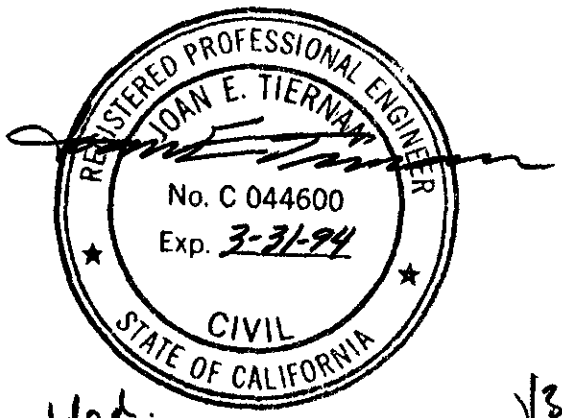
Applied GeoSystems 3315 Almaden Expressway, Suite 34, San Jose, CA 95118 (408) 264-7723

• FREMONT • IRVINE • HOUSTON • BOSTON • SACRAMENTO • CULVER CITY • SAN JOSE

LETTER REPORT
QUARTERLY GROUND-WATER MONITORING
Second Quarter 1991
at
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

Paul Smith / ACHD.

AGS 60026.02



Comment added.
(1) 2,200 ppb PCE in MW 4
(2) PCE decreases from 4,900 ppb since 1/30/91

7/18

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

• FREMONT • IRVINE • BOSTON • SACRAMENTO • CULVER CITY • SAN JOSE

July 11, 1991
0620ccar
AGS 60026.02

Mr. Chuck Carmel
ARCO Products Company
P.O. Box 5811
San Mateo, California 94402

Subject: Second Quarter 1991 Ground-Water Monitoring Report for ARCO Station 276, 10600 MacArthur Boulevard, Oakland, California.

Mr. Carmel:

This letter report summarizes the methods and results of the second quarter 1991 ground-water monitoring performed by RESNA/Applied GeoSystems (AGS) at the above-referenced site. The station is on the southeastern side of the intersection of 106th Avenue and MacArthur Boulevard in Oakland, California, as shown on the Site Vicinity Map, Plate 1. ARCO Products Company (ARCO) has requested that AGS perform monthly ground-water monitoring and quarterly sampling and analyses to monitor hydrocarbon concentrations associated with the former waste-oil and gasoline tanks at the site, and to evaluate trends in the hydrocarbon concentrations and ground-water gradient over time.

Prior to the present monitoring, Kaldveer Associates (Kaldveer), Pacific Environmental Group (Pacific), Western Geologic Resources (WGR), and AGS performed investigations related to the former underground gasoline and waste-oil storage tanks at this site and on the adjacent site (Foothill Square Shopping Center). In 1988, Kaldveer performed environmental assessments which included a survey of past and present site and near-vicinity conditions, drilling 12 soil borings in the Foothill Square Shopping Center, and collecting and analyzing ground-water grab samples from the borings (Kaldveer, October 3, 1988 and October 7, 1988). WGR performed soil sampling and installed five ground-water monitoring wells at Foothill Square Shopping Center (WGR, January 17, 1989). In December 1988, Pacific performed soil sampling and observation during removal of the waste-oil tank (Pacific, February 6, 1989). In March 1989, AGS installed ground-water monitoring wells MW-1 through MW-5 on the site (AGS, August 8, 1989). In June 1989, Pacific performed a soil gas survey on the site and on the Foothill Square Shopping Center property (Pacific, July 17, 1989). In January and February 1990, AGS drilled three exploratory soil borings,

collected soil samples from the new tank pit area and observed removal of the gasoline tanks (AGS, February 11, 1991). Quarterly monitoring at the site was initiated in October 1989 (AGS, April 16, 1991). The results of previous quarterly monitoring and the investigations performed at the site are presented in the reports listed in the references attached to this letter report. The locations of the onsite ground-water monitoring wells and pertinent site features are shown on the Generalized Site Plan, Plate 2. The offsite boring and ground-water monitoring well locations are presented in the referenced reports.

Ground-Water Sampling and Gradient Evaluation

AGS personnel performed monthly monitoring of ground-water elevations on February 27, March 20, April 30, and May 31, 1991; quarterly monitoring was performed on April 30, 1991. Monthly monitoring consisted of measuring depth-to-water (DTW) levels, subjectively analyzing the well water for the presence of petroleum hydrocarbon sheen and floating product, and purging wells that contained petroleum hydrocarbons. Quarterly monitoring consisted of the monthly monitoring tasks and purging and sampling ground water from monitoring wells MW-1, MW-4, and MW-5. Wells MW-2 and MW-3 were not sampled for laboratory analysis because product was noted in well MW-2, and MW-3 was inaccessible due to the installation of a vapor extraction system at the time of quarterly monitoring. The DTW levels, wellhead elevations, and ground-water elevations for this and previous monitoring episodes are summarized in Table 1, Cumulative Ground-Water Monitoring Data. The ground-water sampling protocol is attached in Appendix A. Field procedures were conducted in accordance with the Site Safety Plan (AGS, March 6, 1989).

Subjective analyses of water from well MW-2, the only well screened in the shallow water bearing zone, between February 27 and May 31, 1991 indicated a sheen to approximately 0.02 feet of floating product (see Table 1). Subjective analyses of the other wells did not indicate the presence of free product during this quarter.

Ground-water gradient interpretations from this quarter's monitoring data are shown on the Ground-Water Gradient Maps, Plates 3 through 6. The elevation data for well MW-2 was not used in evaluating the gradient because the well contained free product and is screened in a shallow perched water-bearing zone. Ground-water flow was interpreted to be toward the north-northeast, with gradients of 0.002 to 0.003. These gradient interpretations are generally consistent with previously evaluated ground-water gradients for this site.

Monitoring wells MW-1, MW-4, and MW-5 were purged and sampled on April 30, 1991 in accordance with the attached protocol. Well purge data sheets for each well sampled are also attached in Appendix A.

Laboratory Analysis

Water samples collected from well MW-1, MW-4 and MW-5 were delivered under Chain of Custody protocol to Sequoia Analytical in Redwood City, California (Hazardous Waste Testing Laboratory No. 145). The water samples were analyzed for total petroleum hydrocarbons as gasoline (TPHg), and benzene, toluene, ethylbenzene, and total xylenes (BTEX) using modified Environmental Protection Agency (EPA) Methods 5030/8015/8020. The water samples from well MW-4, located near the former waste-oil tank, were also analyzed for twenty-nine volatile organic compounds (VOCs) by EPA Method 8010. Results of these and previous water analyses are summarized in Table 2, Cumulative Results of Laboratory Analyses of Water Samples. The Chain of Custody Record and Laboratory Analysis Reports are attached in Appendix A. TPHg and benzene concentration contours are shown on Plates 7 and 8, respectively.

Results of this quarter's laboratory analyses of ground-water samples from wells MW-1, MW-4, and MW-5 indicated:

- nondetectable concentrations of TPHg and BTEX in well MW-1;
- concentrations of 2,200 parts per billion (ppb) tetrachloroethene (PCE), 600 ppb TPHg, and 0.43 ppb xylene, and nondetectable concentrations of benzene, toluene, and ethylbenzene in MW-4;
- a concentration of 120 ppb TPHg and nondetectable concentrations of BTEX in MW-5; and
- PCE exceeds the Maximum Contaminant Level (MCL) in well MW-4.

Conclusions and Recommendations

Monitoring well MW-1, downgradient of the former underground storage tanks, continues to show nondetectable concentrations of TPHg and BTEX. In well MW-4, the concentration of tetrachloroethene, which reportedly increased during the fourth quarter of 1990 and first quarter of 1991, decreased during this quarter; TPHg and xylene increased this quarter. TPHg increased in monitoring well MW-5.

It is recommended that monthly ground-water monitoring and quarterly ground-water sampling for TPHg and BTEX in wells MW-1 through MW-5 continue. AGS also recommends analyzing water samples from MW-4 for metals by EPA method 6010, and analyzing water samples from well MW-4 and MW-5 at the site for VOCs by EPA Method

8010 to evaluate the presence and extent of tetrachloroethene and other VOCs in the ground water. Since total oil and grease (TOG) has been nondetectable in MW-4 since July 1990, we recommend annual sampling of this well for TOG. We also recommend continued product removal from well MW-2. Further, we recommend that water level data and quarterly sampling data from offsite wells be correlated with the same data obtained from the onsite wells to allow evaluation of the ground-water gradient flow directions in the shallow and lower water bearing zones, and the extents of petroleum hydrocarbons and VOCs in the site area. Additional recommendations for further assessment will be included under separate cover.

Schedule

AGS will continue the monthly water-level measurements and quarterly ground-water monitoring at this site to evaluate trends in petroleum hydrocarbons and changes in ground-water gradient with time. Routine well maintenance, removal of free product, and quality control will be performed as necessary during these site visits. The third quarter monitoring episode is scheduled for July 30, 1991. The Work Plan for installation of onsite vapor extraction wells was submitted to Alameda County Department of Environmental Health on July 1, 1991.

It is recommended that copies of this report be forwarded to:

Mr. Gil Wistar → Paul Smith
Alameda County Department of Environmental Health
80 Swan Way, Room 200
Oakland, California 94621

Mr. Lester Feldman
Regional Water Quality Control Board
San Francisco Bay Region
2101 Webster, Suite 500
Oakland, California 94612

If you have any questions or comments, please call us at (408) 264-7723.

Sincerely,
RESNA/Applied GeoSystems

L. J. Leet

Lou Leet
Geologic Technician

Joan E. Tiernan
Registered Civil
Engineer 044600

Enclosures: References

Plate 1, Site Vicinity Map
Plate 2, Generalized Site Plan
Plate 3, Ground-Water Gradient Map, February 27, 1991
Plate 4, Ground-Water Gradient Map, March 20, 1991
Plate 5, Ground-Water Gradient Map, April 30, 1991
Plate 6, Ground-Water Gradient Map, May 31, 1991
Plate 7, TPHg Concentration Map
Plate 8, Benzene Concentration Map

Table 1, Cumulative Ground-Water Monitoring Data
Table 2, Cumulative Results of Laboratory Analyses of Water Samples

Appendix A:Ground-Water Sampling Protocol
Chain of Custody Record
Laboratory Analysis Reports

cc: H.C. Winsor, ARCO

REFERENCES

Applied GeoSystems. April 16, 1991. "First Quarter 1991 Ground-Water Monitoring at ARCO Station 276, 10600 MacArthur Boulevard, Oakland, California". AGS Job 60026.02.

Applied GeoSystems, February 11, 1991. " Report Underground Gasoline Storage Tank Removal and Replacement at ARCO Station 276, 10600 MacArthur Boulevard, Oakland, California". AGS Job 19014-5.

Applied GeoSystems. January 29, 1991. "Fourth Quarter 1990 Ground-Water Monitoring at ARCO Station 276, 10600 MacArthur Boulevard, Oakland, California". AGS Job 60026.01.

Applied GeoSystems. January 2, 1991. "Letter Report Quarterly Ground-Water Monitoring Third Quarter 1990 at ARCO Station 276, 10600 MacArthur Boulevard, Oakland, California". AGS Job 60026.01.

Applied GeoSystems. August 6, 1990. "Letter Report Quarterly Ground-Water Monitoring Fourth Quarter 1989 and First and Second Quarters 1990". AGS Job No. 19014-1.

Applied GeoSystems. March 6, 1989. "Site Safety Plan for ARCO Station No. 276, Oakland, California". AGS Job No. 19014-1.

Applied GeoSystems. August 8, 1989. "Report Limited Subsurface Environmental Investigation". AGS Job No. 19014-1.

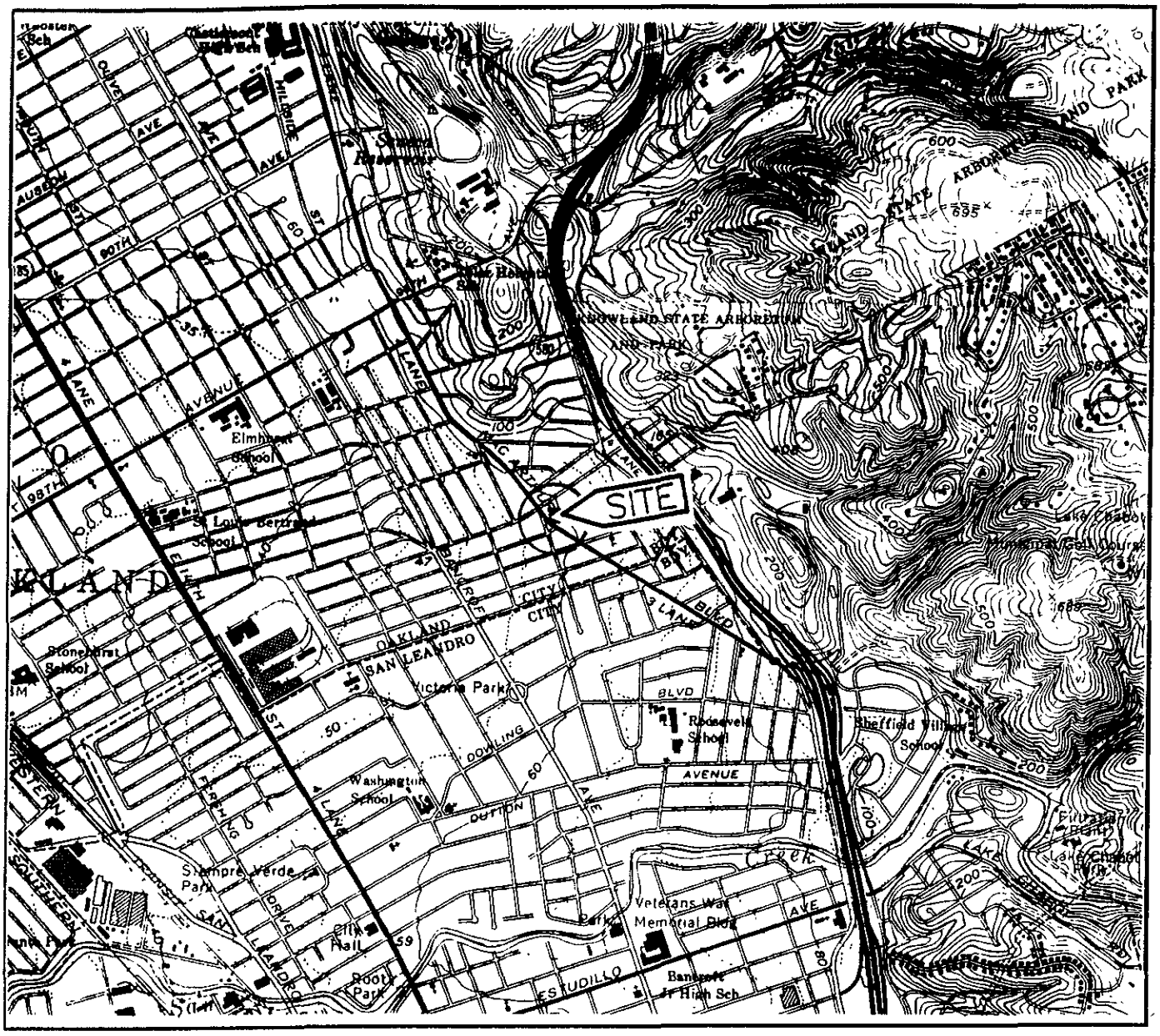
Kaldveer Associates. October 3, 1988. "Preliminary Environmental Assessment Proposed Foothill Square Oakland, California". Job No. KE812-3, 12056.

Kaldveer Associates. October 7, 1988. "Preliminary Soil And Groundwater Quality Testing Program Foothill Square Oakland, California". Job No. KE812-3A, 12302.

Western Geologic Resources, Inc. January 17, 1989. "Soil Sampling and Monitoring Well Installation Foothill Square Shopping Center Oakland, California". Job No. 8-088.01.

Pacific Environmental Group, Inc. February 6, 1989. Former Waste-Oil Tank Pit Analytical Results and Site Plan of ARCO Station No. 276. Copy of letter sent to Ms. Mary Meirs, Alameda County Environmental Health Department Hazardous Material Division.

Pacific Environmental Group, Inc. July 17, 1989. "Soil Gas Investigation at ARCO Station No. 276."



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

N

Approximate Scale

2000 1000 0 2000 4000

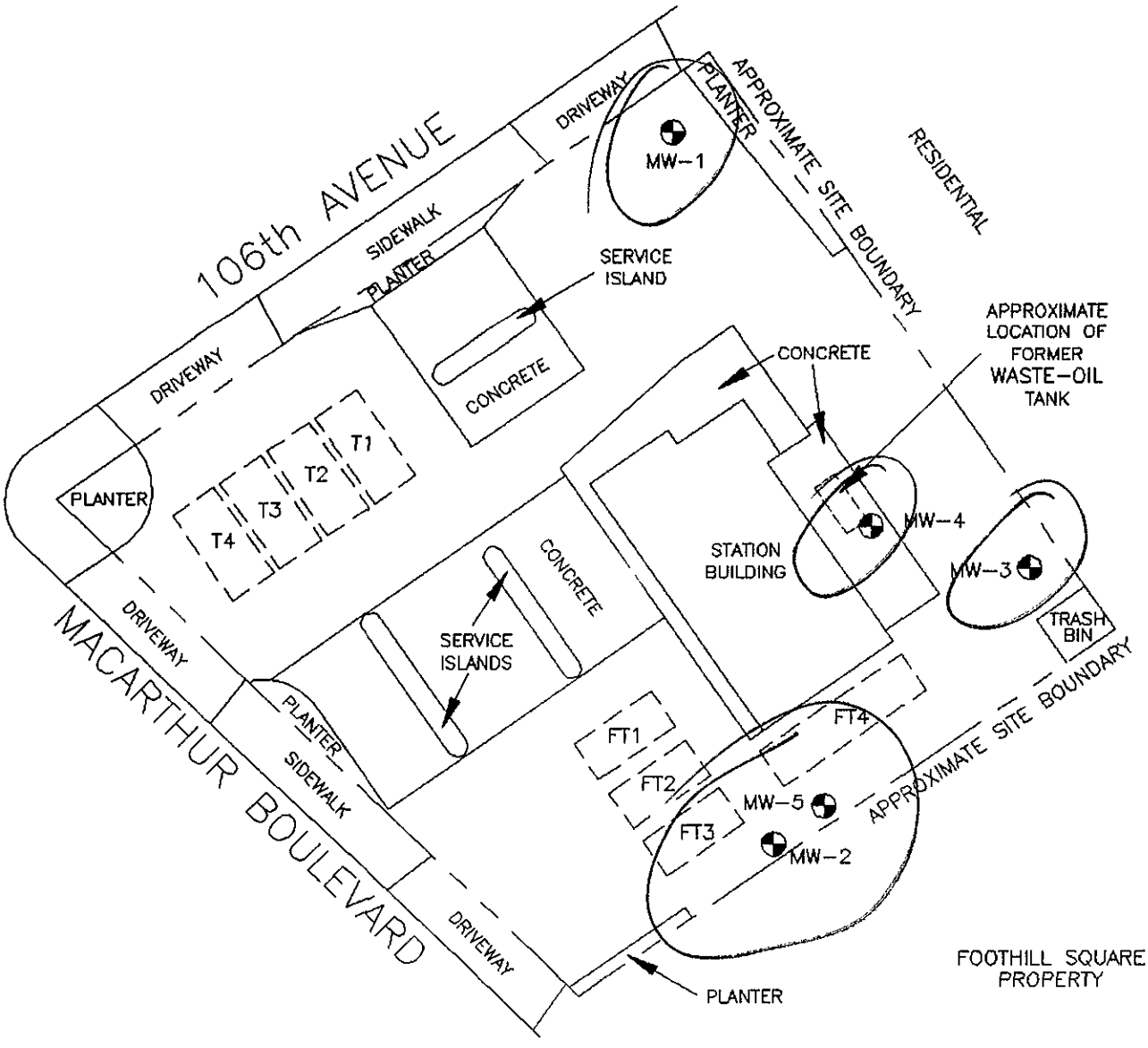
feet

Applied GeoSystems

PROJECT 60026-2

SITE VICINITY MAP
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE
1



EXPLANATION

MW-5 = Monitoring well (Applied GeoSystems, 1989)

T4 = Existing underground Storage Tanks

FT4 = Former underground Storage Tanks

N

Approximate Scale

30 15 0 30 60

feet

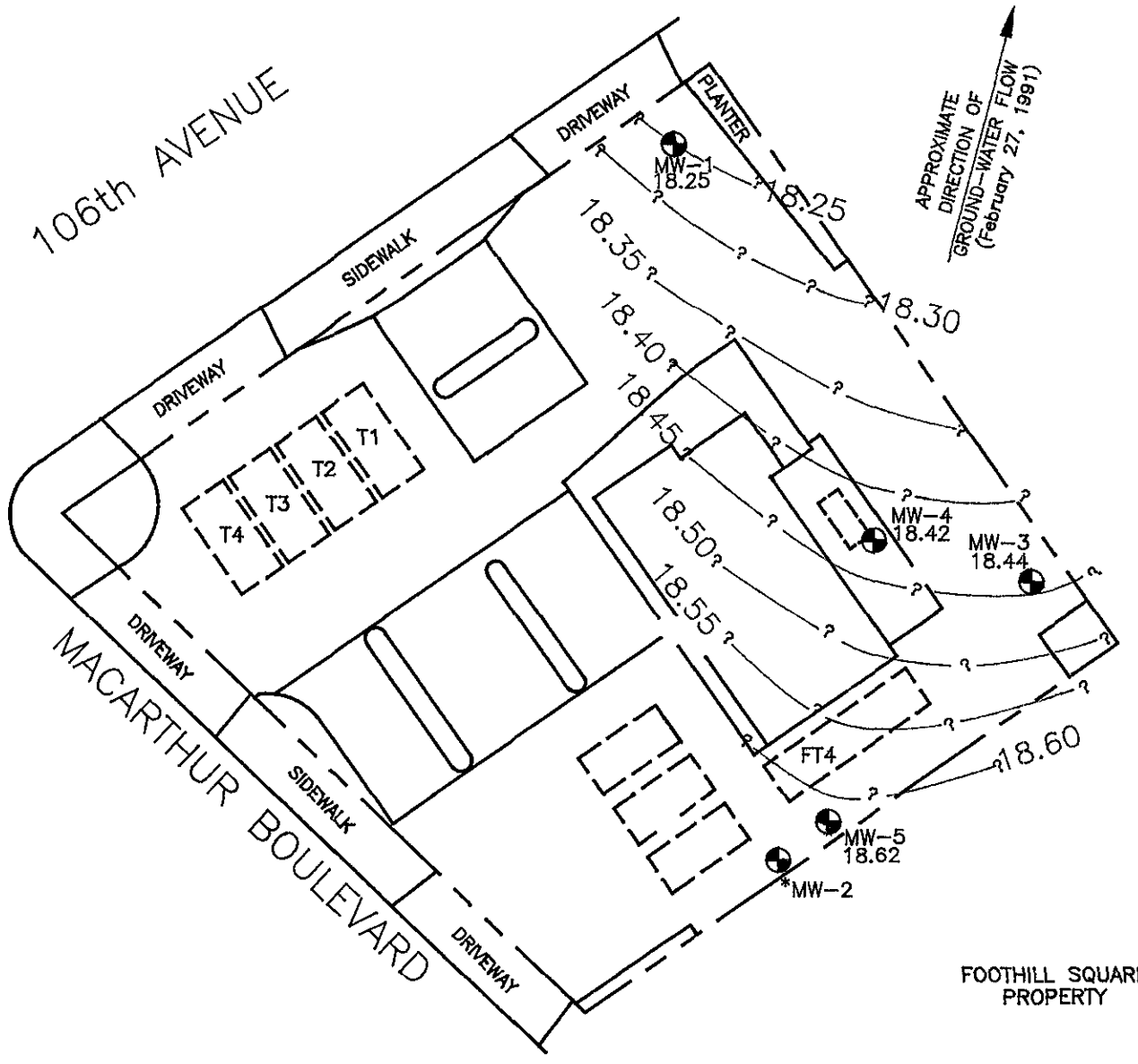
Source: Modified from plan supplied by ARCO and surveyed by Ron Archer, Civil Engineer, Inc.

Applied GeoSystems

PROJECT 60026-2

GENERALIZED SITE PLAN
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE 2



EXPLANATION

18.60 — = Line of equal elevation of ground water above mean sea level (MSL)

18.62 = Elevation of ground water in feet (MSL), February 27, 1991

MW-5 = Monitoring well (Applied GeoSystems, 1989)

*MW-2 = Constructed in a shallow perched zone and not used for ground-water gradient interpretation

Approximate Scale

30 15 0 30 60

feet

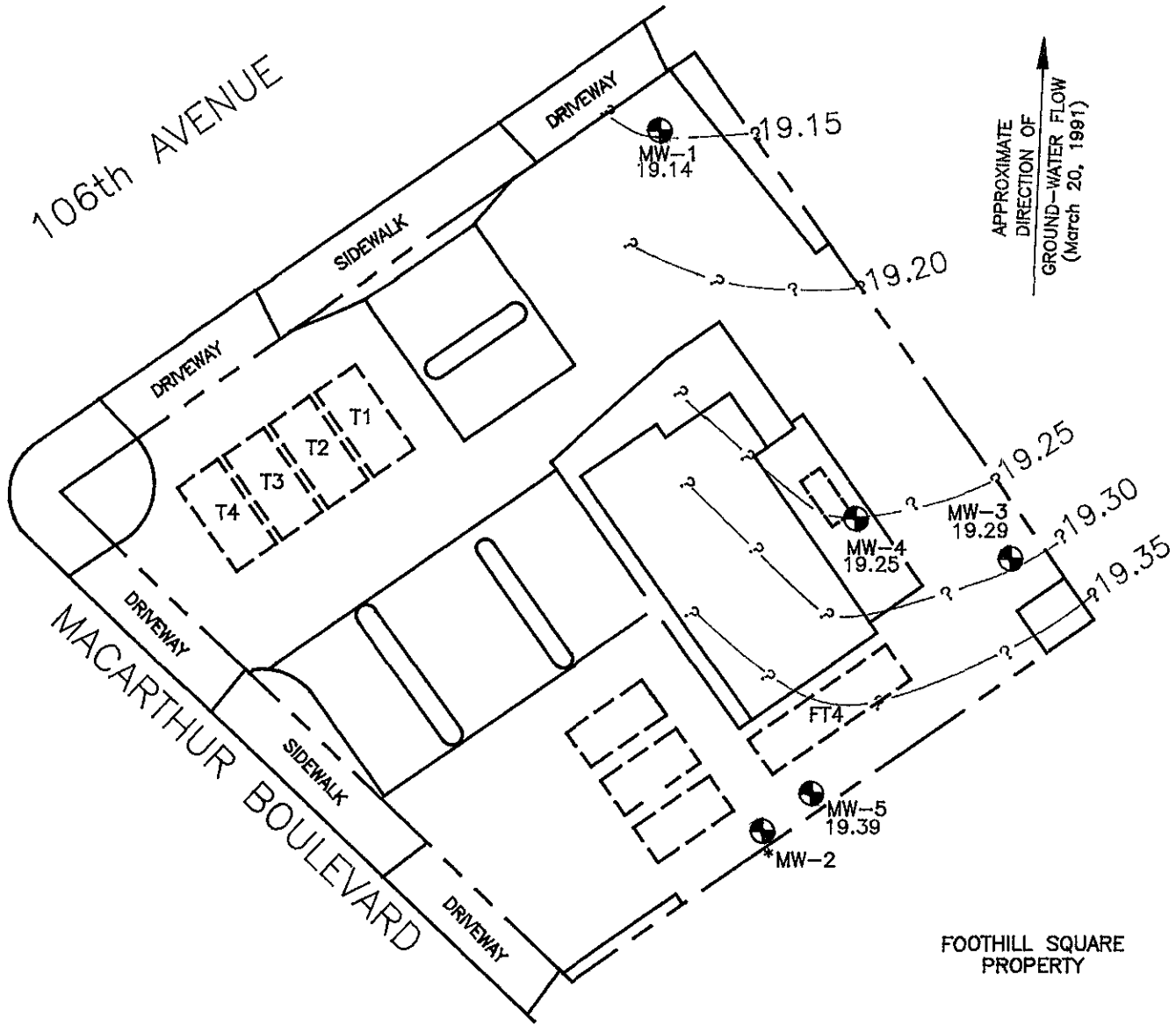
Source: Modified from plan supplied by ARCO and surveyed by Ron Archer, Civil Engineer, Inc.

Applied GeoSystems

PROJECT 60026-2

GROUND-WATER GRADIENT MAP
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE 3



EXPLANATION

19.35 — = Line of equal elevation of ground water above mean sea level (MSL)

19.39 = Elevation of ground water in feet (MSL), March 20, 1991

MW-5 = Monitoring well (Applied GeoSystems, 1989)

* MW-2 = Constructed in a shallow perched zone and not used for ground-water gradient interpretation

Approximate Scale

30 15 0 30 60

feet

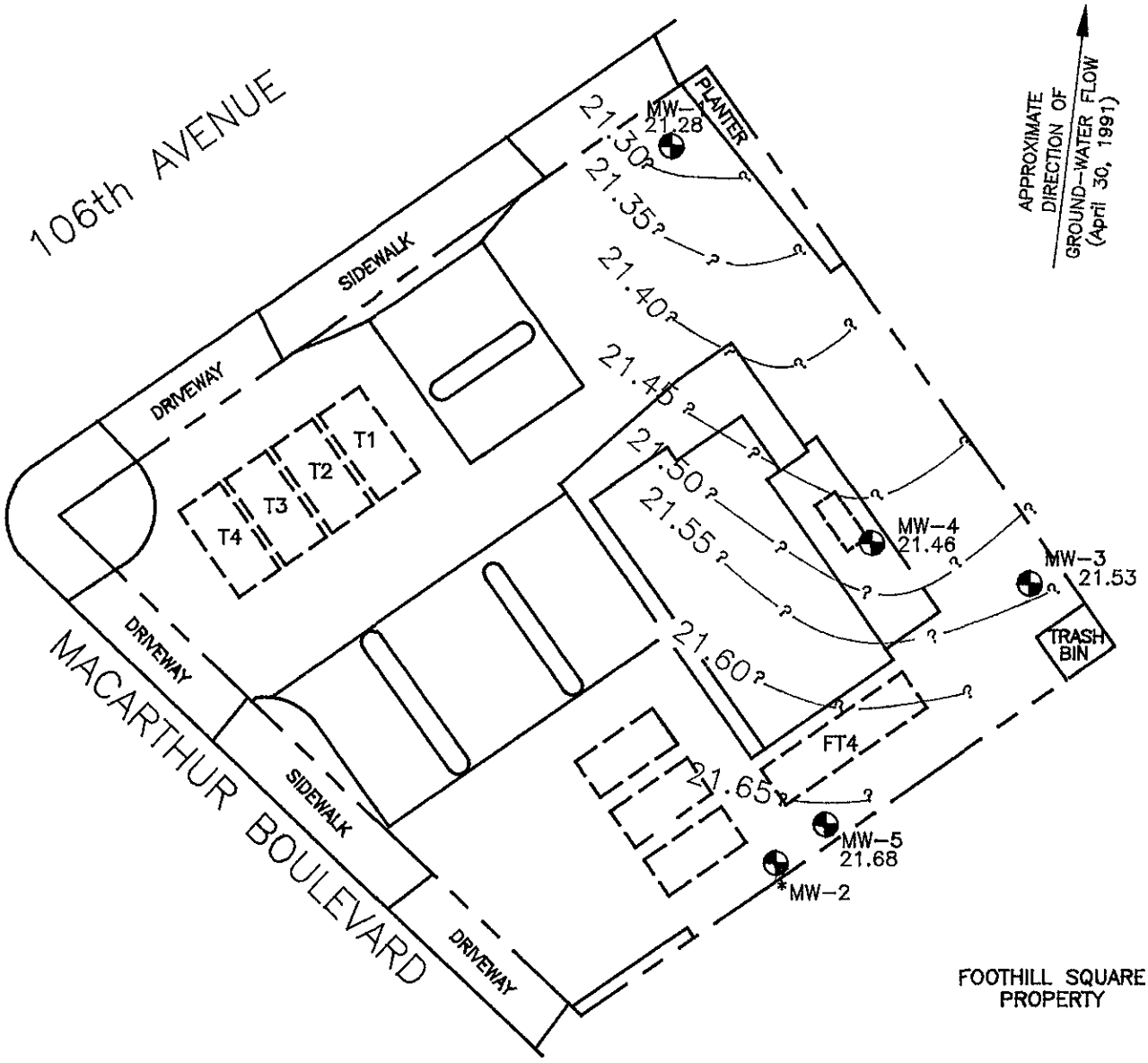
Source: Modified from plan supplied by ARCO and surveyed by Ron Archer, Civil Engineer, Inc.

Applied GeoSystems

PROJECT 60026-2

GROUND-WATER GRADIENT MAP
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE 4



EXPLANATION

21.65 — = Line of equal elevation of ground water above mean sea level (MSL)

21.68 = Elevation of ground water in feet (MSL), April 30, 1991

MW-5 = Monitoring well (Applied GeoSystems, 1989)

*MW-2 = Constructed in a shallow perched zone and not used for ground-water gradient interpretation

N

Approximate Scale

30 15 0 30 60

feet

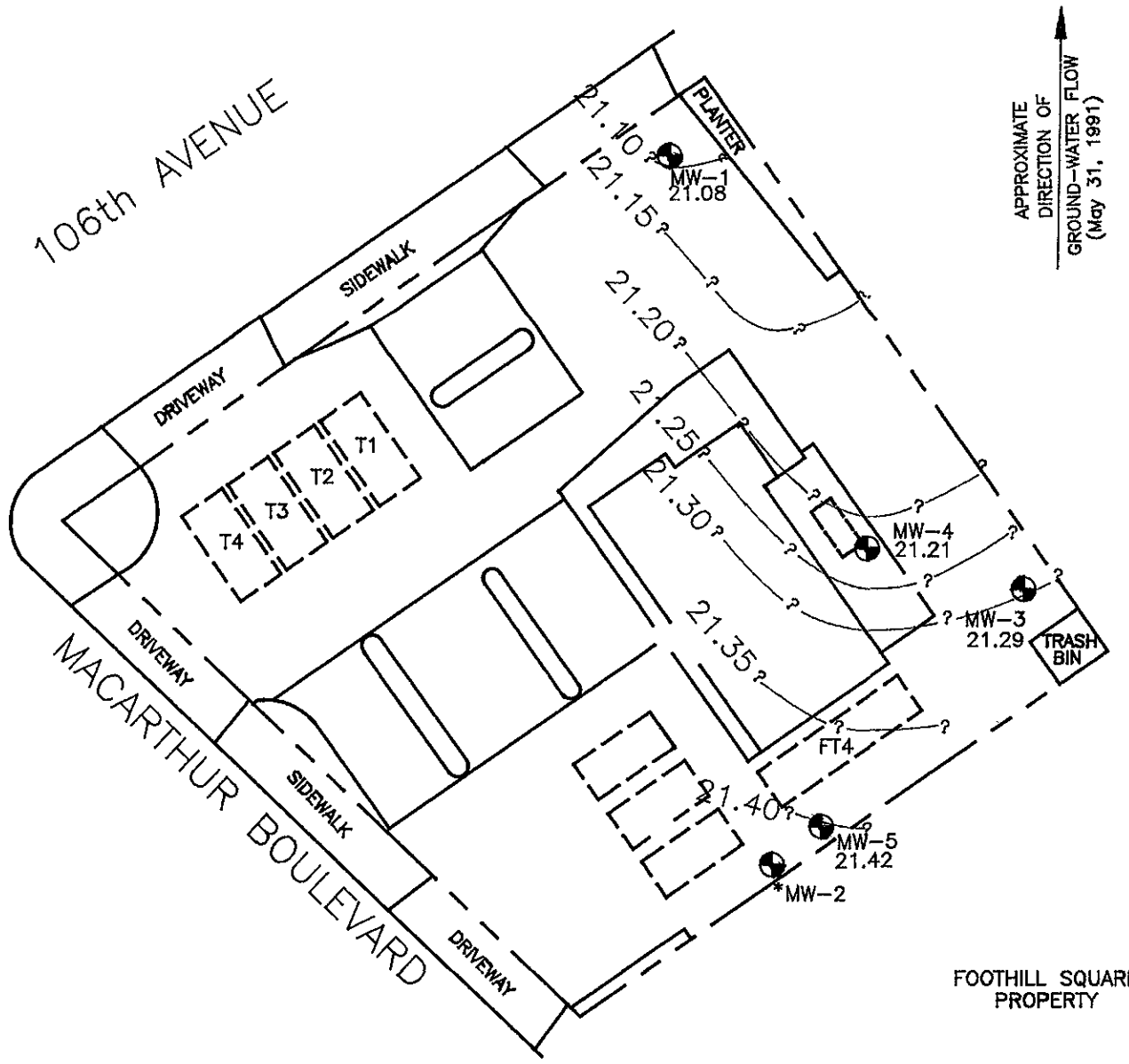
Source: Modified from plan supplied by ARCO and surveyed by Ron Archer, Civil Engineer, Inc.

Applied GeoSystems

PROJECT 60026-2

GROUND-WATER GRADIENT MAP
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE 5



EXPLANATION

21.40 — = Line of equal elevation of ground water above mean sea level (MSL)

21.42 = Elevation of ground water in feet (MSL), May 31, 1991

MW-5 = Monitoring well (Applied GeoSystems, 1989)

*MW-2 = Constructed in a shallow perched zone and not used for ground-water gradient interpretation

Approximate Scale

30 15 0 30 60

feet

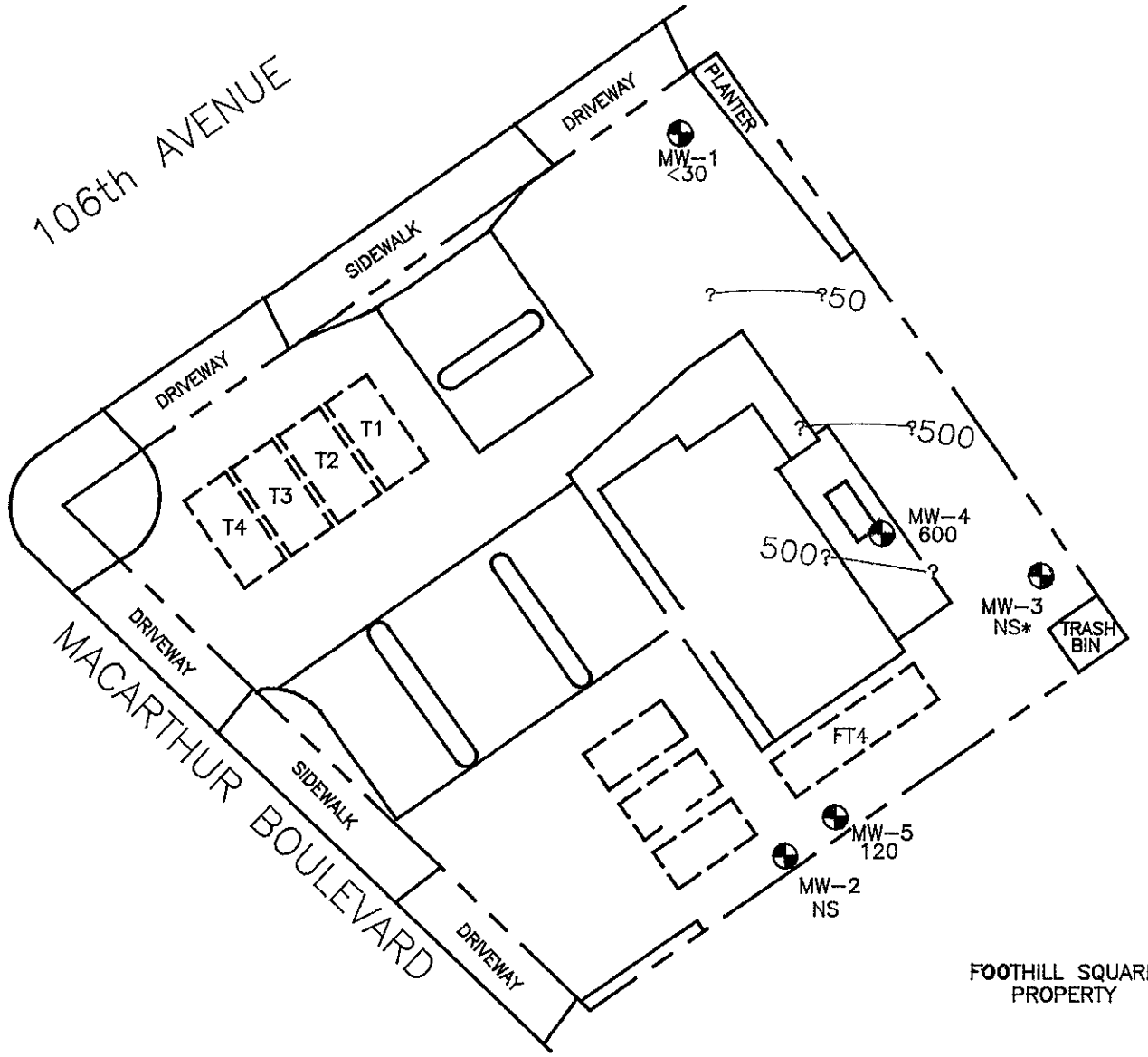
Source: Modified from plan supplied by ARCO and surveyed by Ron Archer, Civil Engineer, Inc.

Applied GeoSystems

PROJECT 60026-2

GROUND-WATER GRADIENT MAP
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE 6



EXPLANATION

500 = Line of equal concentration of TPHg in ground water in ppb, April 30, 1991

600 = Concentration of TPHg in ground water, in ppb, April 30, 1991

NS = Not Sampled

* = Well inaccessible

MW-5 = Monitoring well (Applied GeoSystems, 1989)

Approximate Scale

30 15 0 30 60

feet

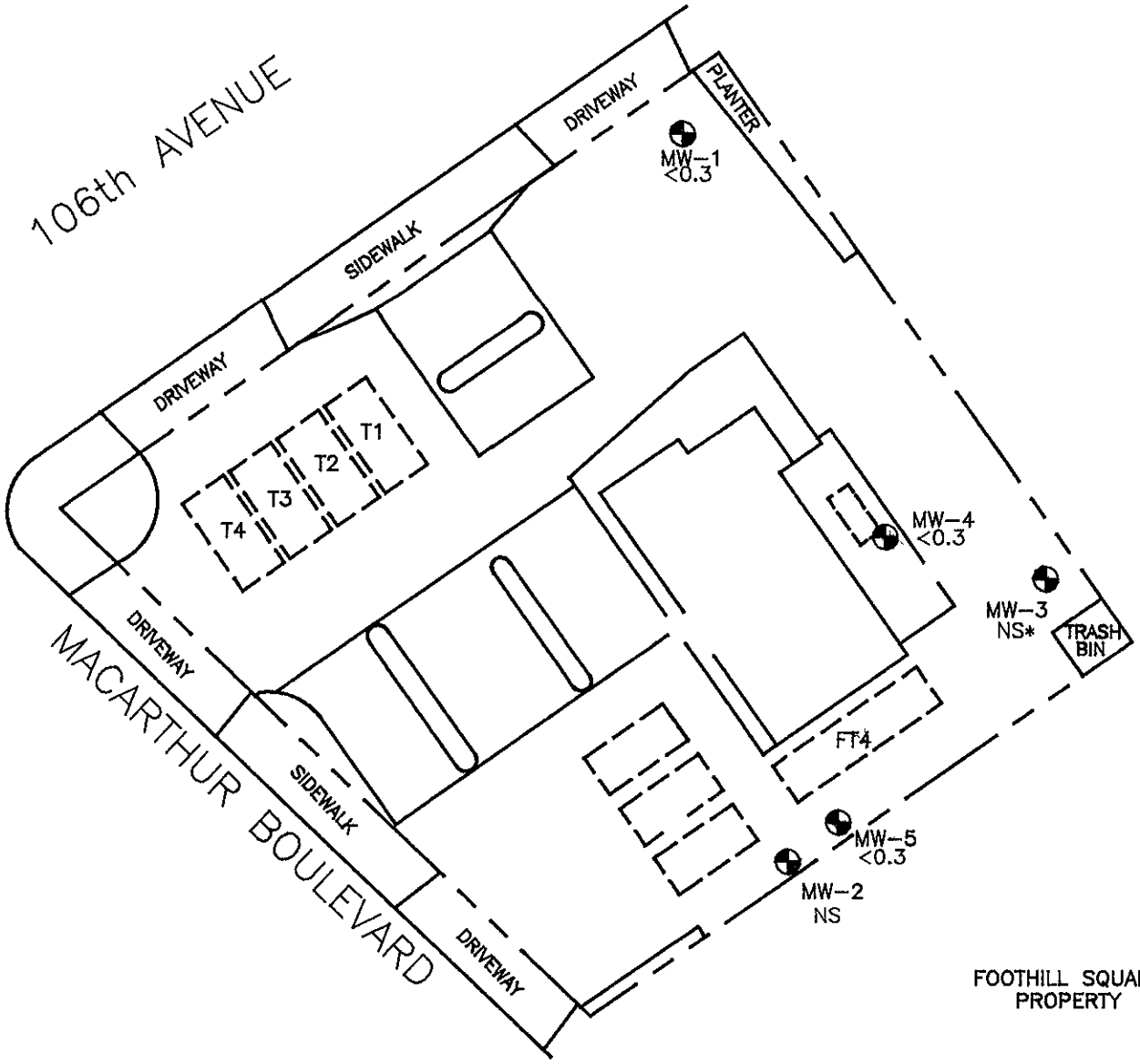
Source: Modified from plan supplied by ARCO and surveyed by Ron Archer, Civil Engineer, Inc.

Applied GeoSystems

PROJECT 60026-2

TPHg CONCENTRATIONS IN GROUND WATER
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE 7



EXPLANATION

<0.3 = Concentration of Benzene in ground water in ppb, April 30, 1991

NS = Not Sampled

* = Well inaccessible

MW-5 = Monitoring well (Applied GeoSystems, 1989)

Approximate Scale

30 15 0 30 60

feet

Source: Modified from plan supplied by ARCO and surveyed by Ron Archer, Civil Engineer, Inc.

Applied GeoSystems

PROJECT 60026-2

BENZENE CONCENTRATIONS IN GROUND WATER
ARCO Station 276
10600 MacArthur Boulevard
Oakland, California

PLATE
8

TABLE 1
CUMULATIVE GROUND-WATER MONITORING DATA
ARCO Station 276
Oakland, California
(Page 1 of 2)

Date Well Measured	Well Elevation	Depth to Water	Water Elevation	Floating Product
MW-1				
04/17/89		33.04	22.87	None
04/24/89		33.84	22.07	None
10/13/89	55.91	37.19	18.72	None
02/01/90		36.73	19.18	None
07/31/90		36.42	19.49	None
08/01/90		36.41	19.50	None
08/28/90		36.88	19.03	None
10/30/90		37.73	18.18	None
11/20/90		37.92	18.37	None
12/19/90		37.90	18.01	None
01/30/91		38.06	17.85	None
02/27/91		37.66	18.25	None
03/20/91		36.77	19.14	None
04/30/91		34.63	21.28	None
05/31/91		34.83	21.08	None
MW-2				
04/17/89		17.20	38.15	None
04/24/89		17.83	37.52	None
10/13/89	55.35	20.15*	35.20*	0.03
02/01/90		NM	NM	None
07/31/90		18.90	36.45	None
08/01/90		18.23*	37.03*	1.04
08/28/90		21.25*	34.10*	0.33
10/30/90		24.21*	31.14*	1.04
11/20/90		25.08*	30.27*	0.60
12/19/90		18.23	37.12	Odor
01/30/91		19.47*	35.88*	0.03
02/27/91		18.84*	36.51*	0.02
03/20/91		16.02*	39.33*	0.01
04/30/91		16.55*	38.80	Sheen
05/31/91		18.41*	36.94*	0.01
MW-3				
04/24/89		34.47	22.08	None
10/13/89	56.55	37.60	18.95	None
02/01/90		37.20	19.35	None
07/31/90		36.90	19.65	None
08/01/90		36.87	19.68	None
08/28/90		37.33	19.22	None
10/30/90		38.15	18.40	None
11/20/90		38.33	18.58	None
12/19/90		38.30	18.25	None

See notes on Page 2 of 2.

TABLE 1
CUMULATIVE GROUND-WATER MONITORING DATA
ARCO Station 276
Oakland, California
(Page 2 of 2)

Date Well Measured	Well Elevation	Depth to Water	Water Elevation	Floating Product
MW-3 Continued				
01/30/91			Well Dry	
02/27/91		38.11	18.44	None
03/20/91		37.26	19.29	None
04/30/91		35.02	21.53	None
05/31/91		35.26	21.29	None
MW-4				
04/17/89		33.87	22.07	None
04/24/89		33.76	22.18	None
10/13/89	55.94	37.03	18.91	None
02/01/90		36.57	19.37	None
07/31/90		36.39	19.55	None
08/01/90		6.32	19.62	None
08/28/90		36.79	19.15	None
10/30/90		37.62	18.32	None
11/20/90		37.82	18.52	None
12/19/90		37.74	18.20	None
01/30/91		37.97	17.97	None
02/27/91		37.52	18.42	None
03/20/91		36.69	19.25	None
04/30/91		34.48	21.46	None
05/31/91		34.73	21.21	None
MW-5				
04/17/89		33.17	22.26	None
04/24/89		33.06	22.37	None
10/13/89	55.43	36.33	19.10	None
02/01/90		35.96	19.47	None
07/31/90		35.70	19.73	None
08/01/90		35.69	19.74	None
08/28/90		36.14	19.29	None
10/30/90		36.94	18.49	None
11/20/90		37.09	18.64	None
12/19/90		37.05	18.38	None
01/30/91		37.26	18.17	None
02/27/91		36.81	18.62	None
03/20/91		36.04	19.39	None
04/30/91		33.75	21.68	None
05/31/91		34.01	21.42	None

Depths are in feet below top of each well casing.
Elevations are referenced in feet above mean sea level.
Floating product reported in feet.
* = Depth to water and water elevation adjusted according to protocol in Appendix A.

TABLE 2
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF WATER SAMPLES
ARCO Station 276
Oakland, California
(Page 1 of 2)

Date/Well	TPHg	TPHd	B	T	E	X	TOG
MW-1							
04/24/89	<50	NA	<0.50	<0.50	<0.50	<0.50	NA
10/13/89	<20	NA	<0.50	<0.50	<0.50	<0.50	NA
02/01/90	91	NA	<0.30	<0.30	<0.30	0.36	NA
07/31/90	<20	NA	<0.50	<0.50	<0.50	<0.50	NA
10/30/90	<50	NA	<0.5	<0.5	<0.5	<0.5	NA
01/30/91	<50	NA	<0.5	<0.5	<0.5	<0.5	NA
04/30/91	<30	NA	<0.30	<0.30	<0.30	<0.30	NA
MW-2							
04/24/89	165,000	NA	13,000	21,000	2,100	12,700	NA
10/13/89			FLOATING PRODUCT				
02/01/90			SHEEN PRESENT				
07/31/90	240,000	NA	14,000	24,000	3,000	17,000	NA
10/30/90	NS	NS	NS	NS	NS	NS	NS
01/30/91	NS	NS	NS	NS	NS	NS	NS
04/30/91	NS	NS	NS	NS	NS	NS	NS
MW-3							
04/24/89	560	NA	0.54	0.75	<0.50	<0.50	NA
10/13/89	450	NA	<0.50	<0.50	<0.50	<0.50	NA
02/01/90	360	NA	<0.30	<0.30	<0.30	0.85	NA
08/01/90	440	NA	<0.50	<0.50	<0.50	<0.50	NA
10/30/90	340	NA	<0.5	<0.5	<0.5	<0.5	NA
01/30/91	NS	NS	NS	NS	NS	NS	NS
04/30/91	NS	NS	NS	NS	NS	NS	NS
MW-4							
04/24/89	2,500	NA	270	1.4	<0.50	85	NA
10/13/89	760	NA	0.86	<0.50	1.2	<0.50	NA
02/01/90	680	NA	<0.30	<0.30	<0.30	1.6	NA
07/31/90	470	240	<0.50	<0.50	<0.50	<0.50	<5,000
10/30/90	430	<100	<0.5	<0.5	<0.5	<0.5	<5,000
01/30/91	<50	<100	<0.5	<0.5	1.2	<0.5	<5,000
04/30/91	600	NA	<0.30	0.30	<0.30	0.43	NA
MW-5							
04/24/89	130	NA	0.67	<0.50	<0.50	<0.50	NA
10/13/89	75	NA	<0.50	<0.50	<0.50	<0.50	NA
02/01/90	81	NA	0.94	0.88	<0.30	1.8	NA
07/31/90	110	NA	<0.50	<0.50	<0.50	<0.50	NA
10/30/90	<50	NA	<0.5	<0.5	<0.5	<0.5	NA
01/30/91	<50	NA	<0.5	<0.5	<0.5	<0.5	NA
04/30/91	120	NA	<0.30	<0.30	<0.30	<0.30	NA

See notes on Page 2 of 2.

TABLE 2
CUMULATIVE RESULTS OF LABORATORY ANALYSES OF WATER SAMPLES
ARCO Station 276
Oakland, California
(Page 2 of 2)

Date/Well		VOCs	MCLs
MW-4			
07/31/90	Trichloroethene	7.5	5.0
	Tetrachloroethene	1600	5.0
	1,2 Dichloroethene	0.7	6.0
10/30/90	Trichloroethene	8.1	5.0
	Tetrachloroethene	3600	5.0
	1,2 Dichloroethene	0.7	6.0
01/30/91	Trichlorethene	12	5.0
	Tetrachloroethene	4,900	5.0
04/30/91	Tetrachloroethene	2,200	5.0

Where it comes from

Results in micrograms per liter (ug/L) = parts per billion (ppb).
TPHg: Total petroleum hydrocarbons as gasoline by EPA method 8015.
TPHd: Total petroleum hydrocarbons as diesel by EPA method 3550/3510.
B: Benzene, T: Toluene, E: Ethylbenzene, T: Total Xylene isomers; BTEX: Measured by EPA method 8020/602.
TOG: Total oil and grease by Standard Method 503A/E.
VOC: Volatile Organic Compounds by EPA method 601/8010.
<: Results reported as less than the detection limit.
NA: Not analyzed.
NS: Not sampled.
Compounds not shown not detected.
MCLs: Maximum Contaminant Levels as reported by the California Department of Health Services 10/24/90.

APPENDIX A

GROUND-WATER SAMPLING PROTOCOL

The static water level in each well that contained water was measured with a Solinst® water-level indicator; this instrument is accurate to the nearest 0.01 foot. The static water level in each well that was suspected to contain floating product was measured with an ORS® interface probe; this instrument is accurate to the nearest 0.01 foot. The probe contains two different sensor units, one for detecting the liquid/air interface, and one for distinguishing between water and hydrocarbon. The thickness of the floating product and the ground-water depths were recorded. The recorded thickness of the floating product was then multiplied by 0.80 to obtain an approximate value for the displacement of water by the floating product. This approximate displacement value was then subtracted from the measured depth to water to obtain a calculated depth to water. These calculated ground-water depths were subtracted from wellhead elevations measured by Ron Archer, Civil Engineer, Inc., of Pleasanton, California, a licensed land surveyor, to calculate the differences in ground-water elevations.

Water samples collected for subjective evaluation were collected by gently lowering approximately half the length of a new disposable bailer or a clean Teflon® bailer past the air-water interface (if possible) and collecting a sample from near the surface of the water in the well. The samples were checked for evidence of free hydrocarbon product.
Before water samples were collected from the ground-water monitoring wells, the wells were purged until stabilization of the temperature, pH, and conductivity was obtained. A minimum of approximately 1 well casing volume of water was purged before these wells were pumped dry or these characteristics stabilized. The quantity of water purged from the wells was calculated as follows:

1 well casing volume = $\pi r^2 h(7.48)$ where:
r = radius of the well casing in feet.
h = column of water in the well in feet (well depth - depth to water).
7.48 = conversion constant from cubic feet to gallons.

gallons of water purged/gallons in 1 well casing volume = well casing volume removed.

After purging, each well was allowed to recharge to at least approximately 80% of the initial water level. Water samples were then collected with an Environmental Protection Agency (EPA) approved Teflon® bailer which had been cleaned with Alconox® and deionized water.

The water samples were carefully poured into 40-milliliter glass vials, which were filled so as to produce a positive meniscus. Each sample container was preserved with hydrochloric acid, sealed with a cap containing a Teflon® septum, and subsequently examined for air bubbles to avoid headspace which would allow volatilization to occur. The samples were promptly transported in iced storage in a thermally-insulated ice chest, accompanied by a Chain of Custody Record, to a California-certified laboratory.

ARCO Products Company

Task Order No. 276-91-2 BP/

Chain of Custody

ARCO Facility no: 276
City (Facility): OAKLAND
Project manager (Consultant): JOEL COFFMAN
Telephone no (ARCO): CHUCK CARMEL
Telephone no (Consultant): 264-7723
Fax no (Consultant): 264-2435
Consultant name: APPLIED GEOSYSTEMS
Address (Consultant): 3315 ALMADEN EXPRESSWAY, SUITE 34, San Jose

Sample #	Lab #	Container no	Matrix: Soil	Water	Other	Preservation: Ice	Acid	Sampling date	Sampling time	BTEX 602/EPA 8020	BTEX/TPH EPA 1602/8020/8015	TPH Modified 8015 Gas / Diesel	Oil and Grease 413.1 / 413.2	TPH EPA 418.1/SM5520	EPA 601/8010	EPA 624/8240	EPA 625/8270	Semi-VOA / VOA Metals	CAM Metals EPA 6010/7000 TTLC / STLC	Lead Org./DHS / Lead EPA 7420/7421
W-35-MW1		4		X		X	X	4-30-91	14:40		X						1050		12	
W-34-MW5		4		X		X	X	4-30-91	15:50		X								13	
W-35-MW4		4		X		X	X	4-30-91	14:12		X								14	
W-35-MW4		2		X		X		4-30-91	14:12						X				15	
W-MW1-BLANK		HOLD		X		X	X												1	

Special detection Limit/reporting

Special QA/QC

Seal condition

Remarks
JOB NO. 60026.02
Please send back foam holder

Lab number

Turnaround time
- Priority Rush 1 Business Day [ ]
- Rush 2 Business Days [ ]
- Expedited 5 Business Days [ ]
- Standard 10 Business Days [X]

Condition of sample: good

Relinquished by sampler: [signature] — Date: 05-01-91 — Time: 10:11

Relinquished by: [signature] — Date: 5-1-91 — Time: 11:40

Relinquished by — Date — Time

Temperature received: cool

Received by: [signature]

Received by: K. Lollard

Received by laboratory — Date — Time

Date/Time

White copy: Laboratory copy — Yellow copy: ARCO Environmental Engineering Pink copy: Consultant

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: Joel Coffman

Project: #60026.02,Arco, #276, Oakland

Enclosed are the results from 4 water samples received at Sequoia Analytical on May 1,1991. The requested analyses are listed below:

SAMPLE #	SAMPLE DESCRIPTION	DATE OF COLLECTION	TEST METHOD
1050012 A-D	Water, W-35-MW1	4/30/91	EPA 5030/8015/8020
1050013 A-D	Water, W-34-MW5	4/30/91	EPA 5030/8015/8020
1050014 A-D	Water, W-35-MW4	4/30/91	EPA 5030/8015/8020
1050015 A - B	Water, W-35-MW4	4/30/91	EPA 5030/8010

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:	#60026.02,Arco, #276, Oakland	Sampled: Apr 30, 1991
3315 Almaden Expressway, Ste 34	Matrix Descript:	Water	Received: May 1, 1991
San Jose, CA 95118	Analysis Method:	EPA 5030/8015/8020	Analyzed: May 1, 1991
Attention: Joel Coffman	First Sample #:	105-0012 A - D	Reported: May 8, 1991

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

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons µg/L (ppb)	Benzene µg/L (ppb)	Toluene µg/L (ppb)	Ethyl Benzene µg/L (ppb)	Xylenes µg/L (ppb)
1050012 A-D	W-35-MW1	N.D.	N.D.	N.D.	N.D.	N.D.
1050013 A-D	W-34-MW5	120	N.D.	N.D.	N.D.	N.D.
1050014 A-D	W-35-MW4	600	N.D.	0.30	N.D.	0.43
Detection Limits:		**30**	**0.30**	**0.30**	**0.30**	**0.30**

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

Please Note:
Low/Medium B.P. Hydrocarbons were concentrated into one unidentified peak.

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:	#60026.02,Arco, #276, Oakland	Sampled:	Apr 30, 1991
3315 Almaden Expressway, Ste 34	Sample Descript:	Water, W-35-MW4	Received:	May 1, 1991
San Jose, CA 95118	Analysis Method:	EPA 5030/8010	Analyzed:	May 1, 1991
Attention: Joel Coffman	Lab Number:	105-0015 A - B	Reported:	May 8, 1991

HALOGENATED VOLATILE ORGANICS (EPA 8010)

Analyte	Detection Limit µg/L	Sample Results µg/L
Bromodichloromethane	25	N.D.
Bromoform	50	N.D.
Bromomethane	50	N.D.
Carbon tetrachloride	25	N.D.
Chlorobenzene	25	N.D.
Chloroethane	50	N.D.
2-Chloroethylvinyl ether	50	N.D.
Chloroform	25	N.D.
Chloromethane	50	N.D.
Dibromochloromethane	25	N.D.
1,2-Dichlorobenzene	25	N.D.
1,3-Dichlorobenzene	25	N.D.
1,4-Dichlorobenzene	25	N.D.
1,1-Dichloroethane	25	N.D.
1,2-Dichloroethane	25	N.D.
1,1-Dichloroethene	25	N.D.
cis-1,2-Dichloroethene	25	N.D.
trans-1,2-Dichloroethene	25	N.D.
1,2-Dichloropropane	25	N.D.
cis-1,3-Dichloropropene	50	N.D.
trans-1,3-Dichloropropene	50	N.D.
Methylene chloride	100	N.D.
1,1,2,2-Tetrachloroethane	25	N.D.
Tetrachloroethene	**25**	**2,200**
1,1,1-Trichloroethane	25	N.D.
1,1,2-Trichloroethane	25	N.D.
Trichloroethene	25	N.D.
Trichlorofluoromethane	50	N.D.
Vinyl chloride	50	N.D.

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

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: Joel Coffman

Client Project ID: #60026.02,Arco, #276, Oakland

QC Sample Group: 1050012 - 1050014

Reported: May 8, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl Benzene	Xylenes	1,1-Dichloro-ethene	Trichloro-ethene	Chloro-benzene
Method:	EPA 8015/8020	EPA 8015/8020	EPA 8015/8020	EPA 8015/8020	EPA 8010	EPA 8010	EPA 8010
Analyst:	S.Chieffo	S.Chieffo	S.Chieffo	S.Chieffo	J.Villar	J.Villar	J.Villar
Reporting Units:	ng	ng	ng	ng	µg/L	µg/L	µg/L
Date Analyzed:	May 1, 1991	May 1, 1991	May 1, 1991	May 1, 1991	May 1, 1991	May 1, 1991	May 1, 1991
QC Sample #:	BLK050191	BLK050191	BLK050191	BLK050191	BLK050191	BLK050191	BLK050191
Sample Conc.:	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	100	100	100	300	5.0	5.0	5.0
Conc. Matrix Spike:	100	100	100	300	5.8	4.6	5.0
Matrix Spike % Recovery:	100	100	100	100	120	92	100
Conc. Matrix Spike Dup.:	100	100	100	300	6.1	5.1	5.2
Matrix Spike Duplicate % Recovery:	100	100	100	100	120	100	100
Relative % Difference:	0.0	0.0	0.0	0.0	5.0	10	3.9

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

SEQUOIA ANALYTICAL

Bjorn A. Biorkman
Project Manager

$$\%\ \text{Recovery} = \frac{\text{Conc. of M.S.} - \text{Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$$

$$\text{Relative \% Difference} = \frac{\text{Conc. of M.S.} - \text{Conc. of M.S.D.}}{(\text{Conc. of M.S.} + \text{Conc. of M.S.D.}) \div 2} \times 100$$