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INTERIM PILOT STUDY REPORT

HARRIMAN SITE
HARRIMAN,NEW YORK

ARCADIS GERAGHTY & MILLER

21 MARCH 2001

PREPARED FOR
The Maybrook Environmental Trust

Prepared By:
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Interim Pilot Study Report, Harriman Site, Harriman, New York

Prepared by ARCADIS Geraghty & Miller, Inc. Date: March 21, 2001

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Date: 3/21/01

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Project Advisor
License Number 073296, New York

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DISCLOSURE STATEMENT

The laws of New York State require that corporations, which render engineering services in New York be owned by individuals licensed to practice engineering in the state. ARCADIS Geraghty & Miller, Inc. cannot meet that requirement. Therefore, all engineering services rendered to The Maybrook and Harriman Environmental Trust in New York are being performed by GM Consulting Engineers, P.C., a New York professional corporation qualified to render professional engineering services in New York. There is no surcharge or extra expense associated with the rendering of professional services by GM Consulting Engineers, P.C.

ARCADIS Geraghty & Miller is performing all those services which do not constitute professional engineering and is providing administrative and personnel support to GM Consulting Engineers, P.C. All matters relating to the administration of the contract with The Maybrook and Harriman Environmental Trust are being performed by ARCADIS Geraghty & Miller pursuant to its amended and restated services agreement with GM Consulting Engineers, P.C. all communications should be referred to Tom C. Eng, Project Manager at ARCADIS Geraghty & Miller.

1. Introduction

ARCADIS Geraghty & Miller, Inc., and its engineering subcontractor, GM Consulting Engineers, P.C. have been retained by The Maybrook and Harriman Environmental Trust (Trust) to prepare this interim pilot study report for the Harriman site (Site), located in Harriman, New York. This interim pilot study report summarizes the methodologies and results of the soil vapor extraction (SVE), vacuum-enhanced recovery (VER), and bioremediation pilot studies. Currently, the bioremediation pilot study is still operating due to its effectiveness in reducing mass concentrations of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs).

2. Purpose

The purpose for performing each of these pilot studies was to determine the effectiveness of each technology in removing or destroying mass based the site's subsurface characteristics (i.e.; geology and hydrogeology). The results of the pilot studies could then be used to design the most effective overall remedial strategy for the impacted overburden aquifer at the site.

3. Pilot Study Locations

The locations for performing these pilot studies at the site, as agreed to with NYSDEC, were as follows. The SVE and VER pilot studies would be performed in the area of test pit 9 (TP-9). TP-9 was identified during the remedial investigation as an area where impacts by the site constituents of concern (COCs) for volatile organic compounds (benzene, toluene, ethylbenzene, xylene, and chlorobenzene) and semi-volatile organic compounds (pyridine, alpha-picoline, and 2-amino-pyridine) were identified. The bioremediation pilot study, consisting of biosparging technology, was performed in the area of MW-25S where recent groundwater sampling results indicated impacts by the site COCs. Figure 1 provides the location of TP-9, the configuration of the SVE/VER pilot study wells, and the location of MW-25S.

4. Site Characterization

4.1 Site Description

The Site is located primarily in the Village of Harriman, (however, a small portion of the south corner of the Site is located within the boundaries of the Town of Woodbury), Orange County, New York on NY Route 17 approximately 1 mile southwest of Exit 16 of the New York State Thruway. The Site is bound to the north by the West Branch of the Ramapo River, to the east by undeveloped land, to the south by Conrail railroad tracks, and to the west by NY Route 17. The Site is presently designated and zoned light industrial/commercial.

The Site consists of 2 parcels of land. The active manufacturing facility occupies a 9.74-acre parcel (containing the parking lot, SPDES lagoon, and former "blind" lagoon) and an 18.64-acre parcel (containing plant processing areas). Together, this 28.38-acre area is defined as the Site.

4.2 Site Topography

The Site lies in the Hudson Highlands Physiographic Province within a northwest trending glacial valley. The Site is situated on a floodplain near the confluence of the main and west branches of the Ramapo River and has relatively low topographic relief. The ground surface elevation of the Site ranges from 545 to 515 feet above mean sea level. Surface runoff from precipitation drains north to Arden House Road or east towards the "Avon" parcel.

4.3 Site Geology/Hydrogeology

In general, four hydrostratigraphic units have been identified at the Site, that consist of the Perched Water Table, the Overburden Aquitard, the Overburden Aquifer, and the Bedrock Aquifer.

The Perched Water Table Unit includes any saturated, permeable materials (native or fill), which overlie, or occur within the upper portion of the Overburden Aquitard Unit. The Perched Water Table Unit is discontinuous and localized on-site. This unit has minimal influence on groundwater flow within the deeper units other than providing a reservoir for surface water infiltration prior to movement to greater depths. These groundwater are considered "perched" due to descriptions of unsaturated (damp or moist) zones within the underlying overburden Aquitard Unit.

The overburden Aquitard Unit is used to describe the low-permeability (i.e., 10-6 cm/s), fine-grained glaciolacustrine deposits occurring on Site. The Overburden Aquitard Unit is highly layered with some variability in the grain size of individual layers, which range from predominantly clay to fine sand. The Overburden Aquitard Unit has markedly different permeability in the horizontal and vertical planes. The cumulative effects of clayey layers greatly reduce the vertical permeability, however, permeable horizontal pathways occur along predominantly sandy layers. The horizontal extent of such sandy layers is variable.

Along the western portion of the Site, the Overburden Aquitard Unit is much thinner and comprised predominantly of fine-grained sand layers with varying amounts of silt and clay. In such areas, the integrity of the overburden Aquitard Unit is greatly reduced and greater rates of vertical groundwater flux may occur. When the vertical hydraulic gradient is downward, shallow groundwater becomes perched on the Overburden Aquitard Unit as it slowly percolates to greater depths. In the case of upward gradients, the Overburden Aquitard Unit acts as a confining layer creating artesian conditions within the underlying aquifer.

The Overburden Aquifer Unit is a broad term used to describe a wide-ranging group of glacial sand and gravel deposits on-site that are not perched above the Aquitard unit. Stratigraphically, the unit generally overlies bedrock, however, a basal lodgment till occurs locally along the northeast and southeast sides of the Site between the Overburden Aquifer Unit and the Bedrock Aquifer Unit. The Overburden Aquifer Unit is confined over all but a portion of the Site and recovery test data indicates leaky aquifer conditions and lateral recharge boundaries. Test results indicate that where the Overburden Aquifer Unit directly overlies the Bedrock Aquifer Unit, a high degree of hydraulic communication occurs.

The Bedrock Aquifer Unit designation pertains to the water-bearing, transmissive fractures within the rock mass. This fracturing is referred to as secondary porosity and permeability and may be highly variable over short distances. The bedrock is most permeable in the uppermost few feet, due to weathering. Fracturing extends below this zone, however, frequency and intensity generally decreases. The most transmissive zones are found in structurally disturbed areas such as fault zones and groundwater flow is concentrated within the larger fractures. Since the Site is within a highly faulted zone, subvertical fracturing may be significant.

The horizontal hydraulic gradient within the Overburden and Bedrock Aquifer Units was calculated across the Site to be approximately 0.0075 feet/feet, southeasterly. The groundwater flux occurring beneath the Site within the Overburden Aquifer was estimated in the Remedial Investigation (CRA 1995) based on the transmissive character interpreted from the IRM shutdown test. The transmissivity of the overburden is considerably less than this value at the upgradient side of the Site where

the Overburden Aquifer is considerably thinner and acts to restrict the flow of groundwater.

The overburden is more variable along the downgradient side of the Site and the Overburden Aquifer is less transmissive in that area and acts to restrict flow. The result is a highly transmissive aquifer body beneath the Site (in the vicinity of the IRM wells) with the groundwater flux being restricted before leaving the aquifer beneath the Site.

5. Pilot Study Methodologies

A description of the pilot studies methodologies for soil vapor extraction (SVE), vacuum-enhanced recovery (VER), and bioremediation studies are provided below.

5.1 Soil Vapor Extraction

Soil vapor extraction is an extraction technology for the removal of volatile contaminant mass from the subsurface unsaturated zone. The technology requires the installation of an extraction well with its' screen interval placed in the unsaturated zone whereby a vacuum can be applied to withdraw the subsurface air and vapors.

5.1.1 Extraction and Monitoring Wells

One SVE extraction well (SVE-1) and three monitoring wells (SVE-2, SVE-3 and SVE-4) were installed for the purposes of the pilot study. The total depth of the SVE wells were based on core samples collected in the field. Sample core and well construction logs are provided in Appendix A. SVE-1 was installed to a depth of 8 feet below land surface (bls) with a screen length of 5 feet from an interval of 3 to 8 feet bls. SVE-1 was constructed of 4-inch diameter, schedule 40, polyvinyl chloride (PVC) casing and 20-slot PVC screen. The three monitoring wells were installed to a depth of 8.5 feet bls with a screen length of 5 feet from an interval of 3.5 to 8.5 feet bls. The monitoring wells were constructed of 2-inch diameter, schedule 40 PVC and 20-slot PVC screen. The monitoring wells were located 5, 15 and 25 feet away from SVE-1 in a radial manner.

5.1.2 SVE Pilot Study System

The SVE pilot study system consisted of a 2 horsepower regenerative blower capable of producing 100 actual cubic feet per minute (acfm) of air at a vacuum of 35 inches of water column. A condensate collection tank was installed in-line prior to the blower to ensure a liquid free air stream into the blower and two carbon units. A schematic of the system along with sample collection ports, flow and vacuum meters are provided in Figure 2.

5.2 Vacuum-Enhanced Recovery

Vacuum-enhanced recovery is a dual phase extraction technology for the removal of volatile contaminant mass from the lower permeability subsurface conditions of the overburden aquifer. The technology requires the installation of an extraction well whereby a vacuum can be applied to the well to increase the effective hydraulic gradient towards the well, thereby increasing the yield of the well. The increased yield enhances the dewatering of the saturated zone, thus allowing air to sweep through the smear zone and the capillary fringe. The location for performing this pilot study at the site was also in the area of TP-9. Figure 1 provides the location of TP-9 along with the configuration of the VER wells.

5.2.1 Extraction and Monitoring Wells

One VER extraction well (VER-1) and three monitoring wells (VER-2, VER-3 and VER-4) were installed for the purposes of the pilot study. The total depth of the VER wells were based on core samples collected in the field. Sample core and well construction logs are provided in Appendix B. VER-1 was installed to a depth of 19 feet below land surface (bls) with a screen length of 5 feet from an interval of 14 to 19 feet bls. VER-1 was constructed of 4-inch diameter, schedule 40, polyvinyl chloride (PVC) casing and 10-slot PVC screen. Two monitoring wells (VER-2 and VER-3) were installed to a depth of 19 feet bls with a screen length of 5 feet from an interval of 14 to 19 feet bls. The third monitoring well (VER-4) could only be installed to a depth of 18.5 feet bls with a screen interval of approximately 13 to 18 feet bls. The monitoring wells were all constructed of 2-inch diameter, schedule 40 PVC and 20-slot PVC screen. The monitoring wells were located 5, 15 and 25 feet away from VER-1 in a radial manner.

5.2.2 VER Pilot Study System

The VER pilot study system consisted of a 7.5 horsepower liquid-ring pump blower capable of producing 20-150 actual cubic feet per minute (acfm) of air at a vacuum of 29 inches of mercury column. A condensate collection tank was installed in-line prior to the blower to ensure a liquid free air stream into the blower and two carbon units. A schematic of the system along with sample collection ports, flow and vacuum meters are provided in Figure 2. Appendix C provides the pilot study system specifications.

5.3 Bioremediation Pilot Study

Biosparging technology involves the injection of compressed air into a well under controlled conditions to create an aerobic environment. By creating the aerobic

environment and increasing the oxygen concentration in the groundwater, the biodegradation rate of the site COCs can be increased.

5.3.1 Biosparging and Monitoring Wells

One biosparging well (BIO-1) and two monitoring wells (OW-6 and OW-7) were installed for the purposes of the pilot study. The existing monitoring well, MW-25S was used as the third monitoring well. The total depth of the biosparging wells were based on core samples collected in the field. Sample core and well construction logs are provided in Appendix D. BIO-1 was installed to a depth of 30 feet below land surface (bls) with a screen length of 2 feet from an interval of 28 to 30 feet bls. BIO-1 was constructed of 1-inch diameter, schedule 40, polyvinyl chloride (PVC) casing and 10-slot PVC screen. Two monitoring wells (OW-6 and OW-7) were installed to a depth of 30 feet bls with a screen length of 10 feet from an interval of 20 to 30 feet bls. The monitoring wells were all constructed of 2-inch diameter, schedule 40 PVC and 20-slot PVC screen. The third monitoring well (MW-25S) is an existing monitoring well with a total depth of 28 feet bls with a 5 foot screen from the interval of 23 to 28 feet bls. The monitoring wells were located 7, 15 and 25 feet away from BIO-1 in a radial manner.

5.3.2 Biosparging Pilot Study System

The biosparging pilot study system consisted of a 3.5 horsepower oil-less compressor capable of producing 6 actual cubic feet per minute (acfm) of air at a pressure of 90 pounds per square inch (psi). The air flow was set at 1 cfm and the pressure was regulated to approximately 10 psi. The compressor is connected to BIO-1 via flexible air hose. Figure 3 provides a schematic of the biosparging system.

6. Pilot Studies Results

6.1 SVE Results

The SVE pilot study was performed on December 7 and 8, 2000. During this test, four different vacuum levels were applied to the SVE well. The vacuum levels ranged from 4 to 34 inches of water column in an attempt to generate air flow in the subsurface unsaturated zone. Air flow could not be established and therefore, no radius of influence was measurable in the monitoring wells. Table 1 summarizes the data collected during the pilot test.

6.2 VER Results

The VER pilot study was performed on December 12, 2000 and the test data is summarized in Table 2. During the test, four different vacuum levels were applied to VER-1. The vacuum levels ranged from 9 to 25 inches of mercury. At 9 inches of mercury, no air or water flow was generated. Vacuum influence was only measurable at VER-2 which was 5 feet away and PID readings of the influence vapor stream ranged from 1.8 to 2.4 parts per million (ppm).

As the vacuum was increased to 12 inches of mercury, an air flow of 3 acfm was measured with no water generation. Vacuum influence was measurable in all monitoring wells. During this test, PID readings ranged from 10 to 13.7 ppm. VER-3, the monitoring well 15 feet away began to show a positive pressure (1.1 inches of water column) indicating that channeling could be occurring. No laboratory vapor samples were collected during this test due to the low air flow rate and low PID readings.

The vacuum was then increased to 18 inches of mercury. The air flow rate remained at 3 acfm and water generation was approximately 0.5 gallons per minute (gpm). Vacuum influence was measurable in all monitoring wells and once again, VER-3 showed a positive pressure (1.6 inches of water column). During this test, the PID reading increased to 15.2 ppm. Laboratory vapor samples were collected of the influent to the liquid ring pump and the effluent from the carbon units. The laboratory vapor sample results are summarized on Table 3.

For the final test, the vacuum was increased to 25 inches to mercury. The air flow rate was measured at 5.5 to 6 acfm and the water generation rate remained at 0.5 gpm. Vacuum influence was measurable in all monitoring wells and once again, VER-3 showed a positive pressure (8.0 inches of water column). During this test, the PID reading increased to 70 ppm. Laboratory vapor samples were also collected of the influent to the liquid ring pump and the effluent from the carbon units and are summarized on Table 3.

6.3 Biosparging Results

The results of the biosparging indicates that this technology has been effective in reducing/destroying contaminant mass and converting the subsurface groundwater environment from anaerobic to aerobic conditions. Table 4 provides a summary of the laboratory analytical pilot test data. Table 5 provides a summary of the weekly monitoring of field parameters.

A comparison of the baseline groundwater sampling results, from November 2000 to January 2001, indicates that VOC concentrations have been reduced in all three

monitoring wells (OW-6, OW-7 and MW-25s) as shown on Figure 4. Generally, SVOCs have also shown a reduction in concentration except for alpha-picoline in OW-7 (see Figure 5).

The biosparging pilot study has also shown that the subsurface groundwater conditions have been changed in the area of MW-25S from anaerobic to aerobic conditions (see Figure 6). Redox potential in the monitoring wells have been changed from negative and positive and dissolve oxygen concentrations have been increasing. Under these aerobic conditions, the site COCs will degrade at much faster rates.

7. Conclusion

7.1 SVE Technology

The results of the SVE pilot study indicate that this technology will have very limited, if any, application at this site. The subsurface geologic and hydrogeologic conditions combined with underground utilities, provide for a very difficult application of this technology. The unsaturated zone consists of a heterogeneous fill layer (0-10 feet) mixed with low permeability soils. The thickness of the unsaturated zone is also limited by the perched water table, which rises and falls seasonally. The unsaturated zone thickness can be as thin as 1 to 3 feet (due to seasonal fluctuations) at many of the locations of the site where SVE as a soil remedy has been prescribed in the Record of Decision (ROD, 1997). The pilot study results showed that air flow could not be achieved in the area of TP-9 and therefore, this technology could not be successfully applied.

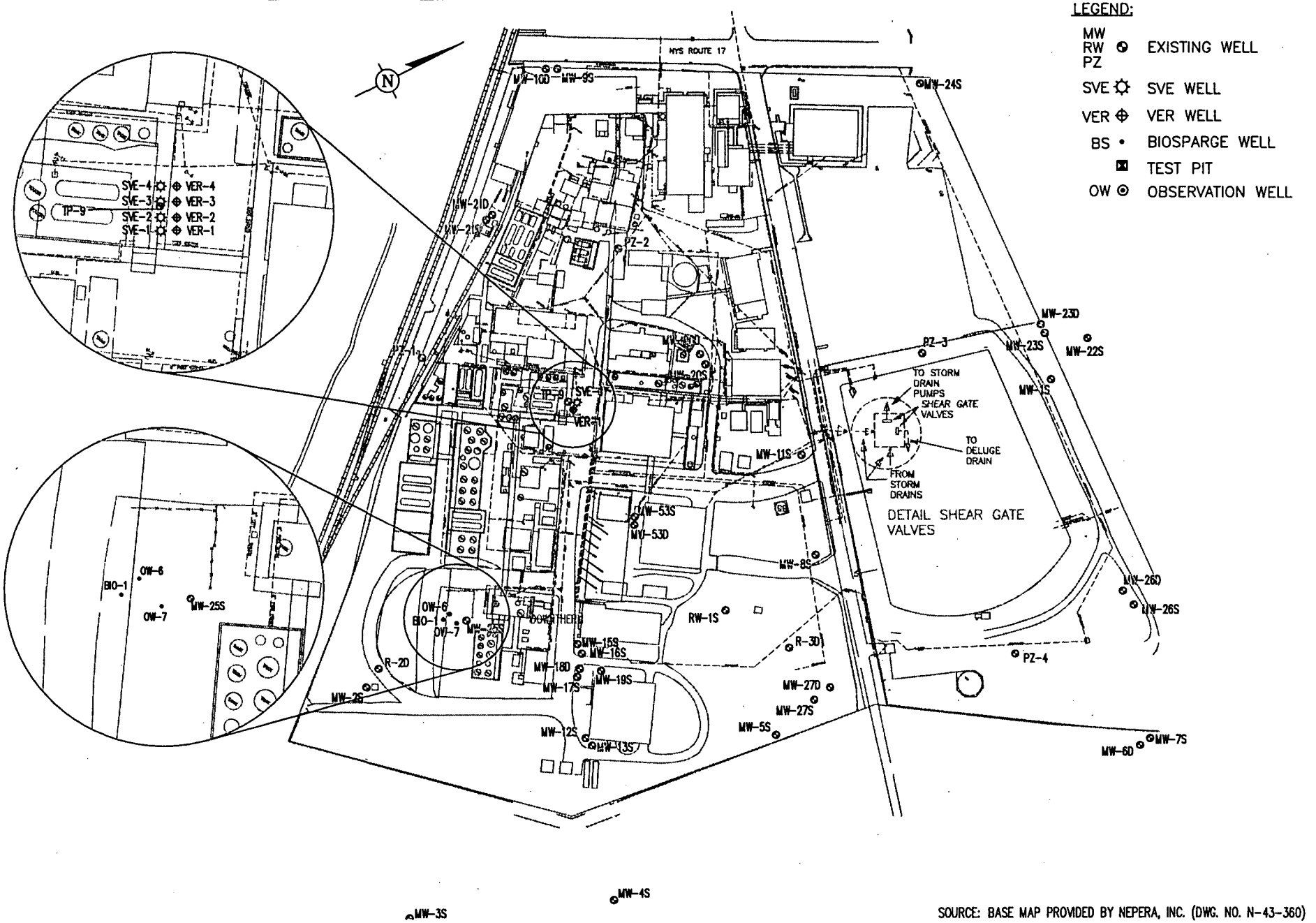
7.2 VER Technology

The results of the VER pilot study indicate that this technology will also have limited effectiveness at this site. At the high vacuum levels of 12 to 25 inches of mercury, only 3 to 6 acfm of air flow were measured and channeling appeared to be occurring. Based on these air flow rates, the mass removal rate of benzene would range from 0.001 to 0.0025 pounds per hour only. This mass removal rate is based on the laboratory vapor analytical result for benzene and typical of this type of extraction system, the mass removal rate would decrease with time. The water generation rate of 0.5 gpm would result in the extraction of 720 gallons per day and a mass removal rate of 0.0002 pounds per gallon extracted. Due to high vacuum levels required to produce these low mass removal rates, the difficulty of water disposal on site, and the control difficulties associated with the air pathways caused by the channeling effects, VER technology does not appear to suitable for application at this site. Any full-scale design of this technology would have to

consider the volume of water generated, water treatment requirements and the plant lagoon's limited hydraulic capacity.

7.3 Bioremediation Technology

The results of the biosparging pilot study indicate that it is the most effective technology of the three pilot tested for the remediation of the site COCs. After only two plus months of operation, VOC concentrations were reduced greatly (e.g. OW-6: from 20,000 ug/L to 1,800 ug/L and OW-7: from 9,500 ug/L to 4,000 ug/L); even concentrations in well MW-25S decreased from 2,300 ug/L to 2,100 ug/L. SVOC concentrations were also reduced (OW-6: from 5,300 ug/L to 1,630 ug/L, and MW-25S: from 314 ug/L to 190 ug/L). OW-7, however showed an increase from 970 ug/L to 1,570 ug/L. Based on these results, it has been decided to continue the operation of the biosparging pilot test system and additional samples will be collected in the future. Additional sparge points can also be considered to affect a larger area in a faster timeframe.



SOURCE: BASE MAP PROVIDED BY NEPERA, INC. (DWG. NO. N-43-360)

0 60 120 180

ARCADIS GERAGHTY & MILLER

DRAWN	DATE	PROJECT MANAGER	DEPARTMENT MANAGER
M.WASILESKI	3/16/01	T.ENG	
		LEAD DESIGN PROF. F.LENZO	CHECKED K.KIEVIT

PILOT STUDIES LOCATIONS

HARRIMAN SITE
HARRIMAN, NEW YORK

PROJECT NUMBER	DRAWING NUMBER
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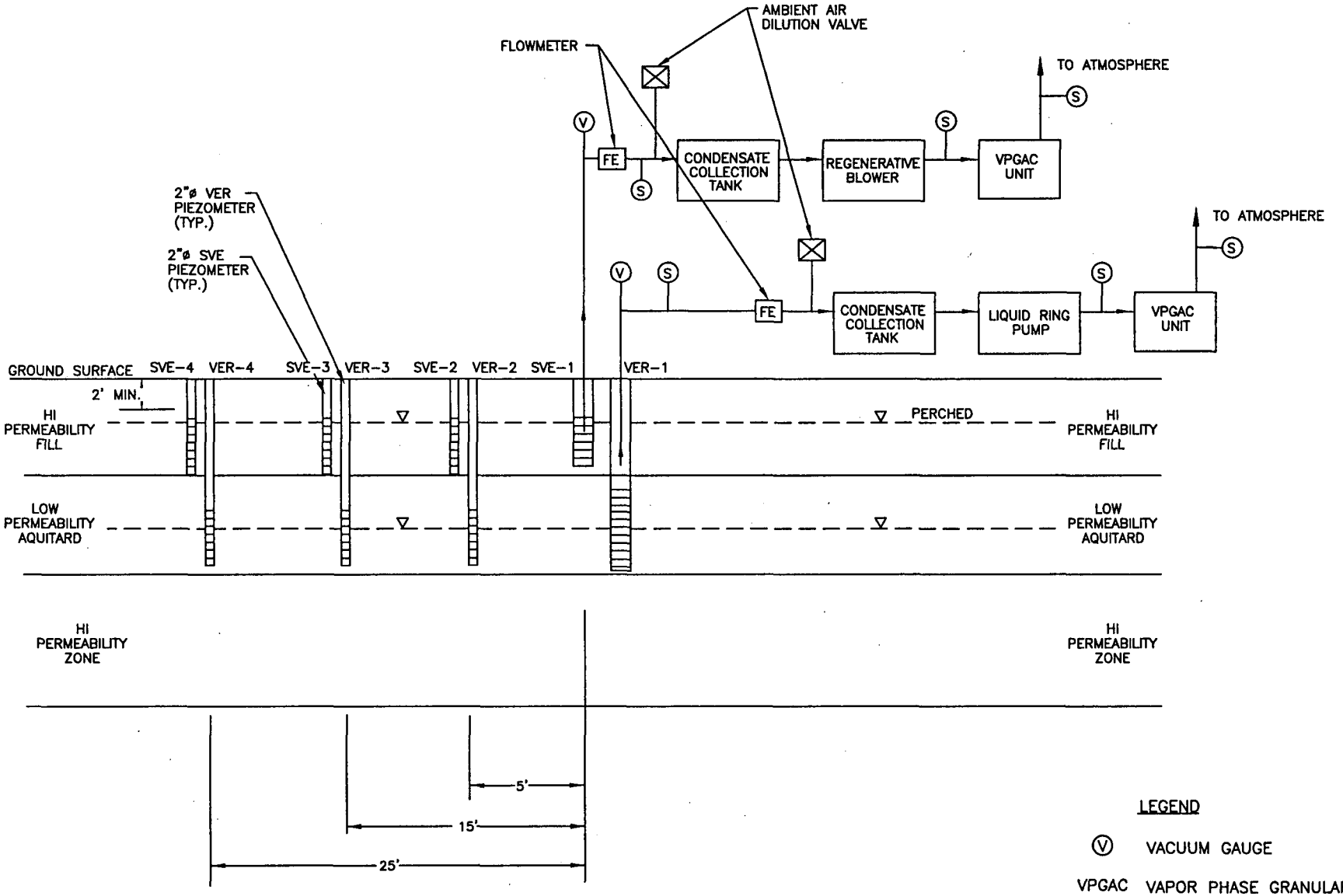


LEGEND

Ⓥ VACUUM GAUGE

VPGAC VAPOR PHASE GRANULAR ACTIVATED CARBON

Ⓢ SAMPLE PORT

DRAWING NOT TO SCALE

NO.	DATE	REVISION DESCRIPTION	BY / CKD

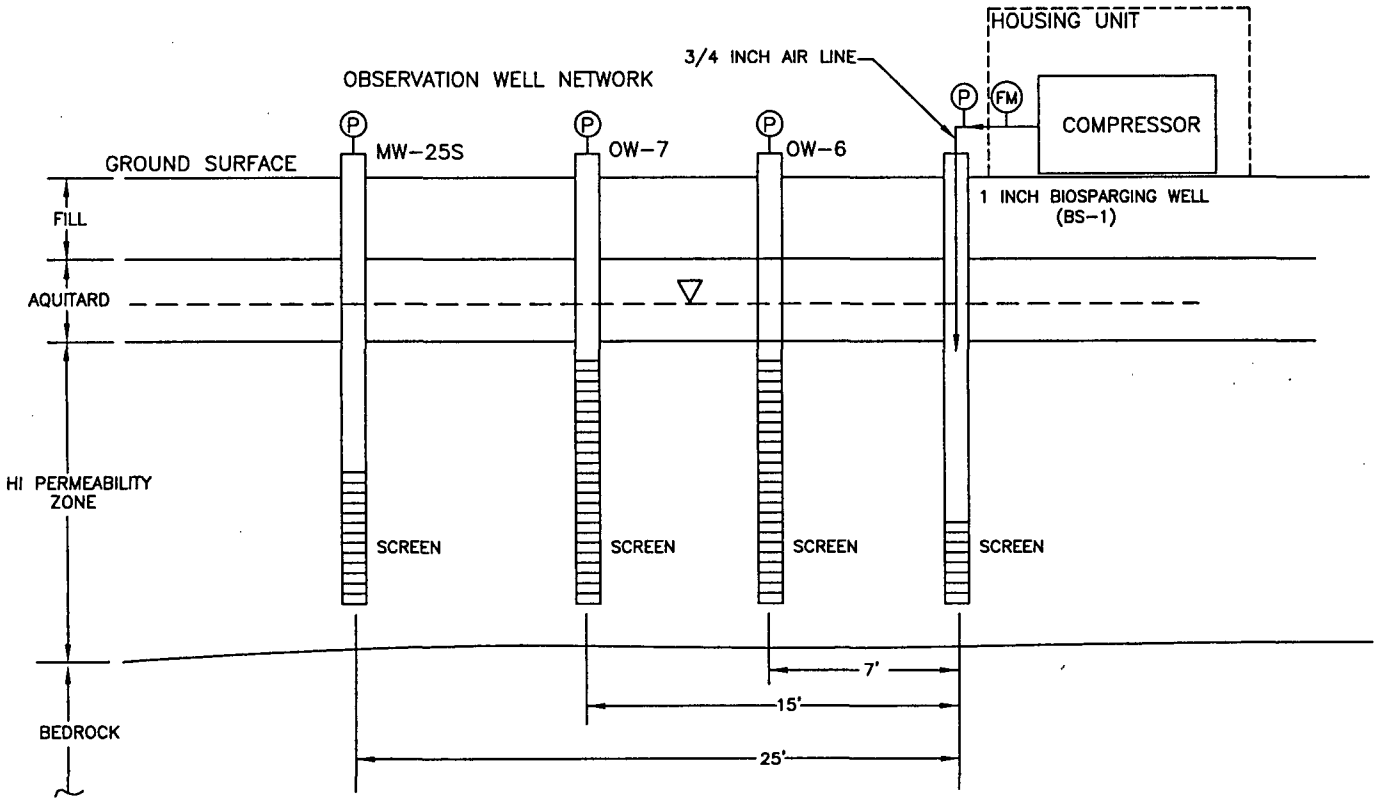
ARCADIS GERAGHTY & MILLER

DRAWN	DATE	PROJECT MANAGER	DEPARTMENT MANAGER
MGW	3/16/01	T. ENG	
		LEAD DESIGN PROF. F. LENZO	CHECKED K. KIEVIT
		PROJECT NUMBER	DRAWING NUMBER

SVE / VER PILOT STUDY
SYSTEM SCHEMATIC
HARRIMAN SITE
HARRIMAN, NEW YORK

NJ000389.0005

2



LEGEND

(P) PRESSURE GAUGE

(FM) FLOW METER

DRAWING NOT TO SCALE

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NO.	DATE	REVISION DESCRIPTION	BY CKD

ARCADIS GERAGHTY & MILLER

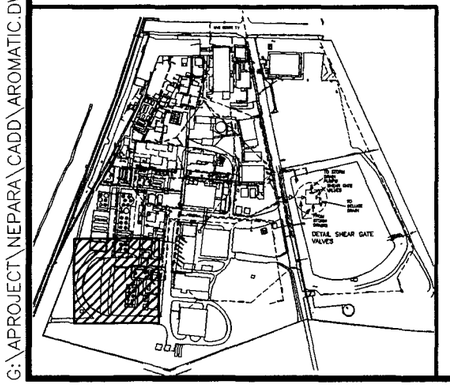
DRAWN	DATE	PROJECT MANAGER	DEPARTMENT MANAGER
MGW	3/16/01	T. ENG	
		LEAD DESIGN PROF. F. LENZO	CHECKED K. KIEVIT

BIOSPARGING PILOT STUDY
SYSTEM SCHEMATIC
HARRIMAN SITE
HARRIMAN, NEW YORK

PROJECT NUMBER	DRAWING NUMBER
NJ000389.0005	3

BASELINE - NOVEMBER 2000

BIOSPARGING FOR 2+ MONTHS - JANUARY 2001



LEGEND:

- BIO-1 ● BIOSPARGE WELL
- OW ● OBSERVATION WELL
- MW ✪ EXISTING WELL
  - VIOLET INDICATES SHALLOW WELL
- OW-6 ✪ *20,000* OBSERVATION WELL-6 WITH AROMATIC CONCENTRATION

AROMATIC CONCENTRATION:
(PARTS PER BILLION (ppb))

- 5 – 99 AROMATIC (ppb)
- 100 – 999 AROMATIC (ppb)
- 1,000 – 10,000 AROMATIC (ppb)
- > 10,000 AROMATIC (ppb)

40 0 40
(IN FEET)
1 inch = 40 ft.

SOURCE: BASE MAP PROVIDED BY NEPERA, INC. (DWG. NO. N-43-360)

NO.	DATE	REVISION DESCRIPTION	BY / CKD

HARRIMAN SITE

HARRIMAN, NEW YORK

AROMATIC CONCENTRATIONS IN THE OVERBURDEN AQUIFER BIOSPARGE PILOT TEST

PROJECT MANAGER T. ENG	DEPARTMENT MANAGER T. ENG
LEAD DESIGN PROF. F .LENZO	CHECKED K.KIEVIT
DRAWN M .WASILEWSKI	DATE 2/26/01
PROJECT NUMBER NJ000389.0005	DRAWING NUMBER 4

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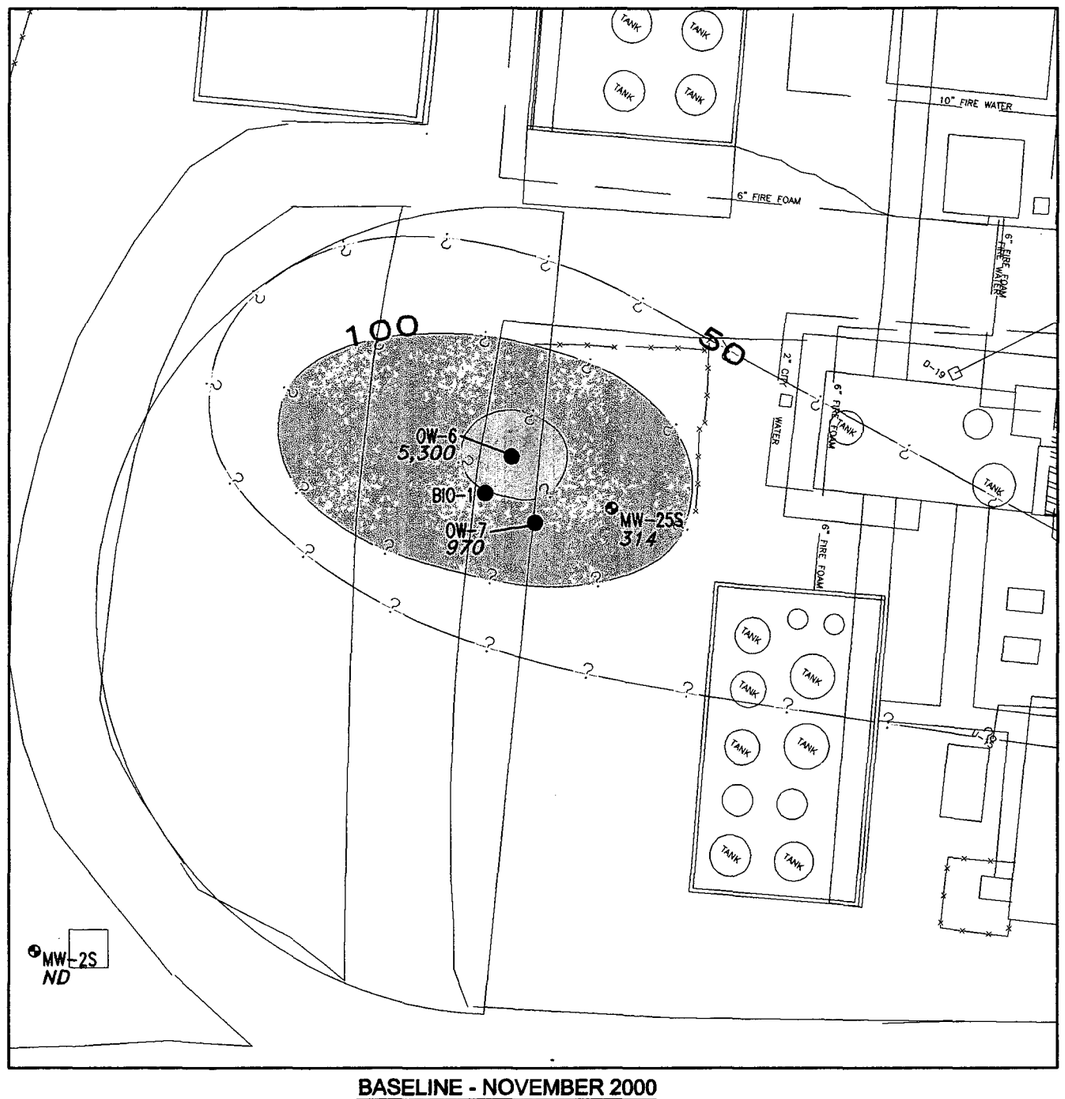
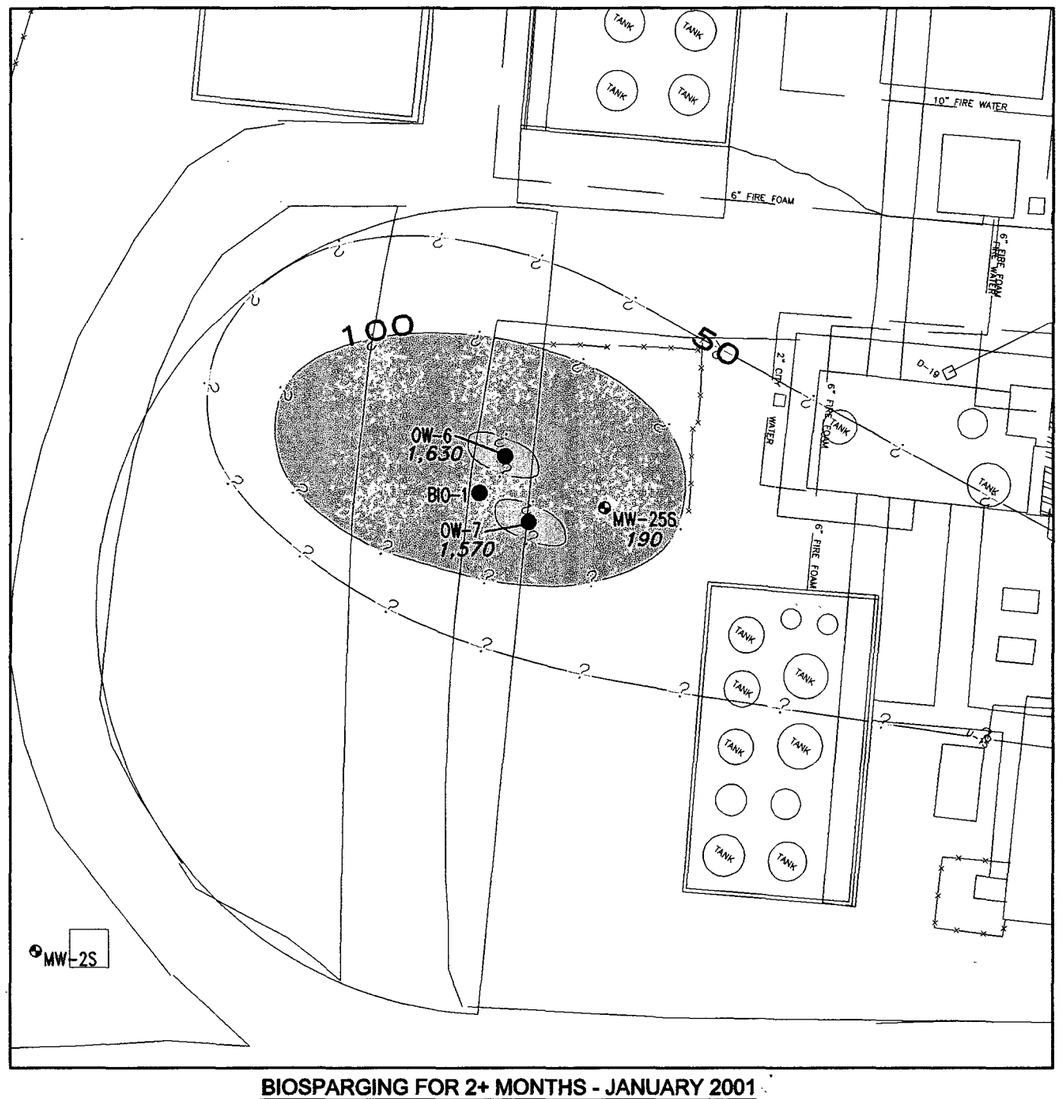
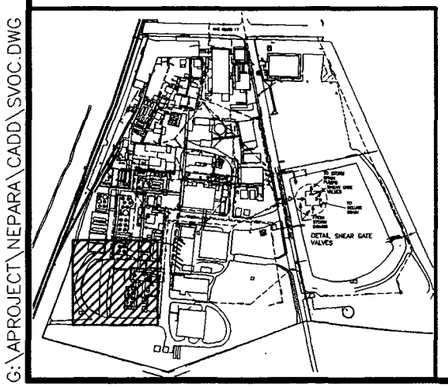


BASELINE - NOVEMBER 2000



BIOSPARGING FOR 2+ MONTHS - JANUARY 2001



LEGEND:

- BIO-1 ● BIOSPARGE WELL
- OW ● OBSERVATION WELL
- MW ⊕ EXISTING WELL
  VIOLET INDICATES SHALLOW WELL
- OW-6 ⊕ 5,300 OBSERVATION WELL-6 WITH SVOC CONCENTRATION

SVOC CONCENTRATION:
(PARTS PER BILLION (ppb))

- 50 – 99 SVOC (ppb)
- 100 – 999 SVOC (ppb)
- 1,000 – 10,000 SVOC (ppb)

40 0 40
(IN FEET)
1 inch = 40 ft.

SOURCE: BASE MAP PROVIDED BY NEPERA, INC. (DWG. NO. N-43-360)

NO.	DATE	REVISION DESCRIPTION	BY / CKD

HARRIMAN SITE

HARRIMAN, NEW YORK

SVOC CONCENTRATIONS IN THE OVERBURDEN AQUIFER BIOSPARGE PILOT TEST

PROJECT MANAGER T. ENG	DEPARTMENT MANAGER T. ENG
LEAD DESIGN PROF. F .LENZO	CHECKED K.KIEWT
DRAWN M .WASILEWSKI	DATE 2/28/01
PROJECT NUMBER NJ000389.0005	DRAWING NUMBER 5

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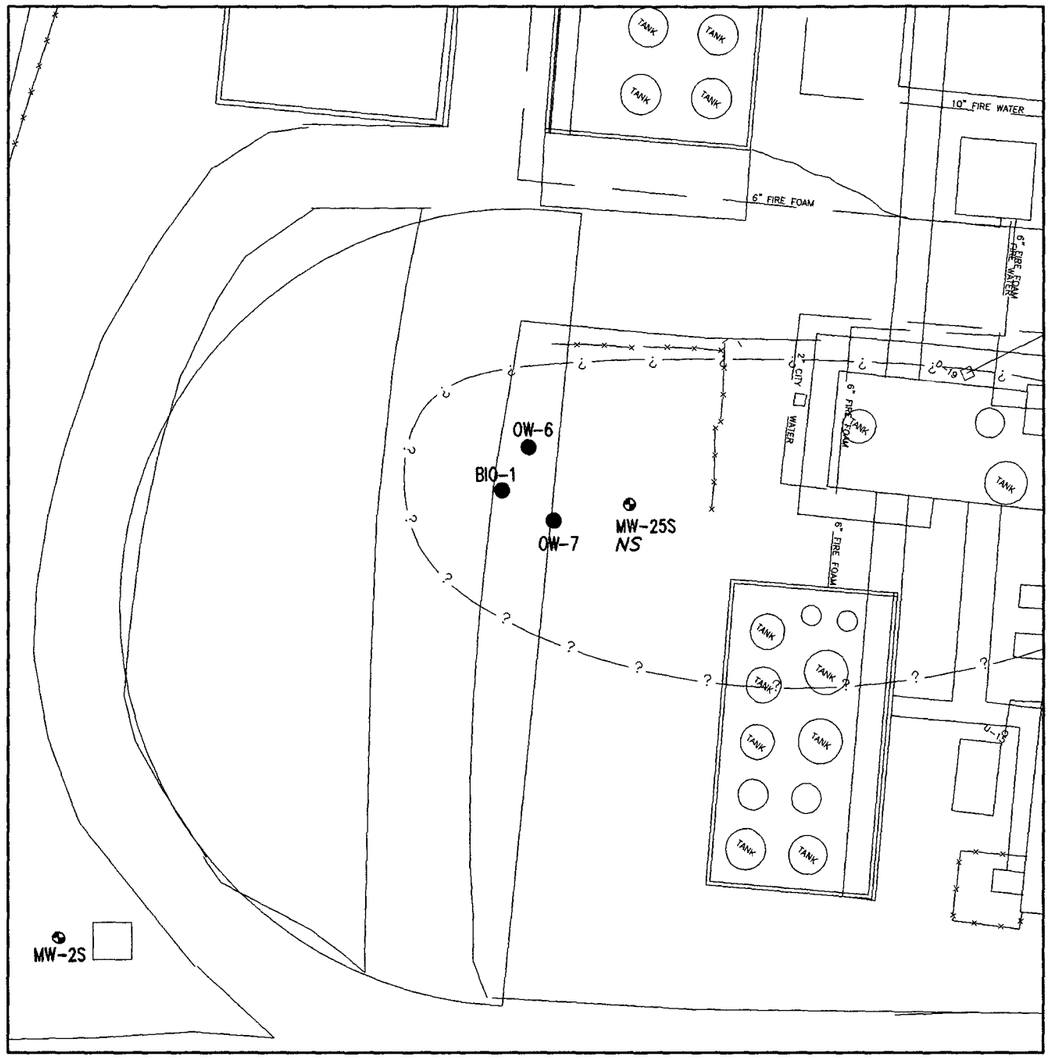
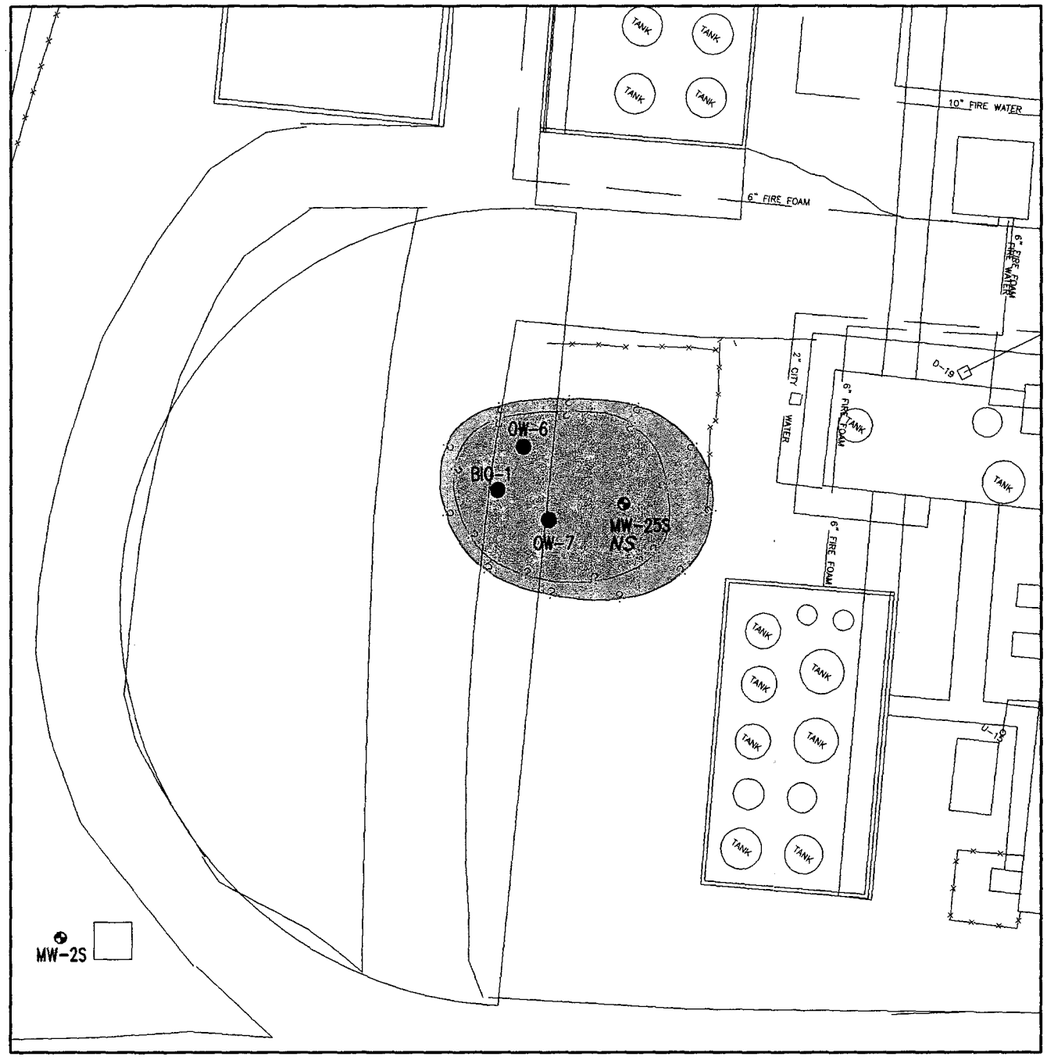
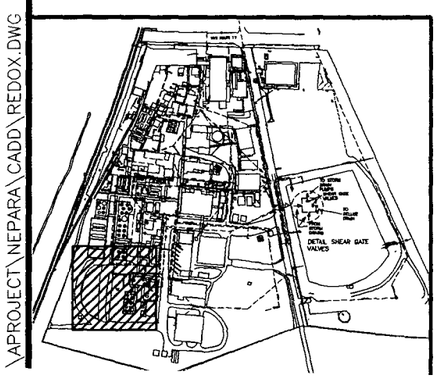


SUBSURFACE ENVIRONMENT - NOVEMBER 2000



SUBSURFACE ENVIRONMENT- JANUARY 2001



LEGEND:

- BIO-1 ● BIOSPARGE WELL
- OW ● OBSERVATION WELL
- MW ⊕ EXISTING WELL
- VIOLET INDICATES SHALLOW WELL

REDOX POTENTIAL (MILLIVOLTS):
(PARTS PER BILLION (ppb))

- AEROBIC OXIDIZING ZONE
- TRANSITIONAL ZONE
- ANAEROBIC REDUCING ZONE

40 0 40

(IN FEET)

1 inch = 40 ft.

SOURCE: BASE MAP PROVIDED BY NEPERA, INC. (DWG. NO. N-43-360)

NO.	DATE	REVISION DESCRIPTION	BY / CKD

HARRIMAN SITE

HARRIMAN, NEW YORK

BIOGEOCHEMICAL PARAMETERS IN THE OVERBURDEN AQUIFER

PROJECT MANAGER T. ENG	DEPARTMENT MANAGER T. ENG
LEAD DESIGN PROF. F .LENZO	CHECKED K.KIEVIT
DRAWN M .WASILEWSKI	DATE 2/28/01
PROJECT NUMBER NJ000389.0005	DRAWING NUMBER 6

\APROJECT\NEPARA\CADD\REDOX.DWG

ARCADIS GERAGHTY & MILLER

Table 1. Summary of the Data Collected During the SVE Pilot Study, Harriman Site, Harriman, New York.

PROJECT NAME (Harriman Site)			HARRIMAN SITE, HARRIMAN, NY				**JOB #:** NJ0003890001			**EXTRACTION WELL ID:** SVE-1		
TYPE OF EQUIPMENT (model #, hp)			ROTRON, 2 HP				**DATE:** 12/12/00					
NOTES	Time	Vacuum at Extraction Well Head (inches H_2O)	Influent Temp (F)	Measured Flow Velocity (ft/min)	Approximate Calculated Flow Rate (CFM)	Measured Oxygen Conc. (%)	PID Reading (ppmv)	LEL (%LEL)	PID Reading After Carbon (ppmv)	MONITORING WELLS		
										SVE-2	SVE-3	SVE-4
										Distances from Extraction Well (ft)		
										5	15	25
										Vacuum at Monitoring Points (inches w.c.)		
12/7/2000 No Flow	1400	4	NA	0	0	20.4	0.0	0.0	0.0	0	0	0
	1415	6	NA	0	0	20.2	0.0	0.0	0.0	0	0	0
	1430	10	NA	0	0	20.2	0.0	0.0	0.0	0	0	0
12/8/00	1100	34	NA	0	0	20.2	0.0	0.0	0.0	0	0	0
Water Level at 2' BMP	1130	34	NA	0	0	NM	0.0	0.0	0.0	0	0	0

Miscellaneous Notes:

Depth to Water in Extraction Well Before Test:	3.54 ft.
Depth to Water in Extraction Well Immediately After Test:	NM

ARCADIS GERAGHTY & MILLER

Table 2. Summary of the Data Collected During the VER Pilot Study, Harriman Site, Harriman, New York.

PROJECT NAME (client/location)	HARRIMAN SITE/HARRIMAN, NY	**JOB #:**	NJ0003890001
TYPE OF EQUIPMENT (model #, hp)	SEIMENS LIQUID RING	**DATE:**	12/12/00

NOTES	Time	Vacuum at Extraction Well Head (inches Hg)	Influent Temp (F)	Measured Flow Velocity (ft/min)	Approximate Calculated Flow Rate (CFM)	Measured Oxygen Conc. (%)	PID Reading (ppmv)	LEL (%LEL)	PID Reading After Carbon (ppmv)	**EXTRACTION WELL ID:** VER-1 — MONITORING WELLS — VER-2 — Distances from Extraction Well (ft) — 5 — Vacuum and DTW at Monitoring Points (inches w.c. and feet)		VER-3 — 15		VER-4 — 25	
Start Test #1	900	9	49	-		20.2	1.9	0.0	0.0	0	-	0	-	0	-
No Measured Flow	915	9	46.8	-		20.4	2.4	0.0	0.0	1.25	-	0	-	0	-
	930	9	NM	-		NM	1.8	0.0	0.0	1.25	9.45	0	8.2	0	7.5
Increased Vacuum to 15"	945	12	48.2	-		20.2		0.0	0.0	1.3	9.38	0	NM	0	NM
	1000	12		115	3	20.2	10	0.0	0.0	7	9.95	0	8.38	0	7.55
Collect Samples INF1 and EFF 1 AT 11:00AM	1030	12				NM	13.7	0.0	0.0	9	10.7	1.1(+pres.)	8.77	0.25	7.65
	1100	18	46.3	115	3	20.4	15.2	0.0	0.0	28	12.8	1.6(+pres.)	9.25	0.2	7.8
Increased Vacuum to 26"	1130	25	33.9	300	6		70	0.0	0.0	-	-	-	-	-	-
Total of 35 gallons of water	1200	25		242	5.5			0.0		16	14.49	8(+pres.)	9.81	0.1	8.14
END: Record ambient readings PID, LEL, O_2 (0.0, 0.0, 20.4)										-	-	-	-	-	-

Miscellaneous Notes: Collected samples INF-2 and EFF-2 and 12:30.

Approximate Water Production Rate was 0.5 gpm.

Depth to Water in Extraction Well Before Test:	7.70 ft.
Depth to Water in Extraction Well Immediately After Test:	17.5 ft.

Table 3: Laboratory Analytical Results, VER Pilot Study, Harriman Site, Harriman, New York.

Constituents	Method Detection Limit	INF-1	EFF-1	INF-2	EFF-2
Benzene	0.07	ND	ND	34.13	ND
Toluene	0.07	ND	ND	ND	ND
Ethyl Benzene	0.07	ND	ND	ND	ND
Xylene (Total)	0.07	ND	ND	ND	ND
Other (1)	0.07	40.97	ND	ND	ND

(1) Other Volatile Compounds Include: Pentane, Hexane, Heptane, Octane, Nonane and Decane

Table 4. Summary of Volatile Organic Compounds, Semi-Volatile Organic Compounds, Dissolved Gases, and Field Parameters, Biosparge Pilot Test, Overburden Aquifer, Harriman Site, Harriman, New York.

CONSTITUENT:	Method Detection Limit	SCGs (ug/L)	Baseline			After 2+ Months		
			OW-6 11/15/00	OW-7 11/15/00	MW-25S 11/8/00	OW-6 1/31/01	OW-7 1/31/01	MW-25S 1/31/01
Volatile Organic Compounds (ug/L)								
Benzene	0.2	5	**20000**	**9500**	**2300**	**1800**	**4000**	**2100**
Toluene	0.3	5	U	U	U	U	U	U
Ethylbenzene	0.2	5	U	U	U	U	U	U
Xylene (total)	0.6	5	U	U	U	U	U	U
Chlorobenzene	0.3	5	U	U	U	U	U	U
Semi-Volatile Organic Compounds (ug/L)								
Pyridine	5.7	50	**1400**	**330**	14 J	**1400**	**270J**	10J
2-Aminopyridine	20	50	U	U	U	U	U	U
Alpha-Picoline	20	50	**3900**	**640**	**300**	**230J**	**1300**	**180**
Dissolved Gases								
Carbon Dioxide (mg/L)	0.60		46.64	58.17	U	30	51	U
Methane (mg/L)	0.000015		11.84	5.80	0.57	1.4	1.8	1
Field Parameters								
Redox Potential (mV)			-152	-175	-49	121.8	-141.1	271.6
Dissolved Oxygen (mg/L)			0.00	0.20	3.15	0.83	0.79	6.11
pH (S.U.)			7.60	7.06	11.43	7.34	7.07	10.31
Conductivity (mS/cm)			0.955	1.030	0.496	0.920	0.848	0.552
Temperature (°C)			13.70	13.20	16.10	13.28	14.17	12.89
Turbidity (NTU)			51	51.7	1.5	NA	1261.6	NA

SCGs Standards, criteria and guidance values of NYS.
ug/L Microgram per liter.
mg/L Milligram per liter.
mV Millivolts.
S.U. Standard pH units.
mS/cm Millisiemans per centimeter.

°C Degrees Celcius.
N. Nephelometric turbidity units.
U Analyzed but not detected
N. Not analyzed.
J Analyte positively identified; value is the approximate concentration.

Table 5. Summary of Weekly Monitoring of Field Parameters, Biosparging Pilot Study, Harriman Site, Harriman, New York.

Date	11/15/00	11/20/00	11/28/00	12/6/00	12/8/00	12/12/00	12/18/00	12/27/00	1/5/01
OW-6	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)
Ph	7.6	7.52	6.68	6.65	7.22	7.46	7.32	7.62	7.38
Cond.	0.955	0.516	0.803	0.668	0.65	0.768	0.798	0.7256	0.9417
DO	0	10.14*	---	---	4.48	6.2	4.32	5.18	3.6
Temp.	13.7	12.1	11.2	12.29	11.46	12.04	11.23	11.75	11.48
Redox.	-152	69	90	114	139	192	121	206	221
OW-7	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)
Ph	7.06	7.5	6.77	7.38	7.16	7.08	7.23	7.22	7.17
Cond.	1.03	0.409	0.485	0.695	0.625	0.8065	1.137	1.129	1.200
DO	0.2	0	---	---	0.72	0.63	0.8	2.21	3.15
Temp.	13.2	11.4	11.02	12.85	11.27	12.09	11.64	11.65	11.15
Redox.	-175	-138	-18	69	106	62	63	41	184
MW-25S	30ft.(bmp)						30ft.(bmp)	30ft.(bmp)	30ft.(bmp)
Ph	11.43						7.66	7.86	7.71
Cond.	0.496						0.8514	0.8446	0.8749
DO	3.15						0.94	0.35	2.20
Temp.	16.1						11.1	11.03	11.15
Redox.	-49						-68	-97	63
Pressure									
Regulator		30 psi	30 psi	25 psi	25 psi	25 psi	25 psi	25 psi	0 psi
Sparge pt.		11 psi	9 psi	9.5 psi	8.5 psi	9 psi	10 psi	10 psi	0 psi
OW-6		.5 psi	5.5 psi	3 psi	5 psi	5 psi	3 psi	2 psi	0 psi
OW-7		0 psi	0 psi	2 psi	0 psi	0 psi	0 psi	0 psi	0 psi
MW-25S		NM	NM	NM	NM	NM	NM	NM	0 psi
Flow		~1 cfm	~1 cfm	~1 cfm	~1 cfm	~1 cfm	~1 cfm	~1 cfm	0 cfm

* Values reflect DO after the pilot was already in effect.
** Low Flow performed on 11/8/00
--- Malfunctioning sensor
(bmp) Below Measuring Point

Table 5. Summary of Weekly Monitoring of Field Parameters, Biosparging Pilot Study, Harriman Site, Harriman, New York.

Date	1/12/01	2/16/01	2/23/01	3/8/01	3/16/01
OW-6	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	24ft.(bmp)
Ph	7.37	7.42	7.47	7.87	7.57
Cond.	0.977	0.7518	0.9389	0.755	0.8561
DO	1.31	6.08	3.11	10.54	7.5
Temp.	12.43	10.58	10.28	9.74	9.34
Redox.	182	307	234	283	388
OW-7	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	25ft.(bmp)	26ft.(bmp)
Ph	7.26	7.21	7.08	7.29	7.35
Cond.	1.127	0.784	0.767	0.730	0.7912
DO	1.32	6.17	3.38	5.25	6.78
Temp.	10.93	11.01	11.2	10.76	10.23
Redox.	176	190	158	204	231
MW-25S	30ft.(bmp)	30ft.(bmp)	30ft.(bmp)	30ft.(bmp)	30ft.(bmp)
Ph	7.75	8.03	8.41	8.42	8.41
Cond.	0.8567	0.7911	0.707	0.7212	0.7447
DO	2.69	0.58	2.19	0.21	0.81
Temp.	11.08	10.97	10.39	10.54	10.50
Redox.	53	8	25	-22	-4
Pressure					
Regulator	0 psi	0 psi	0 psi	25 psi	0 psi
Sparge pt.	0 psi	0 psi	0 psi	16 psi	0 psi
OW-6	0 psi	0 psi	0 psi	6 psi	0 psi
OW-7	0 psi	0 psi	0 psi	3.5 psi	0 psi
MW-25S	0 psi	0 psi	0 psi	0 psi	0 psi
Flow	0 cfm	0 cfm	0 cfm	1 cfm	0 cfm

* Values reflect DO after the pilot was already in effect.
** Low Flow performed on 11/8/00
--- Malfunctioning sensor
(bmp) Below Measuring Point

ARCADIS GERAGHTY & MILLER

Sample/Core Log

Boring/Well SVE-4 Project/No. NJ000389.0005.0003 Page 1 of 1

Site Location Harriman, New York Drilling Started 11/2/00-0855 Drilling Completed 11/2/00-1100

Total Depth Drilled 9 Feet Hole Diameter 4 inches Type of Sample/ Coring Device Split Spoon

Length and Diameter of Coring Device 2'x2" Sampling Interval Continuous

Land-Surface Elev. ____ feet ☐ Surveyed ☐ Estimated Datum ____

Drilling Fluid Used None Drilling Method Drive and Wash

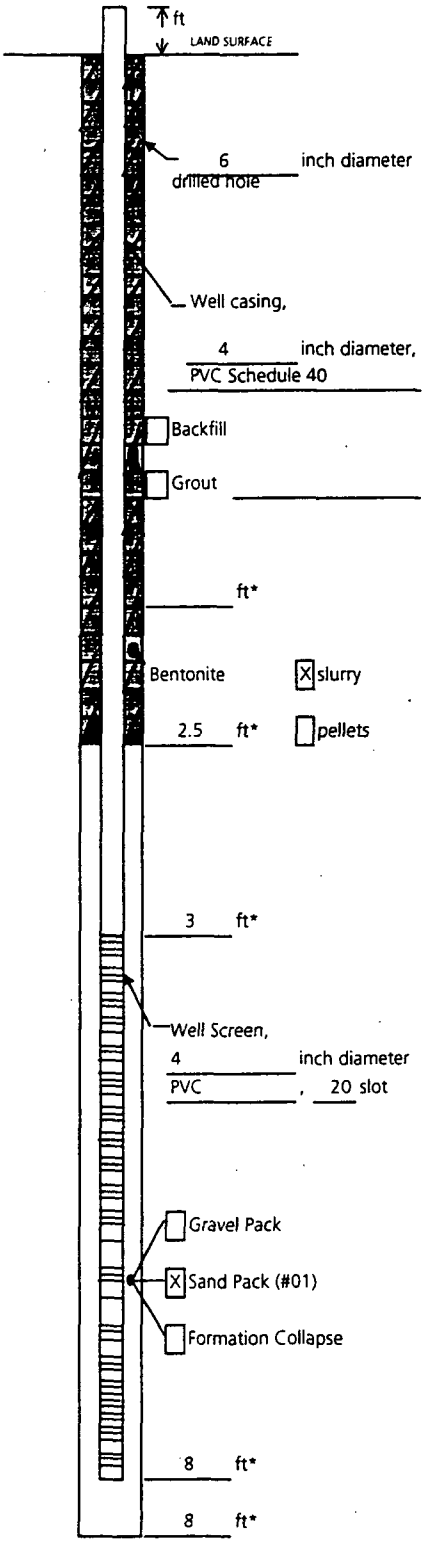
Drilling Contractor Kendrick Drilling Driller T. Kendrick Helper Doug

Prepared By J. Guido

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description*	PID (ppm)
0	1	drilled		0-0.3' Asphalt.	
				0.3-0.8' Concrete.	
1	3	0.5	11-8-3-3	0-0.5' Fill consisting of Silt; some Gravel, fine to coarse; little Sand,	0-80-379
				fine; black, strong odor present.	
3	5	1.5	3-6-11-20	0-1' Clay; and Silt; little Sand, fine; black and dark olive gray.	60-100-170
				1-1.5' Sand, fine to medium; little Gravel, fine; black.	
5	7	1.2	3-10-12-16	0-1.2' Sand, very fine; and Silt; black, moist, shiny, very strong	0-180
				odor.	
7	9	1	11-10-12-12	0-1' Silt; and Clay; olive gray, slight odor.	20-33

ARCADIS GERAGHTY & MILLER

Well Construction Log
(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NJ000389.0005.00003 Well SVE-1

Town/City Harriman

County Rockland State NY

Permit No. NA

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 11/2/00

Drilling Method ~~Air Rotary~~ HOLLOW STEM

Drilling Contractor Kendrick Drilling

Drilling Fluid *None*

Development Technique(s) and Date(s)

Well not developed.

Fluid Loss During Drilling NA gallons

Water Removed During Development NA gallons

Static Depth to Water -- feet below M.P.

Pumping Depth to Water -- feet below M.P.

Pumping Duration NA hours

Yield NA gpm Date NA

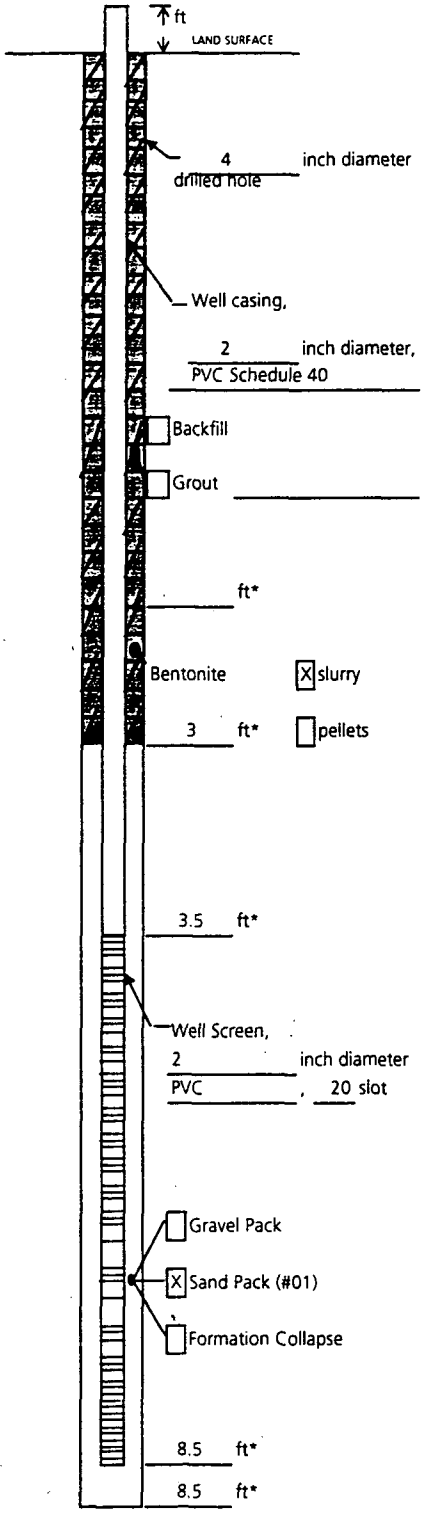
Well Purpose Injection well.

Remarks

Prepared by J. Guido

ARCADIS GERAGHTY & MILLER

Well Construction Log
(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NJ000389.0005.00003 Well SVE-2, 3, & 4

Town/City Harriman

County Rockland State NY

Permit No. NA

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 11/2/00

Drilling Method Drive and Wash

Drilling Contractor Kendrick Drilling

Drilling Fluid None

Development Technique(s) and Date(s)

Wells not developed.

Fluid Loss During Drilling NA gallons

Water Removed During Development NA gallons

Static Depth to Water -- feet below M.P.

Pumping Depth to Water -- feet below M.P.

Pumping Duration NA hours

Yield NA gpm Date NA

Well Purpose Observation wellS.

Remarks

Prepared by J. Guido

ARCADIS GERAGHTY & MILLER

Sample/Core Log

Boring/Well VER-4 Project/No. NJ000389.0005.0003 Page 1 of 1

Site Location Harriman, New York Drilling Started 11/1/00-0950 Drilling Completed 11/1/00-1100

Total Depth Drilled 19 Feet Hole Diameter 4 inches Type of Sample/ Coring Device Split Spoon

Length and Diameter of Coring Device 2'x2" Sampling Interval Continuous

Land-Surface Elev. ____ feet ☐ Surveyed ☐ Estimated Datum ____

Drilling Fluid Used None Drilling Method Drive and Wash

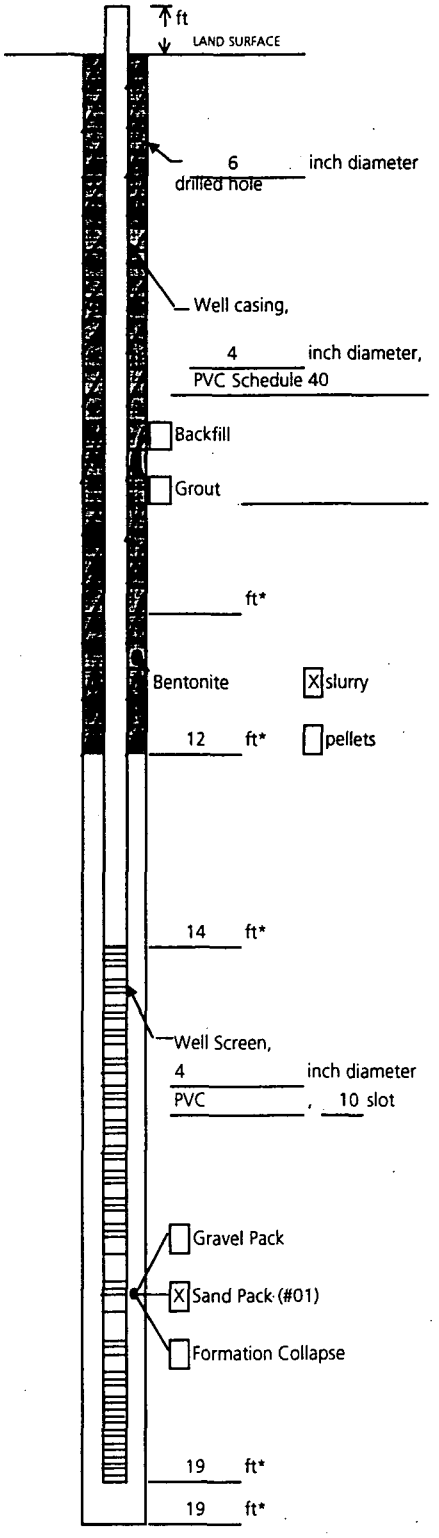
Drilling Contractor Kendrick Drilling Driller T. Kendrick Helper Doug

Prepared By J. Guido

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description*	PID (ppm)
0	0.5	drilled		Concrete	
5	7	0.5	2-1-13-15	0-0.5' Silt; little Wood; odor present, black, moist.	16
7	9	1.5	16-16-11-11	0-1' Same as above.	8
				1-1.5' Silt; some Clay; dark olive gray.	
9	11	1.5	9-13-15-12	0-1.5' Clay; and Silt; trace Sand, medium; less than 1mm thick	10.8
				layers; olive gray.	
11	13	1.5	16-13-14-15	0-0.4' Silt; and Clay; dark olive gray.	80-129
				0.4-0.5' Gravel, medium; subangular, gray.	
				0.5-1.5' Silt; and Clay; trace Sand, fine; dark olive gray, and	
				little black specks.	
13	15	1.5	16-20-8-21	0-1.5' Clay; and Silt; trace Sand, fine; dark olive gray, moist, odor	80-170
				present.	
15	17	1.5	11-20-16-13	0-0.4' Clay; and Silt; little Sand, fine to medium; dark olive gray,	150-801
				moist, odor present.	
				0.4-0.6' Gravel, medium to coarse; olive gray.	
				0.6-0.7' Sand, fine to medium; some Silt; some Clay; black.	
				0.7-1.5' Silt; and Clay; trace Sand, fine; dark olive gray; intermittent	
				layers of Sand, fine to medium; black.	
17	19	1.5		0-1.5' Silt; and Clay; dark olive gray.	20-40

ARCADIS GERAGHTY & MILLER

Well Construction Log
(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NJ000389.0005.00003 Well VER-1

Town/City Harriman

County Rockland State NY

Permit No. NA

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 11/3/00

Drilling Method Hollow Stem Auger

Drilling Contractor Kendrick Drilling

Drilling Fluid None

Development Technique(s) and Date(s)

Well not developed.

Fluid Loss During Drilling NA gallons

Water Removed During Development NA gallons

Static Depth to Water -- feet below M.P.

Pumping Depth to Water -- feet below M.P.

Pumping Duration NA hours

Yield NA gpm Date NA

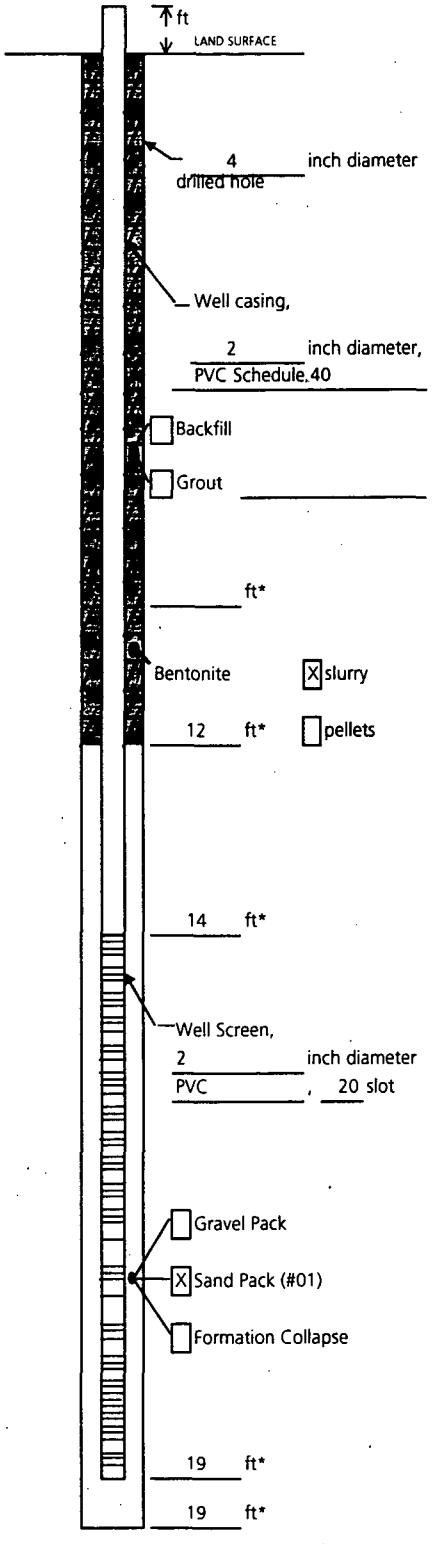
Well Purpose Injection well for vapor enhancement recovery.

Remarks

Prepared by J. Guido

ARCADIS GERAGHTY & MILLER

Well Construction Log
(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NJ000389.0005.00003 Well VER-3 &VER-2

Town/City Harriman

County Rockland State NY

Permit No. NA

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 11/1/00

Drilling Method Drive and Wash

Drilling Contractor Kendrick Drilling

Drilling Fluid None

Development Technique(s) and Date(s)

Well not developed.

Fluid Loss During Drilling NA gallons

Water Removed During Development NA gallons

Static Depth to Water -- feet below M.P.

Pumping Depth to Water -- feet below M.P.

Pumping Duration NA hours

Yield NA gpm Date NA

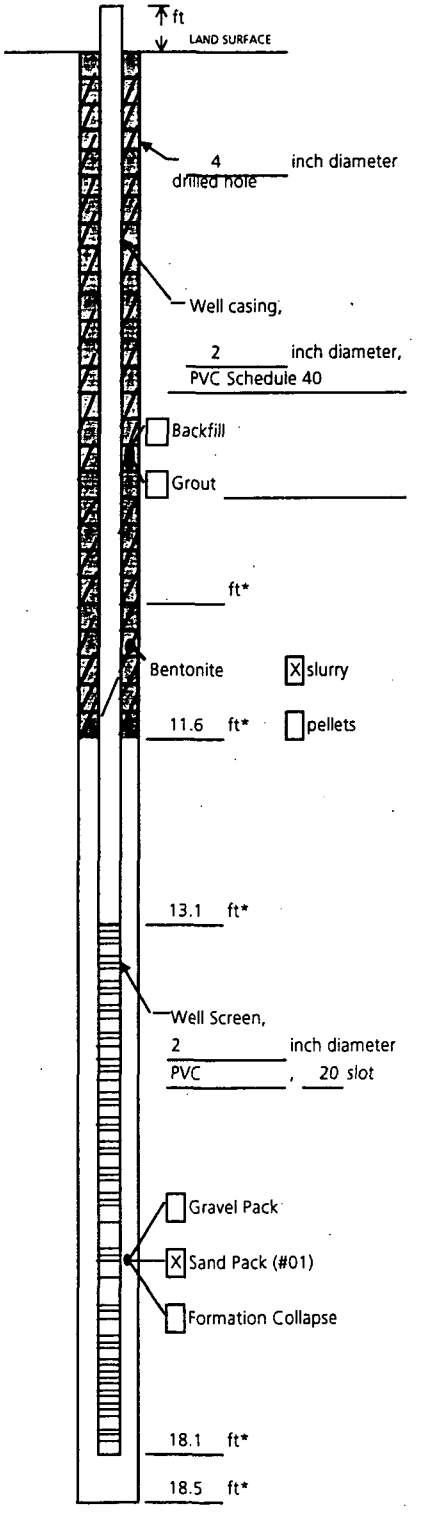
Well Purpose Observation well for vapor enhancement recovery.

Remarks

Prepared by J. Guido

ARCADIS GERAGHTY & MILLER

Well Construction Log
(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project NJ000389.0005.00003 Well VER-4

Town/City Harriman

County Rockland State NY

Permit No. NA

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed

☐ Estimated

Installation Date(s) 11/1/00

Drilling Method Drive and Wash

Drilling Contractor Kendrick Drilling

Drilling Fluid None

Development Technique(s) and Date(s)

Well not developed.

Fluid Loss During Drilling NA gallons

Water Removed During Development NA gallons

Static Depth to Water -- feet below M.P.

Pumping Depth to Water -- feet below M.P.

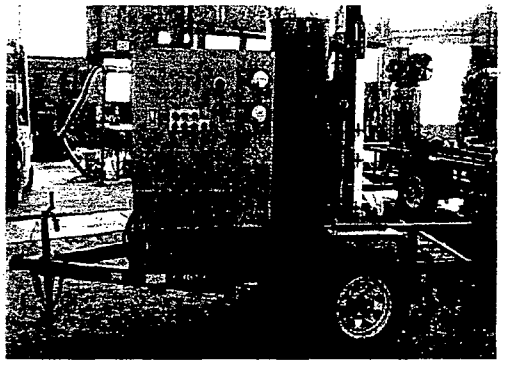
Pumping Duration NA hours

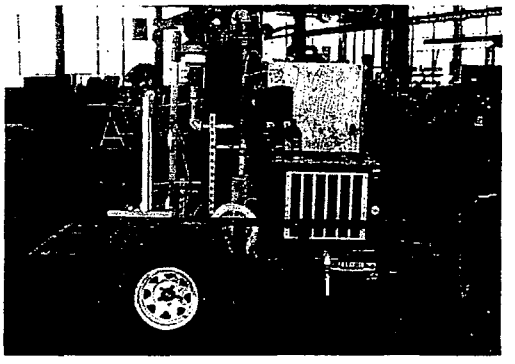
Yield NA gpm Date NA

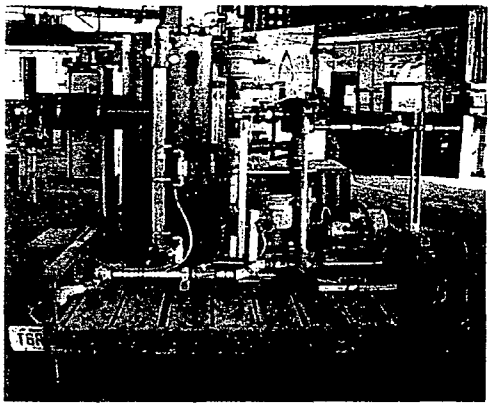
Well Purpose Observation well for vapor enhancement recovery.

Remarks

Prepared by J. Guido







Mobile Vacuum Extraction Unit

The Mobile Vacuum Extraction System is a trailer mounted pilot test unit for vapor extraction that can be attached to a pickup truck for delivery to a site. The mobile system consists of a 7 ½-horsepower liquid ring vacuum pump, a 2 horsepower regenerative blower, an air/water separation tank, a ½ horsepower centrifugal transfer pump and calibrated process instruments and controls. All pumps and blowers are operated automatically or manually. The System requires 460-volt, 3-phase power to operate. A separate generator may also be mobilized to the site in locations where there is no power source.

Equipment Description

1. Vacuum Pump – The Siemens 2BL series liquid-ring pump is used for high vacuum applications and is capable of producing a vacuum of up to 29 inches of mercury. Adjusting an ambient air control valve located on the unit controls the negative pressure applied. It also has the capacity to deliver 20 – 150 scfm. (See attached performance curve for 2BL1251).

2. Blower - The Siemens 2BH regenerative blower is used for low vacuum applications and is capable of providing approximately up to 66 inches water column at 70 scfm. Adjusting an ambient air control valve located on the unit controls the negative pressure applied. It also has the capacity to deliver 66 inches water column at 80 scfm. (See attached performance curve for H25).

3. Air/Water Separation Tank – The 60 gallon vertically mounted condensate tank ensures a liquid free air stream to the blower. Water levels in the tank may be monitored by a site glass mounted on its side.

4. Centrifugal Pump - the transfer pump automatically removes accumulated water from the air/water separation tank. The pump's discharge pipe contains a flow meter/totalizer to accurately determine the quantity of water removed.

5. Pressure Transmitter – The Druck PTX 1240 industrial pressure transmitter has a ±0.25% F.S. BSL and provides a 4-20 mA, two wire output. The pressure transmitter(s) are connected to an Iotech, Inc. DaqBook/216 data logger, which utilizes a universal current/voltage signal conditioner to output a voltage range in bipolar mode at ±5V/channel. The signal is then converted into a compatible number that can be easily read by a computer software program. Up to 20 data points can be monitored at one time.

6. Air Monitoring Equipment –

   PE Photovac 2020 photo ionization detector is an easy to use monitoring instrument for the detection of toxic gases and vapors. An internal pump draws a sample through the instrument at a rate of 350 ml/minute. Contamination levels are shown on a backlit display. Up to 1,000 log entries can be recorded automatically or manually into its data logging memory. Information is processed through a printer or IBM compatible PC into Excel for Windows or similar spreadsheet in various report formats. Separate audible and visual alarm settings for Peak, TWA and STEL measurements are user adjustable. Units with 10.6 and 11.7 eV bulbs are available. Operating range is 0.5 to 2,000 ppm isobutylene equivalent.

PE Photovac MicroFID flame ionization detector combines a one-piece lightweight design and powerful data management software, making it ideal for soil vapor screening, emergency response and landfill monitoring. The Windows based software package features scheduling, measurement, data logging and reporting capabilities. Data logging options are automatic or manual. Monitoring ranges are from 0.1 to 50,000 ppm, with a lower limit of detection of 0.3 ppm Methane.

Landtec Gem-500 gas monitor was specially designed for use in landfills. The unit automatically displays and records Methane, Carbon Dioxide and Oxygen concentrations as well as gas flow rate, Btu content, temperature, pressures and LEL. This all weather self contained monitor uses a self compensating infrared gas analyzer and an internal sample pump capable of drawing a gas sample at up to 70" wc. Stored data can be recalled from up to 500 monitoring points and down loaded to a computer or PC. Features user adjustable alarms and auto logging capabilities. Operating range: Methane, 0-100%; Carbon Dioxide, 0-100%; Oxygen, 0-25%.

The Mobile Vacuum Extraction Unit may be utilized for many applications including:

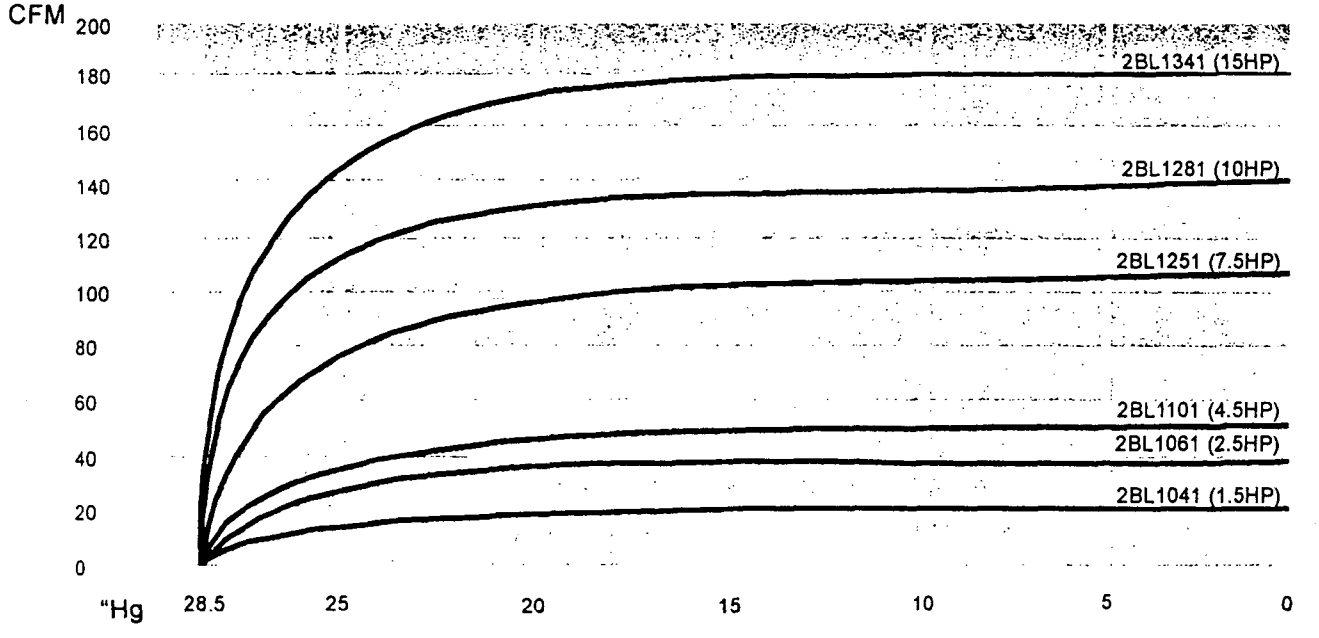
- Pilot test procedures to determine the effectiveness of vacuum extraction or air sparging on specific subsurface formations.
- Temporary ground/water or product recovery for short-term environmental projects.
- Emergency response procedures.

Ground/Water Treatment & Technology, Inc. has a variety of additional equipment to enhance the effectiveness of any small/large scale pilot test project including:

- Air compressors for air sparging processes.
- Vapor/Liquid phase carbon adsorbers.
- A portable generator can be provided if a power source is not available on site.
- Pressure transmitters and intricate data logging equipment.
- Air/Water flow meters.
- Any of the pumps noted above can be replaced with a smaller/larger unit. We have many different capacities available for use with the trailer.

For additional information, please call us at (800) 770-0901 or visit us at our web site at www.GWTTINC.com

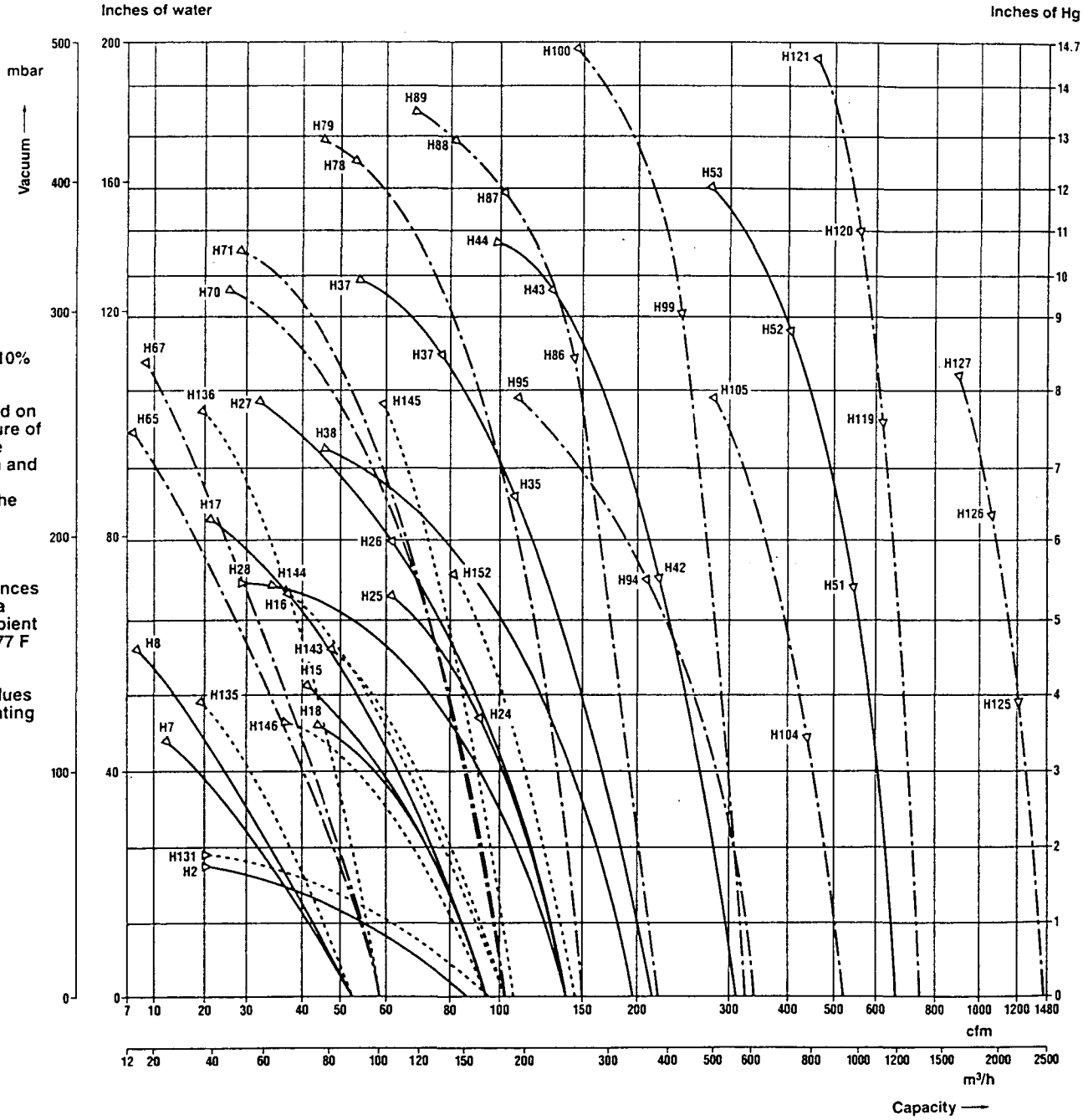
Performance Curves:



Performance Data - Vacuum (60 Hz):

Model	Rated (HP)	Voltage (V)	Rated Amps	Sound dB(A)	Weight (lbs)
2BL1041ONK012	1.5	208-230 / 415-480	4.8 / 2.4	66	95
2BL1061ONK032	2.5	208-230 / 415-480	8.5 / 4.2	67	130
2BL1101ONK012	4.5	208-230 / 415-480	14.0 / 7.0	72	191
2BL12512KK017	7.5	208-230 / 415-480	22.0 / 11.0	71	396
2BL12812KK017	10.0	208-230 / 415-480	27.8 / 13.9	73	408
2BL13412KK017	15.0	208-230 / 415-480	42.0 / 21.0	73	506

Performance Curves - Vacuum



Note:

A) Performance tolerance is +/- 10%

B) Performance curves are based on an air temperature of 60 F (15C) at the inlet connection and 29.92 in Hg abs. (1013 mbar) at the discharge connection.

C) Maximum pressure differences stated apply to a suction and ambient temperature of 77 F (25C).

D) Operating values with other operating conditions on request.

Single Stage (Three Phase): ———— Two Stage (Three Phase): —·—·— Single/Two Stage (Single Phase): ----------

ARCADIS GERAGHTY & MILLER

Sample/Core Log

Boring/Wel BS-1 Project/No. NJ000389.0005.0002 Page 1 of 1

Site Location Harriman, New York

Drilling Started 1400- 8/7/00 Drilling Completed 1300- 8/8/00

Total Depth Drilled 30 Feet Hole Diameter 6 inches Type of Sample/ Coring Device Geoprobe

Length and Diameter of Coring Device 4' x 2" Sampling Interval Continuous

Land-Surface Elev. _____ feet ☐ Surveyed ☐ Estimated Datum _____

Drilling Fluid Used None Drilling Method Hollow Stem Auger

Drilling Contractor Summit, Inc. Driller Jeff Marchesani Helper Russel

Prepared By J. Guido

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Sample/Core Description*	PID (ppm)
0	4	3.5	0-1.5' Fill.	0
			1.5-3.5' Silt; dark grey; some Gravel, fine; some Clay; some Root.	0
4	8	1.5	0-1.5' Clay; greyish green, some grey layers; trace Silt.	0
8	12	2	0-1' Silty Clay; brown; some Gravel, fine.	0
			1-2' Clay; grey; trace Silt.	0
12	16	3	0-3' Silty Clay; trace Sand, fine; grey.	0
16	20	1	0-1' Clay; greyish brown; some Gravel, fine; black; trace Silt; very saturated.	0
20	24	1	0-0.7' Same as above, very saturated.	0
			0.7-1' Sand, fine; some Clay; grey.	0
24	28	0.5	0-0.5' Silty Sand, fine; brown, grey and black.	0
			Could not obtain sample past 28' because hole would cave in.	

ARCADIS GERAGHTY & MILLER

Sample/Core Log

Boring/Well OW-6 Project/No. NJ000389.0005.0002 Page 1 of 1

Site Location Harriman, New York

Drilling Started 0930-8/7/00 Drilling Completed 1130-8/7/00

Total Depth Drilled 30 Feet Hole Diameter 6 inches Type of Sample/ Coring Device Geoprobe

Length and Diameter of Coring Device 4' x 2" Sampling Interval Continuous

Land-Surface Elev. _____ feet ☐ Surveyed ☐ Estimated Datum _____

Drilling Fluid Used None Drilling Method Hollow Stem Auger

Drilling Contractor Summit, Inc. Driller Jeff Marchesani Helper Russel

Prepared By J. Guido

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Sample/Core Description*	PID (ppm)
0	4	3	0-1.5' Fill.	0
			1.5-3' Silt; greenish grey with brown layers; some Root material; little Clay;	0
			little Gravel, fine; grey. Moist at 3'.	
4	8	1	0-1' Clay; green. Saturated at 7'.	0
8	12	3	0-1' Silty Clay; brown, some grey layers.	0
			1-3' Silty Clay; greyish green, some brown layers.	0
12	16	2	0-2' Silty Clay; greyish green; some layers of Silty Sand, fine; grey.	0
16	20	1	0-1' Clay; greyish green; trace Gravel, fine.	0
20	24	0.5	0-0.4' Clay; greyish green; some Gravel, fine.	0
			0.4-0.5' Sand, fine; greenish brown.	0
24	28	0.8'	0-0.8' Sand, fine; greyish green.	0

ARCADIS GERAGHTY & MILLER

Sample/Core Log

Boring/Well OW-7 Project/No. NJ000389.0005.0002 Page 1 of 1

Site Location Harriman, New York

Drilling Started 1220- 8/7/00 Drilling Completed 1530- 8/7/00

Total Depth Drilled 30 Feet Hole Diameter 6 inches Type of Sample/ Coring Device Geoprobe

Length and Diameter of Coring Device 4' x 2" Sampling Interval Continuous

Land-Surface Elev. _____ feet ☐ Surveyed ☐ Estimated Datum _____

Drilling Fluid Used None Drilling Method Hollow Stem Auger

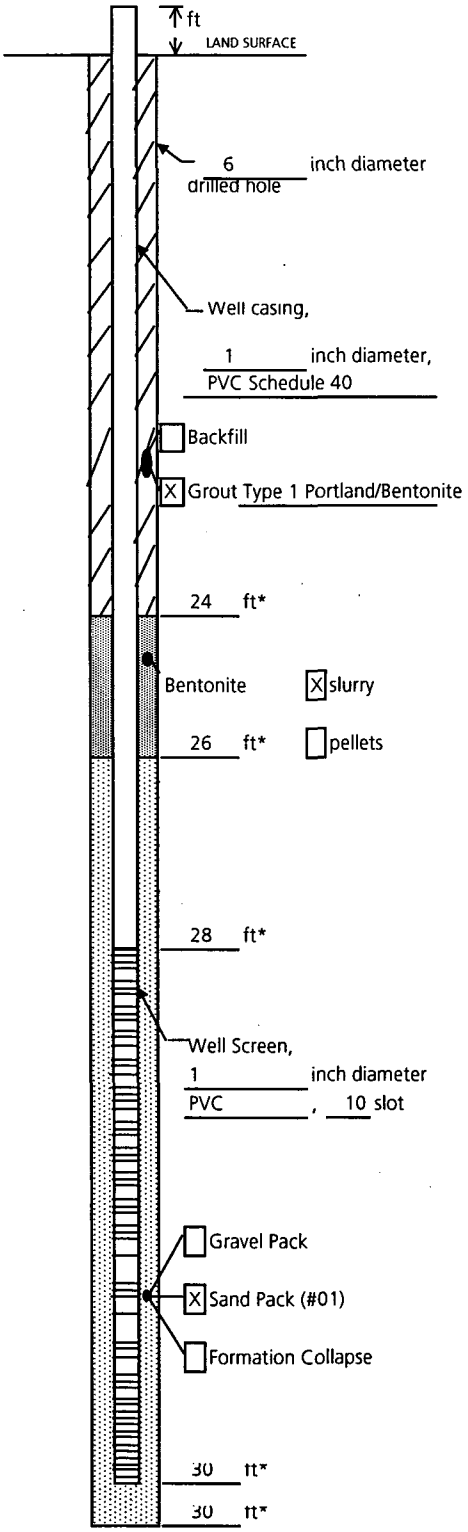
Drilling Contractor Summit, Inc. Driller Jeff Marchesani Helper Russel

Prepared By J. Guido

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Sample/Core Description*	PID (ppm)
0	4	3	0-1.5' Fill consisting of Sand, medium; Gravel, fine to medium; grey.	0
			1.5-3' Sand, fine to medium; some Silt; some Gravel, medium; greyish green.	0
			Wet at 1.5'	
4	8	4	0-1' Same as above.	0
			1-2' Sand, medium; Gravel, fine to medium; greyish green.	0
			2-4' Silty Clay; greyish green, some grey layers.	0
8	12	3	0-3' Same as above. Saturated at 10'.	0
12	16	3	0-3' Silty Clay; greyish green; some Gravel, fine; black and grey.	0
16	20	0.5	0-0.5' Same as above.	0
20	24	2	0-2' Silty Clay; greyish green, very saturated; some Gravel,	0
			fine; black and grey.	
24	28	3	0-2.5' Silty Sand, fine to medium; greyish green, layers of brown and dark grey.	0
			2.5-3' Silt; brown.	0
28	32	2	0-2' Same as above.	0

ARCADIS GERAGHTY & MILLER

Well Construction Log
(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project NJ000389.0005.00002 Well BS-1

Town/City Harriman

County Rockland State NY

Permit No. NA

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 8/8/00

Drilling Method Hollow Stem Auger

Drilling Contractor Summit, Inc.

Drilling Fluid None

Development Technique(s) and Date(s)

Well not developed.

Fluid Loss During Drilling N/A gallons

Water Removed During Development -- gallons

Static Depth to Water Not measured. feet below M.P.

Pumping Depth to Water Not measured. feet below M.P.

Pumping Duration -- hours

Yield -- gpm Date --

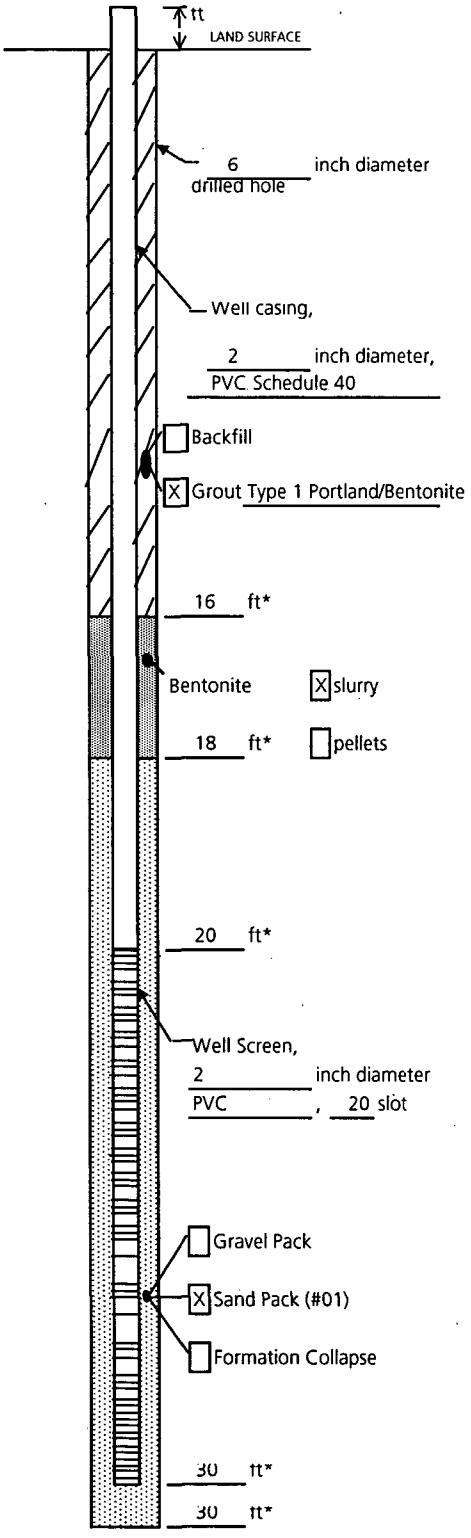
Well Purpose Injection well for biosparge test.

Remarks

Prepared by J. Guido

ARCADIS GERAGHTY & MILLER

Well Construction Log
(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

*. Depth Below Land Surface

Project N3000389.0005.00002 Well OW-6

Town/City Harriman

County Rockland State NY

Permit No. NA

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 8/7/00

Drilling Method Hollow Stem Auger

Drilling Contractor Summit, Inc.

Drilling Fluid None

Development Technique(s) and Date(s)

8/8/00, Pump and surge.

Fluid Loss During Drilling N/A gallons

Water Removed During Development 67.5 gallons

Static Depth to Water Not measured. feet below M.P.

Pumping Depth to Water Not measured. feet below M.P.

Pumping Duration 0.5 hours

Yield 2.5 gpm Date 8/8/00

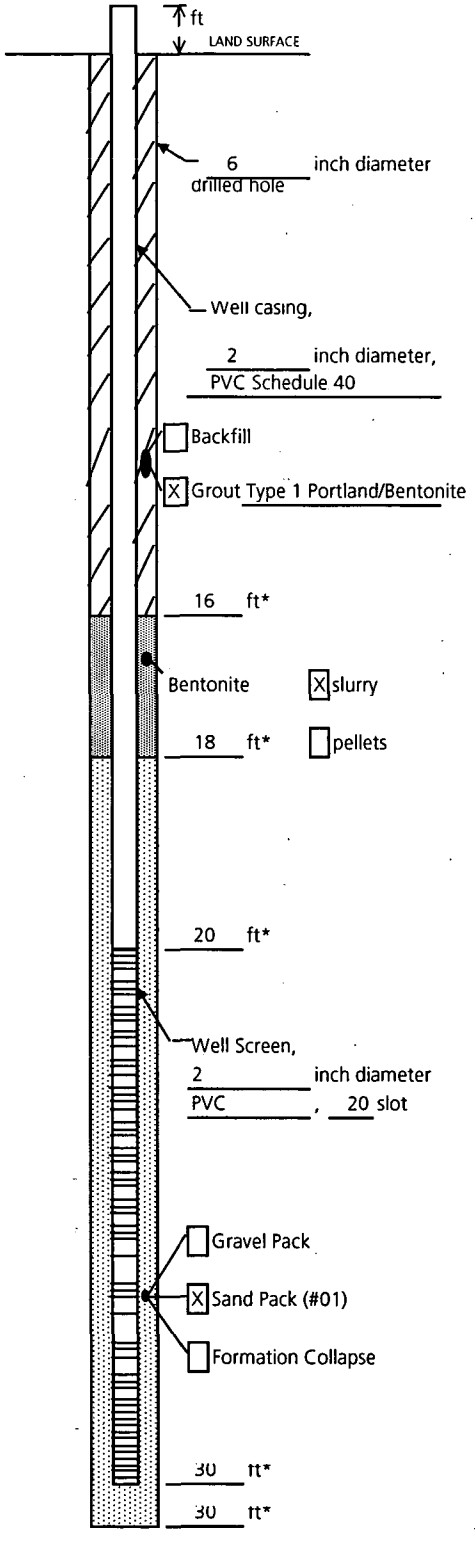
Well Purpose Observation well for biosparge test.

Remarks

Prepared by J. Guido

ARCADIS GERAGHTY & MILLER

Well Construction Log
(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project NJ000389.0005.00002 Well OW-7

Town/City Harriman

County Rockland State NY

Permit No. NA

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 8/7/00

Drilling Method Hollow Stem Auger

Drilling Contractor Summit, Inc.

Drilling Fluid None

Development Technique(s) and Date(s)

8/8/00, Pump and surge.

Fluid Loss During Drilling N/A gallons

Water Removed During Development 110 gallons

Static Depth to Water Not measured feet below M.P.

Pumping Depth to Water Not measured feet below M.P.

Pumping Duration 1.5 hours

Yield 2-2.5 gpm Date 8/8/00

Well Purpose Observation well for biosparge test.

Remarks

Prepared by J. Guido