Applied GeoSystems, Inc. 3315 Almaden Expressway, Suite 34, San Jose, CA 95118 (408) 264-7723

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May 2, 1991

REPORT
PRELIMINARY TANK REPLACEMENT ASSESSMENT
at
ARCO Station 4494
566 Hegenberger Road
Oakland, California

AGS 69038-5

Prepared for

ARCO Products Company
P.O. Box 5811
San Mateo, California

by
Applied GeoSystems

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Project Geologist

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May 2, 1991

TABLE OF CONTENTS

TABLES

PLATES

TABLE OF CONTENTS
(Continued)

APPENDIX A

PREVIOUS ENVIRONMENTAL WORK (7)

APPENDIX B

APPENDIX C

APPENDIX D

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REPORT
PRELIMINARY TANK REPLACEMENT ASSESSMENT
ARCO Station 4494
566 Hegenberger Road
Oakland, California

For ARCO Products Company

INTRODUCTION

At the request of ARCO Products Company (ARCO), RESNA/Applied GeoSystems (AGS) performed a preliminary tank replacement assessment to evaluate the presence of petroleum hydrocarbons in the subsurface soil in the area adjacent to three underground gasoline-storage tanks and in the area of the proposed new tanks prior to future tank removal and replacement operations at ARCO Station 4494 located at 566 Hegenberger Road in Oakland, California. The assessment included drilling twelve soil borings, collecting and laboratory analyzing selected soil samples from the borings, and summarizing previous work performed by others at the site, and preparing this report presenting the field procedures, results, and conclusions of this assessment.

SITE DESCRIPTION AND BACKGROUND

General

The site is an operating gasoline station at 566 Hegenberger Road on the northeastern corner of the intersection of Hegenberger Road and Edes Avenue in Oakland, California, as shown on the Site Vicinity Map (Plate 1). The site is on a relatively flat lot at an elevation of approximately 5 feet above mean sea level. The site is situated in a commercial/industrial area of the City of Oakland, approximately 1,000 feet east of Interstate Highway 880. This commercial/industrial area is occupied by a wide variety of businesses including fast food restaurants, the Oakland SPCA, union halls, tool manufacturers, trucking firms, construction firms, sign painting firms, motels, and inns. The Oakland-Alameda County Coliseum complex is located approximately 1/2-mile northwest of the site. The site is bounded by a restaurant to the north, a parking lot for a restaurant to the east, restaurants to the west across Hegenberger Road, and a Shell Oil service station across Edes Avenue to the south.

Before its development in 1969, the subject property was covered by a sparse growth of native grasses and weeds, and was situated on reclaimed tidal marshlands covered by approximately four feet of artificial fill (Soil Mechanics and Foundation Engineers [SMFE], 1968). The fill material was described by SMFE as heterogeneous sandy gravelly clay containing construction debris, including pieces of concrete, asphalt, and metallic slag. The source of the construction debris was unknown. Below the fill material was marshland soil and bay mud deposits. SMFE reported that the site may contain a buried tidal slough crossing the southern portion of the site. This slough was filled in between 1947 and 1953, based on observations of aerial photographs from those years, and replaced with an

excavated drainage channel (Pacific Aerial Surveys, 1947 and 1953). This drainage channel was then filled in and replaced with a 72-inch storm drain pipeline sometime after 1968. The buried channel is approximately located on the Generalized Site Plan (Plate 2) from information provided by the City of Oakland. Three pipelines were reported by SMFE in 1968 to cross the central portion of the property in a northeast-southwest direction, including the 72-inch-diameter storm drain, a 48-inch-diameter sanitary sewer, and an abandoned sanitary sewer pipeline. Approximate locations of the storm drain and sewer lines based on plans supplied by the City of Oakland Public Works are shown on Plate 2.

Microfiche plans at the City of Oakland Building Inspection Department (OBID) indicate that the site was originally developed by Gulf Oil Company (Gulf) as a service station in 1969. Building plans for the Gulf station show three underground storage tanks (UST) east of the station building, and a fourth tank (possibly a waste-oil tank) may have been located adjacent to the east wall of the station building just south of the USTs. Records of the Oakland Fire Department indicate that Gulf removed and replaced one 10,000-gallon UST in 1975. No record of soil sampling to document possible leakage from the tank(s) was found.

AGS understands from information supplied by ARCO, that ARCO purchased the site from Gulf in 1977, and that one 280-gallon waste-oil storage tank was located west of the station building. On December 16, 1988, the 280-gallon waste-oil storage tank was excavated and removed from the site by Crosby and Overton of Oakland, California. Three 10,000-gallon underground gasoline-storage tanks are at the site: one regular gasoline-storage tank, one super-unleaded gasoline-storage tank, and one regular-unleaded gasoline-storage tank. It is also AGS' understanding that ARCO plans to remodel the site and replace the existing gasoline-storage tanks in 1991.

Geology

The site is located along the eastern margin of San Francisco Bay within the East Bay Plain, in the northwestern portion of the San Leandro Cone near the boundary of the Oakland Alluvial Plain (Hickenbottom, 1988). The East Bay Plain lies within the Coast Range geomorphic province and is characterized by broad alluvial fan margins sloping westward into San Francisco Bay.

The site area formerly was occupied by shallow tidal marshes, and a channelized tidal slough is still located directly across Hegenberger Road from the site. Helley (1979) mapped the earth materials underlying the site area as Holocene-age bay mud estaurine deposits composed of unconsolidated, water-saturated, dark plastic clay and silty clay rich in organic materials, with local lenses and stringers of well-sorted silt, fine sand, and peat. These estaurine materials, known locally as Bay Mud, were deposited primarily in brackish- to salt-water marshes along the margins and beneath the waters of San Francisco Bay during interglacial periods before and after the Wisconsin Glaciation in late Pleistocene time (Goldman, 1969). The estuarine Bay Mud materials interfinger with Holocene-age fine-grained alluvium deposited by standing floodwaters that periodically inundate the low interfluvial basin areas and fresh-water marshes (Helley, 1979).

Hydrogeology

Alameda County uses ground water as part of its domestic water supply. The remainder of the water supply is derived from surface reservoirs and from imported water that is transported in from the Mokelumne Aqueduct, the State Water Project, and the Hetch Hetchy Aqueduct (Hickenbottom, 1988).

Ground-water quality in the water-bearing units of the San Leandro Cone is generally good (meets recommended primary and secondary standards for drinking water). The most productive water wells in the San Leandro Cone are those completed within the older alluvium units. The older alluvium units consist of permeable alluvial fan deposits characterized by poorly consolidated to unconsolidated gravel, sand, silt and clay (Hickenbottom, 1988). These units contain appreciable quantities of ground water, and are therefore considered to be the principal ground-water reservoir in the East Bay Plain area. Smaller amounts of ground water occur in the younger alluvium, fluvial deposits, interfluvial basin deposits, and Bay Mud estaurine deposits. These deposits generally are relatively thin (less than 120 feet thick), and generally yield only small amounts of ground water to wells. The Bay Mud unit is important to the ground-water resources of the East Bay Plain because of the low permeability of the Bay Mud functions as a barrier to the vertical movement of salt water from San Francisco Bay into the older alluvium. The Bay Mud is generally water-saturated because most of it lies below the water table. However, it is not considered as a useable source of ground water to wells because of its low permeability and because it is believed to contain mostly salt water (Hickenbottom, 1988).

The inferred direction of ground-water flow in the vicinity of the site is to the west\southwest based on regional and local topography and drainage patterns. The depth to first ground water has been measured to be approximately 5 to 15 feet in the area of the site (Alameda County Public Works, 1990).

The site is located approximately 3,500 feet east of San Leandro Bay, which is a smaller portion of San Francisco Bay. The nearest streams to the site are Elmhurst Creek, which is located approximately 1,300 feet north of the site, and San Leandro Creek which is located approximately 6,500 feet south of the site. Both creeks originate in the East Bay

Hills, which are a part of the Diablo mountain range, and drain directly into San Leandro Bay. Water enters these creeks by direct runoff from rural and urban areas, through numerous small tributaries, and through numerous storm sewer outlets originating in the urbanized areas. Water also enters the much larger San Leandro Creek from overflow from the East Bay Municipal Utility District's Lake Chabot reservoir located in the East Bay Hills north of the city of Castro Valley.

PREVIOUS WORK

Prior to the present assessment, Pacific Environmental Group (Pacific) performed an environmental investigation related to the removal of the underground waste-oil storage tank (Pacific, 1989). AGS submitted a work plan (AGS, 1989) to the local regulating agencies to perform a limited subsurface environmental investigation (AGS, February 1991), and also performed a site history and limited environmental records search of the surrounding area (AGS, 1990). The results of these investigations are presented in reports by AGS and Pacific listed in references of this report. A brief summary of previous work performed at the site is included in Appendix A of this report. Cumulative laboratory results of soil samples collected during previous investigations are summarized in Tables 1 and 2.

FIELD WORK

A permit was obtained from Alameda County Flood Control and Water Conservation District (Zone 7) before drilling the twelve borings (B-6 through B-17) at the site. A copy of the permit is included in Appendix B. Field work at the site for ARCO was conducted in accordance with AGS field protocol and the Site Safety Plan (AGS, March 1991). A

description of the field methods and the Site Safety Plan is included in Appendix C, Field Methods.

Drilling

On March 11, 1991, one soil boring (B-6) was drilled in the area of the proposed future gasoline-storage tanks, and four soil borings (B-7 through B-10) were drilled around the perimeter of the three existing underground gasoline-storage tanks, to evaluate the presence of gasoline hydrocarbons in the soil in those areas. On March 26, 1991, five soil borings (B-11 through B-15) were drilled in the area of the proposed station building, one soil boring (B-16) was drilled approximately five feet southwest of the southwest corner of the proposed future gasoline-storage tanks, and one boring (B-17) was drilled in the northwest corner of the site to evaluate the presence of petroleum hydrocarbons in the soil in the proposed development areas. The locations of the twelve borings are shown on Plate 2.

Soil Sampling and Description

Soil samples were collected and described from borings B-6 through B-17 during drilling. A summary of the Unified Soil Classification System used to identify the soil encountered during drilling is presented on Plate 3, and the descriptions of the soil encountered in the borings are presented on the Logs of Borings (Plates 4 through 15). Soil samples were collected at intervals of five feet or less from the ground surface to the total depth of the borings. A summary of the sampling methods used for this assessment are presented in Appendix C.

The earth materials encountered in borings B-6 through B-17 consisted primarily of sandy to silty clay and some clayey sand and clayey gravel. Artificial fill material consisting predominantly of moist, dark brown to black sandy to silty clay was encountered from immediately below the asphalt and baserock covering the site to depths of approximately 4 to 11-1/2 feet. The artificial fill materials consisted of a heterogeneous mixture of silty to sandy clay, fragments of metallic slag and glass, concrete debris, and silty to gravelly sand. During drilling, perched ground water was encountered in borings B-6 and B-16 at depths of approximately 6 to 7 feet. Beneath the heterogeneous fill materials, a relatively homogeneous moist to wet, gray to black, silty to fine sandy clay was encountered to depths of approximately 8 to 12-1/2 feet. Beneath the silty to fine sandy clay, ground water was encountered in a gray to black clayey sand to sandy clay, which extended to the bottom of borings B-7, B-9 through B-15, and B-17 at depths of approximately 11 through 15-1/2 feet. Graphic interpretations of the soil stratigraphy encountered during this assessment and in an earlier investigation beneath the site are shown on Geologic Cross Sections A-A', B-B', C-C', D-D', E-E', and F-F' (Plates 16 through 20).

Subjective evidence of hydrocarbons was noted during drilling in borings B-7, B-8, B-9, and B-10 adjacent to the underground-storage tanks, and in boring B-17 in the northwest corner of the site. Field organic vapor meter (OVM) measurements of soil samples from borings B-7 through B-10 ranging from 11.5 to 767 ppm were noted from depths of approximately 4 feet to first-encountered water. A sheen was noted on the surface of the ground water encountered in boring B-17. No subjective evidence of hydrocarbons was noted in samples from borings B-6 and B-16 in the proposed new tank area, or from borings B-11 through B-15 in the proposed station building area.

Sampling of Stockpiled Soil

A composite soil sample was be collected from the approximately one cubic yard of stockpiled drill cuttings from borings B-6 through B-17 on April 11, 1991. A description of composite soil sample collection procedures is included in Appendix C of this report.

LABORATORY METHODS

Selected soil samples collected from borings B-6 through B-10 were analyzed for total petroleum hydrocarbons as gasoline (TPHg) and the gasoline constituents benzene, toluene, ethylbenzene, and total xylene isomers (BTEX) using modified Environmental Protection Agency (EPA) Methods 8020/8015/3050 as per ARCO's Preliminary Tank Replacement Assessment Specifications. The soil samples were analyzed at Applied Analytical Environmental Laboratories (California Hazardous Materials Testing Laboratory Certification No. 1211) in Fremont, California.

Selected soil samples collected from borings B-11 through B-17 were analyzed for TPHg and BTEX using modified EPA Methods 5030/8015/8020, total petroleum hydrocarbons as diesel (TPHd) using modified EPA Methods 3550/8015, and total oil and grease (TOG) using modified EPA Method 413.1. The composite soil sample collected from the drill cuttings stockpile was analyzed for TPHg and BTEX by the methods described above, and for organic lead by the method described in the December 1987 California LUFT Manual. The soil samples were analyzed at Sequoia Analytical Laboratory (California Hazardous Materials Testing Laboratory Certification No. 145) in Redwood City, California.

RESULTS OF LABORATORY ANALYSES

The cumulative results of the laboratory analyses of soil samples are summarized below and in Table 1. Copies of the laboratory analysis data sheets and Chain of Custody Records are included in Appendix D. The laboratory analyses of soil samples indicated the following:

In the area of the existing underground gasoline-storage tanks (borings B-7 through B-10):

- Nondetectable levels (less than 1.0 ppm) of TPHg were reported in soil samples from a depth of 10 feet in borings B-7 and B-9. Low levels ranging from nondetectable (less than 0.005 ppm) to 0.037 ppm of BTEX were reported in the above soil samples.

- Detectable levels of TPHg ranging between 3.0 to 63 ppm and BTEX ranging between nondetectable to 1.0 ppm were reported in soil samples from a depth of 5 feet in borings B-7 through B-10, and at a depth of 10 feet in boring B-10.

In the area of the proposed underground gasoline-storage tanks (borings B-6 and B-16):

- Nondetectable levels of TPHg and BTEX were reported in soil samples from depths of 5 and 5-1/2 feet in boring B-6 and B-16. In addition, nondetectable levels of TPHd (less than 1.0 ppm) and TOG (less than 30 ppm) were reported in the soil sample from a depth of 5-1/2 feet in boring B-16.

In the area of the proposed service station building (borings B-11 through B-15):

- Nondetectable levels of TPHg, BTEX, and TPHd were reported in soil samples from depths of 5, 6, 10-1/2, and 11 feet in borings B-11 through B-15. Nondetectable levels of TOG were reported in soil samples from a depth of 6 feet in borings B-12 and B-13, and from 10-1/2 to 11 feet in borings B-11 through B-15.

- Detectable levels of TOG ranging between 280 to 570 ppm were reported in soil samples from depths of 5 to 6 feet in borings B-11, B-14, and B-15; however, nondetectable levels of TOG were reported in the same borings at depths of 10-1/2 to 11 feet.

In the northwestern corner of the site (boring B-17):

- Detectable levels of TPHg at 69 ppm, TOG at 1,100 ppm, and BTEX ranging from 1.0 to 2.2 ppm were reported in the soil sample from a depth of 6 feet in boring B-17. A nondetectable level of TPHd was reported for the above soil sample; however, the detection limit for this sample was 100 ppm because of the 1,100 ppm TOG reported in the sample.

DISCUSSION AND CONCLUSIONS

The following conclusions are based on the results of this limited assessment:

- The soil above first-encountered ground water near the three existing underground gasoline-storage tanks has been impacted by low levels of gasoline hydrocarbons ranging between nondetectable to 63 ppm TPHg and nondetectable to 1.8 ppm BTEX.

- The soil above first-encountered ground water in the area of the proposed underground gasoline-storage tanks has not been impacted by gasoline hydrocarbons based on nondetectable levels of TPHg and BTEX. However, the former waste-oil storage tank was located in the southern end of the proposed tank pit, and therefore, residual levels of TOG and TPHd may be encountered in this area during excavation, as indicated by laboratory results of a soil sample collected from boring B-1 in October 1989.

- The soil above first-encountered ground water in the area of the proposed station building has not been impacted by gasoline or diesel hydrocarbons based on nondetectable levels of TPHg, BTEX, and TPHd. However, the soil above first-encountered ground water in the eastern area of the proposed station building has been impacted by heavy hydrocarbons based on detectable levels of TOG ranging between 280 to 570 ppm in soil samples collected at a depth of 5 feet in borings B-11, B-14, and B-15. The heterogeneous materials used for artificial filling of the former drainage ditch that crossed the site prior to the site's development may be a potential source of the TOG encountered in this area of the site.

- The soil above first-encountered ground water in the northwestern corner of the site has been impacted by gasoline hydrocarbons at a level of 69 ppm TPHg, and oil and grease hydrocarbons at a level of 1,100 ppm TOG.

- The black hydrocarbon product noted in the soil and ground water during drilling and sampling of boring B-2/well MW-2 in October 1989 was not observed during the drilling of borings B-7 through B-10, suggesting that this black hydrocarbon product is limited laterally to the area of boring B-2.

- The shallow earth materials beneath the site appear to consist of a heterogeneous mixture of imported fill materials, as evidenced by the presence of silty to sandy clay with metallic slag, glass fragments, concrete, and sand and gravel materials encountered during drilling of borings B-6 through B-17. These materials were also encountered during the earlier AGS investigation while drilling borings B-1 through B-5.

- The depth to first-encountered ground water varied beneath the site between the depths of 7 to 12-1/2 feet during drilling of borings B-6 through B-17. The water encountered in borings B-6 and B-16 in the southern portion of the site at depths of 6 to 7 feet appears to be seasonally perched water occurring along the boundary between the fill materials and the underlying native soil. The water encountered in borings B-7 through B-15 and B-17 at depths of 8 to 12-1/2 feet appear to be ground water under semi-confined or confined conditions since the water level rose in most of the borings to approximately 7 feet during drilling.

LIMITATIONS

This report was prepared in accordance with generally accepted standards of environmental geological practice in California at the time of assessment. The assessment was conducted solely to evaluate environmental conditions of the soil for gasoline hydrocarbons at the site in the areas of the existing product-storage tanks and future 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 assessment is made from a limited number of observation points. Further investigation, including subsurface exploration and laboratory testing of soil and ground-water samples at the site, can aid in evaluating subsurface environmental conditions and reduce the inherent uncertainties associated with this type of limited subsurface assessment. Subsurface conditions may vary away from the data points available.

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Pacific Aerial Surveys, Inc. 1953. Black-and-White Aerial Photograph No. AV-253-12-36, flown May 3, 1953. Oakland, California.

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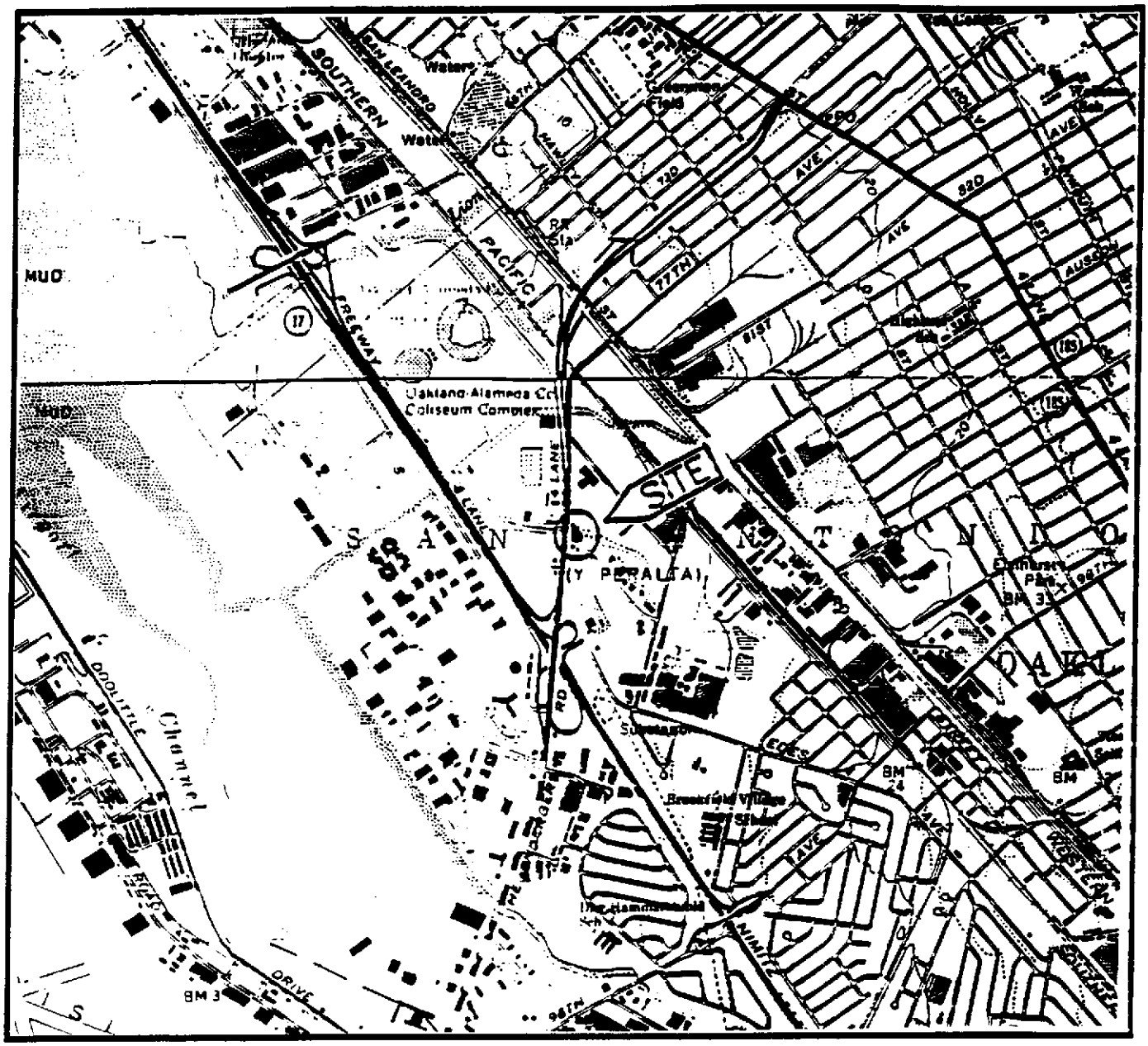
Soil Mechanics and Foundation Engineers. August 30, 1968. Letter to Gulf Oil Company reproduced on microfilm by City of Oakland Department of Public Works, Oakland, California.



Source: U.S. Geological Survey
7.5–Minute Quadrangle
Oakland East/San Leandro,
California
Photorevised 1980

N

Approximate Scale

2000 1000 0 2000 4000

feet

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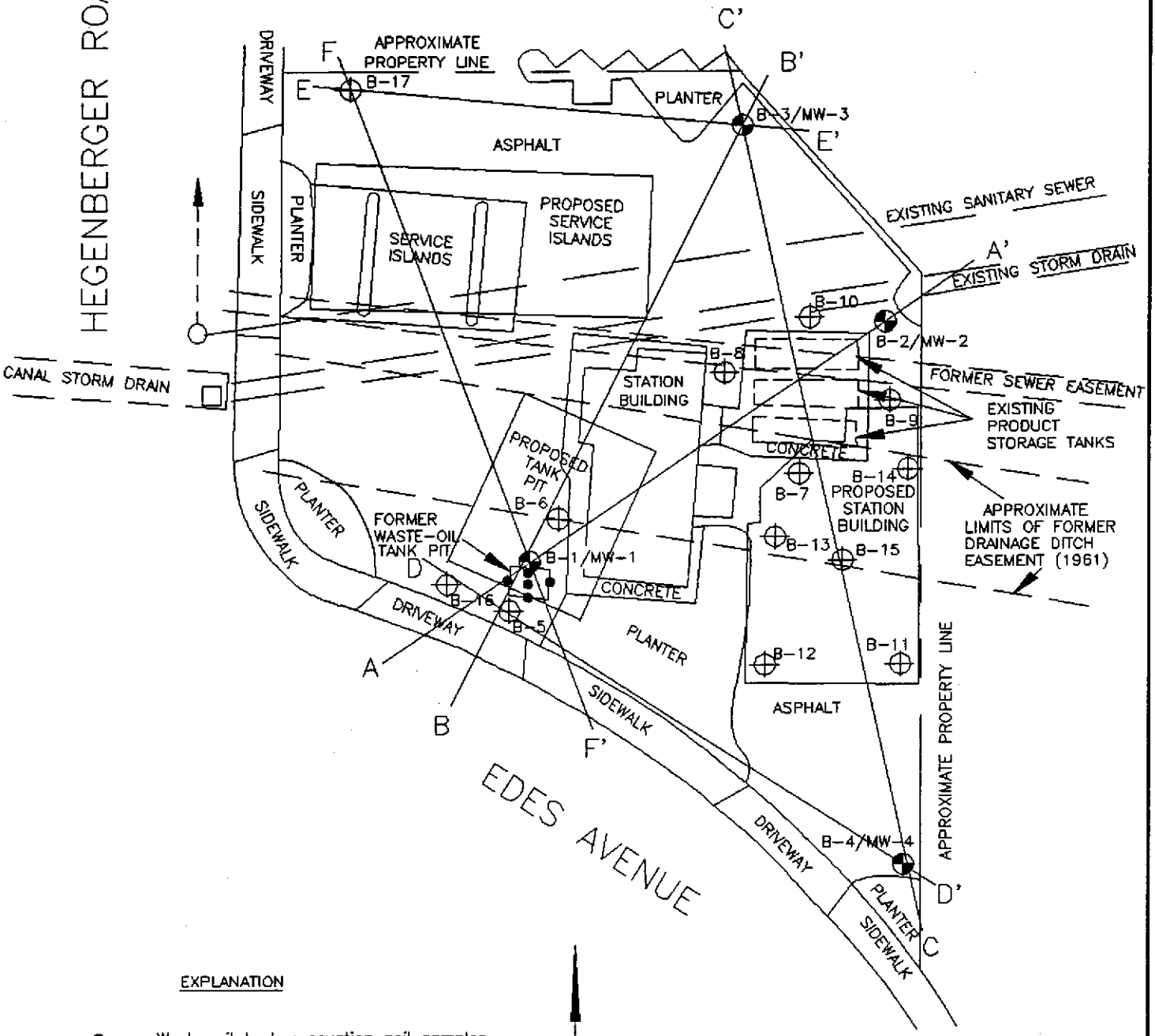
SITE VICINITY MAP
ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE
1



EXPLANATION

- ● = Waste-oil tank excavation soil samples (Pacific Environmental Group, January 1989)
- B-4/MW-4 ◓ = Monitoring wells (Applied GeoSystems, October 1989 and August 1990)
- B-10 ⊕ = Soil boring (Applied GeoSystems, August 1990 and March 1991)
- F — F' = Geologic Cross Sections

N

Approximate Scale

40 20 0 40 80

feet

Source: Modified from plans supplied by ARCO Products Co. (dated August 12, 1982) and City of Oakland Dept. of Public Works (dated December 19, 1961).

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GENERALIZED SITE PLAN
ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE 2

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISION		LTR	DESCRIPTION	MAJOR DIVISION		LTR	DESCRIPTION
COARSE-GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	GW	Well-graded Gravels or Gravel-Sand mixtures, little or no fines.	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.
		GP	Poorly-graded Gravels or Gravel-Sand mixtures, little or no fines.			CL	Inorganic Clays of low to medium plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays.
		GM	Silty Gravels, Gravel-Sand-Silt mixtures.			OL	Organic Silts and Organic Silt-Clays of low plasticity.
		GC	Clayey Gravel, Gravel-Sand-Clay mixtures.		SILTS AND CLAYS LL>50	MH	Inorganic Silts, micaceous or diatomaceous fine Sandy or Silty Soils, Elastic Silts.
	SAND AND SANDY SOILS	SW	Well-graded Sand or Gravelly Sands, little or no fines.			CH	Inorganic Clays of high plasticity, fat Clays.
		SP	Poorly-graded Sands or Gravelly Sands, little or no fines.			OH	Organic Clays of medium to high plasticity, organic Silts.
		SM	Silty Sands, Sand-Silt mixtures.				
		SC	Clayey Sands, Sand-Clay mixtures.	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 Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE
3

Depth of boring: 7 feet Diameter of boring: 6 inches Date drilled: 3-11-91

Well depth: N/A Material type: N/A Casing diameter: N/A

Screen interval: N/A Slot size: N/A

Drilling Company: Exceltech Drilling Driller: Rich and Scott

Method Used: Solid Stem Auger Field Geologist: Ken Mateik

Signature of Registered Professional:

Registration No.: State:

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Paved parking area.	
0					Asphalt (2-1/2 inches) and pea gravel (4 inches).	
2				CL	Sandy clay, dark brown, moist, low to medium plasticity, very stiff: Fill.	
				CH	Silty clay, black, moist, high plasticity, stiff to very stiff: Fill.	
4	S-5	23 27 8	1.7	SP	Gravelly sand with rock fragments, gray and brown, moist very dense: Fill.	
6				CL ▽ ▼	Sandy clay, black, very moist, low to medium plasticity, stiff: Native soil. Wet at 7 feet.	
					Boring terminated at 7 feet.	
8						
10						
12						
14						
16						
18						
20						

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LOG OF BORING B-6

ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE 4

Depth of boring: 15-1/2 feet Diameter of boring: 6 inches Date drilled: 3-11-91

Well depth: N/A Material type: N/A Casing diameter: N/A

Screen interval: N/A Slot size: N/A

Drilling Company: Exceltech Drilling Driller: Rich and Scott

Method Used: Solid Stem Auger Field Geologist: Ken Mateik

Signature of Registered Professional: _____

Registration No.: _____ State: _____

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Paved driveway area.	
0					Asphalt (6 inches) and baserock (6 inches).	
				CL	Sandy clay, brown, moist, medium plasticity, very stiff: Fill.	
2				CH	Silty clay, black, damp to moist, high plasticity, very stiff: Fill.	
4	S-5	10 10 10	29		Noticeable product odor.	
6	S-7	5 10 12	492		Obvious product odor.	
8				CH	Silty clay, black mottled with blue-gray, very moist, high plasticity, stiff; noticeable product odor: Native soil.	
10	S-10	5 7 7	197	▼		
12				▽ SC	Clayey sand, black, wet, medium dense.	
14	S-15	4 6 8				
16					Boring terminated at 15-1/2 feet.	
18						
20						

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LOG OF BORING B-7

ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE 5

Depth of boring: 6-1/2 feet Diameter of boring: 6 inches Date drilled: 3-11-91

Well depth: N/A Material type: N/A Casing diameter: N/A

Screen interval: N/A Slot size: N/A

Drilling Company: Exceltech Drilling Driller: Rich and Scott

Method Used: Solid Stem Auger Field Geologist: Ken Mateik

Signature of Registered Professional: _____

Registration No.: _____ State: _____

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
0						
				SC	Asphalt (3 inches) and baserock (9 inches).	
2				CL	Sandy clay, black, moist, low plasticity, very stiff: Fill.	
					Mottled with light gray, glass and rock fragments common; obvious prodct odor.	
4	S-5	4 8 18	767		Stringers of fine sand.	
6					Refusal at 6-1/2 feet due to concrete debris.	
					Boring terminated at 6-1/2 feet.	
8						
10						
12						
14						
16						
18						
20						

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PROJECT: 69038-5

LOG OF BORING B-8

ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE 6

Depth of boring: 13-1/2 feet Diameter of boring: 6 inches Date drilled: 3-11-91

Well depth: N/A Material type: N/A Casing diameter: N/A

Screen interval: N/A Slot size: N/A

Drilling Company: Exceltech Drilling Driller: Rich and Scott

Method Used: Solid Stem Auger Field Geologist: Ken Mateik

Signature of Registered Professional: _____

Registration No.: _____ State: _____

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Paved driveway area.	
0				CL	Asphalt (2-1/2 inches) and baserock (9 inches).	
2				CL	Silty clay with abundant glass fragments, black, moist, low to medium plasticity, stiff; noticeable product odor: Fill.	
4	S-5	6 8 13	17.5	CH	Silty clay, blue-gray, moist, high plasticity, very stiff; noticeable product odor: Native soil.	
6						
8						
10	S-10	4 4 5	27		Abundant plant organics and peat. Noticeable product odor.	
12	S-13	7 3 3	5.1	SC	Alternating layers of black and gray with peat fragments. ▽ Clayey fine sand, gray, wet, loose; plant roots and medium to coarse sand in sample head.	
14					Boring terminated at 13-1/2 feet.	
16						
18						
20						

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PROJECT: 69038-5

LOG OF BORING B-9

ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE 7

Depth of boring: 11 feet Diameter of boring: 6 inches Date drilled: 3-11-91

Well depth: N/A Materiai type: N/A Casing diameter: N/A

Screen interval: N/A Slot size: N/A

Drilling Company: Exceltech Drilling Driller: Rich and Scott

Method Used: Solid Stem Auger Field Geologist: Ken Mateik

Signature of Registered Professional: _____

Registration No.: _____ State: _____

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
					Paved driveway area.	
0					Asphalt (3 inches) and baserock (12 inches).	
2				CL	Fine sandy clay, black, moist, low to medium plasticity, very stiff; noticeable product odor: Fill.	
4	S-5	7 11 13	11.5		Fragments of metallic/glass slag.	
6				CH	Sandy clay, black and blue-gray, moist, high plasticity, very stiff; noticeable product odor: Fill.	
8					Some peat and roots.	
10	S-10	6 9 13	143		Obvious product odor.	
				GC	Clayey gravel, gray, very moist, medium dense.	
12					Boring terminated at 11 feet due to concrete debris.	
14						
16						
18						
20						

Applied GeoSystems

PROJECT: 69038-5

LOG OF BORING B-10

ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE 8

Depth of boring: 13 feet Diameter of boring: 6 inches Date drilled: 3-26-91

Well depth: N/A Material type: N/A Casing diameter: N/A

Screen interval: N/A Slot size: N/A

Drilling Company: Exceltech Drilling Driller: Cam & Tim

Method Used: Solid Stem Auger Field Geologist: Steve Bittman

Signature of Registered Professional: _____

Registration No.: _____ State: _____

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
0					Asphalt (3 inches) and baserock (10 inches).	
2				CH	Silty clay, black, damp, high plasticity, stiff: Fill.	
4				SM	Silty sand, fine-grained, black, moist, loose, abundant glass fragments: Fill.	
6	S-6	17 7 4	0	CH	Silty clay, gray, moist, high plasticity, stiff: Native soil.	
8	S-8	15 10 14	0		Very stiff.	
10	S-11	7 7 12	0		Small roots and peat fragments.	
12		3 4 2		SC	Clayey sand, gray, wet, loose.	
14					Boring terminated at 13 feet.	
16						
18						
20						

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PROJECT: 69038-5

LOG OF BORING B-11

ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE 9

Depth of boring: 12 feet Diameter of boring: 6 inches Date drilled: 3-26-91

Well depth: N/A Material type: N/A Casing diameter: N/A

Screen interval: N/A Slot size: N/A

Drilling Company: Exceltech Drilling Driller: Cam & Tim

Method Used: Solid Stem Auger Field Geologist: Steve Bittman

Signature of Registered Professional: _____

Registration No.: _____ State: _____

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
0						
					Asphalt (3 inches) and baserock (10 inches).	
2				CL	Silty clay, black, damp, low plasticity, stiff, abundant glass and metal fragments: Fill.	
4						
6	S-6	6 7 13	0	CH ▼	Silty clay, gray, moist, high plasticity, stiff; Native soil.	
8						
10	S-11	4 2 2	0	SC ▽	Clayey sand, medium-grained, gray, moist, loose, abundant plant roots. Wet.	
12					Boring terminated at 12 feet.	
14						
16						
18						
20						

Applied GeoSystems

PROJECT: 69038-5

LOG OF BORING B-12

ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE 10

Depth of boring: 12-1/2 feet Diameter of boring: 6 inches Date drilled: 3-26-91

Well depth: N/A Material type: N/A Casing diameter: N/A

Screen interval: N/A Slot size: N/A

Drilling Company: Exceltech Drilling Driller: Cam & Tim

Method Used: Solid Stem Auger Field Geologist: Steve Bittman

Signature of Registered Professional: _____

Registration No.: _____ State: _____

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
0					Asphalt (3 inches) and baserock (10 inches).	
2				CH	Silty clay, black, damp to moist, high plasticity, very stiff: Fill.	
4						
6	S-6	6 6 7	1	▼	Color change to gray.	
8						
10				CL	Sandy clay with gravel, gray, moist, low plasticity, stiff: Native soil.	
12	S-11	4 4 6	0	▽	Wet.	
14					Boring terminated at 12-1/2 feet.	
16						
18						
20						

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PROJECT: 69038-5

LOG OF BORING B-13

ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE 11

Depth of boring: 13 feet Diameter of boring: 6 inches Date drilled: 3-26-91

Well depth: N/A Material type: N/A Casing diameter: N/A

Screen interval: N/A Slot size: N/A

Drilling Company: Exceltech Drilling Driller: Cam & Tim

Method Used: Solid Stem Auger Field Geologist: Steve Bittman

Signature of Registered Professional: _____

Registration No.: _____ State: _____

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
0						
					Asphalt (3 inches) and baserock (10 inches).	
2				CL	Silty clay, black, damp, low to medium plasticity, stiff; abundant glass and metal fragments: Fill.	
4				SM	Silty sand, fine-grained, black, moist, loose; abundant glass fragments: Fill.	
	S-5	7 11 13	0	CH	Silty clay, gray, damp, medium plasticity, very stiff: Fill.	
6						
8		9		CH		
	S-9	4 8	0		Silty clay, black, moist, high plasticity, stiff: Native soil.	
10		3				
	S-11	3 6	0	SC ▽ ▼	Clayey sand, fine-grained, gray, moist, loose; abundant plant roots.	
12		2			Wet.	
	S-12.5	1 2	0			
					Boring terminated at 13 feet.	
14						
16						
18						
20						

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PROJECT: 69038-5

LOG OF BORING B-14

ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE 12

Depth of boring: 11-1/2 feet Diameter of boring: 6 inches Date drilled: 3-26-91

Well depth: N/A Material type: N/A Casing diameter: N/A

Screen interval: N/A Slot size: N/A

Drilling Company: Exceltech Drilling Driller: Cam & Tim

Method Used: Solid Stem Auger Field Geologist: Steve Bittman

Signature of Registered Professional: _____

Registration No.: _____ State: _____

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
0						
					Asphalt (4 inches) and baserock (8 inches).	
				CL	Sandy clay, dark gray, damp, low plasticity, very stiff: Fill	
2				CH	Silty clay, black, damp, high plasticity, very stiff: Fill.	
					Abundant glass and metal fragments. Hard drilling.	
4						
				CH	Silty clay, gray, damp, high plasticity, very stiff; abundant peat fragments: Native soil.	
6	S-6	11 13 19	0			
8						
10	S-10.5	5 4 6	0	CL	Sandy clay, gray, moist, low plasticity, stiff.	
				▽ ▼	Wet.	
12					Boring terminated at 11-1/2 feet.	
14						
16						
18						
20						

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PROJECT: 69038-5

LOG OF BORING B-15

ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE 13

Depth of boring: 6-1/2 feet Diameter of boring: 6 inches Date drilled: 3-26-91

Well depth: N/A Material type: N/A Casing diameter: N/A

Screen interval: N/A Slot size: N/A

Drilling Company: Exceltech Drilling Driller: Cam & Tim

Method Used: Solid Stem Auger Field Geologist: Steve Bittman

Signature of Registered Professional: _____

Registration No.: _____ State: _____

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
0						
					Asphalt (3 inches) and baserock (6 inches).	
2				CH	Silty clay, dark gray, damp, high plasticity, very stiff: Fill.	
4						
6	S-5.5	5 6 7	0	CL	Sandy clay, dark gray, moist, medium plasticity, stiff: Native soil. Wet.	
					Boring terminated at 6-1/2 feet.	
8						
10						
12						
14						
16						
18						
20						

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PROJECT: 69038-5

LOG OF BORING B-16

ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE 14

Depth of boring: 11-1/2 feet Diameter of boring: 6 inches Date drilled: 3-26-91

Well depth: N/A Material type: N/A Casing diameter: N/A

Screen interval: N/A Slot size: N/A

Drilling Company: Exceltech Drilling Driller: Cam & Tim

Method Used: Solid Stem Auger Field Geologist: Steve Bittman

Signature of Registered Professional: _____

Registration No.: _____ State: _____

Depth	Sample No.	Blows	P.I.D.	USCS Code	Description	Well Const.
0						
					Asphalt (6 inches) and baserock (12 inches).	
2				CL	Silty clay, black, damp, low plasticity, very stiff; abundant glass and metal fragments, very hard to drill: Fill.	
4					Smoother drilling at 4-1/2 feet.	
	S-6	3 7 10	0	CL	Silty clay, dark gray, damp, high plasticity, very stiff: Native soil.	
8				SC	Clayey sand, medium-grained, gray, wet, loose.	
10	S-11	2 3 5	0		Shen on ground water	
12					Boring terminated at 11-1/2 feet.	
14						
16						
18						
20						

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PROJECT: 69038-5

LOG OF BORING B-17

ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

PLATE 15

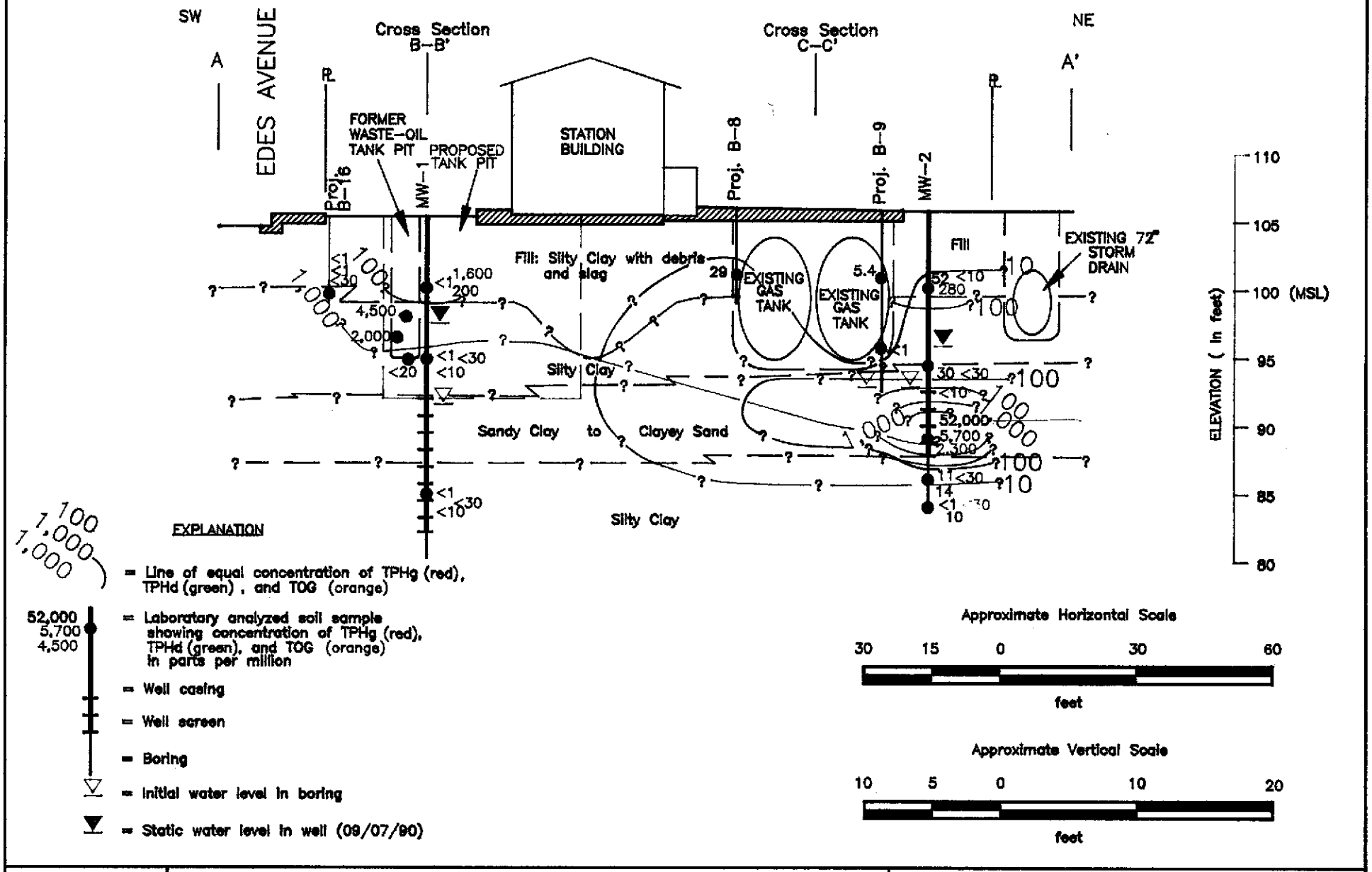
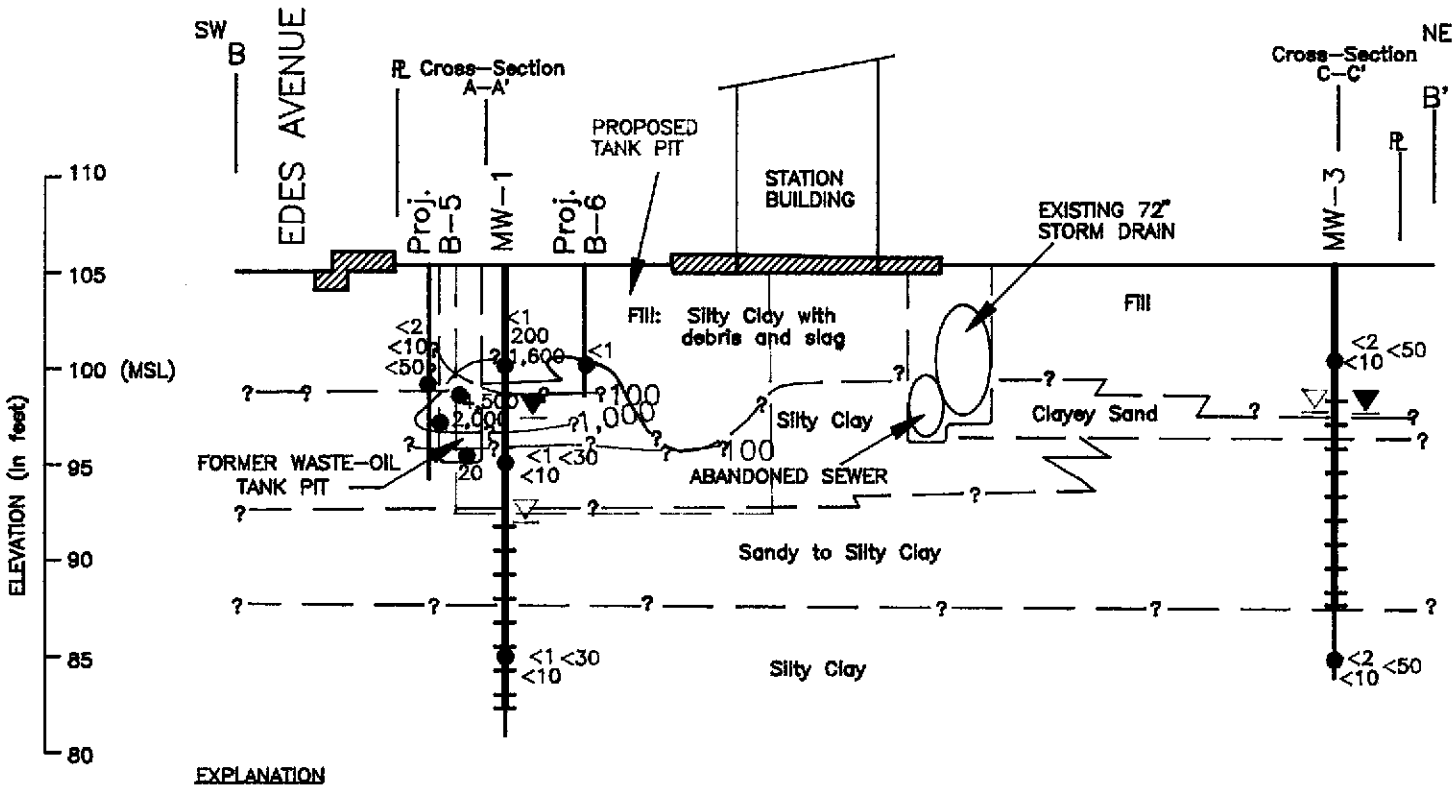


PLATE 16	GEOLOGIC CROSS SECTION A-A' ARCO Service Station 4494 566 Hegenberger Road Oakland, California	Applied GeoSystems PROJECT 69038-5



EXPLANATION

100 / 1,000 = Line of equal concentration of TPHd (green), and TOG (orange)

<2 / 200 / 1,600 = Laboratory analyzed soil sample showing concentration of TPHg (red), TPHd (green), and TOG (orange) in parts per million

= Well casing

= Well screen

= Boring

= Initial water level in boring

= Static water level in well (09/07/90)

Approximate Horizontal Scale

30 15 0 30 60

feet

Approximate Vertical Scale

10 5 0 10 20

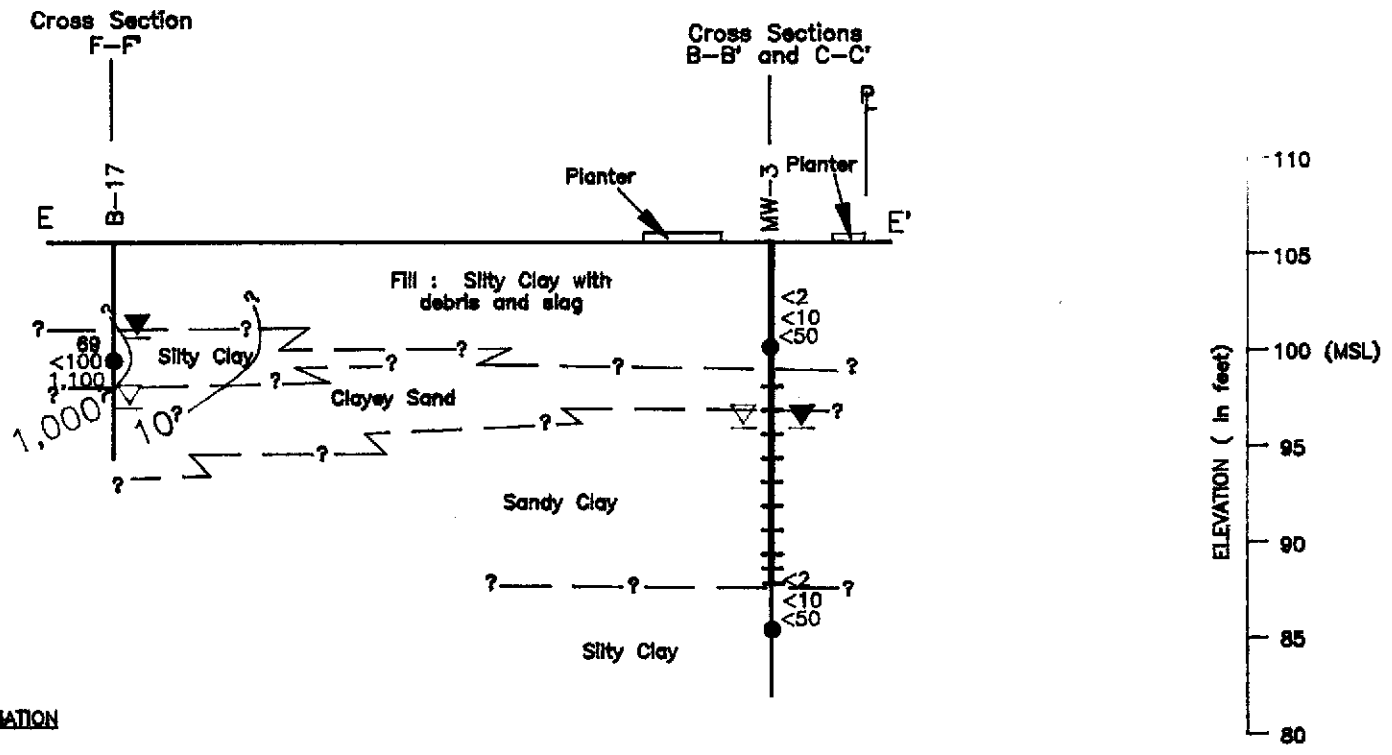
feet

PLATE 17

GEOLOGIC CROSS SECTION B-B'
ARCO Service Station 4494
566 Hegenberger Road
Oakland, California

Applied GeoSystems

PROJECT 69038-5



EXPLANATION

1,000 / 10 = Line of equal concentration of TPHg, (red), and TPHd (green)

<2 / 36 / 0 = Laboratory analyzed soil sample showing concentration of TPHg (red), TPHd (green), and TOG (orange) in parts per million

= Well casing

= Well screen

= Boring

= Initial water level in boring

= Static water level in well (09/07/90)

Approximate Horizontal Scale

30 15 0 30 60

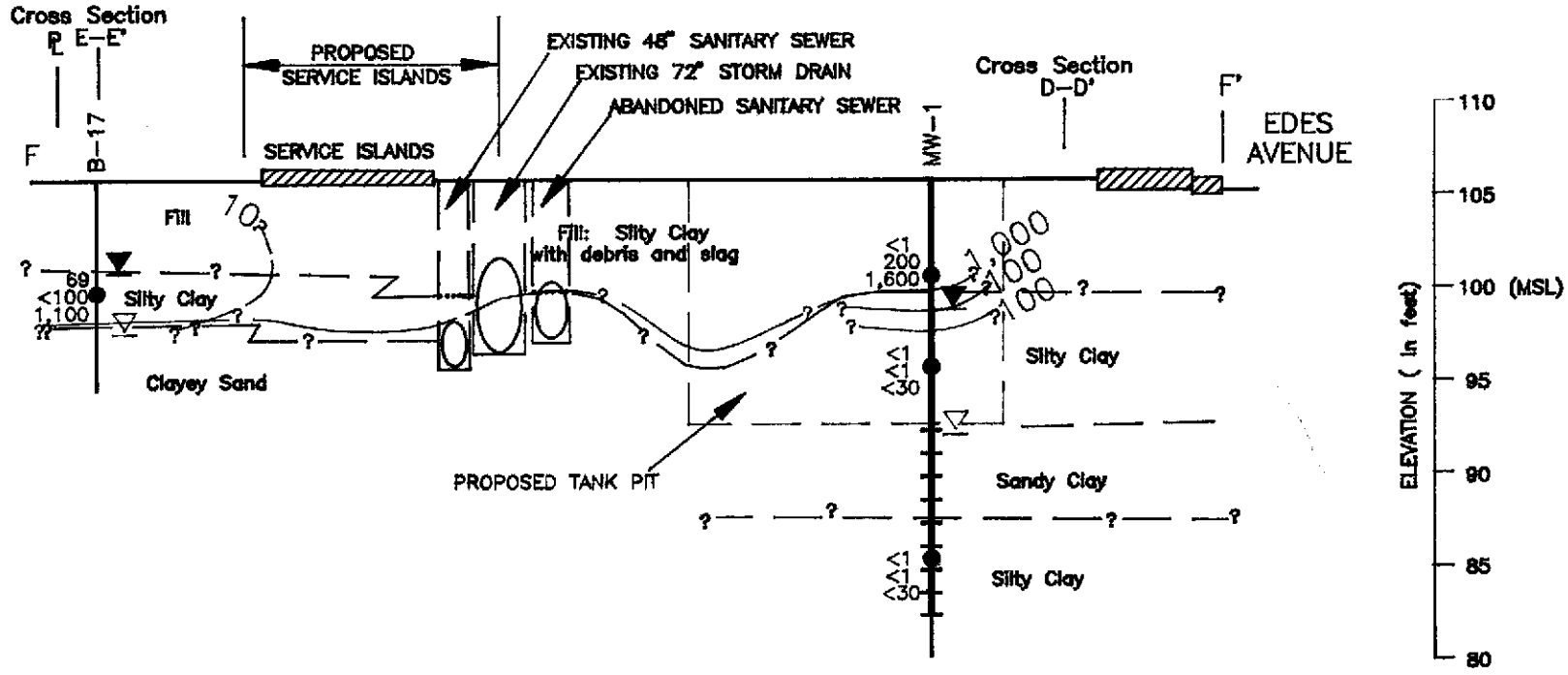
feet

Approximate Vertical Scale

10 5 0 10 20

feet

PLATE 20	**GEOLOGIC CROSS SECTION E-E'** **ARCO Service Station 4494** **566 Hegenberger Road** **Oakland, California**	Applied GeoSystems PROJECT 69038-5



EXPLANATION

- = Line of equal concentration of TPHg (red), and TPHd (green)
- = Laboratory analyzed soil sample showing concentration of TPHg (red), TPHd (green), and TOG (orange) in parts per million
- = Well casing
- = Well screen
- = Boring
- = Initial water level in boring
- = Static water level in well (09/07/90)

Approximate Horizontal Scale

30 15 0 30 60

feet

Approximate Vertical Scale

10 5 0 10 20

feet

PLATE 21	GEOLOGIC CROSS SECTION F-F' ARCO Service Station 4494 566 Hegenberger Road Oakland, California	Applied GeoSystems PROJECT 69038-5

TABLE 1
CUMULATIVE RESULTS OF LABORATORY ANALYSIS OF
SOIL SAMPLES FOR HYDROCARBONS
ARCO Station 4494
Oakland, California
(Page 1 of 3)

Sample Identifier	TPHg	TPHd	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TOG
December 16, 1988 - Waste-Oil Tank Excavation							
WO-1	11.*	370.+**	NA	NA	NA	NA	4,500 (4,800)
WO-2	<5.*	<10.**	NA	NA	NA	NA	<20
January 4, 1989 - Excavation Sidewall Samples							
WOSW-E	NA	<10.**	NA	NA	NA	NA	190 (50)
WOSW-S	NA	<10.**	NA	NA	NA	NA	<10 (<10)
WOSW-W	NA	<10.**	NA	NA	NA	NA	<10 (<10)
WOSW-N	NA	33.**	NA	NA	NA	NA	200 (400)
January 18, 1989							
WOSW-N2	NA	<10.**	NA	NA	NA	NA	10 (<10)
October 1989							
S-5-B1	<1.0	200	<0.005	<0.005	<0.005	<0.005	1,600
S-10-B1	<1.0	<10	<0.005	<0.005	<0.005	<0.005	<30
S-20-B1	<1.0	<10	<0.005	<0.005	<0.005	<0.005	<30
S-5-B2	52	<10	1.8	0.25	0.48	2.6	280
S-11-B2	30	<10	0.75	0.51	0.43	2.7	<30
S-16-B2	52,000	5,700	<100	1,400	440	2,700	2,300
S-16-B2#	-----	-----	(120)	(930)	(490)	(3,200)	-----
S-19-B2	11	14	0.25	1.2	0.22	1.5	<30
S-21-B2	<1.0	<10	<0.005	0.012	<0.005	0.021	<30
S-24-B2	<1.0	<10	<0.005	<0.005	<0.005	<0.005	<30
S-5-B3	<2.0	<10	<0.050	<0.050	<0.050	<0.050	<50
S-20-B3	<2.0	<10	<0.050	<0.050	<0.050	<0.050	<50
August 1990							
S-7-B4	<2.0	36	<0.050	<0.050	<0.050	<0.050	110
S-10-B4	<2.0	<10	<0.050	<0.050	<0.050	<0.050	<50
S-19.5-B4	<2.0	15	<0.050	<0.050	<0.050	<0.050	<50
S-22-B4	NA	<10	NA	NA	NA	NA	NA
S-6-B5	<2.0	<10	<0.050	<0.050	<0.050	<0.050	<50

See notes on page 3 of 3.

TABLE 1
CUMULATIVE RESULTS OF LABORATORY ANALYSIS OF
SOIL SAMPLES FOR HYDROCARBONS
ARCO Station 4494
Oakland, California
(Page 2 of 3)

Sample Identifier	TPHg	TPHd	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TOG
March 1991							
S-5-B6	<1.0	NA	<0.005	<0.005	<0.005	<0.005	NA
S-5-B7	63	NA	1.0	0.23	0.86	1.8	NA
S-10-B7	<1.0	NA	<0.005	<0.005	<0.005	0.006	NA
S-5-B8	29	NA	0.86	0.088	0.36	0.21	NA
S-5-B9	5.4	NA	0.66	0.035	0.31	0.11	NA
S-10-B9	<1.0	NA	0.037	<0.005	0.011	0.036	NA
S-5-B10	3.0	NA	0.28	0.013	<0.005	0.023	NA
S-10-B10	5.2	NA	0.53	0.036	0.096	0.23	NA
S-6-B11	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	330
S-11-B11	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
S-6-B12	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
S-11-B12	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
S-6-B13	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
S-11-B13	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
S-5-B14	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	570
S-11-B14	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
S-6-B15	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	280
S-10-1/2-B15	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
S-5-1/2-B16	<1.0	<1.0	<0.005	<0.005	<0.005	<0.005	<30
S-6-B17	69	<100	1.3	1.7	1.0	2.2	1,100
June 1990 - Composite Soil Sample (Borings B-1 and B-2)							Pb
SP-0619-1A							
SP-0619-1B							
SP-0619-1C	19	110	<0.050	<0.050	0.087	0.67	<0.5
SP-0619-1D							
August 1990 - Composite Soil Sample (Borings B-3 and B-4)							
S-B3-1							
S-B3-2							
S-B4-1	<2.0	<10	<0.050	<0.050	<0.050	<0.050	<0.5
S-B4-2							
S-B4-3							

See notes on page 3 of 3.

TABLE 1
CUMULATIVE RESULTS OF LABORATORY ANALYSIS OF
SOIL SAMPLES FOR HYDROCARBONS
ARCO Station 4494
Hegenberger Road and Edes Avenue
Oakland, California
(Page 3 of 3)

Sample Identifier	TPHg	TPHd	Benzene	Toluene	Ethyl-benzene	Total Xylenes	Pb*
April 1991 - Composite Soil Sample (Borings B-6 through B-17)							
S-0411-1A							
S-0411-1B							
S-0411-1C	<1.0	NA	<0.0050	0.0080	0.0098	0.017	0.11
S-0411-1D							

Results in milligrams per kilogram (mg/kg), or parts per million (ppm).
TPHg: Total petroleum hydrocarbons as gasoline by EPA Method 8015/3050.
TPHd: Total petroleum hydrocarbons as diesel by EPA Method 8015/3550.
TOG: Total oil and grease by EPA Standard Method 503 A/E.
* : Analyzed as low boiling hydrocarbons as gasoline (LBHC-g).
** : Analyzed as high boiling hydrocarbons as diesel (HBHC-d).
(4,800): Analyzed as high boiling hydrocarbons as oil (HBHC-o).
+ : Chromatographic pattern of compounds detected and calculated as diesel does not match that of the diesel standard used for calibration.
# : Results of analysis by EPA Method 8240.
Benzene: 120 ppm Toluene: 930 ppm Ethylbenzene: 490 ppm Total Xylenes: 3,200 ppm
Naphthalene: 11 ppm 2-Methylnaphthalene: 6 ppm
Di-n-Octyl Phthalate: 0.60 ppm Butylbenzylphthalate: 0.77 ppm
Pb: Organic Lead by EPA Method 7420.
Pb*: Organic Lead by California LUFT Manual Method (December 1987).

Soil Sample Identification:

S-12-B10
- B10 — Boring number
- 12 — Approximate sample depth in feet
- S — Soil sample

Composite Soil Sample Identifications:

S-B4-3
- 3 — Storage drum number
- B4 — Boring number
- S — Soil sample

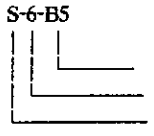
S(P)-0411-1D
- D — Composite soil sample location
- 0411 — Date
- S(P) — Stockpile soil sample

TABLE 2
CUMULATIVE RESULTS OF LABORATORY ANALYSIS
OF SOIL SAMPLES FOR VOCs AND METALS
ARCO Station 4494
Oakland, California

Sample Identifier	VOCs	Total Cadmium	Total Chromium	Total Lead	Total Zinc
October 1989					
S-5-B1	NA	<0.5	46.8	29.8	67.3
S-10-B1	NA	<0.5	31.2	<1.0	48.5
S-20-B1	NA	<0.5	39.2	<1.0	62.5
S-24-B1	NA	0.757	48.2	<1.0	81.5
S-5-B2	NA	<0.5	32.4	19.9	64.1
S-11-B2	NA	<0.5	22.4	2.16	33.4
S-16-B2	NA	<0.5	27.6	10.2	43.3
S-19-B2	NA	<0.5	40.6	<1.0	60.1
S-21-B2	NA	<0.5	51.2	<1.0	126
S-5-B3	NA	1.1	49	66	48
S-20-B3	NA	2.1	55	79	45
August 1990					
S-7-B4	NA	4.8	85	170	31
S-10-B4	NA	2.7	63	88	44
S-19.5-B4	NA	2.3	66	94	52
S-6-B5	ND	3.4	58	84	41
TTLC		100	2,500	1,000	5,000

Results in milligrams per kilogram (mg/kg), or parts per million (ppm).
NA: Not analyzed.
ND: Below the detection limit; see laboratory data sheets for detection limits.
TTLC: Total Threshold Limit Concentration values (Title 22 of California Administrative Code, January 1988).

Sample Identification:



Boring number
Approximate sample depth in feet
Soil sample

APPENDIX A

Previous Environmental Work

PREVIOUS ENVIRONMENTAL WORK

December 1988 to January 1989

An initial environmental investigation at the site was conducted by Pacific Environmental Group (Pacific) of Santa Clara, California, and Crosby & Overton, Inc. (C&O) of Oakland, California, during December 1988 and January 1989. This work consisted of the removal of a 280-gallon waste-oil tank, collection of soil samples for laboratory analyses, and removal of stockpiled soil to a Class I hazardous waste facility by C&O. Pacific reported that the tank showed no signs of leakage, but a strong product odor was noted in the soil beneath the tank. The tank pit was excavated to a depth of 7 feet below grade. Pacific collected a soil sample (WO-1) at this depth (two feet below the bottom of the former waste-oil tank) beneath the fill end of the tank. Pacific also collected a soil sample (WO-2) at a depth of 10 feet below grade directly beneath the location of sample WO-1. The soil samples were analyzed for: (1) total oil and grease (TOG), (2) high boiling point hydrocarbons (HBPH) (calculated as oil and diesel), (3) semi-volatile organic compounds, (4) volatile organic compounds (VOCs), and (5) cadmium, chromium, lead, and zinc at International Technology Corporation (State-certified Hazardous Materials testing laboratory No. 137) in San Jose, California.

Soil sample WO-1, collected at a depth of 7 feet, indicated 4,500 parts per million (ppm) TOG, 4,800 ppm HBPH (calculated as oil), and 370 ppm HBPH (calculated as diesel), respectively. Soil sample WO-2, collected at a depth of 10 feet, indicated nondetectable levels (less than 20 ppm) TOG, nondetectable levels (less than 10 ppm) HBPH (calculated as oil), and nondetectable levels (less than 10 ppm) HBPH (calculated as diesel), respectively.

On January 4, 1989, the pit was further excavated to a depth of 10 feet below grade where Pacific reported no noticeable hydrocarbon odor in the soil. Four sidewall soil samples (WOSW-N, WOSW-E, WOSW-S, and WOSW-W) were collected at a depth of 7 feet from the enlarged excavation. Results of laboratory analysis of these samples indicated:

(1) levels of TOG at 200 ppm, 190 ppm, < 10 ppm, and < 10 ppm, respectively;
(2) HBPH (calculated as oil) at 400 ppm, 50 ppm, < 10 ppm, and < 10 ppm, respectively;
(3) HBPH (calculated as diesel) at 33 ppm, < 10 ppm, < 10 ppm, and < 10 ppm, respectively.

On January 18, 1989, the waste-oil tank excavation was extended 3-1/2 feet on the north side to remove hydrocarbon contamination beyond sidewall sample WOSW-N. Additional

excavation of the eastern wall was not possible because of the wall's proximity to the station building. Sidewall sample WOSW-N2 was obtained from the north wall of the extended pit at an approximate depth of 7 feet. Results of laboratory analysis of this sample indicated 10 ppm TOG, < 10 ppm HBPH (calculated as diesel), and < 10 ppm HBPH (calculated as oil) (Pacific, 1989).

October 1989

In October 1989, AGS drilled and sampled two soil borings (B-1 and B-2), and installed and sampled two ground-water monitoring wells (MW-1 and MW-2, respectively). Earth materials encountered during the drilling of the soil borings are interpreted and construction of the monitoring wells are presented graphically on Plates 3, 4, and 5, Geologic Cross Sections A-A', B-B', and C-C'. During drilling and sampling boring B-2/well MW-2 at the site, a black hydrocarbon product was noted in the soil and ground water.

Laboratory results for the soil and water samples collected from the boring/well indicate predominantly degraded gasoline hydrocarbons. Laboratory analysis of soil samples collected from the borings for the total metals cadmium, chromium, lead, and zinc reported detectable levels below the Total Threshold Limit Concentration Values (TTLC) for soil of Title 22 of the California State Administrative Code, recorded January 1988, for these respective metals.

Laboratory analysis of the ground-water samples collected from well MW-1 for the above total metals reported detectable levels slightly above the Maximum Contaminant Levels (MCLs) for Drinking Water as specified by the California State Department of Health Services (DHS) recorded in October 1990 for these respective metals. A black hydrocarbon product ranging between 2 and 11 inches in thickness was reported in well MW-2 at the time of drilling and well installation. In addition, base neutral and acid extractables (BNAs) and volatile organic compounds (VOCs) do not appear to have impacted soil or ground water [illegible] since soil and water samples collected from boring B-1/MW-1 indicated nondetectable concentrations of BNAs and VOCs.

The inferred direction of ground-water flow is to the west towards San Francisco Bay. This direction is based on topography, but may be influenced locally by tidal actions. Based on the discovery of the black hydrocarbon product in well MW-2 and the inferred direction of ground-water flow, the ongoing subsurface investigation was temporarily stopped until an environmental records search was completed to evaluate potential offsite contaminant sources in the inferred upgradient direction. This environmental records search was requested by Ms. Katherine Chesick of the ACDEH in February 1990.

October 1990

An environmental records search was performed by AGS within an approximately 1/2-mile radius of the site using information supplied by ARCO, Alameda County Flood Control and Water Conservation District (Zone 7), and the California Department of Water Resources (DWR) (AGS, September 1990). Presented below is a summary of our findings:

- Before its development, the subject property was covered by a sparse growth of native weeds, and was situated on reclaimed tidal marshlands covered by approximately four feet of artificial fill. The fill material was described as heterogeneous sandy gravelly clay containing construction debris, including pieces of concrete, asphalt, and metallic slag. The source of the construction debris was not noted. Below the fill material, the marshland soil was described as firm to soft organic silty clay (Bay Mud) containing thin lenses of silty sand and gravel (Soil Mechanics and Foundation Engineers [SMFE], 1968).

- The site contains a buried slough crossing the southern side of the site near the corner of Hegenberger Road and Edes Avenue (SMFE, 1968). This slough was channelized at some time in the past, and the modified channel is approximately located on Plate 2.

- Three sewer lines were reported by SMFE in 1968 to cross the central portion of the property in a northeast-southwest direction, including a 72-inch-diameter storm-sewer drain, a 48-inch-diameter sanitary sewer, and a 39-inch-diameter abandoned sewer pipeline. Approximate locations of these sewer lines are shown on Plate 2.

- The site is surrounded (within 1/2-mile radius) by various industrial facilities which may at one time have been interconnected with the subject property by surface water drainage channels. Two gasoline service stations and several industrial facilities, which currently use or have historically used underground storage tanks for fuels and solvents are located within a 1/2-mile radius of the site.

- Several facilities in the site area are under investigation for soil and ground-water contamination, including solvents, metals, and petroleum hydrocarbons. These facilities are concentrated in the light industrial sector bounded by Baldwin Avenue, 85th Avenue, and Enterprise Drive, and the heavy industrial areas located along the railroad tracks. These facilities include Ran Rob Tool and Die and West Coast Wire Rope and Rigging east and southeast of the site, and the Transamerica Delaval facility south of the site.

- Numerous facilities in the site area have used underground storage tanks for storage of fuels and solvents, many of which were removed in the 1970's and early 1980's when there

were few requirements for testing of soil and ground water during underground storage tank removals. These facilities include several immediately surrounding the site, including the Shell gasoline station to the south; the GMC truck dealership, Castle Golf and Games miniature golf course and predecessor the Malibu Grand Prix racetrack, and Digas gasoline station to the west; Alta Freight, Beava Chemical Company, Conspec Roofing, Golden Gate Freight Lines, and Ran Bob Tool and Die facilities in the light industrial sector to the east and southeast; and former Chevron gasoline station and Transamerica Delaval facility to the south.

August 1990

In August 1990, AGS renewed work on the subsurface environmental investigation at the site by drilling and sampling three soil borings (B-3, B-4, and B-5), and installing and sampling two ground-water monitoring wells (MW-3 and MW-4) in borings B-3 and B-4 (AGS, February 13, 1991). Earth materials encountered during the drilling of the soil borings are interpreted and construction of the monitoring wells are presented graphically on Plates 3, 4, and 5, Geologic Cross Sections A-A', B-B', and C-C'.

Laboratory results for the soil and water samples collected from the borings/wells indicate predominantly degraded gasoline hydrocarbons. The lateral extent of gasoline hydrocarbons in the soil and ground water associated with the gasoline-storage tanks at the site have been delineated to the northwest, west, and south, but may extend further towards the property boundary to the east and north. The vertical extent of the gasoline hydrocarbons in the soil associated with the gasoline-storage tanks at the site has been delineated to nondetectable levels, as indicated by the laboratory results for soil samples collected from boring B-2 below 19 feet. Laboratory analysis of soil samples collected from the borings for the total metals cadmium, chromium, lead, and zinc reported detectable levels below the Total Threshold Limit Concentration Values (TTLC) for soil of Title 22 of the California State Administrative Code, recorded January 1988, for these respective metals.

Laboratory analysis of the ground-water samples collected from wells MW-1, MW-3, and MW-4 for the above total metals reported detectable levels slightly above the Maximum Contaminant Levels (MCLs) for Drinking Water as specified by the California State Department of Health Services (DHS) recorded in October 1990 for these respective metals. A black hydrocarbon product ranging between 2 and 11 inches in thickness was reported in well MW-2 between June and September 1990.

In addition, base neutral and acid extractables (BNAs) and volatile organic compounds (VOCs) do not appear to have impacted soil or ground water near the former waste-oil tank

since soil and water samples collected from boring B-1/MW-1 indicated nondetectable concentrations of BNAs and VOCs. The vertical extent of waste-oil hydrocarbons in the soil associated with the former waste-oil-storage tank at the site has been delineated below 100 ppm, as indicated by the laboratory results for soil samples collected from the waste-oil tank pit excavation and borings B-1 and B-5. A level of TOG of 110 ppm in a soil sample from boring B-4 may be isolated and associated with the fill materials present beneath the site. The lateral extent of waste-oil hydrocarbons in the soil associated with the former waste-oil-storage tank at the site has not been laterally delineated below 100 ppm, as indicated by a soil sample collected from boring B-1 which reported 1,600 ppm TOG at a depth of approximately 5 feet.

During the preparation of the site history assessment (AGS, 1990), it was revealed that the shallow earth materials beneath the site appear to consist of imported fill materials, as evidenced by the presence of metallic slag, concrete, and gravel materials encountered during drilling of borings B-1 through B-4. An earlier geotechnical report (Soil Mechanics and Foundation Engineers [SMFE], 1968) indicated that the fill material consisted of imported sandy gravelly clay, concrete, melted glass, metallic slag, and construction debris, and was imported from unknown sources. These fill materials may be a potential source of the gasoline and diesel hydrocarbons encountered within borings B-2 or B-4 drilled in the inferred upgradient direction of the underground gasoline-storage tanks and near the southern corner of the site.

Another potential source of the hydrocarbon product may have resulted from leakage or over-spilling associated with the onsite underground gasoline-storage tanks prior to purchase of the site by ARCO. This conclusion is based on the fact that Gulf Oil Company removed and replaced a 10,000-gallon underground gasoline-storage tank at the site in the late 1970s, and that no soil sampling data was obtained to demonstrate that leakage and/or overfilling of the tank had not occurred.

Measurements of the ground-water elevations beneath the site between June 6 and November 29, 1990, indicate that the direction of ground-water flow is towards the northeast (away from San Francisco Bay). This direction is opposite from the inferred ground-water gradient direction based on topography, and data presented by Hickenbottom (1988). Evidence uncovered during the site history assessment indicates that a buried tidal slough was present at the site before filling and development took place, and may be influencing the ground-water gradient. The presence of a tidal slough is suggested by the very soft, wet organic materials encountered in boring B-3 between the depths of 9 to 19 feet, and immediately underlying the artificial fill materials.

SMFE also reported in 1968 that shallow perched water was present in the fill materials at a depth of approximately three feet. Commonly, in areas with artificial fill, perched water generally will occur along the boundary between the fill materials and the native soil. This condition may occur seasonally beneath the site.

After artificial filling of the tidal slough at the site occurred, a channel was excavated to provide storm water drainage at the site (City of Oakland, 1968). This channel was then, in turn, filled in with artificial fill around 1969, and replaced with a 72-inch diameter concrete storm drain pipeline. This pipeline was noted in SMFE's report, as well as a 48-inch-diameter sanitary sewer pipeline and a 39-inch-diameter abandoned sanitary sewer pipeline. Based on plans supplied by the City of Oakland, the elevations of these pipelines have been calculated, and graphic representations are shown on the Geologic Cross Sections (Plates 13, 14, and 15). The elevations suggest that these subsurface lines are higher than the water-bearing materials encountered in borings B-1, B-2, and B-4. However, these subsurface lines might act as conduits enabling gasoline and diesel hydrocarbons to migrate horizontally through the fill materials.

It is inferred that tidal influences within the bay channel probably are not transmitted through the sand or gravel packs surrounding the storm drain and sewer lines beneath the site, due to the interpreted elevations of these subsurface lines from plans supplied by the City of Oakland. Due to the proximity of the site to San Francisco Bay, the direction of ground-water flow may be influenced by tidal actions.

A survey of active, inactive, and destroyed water supply wells and monitoring wells listed with the County of Alameda Public Works Agency (CAPWA) within a 1/2-mile radius of the site was performed as part of the investigation. According to the CAPWA records data base, currently there are no active public-use or domestic-use water producing wells, two industrial-use wells, one irrigation well, and 39 monitoring wells (including 4 extraction wells) within a 1/2-mile radius of the site. In addition, there are at least 13 wells of unknown use and 10 destroyed or abandoned wells. The depths of the industrial wells are 448 and 600 feet below the ground surface (bgs), with the level of static water at approximately 59 and 69 feet bgs. The depth of the irrigation well is 175 feet, but the level of static water is unavailable. Monitoring wells located within a 1/2-mile radius of the site range in depth between 20 and 62 feet, and static water levels range in depth between 4 and 15 feet bgs. The depths of the destroyed or abandoned water wells were between 5 and 1,000 feet depth. Additional well research was performed outside the 1/2-mile radius of the site to a distance of approximately one mile from the site toward the northeast. This additional work was performed after the ground-water flow direction beneath the site was evaluated to be towards the northeast. This additional research yielded one industrial water

supply well approximately 400 feet deep with a static water level of approximately 69 feet bgs, and three irrigation water supply wells with depths of 35, 128, and 90 feet bgs, and static water levels of 2, 78, and 8 feet bgs, respectively.

November 1990

Quarterly monitoring for the fourth quarter 1990 was performed on November 29, 1990. Laboratory analysis of ground-water samples obtained from wells MW-1, MW-3, and MW-4 during this episode of quarterly ground-water monitoring by AGS reported nondetectable levels of dissolved gasoline hydrocarbons in the water samples collected from these three wells. A [redacted] of black hydrocarbon product was reported in monitoring well MW-2, which consequently was not sampled.

Static water elevations as measured in wells MW-1, MW-3, and MW-4 have decreased slightly since the ground-water monitoring wells were installed. The ground [redacted] gradient evaluated from ground-water elevation data collected in November and December 1990 has remained [redacted] consistent since August 1990, ranging fro[redacted]12 to the northeast (away from San Francisco Bay). opposite to that expected (SW)

TABLE A1
CUMULATIVE GROUND-WATER MONITORING DATA
ARCO Station 4494
566 Hegenberger Road
Oakland, California

Well Date	Elevation of Wellhead	Depth to Water	Water Elevation	Product Evidence
MW-1				
06/06/90	105.31	6.65	98.66	None
08/16/90		7.00	98.31	None
08/21/90		7.05	98.26	None
09/07/90		7.24	98.07	None
11/20/90		7.46	97.85	None
11/29/90		7.40	97.91	None
MW-2				
06/06/90	105.78	9.00*	96.78*	11" of Black Product
08/16/90		NM	-.-	2" of Black Product
08/21/90		NM	-.-	2" of Black Product
09/07/90		9.17*	96.61*	2" of Black Product
11/20/90		9.20*	96.58*	Heavy Sheen
11/29/90		9.92*	95.86*	~~Heavy Sheen~~
MW-3				
08/16/90	105.51	8.87	96.64	None
08/21/90		8.85	96.66	None
09/07/90		8.98	96.53	None
11/20/90		9.10	96.41	None
11/29/90		9.05	96.46	None
MW-4				
08/16/90	106.61	8.16	98.45	None
08/21/90		8.22	98.39	None
09/07/90		8.39	98.22	None
11/20/90		8.57	98.04	None
11/29/90		8.53	98.08	None

Depth measurements in feet.
* = Floating Product present in well.
NM = Not measured.
Elevations in feet above mean sea level (plus one hundred feet to avoid negative ground-water elevations).

TABLE A2
CUMULATIVE RESULTS OF LABORATORY ANALYSIS
OF WATER SAMPLES FOR HYDROCARBONS
ARCO Station 4494
Hegenberger Road and Edes Avenue
Oakland, California

Well Date	TPHg	TPHd	Benzene	Toluene	Ethyl-benzene	Total Xylenes	TOG
MW-1							
06/19/90	<50	<100	<0.50	<0.50	<0.50	<0.50	<5000
08/16/90	<20	NA	<0.50	<0.50	<0.50	<0.50	NA
09/07/90	NA	NA	NA	NA	NA	NA	<5000
MW-3							
08/16/90	<20	<100	<0.50	<0.50	<0.50	<0.50	NA
09/07/90	NA	NA	NA	NA	NA	NA	<5000
MW-4							
08/16/90	<20	<100	<0.50	<0.50	<0.50	<0.50	NA
09/07/90	NA	NA	NA	NA	NA	NA	<5000

Results in micrograms per liter (ug/l), or parts per billion (ppb).
TPHg: Total petroleum hydrocarbons as gasoline.
TPHd: Total petroleum hydrocarbons as diesel.
TOG: Total oil and grease.
NA: Not Analyzed.

TABLE A3
RESULTS OF LABORATORY ANALYSIS OF WATER SAMPLES
FOR BNAs, VOCs, AND METALS
ARCO Station 4494
Hegenberger Road and Edes Avenue
Oakland, California

Well Date	BNAs	VOCs	Total Cadmium	Total Chromium	Total Organic Lead	Total Zinc
MW-1						
06/19/90	ND	ND	0.024	<0.05	0.10	0.049
08/16/90	NA	NA	NA	NA	NA	NA
MW-3						
08/16/90	ND	ND	<0.01	0.06	0.07	0.07
MW-4						
08/16/90	ND	ND	<0.01	<0.02	<0.02	0.03
MCLs	—	—	**0.010**	**0.05**	**0.05**	**NR**

Results in milligrams per liter (mg/l), or parts per million (ppm).
NA: Not Analyzed.
ND: Below the detection limit; see laboratory data sheets for detection limits.

MCLs: Maximum Contaminant Levels (California Department of Health Services, Office of Drinking Water, October 1990).
NR: No established DWAL or MCL.

ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
5997 PARKSIDE DRIVE ♦ PLEASANTON, CALIFORNIA 94588 ♦ (415) 484-2600

5 March 1991

Applied GeoSystems
3315 Almaden Expressway, Ste. 34
San Jose, CA 95118

Gentlemen:

Enclosed is Groundwater Protection Ordinance permit 91115 for a contamination investigation at 566 Hegenberger Road in Oakland for Arco Products Company.

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

Very truly yours,

J. Killingstad, Chief
Water Resources Engineering

WH:mm
Enc.

ALAMEDA COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
5997 PARKSIDE DRIVE • PLEASANTON, CALIFORNIA 94588 • (415) 484-2600

GROUNDWATER PROTECTION ORDINANCE PERMIT APPLICATION

FOR APPLICANT TO COMPLETE

LOCATION OF PROJECT ARCO 4494
5666 Hegenberger Road
Oakland, CA

CLIENT
Name ARCO Products Co.
Address P.O. Box 5811 Phone 415-571-2234
City San Mateo, CA Zip 94402

APPLICANT
Name Applied GeoSystems/REGNA
Address 3215 Almaden Expressway, Suite 34 Phone 408-264-7723
City San Jose, CA Zip 95118

TYPE OF PROJECT

Well Construction		Geotechnical Investigation	
Cathodic Protection	___	General	___
Water Supply	___	Contamination	X
Monitoring	X	Well Destruction	___

PROPOSED WATER SUPPLY WELL USE
Domestic ___ Industrial ___ Other ___
Municipal ___ Irrigation ___

DRILLING METHOD:
Mud Rotary ___ Air Rotary ___ Auger X
Cable ___ Other ___

DRILLER'S LICENSE NO. 596545 (ExcelTech)

WELL PROJECTS
Drill Hole Diameter ___ in. Maximum
Casing Diameter ___ in. Depth ___ ft.
Surface Seal Depth ___ ft. Number ___

GEOTECHNICAL PROJECTS
Number of Borings 5 Maximum
Hole Diameter 8 in. Depth 20 ft.

ESTIMATED STARTING DATE 3-11-91
ESTIMATED COMPLETION DATE 3-11-91

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

APPLICANT'S SIGNATURE Ken Matzke Date 3-1-91

FOR OFFICE USE

PERMIT NUMBER 91115
LOCATION NUMBER ___

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. 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 drilling log and location sketch for geotechnical projects.
(3.) 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.
2. Minimum seal depth is 50 feet for municipal and industrial wells or 20 feet for domestic and irrigation wells unless a lesser depth is specially approved. Minimum seal depth for monitoring wells is the maximum depth practicable or 20 feet.

(C.) GEOTECHNICAL. Backfill bore hole with compacted cuttings or heavy bentonite and upper two feet with compacted material. In areas of known or suspected contamination, tremied cement grout shall be used in place of compacted cuttings.

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

E. WELL DESTRUCTION. See attached.

Approved Wyman Hong Date 1 Mar 91
Wyman Hong

121989

APPENDIX C

Field Methods

FIELD METHODS

Site Safety Plan

Field work performed by Applied GeoSystems (AGS) at the site on behalf of ARCO Products Company (ARCO) was conducted in accordance with the AGS Site Safety Plan, No. 68038-5S, dated March 4, 1991. The Site Safety Plan describes the safety requirements for the evaluation of waste-oil and gasoline hydrocarbons in soil and ground water 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 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 Borings

Prior to the drilling of exploratory soil borings, permits are acquired from the Alameda County Flood Control and Water Conservation District (Zone 7). Copies of the permits are included in Appendix B of this 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 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 is begun only after a conductor casing is properly installed and allowed to set, to seal the shallow aquifer.

Drill Cuttings

Drill cuttings subjectively evaluated as containing hydrocarbons at levels greater than 100 parts per million (ppm) are separated from those subjectively evaluated as containing hydrocarbons at 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 generated from borings B-6 through B-17 were stockpiled on and covered by plastic sheeting.

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 foil, plastic caps, and aluminized duct tape. The samples are then 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 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.

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 is performed.

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.

APPENDIX D

Chain of Custody Records
Laboratory Analysis Data Sheets

Applied GeoSystems

CHAIN-OF-CUSTODY RECORD

PROJ. NO.	PROJECT NAME
69038-5	ARCO 4494
P.O. NO.	SAMPLERS (Signature)
	Ken Mateik

Due Wed 3/20

DATE MM/DD/YY	TIME		No. of Containers	TPHgasoline (8015)	BTEX (602/8020)	TPHdiesel (8015)					Preserved?	REMARKS	LABORATORY I.D. NUMBER
3/11/91	—	S-5-B6	1	X	X							Iced	
	—	S-5-B7	1	X	X								
	—	S-10-B7	1	X	X								
	—	S-5-B8	1	X	X								
	—	S-5-B9	1	X	X								
	—	S-10-B9	1	X	X								
	—	S-5-B10	1	X	X								
	—	S-10-B10	1	X	X								

RELINQUISHED BY (Signature):	DATE / TIME	RECEIVED BY (Signature):
Ken Mateik	3/11/91 4:13 PM	Dana Smith x598
RELINQUISHED BY (Signature):	DATE / TIME	RECEIVED BY (Signature):
Express-1 #948 mm	3/15/91 930	Anthony Enerio
RELINQUISHED BY (Signature):	DATE / TIME	RECEIVED FOR LABORATORY BY (Signature):
		Anthony Enerio

Laboratory: Applied Analytical

3 day

Turn Around: 2 weeks

SEND REPORTS TO:

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

Proj. Mgr.: Ken Mateik

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. Ken Mateik
Applied GeoSystems
3315 Almaden Expressway
San Jose, CA 95811
Project: AGS 69038-5

Date Sampled: 03-11-91
Date Received: 03-15-91
BTEX Analyzed: 03-16-91
TPHg Analyzed: 03-16-91
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-5-B6 S1103356	ND	ND	ND	ND	ND	NR
S-5-B7 S1103357	1.0	0.23	0.86	1.8	63	NR
S-10-B7 S1103358	ND	ND	ND	0.006	ND	NR
S-5-B8 S1103359	0.86	0.088	0.36	0.21	29	NR
S-5-B9 S1103360	0.66	0.035	0.31	0.11	5.4	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

March 20, 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 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. Ken Mateik	Date Sampled:	03-11-91
	Applied GeoSystems	Date Received:	03-15-91
	3315 Almaden Expressway	BTEX Analyzed:	03-16-91
	San Jose, CA 95811	TPHg Analyzed:	03-16-91
Project:	AGS 69038-5	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-10-B9 S1103361	0.037	ND	0.011	0.036	ND	NR
S-5-B10 S1103362	0.28	0.013	ND	0.023	3.0	NR
S-10-B10 S1103363	0.53	0.036	0.096	0.23	5.2	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

March 20, 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)

SEQUOIA ANALYTICAL
680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems
3315 Almaden Expressway, Ste 34
San Jose, CA 95118
Attention: Ken Mateik

Project: Arco-4494, Oakland

Enclosed are the results from 12 soil samples received at Sequoia Analytical on March 26,1991. The requested analyses are listed below:

SAMPLE #	SAMPLE DESCRIPTION	DATE OF COLLECTION	TEST METHOD
1033493	Soil, S-6-B11	3/26/91	EPA 3550/8015 EPA 413.1 (Gravimetric) EPA 5030/8015/8020
1033494	Soil, S-11-B11	3/26/91	EPA 3550/8015 EPA 413.1 (Gravimetric) EPA 5030/8015/8020
1033495	Soil, S-6-B12	3/26/91	EPA 3550/8015 EPA 413.1 (Gravimetric) EPA 5030/8015/8020
1033496	Soil, S-11-B12	3/26/91	EPA 3550/8015 EPA 413.1 (Gravimetric) EPA 5030/8015/8020
1033497	Soil, S-6-B13	3/26/91	EPA 3550/8015 EPA 413.1 (Gravimetric) EPA 5030/8015/8020
1033498	Soil, S-11-B13	3/26/91	EPA 3550/8015 EPA 413.1 (Gravimetric) EPA 5030/8015/8020
1033499	Soil, S-5-B14	3/26/91	EPA 3550/8015 EPA 413.1 (Gravimetric) EPA 5030/8015/8020
1033500	Soil, S-11-B14	3/26/91	EPA 3550/8015 EPA 413.1 (Gravimetric) EPA 5030/8015/8020
1033501	Soil, S-6-B15	3/26/91	EPA 3550/8015 EPA 413.1 (Gravimetric) EPA 5030/8015/8020
1033502	Soil, S-10.5-B15	3/26/91	EPA 3550/8015 EPA 413.1 (Gravimetric) EPA 5030/8015/8020
1033503	Soil, S-5.5-B16	3/26/91	EPA 3550/8015

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SAMPLE #	SAMPLE DESCRIPTION	DATE OF COLLECTION	TEST METHOD
			EPA 413.1 (Gravimetric) EPA 5030/8015/8020
1033504	Soil, S-6-B17	3/26/91	EPA 3550/8015 EPA 413.1 (Gravimetric) EPA 5030/8015/8020

Please contact me if you have any questions. In the meantime, thank you for the opportunity to work with you on this project.

Very truly yours,

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

SEQUOIA ANALYTICAL
680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems	Client Project ID:	Arco-4494, Oakland	Sampled:	Mar 26, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Soil	Received:	Mar 26, 1991
San Jose, CA 95118	Analysis Method:	EPA 5030/8015/8020	Analyzed:	Mar 27, 1991
Attention: Ken Mateik	First Sample #:	103-3493	Reported:	Mar 28, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons mg/kg (ppm)	Benzene mg/kg (ppm)	Toluene mg/kg (ppm)	Ethyl Benzene mg/kg (ppm)	Xylenes mg/kg (ppm)
103-3493	S-6-B11	N.D.	N.D.	N.D.	N.D.	N.D.
103-3494	S-11-B11	N.D.	N.D.	N.D.	N.D.	N.D.
103-3495	S-6-B12	N.D.	N.D.	N.D.	N.D.	N.D.
103-3496	S-11-B12	N.D.	N.D.	N.D.	N.D.	N.D.
103-3497	S-6-B13	N.D.	N.D.	N.D.	N.D.	N.D.
103-3498	S-11-B13	N.D.	N.D.	N.D.	N.D.	N.D.
103-3499	S-5-B14	N.D.	N.D.	N.D.	N.D.	N.D.
103-3500	S-11-B14	N.D.	N.D.	N.D.	N.D.	N.D.
103-3501	S-6-B15	N.D.	N.D.	N.D.	N.D.	N.D.
103-3502	S-10.5-B15	N.D.	N.D.	N.D.	N.D.	N.D.
Detection Limits:		**1.0**	**0.0050**	**0.0050**	**0.0050**	**0.0050**

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.
Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

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(415) 364-9600 • FAX (415) 364-9233

Applied GeoSystems	Client Project ID:	Arco-4494, Oakland	Sampled:	Mar 26, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Soil	Received:	Mar 26, 1991
San Jose, CA 95118	Analysis Method:	EPA 5030/8015/8020	Analyzed:	Mar 27, 1991
Attention: Ken Mateik	First Sample #:	103-3503	Reported:	Mar 28, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons mg/kg (ppm)	Benzene mg/kg (ppm)	Toluene mg/kg (ppm)	Ethyl Benzene mg/kg (ppm)	Xylenes mg/kg (ppm)
103-3503	S-5.5-B16	N.D.	N.D.	N.D.	N.D.	N.D.
103-3504	S-6-B17	69	1.3	1.7	1.0	2.2
Detection Limits:		**20**	**0.10**	**0.10**	**0.10**	**0.10**

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.
Analytes reported as N.D. were not present above the stated limit of detection. Because matrix effects and/or other factors required additional sample dilution, detection limits for this sample have been raised.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

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Applied GeoSystems	Client Project ID:	Arco-4494, Oakland	Sampled:	Mar 26, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Soil	Received:	Mar 26, 1991
San Jose, CA 95118	Analysis Method:	EPA 3550/8015	Extracted:	Mar 27, 1991
Attention: Ken Mateik	First Sample #:	103-3493	Analyzed:	Mar 27, 1991
			Reported:	Mar 28, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS (EPA 8015)

Sample Number	Sample Description	High B.P. Hydrocarbons mg/kg (ppm)
103-3493	S-6-B11	N.D.
103-3494	S-11-B11	N.D.
103-3495	S-6-B12	N.D.
103-3496	S-11-B12	N.D.
103-3497	S-6-B13	N.D.
103-3498	S-11-B13	N.D.
103-3500	S-11-B14	N.D.
103-3501	S-6-B15	N.D.
103-3502	S-10.5-B15	N.D.
103-3503	S-5.5-B16	N.D.
Detection Limits:		1.0

High Boiling Point Hydrocarbons are quantitated against a diesel fuel standard.
Analytes reported as N.D. were not present above the stated limit of detection.

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Applied GeoSystems	Client Project ID:	Arco-4494, Oakland	Sampled:	Mar 26, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Soil	Received:	Mar 26, 1991
San Jose, CA 95118	Analysis Method:	EPA 3550/8015	Extracted:	Mar 27, 1991
Attention: Ken Mateik	First Sample #:	103-3499	Analyzed:	Mar 27, 1991
			Reported:	Mar 28, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS (EPA 8015)

Sample Number	Sample Description	High B.P. Hydrocarbons mg/kg (ppm)
103-3499	S-5-B14	N.D.

Detection Limits:	10

High Boiling Point Hydrocarbons are quantitated against a diesel fuel standard.
Analytes reported as N.D. were not present above the stated limit of detection. Because matrix effects and/or other factors required additional sample dilution, detection limits for this sample have been raised.

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Applied GeoSystems	Client Project ID:	Arco-4494, Oakland	Sampled:	Mar 26, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Soil	Received:	Mar 26, 1991
San Jose, CA 95118	Analysis Method:	EPA 3550/8015	Extracted:	Mar 27, 1991
Attention: Ken Mateik	First Sample #:	103-3504	Analyzed:	Mar 27, 1991
			Reported:	Mar 28, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS (EPA 8015)

Sample Number	Sample Description	High B.P. Hydrocarbons mg/kg (ppm)
103-3504	S-6-B17	N.D.

Detection Limits:	100

High Boiling Point Hydrocarbons are quantitated against a diesel fuel standard.
Analytes reported as N.D. were not present above the stated limit of detection. Because matrix effects and/or other factors required additional sample dilution, detection limits for this sample have been raised.

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Applied GeoSystems	Client Project ID:	Arco-4494, Oakland	Sampled:	Mar 26, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Soil	Received:	Mar 26, 1991
San Jose, CA 95118	Analysis Method:	EPA 413.1 (Gravimetric)	Extracted:	Mar 27, 1991
Attention: Ken Mateik	First Sample #:	103-3493	Analyzed:	Mar 27, 1991
			Reported:	Mar 28, 1991

TOTAL RECOVERABLE OIL & GREASE

Sample Number	Sample Description	Oil & Grease (ppm)
103-3493	S-6-B11	330
103-3494	S-11-B11	N.D.
103-3495	S-6-B12	N.D.
103-3496	S-11-B12	N.D.
103-3497	S-6-B13	N.D.
103-3498	S-11-B13	N.D.
103-3499	S-5-B14	570
103-3500	S-11-B14	N.D.
103-3501	S-6-B15	280
103-3502	S-10.5-B15	N.D.

Detection Limits:	30

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

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Project Manager

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Applied GeoSystems	Client Project ID:	Arco-4494, Oakland	Sampled:	Mar 26, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Soil	Received:	Mar 26, 1991
San Jose, CA 95118	Analysis Method:	EPA 413.1 (Gravimetric)	Extracted:	Mar 27, 1991
Attention: Ken Mateik	First Sample #:	103-3503	Analyzed:	Mar 27, 1991
			Reported:	Mar 28, 1991

TOTAL RECOVERABLE OIL & GREASE

Sample Number	Sample Description	Oil & Grease (ppm)
103-3503	S-5.5-B16	N.D.
103-3504	S-6-B17	1,100

Detection Limits:	30

Analytes reported as N.D. were not present above the stated limit of detection.

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Project Manager

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Applied GeoSystems
3315 Almaden Expressway, Ste 34
San Jose, CA 95118
Attention: Ken Mateik

Client Project ID: Arco-4494, Oakland
QC Sample Group: 1033493 - 1033504
Reported: Mar 28, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl Benzene	Xylenes	Diesel	Total Oil & Grease
Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020	EPA 8015	EPA 413.1
Analyst:	G.Meyer	G.Meyer	G.Meyer	G.Meyer	R.Lee	L.Laikhthanker
Reporting Units:	ng	ng	ng	ng	ng	mg/kg
Date Analyzed:	Mar 27, 1991	Mar 27, 1991	Mar 27, 1991	Mar 27, 1991	Mar 27, 1991	Mar 27, 1991
QC Sample #:	GLBK032791	GLBK032791	GLBK032791	GLBK032791	DBLK032791	BLK32791
Sample Conc.:	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	100	100	100	300	900	100
Conc. Matrix Spike:	84	85	85	260	830	97
Matrix Spike % Recovery:	84	85	85	87	92	97
Conc. Matrix Spike Dup.:	82	81	80	240	850	90
Matrix Spike Duplicate % Recovery:	82	81	80	80	94	90
Relative % Difference:	2.4	4.8	6.1	8.0	2.4	7.5

Quality Assurance Statement: All standard operating procedures and quality control requirements have been met.

SEQUOIA ANALYTICAL

Bjorn A. Bjorkman
Project Manager

% Recovery:	Conc. of M.S. - Conc. of Sample / Spike Conc. Added	x 100
Relative % Difference:	Conc. of M.S. - Conc. of M.S.D. / (Conc. of M.S. + Conc. of M.S.D.) / 2	x 100