Applied GeoSystems

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TRANSMITTAL

TO: MR. GIL WISTAR
ALAMEDA COUNTY HEALTH AGENCY
DEPARTMENT OF ENVIR. HEALTH
80 SWAN WAY, ROOM 200
OAKLAND, CALIFORNIA 94621

FROM: MR. JOEL COFFMAN
TITLE: ASST. PROJECT GEOLOGIST

DATE: 4/12/91
PROJECT NUMBER: AGS 60000.04
SUBJECT: ARCO STATINO 771, 899 RINCON AVENUE, LIVERMORE, CALIFORNIA

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REPORT
SUPPLEMENTAL SUBSURFACE INVESTIGATION
at
ARCO Station 771
899 Rincon Avenue
Livermore, California

AGS 60000.04

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CIVIL
STATE OF CALIFORNIA

April 12, 1991

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REPORT
SUPPLEMENTAL SUBSURFACE INVESTIGATION
at
ARCO Station 771
889 Rincon Avenue
Livermore, California

AGS 60000.04

For ARCO Products Company

INTRODUCTION

ARCO Products Company (ARCO) contracted with RESNA/Applied GeoSystems (AGS) to perform a supplemental subsurface investigation at ARCO Station 771, located at 889 Rincon Avenue in Livermore, California. The work was performed after concentrations of total petroleum hydrocarbons characterized as gasoline (TPHg) up to 190 parts-per-million (ppm) were discovered in the soil during the drilling of three soil borings (B-1 through B-3) adjacent to the four underground gasoline-storage tanks at the site in February 1990 (AGS, June 1990). The purpose of this investigation was to evaluate the lateral and vertical extent of gasoline hydrocarbons in the soil and first encountered ground water in the area near four onsite underground gasoline-storage tanks. The work performed for this investigation included drilling three soil borings (B-4 through B-6), collecting and describing soil samples from the borings, constructing, developing, and sampling 4-inch diameter ground water monitoring wells (MW-1 through MW-3) in the borings, laboratory analysis of selected soil and ground-water samples, measuring depth-to-water (DTW) levels in the wells and

surveying wellhead elevations, and performing a well search to identify wells within a 1/2-mile radius of the site. This report includes a summary of previous work performed at the site, summaries of field procedures used during this investigation, the results of the investigation, interpretation of the data, and conclusions. The work performed was outlined in the Work Plan, (AGS, September 1990), which was approved by the Alameda County Department of Environmental Health (ACDEH).

SITE DESCRIPTION AND BACKGROUND

General

ARCO Station 771 is located on the southwestern corner of the intersection of Rincon Avenue and Pine Street in Rincon Avenue, Livermore, California, as shown on the Site Vicinity Map, Plate 1. The station is an operating gasoline station and mini-market which retails regular leaded and regular and supreme unleaded gasoline. Residential homes are present to the north of the site and east of the site across Rincon Avenue. A shopping center is to the south and west of the site. The site is on a relatively flat lot at an elevation of approximately 450 feet above mean sea level.

It is our understanding from information provided by ARCO that one 10,000-gallon underground gasoline- storage tank (designated T1), one 6,000-gallon underground gasoline-storage tank (designated T2) and two 4,000-gallon underground gasoline-storage tanks (designated T3 and T4) are present at the site. We also understand that tanks T2, T3, and T4 were installed approximately 25 years ago, tank T1 was installed approximately 15 years ago, and that only gasoline is known to have been stored in the tanks. A 240-gallon waste-oil tank was removed from the site in 1987 (Brown and Caldwell, 1987). The locations of these tanks and other site features are shown on the Generalized Site Plan, Plate 2.

Regional and Local Hydrogeology

The site is in the north-central portion of the Livermore Valley, within the Coast Ranges Geomorphic Province of Northern California. The Livermore Valley is approximately 13 miles long oriented in an east-west direction, approximately 4 miles wide, and is surrounded by hills of the Diablo Range (California Department of Water Resources, 1974). The valley slopes gently toward the west. The principal streams in the area are the Arroyo Valley and Arroyo Mocho, which flow toward the western end of the valley. Arroyo Mocho is approximately 1/10 mile south-southwest of the site, and Arroyo Valley is approximately 2-3/4 miles southwest of the site.

The Livermore Valley ground-water basin is divided into sub-basins on the basis of fault traces or other hydrogeologic discontinuities (California Department of Water Resources, 1974). The ground-water system in Livermore Valley is a multi-layered system with an unconfined aquifer overlying a sequence of leaky or semiconfined aquifers. Ground water in the basin flows downslope toward the east-west-trending axis of the valley and then flows generally to the west. Regional ground water is inferred to flow to the west-northwest and is approximately 30 feet below the ground surface (Alameda County Flood Control, Zone 7, 1986).

Well Research

A search of records obtained from Alameda County Flood Control and Water Conservation District Zone 7 (ACFCWCD) of active, inactive, and destroyed water supply and monitoring wells within 1/2-mile radius of the site was performed as part of this investigation. Records indicate the existence of 14 ground-water monitoring wells and 4 supply wells within 1/2-mile radius of the site. The approximate locations of these wells are shown on Plate 3, Well

Location Map. No well construction details were made available at the time of this investigation.

PREVIOUS WORK

August 1987

In August 1987, a 240-gallon underground waste-oil storage tank was removed from the site by Crosby and Overton Environmental Management, Inc., of Oakland, California. The waste-oil tank pit was excavated to a depth of 10 feet and a soil sample (AL-1) was collected by Brown and Caldwell (B&C) of Sacramento, California, for laboratory analyses. Results of analyses indicated 378 parts per million (ppm) total petroleum fuel hydrocarbon levels. Volatile organic compounds (VOCs) and benzene, toluene, and total xylene isomers (BTX), and polychlorinated biphenols (PCBs) were not detected. One sample of the waste-oil sludge from the tank and two samples from the stockpiled soil were also collected and analyzed by B&C. In September 1987, the waste-oil tank pit was further excavated and B&C collected a soil sample (AL-2) from a depth of 12 feet. Petroleum fuel hydrocarbons were not detected in the sample. In October 1987, soil containing waste-oil was transported to a Class I landfill in Casmalia, California (Brown and Caldwell, 1987).

February 1990

AGS performed a limited environmental site assessment (AGS, June 1990) to evaluate the presence of gasoline hydrocarbons in the subsurface soil in the area adjacent to the four underground gasoline-storage tanks prior to ARCO's planned tank replacement at the site. This work involved drilling and sampling three soil borings (B-1 through B-3), performing laboratory analyses of 12 soil samples from the borings, and preparing a report. The

locations of the borings are shown on Plate 2, Generalized Site Plan. Ground water was first encountered at a depth of approximately 33 feet below the ground surface in boring B-1. Borings B-2 and B-3 were terminated before encountering ground water. Results of laboratory analyses of soil samples indicated the highest concentration (190 ppm) of total petroleum hydrocarbons as gasoline (TPHg) in the soil sample collected from a depth of approximately 32 feet below ground surface in boring B-3. The results of laboratory analysis of soil samples are presented in Table 1, Cumulative Results of Laboratory Analyses of Soil Samples. An approximately 1/8-inch thick layer of floating product was noted on the surface of a ground-water "grab" sample obtained from boring B-1.

FIELD WORK

Drilling

A permit for ground-water monitoring well construction was obtained from the Alameda County Flood Control and Water Conservation District, Zone 7 (ACFCWCD) prior to drilling. A copy of this permit is included in Appendix A. Three soil borings (B-4 through B-6) were drilled and a ground-water monitoring well constructed in each of the borings (MW-1 through MW-3) on December 10 and 11, 1990 under direction of an AGS geologist. Borings B-4 through B-6 were drilled using 10-inch diameter hollow stem augers using a truck-mounted drilling rig operated by Kvilhaug Drilling Company of Concord, California. A summary of the field procedures employed by AGS is included in Appendix B. The work for this investigation was performed in accordance with the Site Safety Plan (AGS, December 1990).

The rationale for the locations of the soil borings/monitoring wells is based on the following: hydrocarbon concentrations reported in soil samples collected during the

previous investigation; the locations of existing utilities; and on future site work planned by ARCO. According to ARCO, the existing underground gasoline-storage tanks are scheduled for replacement in 1991. Locations of soil borings/monitoring wells were therefore not drilled/installed immediately adjacent to the underground gasoline storage-tanks since they would likely be damaged or destroyed during removal of the tanks.

Boring B-4/MW-1 was drilled northwest of the underground gasoline-storage tanks and a ground-water monitoring well (MW-1) was installed in the boring to investigate the presence and extent of gasoline hydrocarbons in the soil and ground water in the inferred downgradient direction of the tanks. The locations of the borings/monitoring wells are shown on Plate 2. Boring B-5/MW-2 was drilled near the southeastern corner of the site, and a ground-water monitoring well (MW-2) was installed in the boring to investigate the extent of gasoline hydrocarbons in the soil near the southeastern corner of the underground gasoline-storage tanks and investigate the presence of gasoline hydrocarbons in the ground water in the inferred upgradient direction of the gasoline tanks. Boring B-6/MW-3 was drilled near the northeastern corner of the site, and a ground-water monitoring well was installed in the boring to evaluate the extent of gasoline hydrocarbons in the soil in the inferred crossgradient direction of the dispenser island and to investigate the presence of gasoline hydrocarbons in the ground water in this area.

Soil Sampling and Description

A total of 37 soil samples were collected from the soil borings and described in accordance with the Unified Soil Classification System and Symbol Key, Plate 4, and as indicated on the Logs of Borings, Plates 5 through 10. Soil samples from borings B-4 through B-6 were collected at a maximum of 5-foot intervals from the ground surface to approximately 30 feet in the borings. Samples were also collected continuously in the borings near first-

encountered ground water at depths of approximately 32 to 38 feet and at approximately 2-1/2 to 3-1/2 foot intervals to the bottom of the borings at 45 to 46-1/2 feet. A summary of the sampling methods used for this investigation are presented in Appendix B.

The earth materials encountered during this investigation consisted primarily of clayey to sandy gravel interbedded with some gravelly and sandy clay. Ground water was first encountered within sandy gravel in borings B-4 through B-6 at a depths of approximately 36 to 38 feet below the ground surface. A stratum of 5 feet of moist sandy clay, which may be a perching or confining layer, was encountered at approximately 38 to 41 feet below the ground surface in borings B-4 through B-6. Graphic interpretations of the soil stratigraphy encountered in the borings are shown on Geologic Cross Sections A-A' and B-B' (Plates 11 and 12).

One composite soil sample was collected from the stockpiled drill cuttings and submitted for analysis on January 15, 1991 to determine proper disposal. The method used to obtain this sample is described in Appendix B.

Monitoring Well Construction and Development

Three ground-water monitoring wells (MW-1, MW-2, and MW-3) were constructed in borings B-4, B-5, and B-6, respectively. The wells were completed with four-inch-diameter schedule 40 polyvinyl chloride (PVC) casing and the screened interval consisted of 4-inch-diameter, 0.020 machine slotted PVC. The screened portion in these wells were set from 30 to 32 feet below the ground surface to 38 to 41 feet below ground surface.

The wells were developed on December 12, 1990 to remove fine-grained sediments and to allow better communication between the water-bearing zone and the ground-water

monitoring well. Development was performed using a combination of surge block and bailing techniques. Details regarding well construction and development are described in Appendix B.

Ground-Water Sampling

DTW measurements were measured in ground-water monitoring wells MW-1 through MW-3 and ground-water samples were collected and visually inspected for floating product on January 15, 1991 and February 27, 1991. Initial water samples collected from well MW-1 exhibited an obvious odor and a product sheen, and approximately 0.16 feet of floating product was measured in well MW-2. Initial water samples from well MW-3 showed no subjective evidence of hydrocarbon product. Ground-water monitoring well MW-3 was then purged and water samples were collected for laboratory analysis on January 15, 1990. Water samples were not collected for laboratory analysis from wells MW-1 and MW-2 due to the presence of hydrocarbon product and sheen in these wells. The ground-water samples were transported under chain-of-custody to Applied Analytical Laboratory (Hazardous Waste Testing Laboratory Certification No. 1211) in Fremont, California. Appendix B contains a description of subjective analysis and ground-water sampling procedures.

EVALUATION OF GROUND-WATER GRADIENT

On January 3, 1991 the wellheads for the ground-water monitoring wells MW-1 through MW-3 were surveyed to a local National Geodetic Vertical Datum benchmark by Ron Archer Civil Engineer, Inc. of Pleasanton, California. The results of this wellhead survey are included in Appendix C, Wellhead Survey. Ground-water elevations for each well were calculated by subtracting the measured DTW from the elevation of the wellhead. The DTW

measurements, wellhead elevations, ground-water elevations, and product evidence are presented in Table 2, Cumulative Ground-Water Monitoring Data.

The ground-water gradient was evaluated from DTW measurements collected from well MW-1 through MW-3 on January 15, and February 27, 1991. The interpreted ground-water gradient for January 15, 1991 is 0.01 to the northeast. The interpreted ground-water gradients for January 15, and February 27, 1991 are shown on Plates 13 and 14, Ground-Water Gradient Maps. This interpreted gradient for February 27, 1991 is 0.02 to the north and may be affected by the presence of floating product and product sheen in wells MW-1 and MW-2.

LABORATORY METHODS

Soil samples collected from borings B-4 through B-6 were analyzed for total petroleum hydrocarbons as gasoline (TPHg) and the purgeable gasoline constituents benzene, toluene, ethylbenzene, and total xylenes (BTEX) using Environmental Protection Agency (EPA) methods 5030/8010/8020. One composite sample from the soil stockpile from the borings was analyzed for TPHg and BTEX. Sixteen soil samples from the borings were selected for laboratory analysis based on:

- location above first-encountered ground-water;
- location in a potential confining or perching layer below first-encountered ground water;
- areas where the presence of gasoline hydrocarbons was suspected; and
- 5-foot intervals and/or change in stratigraphic units, as recommended by State Department of Health Services (DHS) guidelines.

Ground-water samples obtained from monitoring well MW-3 were analyzed for BTEX and TPHg by modified EPA Methods 5030/8015/602. All ground water and soil samples were analyzed by Applied Analytical (Hazardous Waste Testing Laboratory Certification No. 1211).

LABORATORY RESULTS

Soil Samples

Results of laboratory analysis of soil samples are summarized in Table 1, Cumulative Results of Laboratory Analysis of Soil Samples. Chain of Custody forms and Laboratory Analysis Reports for soil samples are included in Appendix D of this report.

Laboratory results of soil samples collected from boring B-4, northwest of the underground gasoline-storage tanks, indicated nondetectable concentrations of TPHg from 20 to 32-1/2 feet below the ground surface, 140 ppm TPHg at a depth of 36-1/2 feet just above first-encountered ground water and 3,800 ppm and 5.5 ppm at depths of 43 and 45-1/2 feet within the sandy clay below first-encountered ground water. BTEX ranged from nondetectable to 280 ppm.

Laboratory results of soil samples collected from boring B-5, southeast of the underground gasoline-storage tanks, indicated nondetectable concentrations of TPHg from 20 to 30 feet below ground surface, 97 ppm TPHg at a depth of 34-1/2 feet just above first-encountered ground water, and 13 ppm and nondetectable TPHg at depths of 39-1/2 and 45 feet within the sandy clay below first ground water. BTEX ranged from nondetectable to 0.66 ppm.

Laboratory results of soil samples collected from boring B-6, north-northwest of the underground gasoline-storage tanks and dispenser island, indicated nondetectable concentrations of TPHg in all the samples analyzed from depths of 20 to 44-1/2 feet, above and below first-encountered ground water. BTEX was nondetectable in all samples except for total xylenes of 0.006 ppm at a depth of 36-1/2 feet.

Water Samples

Results of laboratory analyses of ground-water samples are presented in Table 3, Results of Laboratory Analysis of Ground-Water Samples. Chain of Custody records and Laboratory Analysis Reports for ground-water samples are included in Appendix D.

Laboratory results of water samples from well MW-3, north-northeast of the underground gasoline-storage tanks and dispenser island, indicated 230 (parts per billion) ppb TPHg, nondetectable (<0.5 ppb) benzene and toluene, 2.2 ppb ethylbenzene, and 2.1 ppb total xylenes.

DISCUSSION AND CONCLUSIONS

Gasoline hydrocarbons have impacted soil beneath the site. The majority of gasoline hydrocarbons at concentrations above 100 ppm in the soil at the site appear to be limited to the southern portion of the site at depths between 30 and 43 feet below ground surface.

The extent of gasoline hydrocarbons has not been delineated at the site except for the area north-northeast of the underground gasoline-storage tanks and dispenser island, in the area of boring B-6.

Ground water beneath the site has been impacted by gasoline hydrocarbons. Monitoring well MW-1 contained a product sheen and odor, and MW-2 contained 0.16 feet of floating product. The ground-water samples from monitoring well MW-3 contained detectable concentrations of TPHg, ethylbenzene, and total xylenes but were below detection limits for benzene and toluene. The extent of gasoline hydrocarbons in ground water at the site has not been delineated.

LIMITATIONS

This report was prepared in accordance with generally accepted standards of environmental geological practice in California at the time this investigation was performed. This investigation was conducted solely for the purpose of evaluating environmental conditions of the soil and first ground water with respect to gasoline hydrocarbon contamination at the subject site in the immediate area of and related to the gasoline-storage tanks. No soil engineering or geotechnical implications are stated or should be inferred. Evaluation of the geologic conditions at the site for the purpose of this investigation is made from a limited number of observation points. Subsurface conditions may vary away from the data points available. Additional work, including further subsurface investigation, can reduce the inherent uncertainties associated with this type of investigation.

REFERENCES

Alameda County Flood Control and Water Conservation District, Zone 7, Water Resources Engineering. 1986. Water Level Contours. 1 inch = 3000 feet scale map.

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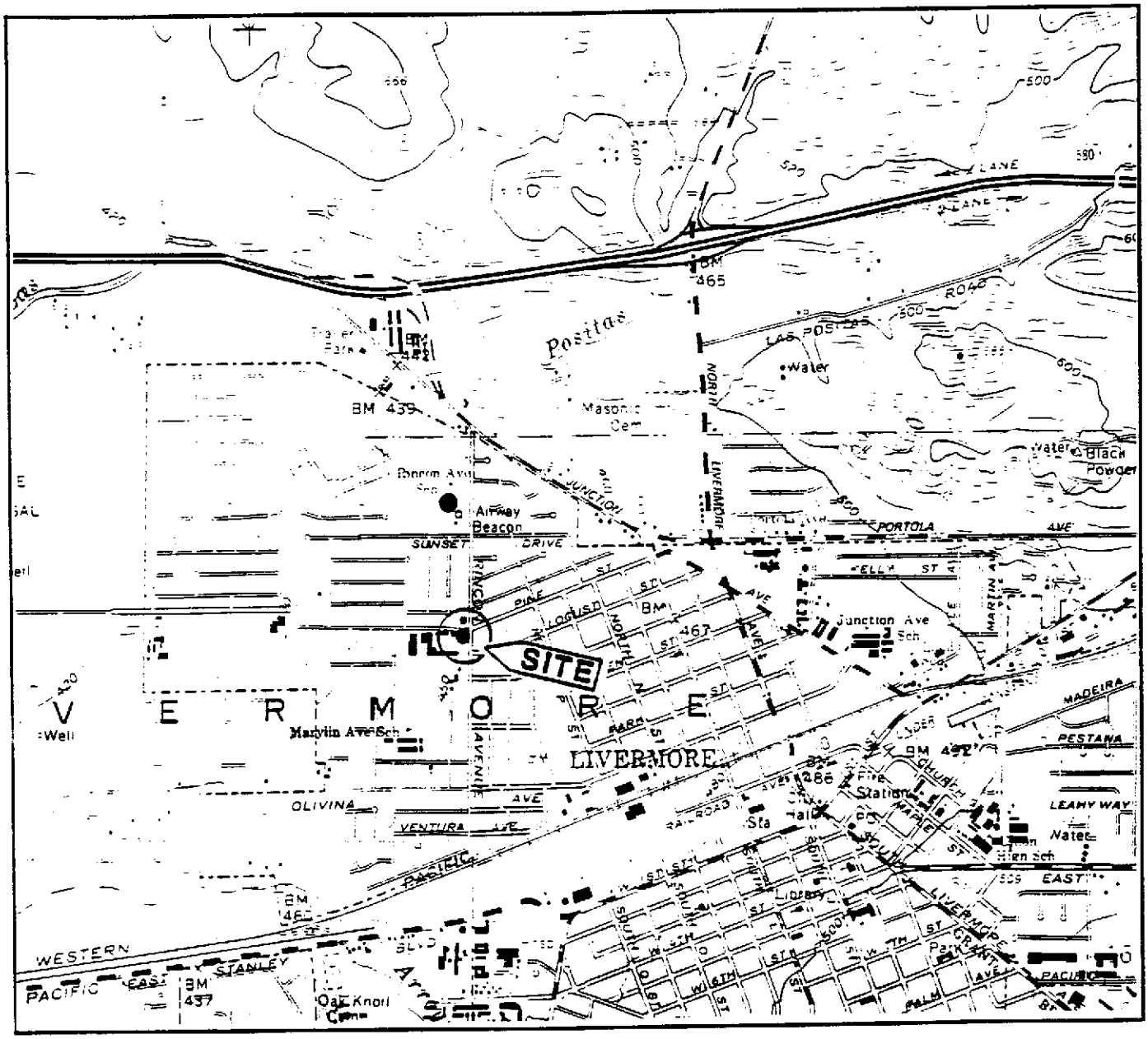
Applied GeoSystems. September 20, 1990. Work Plan for Supplemental Subsurface Investigation at ARCO Station 771, 899 Rincon Avenue, Livermore, California: AGS 60000-3.

Brown and Caldwell. September 16, 1987. Soil Sample Results for Waste Oil Tank Removal, ARCO Station 771: Report No. 17/3456-02/3.

California Department of Water Resources. 1974. Evaluation of Ground-Water Resources Engineering Livermore and Sunol Valleys: Bulletin No. 118-2, Appendix A.



Source: U.S. Geological Survey
7.5-Minute Quadrangles
Livermore, California.
Photorevised 1980

Approximate Scale

2000 1000 0 2000 4000

feet

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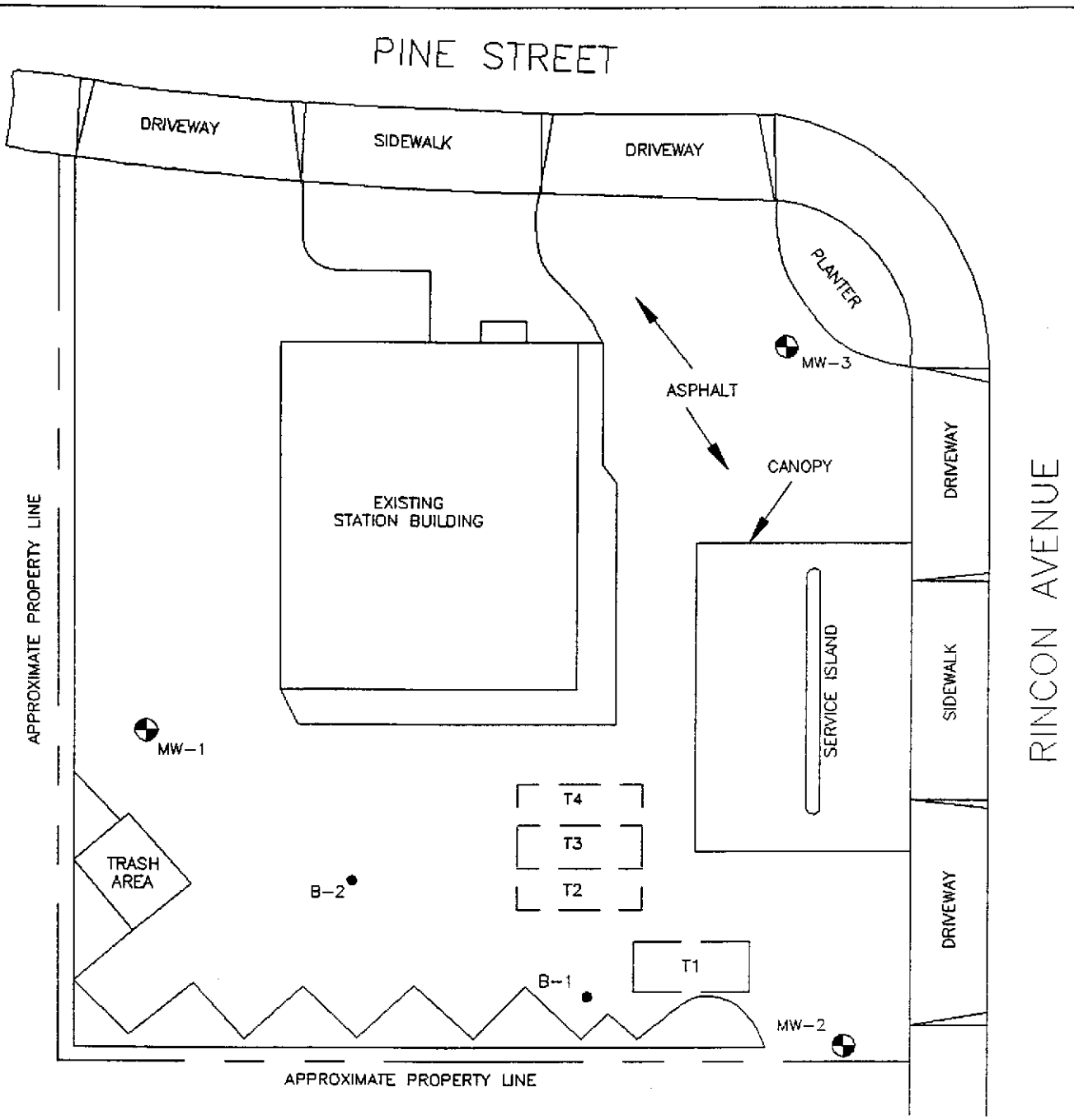
SITE VICINITY MAP
ARCO Station 771
899 Rincon Avenue
Livermore, California

PLATE

1



EXPLANATION

MW-3 = Monitoring well (Applied GeoSystems, December 1990)

B-2 = Soil boring

T4 = Underground gasoline-storage tank

N

Approximate Scale

20 10 0 20 40

feet

Source: Surveyed by Ron Archer Civil Engineer, Inc.

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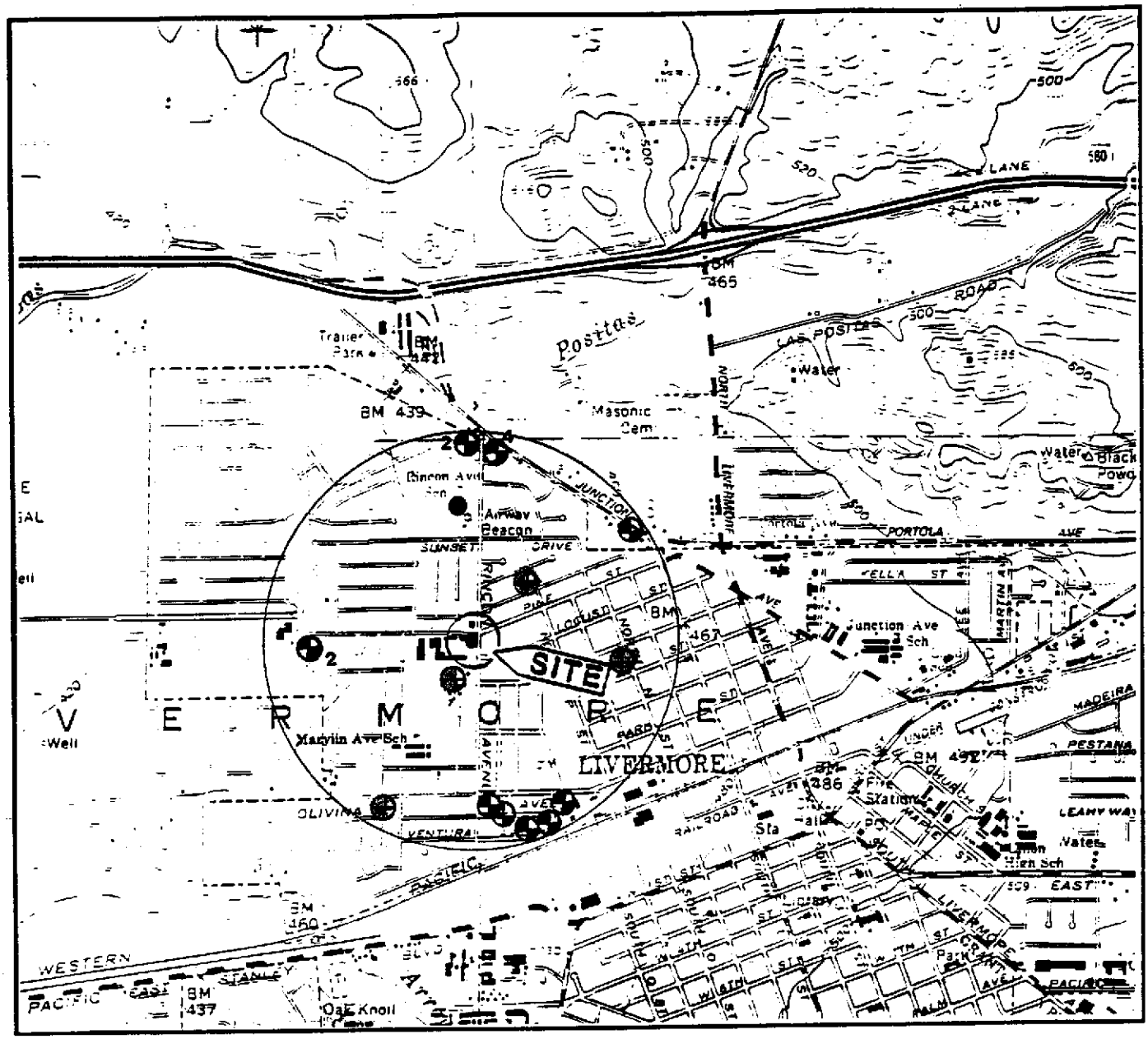
GENERALIZED SITE PLAN
ARCO Station 771
899 Rincon Avenue
Livermore, California

PLATE 2



Source: U.S. Geological Survey
7.5–Minute Quadrangle
Livermore, California
Photorevised 1980

○ = Water supply wells

◒ = Monitoring wells

N

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WELL LOCATION MAP
ARCO Station 771
899 Rincon Avenue
Livermore, California

PLATE

3

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		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 mixtures, little or no fines.
		GM	Silty Gravels, Gravel-Sand-Silt mixtures.
		GC	Clayey Gravel, Gravel-Sand-Clay mixtures.
	SAND AND SANDY SOILS	SW	Well-graded Sand 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 DIVISION		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, organic Silts.
HIGHLY ORGANIC SOILS		PT	Peat and other highly Organic Soils.


Depth through which sampler is driven


Relatively undisturbed sample


No sample recovered


Static water level observed in well/boring


Initial water level observed in boring

S-10 Sample number


Sand pack


Bentonite


Neat cement


Caved native soil


Blank PVC


Machine-slotted PVC

P.I.D. Photoionization detector

BLOWS REPRESENT THE NUMBER OF BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES TO DRIVE THE SAMPLER THROUGH EACH 6 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.

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UNIFIED SOIL CLASSIFICATION SYSTEM AND SYMBOL KEY
ARCO Station 771
899 Rincon Avenue
Livermore, California

PLATE
4

Depth of boring: 46-1/2 feet Diameter of boring: 10 inches Date drilled: 12-10-90

Well depth: 41 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 32 to 41 feet Slot size: 0.020-inch

Drilling Company: Kvilhaug Drilling Co. Driller: Rod and Brian

Method Used: Hollow-Stem Auger Field Geologist: Mike Barminski

Signature of Registered Professional: _____

Registration No.: CE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
0					Asphalt (4 inches).	
2				CL	Gravelly clay with sand, dark brown, moist, low to medium plasticity, hard.	
4	S-5	12 18 27	6.5			
6						
8				GW	Sandy gravel with clay, brown, moist, very dense.	
10	S-10	7 22 40	0			
12						
14	S-15	25 50	0			
16						
18						
20	S-20	30 50	4.2		Noticeable product odor.	
					(Section continues downward)	

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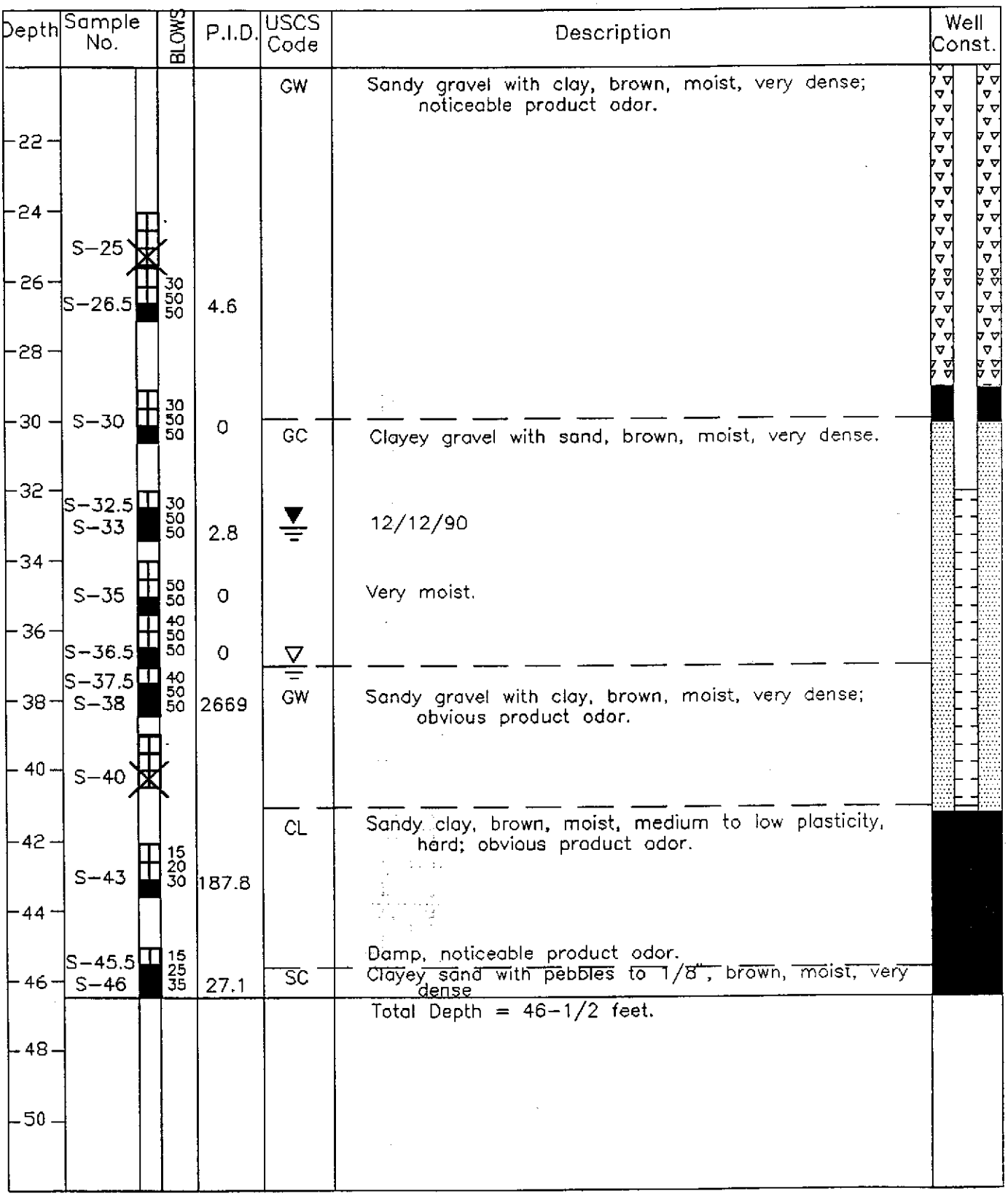
LOG OF BORING B-4/MW-1

ARCO Station 771
899 Rincon Avenue
Livermore, California

PLATE 5



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LOG OF BORING B-4/MW-1
ARCO Station 771
899 Rincon Avenue
Livermore, California

PLATE 6

Depth of boring: 45-1/2 feet Diameter of boring: 10 inches Date drilled: 12-10-90

Well depth: 38 feet Material type: Sch 40 PVC Casing diameter: 4 inches

Screen interval: 30 to 38 feet Slot size: 0.020-inch

Drilling Company: Kvilhaug Drilling Co. Driller: Rod and Brian

Method Used: Hollow-Stem Auger Field Geologist: Mike Barminski

Signature of Registered Professional:

Registration No.: CE 044600 State: CA

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
0					Asphalt (4 inches).	
				GW	Sandy gravel with clay, brown, damp, dense.	
2						
4	S-5	10 38 50	0		Very dense.	
6						
8						
10	S-10	50 50	0.9		Moist.	
	S-11.5	50 50	0			
12						
					Smoother drilling at 14 feet.	
14	S-15	35 50 50	0	CL	Sandy clay, gray, very moist, low to medium plasticity, hard.	
					Rougher drilling at 16 feet.	
16				GW	Sandy gravel with clay, brown, very moist, very dense; noticeable product odor?	
18						
20	S-20	30 50 50	4.6		(Section continues downward)	

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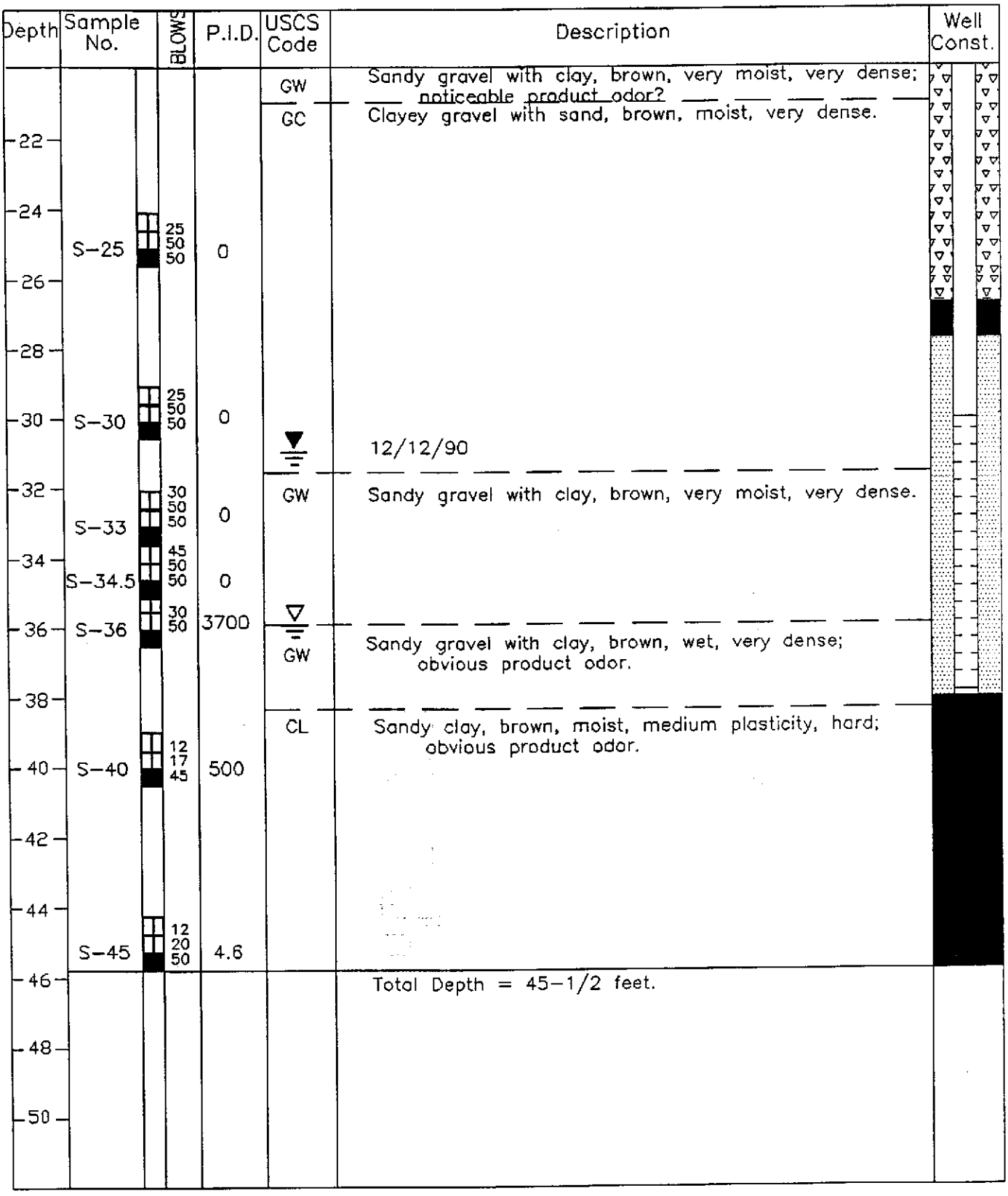
LOG OF BORING B-5/MW-2

ARCO Station 771
899 Rincon Avenue
Livermore, California

PLATE 7



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PROJECT 60000-4

LOG OF BORING B-5/MW-2
ARCO Station 771
899 Rincon Avenue
Livermore, California

PLATE
8

Depth of boring: 45 feet Diameter of boring: 10 inches Date drilled: 12-11-90

Well depth: 40 feet Material type: Sch 40 PVC Casing diameter: 4 inches

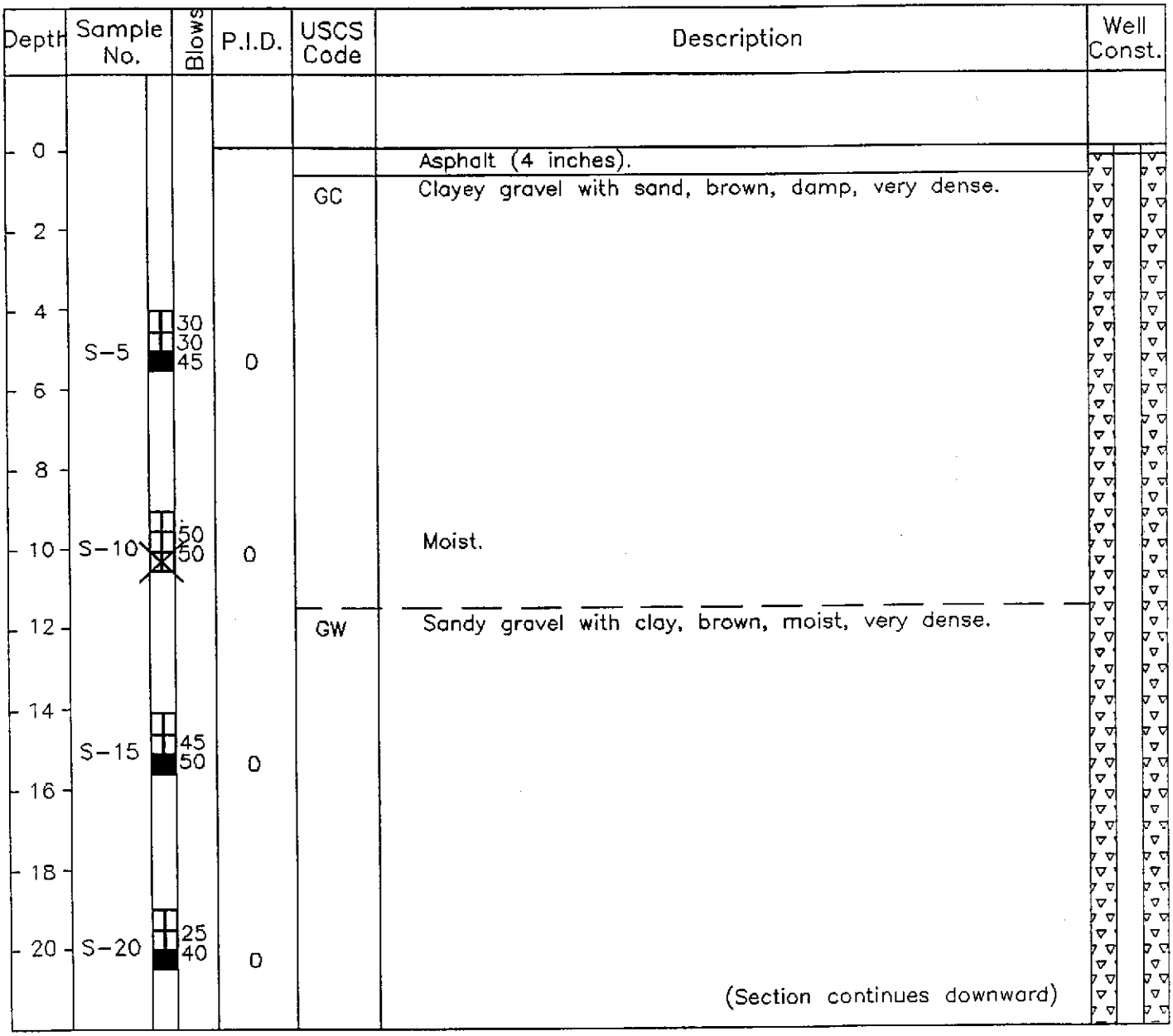
Screen interval: 32 to 40 feet Slot size: 0.020-inch

Drilling Company: Kvilhaug Drilling Co. Driller: Rod and Brian

Method Used: Hollow-Stem Auger Field Geologist: Mike Barminski

Signature of Registered Professional:

Registration No.: CE 044600 State: CA



Applied GeoSystems

PROJECT: 60000-4

LOG OF BORING B-6/MW-3

ARCO Station 771
899 Rincon Avenue
Livemore, California

PLATE 9

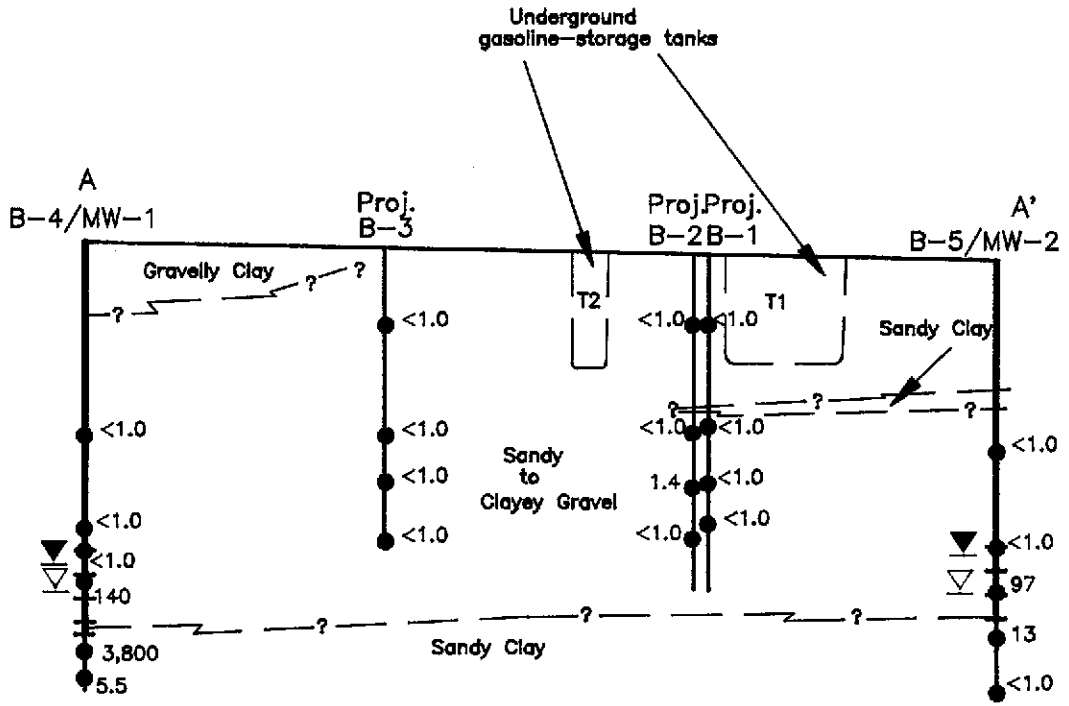
Depth	Sample No.	BLOWS	P.I.D.	USCS Code	Description	Well Const.
22				GW	Sandy gravel with clay, brown, moist, very dense.	
24	S-25	35 50	6.8		Clayier.	
26						
28				GC	Clayey gravel with sand, brown, moist, very dense.	
30	S-29.5 S-30	35 35 35	4.2			
32					12/12/90	
34	S-34.5	50 50	2.8	GW	Sandy gravel with clay, brown, moist, very dense.	
36	S-36.5	14 35 50	3.1			
38	S-38	20 50 50	?		Wet.	
40	S-40.5 S-41	12 15 20	2.8	CL	Sandy clay, brown, moist, low to medium plasticity, hard.	
42						
44	S-44.5	10 18 20	3.2			
46					Total Depth = 45 feet.	
48						
50						

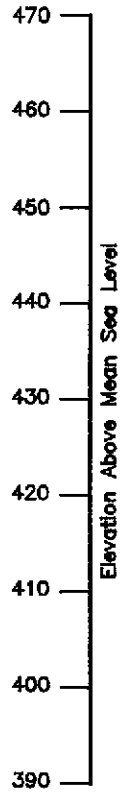
Applied GeoSystems

PROJECT 60000-4

LOG OF BORING B-6/MW-3
ARCO Station 771
899 Rincon Avenue
Livermore, California

PLATE
10





EXPLANATION

3,800 = Laboratory analyzed soil sample showing concentration of TPHg (red) in parts per million

= Well casing

= Well screen

= Boring

= Initial water level in boring

= Static water level in well

Approximate Horizontal and Vertical Scale

20 10 0 20 40

feet

PLATE 11	GEOLOGIC CROSS SECTION A - A' ARCO Station 771 899 Rincon Avenue Livermore, California	Applied GeoSystems PROJECT 60000-4

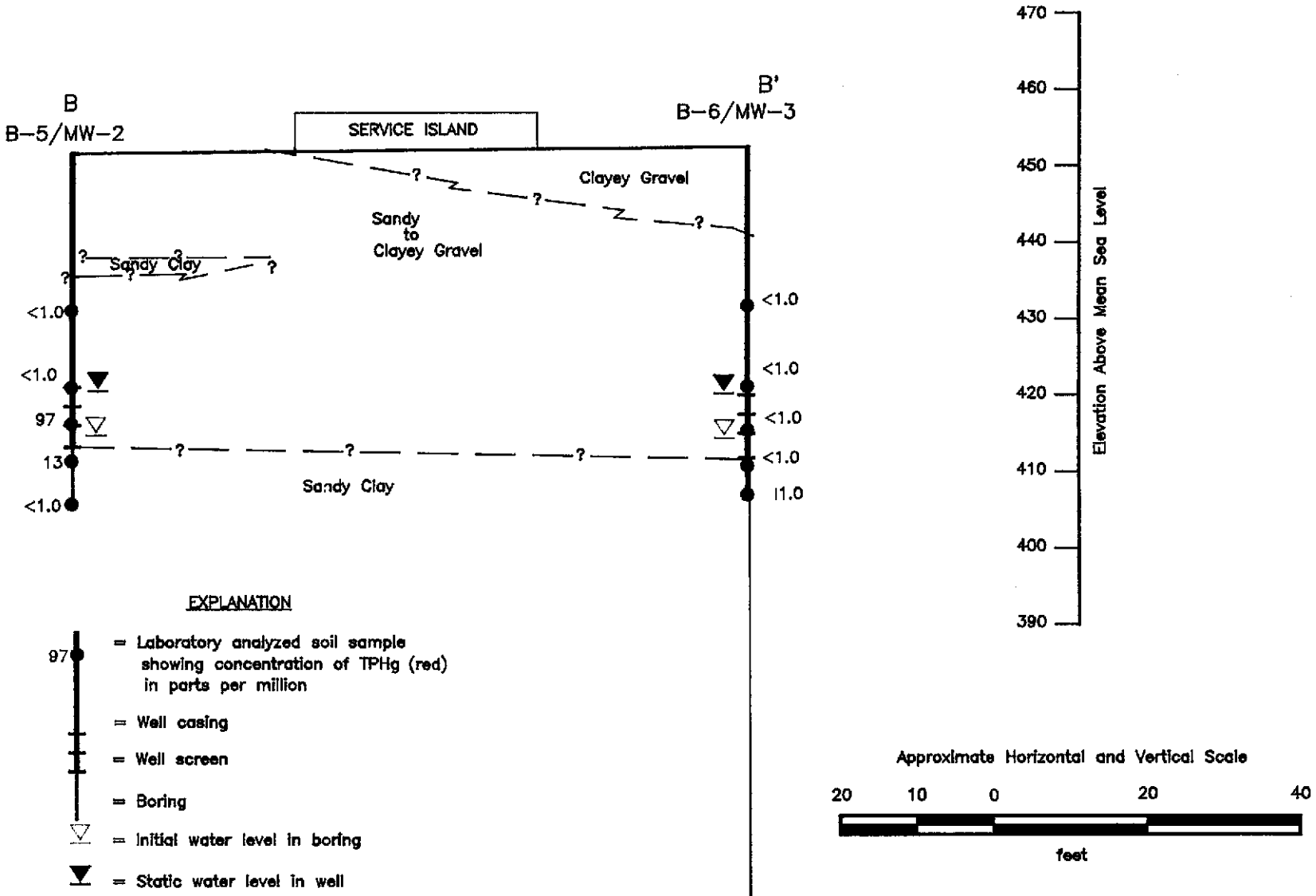
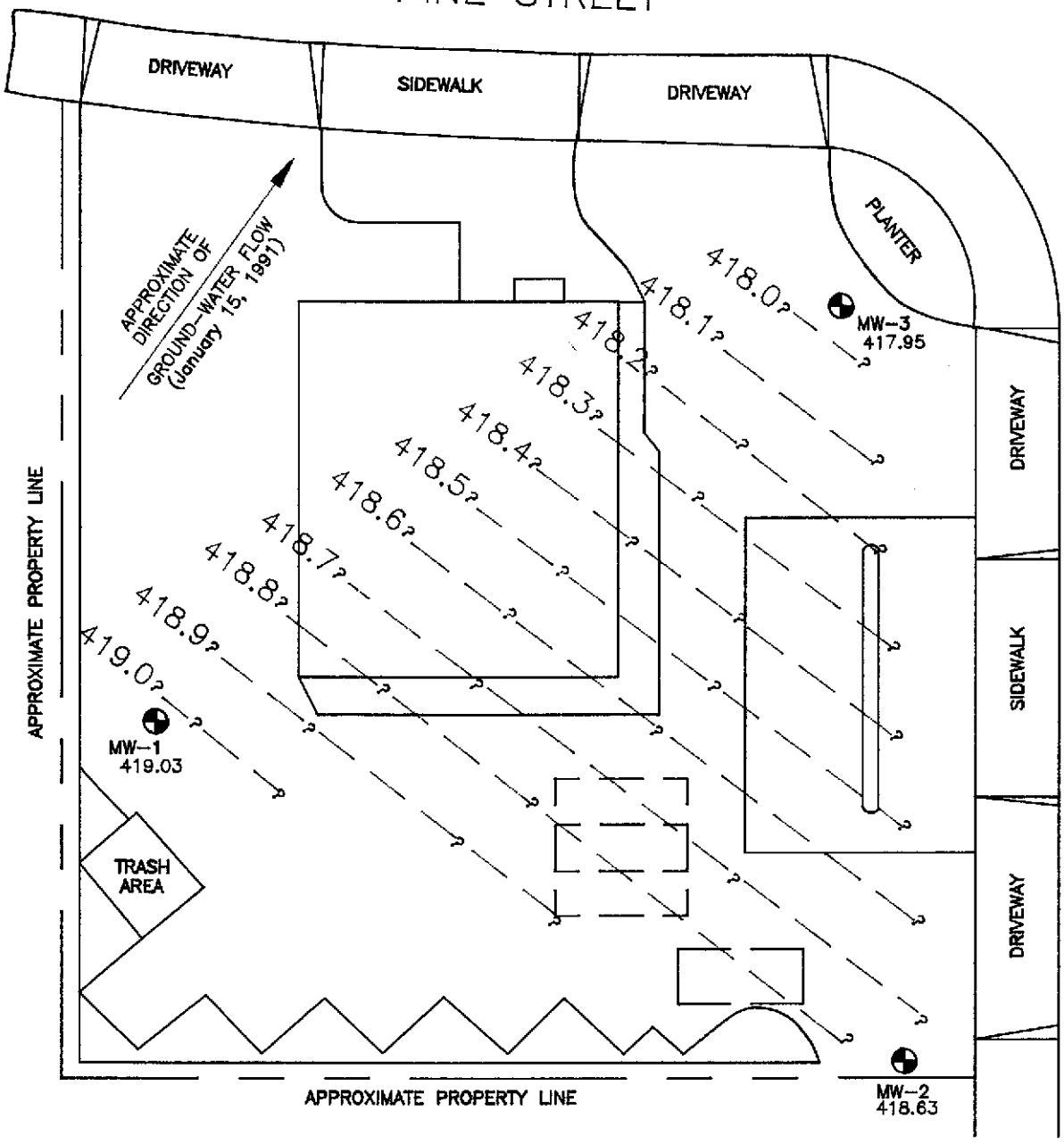


PLATE 12	GEOLOGIC CROSS SECTION B - B' ARCO Station 771 899 Rincon Avenue Livermore, California	Applied GeoSystems PROJECT 60000-4



EXPLANATION

419.0 = Line of equal elevation of ground water January 15, 1991

419.03 = Elevation of ground water in feet, January 15, 1991

MW-3 = Monitoring well (Applied GeoSystems, December 1990)

N

Approximate Scale

20 10 0 20 40

feet

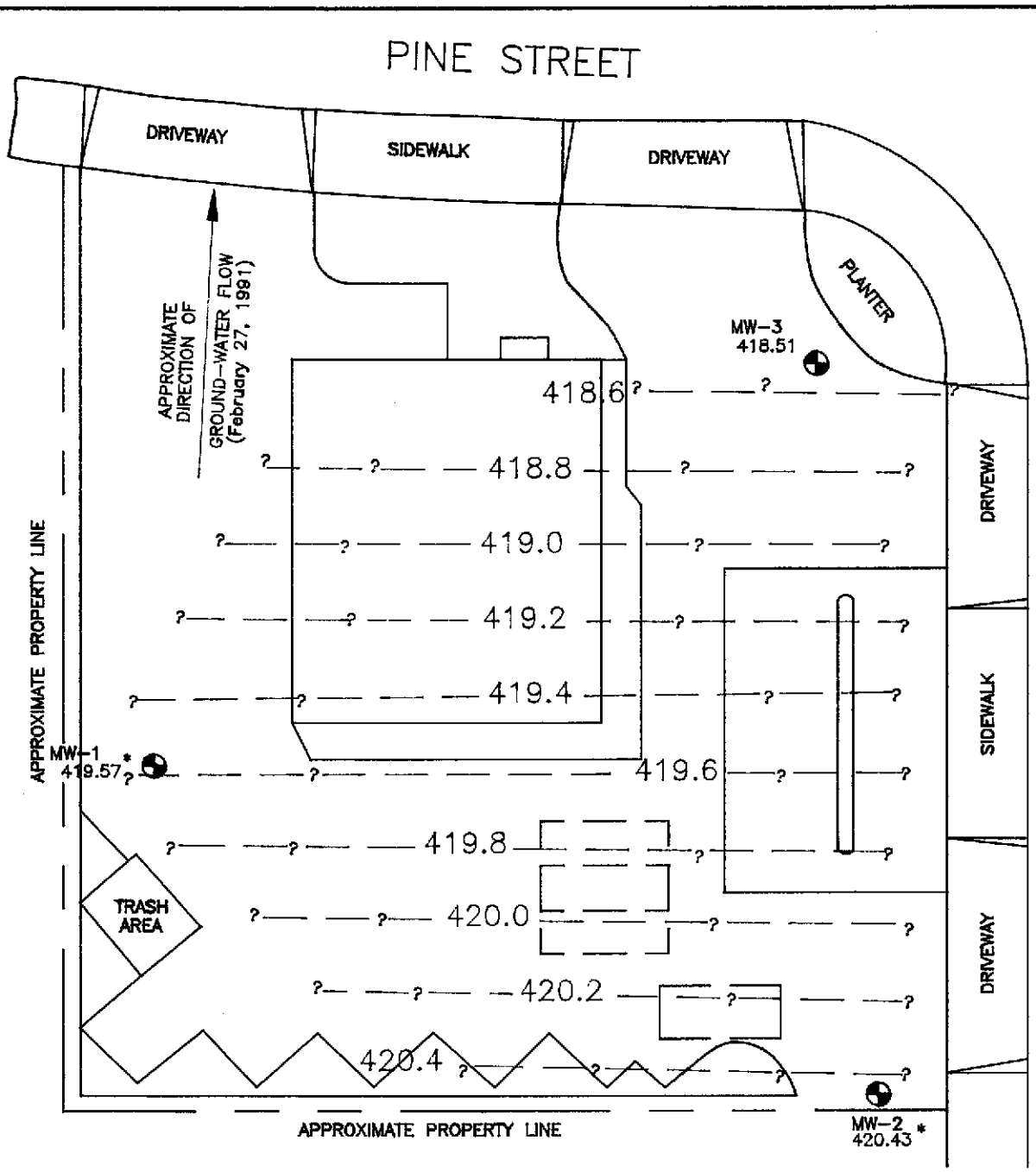
Source: Surveyed by Ron Archer Civil Engineer, Inc.

Applied GeoSystems

PROJECT 60000-4

GROUND-WATER GRADIENT MAP
ARCO Station 771
899 Rincon Avenue
Livermore, California

PLATE 13



EXPLANATION

* = Floating product or product sheen present in well

420.4 = Line of equal elevation of ground water February 27, 1991

420.43 = Elevation of ground water in feet, February 27, 1991

MW-3 = Monitoring well (Applied GeoSystems, December 1990)

N

Approximate Scale

20 10 0 20 40

feet

Source: Surveyed by Ron Archer Civil Engineer, Inc.

Applied GeoSystems

PROJECT 60000-4

GROUND-WATER GRADIENT MAP
ARCO Station 771
899 Rincon Avenue
Livermore, California

PLATE
14

TABLE 1
CUMULATIVE RESULTS OF LABORATORY ANALYSIS OF SOIL SAMPLES
ARCO Station 771
Livermore, California

Sample Identification	TPHg	Benzene	Toluene	Ethyl-benzene	Total Xylenes
February 1990					
S-10-B1	<1.0	<0.005	<0.005	<0.005	<0.005
S-19.5-B1	<1.0	0.022	0.024	<0.005	0.022
S-24.5-B1	<1.0	0.022	0.015	0.010	0.048
S-29.5-B1	<1.0	<0.005	<0.005	<0.005	<0.005
S-10-B2	<1.0	<0.005	<0.005	<0.005	<0.005
S-20-B2	<1.0	0.016	0.020	<0.005	0.025
S-25-B2	1.4	<0.01	<0.01	<0.01	0.018
S-31-B2	<1.0	<0.005	<0.005	<0.005	<0.005
S-10-B3	<1.0	<0.005	<0.005	<0.005	<0.005
S-19.5-B3	<1.0	0.028	<0.005	<0.005	0.017
S-25-B3	4.5	0.047	<0.01	0.011	0.038
S-32.5-B3	190	<1.0	<1.0	<1.0	1.7
December 1990					
S-20-B4	<1.0	0.006	<0.005	<0.005	<0.005
S-30-B4	<1.0	<0.005	<0.005	<0.005	<0.005
S-32-1/2-B4	<1.0	<0.005	<0.005	<0.005	<0.005
S-36-1/2-B4	140	<0.15	0.80	1.7	4.2
S-43-B4	3,800	<1.5	130	50	280
S-45-1/2-B4	5.5	0.16	0.51	0.11	0.82
S-20-B5	<1.0	0.068	0.013	0.009	0.026
S-30-B5	<1.0	<0.005	<0.005	<0.005	<0.005
S-34-1/2-B5	97	<0.005	0.13	0.087	0.22
S-39-1/2-B5	13	0.15	0.66	0.16	1.5
S-45-B5	<1.0	<0.005	0.006	<0.005	0.009
S-20-B6	<1.0	<0.005	<0.005	<0.005	<0.005
S-30-B6	<1.0	<0.005	<0.005	<0.005	<0.005
S-36-1/2-B6	<1.0	<0.005	<0.005	<0.005	0.006
S-41-B6	<1.0	<0.005	<0.005	<0.005	<0.005
S-44-1/2-B6	<1.0	<0.005	<0.005	<0.005	<0.005
S-011591-1ABCD*	31	0.25	0.67	0.34	2.8

Results measured in part per million (ppm).
<: Less than the laboratory detection limit.
TPHg: Total petroleum hydrocarbons as gasoline (analyzed by EPA Method 5030/8015.
BTEX: Analyzed by EPA Method 5030 and 8020/602.
*: Composite sample of four soil samples obtained from stockpiled soil.
Sample Identification: S-44-1/2-B6
- Boring number
- Depth of boring in feet
- Soil sample

TABLE 2
CUMULATIVE GROUND WATER MONITORING DATA
ARCO Station 771
Livermore, California

Date Well Measured	Well Elevation	Depth to Water	Water Elevation	Floating Product	Adjusted Water Elevation
MW-1					
1-15-91	451.80	32.77	419.03	---	---
2-27-91		32.23	419.57	---	---
MW-2					
1-15-91	449.52	30.89*	418.63*	0.16	418.76
2-27-91		29.11*	420.41*	0.02	420.43
MW-3					
1-15-91	450.29	32.34	417.95	---	---
2-27-91		31.78	418.51	---	---

Measurements in feet.
Calculated DTW when floating product is present is calculated using the attached protocol (Appendix A).
* = Floating product present in well.

TABLE 3
RESULTS OF LABORATORY ANALYSIS OF GROUND-WATER SAMPLES
ARCO Station 771
Livermore, California

Sample ID	TPHg	Benzene	Toluene	Ethyl-benzene	Total xylenes
MW1	N/S	N/S	N/S	N/S	N/S
MW2	N/S	N/S	N/S	N/S	N/S
MW3	230	<0.5	<0.5	2.2	2.1

Results in parts per billion (ppb)
<: Less than the laboratory detection limit.
N/S: Not Sampled.
BTEX: Measured by EPA Method 8020/602.
TPHg: Total petroleum hydrocarbons as gasoline (measured by EPA Method 5030/8015).

Sample Identification: MW3
└— Monitoring well number

APPENDIX A

WELL PERMIT

RECEIVED
NOV 28 1990
APPLIED GEOSYSTEMS
SAN JOSE BRANCH

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

(1) LOCATION OF PROJECT 899 Rincon Ave
Livermore, CA 94550

(2) CLIENT
Name ARCO Products Co.
Address P.O. Box 5811 Phone (415) 571-2435
City San Mateo, CA Zip 94402

(3) APPLICANT
Name Steve Bittman
Applied GeoSystems
Address 3315 Almaden Exp #34 Phone (408) 264-7723
City San Jose CA Zip 95118

(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 X
Cable ___ Other ___

WELL PROJECTS
Drill Hole Diameter 10 in. Depth(s) 45 ft.
Casing Diameter 4 in. Number
Surface Seal Depth 30 ft. of Wells 3
Driller's License No. C57-482390

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

(7) ESTIMATED STARTING DATE Dec 10 1990
ESTIMATED COMPLETION DATE Dec 12 1990

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

APPLICANT'S SIGNATURE Steve Bittman Date 11-16-90

FOR OFFICE USE

PERMIT NUMBER 90689
LOCATION NUMBER ___

Approved Wyman Hong Date 21 Nov 90
Wyman Hong

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.

9198

APPENDIX B

FIELD PROTOCOL

FIELD PROTOCOL

The following presents Applied GeoSystems' (AGS) protocol for a typical site investigation involving gasoline hydrocarbon-impacted soil and/or ground-water.

Site Safety Plan

The Site Safety Plan describes the safety requirements for the evaluation of gasoline hydrocarbons in soil, ground-water, and the vadose-zone at the site. The site Safety Plan is applicable to personnel of AGS and its subcontractors. AGS personnel and subcontractors of AGS scheduled to perform the work at the site are be briefed on the contents of the Site Safety Plan before work begins. A copy of the Site Safety Plan is available for reference by appropriate parties during the work. A site Safety Officer is assigned to the project.

Soil Excavation

Permits are acquired prior to the commencement of work at the site. Excavated soil is evaluated using a field calibrated (using isobutylene) Thermo-Environmental Instruments Model 580 Organic Vapor Meter (OVM). This evaluation is done upon arrival of the soil at the ground surface in the excavator bucket by removing the top portion of soil from the bucket, and then placing the intake probe of the OVM against the surface of the soil in the bucket. Field instruments such as the OVM are useful for measuring relative concentrations of vapor content, but cannot be used to measure levels of hydrocarbons with the accuracy of laboratory analysis. Samples are taken from the soil in the bucket by driving laboratory-cleaned brass sleeves into the soil. The samples are sealed in the sleeves using aluminum foil, plastic caps, and aluminized duct tape; labeled; and promptly placed in iced storage. If field subjective analyses suggest the presence of hydrocarbons in the soil, additional excavation and soil sampling is performed, using similar methods. If ground water is encountered in the excavation, ground water samples are collected from the excavation using a clean Teflon® bailer. The ground water samples are collected as described below under "Ground-Water Sampling". The excavation is backfilled or fenced prior to departure from the site.

Sampling of Stockpiled Soil

One composite soil sample is collected for each 50 cubic yards of stockpiled soil, and for each individual stockpile composed of less than 50 cubic yards. Composite soil samples are obtained by first evaluating relatively high, average, and low areas of hydrocarbon concentration by digging approximately one to two feet into the stockpile and placing the intake probe of a field calibrated OVM against the surface of the soil; and then collecting one sample from the "high" reading area, and three samples from the "average" areas. Samples are collected by removing the top one to two feet of soil, then driving laboratory-cleaned brass sleeves into the soil. The samples are sealed in the sleeves using aluminum foil, plastic caps, and aluminized duct tape; labeled; and promptly placed in iced storage for transport to the laboratory, where compositing will be performed.

Soil Borings

Prior to the drilling of borings and construction of monitoring wells, permits are acquired from the appropriate regulatory agency. In addition to the above-mentioned permits, encroachment permits from the City or State are acquired if drilling of borings offsite in the City or State streets is necessary. Copies of the permits are included in the appendix of the project report. Prior to drilling, Underground Services Alert is notified of our intent to drill, and known underground utility lines and structures are approximately marked.

The borings are drilled by a truck-mounted drill rig equipped with 8- or 10-inch-diameter, hollow-stem augers. The augers are steam-cleaned prior to drilling each boring to minimize the possibility of cross-contamination. After drilling the borings, monitoring wells are constructed in the borings, or neat-cement grout with bentonite is used to backfill the borings to the ground surface.

Borings for ground-water monitoring wells are drilled to a depth of no more than 20 feet below the depth at which a saturated zone is first encountered, or a short distance into a stratum beneath the saturated zone which is of sufficient moisture and consistency to be judged as a perching layer by the field geologist, whichever is shallower. Drilling into a deeper aquifer below the shallowest aquifer can begin only after a conductor casing is properly installed and allowed to set, to seal the shallow aquifer.

Drill Cuttings

Drill cuttings subjectively evaluated as having hydrocarbon contamination at levels greater than 100 parts per million (ppm) are separated from those subjectively evaluated as having

hydrocarbon contamination levels less than 100 ppm. Evaluation is based either on subjective evidence of soil discoloration, or on measurements made using a field calibrated OVM. Readings are taken by placing a soil sample into a ziplock type plastic bag and allowing volatilization to occur. The intake probe of the OVM is then inserted into the headspace created in the plastic bag immediately after opening it. The drill cuttings from the borings are placed in labeled 55-gallon drums approved by the Department of Transportation; or on plastic at the site, and covered with plastic. The cuttings remain the responsibility of the client.

Soil Sampling in Borings

Soil samples are collected at no greater than 5-foot intervals from the ground surface to the total depth of the borings. The soil samples are collected by advancing the boring to a point immediately above the sampling depth, and then driving a California-modified, split-spoon sampler containing brass sleeves through the hollow center of the auger into the soil. The sampler and brass sleeves are laboratory-cleaned, steam-cleaned, or washed thoroughly with Alconox® and water, prior to each use. The sampler is driven with a standard 140-pound hammer repeatedly dropped 30 inches. The number of blows to drive the sampler each successive six inches are counted and recorded to evaluate the relative consistency of the soil.

The samples selected for laboratory analysis are removed from the sampler and quickly sealed in their brass sleeves with aluminum soil, plastic caps, and aluminized duct tape. The samples are then be labeled, promptly placed in iced storage, and delivered to a laboratory certified by the State of California to perform the analyses requested.

One of the samples in brass sleeves not selected for laboratory analysis at each sampling interval is tested in the field using an OVM that is field calibrated at the beginning of each day it is used. This testing is performed by inserting the intake probe of the OVM into the headspace created in the plastic bag containing the soil sample as described in the Drill Cuttings section above. The OVM readings are presented in Logs of Borings included in the project report.

Logging of Borings

A geologist is present to log the soil cuttings and samples using the Unified Soil Classification System. Samples not selected for chemical analysis, and the soil in the sampler shoe, are extruded in the field for inspection. Logs include texture, color, moisture, plasticity, consistency, blow counts, and any other characteristics noted. Logs also include

subjective evidence for the presence of hydrocarbons, such as soil staining, noticeable or obvious product odor, and OVM readings.

Monitoring Well Construction

Monitoring wells are constructed in selected borings using clean 2- or 4-inch-diameter, thread-jointed, Schedule 40 polyvinyl chloride (PVC) casing. No chemical cements, glues, or solvents are used in well construction. Each casing bottom is sealed with a threaded end-plug, and each casing top with a locking plug. The screened portions of the wells are constructed of machine-slotted PVC casing with 0.020-inch-wide (typical) slots for initial site wells. Slot size for subsequent wells may be based on sieve analysis and/or well development data. The screened sections in ground-water monitoring wells are placed to allow monitoring during seasonal fluctuations of ground-water levels.

The annular space of each well is backfilled with No. 2 by 12 sand, or similar sorted sand, to approximately two feet above the top of the screened casing for initial site wells. The sand pack grain size for subsequent wells may be based on sieve analysis and/or well development data. A 1- to 2-foot-thick bentonite plug is placed above the sand as a seal against cement entering the filter pack. The remaining annulus is then backfilled with a slurry of water, neat cement, and bentonite to approximately one foot below the ground surface.

An aluminum utility box with a PVC apron is placed over each wellhead and set in concrete placed flush with the surrounding ground surface. Each wellhead cover has a seal to protect the monitoring well against surface-water infiltration and requires a special wrench to open. The design discourages vandalism and reduces the possibility of accidental disturbance of the well.

Ground-Water Monitoring Well Development

The monitoring wells are developed by bailing or over-pumping and surge-block techniques. The wells are either bailed or pumped, allowed to recharge, and bailed or pumped again until the water removed from the wells is determined to be clear. Turbidity measurements (in NTUs) are recorded during well development and are used in evaluating well development. The development method used, initial turbidity measurement, volume of water removed, final turbidity measurement, and other pertinent field data and observations are included in reports. The wells are allowed to equilibrate for at least 48 hours after development prior to sampling. Water generated by well development will be stored in 17E Department of Transportation (DOT) 55-gallon drums on site and will remain the responsibility of the client.

Ground-Water Sampling

The static water level in each well is measured to the nearest 0.01-foot using a Solinst® electric water-level sounder or oil/water interface probe (if the wells contain floating product) cleaned with Alconox® and water before use in each well. The liquid in the onsite wells is examined for visual evidence of hydrocarbons by gently lowering approximately half the length of a Teflon® bailer (cleaned with Alconox® and water) past the air/water interface. The sample is then retrieved and inspected for floating product, sheen, emulsion, color, and clarity. The thickness of floating product detected is recorded to the nearest 1/8-inch.

Wells which do not contain floating product are purged using a submersible pump. The pump, cables, and hoses are cleaned with Alconox® and water prior to use in each well. The wells are purged until withdrawal is of sufficient duration to result in stabilized pH, temperature, and electrical conductivity of the water, as measured using portable meters calibrated to a standard buffer and conductivity standard. If the well becomes dewatered, the water level is allowed to recover to at least 80 percent of the initial water level. Prior to the collection of each ground water sample, the Teflon® bailer is cleaned with Alconox® and rinsed with tap water and deionized water, and the latex gloves worn by the sampler changed. Hydrochloric acid is added to the sample vials as a preservative (when applicable). A sample method blank is collected by pouring distilled water into the bailer and then into sample vials. A sample of the formation water is then collected from the surface of the water in each of the wells using the Teflon® bailer. The water samples are then gently poured into laboratory-cleaned, 40-milliliter (ml) glass vials, 500 ml plastic bottles or 1-liter glass bottles (as required for specific laboratory analysis) and sealed with Teflon®-lined caps, and inspected for air bubbles to check for headspace, which would allow volatilization to occur. The samples are then labeled and promptly placed in iced storage. A field log of well evacuation procedures and parameter monitoring is maintained. Water generated by the purging of wells is stored in 17E DOT 55-gallon drums onsite and remains the responsibility of the client.

Vadose-Zone Sampling

Vapor readings are made with a field calibrated OVM, which has a lower detection limit of 0.1 ppm. Prior to purging each vadose-zone monitoring well, an initial reading is taken inside the well by connecting the tubing of the OVM to a tight fitting at the top of the well. Each vadose-zone monitoring well is then purged for approximately 60 seconds using an electric vacuum pump connected to the tight fitting. Ambient readings of the air at the site are taken with the OVM after each well is purged. The OVM is then connected to the well

fitting, and the reading recorded. The well is then again purged for approximately 30 seconds, and again measured using the OVM. These purging and measuring procedures are repeated until two consecutive OVM readings are within ten percent of each other.

Sample Labeling and Handling

Sample containers are labeled in the field with the job number, sample location and depth, and date, and promptly placed in iced storage for transport to the laboratory. A Chain of Custody Record is initiated by the field geologist and updated throughout handling of the samples, and accompanies the samples to a laboratory certified by the State of California for the analyses requested. Samples are transported to the laboratory promptly to help ensure that recommended sample holding times are not exceeded. Samples are properly disposed of after their useful life has expired.

Aquifer Testing

Bailer Test

The initial water level is measured in the test well, and water bailed from the test well using a Teflon® bailer and cable cleaned with Alconox® and water. Pressure transducers are used to measure water levels in the test well during drawdown and partial recovery phases, over a minimum period of approximately one to two hours. The bailing rate for the designated test well is recorded.

Pumping Test

The initial water levels in wells to be used during the test are measured prior to commencement of pumping. The flow rate of the pump is adjusted to the desired pumping rate, and water levels allowed to recover to initial levels. Pumping then begins, and the starting time of pumping is recorded. Drawdowns in observation wells are recorded at intervals throughout pumping using pressure transducers. Evacuated water is stored in a storage tank at the site and remains the responsibility of the client. After the pump is shut off, recovery measurements are taken in the wells until recovery is at least 80 percent of the initial water level. Barometric pressure and tidal information are collected for the time interval of the pumping test to allow screening of possible effects of atmospheric pressure and tidal fluctuations on the ground water levels.

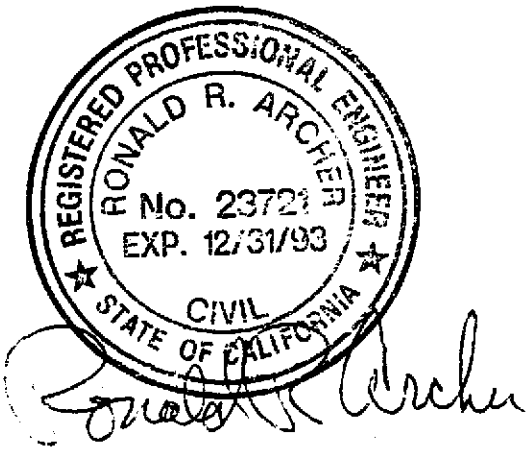
APPENDIX C

WELLHEAD SURVEY

RON ARCHER
CIVIL ENGINEER, INC.

CONSULTING • PLANNING • DESIGN • SURVEYING

4133 Mohr Ave., Suite E • Pleasanton, CA 94566
(415) 462-9372



JANUARY 3, 1991 JOB NO. 1754

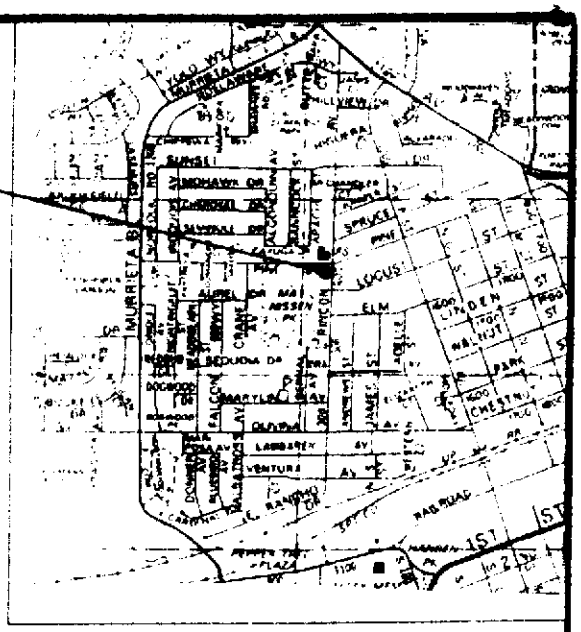
ELEVATIONS OF EXISTING MONITOR WELLS AT THE ARCO STATION NO.771 AT 889 RINCON AVENUE AND PINE STREET ,CITY OF LIVERMORE ,ALAMEDA COUNTY, CALIFORNIA.

FOR:APPLIED GEOSYSTEMS (SAN JOSE)
PROJECT NO. 60000-8

BENCHMARK:
TOP OF PIN IN STANDARD MONUMENT ,WEST SIDE OF INTERSECTION OF RINCON AVENUE AND PINE STREET .ELEVATION TAKEN AS 448.741 CITY OF LIVERMORE DATUM.

MONITOR WELL DATA TABLE

WELL NO.	ELEVATION	DESCRIPTION
MW1	451.80	TOP OF PVC CASING
	452.10	TOP OF BOX
MW2	449.52	TOP OF PVC CASING
	450.05	TOP OF BOX
MW3	450.29	TOP OF PVC CASING
	450.56	TOP OF BOX



VICINITY MAP
NO SCALE

PINE

DWY

ENGINEER

Archer

APPROXIMATE PROPERTY LINE

MW1

TRASH AREA

EX. WALL

DATA TABLE

ON	DESCRIPTION
	TOP OF PVC CASING TOP OF BOX
	TOP OF PVC CASING TOP OF BOX
	TOP OF PVC CASING TOP OF BOX

JOB NO. 1764

B

TOR WELLS AT THE ARCO STATION NO.771 AT
STREET , CITY OF LIVERMORE , ALAMEDA COUNTY,

JOSE)

D MONUMENT, WEST SIDE OF INTERSECTION
PINE SREET. ELEVATION TAKEN AS 448.741
UM.

SCAI

0 10 20

GR

RON ARCHER
CIVIL ENGINEER, INC.
CONSULTING • PLANNING • DESIGN • SURVEYING
4132 Mohr Ave., Suite E • Pleasanton, CA 94566
(415) 462-8372

APPENDIX D

CHAIN OF CUSTODY RECORDS

LABORATORY ANALYSIS DATA SHEETS

Applied GeoSystems

CHAIN-OF-CUSTODY RECORD

PROJ. NO.: 60000-4
PROJECT NAME: ARCO 771, LIVERMORE
P.O. NO.:
SAMPLERS (Signature): Mike Baminoki

DATE MM/DD/YY	TIME		No. of Containers	TPHgasoline (8015)	BTEX (602/8020)	TPHdiesel (8015)	Preserved?	REMARKS	LABORATORY I.D. NUMBER
12/10/90	12:00	S-20-B4 ✓	1	X	X		ice		
		S-30-B4 ✓	1	X	X				
		S-34½-B4 -5	1	X	X				
		S-39½-B4 ✓	1	X	X				
↓	↓	S-45-B4 ✓	1	X	X				
12/11/90	10:00	S-20-B5 ✓	1	X	X				
		S-30-B5 ✓	1	X	X				
		S-32½-B5 -4	1	X	X				
		S-36½-B5 ✓	1	X	X				
		S-43-B5 ✓	1	X	X				
↓	↓	S-45½-B5 ✓	1	X	X				
12/11/90	3:00	S-20-B6 ✓	1	X	X				
		S-30-B6 ✓	1	X	X				
		S-36½-B6 ✓	1	X	X				
		S-41-B6 ✓	1	X	X				
↓	↓	S-44½-B6 ✓	1	X	X		↓		

RELINQUISHED BY (Signature): Mike Baminoki — DATE / TIME: 12/13/90 1:25 — RECEIVED BY (Signature):
RELINQUISHED BY (Signature): — DATE / TIME: — RECEIVED BY (Signature):
RELINQUISHED BY (Signature): — DATE / TIME: — RECEIVED FOR LABORATORY BY (Signature):

Laboratory: Applied ANALytical

Turn Around: 2 week

SEND RESULTS TO:
Applied GeoSystems
3315 Almaden Expressway
Suite 34
San Jose, California 95118
(408) 264-7723

Proj. Mgr.: STEVE BITMAN

APPLIED ANALYTICAL

Environmental Laboratories

42501 Albrae St., Suite 100
Fremont, CA 94538
Bus: (415) 623-0775
Fax: (415) 651-8647

ANALYSIS REPORT

1020lab.frm

Attention: Mr. Steve Bittman
Applied GeoSystems
3315 Almaden Expressway
San Jose, CA 95118
Project: AGS 60000-4

Date Sampled: 12-11-90
Date Received: 12-14-90
BTEX Analyzed: 12-18-90
TPHg Analyzed: 12-18-90
TPHd Analyzed: NR
Matrix: Soil

	Benzene ppm	Toluene ppm	Ethyl-benzene ppm	Total Xylenes ppm	TPHg ppm	TPHd ppm
Detection Limit:	0.005	0.005	0.005	0.005	1.0	10
SAMPLE Laboratory Identification						
S-20-B4 S1012213	0.006	ND	ND	ND	ND	NR
S-30-B4 S1012214	ND	ND	ND	ND	ND	NR
S-32.5-B4 S1012215	ND	ND	ND	ND	ND	NR
S-20-B6 S1012219	ND	ND	ND	ND	ND	NR
S-30-B6 S1012220	ND	ND	ND	ND	ND	NR

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

ANALYTICAL PROCEDURES

BTEX– Benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction using EPA Method 5030 followed by analysis using EPA Method 8020/602, which utilizes a gas chromatograph (GC) equipped with a photoionization detector (PID) and a flame-ionization detector (FID) in series.

TPHg–Total petroleum hydrocarbons as gasoline (low-to-medium boiling points) are measured by extraction using EPA Method 5030, followed by analysis using modified EPA Method 8015, which utilizes a GC equipped with an FID.

TPHd–Total petroleum hydrocarbons as diesel (high boiling points) are measured by extraction using EPA Method 3550 for soils and EPA Method 3510 for water, followed by modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

Laboratory Representative

December 27, 1990
Date Reported

APPLIED ANALYTICAL

Environmental Laboratories

42501 Albrae St., Suite 100
Fremont, CA 94538
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ANALYSIS REPORT

1020lab.frm

Attention: Mr. Steve Bittman
Applied GeoSystems
3315 Almaden Expressway
San Jose, CA 95118
Project: AGS 60000-4

Date Sampled: 12-11-90
Date Received: 12-14-90
BTEX Analyzed: 12-18-90
TPHg Analyzed: 12-18-90
TPHd Analyzed: NR
Matrix: Soil

	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TPHg	TPHd
	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit:	0.15	0.15	0.15	0.15	30	10
SAMPLE Laboratory Identification						
S-36.5-B4 S1012216	ND	0.80	1.7	4.2	140	NR

ppm = parts per million = mg/kg = milligrams per kilogram.
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NR = Analysis not requested.

ANALYTICAL PROCEDURES

BTEX– Benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction using EPA Method 5030 followed by analysis using EPA Method 8020/602, which utilizes a gas chromatograph (GC) equipped with a photoionization detector (PID) and a flame-ionization detector (FID) in series.

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ANALYSIS REPORT

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Attention: Mr. Steve Bittman
Applied GeoSystems
3315 Almaden Expressway
San Jose, CA 95118
Project: AGS 60000-4

Date Sampled: 12-11-90
Date Received: 12-14-90
BTEX Analyzed: 12-18-90
TPHg Analyzed: 12-18-90
TPHd Analyzed: NR
Matrix: Soil

	Benzene ppm	Toluene ppm	Ethyl-benzene ppm	Total Xylenes ppm	TPHg ppm	TPHd ppm
Detection Limit:	1.5	1.5	1.5	1.5	300	10
SAMPLE Laboratory Identification						
S-43-B4 S1012217	ND	130	50	280	3800	NR

ppm = parts per million = mg/kg = milligrams per kilogram.
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NR = Analysis not requested.

ANALYTICAL PROCEDURES

BTEX– Benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction using EPA Method 5030 followed by analysis using EPA Method 8020/602, which utilizes a gas chromatograph (GC) equipped with a photoionization detector (PID) and a flame-ionization detector (FID) in series.

TPHg–Total petroleum hydrocarbons as gasoline (low-to-medium boiling points) are measured by extraction using EPA Method 5030, followed by analysis using modified EPA Method 8015, which utilizes a GC equipped with an FID.

TPHd–Total petroleum hydrocarbons as diesel (high boiling points) are measured by extraction using EPA Method 3550 for soils and EPA Method 3510 for water, followed by modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

Laboratory Representative

December 27, 1990
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ANALYSIS REPORT

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Attention: Mr. Steve Bittman
Applied GeoSystems
3315 Almaden Expressway
San Jose, CA 95118
Project: AGS 60000-4

Date Sampled: 12-11-90
Date Received: 12-14-90
BTEX Analyzed: 12-18-90
TPHg Analyzed: 12-18-90
TPHd Analyzed: NR
Matrix: Soil

	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TPHg	TPHd
	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit:	0.03	0.03	0.03	0.03	6.0	10
SAMPLE Laboratory Identification						
S-45.5-B4 S1012218	0.16	0.51	0.11	0.82	5.5	NR

ppm = parts per million = mg/kg = milligrams per kilogram.
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NR = Analysis not requested.

ANALYTICAL PROCEDURES

BTEX– Benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction using EPA Method 5030 followed by analysis using EPA Method 8020/602, which utilizes a gas chromatograph (GC) equipped with a photoionization detector (PID) and a flame-ionization detector (FID) in series.

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Laboratory Representative

December 27, 1990
Date Reported

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ANALYSIS REPORT

1020lab.frm

Attention: Mr. Steve Bittman
Applied GeoSystems
3315 Almaden Expressway
San Jose, CA 95118
Project: AGS 60000-4

Date Sampled: 12-10-90
Date Received: 12-14-90
BTEX Analyzed: 12-18-90
TPHg Analyzed: 12-18-90
TPHd Analyzed: NR
Matrix: Soil

	Benzene ppm	Toluene ppm	Ethyl-benzene ppm	Total Xylenes ppm	TPHg ppm	TPHd ppm
Detection Limit:	0.005	0.005	0.005	0.005	1.0	10
SAMPLE Laboratory Identification						
S-20-B5 S1012208	0.068	0.013	0.009	0.026	ND	NR
S-30-B5 S1012209	ND	ND	ND	ND	ND	NR
S-34.5-B5 S1012210	ND	0.13	0.087	0.22	97	NR
S-39.5-B5 S1012211	0.15	0.66	0.16	1.5	13	NR
S-45-B5 S1012212	ND	0.006	ND	0.009	ND	NR

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ANALYTICAL PROCEDURES

BTEX– Benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction using EPA Method 5030 followed by analysis using EPA Method 8020/602, which utilizes a gas chromatograph (GC) equipped with a photoionization detector (PID) and a flame-ionization detector (FID) in series.
TPHg–Total petroleum hydrocarbons as gasoline (low-to-medium boiling points) are measured by extraction using EPA Method 5030, followed by analysis using modified EPA Method 8015, which utilizes a GC equipped with an FID.
TPHd–Total petroleum hydrocarbons as diesel (high boiling points) are measured by extraction using EPA Method 3550 for soils and EPA Method 3510 for water, followed by modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

Laboratory Representative

December 27, 1990
Date Reported

APPLIED ANALYTICAL LABORATORY IS CERTIFIED BY THE STATE OF CALIFORNIA DEPARTMENT OF HEALTH SERVICES AS A HAZARDOUS WASTE TESTING LABORATORY
(Certification No. 1211)

APPLIED ANALYTICAL

Environmental Laboratories

42501 Albrae St., Suite 100
Fremont, CA 94538
Bus: (415) 623-0775
Fax: (415) 651-8647

ANALYSIS REPORT

1020lab.frm

Attention: Mr. Steve Bittman
Applied GeoSystems
3315 Almaden Expressway
San Jose, CA 95118
Project: AGS 60000-4

Date Sampled: 12-11-90
Date Received: 12-14-90
BTEX Analyzed: 12-18-90
TPHg Analyzed: 12-18-90
TPHd Analyzed: NR
Matrix: Soil

	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TPHg	TPHd
	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit:	0.005	0.005	0.005	0.005	1.0	10
SAMPLE Laboratory Identification						
S-36.5-B6 S1012221	ND	ND	ND	0.006	ND	NR
S-41-B6 S1012222	ND	ND	ND	ND	ND	NR
S-44.5-B6 S1012223	ND	ND	ND	ND	ND	NR

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

ANALYTICAL PROCEDURES

BTEX– Benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction using EPA Method 5030 followed by analysis using EPA Method 8020/602, which utilizes a gas chromatograph (GC) equipped with a photoionization detector (PID) and a flame-ionization detector (FID) in series.

TPHg--Total petroleum hydrocarbons as gasoline (low-to-medium boiling points) are measured by extraction using EPA Method 5030, followed by analysis using modified EPA Method 8015, which utilizes a GC equipped with an FID.

TPHd--Total petroleum hydrocarbons as diesel (high boiling points) are measured by extraction using EPA Method 3550 for soils and EPA Method 3510 for water, followed by modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

Laboratory Representative

December 27, 1990
Date Reported

APPLIED ANALYTICAL LABORATORY IS CERTIFIED BY THE STATE OF CALIFORNIA DEPARTMENT OF HEALTH SERVICES AS A HAZARDOUS WASTE TESTING LABORATORY
(Certification No. 1211)

Applied GeoSystems

CHAIN-OF-CUSTODY RECORD

PROJ. NO.	PROJECT NAME
60000-4	ARCO 771
P.O. NO.	SAMPLERS (Signature)
	Mike Bamish

* Rush

DATE MM/DD/YY	TIME	SAMPLE I.D.	No. of Con-tainers	TPHg	BTEX	TPHd	Preserved?	LABORATORY I.D. NUMBER
1/15/91	1:00	S-011591-1ABCD	4	X	X			Composite Soil Analysis

ANALYSIS

RELINQUISHED BY (Signature):	DATE / TIME	RECEIVED BY (Signature):
Mike Bamish	1/15/91 6:30	
RELINQUISHED BY (Signature):	DATE / TIME	RECEIVED BY (Signature):
RELINQUISHED BY (Signature):	DATE / TIME	RECEIVED FOR LABORATORY BY (Signature):
		[illegible] 1/15/91

REMARKS:
24 hour
Rush

SEND RESULTS TO:
Applied GeoSystems
3315 Almaden Expressway
Suite 34
San Jose, California 95118
(408) 264-7723

Proj. Mgr.: Steve Bitman

APPLIED ANALYTICAL

Environmental Laboratories

42501 Albrae St., Suite 100
Fremont, CA 94538
Bus: (415) 623-0775
Fax: (415) 651-8647

ANALYSIS REPORT

1020lab.frm

Attention: Mr. Steve Bittman
Applied GeoSystems
3315 Almaden Expressway
San Jose, CA 95118
Project: AGS 60000-4

Date Sampled: 01-15-91
Date Received: 01-15-91
BTEX Analyzed: 01-15-91
TPHg Analyzed: 01-15-91
TPHd Analyzed: NR
Matrix: Soil

	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TPHg	TPHd
	ppm	ppm	ppm	ppm	ppm	ppm
Detection Limit:	0.005	0.005	0.005	0.005	1.0	10
SAMPLE Laboratory Identification						
S-011591-1ABCD S1101179	0.25	0.67	0.34	2.8	31	NR

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

ANALYTICAL PROCEDURES

BTEX– Benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction using EPA Method 5030 followed by analysis using EPA Method 8020/602, which utilizes a gas chromatograph (GC) equipped with a photoionization detector (PID) and a flame-ionization detector (FID) in series.
TPHg–Total petroleum hydrocarbons as gasoline (low-to-medium boiling points) are measured by extraction using EPA Method 5030, followed by analysis using modified EPA Method 8015, which utilizes a GC equipped with an FID.
TPHd–Total petroleum hydrocarbons as diesel (high boiling points) are measured by extraction using EPA Method 3550 for soils and EPA Method 3510 for water, followed by modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

Laboratory Representative

January 16, 1991
Date Reported

APPLIED ANALYTICAL LABORATORY IS CERTIFIED BY THE STATE OF CALIFORNIA DEPARTMENT OF HEALTH SERVICES AS A HAZARDOUS WASTE TESTING LABORATORY
(Certification No. 1211)

Applied GeoSystems

CHAIN-OF-CUSTODY RECORD

PROJ. NO.	PROJECT NAME
60000-4	ARCO 771
P.O. NO.	SAMPLERS (Signature)
	Mike Bauinski

DATE MM/DD/YY	TIME	SAMPLE I.D.	No. of Containers	TPHg	BTEX	TPHd	Preserved? HCl	LABORATORY I.D. NUMBER
1/15/91	2:45	W-32-MW3	4	X	X		X	

ANALYSIS

RELINQUISHED BY (Signature):	DATE / TIME	RECEIVED BY (Signature):	REMARKS:	SEND RESULTS TO:
Mike Bauinski	1/15/91 6:30		2 week turnaround	**Applied GeoSystems** 3315 Almaden Expressway Suite 34 San Jose, California 95118 (408) 264-7723
RELINQUISHED BY (Signature):	DATE / TIME	RECEIVED BY (Signature):		
RELINQUISHED BY (Signature):	DATE / TIME	RECEIVED FOR LABORATORY BY (Signature): M Hallman 1/15/91		Proj. Mgr.: Steve Bittmenn

APPLIED ANALYTICAL

Environmental Laboratories

42501 Albrae St., Suite 100
Fremont, CA 94538
Bus: (415) 623-0775
Fax: (415) 651-8647

ANALYSIS REPORT

1020lab.frm

Attention: Mr. Steve Bittman
Applied GeoSystems
3315 Almaden Expressway
San Jose, CA 95118
Project: AGS 60000-4

Date Sampled: 01-15-91
Date Received: 01-15-91
BTEX Analyzed: 01-18-91
TPHg Analyzed: 01-18-91
TPHd Analyzed: NR
Matrix: Water

	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TPHg	TPHd
	ppb	ppb	ppb	ppb	ppb	ppb
Detection Limit:	0.5	0.5	0.5	0.5	50	100
SAMPLE Laboratory Identification						
W-32-MW3 W1101180	ND	ND	2.2	2.1	230	NR

ppb = parts per billion = µg/L = micrograms per liter.
ND = Not detected. Compound(s) may be present at concentrations below the detection limit.
NR = Analysis not requested.

ANALYTICAL PROCEDURES

BTEX-- Benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) are measured by extraction using EPA Method 5030 followed by analysis using EPA Method 8020/602, which utilizes a gas chromatograph (GC) equipped with a photoionization detector (PID) and a flame-ionization detector (FID) in series.
TPHg--Total petroleum hydrocarbons as gasoline (low-to-medium boiling points) are measured by extraction using EPA Method 5030, followed by analysis using modified EPA Method 8015, which utilizes a GC equipped with an FID.
TPHd--Total petroleum hydrocarbons as diesel (high boiling points) are measured by extraction using EPA Method 3550 for soils and EPA Method 3510 for water, followed by modified EPA Method 8015 with direct sample injection into a GC equipped with an FID.

Laboratory Representative

January 22, 1991
Date Reported

APPLIED ANALYTICAL LABORATORY IS CERTIFIED BY THE STATE OF CALIFORNIA
DEPARTMENT OF HEALTH SERVICES AS A HAZARDOUS WASTE TESTING LABORATORY
(Certification No. 1211)