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VACUUM ENHANCED RECOVERY
PILOT TEST REPORT
ALCAS FACILITY
OLEAN, NEW YORK

GERAGHTY
& MILLER, INC.
Environmental Services
A Heidemij Company

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May 30, 1995

Mr. Thomas Taccone
Chief, New York, Caribbean
Superfund Branch II
Emergency and Remedial Response Division
United States Environmental
Protection Agency
290 Broadway - 20th Floor
New York, New York 10007

Re: Alcas Pilot Test Report (Project No. AY0179.001)

Dear Mr. Taccone:

Enclosed please find three copies of "Vacuum Enhanced Recovery Pilot Test Report, Alcas Facility, Olean, New York".

If you have any questions or comments regarding this document please contact us.

Sincerely,

GERAGHTY & MILLER, INC.

William J Gray

William J. Gray
Senior Scientist/Project Manager

Andrew J Barber

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cc: Olean Distribution List

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VACUUM ENHANCED RECOVERY
PILOT TEST REPORT
ALCAS FACILITY
OLEAN, NEW YORK

May 1995

Prepared for

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Project No. AY0179.001

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OLEAN, NEW YORK

1.0 INTRODUCTION

Geraghty & Miller, Inc. has, in accordance with the U.S. Environmental Protection Agency (USEPA)-approved "Olean Well Field, Pilot Test Work Plans, Olean, New York" dated July 19, 1994, and the addendum to that work plan dated October 25, 1994, performed a Vacuum-Enhanced Recovery (VER) Pilot Test for the Olean Cooperating Industries (CIs) at the Alcas Facility in Olean, New York (Figure 1). The pilot test was performed between November 14 through 18, 1994.

In addition to determining the effectiveness of VER at this location, the pilot test was also intended to generate sufficient data to design the final VER system. The pilot test consisted of applying vacuum to a recovery well and monitoring changes in performance parameters (such as vacuum, flow rate, etc.) in the recovery and monitoring wells.

The test was scheduled to run a minimum of 8 hours to a maximum of 24 hours. Field judgement of parameter stabilization resulted in a test duration of 24 hours.

This report outlines the findings of the pilot test and includes analytical results and monitoring data, as well as Geraghty & Miller's recommendations for a final remedial strategy for the Alcas site.

2.0 PURPOSE AND OBJECTIVES

The purpose of the pilot test was to determine the effectiveness of vacuum enhanced recovery (groundwater pumping and vapor extraction) to remove volatile organic compounds (VOCs) from the subsurface at the Alcas facility, as well as other facilities in the Olean Well Field with similar subsurface conditions. In addition, the data collected from the test can be used to design a final remedial system. Specifically, the final design will specify the number and location of recovery wells, the pumping systems, piping, electric and other utilities, and appropriate vapor and groundwater treatment systems.

Vacuum-enhanced recovery is a technique that has been used to increase the performance of conventional groundwater pumping systems in hydrogeologic units with a small saturated thickness and/or low permeability. This technique works by applying a high vacuum (suction) to a well by use of a liquid ring vacuum pump. The two main conditions to be achieved by use of the liquid ring vacuum pump were 1) to lower the water table in the vicinity of the recovery well to expose a greater vadose zone and 2) to induce air flow towards the recovery well in the vadose zone. Vacuum applied to a drop tube, installed inside the well, enables groundwater to be removed to the surface. A groundwater gradient (cone of depression) is established toward the well. Once water is completely withdrawn from the well, the amount of vacuum generally drops rapidly (depending on the permeabilities of the aquifer and the unsaturated zone) due to the migration of air into the well. As a result of the created gradient, groundwater continues to flow into the well and concurrently, soil vapors start flowing from the pore space of the unsaturated zone into the well. This vapor removal process is also referred to as vapor extraction. An increase in the amount of vacuum applied to the drop tube causes an increase in dewatering in the well, until the water level drops to the bottom of the drop tube. This increase is directly proportional to the amount of vacuum applied to the well. The increased dewatering results in corresponding increases in the hydraulic gradient, well yield, and the size of the capture zone.

As indicated above, vacuum-enhanced recovery is also used to remediate soils in the vadose zone concurrent with groundwater remediation. In vapor extraction, vacuum applied to a well causes movement of soil vapors toward the well. The rate and extent of the vapor movement depends on the amount of vacuum applied, the permeability of the unsaturated zone, the size of the vertical screened interval and the unsaturated thickness. The extraction of soil vapor causes volatilization of condensed VOCs from the solid (soil) matrix according to contaminant vapor pressure.

3.0 METHODOLOGY

3.1 INSTALLATION OF RECOVERY WELLS

One 4-inch diameter recovery well (RW-1) was installed at the location shown on Figure 2. The well was drilled by Parratt-Wolff, Inc. of East Syracuse, New York, using hollow-stem auger drilling techniques. The borehole was advanced to a depth of approximately 22 feet below land surface (bls). A 15-foot long, 4-inch diameter, 0.020-inch slot, PVC well screen with a 2 foot solid sump was then placed in the borehole with the screened interval spanning approximately 5 to 20 feet bls. Review of the geology (Boring Logs), included in the Alcas additional investigation report dated September 7, 1994, determined the depth of the recovery well. The well was installed to a depth near the bottom of the less permeable layer. This was done in an attempt to increase the radius of influence in the less permeable layer and to prevent drawing contamination into the lower aquifer. The annular space around the sump and screen was backfilled with No. 1 Morie silica sand to approximately one foot above the top of the screen. The remaining annular space was backfilled with hydrated bentonite pellets to seal the well, and completed with a 2-foot cement seal. The first few hours of the pilot test served as the well development phase. The recovery well construction log is provided in Appendix A.

3.2 INSTALLATION OF MONITORING WELLS

Four 2-inch diameter PVC monitoring wells (VER-MW-1, VER-MW-2, VER-MW-3, and VER-MW-4) were installed in the configuration shown on Figure 2. The boreholes for these wells were drilled using hollow-stem auger drilling techniques. The boreholes were advanced to approximately 20 feet bls. A 2-inch diameter, 0.020-inch slot, PVC well screen, 15 feet in length, was placed in the borehole with the screened interval spanning approximately 5 to 20 feet bls. The annular space around the screened section was backfilled with No. 1 Morie silica sand to approximately one foot above the screen. The remaining annular space was backfilled with hydrated bentonite pellets to seal the well, and completed with a 2-foot cement seal. A 2-foot section of the well casing was left extending above land surface for the purpose of attaching pilot test equipment. The monitoring well construction logs are provided in Appendix A.

3.3 TEST SET-UP

The pilot test was performed on the 4-inch diameter Recovery Well RW-1. The test utilized 2-inch diameter observation wells (VER-MW1, VER-MW2, VER-MW3, VER-MW4), existing on-site Monitoring Well D-2 and existing Piezometers P4 and P5 as monitoring points. The location of the on-site monitoring wells are shown on Figure 3.

The portable vacuum-enhanced pilot test trailer and associated piping were set up near the test well. The pilot test trailer consists of a 5 horsepower (HP) motor liquid-ring vacuum pump, two air/water separator tanks, two 1/2 HP electric motor positive displacement transfer pumps and calibrated process instruments and controls, see Figure 4. The liquid ring pump is capable of producing a vacuum of up to 29 inches of mercury (in.Hg.). The operation of the liquid-ring pump requires a continuous water feed (seal water) to create an internal seal in the pump.

The first air/water separator tank serves two purposes; first, as a reservoir for the necessary seal water for the liquid-ring pump, and secondly, to remove any remaining moisture in the vapor process stream prior to treatment by means of a demister. The seal water continuously circulates between the liquid-ring pump and this separator tank with minimal seal water losses, by way of a 1/2 HP electric transfer pump.

The second air/water separator tank is in-line between the test wells and the liquid-ring pump. This separator serves solely as a knockout for the process stream influent water and vapors. The vapor process stream then continues on, by way of the liquid-ring pump to the first separator tank where remaining moisture in the stream is removed. Moisture dropped out of the process stream is added to the seal water reservoir. The process air stream was then directed through vapor phase granular activated carbon (VGAC) treatment prior to being discharged to the atmosphere. A 4-inch diameter PVC piping manifold was used to interface the separator vapor discharge with the VGAC units.

The water and vapor-moisture collected in the second separator are pumped with a 1/2 HP electric transfer pump. High and low level switches located in the separator control operation of the pump. The water is pumped through liquid-phase GAC (LGAC) treatment prior to being discharged. The system discharge flow rate and cumulative gallons pumped were recorded with an electric totalizer flow meter. A 1 1/4-inch flexible hose connected the system to the LGAC treatment and then to the POTW discharge point. A schematic of the portable pilot test trailer is shown on Figure 4.

Set-up of the recovery well consisted of installing a 1-inch diameter, PVC drop tube to approximately two feet above the bottom of the well. The drop tube was inserted through a 4-inch diameter PVC cap which sealed the well from the atmosphere. The drop tube was connected to a 3/4-inch diameter PVC manifold consisting of a regulating valve and a vacuum gauge. The vacuum gauge allowed for continuous monitoring of vacuum applied to the well head. The well head manifold was then fastened to a 2-inch diameter flexible vacuum hose supplied with the pilot test unit.

The observation wells were equipped with 2-inch diameter PVC caps and 3/4-inch diameter PVC drop tubes extending to approximately one foot above the bottom of the well. The observation wells were sealed to allow measurement of induced soil vacuum. The drop tubes allowed for monitoring of ground water levels without shortcircuiting the vacuum in the well to the atmosphere. The existing piezometers (P4 and P5) were installed on August 2 and August 3, 1994 to the specifications set forth in the Alcas Additional Investigation report dated September 7, 1994. P4 and P5 were installed for the purpose of groundwater monitoring and sampling. P4 and P5 have casing diameters of 1.25 inches (in.) and .75 in., respectively. Such small diameters disallow the installation of drop tubes large enough to be utilized for water level measurements. Consequently, P4 and P5 were used to monitor subsurface vacuum only. Existing well D-2 was used to monitor fluctuation in groundwater levels.

3.4 VACUUM-ENHANCED RECOVERY TEST DURATION AND MONITORING

The duration of the pilot test was 24 hours. The anticipated time duration for the pilot test was 8 to 24 hours. The test was discontinued when the maximum time set forth by the work plan, had been achieved. Although steady-state conditions were not achieved, sufficient stabilization of critical parameters (vacuum, air and water flow, temperature, water levels) occurred in order to conclude the test.

Prior to start-up of the test, static fluid levels in the monitoring wells were measured, to the nearest hundredth of a foot (.01 ft.), using an electronic water-level meter manufactured by Solinst. During the course of the test, the following parameters were measured and recorded at least hourly:

- Liquid Production Rate - The liquid production rate from the test well was measured continually with a totalizing type flow meter.

- Soil Gas Extraction Rate - The extracted vapor velocity was calculated with a pitot tube and a magnehelic gauge installed in the effluent process stream pipe prior to treatment. The pitot tube measured differential pressure of the vapor process stream. Readings obtained from the magnehelic gauge attached to the pitot tube are converted to standard cubic feet per minute (SCFM) of soil gas extracted using engineering nanographs.

- Extracted VOC Concentrations - VOC concentrations were measured with an organic vapor meter (OVM); Model 580B, manufactured by Thermo Environmental Instruments, equipped with a 11.7 electronvolt (eV) lamp. Prior to use, the OVM was calibrated utilizing a 100 ppm isobutylene calibration gas manufactured by Hazco. OVM readings were taken from the process stream influent (prior to VGAC treatment) and effluent (after VGAC treatment).

- Vacuum Influence Readings - Vacuum influence readings were taken in the observation wells equipped with drop tubes. These measurements were read directly from magnehelic gauges connected to the well casing surrounding the drop tube. In the case of the P4 and P5 piezometers, where drop tubes were not able to be installed, magnehelic gauges were connected directly to the well cap. Vacuum readings were taken several times during the first hour and hourly for the remainder of the test. Vacuum readings were recorded in inches of water column (in.w.c.).

- Water Levels - Water levels were measured in monitoring wells to monitor fluctuation above or below the static levels. Measurements were taken using a Solinst electronic water-level meter.

- Temperature - Temperature readings were taken from thermal wells installed in the vapor process stream influent and effluent and liquid process stream in the first carbon drum.

- Recovery Well Vacuum - The vacuum applied to the recovery wellhead was recorded hourly with a calibrated vacuum pressure gauge installed on the wellhead manifold.

- Vacuum at the liquid ring pump - Vacuum at the liquid ring pump was measured hourly on the first knockout tank to which the liquid ring pump is directly connected.

3.5 SOIL GAS VAPOR AND WATER QUALITY SAMPLING

During the course of the test, samples of the influent liquid process stream were collected at the beginning of the test, after four hours, after eight hours, after 16 hours, and at the conclusion of the test (24 hours).

At the conclusion of the test, a sample of the effluent liquid process stream (after treatment) was collected, as required by the City of Olean Department of Public Works.

Liquid samples were collected in preserved (hydrochloric acid) 40 milliliter (ml) vials supplied by the laboratory. After collection, the samples were packed in ice and were shipped to IEA Laboratories, Monroe, Connecticut, for analysis of volatile organic compounds using USEPA Method 8240.

The vapor process stream was sampled at the beginning (00 hours), in the middle (12 hours), and end (24 hours) of the test. Samples were collected from a sample port located in the effluent process stream pipe prior to the carbon canisters. The samples were collected using a 60 cubic centimeter (cc) disposable syringe and then injected into a pre-evacuated vial. New syringes were used for each sample to prevent cross contamination. At the conclusion of the test, the samples were shipped to Microseeps, Ltd., of Pittsburgh, Pennsylvania.

The air samples were analyzed for USEPA Method 624 parameters, using Microseep's analytical method AM4. Method AM4 is a modification of USEPA Methods 3810 (headspace) and 8000 (Gas Chromatography). Modifications are made to the method to accommodate the gas phase sample type. In addition, samples were analyzed for permanent gases (oxygen, carbon dioxide, carbon monoxide, nitrogen, and methane).

4.0 RESULTS

The pilot test, began at 1:00 PM on November 16, 1994 using RW-1 as the recovery well and concluded at 1:00 PM on November 17, 1994, for a duration of 24 hours. Recorded data from this test (water level, vacuum, PID measurements, air and water flow and temperature measurements) are included in Tables 1 through 4.

The applied vacuum to RW-1, varied from 11 in/Hg to 17 in/Hg for the first two hours, but then remained constant at 16 in/Hg for the duration of the test. Soil gas was extracted at rates ranging from approximately 17 to 35 cubic feet per minute (cfm) during the first 18 hours of the test and from 60 to 174 cfm during the last 6 hours of the test for an average rate of 48 cfm for the duration of the test. Vacuum influence was observed in Monitoring Wells VER-MW1, VER-MW2, VER-MW3, VER-MW4, P4, and P5, located approximately 12 feet, 16 feet, 20 feet, 35 feet, 15 feet, and 10 feet from RW-1 respectively. The radius of influence was determined to be a minimum of 35 feet, using the vacuum results for VER-MW1 through VER-MW4 (Table 2), as well as the groundwater drawdown data (Table 1).

Groundwater drawdown was observed in VER-MW1, VER-MW2, VER-MW3, and VER-MW4. The drawdown varied between approximately 8 feet at VER-MW1 and 3 feet at the most distant well, VER-MW4. Drawdown is shown graphically in Appendix B. A total of 3,739 gallons of groundwater were recovered from RW-1 over a period of 24 hours (2.60 gallons per minute [gpm]).

The influent vapor process stream was monitored in the field using an OVM which produced VOC readings ranging from a minimum of 1,215 parts per million by volume (ppmv) to a maximum of 1,835 ppmv total VOCs. Additional monitoring of the process stream was conducted using a combination meter (infrared gas analyzer, lower explosive limit (LEL), and Oxygen [O_2]). Using the combination meter, methane was detected at 0.1 percent early in the test on one occasion and was not detected for the remainder of the test.

4.1 LABORATORY RESULTS

A summary of laboratory results for the liquid and vapor samples collected during the test are presented in Tables 5, 6, and 7 and copies of the laboratory reports are included in Appendix C. Table 5 summarizes the analytical results of the influent groundwater samples collected during the test. Tables 6 and 7 summarize the results of the influent vapor samples collected during the test.

The main contaminants detected in the influent groundwater samples were: trichloroethylene, ranging from 4,100 micrograms per liter (ug/L) to 14,000 ug/L; 1,2-dichloroethylene, ranging from 1,200 ug/L to 5,100 ug/L; methylene chloride, ranging from 19 ug/L to 110 ug/L; and chloroform, ranging from 15 ug/L to 51 ug/L. Methylene chloride is a common laboratory artifact and detection may be attributed to lab practices.

The main contaminants detected from the analysis of the influent vapor samples were: trichloroethylene, ranging from 951.5 parts per million by volume (ppmv) to 2,381.7 ppmv; vinyl chloride, ranging from 323 ppmv to 55 ppmv; 1,1-dichloroethylene, ranging from 4.66 ppmv to 0.75 ppmv; and tetrachloroethylene, ranging from 1.91 ppmv to 1.07 ppmv.

The concentration of methane was 0.08 percent, 0.20 percent, and 0.17 percent at the beginning, middle, and end of the test, respectively. The permanent gas sample analytical data is shown in Table 7. Copies of the laboratory reports are included in Appendix C.

4.2 MASS REMOVALS

4.2.1 Liquid Phase Mass Removal

Tables 4 through 8 in Appendix E include the mass removal calculations for the liquid phase. In summary, during the test, the following VOC concentrations, flow rates, and liquid phase mass removal rates were observed:

Time Elapsed (hours)	Total VOC Concentration (mg/L)	Average Flow Rate (gpm)	Mass Removal Rate (lbs/hr)
1	20.65	2.56	.028
4	11.10	2.56	.016
8	11.25	2.56	.014
16	7.38	2.56	.009
24	5.34	2.56	.007

The mass removal rates were calculated using the laboratory measured contaminant concentrations and an average liquid recovery flow rate for the duration of the test. The sample times (time elapsed from test start-up) were recorded in the field.

Using an estimated time weighted average concentration, the total liquid mass removed was calculated. The five samples were taken at one hour, 4 hours, 8 hours, 16 hours, and 24 hours into the test. Assuming that the respective concentrations were maintained over a period of 2 hours, 4 hours, 6 hours, 6 hours, and 6 hours, respectively, gives a total mass removed of approximately 0.30 pounds (lbs) via the liquid phase over a 24 hour period.

4.2.2 Vapor Phase Mass Removal

Tables 1 through 3 in Appendix E include the vapor phase mass removal calculations. In summary, the following VOC concentrations, air flow rates, and vapor phase mass removal rates were observed.

Time Elapsed (hours)	Flow Rate (cfm)	Total VOC Concentration (ppmv)	Mass Removal Rate (lbs/hour)
1.34	21.8	2720.2	1.22
12.75	21.8	1333.5	.62
24.00	135.2	1012.08	3.77

The vapor mass removal rates were calculated using laboratory measured contaminant concentrations and air flow rates measured in the field by a pitot tube prior to obtaining the vapor samples.

Using an estimated time weighted average, the total vapor mass removed was calculated. The three samples were taken at 1.34 hours, 12.75 hours, and 24.00 hours. Estimating the contaminant concentrations over a duration of 9 hours, 9 hours, and 6 hours, respectively, gives a total mass removed of approximately 39.2 lbs over a 24 hour period. The removal rate durations were estimated by reviewing the duration of measured flow rates.

5.0 DISCUSSION OF RESULTS

5.1 DATA ANALYSIS AND INTERPRETATION

Interpretation of the data produced by the pilot test indicates very favorable results for the application of VER technology at this site. Water table drawdown and vacuum influence occurred in monitoring points within a 35 foot radius of the recovery well.

Drawdown of the water table is necessary in order to expose the bottom of the drop tube, and thus vacuum, to the vadose zone. The further away from the recovery well that drawdown occurs, the greater the radius of influence is.

Air permeability of soils is a function of soil moisture content. Thus, as soil moisture levels drop in the vadose and dewatered zones, air flow rates toward the recovery well should increase. This was evident in the Alcas pilot test for the following reasons:

- There was vacuum influence in each of the surrounding monitoring wells and piezometers. Vacuum difference between the monitoring wells and the recovery well is indicative of induced air flow from the monitoring wells and piezometers toward the recovery well.

- A sharp increase in the air flow, as measured by the pitot tube, occurred for the last 6 hours of the test. This is due to the exposure of the bottom of the drop tube to the unsaturated zone, the dewatering of the unsaturated and saturated zones, and thus, an increase in vapor phase recovery.

- Observed vacuum at the above locations was plotted as a function of time, as outlined in the EPA Interim Guidance, Guide for Conducting Treatability Studies under CERCLA: Soil Vapor Extraction, (USEPA September 1991). These graphs may be found in Appendix D. The slope and y-intercept of such plots may be used in conjunction with site-specific subsurface and atmospheric parameters to calculate the air permeability of the localized geology. The plot of vacuum versus time for VER-MW1 produced a graph with a correlation coefficient of .92, and thus, values from this plot were utilized in air permeability calculations. The air permeability value produced from this calculation was greater than $10^{-6}cm^2$ and indicates highly favorable conditions for the use of Vacuum Enhanced Recovery at the Alcas site.

5.1.1 Analysis of Waste Stream Characteristics

Dewatering of the impacted area and inducing air flow across this area is important. Volatile contaminants, such as the ones found at the Alcas site, are more readily transported in the vapor phase than they are in the dissolved phase.

The laboratory reports (Appendix C) show contaminant concentrations in the vapor phase to be much higher than those in the liquid phase. The mass removal rates (Appendix E) for both the liquid and vapor phases were calculated. Further calculations presented in Section 4.2 show that the total mass removed in the vapor phase was more than 115 times greater than that removed in the liquid phase; 0.30 lbs in liquid phase and 39.2 lbs in the vapor phase.

Temperature readings of the vapor and liquid process streams were recorded for use in discharge permit applications, if necessary. These are shown in Table 4. All temperature readings ranged between 34° (during the night) and 70° (during noon time), and are typical values for a VER system.

5.1.2 Comparison to Test Purpose and Objectives

The purpose of the test, to determine effectiveness of vacuum enhanced recovery, has been satisfied. The vacuum, flow rate, and mass removal data shows that vacuum enhanced recovery is an effective remedial technology for the Alcas site.

An objective of the pilot test was to accumulate sufficient data to assist in the design of the final remedial system. Sufficient data, such as radius of influence, removal rates, vapor and water quality data, vacuum requirements, etc. was produced to achieve this.

5.1.3 Quality Assurance

Upon breakdown of the pilot test system, a partial blockage was found in the hose barb connected to piezometer P-5. Further review of the data reveals vacuum influence readings much lower than would be expected for a monitoring well at this distance (9.8 feet) from the recovery well. However, the cross section of the pilot test wells (Figures 6, 7 and 8) shows that P-5 has a screen interval deeper than the recovery well and other monitoring wells. This ideally would be the origin of the lower vacuum readings. As drawdown of the water table increases, towards the last couple hours of the test, vacuum readings in P-5 increase dramatically. This again points toward the screen interval as the origin for the previous lower vacuum readings. Also, extreme cold temperature caused freezing in the magnehelic gauge connected to P-5. As the morning sun helped to warm the gauge, the readings increased rapidly; apparently catching up to overnight increases in vacuum influence. Thus, the partial blockage is not judged to have negatively affected the study.

Piezometers P-4 and P-5 were installed at an earlier date to monitor groundwater fluctuation; they were installed using a Geoprobe and they do not have gravel packs. Piezometers P-4 and P-5 were not originally intended for use as a pilot test monitoring well and have screen intervals of 10 to 15 feet and 20 to 23 feet, respectively. These screen intervals easily correlate with the vacuum data collected from the P-4 and P-5 piezometers. Cross section A-A' (Figure 7) shows the initial (static) water level to be above the screened interval for P-4 and P-5. Consequently, the vacuum data recorded for P-4 and P-5 was zero for the first 1 to 1 1/2 hours. As dewatering occurs, the screens are exposed to air flow and vacuum influence is observed. Water levels were not taken from P-4 or P-5 and thus, water levels indicated on Figure 7 are estimated from water levels in the surrounding wells.

The test was originally started at 10:45 am on November 16, 1994 and ran for 45 minutes before being shut down for repairs and restarted at 1:00 pm the same day. Although this had no effect on the test, it must be stated for the following two reasons: (1) to explain the inclusion of data from 10:30 am to 11:30 am, in Tables 1 through 4, that is not used in any analysis, and (2) during shutdown, 51 gallons of clean water was run through the system to test the repairs made and thus, 51 gallons of water must be subtracted from the groundwater flow (Table 2) data before making any calculations or analysis (i.e. 3739 total gallons on Table 2, 3688 total gallons used in calculations).

Quality assurance/quality control (QA/QC) were carried out by the laboratories in the form of trip blanks, method blanks, and matrix spike/matrix spike duplicates (MS/MSD) for the water samples and calibration checks and lab blanks for the vapor samples. Results for these QA/QC procedures are included in the laboratory reports (Appendix C). The QA/QC results fall within acceptable ranges.

The overall quality assurance of the data collected during the test is very high due to the abundant number of readings. The critical parameters (vacuum, air and water flow, temperature, water level readings) were measured and recorded every hour for the duration of the 24 hour test. Although steady state conditions were not achieved, critical parameters had stabilized enough so that the 24 hour total duration was adequate for establishing final design criteria. The frequent readings provides a large database from which to base our conclusions.

6.0 CONCLUSIONS

The results from the vacuum enhanced recovery pilot test conducted at the Alcas Facility, Olean, New York, indicate that the technology is applicable for the remediation of contaminated soils and groundwater within the impacted area at the site. Specific findings during the testing activities and ensuing analysis that led to this conclusion include:

- A hydraulic gradient towards the recovery wells was induced as indicated by the drawdown observed in surrounding monitoring wells. This dewatering effect exposes a greater volume of aquifer material to the vapor extraction recovery system. Although total dewatering did not occur during the pilot test, sharp rises in extracted air flow rates toward the end of the test are the result of lowering the water table and moisture reduction from the dewatered zone.

- The radius of influence in the vadose zone was a minimum of 35 feet based on the vacuum readings at the most distant well, VER-MW4. The detection of vacuum difference at all of the observation wells (VER-MW1, VER-MW2, VER-MW3, VER-MW4, P4 and P5) indicates air flow is present at these locations.

- The extracted soil gas flow rates indicate adequate air movement within the vadose zone, particularly after moisture removal, to cause desorption of VOCs from subsurface material.

- Significant mass removal of contaminants, both in the vapor and dissolved phase, was achieved. Mass removal in the vapor phase exceeded the mass removal in the dissolved phase by more than 115 times (Mass removal tables are included in Appendix E).

- Although concentrations of VOCs in the vapor phase decreased in the final sample, the flow rate of extracted air increased by six or seven times. At this increased flow, a larger mass removal per hour was achieved.

- An objective of the pilot test was to accumulate sufficient data to assist in the design of the final remedial system. Sufficient data, such as radius of influence, removal rates, vapor and water quality data, vacuum requirements, etc. was produced to achieve this task.

7.0 RECOMMENDATIONS

The purpose of the pilot test was to evaluate the effectiveness of the vacuum-enhanced recovery remedial technology at the Alcas facility. The previous sections of this report have described and evaluated the vacuum-enhanced recovery technology with respect to its applicability and effectiveness at this site. Given the principal findings of the test, it is evident that vacuum-enhanced recovery is a suitable technology to mitigate VOC contamination in soils and groundwater at the Alcas facility.

Data collected during the pilot testing activities are sufficient to proceed with the final remedial design of the remedial measure. The final design will specify:

- Number and locations of additional recovery wells
- Number and locations of additional monitoring wells
- Pumping system(s)
- Vapor treatment system
- Groundwater treatment system
- Permitting
- Utilities
- System operation and maintenance plan

TABLES

Table 1. Water Level Data, Pumping Well RW-1, Alcas Facility, Olean, New York.

				Depth to Water (ft)				
Date	**Time**	**VER-MW-1**	**VER-MW-2**	**VER-MW-3**	**VER-MW-4**	**VER-RW-1**	**2D**	**Remarks**
11/16/94	10:30 AM	6.71	6.36	6.14	6.78	8.28	25.27	26.38 at approximately 9:00 AM
	11:00	7.11	6.46	6.28	6.81	--	25.27	Start-up at 10:45
	12:55 PM	8.65	7.30	7.08	7.45	--	25.27	Restart at 1:00 - take levels prior to
	1:15	8.79	7.37	7.15	7.51	--	25.25	
	1:35	9.61	7.54	7.42	7.56	--	24.24	
	2:00	10.43	7.93	7.83	7.81	--	25.24	H_2O sample at 2:10
	3:00	12.26	8.78	8.50	8.62	--	25.27	
	4:00	13.20	9.17	8.75	9.08	--	25.27	
	5:00	13.62	9.50	9.01	9.41	--	25.31	H_2O sample at 5:00
	6:00	13.21	9.82	9.23	9.71	--	25.34	
	7:00	13.00	9.93	9.30	9.99	--	25.37	
	8:00	13.44	9.96	9.32	9.44	--	25.38	
	9:00	13.76	9.99	9.30	10.02	--	25.36	H_2O sample taken at 9:00
	10:00	13.97	10.04	9.36	10.06	--	25.37	
	11:00	14.11	10.08	9.39	10.09	--	25.37	
11/17/94	12:00 Mid	14.20	10.15	9.43	10.16	--	25.38	
	1:00	14.26	10.21	9.46	10.27	--	25.34	
	2:00	14.28	10.25	9.52	10.28	--	25.35	
	3:00	14.31	10.29	9.51	10.28	--	25.32	
	4:00	14.35	10.27	9.51	10.28	--	25.31	Temperature 27°
	5:00	14.31	10.32	9.52	10.33	--	25.33	H_2O sample taken at 5:00
	6:00	14.44	10.33	9.56	10.33	--	25.32	
	7:00	14.42	10.37	9.60	10.38	--	25.33	Sunrise at 6:30
	8:00	14.48	10.42	9.93	10.42	--	25.35	
	9:00	14.51	10.45	9.64	10.45	--	25.34	

Table 1. Water Level Data, Pumping Well RW-1, Alcas Facility, Olean, New York.

		Depth to Water (ft)						
Date	**Time**	**VER-MW-1**	**VER-MW-2**	**VER-MW-3**	**VER-MW-4**	**VER-RW-1**	**2D**	**Remarks**
11/17/94	10:00	14.42	10.45	9.65	10.47	–	25.33	
	11:00	14.40	10.47	9.65	10.49	–	25.29	
	12:00 Noon	14.27	10.40	9.59	10.44	–	25.25	
	1:00	14.21	10.39	9.61	10.41	–	25.24	Shutdown. Influent and Effluent H_2O sample taken.
	2:00	12.31	9.76	8.91	9.96	14.28		2:00 levels to check recharging

Table 2. Vacuum Enhanced Recovery Pilot Test Data, Pumping Well RW-1, Alcas Facility, Olean, New York.

	Recorded Time			Vacuum Enhanced (IN. W.C.)						Wellhead	Pitot	Air Flow	Groundwater	Knockout
Date	Time of Day	Elapsed (minutes)	Log Time	VER-MW-1	VER-MW-2	VER-MW-3	VER-MW-4	P-4	P-5	Vacuum (IN.Hg.)	Tube Readings	Rate (cfm)	Cumulative Flow (gallons)	Tank Vacuum
11/16/94														
Start	10:45 AM	0		--	--	--	--	--	--	0.0	--	--	--	--
	10:46	1		--	--	--	--	--	--	5	--	--	--	--
	10:48	3		--	--	--	--	--	--	11.50	--	--	--	--
	10:50	5		--	--	--	--	--	--	8.50	--	--	--	--
	10:55	10		0.13	0.03	0.18	0.0	0.0	0.0	6	0.025	54.94	0.0	--
	11:05*	20		--	--	--	--	--	--	12	--	--	--	--
	11:15	30		0.80	0.06	0.05	0.45	0.0	0.0	11	0.01	34.88	20	--
Restart	1:00 PM	0		--	--	--	--	--	--	--	--	--	150	--
	1:05	5	0.69897	0.25	0.08	0.09	0.04	0.0	0.0	15	0.01	34.88	150	--
	1:10	10	1	0.30	0.07	0.06	0.05	0.0	0.0	14.50	0.005	21.80	157	23
	1:15	15	1.1760913	0.30	0.07	0.04	0.04	0.0	0.0	11	0.01	34.88	157	24
	1:35	35	1.544068	3.50	0.26	0.80	0.11	0.0	0.0	17	0.005	21.80	203	25
	2:00	60	1.7781513	2.01	0.28	0.57	0.15	Trace	0.0	16	0.005	21.80	286	25
	3:00	120	2.0791812	10.00	0.18	0.51	0.15	0.005	0.0	16.50	0.005	21.80	489	25
	4:00	180	2.2552725	12.00	0.09	0.50	0.09	0.0	2.25	16	0.005	21.80	654	24
	5:00	240	2.3802112	16.00	0.09	0.40	0.075	0.015	4.80	16	0.005	21.80	836	24
	6:00	300	2.4771213	18.00	0.07	0.20	0.055	0.025	0.0	16	0.005	21.80	1017	23.5
	7:00	360	2.5563025	17.50	0.04	0.10	0.03	0.025	2.90	16	0.005	21.80	1178	23.5
	8:00	420	2.6232493	18.50	0.07	0.20	0.02	0.025	4.80	16	0.005	21.80	1314	24
	9:00	480	2.6812412	16.00	0.02	0.05	0.01	0.025	4.30	17	0.005	21.80	1494	23.5
	10:00	540	2.7323938	17.00	0.04	0.20	0.01	0.035	1.40	16	0.01	34.88	1641	23.5
	11:00	600	2.7781513	17.50	0.03	0.10	0.0	0.035	3.50	16	0.01	34.88	1793	23
11/17/94	12:00 Mid	660	2.8195439	18.00	0.03	0.20	0.0	0.035	4.70	16	0.005	21.80	1951	23
	1:00	720	2.8573325	18.00	0.03	0.20	0.0	0.03	4.90	16	0.002	17.44	2094	23
	2:00	780	2.8920946	18.00	0.02	0.05	0.0	0.03	2.20	16	0.005	21.80	2250	23

* Dilution valve fully closed

Table 2. Vacuum Enhanced Recovery Pilot Test Data, Pumping Well RW-1, Alcas Facility, Olean, New York.

	Recorded Time		Vacuum Enhanced (IN. W.C.)							Wellhead	Pitot	Air Flow	Groundwater	Knockout
Date	Time of Day	Elapsed (minutes)		VER-MW-1	VER-MW-2	VER-MW-3	VER-MW-4	P-4	P-5	Vacuum (IN.Hg.)	Tube Readings	Rate (cfm)	Cumulative Flow (gallons)	Tank Vacuum
11/17/94	3:00	840	2.9242793	18.50	0.01	0.05	0.0	0.03	3.20	16	0.003	19.18	2378	23
	4:00	900	2.9542425	17.50	0.00	0.05	0.0	0.03	4.10	16	0.003	19.18	2526	23
	5:00	960	2.9822712	18.00	0.00	0.0	0.001	0.03	4.70	16	0.005	21.80	2694	23
	6:00	1020	3.0086002	18.50	0.05	0.05	0.25	0.03	4.80	16	0.01	34.88	2814	23
	7:00	1080	3.0334238	19.00	0.05	0.05	0.30	0.03	4.80	16	0.01	34.88	2947	23
	8:00	1140	3.0569049	21.00	0.15	0.20	0.51	0.0	5.0	16	0.03	60.60	3095	23
	9:00	1200	3.0791812	20.00	0.01	0.01	0.60	0.005	4.90	16	0.25	174.4	3215	23
	10:00	1260	3.1003705	21.00	0.04	0.0	0.82	0.015	4.70	16	0.13	126.44	3354	23
	11:00	1320	3.1205739	22.50	0.04	0.01	0.89	0.75	4.20	16	0.19	152.6	3488	22.5
	12:00 Noon	1380	3.1398791	22.50	0.03	0.03	0.87	0.11	3.70	16	0.15	135.16	3603	22.5
	1:00	1440	3.1583625	21.50	0.03	0.05	0.88	0.11	3.40	16	0.15	135.16	3739	22

Table 3. Vacuum Enhanced Recovery Pilot Test, Process Stream Data, Alcas Facility, Olean, New York.

	Recorded Time		Influent Process Stream					Effluent Process Stream	
Date	**of Day**	**Elapses (minutes)**	**% LEL**	**% O_2**	**% CO_2**	**% CH_4**	**Influent PID (ppm)**	**Effluent PID (ppm)**	**Remarks**
11/16/94	11:15 AM	30	0.0	21.1	--	0.0	45	0.0	Shutdown at 11:30
	1:20 PM	20	0.0	20.4	--	0.0	1491	0.0	Restart at 1:00
	1:45	45	0.0	21.0	--	0.0	1299	0.0	
	2:00	60	2%	13.2	8.8%	0.1	1312	0.0	Air Sample at 2:20
	3:00	120	0.0	15.6	6.4%	0.0	--	--	
	4:00	180	0.0	16.6	5.5%	0.0	1558	0.0	
	5:00	240	0.0	17.0	5.0%	0.0	1632	0.0	
	6:00	300	0.0	17.4	4.5%	0.0	1591	0.0	
	7:00	360	0.0	17.6	4.0%	0.0	1503	0.0	
	8:00	420	0.0	17.6	3.8%	0.0	1450	0.0	
	9:00	480	0.0	17.6	3.6%	0.0	1273	0.0	
	10:00	540	0.0	17.8	3.5%	0.0	1499	0.0	
	11:00	600	0.0	17.6	3.6%	0.0	1437	0.0	
11/17/94	12:00 Mid	660	0.0	17.0	4.0%	0.0	1352	0.0	
	1:00	720	0.0	16.8	3.8%	0.0	1656	0.0	
	2:00	780	0.0	17.2	2.8%	0.0	1832	0.0	Air Sample at 1:45 AM
	3:00	840	0.0	18.0	2.6%	0.0	1620	0.0	
	4:00	900	0.0	18.5	2.5%	0.0	1376	0.0	
	5:00	960	0.0	18.2	2.2%	0.0	1314	0.0	
	6:00	1020	0.0	18.4	2.1%	0.0	1215	0.0	

Table 3. Vacuum Enhanced Recovery Pilot Test, Process Stream Data, Alcas Facility, Olean, New York.

	Recorded Time		Influent Process Stream					Effluent Process Stream	
Date	of Day	Elapses (minutes)	% LEL	% O_2	% CO_2	% CH_4	Influent PID (ppm)	Effluent PID (ppm)	Remarks
11/17/94	7:00	1080	0.0	18.3	2.0%	0.0	1241	0.0	
	8:00	1140	0.0	18.3	2.0%	0.0	1835	0.0	
	9:00	1200	0.0	18.3	2.0%	0.0	1677	0.0	
	10:00	1260	0.0	18.3	2.0%	0.0	1682	0.9	
	11:00	1300	0.0	18.4	2.0%	0.0	1649	--	
	12:00 Noon	1360	0.0	18.5	2.0%	0.0	1501	2.0	
	1:00	1420	0.0	18.5	2.0%	0.0	1347	2.6	Air Sample Taken

Table 4. Vacuum Enhanced Recovery Pilot Test, Liquid and Vapor Process Stream Temperatures, Alcas Facility, Olean, New York

Date	Time	Time Elapsed (minutes)	Temperature Readings (F°)		
			Vapor Process		Liquid Process in Carbon #1
			Prior to Carbon	After Carbon	
11/16/94	11:15 AM	30	49	44	51
	1:45 PM	45	54	51	50
	3:00	120	52	51	51
	4:00	180	--	56	50
	5:00	240	54	52	47
	6:00	300	52	49	47
	7:00	360	52	50	47
	8:00	420	51	49	46
	10:00	540	46	44	40
	11:00	600	44	40	38
11/17/94	12:00 Mid	660	44	41	38
	1:00	720	45	38	37
	2:00	780	42	36	34
	3:00	840	43	36	37
	4:00	900	43	36	36
	5:00	960	41	36	35
	6:00	1020	42	35	35
	7:00	1080	43	35	35
	8:00	1140	48	36	42
	9:00	1200	56	44	48
	10:00	1260	61	50	60
	11:00	1320	68	59	62
	12:00 Noon	1380	70	62	61
	1:00	1440	74	68	66

Table 5. Vacuum Enhanced Recovery Pilot Test Influent Water Quality Data, Well RW-1, Vacuum Enhanced Recovery Pilot Test, November, 1994, Alcas Facility, Olean, New York.

Parameter	Quantitation Limits With No Dilution	Sample ID:	Influent 1	Influent 2	Influent 3	Influent 4	Influent 5
		Sample Date:	11/17/94	11/17/94	11/17/94	11/17/94	11/17/94
		Dilution Factor:	100.0	50.0	50.0	50.0	25.0
Chloromethane	10		U	U	U	U	U
Bromomethane	10		U	U	U	U	U
Vinyl chloride	10		390J	110J	U	U	U
Chloroethane	10		U	U	U	U	U
Methylene chloride	5		110J	68J	76J	40J	19J
Acetone	10		1,000B	510B	560B	U	U
Carbon disulfide	5		U	U	U	U	U
1,1-Dichloroethene	5		U	U	U	U	U
1,1-Dichloroethane	5		U	U	U	U	U
1,2-Dichloroethene (total)	5		5,100	3,100	2,500	1,600	1,200
Chloroform	5		51J	15J	17J	43J	24J
1,2-Dichloroethane	5		U	U	U	U	U
2-Butanone	10		U	U	U	U	U
1,1,1-Triochloroethane	5		U	U	U	U	U
Carbon tetrachloride	5		U	U	U	U	U
Vinyl acetate	10		U	U	U	U	U
Bromodichloromethane	5		U	U	U	U	U
1,2-Dichloropropane	5		U	U	U	U	U
cis-1,3-Dichloropropene	5		U	U	U	U	U
Trichloroethene	5		14,000B	7,300B	8,100B	5,700B	4,100B
Dibromochloromethane	5		U	U	U	U	U
1,1,2-Trichloroethane	5		U	U	U	U	U
Benzene	5		U	U	U	U	U
trans-1,3-Dichloropropen	5		U	U	U	U	U
Bromoform	5		U	U	U	U	U
4-Methyl-2-pentanone	10		U	U	U	U	U
2-Hexanone	10		U	U	U	U	U
Tetrachloroethene	5		U	U	U	U	U
1,1,2,2-Tetrachloroethane	5		U	U	U	U	U
Toluene	5		U	U	U	U	U
Chloroebenzene	5		U	U	U	U	U
Ethylbenzene	5		U	U	U	U	U
Styrene	5		U	U	U	U	U
Xylene (total)	5		U	U	U	U	U

Concentrations reported in micrograms per liter (ug/L).

U Compound not detected at or above the quantitation limit (method detection limit x dilution factor).

J Estimated value.

E Indicates that concentration exceeds the calibration curve range.

B Analyte also detected in the associated blanks.

Table 6. Concentrations of Volatile Organic Compounds Detected in Extracted Soil Gas, Vaccuum Enchanced Recovery Pilot Test, November 16 and 17, 1994, Alcas Facility, Olean, New York.

Compound	Sample ID: Date Sampled:	Influent - 1 11/16/94	Influent - 2 11/17/94	Influent - 3 11/17/94	LDLs
Chloromethane		--	--	--	1
Vinyl chloride		323	88	55	1
Bromomethane/Chloroethane*		--	--	--	1
Fluorotrichloromethane		--	--	--	0.005
1,1-Dichloroethylene		4.66	1.12	0.75	0.01
Methylene chloride		--	--	--	1.0
trans-1,2-Dichloroethylene		7.10	3.3	2.40	0.1
1,1-Dichloroethane		0.22	0.11	0.08	0.01
Chloroform		0.49	0.29	0.22	0.005
1,1,1-Trichloroethane		0.51	0.26	0.20	0.005
Carbon tetrachloride		0.04	0.02	0.02	0.005
Benzene		0.22	0.13	0.10	0.07
1,2-Dichloroethane		0.15	0.09	0.07	0.01
Trichloroethylene		2381.71	1238.23	951.50	0.005
1,2-Dichloropropane		--	--	--	0.01
Bromodichloromethane		0.02	0.01	0.01	0.005
cis-1,3-Dichloropropylene		--	--	--	0.01
Toluene		0.46	0.32	0.37	0.07
trans-1,3-Dichloropropylene		--	--	--	0.01
1,1,2-Trichloroethane		0.42	0.33	0.23	0.005
Tetrachloroethylene		1.91	1.27	1.07	0.005
Chlorodibromomethane		--	--	--	0.005
Chlorobenzene		--	--	--	0.07
Ethyl benzene		--	--	--	0.07
Bromoform		--	--	--	0.005
1,1,2,2-Tetrachloroethane		--	--	--	0.005
1,3-Dichlorobenzene		--	--	--	0.07
1,4-Dichlorobenzene		--	--	--	0.07
1,2-Dichlorobenzene		--	--	--	0.07
	Total VOCs	**2713.82 ppmv** (87.5% TCE)	**1333.47 ppmv** (93% TCE)	**1011.91 ppmv** (94% TCE)	

* Compounds elute together on ECD: Concentrations represent either or a combination of both.
-- Compounds not detected at or above the lower detection limit (LDL)
Concentrations reported in parts per million by volume (ppmv)
Volatile Organic Compounds (VOCs)

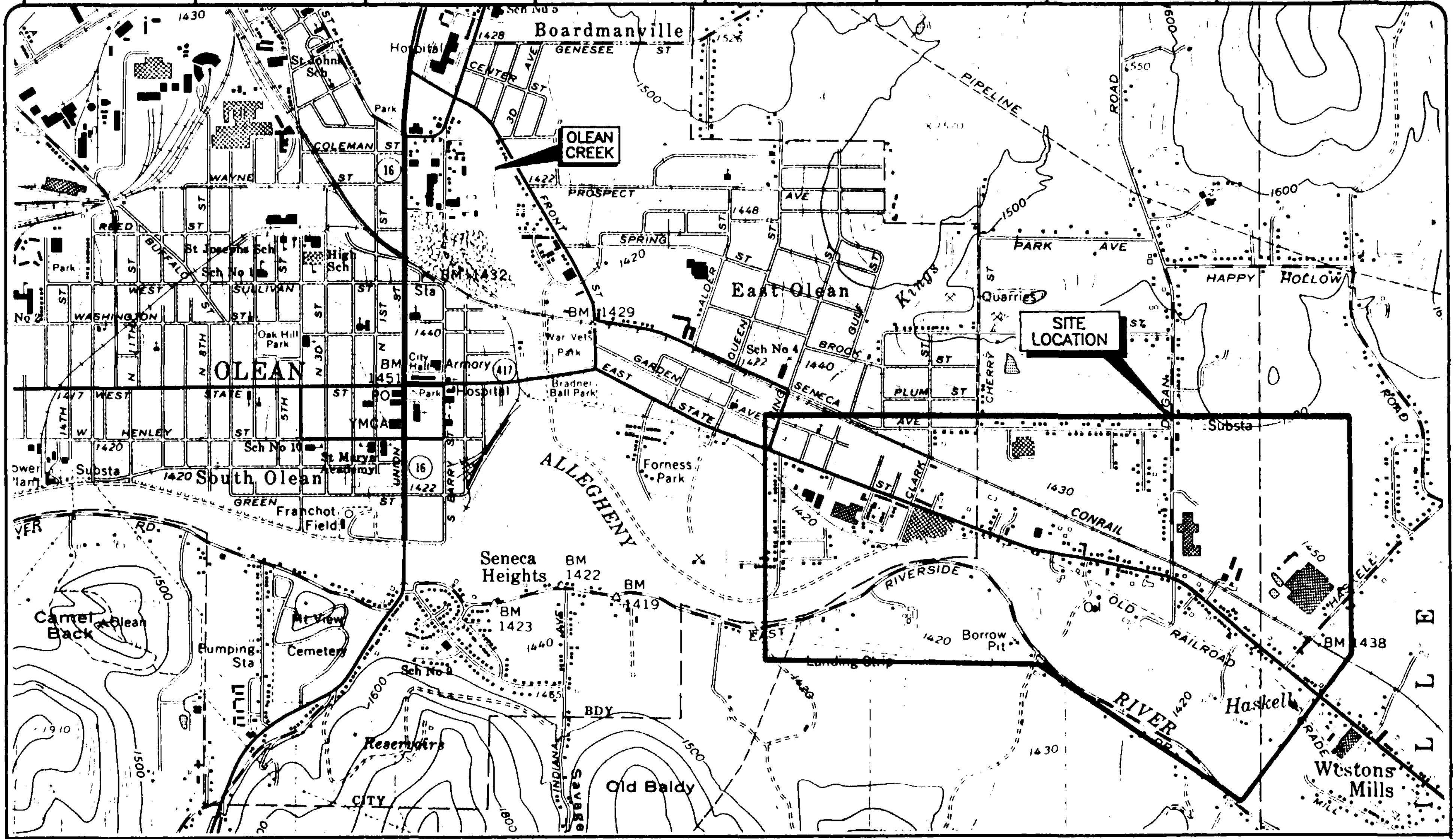
Table 7. Concentrations of Permanent Gases Detected in Extracted Soil Gas, Vacuum Enhanced Recovery Pilot Test November, 1994, Alcas Facility, Olean, New York.

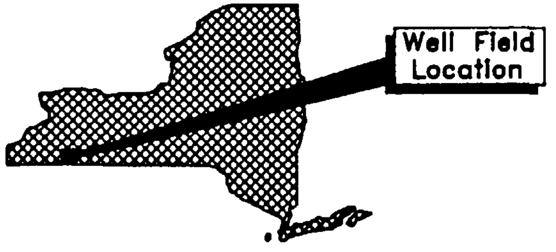
Parameter	Lower Detection Limits	Sample ID:	Influent-1	Influent-2	Influent-3
		Time:	0	12.75 hours	24 hours
		Date:	11/16/94	11/17/94	11/17/94
Methane (%)	0.01		0.08	0.20	0.17
Carbon Dioxide (%)	0.01		6.77	2.56	1.93
Oxygen (%)	0.01		16.68	19.50	19.58
Nitrogen (%)	0.01		74.56	76.33	75.63
Carbon Monoxide (%)	0.01		<.01	<.01	<.01

FIGURES

400092 A

DATE: OCT. 1993 | PRJCT. NO.: AY08803 | FILE NO.: | CAD FILE: G36AA | COMPILER: B. GRAY | MGR.: B. GRAY | DRAFTER: TAD





N

Reference: U.S. Geological Survey, 7.5 Minute Quadrangle, Olean, NY. Edited 1961.

0 1000 2000
Scale in feet

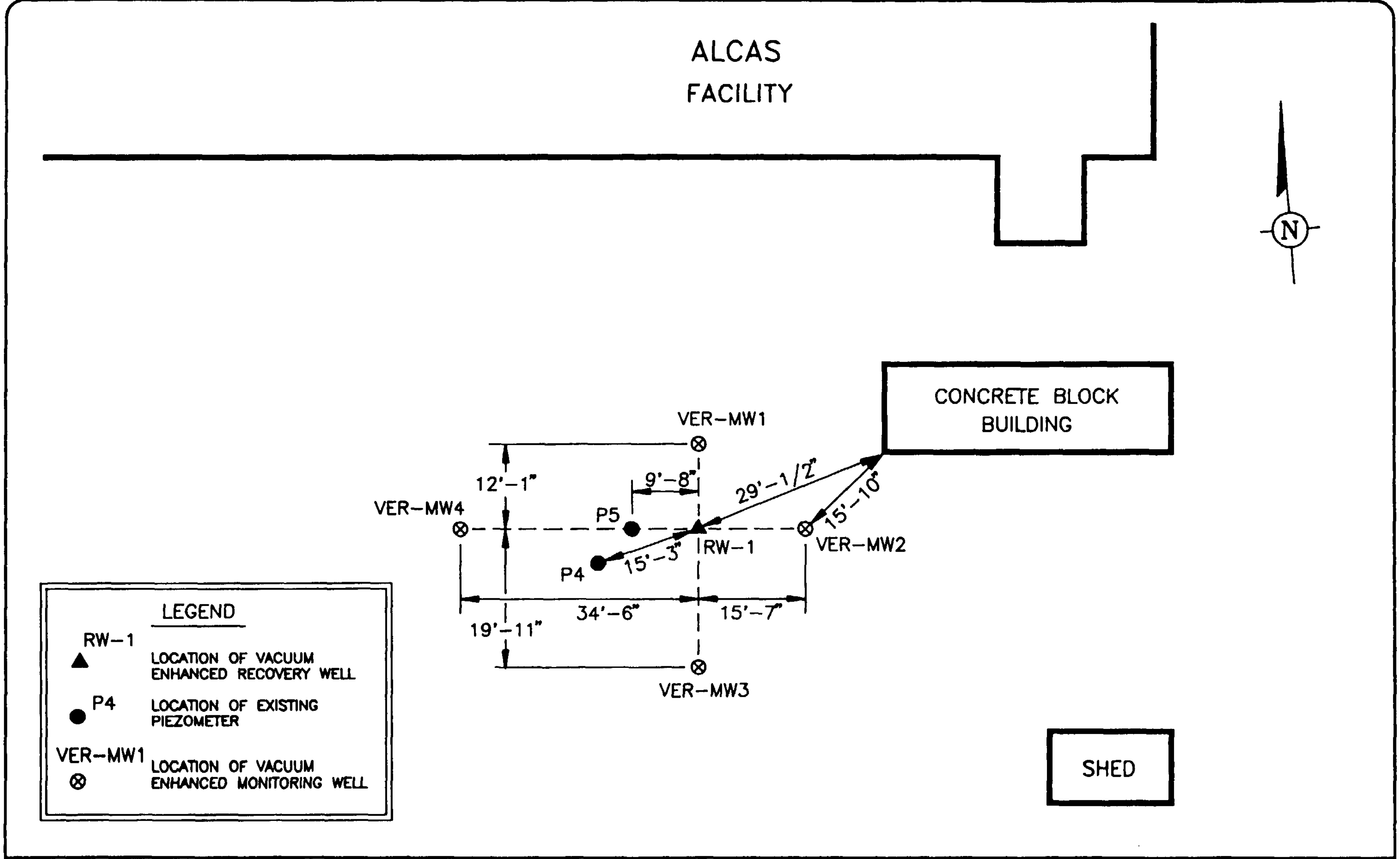
GERAGHTY & MILLER, INC.
Environmental Services

OLEAN WELL FIELD LOCATION

OLEAN, NEW YORK

FIGURE 1

DATE: DEC. 1994	PRJCT. NO.: AY0179001	FILE NO.:	CAD FILE: G211B	CO[illegible]ER: M. WRIGHT	MGR.: B. GRAY	DRAFTER: TAD/FJF



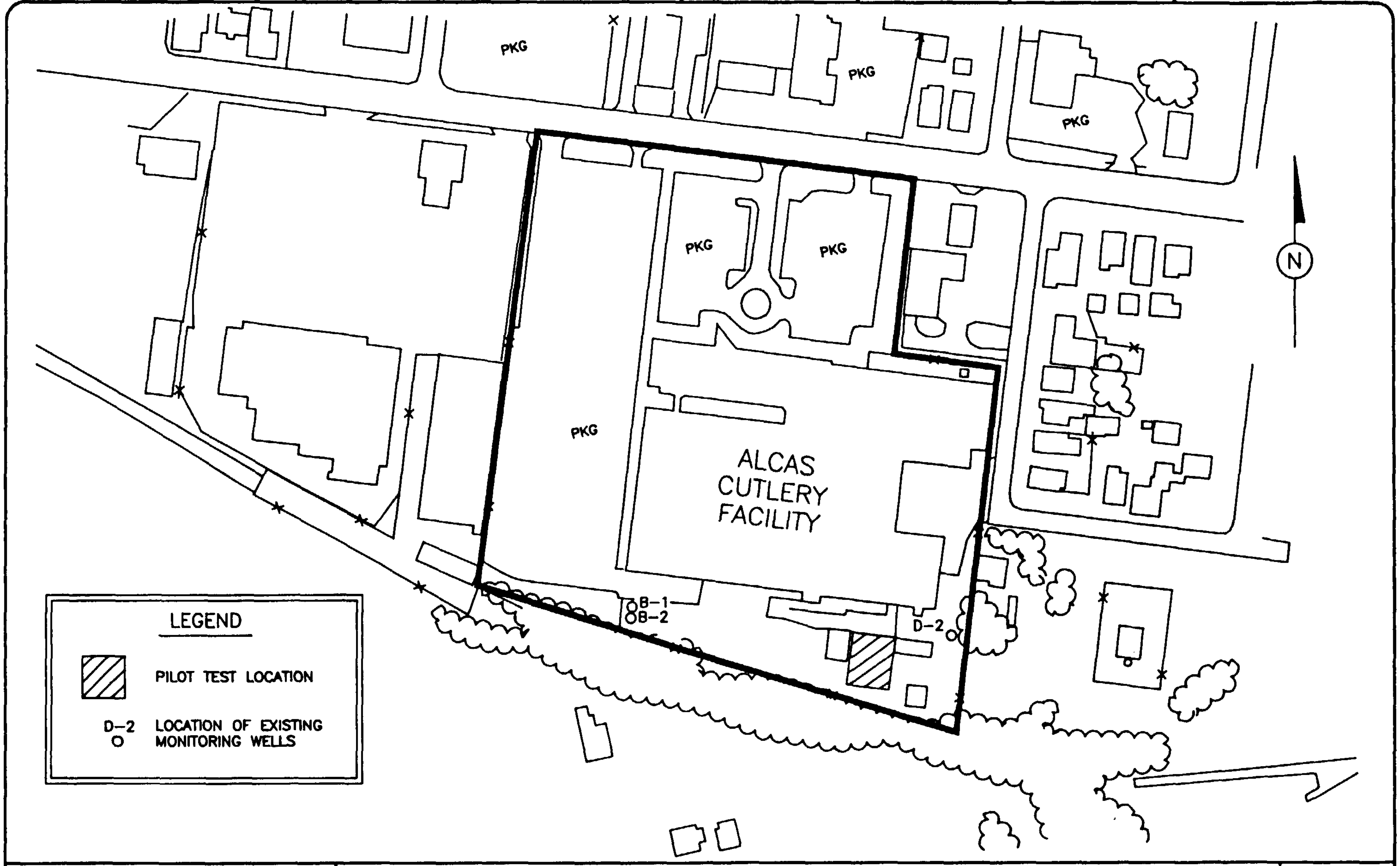
0 20
Scale in feet

GERAGHTY & MILLER, INC.
Environmental Services

LOCATION OF VACUUM ENHANCED RECOVERY AND MONITORING WELLS
ALCAS FACILITY
OLEAN, NEW YORK

FIGURE
2

DATE: DEC. 1994 | PRJCT. NO.: AY0179001 | FILE NO.: | CAD FILE: G211B | CONTROLLER: M. WRIGHT | MGR.: B. GRAY | DRAFTER: TAD/FJF



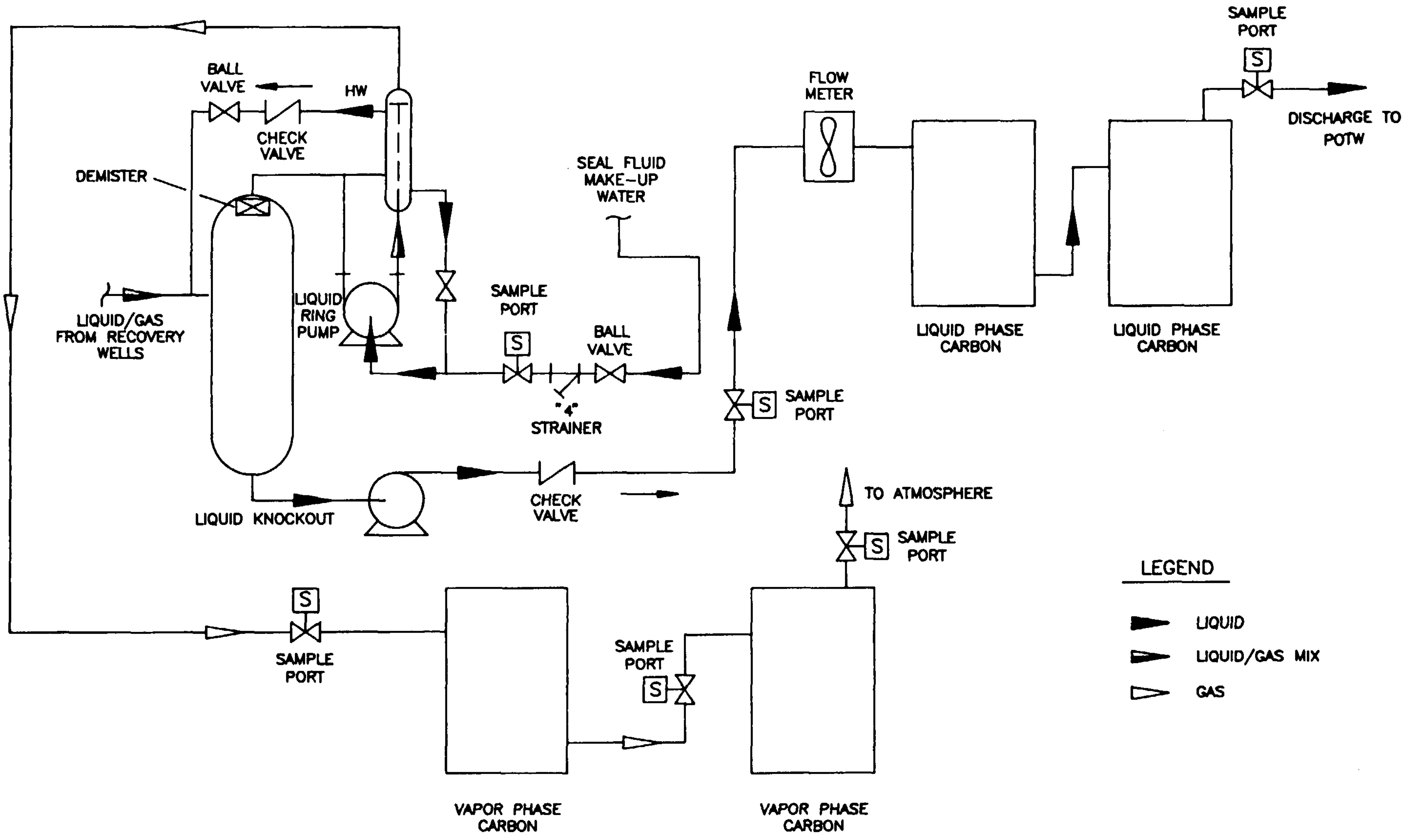
0 85 170
Scale in feet

GERAGHTY & MILLER, INC.
Environmental Services

EXISTING MONITORING WELL LOCATIONS
ALCAS CUTLERY FACILITY
OLEAN, NEW YORK

FIGURE
3

DATE: DEC. 1994	PRJCT. NO.: AY0179001	FILE NO.:	CAD FILE: G211B	COMPILER: M. WRIGHT	MGR.: B. GRAY	DRAFTER: TAD/FJF



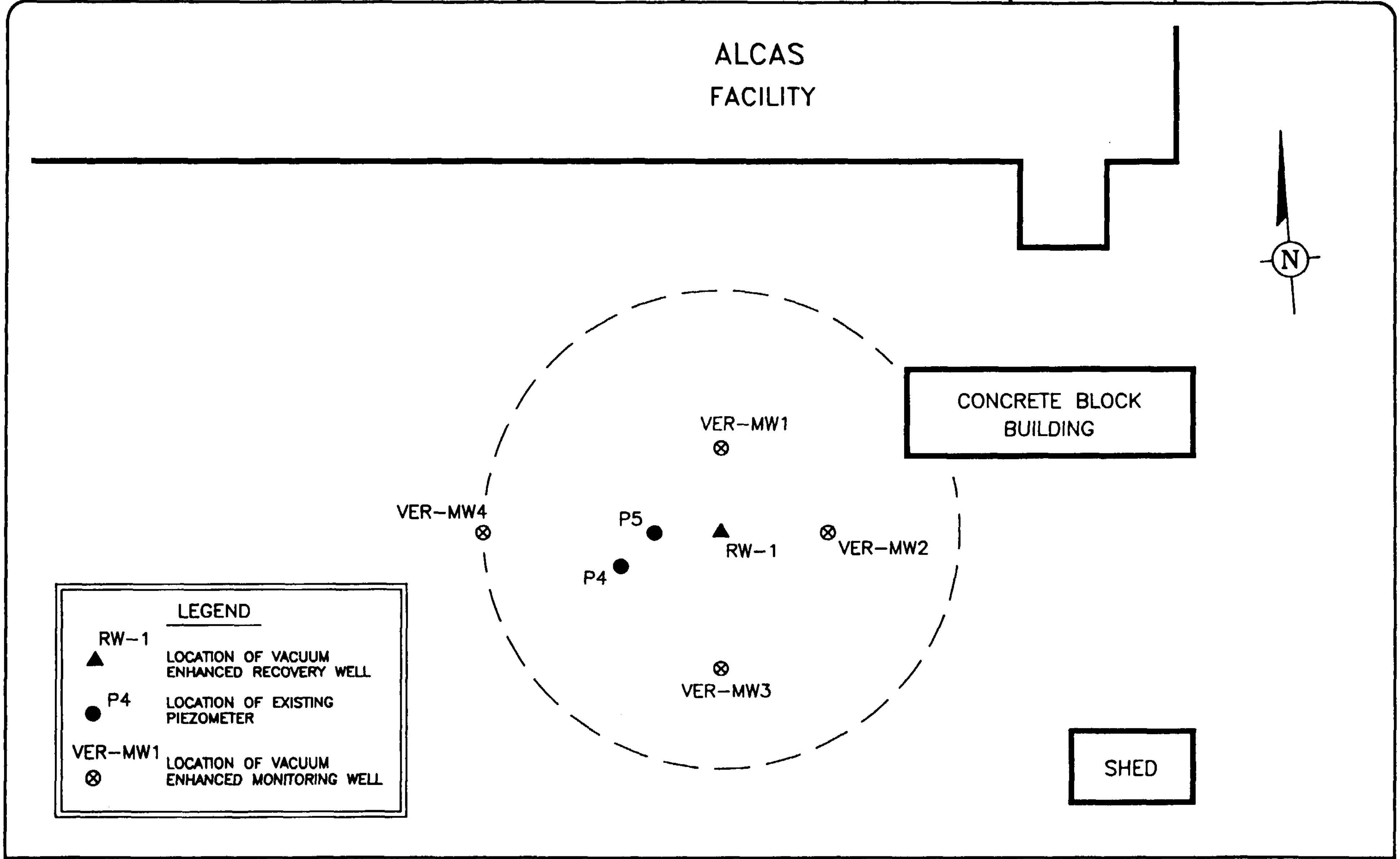
NO SCALE

GERAGHTY & MILLER, INC.
Environmental Services

PORTABLE PILOT TEST TRAILER EQUIPMENT SCHEMATIC
ALCAS FACILITY
OLEAN, NEW YORK

FIGURE
4

DATE: DEC. 1994 | PRJCT. NO.: AY0179001 | FILE NO.: | CAD FILE: G2118 | COMPILER: M. WRIGHT | MGR.: B. GRAY | DRAFTER: TAD/FJF



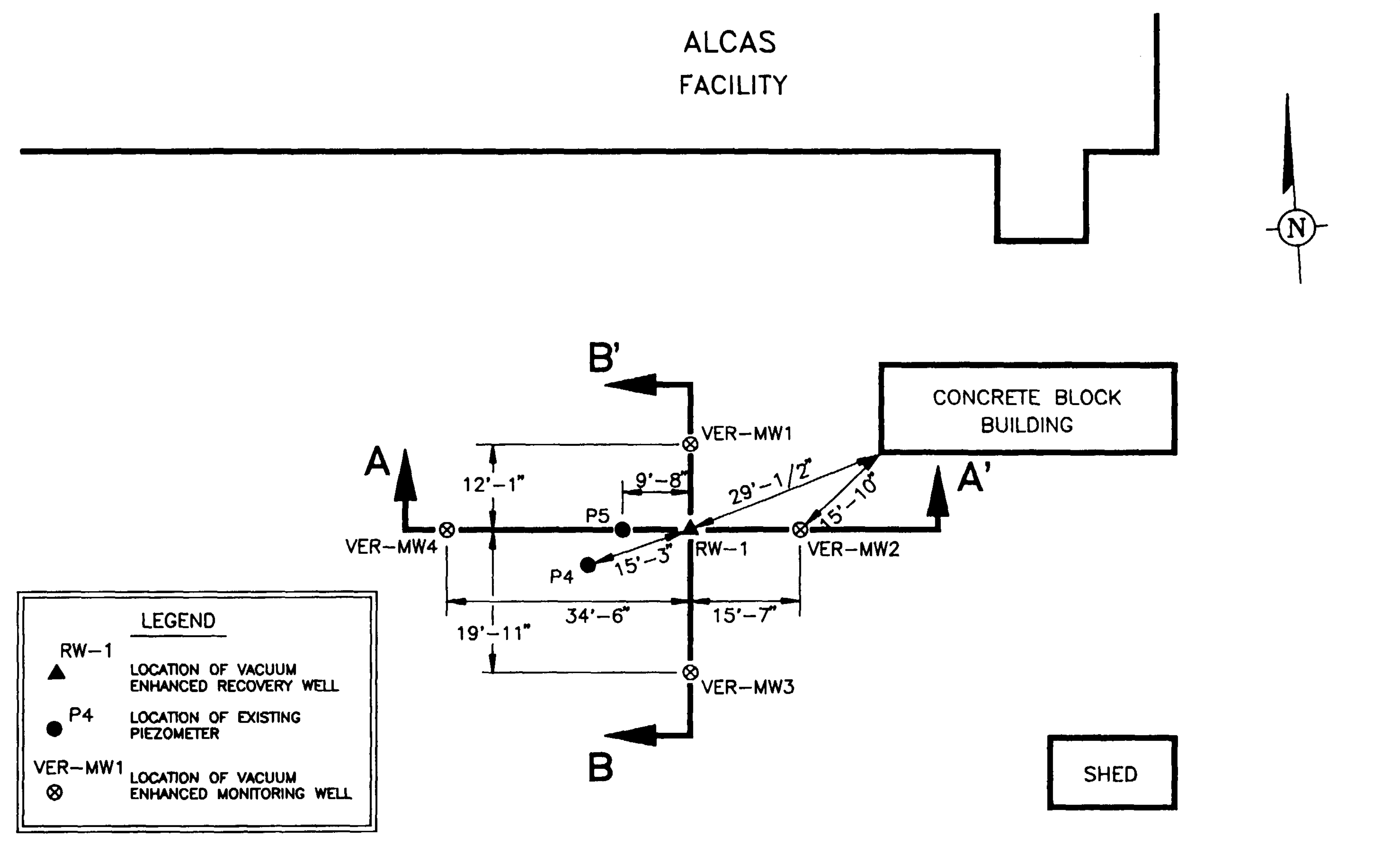
0 20
Scale in feet

GERAGHTY & MILLER, INC.
Environmental Services

MINIMUM RADIUS OF INFLUENCE
VACUUM ENHANCED RECOVERY PILOT TEST
ALCAS FACILITY
OLEAN, NEW YORK

FIGURE
5

DATE: DEC. .4	PRJCT. NO.: AY0179001	FILE NO.:	CAD FILE: G2118	C ER: M. WRIGHT	MGR.: B. GRAY	DRAFTER: TAD/FJF

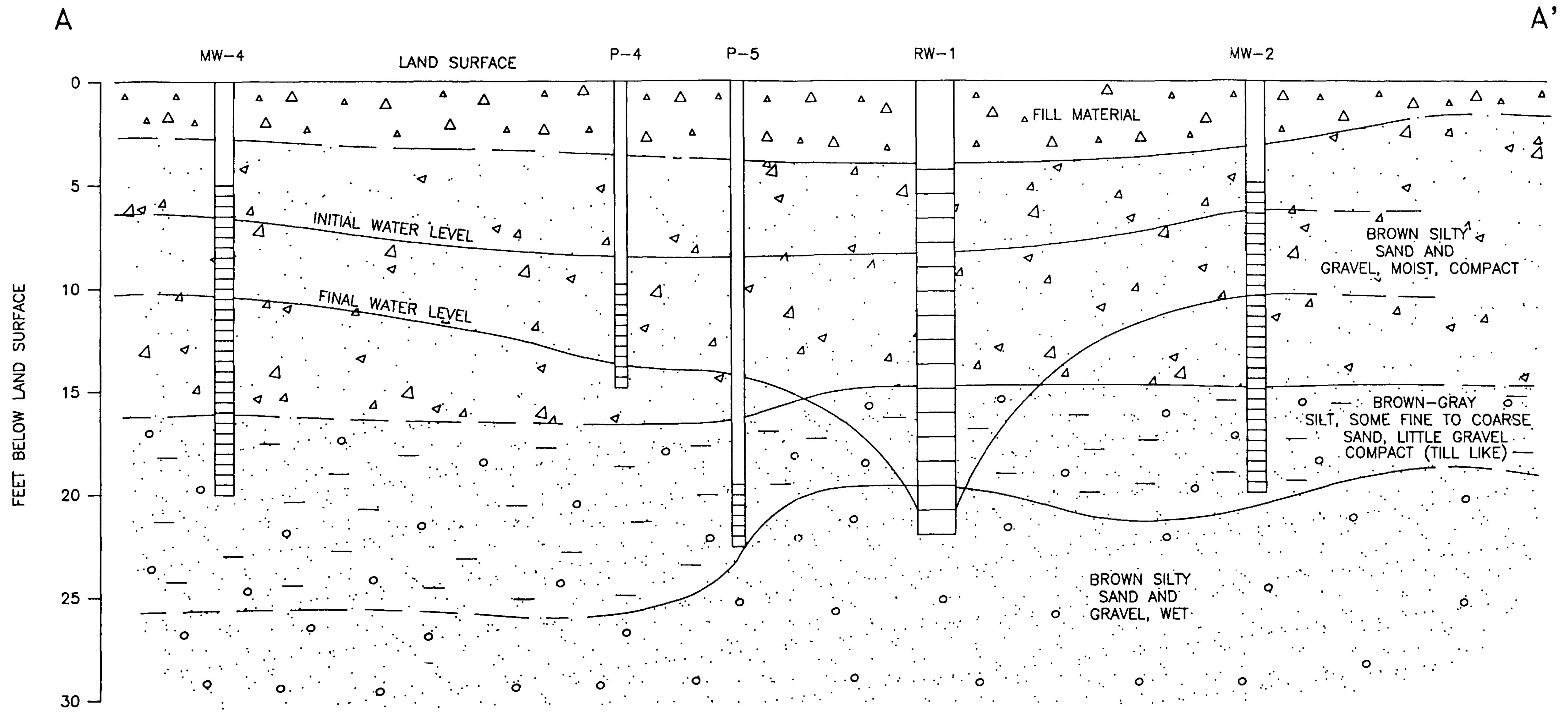


0 20
Scale in feet

GERAGHTY & MILLER, INC.
Environmental Services

LOCATION OF CROSS SECTIONS A–A' AND B–B'
ALCAS FACILITY
OLEAN, NEW YORK

FIGURE 6



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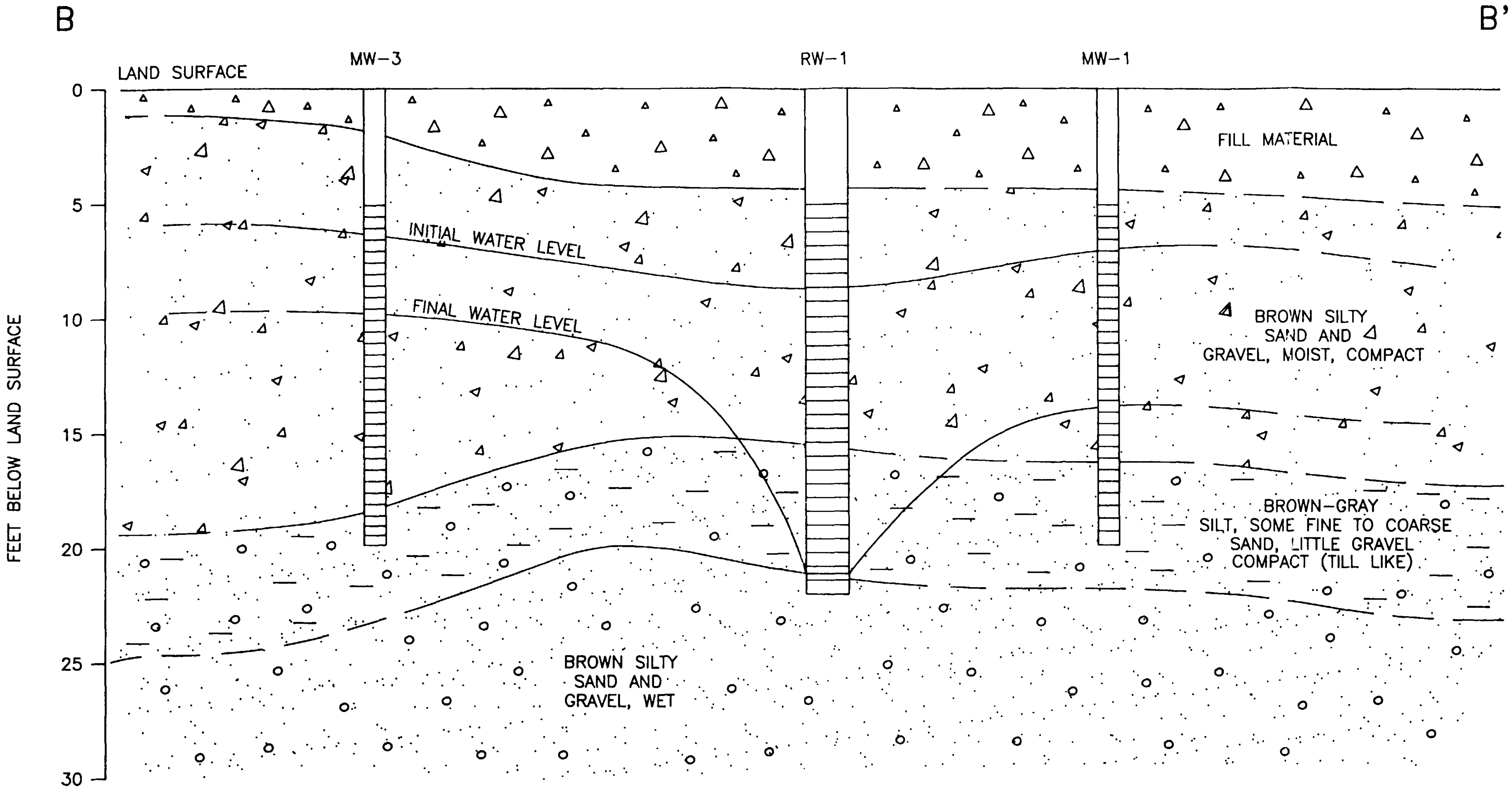
SCALE: 1" = 5'

CROSS SECTION A–A'
INITIAL AND STEADY STATE WATER DEPTHS
ALCAS SITE
OLEAN, NEW YORK

FIGURE
7



GERAGHTY & MILLER, INC.
Environmental Services

SCALE: 1" = 5'

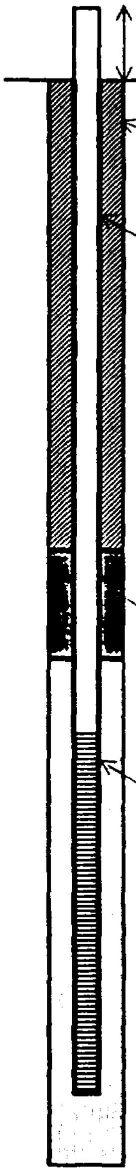
CROSS SECTION B-B'
INITIAL AND STEADY STATE WATER DEPTHS
ALCAS SITE
OLEAN, NEW YORK

FIGURE
8

APPENDIX A

WELL CONSTRUCTION LOGS

WELL CONSTRUCTION LOG
(UNCONSOLIDATED)



2 ft.
Land Surface

10 inch diameter
drilled hole

Well Casing
4 inch diameter,
Schedule 40 PVC

☐ Backfill
☒ Grout Cement

2.0 ft.*

Bentonite ☐ slurry
4.0 ft.* ☒ pellets

5.0 ft.*

Well Screen
4 inch diameter
PVC .020 slot

☐ Gravel Pack
☒ Sand Pack
☐ Formation Collapse

20.0 ft.

22.0 ft.

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project Alcas (AY0179.001) Well RW-1
Town/City Olean
County Cattaraugus State New York
Permit No. N/A
Land-Surface Elevation
and Datum ____ feet ☐ Surveyed ☐ Estimated
Installation Date(s) 14-Nov-94
Drilling Method Hollow Stem Auger 6.25"
Drilling Contractor Parratt Wolff Inc.
Drilling Fluid None

Development Technique(s) and Date(s)
No Development Conducted

Fluid Loss During Drilling None gallons
Water Removed During Development N/A gallons
Static Depth to Water ____ feet below M.P.
Pumping Depth to Water N/A feet below M.P.
Pumping Duration N/A hours
Yield N/A gpm Date ____
Specific Capacity N/A gpm/ft.

Well Purpose Vacuum Enhanced Recovery Pilot Test
Well

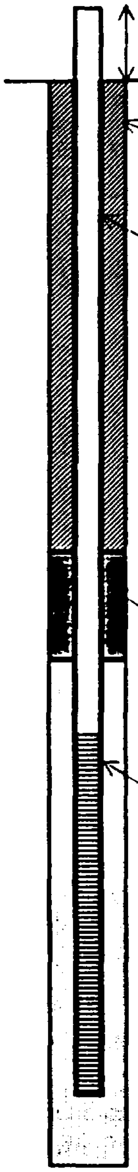
Remarks Bentonite Pellets Hydrated for Proper Seal

A 2-foot solid sump was installed at the bottom of the
well screen from 20 feet to 22 feet below land surface.

Prepared by Michael T. Wright

WELL CONSTRUCTION LOG

(UNCONSOLIDATED)



2 ft.

Land Surface

8 inch diameter drilled hole

Well Casing
2 inch diameter,
Schedule 40 PVC

☐ Backfill
☒ Grout Cement

2.0 ft.*

Bentonite ☐ slurry
4.0 ft.* ☒ pellets

5.0 ft.*

Well Screen
2 inch diameter
PVC .020 slot

☐ Gravel Pack
☒ Sand Pack
☐ Formation Collapse

20.0 ft.

21.0 ft.

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project Alcas (AY0179.001) Well VER-MW-1
Town/City Olean
County Cattaraugus State New York
Permit No. N/A
Land-Surface Elevation
and Datum ______ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 15-Nov-94
Drilling Method Hollow Stem Auger 4.25"
Drilling Contractor Parratt Wolff Inc.
Drilling Fluid None

Development Technique(s) and Date(s)
No Development Conducted

Fluid Loss During Drilling None gallons
Water Removed During Development N/A gallons
Static Depth to Water ______ feet below M.P.
Pumping Depth to Water N/A feet below M.P.
Pumping Duration N/A hours
Yield N/A gpm Date ______
Specific Capacity N/A gpm/ft.

Well Purpose Vacuum Enhanced Recovery Pilot Test
Monitoring Well

Remarks Bentonite Pellets Hydrated for Proper Seal

Prepared by Michael T. Wright

WELL CONSTRUCTION LOG
(UNCONSOLIDATED)

2 ft.
Land Surface

8 inch diameter drilled hole

Well Casing
2 inch diameter,
Schedule 40 PVC

☐ Backfill
☒ Grout Cement

2.0 ft.*

Bentonite ☐ slurry
4.0 ft.* ☒ pellets

5.0 ft.*

Well Screen
2 inch diameter
PVC .020 slot

☐ Gravel Pack
☒ Sand Pack
☐ Formation Collapse

20.0 ft.

21.0 ft.

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project Alcas (AY0179.001) Well VER-MW-2
Town/City Olean
County Cattaraugus State New York
Permit No. N/A
Land-Surface Elevation
and Datum ______ feet ☐ Surveyed ☐ Estimated
Installation Date(s) 15-Nov-94
Drilling Method Hollow Stem Auger 4.25"
Drilling Contractor Parratt Wolff Inc.
Drilling Fluid None

Development Technique(s) and Date(s)
No Development Conducted

Fluid Loss During Drilling None gallons
Water Removed During Development N/A gallons
Static Depth to Water ______ feet below M.P.
Pumping Depth to Water N/A feet below M.P.
Pumping Duration N/A hours
Yield N/A gpm Date ______
Specific Capacity N/A gpm/ft.

Well Purpose Vacuum Enhanced Recovery Pilot Test
Monitoring Well

Remarks Bentonite Pellets Hydrated for Proper Seal

Prepared by Michael T. Wright

WELL CONSTRUCTION LOG
(UNCONSOLIDATED)

2 ft.
Land Surface

8 inch diameter drilled hole

Well Casing
2 inch diameter,
Schedule 40 PVC

☐ Backfill
☒ Grout Cement

2.0 ft.*

Bentonite ☐ slurry
4.0 ft.* ☒ pellets

5.0 ft.*

Well Screen
2 inch diameter
PVC .020 slot

☐ Gravel Pack
☒ Sand Pack
☐ Formation Collapse

20.0 ft.

21.0 ft.

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project Alcas (AY0179.001) Well VER-MW-3
Town/City Olean
County Cattaraugus State New York
Permit No. N/A
Land-Surface Elevation
and Datum _____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 15-Nov-94
Drilling Method Hollow Stem Auger 4.25"
Drilling Contractor Parratt Wolff Inc.
Drilling Fluid None

Development Technique(s) and Date(s)
No Development Conducted

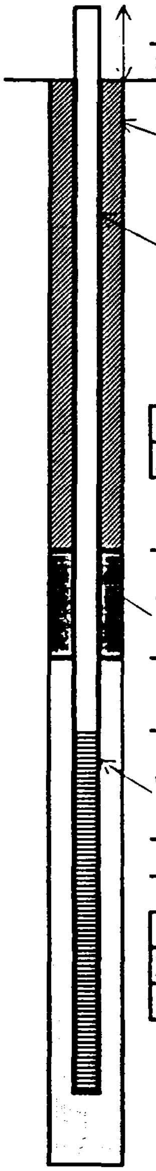
Fluid Loss During Drilling None gallons
Water Removed During Development N/A gallons
Static Depth to Water _____ feet below M.P.
Pumping Depth to Water N/A feet below M.P.
Pumping Duration N/A hours
Yield N/A gpm Date _____
Specific Capacity N/A gpm/ft.

Well Purpose Vacuum Enhanced Recovery Pilot Test
Monitoring Well

Remarks Bentonite Pellets Hydrated for Proper Seal

Prepared by Michael T. Wright

WELL CONSTRUCTION LOG
(UNCONSOLIDATED)



2 ft.
Land Surface

8 inch diameter drilled hole

Well Casing
2 inch diameter, Schedule 40 PVC

☐ Backfill
☒ Grout Cement

2.0 ft.*

Bentonite ☐ slurry
4.0 ft.* ☒ pellets

5.0 ft.*

Well Screen
2 inch diameter
PVC .020 slot

☐ Gravel Pack
☒ Sand Pack
☐ Formation Collapse

20.0 ft.

21.0 ft.

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project Alcas (AY0179.001) Well VER-MW-4
Town/City Olean
County Cattaraugus State New York
Permit No. N/A
Land-Surface Elevation
and Datum ________ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 15-Nov-94
Drilling Method Hollow Stem Auger 4.25"
Drilling Contractor Parratt Wolff Inc.
Drilling Fluid None

Development Technique(s) and Date(s)
No Development Conducted

Fluid Loss During Drilling None gallons
Water Removed During Development N/A gallons
Static Depth to Water ________ feet below M.P.
Pumping Depth to Water N/A feet below M.P.
Pumping Duration N/A hours
Yield N/A gpm Date ________
Specific Capacity N/A gpm/ft.

Well Purpose Vacuum Enhanced Recovery Pilot Test
Monitoring Well

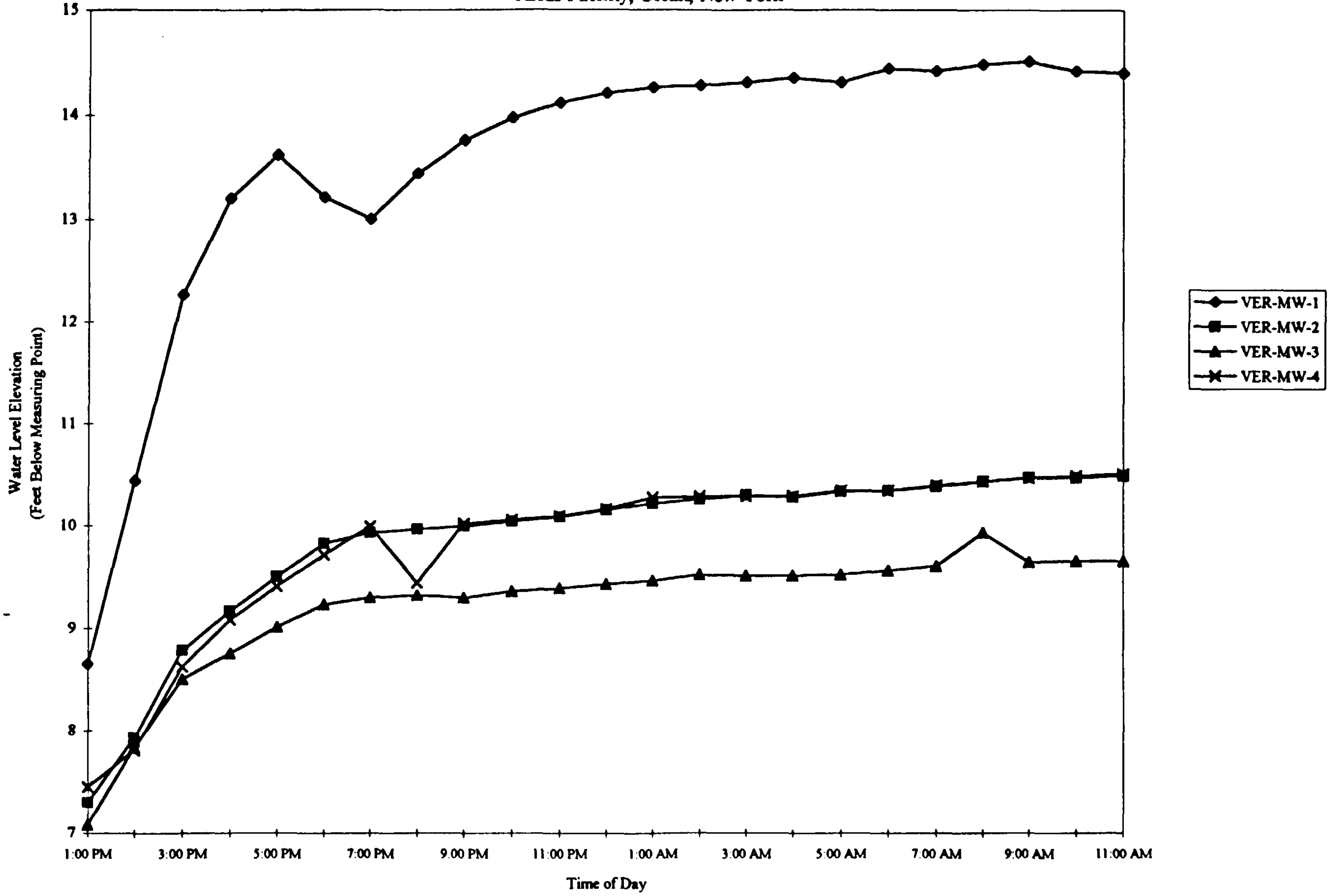
Remarks Bentonite Pellets Hydrated for Proper Seal

Prepared by Michael T. Wright

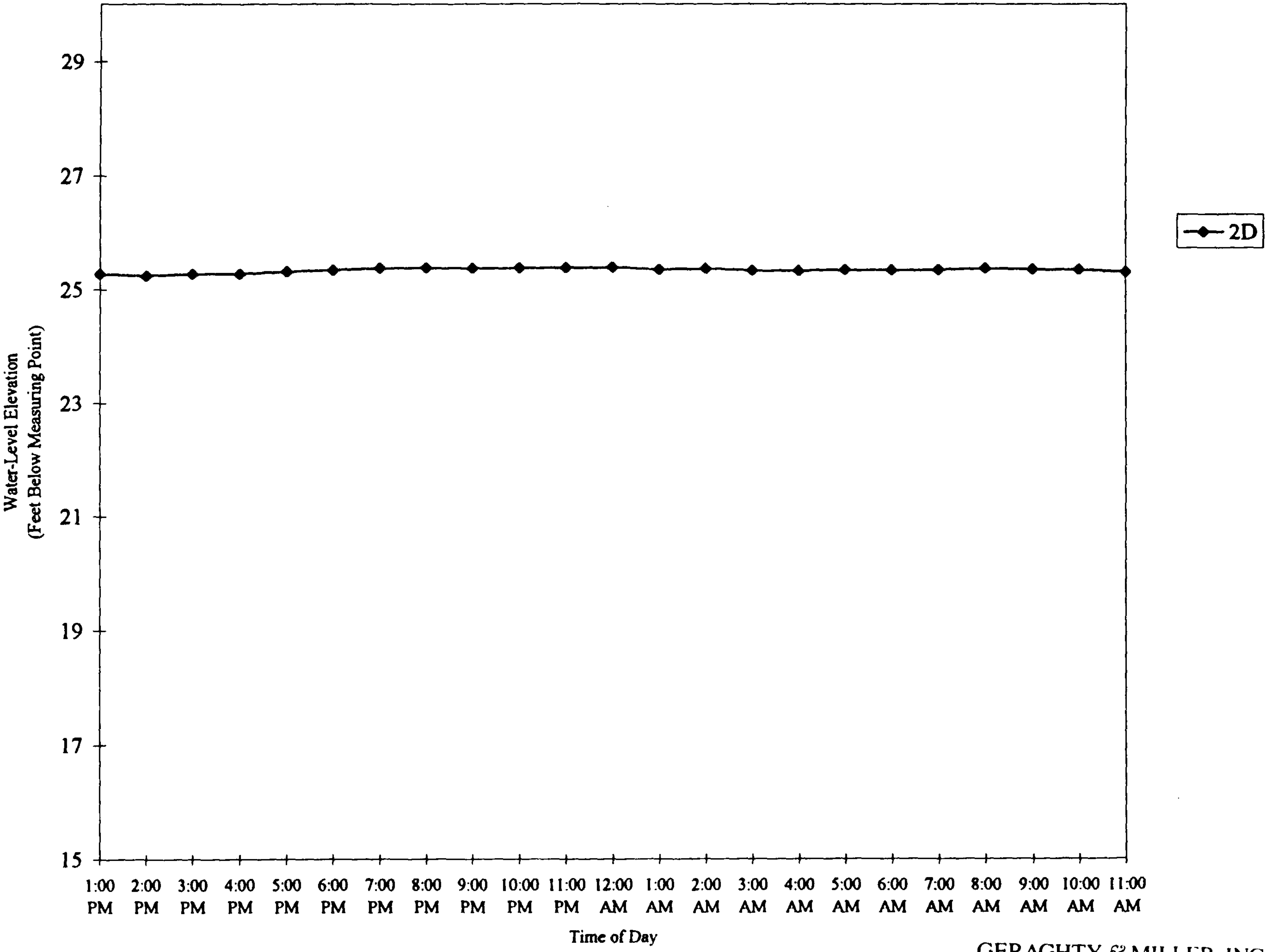
APPENDIX B

DRAWDOWN GRAPHS

Vacuum Enhanced Recovery Pilot Test
Recovery Well RW-1
Groundwater Level Fluctuation Data
Alcas Facility, Olean, New York



Vacuum Enhanced Recovery Pilot Test
Recovery Well RW-1
Groundwater Level Fluctuation Data
Alcas Facility, Olean, New York



APPENDIX C

LABORATORY RESULTS

MICROSEEPS

University of Pittsburgh Applied Research Center
220 William Pitt Way, Pittsburgh, PA 15238
(412) 826-5245
FAX (412) 826-3433

November 30, 1994

Mr. Michael T. Wright
Geraghty & Miller Inc.
24 Madison Avenue Extension
Albany, NY 12203

Dear Mr. Wright:

Attached is the final data listing for the samples we received on November 18, 1994, your reference AY0178.001.

Please give me a call if you have questions or I can be of further assistance. Thank you for using MICROSEEPS.

Sincerely,

David J. Masdea

DJM/lsp

Attachment GM616

DEC - 5

Geochemical and Environmental Surveying for Government and Industry

MICROSEEPS

ANALYSIS OF VOLATILE ORGANICS IN GAS SAMPLES

Gas samples are received and secured in accordance with Microseeps documented sample receipt procedures. Analyses are performed using Microseeps Analytical Method AM4.02. Analytical method AM4.02 is a modification of USEPA Method 3810 (Headspace) and 8000 (Gas Chromatography). Modifications implemented are to accommodate the gas phase sample type only. All applicable quality control procedures are followed including continuing calibration check standards and laboratory blanks. Microseeps Analytical Method AM4.02 will be supplied upon request.

MICROSEEPS

GM616

----- GERAGHTY & MILLER, INC. -----
----- PROJECT LOC. OLEAN, NY -----
----- PROJECT NO. AY0178.001 -----
----- 601/602 SCAN -----
----- CONCENTRATIONS IN PPMV -----

COMPOUND NAME	SAMPLE INFLUENT-1	SAMPLE INFLUENT-2	SAMPLE INFLUENT-3	LDLs
CHLOROMETHANE	<1	<1	<1	1
VINYL CHLORIDE	323	88	55	1
BROMOMETHANE/CHLOROETHANE*	<1	<1	<1	1
FLUOROTRICHLOROMETHANE	<.005	<.005	<.005	0.005
1,1 DICHLOROETHYLENE	4.66	1.12	0.75	0.01
METHYLENE CHLORIDE	<1	<1	<1	1.0
TRANS-1,2 DICHLOROETHYLENE	7.1	3.3	2.4	0.1
1,1 DICHLOROETHANE	0.22	0.11	0.08	0.01
CHLOROFORM	0.493	0.286	0.217	0.005
1,1,1 TRICHLOROETHANE	0.509	0.260	0.202	0.005
CARBON TETRACHLORIDE	0.043	0.021	0.020	0.005
BENZENE	0.22	0.13	0.10	0.07
1,2 DICHLOROETHANE	0.15	0.09	0.07	0.01
TRICHLOROETHYLENE	2381.709	1238.229	951.498	0.005
1,2 DICHLOROPROPANE	<.01	<.01	<.01	0.01
BROMODICHLOROMETHANE	0.018	0.011	0.007	0.005
CIS-1,3 DICHLOROPROPYLENE	<.01	<.01	<.01	0.01
TOLUENE	0.46	0.32	0.37	0.07
TRANS-1,3 DICHLOROPROPYLENE	<.01	<.01	<.01	0.01
1,1,2 TRICHLOROETHANE	0.423	0.328	0.231	0.005
TETRACHLOROETHYLENE	1.913	1.265	1.068	0.005
CHLORODIBROMOMETHANE	<.005	<.005	<.005	0.005
CHLOROBENZENE	<.07	<.07	<.07	0.07
ETHYL BENZENE	<.07	<.07	<.07	0.07
BROMOFORM	<.005	<.005	<.005	0.005
1,1,2,2 TETRACHLOROETHANE	<.005	<.005	<.005	0.005
1,3 DICHLOROBENZENE	<.07	<.07	<.07	0.07
1,4 DICHLOROBENZENE	<.07	<.07	<.07	0.07
1,2 DICHLOROBENZENE	<.07	<.07	<.07	0.07
FILE NAME	W47 101	W47 102	W47 103	
DATE SAMPLED	11/16/94	11/17/94	11/17/94	
DATE RECEIVED	11/18/94	11/18/94	11/18/94	
DATE ANALYZED	11/20/94	11/20/94	11/20/94	

* COMPOUNDS ELUTE TOGETHER ON ECD: VALUES REPRESENT EITHER OR A COMBINATION OF BOTH.

22-Nov-94 ANALYST INITIALS ______ LAB MANAGER INITIALS DJM

MICROSEEPS

GM616

**** QUALITY CONTROL ****
----- GERAGHTY & MILLER, INC. -----
----- PROJECT LOC. OLEAN, NY -----
----- PROJECT NO. AY0178.001 -----
----- 601/602 SCAN -----
----- CONCENTRATIONS IN PPMV -----

CONTINUING CALIBRATION CHECK

STANDARDS: "624"(LEVEL 2), "624"(LEVEL 1), "VC-996"
REFERENCE: W47A/B.94, W47A/B.95, W47A.96

COMPOUND	KNOWN	RESULT	PERCENT DIFFERENCE
CHLOROMETHANE	2.1	1.8	13.97
VINYL CHLORIDE	996.0	966.2	3.08
BROMOMETHANE/CHLOROETHANE*	2.7	2.8	4.53
FLUOROTRICHLOROMETHANE	0.765	0.798	4.14
1,1 DICHLOROETHYLENE	1.09	1.08	0.09
METHYLENE CHLORIDE	1.24	1.24	0.40
TRANS-1,2 DICHLOROETHYLENE	1.09	1.12	2.69
1,1 DICHLOROETHANE	1.06	1.09	2.21
CHLOROFORM	0.881	0.914	3.61
1,1,1 TRICHLOROETHANE	0.788	0.831	5.17
CARBON TETRACHLORIDE	0.684	0.711	3.80
BENZENE & 1,2-DCA**	2.41	2.52	4.29
1,2 DICHLOROETHANE	1.06	1.05	0.85
TRICHLOROETHYLENE	0.800	0.862	7.19
1,2 DICHLOROPROPANE	0.93	0.91	1.86
BROMODICHLOROMETHANE	0.642	0.662	3.02
CIS-1,3 DICHLOROPROPYLENE	0.95	0.95	0.32
TOLUENE	1.14	1.15	0.78
TRANS-1,3 DICHLOROPROPYLENE	0.95	0.94	0.85
1,1,2 TRICHLOROETHANE	0.788	0.797	1.13
TETRACHLOROETHYLENE	0.634	0.631	0.48
CHLORODIBROMOMETHANE	0.505	0.511	1.17
CHLOROBENZENE	0.93	0.91	2.75
ETHYL BENZENE	0.99	0.97	2.27
BROMOFORM	0.416	0.409	1.71
1,1,2,2 TETRACHLOROETHANE	0.626	0.580	7.93
1,3 DICHLOROBENZENE	0.72	0.62	15.14
1,4 DICHLOROBENZENE	0.72	0.60	18.38
1,2 DICHLOROBENZENE	0.72	0.62	15.70

* COMPOUNDS ELUTE TOGETHER ON ECD: VALUES REPRESENT EITHER OR A COMBINATION OF BOTH.
** COMPOUNDS ELUTE TOGETHER ON FID - VALUE REPRESENTS A COMBINATION OF BOTH.

22-Nov-94 ANALYST INITIALS LAB MANAGER INITIALS

MICROSEEPS

GM616

**** QUALITY CONTROL ****
----- GERAGHTY & MILLER, INC. -----
----- PROJECT LOC. OLEAN, NY -----
----- PROJECT NO. AY0178.001 -----
----- 601/602 SCAN -----
----- CONCENTRATIONS IN PPMV -----

LABORATORY BLANK RESULTS

BLANK: N2 IN VIAL
REFERENCE: W47A/B1.00

COMPOUND	BLANK	LOWER DETECTION LIMIT
CHLOROMETHANE	ND	1.0
VINYL CHLORIDE	ND	1.0
BROMOMETHANE/CHLOROETHANE*	ND	1.0
FLUOROTRICHLOROMETHANE	ND	0.005
1,1 DICHLOROETHYLENE	ND	0.01
METHYLENE CHLORIDE	ND	1.00
TRANS-1,2 DICHLOROETHYLENE	ND	0.10
1,1 DICHLOROETHANE	ND	0.01
CHLOROFORM	ND	0.005
1,1,1 TRICHLOROETHANE	ND	0.005
CARBON TETRACHLORIDE	ND	0.005
BENZENE	ND	0.07
1,2 DICHLOROETHANE	ND	0.01
TRICHLOROETHYLENE	ND	0.005
1,2 DICHLOROPROPANE	ND	0.01
BROMODICHLOROMETHANE	ND	0.005
CIS-1,3 DICHLOROPROPYLENE	ND	0.01
TOLUENE	ND	0.07
TRANS-1,3 DICHLOROPROPYLENE	ND	0.01
1,1,2 TRICHLOROETHANE	ND	0.005
TETRACHLOROETHYLENE	ND	0.005
CHLORODIBROMOMETHANE	ND	0.005
CHLOROBENZENE	ND	0.07
ETHYL BENZENE	ND	0.07
BROMOFORM	ND	0.005
1,1,2,2 TETRACHLOROETHANE	ND	0.005
1,3 DICHLOROBENZENE	ND	0.07
1,4 DICHLOROBENZENE	ND	0.07
1,2 DICHLOROBENZENE	ND	0.07

* COMPOUNDS ELUTE TOGETHER ON ECD - VALUES REPRESENT EITHER OR A COMBINATION OF BOTH.
** COMPOUNDS ELUTE TOGETHER ON FID - VALUE REPRESENTS A COMBINATION OF BOTH.

400115

22-Nov-94 ANALYST INITIALS GLW LAB MANAGER INITIALS DTM

MICROSEEPS

GM616

----- GERAGHTY & MILLER, INC. -----
----- PROJECT LOC: OLEAN, NY -----
----- PROJECT NO. AY0178.001 -----

SAMPLE NAME	CO2 (%)	OXYGEN (%)	NITROGEN (%)	METHANE (%)	CO (%)	FILE NAME	DATE COLLECTED	DATE RECEIVED	DATE ANALYZED
INFLUENT-1	6.77	16.68	74.56	0.08	<.01	P4A 37	11/16/94	11/18/94	11/18/94
INFLUENT-2	2.56	19.50	76.33	0.20	<.01	P4A 40	11/17/94	11/18/94	11/18/94
INFLUENT-3	1.93	19.58	75.63	0.17	<.01	P4A 39	11/17/94	11/18/94	11/18/94
MDLs FOR ABOVE SAMPLES	0.01	0.01	0.01	0.01	0.01				

22-Nov-94

ANALYST INITIALS

LAB MANAGER INITIALS DJM

MICROSEEPS

GM616

**** QUALITY CONTROL ****

----- GERAGHTY & MILLER, INC. -----
----- PROJECT LOC: OLEAN, NY -----
----- PROJECT NO. AY0178.001 -----

CONTINUING CALIBRATION CHECK

STANDARDS: "237"
REFERENCE: P4A 36

COMPOUND	KNOWN (%)	RESULT (%)	PERCENT DIFFERENCE
CO2	15.00	15.17	1.12
OXYGEN	7.03	7.08	0.71
NITROGEN	66.47	67.56	1.61
METHANE	4.50	4.20	7.14
CO	7.00	7.15	2.10

LABORATORY BLANK RESULTS

BLANK: HE IN LOOP
REFERENCE: P4A 38

COMPOUND	BLANK (%)	LOWER DETECTION LIMIT (%)
CO2	ND	0.01
OXYGEN	ND	0.01
NITROGEN	ND	0.01
METHANE	ND	0.01
CO	ND	0.01

22-Nov-94

ANALYST INITIALS

LAB MANAGER INITIALS DJM

5 61

MICROSEEPS, Inc.

220 William Pitt Way, Pittsburgh, PA 15238
Phone: (412) 826-5245 Fax: (412) 826-3433

CHAIN-OF-CUSTODY RECORD

Note: Enter proper letters in Requested Analyses columns below.

Note: If analysis D,E,or K is selected, scratch (option) NOT wanted.

Company Name: GERAGHTY & MILLER, INC.
ldress: 24 MADISON AVE EXT. ALBANY, NY 12203
bj. Manager: BILL GRAY
oj. Location: OLEAN, NY
Proj. Number: AY0178.001
Phone # : 518 452 7826 Fax # : 518 452 4398

Sampler's signature :

Analysis Options

* A	C1 -C4	G	Chlorinated HC
* B	Hydrogen & Helium	H	BTEX
* C	Permanent Gases (CH4, CO, CO2, N2, O2)	J	BTEX & C5 - C10
D	Mercury (Soil) or (Air **)	K	TPH (C5 - C10) or (C4 -C12)
E	TO-14 by GC/MS (Ambient) or (Source **)	L	C11 - C18
F	601 & 602 Compounds	Other	Specify below.

* An additional 22 ml vial of sample is required when requested in combination with another analysis.

** Available upon request.

Collection Date	Collection Time	Number of Containers	"Summa" # if Can. used	Sample Type	Sample Identification	Requested Analyses					(Other)	Remarks
11-16		3		AIR	INFLUENT 1	C					624 SCAN	
11-17		2		AIR	INFLUENT 2	C					624 SCAN	
11-17		3		AIR	INFLUENT 3	C					624 SCAN	

Results to : MICHAEL WRIGHT
GERAGHTY & MILLER
ABOVE ADDRESS

Invoice to :

Relinquished by : MICHAEL WRIGHT	Company : GERAGHTY & MILLER	Date : 11-17-94	Time : 4:20	Received by :	Company : MICROSEEPS	Date : 11/18/94	Time : 1300
Relinquished by :	Company :	Date :	Time :	Received by :	Company :	Date :	Time :
Relinquished by :	Company :	Date :	Time :	Received by :	Company :	Date :	Time :

WHITE COPY : Laboratory to return. YELLOW COPY : Laboratory PINK COPY : Submitter

IEA
An Aquarion Company

200 Monroe Turnpike
Monroe, Connecticut 06468

Phone 203·261·4458
Fax 203·268·5346

November 30, 1994

Mr. Bill Gray
Geraghty & Miller
24 Madison Avenue Extension
Albany, NY 12203

Dear Mr. Gray:

Please find enclosed the analytical results of seven samples received at our laboratory on November 18, 1994. This report contains sections addressing the following information at a minimum:

- sample summary
- analytical methodology
- state certifications
- definitions of data qualifiers and terminology
- analytical results
- chain-of-custody

IEA Report #3094-1327	Purchase Order #AY0179.001
Project ID: OLEAN	

Copies of this analytical report and supporting data are maintained in our files for a minimum of five years unless special arrangements have been made. Unless specifically indicated, all analytical testing was performed at this laboratory location and no portion of the testing was subcontracted.

We appreciate your selection of our services and welcome any questions or suggestions you may have relative to this report. Please contact your customer service representative at (203) 261-4458 for any additional information. Thank you for utilizing our services; we hope you will consider us for your future analytical needs.

I have reviewed and approved the enclosed data for final release.

Very truly yours,

Jeffrey C. Curran
Laboratory Manager

DEC - 5

JCC/adj

3094-1327
GERAGHTY & MILLER
PROJECT SUMMARY

The samples were analyzed for the parameters listed in the Analytical Summary Table.

METHODOLOGY/DISCUSSION

Volatile Organics - Volatile organics were determined by purge and trap GC/MS using guidance provided in Method 8240A. The instrumentation used was a Tekmar/Dynamic Headspace Concentrator interfaced with a Hewlett-Packard Model 5995/5972A GC/MS/DS or a Tekmar/Dynamic Headspace Concentrator interfaced with a Hewlett-Packard Gas Chromatograph coupled with a Mass Selective Detector.

Due to high target compound concentrations, the following samples were analyzed at dilutions:

INFLUENT-1 - 1:100
INFLUENT-2 - 1:50
INFLUENT-3 - 1:50
INFLUENT-4 - 1:50
INFLUENT-5 - 1:25

RESULTS

The results are presented in the following Tables. Also enclosed is all relevant data.

Aqueous

TABLE VO-1.0
3094-1327
GERAGHTY & MILLER
EPA TCL VOLATILE ORGANICS

All values are ug/L.

Sample Identification

Dilution Factor	1.0	1.0	100.0	50.0	
Method Blank I.D.	VBLKG8	VBLKG8	VBLKG8	VBLKG8	
Compound	Method Blank	TB 111794	INFLUENT -1	INFLUENT -2	Quantitation Limits with no Dilution
Chloromethane	U	U	U	U	10
Bromomethane	U	U	U	U	10
Vinyl Chloride	U	U	390J	110J	10
Chloroethane	U	U	U	U	10
Methylene Chloride	U	0.6J	110J	68J	5
Acetone	8J	U	1,000B	510B	10
Carbon Disulfide	U	U	U	U	5
1,1-Dichloroethene	U	U	U	U	5
1,1-Dichloroethane	U	U	U	U	5
1,2-Dichloroethene (total)	U	U	5,100	3,100	5
Chloroform	U	1J	51J	15J	5
1,2-Dichloroethane	U	U	U	U	5
2-Butanone	U	U	U	U	10
1,1,1-Trichloroethane	U	U	U	U	5
Carbon Tetrachloride	U	U	U	U	5
Vinyl Acetate	U	U	U	U	10
Bromodichloromethane	U	U	U	U	5
1,2-Dichloropropane	U	U	U	U	5
cis-1,3-Dichloropropene	U	U	U	U	5
Trichloroethene	0.9J	1JB	14,000B	7,300B	5
Dibromochloromethane	U	U	U	U	5
1,1,2-Trichloroethane	U	U	U	U	5
Benzene	U	U	U	U	5
trans-1,3-Dichloropropene	U	U	U	U	5
Bromoform	U	U	U	U	5
4-Methyl-2-pentanone	U	U	U	U	10
2-Hexanone	U	U	U	U	10
Tetrachloroethene	U	U	U	U	5
1,1,2,2-Tetrachloroethane	U	U	U	U	5
Toluene	U	3J	U	U	5
Chlorobenzene	U	U	U	U	5
Ethylbenzene	U	0.6J	U	U	5
Styrene	U	U	U	U	5
Xylene (total)	U	3J	U	U	5

See Appendix for qualifier definitions.
Note: Sample detection limit = quantitation limit x dilution factor.

Aqueous

TABLE VO-1.1
3094-1327
GERAGHTY & MILLER
EPA TCL VOLATILE ORGANICS

All values are ug/L.

	Sample Identification				
Dilution Factor	1.0	50.0	50.0	25.0	
Method Blank I.D.	VBLKG8	VBLKG8	VBLKG8	VBLKG8	
Compound	Method Blank	INFLUENT -3	INFLUENT -4	INFLUENT -5	Quantitation Limits with no Dilution
Chloromethane	U	U	U	U	10
Bromomethane	U	U	U	U	10
Vinyl Chloride	U	U	U	U	10
Chloroethane	U	U	U	U	10
Methylene Chloride	U	76J	40J	19J	5
Acetone	8J	560B	U	U	10
Carbon Disulfide	U	U	U	U	5
1,1-Dichloroethene	U	U	U	U	5
1,1-Dichloroethane	U	U	U	U	5
1,2-Dichloroethene (total)	U	2,500	1,600	1,200	5
Chloroform	U	17J	43J	24J	5
1,2-Dichloroethane	U	U	U	U	5
2-Butanone	U	U	U	U	10
1,1,1-Trichloroethane	U	U	U	U	5
Carbon Tetrachloride	U	U	U	U	5
Vinyl Acetate	U	U	U	U	10
Bromodichloromethane	U	U	U	U	5
1,2-Dichloropropane	U	U	U	U	5
cis-1,3-Dichloropropene	U	U	U	U	5
Trichloroethene	0.9J	8,100B	5,700B	4,100B	5
Dibromochloromethane	U	U	U	U	5
1,1,2-Trichloroethane	U	U	U	U	5
Benzene	U	U	U	U	5
trans-1,3-Dichloropropene	U	U	U	U	5
Bromoform	U	U	U	U	5
4-Methyl-2-pentanone	U	U	U	U	10
2-Hexanone	U	U	U	U	10
Tetrachloroethene	U	U	U	U	5
1,1,2,2-Tetrachloroethane	U	U	U	U	5
Toluene	U	U	U	U	5
Chlorobenzene	U	U	U	U	5
Ethylbenzene	U	U	U	U	5
Styrene	U	U	U	U	5
Xylene (total)	U	U	U	U	5

See Appendix for qualifier definitions.
Note: Sample detection limit = quantitation limit x dilution factor.

ORGANICS APPENDIX

U	Indicates that the compound was analyzed for but not detected.
J	Indicates that the compound was analyzed for and determined to be present in the sample. The mass spectrum of the compound meets the identification criteria of the method. The concentration listed is an estimated value, which is less than the specified minimum detection limit but is greater than zero.
B	This flag is used when the analyte is found in the blanks as well as the sample. It indicates possible sample contamination and warns the data user to use caution when applying the results of this analyte.
N	Indicates that the compound was analyzed for but not requested as an analyte. Value will not be listed on tabular result sheet.
S	Estimated due to surrogate outliers.
X	Matrix spike compound.
(1)	Cannot be separated.
(2)	Decomposes to azobenzene. Measured and calibrated as azobenzene.
A	This flag indicates that a TIC is a suspected aldol condensation product.
E	Indicates that it exceeds calibration curve range.
D	This flag identifies all compounds identified in an analysis at a secondary dilution factor.
C	Confirmed by GC/MS.
T	Compound present in TCLP blank.
P	This flag is used for a pesticide/aroclor target analyte when there is a greater than 25 percent difference for detected concentrations between the two GC columns (see Form X).

STATE CERTIFICATIONS

In some instances it may be necessary for environmental data to be reported to a regulatory authority with reference to a certified laboratory. For your convenience, the laboratory identification numbers for the IEA-Connecticut laboratory are provided in the following table. Many states certify laboratories for specific parameters or tests within a category (i.e. method 325.2 for wastewater). The information in the following table indicates the lab is certified in a general category of testing such as drinking water or wastewater analysis. The laboratory should be contacted directly if parameter-specific certification information is required.

IEA-Connecticut
Certification Summary (as of June 1993)

State	Responsible Agency	Certification	Lab Number
Connecticut	Department of Health Services	Drinking Water, Wastewater	PH-0497
Kansas	Department of Health and Environmental Services	Drinking Water, Wastewater/Solid, Hazardous Waste	E-210/E-1185
Massachusetts	Department of Environmental Protection	Potable/Non-Potable Water	CT023
New Hampshire	Department of Environmental Services	Drinking Water, Wastewater	252891
New Jersey	Department of Environmental Protection	Drinking Water, Wastewater	46410
New York	Department of Health	CLP, Drinking Water, Wastewater, Solid/ Hazardous Waste	10602
North Carolina	Division of Environmental Management	Wastewater	388
Rhode Island	Department of Health	Chemistry...Non-Potable Water and Wastewater	A43
California	Department of Health Services	Hazardous Waste	1778

30940-1327
GERAGHTY & MILLER
SAMPLE SUMMARY

CLIENT ID	LAB ID	MATRIX	DATE COLLECTED	DATE RECEIVED
INFLUENT-1	1327001	LIQUID	11/16/94	11/18/94
INFLUENT-2	1327002	LIQUID	11/16/94	11/18/94
INFLUENT-3	1327003	LIQUID	11/16/94	11/18/94
INFLUENT-4	1327004	LIQUID	11/17/94	11/18/94
INFLUENT-5	1327005	LIQUID	11/17/94	11/18/94
TB 111794	1327006	LIQUID		11/18/94
EFFLUENT	1327007	LIQUID	11/17/94	11/18/94

IEA, INC.
ANALYTICAL SUMMARY

GERAGHTY & MILLER
OLEAN
3094-1327

#SAMPLES	MATRIX	#REPS	DESCRIPTION
6	AQUEOUS	1	TARGET COMPOUND VOLATILES

SAMPLE IDs : INFLUENT-1, INFLUENT-2, INFLUENT-3,
: INFLUENT-4, INFLUENT-5, EFFLUENT

#SAMPLES	MATRIX	#REPS	DESCRIPTION
1 QC-TB	AQUEOUS		FOR FOLLOWING PARAMETERS :
		1	TARGET COMPOUND VOLATILES

SAMPLE IDs : TB 111794

IEA
An Aquarion Company

200 Monroe Turnpike
Monroe, CT 06468
203-261-4458

CHAIN OF CUSTODY RECORD

PAGE 01 OF 01

NO. BT94-B016

IEA JOB #: 3094- 1327

CLIENT: GERAGHTY & MILLER

PROJECT ID: OLEAN

IEA PROJECT MGR: STEPHANIE PLINKETT

RUSH ☐ YES ☐ NO DUE DATE

						TESTS								GENERAL REMARKS
						8240 VOL-TCL								
						BOTTLE TYPE AND PRESERVATIVE								
						HCL VOAVIAL								
						FIELD FILTERED CIRCLE Y or N								
BOTTLE SET #	CLIENT SAMPLE ID	[illegible]	[illegible]	[illegible]	[illegible]	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	SAMPLE REMARKS
001	INFLUENT -1	11-16	AQ	001	N	3								
002	INFLUENT-2	11-16	AQ	002	N	3								
003	INFLUENT-3	11-16	AQ	003	N	3								
004	INFLUENT-4	11-17	AQ	004	N	3								
005	INFLUENT-5	11-17	AQ	005	N	3								
006	TRIP BLANK		AQ	006	N	3								
007	EFFLUENT	11-17	TB	007	N	2								

MATRIX CODES

A	AIR	S	SOIL
AQ	AQUEOUS	SL	SLUDGE
C	COMPLEX	W	WIPE
D	DRUM WASTE	O	OTHER
OI	OIL	FB	FIELD BLANK
		TB	TRIP BLANK

BOTTLES PREPPED BY: EN JOHNSON DATE / TIME: 11/8/94 1515
SIGNATURE: EN Johnson

BOTTLES REC'D BY: DATE / TIME:
SIGNATURE:

SAMPLES COLLECTED BY: MICHAEL WRIGHT DATE / TIME: 11-16 & 11-17
SIGNATURE: Michael T Wright

RECEIVED IN LAB BY: EN Johnson DATE / TIME: 11/18/94 1100
SIGNATURE: EN Johnson

REMARKS ON SAMPLE RECEIPT

☒ BOTTLES INTACT
☒ PRESERVED
☒ CHILLED
☒ CUSTODY SEALS
☒ SEALS INTACT
☐ SEE REMARKS

IEA CT
Internal Chain of Custody Form

1327

Client : G & M

Custody Seal: [✓ present] / absent
[✓ intact] / not intact

Field Chain of Custody [✓ present] / absent

Sample Tags : present / [✓ absent]
: listed / not listed

SMO Forms : present / [✓ absent]

IEA Job #: 3094-1327

Case # : USPS

Airbill #: EF365431921US

Sample #s: 001-007

Location : 34

Sample Custodian: EM JOHNSON (print) E M Johnson (signature) Date/Time: 11/18/94 1100

Laboratory Sample Number	Removed By (Full Signature)	Date	Time	Reason	Returned By (Full Signature)	Date	Time	Returned To Ref. #
1-7	Karen Zmijewski	11/25	14:00	Voa	used			

Page ____ of ____

IEA / CT
LABORATORY CHRONICLE

SAMPLE PREPARATION AND ANALYSIS SUMMARY
VOA - TCL
ANALYSIS

JOB # : 3094-1327

SAMPLE ID	MATRIX	DATE COLLECTED	DATE RECVD AT LAB	DATE EXTRACTED	DATE ANALYZED
INFLUENT-1	Aqueous	11/16/94	11/18/94	N/A	11/28/94
INFLUENT-2	Aqueous		11/18/94		
INFLUENT-3	Aqueous		11/18/94		
INFLUENT-4	Aqueous	11/17/94	11/18/94		
INFLUENT-5	Aqueous		11/18/94		
TB 111794	Aqueous		11/18/94		
EFFLUENT	Aqueous	11/17/94	11/18/94		

Section Supervisor (Signature)
Review & Approval (Printed Name) Lawrence H. Deck
(Date) 11 / 29 / 94

QC Supervisor (Signature) ____________
Review & Approval (Printed Name) ____________
(Date) ___/___/___

3A
WATER VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

ab Name: IEA Contract:

ab Code: Case No.: 1327 SAS No.: SDG No.: Z1327

atrix Spike - EPA Sample No.: INFLUENT-1

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS % REC #	QC LIMITS REC.
1,1-Dichloroethene	5000.000	0.000	5800.000	116	61-145
Trichloroethene	5000.000	14000.000	19000.000	100	71-120
Benzene	5000.000	0.000	4900.000	98	76-127
Toluene	5000.000	0.000	5000.000	100	76-125
Chlorobenzene	5000.000	0.000	5000.000	100	75-130

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD % REC #	% RPD #	QC LIMITS	
					RPD	REC.
1,1-Dichloroethene	5000.000	5800.000	116	0	14	61-145
Trichloroethene	5000.000	18000.000	80	22*	14	71-120
Benzene	5000.000	4900.000	98	0	11	76-127
Toluene	5000.000	5200.000	104	4	13	76-125
Chlorobenzene	5000.000	5200.000	104	4	13	75-130

Column to be used to flag recovery and RPD values with an asterisk

* Values outside of QC limits

PD: 1 out of 5 outside limits
pike Recovery: 0 out of 10 outside limits

COMMENTS:

APPENDIX D

VACUUM VERSUS LOG TIME GRAPHS

Figure 1
Vacuum Enhanced Recovery Test Data
Monitoring Point VER-MW-1
Alcas Facility, Olean, New York

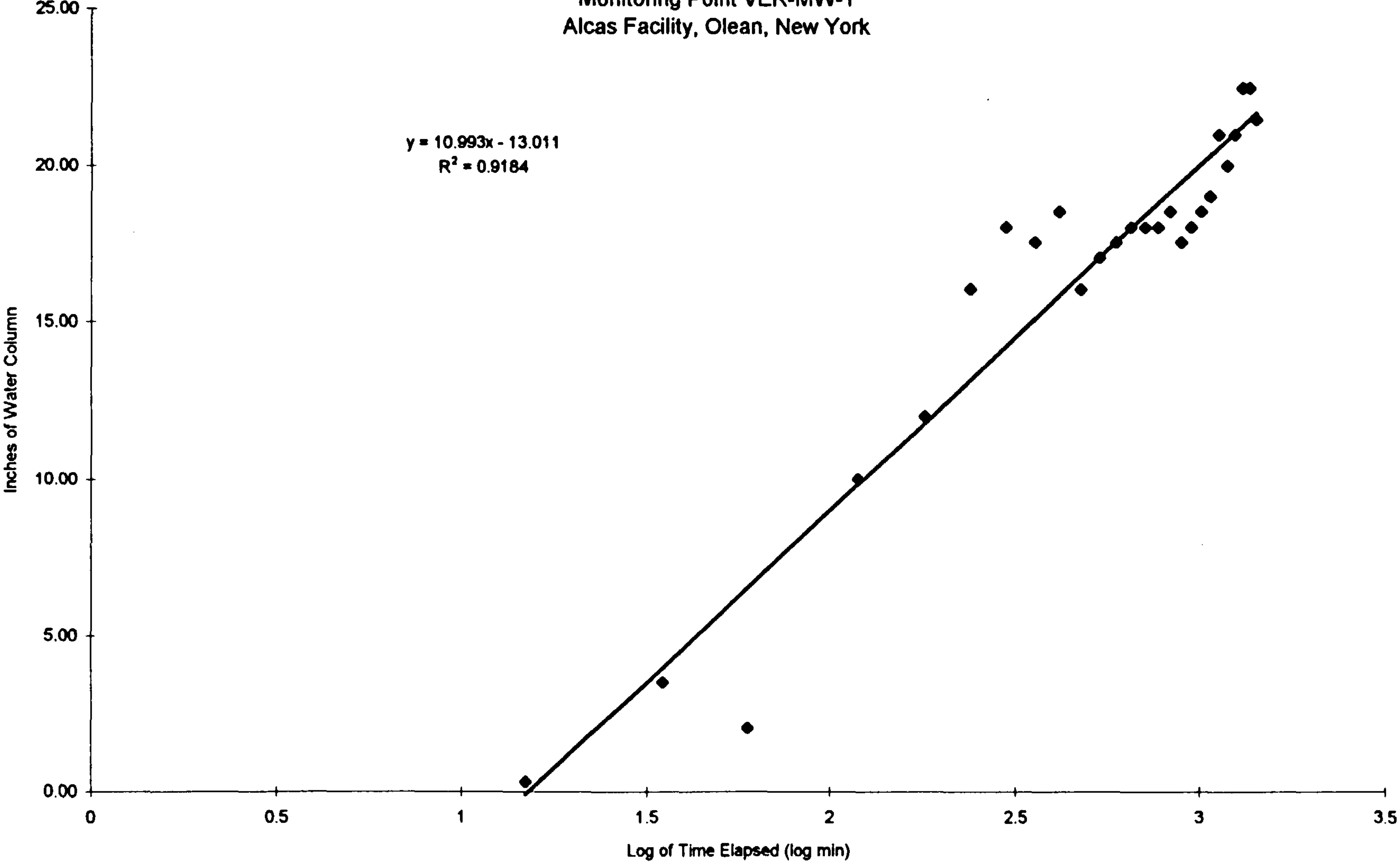


Figure 2
Vacuum Enhanced Recovery Test Data
Monitoring Point VER-MW-2
Alcas Facility, Olean, New York

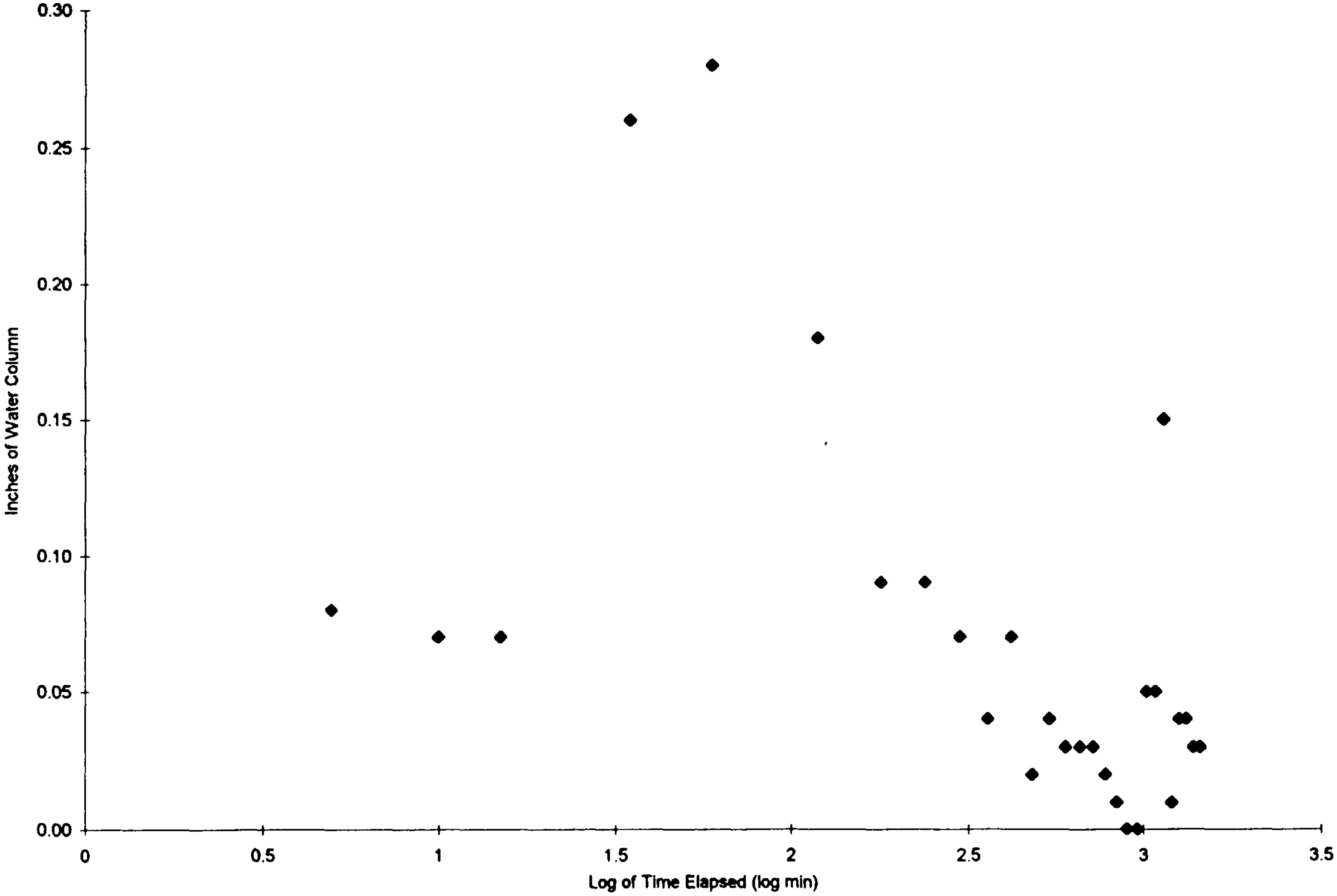
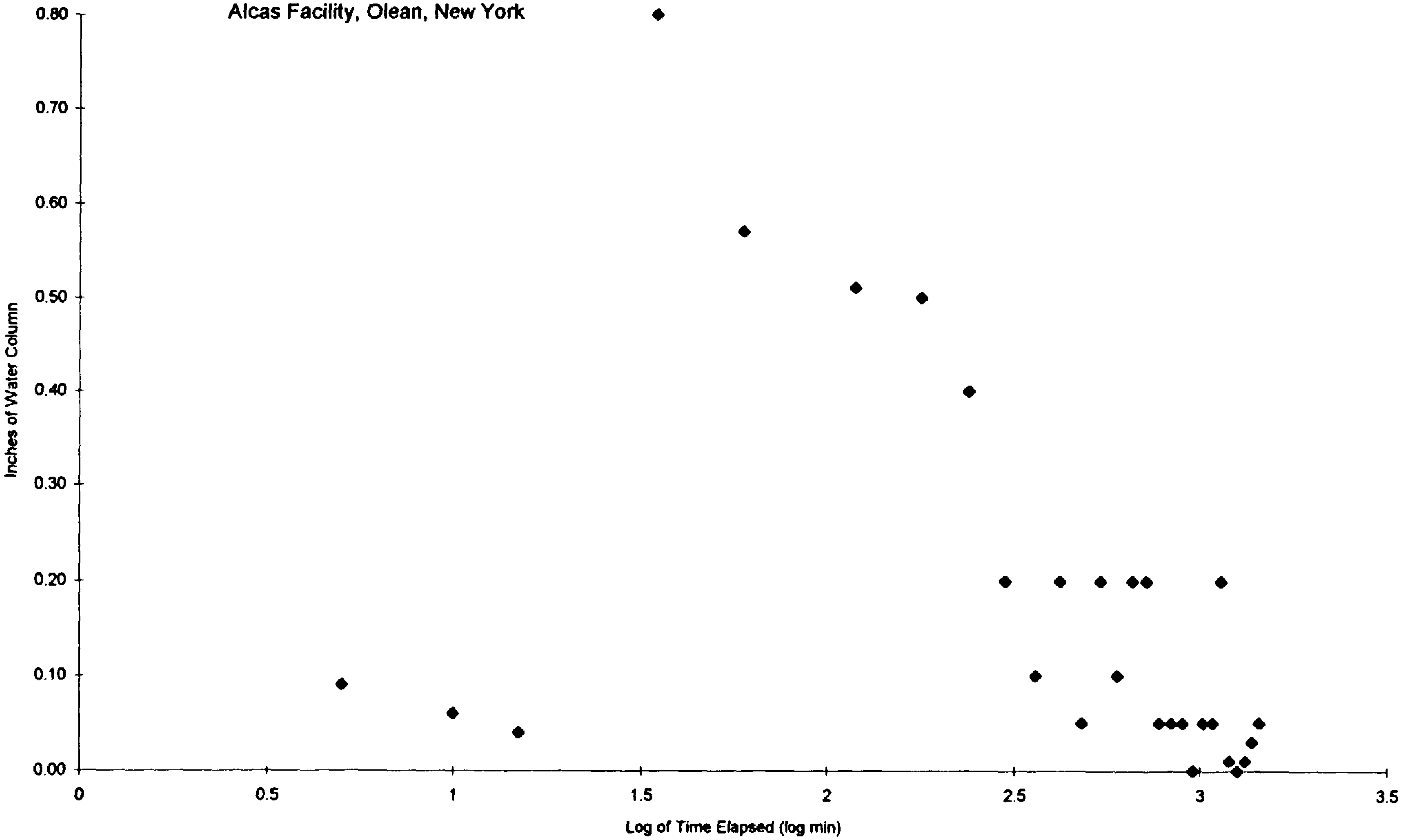
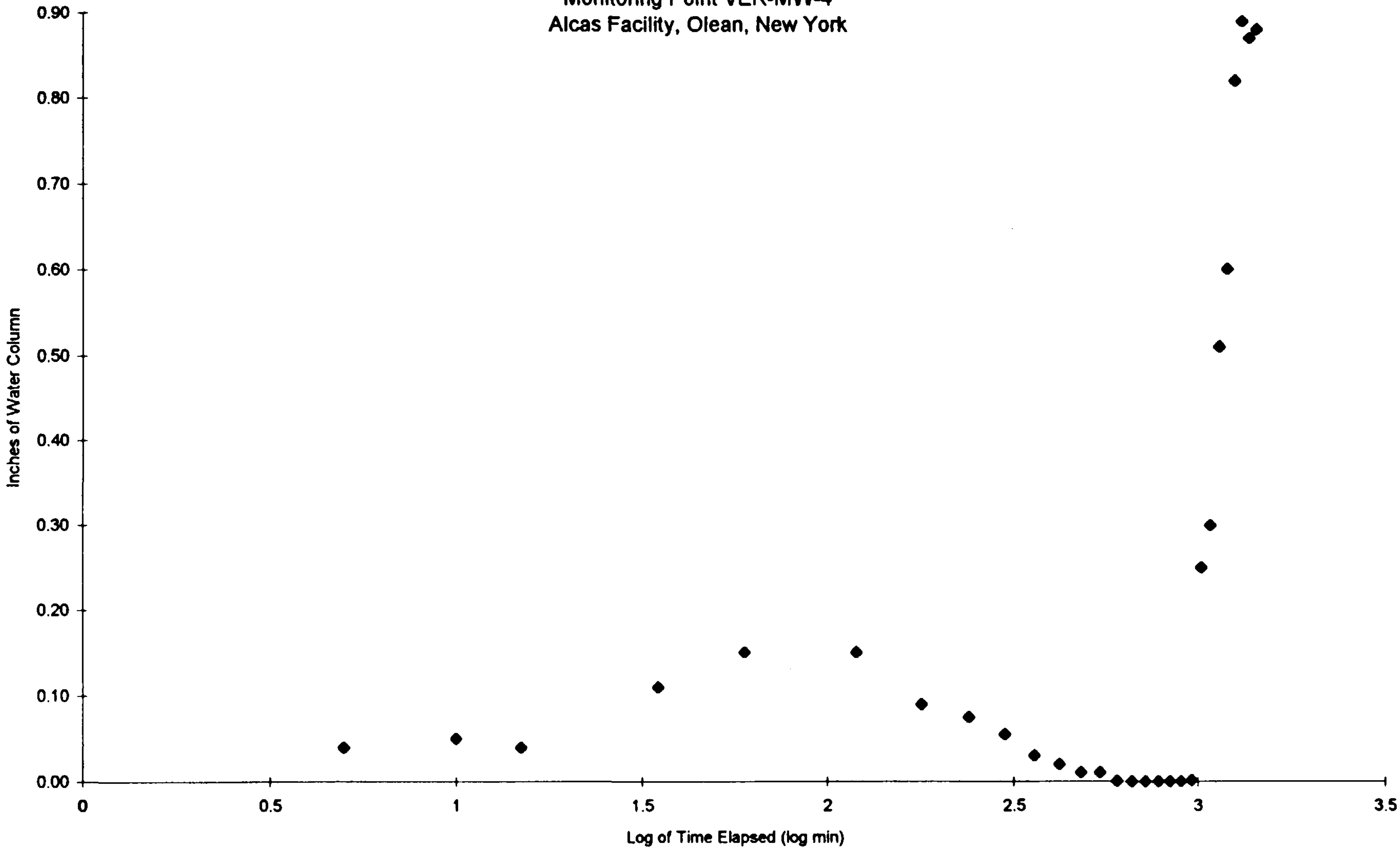


Figure 3
Vacuum Enhanced Recovery Test Data
Monitoring Point VER-MW-3
Alcas Facility, Olean, New York



400134

Figure 4
Vacuum Enhanced Recovery Test Data
Monitoring Point VER-MW-4
Alcas Facility, Olean, New York



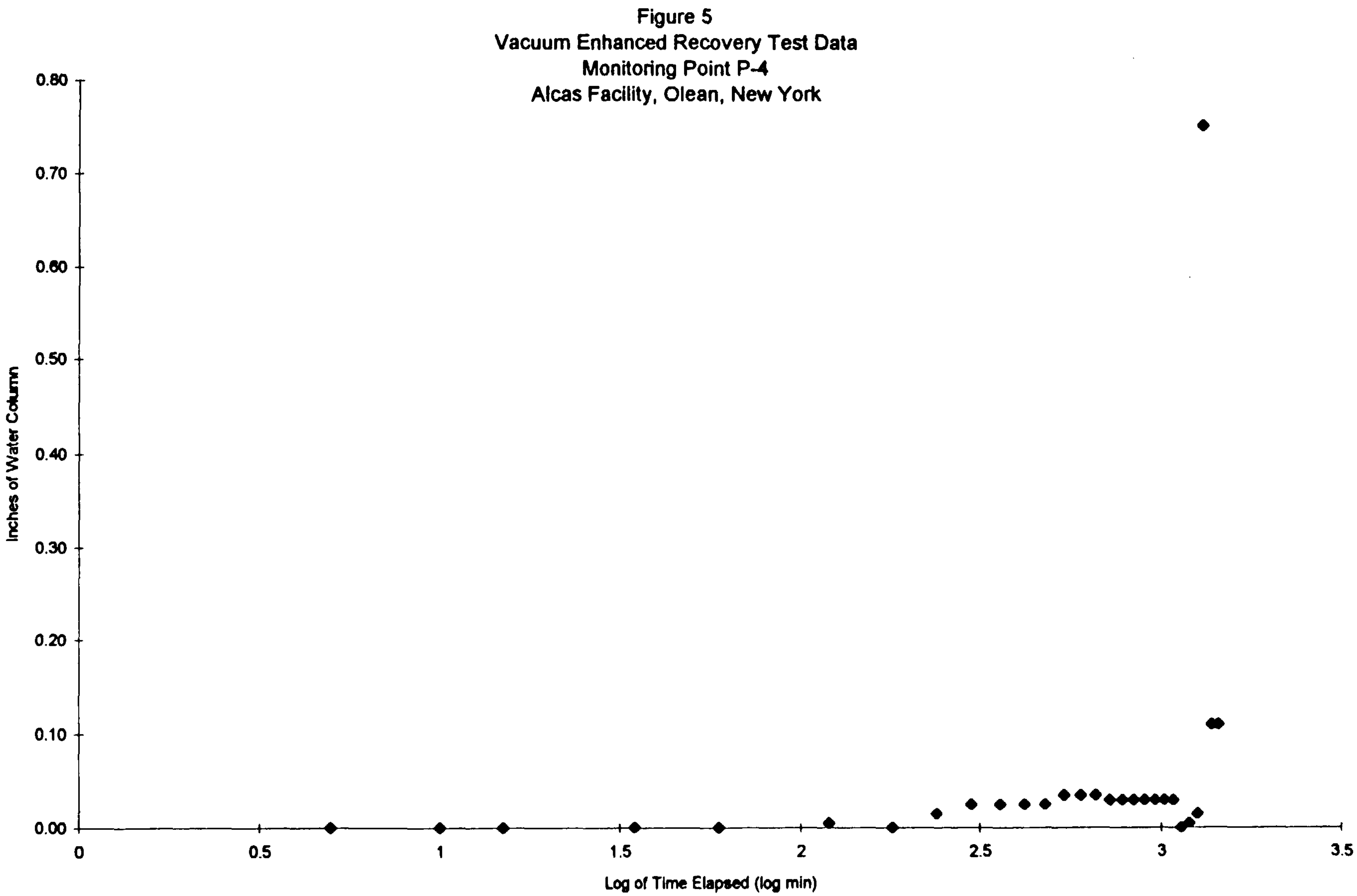


Figure 5
Vacuum Enhanced Recovery Test Data
Monitoring Point P-4
Alcas Facility, Olean, New York

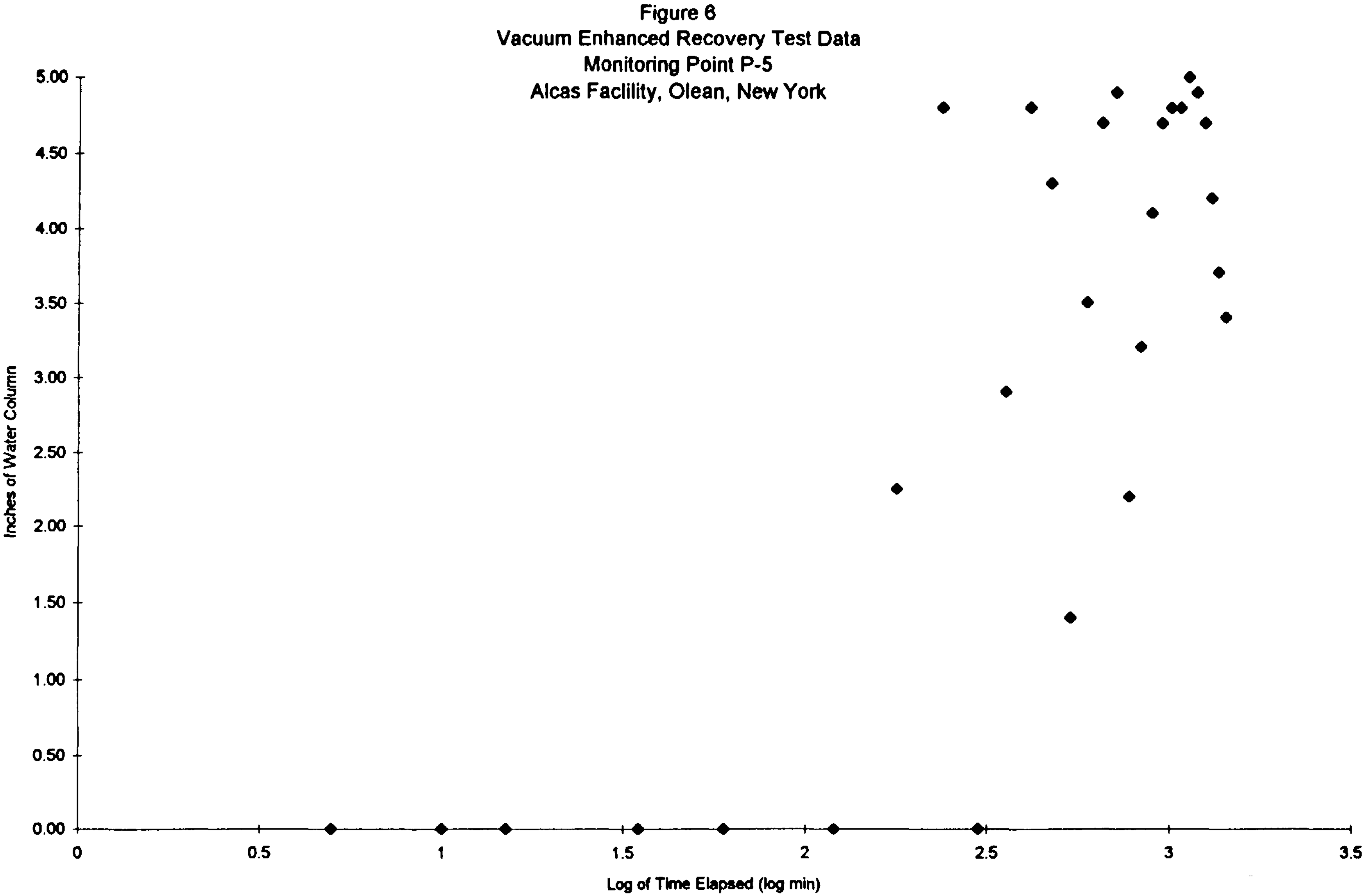


Figure 6
Vacuum Enhanced Recovery Test Data
Monitoring Point P-5
Alcas Faclility, Olean, New York

APPENDIX E

MASS REMOVAL TABLES

Table 1. Total Vapor Mass Removal - Vacuum Enhanced Recovery Pilot Test, Alcas Facility, Olean, New York, November 16 and 17, 1994.

Assumptions:
Total Vapor Concentration per attached sampling data concentrations
Measured Flow Rate = 21.80 CFM
Effluent Stream Loading Estimate

Compound	**Concentration (PPMv)**						**Stream Loading**
t-1,2-DCE	7.1 Standard cu ft trans-1,2-dichloroethylene	21.80 Standard cu ft	60 min	lb mol	96.94 lb t-1,2-DCE	= .0025	lb t-1,2-DCE
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft t-1,2-DCE	lb mole		hour
$CHCL_3$	0.493 Standard cu ft chloroform	21.80 Standard cu ft	60 min	lb mol	119.39 lb $CHCl_3$	= .0002	lb $CHCL_3$
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft $CHCl_3$	lb mole		hour
1,1,1-TCA	0.509 Standard cu ft 1,1,1-trichloroethane	21.80 Standard cu ft	60 min	lb mol	133.42 lb 1,1,1-TCA	= .0003	lb 1,1,1-TCA
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft 1,1,1-TCA	lb mole		hour
TCE	2381.709 Standard cu ft trichloroethylene	21.80 Standard cu ft	60 min	lb mol	131.4 lb TCE	= 1.1396	lb TCE
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft TCE	lb mole		hour
PCE	1.913 Standard cu ft tetrachloroethylene	21.80 Standard cu ft	60 min	lb mol	165.85 lb PCE	= .0012	lb PCE
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft PCE	lb mole		hour
ClCH = CHCl	4.66 Standard cu ft 1,1-dichloroethylene	21.80 Standard cu ft	60 min	lb mol	97 lb ClCH = CHCl	= .0016	lb ClCH = CHCl
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft ClCH = CHCl	lb mole		hour
CCl_4	0.043 Standard cu ft carbon tetrachloride	21.80 Standard cu ft	60 min	lb mol	153.8 lb CCl_4	= .00003	lb CCl_4
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft CCl_4	lb mole		hour
C_6H_6	0.22 Standard cu ft benzene	21.80 Standard cu ft	60 min	lb mol	75.1 lb C_6H_6	= .00006	lb C_6H_6
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft C_6H_6	lb mole		hour
$CHCl_2CH_2Cl$	0.423 Standard cu ft 1,1,1-trichloroethane	21.80 Standard cu ft	60 min	lb mol	133.4 lb $CHCl_2CH_2Cl$	= .0002	lb $CHCL_2CH_2Cl$
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft $CHCl_2CH_2Cl$	lb mole		hour
C_7H_8	0.46 Standard cu ft toluene	21.80 Standard cu ft	60 min	lb mol	92.14 lb C_7H_8	= .0002	lb C_7H_8
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft C_7H_8	lb mole		hour
$CHBrCl_2$	0.018 Standard cu ft bromodichloromethane	21.80 Standard cu ft	60 min	lb mol	163.83 lb $CHBrCl_2$	= .00001	lb $CHBrCl_2$
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft $CHBrCl_2$	lb mole		hour
C_2H_3Cl	323 Standard cu ft vinyl chloride	21.80 Standard cu ft	60 min	lb mol	62.5 lb C_2H_3Cl	= .0735	lb C_2H_3Cl
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft C_2H_3Cl	lb mole		hour
$ClCH_2CH_2Cl$	0.15 Standard cu ft 1,2-dichloroethane	21.80 Standard cu ft	60 min	lb mol	98.96 lb $ClCH_2CH_2Cl$	= .00005	lb $ClCH_2CH_2Cl$
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft $ClCH_2CH_2Cl$	lb mole		hour
CH_3CHCl_2	0.22 Standard cu ft 1,1-dichloroethane	21.80 Standard cu ft	60 min	lb mol	98.96 lb CH_3CHCl_2	= .00008	lb CH_3CHCl_2
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft CH_3CHCl_2	lb mole		hour
					Total Vapor Mass Removal	**= 1.21953**	**lb VOCs**
							hour

Table 2. Total Vapor Mass Removal - Vacuum Enhanced Recovery Pilot Test, Alcas Facility, Olean, New York, November 16 and 17, 1994.

Assumptions:
Total Vapor Concentration per attached sampling data concentrations
Measured Flow Rate = 21.80 CFM

Effluent Stream Loading Estimate

Compound	**Concentration (PPMv)**						**Stream Loading**
t-1,2-DCE	3.3 Standard cu ft trans-1,2-dichloroethylene	21.80 Standard cu ft	60 min	lb mol	96.94 lb t-1,2-DCE	= .0012	lb t-1,2-DCE
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft t-1,2-DCE	lb mole		hour
$CHCL_3$	0.286 Standard cu ft chloroform	21.80 Standard cu ft	60 min	lb mol	119.39 lb $CHCl_3$	= .0001	lb $CHCL_3$
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft $CHCl_3$	lb mole		hour
1,1,1-TCA	0.260 Standard cu ft 1,1,1-trichloroethane	21.80 Standard cu ft	60 min	lb mol	133.42 lb 1,1,1-TCA	= .0001	lb 1,1,1-TCA
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft 1,1,1-TCA	lb mole		hour
TCE	1238.229 Standard cu ft trichloroethylene	21.80 Standard cu ft	60 min	lb mol	131.4 lb TCE	= .5925	lb TCE
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft TCE	lb mole		hour
PCE	1.265 Standard cu ft tetrachloroethylene	21.80 Standard cu ft	60 min	lb mol	165.85 lb PCE	= .0008	lb PCE
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft PCE	lb mole		hour
ClCH = CHCl	1.12 Standard cu ft 1,1-dichloroethylene	21.80 Standard cu ft	60 min	lb mol	97 lb ClCH = CHCl	= .0004	lb ClCH = CHCl
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft ClCH = CHCl	lb mole		hour
CCl_4	0.021 Standard cu ft carbon tetrachloride	21.80 Standard cu ft	60 min	lb mol	153.8 lb CCl_4	= .00001	lb CCl_4
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft CCl_4	lb mole		hour
C_6H_6	0.13 Standard cu ft benzene	21.80 Standard cu ft	60 min	lb mol	75.1 lb C_6H_6	= .00004	lb C_6H_6
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft C_6H_6	lb mole		hour
$CHCl_2CH_2Cl$	0.328 Standard cu ft 1,1,1-trichloroethane	21.80 Standard cu ft	60 min	lb mol	133.4 lb $CHCl_2CH_2Cl$	= .0002	lb $CHCL_2CH_2Cl$
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft $CHCl_2CH_2Cl$	lb mole		hour
C_7H_8	0.32 Standard cu ft toluene	21.80 Standard cu ft	60 min	lb mol	92.14 lb C_7H_8	= .0001	lb C_7H_8
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft C_7H_8	lb mole		hour
$CHBrCl_2$	0.011 Standard cu ft bromodichloromethane	21.80 Standard cu ft	60 min	lb mol	163.83 lb $CHBrCl_2$	= .000008	lb $CHBrCl_2$
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft $CHBrCl_2$	lb mole		hour
C_2H_3Cl	88 Standard cu ft vinyl chloride	21.80 Standard cu ft	60 min	lb mol	62.5 lb C_2H_3Cl	= .0200	lb C_2H_3Cl
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft C_2H_3Cl	lb mole		hour
$ClCH_2CH_2Cl$	0.09 Standard cu ft 1,2-dichloroethane	21.80 Standard cu ft	60 min	lb mol	98.96 lb $ClCH_2CH_2Cl$	= .00003	lb $ClCH_2CH_2Cl$
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft $ClCH_2CH_2Cl$	lb mole		hour
CH_3CHCl_2	0.11 Standard cu ft 1,1-dichloroethane	21.80 Standard cu ft	60 min	lb mol	98.96 lb CH_3CHCl_2	= .00004	lb CH_3CHCl_2
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft CH_3CHCl_2	lb mole		hour
					Total Vapor Mass Removal	**= .615528**	**lb VOCs**
							hour

Table 3. Total Vapor Mass Removal - Vacuum Enhanced Recovery Pilot Test, Alcas Facility, Olean, New York, November 16 and 17, 1994.

Assumptions:
Total Vapor Concentration per attached sampling data concentrations
Measured Flow Rate = 135.16 CFM

Effluent Stream Loading Estimate

Compound	**Concentration (PPMv)**						**Stream Loading**
t-1,2-DCE	2.4 Standard cu ft trans-1,2-dichloroethylene	135.16 Standard cu ft	60 min	lb mol	96.94 lb t-1,2-DCE	= .0053	lb t-1,2-DCE
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft t-1,2-DCE	lb mole		hour
$CHCL_3$	0.217 Standard cu ft chloroform	135.16 Standard cu ft	60 min	lb mol	119.39 lb $CHCl_3$	= .0006	lb $CHCL_3$
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft $CHCl_3$	lb mole		hour
1,1,1-TCA	0.202 Standard cu ft 1,1,1-trichloroethane	135.16 Standard cu ft	60 min	lb mol	133.42 lb 1,1,1-TCA	= .0006	lb 1,1,1-TCA
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft 1,1,1-TCA	lb mole		hour
TCE	951.498 Standard cu ft trichloroethylene	135.16 Standard cu ft	60 min	lb mol	131.4 lb TCE	= 2.8163	lb TCE
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft TCE	lb mole		hour
PCE	1.068 Standard cu ft tetrachloroethylene	135.16 Standard cu ft	60 min	lb mol	165.85 lb PCE	= .0399	lb PCE
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft PCE	lb mole		hour
ClCH = CHCl	0.75 Standard cu ft 1,1-dichloroethylene	135.16 Standard cu ft	60 min	lb mol	97 lb ClCH = CHCl	= .0164	lb ClCH = CHCl
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft ClCH = CHCl	lb mole		hour
CCl_4	0.020 Standard cu ft carbon tetrachloride	135.16 Standard cu ft	60 min	lb mol	153.8 lb CCl_4	= .0007	lb CCl_4
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft CCl_4	lb mole		hour
C_6H_6	0.10 Standard cu ft benzene	135.16 Standard cu ft	60 min	lb mol	75.1 lb C_6H_6	= .0017	lb C_6H_6
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft C_6H_6	lb mole		hour
$CHCl_2CH_2Cl$	0.231 Standard cu ft 1,1,1-trichloroethane	135.16 Standard cu ft	60 min	lb mol	133.4 lb $CHCl_2CH_2Cl$	= .0069	lb $CHCL_2CH_2Cl$
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft $CHCl_2CH_2Cl$	lb mole		hour
C_7H_8	0.37 Standard cu ft toluene	135.16 Standard cu ft	60 min	lb mol	92.14 lb C_7H_8	= .0077	lb C_7H_8
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft C_7H_8	lb mole		hour
$CHBrCl_2$	0.007 Standard cu ft bromodichloromethane	135.16 Standard cu ft	60 min	lb mol	163.83 lb $CHBrCl_2$	= .0003	lb $CHBrCl_2$
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft $CHBrCl_2$	lb mole		hour
C_2H_3Cl	55 Standard cu ft vinyl chloride	135.16 Standard cu ft	60 min	lb mol	62.5 lb C_2H_3Cl	= .7742	lb C_2H_3Cl
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft C_2H_3Cl	lb mole		hour
$ClCH_2CH_2Cl$	0.07 Standard cu ft 1,2-dichloroethane	135.16 Standard cu ft	60 min	lb mol	98.96 lb $ClCH_2CH_2Cl$	= .0016	lb $ClCH_2CH_2Cl$
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft $ClCH_2CH_2Cl$	lb mole		hour
CH_3CHCl_2	0.08 Standard cu ft 1,1-dichloroethane	135.16 Standard cu ft	60 min	lb mol	98.96 lb CH_3CHCl_2	= .0018	lb CH_3CHCl_2
	1,000,000 Standard cu ft air	min	hour	359 Standard cu ft CH_3CHCl_2	lb mole		hour
					Total Vapor Mass Removal	**= 3.774**	**lb VOCs**
							hour

Table 4. Total Dissolved Mass Removal - Vacuum Enhanced Recovery Pilot Test, Alcas Facility, Olean, New York, November 16, 1994.

Assumptions:
Total Concentration = Influent 1
Average Flow Rate = 2.56 GPM

Compound	**Effluent Stream Loading Estimate Concentration (ug/L)**						
Vinyl chloride	153.67 Gallons	3.785 Liters	.390 mg C_2H_3Cl	2.205 lbs	1 kg	= 0.0005	lbs C_2H_3Cl
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Acetone	153.67 Gallons	3.785 Liters	1 mg CH_3COCH_3	2.205 lbs	1 kg	= 0.0013	lbs CH_2COCH_3
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Trichloroethylene	153.67 Gallons	3.785 Liters	14 mg TCE	2.205 lbs	1 kg	= 0.0180	lbs TCE
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Chloroform	153.67 Gallons	3.785 Liters	.051 mg $CHCl_3$	2.205 lbs	1 kg	= 0.00008	lbs $CHCl_3$
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Methylene chloride	153.67 Gallons	3.785 Liters	.110 mg CH_2Cl_2	2.205 lbs	1 kg	= 0.0013	lbs CH_2Cl_2
	Hour	Gallon	Liter	kg	10^6 mg		Hour
1,2-dichloroethene (total)	153.67 Gallons	3.785 Liters	5.1 mg $C_2H_2Cl_2$	2.205 lbs	1 kg	= 0.0065	lbs $C_2H_2Cl_2$
	Hour	Gallon	Liter	kg	10^6 mg		Hour

Total Dissolved Mass Removal = .028 $\frac{\text{lbs}}{\text{Hour}}$

Table 5. Total Dissolved Mass Removal - Vacuum Enhanced Recovery Pilot Test, Alcas Facility, Olean, New York, November 16, 1994.

Assumptions:
Total Concentration = Influent 2
Average Flow Rate = 2.56 GPM

Effluent Stream Loading Estimate

Compound	**Concentration (ug/L)**						
Vinyl chloride	153.67 Gallons	3.785 Liters	110 mg C_2H_3Cl	2.205 lbs	1 kg	= 0.0013	lbs C_2H_3Cl
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Acetone	153.67 Gallons	3.785 Liters	.510 mg CH_3COCH_3	2.205 lbs	1 kg	= 0.0007	lbs CH_3COCH_3
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Trichloroethylene	153.67 Gallons	3.785 Liters	7.3 mg TCE	2.205 lbs	1 kg	= 0.0094	lbs TCE
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Chloroform	153.67 Gallons	3.785 Liters	.015 mg $CHCl_3$	2.205 lbs	1 kg	= 0.00002	lbs $CHCl_3$
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Methylene chloride	153.67 Gallons	3.785 Liters	0.068 mg CH_2Cl_2	2.205 lbs	1 kg	= 0.00008	lbs CH_2Cl_2
	Hour	Gallon	Liter	kg	10^6 mg		Hour
1,2-dichloroethene (total)	153.67 Gallons	3.785 Liters	3.1 mg $C_2H_2Cl_2$	2.205 lbs	1 kg	= 0.0040	lbs $C_2H_2Cl_2$
	Hour	Gallon	Liter	kg	10^6 mg		Hour

Total Dissolved Mass Removal = .016 $\frac{\text{lbs}}{\text{Hour}}$

Table 6. Total Dissolved Mass Removal - Vacuum Enhanced Recovery Pilot Test, Alcas Facility, Olean, New York, November 16, 1994.

Assumptions:
Total Concentration = Influent 3
Average Flow Rate = 2.56 GPM

Compound	Effluent Stream Loading Estimate Concentration (ug/L)						
Vinyl chloride	153.67 Gallons	3.785 Liters	0 mg C_2H_3Cl	2.205 lbs	1 kg	= 0.0	lbs C_2H_3Cl
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Acetone	153.67 Gallons	3.785 Liters	.560 mg CH_3COCH_3	2.205 lbs	1 kg	= 0.0007	lbs CH_2COCH_3
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Trichloroethylene	153.67 Gallons	3.785 Liters	8.1 mg TCE	2.205 lbs	1 kg	= 0.0104	lbs TCE
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Chloroform	153.67 Gallons	3.785 Liters	0.017 mg $CHCl_3$	2.205 lbs	1 kg	= .00002	lbs $CHCl_3$
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Methylene chloride	153.67 Gallons	3.785 Liters	0.076 CH_2Cl_2	2.205 lbs	1 kg	= .00008	lbs CH_2Cl_2
	Hour	Gallon	Liter	kg	10^6 mg		Hour
1,2-dichloroethene (total)	153.67 Gallons	3.785 Liters	2.5 mg $C_2H_2Cl_2$	2.205 lbs	1 kg	= .0032	lbs $C_2H_2Cl_2$
	Hour	Gallon	Liter	kg	10^6 mg		Hour
					Total Dissolved Mass Removal	**= .014**	**lbs**
							Hour

Table 7. Total Dissolved Mass Removal - Vacuum Enhanced Recovery Pilot Test, Alcas Facility, Olean, New York, November 16, 1994.

Assumptions:
Total Concentration = Influent 4
Average Flow Rate = 2.56 GPM

Compound	**Effluent Stream Loading Estimate** **Concentration (ug/L)**						
Vinyl chloride	$\frac{153.67\ \text{Gallons}}{\text{Hour}}$	$\frac{3.785\ \text{Liters}}{\text{Gallon}}$	$\frac{0\ \text{mg}\ C_2H_3Cl}{\text{Liter}}$	$\frac{2.205\ \text{lbs}}{\text{kg}}$	$\frac{1\ \text{kg}}{10^6\ \text{mg}}$	= 0.0	$\frac{\text{lbs}\ C_2H_3Cl}{\text{Hour}}$
Acetone	$\frac{153.67\ \text{Gallons}}{\text{Hour}}$	$\frac{3.785\ \text{Liters}}{\text{Gallon}}$	$\frac{0\ \text{mg}\ CH_3COCH_3}{\text{Liter}}$	$\frac{2.205\ \text{lbs}}{\text{kg}}$	$\frac{1\ \text{kg}}{10^6\ \text{mg}}$	= 0.0	$\frac{\text{lbs}\ CH_2COCH_3}{\text{Hour}}$
Trichloroethylene	$\frac{153.67\ \text{Gallons}}{\text{Hour}}$	$\frac{3.785\ \text{Liters}}{\text{Gallon}}$	$\frac{5.7\ \text{mg TCE}}{\text{Liter}}$	$\frac{2.205\ \text{lbs}}{\text{kg}}$	$\frac{1\ \text{kg}}{10^6\ \text{mg}}$	= .0073	$\frac{\text{lbs TCE}}{\text{Hour}}$
Chloroform	$\frac{153.67\ \text{Gallons}}{\text{Hour}}$	$\frac{3.785\ \text{Liters}}{\text{Gallon}}$	$\frac{0.043\ \text{mg}\ CHCl_3}{\text{Liter}}$	$\frac{2.205\ \text{lbs}}{\text{kg}}$	$\frac{1\ \text{kg}}{10^6\ \text{mg}}$	= .00004	$\frac{\text{lbs}\ CHCl_3}{\text{Hour}}$
Methylene chloride	$\frac{153.67\ \text{Gallons}}{\text{Hour}}$	$\frac{3.785\ \text{Liters}}{\text{Gallon}}$	$\frac{0.040\ CH_2Cl_2}{\text{Liter}}$	$\frac{2.205\ \text{lbs}}{\text{kg}}$	$\frac{1\ \text{kg}}{10^6\ \text{mg}}$	= .00004	$\frac{\text{lbs}\ CH_2Cl_2}{\text{Hour}}$
1,2-dichloroethene (total)	$\frac{153.67\ \text{Gallons}}{\text{Hour}}$	$\frac{3.785\ \text{Liters}}{\text{Gallon}}$	$\frac{1.6\ \text{mg}\ C_2H_2Cl_2}{\text{Liter}}$	$\frac{2.205\ \text{lbs}}{\text{kg}}$	$\frac{1\ \text{kg}}{10^6\ \text{mg}}$	= .0020	$\frac{\text{lbs}\ C_2H_2Cl_2}{\text{Hour}}$

Total Dissolved Mass Removal = .009 $\frac{\textbf{lbs}}{\textbf{Hour}}$

Table 8. Total Dissolved Mass Removal - Vacuum Enhanced Recovery Pilot Test, Alcas Facility, Olean, New York, November 16, 1994.

Assumptions:
Total Concentration = Influent 5
Average Flow Rate = 2.56 GPM

Compound	**Effluent Stream Loading Estimate** **Concentration (ug/L)**						
Vinyl chloride	153.67 Gallons	3.785 Liters	0 mg C_2H_3Cl	2.205 lbs	1 kg	= 0.0	lbs C_2H_3Cl
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Acetone	153.67 Gallons	3.785 Liters	0 mg CH_3COCH_3	2.205 lbs	1 kg	= 0.0	lbs CH_2COCH_3
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Trichloroethylene	153.67 Gallons	3.785 Liters	4.1 mg TCE	2.205 lbs	1 kg	= .0053	lbs TCE
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Chloroform	153.67 Gallons	3.785 Liters	0.024 mg $CHCl_3$	2.205 lbs	1 kg	= .00003	lbs $CHCl_3$
	Hour	Gallon	Liter	kg	10^6 mg		Hour
Methylene chloride	153.67 Gallons	3.785 Liters	0.019 CH_2Cl_2	2.205 lbs	1 kg	= .00003	lbs CH_2Cl_2
	Hour	Gallon	Liter	kg	10^6 mg		Hour
1,2-dichloroethene (total)	153.67 Gallons	3.785 Liters	1.2 mg $C_2H_2Cl_2$	2.205 lbs	1 kg	= .0015	lbs $C_2H_2Cl_2$
	Hour	Gallon	Liter	kg	10^6 mg		Hour

Total Dissolved Mass Removal = .007 lbs/Hour