get "turnovers" of dissolved phase TCE, where the dissolved phase is fed by desorption, the DCE levels systematically increase. Once again, the DCE build-up is a function of the kinetic disparity, i.e., the slower rate of removal of the DCE relative to the TCE

This, in fact, is the case in several of our data sets and indicates we were treating an area with an unknown residual. This is not uncommon due to the fact that it is often hard to precisely locate a DNAPL source. As a result if we see a small reduction on TCE and a much larger increase in DCE in the same time period we are probably "turning over" the TCE pool by desorption. Two examples of this are presented as follows. The full studies are in the book entitled Accelerated Bioremediation of Chlorinated Compounds in Groundwater. Copies are available free of charge at our web site.

<u>Case 1: Project Conducted by Haley & Aldrich</u>

A site in New York was contaminated with TCE at concentrations reaching 26,000 ug/L in a very tight glacial till and clay aquifer with a very low velocity (hydraulic conductivity = 0.01 ft/day). Depth to groundwater was recorded at approximately 5 ft bgs. Approximately 500 lb of HRC were injected into borings spaced 5 ft on center in a 560 ft^2 grid.

Figure 5 clearly shows that the DCE daughter product appears in excess of the TCE parent material over time. Also, the data is particularly valid because it expresses total mass in the system as a function of a kreiging modeling exercise that can determine the mass from a collection of individual well measurements. In the initial time period from Day 0 to Day 89 there is a decrease in total TCE mass from 625g to 477g – a difference of 148 g, yet there was an increase in DCE from 43 to 430 g for a net gain of 387 g. Looking at it on a more accurate molar basis, 1.12 moles of TCE were removed and 3.99 moles of DCE were formed which is a difference of about 3.5 X!

Between Day 89 and Day 166 we see a fairly robust reduction of both constituents, but then again beginning at Day 166 through to Day 461 there are clear build-ups of DCE in a background of a minimally variable TCE change. As another case in point, from Day 166 to Day 273 we see a mass increase of 226 g of DCE for a loss of only 3 g of TCE. Again on a molar basis 2.33 moles of DCE formed from an apparent loss of 0.02 moles of TCE – a 100-fold difference. We believe that these discrepancies reflect the fact that TCE is being replenished through desorption as it is remediated and forming the less reactive DCE.

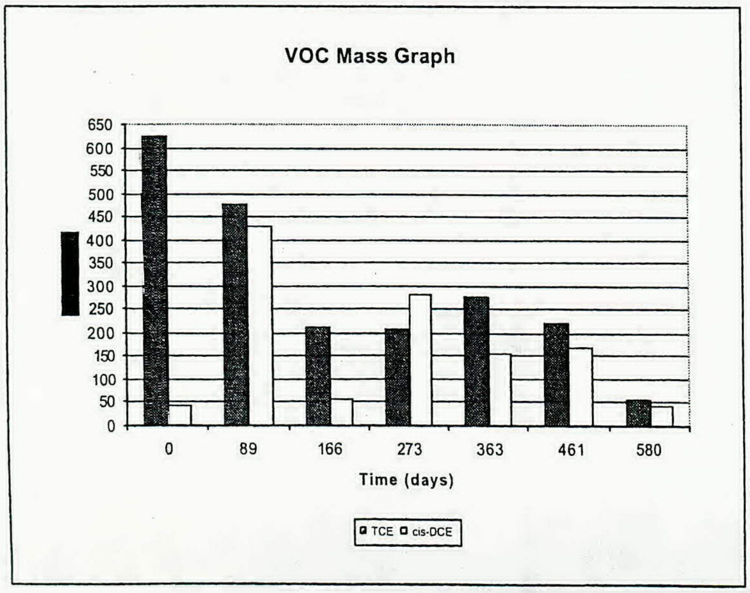


Figure 5. Haley & Aldrich Mass Graph

Case 2: Project Conducted by Harding Lawson

A site in Kansas was contaminated with PCE at concentrations reaching 7,000 ug/L in a silt and clay aquifer with a groundwater velocity of approximately 0.03 ft/day. Depth to groundwater ranges from 5 to 9 ft bgs. HRC was applied to the area using 15 injection points.

Figure 6, displaying the results from a single downgradient sentinel well, clearly shows that the DCE daughter product appears in excess of the PCE parent material over time. From day 0 to day 27, we see PCE concentrations decrease from 6,500 ug/L to 210 ug/L (97%). Past day 27, PCE levels remain stable. TCE decreases from 840 ug/L at day 0 to 540 ug/L at day 118. DCE rises from a baseline concentration of 560 ug/L to a final concentration of 15,000 ug/L at day 118. Translating this into moles, the removal of 38 moles of PCE and 2 moles of TCE produced 149 mol/L of DCE. The 3.8x differential of DCE mass could be attributed to a desorbtive turnover of PCE and TCE.

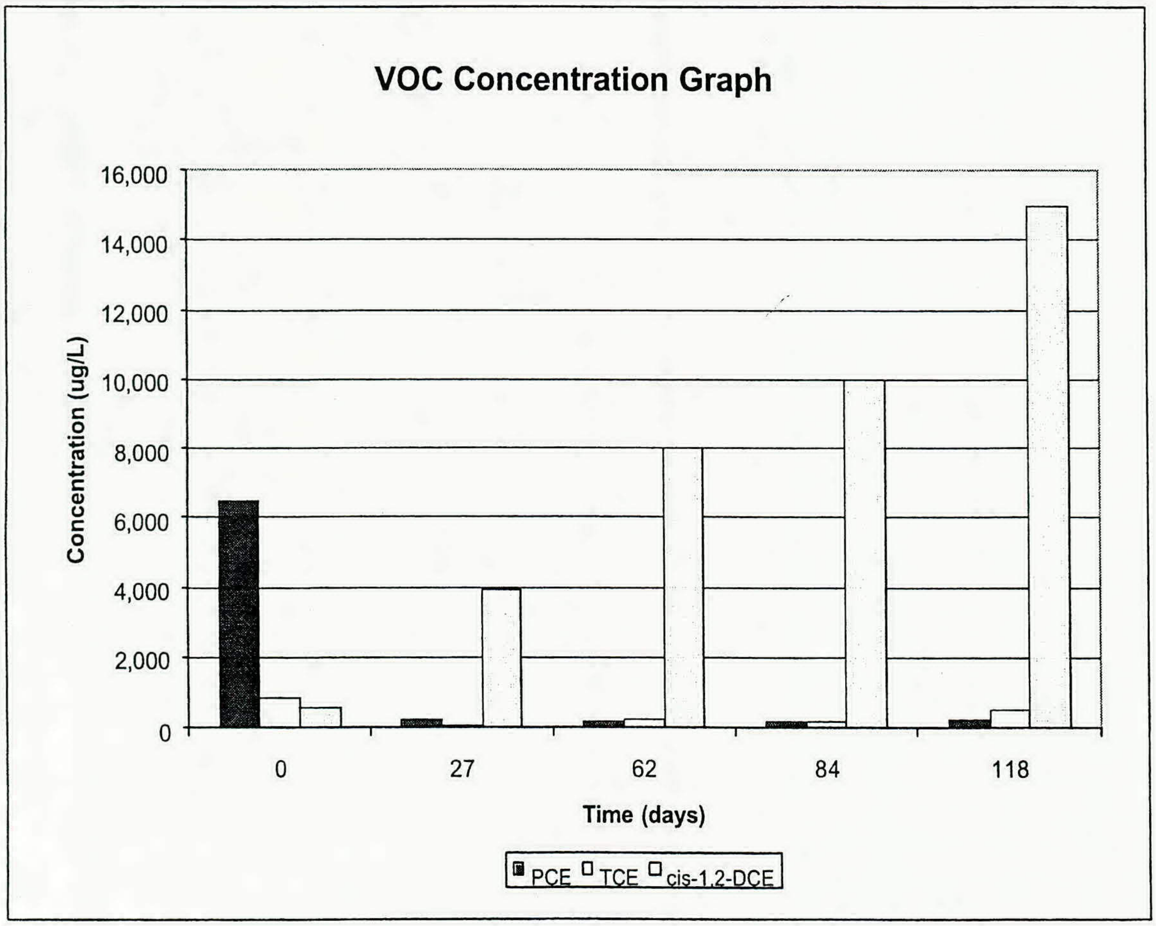


Figure 6. Harding Lawson Concentration Graph

Case 3: Project Conducted by ODEQ - Results from an Intentional DNAPL Remediation Effort

A site in Oregon was contaminated with PCE at concentrations reaching 120,000 ug/L in a silty sand aquifer. Groundwater velocity at this site is 0.3 ft/day, and depth to groundwater was recorded at approximately 5 ft bgs. Approximately 700 lbs. of HRC were injected into five points, covering a potential DNAPL area of 250 ft^2.

Figure 7 shows the results of the application through 286 days. PCE has dropped from 98,000 ug/L down to non-detect levels. TCE rose from 8,300 ug/L to 35,900 ug/L by day 197, and then dropped to 680 ug/L at day 286. DCE rose from 740 ug/L at baseline to 73,700 ug/L at day 286. Translating this into moles, a removal of 591 moles of PCE and 58 moles of TCE produced 753 moles of DCE, producing an exceptional mass balance. This indicates that the drop in PCE was a result of reductive dechlorination, and not a physical phenomenon such as a shift in direction or elevation of groundwater flow.

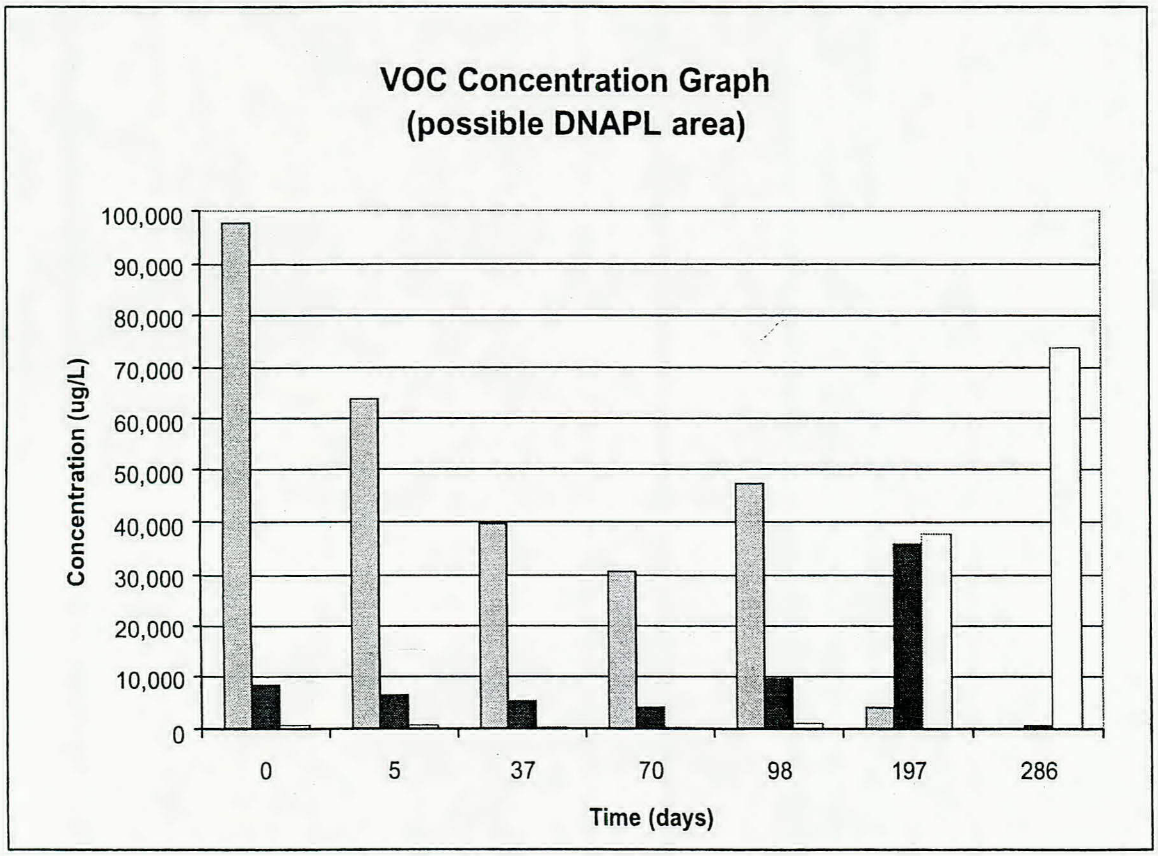
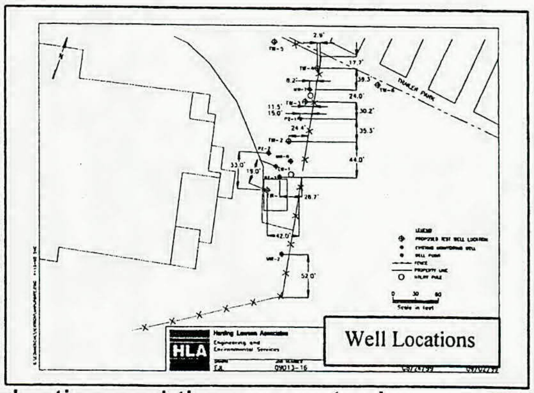


Figure 7. Oregon DEQ VOC Concentration Graph

Conclusion

Several lines of evidence point to the fact the HRC can stimulate the rapid desorption and degradation of hydrophobically sorbed and residual DNAPL. The literature is now beginning to actively report on this phenomenon and our own laboratory experiments verify these observations. Some of our HRC treatment data sets are also able to reveal footprints of this facilitated desorption process as illustrated. In addition, one recent HRC treatment effort involved the intentional and hugely successful remediation of DNAPL. Clearly the use of HRC is a sensible strategy to treat appropriate levels of sorbed DNAPL, in addition to its classical application for treatment of dissolved phase plumes.

5.2 Cookville, Tennessee



Background

In Cookville, TN, on and offsite soil (tight clays) and groundwater, contaminated with chlorinated solvents, was discovered as the result of a Phase I and several Phase II investigations. The client entered the State of Tennessee Voluntary Clean-up Oversight and Assistance Program (VCOAP), which resulted in a Remedial Action/Remedial Design Work Plan (RD/RA). This process presented a proposed technology evaluation and the conceptual remedial approach utilizing the selected remedial alternative. The consultant, Harding ESE, selected Hydrogen Release Compound (HRC®) as the technology of choice to remediate an area of excessive chlorinated solvent contaminated groundwater. HRC was chosen as it offered an effective remediation technology with the added, cost-effective benefits of no interruption to facility operations, no lengthy operations and maintenance and no construction of unsightly/obtrusive remedial systems.

Pilot and Full Scale Application

The goal of groundwater treatment at this site was to degrade the contaminants to concentrations at or below federal MCLs at the property boundary. Thus a pilot test was conducted in January 2000 followed by a full-scale application in June 2001. The pilot included 16 injection points within the center of the groundwater plume with TCE concentrations ranging up to 200 mg/L. Additionally, an outer plume area with lower contaminant concentrations received 6 HRC application injections. Product application and injection was completed with a standard GeoProbe® unit. Due to the success of the pilot study, full-scale application occurred in June 2001. It required a total of 81 injection points in the most contaminated area, averaging 10.6 lbs/ft of HRC, and 54 injection points in the outer plume area, averaging 3.5 lbs/ft of HRC.

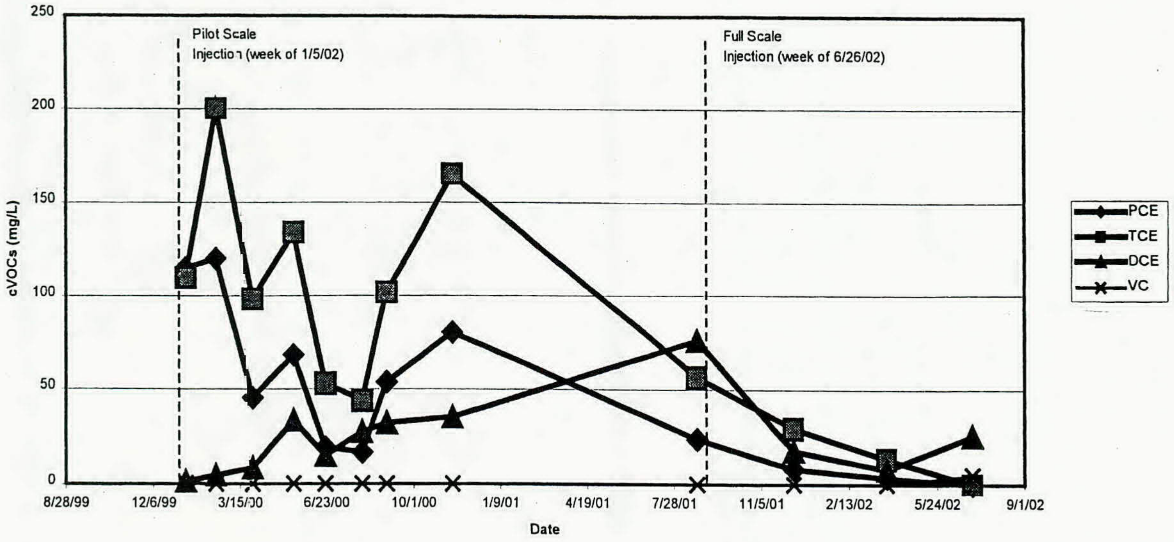
Results

Nine months worth of monitoring events were conducted for the remainder of the pilot study phase. Results from the pilot scale study indicated that the enhanced remedial process worked successfully and primary solvents TCE and DCE were broken down, at an accelerated rate, and ultimately into less harmful daughter products like ethene.

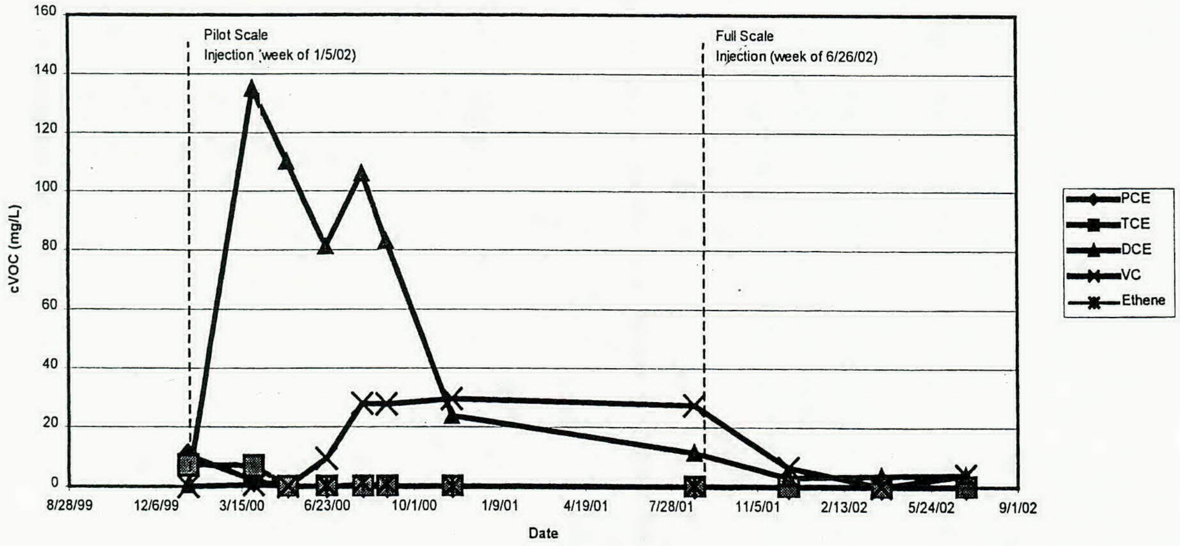
For the full-scale application, quarterly monitoring began in August 2001, and the fourth quarterly event took place in June 2002. Results indicate that in the most contaminated area, initial concentrations of 200 mg/L TCE and 110 mg/L PCE were reduced to less than 100 ug/L(>99% reduction). Daughter products such as 1,2-DCE and VC have been detected, and levels continue to decrease over time. There has been a reduction of >85% of the total mass of VOCs at the most contaminated well without any significant detection of vinyl chloride. Biodegradation of remaining compounds is expected to continue over the next year. One final injection is being considered for September 2002, and closure is expected at the site in 2003.

Project Notes

Cookville is unique in that it was the one of the first to utilize enhanced bioremediation (via HRC) for treating concentration levels in the hundreds of parts per million for TCE and DCE. This site also represents a successful HRC application in tight clay soils.

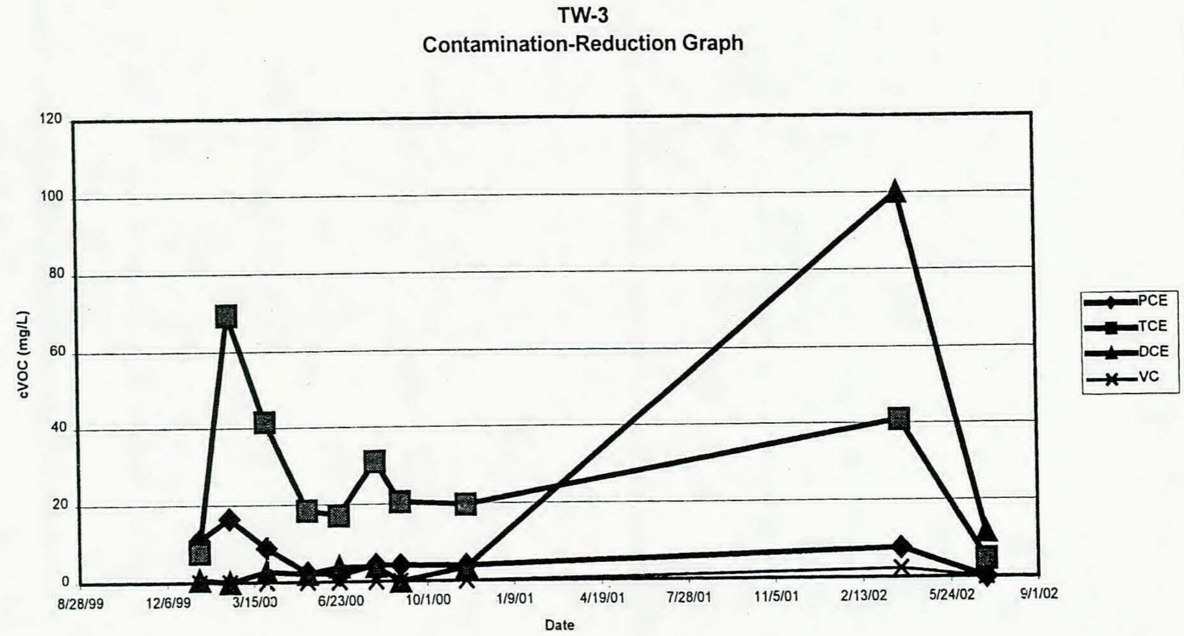


TW-2
Contamination-Reduction Graph

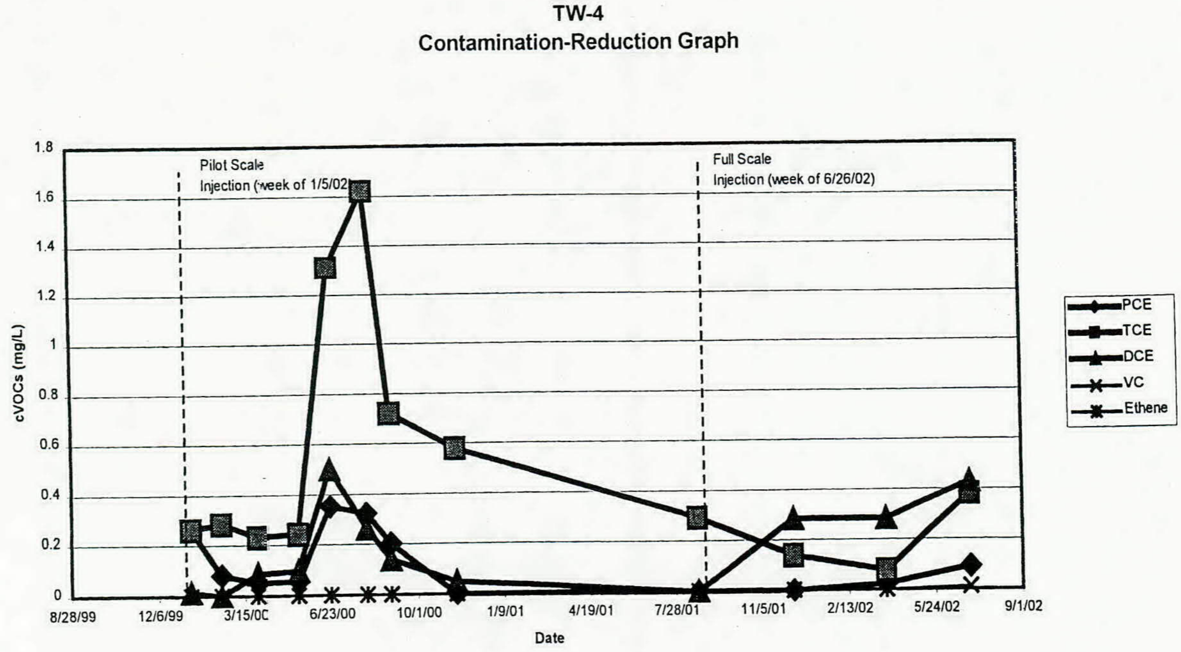


PZ-2
Contamination-Reduction Graph

Source Area Figures



Mid-Plume Figure (TW-3)



Property Boundary Figure (TW-4)

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