Release ID#: 1548
Seattle

Investigation Report
For
Washington State Department of Ecology
Mixed Funding LUST Sites

BP Oil Station #11352
Country Junction Store
Hansville General Store
Cornet Bay Marina
Circle K Station #1461
Tiki Car Wash

Prepared for

Washington State Department of Ecology
Toxics Cleanup Program
Northwest Regional Office

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June 2005
Revision: 1
EA Project No. 61994.01

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LIST OF ACRONYMS

AS	Air sparging
AST	Aboveground storage tank
bgs	Below ground surface
btoc	Below top of casing
BOD	Biochemical oxygen demand
BTEX	Benzene, toluene, ethylbenzene, and xylenes
COD	Chemical oxygen demand
CPAH	Carcinogenic polyaromatic hydrocarbons
cyd	Cubic yards
DO	Dissolved oxygen
DRO	Diesel-range organics
EA	EA Engineering, Science, and Technology, Inc.
Ecology	Washington State Department of Ecology
EDB	1,2-dibromoethane
EDC	1,2-dichloroethane
EFR	Enhanced Fluid Recovery
GPS	Global positioning system
GRO	Gasoline-range organics
HASP	Health and Safety Plan
IWS	In-well Stripping
LDPE	Low-density polyethelene
LRO	Lube-oil range organics
LUST	Leaking underground storage tank
µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
MTBE	Methyl tertiary-butyl ether
MTCA	Model Toxics Control Act
NCA	North Creek Analytical, Inc.
NTU	Nephelometric Turbidity Units
ORP	Oxidation-reduction (Redox) potential

PCB	Polychlorinated biphenyls
PCS	Petroleum-contaminated soil
PID	Photoionization detector
PP	Priority Pollutant
ppm	Parts per million
PVC	Polyvinyl chloride
SAP	Sampling and Analysis Plan
SVE	Soil vapor extraction
UST	Underground storage tank
VOC	Volatile organic compound
WAC	Washington Administrative Code

1. INTRODUCTION

1.1 BACKGROUND

EA Engineering, Science, and Technology, Inc. (EA) has been contracted by the Northwest Regional Office of the Washington Department of Ecology (Ecology) to perform investigational activities at multiple leaking underground storage tank (LUST) sites in the Puget Sound area. This report has been prepared to present the results of site activities performed to further define known petroleum contamination at the sites, as well as results of data acquisition to evaluate remedial alternatives. Recommendations for future remedial actions are provided for three of the sites, as requested by Ecology.

The sites are classified as "Mixed Funding" LUST sites by Ecology. Property owners for the sites applied for financial assistance under Washington Administrative Code (WAC) 173-340-560 and subsequently entered into Consent Decrees with Ecology. The sites being investigated and/or evaluated are:

- BP Oil Station #11352 – 18725 Bothell Way NE, Bothell, King County.
- Country Junction Store – 5310 SE Hwy 160, Port Orchard, Kitsap County.
- Hansville General Store – 7532 Twin Spits Road, Hansville, Kitsap County.
- Cornet Bay Marina – 200 North Cornet Bay Road, Oak Harbor, Island County.
- Circle K Station #1461 – 2350 24th Avenue East, Seattle, King County.
- Tiki Car Wash – 11909 NE 8th Street, Bellevue, King County.

Table 1.1 provides a summary of location information for each site including section, township, range, latitude, and longitude.

A Sampling and Analysis Plan (SAP) and a SAP Addendum were prepared and submitted to Ecology before performing the field tasks (EA 2005a and b). A Health and Safety Plan (HASP) was included as an appendix to the SAP. The SAP and Addendum provide details regarding the investigation objectives for each site, planned sampling activities, and field procedures and laboratory methods.

Laboratory analyses for this project were performed by North Creek Analytical, Inc. (NCA) of Bothell, Washington. Drilling services were provided by Cascade Drilling, Inc., of Woodinville, Washington.

1.2 REPORT ORGANIZATION

Sections 2 through 7 of this report are organized by site, in the order listed above. A brief description of each site and its history is provided, along with general information on the site geology and hydrogeology. An overview of the work performed is provided, as well as a discussion of the findings. Finally, a brief summary of site conditions and recommendations for future site remediation are provided. A list of references cited for each site is provided in Section 8. Figures and Tables are numbered to correspond with the appropriate site section

(i.e., Tables 2.1 through 2.4 provide information on BP Oil Station #11352, discussed in Section 2). Appendices A through F are also organized by site, in the order listed above. Information provided in each site-specific appendix includes supporting historic data, boring logs, and laboratory reports and chromatograms.

Data collected during this investigation are also being submitted in an electronic format compatible with Ecology's environmental information management (EIM) system. NCA is handling the submittal of electronic data deliverables for this project. The EIM database system is new and has not been used routinely for data submission to date. The deliverables are designed to be directly uploaded into Ecology's EIM system. However, a number of difficulties have been encountered with this process. NCA has been working with Ecology's EIM Data Coordinator to resolve these problems. Most of the difficulties appear to have been resolved at this point, although NCA is currently unable to directly upload the data due to computer system incompatibilities (apparently due to NCA's firewall). The electronic data deliverables are being sent to the Ecology EIM Data Coordinator for her to upload to the system. We anticipate that the database submittals for this project will be successfully uploaded to the Ecology system by the project closing date of 30 June 2005, or shortly thereafter.

1.3 TREATMENT TECHNOLOGY ALTERNATIVES

A number of potential treatment technologies were reviewed when making recommendations for remediation of these sites. The primary alternatives reviewed include the following:

Excavation – Excavation is primarily used to remove contaminated soil from a source area. This approach can be effective and relatively inexpensive if the contaminants are located above the water table, at a shallow depth, and there are no major structures on the site. Although excavation is possible below the water table, it can be substantially more expensive because it is necessary to either dewater the site (if possible) or to provide for water management from the saturated soils. The excavation depth is typically limited by available equipment. Standard backhoes can reach an average depth of 15 ft below the ground surface (bgs); deeper excavations require either larger, more expensive equipment or placing the equipment on a bench below the ground surface. Roads and structures at the site can limit the location and depth of excavations, particularly in unstable soils. Shoring may be necessary in these areas.

Soil Vapor Extraction (SVE) – SVE is used to remove volatile organic compounds (VOCs) from the vadose (unsaturated) zone. This system does not remove contaminants from saturated soils below the water table. SVE systems typically consist of either vertical or horizontal wells connected to a network of air supply lines. VOCs are drawn from the soil through the well screens using a blower. The air is treated to remove the VOCs prior to discharging the air to the atmosphere. Placement of the well screens is important in the system design. If the screens are too close to the surface, short circuiting can occur, limiting the effectiveness of the system (short circuiting is when clean air is drawn into the SVE system). The land surface is typically paved or covered with an impermeable barrier to minimize this. If the water table is high or the screens are set too close to the water table, groundwater can be drawn into the wells and vacuum lines, greatly reducing the ability of the system to remove VOCs.

Enhanced Fluid Recovery (EFR) – EFR is a form of a multi-phased extraction system aimed at removing free product and contaminants from the smear zone. The well is connected to a vacuum truck using piping placed in the well. Once a vacuum is applied, free product, contaminated groundwater, and soil vapors are drawn into the well and discharged into the truck. The water/product is hauled offsite for disposal at a permitted facility. EFR can be a relatively inexpensive treatment method. There are no upfront costs unless additional wells are needed. A typical EFR event lasts for one day. EFR events typically need to be repeated at widely spaced time intervals in order to sufficiently reduce contaminant concentrations. While primarily used for removing gasoline contamination, EFR has recently been used on diesel-range organics (DRO) with some success. For DRO sites, a surfactant can be injected into the well a couple of days before treatment, to loosen the DRO and allow for its removal. However, this may also mobilize DRO and allow it to migrate further.

Pump and Treat – Pump and treat systems have been used for years for groundwater remediation systems but their use has fallen into disfavor in recent years. A primary concern with these types of systems is the volume of clean water that is necessary to pump from the site to achieve cleanup levels. In general, a pump and treat system consists of a series of extraction wells screened in the contaminated groundwater. Pumps in the wells extract the contaminated groundwater and pump it to a central location for treatment. The treated groundwater can then be discharged to a sewer system, reinfiltrated back into the groundwater, or discharged to surface water. The practicality of these systems is limited by the ability to extract contaminants from the groundwater and by the ability to dispose of the treated water. Extraction of contaminants from the groundwater is limited by the formation and it may not be possible to reduce contaminant concentrations below the groundwater cleanup levels. Discharge to a storm sewer is generally not permitted; discharge to a sanitary sewer can be expensive.

In-well Stripping (IWS) – IWS is an in-situ treatment process where air-lift pumping is used to move groundwater through a vertical circulation well. The VOCs dissolved in the water are stripped from the groundwater within the well casing by the injected air. The off-gasses are recovered for aboveground treatment. Water is recirculated back into the aquifer at a different vertical elevation (generally higher) from the intake screen. The system is similar to ex-situ air stripping where, in this case, the air-stripping tower is the well itself. Because of the circulation patterns established around the treatment well, contaminated groundwater may be captured and stripped several times as it passes through the treatment zone.

Air Sparging (AS) – AS is an in-situ process where air is blown into the contaminated aquifer to remove VOCs. The injected air moves vertically and horizontally through the saturated soil, stripping the VOCs from the groundwater. Typically, AS is used in conjunction with a vapor extraction system, such as SVE, to capture the vapor phase contamination. It can also be used in conjunction with a pump and treat system. In this instance, the AS system strips the VOCs, mobilizing the contaminants which are carried along with the groundwater to be removed by a pump and treat system. The effectiveness of AS systems is controlled by the soil characteristics.

Injectable Technologies – Injectable technologies are aimed at enhancing conditions in the natural environment that assist in breaking down contaminants or promote the biodegradation of contaminants. Depending on the contaminants at a site, the specific injectables will vary. The design of these types of systems relies on the depth and spacing of injection points and the type of injectable used. To ensure complete remediation of a site, it is key to be able to fully cover the areas of contamination or to create a reactive wall. For gasoline, oxygen enhancements are common. While this type of treatment does not require installation of a mechanical system or routine O&M, drilling costs for injection points and costs for the injectable itself can be high. Multiple injection events may be required to sufficiently reduce contaminant concentrations. Injected technologies target the saturated zone; unsaturated soils are not treated.

All of the above-described systems/methods can be quite effective with gasoline contamination. However, none work very well with heavier hydrocarbons such as DRO, with the possible exception of EFR and excavation.

6. CIRCLE K STATION #1461

6.1 SITE DESCRIPTION AND HISTORY

The former Circle K site (now known as Jay's Cleaners) is located at 2350 24th Avenue East, in the Montlake area of Seattle, King County, Washington (Figure 6.1). The facility was operated as a convenience store and gasoline station from 1968 to 1981. The owner leased the site to the now bankrupt Circle K Corporation from 1981 to July 1990. The facility continued to operate as a convenience store with gasoline (leaded and unleaded) sales during that time. Prior to 1968, the site was likely residential.

In August 1989, a leak was discovered in one of the gasoline USTs. Reportedly, a review of the inventory records for the 4,000-gallon tank indicated that approximately 4,000 to 6,000-gallons of gasoline were released between 22 June 1989 and 7 August 1989 (GeoEngineers 1990). Remaining product in the tank reportedly was removed on 7 August 1989. All six onsite USTs were excavated in October 1989, along with approximately 900 cyd of contaminated soil. The removed USTs included two 4,000-gallon gasoline tanks, two 6,000-gallon gasoline tanks, one 500-gallon waste oil tank, and one 500-gallon heating oil tank. The former tank locations are indicated in a figure included in Appendix E. Contaminated soil in the gasoline UST area was removed to a depth of approximately 14 to 16 ft bgs. Contaminated soil remained at the limits of the excavation (GeoEngineers 1990).

In December 1989, installation of a product recovery and treatment system was completed. The groundwater treatment system consisted of (1) a recovery well and a series of recovery trenches (excavated toward the free product plume and backfilled with pea gravel), (2) a dual pumping system for recovering free product and contaminated groundwater, and (3) an aboveground groundwater treatment system using a series of activated carbon filters. Figures showing the system configuration are included in Appendix E. The system was operated briefly after it was installed, and again from 1992 through 1996, at which time it was shut down due to a low recovery rate.

An SVE system was also installed in the tank excavation area. Slotted PVC pipe was installed horizontally at depths of 4 to 5 ft bgs. The vapor recovery pipes were connected to a blower and the extracted vapors ran through a condensate trap and a series of two activated carbon filters. The period of operation of the SVE system is not known; however, it apparently was shut down in 1997 after readings indicated insignificant concentrations of hydrocarbons were being removed.

Sixteen monitoring wells were installed during 3 phases of a site assessment performed by GeoEngineers in September, October, and December 1989 (GeoEngineers 1990). Five of the wells have since been abandoned, leaving 11 wells currently available to monitor the plume. Three of these wells are on the Circle K property (MW-4, MW-7, and MW-13); five of the wells are in East McGraw Street (MW-6, MW-8, MW-9, MW-10, and MW-16); and three of the wells are north of McGraw Street in the road right-of-way (MW-11, MW-14, and MW-15). Most of

the wells reportedly were screened from 5 to 20 ft bgs. Several wells were screened from about 4 to 19 ft bgs. Available well construction details for the remaining wells are provided in Table 6.1. Copies of the well logs are included in Appendix E.

Prior to this investigation, the wells were last sampled in June 2003. Free product was observed in four of the wells (MW-4, MW-8, MW-9, and MW-13) at that time. Benzene and GRO were detected at concentrations above the MTCA Method A cleanup criteria in groundwater from well MW-15. MTBE was reported at a concentration below the cleanup criteria in MW-15 (by EPA Method 8021B, which is prone to false positives). Petroleum constituents were not detected the six other monitoring wells. A summary of the June 2003 date is provided in Appendix E.

6.2 GEOLOGY AND HYDROGEOLOGY

According to GeoEngineers, layers of sandy silt and silty fine sand were encountered beneath surface layers of asphalt, concrete, and fill material. Individual layers of sandy silt and silty sand vary in thickness over short distances and are often laterally discontinuous (GeoEngineers 1990). Occasional gravel and cobbles were encountered. A very dense to hard layer consisting of fine-grained glacial sediment was encountered at depths greater than approximately 14 ft in most of the borings.

Groundwater at the site occurs approximately 9 to 12 ft bgs, based on available data. Water level data obtained in 1989 was used to evaluate groundwater flow. The groundwater flow direction at that time was determined to be to the northeast at a gradient of approximately 0.024 ft/ft in 1989 (GeoEngineers 1990). Early product thickness measurements in site monitoring wells ranged up to 9.5 ft (in well MW-8; see table in Appendix E). GeoEngineers noted that free product appeared to have flowed in a northwest direction (different from the apparent groundwater flow direction) away from the leaky UST, based on their free product measurements obtained in 1989. Water level data obtained in June 2003 and in May 2005 did not clearly establish the groundwater flow direction.

6.3 FIELD ACTIVITIES

6.3.1 Initial Monitoring Well Sampling

On 31 May 2005, EA performed the gauging of groundwater and free product levels in the 11 monitoring wells at the former Circle K site. Free product was observed in monitoring wells: MW-4 (0.3 ft), MW-8 (trace), MW-9 (0.02 ft), and MW-13 (0.01 ft). See Table 6.1 for monitoring well gauging and construction information. Groundwater samples were not collected from monitoring wells that contained free product.

A groundwater sample was collected from MW-15 using a peristaltic pump and low-flow sampling procedures. Monitoring well MW-15 was first opened and water level, product level, and total depth measurements obtained and recorded before installing ¼-inch diameter tubing in the well. The tubing intake was placed approximately 2 ft below the water surface. A peristaltic pump was used to purge groundwater at a rate of 300-500 ml/min. Groundwater quality

parameters were measured every 3 minutes during purging until parameters stabilized. A groundwater sample was then collected. Groundwater quality parameters stabilized at the following readings: pH (5.08), specific conductivity (0.157 mS/cm), turbidity (0 NTUs), DO (0.00 mg/L), temperature (13.9 Celsius), and ORP (211 millivolts). The groundwater sample (from MW-15) was analyzed for GRO, BTEX, MTBE, and total lead.

6.3.2 Enhanced Fluid Recovery Pilot Test

On 9 June 2005, an EFR pilot test was performed at the site in an effort to remove free product, impacted groundwater, and petroleum vapors from targeted monitoring well locations. EcoVac Services, Inc., was contracted to perform the test on four monitoring wells at the former Circle K site (MW-4, MW-8, MW-9, and MW-13). Free product measurements were made in the wells prior to conducting the test. Free product thickness measurements at that time were as follows: 0.42 ft in MW-4, a sheen in MW-8, 0.01 ft in MW-9, and 0.01 ft in MW-13.

A vacuum truck from Emerald Services, Inc., was used to provide the vacuum for the test and also the storage, transportation and disposal of the wastewater generated during the test. The EFR test was performed over an 8-hour period and included multiple well extraction tests as well as individual well tests.

Drop tube assemblies were placed in each of the four wells to be used during the test. Vacuum hose ran from each well to a manifold, then to the vacuum truck. The hose ran under a driving ramp placed across the southern lane of East McGraw Street, to allow traffic to pass by during the test. A traffic plan was prepared by Traffic Control Services and submitted to the City of Seattle prior to the test. Traffic flaggers and signs were used to divert traffic around the closed northern lane of East McGraw Street.

Water levels were measured in surrounding wells while the test was being performed to assess drawdown effects of the test. Vacuum readings were later recorded from surrounding wells to assess the radius of influence the EFR test was having at the site.

At the completion of the EFR test, a drop tube assembly was lowered into MW-14 to remove accumulated sediments from the well. Prior to this, the measured total depth of MW-14 was 10.5 ft btoc. After removal of sediment and water from well the total depth of the well was measured to be 18.87 ft btoc. This well may have damage to the PVC screen or casing joints, based on the amount of sediment that was observed in the well.

6.3.3 Follow-up Monitoring Well Sampling

On 23 June 2005, two weeks after the EFR test, the five monitoring wells within the plume boundaries (MW-4, MW-8, MW-9, MW-13, and MW-15) were gauged for the presence of free product. Free product was measured in well MW-8 at a thickness of 0.01 ft. Less than 0.01 feet of product (trace) was measured in MW-9 and MW-4. Free product was not observed in MW-15 or MW-13.

Monitoring wells with less than 0.01 feet of free product were sampled. Sampling procedures were the same as during the first sampling round. Groundwater samples were analyzed for GRO, BTEX, MTBE, and DRO. Hydrocarbon odors were noted emanating from the purged groundwater from the four wells sampled.

6.4 RESULTS

Field parameter measurements for both rounds of sampling are provided in Table 6.1. Analytical results for the first round of groundwater sampling (one sample) are discussed below. Results for the second round of groundwater samples were not available in time to be included in this report.

6.4.1 Initial Monitoring Well Sampling

GRO was detected in the groundwater sample from MW-15 at a concentration of 878 µg/L, which is just above the MTCA Method A cleanup criteria of 800 µg/L (for samples also containing benzene). Benzene (1.26 µg/L), ethylbenzene (2.60 µg/L), and xylenes (3.39 µg/L) were detected at concentrations below the cleanup criteria. Toluene and MTBE results were below the laboratory detection limits.

6.4.2 Enhanced Fluid Recovery Pilot Test

Approximately 1,600 gallons of contaminated groundwater/liquid phase product was removed from the site during the 8-hour EFR test period. The total amount of hydrocarbons removed during the EFR test was estimated to be 112 pounds, as measured in the vapor phase. This mass of hydrocarbons is equivalent to approximately 18 gallons of gasoline. The highest extraction rate observed during the test was 5.7 pounds per hour from MW-9. Extraction rates calculated for the remaining tested wells were: 5.0 pounds per hour from MW-4, 4.5 pounds per hour from MW-8, and 1.9 pounds per hour from MW-13.

Vacuum was observed in the following surrounding wells; MW-6, MW-7, and MW-16. Water levels measured during the test period indicate the greatest drawdown occurred in MW-16. EcoVac's report on the EFR results is included in Appendix E.

6.4.3 Follow-up Monitoring Well Sampling Results

Follow-up groundwater sampling was performed on 23 June. Results of analytical testing of these groundwater samples have not yet been received. They will be forwarded to Ecology when they become available.

6.5 CONCLUSIONS AND RECOMMENDATIONS

The EFR test was performed as a product and mass removal action pilot test. It was not meant to provide final site remediation and cleanup. EFR helped remediate the site by removing free

phase hydrocarbons, dissolved phase hydrocarbons and vapors from the subsurface. A total of approximately 112 pounds of hydrocarbons were removed from site by the EFR test.

The limited vacuum and drawdown observed in surrounding monitoring wells is evidence of very tight soil conditions at the site. These conditions have limited the migration of contaminants, but also limit the effectiveness of remedial/recovery equipment in removing hydrocarbons.

The five monitoring wells in the contaminant plume area were gauged two weeks following the EFR test. Free product, ranging from a trace to 0.01 ft, was detected in three of the wells at that time. Additional monitoring of site wells is recommended on at least a quarterly basis to evaluate the impact of the EFR test and to determine if additional EFR remediation (or another type of remediation) appears warranted. At a minimum, wells MW-4, MW-8, MW-9, MW-13, and MW-15 should be monitored. Occasional sampling of the remaining monitoring wells is also recommended to confirm that the plume is not migrating. Resurveying of the site monitoring wells is also recommended due to the irregular water level measurements obtained.

FIGURES

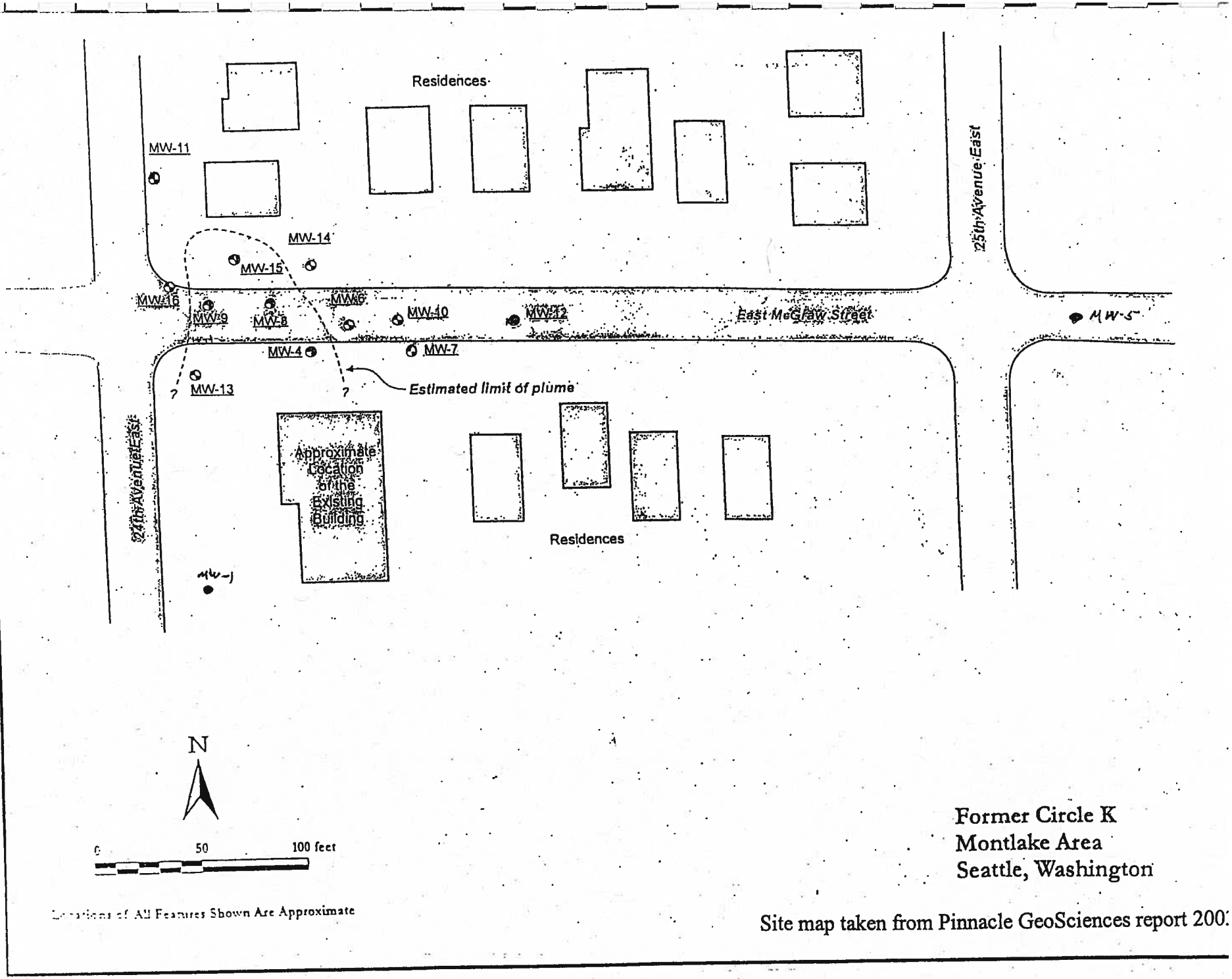


Figure 6.1 Site Map, Circle K Station #1461

TABLES

TABLE 6.1. MONITORING WELL CONSTRUCTION AND FIELD MEASUREMENT DATA
CIRCLE K STATION #1461

Well ID	Date Installed	Well Diameter (inches)	Reported Screen Depth (ft bgs)	Measured Total Depth 31 May 2005 (ft btoc)	Top of Casing Elevation (ft)	Depth to Water 31 May 2005 (ft btoc)	Depth to Product 31 May 2005 (ft btoc)	Groundwater Elevation 31 May 2005 (ft)	Corrected Elevation* 31 May 2005 (ft)
MW-4	9/12/1989	2	4 - 18.5	17.90	100.73	10.01	9.71	90.72	90.98
MW-6	10/2/1989	2	5 - 20	20.53	100.25	11.55	NA	88.70	NA
MW-7	10/2/1989	2	5 - 20	20.49	99.75	9.12	trace	90.63	NA
MW-8	10/3/1989	2	5 - 20	19.60	100.70	10.01	trace	90.69	NA
MW-9	10/3/1989	2	5 - 21	20.35	101.42	10.09	10.07	91.33	91.35
MW-10	10/3/1989	2	5 - 20	20.47	99.96	9.83	trace	90.13	NA
MW-11	10/4/1989	2	5 - 20	20.29	100.91	8.66	NA	92.25	NA
MW-12	10/4/1989	2	5 - 20	abandoned	98.97	NA	NA	NA	NA
MW-13	12/20/1989	2	4 - 19	18.89	102.19	10.91	10.90	91.28	91.29
MW-14	12/20/1989	2	4 - 19	18.87	100.41	8.79	8.78	91.62	91.63
MW-15	12/21/1989	2	4 - 18.5	16.96	101.31	9.43	NA	91.88	NA
MW-16	12/21/1989	2	4 - 19	18.94	101.16	9.51	trace?	91.65	NA

Well	Date Measured	Water Quality Parameters					
		pH	Conductivity (mS/cm)	Turbidity (NTUs)	Dissolved Oxygen (mg/L)	Temperature (°C)	Oxidation-Reduction Potential (mV)
MW-15	5/31/2005	5.08	0.157	0	0.00	13.9	211
MW-4	6/23/2005	5.57	0.15	0	0.00	15.7	-81
MW-9	6/23/2005	5.55	0.42	0	0.00	15.6	7
MW-13	6/23/2005	5.52	0.345	1	0.00	16.1	-95
MW-15	6/23/2005	4.87	0.15	0	0.21	14.6	209

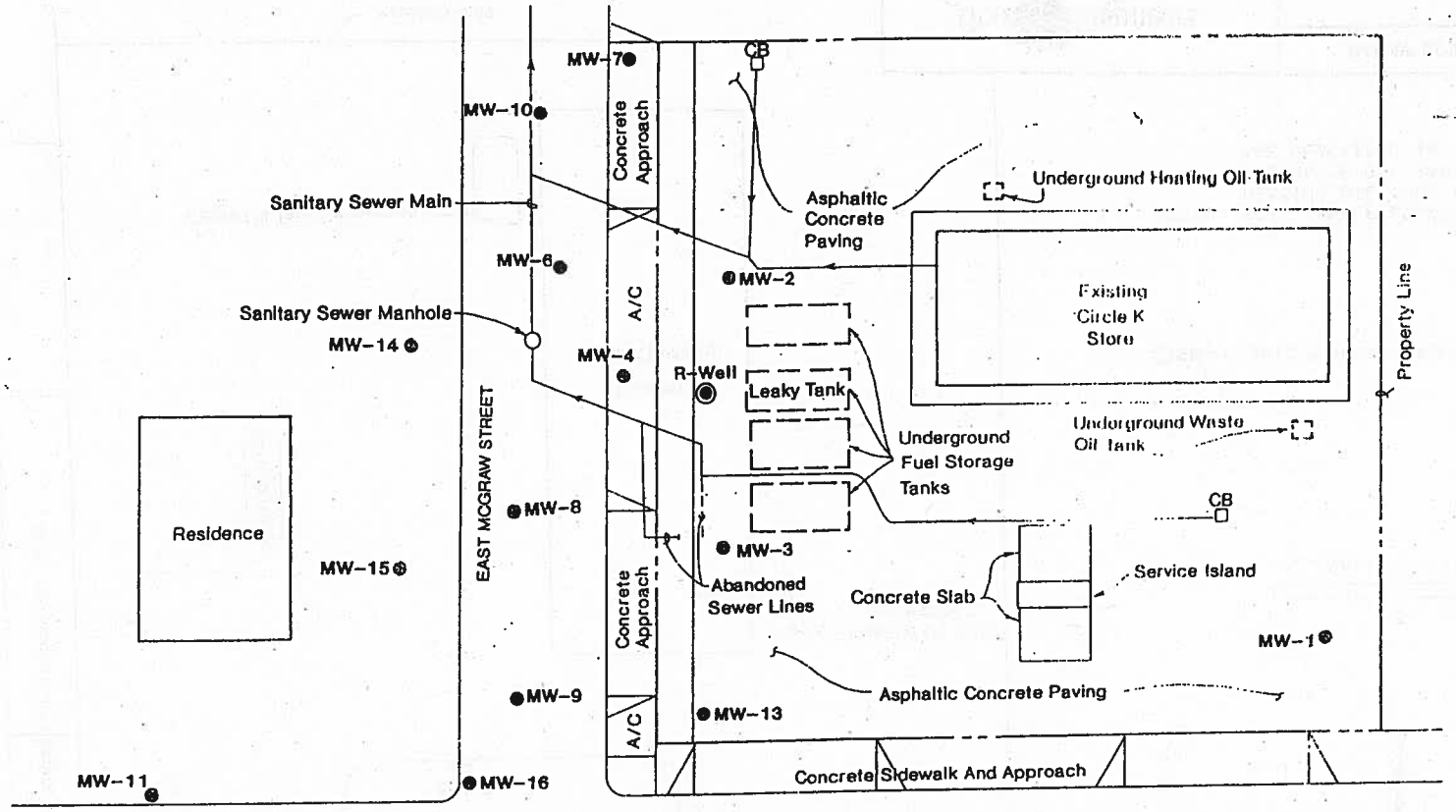
NOTES:
°C = degrees Celsius.
ft bgs = feet below ground surface.
ft btoc = feet below top of casing.
mg/L = milligrams per liter
mS/cm = milliSiemans per centimeter.
mV = milliVolts
NA = Not applicable.
NTUs = Nephelometric turbidity units.

Appendix E

Circle K Station #1461

CONTENTS

Note: Laboratory reports and sample chromatograms for this site are included in Appendix F (samples were submitted with those from the Tiki Car Wash). For standard chromatograms, refer to Appendix A.



EXPLANATION:

MW-1 ● MONITOR WELL LOCATION AND NUMBER.

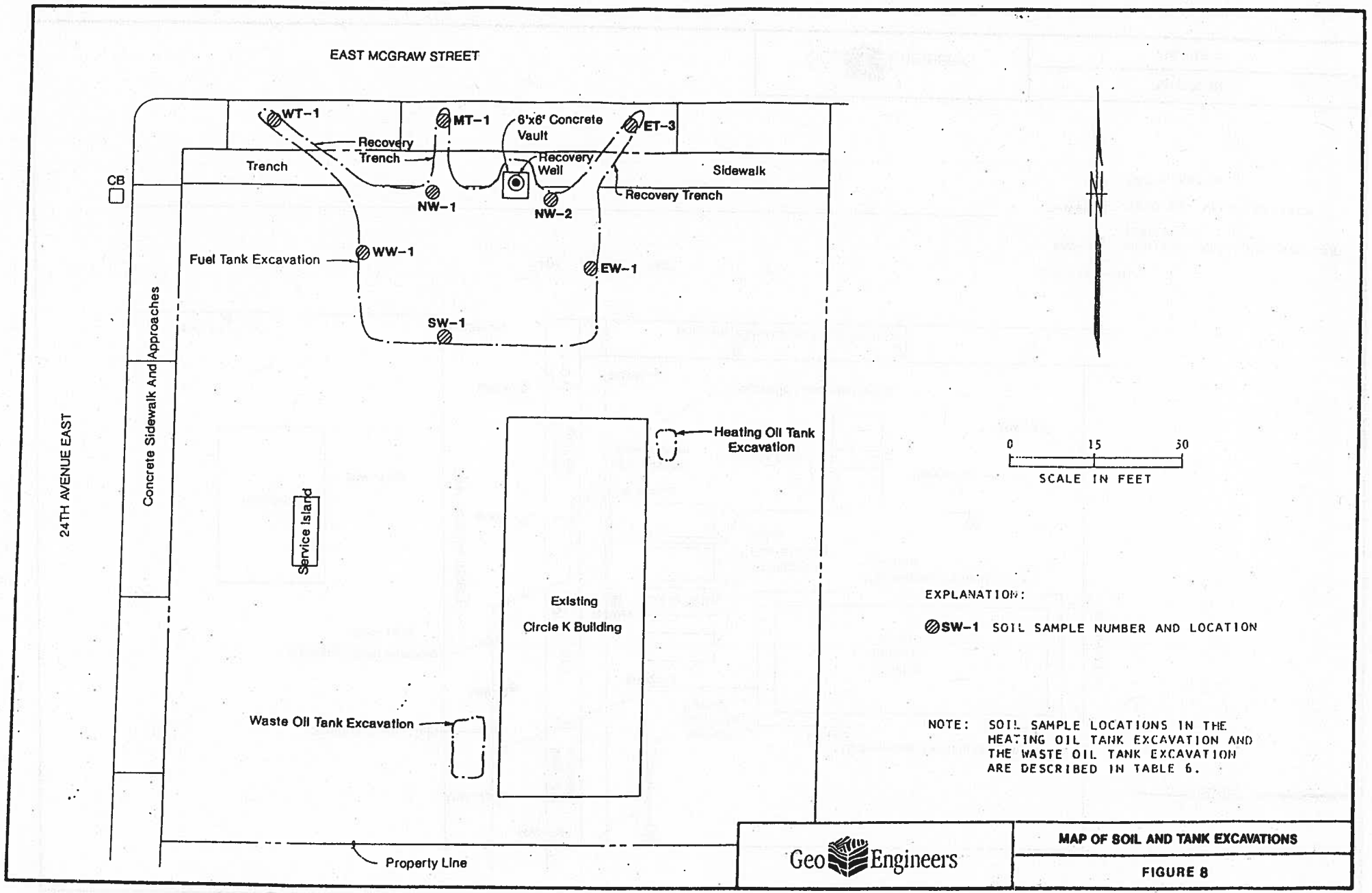
R-Well ◉ RECOVERY WELL LOCATION

CB □ CATCH BASIN

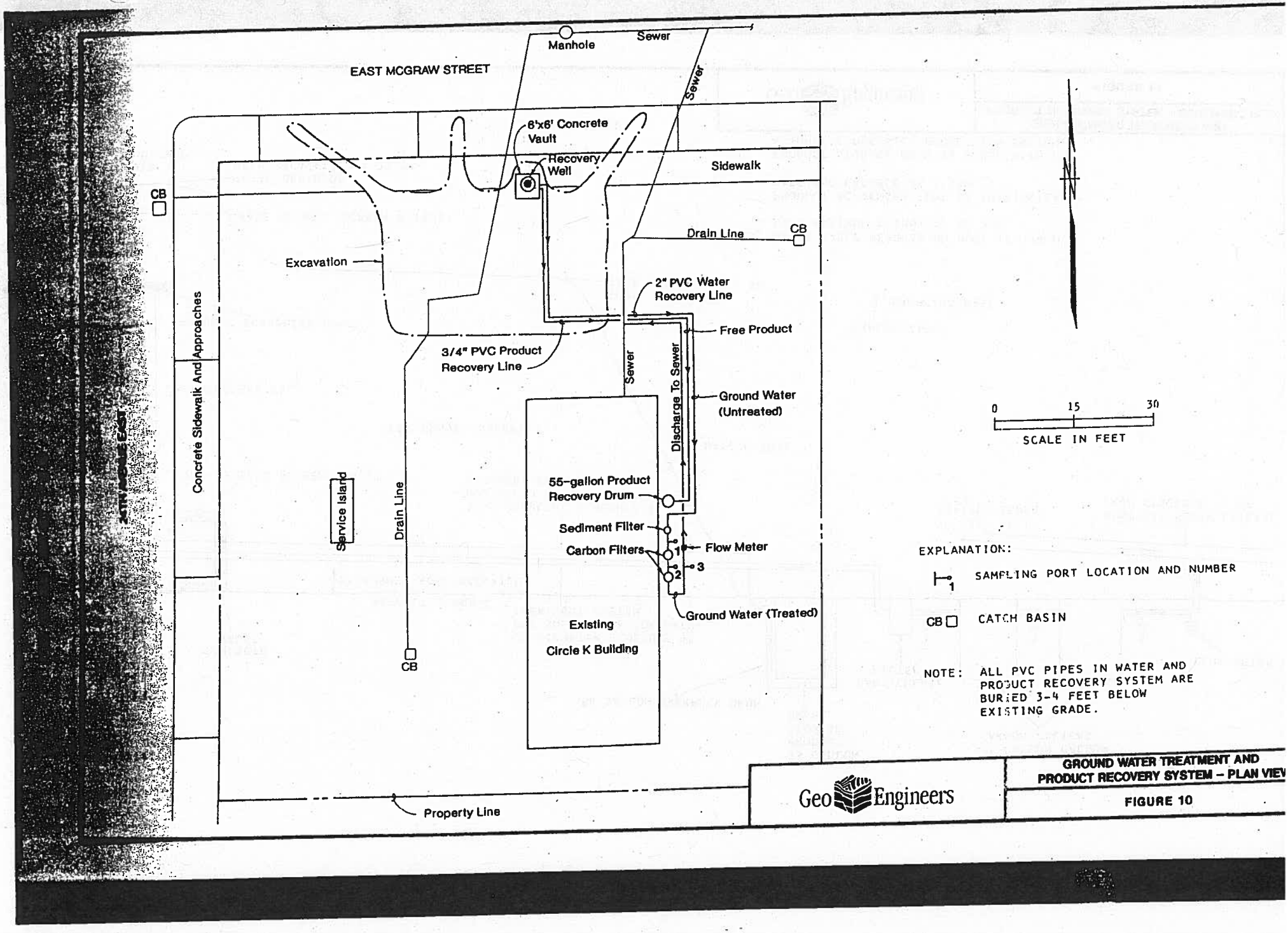
Geo Engineers

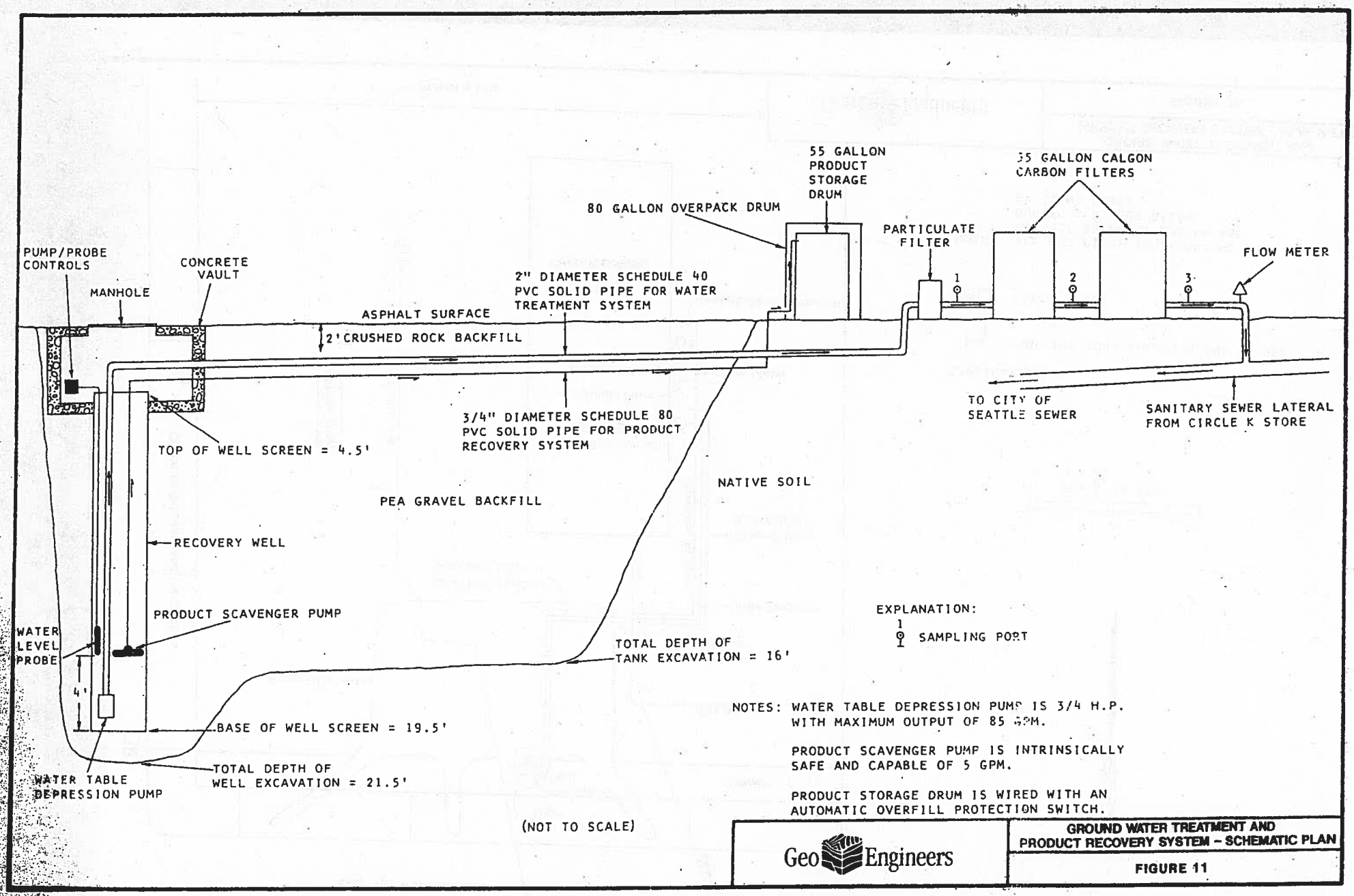
SITE PLAN

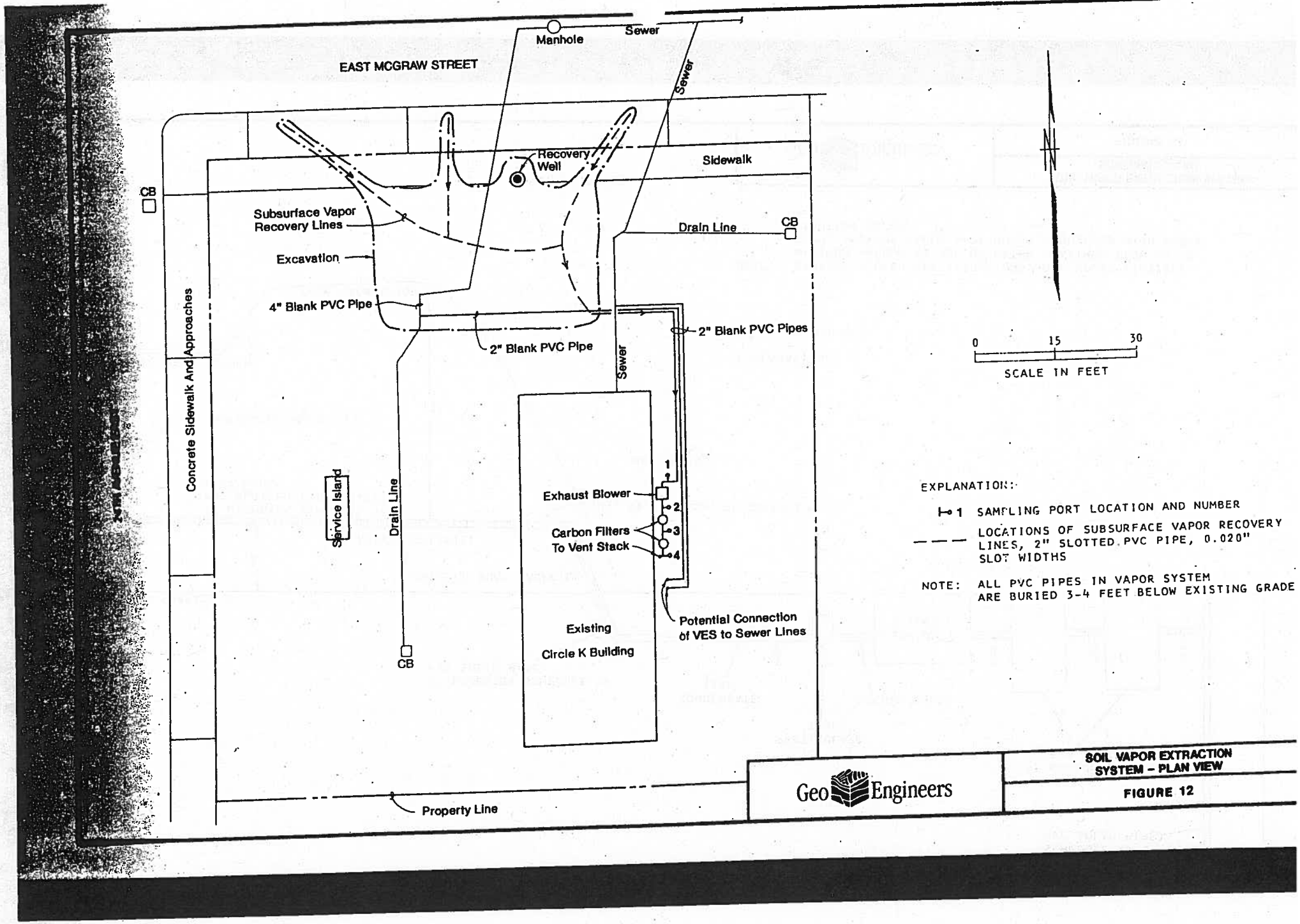
FIGURE 2

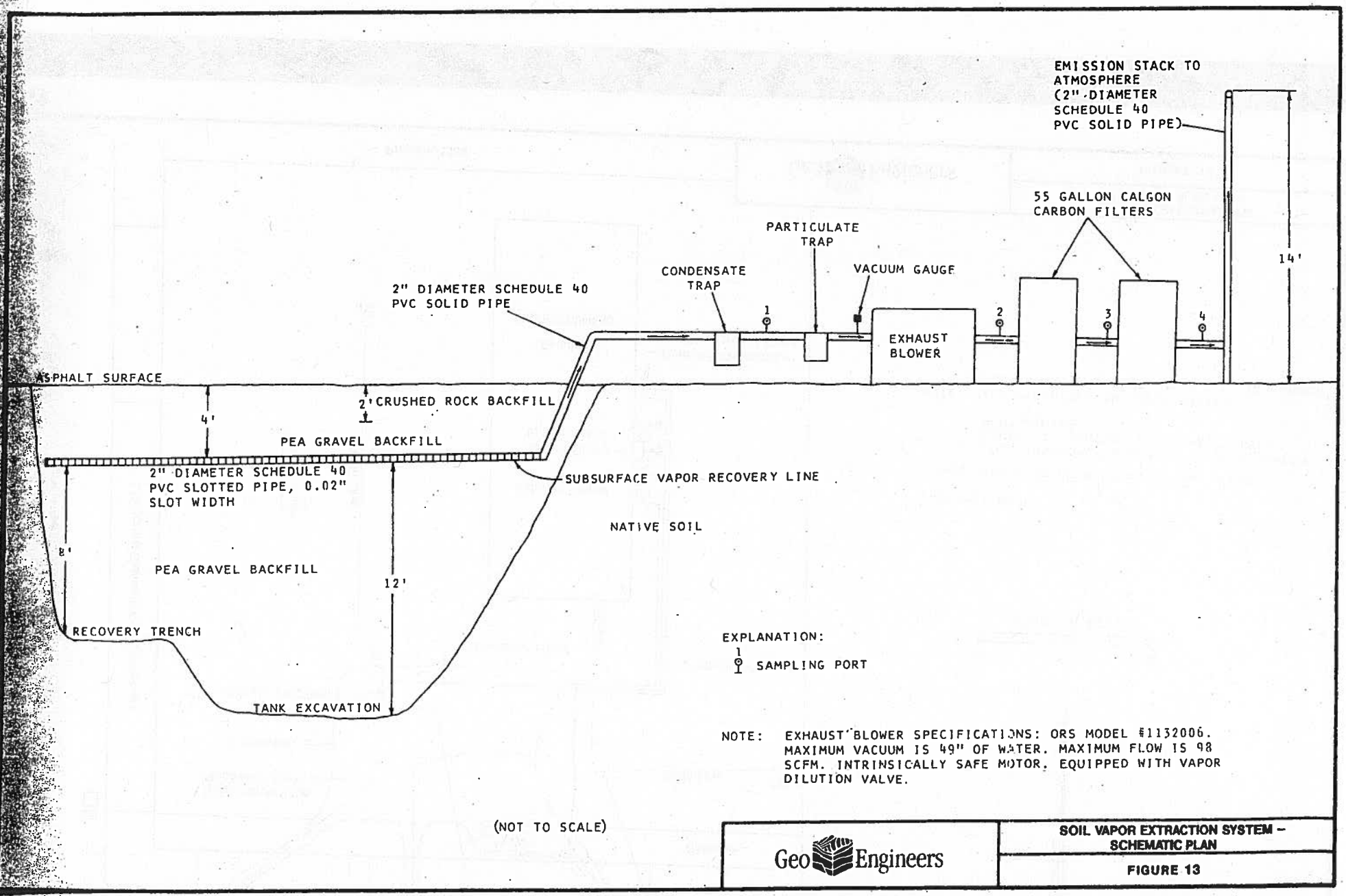


1180-001-804 JGR:BDH 1-16-90


Manhole
Sewer
EAST MCGRAW STREET
Sewer
6'x6' Concrete Vault
Recovery Well
Sidewalk
CB
Drain Line
CB
Excavation
2" PVC Water Recovery Line
Free Product
3/4" PVC Product Recovery Line
Sewer
Discharge To Sewer
Ground Water (Untreated)
Concrete Sidewalk And Approaches
Service Island
Drain Line
55-gallon Product Recovery Drum
Sediment Filter
Carbon Filters
1
2
3
Flow Meter
Ground Water (Treated)
Existing
Circle K Building
CB
Property Line
0
15
30
SCALE IN FEET
EXPLANATION:
SAMPLING PORT LOCATION AND NUMBER
CB
CATCH BASIN
NOTE: ALL PVC PIPES IN WATER AND PRODUCT RECOVERY SYSTEM ARE BURIED 3-4 FEET BELOW EXISTING GRADE.
Geo Engineers
GROUND WATER TREATMENT AND PRODUCT RECOVERY SYSTEM – PLAN VIEW
FIGURE 10


55 GALLON PRODUCT STORAGE DRUM
55 GALLON CALGON CARBON FILTERS
80 GALLON OVERPACK DRUM
PARTICULATE FILTER
FLOW METER
PUMP/PROBE CONTROLS
CONCRETE VAULT
MANHOLE
2" DIAMETER SCHEDULE 40 PVC SOLID PIPE FOR WATER TREATMENT SYSTEM
ASPHALT SURFACE
2' CRUSHED ROCK BACKFILL
1
2
3
TO CITY OF SEATTLE SEWER
SANITARY SEWER LATERAL FROM CIRCLE K STORE
3/4" DIAMETER SCHEDULE 80 PVC SOLID PIPE FOR PRODUCT RECOVERY SYSTEM
TOP OF WELL SCREEN = 4.5'
NATIVE SOIL
PEA GRAVEL BACKFILL
RECOVERY WELL
PRODUCT SCAVENGER PUMP
WATER LEVEL PROBE
TOTAL DEPTH OF TANK EXCAVATION = 16'
4'
BASE OF WELL SCREEN = 19.5'
TOTAL DEPTH OF WELL EXCAVATION = 21.5'
WATER TABLE DEPRESSION PUMP
EXPLANATION:
1
SAMPLING PORT
NOTES: WATER TABLE DEPRESSION PUMP IS 3/4 H.P. WITH MAXIMUM OUTPUT OF 85 GPM.
PRODUCT SCAVENGER PUMP IS INTRINSICALLY SAFE AND CAPABLE OF 5 GPM.
PRODUCT STORAGE DRUM IS WIRED WITH AN AUTOMATIC OVERFILL PROTECTION SWITCH.
(NOT TO SCALE)
Geo Engineers
GROUND WATER TREATMENT AND PRODUCT RECOVERY SYSTEM – SCHEMATIC PLAN
FIGURE 11


EAST MCGRAW STREET
Manhole
Sewer
Sewer
Recovery Well
Sidewalk
CB
Subsurface Vapor Recovery Lines
Drain Line
CB
Excavation
4" Blank PVC Pipe
2" Blank PVC Pipe
2" Blank PVC Pipes
Sewer
Concrete Sidewalk And Approaches
Service Island
Drain Line
Exhaust Blower
Carbon Filters To Vent Stack
1
2
3
4
CB
Existing Circle K Building
Potential Connection of VES to Sewer Lines
Property Line
0
15
30
SCALE IN FEET
EXPLANATION:
1 SAMPLING PORT LOCATION AND NUMBER
LOCATIONS OF SUBSURFACE VAPOR RECOVERY LINES, 2" SLOTTED PVC PIPE, 0.020" SLOT WIDTHS
NOTE: ALL PVC PIPES IN VAPOR SYSTEM ARE BURIED 3-4 FEET BELOW EXISTING GRADE
Geo Engineers
SOIL VAPOR EXTRACTION SYSTEM - PLAN VIEW
FIGURE 12



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SOIL VAPOR EXTRACTION SYSTEM – SCHEMATIC PLAN

FIGURE 13

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND MORE THAN 50% OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS MORE THAN 50% PASSES NO. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY LIQUID LIMIT 50 OR MORE	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-83.
2. Soil classification using laboratory tests is based on ASTM D2487-83.
3. Descriptions of soil density or consistency are based on interpretation of blowcount data, visual appearance of soils, and/or test data.

SOIL MOISTURE MODIFIERS:

Dry – Absence of moisture, dusty, dry to the touch

Moist – Damp, but no visible water

Wet – Visible free water or saturated, usually soil is obtained from below water table

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SOIL CLASSIFICATION SYSTEM

FIGURE A-1

GEI 85-8

LABORATORY TESTS:

CA Chemical Analysis

VAPOR CONCENTRATION DATA:

Vapor concentration given in parts per million

SHEEN CLASSIFICATION SYSTEM:

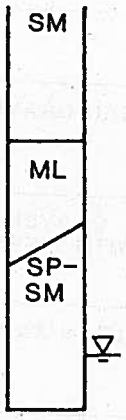
NS No visible sheen

SS Slight sheen

MS Moderate sheen

HS Heavy sheen

SOIL GRAPH:



Soil Group Symbol (See Note 2)

Distinct Contact Between Soil Strata

Gradual Change Between Soil Strata

Water Level

Bottom of Boring

BLOW-COUNT/SAMPLE DATA:

Blows required to drive a split-barrel sampler (2.4-inch I.D.) 12 inches or other indicated distances using 300 pound hammer falling 30 inches.

22 ■ Location of relatively undisturbed sample

12 ⊠ Location of disturbed sample

"P" indicates sampler pushed with weight of hammer or hydraulics of drill rig.

P □ Location of sampling attempt with no recovery

Blows required to drive a split-barrel sampler (1.5-inch I.D.) 12 inches or other indicated distances using 140 pound hammer falling 30 inches.

10 ◪ Location of sample attempt using Standard Penetration Test procedures

NOTES:

1. Information presented in the attached text and the Key To Boring Log Symbols is required to adequately explain the data on the boring logs.
2. Soil classification system is summarized in Figure A-1.
3. The reader must refer to the discussion in the report test as well as the exploration logs for a proper understanding of subsurface conditions.

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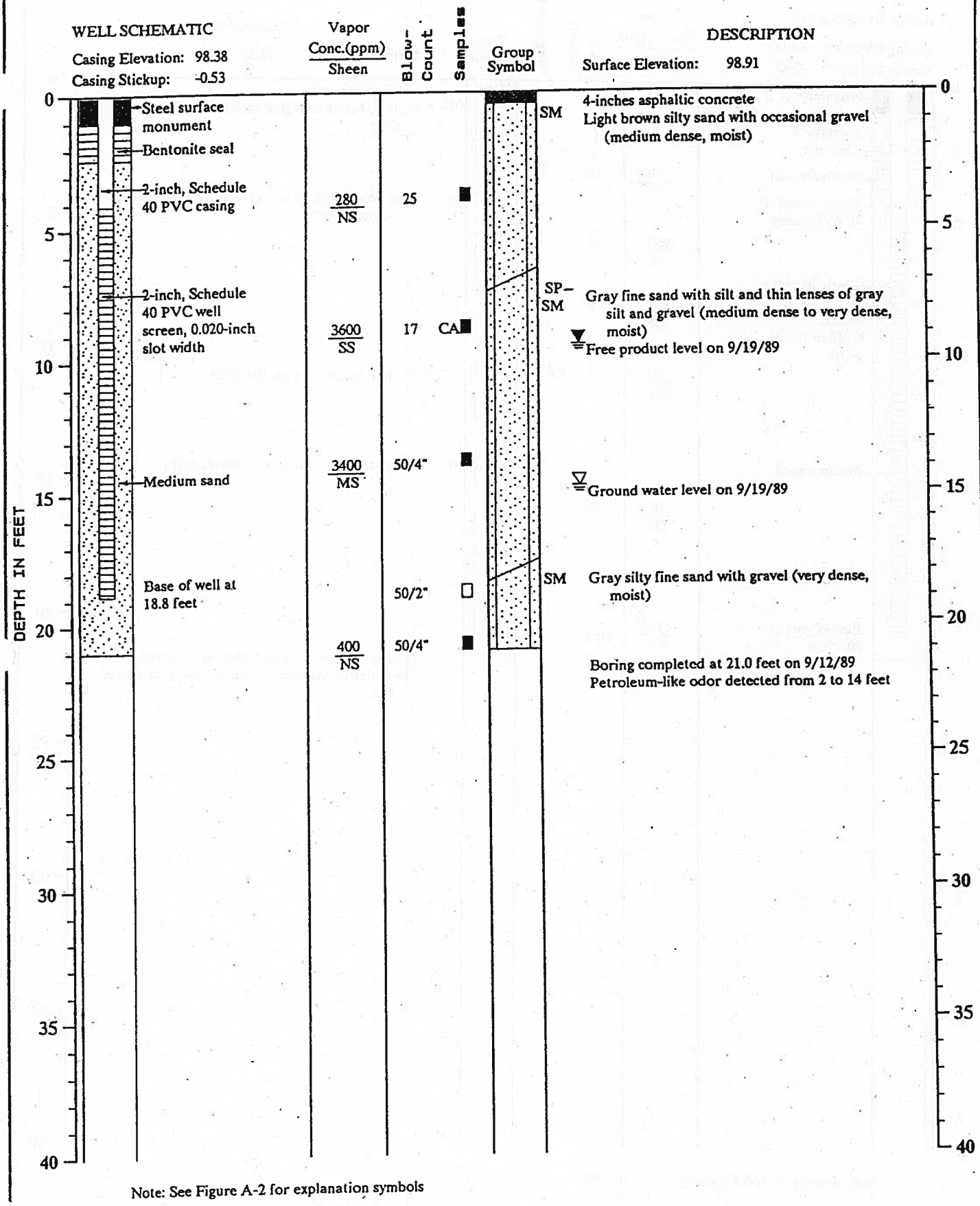
KEY TO BORING LOG SYMBOLS

FIGURE A-2

MONITOR WELL NO. MW-4



Note: See Figure A-2 for explanation symbols

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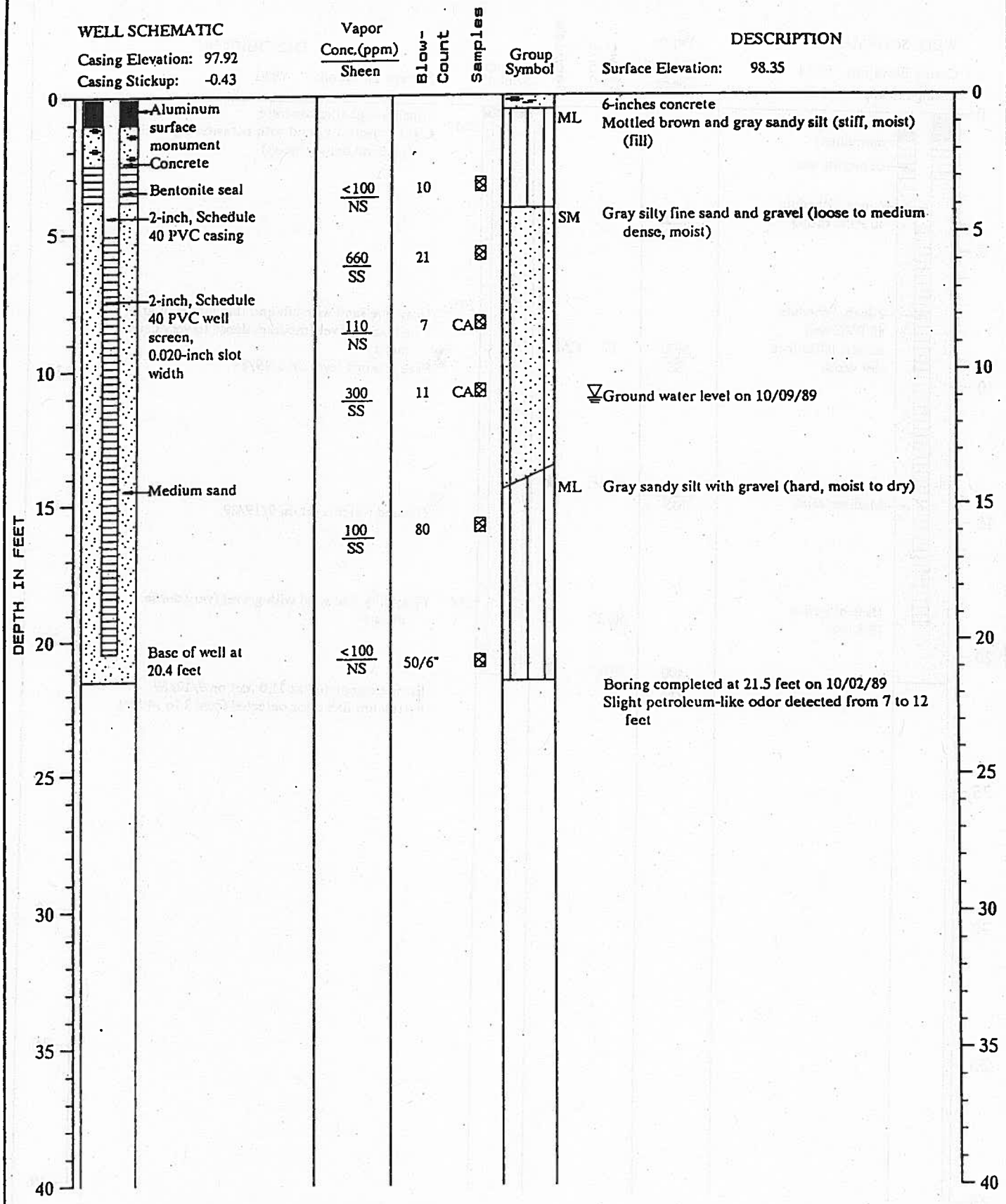
Log of Monitor Well

Figure A-6

MONITOR WELL NO. MW-6



Note: See Figure A-2 for explanation symbols

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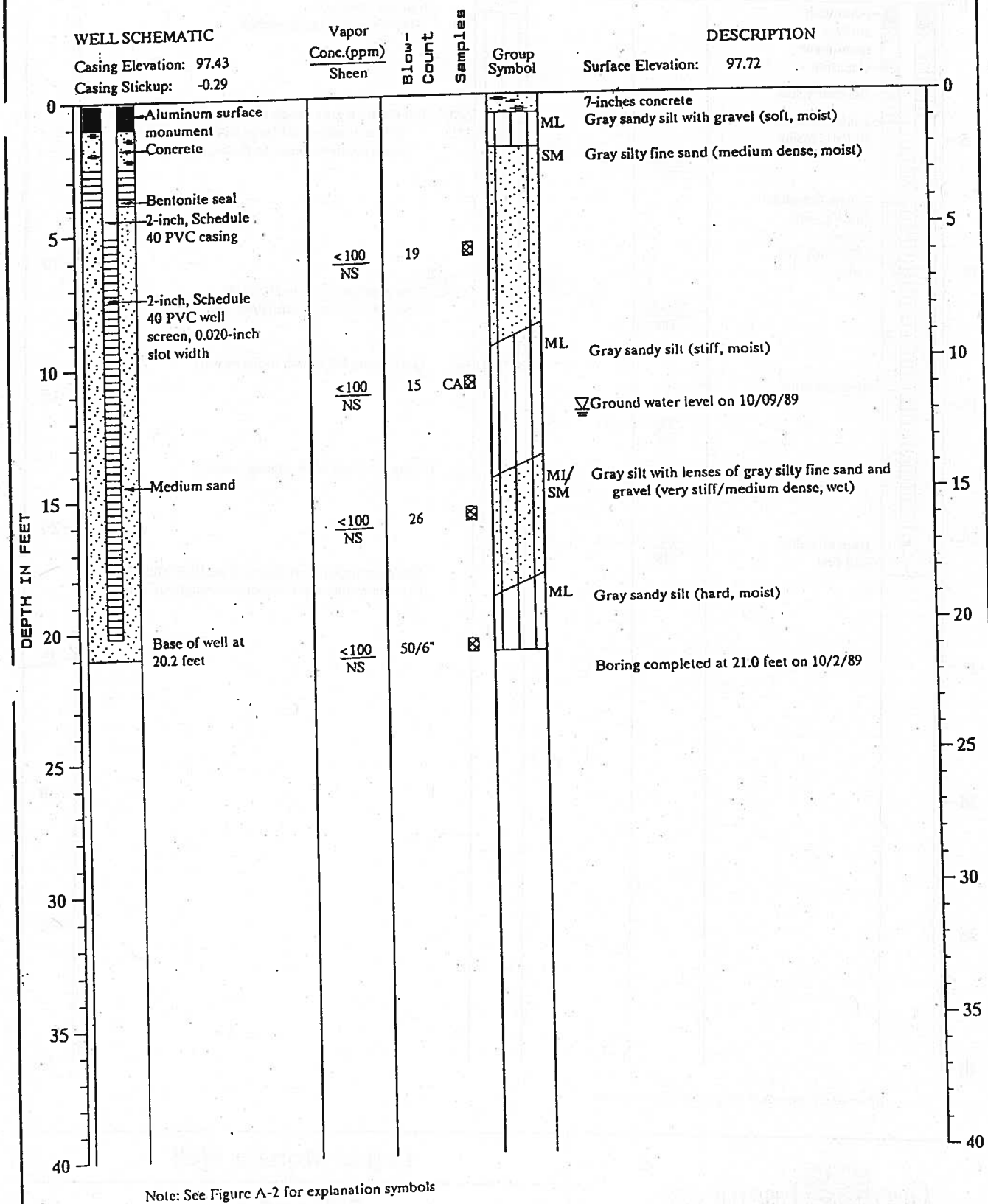
Log of Monitor Well

Figure A-8

MONITOR WELL NO. MW-7



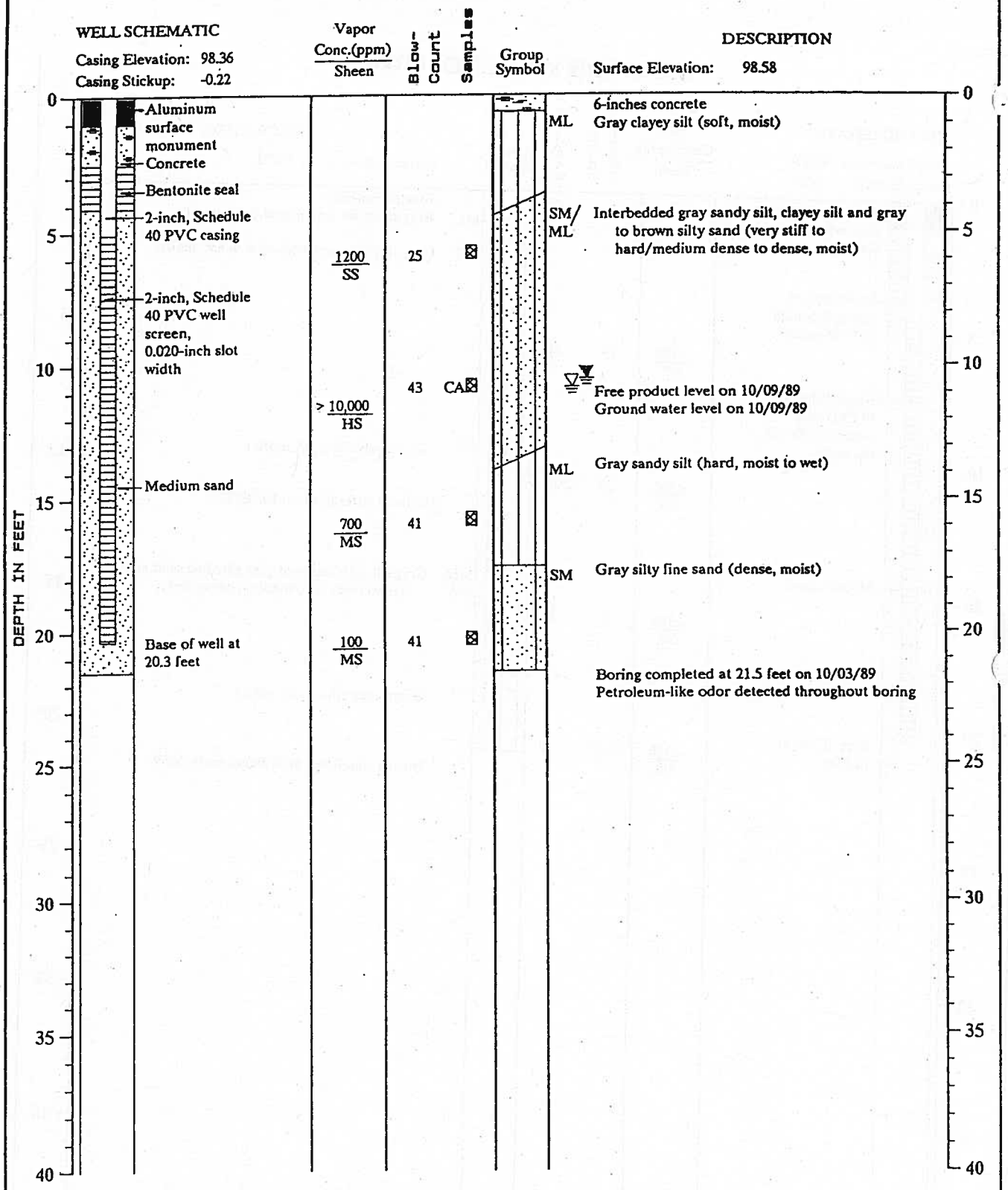
Note: See Figure A-2 for explanation symbols

Geo Engineers

Log of Monitor Well

Figure A-9

MONITOR WELL NO. MW-8



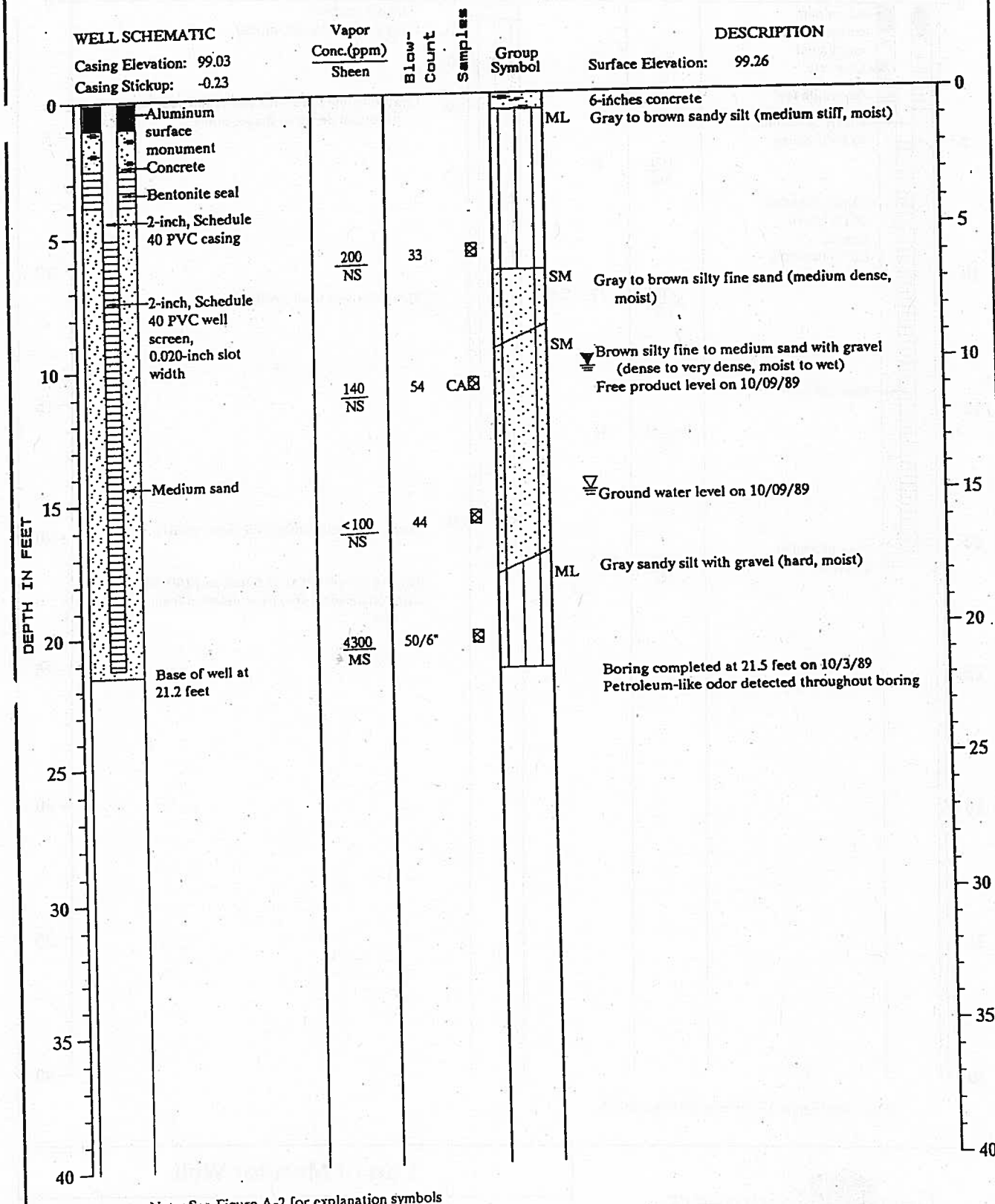
Note: See Figure A-2 for explanation symbols

GeoEngineers

Log of Monitor Well

Figure A-10

MONITOR WELL NO. MW-9



Note: See Figure A-2 for explanation symbols

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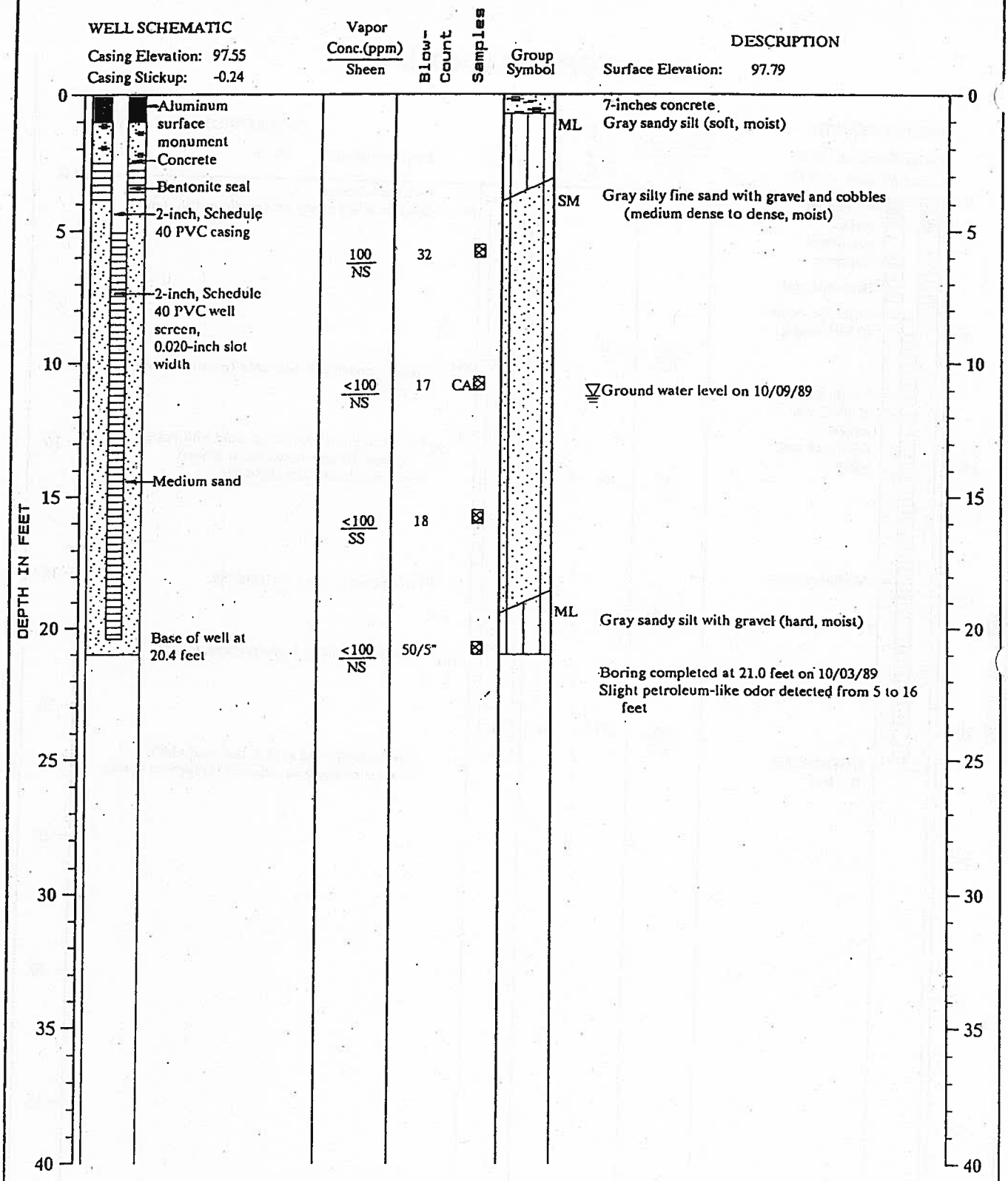
Log of Monitor Well

Figure A-11

MONITOR WELL NO. MW-10



Note: See Figure A-2 for explanation symbols

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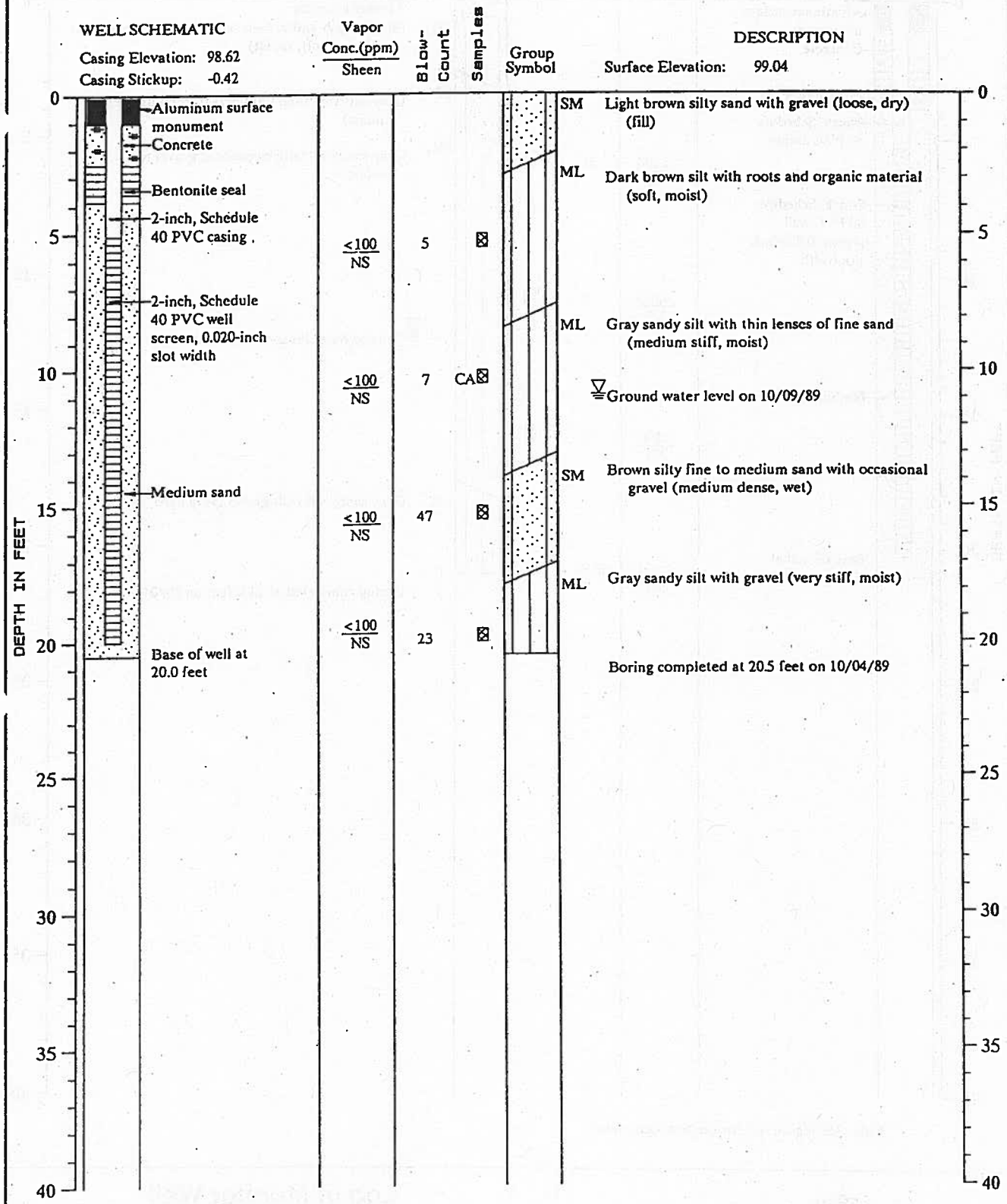
Log of Monitor Well

Figure A-12

MONITOR WELL NO. MW-11



Note: See Figure A-2 for explanation symbols

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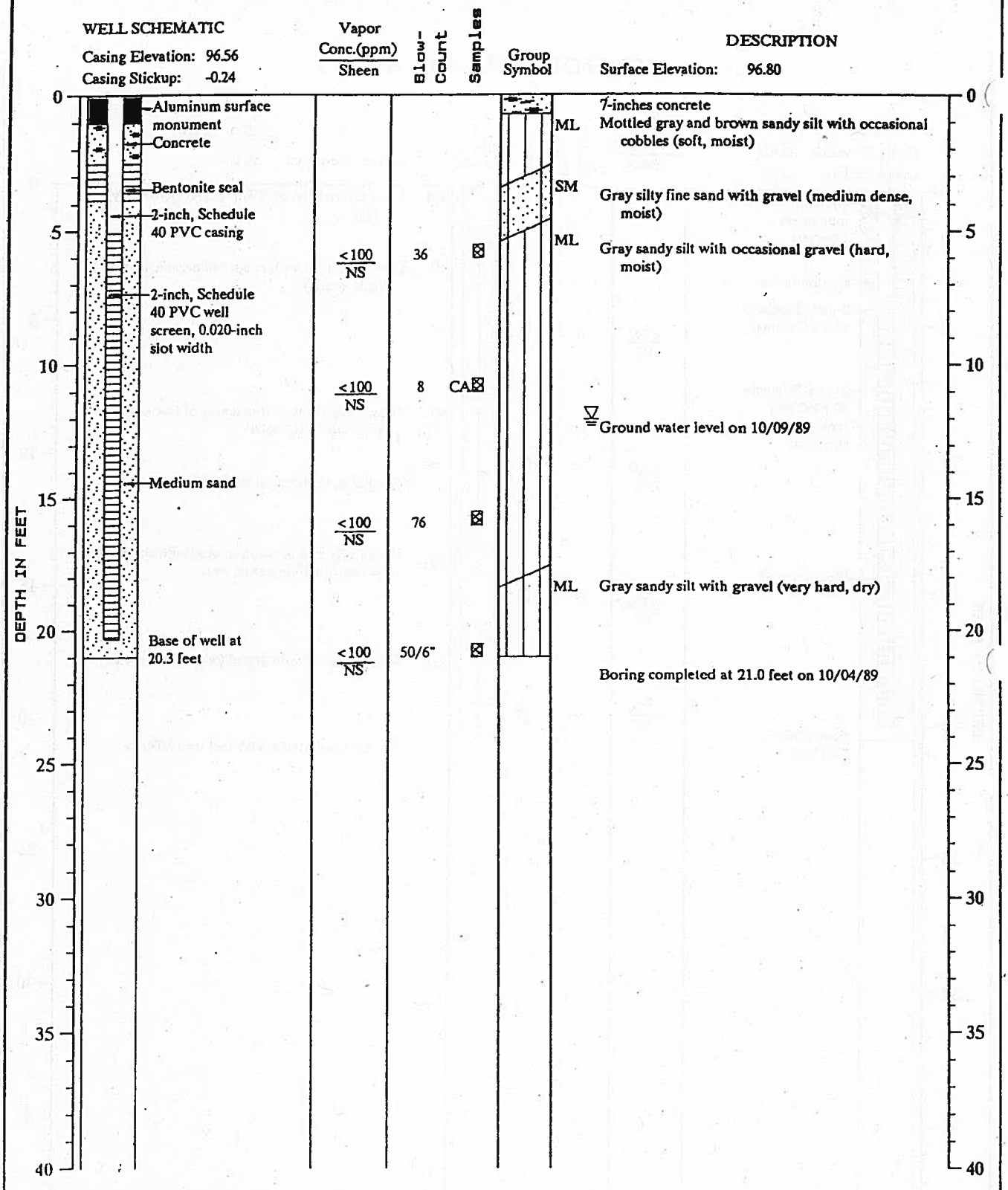
Log of Monitor Well

Figure A-13

MONITOR WELL NO. MW-12



Note: See Figure A-2 for explanation symbols

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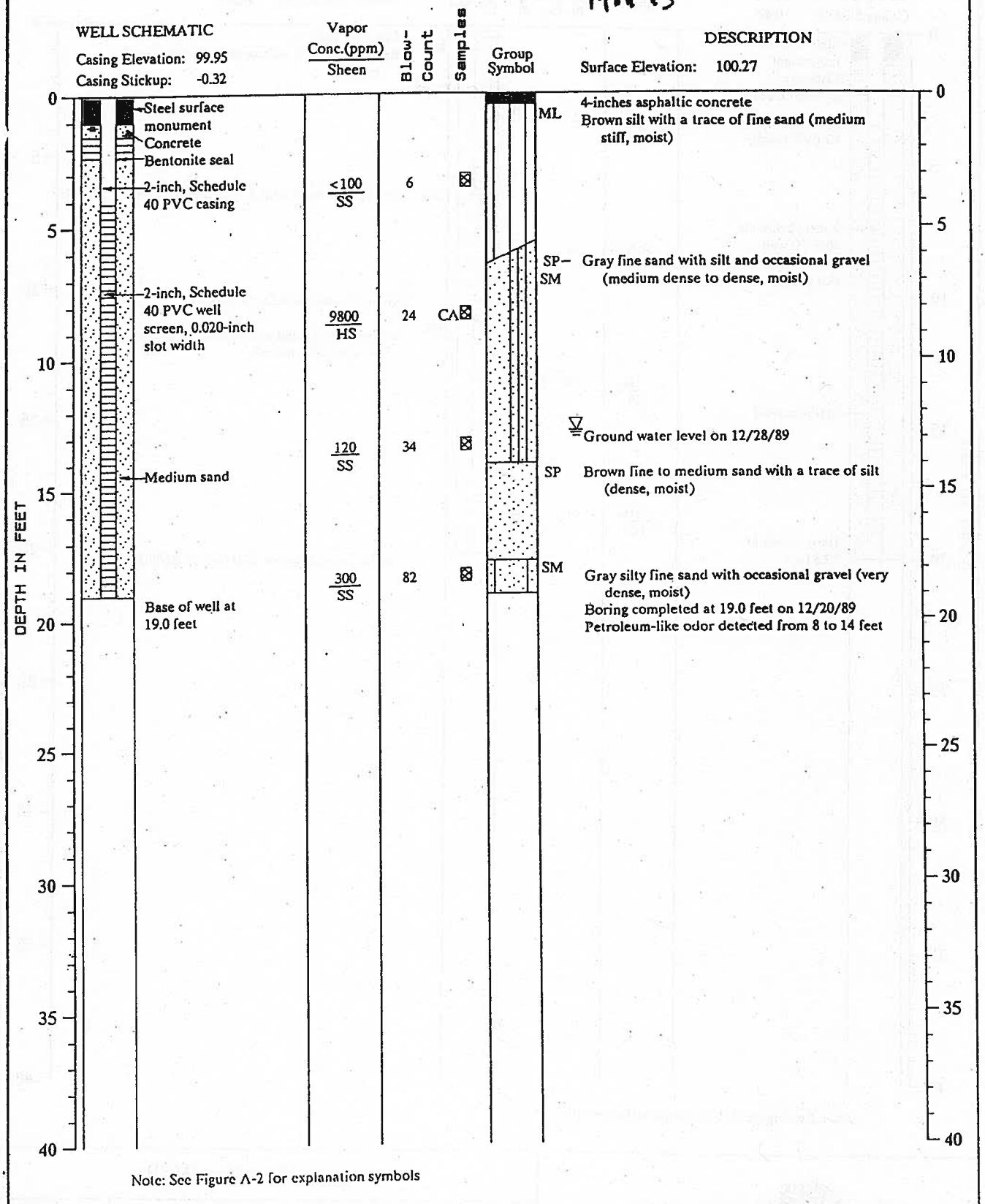
Log of Monitor Well

Figure A-14

MONITOR WELL NO. MW-13



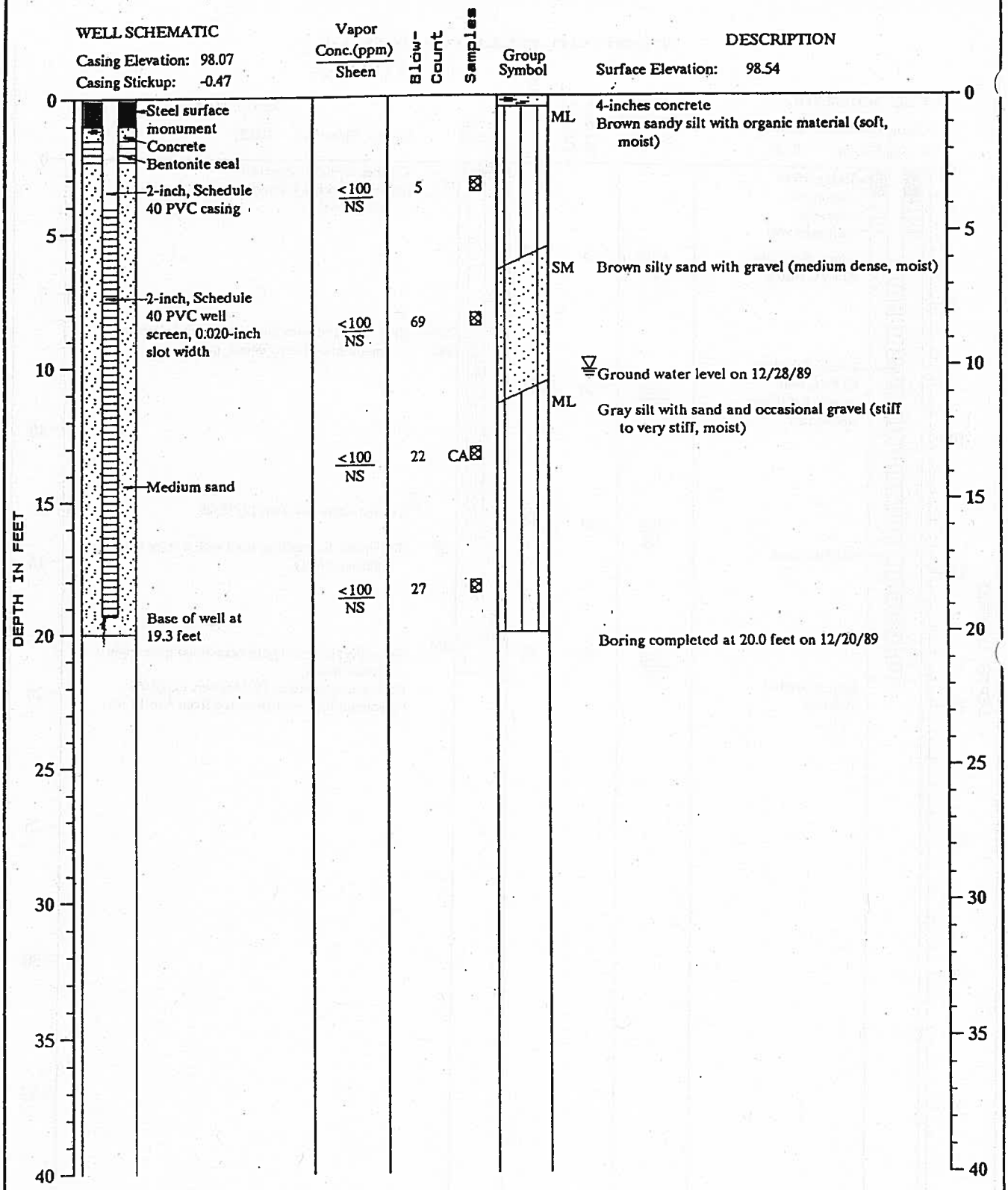
Note: See Figure A-2 for explanation symbols

Geo Engineers

Log of Monitor Well

Figure A-15

MONITOR WELL NO. MW-14



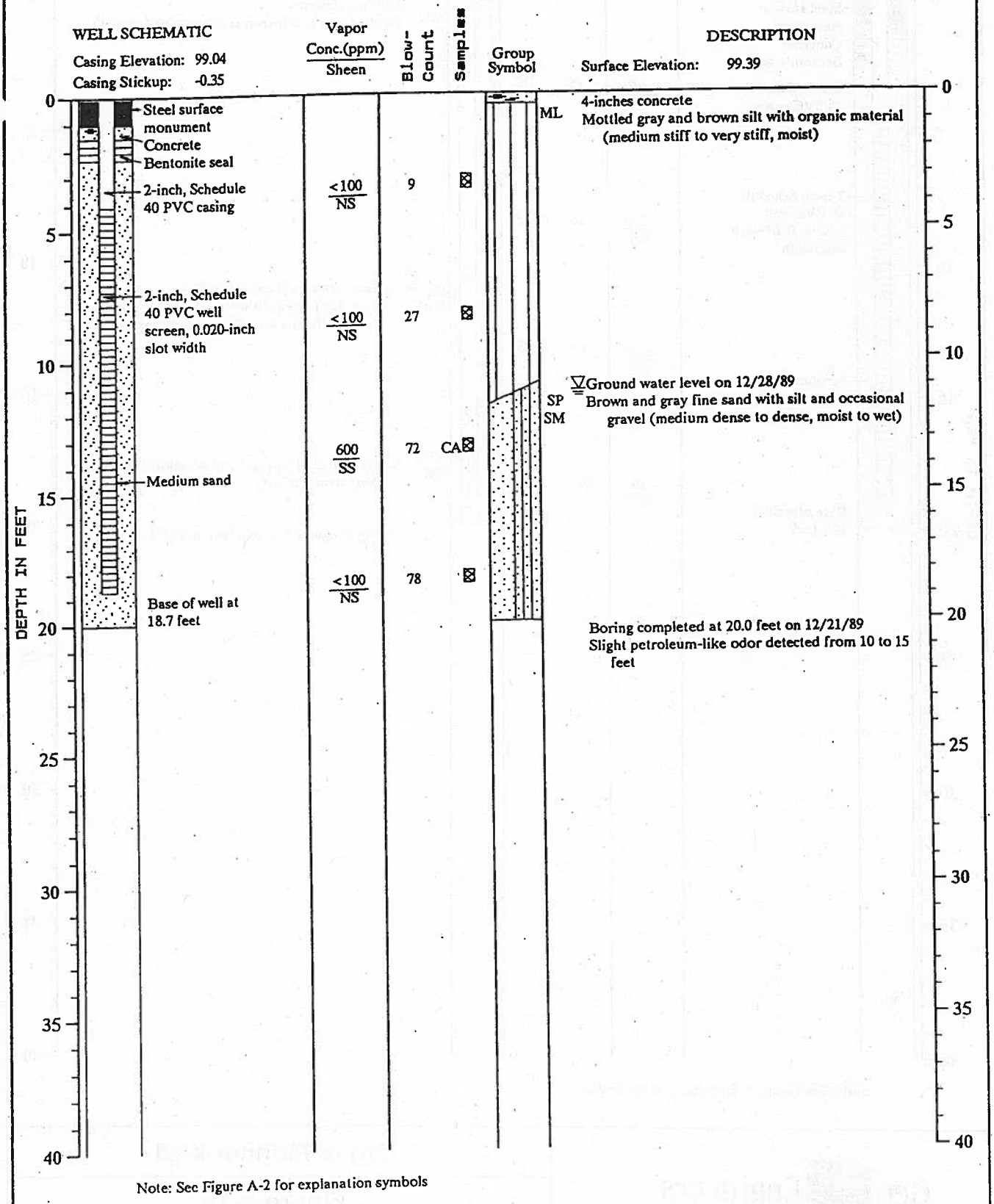
Note: See Figure A-2 for explanation symbols

GeoEngineers

Log of Monitor Well

Figure A-16

MONITOR WELL NO. MW-15



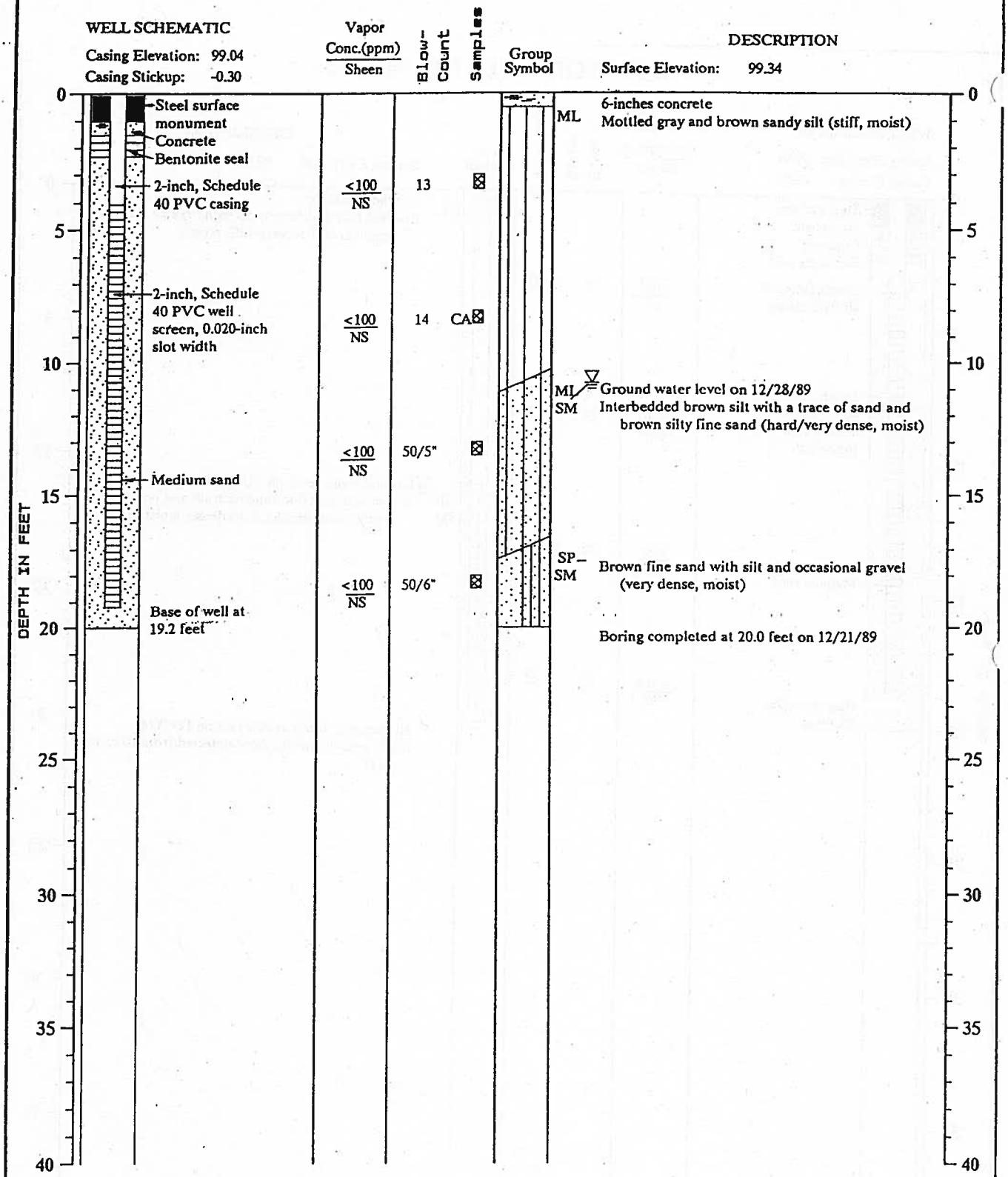
Note: See Figure A-2 for explanation symbols

Geo Engineers

Log of Monitor Well

Figure A-17

MONITOR WELL NO. MW-16



Note: See Figure A-2 for explanation symbols

GeoEngineers

Log of Monitor Well

Figure A-18

TABLE 1 (page 1 of 3)
SUMMARY OF GROUND WATER FIELD DATA
MONTLAKE CIRCLE K
SEATTLE, WASHINGTON

Monitoring Well Number	Date Measured	Casing Rim Elevation [1] (feet)	Depth to Water [2] (feet)	Depth to Product [2] (feet)	Ground Water Elevation [1] (feet)	Corrected Elevation [3] (feet)	Change in Elevation [4] (feet)
MW-1	11-Apr-01	100.94	12.62	--	88.32		--
	16-Jun-03	103.25	12.13	--	91.12		
	11-Jul-03	103.25	12.34	--	90.91		
MW-4	11-Apr-01	98.38	10.23	10.20	88.15	88.18	--
	16-Jun-03	100.73	10.56	10.47	90.17	90.25	
	11-Jul-03	100.73	10.72	10.62	90.01	90.10	
MW-5	11-Apr-01	90.94	9.97	--	80.97		--
	16-Jun-03	93.34	10.95	--	82.39		
	11-Jul-03	93.34	11.31	--	82.03		
MW-6	11-Apr-01	97.92	11.57	--	86.35		--
	16-Jun-03	100.25	11.63	--	88.62		
	11-Jul-03	100.25	11.63	--	88.62		
MW-7	11-Apr-01	97.43	8.15	--	89.28		--
	16-Jun-03	99.75	10.38	--	89.37		
	11-Jul-03	99.75		--	~~99.75~~		
MW-8	11-Apr-01	98.36	10.18	10.17	88.18	88.19	--
	16-Jun-03	100.70	10.68	10.67	90.02	90.03	
	11-Jul-03	100.70	10.87	10.86	89.83	89.84	

TABLE 1 (page 2 of 3)
SUMMARY OF GROUND WATER FIELD DATA
MONTLAKE CIRCLE K
SEATTLE, WASHINGTON

Monitoring Well Number	Date Measured	Casing Rim Elevation [1] (feet)	Depth to Water [2] (feet)	Depth to Product [2] (feet)	Ground Water Elevation [1] (feet)	Corrected Elevation [3] (feet)	Change in Elevation [4] (feet)
MW-9	11-Apr-01	99.03	10.34	10.33	88.69	88.70	--
	16-Jun-03	101.42	10.97	10.95	90.45	90.47	
	11-Jul-03	101.42	11.22	11.21	90.20	90.21	
MW-10	11-Apr-01	97.55	9.66	--	87.89		--
	16-Jun-03	99.96	10.53	--	89.43		
	11-Jul-03	99.96	10.86	--	89.10		
MW-11	11-Apr-01	98.62	2.89 ?	--	95.73		--
	16-Jun-03	100.91	10.07	--	90.84		
	11-Jul-03	100.91	10.80	--	90.11		
MW-12	11-Apr-01	96.56	11.18	--	85.38		--
	16-Jun-03	98.97	11.27	--	87.70		
	11-Jul-03	98.97	11.23	--	87.74		
MW-13	11-Apr-01	99.95	NM	NM	--		--
	11-Jul-03	102.19	11.86	11.84	90.33	90.35	
MW-14	11-Apr-01	98.07	8.46	--	89.61		--
	16-Jun-03	100.45	9.87	--	90.58		
	11-Jul-03	100.41	Dry	--	--		

abandoned

TABLE 1 (page 3 of 3)
SUMMARY OF GROUND WATER FIELD DATA [1]
MONTLAKE CIRCLE K
SEATTLE, WASHINGTON

Monitoring Well Number	Date Measured	Casing Rim Elevation [1] (feet)	Depth to Water [2] (feet)	Depth to Product [2] (feet)	Ground Water Elevation [1] (feet)	Corrected Elevation [3] (feet)	Change in Elevation [4] (feet)
MW-15	11-Apr-01	99.04	9.11	9.10	89.93	89.94	--
	16-Jun-03	101.34	10.69	--	90.65		
	11-Jul-03	101.31	11.11	--	90.20		
MW-16	11-Apr-01	99.04	9.43	--	89.61		--
	16-Jun-03	101.25	10.60	--	90.65		
	11-Jul-03	101.16	10.98	--	90.18		

[1] April 2001 elevations are based on GeoEngineers, Inc. *Progress Report No. 1; Remedial Monitoring Program; Circle K Facility 1461; August 23, 1990*. The June and July 2003 elevations are based on a new survey performed on July 1, 2003 and are relative to a temporary benchmark with an assumed elevation of 100.00 feet, shown in Figure 1.

[2] Depth to water and product below a fixed spot on the well casing rim.

[3] Ground water elevation corrected for the presence of free product, assuming a specific gravity of 0.85 for the product.

[4] Change in ground water elevation since preceeding monitoring event. Positive number indicates rising water level, negative indicates falling water level.

TABLE 2 (page 1 of 3)
SUMMARY OF GROUND WATER SAMPLE ANALYTICAL DATA [1]
MONTLAKE CIRCLE K #1461
SEATTLE, WASHINGTON

Monitoring Well Number [2]	Date	Benzene [3] (µg/L)	DQ	Toluene [3] (µg/L)	DQ	Ethyl-benzene [3] (µg/L)	DQ	Xylenes [3] (µg/L)	DQ	MTBE [3] (µg/L)	DQ	GRO [4] (mg/L)	DQ	Free Product Present?
MW-1	11-Apr-01	0.500	U	0.500	U	0.500	U	1.00	U	--		0.0500	U	No
	16-Jun-03	0.500	U	0.500	U	0.500	U	1.00	U	1.00	U	0.0500	U	No
MW-4	11-Apr-01	7,370		28,000		2,680		17,100		--		117		Yes
	16-Jun-03	--		--		--		--		--		--		Yes
MW-5	11-Apr-01	0.500	U	0.500	U	0.500	U	1.00	U	--		0.0500	U	No
	16-Jun-03	0.500	U	0.500	U	0.500	U	1.00	U	1.00	U	0.0500	U	No
MW-6	11-Apr-01	0.500	U	0.500	U	0.500	U	1.00	U	--		0.0500	U	No
	16-Jun-03	0.500	U	0.500	U	0.500	U	1.00	U	1.00	U	0.0500	U	No
MW-7	11-Apr-01	0.500	U	0.500	U	0.500	U	1.00	U	--		0.0500	U	No
	16-Jun-03	0.500	U	0.500	U	0.500	U	1.00	U	1.00	U	0.0500	U	No
MW-8	11-Apr-01	802		9,770		1,520		7,030		--		46.4		Yes
	16-Jun-03	--		--		--		--		--		--		Yes
MW-9	11-Apr-01	420		2,310		1,500		7,350		--		35.4		Yes
	16-Jun-03	--		--		--		--		--		--		Yes
Cleanup Level [5]		5		1,000		700		1,000		20		0.8/1.0 [6]		

TABLE 1 (page 2 of 3)

SUMMARY OF GROUND WATER SAMPLE ANALYTICAL DATA [1]

MONTLAKE CIRCLE K #1461

SEATTLE, WASHINGTON

Monitoring Well Number [2]	Date	Benzene [3] (µg/L)	DQ	Toluene [3] (µg/L)	DQ	Ethyl-benzene [3] (µg/L)	DQ	Xylenes [3] (µg/L)	DQ	MTBE [3] (µg/L)	DQ	GRO [4] (mg/L)	DQ	Free Product Present
MW-10	11-Apr-01	0.500	U	0.500	U	0.500	U	1.00	U	--		0.0500	U	No
	16-Jun-03	0.500	U	0.500	U	0.500	U	1.00	U	1.00	U	0.0500	U	No
MW-11	11-Apr-01	0.500	U	0.500	U	0.500	U	1.00	U	--		0.0500	U	No
	16-Jun-03	0.500	U	0.500	U	0.500	U	1.00	U	1.00	U	0.0500	U	No
MW-12	11-Apr-01	0.500	U	0.500	U	0.500	U	1.00	U	--		0.0500	U	No
	16-Jun-03	0.500	U	0.500	U	0.500	U	1.00	U	1.00	U	0.0500	U	No
MW-13	11-Apr-01	--		--		--		--		--		--		
	16-Jun-03	--		--		--		--		--		--		
MW-14	11-Apr-01	0.500	U	0.500	U	0.500	U	1.00	U	--		0.0500	U	No
(Assoc. w/ MW-15)	16-Jun-03	0.500	U	0.500	U	0.500	U	1.00	U	--		0.0500	U	No
MW-15	11-Apr-01	58.4		310		526		2,920		--		22.8		No
	16-Jun-03	6.22		83.3		12.6		199		15.5		3.15		No
MW-16	11-Apr-01	0.500	U	0.500	U	0.500	U	1.00	U	--		0.0500	U	No
	16-Jun-03	0.500	U	0.500	U	0.500	U	1.00	U	1.00	U	0.0500	U	No
Cleanup Level [5]		5		1,000		700		1,000		20		0.8/1.0	[6]	

TABLE 2 (page 3 of 3)
SUMMARY OF GROUND WATER SAMPLE ANALYTICAL DATA [1]
MONTLAKE CIRCLE K #1461
SEATTLE, WASHINGTON

Notes:

[1] Samples analyzed by North Creek Analytical, Inc. of Bothell, Washington.

[2] Well locations are shown on Figure 2.

[3] By EPA Method 8021B.

[4] Gasoline-range organics by Ecology Method NWTPH-G.

[5] MTCA Method A Ground Water Cleanup Level.

[6] The cleanup level for gasolinerange organics is 0.8 mg/L when benzene is present, and 1.0 mg/L when benzene is not present.

µg/L = micrograms per liter

mg/L = milligrams per liter

"--" = not tested

DQ = data qualifier

U = not detected at or above the specified concentration

J = estimated concentration outside instrument calibration range

Stippled concentrations exceed the MTCA Method A ground water cleanup levels.

TABLE 4
THICKNESS OF FREE PRODUCT IN GROUND WATER MONITOR WELLS, SEPTEMBER 1989 THROUGH DECEMBER 1989

Monitor Well Number	THICKNESS OF FREE PRODUCT (Feet)											
	09/13/89	09/19/89	09/22/89	10/05/89	10/09/89	11/06/89	12/06/89	12/08/89	12/11/89	12/13/89	12/18/89	12/28/89
MW-2	0.10	1.15	1.60	NM	2.11	---	---	---	---	---	---	---
MW-3	0.32	2.08	2.81	NM	4.43	---	---	---	---	---	---	---
MW-4	0.80	5.34	6.28	NM	5.90	1.73	3.35	5.30	1.80	1.75	0.50	0.55
MW-8	---	---	---	0.19	0.11	NM	NM	9.50	9.20	6.10	2.33	0.37
MW-9	---	---	---	2.98	4.63	2.73	NM	0.50	0.61	0.65	0.30	0.27
R-WELL	---	---	---	---	---	0.10	0.02	0.08	0.15	0.10	NM	0.06

Notes:
"NM" = Not measured
"---" = Monitor well not yet constructed, or destroyed during remediation activities.
R-WELL = Ground water recovery well; depression pump was activated after measuring the thickness of free product on 12-06-89.

ECOVAC SERVICES

The World Leader in Mobile Dual-Phase/Multi-Phase Extraction

June 13, 2005

Ms. Cathy Böhlke
EA Engineering, Science, and Technology, Inc.
12011 Bellevue-Redmond Road, Suite 200
Bellevue, Washington 98005
cbohlke@eaest.com

Subject: **Enhanced Fluid Recovery (EFR®) Results**
Event No. 1
Former Circle K (Jay's Cleaners)
2350 24th Avenue E
Seattle, Washington

Dear Ms. Böhlke:

Please find attached the data summary for the initial EFR® event conducted at the subject site on June 9, 2005. The following summarizes the results of this EFR® event.

SUMMARY OF RESULTS

Separate phase hydrocarbons (SPH) were detected in four monitor wells prior to conducting this EFR® event (MW-4 – 0.42 feet, MW-8 – sheen, MW-9 and MW-13 – 0.01 feet). This EFR® event was performed for a duration of eight hours at four extraction points, consisting of monitor wells MW-4, MW-8, MW-9, and MW-13. Extraction was performed at MW-4, MW-8, and MW-9 during the initial 15 minutes of the event and MW-4, MW-8, MW-9, and MW-13 during the ensuing 2.75 hours. An individual well removal rate test was conducted at 15 minute intervals for each extraction well during the fourth hour of the event. The final three hours of the event were conducted at MW-4, MW-8, and MW-9. A calculated total of 112 pounds of petroleum hydrocarbons (approximately 18 equivalent gallons of gasoline) was removed during this EFR® event.

Vapor-phase hydrocarbon removal rates ranged from 1.9 to 38 pounds per hour. Removal rates changed throughout the event depending on the extraction array utilized, as shown below in order from highest to lowest removal rates:

Extraction Well Array	Removal Rates
MW-4,8,9	8.8 to 38 pounds per hour
MW-4,8,9,13	15 to 35 pounds per hour
MW-9	5.7 pounds per hour
Extraction Well Array	Removal Rates

MW-4	5.0 pounds per hour
MW-8	4.5 pounds per hour
MW-13	1.9 pounds per hour

Offgas concentrations during this event ranged from 5,400 to 50,000 parts per million (ppm). Air flow rates to the atmosphere ranged from 29 to 118 cubic feet per minute (CFM). The range of vacuum readings recorded at the extraction wells during this EFR® event are detailed in the EFR® Field Data Sheet and summarized below:

Extraction Well Location	Vacuum Readings
MW-4	15 to 19 inches of mercury
MW-8	13 to 16 inches of mercury
MW-9	13 to 16 inches of mercury
MW-13	14 to 17 inches of mercury

Differential pressures were recorded at adjacent monitor wells to assess the vacuum influence induced by EFR® in the vadose zone. The differential pressure data are detailed in the attached table and summarized below:

Monitor Well	Maximum Vacuum	Nearest Extraction Well (Approx. Distance)
MW-16	-0.07 inches of water	MW-9 (19 feet)
MW-6	-0.03 inches of water	MW-4 (22 feet)
MW-15	0.00 inches of water	MW-9 (25 feet)
MW-14	0.00 inches of water	MW-8 (27 feet)
MW-10	0.00 inches of water	MW-4 (43 feet)
MW-7	-0.06 inches of water	MW-4 (48 feet)

Groundwater levels were also recorded during the event to determine drawdown of the aquifer. The groundwater drawdown data are detailed in the attached data table and summarized below:

Monitor Well	Maximum Vacuum	Nearest Extraction Well (Approx. Distance)
MW-16	-2.75 feet	MW-9 (19 feet)
MW-6	-0.08 feet	MW-4 (22 feet)
MW-15	-1.66 feet	MW-9 (25 feet)
MW-14	-0.43 feet	MW-8 (27 feet)
MW-10	-0.09 feet	MW-4 (43 feet)
MW-7	-0.09 feet	MW-4 (48 feet)

Approximately 1,597 gallons of liquid were recovered during this EFR® event and transported to Emerald Services' treatment facility (Seattle, WA) for disposal. SPH was not detected in the vacuum truck tank prior to offloading of the liquids.

Thank you for this opportunity to team with EA Engineering in serving the environmental needs of your clients. We look forward to working with you again in the future to provide innovative and cost effective environmental solutions at this and other sites.

Sincerely,

EcoVac Services

Mark Patterson

EFR® FIELD DATA SHEET

Client: EA Engineering	Facility Name: Former Circle K (Jay's Cleaners)	Event #: 1
Facility Address: 2350 24th Avenue E - Seattle, WA	Technician: M. Patterson	Date: 6/9/05

Extraction Well(s)	Time hh:mm	Extraction Well-head Vacuum (in. Hg)									Vacuum Truck Exhaust				
		Inlet	MW-4	MW-8	MW-9	MW-13					Concentration PPM	Offgas Velocity FT/MIN	Flow Rate CFM	Removal Rate LBS/HR	Interval Removal LBS
Start Time:	7:15														
MW-4,8,9	7:30	22	17	15	15	-					50,000	1,300	64	38	9.5
MW-4,8,9,13	7:45	21	16	15	15	16					38,000	1,600	78	35	8.8
"	8:15	21	16	15	15	16					26,000	1,650	81	25	12
"	8:45	21	16	14	14	15					20,000	1,750	86	20	10
"	9:15	20	15	13	13	14					16,000	2,000	98	19	9.3
"	9:45	20	15	13	13	14					13,000	2,200	108	17	8.3
"	10:15	20	15	13	13	14					11,000	2,400	118	15	7.7
MW-4	10:30	24	19	-	-	-					8,600	1,000	49	5.0	1.3
MW-8	10:45	22	-	16	-	-					11,000	700	34	4.5	1.1
MW-13	11:00	24	-	-	-	17					5,400	600	29	1.9	0.5
MW-9	11:15	22	-	-	16	-					14,000	700	34	5.7	1.4
MW-4,8,9	11:45	21	16	15	15	-					10,000	2,100	103	12	6.1
"	12:15	21	16	15	15	-					9,400	2,200	108	12	6.0
"	13:15	21	16	15	15	-					8,600	2,100	103	11	11
"	14:15	21	16	15	15	-					8,000	2,100	103	10	10
"	15:15	21	16	15	15	-					7,200	2,100	103	8.8	8.8

Well Gauging Data:			Before EFR® Event			After EFR® Event			Corr. DTW
Well No.	Diam.	TD (ft)	DTS (ft)	DTW (ft)	SPH (ft)	DTS (ft)	DTW (ft)	SPH (ft)	Change (ft)
MW-4	2"	17.90	9.87	10.29	0.42	-	17.42	0.00	-7.45
MW-6	2"		-	11.54	0.00	-	11.62	0.00	-0.08
MW-7	2"		-	8.76	0.00	-	8.85	0.00	-0.09
MW-8	2"	19.60	-	10.18	sheen	-	16.80	0.00	-6.62
MW-9	2"	20.35	10.30	10.31	0.01	-	15.89	0.00	-5.59
MW-10	2"		-	9.90	0.00	-	9.99	0.00	-0.09
MW-13	2"	18.90	11.07	11.08	0.01	-	17.05	0.00	-5.98
MW-14	2"	*note	-	9.08	0.00	-	9.51	0.00	-0.43
MW-15	2"		-	9.77	0.00	-	11.43	0.00	-1.66
MW-16	2"		-	9.76	0.00	-	12.51	0.00	-2.75

Vacuum Truck Information	
Subcontractor:	Emerald
Truck Operator:	D. Knechtel
Truck No.:	737
Vacuum Pumps:	Fruitland
Pump Type:	RCF500
Tank Capacity (gal.):	3,000
Stack I.D. (inches)	3.0

Well ID	Breather Port	Stinger Depth
MW-4	0(closed)	15 to 17.5 ft**
MW-8	0(closed)	15 to 17.5 ft**
MW-9	0(closed)	15 to 17 ft**
MW-13	0(closed)	14.5 to 17.5 ft**

Recovery/Disposal Information		
Hydrocarbons Removed (vapor):	112	pounds
Hydrocarbons Removed (liquid):	0	gallons
Total Hydrocarbons Removed:	18	equiv. gal.
Molecular Weight Utilized:	75	g/mole
Disposal Facility:	Emerald Services	
Bill of Lading #:	28797	
Total Liquids Removed:	1,597	gallons

ECOVAC SERVICES
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888-4ECOVAC

Time:	7:15 to 15:15
# Pumps:	1
RPMs:	900
Time:	
# Pumps:	
RPMs:	

* Silt and mud was evacuated from MW-14 upon completion of the event, extending the total depth from approx. 15.5 to 19 feet below TOC

** Stinger depths were increased at 10:30 due to decreasing liquid production and corresponding increase in air flow and decrease in wellhead vacuums

Differential Pressure and Groundwater Drawdown Data Recorded During EFR®
Event #: 1 Date: 6/9/05
Facility Name: Former Circle K (Jay's Cleaners)
Facility Address: 2350 24th Avenue E - Seattle, WA

DIFFERENTIAL PRESSURE DATA

		Well Designation:					
		MW-16	MW-6	MW-15	MW-14	MW-10	MW-7
Nearest Extraction Well:		MW-9	MW-4	MW-9	MW-8	MW-4	MW-4
Approximate Distance:		19 feet	22 feet	25 feet	27 feet	43 feet	48 feet
Time	Elapsed Time	Differential Pressure Readings (inches of water):					
7:45	0.5 hr.	-0.07	0.00	0.00	0.00	0.00	0.00
8:15	1 hr.	-0.05	-0.02	0.00	0.00	0.00	-0.06
9:15	2 hrs.	-0.02	-0.03	0.00	0.00	0.00	-0.02
10:15	3 hrs.	-0.02	-0.02	0.00	0.00	0.00	-0.02
13:15	6 hrs.	-0.03	-0.02	0.00	0.00	0.00	-0.03
Maximum Change:		-0.07	-0.03	0.00	0.00	0.00	-0.06

GROUNDWATER DRAWDOWN DATA

		Well Designation:					
		MW-16	MW-6	MW-15	MW-14	MW-10	MW-7
Nearest Extraction Well:		MW-9	MW-4	MW-9	MW-8	MW-4	MW-4
Approximate Distance:		19 feet	22 feet	25 feet	27 feet	43 feet	48 feet
Time	Elapsed Time	Depth to Liquid (feet below top of casing):					
Prior to EFR®		9.76	11.54	9.77	9.08	9.90	8.76
10:15	3 hrs.	12.10	11.59	10.89	9.32	9.93	8.78
13:15	6 hrs.	12.41	11.60	11.17	9.43	9.96	8.82
15:15	8 hrs.	12.51	11.62	11.43	9.51	9.99	8.85
Maximum Change:		-2.75	-0.08	-1.66	-0.43	-0.09	-0.09

Emerald SERVICES INC.

7343 EAST MARGINAL WAY SOUTH
SEATTLE, WASHINGTON 98108
(206) 832-3000
FAX: (206) 832-3030
24 HOUR EMERGENCY PHONE: 1-800-424-9300

28797

BILL OF LADING AND GALLONAGE TICKET

SHIPPER/GENERATOR ECOVAC	CONTACT	JOB # 36/57789
ADDRESS 2350 24th AVE EAST	PHONE#	LOAD #
CITY, STATE, ZIP SEATTLE WA		DATE 06-09-05
CARRIER ESI	PHONE#	DOCUMENT #
CONSIGNEE ESFS	CONTACT	TRUCK # 797
ADDRESS 1500 AIRPORT WAY S	PHONE#	PRODUCT TYPE L
CITY, STATE, ZIP SEATTLE WA		EST. GALLONS

HM	ITEM #	U.S. DOT DESCRIPTION	#	TYPE	QTY.
	A	Non Regulated Material		TT	4200
	B				1597
	C				
	D				

A. WPO #: ______ DISP. CODE: 400 591
B. WPO #: ______ DISP. CODE: ______
C. WPO #: ______ DISP. CODE: ______
D. WPO #: ______ DISP. CODE: ______

DISPOSAL

DUMP DELAY TIME ______

WASH OUT: YES ( ) NO ( )

TIME IN ______ TIME OUT ______

E. WATER ______ GALLONS LOCATION ______ TEST ______ DISP. CODE ______

F. SOLIDS ______ GALLONS LOCATION ______ TEST ______ DISP. CODE ______

______ % SUSPENDED SOLIDS BY CENTRIFUGE ______ GALS SEDIMENT ______

G. OIL/DIESEL/GAS ______ GALLONS LOCATION ______ TEST ______ DISP. CODE ______

HOC'S ______ PCB'S ______ B.S.&W. ______ API ______ LAB: Y / N

Shipper's Certification: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labeled, and are in all respects in proper condition for transport by highway, vessel and rail according to applicable international and national government regulations and this material is not regulated as a hazardous waste in accordance with WAC 173-303, 40 CFR. Part 261 or 40 CFR Part 761.

X D. KNECHTEL X [signature] DATE: 06-09-05
SHIPPER (PRINT NAME) SIGNATURE

X Mark McGrison X [signature] DATE: 6-9-05
CARRIER - DRIVER 1 (PRINT NAME) SIGNATURE

X ______ X ______ DATE: ______
CARRIER - DRIVER 2 (PRINT NAME) SIGNATURE

X ______ X ______ DATE: ______
CONSIGNEE (PRINT NAME) SIGNATURE