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C-49-10-7-052

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Project Number 5253

Mr. George Heitzman
New York State Department of Environmental Conservation
Division of Environmental Remediation
50 Wolf Road
Albany, New York 12233-7010

Reference: Clean Contract No. N62472-90-D-1298,
Contract Task Order Number 0213

Subject: Draft Interim Results Letter (July 1997)
NWIRP Bethpage, New York

Dear Mr. Heitzman:

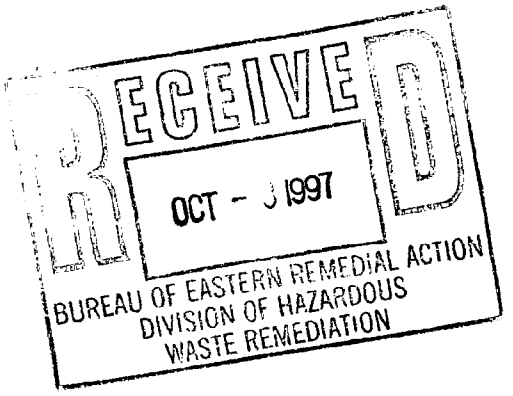
As per the request of Mr. Jim Colter, please find enclosed one copy of the subject report for your use.

If you have any questions or require additional information, please call me at (412) 921-8375.

Sincerely

David D. Brayack
Project Manager

/DDB



cc: Mr. R. Boucher (Navy) w/o attachment
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1.0 INTRODUCTION

1.1 AUTHORIZATION

The Northern Division of the Naval Facilities Engineering Command has issued Contract Task Order (CTO) 0213 to CF Braun Engineering Corporation (CF Braun) under a master agreement with Brown & Root Environmental under Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract N62472-90-D-1298. Under CTO 213, CF Braun installed a Pilot Scale Air Sparging/Soil Vapor Extraction System (AS/SVE) and is conducting a physical and chemical evaluation of the system. This work is part of the Remedial Design, Phase II, for Site 1 at the Naval Weapons Industrial Reserve Plant (NWIRP) located in Bethpage, New York.

1.2 OPERATION AND CONSTRUCTION SUMMARY

Construction of the pilot-scale AS/SVE system was started in mid-March 1997 and completed in April 1997. Startup and checkout of the system occurred the week of April 14, 1997. Radius of influence tests were conducted the weeks of April 21 and April 28, 1997. Continuous operation started on May 2, 1997 and is scheduled to continue until at least mid-July 1997. In July 1997, a decision will be made as to whether to continue system operation through the summer, (as an interim remedial measure while design and the full scale system implementation continues), or to discontinue the operation of the pilot-scale system.

The AS/SVE pilot system was constructed in accordance with the "Pilot-Scale Air Sparging/Soil Vapor Extraction System Work Plan" for the NWIRP Bethpage, New York (CF Braun 1997). The AS/SVE system consists of an air injection system, a soil vapor extraction system, a vapor phase carbon treatment system, one air injection well, five soil vapor extraction wells, and eight monitoring wells (soil vapor pressure and/or groundwater monitoring). Construction details are summarized in Section 2.0 of this Interim Letter Report. Complete documentation will be provided in the Final Results Letter, currently scheduled for submittal on October 15, 1997.

1.3 PURPOSE AND OBJECTIVES

As stated in the project Work Plan, the specific objectives of the pilot study are as follows.

- Determine the physical parameters required for a full scale system design (well spacing, extraction/injection rates, and well depths).

- Evaluate the effectiveness of air sparging/soil vapor extraction in removing VOCs from site soils, cesspools, and shallow groundwater.

- Estimate the time required for cleanup of soils, groundwater, and cesspool contents.

- Determine the requirements for offgas treatment.

The primary purpose of this letter report is to present the results of the physical parameter testing and thereby achieve the first objective. These results will be used to proceed with the design of a full scale remediation system in early July 1997, with a design submittal scheduled for August 27 1997. Results of currently available chemical data is also presented in this Interim Results Report. However, the chemical information is being presented at this time for informational purposes only. A complete evaluation of the chemical data will be present in the Final Results Letter, scheduled for submittal on October 15, 1997.

1.4 BACKGROUND INFORMATION

Site 1 - Former Drum Marshaling Area occupies an area of approximately 4 acres. It is surrounded on three sides by a fence and on the fourth side by Plant No. 3. The site is relatively flat, with the eastern portion covered with bare sandy soils, gravel, grass, and one concrete pad. The western portion of the site is predominantly covered with concrete. A vegetated wind row (pine) and fence are present along the eastern edge of the site to reduce community visibility.

The original basis for the work conducted at the Navy's Site 1 resulted from pubic water supply wells being impacted by VOC contamination. In response to this impact, a regional

groundwater quality study was conducted in the 1980s. The results of this study indicated that the Navy's Site 1 to be one of several potential sources of a relatively large groundwater VOC plume originating near this area and extending for several thousand feet to the south (hydraulic downgradient direction).

The Navy conducted a Remedial Investigation in the early 1990s to investigate potential sources of the VOC contamination, (Halliburton NUS, May 1992 and Halliburton NUS July, 1993). Based on this investigation, the source of the groundwater contamination at Site 1 was determined to originate near the former drum marshaling pads. All shallow groundwater samples collected south of the Former Cinder Drum Marshaling Pad, and a few shallow groundwater samples collected north of the pad, exhibited VOC contamination. However, this area of groundwater contamination also coincides with the location of cesspools at the site. The cesspools could also be a source of the VOC contamination.

Soil testing during the Remedial Investigation determined that Site 1 soils contained VOC, PCB, and arsenic contamination. Subsequent soil testing at the site confirmed the presence of PCB and VOC contamination; however, the arsenic contamination could not be confirmed. In addition, testing of the cesspool contents revealed even higher concentrations of VOCs and PCBs in the cesspools then in the surrounding soils, and revealed the presence of cadmium contamination.

1.5 REPORT FORMAT

This report is divided into four sections. Section 1.0 is this Introduction. Section 2.0 provides a brief description of the system construction. Results are presented in Section 3.0 and Conclusions and Recommendations are provided in Section 4.0.

2.0 SYSTEM CONSTRUCTION

Construction details for the AS/SVE pilot system at NWIRP Bethpage are summarized in this section. Compete details will be provided in the Results Report, scheduled for submittal in October 1997.

2.1 PILOT SCALE CONSTRUCTION

The AS/SVE pilot scale system was constructed from March 26 to April 16, 1997. The pilot scale system consists of an air injection system, a soil vapor extraction system, an offgas treatment system consisting of vapor phase carbon units, and soil vapor/groundwater monitoring points. During construction, subsurface soil and groundwater samples were collected to evaluate environmental conditions prior to the study to establish a baseline to compare future samples against.

Subsurface Soil Samples

Seven split spoon soil boring samples, including one duplicate, were collected on March 26, 1997 for laboratory Volatile Organic Compound (VOC) analysis. The soil samples were collected at 3 soil boring locations which are shown on Figure 1.

One soil boring (SB02) was placed inside cesspool number 79. Split spoon samples were collected at depths of 10 and 40 feet below ground surface (bgs) and correspond to cesspool contents and soil underlying the cesspool, respectively. This cesspool also corresponds to the location of extraction well EW-05.

The other two soil borings were located outside the cesspools. The location and depth of these soil samples were based on field measurements conducted during the installation of the extraction wells, injection well, and monitoring wells. Three split spoon samples including one duplicate sample were collected from soil boring SB03 at depths of 20 and 40 feet bgs. Soil boring SB03 corresponds to a mid-range of PID readings observed during well installation. This location is also near the edge of the suspected VOC-contaminated soils.

Split spoon samples were collected at depths of 30 and 40 feet bgs from soil boring SB04 and correspond to the location of the highest PID readings observed during well installation. This soil boring is also near the location of the two former drum marshaling pads. The same soil boring locations and sampling depths will be used for the final sampling event at the end of the pilot study.

In addition, three split spoon soil boring samples were collected for geotechnical parameters during the installation of two of the monitoring points. Samples were collected at 10 to 12 feet bgs and 28 to 29 feet bgs during the installation of SVPM 3 and 66 to 68 feet bgs during the installation of GPM 3, respectively. A grain size distribution geotechnical analysis was performed to provide representative data throughout the site.

A clay layer (approximately 2 feet thick) was encountered at approximately 50 to 52 feet bgs during the installation of the injection well, extraction wells, and monitoring points. A perched water layer of approximately one foot thick was encountered during the installation of EW-01 and EW-02. The area-wide water table was encountered at a depth of approximately 57 bgs. The presence of this clay layer requires consideration to ensure capture of all injected air.

Air Injection System

The air injection system consists of an injection well, a blower, and conveyance piping.

The air injection well is a 2-inch PVC riser pipe and screen installed to a total depth of 66.5 feet bgs. This well was installed on March 18, 1997. A 2-feet long 0.020 inch slot size well screen was installed 8 feet below the water table (between 64.5 to 66.5 feet bgs). The location of the injection well location is presented in Figure 1.

The blower is a rotary lobe-type Frame 32 Universal RAI Blower rated for 35 to 60 standard cubic feet per minute (SCFM) at a pressure of 6 pounds per square inch (PSI). The blower was manufactured by the Roots Division of Dresser Industries Inc.. The blower, an associated control panel, and a 7.5 horsepower (HP) motor were pre-assembled and mounted on a skid by Airtek Inc. Temperature and pressure cutoff switches were set at approximately 240

degrees Fahrenheit and 8 psi, respectively. The temperature set point is used to protect the plastic piping. The pressure switch set point is based on protecting the motor from overload.

In addition, a vacuum switch was installed on the soil vapor extraction suction line to provide an interlock between the injection blower and the extraction blower. As currently set, the injection blower will only operate when a vacuum is present in the soil vapor extraction piping. The exact set point was not measured, but was estimated to be in the range of 1 to 2 inches of water column. Based on the relatively low vacuum required for the soil vapor extraction system, the injection blower shutdown switch must be manually reset prior to re-starting the injection blower. A more sensitive switch is required for full scale implementation.

Conveyance piping for the injection line consists of a 40 foot length of 2-inch carbon steel pipe adjacent to the blower to dissipate heat, a rubber coupling for vibration control, 2-inch schedule 40 PVC pipe, two 2-inch ball valves to control air flow to the injection well and provide a manual pressure/air flow bleed off, and a 4-inch noise suppresser on the pressure bleed off. An automatic pressure relief valve is also present on the blower.

Soil Vapor Extraction System

The soil vapor extraction system consists of soil vapor extraction wells, a moisture separator, a blower, and conveyance piping.

There are five soil vapor extraction wells, as shown in Figure 1. Each well consists of a 2-inch PVC riser pipe and a 0.020 slot size screen. Total depth and screened intervals are summarized as follows.

Extraction Well	Installation Date	Total Depth (feet bgs)	Screen Length and Interval
EW-01	3/18/97	61.5	15 feet long, 10 feet above water table to 5 feet below water table (46 to 61 feet bgs)
EW-02	3/24/97	62	15 feet long, 10 feet above water table to 5 feet below water table (47 to 62 feet bgs)

Extraction Well	Installation Date	Total Depth (feet bgs)	Screen Length and Interval
EW-03	3/19/97	61	15 feet long, 10 feet above water table to 5 feet below water table (46 to 61 feet bgs)
EW-04	3/25/97	30	10 feet long, located at middle of unsaturated zone (20 to 30 feet bgs)
EW-05	3/25/97	20	5 feet long, located near the bottom of the cesspool (15 to 20 feet bgs)

The extraction blower is a positive displacement rotary lobe-type blower. The blower is a Frame 36 Universal RAI Blower rated for 100 to 150 scfm at +1 psi/-5 inches of mercury, manufactured by the Roots Division of Dresser Industries Inc. The blower, an associated control panel, a 55-gallon moisture separator, and a 7.5 HP motor were pre-assembled and mounted to a skid by Airtek Inc.

Temperature and vacuum pressure cutoff switches were set at approximately 250 degrees Fahrenheit and -5 inches of mercury, respectively. The temperature set point is used to protect the plastic piping. The pressure switch set point is based on protecting the motor from overload. An automatic vacuum relief valve is also present on the inlet to the blower.

Conveyance piping for the extraction lines consists of a flexible rubber coupling for vibration control, a 4-inch PVC header, five 2-inch schedule 40 PVC lines (one to each well), and one vacuum bleed valve. Each extraction line has a 2-inch ball valve to control air flow.

Offgas Treatment System

VOCs removed by the soil vapor extraction system were treated with two 1,800-pound vapor phase activated carbon units connected in series prior to discharge to the atmosphere. The carbon units were provided by General Carbon Corporation. Pressure piping consisted of a 20 foot length of 3-inch carbon steel at the blower outlet, a rubber coupling for vibration control, and 4-inch schedule 40 PVC pipe leading to, between, and after the carbon unit. The 3-inch carbon steel pipe is used to dissipate heat from the blower.

Monitoring Points

A series of monitoring points was used to determine the effective radius of influence distances and monitor groundwater quality. The monitor points consist of one water table groundwater monitoring wells, 5 soil vapor pressure monitors (SVPM), and 2 groundwater pressure monitors (GPM), as well as the 5 soil vapor extraction wells. The location of the monitoring points is presented in Figure 1.

Monitoring well CFB-MW-01 consisted of a 2-inch PVC riser pipe and screen installed to a total depth of 64 feet bgs on March 20, 1997. A 10-feet long 0.020 inch slot size well screen was installed from 2 feet above the water table to 8 feet below the water table (54 to 64 feet bgs). The monitoring well is located 30 feet hydraulically downgradient from the injection well.

Two dedicated groundwater pressure monitors (GPM 2 and GPM 3) were installed. Each monitor consists of 2-inch riser pipe and screen with total depth and screened interval as follows. A 0.020 slot screen size was used.

Groundwater Pressure Monitors	Installation Date	Total Depth (feet bgs)	Screened Interval
GPM 2	3/20/97	62	2 feet long, 4 feet below the water table (60 to 62 feet bgs)
GPM 3	3/21/97	66	2 feet long, 4 feet below the water table (61 to 63 feet bgs)

These wells were used in junction with water table wells to determine if vertical groundwater flow gradients exist as a result of air injection.

There are five soil vapor pressure monitoring wells, as shown in Figure 1. Each well consists of a 2-inch PVC riser pipe and a 0.020 slot size screen. Total depth and screened intervals are summarized as follows.

Soil Vapor Pressure Monitors	Installation Date	Total Depth (feet bgs)	Screened Interval
SVPM 1	3/19/97	30	5 feet long, located at middle of unsaturated zone (25 to 30 feet bgs)
SVPM 2	3/21/97	30	5 feet long at middle of unsaturated zone (25 to 30 feet bgs)
SVPM 3	3/21/97	30	5 feet long at middle of unsaturated zone (25 to 30 feet bgs)
SVPM 4	3/24/97	30	5 feet long at middle of unsaturated zone (25 to 30 feet bgs)
SVPM 5	3/25/97	20	5 feet long at middle of unsaturated zone (15 to 20 feet bgs)

The soil vapor extraction wells were also used to supplement the soil vapor pressure monitors during the air injection and extraction system testing. In addition, the three air extraction wells located at the water table (EW-01, EW-02, and EW-03), were used to monitor groundwater table fluctuations during testing.

3.0 TEST RESULTS

This section provides a description of the physical and chemical test results.

3.1 PHYSICAL PARAMETERS

Stratification Testing

The purpose of the stratification tests was to determine whether the presence of a denser than air gas (such as trichloroethane and tetrachloroethene) would cause contaminant stratification to occur within the screened interval of the soil vapor extraction well. The implication being that stratification within the unsaturated zone may prevent or inhibit the primary chemicals of concern from being extracted from the contaminated soils. If stratification was observed, then a second test would be conducted during operation of the system to determine whether the stratification could be minimized or eliminated by adjusting soil vapor extraction rates or by the injection of air. A second objective of the test was to confirm that excessive LEL or low oxygen conditions were not present in the system prior to the startup of the test.

Soil stratification testing of the soil vapor extraction wells was conducted on April 9, 1997. The test consisted of using a low-flow air pump to with draw soil vapor from the top, middle, and bottom of the 10-foot section of screen located above the water table. The tests were conducted a minimum of 5 days after well development to allow static conditions to develop.

To conduct the test, a weighted 1/4-inch ID tube was lowered into the Extraction Well (EW01, EW02, or EW03) to appropriate depth relative to the screen position. The well was sealed with a cap to minimize air intrusion from the surface. A positive displacement air pump (operating at approximately 0.044 CFM (1.3 liter per minute) was used to extract the soil vapor from the tube. The pump discharged into a 0.017 CF flow through cell, where PID and LEL/O_2 probes were mounted. PID and LEL/O_2 readings were then taken every 5 to 10 minutes, to confirm that the readings had stabilized.

The results of this testing are provided in Table 1. To conduct the evaluation, a comparison of the PID readings in each well with the average PID reading across the well was conducted. This comparison found an individual variance of only 19% to 55% from the mean. If stratification was present, a variance of several hundred to several thousand percent would be expected, with highest PID readings near at the bottom of the well screen. Since this is not the case, stratification within the wells is not expected to be significant.

Radius of Influence Testing

The radius of influence of the AS/SVE system describes the distance that a well can obtain a measurable flow rate of groundwater or soil vapor. The radius depends on several factors including the soil type (e.g. sand or clay), soil homogeneity, depth of injection below the water table, injection/extraction air pressure and flow rate.

Since soil vapor and groundwater flow rates cannot be measured reliability insitu, soil vapor pressure and groundwater level/pressure differences are used as a positive indication of flow. The assumption is generally valid as long at there is no continuous barrier to flow between the points monitored. Based on the behavior of the monitoring wells during testing, this assumption is believed to be reasonably valid at this site. However, as indicated previously, there is a thin horizontal clay layer approximately 5 feet above the water table which requires consideration. Monitoring wells above this clay layer did not conclusively respond during all of the air injection tests.

Initial water level measurements and soil vapor pressures/vacuums were obtained at the start of each testing day. Flow rates were controlled by a 2-inch ball valve on the injection and extraction lines and measured with a Dwyer Thermal Anemometer Series 470 instrument. The Dwyer Magnehelic pressure gauges produced pressure/vacuum readings from 0.02 to 1.00, 0.2 to 10, and 2 to 100 inches of water column (gauge). .

TABLE 1

SOIL GAS STRATIFICATION TESTING
AIR SPARGING/SOIL VAPOR EXTRACTION PILOT STUDY
NWIRP BETHPAGE, NEW YORK

1.0 Extraction Well EW-01

Time (minutes)	PID (ppm)	LEL (%)	O_2 (%)
Test Location - Top of Well Screen			
0.0	300	0.0	20.9
15	353	-	-
30	338	0.0	20.9
Test Location - Middle of Well Screen			
0.0	439	3.0	18.2
15	435	3.0	20.2
Test Location - Bottom of Well Screen			
0.0	388	2.0	20.9
15	239	0.0	20.9
37	150	0.0	20.9

2.0 Extraction Well EW-02

Time (minutes)	PID (ppm)	LEL (%)	O_2 (%)
Test Location - Top of Well Screen			
0.0	32	0.0	20.7
15	25	0.0	20.6
35	35	0.0	20.6
50	26	0.0	20.6
Test Location - Middle of Well Screen			
0.0	35	0.0	20.6
15	26	0.0	20.6
Test Location - Bottom of Well Screen			
0.0	44	0.0	20.6
15	43	0.0	20.4

3.0 Extraction Well EW-03

Time (minutes)	PID (ppm)	LEL (%)	O_2 (%)
Test Location - Top of Well Screen			
0.0	64	0.0	20.9
20	43	0.0	20.9
Test Location - Middle of Well Screen			
0.0	73	0.0	20.9
15	71	0.0	20.9
Test Location - Bottom of Well Screen			
0.0	80	0.0	20.7
15	73	0.0	20.7

PID: Photoionization Detector measures in parts per million (ppm).
LEL: Lower Explosive (flammable) Limit in air.

Soil Vapor Extraction Tests

The radius of influence testing consisted of measuring pressures/vacuums and/or water levels while operating one extraction well or injection well at a time at varied flow rates. The soil vapor extraction rates were generally conducted at 5, 20, and 80 scfm. During each of the extraction well tests, soil vapor pressures readings were recorded from all extraction wells, groundwater monitoring well MW-01, and the soil vapor pressure monitoring points. The readings were collected over time until they were stable, (less than 10% change over three consecutive readings).

Table 2 presents all the results of the radius of influence testing for the soil vapor extraction well testing. An evaluation of the measurable vacuum as a function of distance was performed using statistical analysis. The analysis included linear regressions on the data as received, as well as on semi-logarithmic plots. The regressions generally found correlation coefficients of greater than 0.8, and in most cases, the semi-logarithmic evaluation resulted in a better correlation than analysis of the non-logarithmic evaluation. These correlation coefficients are considered to be reasonable and the semi-logarithmic correlations are typical for flow in radial directions. The linear regression data will be supplied in the Results Report, but the findings of the analysis are summarized in this report.

Figures 2 and 3 provide a graphic presentation of the natural log of the soil vapor pressures at the water table and middle of unsaturated zone, respectfully, as a function of distance from EW-01, (which is screened at the water table). Based on data in Figure 2, this is a direct relationship between the flow rate, the soil vapor pressure, and the distance from the well for extraction and monitoring at the water table.

Similarly, based on the data presented in Figure 3, there is a relationship between soil vapor extraction rate and the vacuum achieved at the middle of the unsaturated zone. However, there is no apparent correlation between soil vapor pressure and distance from the soil vapor extraction well. This lack of correlation is likely an indication that horizontal conductivity is much higher than vertical conductivity as is common for this area. Trends for the EW-02 tests are very similar to those for EW-01, with on the magnitude and slope of the trends being different.

TABLE 2

RADIUS OF INFLUENCE TEST RESULTS
SOIL VAPOR EXTRACTION WELLS
AIR SPARGING/SOIL VAPOR EXTRACTION PILOT STUDY
NWIRP BETHPAGE, NEW YORK

EW-01 tests (SVE and monitoring performed at water table)

Well ID	Distance from SVE Well (ft)	Soil Vapor Pressure (inches of water column)				
		5 cfm	10 cfm	20 cfm	40 cfm	80 cfm
EW-01	0	-0.86	-1.5	-4.7	-14	-25
MW-01	21.3	-0.2	-0.36	-0.88	-1.6	-3.2
EW-03	27.5	-0.11	-0.18	-0.48	-0.96	-1.5
EW-02	44	-0.11	-0.15	-0.35	-0.82	-1.3

EW-01 tests (SVE performed at water table, monitoring points at middle of unsaturated zone)

Well ID	Distance from SVE Well (ft)	Soil Vapor Pressure (inches of water column)				
		5 cfm	10 cfm	20 cfm	40 cfm	80 cfm
SVPM 2	16.8	-0.007	-0.02	-0.03	-0.06	-0.07
SVPM 3	25.9	-0.007	-0.02	-0.03	-0.05	-0.06
SVPM 1	61	-0.007	-0.01	-0.02	-0.08	-0.11
SVPM 4	35.1	-	-0.02	-0.03	-0.06	-0.05
EW-04	45	-	-0.01	-0.03	-0.06	-0.06
SVPM 5	53.3	-	-0.02	-0.03	-0.05	-0.05
EW-05	64	-	-0.02	-0.03	-0.05	-0.05

TABLE 2 (Continued)
RADIUS OF INFLUENCE TEST RESULTS
SOIL VAPOR EXTRACTION WELLS

EW-04 tests (SVE and monitoring performed at middle of unsaturated zone, monitoring at water table)

Well ID	Distance from SVE Well (ft)	Soil Vapor Pressure (inches of water column)		
		5 cfm	20 cfm	80 cfm
EW-04	0	-0.11	-0.75	-4.8
SVPM-5	10.1	-0.06	-0.11	-0.43
SVPM-4	10.9	-0.05	-0.14	-0.47
SVPM-3	20.1	-0.05	-0.07	-0.33
EW-05	20.7	-0.06	-0.08	-0.31
SVPM-2	31.2	-0.07	-0.06	-0.23
SVPM-1	98	-0.05	-0.02	-0.06

EW-05 tests (SVE performed at middle of unsaturated zone, monitoring at water table)

Well ID	Distance from SVE Well (ft)	Soil Vapor Pressure (inches of water column)		
		5 cfm	20 cfm	80 cfm
EW-02	21.2	0.02	0.07	0.04
EW-01	64	0.02	0.05	0.01
MW-01	74.6	0.003	0.03	0.01
EW-03	75	0.02	0.05	0.02

EW-05 tests (SVE and monitoring performed at middle of unsaturated zone, monitoring at water table)

Well ID	Distance from SVE Well (ft)	Soil Vapor Pressure (inches of water column)		
		5 cfm	20 cfm	80 cfm
EW-05	0	-0.25	-1.4	-8.3
SVPM 5	11.7	-0.04	-0.11	-0.43
EW-04	20.7	-0.01	-0.08	-0.28
SVPM 4	30.4	-0.02	-0.04	-0.21
SVPM 3	39.6	-0.01	-0.04	-0.17
SVPM 2	50.9	-0.01	-0.03	-0.13
SVPM 1	117.6	-0.01	-0.02	-0.03

cfm: cubic feet per minute SVE: Soil Vapor Extraction
A negative pressure (e.g. -1.4) indicates that the monitoring are reading a vacuum relative to atmospheric pressure.

TABLE 2 (Continued)
RADIUS OF INFLUENCE TEST RESULTS
SOIL VAPOR EXTRACTION WELLS

EW-02 tests (SVE performed and monitcring performed at water table)

Well ID	Distance from SVE Well (ft)	Soil Vapor Pressure (inches of water column)		
		5 cfm	20 cfm	80 cfm
EW-02	0	-0.06	-2.4	-13
EW-01	44	-0.06	-0.46	-1.3
EW-03	55.6	-0.06	-0.41	-1.2
MW-01	56.1	-0.02	-0.3	-0.98
27-S3	98		-0.04	

EW-02 tests (SVE performed at water table, monitoring at middle of unsaturated zone)

Well ID	Distance from SVE Well (ft)	Soil Vapor Pressure (inches of water column)		
		5 cfm	20 cfm	80 cfm
EW-04	3.7	0.003	-0.05	-0.09
SVPM 4	10.1	-0.01	-0.03	-0.09
SVPM 5	10.5	-0.003	-0.04	-0.07
SVPM 3	19.3	0.003	-0.03	-0.09
EW-05	21.2	-0.02	-0.04	-0.07
SVPM 2	31.7	0.003	-0.03	-0.07
SVPM 1	98.1	0.01	-0.03	-0.12

EW-04 tests (SVE performed at middle of unsaturated zone, monitoring at water table)

Well ID	Distance from SVE Well (ft)	Soil Vapor Pressure (inches of water column)		
		5 cfm	20 cfm	80 cfm
EW-02	3.7	-0.11	-0.07	-0.08
EW-01	55.3	-0.11	-0.03	-0.06
MW-01	74.6	-0.11	-0.06	-0.06
EW-03	75	-0.1	-0.06	-0.06

Figures 4 and 5 present the natural log of soil vapor pressures at the water table and middle of unsaturated zone, respectfully, as a function of distance from EW-05 (which is screened at the middle of the unsaturated zone). The results of this testing is very similar to that for the testing at EW-01, except that here the trend is reversed. Under these tests, the operation of EW-05 did not cause of significant vacuum to form at the water table (Figure 4). However, vacuums were noted at the middle of the unsaturated zone and were dependent on the soil vapor extraction rate and distance, indicating a reasonable correlation (Figure 5). These trends allowed the development of a calculated radius of influence as a function of flowrate, and are discussed below.

The testing below, in, and near the cesspool found that the structure of the cesspool did not appreciably inhibit air flow rate, or serve as a preferred pathway for air flow.

Air Injection Tests

The injection well was evaluated at flow rates of 10, 20, 30, and 60 scfm. During the testing, it was noted that air injection rates of 10 to 20 cfm could routinely be achieved. However, injection rates of 30 and 60 scfm could not be consistently achieved. The higher flow rates were only achieved after a consistent air injection rate of 10 to 20 cfm for a period of several days. After a system shutdown, it took as long as one or more days to again establish a flow rate of 30 cfm.

Monitoring points consisted of water level measurements at EW-01, EW-02, EW-03, MW-01, GPM 2, GPM 3, and HN-27-S3 (background monitoring well) over time until a change of 10% was noted over three consecutive readings. Soil vapor pressures were also monitored during the testing. The results of this testing are presented in Table 3 and are graphed in Figure 6.

This data was analyzed similar to the soil vapor extraction data, except that pressure gradients in the water were evaluated. Also, linear regressions were calculated for both the normal (non-log) and semi-log plots. Correlation coefficients of only 0.4 to 0.6 were obtained with this analysis, indicating a correlation did exist, but that is was relatively weak. Again the correlation was better for the semi-log analysis, which would be expected.

TABLE 3

INJECTION WELL TEST RESULTS AND
INJECTION TO EXTRACTION FLOW RATIOS
AIR SPARGING/SOIL VAPOR EXTRACTION PILOT STUDY
NWIRP BETHPAGE, NEW YORK

IW-01 Tests

Well ID	Distance from AS Well (ft)	Hydrostatic Head (feet of water column)[1]			
		10 cfm	20 cfm	30 cfm	60 cfm
EW-01	8	1.97	3.61	3.61	4.3
EW-03	20	0.07	0.05	0.05	0.19
MW-01	30	0.13	0.22	0.22	0.44
EW-02	40	0.06	0.09	0.09	0.11
27-S3	98	-0.02	0.01	0.09	0.11

IW-01/EW-02 Tests (Monitoring at water table)

Well ID	Distance from AS Well (ft)	Soil Vapor Pressure[2] (inches of water column)		
		SVE/AS Ratio: 1.5	SVE/AS Ratio: 2.0	SVE/AS Ratio: 3.0
EW-01	8	0.21	0.17	-0.33
EW-03	20	0.05	0.03	-0.38
MW-01	30	1.0	1.2	1.0
EW-02	40	-4.3	-5.9	-12

IW-01/EW-02 Tests (Monitoring at middle of unsaturated zone)

Well ID	Distance from AS Well (ft)	Soil Vapor Pressure[2] (inches of water column)		
		SVE/AS Ratio: 1.5	SVE/AS Ratio: 2.0	SVE/AS Ratio: 3.0
SVPM 2	10	0.02	0.03	-0.03
SVPM 3	21	-0.01	0.03	-0.03
SVPM 4	29	-0.01	0.03	-0.03
EW-04	41	-0.03	0.04	-0.04
SVPM 1	48.5	0.03	-0.003	-0.03
SVPM 5	49	-0.04	0.03	-0.04
EW-05	59.5	-0.04	0.03	-0.03

1. A positive increase in hydrostatic head indicates that the water level increased by that height, with the change adjusted for soil vapor pressure.
2. A negative soil vapor pressure reading indicates a vacuum.

Qualitative analysis of the results, found a significant impact (water table rise) in the well at a distance of 8 and 30 feet hydraulically downgradient from the air injection well. As the flowrate to the well increased, the resulting water level also increased. Monitoring wells located at 20 feet upgradient and 40 feet side gradient of the air injection well may have been effected. However, consistent changes in water level were not observed as a function of flowrate.

Air Injection/Soil Vapor Extraction Tests

A test was conducted in which air was injected in well IW02 and extracted from well EW-02. The test used a fixed injection rate of 20 scfm. The soil vapor extraction rate was set at 1.5, 2.0, and 3.0 times the injection rate. Water levels and soil vapor pressures/vacuums were measured during this test.

Table 3 presents the results of the injection well testing and simultaneous injection/extraction testing. Qualitative analysis of these results, indicates that an extraction ratio of 2 to 3 times the air injection rates is needed to assure capture of all injected air.

RADIUS OF INFLUENCE AS A FUNCTION OF FLOW RATE

Soil Vapor Extraction

Table 4 presents the data representing the calculated radius of influence as a function of flow rate for extraction tests performed at the water table and the middle of the unsaturated zone. The radius of influence is calculated based on a linear regression analysis of soil vapor pressures. The detection limit used was 0.05 inches of water column for measurements at the water table and 0.02 inches of water column at the middle of the unsaturated zone. These values were selected based on the accuracy of the instrument (detection limit equal to 0.02 inches water column), the observed effects of atmospheric disturbances (weather systems), and the time for the soil vapor system to respond to changes.

TABLE 4

RESULTS OF
RADIUS OF INFLUENCE AS A FUNCTION OF SOIL VAPOR EXTRACTION RATES
AIR SPARGING/SOIL VAPOR EXTRACTION PILOT STUDY
NWIRP BETHPAGE, NEW YORK

EW-01 & EW-02 tests (SVE at water table, monitoring points at water table)

SVE Flow Rate (cfm)	EW-01 - Radius of Influence (feet)[1]	EW-02 - Radius of Influence (feet)[1]
5	53	48
10	59	-
20	71	98
40	79	-
80	84	121

EW-04 & EW-05 tests (SVE and monitoring points at middle of unsaturated zone)

	Calculated Radius of Influence (in feet using 0.05 inches of water reference point)	
SVE Flow Rate (cfm)	EW-04 - Radius of Influence (feet)[2]	EW-05 - Radius of Influence (feet)[2]
5	-	42
20	51	88
80	91	111

1. 0.05 feet of vacuum (water) is used as the reference point.
2. 0.02 feet of vaccum (water) is used as the reference point.

cfm: cubic feet per minute.
SVE: Soil Vapor Extraction

Figures 7 and 8 represents combined extraction test data from the water table and middle of unsaturated zone and represent design curves for the soil vapor extraction system. For extraction at the water table, a similar radius of influence was noted for the shallow soils. However for extraction at the middle of the unsaturated zone, it is apparent that stagnant (no flow) zones may have developed at the water table.

Air Injection

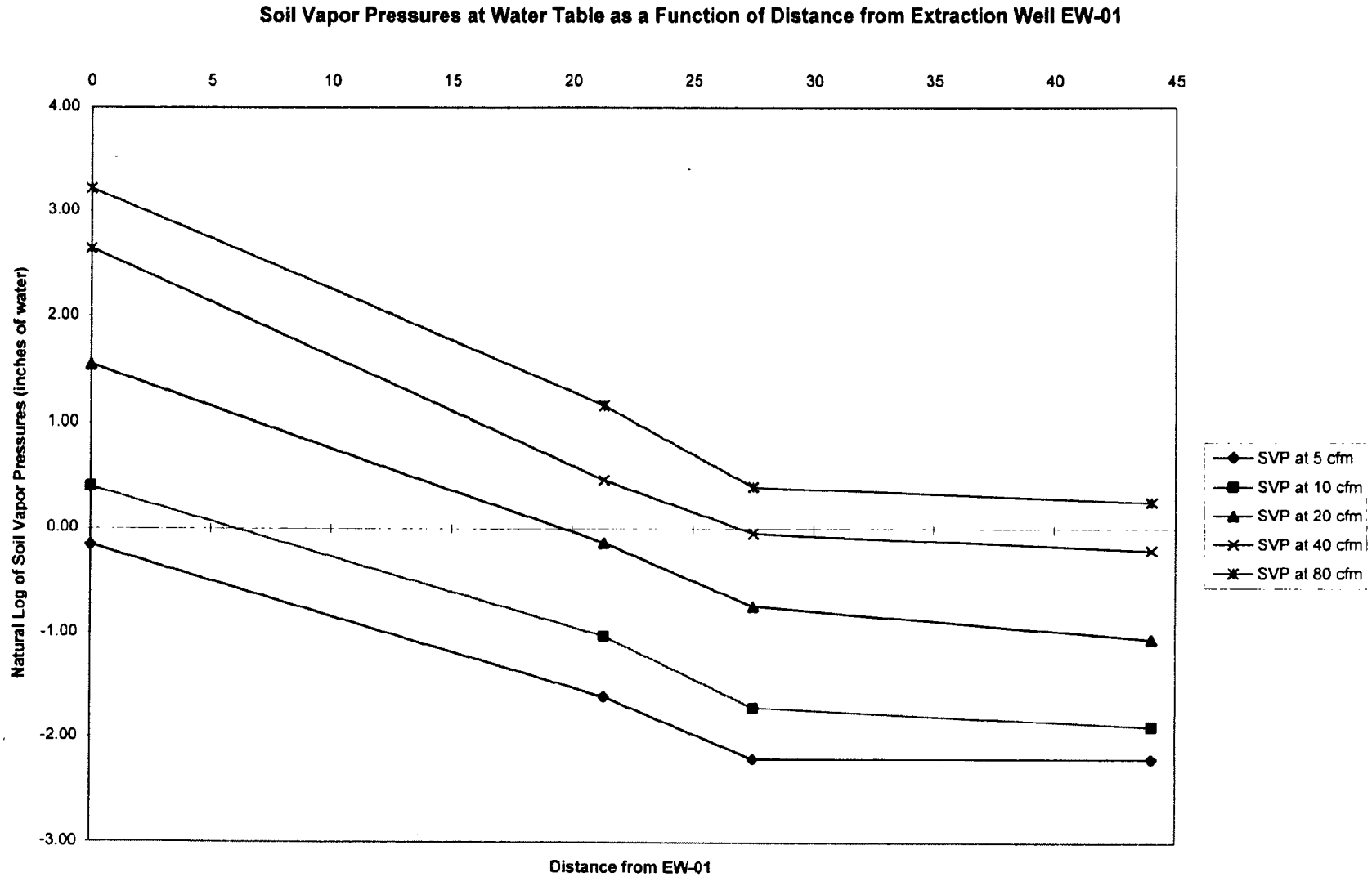
Design curves for the air injection wells could not be developed as they were for the soil vapor extraction wells. Based on the data collected to date, an apparent radius of influence is not directly dependent on air injection water is likely to be between 20 and 40 feet. Results from the chemical testing of groundwater may provide a more supportable radius of influence for groundwater. For current purposes, the design radius of influence for air injection at 10 CFM per well will be assumed to be 30 feet.

3.2 CHEMICAL PARAMETERS

Carbon System Data

General operating parameters of the vapor phase activated carbon system are presented in Table 5. PID readings are used to identify breakthrough of contaminants through the carbon units. Initial breakthrough of the first carbon unit occurred approximately June 5, 1997, which is approximately 60% into the test. Based on the first carbon unit continuing to remove approximately 95% of the VOCs on June 19, 1997, complete breakthrough of the first carbon unit has not yet occurred.

FIGURE 2

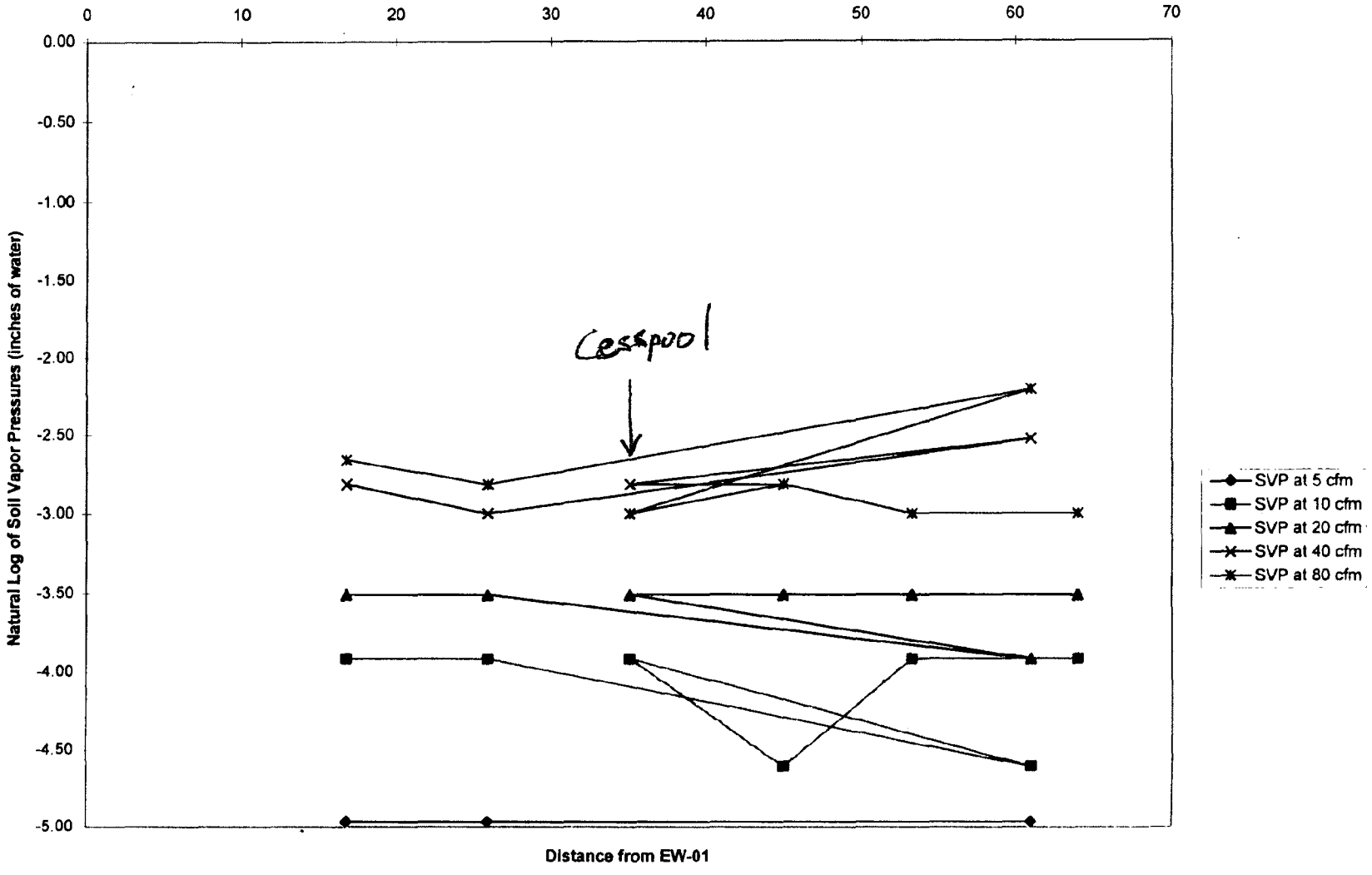


BP9701W AS.CH Chart 1

6/23/97 12:45 PM

FIGURE 3

Soil Vapor Pressures at Middle of Unsaturated Zone as a Function of Distance from Extraction Well EW-01



BP9701M AS.CH Chart 1

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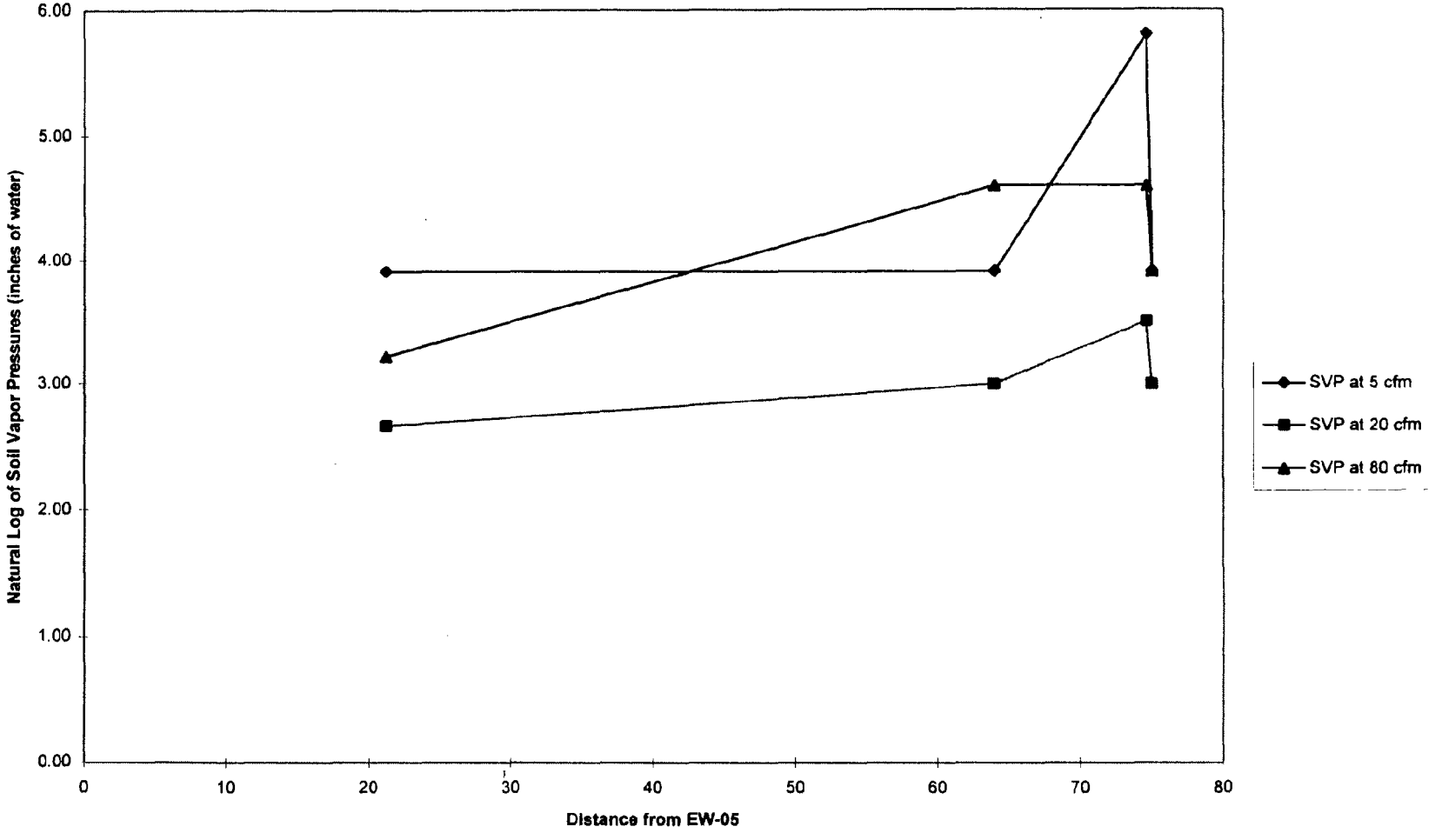
FIGURE 4

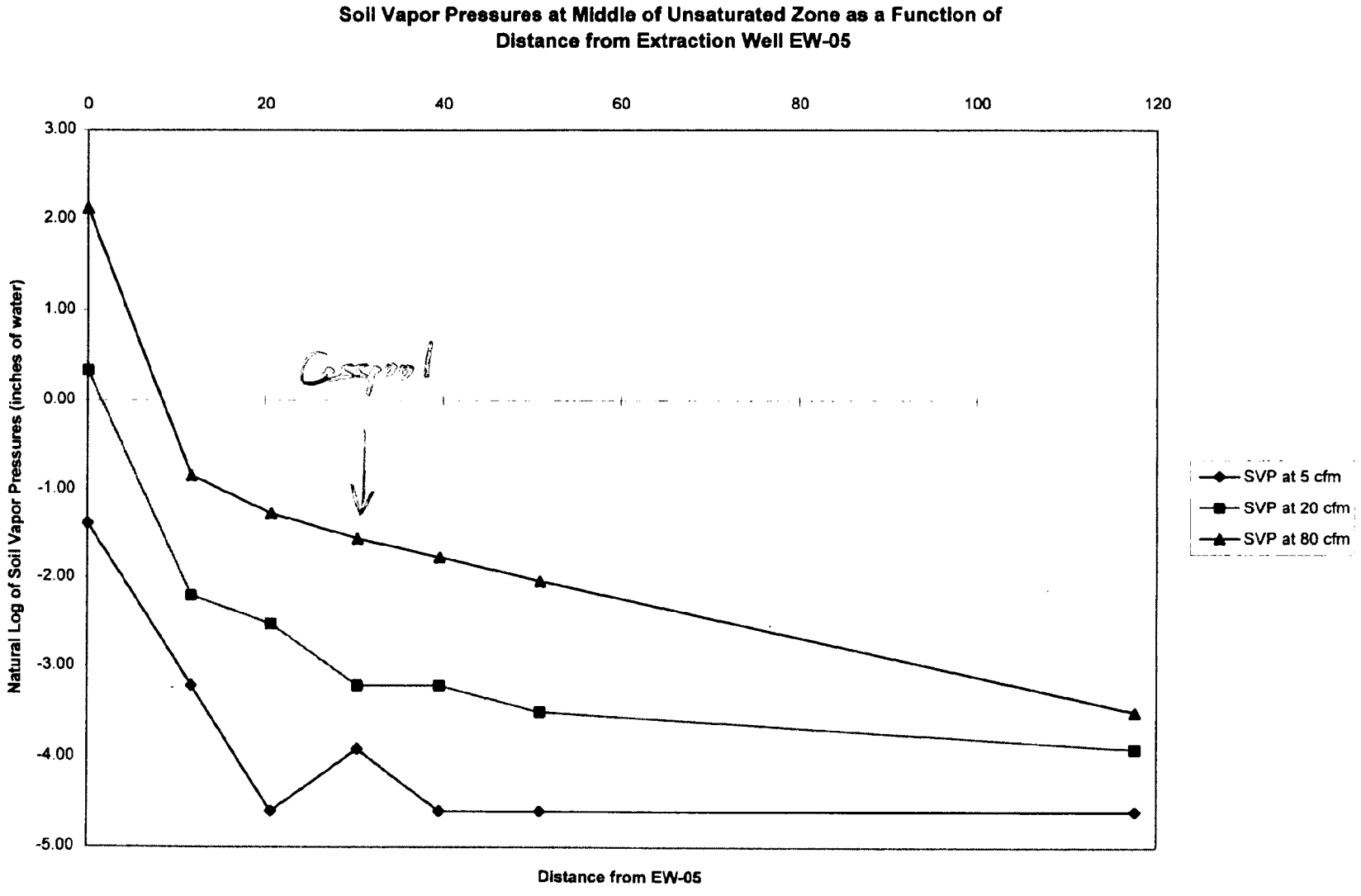
Soil Vapor Pressures at Water Table as a Function of Distance from Extraction Well EW-05



BP9705W AS.CH Chart 1

6/23/97 12:51 PM

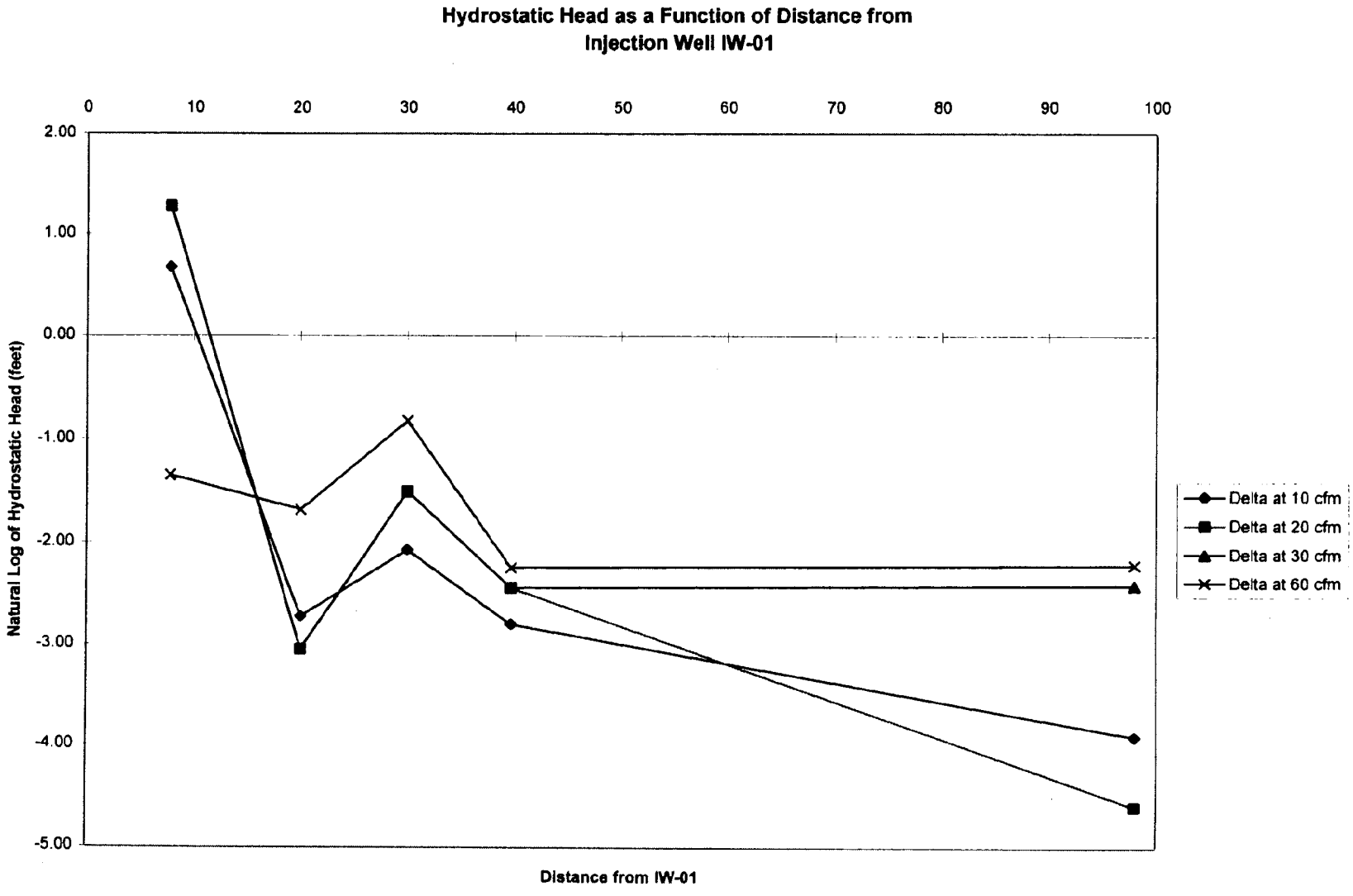
FIGURE 5



BP9705M AS.CH Chart 1

6/23/97 12:51 PM

FIGURE 6

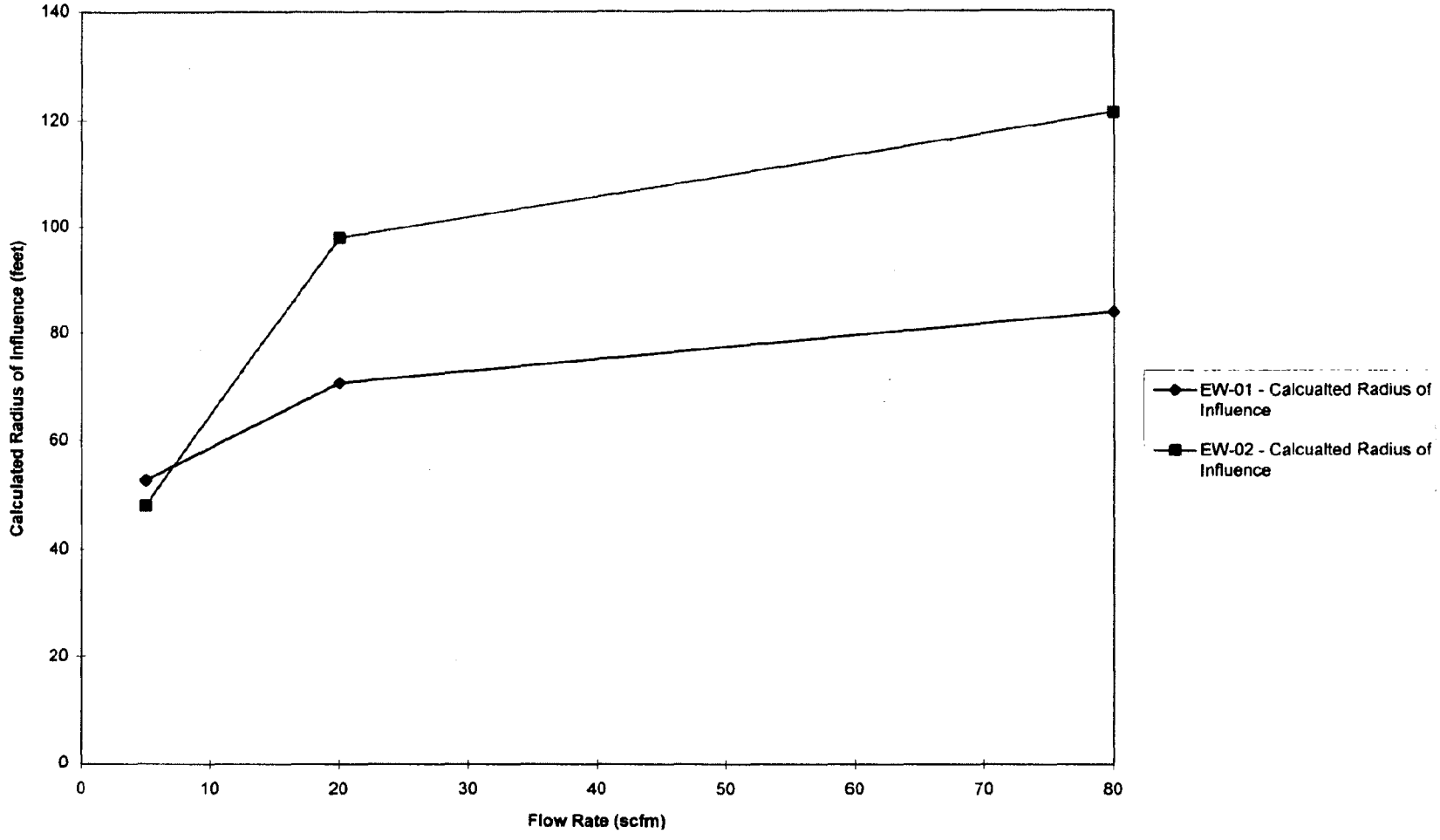


BP97IW AS.CH Chart 3

6/23/97 12:49 PM

FIGURE 7

Calculated Radius of Influence as a Function of Flow Rate from Extraction Wells EW-01 and EW-02



BP970102 AS.RAD Chart 1

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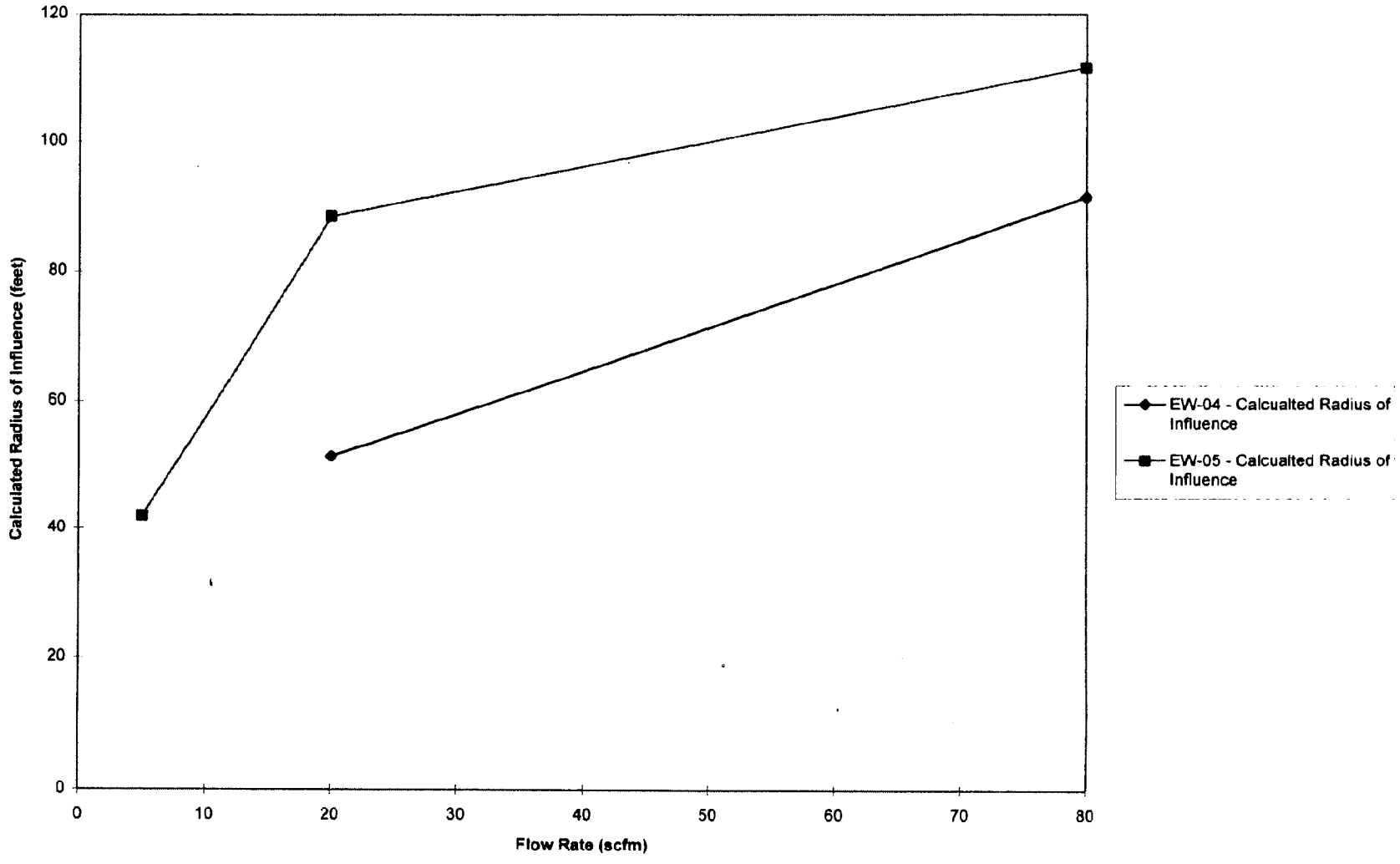
FIGURE 8

Calculated Radius of Influence as a Function of Flow Rate from Extraction Wells EW-04 and EW-05



BP970405 AS.RAD Chart 3

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TABLE 5

CARBON SYSTEM OPERATION DATA
AIR SPARGING/SOIL VAPOR EXTRACTION PILOT STUDY
NWIRP BETHPAGE, NEW YORK

1. PRE-CARBON Treatment Units

Check List Date	4/23/97	5/2/97	5/7/97	5/15/97	5/20/97	5/29/97	6/5/97	6/12/97	6/19/97
Pressure (inches of H_2O)	2.9	2.3	2.7	2.4	2.7	6.2	5.7	5.7	6.3
Flow Rate (scfm)	23	104	104	108	108	152	170	170	166
PID Reading (ppm)	1,106	1,097	*	185	125	62	58	51	68

2. BETWEEN CARBON Treatment Units

Check List Date	4/23/97	5/2/97	5/7/97	5/15/97	5/20/97	5/29/97	6/5/97	6/12/97	6/19/97
Pressure (inches of H_2O)	1.3	1.1	1.4	1.7	1.4	3.1	2.8	3.0	3.1
Flow Rate (scfm)	21	100	100	104	104	152	170	170	156
PID Reading (ppm)	0	0	*	0	0	0	5.3	0	2.5

3. POST CARBON Treatment Units

Check List Date	4/23/97	5/2/97	5/7/97	5/15/97	5/20/97	5/29/97	6/5/97	6/12/97	6/19/97
Pressure (inches of H_2O)	0.09	0.60	0.81	0.09	0.9	0.09	0.03	0.04	0.12
Flow Rate (scfm)	20	100	100	104	104	148	148	166	156
PID Reading (ppm)	0	0	*	0	0	0	3.8	0	0

SCFM - Standard Cubic Feet per Minute
PID - Photoionization Detector measures in Parts Per Million.
* - PID reading was not obtained.

System Operation Data

General system data collected to date is provided in Table 6. With the except of two unplanned outages, the system is operating as expected. The first outage lasted approximately one week and resulted from the adjacent building being demolished and interruption of the blower power supply. The second outage lasted for approximately five days and is believed to have resulted from an electrical storm temporarily disrupting the power supply. The blowers are not set to automatically restart without operator attention.

Two other notable findings to date include the following.

- SVPM-1 which is the soil vapor pressure monitor located at the middle of the unsaturated zone and nearest the residential neighborhood was consistently maintained at a vacuum. This finding indicates that soil vapor flow in this area would be from the neighborhood toward the extraction system.

- The pressure in the monitoring well (MW-01), which is screened entirely below the clay lens, has shown both positive and negative readings. Even though it is unlikely that injected air is reaching the fence line, a negative vacuum at this location should be maintained to confirm capture. As a result, the air injection rate has been decreased and the air extraction rate around the injection well has been increased.

Chemical Data

The results of soil, groundwater, and soil vapor data collected to date are presented in Table 7, 8, and 9, respectively. Based on the soil and groundwater data, the pilot study is properly located relatively to the site contaminants. The groundwater results (Table 8) indicate that there is a downward trend in VOC concentrations throughout all monitoring wells. Monitoring well PS-EW01 (located 8 feet downgradient of the injection well) is definitely effected. The results for the other wells are currently inclusive.

The soil vapor data (Table 9) indicates that relatively high quantities of VOCs are being removed from the soil vapor extraction system. Near the beginning of the study, approximately

50 pound per day of VOCs were being removed. Approximately one month in the study, the removal had decreased to approximately 7 pounds per day. The vapor phase carbon units are removing greater than 99% of extracted VOCs.

TABLE 6

SYSTEM OPERATION DATA
AIR SPARGING/SOIL VAPOR EXTRACTION PILOT STUDY
NWIRP BETHPAGE

1. Extraction Wells

Check List Date	4/23/97	5/2/97	5/7/97	5/15/97	5/20/97	5/29/97	6/5/97	6/12/97	6/18/97	6/25/97
EW-01	Initial Water Level = 58.10 feet									
Flow Rate (scfm)	24.0	21.8	22.9	22.9	22.9	36.0	38.2	15.3		
PID Reading (ppm)	1,147	1,076	**	94.4	15.9	9.7	13.5	21.1		
Pressure (" water)	-5.6	-2.4	-5.7	-5.9	-4.5	-9.4	-17	-9.5		
Level Change (ft)*	2.92	0.08	1.52	1.67	0.35	2.5	1.8	3.3		
TCA (ppm)	T	ND	ND	ND	ND	ND	ND	ND		
CO_2 (0.5-10 Vol.%)	4.5	0.5	0.75	0.75	0.75	0.75	0.75	1.0		
V. Chloride (ppm)	T	ND	ND	ND	ND	ND	ND	ND		

Check List Date	4/23/97	5/2/97	5/7/97	5/15/97	5/20/97	5/29/97	6/5/97	6/12/97	6/18/97	6/25/97
EW-02	Initial Water Level = 58.77 feet									
Flow Rate (scfm)	24.0	24.0	21.8	21.8	20.7	32.7	34.9	40.4		
PID Reading (ppm)	789	694	**	122	152	85.8	61.8	53.7		
Pressure (" water)	-3.1	-3.5	-2.8	-3.4	-3.4	-5.4	-6.2	-7.4		
Level Change (ft)*	0.23	0.27	0.45	0.5	1.0	1.57	1.57	1.97		
TCA (ppm)	75	ND	40	75	25	25	25	15		
CO_2 (0.5-10 Vol.%)	1.5	2.0	2.0	3.5	3.75	1.25	1.0	1.0		
V. Chloride (ppm)	T	T	T	T	T	T	ND	ND		

TABLE 6 (Continued)
SYSTEM OPERATION DATA

Check List Date	4/23/97	5/2/97	5/7/97	5/15/97	5/20/97	5/29/97	6/5/97	6/12/97	6/18/97	6/25/97
EW-03	Initial Water Level = 58.03 feet									
Flow Rate (scfm)	24.0	21.8	22.9	21.8	21.8	34.9	38.2	45.8		
PID Reading (ppm)	1,967	1,834	**	46.1	101	64.7	48.5	52.0		
Pressure (" water)	-4.9	-5.5	-4.5	-5.1	-4.9	-8.1	-8.9	-9.8		
Level Change (ft)*	0.34	0.22	0.34	0.28	0.16	0.41	4.63	2.43		
TCA (ppm)	50	ND	ND	T	ND	ND	ND	ND		
CO_2 (0.5-10 Vol.%)	7.0	3.0	2.5	2.25	1.5	1.0	1.25	1.5		
V. Chloride (ppm)	10	15	T	T	T	T	T	ND		

Check List Date	4/23/97	5/2/97	5/7/97	5/15/97	5/20/97	5/29/97	6/5/97	6/12/97	6/18/97	6/25/97
EW-04										
Flow Rate (scfm)	24.0	22.9	22.9	22.9	20.7	32.7	33.8	45.8		
PID Reading (ppm)	878	782	**	73.7	63.3	61.8	52.0	43.2		
Pressure (" water)	-0.9	-0.33	-0.82	-0.73	-0.79	-1.3	-1.6	-2.4		
Level Change (ft)	-	-	-	-	-	-	-	-		
TCA (ppm)	ND	ND	ND	ND	ND	ND	ND	ND		
CO_2 (0.5-10 Vol.%)	3.5	0.75	1.75	1.25	1.25	1.0	0.5	0.5		
Vinyl Chloride (ppm)	T	ND	ND	ND	ND	ND	ND	ND		

TABLE 6 (Continued)
SYSTEM OPERATION DATA

Check List Date	4/23/97	5/2/97	5/7/97	5/15/97	5/20/97	5/29/97	6/5/97	6/12/97	6/18/97	6/25/97
GPM 2	Initial Water Level = 59.16 feet									
Water Level Change (feet)*	0.02	-0.10	0.09	0.02	-0.13	-0.01	0.99	1.59		
GPM 3	Initial Water Level = 59.10 feet									
Water Level Change (feet)*	0.02	-0.09	0.07	0.0	-0.13	-0.04	0.89	1.55		
MW-01	Initial Water Level = 59.16 feet									
Well Point Pressure (inches of water)	-0.49	-0.77	0.14	0.07	-0.93	1.6	3.5	5.4		
Water Level Change (feet)*	0.02	-0.08	0.05	-0.01	-0.13	-0.03	0.83	1.51		
HN-27-S3	Initial Water Level = 56.81 feet									
Water Level Change (feet)*	0.09	-0.15	-0.08	-0.11	-0.21	-0.11	-0.08	1.95		

* Approximate water level change due to bubbling in extraction wells.
** Photoionization detector (PID) reading was not obtained.
PPM PID readings are measured in Parts Per Million.
SCFM Flow rates are measured in Standard Cubic Feet per Minute.
PSI Injection pressure is measured in Pounds-Force per Square Inch.
T Trace indicates slight color change in Drager Tube.
ND Not Detected no color change in Drager Tube

Drager Tube	Trace	Not Detected
TCA (ppm)	Less than 25 ppm color change.	Less than 10 ppm color change.
CO_2 (%)	Less than 0.25 % color change.	Less than 0.1% color change.
Vinyl Chloride (ppm)	Less than 5 ppm color change.	Less than 2 ppm color change.

TABLE 6 (Continued)
SYSTEM OPERATION DATA

Check List Date	4/23/97	5/2/97	5/7/97	5/15/97	5/20/97	5/29/97	6/5/97	6/12/97	6/18/97	6/25/97
EW-05										
Flow Rate (scfm)	24.0	22.9	22.9	22.9	20.7	32.7	28.4	17.4		
PID Reading (ppm)	274	253	**	26.6	22.4	19.2	13.2	6.7		
Pressure (" water)	-1.4	-1.9	-1.4	-1.7	-1.7	-2.5	-3.1	-1.4		
Level Change (ft)	-	-	-	-	-	-	-	-		
TCA (ppm)	ND	ND	ND	ND	ND	ND	ND	ND		
CO_2 (0.5-10 Vol.%)	2.0	0.5	0.5	0.5	T	T	0.5	0.25		
V. Chloride (ppm)	ND	ND	ND	ND	ND	ND	ND	ND		

2.0 Injection Well

Check List Date	4/23/97	5/2/97	5/7/97	5/15/97	5/20/97	5/29/97	6/5/97	6/12/97	6/18/97	6/25/97
IW-01										
Pressure (psi)	4.0	4.0	4.0	3.8	3.5	3.5	4.0	3.0		
Flow Rate (scfm)	9.8	9.8	10.0	9.3	10.9	37.1	38.2	37.1		

3.0 Monitoring Points

Check List Date	4/23/97	5/2/97	5/7/97	5/15/97	5/20/97	5/29/97	6/5/97	6/12/97	6/18/97	6/25/97
Well ID	**Well Point Pressure (inches of water)**									
SVPM 1	-0.16	-0.10	-0.12	-0.10	-0.14	-0.15	-0.15	-0.16		
SVPM 2	-0.19	-0.19	-0.13	-0.15	-0.16	-0.21	-0.25	-0.23		
SVPM 3	-0.21	-0.16	-0.12	-0.10	-0.14	-0.15	-0.28	-0.32		
SVPM 4	-0.29	-0.18	-0.13	-0.15	-0.16	-0.21	-0.36	-0.39		
SVPM 5	-0.03	-0.22	-0.22	-0.17	-0.20	-0.26	-0.41	-0.36		

TABLE 7

SOIL RESULTS
FORMER DRUM MARSHALLING AREA
PILOT SCALE - AIR SPARGE/SOIL VAPOR EXTRACTION SYSTEM
NWIRP BETHPAGE, NEW YORK

Sample Location	Parameter	Pre-test Result (ug/kg)	Post-test Result (ug/kg)	Change (%)
PS-SB-0210	Acetone	890		
	Tetrachloroethene	80		
PS-SB-0240	Acetone	18,000		
	Tetrachloroethene	59		
PS-SB-0320	Acetone	3,600		
	Tetrachloroethene	47		
PS-SB-0340	Acetone	47		
PS-SB-0430	Acetone	48		
	1,1-Dichloroethane	17		
	1,2-Dichloroethene	150		
	1,1,1-Trichloroethane	50		
	Trichloroethene	120		
	Tetrachloroethene	170		
PS-SB-0440	None detected			

Pre-test result is from April 1997.

TABLE 8

GROUNDWATER RESULTS (ug/l)
FORMER DRUM MARSHALLING AREA
PILOT SCALE AIR SPARGE/SOIL VAPOR EXTRACTION SYSTEM
NWIRP BETHPAGE, NEW YORK

Sample Location	Parameter	Pre-test Results (04/08/97)	Mid-Test Results (One Month - 05/21/97)	Mid-Test Results (Two Months)	End of Test Results (Three Months)
PS-MW01	1,1-Dichloroethene	6			
	1,1-Dichloroethane	110	36		
	c-1,2-Dichloroethene	500	110		
	1,1,1-Trichloroethane	390	94		
	Trichloroethene	630	160		
	Tetrachloroethene	2,800	710		
	Total	4,436	1,110		
PS-IW01	Acetone	560			
	2-Butanone	1,700			
	1,1,1-Trichloroethane	7	8		
	Tetrachloroethene	19	15		
	Total	26	23		

TABLE 8 (CONTINUED)
GROUNDWATER RESULTS (ug/l)
FORMER DRUM MARSHALLING AREA
PILOT SCALE AIR SPARGE/SOIL VAPOR EXTRACTION SYSTEM
NWIRP BETHPAGE, NEW YORK

Sample Location	Parameter	Pre-test Results (04/08/97)	Mid-Test Results (One Month - 05/21/97)	Mid-Test Results (Two Months)	End of Test Results (Three Months)
PS-EW01	1,1-Dichloroethene				
	1,1-Dichloroethane	80			
	c-1,2-Dichloroethene	380	15		
	1,1,1-Trichloroethane	220	5		
	Trichloroethene	370	9		
	Tetrachloroethene	1600	27		
	Total	2,650	56		
PS-EW02	1,1-Dichloroethene	11	12		
	1,1-Dichloroethane	170	160		
	c-1,2-Dichloroethene	840	340		
	t-1,2-Dichloroethene	6			
	Chloroform	5			
	1,1,1-Trichloroethane	1,200	770		
	Trichloroethene	1,500	580		
	Tetrachloroethene	11,000	4,500		
	Total	14,732	6,362		
PS-EW03	Acetone		83		
	1,1-Dichloroethane	49	51		
	c-1,2-Dichloroethene	240	160		
	1,1,1-Trichloroethane	200	170		
	Trichloroethene	380	230		
	Tetrachloroethene	1,400	920		
	Total	2,269	1,531		

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TABLE 9

SOIL VAPOR RESULTS (PPM-V)
FORMER DRUM MARSHALLING AREA
PILOT SCALE AIR SPARGE/SOIL VAPOR EXTRACTION SYSTEM
NWIRP BETHPAGE, NEW YORK

Sample Location	Parameter	Initial Results (April 1997)	Mid-Test Results (One Month - May 1997)	Mid-Test Results (Two Months)	End of Test Results (Three Months)
Pre-carbon gas sample	Freon 113	22	2.8		
	2-Butanone				
	Tetrahydrofuran				
	Acetone				
	Methylene Chloride				
	Vinyl Chloride				
	1,1-Dichloroethane	5.2	2.5		
	1,1-Dichloroethene		0.41		
	1,2-Dichlorothene	20	2.6		
	1,1,1 Trichloroethane	75	27		
	Toluene				
	Trichloroethene	51	4.6		
	Tetrachloroethene	580	52		
	Total	753.2	91.9		

TABLE 9 (CONTINUED)
SOIL VAPOR RESULTS (PPM-V)
FORMER DRUM MARSHALLING AREA
PILOT SCALE AIR SPARGE/SOIL VAPOR EXTRACTION SYSTEM
NWIRP BETHPAGE, NEW YORK

Sample Location	Parameter	Initial Results (April 1997)	Mid-Test Results (One Month - May 1997)	Mid-Test Results (Two Months)	End of Test Results (Three Months)
Post-carbon gas sample	Freon 113				
	2-Butanone	0.013			
	Tetrahydrofuran	0.015	0.019		
	Acetone	0.006	0.019		
	Methylene Chloride	0.004	0.005		
	Vinyl Chloride		0.012		
	1,1-Dichloroethane				
	1,1-Dichloroethene				
	1,2-Dichlorothene				
	1,1,1 Trichloroethane				
	Toluene	0.002			
	Trichloroethene				
	Tetrachloroethene		0.006		
	Total	0.040	0.061		
Lab Blank					

4.0 CONCLUSIONS

The conclusions derived to data from the pilot study are summarized as follows.

1. Stratification testing results indicate that dense VOCs do not preferentially accumulate near the bottom of an extraction well.

2. Soil vapor extraction radius of influence testing found that the site soils are highly permeable, with extraction rates of 80 cfm per well achievable. Measured radius of influences ranged from 50 feet at 5 cfm to approximately 100 feet at 80 cfm. A reasonable correlation was developed between flow rate and radius of influence.

3. Soil vapor extraction at the water table resulted in flow through both the upper and lower soil zones. Soil vapor extraction at the middle of the unsaturated zone resulted in flow through the middle of the unsaturated zone, but may have created stagnant flow conditions near the water table.

4. The cesspool structures do not appear to restrict air flow through them.

5. Air injection rates of as high as 60 cfm were achieved. However, rates greater than 20 cfm were difficult to consistently achieve and maintain.

6. The air injection tests were partially successful. An estimated radius of influence for air injection of 10 to 40 feet was obtained. Based on the testing data, the radius of influence for air injection is not a strong function of air flow rate. Chemical results from groundwater testing will be needed to refine the radius of influence results.

7. The presence of a clay lens within approximately 5 feet of the water table at the site requires special consideration for the design of air injection wells. To ensure capture of injected air, soil vapor extraction must be implemented between the clay lens and air injection. Soil boring samples will be required during installation for confirm location of clay lens.

8. Based on the testing, an soil vapor extraction to air injection ratio of approximately 2 to 3 is required to capture all of the injected air.

9. Preliminary design criteria for the full scale system are summarized as follows.

- Two to three lines of air injection wells located near the center of the groundwater contamination and near the downgradient border of the site to treat the most contaminated groundwater and soil contamination along the interface between groundwater and soil.

- Pending receipt of additional groundwater data, the preliminary design injection wells should be on 50 foot centers. Each line of wells will contain 3 to 4 air injections wells (total of approximately 11).

- Air injection rates for each well will be approximately 10 cfm (110 cfm total air injection).

- Soil vapor extraction wells should be on approximately 100 foot centers. Approximately 4 lines of soil vapor extraction well should be located near the northern and southeast soil contaminant zones. These wells will be used to extract soil vapors and injected air.

- Each line of wells will contain approximately 3 to 4 wells, (total of approximately 14 wells).

- Soil vapor extraction rates will be approximately 20 to 30 cfm per well (300 cfm total soil vapor extraction). This rate includes criteria for both radius of influence and a SVE to AS ratio of greater than 2.0.