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

WORK PLAN
SUPPLEMENTAL SUBSURFACE ENVIRONMENTAL INVESTIGATION
at
ARCO Service Station
Armour Oil Company No. 188
First and Ray Streets
Pleasanton, California

10/22/87
AGS Job No. 87086-2P

Report prepared for

Armour Oil Company
P.O. Box 85302
San Diego, California 92138-5302

by
Applied GeoSystems

Glenn R. Dembroff
Director of Geologic Operations

Michael N. Clark
C.E.G. 1264

October 22, 1987

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

October 22, 1987
AGS 87086-2P

Mr. Byron Armour
Armour Oil Company
P.O. Box 85302
San Diego, California 92138-5302

Subject: Transmittal of Work Plan No. 87086-2P, Supplemental Subsurface Environmental Investigation at ARCO Service Station, Armour Oil Company No. 188, First and Ray Streets, Pleasanton, California.

Mr. Armour:

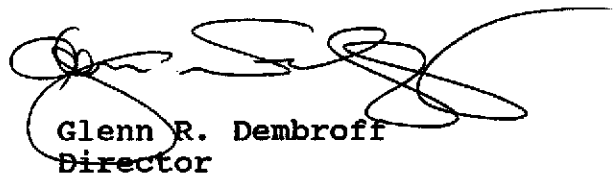
This work plan presents the results of previous environmental investigations performed at the above-referenced site and proposes additional work necessary to assess and, if necessary, mitigate hydrocarbon contamination of soil and ground water.

The proposed work includes removing underground storage tanks from the site, sampling and analyzing soil samples from the tank pit excavation for hydrocarbon contamination, removing product lines from the site and sampling soil from the product-line trenches, replacing the tanks with double-walled steel tanks, replacing the product lines in fiberglass-lined trenches, drilling three soil borings and constructing 2-inch-diameter ground-water monitoring wells in the borings, developing and sampling water from the wells for laboratory analysis, performing a ground-water gradient evaluation, performing a search for wells within a 1/2-mile radius of the site, and preparing a comprehensive report documenting field methodology and presenting our findings, conclusions, and recommendations.

In our opinion, this work is necessary to minimize the risk of further contamination at the site from hydrocarbon product storage and transferal, to evaluate the lateral and vertical extent of soil contamination at the site, and to assess to what extent ground-water resources beneath the site have been impacted by hydrocarbon contamination.

Please do not hesitate to call if you have any questions regarding the contents of this work plan.

Sincerely,
Applied GeoSystems



Glenn R. Dembroff
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ARCO Service Station
Armour Oil Company NO.188
First and Ray Streets
Pleasanton, California
For: Armour Oil Company

INTRODUCTION

The following work plan describes the work necessary to evaluate the extent of hydrocarbon contamination of soil and ground-water resources and to minimize the risk of further hydrocarbon releases at the above-referenced site. The work proposed includes !) replacement of current storage tanks with double-walled steel tanks, 2) replacement of product lines and double-containment of product line trenches, 3) drilling and sampling three soil borings near the underground storage tank cavity, 4) developing the monitoring wells and sampling ground water from the wells for analysis of hydrocarbon contaminants, 5) performing a ground-water gradient evaluation, 6) performing a search of

wells within a 1/2-mile radius of the site, and 7) preparing a comprehensive report documenting field methodology and presenting our findings, conclusions, and recommendations.

BACKGROUND AND PREVIOUS WORK

The ARCO Service Station site is located on the northwest corner of the intersection of First Street and Ray Street in Pleasanton, California as shown on the Site Vicinity Map, Plate P-1. We understand that four 12,000-gallon, underground petroleum product storage tanks are buried at the site. The four storage tanks, which contain gasoline product for retail sale, are located adjacent to one another in the northeast portion of the property. The Generalized Site Plan, Plate P-2, shows the service station property and approximate locations of the station facilities.

Applied GeoSystems previously drilled three soil borings at the site on June 30, 1987 for UNOCAL Corporation in order to evaluate hydrocarbon contamination at the site prior to a real estate transaction. Two borings (B-1 and B-2) were drilled to approximately 46.5 feet in depth and one boring (B-3) was drilled to approximately 55 feet in depth. No ground water was

encountered during the course of drilling, and the borings were backfilled from total depth to a few inches below grade with a slurry of neat cement and 5 percent bentonite. The borings were then capped with asphalt to grade. Applied GeoSystems' report AGS 87065-1, dated July 14, 1987, describes the initial investigation and presents our conclusions and recommendations based on the data available at the time. Plate P-2 of this report shows the approximate locations of the three initial borings.

Laboratory analytical results of nine soil samples collected from the three boreholes showed non-detectable to relatively high levels (1325 parts per million) of hydrocarbon contamination in the three initial borings. The results of these analyses, initially presented in Applied GeoSystems report AGS 87065-1, are presented in Table 1.

TABLE 1
RESULTS OF CHEMICAL ANALYSES
OF SOIL SAMPLES
ARCO Service Station
First and Ray Streets
Pleasanton, California

Sample Number	TVH	Benzene	Ethyl Benzene	Toluene	Xylenes	TEH
S-20-B1	281.9	17.1	17.0	73.6	92.3	NA
S-35-B1	126.13	2.06	0.84	1.02	6.59	1325
S-45-B1	9.36	0.64	0.26	1.06	1.47	NA
S-25-B2	188.8	13.1	6.1	6.3	56.2	NA
S-35-B2	56.81	1.47	1.81	1.58	18.09	NA
S-45-B2	9.09	0.07	0.18	0.26	1.30	NA
S-10-B3	ND	ND	ND	ND	ND	NA
S-30-B3	7.72	3.95	0.13	0.51	0.85	NA
S-40-B3	180.7	12.4	9.4	47.8	45.1	NA

Results in milligrams/kilogram(mg/kg)=parts per million(ppm)
TVH: Total volatile hydrocarbons
TEH: Total extractable hydrocarbons
ND: Non Detectable
NA: Not Analyzed
Detection limits: 0.05 ppm (TVH - S-35-B1, S-45-B1, S-35-B2, S-45-B2, S-10-B3, B-30-B3)
0.5 ppm (TVH - S-20-B1, S-25-B2, S-40-B3)
5.0 ppm (TEH - S-35-B1)

Armour Oil Company supplied Applied GeoSystems with a copy of a Petro Tite system test performed at the service station in September 1986. The tank system test results indicated no detectable leaks.

Based on the initial laboratory analytical results, Armour Oil Company contracted with Applied GeoSystems to drill an additional soil boring adjacent to boring B-1 to evaluate the vertical extent of the hydrocarbon contamination. The intent of this work was to encounter either ground water or two successive soil samples (collected at 5-foot intervals) that showed no subjective evidence of hydrocarbon contamination. The direction of ground water flow was inferred to be to the northwest prior to drilling. This flow direction was inferred from the general surface topography in the area. Boring B-4 was drilled adjacent to boring B-1 based on the proximity to the tank pit, the inferred direction of ground-water flow, and the fact that boring B-1 contained the highest subjective levels of hydrocarbon contamination.

The boring (B-4) was drilled to a depth of approximately 66.5 feet. A monitoring well was not installed because no subjective evidence of hydrocarbon contamination was detected in the lowest

10 feet of the boring and because no ground water was encountered. The boring was backfilled with a slurry of 5 percent bentonite and neat cement. The location of boring B-4, with respect to the previous borings and other site features, is shown on the Generalized Site Plan.

Soil samples were collected at 5-foot intervals from the ground surface to total depth in boring B-4. A subjective analysis for presence of hydrocarbon contamination was performed and the results recorded for each soil sample collected from the boring. The sample with the highest subjective level of contamination and the sample from the base of the boring (S-35-B4 and S-65-B4) were analyzed for total volatile hydrocarbons (TVH) and the hydrocarbon constituents benzene, ethylbenzene, toluene, and total xylene isomers (BETX) and for total extractable hydrocarbons (TEH). The results of the chemical analyses are presented in Table 2.

TABLE 2
RESULTS OF CHEMICAL ANALYSES
OF SOIL SAMPLES
ARCO Service Station
Armour Oil Company No. 188
First and Ray Streets
Pleasanton, California

Sample Number	TVH	Benzene	Ethyl Benzene	Toluene	Xylenes	TEH
S-35-B4	100.5	1.4	0.5	0.6	4.4	1835
S-65-B4	0.45	ND	ND	ND	ND	ND

Results in milligrams/kilogram(mg/kg) = parts per million(ppm)
TVH: Total volatile hydrocarbons
TEH: Total extractable hydrocarbons
ND: Non Detectable
Detection limits: 0.2 ppm (TVH - S-35-B4)
0.05 ppm (TVH - S-65-B4)
5.0 ppm (TEH)

The results of analyses on the soil samples collected from the two studies indicate that low to relatively high levels of hydrocarbon contamination are present adjacent to the tank pit and product lines. As shown in Tables 1 and 2 the level of

contamination decreases with depth in borings B-1, B-2, and B-4. Subjective analyses indicate that the level of contamination decreases with depth below 40 feet in boring B-3 as well.

Inspection of the chromatograms (graphical results of the analyses) suggests that the hydrocarbon contamination is derived from a combination of two sources. One portion of the contamination appears to be derived from gasoline; the other portion appears to be derived from diesel. Gasoline constituent concentrations are measured with the total volatile hydrocarbons (TVH) analysis, and the diesel constituent concentrations are measured with the total extractable hydrocarbons (TEH) analysis. The analyses indicate that the majority of the contamination at the site is derived from diesel.

We understand, based on information supplied by Armour Oil Company, that diesel has never been sold at the subject service station since it was constructed by Armour Oil Company in the 1970's. This information suggests that the contamination found in the soil may be derived from previous operations at the site or adjacent sites.

Alameda County Flood Control and Water Conservation District ground-water contour maps show the ground-water surface to be approximately 55 feet below the ground surface in the vicinity of the site. Ground water was not encountered to a depth of approximately 66.5 feet in boring B-4, and no aquifer materials (such as sand and gravel) were encountered in the lower portion of the boring. For these reasons a confined aquifer system may be present below the total depth of boring B-4. Conversely, the aquifer may be unconfined and deeper than approximately 66.5 feet. The ground-water surface elevation depicted on the Alameda County Flood Control District maps may represent the potentiometric surface (surface to which water in the aquifer would rise under hydrostatic pressure) of a confined aquifer in the vicinity of the site. These maps are interpretive and the ground-water levels depicted beneath the site may be approximations.

The trend of decreasing levels of hydrocarbon contamination to very low to non-detectable levels at the base of boring B-4, and the fact that ground water is deeper than approximately 66.5 feet, indicate that the contamination has not reached the ground water in the vicinity of boring B-4 at the present time.

PROPOSED WORK

The proposed work at the site is designed to both minimize the risk of future hydrocarbon contamination related to hydrocarbon product storage at the site and to evaluate the degree and lateral and vertical extent of hydrocarbon contamination on the subject property. The following work elements are proposed:

1) Excavate and remove the four single-walled underground storage tanks and associated product piping at the site. Soil sampling and laboratory analyses, as required by local and State agencies, will be performed in the tank pit and product line trenches.

2) Replace the tanks with double-walled steel tanks that are equipped with double-containment around their fill ports. Replace the product piping with fiberglass lines in a fiberglass-lined trench.

3) Excavate three soil borings at locations shown on the Generalized Site Plan. The borings will be drilled to a point approximately 20 feet below the ground-water surface and used for the installation of ground-water monitoring wells.

4) Collect and classify relatively undisturbed soil samples taken at 5-foot intervals in the soil borings.

5) Construct three ground-water monitoring wells in the boreholes with 2-inch inside-diameter polyvinyl chloride (PVC) casing.

6) Develop the wells and collect ground-water samples.

7) Analyze selected soil and ground-water samples for total hydrocarbons and gasoline-product constituents in a California State-certified laboratory.

8) Evaluate local ground-water gradient by surveying the top of each well casing, measuring static ground-water depths in the wells, and calculating the relative elevation of the ground-water surface in each well.

9) Interpret field and laboratory data to evaluate the extent of contamination.

10) Describe the subsurface conditions at the site as revealed in the borings.

11) Conduct a search for wells within a 1/2-mile radius of the site. The purpose of the search is to locate nearby wells, determine the wells' uses (e.g. domestic water supply, irrigation, etc.), and detail the wells' construction and depth of water pumping.

12) Prepare a final report summarizing our findings, conclusions, and recommendations.

The first proposed well, MW-1, will be located north of the product tanks, near the northern boundary of the property, to evaluate the subsurface soil and ground-water conditions in the inferred downgradient direction from the product storage tanks. The second well, MW-2, will be constructed west of the storage tanks in order to evaluate the subsurface soil and ground-water conditions in the inferred downgradient direction of the product piping. The third well, MW-3, will be located south of the hydrocarbon-product storage tanks to evaluate background conditions of soil and ground-water resources at the site and to

provide the third data point necessary for a ground-water gradient evaluation. Drilling will be stopped if any saturated clay layer (aquitard) that is greater than 5 feet thick is encountered below the ground-water surface. Applied GeoSystems will contact Underground Services Alert (USA) to delineate utility lines on public property adjacent to the site before we begin drilling.

Soil boring/sampling

The soil borings will be drilled using 8- to 10-inch-diameter, continuous flight, hollow stem augers and a Mobile B-61, or similar, drill rig. Auger flights will be steam-cleaned prior to use to minimize the possibility of downhole- or cross-contamination. The drilling will be performed under the guidance of a field geologist and the earth materials in the boring will be logged as drilled.

During drilling, soil samples will be collected at 5-foot intervals using a California-modified split-spoon sampler (2-1/2-inch inside-diameter) equipped with laboratory-cleaned brass sleeves. Samples will be collected by advancing the boring to a point immediately above the sampling depth, then driving the sampler into the native soil through the hollow center of the auger. The sampler will be driven 18 inches with a standard 140 pound hammer dropped 30 inches. The number of blows required to drive the sampler each successive 6 inches will be counted and recorded to give an indication of soil consistency. Copies of a Field Boring Log, as well as a Boring Log Plate used in our final report, are included with this work plan.

Soil samples collected for possible chemical analyses will be sealed with aluminum foil, plastic end caps, and airtight tape. The samples will then be labeled and immediately placed in iced storage for transport to a laboratory that is certified to perform the required chemical analyses. A Chain of Custody Record will be initiated in the field and will accompany the samples to the laboratory. A copy of the Chain of Custody Record, an example of which is included in this work plan, will be included in the final report.

Disposal of Cuttings

Soil hydrocarbon contamination in the proposed boreholes is expected to be relatively low. Relative hydrocarbon contamination of the cuttings can be characterized during drilling with an organic vapor analyzer or equivalent instrument and this characterization can later be verified in the laboratory by analyses of soil samples collected during drilling. Soil cuttings that are found to contain greater than 100 ppm hydrocarbon will be either placed in appropriately-lined Department of Transportation (DOT) type 17H 55-gallon drums or stockpiled at the site for future aeration or treatment (if necessary). Soil cuttings that are found to contain less than 100 ppm will be placed on plastic at the station site.

Drill cuttings generated during drilling will remain the responsibility of Armour Oil Company. Applied GeoSystems can arrange to have the soil aerated or treated (if necessary) and removed to an appropriate disposal facility with Armour Oil Company's authorization.

Monitoring Well Construction

The monitoring wells will be constructed of thread-jointed 2-inch inside-diameter (I.D.), schedule 40, polyvinyl chloride (PVC) casing. No chemical cements, glues, or solvents will be used in well construction. The screened portion of the well will consist of factory-perforated 0.020-inch-wide slotted casing. The well screen will extend from total depth of the well to approximately 10 feet above the upper zone of saturation to allow monitoring through expected seasonal fluctuations of ground water.

The screened section annulus will be packed with sorted sand to a minimum of 2 feet above the perforations. A 1- to 2-foot-thick bentonite plug will be placed above the sand as a seal against cement entering the sand pack. The remaining annulus will be backfilled with neat cement or a slurry of neat cement and 5 percent bentonite to a few inches below grade. The well will be developed before collecting water samples by swabbing, surge pumping, or other suitable method. The well will be pumped until the discharge is relatively clean and free of suspended sediment. Pumped water will be contained in 55-gallon drums that will be

left on site. Laboratory analyses of the water will confirm whether this water can be disposed in the sanitary sewer system or must be transported to another disposal location.

A locking well cage and padlock will be concreted over the well head and a traffic-rated cast-aluminum utility box with PVC apron will be placed over each well and set with concrete flush with the surrounding station pad. This box has a water-tight seal to protect against surface water infiltration and requires a specially-designed wrench to open. This design reduces the possibility of either vandalism or accidental disturbance of the well.

Water Sampling

Ground water will be allowed to recover to static conditions in the wells and an initial water level measurement will be made. A bailer will be then used to obtain a sample from the surface of the water in the well. Any subjective evidence of product detected in the well will be recorded. If floating product is encountered in a well, the well will not be purged or sampled. If no floating product is observed in a well, a formation water sample will be collected after the well is purged. The well will

be purged of at least three well volumes and sampled using a Teflon bailer that is cleaned with Alconox and rinsed with tap water and deionized water.

The water samples will be sealed in laboratory-cleaned 40-milliliter glass vials with Teflon-lined lids, and will be labeled, and immediately placed in iced storage. A Chain of Custody Record will be initiated by the sampler and will accompany the samples to a laboratory certified for the types of analyses requested. A copy of the Chain of Custody Record form will be included in our final report.

Laboratory Analysis

Soil samples from each borehole with the highest hydrocarbon concentration will be selected for laboratory analysis of total petroleum hydrocarbons and the aromatic hydrocarbons benzene, ethylbenzene, toluene, and total xylene isomers (BETX) by Environmental Protection Agency (EPA) Methods 8015 and 8020. The organic vapor analyzer will be used during drilling to evaluate the relative hydrocarbon concentrations of each sample collected. Water samples will be analyzed for total hydrocarbons and BETX by

EPA Methods 8015 and 602. Detection limits suitable for the soil and water tests requested and concentrations present will be stated on the laboratory report.

Measurement of Ground-Water Gradient

The gradient will be measured and the direction of local ground-water flow will be estimated. A leveling instrument will be used to measure the differences (to the nearest 0.001 foot) in elevation between the instrument and the top of the casing in each ground-water monitoring well. Elevation differences will be combined with depth to static water measurements (taken to the nearest 0.01 foot) in the respective wells to calculate the differences in water level elevations. The calculations will be used to create a ground-water potentiometric surface map for the site.

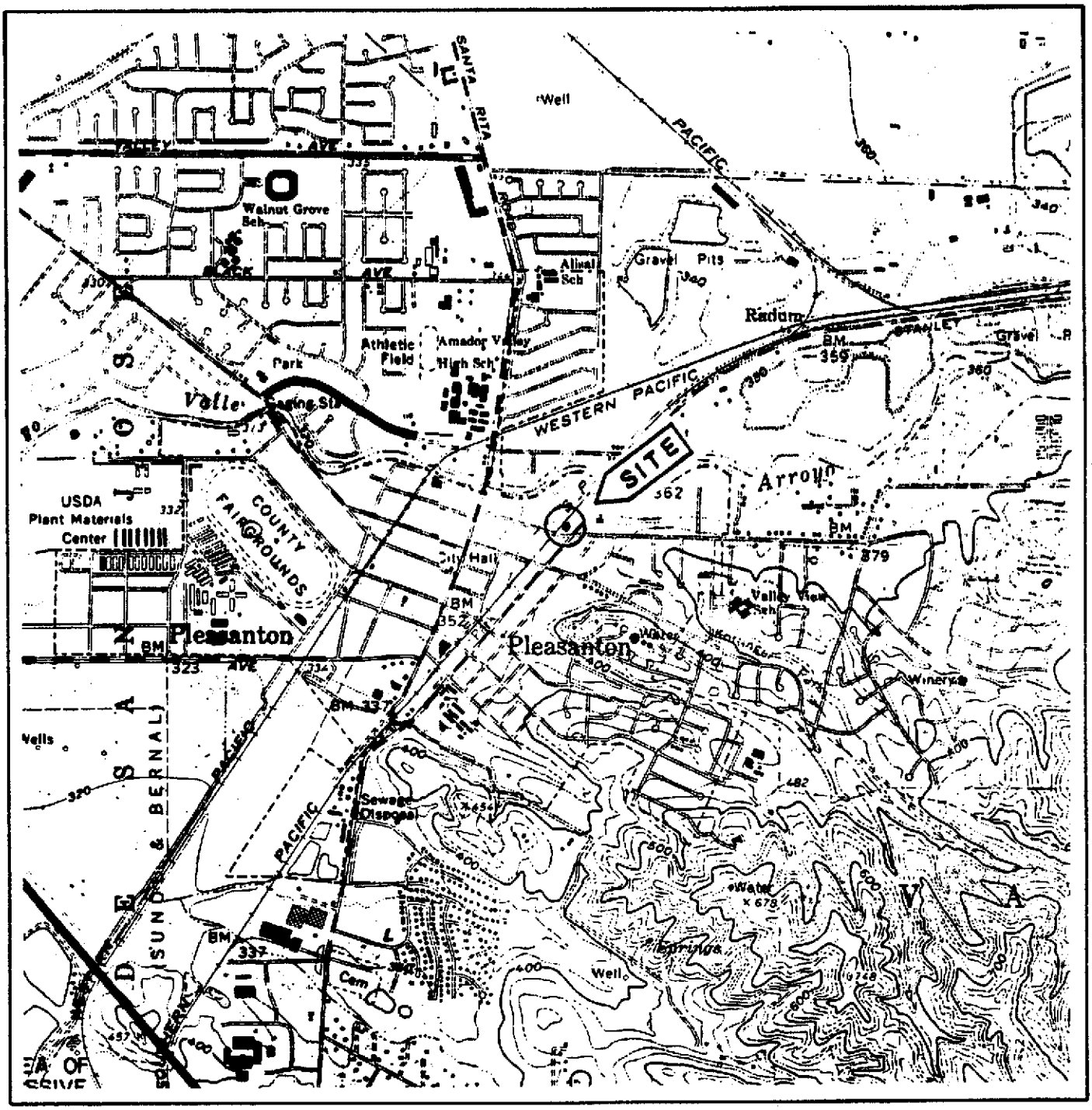
Report Preparation

A final report summarizing the soil stratigraphy, field and laboratory procedures, well construction details, laboratory results, ground-water gradient, and recommendations for further

work, if needed, will be supplied to Armour Oil Company approximately 30 days after field work is completed. All information gathered during the study will be considered confidential and released only upon authorization by Armour Oil Company.

PROJECT STAFF

Mr. Michael N. Clark, a Registered Geologist (RG 3868) and Certified Engineering Geologist (CEG 1264) in the state of California, will be in overall charge of this project. Mr. William R. Short, project geologist, will manage field and office operations of the project. Applied GeoSystems employs a staff of geologists and technicians who will additionally be used to see the project to completion.



Source: State of California
Special Studies Zone
Dublin/Livermore
7.5 Minute Quadrangle

N

Approximate Scale
2000 1000 0 2000 4000
feet

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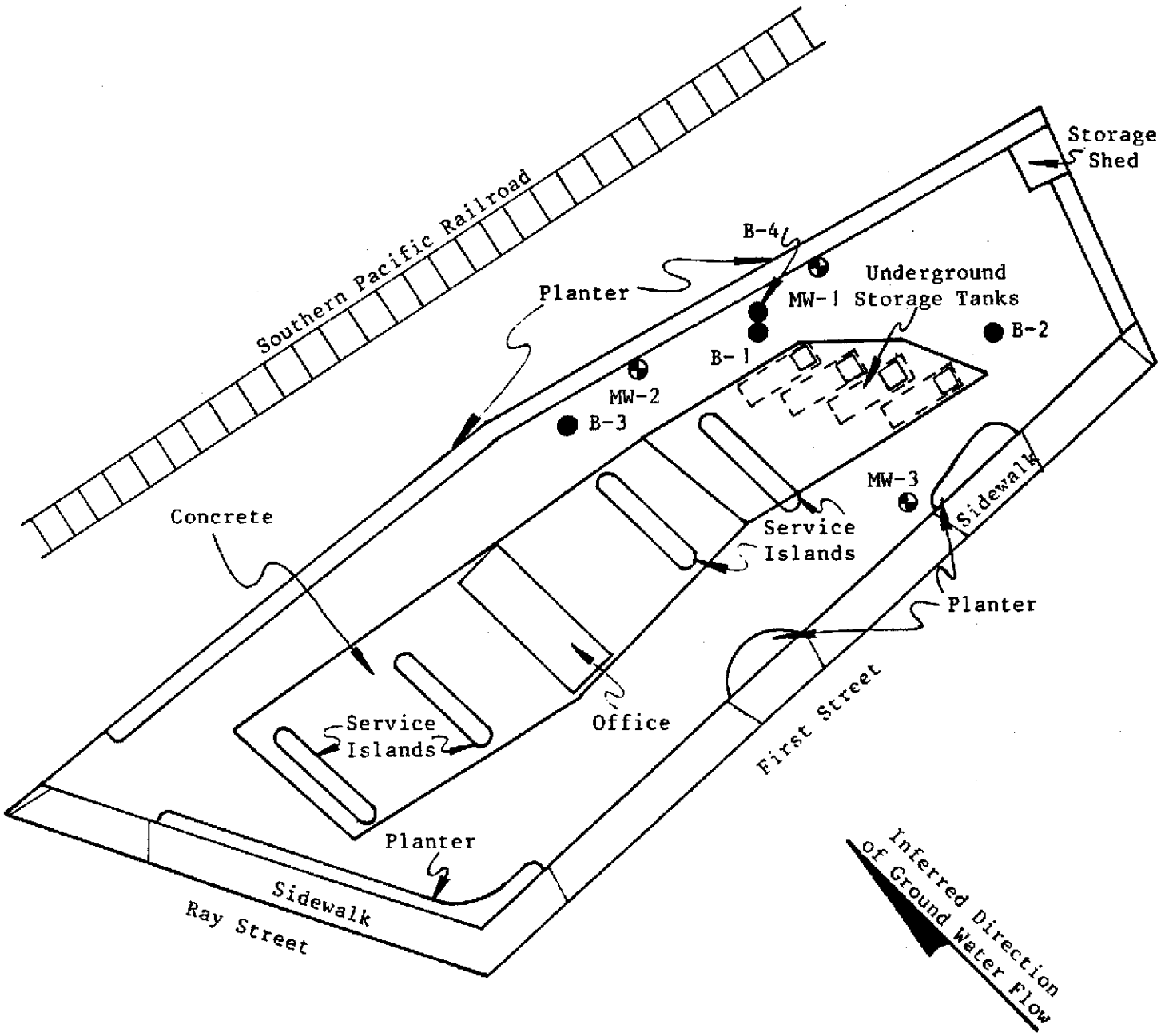
PROJECT NO. 87086-2P

SITE VICINITY MAP
Arco Station
First and Ray Street
Pleasanton, California

PLATE
P-1



● = Previous Soil Boring Location

⊕ = Proposed Soil Boring/ Ground-water Monitoring Well

N

Approximate Scale

40 0 40 80

feet

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PROJECT NO. 87086-2P

GENERALIZED SITE PLAN
Arco Station
First and Ray Street
Pleasanton, California

PLATE

P-2

DRILLING METHOD

BORING NO.

SHEET P-3

SAMPLING METHOD

DRILLING START TIME / DATE

FINISH TIME / DATE

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

UM ELEVATION

SAMPLE TYPE	SAMPLE DEPTH	BLOWS PER 6 in.	MOISTURE CONTENT	PRODUCT ODOR	DEPTH IN FEET	USCS CODE
					0	
					1	
					2	
					3	
					4	
					5	
					6	
					7	
					8	
					9	
					10	
					11	
					12	
					13	
					14	
					15	
					16	
					17	
					18	
					19	
					20	

SURFACE CONDITIONS:

FIELD BOREHOLE LOG

Blows/ Ft.	Sample No.	USCS	DESCRIPTION	WELL CONST.

DEPTH IN FEET

REPORT BOREHOLE LOG

Applied GeoSystems

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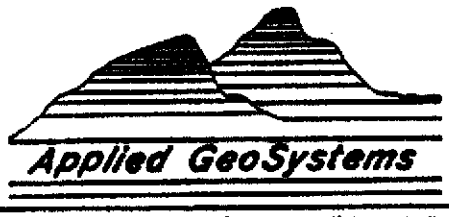
LOG OF BORING

PLATE

PROJECT NO.

CHAIN OF CUSTODY RECORD



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SAMPLER (signature): _____

Phone: _____

LABORATORY: _____

TURNAROUND TIME: _____

Attention: _____

Phone No. _____

SHIPPING INFORMATION:

Shipper _____

Address _____

Date Shipped _____

Service Used _____

Airbill No. _____ Cooler No. _____

Relinquished by: (signatures)	Received by: (signatures)	Date	Time
	Received for laboratory by:		

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

Sample No.	Site Identification	Date Sampled	Analyses Requested	Sample Condition Upon Receipt

SAMPLE