Union 76 Division: Western Region

Union Oil Company of California
2901 Western Avenue, Seattle, Washington 98121
Telephone: (206) 223-7600

UNION 76

July 17, 1986

State of Washington
Department of Ecology
4350-150th Ave. N.E.
Redmond, Washington 98052

Mr. John H. Glynn:

Attached find a copy of Geoengineers Incorporated's geotechnical report on the subsurface contamination study at Unocal's service station located at 247 D Street, Blaine, Washington.

Geoengineer's report comprehensively analyzes the incident. Subsurface soil and ground water conditions were examined. Contamination monitoring and evaluation has been detailed. Tank and line testing has been discussed. And the tank removal operations are explained.

Although the investigation detected hydrocarbon contamination, soil conditions prevented rapid migration of the product. Minor amounts of free floating product found on top of the tanks was removed and disposed of properly. The low levels of soil and ground water contamination surrounding the tank area were determined to pose no threat to any drinking aquifer and were therefore undisturbed. Over time natural processes will dissipate any residual contamination.

Geoengineers concluded that the City of Blaine's gasoline problem in their sewer system was not a result of underground leaks at Unocal's service station. Even though hydrostatic testing of the tanks and lines were unconclusive in identifying leaks, the tanks were replaced as a precaution.

Based on the data and conclusions of Geoengineer's investigation, Unocal is requesting that the State of Washington's Department of Ecology consider this incident concluded and closed.

Yours truly,

Alan Hawickhorst

Alan Hawickhorst
Construction Engineer

AH:dc
Attachment

REPORT OF GEOTECHNICAL SERVICES
SUBSURFACE CONTAMINATION STUDY
UNOCAL SERVICE STATION 5028
BLAINE, WASHINGTON
FOR
UNOCAL

July 1986

GeoEngineers
Incorporated

GeoEngineers
Incorporated

(206) 746-5200
2405 - 140th Ave. N.E.
Bellevue, WA 98005

Consulting Geotechnical
Engineers and Geologists

July 7, 1986

Unocal
2901 Western Avenue
Seattle, Washington 98121

Attention: Mr. Alan Hawickhorst

Gentlemen:

We are submitting four copies of our subsurface contamination study at the site of Unocal Service Station 5028 in Blaine, Washington. Our services were authorized verbally by Mr. Hawickhorst on May 20, 1986. Contractual terms for our services are described in the blanket contract recently negotiated between GeoEngineers, Inc. and Unocal.

We appreciate the opportunity to be of continued service to Unocal. Please call if you have any questions regarding this report.

Yours very truly,

GeoEngineers, Inc.

James A. Miller

James A. Miller
Associate

SEW:JAM:wd

File No. 161-26

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REPORT OF GEOTECHNICAL SERVICES
SUBSURFACE CONTAMINATION STUDY
UNOCAL SERVICE STATION 5028
BLAINE, WASHINGTON

INTRODUCTION

The results of our subsurface contamination study of Service Station 5028 are presented in this report. The station is currently active and is located along the Interstate 5 corridor, east of Exit 276 and south of "D" Street. The site location is shown relative to surrounding physical features in Figure 1. A generalized site plan of the facility is shown in Figure 2.

This study was initiated by Unocal over concern of a reported discharge of gasoline into Blaine's storm and sanitary sewers. The gasoline was first noted in the Blaine sewage treatment plant on May 19, 1986. Flammable gas readings in storm and sanitary sewers traced the source of the gasoline to the vicinity of Service Station 5028. The visible presence of floating gasoline in the turbine pump vaults at the service station suggested to local officials that Service Station 5028 was the likely source of gasoline in the sewers.

The purpose of our services is to explore and evaluate subsurface contamination at the site and coordinate cleanup response activities.

The scope of services completed for this study is listed below.

1. Drilling six exploration borings at the site.
2. Obtaining soil samples from each boring at 5-foot intervals.
3. Installing monitor well casings with flush-grade surface monuments in each boring.
4. Developing the well screens for Borings B-1 through B-3 by hand bailing with a stainless steel bailer.
5. Determining the monitor well casing elevations to an accuracy of 0.01 feet using our engineer's level and an assumed site datum.
6. Measuring the air space in each well casing for flammable gases using an explosimeter.
7. Measuring water table elevations for all of the wells and sampling each well for the presence of free (floating) hydrocarbons.

8. Obtaining ground water samples from the wells for laboratory analysis.
9. Testing one soil sample from each boring plus the six ground water samples for the presence of petroleum hydrocarbons.
10. Monitoring the installation of two new fiberglass tanks.
11. Coordinating site cleanup activities during tank replacement operations.
12. Reviewing the field and laboratory data as a basis for evaluating whether underground fuel leaks at the site may have resulted in the reported gasoline problems in Blaine's storm and sanitary sewers.

SITE CONDITIONS

GENERAL

Service Station 5028 is situated in a relatively low density commercial district east of downtown Blaine. An undeveloped building lot is present east of the site. The topography of the area slopes westerly toward Drayton Harbor and the altitude of the site is apparently 50 feet above sea level.

The entire service station site is paved with asphaltic concrete, with the exception of concrete pavement around the two fuel islands. Two underground gasoline storage tanks are located west of the service station building. Underground heating and waste oil tanks are located south of the service station building, as indicated in Figure 2.

SUBSURFACE SOIL CONDITIONS

Subsurface soil conditions beneath the service station site were explored by drilling six test borings at the locations indicated in Figure 2. Details of the field exploration program are presented in Appendix A.

The borings encountered silt beneath the surficial fill that supports the pavement. Approximately the upper 5 feet of silt consists of locally derived fill. Native clayey silt soils underlie the silt fill. Both the silt fill and native silt have a relatively low permeability. Detailed descriptions of the soils are given in the monitor well logs in Appendix A, Figures A-3 through A-9.

GROUND WATER CONDITIONS

Ground water conditions at the site were explored by installing a permanent monitor well in each boring. Construction details for the wells are included in Appendix A. We determined the water table depth and elevation in each boring on May 30, 1986, two to three days after the wells were installed.

The water table at the site ranged from 1 to 3 feet below pavement grades at the time of our field measurements. The tops of the underground gasoline storage tanks were found to be approximately 3 feet below the water table.

Water table elevations on May 30 are indicated in Figure 2. The water table elevation data were used to construct contours of the water table surface (contours also shown in Figure 2). Based on the water table contours, the flow direction for shallow ground water at the site is westward, toward Interstate 5 and Drayton Harbor. The slope of the water table across the site is relatively flat, indicating slow movement of ground water.

SUBSURFACE CONTAMINATION

Subsurface contamination at the site due to past leaks or spills of fuel products was evaluated by:

1. Observing soil and ground water conditions during tank inspection and removal operations.
2. Physical examination of soil samples and noting the presence of petroleum odor in the samples.
3. Measuring the air space in the monitor well casings for flammable vapors.
4. Sampling the water table interface in each well for the presence of free (floating) hydrocarbons.
5. Testing soil and ground water samples from each boring for petroleum hydrocarbons.

The subsurface contamination data at the boring sites are summarized in Table 1. Laboratory reports for soil and water samples are included in Appendix B.

Free (floating) hydrocarbons were not found in the monitor wells. However, free hydrocarbons were observed in the turbine pump vaults on May 21, prior to removal of the underground tanks. We understand that Petroleum Equipment Service (PES) of Burlington, Washington removed approximately 15 to 20 gallons of gasoline from the water table in the pump vaults between May 20 and 21.

Flammable vapors were detected in high concentrations in Wells B-1 through B-4, which are in the general vicinity of the underground fuel tanks. Flammable vapors were not detected in Wells B-5 or B-6.

No gasoline or diesel was detected in any of the soil samples that were analyzed, even for the borings located in immediate proximity to the underground fuel tanks. However, relatively high concentrations of volatile aromatic hydrocarbons were measured in ground water samples obtained from Wells B-1 through B-4. The soil samples that were analyzed were obtained from depths of 2.5 to 3.5 feet. The low concentration of fuel in the soil probably reflects the high water table at the site. This high ground water level prevents any floating product from extending below the water table zone.

TANK AND LINE TESTING

Petroleum Equipment Service (PES) conducted petro-tite tests on the service lines and the unleaded gasoline tank on May 21 and May 27, respectively. We understand that no leaks were detected in the service lines. The test on the unleaded tank resulted in erratic readings and was inconclusive.

Based on the erratic results of the tank test and vapor reports in nearby storm and sanitary sewers, Unocal elected to install new fiberglass tanks, tank fittings and submerged turbine pumps as a precaution.

TANK REMOVAL OPERATIONS

The underground fuel tanks at Service Station 5028 were removed and replaced with fiberglass tanks on June 2 and 3, 1986. We examined the two steel tanks after they were removed from the excavation. Although no obvious leaks were observed, we noted numerous "buttons" of corroded steel, particularly on the former unleaded tank. These corrosion buttons could be chipped off the tank walls easily. In one case a hole in the tank wall

was exposed beneath a button. Corrosion damage to the unleaded tank appeared to be more severe than that which was visible on the regular gasoline tank.

Crowley Environmental Services Corporation (CES) was on site to remove water and gasoline from the tank excavation during the tank replacement program. CES used a vacuum truck to remove approximately 2000 gallons of water and a trace of gasoline from the tank excavation. Representatives from the Blaine Fire and Police Departments and the Washington Department of Ecology visited the site during the tank replacement program.

The tank removal operations resulted in destruction of Wells B-1, B-2 and B-4.

DISCUSSION AND CONCLUSIONS

The results of our site explorations, observations and testing clearly indicate the presence of gasoline contamination in the vicinity of the underground fuel tank area. However, only a minor amount of gasoline was found in the tank area, and most of this was recovered prior to replacement of the tanks. The gasoline problems at Blaine's sewage treatment plant suggested a sudden influx of several hundred gallons of gasoline. Conditions at Service Station 5028 do not suggest a mechanism for sudden release of this quantity of product via subsurface leaks or spills.

In our opinion, the gasoline observed in the tank area could have originated from accidental spills during tank filling operations or from leaks in the tank walls, tank fittings or turbine pumps. High water table conditions at this site (water levels above the top of the tanks) would preclude rapid leakage of gasoline from the tanks. The low permeability of the native soils and silt fill at the site would prevent rapid or sudden migration or product through the soil. We found no direct connection of utility trenches that access the underground fuel tank area with utility trenches that contain storm drains or sanitary sewers.

Based on our site explorations and evaluations, it is our opinion that the gasoline problems reported in mid-May for Blaine's storm drains, sewers and sewage treatment plant were not a result of underground leaks at Service Station 5028. However, the underground fuel tanks at this site were moderately to severely damaged by corrosion, and tank replacement was warranted by the condition of the tanks.

LIMITATIONS

We have prepared this report for use by Unocal in their evaluation of a potential subsurface gasoline leak. This report may be made available to local officials from the City of Blaine and the representatives of the Washington Department of Ecology. The report is not intended for use by others and the information contained herein may not be applicable to other sites.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No other conditions, express or implied, should be understood.

Please call if you have questions concerning our report.

Respectfully, submitted,

GeoEngineers, Inc.

Scott E. Widness/by JAM

Scott E. Widness
Staff Hydrogeologist

James A. Miller

James A. Miller
Associate

SEW:JAM:el

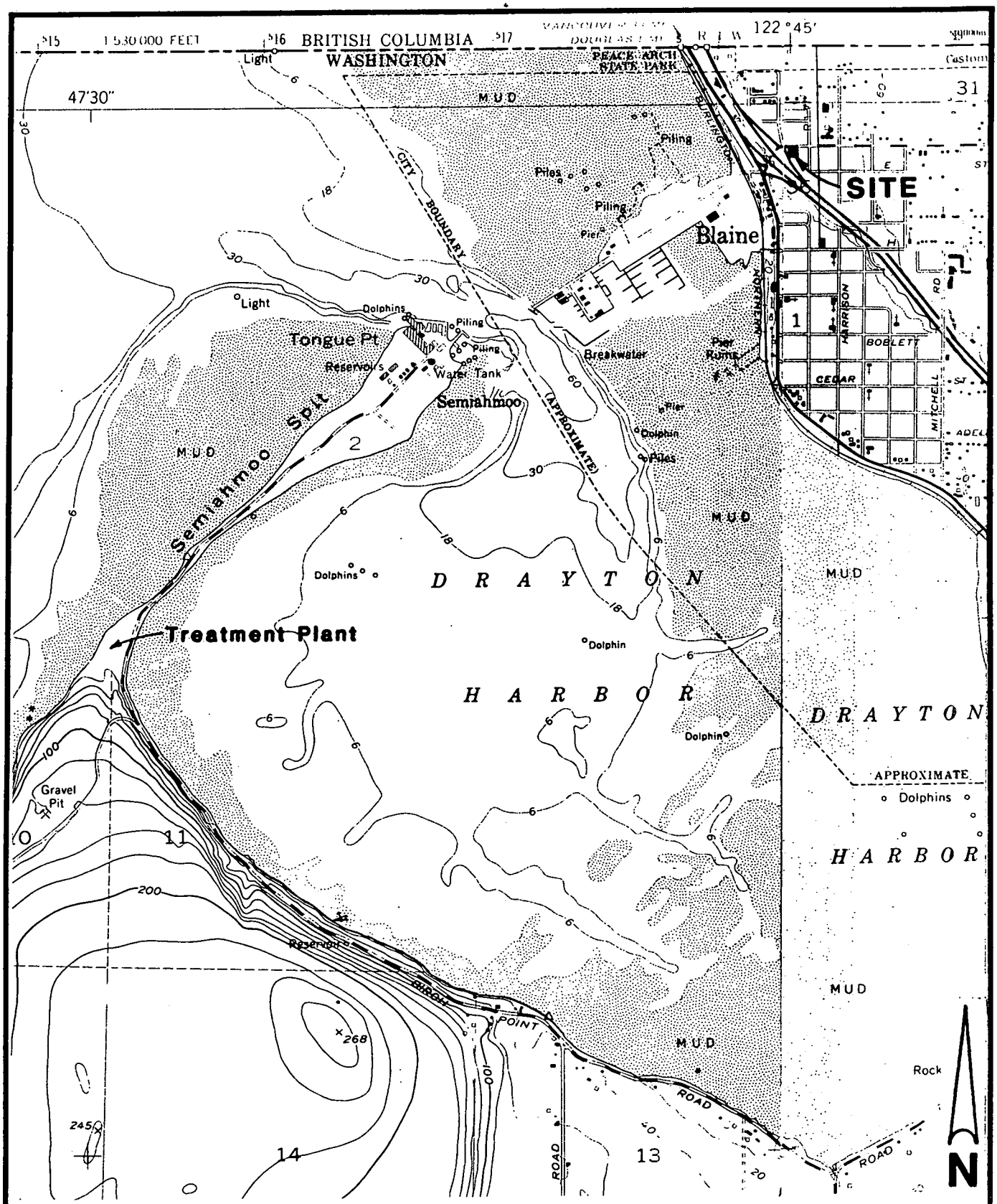
TABLE 1

SUMMARY OF SUBSURFACE CONTAMINATION DATA

Boring No.	Soil Odor During Drilling[1]	Explosimeter Data (Percent L.E.L.)[2]	Water Table Conditions[2]	Total Petroleum Hydrocarbons in Soil (PPM)[3]	Summation of Volatile Aromatic Hydrocarbons in Ground Water (PPM)[3]
B-1	Slight	5	No Sheen	<1	18.4
B-2	Strong	100	No Sheen	<1	62.7
B-3	Slight	40	No Sheen	<1	16.0
B-4	Slight	7	No Sheen	<1	14.0
B-5	None	0	No Sheen	<1	0
B-6	None	0	No Sheen	<1	0

Notes:

1. Drilling observations made on 5/27/86 and 5/28/86.
2. Well measurements and observations made on 5/30/86.
3. Laboratory reports by Kennedy/Jenks/Chilton are included.
4. Soil samples analyzed from Borings B-1 through B-3 were obtained near the water table at a depth of 2.5 feet.



REFERENCE: U.S.G.S. 7.5' TOPOGRAPHIC QUADRANGLE SHEETS "BLAINE, WASH. & BIRCH POINT, WASH."

0 2000 4000

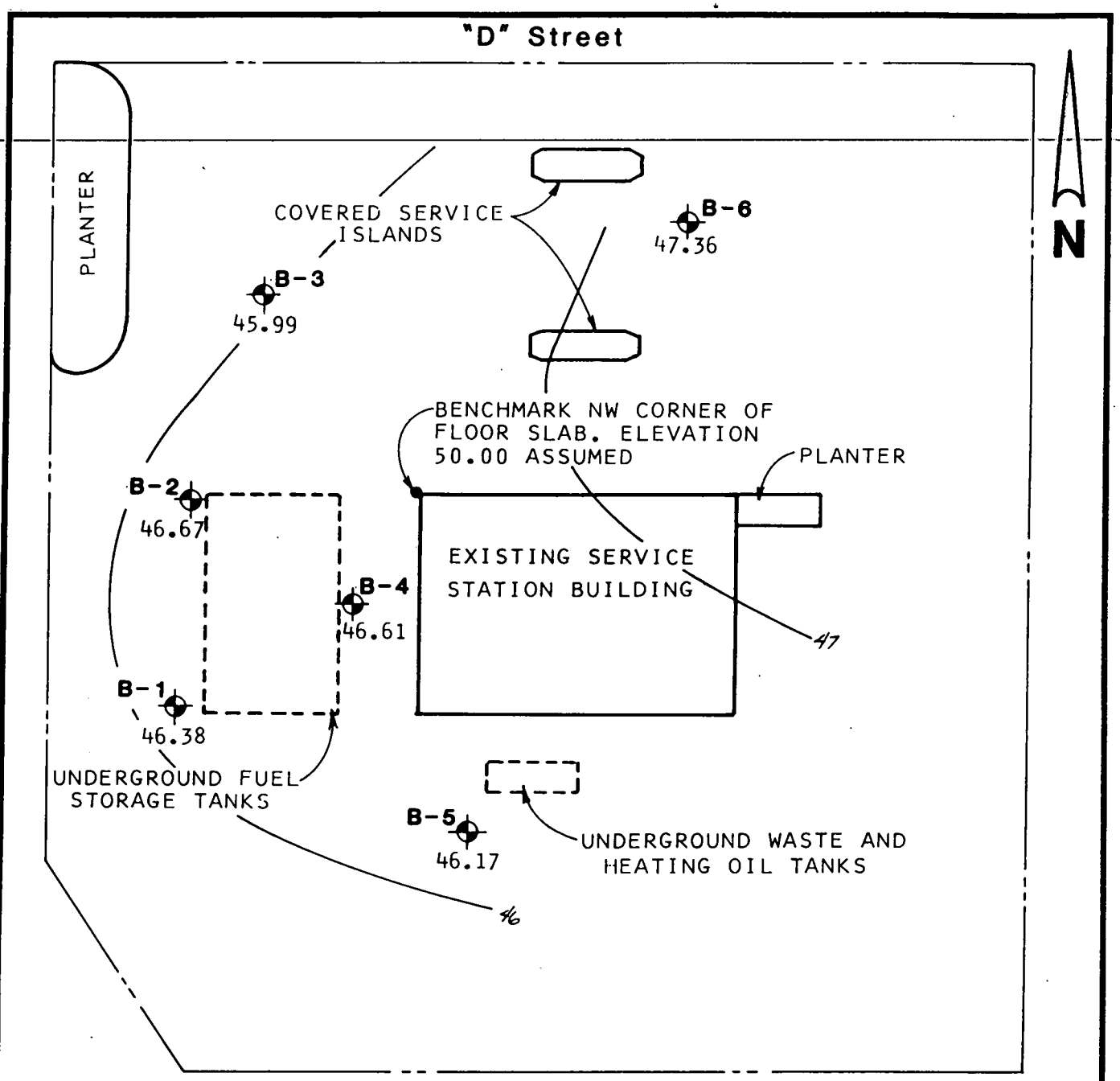
SCALE IN FEET

GeoEngineers Incorporated

VICINITY MAP

FIGURE 1

6-6-86 SEW: DMP 161-26



EXPLANATION:

46.38 — MONITOR WELL LOCATION AND NUMBER

WATER TABLE ELEVATION ON 5-30-86

46 — GROUND WATER CONTOUR BASED ON 5-30-86 SITE DATA

REFERENCE:

DRAWING ENTITLED "GENERAL ARRANGEMENT" BY UNION OIL COMPANY, DATED 9-7-65, PROVIDED BY UNOCAL.

0 20 40

SCALE IN FEET

GeoEngineers Incorporated

SITE PLAN

FIGURE 2

APPENDIX A

FIELD EXPLORATIONS

APPENDIX A

FIELD EXPLORATIONS

DRILLING AND SOIL SAMPLING PROGRAM

Subsurface conditions at Service Station 5028 were explored by drilling six borings at the locations indicated in Figure 2. The borings were drilled on May 27 and 28, 1986 using truck-mounted, hollow-stem auger drilling equipment owned and operated by Subterranean, Inc. Each boring was drilled to a depth of 13.5 feet.

A geologist from our staff determined the boring locations, examined and classified the soils encountered, and prepared a detailed log of each boring. Soils encountered were classified visually in general accordance with ASTM D-2487-83, which is described in Figure A-1. An explanation of the boring log symbols is presented in Figure A-2. The boring logs are given in Figures A-3 through A-8.

Relatively undisturbed soil samples were obtained from each boring using a Dames & Moore split barrel sampler (2.4-inch-ID). The sampler was driven 18 inches by a 250-pound weight falling a vertical distance of 30 inches. The number of blows needed to advance the sampler the final 12 inches is indicated to the left of the corresponding sample notations on the boring logs.

The soil samples obtained from the borings were carefully reexamined in our soils laboratory. One representative soil sample from each boring was selected for chemical analysis of total petroleum hydrocarbons.

MONITOR WELL CONSTRUCTION

Two-inch-diameter, Schedule 40 PVC pipe was installed in each boring at the completion of drilling. The lower portion of PVC pipe is machine slotted (0.02-inch slot width) to allow entry of water, floating hydrocarbons, or flammable vapors into the well casings. Coarse sand was placed in the borehole annulus surrounding the slotted portion of the wells. The well casings are protected within a flush-grade surface monument. Monitor well construction is indicated in Figures A-3 through A-8.

The monitor wells were developed on May 28, 1986 by removing approximately 15 gallons of water from each well with a stainless steel bailer. We determined the elevations of the well casings to the nearest 0.01 foot with an engineers level on May 30, 1986. An elevation of 50 feet was assumed at the southeast corner of the service station building floor slab for a datum (see Figure 2). Elevation data are included on the monitor well logs.

GROUND WATER SAMPLING PROGRAM

Ground water samples were collected from the monitor wells by GeoEngineers on May 30, 1986. The water samples were obtained with a stainless steel bailer after a minimum of six gallons of water was removed from each well casing. The water samples were transferred to septum vials in the field and kept cool during transport to the testing laboratory.

The bailer was cleaned prior to each sampling attempt with a distilled water rinse, tri-sodium phosphate wash, and a second distilled water rinse.

GROUND WATER ELEVATIONS

The depth to the ground water table was measured from the monitor well casing rims on May 30, 1986. Ground water elevations were calculated by subtracting the water table depth from the casing rim elevations.

FLAMMABLE VAPOR CONCENTRATIONS

Flammable vapor concentrations were measured in each monitor well on May 30, 1986. Vapor concentrations in percent of the lower explosive limit (LEL) were measured with our Bacharach Model H Explosimeter, which is calibrated to methane. The vapor data are presented on Table 1 in the main body of this report.

CHEMICAL ANALYTICAL PROGRAM

Six soil samples and six ground water samples were analyzed by the laboratory division of Kennedy/Jenks/Chilton. The soil samples were analyzed for total gasoline and diesel using gas chromatography methods. Gas chromatography was also used to quantify specific aromatic hydrocarbons in the water samples. The laboratory reports are presented in Appendix B.

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

GeoEngineers Incorporated

SOIL CLASSIFICATION SYSTEM

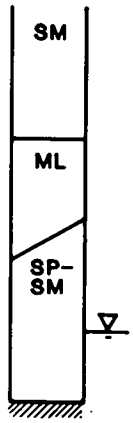
FIGURE A-1

GEI 85-85 SEW:JAM:EL 161-26 7/1/86

LABORATORY TESTS:

AL	Atterberg limits
CP	Compaction
CS	Consolidation
DS	Direct shear
GS	Grain-size analysis
HA	Hydrometer analysis
K	Permeability
M	Moisture content
MD	Moisture and density
SP	Swelling pressure
TX	Triaxial compression
UC	Unconfined compression
CA	Chemical Analysis

SOIL GRAPH:



Soil Group Symbol (See Note 1)

Distinct contact between Soil Strata

Gradual Change between Soil Strata

Water Level

Bottom of Boring

BLOW-COUNT/SAMPLE DATA:

Blows required to drive sampler 12 inches or other indicated distances using 300 pound hammer falling 30 inches.

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

22 ■ Location of relatively undisturbed sample

12 ⊠ Location of disturbed sample

P □ Location of sampling attempt with no recovery

10 ◪ Location of sample attempt using Standard Penetration Test procedures

Location of relatively undisturbed sample using Shelby Tube

NOTES:

1. Soil classification system is summarized in Figure A-1
2. The reader must refer to the discussion in the report text as well as the exploration logs for a proper understanding of subsurface conditions.

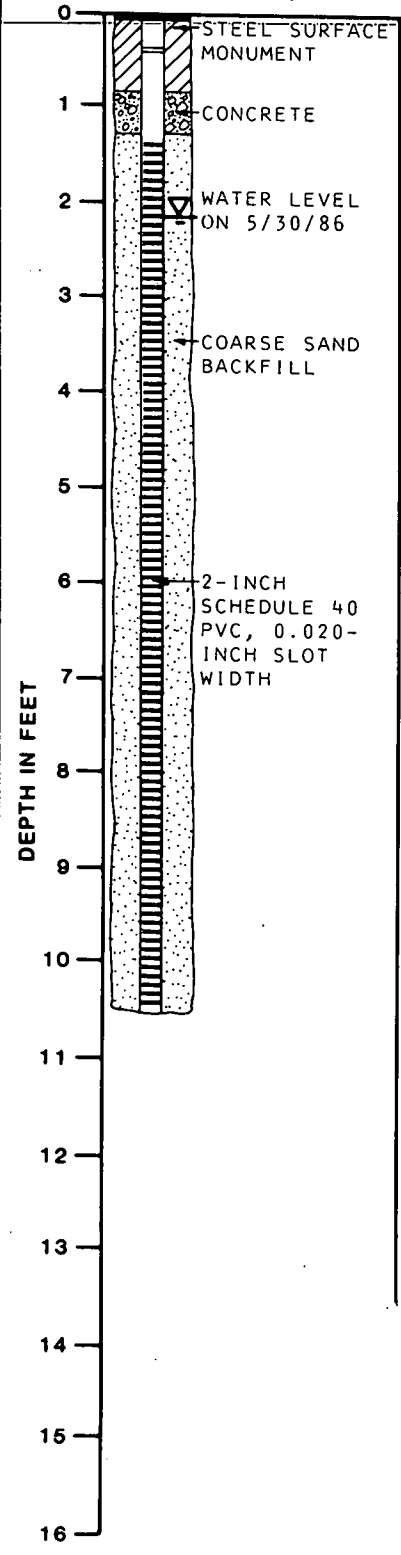
GEI 86-85

GeoEngineers Incorporated

KEY TO BORING LOG SYMBOLS

FIGURE A-2

MONITOR WELL NO. B-1



Blow-Count	Sample	Group Symbol	DESCRIPTION Surface Elevation: 48.5
		GR	2 INCHES ASPHALTIC CONCRETE PAVEMENT 4 INCHES GRAVEL BASE COURSE
		ML	BROWN FINE SANDY SILT WITH A SLIGHT GASOLINE ODOR (MEDIUM STIFF, MOIST)
15	CA ■	ML	GRAY FINE SANDY SILT WITH LENSES OF CLAYEY SILT (MEDIUM STIFF TO SOFT, WET) SLIGHT GASOLINE ODOR AT 2.5 FEET AND 7.5 FEET
4	■		
2	■		
			BORING COMPELTED AT 13.5 FEET ON 5/27/86

Note: See Figure A-2 for Explanation of Symbols

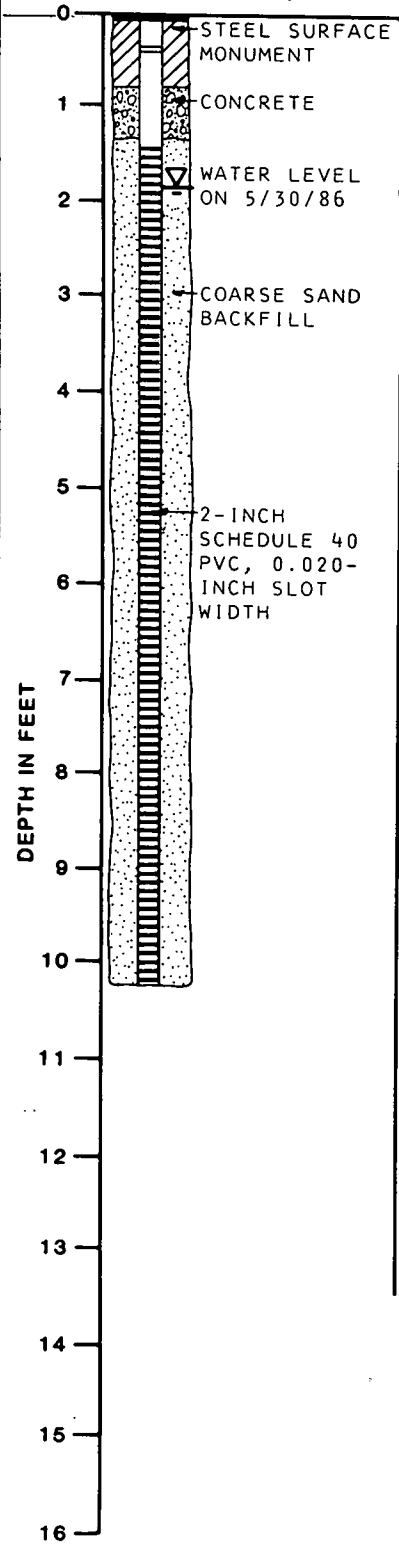
SEW:JAM:EL 161-26 6/6/86

GeoEngineers Incorporated

LOG OF MONITOR WELL

FIGURE A-3

MONITOR WELL NO. B-2



Blow-Count	Samples	Group Symbol	DESCRIPTION Surface Elevation: 48.4
		GP	2 INCHES ASPHALTIC CONCRETE PAVEMENT 10 INCHES GRAVEL BASE COURSE WITH STRONG GASOLINE ODOR
		ML	DARK BROWN SILT (SOFT, MOIST)
6	CA	ML	GRAY FINE SANDY SILT WITH A GASOLINE ODOR (SOFT, WET)
		ML	BROWN AND GRAY CLAYEY SILT AND FINE SANDY SILT (SOFT, WET)
2			
2			
			BORING COMPLETED AT 13.5 FEET ON 5/27/86

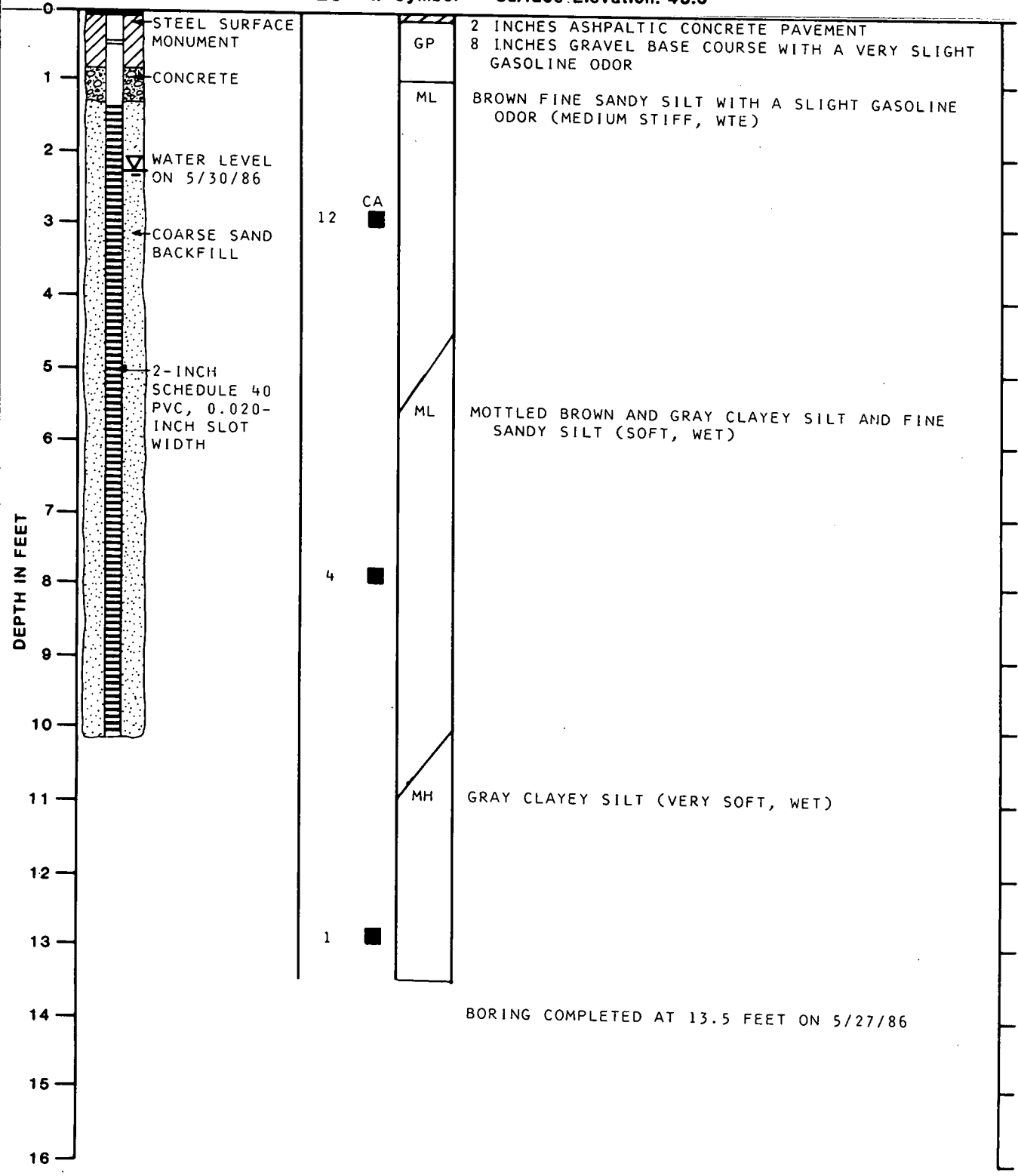
SEW:JAM:EL 161-26 6/6/86

GeoEngineers Incorporated

LOG OF MONITOR WELL

FIGURE A-4

MONITOR WELL NO. B-3



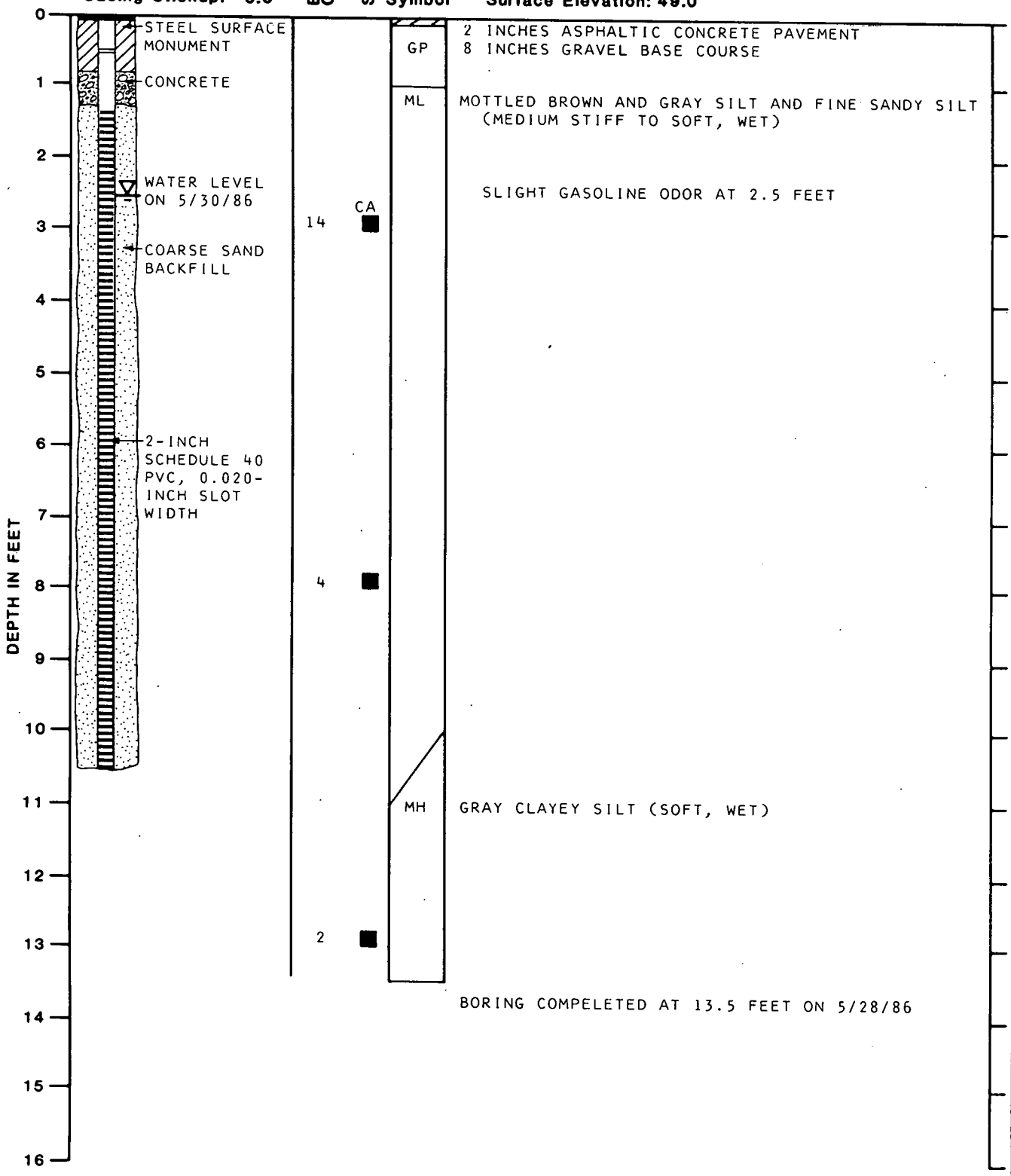
SEW:JAM:EL 161-26 6/6/86

GeoEngineers Incorporated

LOG OF MONITOR WELL

FIGURE A-5

MONITOR WELL NO. B-4



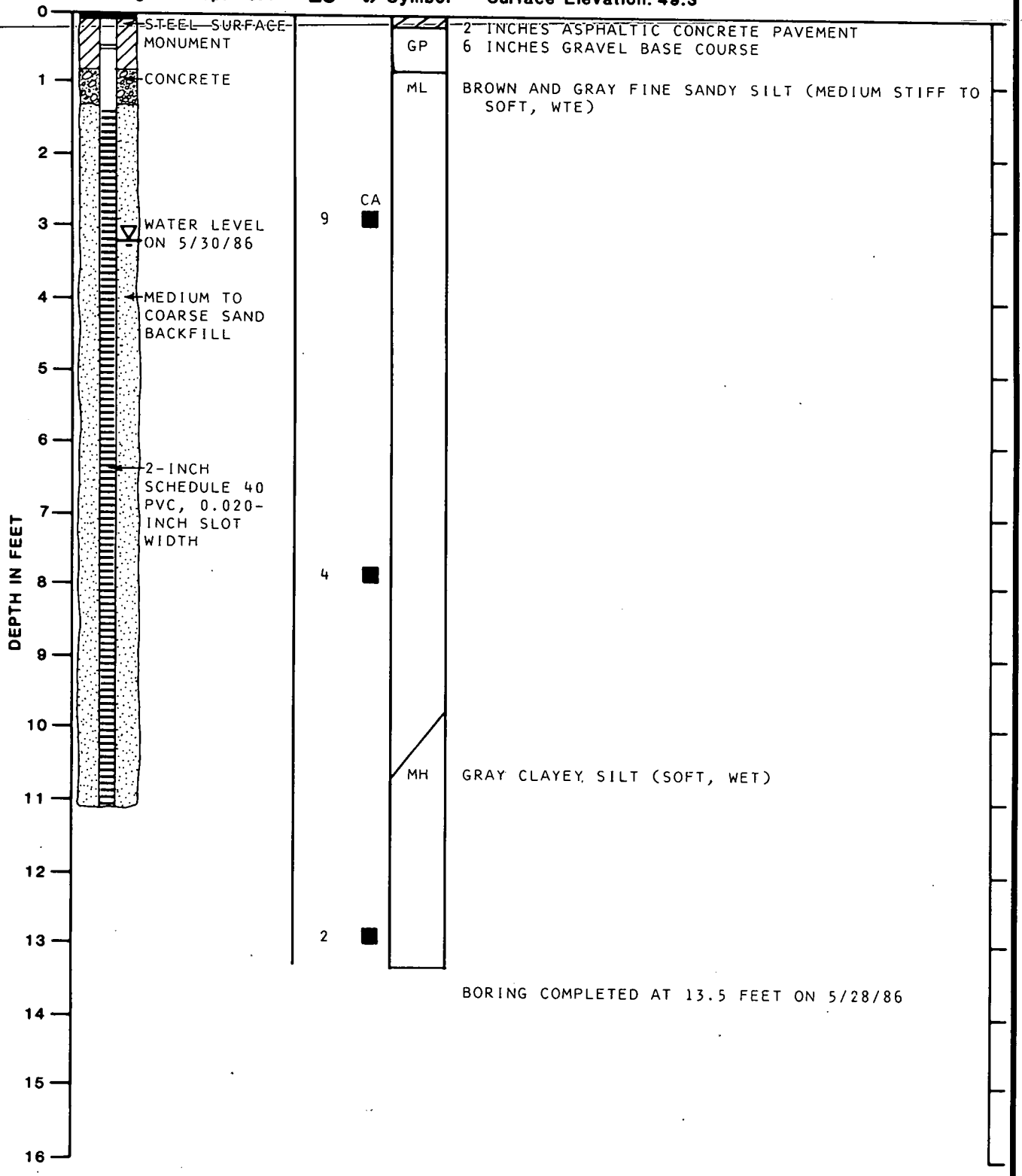
SEW:JAM:EL 161-26 6/6/86

GeoEngineers Incorporated

LOG OF MONITOR WELL

FIGURE A-6

MONITOR WELL NO. B-5



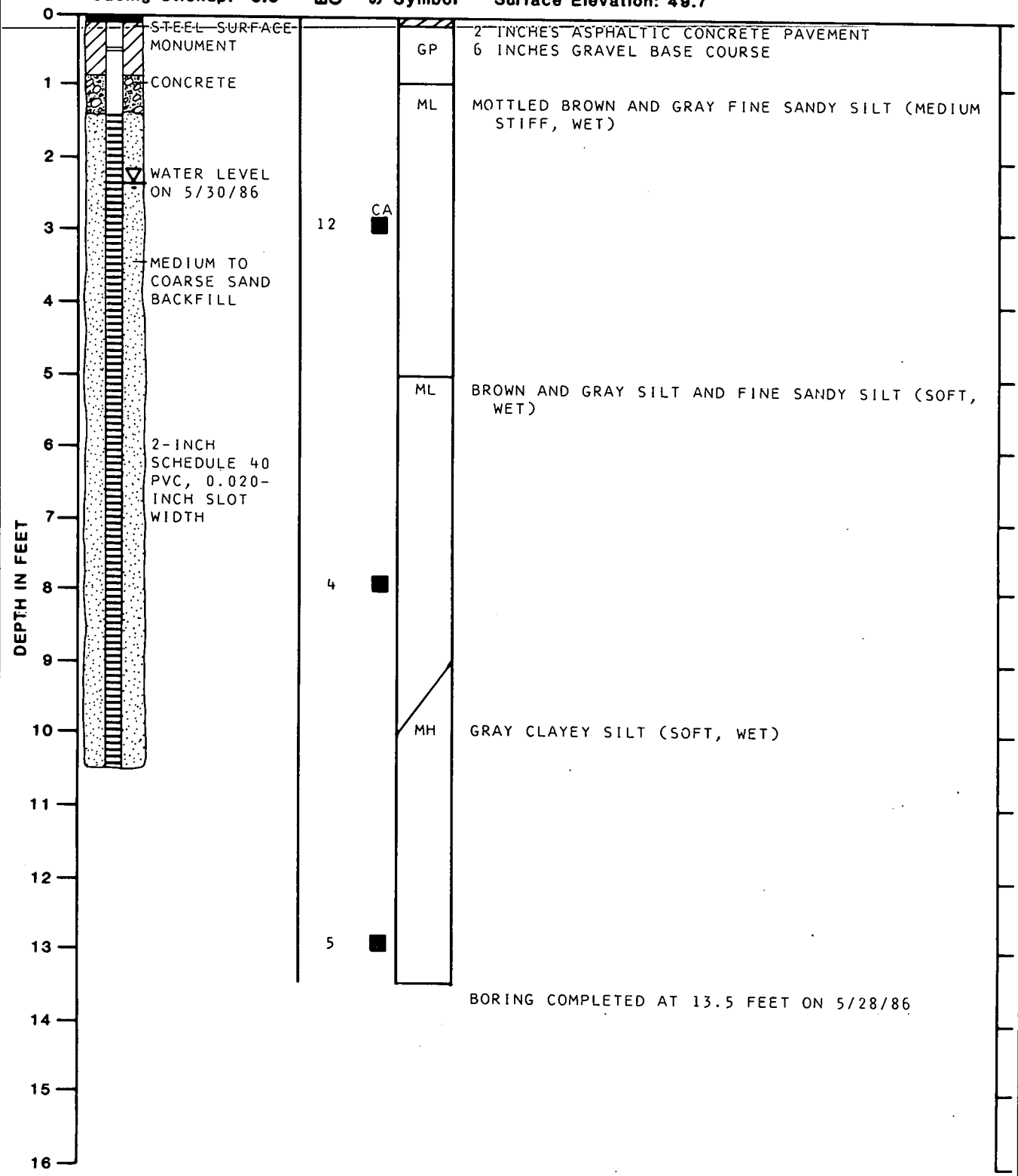
SEW:JAM:EL 161-26 6/6/86

GeoEngineers Incorporated

LOG OF MONITOR WELL

FIGURE A-7

MONITOR WELL NO. B-6



SEW:JAM:EL 161-26 6/6/86

GeoEngineers Incorporated

LOG OF MONITOR WELL

FIGURE A-8

APPENDIX B

CHEMICAL ANALYTICAL DATA

Kennedy/Jenks/Chilton, Laboratory Division
657 Howard Street
San Francisco, CA 94105
415-362-6065

Received 6/3/86
Reported 6/12/86

Water Analysis Report

For: Kennedy/Jenks/Chilton
Attn: Nathan Graves
Address: 33301 Ninth Avenue South, Suite 100
Federal Way, WA 98003

(K/J/C 6717-S-08)

Lab. No.: 863274

Source: Water, MW-1
Unocal - Blaine

Date Collected: 5/30/86

Time Collected: -

Collected by: Geo Engineers, Inc.

Analysis	Units*	Analytical Results
PURGEABLES		
Benzene	ug/L	4200
Chlorobenzene	ug/L	<10
1,2-Dichlorobenzene	ug/L	<10
1,3-Dichlorobenzene	ug/L	<10
1,4-Dichlorobenzene	ug/L	<10
Ethylbenzene	ug/L	<10
Toluene	ug/L	5200
o-xylene	ug/L	2800
m-xylene	ug/L	4700
p-xylene	ug/L	1500

Comments: Analysis by EPA Method 602 (Purgeable Aromatics)

* Micrograms per liter

Analyst NI

Manager Everett R. Smith

Soil Analysis Report

Kennedy/Jenks/Chilton
Laboratory Division
657 Howard Street
San Francisco, California 94105
415-362-6065

For	Kennedy/Jenks/Chilton	Received	6/3/86
Attention	Nathan Graves	Reported	6/16/86
Address	33301 Ninth Avenue South, Suite 100		
	Federal Way, WA 98003		(K/J/C 6717-S-08)

Lab. No.	863280
Source Unocal - Blaine	Soil, B-1, S-1
Date Collected	5/27/86
Time Collected	-
Collected by	Geo Engineers, Inc.

Analysis	Units	Analytical Results
Petroleum hydrocarbons	mg/kg	<1

Comments:

Analysis of pentane extract by capillary gas chromatography, using flame ionization detection. Commercial products used as comparison standards. Results reported in milligrams per kilogram, wet (as received) weight basis.

Analyst EW, AL Manager Everett R. Smith

Soil Analysis Report

Kennedy/Jenks/Chilton
Laboratory Division
657 Howard Street
San Francisco, California 94105
415-362-6065

For	Kennedy/Jenks/Chilton	Received	6/3/86
Attention	Nathan Graves	Reported	6/16/86
Address	33301 Ninth Avenue South, Suite 100		
	Federal Way, WA 98003		(K/J/C 6717-S-08)

Lab. No.	863281
Source Unocal - Blaine	Soil, B-2, S-1
Date Collected	5/27/86
Time Collected	-
Collected by	Geo Engineers, Inc.

Analysis	Units	Analytical Results
Petroleum hydrocarbons	mg/kg	<1

Comments:

Analysis of pentane extract by capillary gas chromatography, using flame ionization detection. Commercial products used as comparison standards. Results reported in milligrams per kilogram, wet (as received) weight basis.

Analyst EW, AL Manager Everett R. Smith

Soil Analysis Report

Kennedy/Jenks/Chilton
Laboratory Division
657 Howard Street
San Francisco, California 94105
415-362-6065

For	Kennedy/Jenks/Chilton	Received	6/3/86
Attention	Nathan Graves	Reported	6/16/86
Address	33301 Ninth Avenue South, Suite 100		
	Federal Way, WA 98003		(K/J/C 6717-S-08)

Lab. No.	863282
Source Unocal - Blaine	Soil, B-3, S-1
Date Collected	5/27/86
Time Collected	-
Collected by	Geo Engineers, Inc.

Analysis	Units	Analytical Results
Petroleum hydrocarbons	mg/kg	<1

Comments:

Analysis of pentane extract by capillary gas chromatography, using flame ionization detection. Commercial products used as comparison standards. Results reported in milligrams per kilogram, wet (as received) weight basis.

Analyst EW, AL Manager Leverett R. Smith

Soil Analysis Report

Kennedy/Jenks/Chilton
Laboratory Division
657 Howard Street
San Francisco, California 94105
415-362-6065

For	Kennedy/Jenks/Chilton	Received	6/3/86
Attention	Nathan Graves	Reported	6/16/86
Address	33301 Ninth Avenue South, Suite 100		
	Federal Way, WA 98003		(K/J/C 6717-S-08)

Lab. No.	863283
Source Unocal - Blaine	Soil, B-4, S-1
Date Collected	5/28/86
Time Collected	-
Collected by	Geo Engineers, Inc.

Analysis	Units	Analytical Results
Petroleum hydrocarbons	mg/kg	<1

Comments:

Analysis of pentane extract by capillary gas chromatography, using flame ionization detection. Commercial products used as comparison standards. Results reported in milligrams per kilogram, wet (as received) weight basis.

Analyst EW, AL Manager Leverett R. Smith

Soil Analysis Report

Kennedy/Jenks/Chilton
Laboratory Division
657 Howard Street
San Francisco, California 94105
415-362-6065

For	Kennedy/Jenks/Chilton	Received	6/3/86
Attention	Nathan Graves	Reported	6/16/86
Address	33301 Ninth Avenue South, Suite 100		
	Federal Way, WA 98003		(K/J/C 6717-S-08)

Lab. No.	863284
Source Unocal - Blaine	Soil, B-5, S-1
Date Collected	5/28/86
Time Collected	-
Collected by	Geo Engineers, Inc.

Analysis	Units	Analytical Results
Petroleum hydrocarbons	mg/kg	<1

Comments:

Analysis of pentane extract by capillary gas chromatography, using flame ionization detection. Commercial products used as comparison standards. Results reported in milligrams per kilogram, wet (as received) weight basis.

Analyst EW, AL Manager Leverett R. Smith

Soil Analysis Report

Kennedy/Jenks/Chilton
Laboratory Division
657 Howard Street
San Francisco, California 94105
415-362-6065

For	Kennedy/Jenks/Chilton	Received	6/3/86
Attention	Nathan Graves	Reported	6/16/86
Address	33301 Ninth Avenue South, Suite 100		
	Federal Way, WA 98003		(K/J/C 6717-S-08)

Lab. No.	863285
Source Unocal - Blaine	Soil, B-6, S-1
Date Collected	5/28/86
Time Collected	-
Collected by	Geo Engineers, Inc.

Analysis	Units	Analytical Results
Petroleum hydrocarbons	mg/kg	<1

Comments:

Analysis of pentane extract by capillary gas chromatography, using flame ionization detection. Commercial products used as comparison standards. Results reported in milligrams per kilogram, wet (as received) weight basis.

Analyst EW, AL Manager Leverett R. Smith

Kennedy/Jenks/Chilton, Laboratory Division
657 Howard Street
San Francisco, CA 94105
415-362-6065

Received 6/3/86
Reported 6/12/86

Water Analysis Report

For: Kennedy/Jenks/Chilton
Attn: Nathan Graves
Address: 33301 Ninth Avenue South, Suite 100
Federal Way, WA 98003

(K/J/C 6717-S-08)

Lab. No.: 863279

Source: Water, MW-6
Unocal - Blaine

Date Collected: 5/30/86

Time Collected: -

Collected by: Geo Engineers, Inc.

Analysis	Units*	Analytical Results
PURGEABLES		
Benzene	ug/L	<1
Chlorobenzene	ug/L	<1
1,2-Dichlorobenzene	ug/L	<1
1,3-Dichlorobenzene	ug/L	<1
1,4-Dichlorobenzene	ug/L	<1
Ethylbenzene	ug/L	<1
Toluene	ug/L	<1
o-xylene	ug/L	<1
m-xylene	ug/L	<1
p-xylene	ug/L	<1

Comments: Analysis by EPA Method 602 (Purgeable Aromatics)

* Micrograms per liter

Analyst NI

Manager Leverett R. Smith

Kennedy/Jenks/Chilton, Laboratory Division
657 Howard Street
San Francisco, CA 94105
415-362-6065

Received 6/3/86
Reported 6/12/86

Water Analysis Report

For: Kennedy/Jenks/Chilton
Attn: Nathan Graves
Address: 33301 Ninth Avenue South, Suite 100
Federal Way, WA 98003

(K/J/C 6717-S-08)

Lab. No.: 863276

Source: Water, MW-3
Unocal - Blaine

Date Collected: 5/30/86

Time Collected: -

Collected by: Geo Engineers, Inc.

Analysis	Units*	Analytical Results
PURGEABLES		
Benzene	ug/L	5100
Chlorobenzene	ug/L	<10
1,2-Dichlorobenzene	ug/L	<10
1,3-Dichlorobenzene	ug/L	<10
1,4-Dichlorobenzene	ug/L	<10
Ethylbenzene	ug/L	<10
Toluene	ug/L	7000
o-xylene	ug/L	1600
m-xylene	ug/L	1300
p-xylene	ug/L	1020

Comments: Analysis by EPA Method 602 (Purgeable Aromatics)

* Micrograms per liter

Analyst NI

Manager Everett R. Smith

Kennedy/Jenks/Chilton, Laboratory Division
657 Howard Street
San Francisco, CA 94105
415-362-6065

Received 6/3/86
Reported 6/12/86

Water Analysis Report

For: Kennedy/Jenks/Chilton
Attn: Nathan Graves
Address: 33301 Ninth Avenue South, Suite 100
Federal Way, WA 98003

(K/J/C 6717-S-08)

Lab. No.: 863277

Source: Water, MW-4
Unocal - Blaine

Date Collected: 5/30/86

Time Collected: -

Collected by: Geo Engineers, Inc.

Analysis	Units*	Analytical Results
PURGEABLES		
Benzene	ug/L	3900
Chlorobenzene	ug/L	<10
1,2-Dichlorobenzene	ug/L	<10
1,3-Dichlorobenzene	ug/L	<10
1,4-Dichlorobenzene	ug/L	<10
Ethylbenzene	ug/L	<10
Toluene	ug/L	5500
o-xylene	ug/L	1500
m-xylene	ug/L	1600
p-xylene	ug/L	1500

Comments: Analysis by EPA Method 602 (Purgeable Aromatics)

* Micrograms per liter

Analyst NI

Manager Everett R. Smith

Kennedy/Jenks/Chilton, Laboratory Division
657 Howard Street
San Francisco, CA 94105
415-362-6065

Received 6/3/86
Reported 6/12/86

Water Analysis Report

For: Kennedy/Jenks/Chilton
Attn: Nathan Graves
Address: 33301 Ninth Avenue South, Suite 100
Federal Way, WA 98003

(K/J/C 6717-S-08)

Lab. No.: 863278

Source: Water, MW-5
Unocal - Blaine

Date Collected: 5/30/86

Time Collected: -

Collected by: Geo Engineers, Inc.

Analysis	Units*	Analytical Results
PURGEABLES		
Benzene	ug/L	<1
Chlorobenzene	ug/L	<1
1,2-Dichlorobenzene	ug/L	<1
1,3-Dichlorobenzene	ug/L	<1
1,4-Dichlorobenzene	ug/L	<1
Ethylbenzene	ug/L	<1
Toluene	ug/L	<1
o-xylene	ug/L	<1
m-xylene	ug/L	<1
p-xylene	ug/L	<1

Comments: Analysis by EPA Method 602 (Purgeable Aromatics)

* Micrograms per liter

Analyst NI

Manager Everett R. Smith

Kennedy/Jenks/Chilton, Laboratory Division
657 Howard Street
San Francisco, CA 94105
415-362-6065

Received 6/3/86
Reported 6/12/86

Water Analysis Report

For: Kennedy/Jenks/Chilton
Attn: Nathan Graves
Address: 33301 Ninth Avenue South, Suite 100
Federal Way, WA 98003

(K/J/C 6717-S-08)

Lab. No.: 863275

Source: Water, MW-2
Unocal - Blaine

Date Collected: 5/30/86

Time Collected: -

Collected by: Geo Engineers, Inc.

Analysis	Units*	Analytical Results
PURGEABLES		
Benzene	ug/L	9900
Chlorobenzene	ug/L	<50
1,2-Dichlorobenzene	ug/L	<50
1,3-Dichlorobenzene	ug/L	160
1,4-Dichlorobenzene	ug/L	<50
Ethylbenzene	ug/L	<50
Toluene	ug/L	32,000
o-xylene	ug/L	6600
m-xylene	ug/L	10,700
p-xylene	ug/L	3300

Comments: Analysis by EPA Method 602 (Purgeable Aromatics)

* Micrograms per liter

Analyst NI

Manager Leverett R. Smith