Applied GeoSystems, Inc.
A RESNA Company

RESNA
Working To Restore Nature

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TRANSMITTAL

TO: Mr. Scott Seery
ACHCSA
Department of Environmental Health
80 Swan Way, Room 200
Oakland, California 94621

DATE: September 29, 1992
PROJECT NUMBER: 60006.04
SUBJECT: ARCO Station 6041, 7249 Village Parkway, Dublin, California.

FROM: Lou Leet
TITLE: Environmental Scientist

WE ARE SENDING YOU:

COPIES	DATED	NO.	DESCRIPTION
1	9/29/92	60006.04	Work Plan for Initial Offsite and Additional Onsite Subsurface Investigations at ARCO Station 6041, 7249 Village Parkway, Dublin, California.

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REMARKS:
Per ARCO's request, (Mr. Michael Whelan) copies of this Work Plan have been sent to you for your review.

Copies: 1 to RESNA project file no. 60006.04

reviewed + approved
10/1/92 SOS

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WORK PLAN
for
INITIAL OFFSITE AND ADDITIONAL ONSITE SUBSURFACE INVESTIGATIONS
at
ARCO Station 6041
7249 Village Parkway
Dublin, California

9/29/92

60006.04

Prepared for
ARCO Products Company
P.O. Box 5811
San Mateo, California 94402

by
RESNA Industries Inc.

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CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

James L. Nelson
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Applied GeoSystems, Inc.
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Dublin, California
for
ARCO Products Company

INTRODUCTION

This Work Plan summarizes work previously performed by RESNA Industries Inc. (RESNA, formerly Applied GeoSystems [AGS]) and describes a proposed two-step project which has the following objectives: to further delineate the extent of gasoline hydrocarbons in the soil and groundwater at the site and in the vicinity of the site; to confirm the gradient of the first encountered groundwater beneath the site; to identify potential offsite sources of hydrocarbons detected in the soil and groundwater at the site; and to evaluate the feasibility and design of future remediation systems. ARCO Products Company (ARCO) requested that RESNA prepare this Work Plan for submittal to the Regional Water Quality Control Board (RWQCB) and the Alameda County Health Care Services Agency (ACHCSA). This Work Plan was initiated in response to the results of previous subsurface environmental investigation performed by RESNA at the subject site (RESNA, February 12, 1992).

The tasks in Step 1 of the project include drilling seven onsite soil borings (B-4 through B-10); collecting soil samples from the borings for laboratory analyses; installing three 4-inch diameter groundwater monitoring wells (MW-4 through MW-6) and four vapor extraction wells (VW-1 through VW-4); directing the survey of the wells; performing an environmental records search and a well survey; developing and sampling the wells; performing a vapor extraction test (VET); and measuring depth-to-water (DTW) in all of the groundwater wells for three months to evaluate groundwater direction.

The tasks in Step 2 include obtaining permits for installation of two offsite groundwater monitoring wells; drilling one onsite boring (B-11) and two offsite borings (B-12 and B-13); collecting soil samples for laboratory analyses; installing one onsite 6-inch recovery well (RW-1) and two offsite 2-inch groundwater monitoring wells (MW-7 and MW-8); directing the survey of the new wells; developing the new wells; sampling all onsite groundwater monitoring wells (MW-1 through MW-6 and RW-1) and offsite groundwater monitoring wells (MW-7 and MW-8); performing a pump test; and preparing a report of RESNA's findings, interpretations, and conclusions. Recommendations will be included under separate cover as requested.

SITE DESCRIPTION AND BACKGROUND

General

ARCO Station 6041 is located at the northern corner of the intersection of Village Parkway and Amador Valley Boulevard in Dublin, California. The location is shown on Plate 1, Site Vicinity Map. The site is on a relatively flat, predominantly asphalt- and concrete-covered lot at an elevation of approximately 335 feet above mean sea level. Pertinent site features include four service islands (two located in the northwestern portion of the site and two located in the southeastern portion of the site), a station building, four underground gasoline-storage tanks (USTs) in the southern part of the site, and the former waste-oil tank pit adjacent to the northern wall of the station building in the northern portion of the site. Pertinent site features are shown on Plate 2, Generalized Site Plan.

Regional and Local Hydrogeology

ARCO Station 6041 is located in the northwestern end of the Livermore Valley, within the Coast Ranges Geomorphic Province of Northern California. The Livermore Valley is approximately 13 miles long oriented in an east-west direction, approximately 4 miles wide, and is surrounded by hills of the Diablo Range. In the vicinity of the site, the valley floor slopes gently to the south-southeast. Soil in the vicinity of the subject site is mapped as Holocene alluvium that consists of unconsolidated, moderately to poorly sorted silt and clay rich in organic material, interfingered with and graded into coarser grained stream deposits toward higher elevations (Helley and others, 1979). Holocene alluvium (estimated to be 10 to 50 feet thick) overlies Pleistocene alluvium, which consists of weakly consolidated, poorly sorted, irregularly interbedded clay, silt, sand and gravel, and older sedimentary deposits. The Calaveras Fault is situated approximately 1/2-mile west of the site.

The Livermore Valley groundwater basin is divided into subbasins on the basis of fault traces or other hydrogeologic discontinuities (California Department of Water Resources, 1974). The groundwater system in Livermore Valley is a multi-layered system with an unconfined aquifer overlying a sequence of leaky or semi-confined aquifers. The subject site is located within the Dublin groundwater subbasin. The groundwater in this subbasin has been reported to be at depths ranging from 10 to 60 feet below ground surface (Alameda County Flood Control and Water Conservation District [ACFCWCD]), January 16, 1991). The groundwater gradient is generally toward the south-southeast (ACFCWCD, January 16, 1991). The principal streams in the vicinity of the site are Alamo Canalis situated about 2/3 of a mile southeast of the site, and Dublin Creek which joins Alamo Canal about 2/3 of a mile south of the site.

PREVIOUS WORK

Waste-Oil Tank Removal

On June 6 and 7, 1990, one 550-gallon waste-oil tank of single wall steel construction was excavated and removed from its location adjacent to the northern wall of the station building at the site. A RESNA geologist examined the outer surface of the tank for signs of leakage, holes, pitting, and areas of weakness. The tank appeared to be in very good condition; the geologist observed light localized rusting on the surface of the tank, but no pitting, holes or cracks were observed. No signs of overfill staining were observed on the top and sides of the tank (Applied GeoSystems, September 19, 1990). Information supplied by the station manager indicated that the tank was at least 13 years old.

Soil excavated from the tank pit was screened for evidence of volatile hydrocarbon compounds, both visually and with a portable Organic Vapor Meter (OVM). Initial random screening of backfill material excavated from around the tank yielded OVM readings ranging from nondetectable to 0.8 parts per million (ppm). Excavation proceeded beneath the former tank location to a final depth of approximately 10-1/2 feet. At the limits of the excavation, random grab samples yielded nondetectable readings from the north, south, east and west walls and an OVM reading of 3.25 ppm from the center of the tank pit. No subjective evidence of hydrocarbons such as product odor or soil discoloration was noted in the backfill material or native soil during the excavation process.

Ten soil samples were collected from the tank pit excavation. Two samples were collected from each of the four sidewalls of the tank pit, and two samples were collected from the center of the tank pit floor at the limits of the excavation. The samples were divided into two sets, A and B, with each set consisting of five samples: one from each of the sidewalls, and one from the floor of the tank pit. The samples in set A were analyzed for total oil and grease (TOG) and halogenated volatile organic compounds (HVOCs). The samples in set B were analyzed for total petroleum hydrocarbons as gasoline (TPHg), total petroleum hydrocarbons as diesel (TPHd), and the gasoline constituents benzene, toluene, ethylbenzene, and total xylenes (BTEX). Four soil samples for compositing and laboratory analyses were collected from the soil stockpile. Analyses of the soil samples collected from the waste-oil tank pit indicated nondetectable levels of TOG, HVOCs, TPHg, TPHd, and BTEX. Approximately 15 to 20 cubic yards of soil were excavated from the tank pit. According to information obtained from ARCO, the soil stockpile was removed from the site by Dillard Trucking, Inc. of Hayward, California and admitted to Chem-Waste Management's facility in Kettleman City on June 12, 1990. On the basis of field observations and the results of analyses of tank pit soil samples, RESNA concluded that no further excavation in the vicinity of the former waste-oil tank was necessary.

Fuel Spill Sampling

On September 25, 1990, a RESNA geologist attempted to collect a soil sample at a reported fuel spill beneath a dispenser pump in the southeastern portion of the site at the approximate location shown on Plate 2. We understand that the spill occurred when a station customer failed to remove the hose from the vehicle after use. The vehicle drove off pulling the hose from the pump. This in turn caused a filter in the pump to fail resulting in a relatively small release of gasoline from the pump. The dispenser pump made collection of a soil sample impractical; however, pea gravel beneath the pump was removed. The OVM reading for the pea gravel sample collected from the depth of ½-foot beneath the pump where the spillage occurred was 750 ppm. Mr. Tom Hathcox of the Dogherty Regional Fire Department estimated that approximately 10 gallons of fuel spilled on the ground. We understand from the station manager that the pump was turned off shortly after the hose was pulled off the pump.

Subsurface Environmental Investigation

In September 1991, RESNA performed a subsurface environmental investigation to evaluate the impact of hydrocarbons released during the fuel spill, which occurred in September 1990, on the soil and groundwater beneath the subject site (RESNA, February 12, 1992). Work performed for this investigation included drilling three soil borings (B-1 through B-3), collecting and describing soil samples from the borings, installing and developing three 4-inch-diameter groundwater monitoring wells (MW-1 through MW-3) in the borings, sampling groundwater from the monitoring wells, performing laboratory analyses on selected soil and groundwater samples, measuring groundwater levels, surveying wellhead elevations, and preparing the report presenting field procedures, results, and conclusions.

Results of the investigation indicated that the soil beneath the site has been impacted by gasoline hydrocarbons, however TPHg concentrations over 100 ppm were not reported in the soil samples collected from the borings, with the exception of one sample from a depth of 9-1/2 feet in B-1 (150 ppm) located near the southwestern service islands. The soil in the vicinity of the southeastern service islands, where the unauthorized fuel spill reportedly occurred in September 1990, has been impacted by low levels of gasoline hydrocarbons (less than 10 ppm of TPHg). The lateral extent of gasoline hydrocarbons in the soil at the site has not been delineated below 10 ppm except in the southeastern part of the site. However, the vertical extent of gasoline hydrocarbons in the soil has been delineated to nondetectable levels (less than 1 ppm) at the depth of approximately 14-1/2 to 19-1/2 feet below ground surface. Results of laboratory analyses of soil samples from the borings are summarized in Table 1, Results of Laboratory Analyses of Soil Samples from Borings. The presently interpreted extent of hydrocarbon impacted soil beneath the site is presented on Geologic Cross Sections A-A', B-B' and C-C', Plate 3.

Shallow groundwater was encountered at the site in a relatively thin (2 to 3 feet thick) clayey sand layer at a depth of approximately 10-1/2 to 15 feet and stabilized in the wells at depths of approximately 9 to 11 feet. Groundwater gradient direction was interpreted to be toward the southwest. The DTW measurements, wellhead elevations, and groundwater elevations are summarized in Table 2, Cumulative Groundwater Monitoring Data.

Results of the investigation indicated that the first encountered groundwater beneath the site has been impacted by gasoline hydrocarbons at concentrations up to 990 ppb TPHg and up to 50 ppb benzene. The benzene concentrations in all three wells exceeded the State of California Maximum Contaminant Level (MCL). Ethylbenzene and total xylene concentrations were below MCLs in the wells, and toluene concentrations were below the recommended Drinking Water Action Level (DWAL) in wells MW-1 and MW-2 and at the DWAL in well MW-3. The extent of gasoline hydrocarbons in the groundwater was not delineated. The results of laboratory analyses of water samples are summarized in Table 3, Cumulative Results of Laboratory Analyses of Groundwater Samples.

Based on the results of the investigation, RESNA concluded that the fuel spill which occurred on September 25, 1990, did not appear to be the sole source of gasoline hydrocarbons detected beneath the site.

Groundwater Monitoring and Sampling

RESNA began monthly groundwater monitoring in October 1991 and quarterly sampling in December 1992 at the site. Data from these and subsequent groundwater monitoring episodes are summarized in Table 2. Water elevations fluctuated up to 0.44 feet between September and December 1991 (RESNA, April 5, 1992) and up to 2 feet between January and March 1992 (RESNA, May 1, 1992). The interpreted local groundwater gradient relatively flat (less than 0.01); groundwater was interpreted as flowing toward the southwest during September and October 1991, north-northwest during November and December 1991, and south-southwest during January, February, and March 1992. Water elevation data from March 1992, were interpreted as shown on the Groundwater Gradient Map, Plate 4. Results of water analyses are summarized in Table 3.

PROPOSED WORK

RESNA proposes the following Step 1 and Step 2 to be implemented upon regulatory approval of this Work Plan and upon ARCO's authorization to proceed based on the results of previous investigations. Field work involved with the following project steps will be performed in accordance with the attached RESNA Field Protocol in Appendix A. All work will be conducted with an updated Site Safety Plan.

STEP 1:

Task 1: Receive approval of a Work Plan from ACHCSA describing the proposed work for this phase for the subject site.

Task 2: Obtain well construction permits. Drill and obtain soil samples for soil classification and laboratory analyses from seven onsite soil borings (B-4 through B-10) as shown on Plate 6, Proposed Boring/Well Locations and install three groundwater monitoring wells (MW-4 through MW-6) and four vapor extraction wells (VW-1 through VW-4).

Specifically, drill borings B-4 through B-6 to a maximum of 5 feet into a possible perching or confining layer beneath the first encountered groundwater (total depth of approximately 25 feet below the ground surface). Install three onsite groundwater monitoring wells (MW-4 through MW-6) with 4-inch diameter well casing in borings B-4 through B-6, respectively. These soil borings/wells will be located to further investigate the presence and extent of gasoline hydrocarbons in soil and groundwater at the site and in its vicinity and to verify the flow direction of first encountered groundwater beneath the site.

Drill soil borings B-7 through B-10 above the first encountered groundwater (total depth of approximately 15 feet) and install 4-inch-diameter vapor extraction wells (VW-1 through VW-4, respectively) in the borings for use in a VET. These soil borings/wells will be located to further investigate the presence and extent of gasoline hydrocarbons in soil and for evaluating future remediation alternatives.

Submit selected soil samples from borings B-4 through B-10 to a State-certified laboratory for analyses of TPHg and BTEX by Environmental Protection Agency (EPA) methods 5030/8015/8020.

Task 3: Survey monitoring wells MW-4 through MW-7 to a National Geodetic Vertical Datum for top of casing elevations relative to mean sea level (msl).

Task 4: Develop monitoring wells MW-4 through MW-6.

Task 5: Measure DTW, record visual evidence of floating product in initial groundwater samples, and purge and collect groundwater samples for laboratory analyses from monitoring wells MW-1 through MW-6. Submit groundwater samples to a State-certified laboratory for analyses for TPHg and BTEX by EPA methods 5030/8015/8020.

Task 6: Perform a VET using vapor extraction wells VW-1 through VW-4 to evaluate the feasibility and design of future remediation systems.

Task 7: Perform an environmental records search to identify potential offsite sources of hydrocarbons that may be detected in soil and groundwater at the subject site; perform a well survey to determine domestic, commercial, agricultural, and monitoring wells within a 1/2-mile radius of the site.

Task 8: Perform groundwater monitoring of wells MW-1 through MW-6 for three months to verify groundwater flow direction.

Step 2: (To be performed after three months of groundwater monitoring and evaluating the groundwater gradient and flow direction)

Task 1: Obtain offsite access for installation of two 2-inch diameter groundwater monitoring wells (MW-7 and MW-8) and evaluate the optimum position for recovery well RW-1 by utilizing data acquired from installation and three months groundwater monitoring of groundwater monitoring wells MW-4 through MW-6. Drill and obtain soil samples for soil classification and laboratory analyses from one onsite (B-11) and two offsite borings (B-12 and B-13). Install one onsite 6-inch diameter recovery well (RW-1) and two 2-inch diameter offsite groundwater monitoring wells (MW-7 and MW-8).

These soil borings/wells will be located to further investigate the presence and extent of gasoline hydrocarbons in soil and groundwater at the site and in its vicinity and to provide an extraction point for performing a pump test and to evaluate future groundwater recovery as a possible means of remediation.

Submit selected soil samples from borings B-11 through B-13 to a State-certified laboratory for analyses of TPHg and BTEX by EPA methods 5030/8015/8020.

Task 2: Develop wells RW-1, MW-7, and MW-8.

Task 3: Survey monitoring wells MW-4 through MW-7 to a National Geodetic Vertical Datum for top of casing elevations relative to msl.

Task 4: Measure DTW, record visual evidence of floating product in initial groundwater samples, and purge and collect groundwater samples for laboratory analyses from monitoring wells MW-1 through MW-8 and RW-1. Submit groundwater samples to a State-certified laboratory for analyses for TPHg and BTEX by EPA methods 5030/8015/8020.

Task 5: Perform a pump test using recovery well RW-1 as the pumping well. Data obtained from this pumping test is used to evaluate the sustainable pumping rate from the pumping well and obtain an estimate of the hydraulic conductivity and storativity of the aquifer. The information is also used to evaluate the zone of capture of the recovery well and the feasibility of groundwater extraction as a means of remediation at the site.

Task 6: Prepare a draft report, including results of the investigation and RESNA's interpretations and conclusions, and submit to ARCO for review.

Task 7: Review reported findings with ARCO.

Task 8: Finalize report and submit to ARCO and Regulatory Agencies.

SCHEDULE OF OPERATIONS

A preliminary time schedule to perform the steps described above is included as Plate 7, Preliminary Time Schedule. This time schedule is an estimate and is subject to change should circumstances dictate. ARCO and the appropriate regulatory agencies will be informed should the estimated time for completion of the work proposed in this Work Plan be delayed beyond the estimated time of completion depicted in Plate 7. Time is estimated in weeks after gaining regulatory approval of the Work Plan and any changes which must be incorporated into this Work Plan upon regulatory request. RESNA can begin work at the site within 1 to 2 weeks after receiving work plan approval and authorization to proceed. If Work Plan approval is not received from the ACHCSA within 60 days from receipt of this Work Plan, under Title 23, Article 11, Chapter 16, Sections 2722 (b)(5) and 2726 (c)(1), and at the direction of ARCO, RESNA will proceed with the proposed work in the Work Plan.

PROJECT STAFF

Mr. James L. Nelson, a Certified Engineering Geologist in the State of California (C.E.G. 1463) will be in charge of hydrogeologic aspects of this project and Dr. Joan E. Tiernan, Ph.D., a Registered Civil Engineer in the State of California (C.E. 044600) will be in overall charge of engineering aspects of this project. Mr. Greg Barclay, General Manager, will provide supervision of field and office operations of the project. Mr. Joel Coffman, Project Geologist, will be responsible for the day-to-day field and office operations of the project. RESNA employs a staff of geologists, engineers and technicians who will assist with the project.

DISTRIBUTION

RESNA recommends that copies of this Work Plan should be sent to the following regulatory agencies:

Mr. Scott Seery
Alameda County Health Care Services Agency
Department of Environmental Health
80 Swan Way, Room 200
Oakland, California 94621

Mr. Richard Hiett
California Regional Water Quality Control Board
San Francisco Bay Region
2101 Webster Street, Suite 500
Oakland, California 94612

REFERENCES

Alameda County Flood Control and Water Conservation District, Zone 7. January 16, 1991. Fall 1990 Groundwater Level Report.

Applied GeoSystems. September 19, 1990. Letter Report Limited Environmental Related to the Removal of Waste-Oil Tank at ARCO Station 6041, 7249 Village Parkway, Dublin, California. 60006-1.

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

Helley E.J., K.R. Lajoie, W.E. Spangle, and M.L. Blair. 1979. Flatland deposits of the San Francisco Bay Region, California. U.S. Geological Survey Professional Paper 943.

RESNA, August 22, 1991. Work Plan for Subsurface Investigation and Remediation at ARCO Station 6041, 7249 Village Parkway, Dublin, California. RESNA 60006.02

RESNA, August 22, 1991. Addendum One to Work Plan for Subsurface Investigation and Remediation at ARCO Station 6041, 7249 Village Parkway, Dublin, California. RESNA 60006.02

RESNA, August 30, 1991. Site Safety Plan for the ARCO Station 6041, 7249 Village Parkway, Dublin, California. RESNA 60006.02S

RESNA, February 12, 1992. Subsurface Environmental Investigation at ARCO Station 6041, 7249 Village Parkway, Dublin, California. RESNA 60006.02.

RESNA, April 5, 1992. Letter Report Quarterly Groundwater Monitoring Fourth Quarter 1991 at ARCO Station 6041, 7249 Village Parkway, Dublin, California. RESNA 60006.03.

RESNA, May 1, 1992. Letter Report Quarterly Groundwater Monitoring First Quarter 1992 at ARCO Station 6041, 7249 Village Parkway, Dublin, California. RESNA 60006.03.

RESNA, September 25, 1992. Letter Report Quarterly Groundwater Monitoring Second Quarter 1992 at ARCO Station 6041, 7249 Village Parkway, Dublin, California. RESNA 60006.03.

TABLE 1
RESULTS OF LABORATORY ANALYSES
OF SOIL SAMPLES FROM BORINGS
ARCO Station 6041
Dublin, California
September 12-13, 1991

Sample Identification	TPHg	B	T	E	X
S-9-1/2-B1	150	0.90	4.2	2.4	13
S-14-1/2-B1	<1.0	0.0060	0.019	0.0090	0.060
S-21-1/2-B1	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
S-4-1/2-B2	2.5	0.071	<0.0050	0.093	0.017
S-9-1/2-B2	6.3	0.30	0.011	0.30	0.060
S-15-1/2-B2	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
S-9-1/2-B3	52	1.2	2.5	1.4	8.5
S-19-1/2-B3	<1.0	<0.0050	<0.0050	<0.0050	<0.0050
SP1-A-D*	1.9	0.027	<0.0050	0.035	0.0070
SP2-A-D*	18	0.045	0.43	0.29	1.8

Results measured in part per million (ppm).
TPHg: Total petroleum hydrocarbons as gasoline (analyzed by EPA Method 5030/8015/8020).
B: benzene; T: toluene; E: ethylbenzene; X: total xylenes.
BTEX: Analyzed by EPA Method 5030/8015/8020.
*: Composite sample of four soil samples obtained from stockpiled soil.
<: Less than the laboratory detection limit.

Sample Identification:

S-19-1/2-B3
- B3 — Boring number
- 19-1/2 — Depth in feet
- S — Soil sample

SP1-A-D
- A-D — Composite sample A through D
- SP1 — Stockpile sample

TABLE 2
CUMULATIVE GROUNDWATER MONITORING DATA
ARCO Station 6041
Dublin, California

Date Measured	Well Elevation	Depth to Water	Water Elevation	Floating Product
MW-1				
9-20-91	336.56	11.20	325.36	None
10-22-91		11.48	325.08	None
11-27-91		11.27	325.29	None
12-16-91		11.55	325.01	None
01-18-92		11.37	325.19	None
02-21-92		9.13	327.43	None
03-16-92		9.70	326.86	None
MW-2				
9-20-91	334.80	9.22	325.58	None
10-22-91		9.66	325.14	None
11-27-91		9.48	325.32	None
12-16-91		9.76	325.04	None
01-18-92		9.47	325.33	None
02-21-92		7.62	327.18	None
03-16-92		7.84	326.96	None
MW-3				
9-20-91	335.53	10.16	325.37	None
10-22-91		10.48	325.05	None
11-27-91		10.17	325.36	None
12-16-91		10.25	325.28	None
01-18-92		10.71	324.82	None
02-21-92		8.68	326.85	None
03-18-92		8.91	326.62	None

Measurements in feet.
Wells surveyed on October 11, 1991. Datum is City of Dublin = (USGS)

TABLE 3
CUMULATIVE RESULTS OF LABORATORY ANALYSES
OF GROUNDWATER SAMPLES
ARCO Station 6041
Dublin, California

Sample ID	TPHg	Benzene	Toluene	Ethyl-benzene	Total xylenes
MW-1					
9-20-91	410	28	36	4.3	89
12-16-91	840	50	50	3.9	12
03-16-92	780	22	12	45	22
MW-2					
9-20-91	130	6.6	0.96	1.4	1.5
12-16-91	83	0.96	<0.30	<0.30	<0.30
03-16-92	430	130	<2.5*	37	5.0
MW-3					
9-20-91	990	50	100	11	200
12-16-91	1,000	180	5.1	23	4.3
03-16-92	430	86	<1.0*	22	3.4
MCL	—	1	—	680	1,750
DWAL	—	—	100	—	—

Results in parts per billion (ppb)
Benzene, toluene, ethylbenzene, and total xylenes analyzed by EPA Method 5030/8015/8020.
TPHg: Total petroleum hydrocarbons as gasoline (analyzed by EPA Method 5030/8015/8020).
MCL: Maximum contaminant level in drinking water (DHS, July 1989).
DWAL: Department of Health Services Recommended drinking water action level (DHS, January 1990).
*: Raised method reporting limit due to high analyte concentration requiring sample dilution, as reported by Columbia Analytical Services, Inc.

Sample Identification: MW-3
└── Monitoring well number

APPENDIX A

FIELD PROTOCOL

FIELD PROTOCOL

The following presents RESNA's protocol for a typical site investigation involving gasoline hydrocarbon-impacted soil and/or groundwater.

Site Safety Plan

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

Soil Excavation

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

Sampling of Stockpiled Soil

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

Soil Borings

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

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

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

Drill Cuttings

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

Soil Sampling in Borings

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

The samples selected for laboratory analyses 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 to be labeled, promptly placed in iced storage, and delivered to a laboratory certified by the State of California to perform the analyses requested.

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

Logging of Borings

A geologist is present to log the soil cuttings and samples using the Unified Soil Classification System. Samples not selected for chemical analyses, and the soil in the sampler shoe, are extruded in the field for inspection. Logs include texture, color, moisture, plasticity, consistency, blow counts, and any other characteristics noted. Logs also include subjective evidence for the presence of hydrocarbons, such as soil staining, noticeable or obvious product odor, and OVM readings.

Monitoring Well Construction

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

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

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

Groundwater Monitoring Well Development

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

Groundwater Sampling

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

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

Vadose-Zone Sampling

Vapor readings are made with a field calibrated OVM, which has a lower detection limit of 0.1 ppm. Prior to purging each vadose-zone monitoring well, an initial reading is taken inside the well by connecting the tubing of the OVM to a tight fitting at the top of the well. Each vadose-zone monitoring well is then purged for approximately 60 seconds using an electric vacuum pump connected to the tight fitting. Ambient readings of the air at the site are taken with the OVM after each well is purged. The OVM is then connected to the well fitting, and the reading recorded. The well is then again purged for approximately 30 seconds, and again measured using the OVM. These purging and measuring procedures are repeated until two consecutive OVM readings are within ten percent of each other.

Sample Labeling and Handling

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

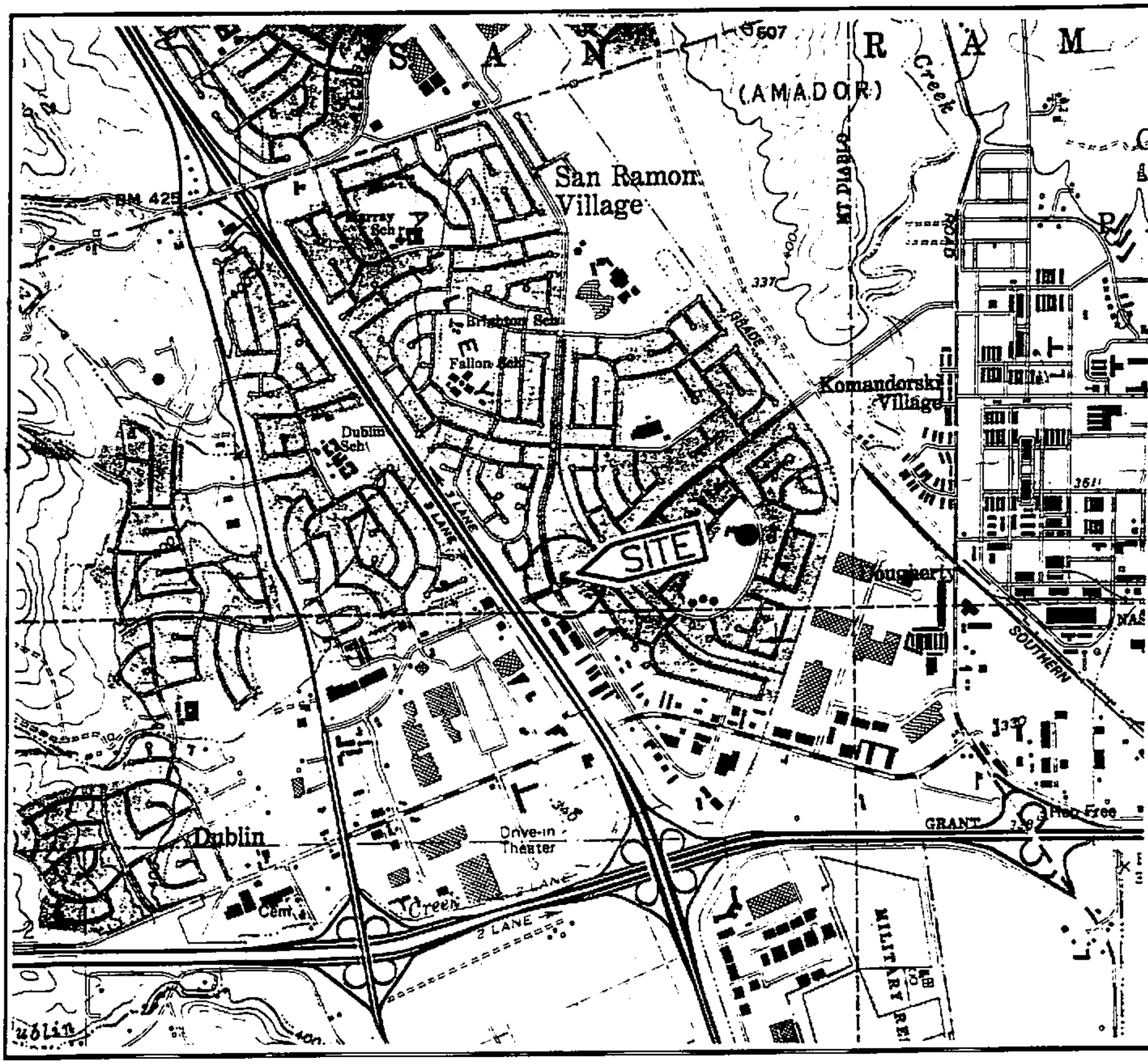
Aquifer Testing

Bailer Test

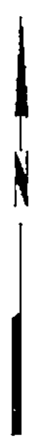
The initial water level is measured in the test well, and water bailed from the test well using a Teflon® bailer and cable cleaned with Alconox® and water. Pressure transducers are used to measure water levels in the test well during drawdown and partial recovery phases, over a minimum period of approximately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

Pumping Test

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



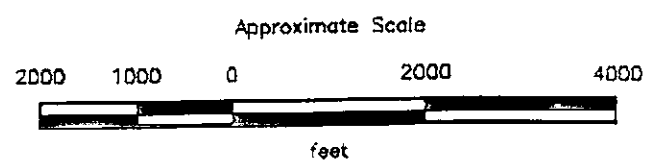
Base: U.S. Geological Survey
7.5-Minute Quadrangles
Dublin, California.
Photorevised 1980



LEGEND

(•) = Site Location

Approximate Scale



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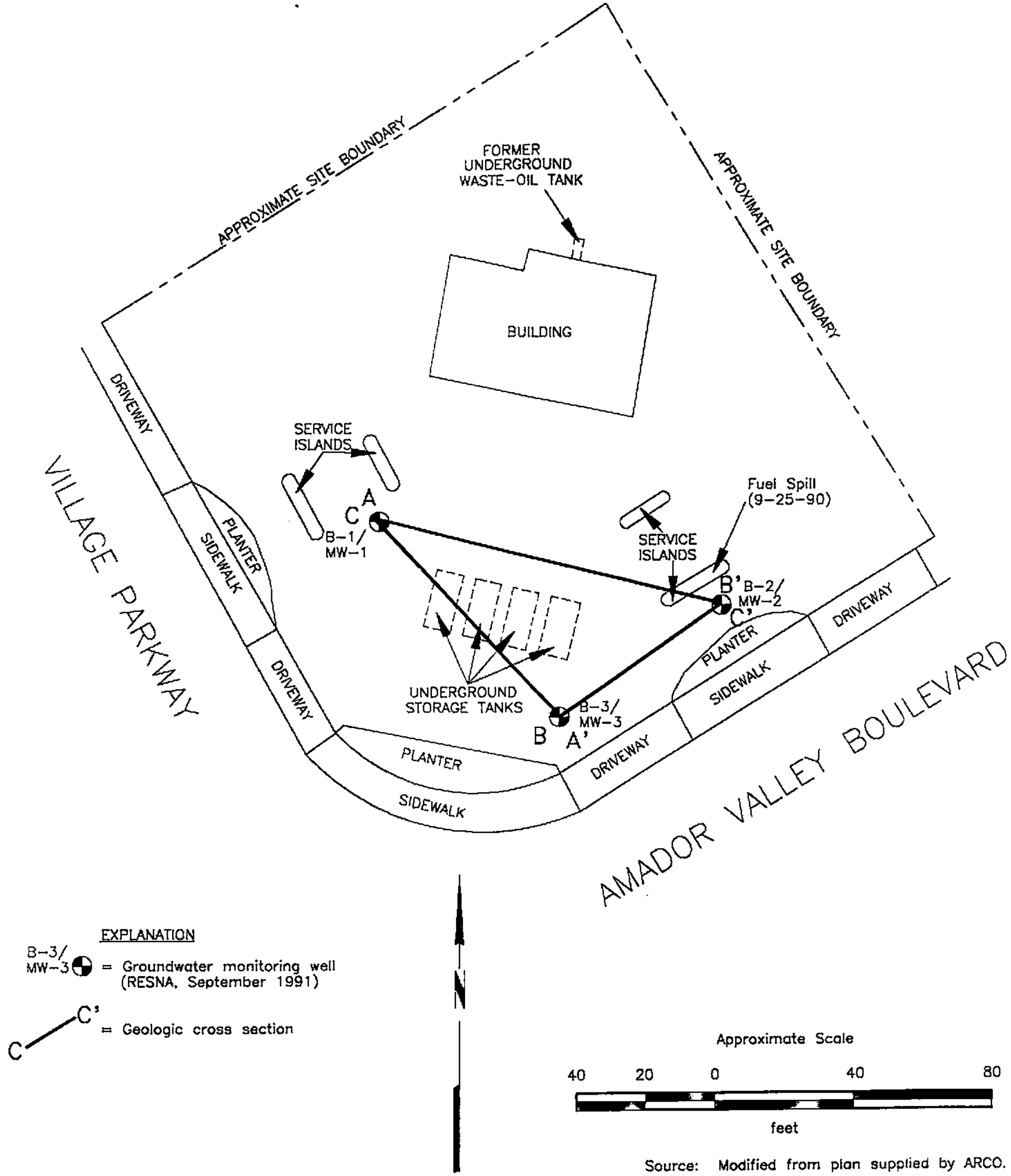
SITE VICINITY MAP
ARCO Service Station 6041
7249 Village Parkway
Dublin, California

PLATE
1

PROJECT 60006.04



RESNA
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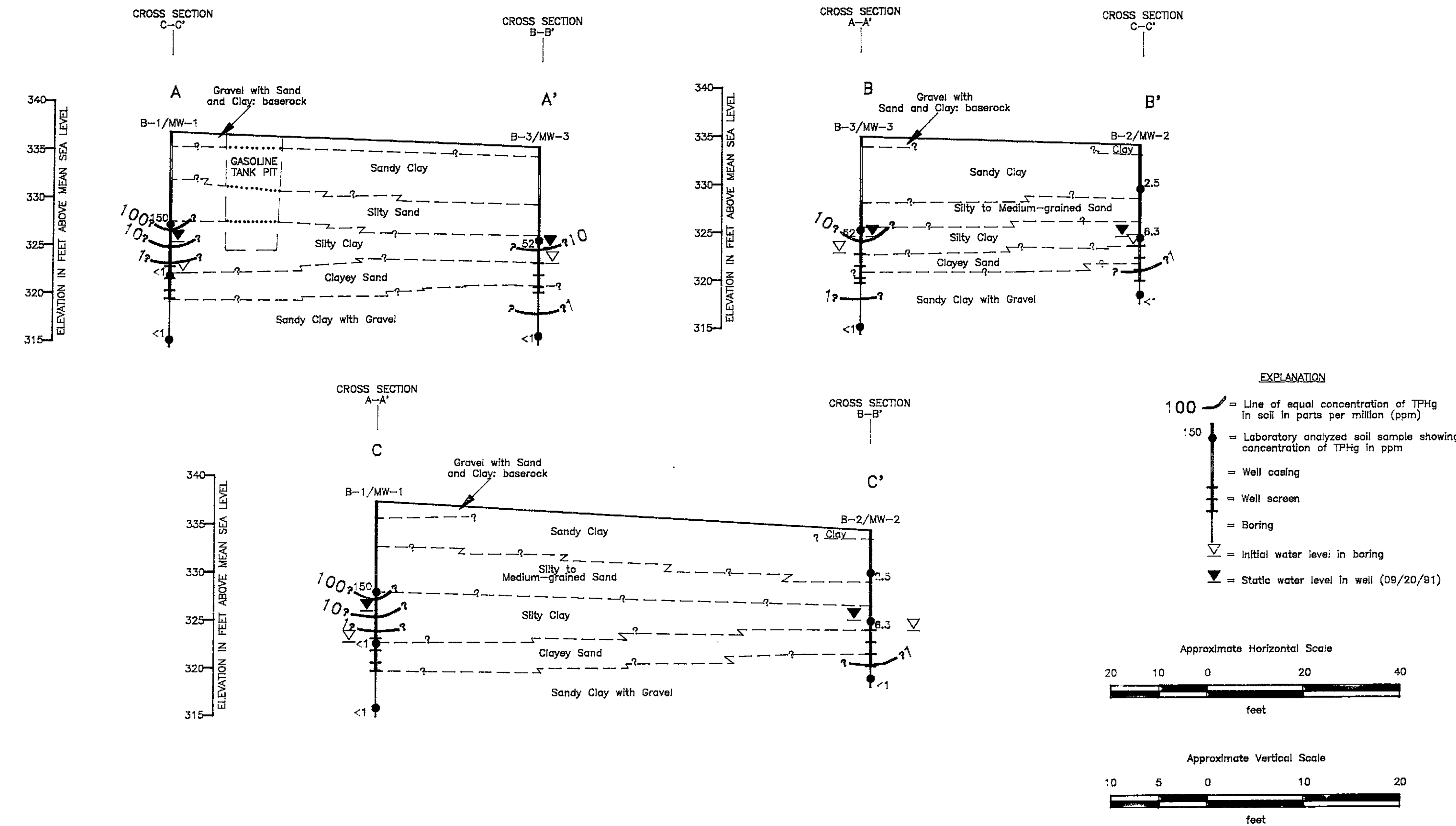
PROJECT 60006.04

GENERALIZED SITE PLAN
ARCO Service Station 6041
7249 Village Parkway
Dublin, California

PLATE 2



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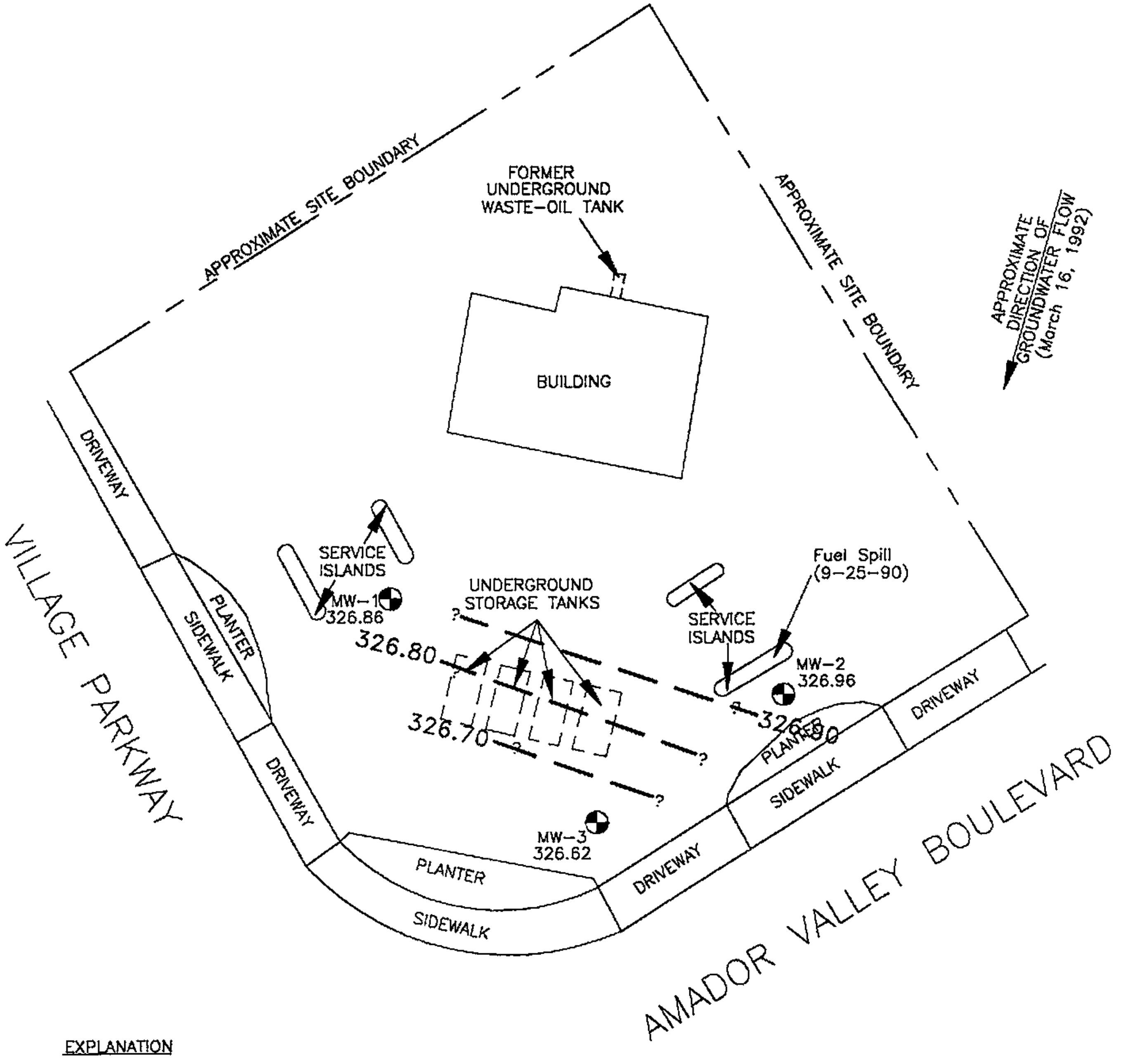
PROJECT **60006.04**

GEOLOGIC CROSS SECTIONS A-A', B-B', AND C-C'
ARCO Service Station 6041
7249 Village Parkway
Dublin, California

PLATE
3



EXPLANATION

326.90 = Line of equal elevation of groundwater in feet above mean sea level (MSL)

326.96 = Elevation of groundwater in feet above MSL, March 16, 1992

MW-3 = Groundwater monitoring well (RESNA, September 1991)

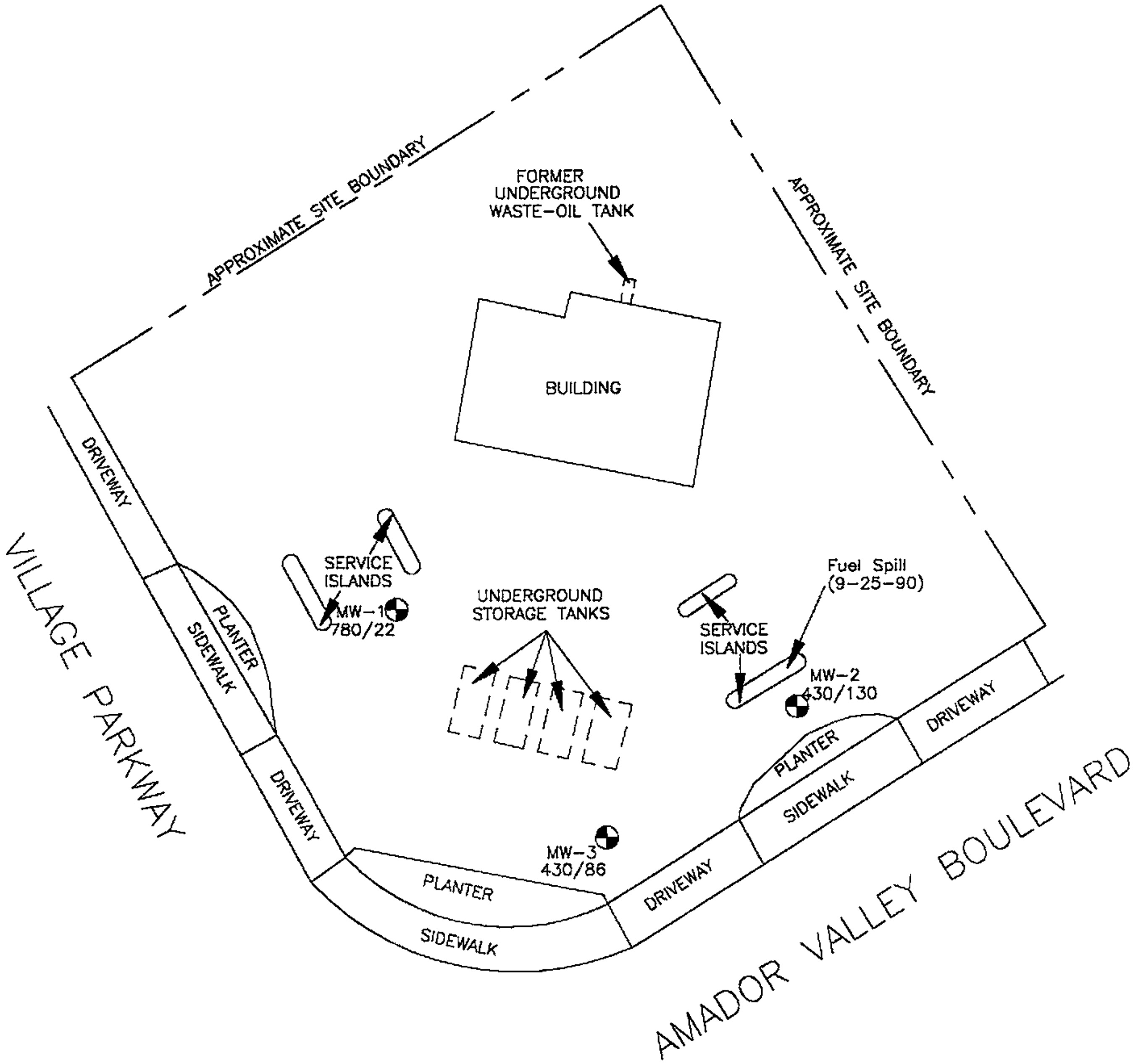
Approximate Scale

40 20 0 40 80

feet

Source: Modified from plan supplied by ARCO.

RESNA *Working to Restore Nature*	GROUNDWATER GRADIENT MAP ARCO Service Station 6041 7249 Village Parkway Dublin, California	PLATE 4
PROJECT 60006.04		



EXPLANATION

780/22 = Concentration of TPHg/benzene in groundwater in parts per billion, March 16, 1992

MW-3 = Groundwater monitoring well (RESNA, September 1991)

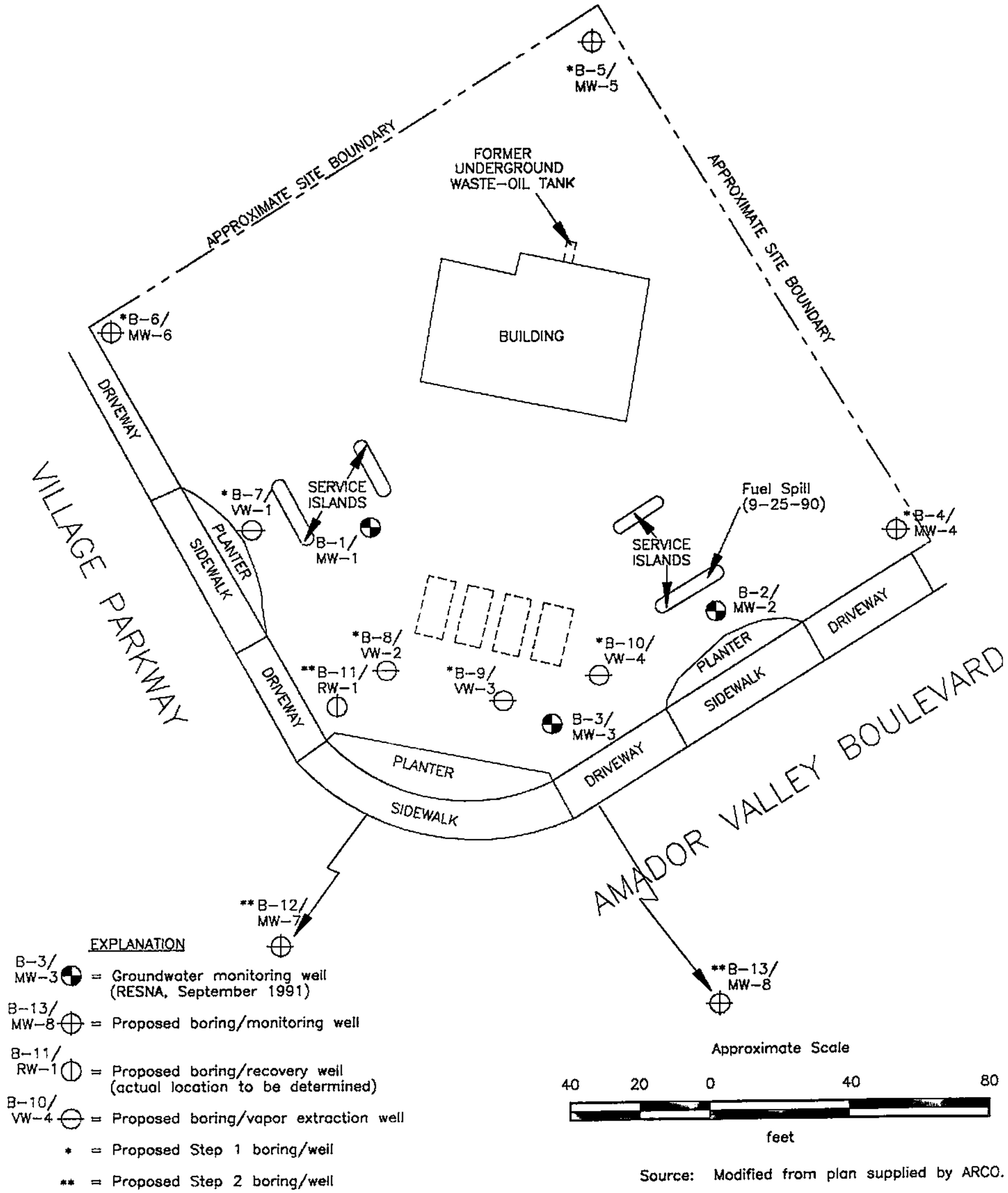
Approximate Scale

40 20 0 40 80

feet

Source: Modified from plan supplied by ARCO.

RESNA *Working to Restore Nature*	**TPHg/BENZENE CONCENTRATIONS IN GROUNDWATER ARCO Service Station 6041 7249 Village Parkway Dublin, California**	**PLATE**
PROJECT 60006.04		**5**



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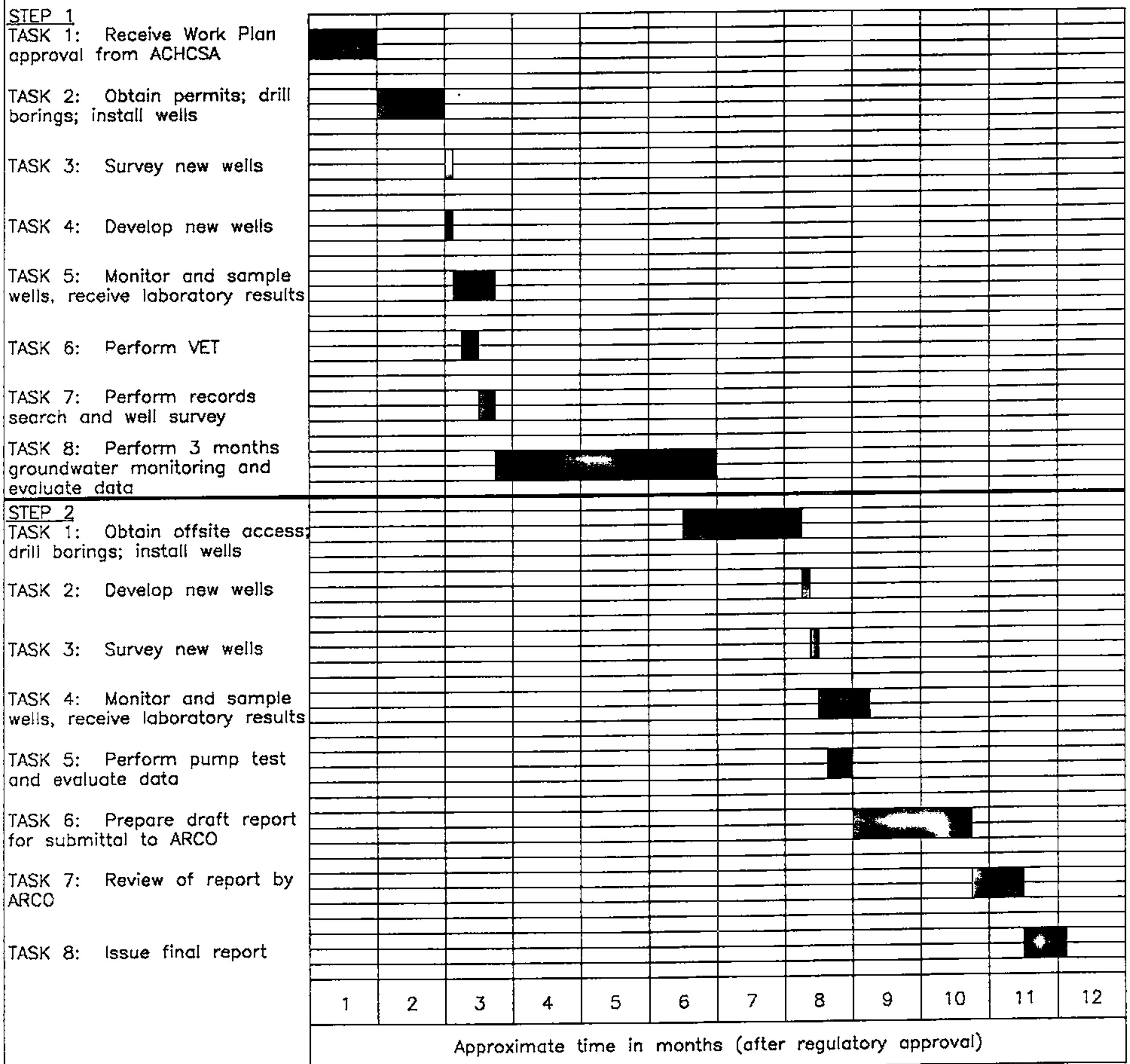
PROJECT **60006.04**

PROPOSED BORING/WELL LOCATIONS
ARCO Service Station 6041
7249 Village Parkway
Dublin, California

PLATE
6



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PRELIMINARY TIME SCHEDULE
ARCO Service Station 6041
7249 Village Parkway
Dublin, California

PLATE
7