Applied GeoSystems 43255 Mission Boulevard, Fremont, CA 94539 (415) 651-1906

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REPORT
SOIL VAPOR INVESTIGATION, DRILLING OF SOIL BORINGS, AND INSTALLATION OF GROUND-WATER MONITORING WELLS
at
Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

4-22-88

AGS Job No. 018034-1

Report prepared for

Exxon Company, U.S.A.
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by
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REPORT
SOIL VAPOR INVESTIGATION, DRILLING OF SOIL BORINGS, AND INSTALLATION OF GROUND-WATER MONITORING WELLS
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For: Exxon Company, U.S.A.

INTRODUCTION

Exxon Company, U.S.A., contracted with Applied GeoSystems to perform an initial environmental investigation at the above-referenced Exxon station after a release of gasoline product was reported by the service station's manager. The purpose of the investigation was to evaluate whether, and to what extent, hydrocarbon product has affected the local ground water at the site and the water in a nearby municipal water-supply well.

This report describes the work conducted to identify potential sensitive receptors, drill five boreholes and install four ground-water monitoring wells, perform a soil vapor investigation, and install a floating hydrocarbon product recovery system. The results of laboratory analyses of soil and water,

our interpretations of that data, and our conclusions are also presented.

LOCATION AND BACKGROUND

Exxon Station No. 7-3399 is located at 2991 Hopyard Road in Pleasanton, California. The station is situated on the southeast corner of the intersection of Hopyard Road and Valley Avenue, as shown on the Site Vicinity Map (Plate P-1) in Appendix A. Facilities at the site include a station building with an auto maintenance bay, two dispenser islands, three underground gasoline storage tanks, and one underground waste oil storage tank. The 6,000-, 8,000-, and 10,000-gallon gasoline storage tanks are used to store premium unleaded, regular leaded, and regular unleaded gasoline, respectively, and are located on the south edge of the property. The 500-gallon waste oil tank is located adjacent to and south of the station building. The relative locations of these facilities are shown on the Generalized Site Plan (Plate P-2) in Appendix A.

On March 31, 1988, representatives of Exxon requested that Applied GeoSystems perform this initial investigation. We understand from Exxon personnel that approximately 639 gallons of regular leaded gasoline was released sometime during March 1988.

The release was detected through checks of product inventory by the dealer. Product loss was suspected and later confirmed to be through a flexible connection between the turbine pump and product line for the regular leaded gasoline tank. Paradiso Construction Company of Oakland, California, replaced the leak detectors and flexible connectors for all three gasoline tanks and lines on April 1, 1988, and pressure-tested the lines on April 2, 1988. At this time all lines tested tight. In addition, all tanks were tested on April 15 and 19, 1988, and all tanks tested tight.

REGIONAL HYDROGEOLOGY

The City of Pleasanton is located near the western edge of Livermore Valley, which is an intermontane valley in the Coast Ranges Geomorphic Province. The valley is approximately 13 miles long in an east-west direction and 4 miles wide and is surrounded by hills of the Diablo Range (California Department of Water Resources [DWR], 1974). The valley floor slopes gently toward the west. The principal streams in the area are Arroyo Valle and Arroyo Mocho, which flow toward the west end of the valley.

Livermore Valley is underlain by nonwater-bearing rocks and water-bearing rocks and sediments (DWR, 1966, 1974). The

nonwater-bearing rocks are marine sandstone, shale, and conglomerate of Jurassic to Cretaceous age and marine conglomerate, shale, and sandstone of Eocene to Miocene age. These rocks are exposed in the mountains surrounding Livermore Valley and are found at depths greater than 1,000 feet beneath the valley floor.

The water-bearing rocks and sediments comprise the entire floor of the Livermore Valley and units include the Tassajara Formation, the Livermore Formation, and valley-fill materials. The Tassajara Formation (Pliocene age) consists of folded beds of sandstone, siltstone, shale, conglomerate, and limestone. This formation occurs north of Livermore Valley but also extends beneath the central portion of the valley at depths of 200 to 750 feet.

The Livermore Formation (Plio-Pleistocene age) overlaps the Tassajara Formation beneath the north portion of the valley and is exposed over broad regions south of the valley. Sediments of this formation consist primarily of clayey gravel in a sandy clay matrix. Sedimentary units south of the valley dip gently north, are nearly level beneath the valley floor, and dip gently south beneath the north edge of the valley. Depths to the top of the

Livermore Formation beneath the valley range from a few tens of feet to greater than 400 feet.

Surficial valley-fill materials overlie both the Tassajara and Livermore Formations and range in thickness from a few feet to approximately 400 feet. The Pleistocene to Holocene age sediments include unconsolidated sand, gravel, silt, and clay which occur as either terrace deposits, alluvial fan deposits with gravelly and clayey facies, alluvium, basin deposits, and channel deposits of active streams (DWR, 1974).

The water-bearing units comprise the Livermore Valley ground-water basin, which is divided into subbasins based on fault traces or other hydrologic discontinuities. The ground-water system in Livermore Valley consists of multilayered systems with an unconfined aquifer overlying a sequence of leaky or semiconfined aquifers, each aquifer with its own potentio-metric surface. Ground water in the basin moves downslope toward the east-west-trending axis of the valley and then generally to the west. Ground-water movement between subbasins is primarily controlled by faulting.

Exxon Station No. 7-3399 is located in the Bernal subbasin. This basin is bounded on the north, west, and east by faults and on

the south by the contact between water-bearing and nonwater-bearing rocks. The streams that drain Livermore Valley and ground water in the valley moves toward this subbasin. The aquifer system is contained within valley-fill materials of sandy gravel and sandy clayey gravel beds that are up to 100 feet thick and are separated by confining beds of silty clay up to 30 feet thick. Both the aquifer and confining units appear to be laterally continuous across the subbasin, as shown in hydrogeologic sections (DWR, 1974). The total thickness of the valley fill in the Bernal subbasin is approximately 400 feet. The Livermore Formation, which consists of sandy gravels and cemented gravel beds separated by relatively thin beds of silty clay and hard clay, conformably underlies the valley-fill materials.

SENSITIVE RECEPTORS

A representative of the Alameda County Flood Control and Water Conservation District indicated that the uppermost ground-water aquifer is probably connected to deeper aquifers that are tapped by municipal wells (C. Mayfield, personal commun., April 1988). Water in the uppermost aquifer, although of lower quality than water from lower aquifers, mixes with the deeper water and is

considered to have beneficial uses (J. Killingstad, personal commun., April 1988).

According to the records of Zone 7 of the Alameda County Flood Control and Water Conservation District (Well Location Map, November 9, 1987), four active municipal wells (A1, A5, D2, and N1) are located within 2,500 feet of the station. The nearest well (A5, or City of Pleasanton well No. 7) is approximately 300 feet northwest of the station property across Valley Av[illegible] and is currently being used for public water supply. At the request of the Regional Water Quality Control Board, San Francisco Bay Region, pumping of this well ceased on April 2, 1988. [illegible] records indicate that well No. 7 was drilled to a depth of 454 feet in 1967 and casing was set to a depth of 440 feet. [illegible] casing is perforated from 120 to 440 feet. As measured by representatives of the Alameda County Flood Control and Water Conservation District, the depth to the pumping water level in well No. 7 was 48.5 feet on April 1, 1988, and to the static water level was 44.5 feet on April 15, 1988. The remaining wells are located 1,500 to 2,500 feet northeast and northwest of the station property. The locations of the four municipal wells are shown on the Site Vicinity Map (Plate P-1).

The Pleasanton Canal, which runs northeast-southwest, is approximately 500 feet north of the station. No other surface-water bodies are within 1,000 feet of the property. Also, no schools, basements, or subways are located within 1,000 feet of the site.

SOIL BORINGS AND MONITORING WELLS

Representatives of Zone 7 of the Alameda County Flood Control and Water Conservation District verbally granted permission to install the ground-water monitoring wells at the site on March 31, 1988. Applied GeoSystems submitted a permit application for the wells on April 11, 1988. A copy of the application is included in Appendix B of this report.

Locations of Borings

Five soil borings were drilled at the site, and ground-water monitoring wells were constructed in four of the borings. The locations of borings B-1 through B-5 were chosen based on the locations of the nearby municipal water-supply wells and the area of the product release. Borings B-1 and B-3 were drilled near the northwest edge of the station property between the gasoline storage tanks and municipal water-supply well No. 7. Boring B-2

was drilled at the southeast edge of the station property on the opposite side of the gasoline storage tanks from well No. 7. Boring B-4 was drilled adjacent to the turbine end of the regular leaded gasoline tank where the product release occurred. Boring B-5 was drilled near the north corner of the station property and was placed downgradient from the product tanks (as calculated from wells installed in borings B-1 through B-3).

Description of Drilling Method

Drilling and well construction took place between April 1 and 7, 1988. The five boreholes were drilled with a CME-75 truck-mounted drill rig operated by Datum Exploration, Inc., of Pittsburg, California. Steam-cleaned, 8-inch-diameter, continuous-flight, hollow-stem augers were used to drill to depths of 57 and 60 feet, except for boring B-4, which was drilled to a depth of 40 feet. Borings B-1, B-2, B-3, and B-5 were reamed with 10-inch-diameter hollow-stem augers so that 4-inch-diameter casing could be installed. Drilling was terminated approximately 20 feet below the top of the zone of saturation in borings B-1 through B-3 and B-5 and at the approximate depth of ground water in boring B-4. Ground water was noted during drilling at depths between approximately 36 to

38 feet below ground level and appears to be either slightly confined or semiconfined.

Cuttings generated during drilling were stockpiled at the site. On April 19, 1988, Applied GeoSystems tested the soil cuttings with a Photovac TIP organic vapor detector. Soil that registered less than 50 parts per million (ppm) on the TIP detector was removed from the site and transported to a Class III landfill facility. The remaining cuttings will be aerated and removed shortly.

Sampling and Description of Soil

Soil samples were collected at 5-foot intervals from the ground surface to the total depths of the borings. The augers were advanced to a point immediately above the sampling depth, and a California-modified split-spoon sampler (2-1/2-inch inside diameter) containing three 6-inch-long brass sleeves was driven into the soil through the hollow center of the auger. The sampler was driven 18 inches with a standard 140-pound hammer repeatedly dropped 30 inches. The number of blows to drive the sampler each 6-inch increment was counted and recorded to evaluate the relative consistency of soil materials. The samples were removed from the sampler, and the lowermost brass sleeve was

immediately sealed with aluminum foil, plastic caps, and plastic tape. The sleeves were then labeled and placed in iced storage for transport to Applied Geosystems' laboratory for refrigerated storage.

An organic vapor analyzer (OVA) was used to measure relative vapor concentrations of the samples. Readings were collected by placing the rubber cup that skirts the intake probe flush with the soil at the top of the lower brass sleeve. **The OVA readings indicate relative organic vapor concentrations but cannot be used to directly [redacted] or hydrocarbon contaminants in the soil.**

High vapor readings were found in samples collected from borings B-2 and B-4, located adjacent to the underground storage tanks. Concentrations ranging from 5,000 ppm to the maximum capability of the OVA (100,000 ppm) were dominant in these two borings. **Hydrocarbon product was also noted on the sampling tool at the 40-foot depth in boring B-2.** Vapor readings were at ambient levels (maximum 5 ppm) in borings B-1, B-3, and B-5.

Soil contained in the middle and upper brass sleeves at each sample interval was removed from the sleeves and identified using the Unified Soil Classification System. A summary of this

system is presented on Plate P-3 included in Appendix C of this report. Descriptions of the earth materials encountered in the boreholes are shown on the Logs of Borings (Plates P-4 through P-13), which are also included in Appendix C. The depth at which the samples were collected for possible laboratory analysis, the number of hammer blows required to drive the sampler a distance of 1 foot (the last two 6-inch increments), and the OVA readings are also indicated on these logs. A discussion of the local subsurface geology is presented in a later section.

Construction of Monitoring Wells

Ground-water monitoring wells MW-1, MW-2, MW-3, and MW-4 were constructed in borings B-1, B-2, B-3, and B-5, respectively. Boring B-4 was backfilled to the surface with a neat cement/ bentonite slurry. The wells were constructed of 4-inch-diameter, Schedule 40 polyvinyl chloride (PVC) casing. The casing consists of screened sections with 0.020-inch-wide slots which were set from approximately 37 to 57 feet, or just above the approximate depth of the base of the confining strata. The top of the screened casing in well MW-1 was set at approximately 32 feet below ground level. Screened casing was set close to the aquiclude/aquifer interface to minimize possible migration of hydrocarbons from the soil into the wells. Blank casing was set

from the top of the screen to a few inches below the ground surface. All casing joints are flush-threaded; no glues, chemical cements, or solvents were used in well construction. The top of each casing is covered with a slip cap; the bottom of each casing has a threaded end plug.

The annular space of each well was backfilled with No. 3 size sand from the total depth of the well to approximately 1 to 3 feet above the top of the screened casing. Bentonite pellet plugs approximately 1 to 2 feet thick were placed above the sand as seals against cement entering the sand pack, and the remaining annulus of each well was backfilled with neat cement (mixed with approximately 5 percent bentonite powder) to a few inches below grade. Details of well constructions are shown in Table 1; graphic representations of these constructions are shown in the right columns of the Logs of Borings in Appendix C, and a key to the symbols used to illustrate the well constructions is shown on Plate P-3 in Appendix C.

A cast aluminum utility box with a PVC apron was placed over each well head and secured in place with concrete set flush with the

TABLE 1
DETAILS OF WELL CONSTRUCTIONS
Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

Well	Diameter	Total Depth	Top of Screen	Top of Sand Pack	Top of Bentonite
MW-1	4	57	32	30	28
MW-2	4	57	37	34	32
MW-3	4	56	36	35	34
MW-4	4	57	37	36	35

Diameter in inches.
All other values in feet below the existing ground surface.

surrounding surface grade. The utility box has a watertight seal to protect the ground-water well from infiltration of surface water; the box requires a specially designed wrench to open. The utility box is designed to reduce the possibilities of vandalism or accidental disturbance of the well.

Boring B-4 was backfilled from the total depth of the boring to the ground surface. This hole was backfilled with a mixture of neat cement and approximately 5 percent bentonite powder.

Sampling and Development of Wells

Wells MW-1, MW-3, and MW-4 were developed by air-jetting and pumping to pack the annular sand and remove fine-grained materials from the wells. The wells were allowed to recharge before sampling for subjective inspection. Depth-to-water measurements were made with a Solinst electric water-level indicator. Measurements were made to the nearest 0.01-foot. Liquid samples were then collected from each well by gently lowering approximately half the length of a Teflon bailer past the air/liquid interface. The bailer was washed with Alconox (a commercial laboratory soap) and rinsed with water before use in each well.

The samples were retrieved and examined for floating product, sheen, and product color. Approximately 3 inches of floating hydrocarbon product was initially encountered in well MW-2 after well installation (on April 2, 1988). This thickness increased to approximately 3.2 feet (as measured with an oil/water interface probe) before an automatic product-skimmer pump was installed on April 7, 1988. The pump was shut down, and the well was allow to recharge for approximately 3 hours on April 19; 2.48 feet of product was measured. This product was clear and colored pink and was similar to the regular gasoline dispensed at the

station. No floating product or sheen was found in water from wells MW-1, MW-3, and MW-4. Water which had flowed into the augers in boring B-4 was also subjectively inspected before this borehole was backfilled. No floating product or sheen was found on the water sampled from this borehole. The results of the subjective analyses are presented in Table 2.

Wells MW-1, MW-3, and MW-4 were then purged by pumping until the temperature and acidity of the pumped fluids were stabilized (as measured by a thermometer and a pH/conductivity meter). Stabilized readings would indicate that the water to be sampled was representative of the formation. After purging, the water was allowed to recharge to near static level before sampling for laboratory analyses. Well MW-2 was not purged and sampled because of the presence of floating product.

Water samples were collected with a Teflon bailer that was washed with Alconox and rinsed with deionized water before use. The bailer was lowered to a point just below the air/water interface in each well to retrieve a sample of the water. The samples were slowly transferred to laboratory-cleaned, 40-milliliter, volatile organic analysis (VOA) glass sample vials; hydrochloric acid was added to minimize bacterial degradation of any hydrocarbons.

TABLE 2
SUBJECTIVE ANALYTICAL RESULTS OF WATER IN WELLS
Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

Date	Well	Depth to Water	Floating Product	Sheen
4/6/88	MW-1	36.34	None	None
4/8/88	MW-1	36.29	None	None
4/19/88	MW-1	36.36	None	None
4/2/88	MW-2	--	3.0	Heavy
4/4/88	MW-2	--	18.0	Heavy
4/5/88	MW-2	--	18.0	Heavy
4/6/88	MW-2	39.31	38.4	Heavy
4/8/88	MW-2	--*	--*	--*
4/19/88	MW-2	38.90	29.76**	Heavy
4/6/88	MW-3	37.19	None	None
4/8/88	MW-3	37.14	None	None
4/19/88	MW-3	37.22	None	None
4/8/88	MW-4	36.41	None	None
4/19/88	MW-4	36.51	None	None
4/2/88	B-4	--	None	None

Depth to water is in feet below top of casing.
Thickness of floating product is in inches.
-- = Not measured
* = Not measured because of installed product-skimmer pump
** = Thickness of floating product after the well was allowed to recharge for approximately 3 hours.

The samples were immediately sealed in the vials with Teflon-lined caps, labeled, and placed in iced storage for transport to Applied GeoSystems' laboratory for testing.

LABORATORY ANALYSES AND RESULTS

Chain of Custody Records for soil and water samples were initiated during sample collection and accompanied the samples to Applied GeoSystems' laboratory. Copies of these forms, which document the transfer of the soil and water samples, are included in Appendix D of this report.

The soil samples were collected just above the water table in borings B-1 through B-3 and B-5 for testing by Applied GeoSystems' laboratory. Three soil samples from boring B-4 were selected to evaluate the downward change in hydrocarbon levels from the samples with the highest concentrations measured by the OVA to the sample collected closest to and above the water table. The soil samples were analyzed for total petroleum hydrocarbons (TPH) by Environmental Protection Agency (EPA) Method 8015, modified for gasoline. The analyses were performed by gas chromatography with photoionization and flame-ionization detection. The results of analyses are presented in Table 3 and in the laboratory Analysis Reports included in Appendix D.

The water samples were analyzed for TPH by EPA Method 8015, modified for gasoline, and for benzene, toluene, ethylbenzene,

TABLE 3
ANALYTICAL RESULTS OF SOIL AND WATER
Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

Sample No.	TPH	B	T	E	X
SOIL					
S-34.5-B1	<2.0	--	--	--	--
S-34.5-B2	<2.0	--	--	--	--
S-35-B3	<2.0	--	--	--	--
S-29.5-B4	965	--	--	--	--
S-29.5-B4	3	--	--	--	--
S-34.5-B4	<2.0	--	--	--	--
S-35-B5	<2.0	--	--	--	--
WATER					
W-38-MW1	<0.02	<0.0005	0.0017	<0.0005	<0.0005
W-39-MW3	0.02	<0.0005	<0.0005	<0.0005	<0.0005
W-37-MW4	0.08	0.0018	0.0163	0.0006	0.0071

Results in **parts per million** (ppm).
TPH = total petroleum hydrocarbons; B = benzene; T = toluene;
E = ethylbenzene; X = total xylene isomers
< = less than the laboratory detection limit for the method of analysis
-- = **sample not tested for listed constituent**

and total xylene isomers by EPA Method 602. The results of analyses are also presented in Table 3 and in the laboratory Analysis Reports included in Appendix D.

SOIL VAPOR SURVEY

Applied GeoSystems performed a deep soil vapor survey at the subject site on April 14, 1988. Field work included use of Applied GeoSystems' Mobile Soil Vapor Laboratory to collect and analyze soil vapor at 11 sampling locations. The purpose of the survey was to measure the concentrations of hydrocarbon vapors in unsaturated soil near the water table and evaluate the potential for degradation of ground water from vapors migrating from the released product. Data from this type of survey are useful in identifying and delineating the subsurface distribution of hydrocarbons in soil and ground water. This type of survey cannot measure absolute levels of hydrocarbon contamination in soil because the soil media is not directly analyzed. Hydrocarbon vapor values, therefore, are used to evaluate relative concentrations of hydrocarbons in the soil and water.

Soil Vapor

Application of the soil vapor survey is based on the tendency of hydrocarbons with low molecular weights to volatilize and migrate through the pore spaces of soil. Hydrocarbon product can migrate through the subsurface as free product, as dissolved product in water, or as vapor in the soil. Each form of migrating product

may act as a source of hydrocarbon vapor in the soil pores. In addition, residual product trapped or bound within pore spaces may act as a source of hydrocarbon vapor.

Variables that influence hydrocarbon movement in the soil include the physical and chemical properties of the organic contaminants, properties of the unsaturated zone, and hydrogeologic properties of the site. Site-specific parameters may include the vapor pressure, water solubility, and concentration of the chemical; the porosity, moisture content, and organic content of the site soil; and the flow direction and velocity of the ground water.

Vapor Survey Equipment and Sampling Procedure

Equipment used to sample soil vapor included a hardened steel drive-tip, a downhole sampling assembly with vacuum vials, steel probe rod with an outside diameter of 1.75 inches, and a driving unit. The probe rod and tip were hydraulically pushed to a predetermined depth at which point the drive-tip was opened. The sampling assembly was then lowered through the hollow center of the probe rod to collect the vapor sample. Contamination by atmospheric gas was thus eliminated, giving a reliable and reproducible reading of the concentration of the hydrocarbon vapor in the soil at the sample depth. The number of variables

associated with vapor sampling was reduced because each sample vial is the same size (i.e., constant volume of gas) and was evacuated to the same degree. Reducing variation in the vapor sampling procedure provided consistency in sampling at different locations.

Selection of Sample Locations and Depths

Initial sample locations were placed around the underground fuel tanks and in the areas of the reported product release and floating hydrocarbon product. Additional samples were distributed across the site concentrating primarily in those areas downgradient of the underground tanks and in the area of well MW-4 where low concentrations of hydrocarbons were detected in water. **The soil vapor probe locations are shown on Plate P-14 in Appendix E.**

A sample depth of 33 feet was chosen to evaluate vapor concentrations near the water table but above the capillary zone because little or no vapor transport occurs below this zone. The capillary zone varies in thickness depending on the soil type but is generally assumed to extend upward from the water table a few feet. Ground water was measured at approximately 37 feet below the ground surface in monitoring wells onsite. To remain above

the inferred depth of the saturated zone, the sampling horizon was established at a depth of 33 feet.

At the completion of probing, probe holes were backfilled with bentonite pellets to within a few inches of the existing ground surface and then topped off with asphalt or other surfacing appropriate to the site. A Wild NA-24 automatic leveling instrument was used to survey probe hole locations relative to other facilities at the site.

Description of Chromatograph and Method of Analysis

A 0.10-milliliter vapor sample was withdrawn from the sample vial using a 0.10-milliliter syringe and injected into a Photovac 10S70 portable gas chromatograph for analysis. The instrument is a dual-column, manual-injection chromatograph with a photo-ionization detector that is sensitive to concentrations of hydrocarbon constituents in the range of parts per billion. The analytical equipment used in this survey is housed in Applied GeoSystems' Mobile Soil Vapor Laboratory, which provides a clean, temperature-controlled environment. The detection limit for the chromatograph was set using standard gas containing equal concentrations (1 ppm) benzene and toluene. Before analyzing the vapor samples, the Photovac was calibrated with a standard

gas containing equal concentrations (20 ppm) of benzene and toluene.

Results of Soil Vapor Analyses

Hydrocarbon vapor contained in the soil gas as benzene and toluene was measured in parts per million with the chromatograph. The concentrations of the constituents that were ionized before benzene were recorded as the sum of the individual areas beneath the chromatogram spikes and were designated "pre-benzene." These values are recorded in volt-seconds; one volt-second equals approximately 0.7 ppm benzene. Results of the soil vapor survey are presented in Table 4.

Data from this survey are presented on Plates P-15 through P-17 (in Appendix E) as relative concentrations of the two species of chemical constituents, benzene and toluene, and the sum of those constituents lighter than benzene (represented by volt-seconds, or the area beneath the pre-benzene chromatogram spikes) that are associated with the more volatile phase of gasoline. Results of the soil vapor analyses performed at the 11 vapor probe locations revealed that measured concentrations at the 33-foot depth were relatively low (maximum of 208 ppm benzene), and detectable concentrations were only found within 50 feet of

TABLE 4
SOIL VAPOR SURVEY DATA
Exxon Station Number 7-3399
2991 Hopyard Road
Pleasanton, California

Sample	Depth	Benzene	Toluene	Pre-benzene
VP-1	33	30	12	62
VP-2	33	54	41	129
VP-3	33	26	<1	58
VP-6	33	<1	<1	3
VP-9	33	208	109	39
VP-10	33	35	9	18
VP-11	33	<1	<1	3
VP-14	33	<1	<1	<1
VP-15	33	<1	<1	<1
VP-16	33	<1	<1	3
VP-17	33	<1	<1	<1

Benzene and toluene concentrations are in parts per million (ppm).
Pre-benzene concentrations are in volt-seconds (VS).
1 ppm benzene = approximately 0.7 VS benzene
< = less than the method detection limit of 1 ppm.

the underground storage tanks. No detectable soil vapor was found near well MW-4. The data suggest that contaminant migration is primarily in an east-west direction at this depth. The relatively restricted lateral extent of vapors and the higher concentrations of pre-benzene and benzene relative to toluene suggest that the soil vapor is the result of a rather recent product release.

PRODUCT RECOVERY

Hydrocarbon product and water were removed from well MW-2 by bailing and pumping on April 4 and 5, 1988. A total of 17.5 gallons of product and 18.5 gallons of water were recovered from the well and removed from the site by Armour Petroleum Service and Equipment Corporation of Vacaville, California.

Personnel from Applied GeoSystems installed an air-lift type, automatic product-skimmer pump in well MW-2 on April 6 and 7, 1988. Product removal commenced April 7, and approximately 19.5 gallons of product were recovered by April 21, for a cumulative total recovery of 37 gallons.

GRADIENT AND DIRECTION OF GROUND-WATER FLOW

Wells MW-1 through MW-4 were surveyed using a Wild NA-24 automatic leveling instrument. The surveying was conducted to locate the wells with reference to each other and other station facilities and to measure the relative differences in elevation between the leveling instrument and the top of the casing of each well. Leveling measurements were recorded to the nearest 0.01-foot. The depth to the static water level was also measured to the nearest 0.01-foot using a Solinst electric water-level

indicator. The leveling and depth-to-water measurements were combined to calculate the depth to water below a reference datum and to estimate the potentiometric surface of the ground water across the site. The water elevation data are presented in Table 5, and the potentiometric surface is shown on the Ground-Water Potentiometric Surface Map (Plate P-18) in Appendix E. The approximate direction of ground-water flow on April 8, 1988, was north 55 degrees west, and the calculated gradient ranged from 0.13- to 0.19-foot per 100 feet.

DESCRIPTION OF LOCAL GEOLOGY

The sediments encountered during drilling consist predominantly of interbedded units of silty clay and clayey silt to approximate depths of 37 to 39 feet below the ground surface. These sediments are inferred to be relatively impermeable. A relatively thin silty sand unit was found in the five boreholes at depths between 7 and 12 feet, which suggests that this unit is relatively continuous across the site. No other sandy units were encountered in the boreholes until the uppermost aquifer was

TABLE 5
DIFFERENCES IN GROUND-WATER ELEVATIONS
(measured on April 8, 1988)
Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

Monitoring Well	Top of Casing Below Datum	Static Water Level	Water Level Below Datum
MW-1	0.84	36.29	37.13
MW-2	0.26	36.69*	36.95
MW-3	0.00	37.14	37.14
MW-4	0.72	36.41	37.13

Measurements are in feet.
Static water level in feet below top of casing.
Datum is an arbitrary elevation that corresponds to the top of casing of well MW-3.
* Corrected from the level measured with floating product.

encountered between 37 to 39 feet. The aquifer materials found to a depth of 60 feet include clayey and gravelly sand, sand, clayey gravel, and gravel. Clay was encountered at approximately 59.5 feet in the borehole drilled for well MW-3. The distribution of geologic units beneath the station property is shown on Hydrogeologic Cross Sections A-A' and B-B' (Plates P-19 and P-20) in Appendix E.

Sediments exposed in the area of the site are mapped as alluvium (DWR, 1974) and include unconsolidated deposits of interbedded clay, silt, fine-grained sand, and lenses of clayey gravel. This description appears to correlate with subsurface materials encountered in the boreholes to the 60-foot depth. The lithologic description of municipal well No. 7 shows alternating units of clay and gravel to a depth of 389 feet followed by cemented gravel to the total depth of 454 feet. The cemented gravels are interpreted to represent rocks of the Livermore Formation, which is consistent with the interpretation of DWR (1974). Table 6 is the lithologic description of well No. 7, as presented on the DWR Water Well Drillers Report. The description between approximately the 50-foot depth and the depth to the top of the well's perforations shows clay and gravel (47 to 59 feet), gravel (59 to 81 feet), and clay and gravel (81 to 116 feet).

The north boundary of the Bernal subbasin, located approximately 1/2-mile north of the station property, is marked by the Parks Fault. This fault trends east-northeast and has disrupted sediments approximately 100 feet and greater below ground level. An unnamed, similar east-northeast-trending fault is shown by the DWR (1974) to pass almost directly beneath the site at a depth of

TABLE 6
LITHOLOGIC DESCRIPTION OF
MUNICIPAL WELL NO. 7
Hopyard Road and Valley Avenue
Pleasanton, California

Depth	Lithologic Description
0 to 1	Fill
1 to 4	Adobe
4 to 30	Yellow sandy clay
30 to 47	Yellow clay with gravel streaks
47 to 59	Yellow clay and gravel
59 to 81	Gravel
81 to 116	Blue clay and gravel
116 to 134	Gravel
134 to 140	Clay
140 to 162	Gravel
162 to 185	Clay and gravel
185 to 192	Gravel
192 to 204	Yellow clay
204 to 219	Gravel, some clay
219 to 229	Yellow clay (gravel streaks)
229 to 256	Clay
256 to 275	Gravel
275 to 302	Clay and gravel
302 to 318	Gravel
318 to 330	Clay
330 to 346	Gravel
346 to 366	Sandy clay and gravel
366 to 389	Gravel (yellow clay streaks)
389 to 409	Cemented gravel
409 to 454	Cemented gravel (yellow clay streaks)

Depth in feet below the ground surface.

approximately 100 feet. Differences in deeper ground-water levels across the Parks Fault indicate a barrier to horizontal ground-water movement, but no such barrier is apparent across the unnamed fault.

DISCUSSION

The ground-water levels in wells MW-1 through MW-4 indicate that the local ground water beneath the site moves generally toward the northwest. Laboratory analyses of water samples from wells MW-1, MW-3, and MW-4, located at the downgradient edge of the station property, show either nondetectable or very low concentrations of hydrocarbons and indicate that dissolved hydrocarbons which may result from the floating product have not migrated far from the area of the underground storage tanks. The results of the soil vapor survey also show that hydrocarbon vapors, which may potentially degrade the ground water, have not migrated more than 50 feet from the product tanks.

The low levels of hydrocarbons detected in water from well MW-4 appears to be related to either a localized and minor product release (i.e., spillage on the surface) or to introduction of hydrocarbons by sampling equipment. The analysis showed a higher concentration of the heavier toluene relative to the lighter

benzene, which indicates an older, more weathered product. Further, no detectable hydrocarbon vapor concentrations were found at vapor probe location VP-17 located near well MW-4. These data indicate that the detected hydrocarbons are not related to vapors migrating from the product release.

Hydrocarbon product removed from well MW-2 appears to be fresh and unweathered. The color of this product is close to the regular leaded gasoline dispensed at the station. No floating hydrocarbon product was encountered in boring B-4, which was drilled to a depth of 40 feet adjacent to the regular gasoline tank and approximately 20 feet downgradient of well MW-2. The drilling augers in this borehole were left in the ground overnight and water that collected in the hole was sampled and subjectively inspected the next morning (April 2, 1988). No product was found in this borehole. This information suggests that the product has been recently released and has not migrated far from the source area. Hydrogeologic Cross Section B-B' (Plate P-20) in Appendix E shows an estimated extent of free-floating product based on the information gathered to date.

Approximately 20 feet of unsaturated silty and clayey soil underlies the product tanks. These type soils are finer grained and typically contain higher organic material content than sandy

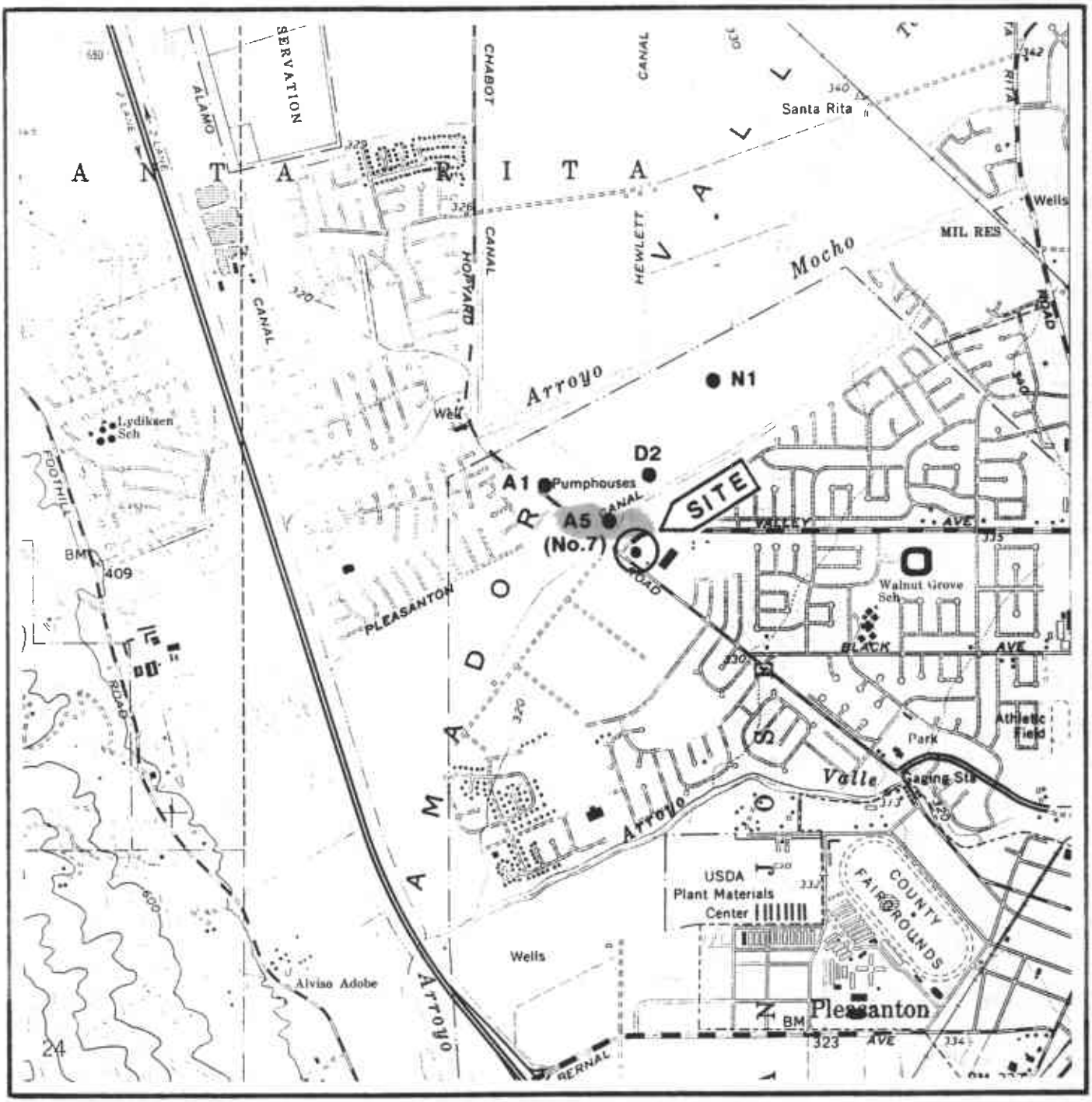
and gravelly soil. Consequently, these soils have a relatively high capacity to adsorb downward-migrating hydrocarbon product. A relatively large percentage of the estimated 639 gallons of product released is probably adsorbed to soil particle surfaces in this soil interval. Approximately 6 percent of this product has been recovered to date. Additional product will be recovered by the automatic skimmer pump installed in well MW-2 to minimize migration of the product plume. The evidence collected thus far suggests that the volume of floating product which has migrated to the ground water is not large.

REFERENCES CITED

California Department of Water Resources, 1966, Evaluation of ground water resources, Livermore and Sunol Valleys, Appendix A: geology: California Department of Water Resources Bulletin No. 118-2.

_____, 1974, Evaluation of ground water resources: Livermore and Sunol Valleys: California Department of Water Resources Bulletin 118-2, 153 p.

APPENDIX A



Source: U.S. Geological Survey
7.5-Minute Quadrangle
Dublin, California
Photorevised 1980

● = Water-supply well

N

Approximate Scale
2000 1000 0 2000 4000
feet

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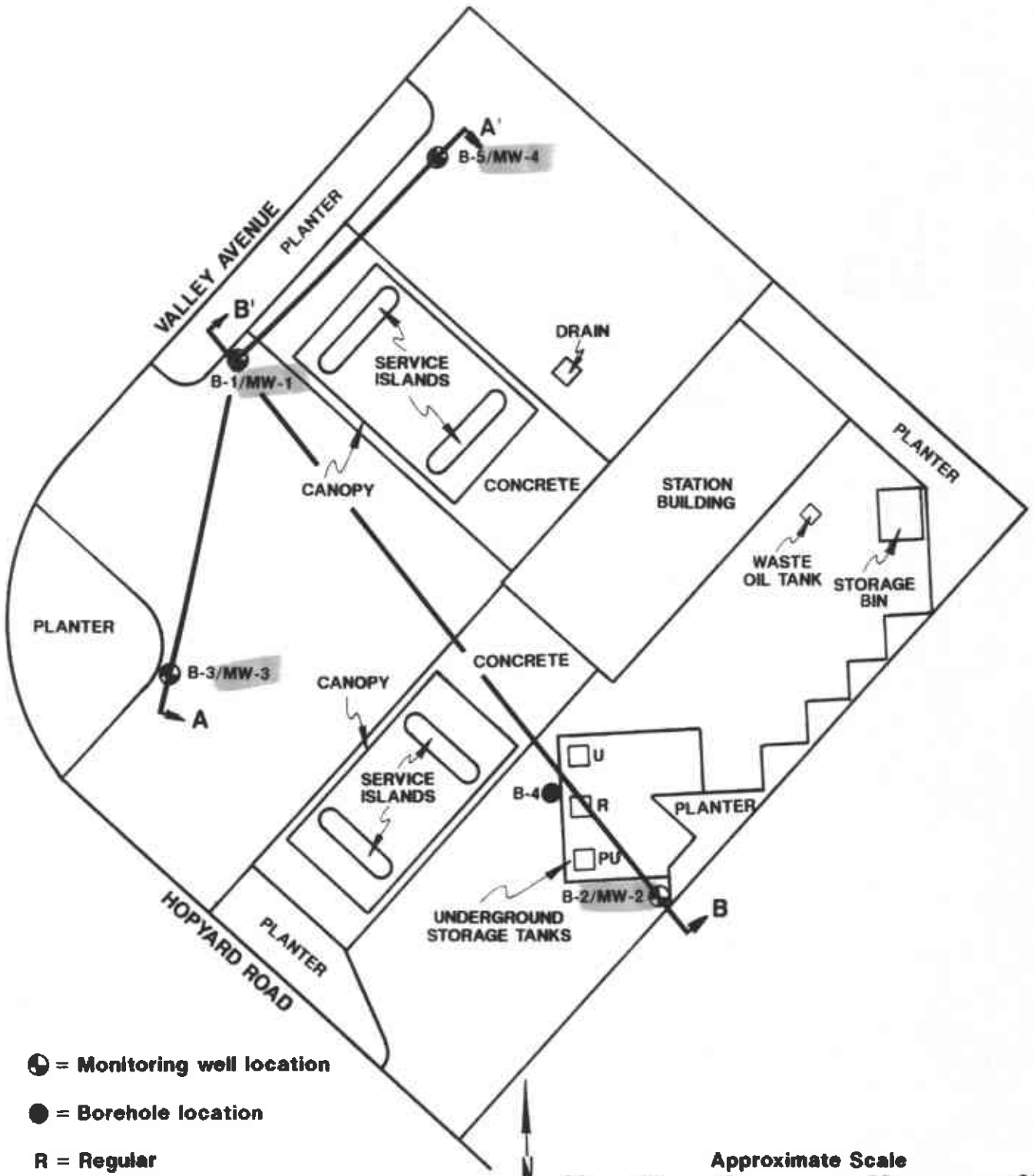
PROJECT NO. AGS 018034-1

SITE VICINITY MAP
Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE
P - 1



◔ = Monitoring well location

● = Borehole location

R = Regular

U = Unleaded

PU = Premium Unleaded

A A' = Location of hydrogeologic cross section

N

Approximate Scale

30 15 0 30 60

feet

Source: Measured by transit, compass and stadia

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PROJECT NO. AGS 018034-1

GENERALIZED SITE PLAN
Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE
P - 2

APPENDIX B

ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
5997 PARKSIDE DRIVE • PLEASANTON, CALIFORNIA 94566 • (415) 484-2600

15 April 1988

Ms. Robin Ross
Applied Geosystems
43255 Mission Boulevard
Fremont, CA 94539

Dear Ms. Ross:

Enclosed is Groundwater Protection Ordinance permit 88122 for your monitoring well construction project at 2991 Hopyard Road in Pleasanton for Exxon Company.

Please note that permit condition A-1 requests that an application be submitted five days prior to your proposed start of work. Also note that condition A-3 requires that the report, consisting of logs and location sketch, be submitted after completion of the work.

If you have any questions, please contact Wyman Hong or Craig Mayfield at 484-2600.

Very truly yours,

Mun J. Mar
General Manager

By J. Killingstad
J. Killingstad, Chief
Water Resources Engineering

WH:bkm
Enc.

ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

5997 PARKSIDE DRIVE • PLEASANTON, CALIFORNIA 94566 • (415) 484-2600

GROUNDWATER PROTECTION ORDINANCE PERMIT APPLICATION

FOR APPLICANT TO COMPLETE

#7-3399

FOR OFFICE USE

PERMIT NUMBER 88122

LOCATION NUMBER

(1) LOCATION OF PROJECT EXXON SERVICE STATION
2991 HOPYARD ROAD
PLEASANTON, CA

(2) CLIENT
Name EXXON COMPANY, U.S.A.
Address P.O. BOX 4415 Phone (713) 656-7755
City HOUSTON, TX Zip 77210-4415

Approved Wyman Hong Date 31 Mar 88
Wyman Hong

(3) APPLICANT
Name APPLIED GEOSYSTEMS
Address 43255 MISSION BLVD Phone (415) 651-1906
City FREMONT, CA Zip 94539

(4) DESCRIPTION OF PROJECT
Water Well Construction X Geotechnical ___
Cathodic Protection ___ Well Destruction ___

(5) PROPOSED WATER WELL USE
Domestic ___ Industrial ___ Irrigation ___
Municipal ___ Monitoring X Other ___

(6) PROPOSED CONSTRUCTION
Drilling Method:
Mud Rotary ___ Air Rotary ___ Auger ___
Cable ___ Other HOLLOW-STEM AUGER

WELL PROJECTS MONITORING WELL 4
Drill Hole Diameter 10 in. Depth(s) 60 ft.
Casing Diameter 4 in. Number
Surface Seal Depth 30 ft. of Wells 1 *
Driller's License No. ___

GEOTECHNICAL PROJECTS
Number ___
Diameter ___ in. Maximum Depth ___ ft.

(7) ESTIMATED STARTING DATE 4/1/88
ESTIMATED COMPLETION DATE 4/7/88

(8) I hereby agree to comply with all requirements of this permit and Alameda County Ordinance No. 73-68.

APPLICANT'S SIGNATURE C. Robin Ross Date 4/11/88

PERMIT CONDITIONS

Circled Permit Requirements Apply

(A.) GENERAL
1. A permit application should be submitted so as to arrive at the Zone 7 office five days prior to proposed starting date.
2. Notify this office (484-2600) at least one day prior to starting work on permitted work and before placing well seals.
3. Submit to Zone 7 within 60 days after completion of permitted work the original Department of Water Resources Water Well Drillers Report or equivalent for well projects, or bore hole logs and location sketch for geotechnical projects. Permitted work is completed when the last surface seal is placed or the last boring is completed.
4. Permit is void if project not begun within 90 days of approval date.

(B.) WATER WELLS, INCLUDING PIEZOMETERS
1. Minimum surface seal thickness is two inches of cement grout placed by tremie, or equivalent.
2. Minimum seal depth is 50 feet for municipal and industrial wells or 20 feet for domestic, irrigation, and monitoring wells unless a lesser depth is specially approved.

C. GEOTECHNICAL. Backfill bore hole with compacted cuttings or heavy bentonite and upper two feet with compacted material.

D. CATHODIC. Fill hole above anode zone with concrete placed by tremie, or equivalent.

E. WELL DESTRUCTION. See attached.

* four monitoring wells

91987

APPENDIX C

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS		LTR	DESCRIPTION
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded gravels or gravel sand mixtures, little or no fines.
		GP	Poorly-graded gravels or gravel sand mixture, little or no fines
		GM	Silty gravels, gravel-sand-clay mixtures.
		GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded sands or gravelly sands, little or no fines.
		SP	Poorly-graded sands or gravelly sands, little or no fines.
		SM	Silty sands, sand-silt mixtures.
		SC	Clayey sands, sand-clay mixtures.

MAJOR DIVISIONS		LTR	DESCRIPTION
FINE GRAINED SOILS	SILTS AND CLAYS LL<50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silt-clays of low plasticity.
	SILTS AND CLAYS LL<50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.

Depth through which sampler is driven

Relatively undisturbed sample

Missed sample

Ground water level observed in boring

S-10 Sample number

Sand pack

Bentonite annular seal

Neat cement annular seal

Blank PVC

Machine-slotted PVC

BLOW/FT. REPRESENTS THE NUMBER OF BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES TO DRIVE THE SAMPLER THROUGH THE LAST 12 INCHES OF AN 18 INCH PENETRATION.

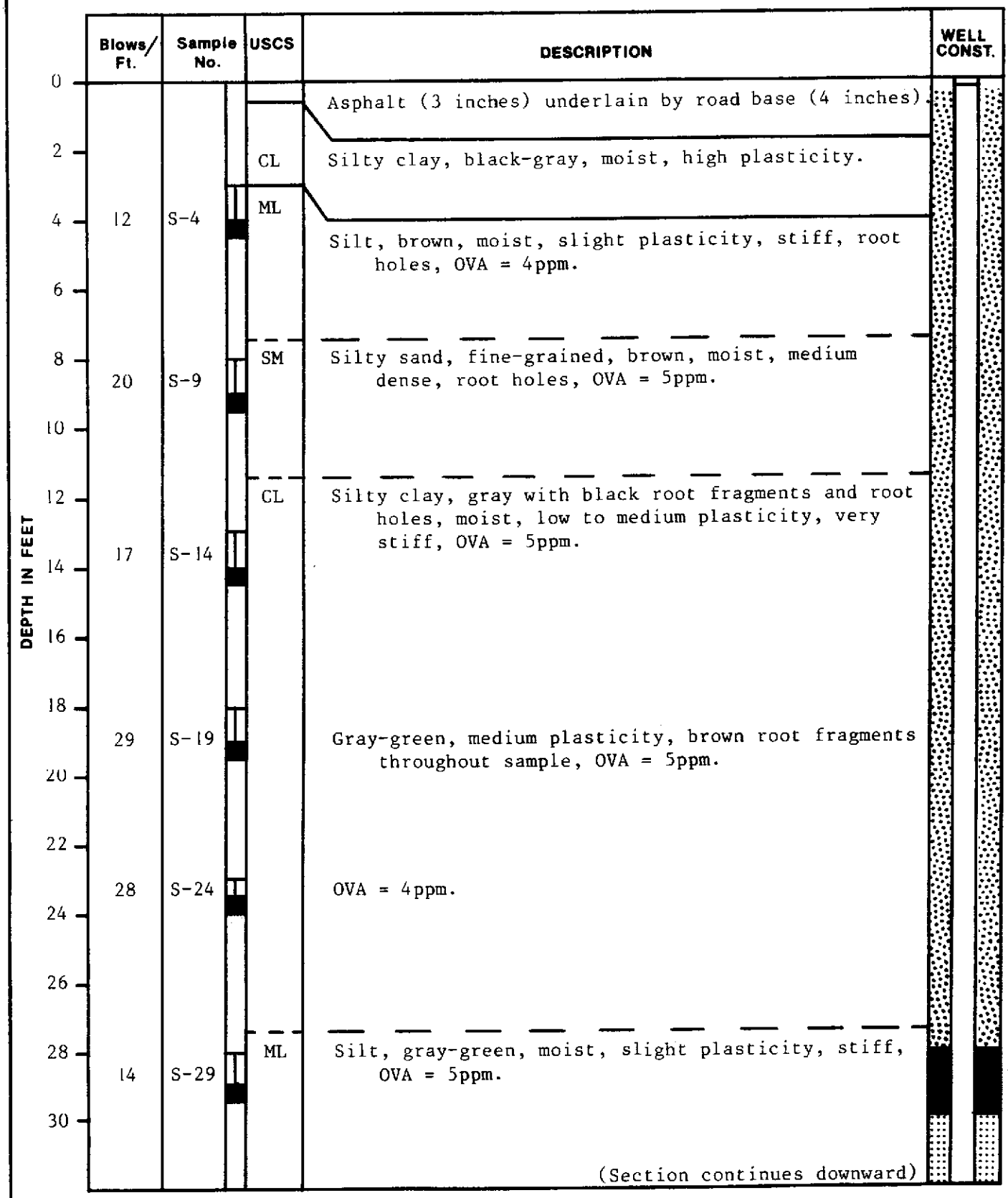
DASHED LINES SEPARATING UNITS ON THE LOG REPRESENT APPROXIMATE BOUNDARIES ONLY. ACTUAL BOUNDARIES MAY BE GRADUAL. LOGS REPRESENT SUBSURFACE CONDITIONS AT THE BORING LOCATION AT THE TIME OF DRILLING ONLY.

Applied GeoSystems
43255 Mission Blvd Suite B Fremont, CA 94539 (415) 651-1906

PROJECT NO. AGS 018034-1

UNIFIED SOIL CLASSIFICATION SYSTEM AND SYMBOL KEY
Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE
P - 3



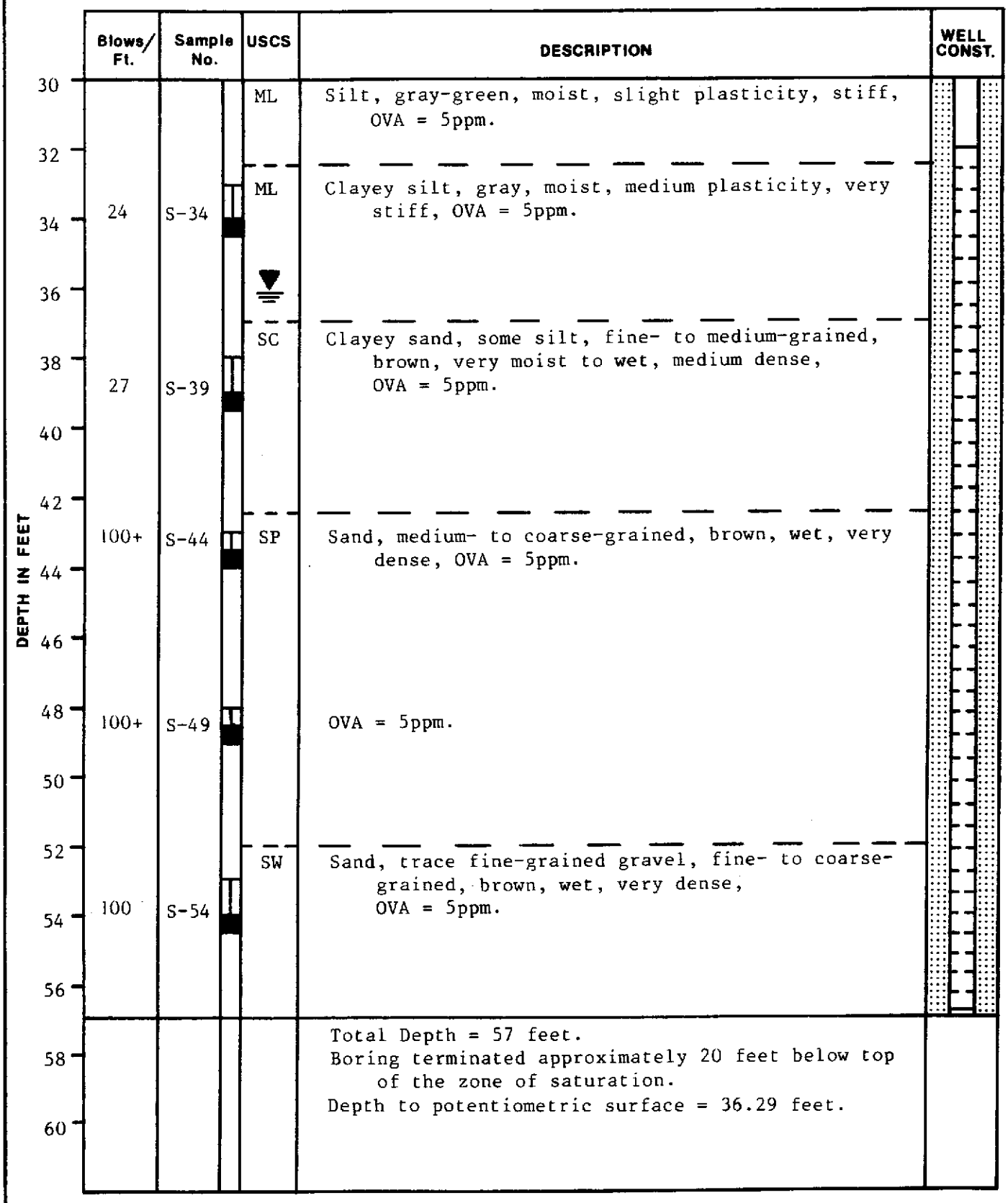
Applied GeoSystems
43255 Mission Blvd Suite B Fremont, CA 94539 (415) 651-1906

PROJECT NO. AGS 018034-1

LOG OF BORING [redacted]

Exxon Station No. 7-3390
2991 Hopyard Road
Pleasanton, California

PLATE
P - 4



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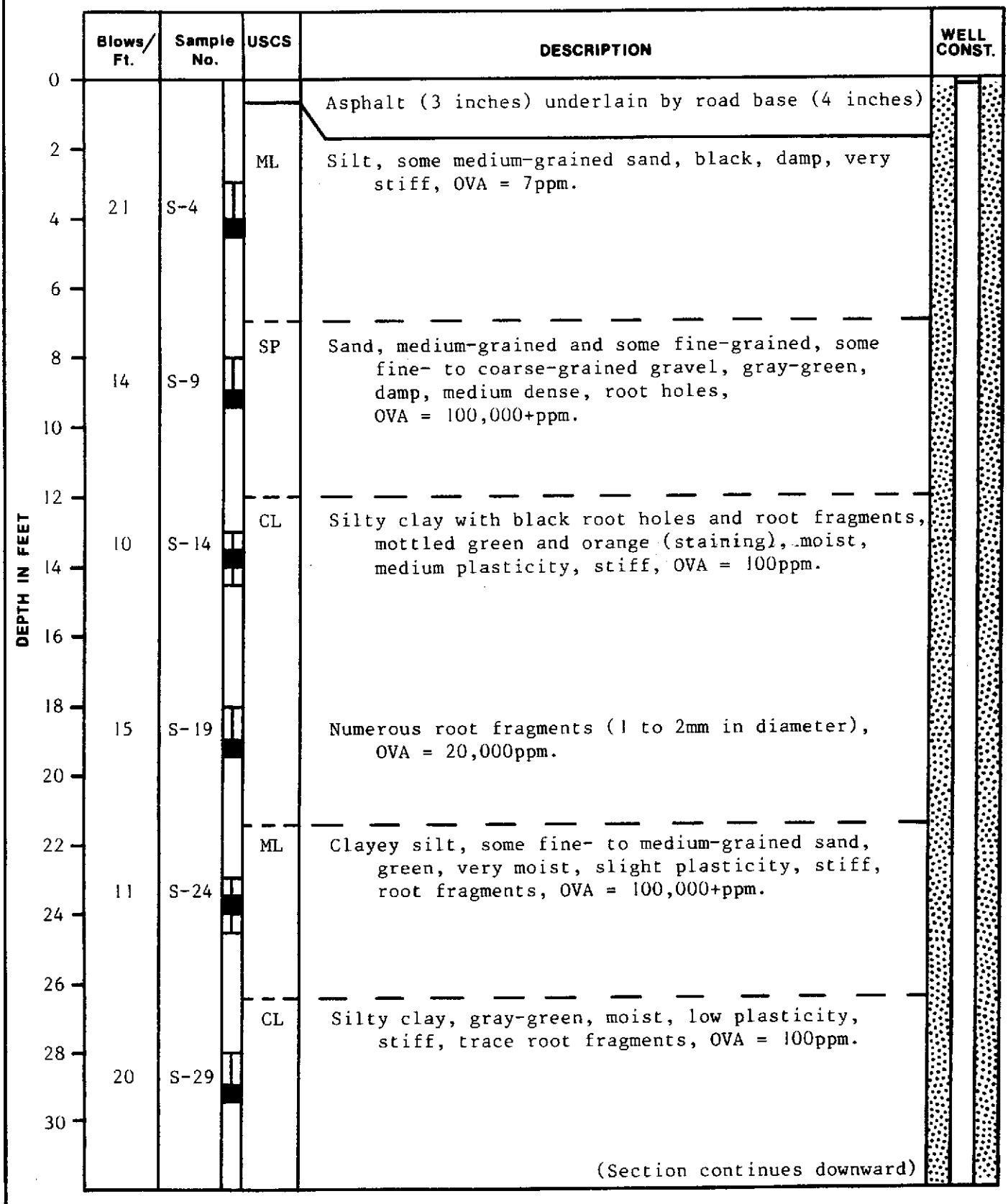
PROJECT NO. AGS 018034-1

LOG OF BORING MW - 1

Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE
P - 5



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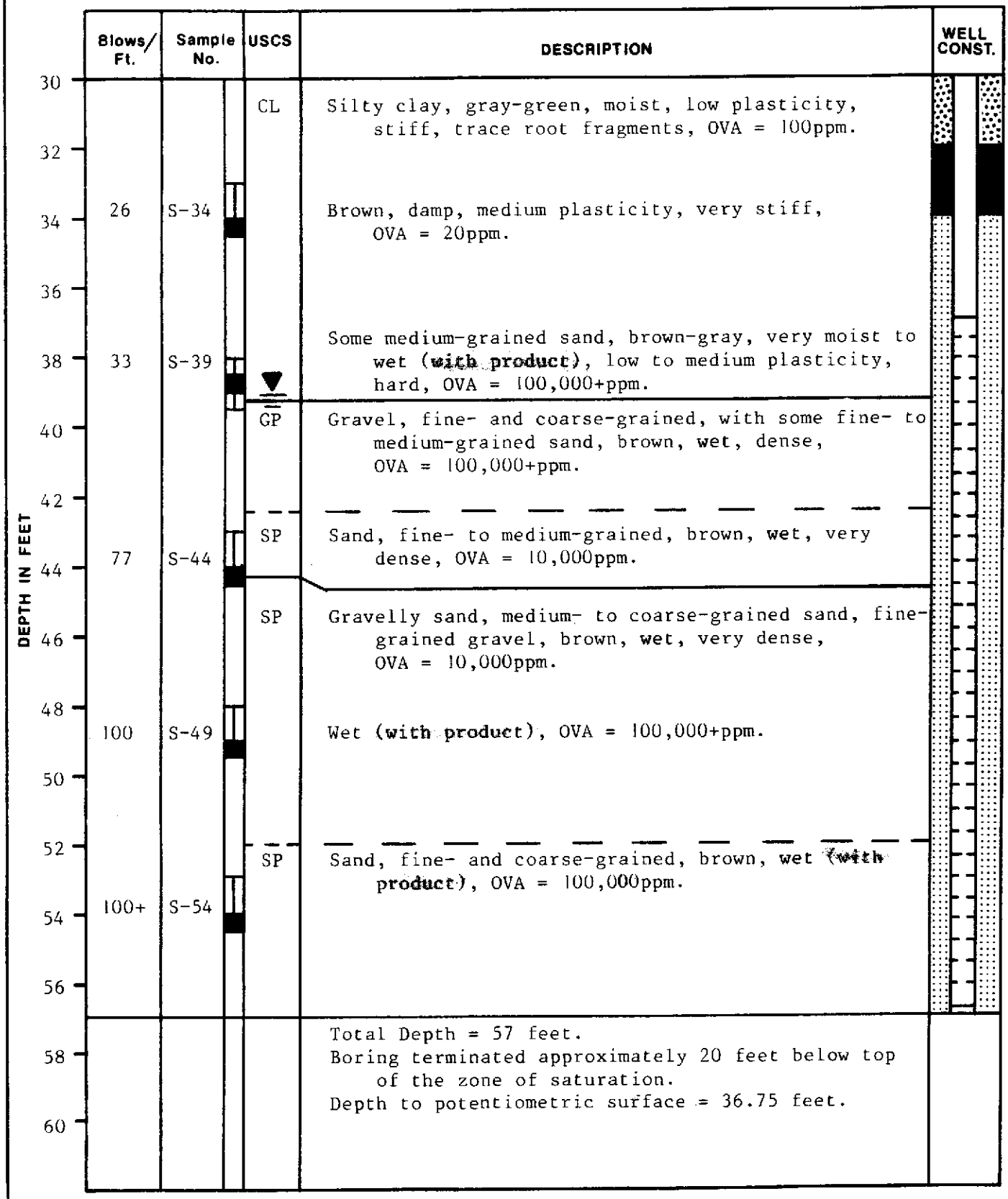
PROJECT NO. AGS 018034-1

LOG OF BORING [redacted]

Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE
P - 6



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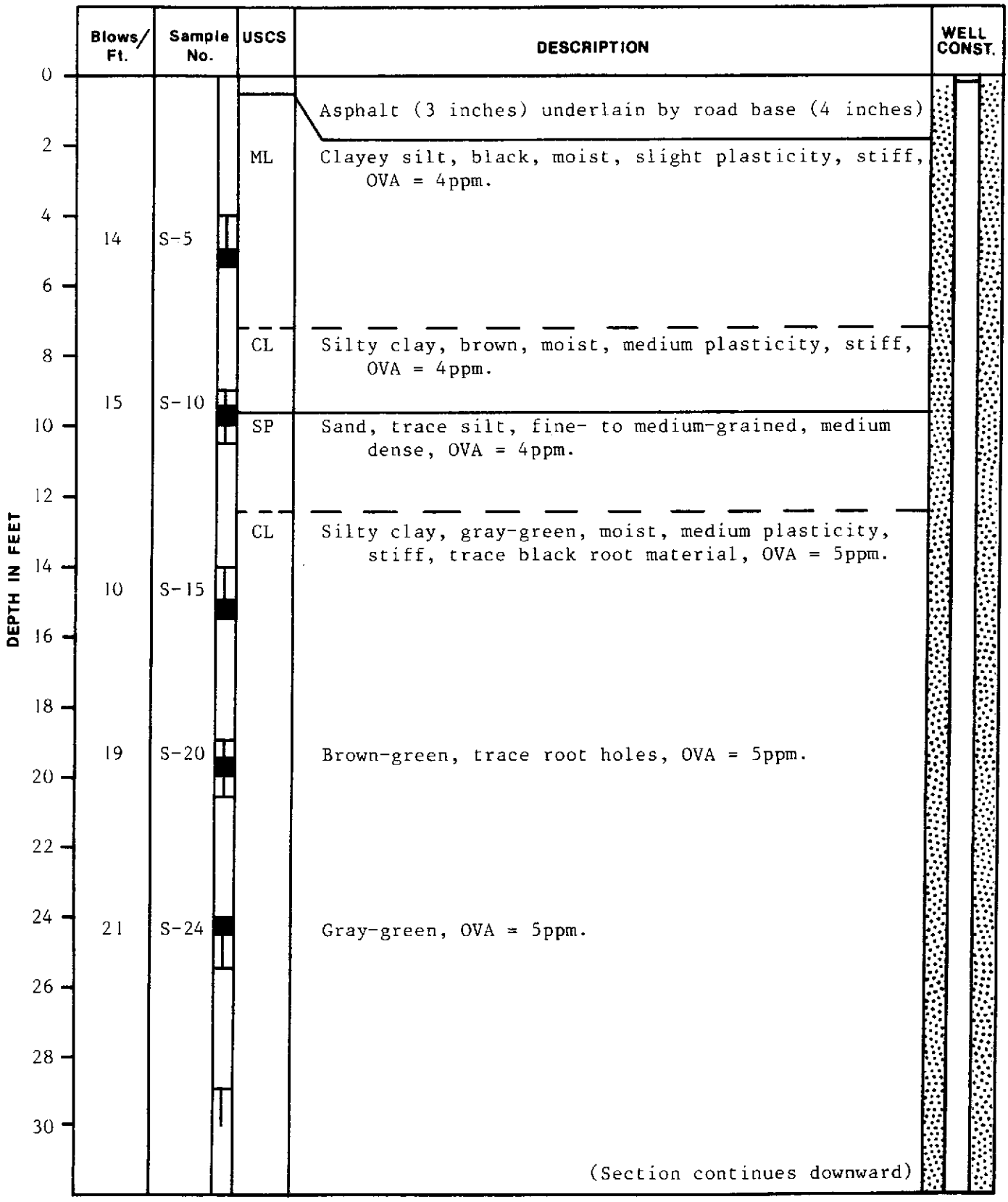
PROJECT NO. AGS 018034-1

LOG OF BORING MW - 2

Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE
P - 7



Applied GeoSystems
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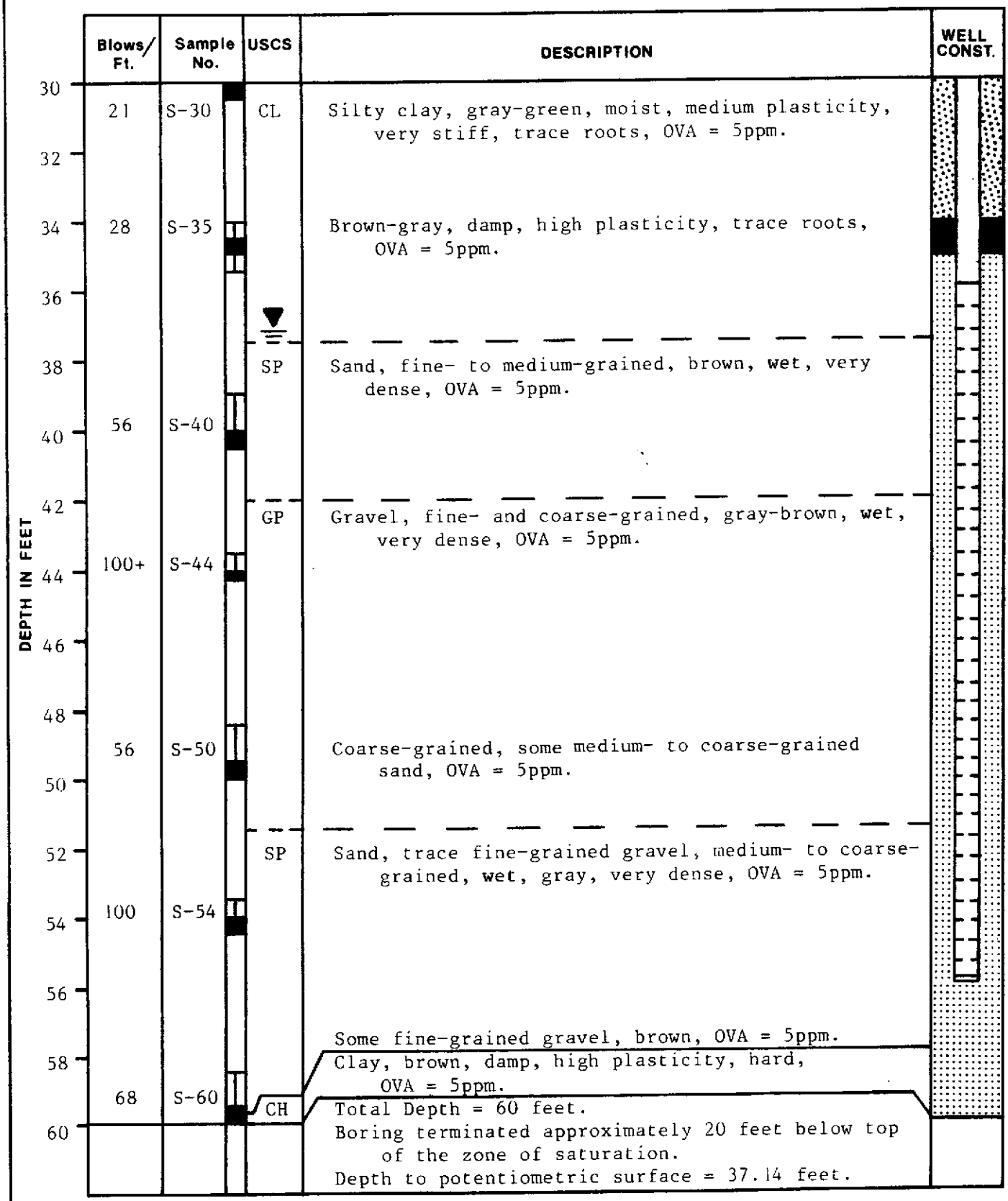
PROJECT NO. AGS 018034-1

LOG OF BORING [redacted]3

Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE
P - 8



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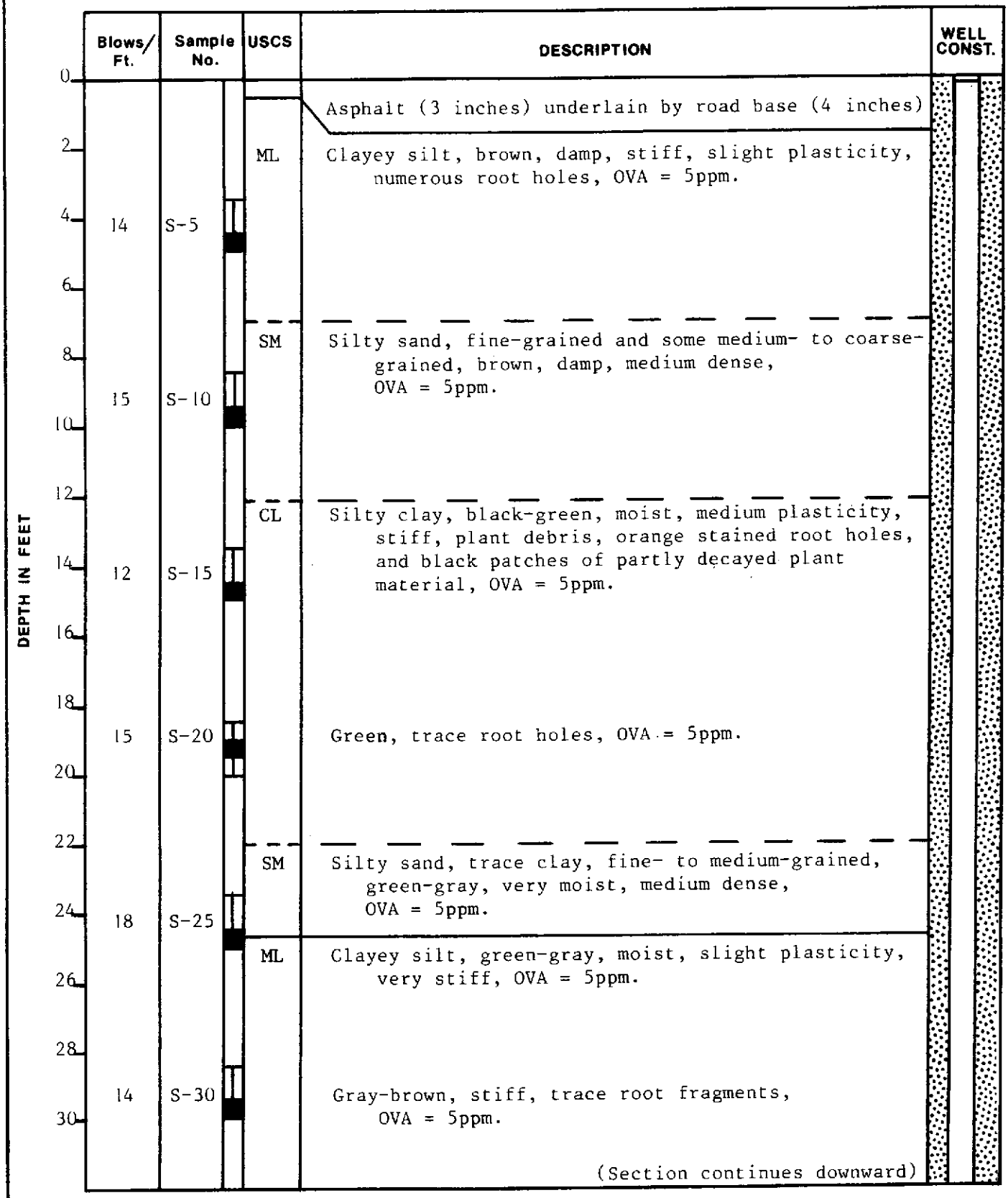
PROJECT NO. AGS 018034-1

LOG OF BORING MW - 3

Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE
P - 9



Applied GeoSystems
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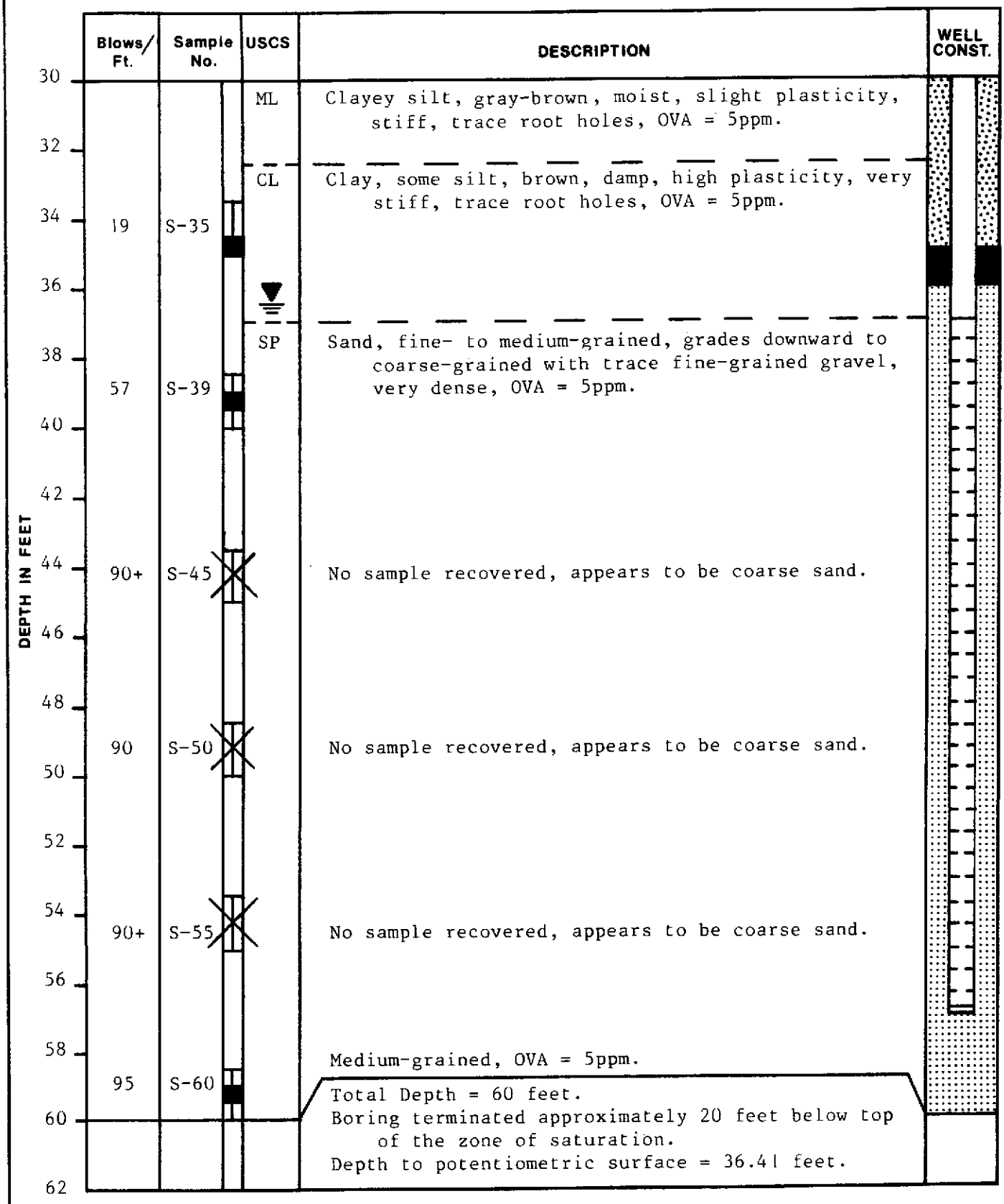
PROJECT NO. AGS 018034-1

LOG OF BORING [redacted]

Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE
P - 10



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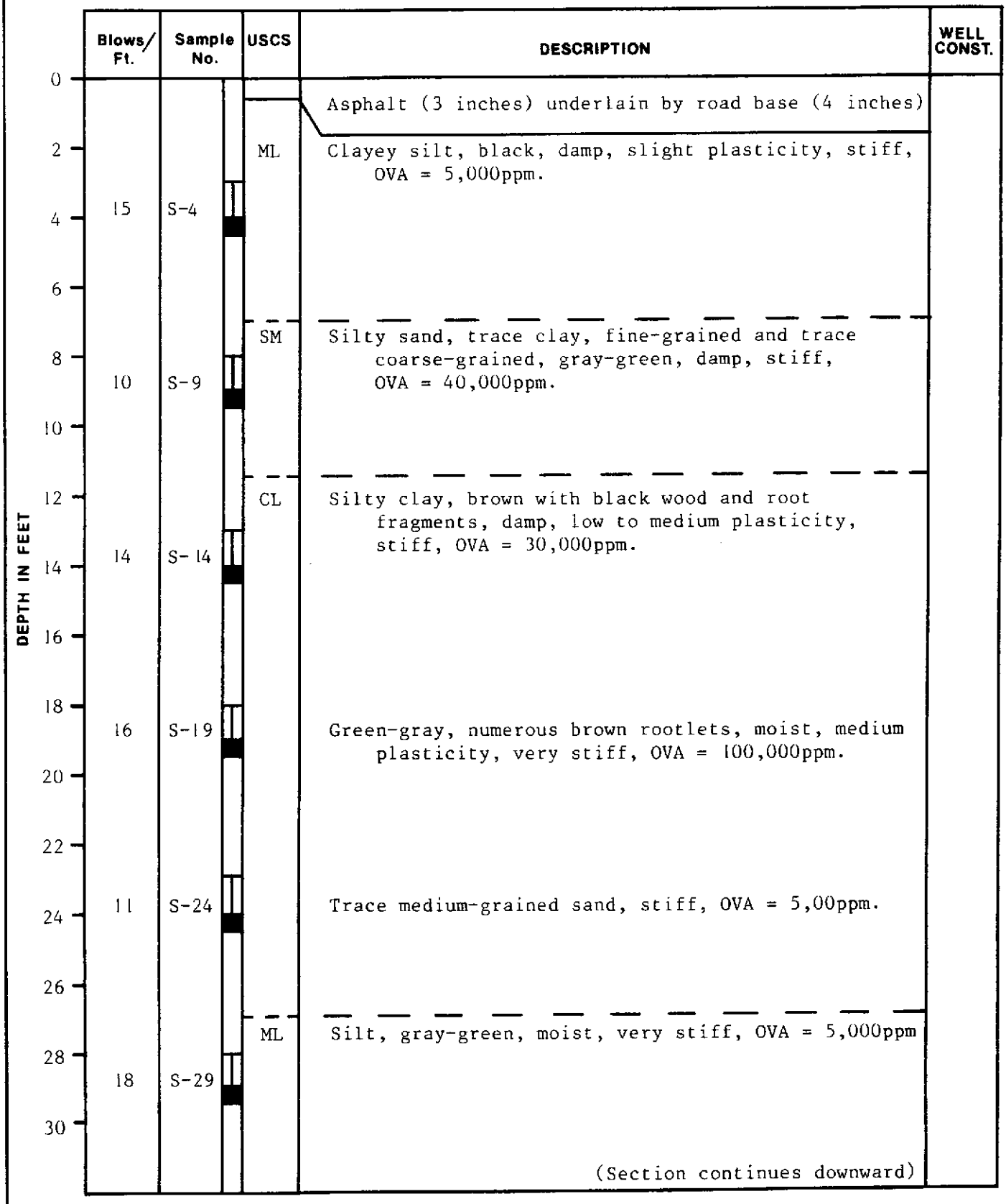
PROJECT NO. AGS 018034-1

LOG OF BORING MW - 4

Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE
P - 11



Applied GeoSystems
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PROJECT NO. AGS 018034-1

LOG OF BORING B - 4

Exxon Station No. 7-3399

2991 Hopyard Road

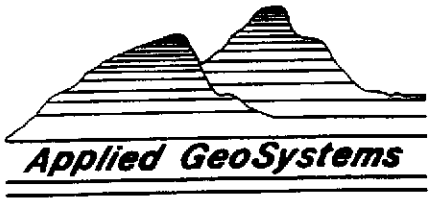
Pleasanton, California

PLATE

P - 12

APPENDIX D

CHAIN OF CUSTODY RECORD



43255 Mission Blvd. Suite B Fremont, CA 94539 (415) 651-1906

SAMPLER (signature): William Rivera

Phone: (415) 651-1906

LABORATORY: Applied GeoSystems

TURNAROUND TIME: < 24 hr

Project Leader: Rodger Witham

Phone No. (415) 651-1906

SHIPPING INFORMATION:

Shipper

Address

Date Shipped

Service Used

Airbill No. Cooler No.

Relinquished by: (signatures)	Received by: (signatures)	Date	Time
William Rivera			
	Received for laboratory by:	4-2-88	8:00Am

LABORATORY SHOULD SIGN UPON RECEIPT AND RETURN A COPY OF THIS FORM WITH THE LABORATORY RESULTS

Sample No.	Site Identification	Date Sampled	Analyses Requested	Sample Condition Upon Receipt
S-34½-B4	018034-1	4 1 88	TPH	ICE
S-19½-B4	018034-1	4 1 88	TPH	ICE
S-29½-B4	018034-1	4 1 88	TPH	ICE
S-34½-B4	018034-1	4 1 88	TPH	

CHAIN OF CUSTODY RECORD

SAMPLER (signature): [signature]

Phone:

LABORATORY: Applied GeoSystems

TURNAROUND TIME: 24 hours

Project Leader: Rodger Witham

Phone No. (415) 651-1906

Applied GeoSystems

43255 Mission Blvd. Suite B Fremont, CA 94539 (415) 651-1906

SHIPPING INFORMATION:

Shipper

Address

Date Shipped

Service Used

Airbill No. Cooler No.

Relinquished by: ~~(signatures)~~	Received by: (signatures)	Date	Time
[signature]			
	Received for laboratory by: [signature]	4-7-88	9:40 AM

LABORATORY SHOULD SIGN UPON RECEIPT AND RETURN A COPY OF THIS FORM WITH THE LABORATORY RESULTS

Sample No.	Site Identification	Date Sampled	Analyses Requested	Sample Condition Upon Receipt
S-34½-B2	018034-1	4/2/88	TPH (EPA 8015)	Iced

CHAIN OF CUSTODY RECORD

SAMPLER (signature): William [signature]

Phone: (415) 651-1906

Applied GeoSystems

43255 Mission Blvd. Suite B Fremont, CA 94539 (415) 651-1906

LABORATORY: Applied GeoSystems

TURNAROUND TIME: RCW ~~1 week~~ 24 hours

Project Leader: Rodger Witham

Phone No. (415) 651-1906

SHIPPING INFORMATION:

Shipper

Address

Date Shipped

Service Used

Airbill No. Cooler No.

Relinquished by: (signatures)	Received by: (signatures)	Date	Time
William [signature]	Rodger C. Witham	4/6/88	9:00 am
Rodger C. Witham	Received for laboratory by: [signature]	4-6-88	9:00 AM

LABORATORY SHOULD SIGN UPON RECEIPT AND RETURN A COPY OF THIS FORM WITH THE LABORATORY RESULTS

Sample No.	Site Identification	Date Sampled	Analyses Requested	Sample Condition Upon Receipt
S-35-B3	018034-1	4/4/88	TPH (EPA 8015)	Ice

CHAIN OF CUSTODY RECORD

Applied GeoSystems
43255 Mission Blvd. Suite B Fremont, CA 94539 (415) 651-1906

SAMPLER (signature): William Stinar
Phone: (415) 651 1906

LABORATORY: Applied GeoSystems

TURNAROUND TIME: 24 hours

Project Leader: Rodger Witham
Phone No. (415) 651-1906

SHIPPING INFORMATION:
Shipper
Address
Date Shipped
Service Used
Airbill No. Cooler No.

Relinquished by: (signatures)	Received by: (signatures)	Date	Time
William Stinar	Rodger C. Witham	4/7/88	9:40 a.m.
Rodger C. Witham	Received for laboratory by:	4-7-88	9:40 AM

LABORATORY SHOULD SIGN UPON RECEIPT AND RETURN A COPY OF THIS FORM WITH THE LABORATORY RESULTS

Sample No.	Site Identification	Date Sampled	Analyses Requested	Sample Condition Upon Receipt
S-35-B5	018034-1	4/6/88	TPH (EPA 8015)	Iced
W-39-MW3	018034-1	4/6/88	TPH (EPA 8015)	Iced
			BTEX (EPA 602)	Iced

CHAIN OF CUSTODY RECORD

SAMPLER (signature): [signature]

Phone: (415) 651-1906

LABORATORY: Applied GeoSystems

TURNAROUND TIME: 24-hour

Project Leader: Rodger Witham

Phone No. (415) 651-1906

Applied GeoSystems

43255 Mission Blvd Suite B Fremont, CA 94539 (415) 651-1906

SHIPPING INFORMATION:

Shipper

Address

Date Shipped

Service Used

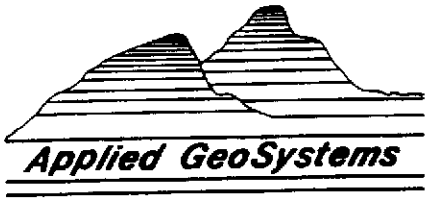
Airbill No. Cooler No.

Relinquished by: (signatures)	Received by: (signatures)	Date	Time
[signature]	Rodger C. Witham	4/4/88	9:00 a.m.
Rodger C. Witham	Received for laboratory by: [signature]	4.4.88	15:45

LABORATORY SHOULD SIGN UPON RECEIPT AND RETURN A COPY OF THIS FORM WITH THE LABORATORY RESULTS

Sample No.	Site Identification	Date Sampled	Analyses Requested	Sample Condition Upon Receipt
W-38-MW1	018034-1	4/2/88	TPH (8015)	ICE + HCl
W			BTEX (602)	

CHAIN OF CUSTODY RECORD



43255 Mission Blvd Suite B Fremont, CA 94539 (415) 651-1906

SAMPLER (signature): Tim O'Brien

Phone: 415 651 1906

LABORATORY: Applied GeoSystems

TURNAROUND TIME: 24 hrs.

Project Leader: Rodger Witham

Phone No. 415 651 1906

SHIPPING INFORMATION:

Shipper _____

Address _____

Date Shipped _____

Service Used _____

Airbill No. _____ Cooler No. _____

Relinquished by: (signatures)	Received by: (signatures)	Date	Time
Tim O'Brien			
	Received for laboratory by:	4-11-88	14:30

LABORATORY SHOULD SIGN UPON RECEIPT AND RETURN A COPY OF THIS FORM WITH THE LABORATORY RESULTS

Sample No.	Site Identification	Date Sampled	Analyses Requested	Sample Condition Upon Receipt
W-37-MW4	018034-1	4/1/88	TPH(8015) & BETX(602)	iced

Applied GeoSystems 43255 Mission Boulevard, Fremont, CA 94539 (415) 651-1906

• FREMONT • COSTA MESA • SACRAMENTO • HOUSTON

ANALYSIS REPORT

0212lab.frm

Report Prepared for:
Applied GeoSystems
43255 Mission Blvd.
Fremont, CA 94539
Attention: Rodger C. Witham

Date Received: 4-02-88
Laboratory Number: 04007S01
Project: 018034-1
Sample: S-34.5-B1
Matrix: Soil

Parameter	Result (mg/kg)	Result (mg/L)	Detection Limit (mg/kg)	Detection Limit (mg/L)	Date Analyzed	Notes
TVH as Gasoline	ND		2		04-02-88	NR
TPH as Gasoline						
TEH as Diesel						NR
Benzene						NR
Toluene						NR
Ethylbenzene						NR
Total Xylenes						NR

mg/kg = milligrams per kilogram = parts per million (ppm).
mg/L = milligrams per liter = ppm.
ND = Not detected. Compound(s) may be present at concentrations below the detection limit.
NR = Analysis not required.

PROCEDURES

TVH/BTEX--Total volatile hydrocarbons (TVH) and benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction according to EPA Method 5030 followed by analysis by a EPA Method 8020/602 (modified for TVH) which uses a gas chromatograph (GC) equipped with a photo-ionization detector (PID) and a flame-ionization detector (FID) in series. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TPH--Total petroleum hydrocarbons (low-to-medium boiling points) are measured by extraction according to EPA Method 5030 followed by analysis by a modified EPA Method 8015 which uses a GC equipped with an FID. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TEH--Total extractable hydrocarbons (high boiling points) are measured by extraction according to EPA Method 3550 for soils or EPA Method 3510 for water followed by a modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

Tia Tran, Laboratory Supervisor

4-08-88
Date Reported

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ANALYSIS REPORT

0212lab.frm

Report Prepared for:
Applied GeoSystems
43255 Mission Blvd.
Fremont, CA 94539
Attention: Rodger C. Witham

Date Received: 4-07-88
Laboratory Number: 04011S01
Project: 018034-1
Sample: S-34.5-B2
Matrix: Soil

Parameter	Result (mg/kg)	Result (mg/L)	Detection Limit (mg/kg)	Detection Limit (mg/L)	Date Analyzed	Notes
TVH as Gasoline						NR
TPH as Gasoline	ND		2		04-07-88	
TEH as Diesel						NR
Benzene						NR
Toluene						NR
Ethylbenzene						NR
Total Xylenes						NR

mg/kg = milligrams per kilogram = parts per million (ppm).
mg/L = milligrams per liter = ppm.
ND = Not detected. Compound(s) may be present at concentrations below the detection limit.
NR = Analysis not required.

PROCEDURES

TVH/BTEX--Total volatile hydrocarbons (TVH) and benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction according to EPA Method 5030 followed by analysis by a EPA Method 8020/602 (modified for TVH) which uses a gas chromatograph (GC) equipped with a photo-ionization detector (PID) and a flame-ionization detector (FID) in series. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TPH--Total petroleum hydrocarbons (low-to-medium boiling points) are measured by extraction according to EPA Method 5030 followed by analysis by a modified EPA Method 8015 which uses a GC equipped with an FID. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TEH--Total extractable hydrocarbons (high boiling points) are measured by extraction according to EPA Method 3550 for soils or EPA Method 3510 for water followed by a modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

Tia Tran, Laboratory Supervisor

4-08-88
Date Reported

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Report Prepared for:
Applied GeoSystems
43255 Mission Blvd.
Fremont, CA 94539
Attention: Rodger C. Witham

Date Received: 4-06-88
Laboratory Number: 04019S01
Project: 018034-1
Sample: S-35-B3
Matrix: Soil

Parameter	Result (mg/kg)	Result (mg/L)	Detection Limit (mg/kg)	Detection Limit (mg/L)	Date Analyzed	Notes
TVH as Gasoline						NR
TPH as Gasoline	ND		2		04-07-88	
TEH as Diesel						NR
Benzene						NR
Toluene						NR
Ethylbenzene						NR
Total Xylenes						NR

mg/kg = milligrams per kilogram = parts per million (ppm).
mg/L = milligrams per liter = ppm.
ND = Not detected. Compound(s) may be present at concentrations below the detection limit.
NR = Analysis not required.

PROCEDURES

TVH/BTEX--Total volatile hydrocarbons (TVH) and benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction according to EPA Method 5030 followed by analysis by a EPA Method 8020/602 (modified for TVH) which uses a gas chromatograph (GC) equipped with a photo-ionization detector (PID) and a flame-ionization detector (FID) in series. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TPH--Total petroleum hydrocarbons (low-to-medium boiling points) are measured by extraction according to EPA Method 5030 followed by analysis by a modified EPA Method 8015 which uses a GC equipped with an FID. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TEH--Total extractable hydrocarbons (high boiling points) are measured by extraction according to EPA Method 3550 for soils or EPA Method 3510 for water followed by a modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

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Report Prepared for:
Applied GeoSystems
43255 Mission Blvd.
Fremont, CA 94539
Attention: Rodger C. Witham

Date Received: 4-02-88
Laboratory Number: 04007S02
Project: 018034-1
Sample: S-19.5-B4
Matrix: Soil

Parameter	Result (mg/kg)	Result (mg/L)	Detection Limit (mg/kg)	Detection Limit (mg/L)	Date Analyzed	Notes
TVH as Gasoline						NR
TPH as Gasoline	965		20		04-02-88	
TEH as Diesel						NR
Benzene						NR
Toluene						NR
Ethylbenzene						NR
Total Xylenes						NR

mg/kg = milligrams per kilogram = parts per million (ppm).
mg/L = milligrams per liter = ppm.
ND = Not detected. Compound(s) may be present at concentrations below the detection limit.
NR = Analysis not required.

PROCEDURES

TVH/BTEX--Total volatile hydrocarbons (TVH) and benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction according to EPA Method 5030 followed by analysis by a EPA Method 8020/602 (modified for TVH) which uses a gas chromatograph (GC) equipped with a photo-ionization detector (PID) and a flame-ionization detector (FID) in series. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TPH--Total petroleum hydrocarbons (low-to-medium boiling points) are measured by extraction according to EPA Method 5030 followed by analysis by a modified EPA Method 8015 which uses a GC equipped with an FID. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TEH--Total extractable hydrocarbons (high boiling points) are measured by extraction according to EPA Method 3550 for soils or EPA Method 3510 for water followed by a modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

Tia Tran, Laboratory Supervisor

4-08-88
Date Reported

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Report Prepared for:
Applied GeoSystems
43255 Mission Blvd.
Fremont, CA 94539
Attention: Rodger C. Witham

Date Received: 4-02-88
Laboratory Number: 04007S03
Project: 018034-1
Sample: S-29.5-B4
Matrix: Soil

Parameter	Result (mg/kg)	Result (mg/L)	Detection Limit (mg/kg)	Detection Limit (mg/L)	Date Analyzed	Notes
TVH as Gasoline						NR
TPH as Gasoline	3		2		04-02-88	
TEH as Diesel						NR
Benzene						NR
Toluene						NR
Ethylbenzene						NR
Total Xylenes						NR

mg/kg = milligrams per kilogram = parts per million (ppm).
mg/L = milligrams per liter = ppm.
ND = Not detected. Compound(s) may be present at concentrations below the detection limit.
NR = Analysis not required.

PROCEDURES

TVH/BTEX--Total volatile hydrocarbons (TVH) and benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction according to EPA Method 5030 followed by analysis by a EPA Method 8020/602 (modified for TVH) which uses a gas chromatograph (GC) equipped with a photo-ionization detector (PID) and a flame-ionization detector (FID) in series. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TPH--Total petroleum hydrocarbons (low-to-medium boiling points) are measured by extraction according to EPA Method 5030 followed by analysis by a modified EPA Method 8015 which uses a GC equipped with an FID. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TEH--Total extractable hydrocarbons (high boiling points) are measured by extraction according to EPA Method 3550 for soils or EPA Method 3510 for water followed by a modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

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Report Prepared for:
Applied GeoSystems
43255 Mission Blvd.
Fremont, CA 94539
Attention: Rodger C. Witham

Date Received: 4-02-88
Laboratory Number: 04007S04
Project: 018034-1
Sample: S-34.5-B4
Matrix: Soil

Parameter	Result (mg/kg)	Result (mg/L)	Detection Limit (mg/kg)	Detection Limit (mg/L)	Date Analyzed	Notes
TVH as Gasoline						NR
TPH as Gasoline	ND		2		04-02-88	
TEH as Diesel						NR
Benzene						NR
Toluene						NR
Ethylbenzene						NR
Total Xylenes						NR

mg/kg = milligrams per kilogram = parts per million (ppm).
mg/L = milligrams per liter = ppm.
ND = Not detected. Compound(s) may be present at concentrations below the detection limit.
NR = Analysis not required.

PROCEDURES

TVH/BTEX--Total volatile hydrocarbons (TVH) and benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction according to EPA Method 5030 followed by analysis by a EPA Method 8020/602 (modified for TVH) which uses a gas chromatograph (GC) equipped with a photo-ionization detector (PID) and a flame-ionization detector (FID) in series. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TPH--Total petroleum hydrocarbons (low-to-medium boiling points) are measured by extraction according to EPA Method 5030 followed by analysis by a modified EPA Method 8015 which uses a GC equipped with an FID. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TEH--Total extractable hydrocarbons (high boiling points) are measured by extraction according to EPA Method 3550 for soils or EPA Method 3510 for water followed by a modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

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Report Prepared for:
Applied GeoSystems
43255 Mission Blvd.
Fremont, CA 94539
Attention: Rodger C. Witham

Date Received: 4-07-88
Laboratory Number: 04020S01
Project: 018034-1
Sample: S-35-B5
Matrix: Soil

Parameter	Result (mg/kg)	Result (mg/L)	Detection Limit (mg/kg)	Detection Limit (mg/L)	Date Analyzed	Notes
TVH as Gasoline						NR
TPH as Gasoline	ND		2		04-07-88	
TEH as Diesel						NR
Benzene						NR
Toluene						NR
Ethylbenzene						NR
Total Xylenes						NR

mg/kg = milligrams per kilogram = parts per million (ppm).
mg/L = milligrams per liter = ppm.
ND = Not detected. Compound(s) may be present at concentrations below the detection limit.
NR = Analysis not required.

PROCEDURES

TVH/BTEX--Total volatile hydrocarbons (TVH) and benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction according to EPA Method 5030 followed by analysis by a EPA Method 8020/602 (modified for TVH) which uses a gas chromatograph (GC) equipped with a photo-ionization detector (PID) and a flame-ionization detector (FID) in series. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TPH--Total petroleum hydrocarbons (low-to-medium boiling points) are measured by extraction according to EPA Method 5030 followed by analysis by a modified EPA Method 8015 which uses a GC equipped with an FID. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TEH--Total extractable hydrocarbons (high boiling points) are measured by extraction according to EPA Method 3550 for soils or EPA Method 3510 for water followed by a modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

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Report Prepared for:
Applied GeoSystems
43255 Mission Blvd.
Fremont, CA 94539
Attention: Rodger C. Witham

Date Received: 4-04-88
Laboratory Number: 04009W01
Project: 018034-1
Sample: W-38-MW1
Matrix: Water

Parameter	Result (mg/kg)	Result (mg/L)	Detection Limit (mg/kg)	Detection Limit (mg/L)	Date Analyzed	Notes
TVH as Gasoline						NR
TPH as Gasoline		ND		0.02	04-04-88	
TEH as Diesel						NR
Benzene		ND		0.0005	04-04-88	
Toluene		0.0017		0.0005	04-04-88	
Ethylbenzene		ND		0.0005	04-04-88	
Total Xylenes		ND		0.0005	04-04-88	

mg/kg = milligrams per kilogram = parts per million (ppm).
mg/L = milligrams per liter = ppm.
ND = Not detected. Compound(s) may be present at concentrations below the detection limit.
NR = Analysis not required.

PROCEDURES

TVH/BTEX--Total volatile hydrocarbons (TVH) and benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction according to EPA Method 5030 followed by analysis by a EPA Method 8020/602 (modified for TVH) which uses a gas chromatograph (GC) equipped with a photo-ionization detector (PID) and a flame-ionization detector (FID) in series. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TPH--Total petroleum hydrocarbons (low-to-medium boiling points) are measured by extraction according to EPA Method 5030 followed by analysis by a modified EPA Method 8015 which uses a GC equipped with an FID. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TEH--Total extractable hydrocarbons (high boiling points) are measured by extraction according to EPA Method 3550 for soils or EPA Method 3510 for water followed by a modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

Tia Tran, Laboratory Supervisor

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Report Prepared for:
Applied GeoSystems
43255 Mission Blvd.
Fremont, CA 94539
Attention: Rodger C. Witham

Date Received: 4-07-88
Laboratory Number: 04021W01
Project: 018034-1
Sample: W-39-MW3
Matrix: Water

Parameter	Result (mg/kg)	Result (mg/L)	Detection Limit (mg/kg)	Detection Limit (mg/L)	Date Analyzed	Notes
TVH as Gasoline						NR
TPH as Gasoline		0.02		0.02	04-07-88	
TEH as Diesel						NR
Benzene		ND		0.0005	04-07-88	
Toluene		ND		0.0005	04-07-88	
Ethylbenzene		ND		0.0005	04-07-88	
Total Xylenes		ND		0.0005	04-07-88	

mg/kg = milligrams per kilogram = parts per million (ppm).
mg/L = milligrams per liter = ppm.
ND = Not detected. Compound(s) may be present at concentrations below the detection limit.
NR = Analysis not required.

PROCEDURES

TVH/BTEX--Total volatile hydrocarbons (TVH) and benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction according to EPA Method 5030 followed by analysis by a EPA Method 8020/602 (modified for TVH) which uses a gas chromatograph (GC) equipped with a photo-ionization detector (PID) and a flame-ionization detector (FID) in series. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TPH--Total petroleum hydrocarbons (low-to-medium boiling points) are measured by extraction according to EPA Method 5030 followed by analysis by a modified EPA Method 8015 which uses a GC equipped with an FID. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TEH--Total extractable hydrocarbons (high boiling points) are measured by extraction according to EPA Method 3550 for soils or EPA Method 3510 for water followed by a modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

Tia Tran, Laboratory Supervisor

4-08-88
Date Reported

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Report Prepared for:
Applied GeoSystems
43255 Mission Blvd.
Fremont, CA 94539
Attention: Rodger C. Witham

Date Received: 4-11-88
Laboratory Number: 04027W01
Project: 018034-1
Sample: W-37-MW4
Matrix: Water

Parameter	Result (mg/kg)	Result (mg/L)	Detection Limit (mg/kg)	Detection Limit (mg/L)	Date Analyzed	Notes
TVH as Gasoline						NR
TPH as Gasoline		0.08		0.02	04-11-88	
TEH as Diesel						NR
Benzene		0.0018		0.0005	04-11-88	
Toluene		0.0163		0.0005	04-11-88	
Ethylbenzene		0.0006		0.0005	04-11-88	
Total Xylenes		0.0071		0.0005	04-11-88	

mg/kg = milligrams per kilogram = parts per million (ppm).
mg/L = milligrams per liter = ppm.
ND = Not detected. Compound(s) may be present at concentrations below the detection limit.
NR = Analysis not required.

PROCEDURES

TVH/BTEX--Total volatile hydrocarbons (TVH) and benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction according to EPA Method 5030 followed by analysis by a EPA Method 8020/602 (modified for TVH) which uses a gas chromatograph (GC) equipped with a photo-ionization detector (PID) and a flame-ionization detector (FID) in series. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

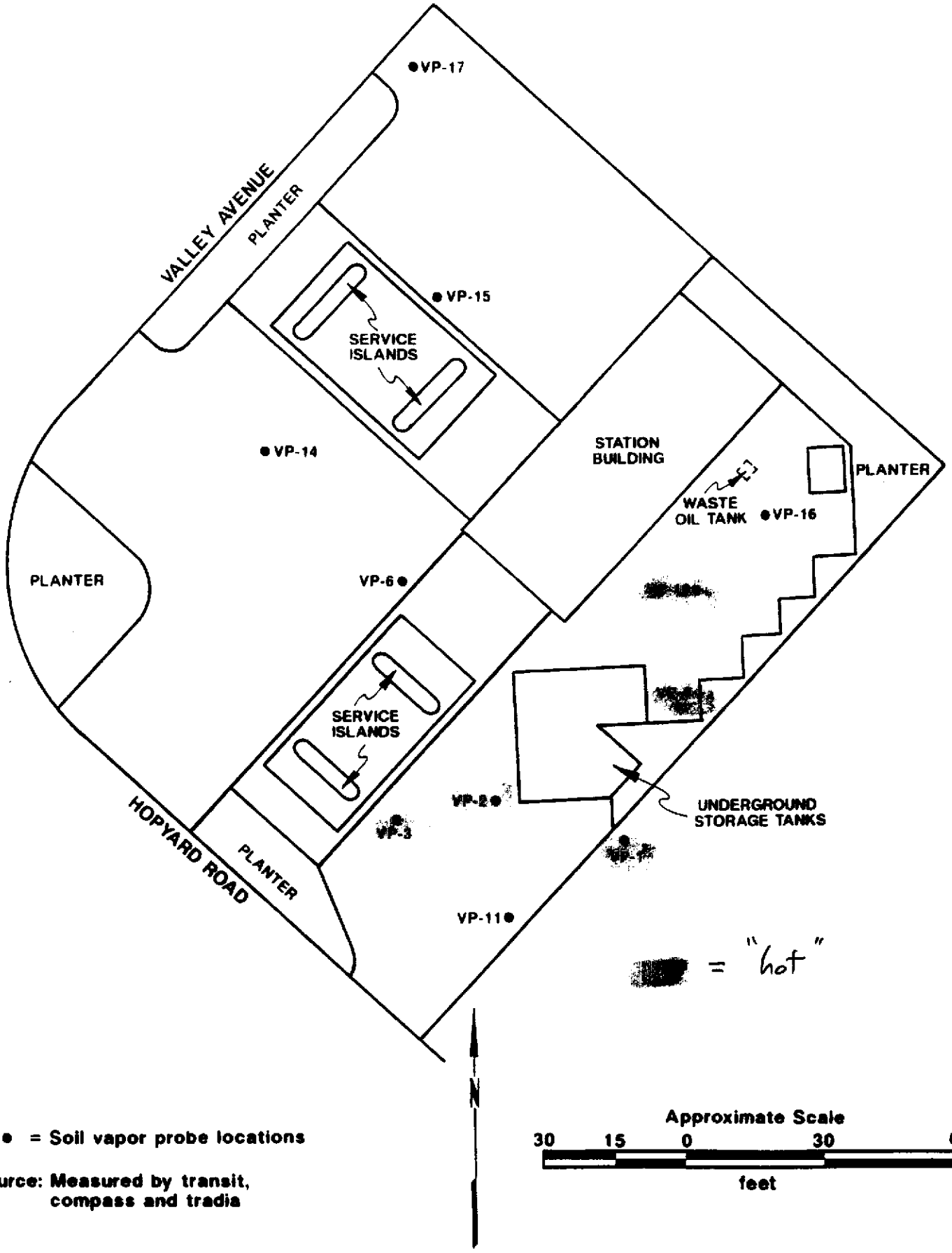
TPH--Total petroleum hydrocarbons (low-to-medium boiling points) are measured by extraction according to EPA Method 5030 followed by analysis by a modified EPA Method 8015 which uses a GC equipped with an FID. Soil extracts and water samples are subjected to purge-and-trap introduction into the GC.

TEH--Total extractable hydrocarbons (high boiling points) are measured by extraction according to EPA Method 3550 for soils or EPA Method 3510 for water followed by a modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

Tia Tran, Laboratory Supervisor

4-13-88
Date Reported

APPENDIX E



● = Soil vapor probe locations

Source: Measured by transit, compass and tradia

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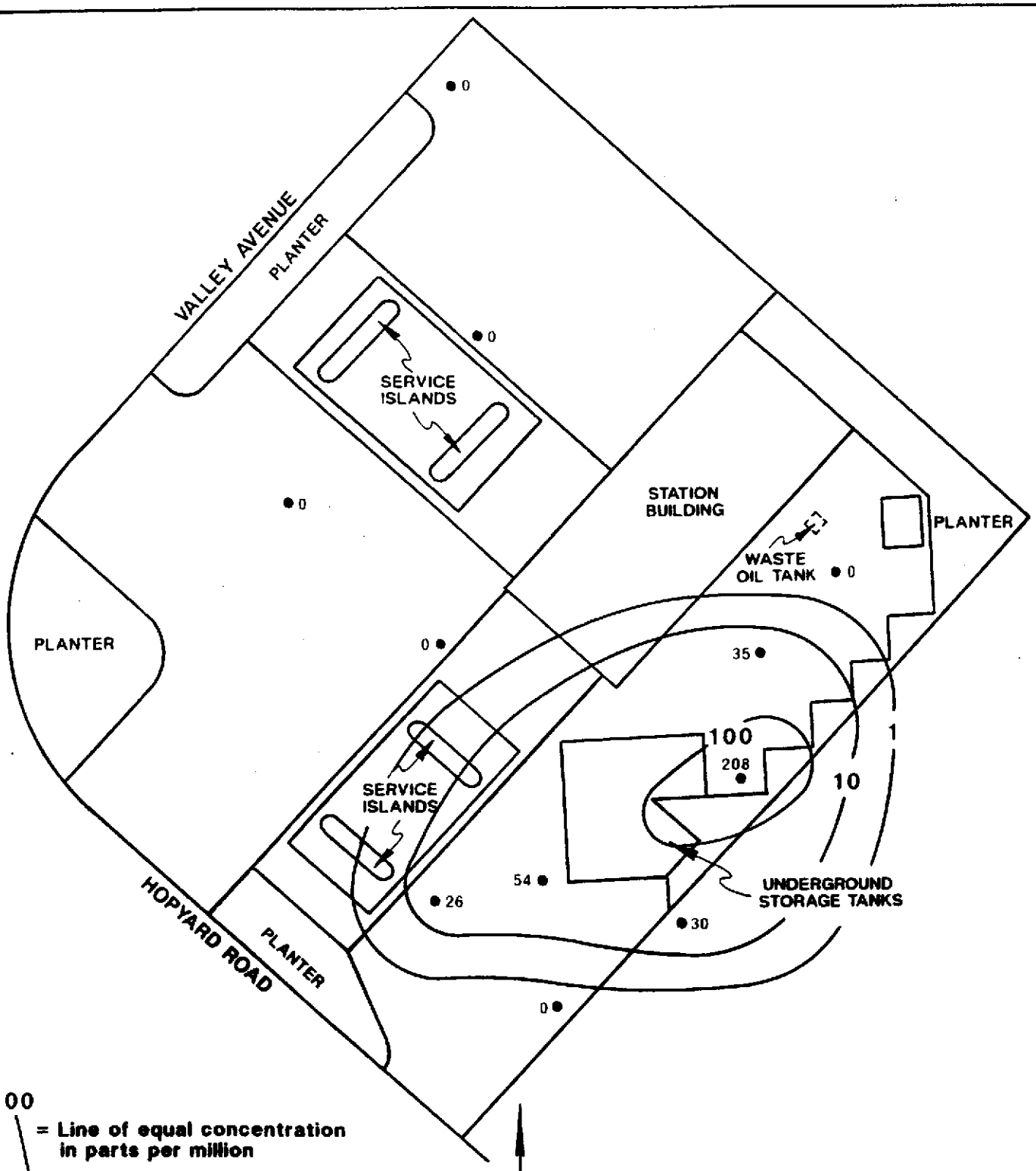
43255 Mission Blvd Suite B Fremont CA 94539 (415) 651-9106

PROJECT NO. AGS 018034-1

SOIL VAPOR PROBE LOCATIONS
Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE
P - 14

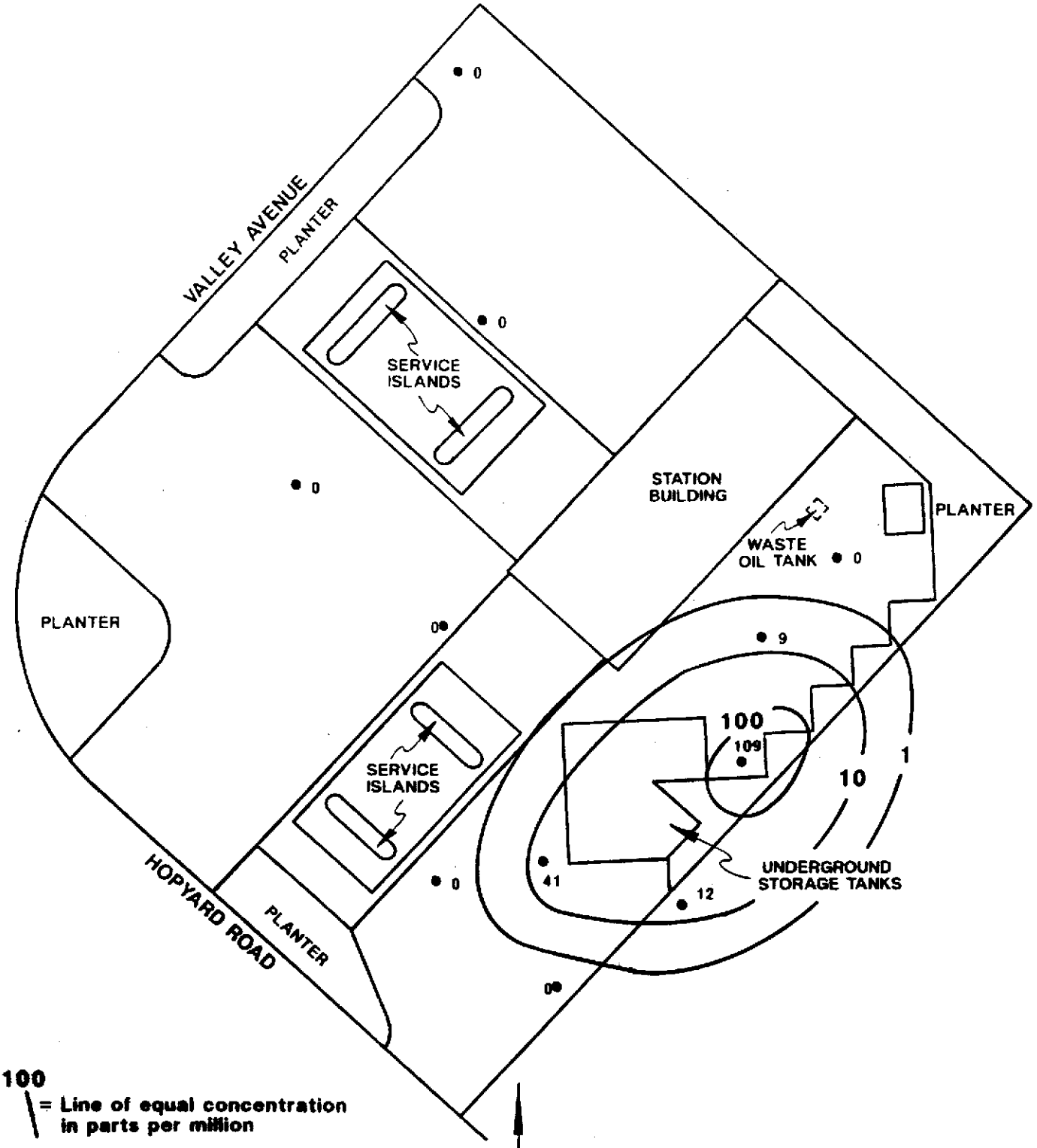


Applied GeoSystems

PROJECT NO. AGS 018034-1

CONCENTRATION OF BENZENE IN SOIL VAPOR AT 33 FEET
Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE
P - 15



100 = Line of equal concentration in parts per million

109 = Concentration in parts per million

● = Soil vapor probe locations

Source: Measured by transit, compass and tradia

N

Approximate Scale

30 15 0 30 60

feet

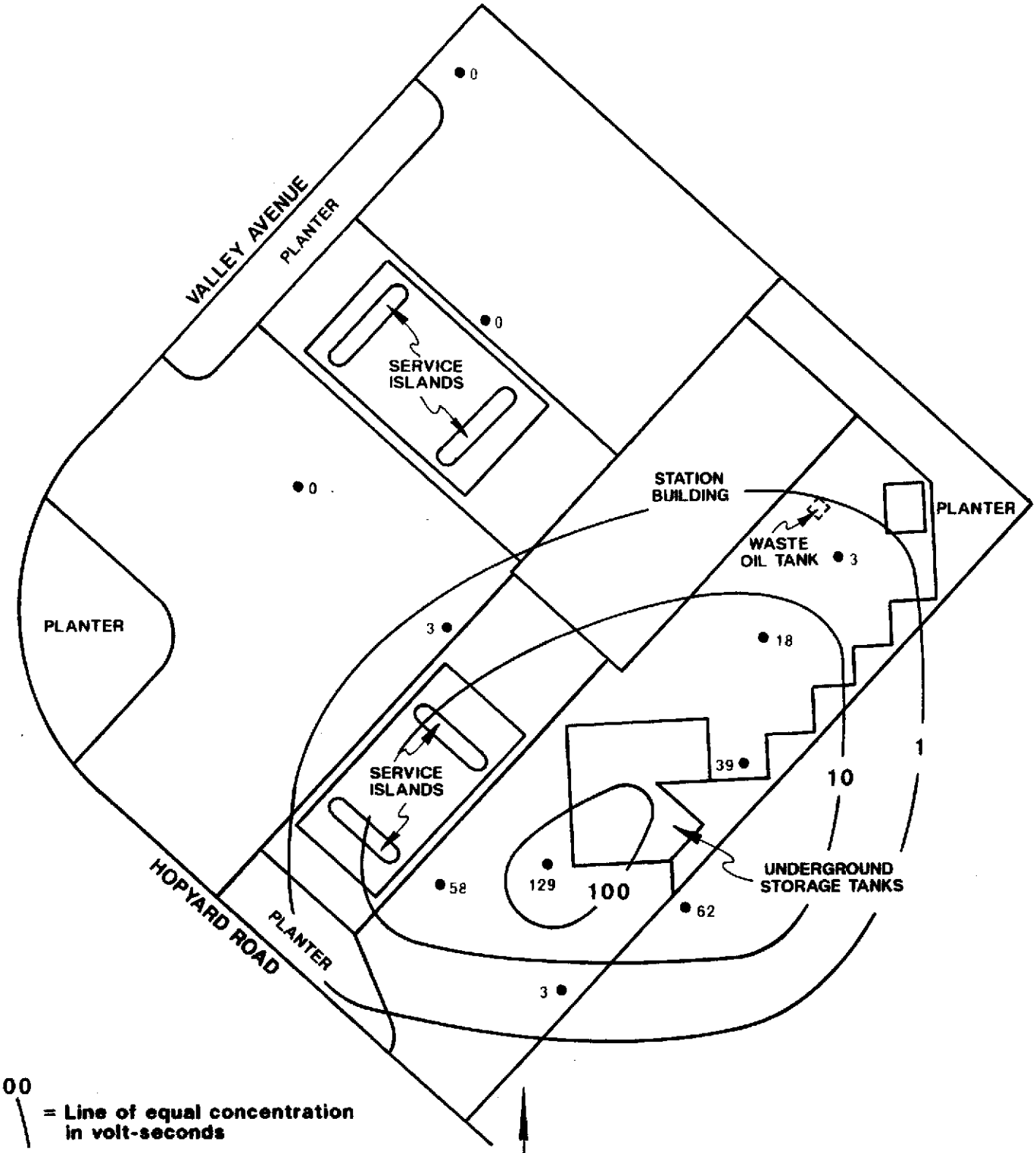
Applied GeoSystems

PROJECT NO. AGS 018034-1

CONCENTRATION OF TOLUENE IN SOIL VAPOR AT 33 FEET
Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE

P - 16

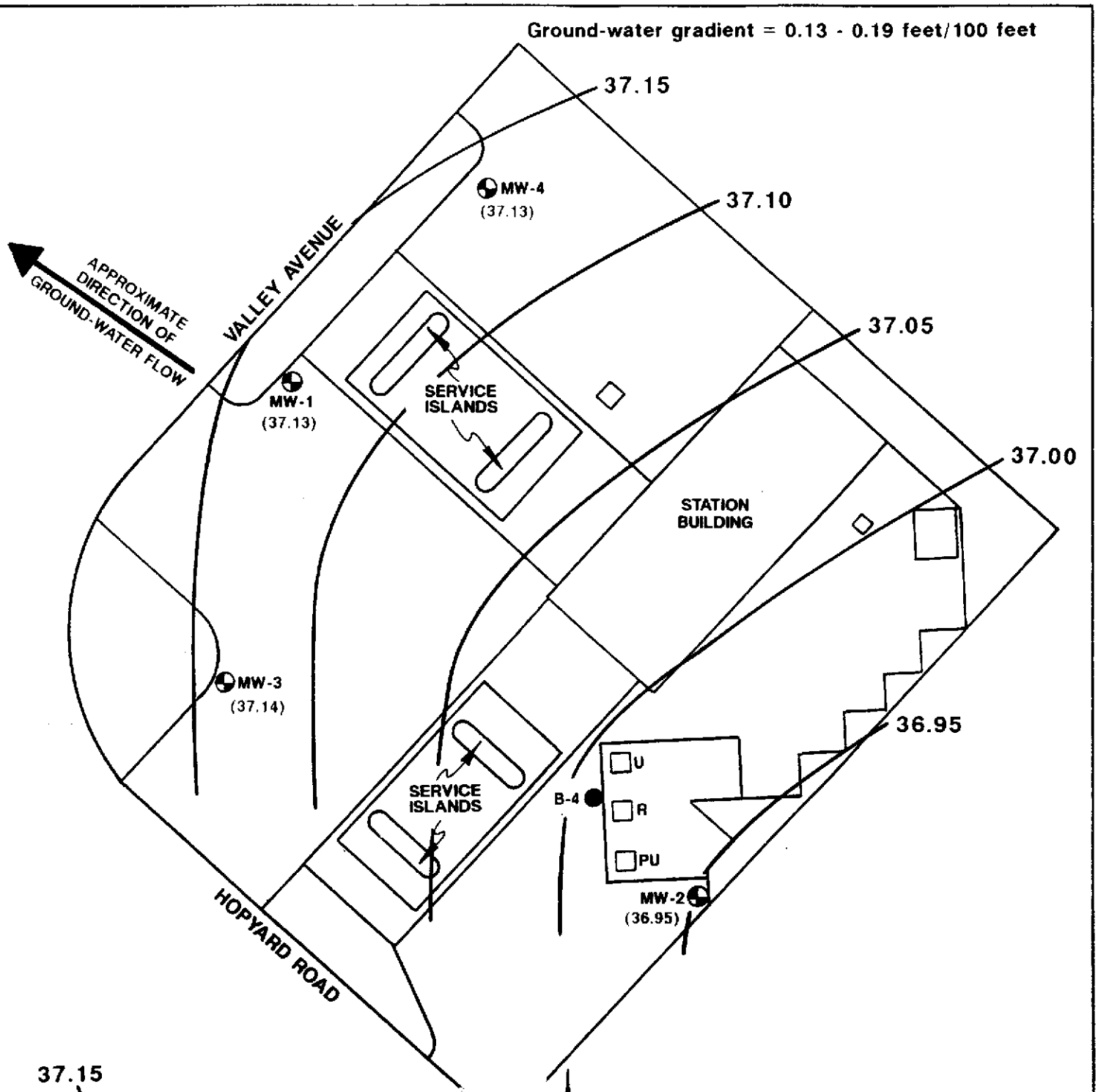


Applied GeoSystems
43255 Mission Blvd Suite B Fremont CA 94539 (415) 651-1906

PROJECT NO. AGS 018034-1

CONCENTRATION OF PRE-BENZENE IN SOIL VAPOR AT 33 FEET
Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE
P - 17



37.15 = Line of equal depth to ground water in feet below top of casing of MW-3

(36.95) = Depth to ground water below top of casing of MW-3

= Monitoring well location

= Borehole location

U = Unleaded

R = Regular

PU = Premium Unleaded

N

Approximate Scale

30 15 0 30 60

feet

Source: Measured by transit, compass and stadia

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PROJECT NO. AGS 018034-1

GROUND-WATER POTENTIOMETRIC SURFACE MAP

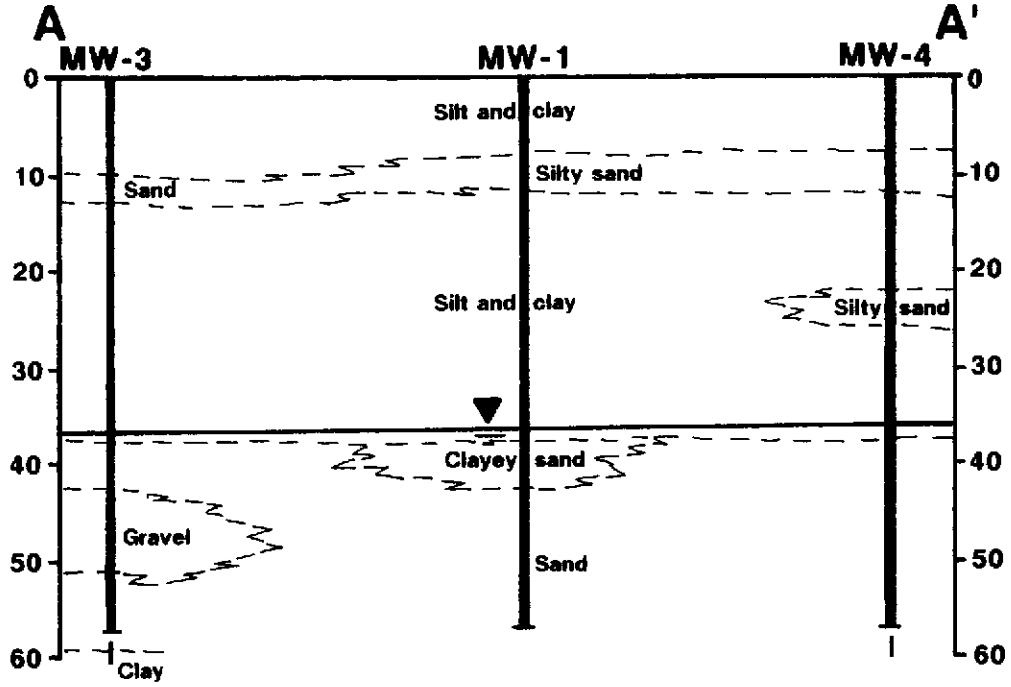
April 8, 1988

Exxon Station No. 7-3399

Pleasanton, California

PLATE

P - 18



Approximate Horizontal Scale

30 15 0 30 60

feet

Approximate Vertical Scale

20 10 0 20 40

feet

▼ = Ground-water level

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PROJECT NO. AGS 018034-1

HYDROGEOLOGIC CROSS SECTION A - A'

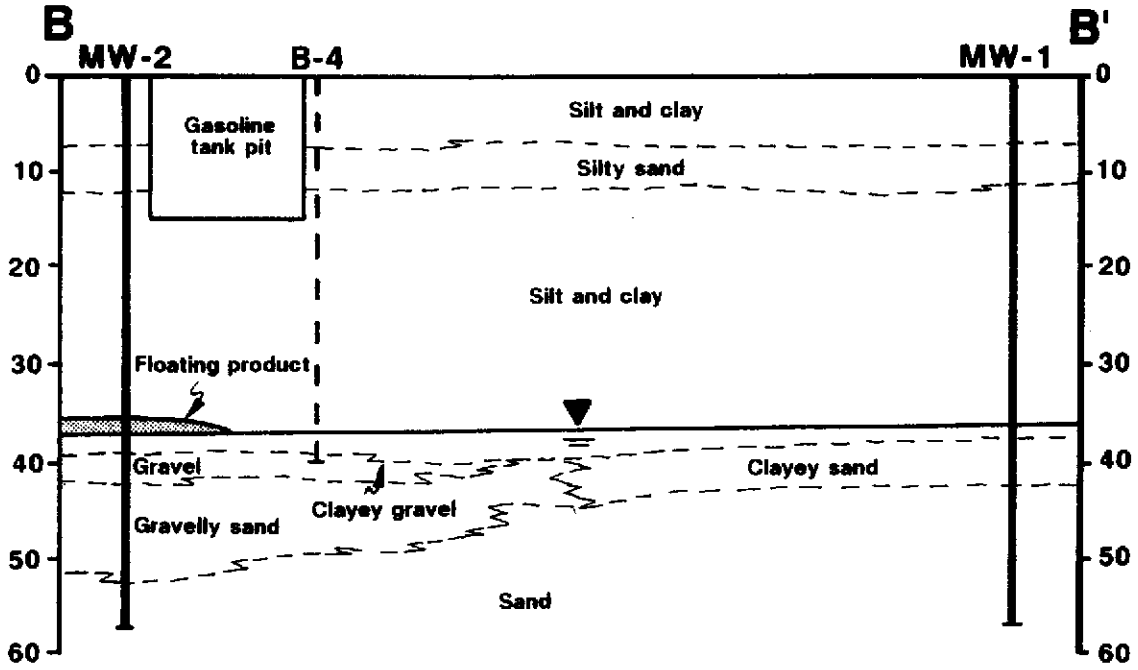
Exxon Station No. 7-3399

2991 Hopyard Road

Pleasanton, California

PLATE

P - 19



Approximate Horizontal Scale

30 15 0 30 60

feet

Approximate Vertical Scale

20 10 0 20 40

feet

▼ = Ground-water level

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43775 Mission Blvd Suite B Fremont, CA 94539 (415) 651-1906

PROJECT NO. AGS 018034-1

HYDROGEOLOGIC CROSS SECTION B - B'
Exxon Station No. 7-3399
2991 Hopyard Road
Pleasanton, California

PLATE
P - 20