Pinnacle
ENVIRONMENTAL SOLUTIONS

a division of
EMCON

RO#0

November 13, 1998
Project 20805-213.001

98 NOV 18 PM 1:31
PROTECTION

Mr. Paul Supple
ARCO Products Company
P.O. Box 6549
Moraga, California 94570

Re: Quarterly Groundwater Monitoring Report, Second Quarter 1998, for ARCO Service Station No. 4931, located at 731 West MacArthur Boulevard, Oakland, California

Dear Mr. Supple:

Pinnacle Environmental Solutions, a division of EMCON (Pinnacle), is submitting the attached report which presents the results of the second quarter 1998 groundwater monitoring program at ARCO Products Company (ARCO) Service Station No. 4931, located at 731 West MacArthur Boulevard, Oakland, California. The monitoring program complies with the Alameda County Health Care Services Agency requirements regarding underground tank investigations.

LIMITATIONS

No monitoring event is thorough enough to describe all geologic and hydrogeologic conditions of interest at a given site. If conditions have not been identified during the monitoring event, results should not be construed as a guarantee of the absence of such conditions at the site, but rather as the product of the scope and limitations of work performed during the monitoring event.

Please call if you have questions.

Sincerely,

Pinnacle

Glen VanderVeen
Project Manager

Jay R. Johnson, R.G.
Senior Project Supervisor

Attachment: Quarterly Groundwater Monitoring Report, Second Quarter 1998

cc: Mr. John Kaiser, Regional Water Quality Control Board - San Francisco Bay Region
Ms. Susan Hugo, Alameda County Health Care Services Agency

WC\S:\ARCO\4931\QTRLY\4931Q298.DOC\uh·1

Date: November 13, 1998

ARCO QUARTERLY GROUNDWATER MONITORING REPORT

Facility No.: 4931 Address: 731 West MacArthur Boulevard, Oakland, California

ARCO Environmental Engineer: Paul Supple

Consulting Co./Contact Person: Pinnacle Environmental Solutions/ Glen VanderVeen

Consultant Project No.: 20805-213.001

Primary Agency/Regulatory ID No.: Alameda County Health Care Services Agency

WORK PERFORMED THIS QUARTER (SECOND - 1998):

1. Prepared and submitted quarterly groundwater monitoring report for first quarter 1998.
2. Performed quarterly groundwater monitoring and sampling for second quarter 1998.

WORK PROPOSED FOR NEXT QUARTER (THIRD - 1998):

1. Prepare and submit quarterly groundwater monitoring report for second quarter 1998.
2. Perform quarterly groundwater monitoring and sampling for third quarter 1998.

QUARTERLY MONITORING:

Current Phase of Project:	Monitoring/Remediation
Frequency of Groundwater Sampling:	Annual (2nd Quarter): A-7, A-13 Semi-Annual (2nd/4th Quarter): A-3, A-5, A-11, A-12 Quarterly: A-2, A-4, A-6, A-8, A-9
Frequency of Groundwater Monitoring:	Quarterly
Is Free Product (FP) Present On-Site:	No
FP Recovered this Quarter:	None
Cumulative FP Recovered to Date:	Unknown
Bulk Soil Removed This Quarter:	None
Bulk Soil Removed to Date:	Unknown
Current Remediation Techniques:	Intrinsic Bioremediation Enhancement
Approximate Depth to Groundwater:	8.5 feet
Groundwater Flow Direction and Gradient (Average):	0.02 ft/ft toward West-Southwest
Period TPPH- g/Benzene Removed:	0.0/0.0
Cumulative TPPH-g/Benzene Removed:	0.45/0.06 gallons

DISCUSSION:

- Bioremediation enhancement is ongoing using oxygen release compound socks (ORC) in wells AR-1, A-4 , A-8 and A-9.

ATTACHMENTS:

- Table 1 - Groundwater Elevation and Analytical Data
- Figure 1 - Groundwater Analytical Summary Map
- Figure 2 - Groundwater Elevation Contour Map
- Appendix A - Sampling and Analysis Procedures
- Appendix B - Certified Analytical Report and Chain-of-Custody Documentation
- Appendix C - Field Data Sheets
- Appendix D - Remedial System Performance Summary

Table 1
Groundwater Elevation and Analytical Data
Total Purgeable Petroleum Hydrocarbons
(TPPH as Gasoline, BTEX Compounds, and MtBE)

ARCO Service Station 4931
731 West MacArthur Boulevard at West Street
Oakland, California

Well Number	Date Gauged/ Sampled	Well Elevation (feet, MSL	Depth to Water (feet, TOB)	Groundwate Elevation (feet, MSL)	TPPH as Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl-benzene (ppb)	Xylenes (ppb)	MtBE (ppb)	Dissolved Oxygen (ppm)	Purged/ not purged
A-2	03/26/96	55.48	5.37	50.11	<50	<0.5	<0.5	<0.5	<0.5	NA	NM	
	05/22/96		5.25	50.23	<50	<0.5	<0.5	<0.5	<0.5	NA	NM	
	08/22/96		10.45	45.03	<50	1.1	1.8	<0.5	1.3	<2.5	NM	
	12/19/96		5.53	49.95	<50	<0.5	<0.5	<0.5	<0.5	2.7	NM	
	04/01/97		8.77	46.71	<50	<0.5	<0.5	<0.5	<0.5	<2.5	NM	
	05/27/97		9.87	45.61	<50	<0.5	<0.5	<0.5	<0.5	4.6	NM	
	08/12/97		11.11	44.37	<50	<0.5	<0.5	<0.5	<0.5	5.6	NM	
	11/14/97		10.63	44.85	<50	0.9	2.8	<0.5	2.4	27	2.6	
	03/18/98		3.58	51.90	<50	<0.5	<0.5	<0.5	<0.5	<3.0	NM	
	05/19/98		4.82	50.66	<50	<0.5	<0.5	<0.5	<0.5	<3.0	1.30	P
A-3	03/26/96	54.66	7.20	47.46	---------- Well Sampled Semiannually ----------							
	05/22/96		7.70	46.96	<50	1.2	1.9	0.7	1.3	NA	NM	
	08/22/96		10.88	43.78	---------- Well Sampled Semiannually ----------							
	12/19/96		7.70	46.96	5,900	<25	<25	<25	<25	5300*	NM	
	04/01/97		9.78	44.88	---------- Well Sampled Semiannually ----------							
	05/27/97		10.55	44.11	2,300	<20	<20	<20	<20	3,800	NM	
	08/12/97		11.12	43.54	---------- Well Sampled Semiannually ----------							
	11/14/97		8.24	46.42	<1,000	<10	<10	<10	<10	1,500	3.8	
	03/18/98		5.05	49.61	---------- Well Sampled Semiannually ----------							
	05/19/98		9.00	45.66	<250	<2.5	<2.5	<2.5	<2.5	220	4.60	P
A-4	03/26/96	54.73	7.95	46.78	8,900	1,200	21	200	220	NA	NM	
	05/22/96		8.35	46.38	5,300	700	<10	170	130	NA	NM	
	08/22/96		11.03	43.70	3,000	480	<5.0	75	26	150	NM	
	12/19/96		8.67	46.06	<2,000	<20	<20	<20	<20	15000*	NM	
	04/01/97		11.95	42.78	8,900	1,700	22	310	260	6,900	NM	
	05/27/97		10.80	43.93	7,100	960	<20	150	74	7,900	NM	
	08/12/97		11.38	43.35	4,300	670	12	51	27	2,800	NM	
	11/14/97		7.74	46.99	<20,000	300	500	<200	<200	27,000	2.2	
	03/18/98		6.80	47.93	4,700	600	<20	99	94	1,200	1.0	
	05/19/98		9.06	45.67	<2000	<20	<20	<20	720	2,000	1.28	P
A-5	03/26/96	54.17	7.93	46.24	---------- Well Sampled Semiannually ----------							
	05/22/96		8.20	45.97	<50	<0.5	<0.5	<0.5	<0.5	NA	NM	
	08/22/96		10.70	43.47	---------- Well Sampled Semiannually ----------							
	12/19/96		8.39	45.78	9,900	1,100	330	230	700	24	NM	
	04/01/97		10.83	43.34	---------- Well Sampled Semiannually ----------							
	05/27/97		10.65	43.52	100	<0.5	<0.5	<0.5	<0.5	120	NM	
	08/12/97		11.05	43.12	---------- Well Sampled Semiannually ----------							
	11/14/97		10.51	43.66	<50	<0.5	<0.5	<0.5	<0.5	41	4.8	
	03/18/98		8.10	46.07	---------- Well Sampled Semiannually ----------							
	05/19/98		9.31	44.86	590	<5	<5	<5	<5	710	2.48	P

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(TPPH as Gasoline, BTEX Compounds, and MtBE)

ARCO Service Station 4931
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Oakland, California

Well Number	Date Gauged/ Sampled	Well Elevation (feet, MSL	Depth to Water (feet, TOB)	Groundwate Elevation (feet, MSL)	TPPH as Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl-benzene (ppb)	Xylenes (ppb)	MtBE (ppb)	Dissolved Oxygen (ppm)	Purged/ not purged
A-6	03/26/96	55.17	7.15	48.02	52	2.7	<0.5	1.1	2.0	NA	NM	
	05/22/96		7.35	47.82	<50	2.4	<0.5	0.88	1.7	NA	NM	
	08/22/96		10.12	45.05	<50	<0.5	<0.5	<0.5	<0.5	<2.5	NM	
	12/19/96		7.43	47.74	<50	1.7	<0.5	0.78	1.5	<2.5	NM	
	04/01/97		9.97	45.20	<50	4.7	<0.5	1.9	3.2	<2.5	NM	
	05/27/97		9.66	45.51	<50	0.69	<0.5	<0.5	<0.5	<2.5	NM	
	08/12/97		10.43	44.74	<50	<0.5	<0.5	<0.5	<0.5	<2.5	NM	
	11/14/97		9.76	45.41	<50	<0.5	<0.5	<0.5	<0.5	<3.0	<1.0	
	03/18/98		7.00	48.17	<50	6.2	0.5	2.3	2.6	<3.0	3.0	
	05/19/98		8.27	46.90	<50	<0.5	<0.5	1.3	4.7	<3.0	2.16	P
A-7	03/26/96	54.71	6.90	47.81	---------- Well Sampled Semiannually ----------							
	05/22/96		8.27	46.44	<50	<0.5	<0.5	<0.5	<0.5	NA	NM	
	08/22/96		9.80	44.91	---------- Well Sampled Semiannually ----------							
	12/19/96		7.19	47.52	---------- Well Sampled Annually ----------							
	04/01/97		9.63	45.08	---------- Well Sampled Annually ----------							
	05/27/97		9.34	45.37	<50	<0.5	<0.5	<0.5	<0.5	<2.5	NM	
	08/12/97		10.10	44.61	---------- Well Sampled Annually ----------							
	11/14/97		9.35	45.36	---------- Well Sampled Annually ----------							
	03/18/98		6.75	47.96	---------- Well Sampled Annually ----------							
	05/19/98		8.85	45.86	<50	<0.5	<0.5	<0.5	<0.5	<3	1.82	P
A-8 a	03/26/96	53.77	7.10	46.67	48,000	2,600	<100	650	1,100	NA	NM	
	05/22/96		7.20	46.57	14,000	2,800	160	320	190	NA	NM	
	08/22/96		11.57	42.20	8,000	1,000	76	150	96	4,300	NM	
	12/19/96		8.04	45.73	12,000	450	110	210	230	<500	NM	
	04/01/97		9.98	43.79	---------- Well Sampled Semiannually ----------							
	05/27/97		11.45	42.32	11,000	1,600	100	220	210	2,300	NM	
	08/12/97		11.59	42.18	---------- Well Sampled Semiannually ----------							
	11/14/97		9.85	43.92	26,000	2,300	<200	400	400	4,100	2.2	
	03/18/98		7.80	45.97	---------- Well Sampled Semiannually ----------							
	05/19/98		8.78	44.99	88,000	4,200	150	640	600	6,700	1.36	P
A-9 b	03/26/96	53.04	7.05	45.99	<50	<0.5	<0.5	<0.5	<0.5	NA	NM	
	05/22/96		7.20	45.84	<50	<0.5	<0.5	<0.5	<0.5	NA	NM	
	08/22/96		9.68	43.36	<50	<0.5	<0.5	<0.5	<0.5	8.5	NM	
	12/19/96		7.43	45.61	<50	<0.5	<0.5	<0.5	<0.5	2.6	NM	
	04/01/97		9.95	43.09	---------- Well Sampled Semiannually ----------							
	05/27/97		9.56	43.48	<50	2.3	<0.5	<0.5	<0.5	45	NM	
	08/12/97		10.15	42.89	---------- Well Sampled Semiannually ----------							
	11/14/97		8.64	44.40	<200	<2.0	<2.0	<2.0	<2.0	190	9.6	
	03/18/98		6.45	46.59	---------- Well Sampled Semiannually ----------							
	05/19/98		8.35	44.69	<50	<0.5	<0.5	<0.5	<0.5	7	1.27	P

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Well Number	Date Gauged/ Sampled	Well Elevation (feet, MSL	Depth to Water (feet, TOB)	Groundwate Elevation (feet, MSL)	TPPH as Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl-benzene (ppb)	Xylenes (ppb)	MtBE (ppb)	Dissolved Oxygen (ppm)	Purged/ not purged
A-10	03/26/96	54.26	8.28	45.98	---------- Well Removed from Sampling Program ----------							
	05/22/96		8.60	45.66	---------- Well Removed from Sampling Program ----------							
	08/22/96		10.98	43.28	---------- Well Removed from Sampling Program ----------							
	12/19/96		8.80	45.46	---------- Well Removed from Sampling Program ----------							
	04/01/97		11.15	43.11	---------- Well Removed from Sampling Program ----------							
	05/27/97		10.90	43.36	---------- Well Removed from Sampling Program ----------							
	08/12/97		11.30	42.96	---------- Well Removed from Sampling Program ----------							
	11/14/97		10.80	43.46	---------- Well Removed from Sampling Program ----------							
	03/18/98		--	--	---------- Well Removed from Sampling Program ----------							
	05/19/98		--	--	---------- Well Removed from Sampling Program ----------							
A-11	03/26/96	53.74	8.10	45.64	---------- Well Sampled Semiannually ----------							
	05/22/96		8.25	45.49	<50	<0.5	<0.5	<0.5	<0.5	NA	NM	
	08/22/96		10.58	43.16	---------- Well Sampled Semiannually ----------							
	12/19/96		8.37	45.37	<50	<0.5	<0.5	<0.5	<0.5	<2.5	NM	
	04/01/97		10.95	42.79	---------- Well Sampled Semiannually ----------							
	05/27/97		10.60	43.14	<50	<0.5	<0.5	<0.5	<0.5	3.1	NM	
	08/12/97		11.07	42.67	---------- Well Sampled Semiannually ----------							
	11/14/97		10.58	43.16	<50	<0.5	<0.5	<0.5	<0.5	<3.0	1.6	
	03/18/98		8.14	45.60	---------- Well Sampled Semiannually ----------							
	05/19/98		9.40	44.34	<50	<0.5	<0.5	<0.5	<0.5	<3.0	1.13	P
A-12	03/26/96	52.05	7.83	44.22	---------- Well Sampled Semiannually ----------							
	05/22/96		7.80	44.25	<50	<0.5	<0.5	<0.5	<0.5	NA	NM	
	08/22/96		9.97	42.08	---------- Well Sampled Semiannually ----------							
	12/19/96		8.18	43.87	85	<0.5	<0.5	<0.5	<0.5	170	NM	
	04/01/97		10.30	41.75	---------- Well Sampled Semiannually ----------							
	05/27/97		10.05	42.00	50	12	<0.5	<0.5	<0.5	96	NM	
	08/12/97		10.46	41.59	---------- Well Sampled Semiannually ----------							
	11/14/97		9.70	42.35	<50	<0.5	<0.5	<0.5	<0.5	75	7.0	
	03/18/98		8.15	43.90	---------- Well Sampled Semiannually ----------							
	05/19/98		9.15	42.90.	<50	<0.5	<0.5	<0.5	<0.5	29	1.47	P
A-13	03/26/96	55.11	---------- Well Inaccessible ----------									
	05/22/96		---------- Well Inaccessible ----------									
	08/22/96		---------- Well Inaccessible ----------									
	04/01/97		---------- Well Inaccessible ----------									
	05/27/97		---------- Well Inaccessible ----------									
	08/12/97		---------- Well Inaccessible ----------									
	11/14/97		---------- Well Inaccessible ----------									
	03/18/98		---------- Well Inaccessible ----------									
	05/19/98		---------- Well Inaccessible ----------									

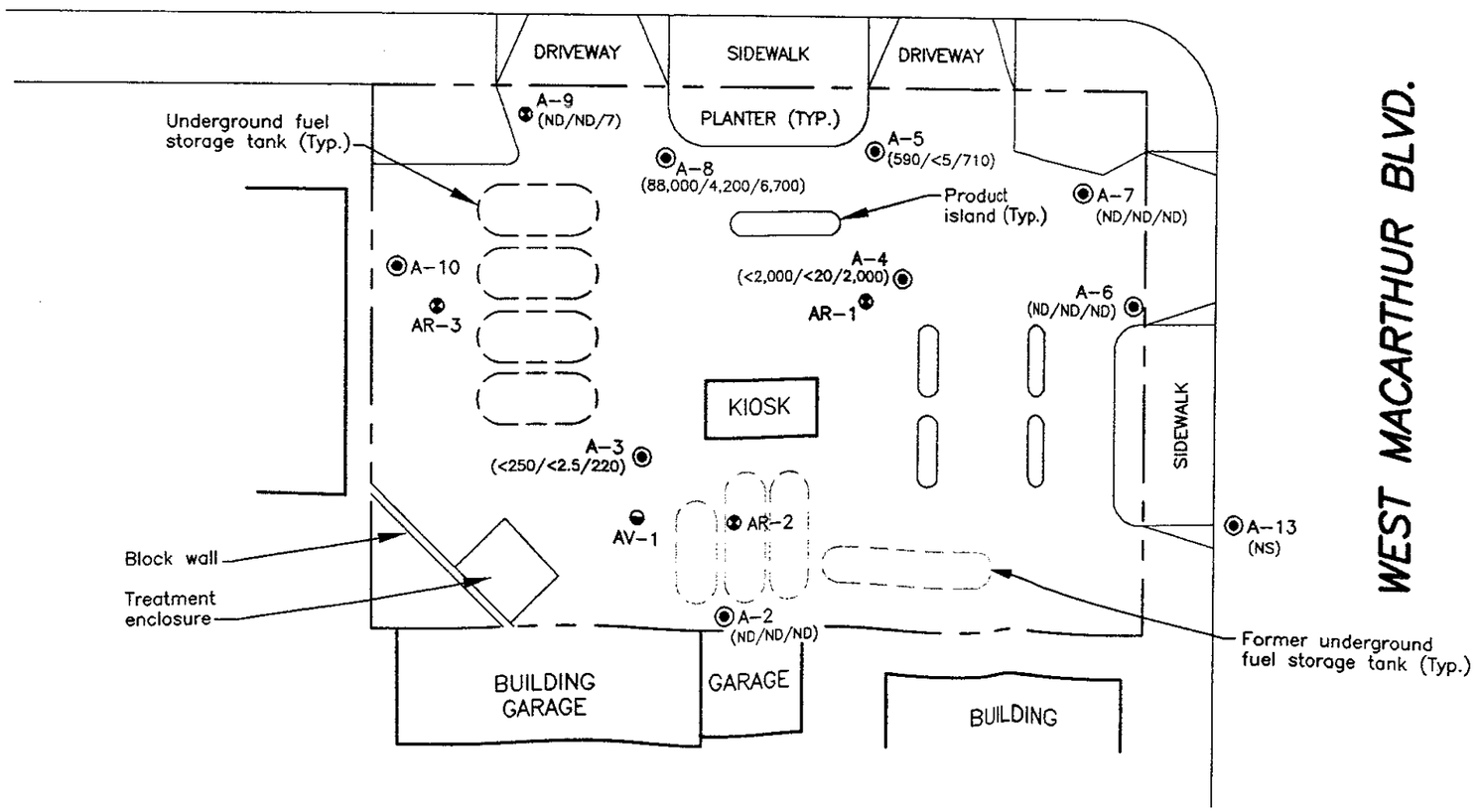
Table 1
Groundwater Elevation and Analytical Data
Total Purgeable Petroleum Hydrocarbons
(TPPH as Gasoline, BTEX Compounds, and MtBE)

ARCO Service Station 4931
731 West MacArthur Boulevard at West Street
Oakland, California

Well Number	Date Gauged/ Sampled	Well Elevation (feet, MSL	Depth to Water (feet, TOB)	Groundwate Elevation (feet, MSL)	TPPH as Gasoline (ppb)	Benzene (ppb)	Toluene (ppb)	Ethyl-benzene (ppb)	Xylenes (ppb)	MtBE (ppb)	Dissolved Oxygen (ppm)	Purged/ not purged
AR-1	03/26/96	54.72	8.13	46.59	6,200	110	64	38	520	NA	NM	
	05/22/96		8.57	46.15	NS	NS	NS	NS	NS	NS	NM	
	08/22/96		10.97	43.75	5,600	100	28	29	310	960	NM	
	12/19/96		8.93	45.79	---------- Well Removed from Sampling Program ----------							
	04/01/97		11.78	42.94	---------- Well Removed from Sampling Program ----------							
	05/27/97		10.76	43.96	---------- Well Removed from Sampling Program ----------							
	08/12/97		11.40	43.32	---------- Well Removed from Sampling Program ----------							
	11/14/97		10.80	43.92	---------- Well Removed from Sampling Program ----------							
AR-2	03/26/96	54.77	4.93	49.84	<50	<0.5	<0.5	<0.5	<0.5	NA	NM	
	05/22/96		5.65	49.12	NS	NS	NS	NS	NS	NS	NM	
	08/22/96		7.27	47.50	<50	<0.5	<0.5	<0.5	<0.5	200	NM	
	12/19/96		7.78	46.99	---------- Well Removed from Sampling Program ----------							
	04/01/97		6.80	47.97	---------- Well Removed from Sampling Program ----------							
	05/27/97		6.32	48.45	---------- Well Removed from Sampling Program ----------							
	08/12/97		7.43	47.34	---------- Well Removed from Sampling Program ----------							
	11/14/97		8.95	45.82	---------- Well Removed from Sampling Program ----------							
AR-3	03/26/96	54.19	7.95	46.24	<50	<0.5	<0.5	<0.5	<0.5	NA	NM	
	05/22/96		8.30	45.89	NS	NS	NS	NS	NS	NS	NM	
	08/22/96		10.84	43.35	---------- Well Removed from Sampling Program ----------							
	12/19/96		8.56	45.63	---------- Well Removed from Sampling Program ----------							
	04/01/97		11.24	42.95	---------- Well Removed from Sampling Program ----------							
	05/27/97		10.67	43.52	---------- Well Removed from Sampling Program ----------							
	08/12/97		11.10	43.09	---------- Well Removed from Sampling Program ----------							
	11/14/97		10.60	43.59	---------- Well Removed from Sampling Program ----------							

MSL = Mean sea level
TOB = Top of box
ppb = Parts per billion
ppm = Parts per million
< = Denotes laboratory detection limit
NA = Not analyzed
NM = Not measured
NS = Not sampled
a. = Bioremediation enhancement at this well has been in progress since 05/22/96.
b. = Bioremediation enhancement at this well has been in progress since 11/17/95.
* = MtBE results confirmed by EPA Method 8260.

Pinnacle



EXPLANATION

- ◉ Groundwater monitoring well
- ⊗ Groundwater extraction well
- ◒ Soil vapor well
- (590/<5/710) Concentration of total petroleum hydrocarbons as gasoline (TPHG), benzene, and MTBE in groundwater (ug/L); samples collected 5/19/98
- ND Not detected at or above the method reporting limit for TPHG (50 ug/L), benzene (0.5 ug/L), or MTBE (3 ug/L)
- < Method reporting limit raised due to high analyte concentration requiring sample dilution or matrix interference
- NS Not sampled

Base map from Pacific Environmental Group, Inc.

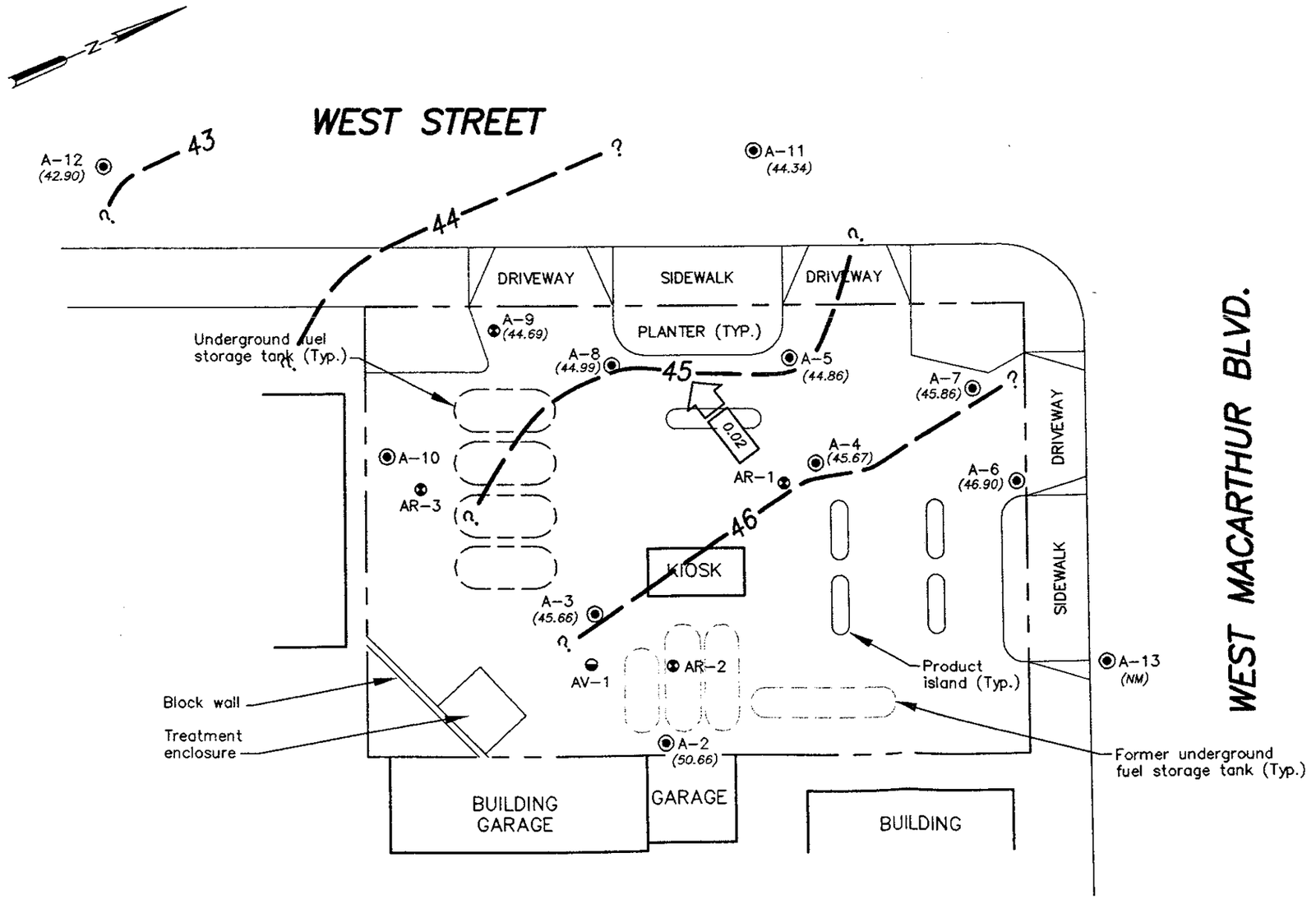
Pinnacle
ENVIRONMENTAL SOLUTIONS
A DIVISION OF EMCON

0 30 60
SCALE IN FEET

DATE SEPT. 1998
DWN KAB
APP
REV 0
PROJECT NO.
20805-213.001

FIGURE 1
ARCO PRODUCTS COMPANY
SERVICE STATION 4931, 731 W. MACARTHUR BLVD.
OAKLAND, CALIFORNIA
GROUNDWATER ANALYTICAL SUMMARY
SECOND QUARTER 1998

IMAGE Files: <No Images>
XREF Files: <No Xrefs>
SANJOSE/CADD: N:\DWG\PINACL\4931\4931CHEM.DWG Fri, 08/Nov/98 10:10am kblack
Dimscale: 30 Ltscale: 30 Psltscale: 1
1" 1/2" 0" 1"



EXPLANATION

- Groundwater monitoring well
- Groundwater extraction well
- Soil vapor well
- (46.90) Groundwater elevation (Ft.–MSL); measured 5/19/98
- Groundwater elevation contour (Ft.–MSL)
- NM Not measured; well inaccessible
- Approximate direction of groundwater flow showing gradient

Base map from Pacific Environmental Group, Inc.

Pinnacle
ENVIRONMENTAL SOLUTIONS
A DIVISION OF EMCON

0 30 60
SCALE IN FEET

DATE SEPT. 1998
DWN KAB
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FIGURE 2
ARCO PRODUCTS COMPANY
SERVICE STATION 4931, 731 W. MACARTHUR BLVD.
OAKLAND, CALIFORNIA
GROUNDWATER ELEVATION CONTOURS
SECOND QUARTER 1998

IMAGE Files: <No Images>
XREF Files: <No Xrefs>
SANJOSE/CADD: N:\DWG\PINACL\4931\4931GWC.DWG Fri, 06/Nov/98 10:11am kblack
Dimscale: 30 Ltscale: 30 Psltscale: 1
1" 1/2" 0" 1"

APPENDIX A

SAMPLING AND ANALYSIS PROCEDURES

APPENDIX A

SAMPLING AND ANALYSIS PROCEDURES

The sampling and analysis procedures for water quality monitoring programs are contained in this appendix. The procedures provided for consistent and reproducible sampling methods, proper application of analytical methods, and accurate and precise analytical results. Finally, these procedures provided guidelines so that the overall objectives of the monitoring program were achieved.

The following documents have been used as guidelines for developing these procedures:

- Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities, Environmental Protection Agency (EPA)-530/SW-611, August 1977
- Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Technical Enforcement Guidance Document, Office of Solid Waste and Emergency Response (OSWER) 9950.1, September 1986
- Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA SW-846, 3rd edition, November 1986
- Methods for Organic Chemical Analysis of Municipal and Industrial Waste Water, EPA-600/4-82-057, July 1982
- Methods for Organic Chemical Analysis of Water and Wastes, EPA-600/4-79-020, revised March 1983
- Leaking Underground Fuel Tank (LUFT) Field Manual, California State Water Resources Control Board, revised October 1989

Sample Collection

Sample collection procedures include equipment cleaning, water level and total well depth measurements, and well purging and sampling.

Equipment Cleaning

Before the sampling event was started, equipment that was used to sample groundwater was disassembled and cleaned with detergent water and then rinsed with deionized water. During field sampling, equipment surfaces that were placed in the well or came into contact with groundwater during field sampling were steam cleaned with deionized water before the next well was purged or sampled.

Water Level, Floating Hydrocarbon, and Total Well Depth Measurements

Before purging and sampling occurred, the depth to water, floating hydrocarbon thickness, and total well depth were measured using an oil/water interface measuring system. The oil/water interface measuring system consists of a probe that emits a continuous audible tone when immersed in a nonconductive fluid, such as oil or gasoline, and an intermittent tone when immersed in a conductive fluid, such as water. The floating hydrocarbon thickness and water level were measured by lowering the probe into the well. Liquid levels were recorded relative to the tone emitted at the groundwater surface. The sonic probe was decontaminated by being rinsed with deionized water or steam cleaned after each use. A bottom-filling, clear Teflon® bailer was used to verify floating hydrocarbon thickness measurements of less than 0.02 foot. Alternatively, an electric sounder and a bottom-filling Teflon bailer may have been used to record floating hydrocarbon thickness and depth to water.

The electric sounder is a transistorized instrument that uses a reel-mounted, two-conductor, coaxial cable that connects the control panel to the sensor. Cable markings are stamped at 1-foot intervals. The water level was measured by lowering the sensor into the monitoring well. A low-current circuit was completed when the sensor contacted the water, which served as an electrolyte. The current was amplified and fed into an indicator light and audible buzzer, signaling when water had been contacted. A sensitivity control compensated for highly saline or conductive water. The electric sounder was decontaminated by being rinsed with deionized water after each use. The bailer was lowered to a point just below the liquid level, retrieved, and observed for floating hydrocarbon.

Liquid measurements were recorded to the nearest 0.01 foot on the depth to water/floating product survey form. The groundwater elevation at each monitoring well was calculated by subtracting the measured depth to water from the surveyed elevation of the top of the well casing. (Every attempt was made to measure depth to water for all wells on the same day.) Total well depth was then measured by lowering the sensor to the bottom of the well. Total well depth, used to calculate purge volumes and to determine whether the well screen was partially obstructed by silt, was recorded to the nearest 0.1 foot on the depth to water/floating product survey form.

Well Purging

If the depth to groundwater was above the top of screens of the monitoring wells, then the wells were purged. Before sampling occurred, a polyvinyl chloride (PVC) bailer, centrifugal pump, low-flow submersible pump, or Teflon bailer was used to purge standing water in the casing and gravel pack from the monitoring well. Monitoring wells were purged according to the protocol presented in Figure A-1. In most monitoring wells, the amount of water purged before sampling was greater than or equal to three casing volumes. Some monitoring wells were expected to be evacuated to dryness after removing fewer than three casing volumes. These low-yield monitoring wells were allowed to recharge for up to 24 hours. Samples were obtained as soon as the monitoring wells recharged to a level sufficient for sample collection. If insufficient water recharged after 24 hours, the monitoring well was recorded as dry for the sampling event.

Groundwater purged from the monitoring wells was transported in a 500-gallon water trailer, 55-gallon drum, or a 325-gallon truck-mounted tank to EMCON's San Jose or Sacramento office location for temporary storage. EMCON arranged for transport and disposal of the purged groundwater through Integrated Waste Stream Management, Inc.

Field measurements of pH, specific conductance, and temperature were recorded in a waterproof field logbook. Figure A-2 shows an example of the water sample field data sheet on which field data are recorded. Field data sheets were reviewed for completeness by the sampling coordinator after the sampling event was completed.

The pH, specific conductance, and temperature meter were calibrated each day before field activities were begun. The calibration was checked once each day to verify meter performance. Field meter calibrations were recorded on the water sample field data sheet.

Well Sampling

A Teflon bailer was the only equipment acceptable for well sampling. When samples for volatile organic analysis were being collected, the flow of groundwater from the bailer was regulated to minimize turbulence and aeration. Glass bottles of at least 40-milliliters volume and fitted with Teflon-lined septa were used in sampling for volatile organics. These bottles were filled completely to prevent air from remaining in the bottle. A positive meniscus formed when the bottle was completely full. A convex Teflon septum was placed over the positive meniscus to eliminate air. After the bottle was capped, it was inverted and tapped to verify that it contained no air bubbles. The sample containers for other parameters were filled, filtered as required, and capped.

When required, dissolved concentrations of metals were determined using appropriate field filtration techniques. The sample was filtered by emptying the contents of the Teflon bailer into a pressure transfer vessel. A disposable 0.45-micron acrylic copolymer filter was threaded onto the transfer vessel at the discharge point, and the vessel was sealed. Pressure was applied to the vessel with a hand pump and the filtrate directed into the appropriate containers. Each filter was used once and discarded.

Sample Preservation and Handling

The following section specifies sample containers, preservation methods, and sample handling procedures.

Sample Containers and Preservation

Sample containers vary with each type of analytical parameter. Container types and materials were selected to be nonreactive with the particular analytical parameter tested.

Sample Handling

Sample containers were labeled immediately prior to sample collection. Samples were kept cool with cold packs until received by the laboratory. At the time of sampling, each sample was logged on an ARCO chain-of-custody record that accompanied the sample to the laboratory.

Samples that required overnight storage prior to shipping to the laboratory were kept cool (4° C) in a refrigerator. The refrigerator was kept in a warehouse, which was locked when not occupied by an EMCON employee. A sample/refrigerator log was kept to record the date and time that samples were placed into and removed from the refrigerator.

Samples were transferred from EMCON to an ARCO-approved laboratory by courier or taken directly to the laboratory by the environmental sampler. Sample shipments from EMCON to laboratories performing the selected analyses routinely occurred within 24 hours of sample collection.

Sample Documentation

The following procedures were used during sampling and analysis to provide chain-of-custody control during sample handling from collection through storage. Sample documentation included the use of the following:

- Water sample field data sheets to document sampling activities in the field
- Labels to identify individual samples
- Chain-of-custody record sheets for documenting possession and transfer of samples
- Laboratory analysis request sheets for documenting analyses to be performed

Field Logbook

In the field, the sampler recorded the following information on the water sample field data sheet (see Figure A-2) for each sample collected:

- Project number
- Client's name
- Location
- Name of sampler
- Date and time
- Well accessibility and integrity
- Pertinent well data (e.g., casing diameter, depth to water, well depth)
- Calculated and actual purge volumes
- Purging equipment used
- Sampling equipment used
- Appearance of each sample (e.g., color, turbidity, sediment)
- Results of field analyses (temperature, pH, specific conductance)
- General comments

The water sample field data sheet was signed by the sampler and reviewed by the sampling coordinator.

Labels

Sample labels contained the following information:

- Project number
- Sample number (i.e., well designation)
- Sample depth
- Sampler's initials
- Date and time of collection
- Type of preservation used (if any)

Sampling and Analysis Chain-of-Custody Record

The ARCO chain-of-custody record initiated at the time of sampling contained, at a minimum, the sample designation (including the depth at which the sample was collected), sample type, analytical request, date of sampling, and the name of the sampler. The record sheet was signed, timed, and dated by the sampler when transferring the samples. The number of custodians in the chain of possession was minimized. A copy of the ARCO chain-of-custody record was returned to EMCON with the analytical results.

Groundwater Sampling and Analysis Request Form

A groundwater sampling and analysis request form (see Figure A-3) was used to communicate to the environmental sampler the requirements of the monitoring event. At a minimum, the groundwater sampling and analysis request form included the following information:

- Date scheduled
- Site-specific instructions
- Specific analytical parameters
- Well number
- Well specifications (expected total depth, depth of water, and product thickness)

MONITORING WELL PURGING PROTOCOL

OWT

MEASURE AND RECORD DEPTH TO WATER AND WELL TOTAL DEPTH

CHECK FOR FLOATING PRODUCT

YES

MEASURE AND DOCUMENT FLOATING PRODUCT THICKNESS. DO NOT SAMPLE WELL FOR DISSOLVED CONSTITUENTS.

NO

CALCULATE PURGE VOLUME BY USING THE FOLLOWING EQUATION:

$P = \pi r^2 \times 7.48 \times 3$

where:

P = calculated purge volume (gallons)

$\pi = 3.14$

r = radius of well casing in feet

h = height of water column in feet

EVACUATE WATER FROM WELL EQUAL TO THE CALCULATED PURGE VOLUME WHILE MONITORING GROUNDWATER STABILIZATION INDICATOR PARAMETERS (pH, CONDUCTIVITY, TEMPERATURE) AT INTERVALS OF ONE CASING VOLUME.

WELL EVACUATED TO PRACTICAL LIMITS OF DRYNESS BEFORE REMOVING CALCULATED PURGE VOLUME

NO

FINAL TWO SETS OF GROUNDWATER STABILIZATION INDICATOR PARAMETER MEASUREMENTS MEET THE FOLLOWING CRITERIA:

pH = ± 0.1 pH units

COND. = ± 10 %

TEMP. = ± 1.0 °F

YES

WELL PURGING CRITERIA MET: PROCEED TO WELL SAMPLING.

NO

CONTINUE PURGING: EVACUATE ADDITIONAL CASING VOLUME OF WATER. MONITORING INDICATOR PARAMETERS FOR STABILITY.

YES

WELL RECHARGES TO A LEVEL SUFFICIENT FOR SAMPLE COLLECTION WITHIN 24 HOURS OF EVACUATION TO DRYNESS.

YES

FIELD TEST FIRST RECHARGE WATER FOR INDICATOR PARAMETERS, THEN PROCEED TO WELL SAMPLING.

NO

RECORD WELL AS DRY FOR PURPOSES OF SAMPLING.

EMCON

MONITORING WELL PURGING PROTOCOL

FIGURE A-1

WATER SAMPLE FIELD DATA SHEET

Rev. 5/96

OWT

PROJECT NO : _____ SAMPLE ID : _____

PURGED BY : _____ CLIENT NAME : _____

SAMPLED BY : _____ LOCATION : _____

TYPE: Groundwater ____ Surface Water ____ Leachate ____ Other _____

CASING DIAMETER (inches): 2 ____ 3 ____ 4 ____ 4.5 ____ 6 ____ Other _____

CASING ELEVATION (feet/MSL) : _____ VOLUME IN CASING (gal.) : _____

DEPTH OF WELL (feet) : _____ CALCULATED PURGE (gal.) : _____

DEPTH OF WATER (feet) : _____ ACTUAL PURGE VOL. (gal.) : _____

DATE PURGED : _____ END PURGE : _____

DATE SAMPLED : _____ SAMPLING TIME : _____

TIME (2400 HR)	VOLUME (gal.)	pH (units)	E.C. (µmhos/cm@25°c)	TEMPERATURE (°F)	TURBIDITY (visual/NTU)	TIME (2400 HR)

OTHER: _____ ODOR: _____ (COBALT 0-100) (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1) : _____

PURGING EQUIPMENT

____ 2" Bladder Pump ____ Bailer (Teflon)
____ Centrifugal Pump ____ Bailer (PVC)
____ Submersible Pump ____ Bailer (Stainless Steel)
____ Well Wizard™ ____ Dedicated
Other: _____

SAMPLING EQUIPMENT

____ 2" Bladder Pump ____ Bailer (Teflon)
____ Bomb Sampler ____ Bailer (Stainless Steel)
____ Dipper ____ Submersible Pump
____ Well Wizard™ ____ Dedicated
Other: _____

WELL INTEGRITY: _____ LOCK: _____

REMARKS: _____

pH, E.C., Temp. Meter Calibration:Date: _____ Time: _____ Meter Serial No.: _____

E.C. 1000 _____ / _____ pH 7 _____ / _____ pH 10 _____ / _____ pH 4 _____ / _____

Temperature °F _____

SIGNATURE: _____ REVIEWED BY: _____ PAGE _____ OF _____

EMCON

WATER SAMPLE FIELD DATA SHEET

FIGURE A-2

OWT

EMCON - SACRAMENTO
GROUNDWATER SAMPLING AND ANALYSIS REQUEST FORM

PROJECT NAME :

SCHEDULED DATE :

SPECIAL INSTRUCTIONS / CONSIDERATIONS :

Project Authorization: _____
EMCON Project No.: _____
OWT Project No.: _____
Task Code: _____
Originals To: _____
cc: _____

Well Lock Number (s)

__ CHECK BOX TO AUTHORIZE DATA ENTRY

Site Contact: _____ Name _____ Phone #

Well Number or Source	Casing Diameter (inches)	Casing Length (feet)	Depth to Water (feet)	ANAYSES REQUESTED

Laboratory and Lab QC Istructions:

EMCON

SAMPLING AND ANALYSIS REQUEST FORM

FIGURE
A-3

APPENDIX B

CERTIFIED ANALYTICAL REPORTS, AND CHAIN OF CUSTODY DOCUMENTATION

Columbia Analytical Services, Inc.

June 4, 1998

Service Request No.: S9801258

Glen Vanderveen
PINNACLE
144 A Mayhew Wy.
Walnut Creek, CA 94596

RE: 21775-302.003/TO#22312.00/RAT8/4931 OAKLAND

Dear Mr. Vanderveen:

The following pages contain analytical results for sample(s) received by the laboratory on May 20, 1998. Results of sample analyses are followed by Appendix A which contains sample custody documentation and quality assurance deliverables requested for this project. The work requested has been assigned the Service Request No. listed above. To help expedite our service, please refer to this number when contacting the laboratory.

Analytical results were produced by procedures consistent with Columbia Analytical Services' (CAS) Quality Assurance Manual (with any deviations noted). Signature of this CAS Analytical Report below confirms that pages 2 through 20, following, have been thoroughly reviewed and approved for release in accord with CAS Standard Operating Procedure ADM-DatRev3.

Please feel welcome to contact me should you have questions or further needs.

Sincerely,

Steven L. Green
Project Chemist

Lunadith J Cox for

Greg Anderson
Regional QA Coordinator

COLUMBIA ANALYTICAL SERVICES, Inc.
Acronyms

A2LA	American Association for Laboratory Accreditation
ASTM	American Society for Testing and Materials
BOD	Biochemical Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CAM	California Assessment Metals
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
COD	Chemical Oxygen Demand
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DLCS	Duplicate Laboratory Control Sample
DMS	Duplicate Matrix Spike
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
IC	Ion Chromatography
ICB	Initial Calibration Blank sample
ICP	Inductively Coupled Plasma atomic emission spectrometry
ICV	Initial Calibration Verification sample
J	Estimated concentration. The value is less than the MRL, but greater than or equal to the MDL. If the value is equal to the MRL, the result is actually <MRL before rounding.
LCS	Laboratory Control Sample
LUFT	Leaking Underground Fuel Tank
M	Modified
MBAS	Methylene Blue Active Substances
MCL	Maximum Contaminant Level. The highest permissible concentration of a substance allowed in drinking water as established by the U. S. EPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
MS	Matrix Spike
MTBE	Methyl tert-Butyl Ether
NA	Not Applicable
NAN	Not Analyzed
NC	Not Calculated
NCASI	National Council of the paper industry for Air and Stream Improvement
ND	Not Detected at or above the method reporting/detection limit (MRL/MDL)
NIOSH	National Institute for Occupational Safety and Health
NTU	Nephelometric Turbidity Units
ppb	Parts Per Billion
ppm	Parts Per Million
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RPD	Relative Percent Difference
SIM	Selected Ion Monitoring
SM	Standard Methods for the Examination of Water and Wastewater, 18th Ed., 1992
STLC	Solubility Threshold Limit Concentration
SW	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd Ed., 1986 and as amended by Updates I, II, IIA, and IIB.
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TPH	Total Petroleum Hydrocarbons
tr	Trace level. The concentration of an analyte that is less than the PQL but greater than or equal to the MDL. If the value is equal to the PQL, the result is actually <PQL before rounding.
TRPH	Total Recoverable Petroleum Hydrocarbons
TSS	Total Suspended Solids
TTLC	Total Threshold Limit Concentration
VOA	Volatile Organic Analyte(s)

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	ARCO Products Company	**Service Request:**	S9801258
Project:	21775-302.003/TO#22312.00/RAT8/4931 OAKLAND	**Date Collected:**	5/19/98
Sample Matrix:	Water	**Date Received:**	5/20/98

BTEX, MTBE and TPH as Gasoline

Sample Name:	A-3(17')	Units:	ug/L (ppb)
Lab Code:	S9801258-001	Basis:	NA
Test Notes:			

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	5	NA	5/27/98	<250	C1
Benzene	EPA 5030	8020	0.5	5	NA	5/27/98	<2.5	C1
Toluene	EPA 5030	8020	0.5	5	NA	5/27/98	<2.5	C1
Ethylbenzene	EPA 5030	8020	0.5	5	NA	5/27/98	<2.5	C1
Xylenes, Total	EPA 5030	8020	0.5	5	NA	5/27/98	<2.5	C1
Methyl *tert*-Butyl Ether	EPA 5030	8020	3	5	NA	5/27/98	220	

C1 The MRL was elevated due to high analyte concentration requiring sample dilution.

1S22/020597p

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	ARCO Products Company	**Service Request:**	S9801258
Project:	21775-302.003/TO#22312.00/RAT8/4931 OAKLAND	**Date Collected:**	5/19/98
Sample Matrix:	Water	**Date Received:**	5/20/98

BTEX, MTBE and TPH as Gasoline

Sample Name:	A-5(25')	Units:	ug/L (ppb)
Lab Code:	S9801258-002	Basis:	NA
Test Notes:			

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	10	NA	5/27/98	590	G2
Benzene	EPA 5030	8020	0.5	10	NA	5/27/98	<5	C1
Toluene	EPA 5030	8020	0.5	10	NA	5/27/98	<5	C1
Ethylbenzene	EPA 5030	8020	0.5	10	NA	5/27/98	<5	C1
Xylenes, Total	EPA 5030	8020	0.5	10	NA	5/27/98	<5	C1
Methyl *tert*-Butyl Ether	EPA 5030	8020	3	10	NA	5/27/98	710	

C1 The MRL was elevated due to high analyte concentration requiring sample dilution.

G2 The sample contains a single non-fuel component eluting in the gasoline range, and quantitated as gasoline. The chromatogram does not match the typical gasoline fingerprint.

1S22/020597p

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	ARCO Products Company	**Service Request:**	S9801258
Project:	21775-302.003/TO#22312.00/RAT8/4931 OAKLAND	**Date Collected:**	5/19/98
Sample Matrix:	Water	**Date Received:**	5/20/98

BTEX, MTBE and TPH as Gasoline

Sample Name:	A-6(25')	Units:	ug/L (ppb)
Lab Code:	S9801258-003	Basis:	NA
Test Notes:			

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	5/24/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	5/24/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	5/24/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	5/24/98	1.3	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	5/24/98	4.7	
Methyl *tert*-Butyl Ether	EPA 5030	8020	3	1	NA	5/24/98	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	ARCO Products Company	**Service Request:**	S9801258
Project:	21775-302.003/TO#22312.00/RAT8/4931 OAKLAND	**Date Collected:**	5/19/98
Sample Matrix:	Water	**Date Received:**	5/20/98

BTEX, MTBE and TPH as Gasoline

Sample Name:	A-7(22')	Units:	ug/L (ppb)
Lab Code:	S9801258-004	Basis:	NA
Test Notes:			

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	5/24/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	5/24/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	5/24/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	5/24/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	5/24/98	ND	
Methyl *tert*-Butyl Ether	EPA 5030	8020	3	1	NA	5/24/98	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: 21775-302.003/TO#22312.00/RAT8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9801258
Date Collected: 5/19/98
Date Received: 5/20/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-8(22')
Lab Code: S9801258-005
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	200	NA	5/27/98	88000	
Benzene	EPA 5030	8020	0.5	200	NA	5/27/98	4200	
Toluene	EPA 5030	8020	0.5	200	NA	5/27/98	150	
Ethylbenzene	EPA 5030	8020	0.5	200	NA	5/27/98	640	
Xylenes, Total	EPA 5030	8020	0.5	200	NA	5/27/98	600	
Methyl *tert*-Butyl Ether	EPA 5030	8020	3	200	NA	5/27/98	6700	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	ARCO Products Company	**Service Request:**	S9801258
Project:	21775-302.003/TO#22312.00/RAT8/4931 OAKLAND	**Date Collected:**	5/19/98
Sample Matrix:	Water	**Date Received:**	5/20/98

BTEX, MTBE and TPH as Gasoline

Sample Name:	A-9(38')	Units:	ug/L (ppb)
Lab Code:	S9801258-006	Basis:	NA
Test Notes:			

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	5/27/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	5/27/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	5/27/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	5/27/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	5/27/98	ND	
Methyl *tert*-Butyl Ether	EPA 5030	8020	3	1	NA	5/27/98	7	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	ARCO Products Company	**Service Request:**	S9801258
Project:	21775-302.003/TO#22312.00/RAT8/4931 OAKLAND	**Date Collected:**	5/19/98
Sample Matrix:	Water	**Date Received:**	5/20/98

BTEX, MTBE and TPH as Gasoline

Sample Name:	A-2(19')	Units:	ug/L (ppb)
Lab Code:	S9801258-007	Basis:	NA
Test Notes:			

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	5/24/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	5/24/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	5/24/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	5/24/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	5/24/98	ND	
Methyl *tert*-Butyl Ether	EPA 5030	8020	3	1	NA	5/24/98	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: 21775-302.003/TO#22312.00/RAT8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9801258
Date Collected: 5/19/98
Date Received: 5/20/98

BTEX, MTBE and TPH as Gasoline

Sample Name: A-4(20')
Lab Code: S9801258-008
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	40	NA	5/24/98	<2000	C1
Benzene	EPA 5030	8020	0.5	40	NA	5/24/98	<20	C1
Toluene	EPA 5030	8020	0.5	40	NA	5/24/98	<20	C1
Ethylbenzene	EPA 5030	8020	0.5	40	NA	5/24/98	<20	C1
Xylenes, Total	EPA 5030	8020	0.5	40	NA	5/24/98	720	
Methyl *tert*-Butyl Ether	EPA 5030	8020	3	40	NA	5/24/98	2000	

C1 The MRL was elevated due to high analyte concentration requiring sample dilution.

1S22/020597p

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	ARCO Products Company	**Service Request:**	S9801258
Project:	21775-302.003/TO#22312.00/RAT8/4931 OAKLAND	**Date Collected:**	5/19/98
Sample Matrix:	Water	**Date Received:**	5/20/98

BTEX, MTBE and TPH as Gasoline

Sample Name:	A-11(29')	Units:	ug/L (ppb)
Lab Code:	S9801258-009	Basis:	NA
Test Notes:			

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	5/24/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	5/24/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	5/24/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	5/24/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	5/24/98	ND	
Methyl *tert*-Butyl Ether	EPA 5030	8020	3	1	NA	5/24/98	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	ARCO Products Company	**Service Request:**	S9801258
Project:	21775-302.003/TO#22312.00/RAT8/4931 OAKLAND	**Date Collected:**	5/19/98
Sample Matrix:	Water	**Date Received:**	5/20/98

BTEX, MTBE and TPH as Gasoline

Sample Name:	A-12(30')	Units:	ug/L (ppb)
Lab Code:	S9801258-010	Basis:	NA
Test Notes:			

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	5/26/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	5/26/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	5/26/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	5/26/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	5/26/98	ND	
Methyl *tert*-Butyl Ether	EPA 5030	8020	3	1	NA	5/26/98	29	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	ARCO Products Company	**Service Request:**	S9801258
Project:	21775-302.003/TO#22312.00/RAT8/4931 OAKLAND	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA

BTEX, MTBE and TPH as Gasoline

Sample Name:	Method Blank	Units:	ug/L (ppb)
Lab Code:	S980523-WB1	Basis:	NA
Test Notes:			

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	5/23/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	5/23/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	5/23/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	5/23/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	5/23/98	ND	
Methyl *tert*-Butyl Ether	EPA 5030	8020	3	1	NA	5/23/98	ND	

1S22/020597p

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	ARCO Products Company	**Service Request:**	S9801258
Project:	21775-302.003/TO#22312.00/RAT8/4931 OAKLAND	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA

BTEX, MTBE and TPH as Gasoline

Sample Name:	Method Blank	Units:	ug/L (ppb)
Lab Code:	S980523-WB2	Basis:	NA
Test Notes:			

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	5/23/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	5/23/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	5/23/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	5/23/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	5/23/98	ND	
Methyl *tert*-Butyl Ether	EPA 5030	8020	3	1	NA	5/23/98	ND	

1S22/020597p

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	ARCO Products Company	**Service Request:**	S9801258
Project:	21775-302.003/TO#22312.00/RAT8/4931 OAKLAND	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA

BTEX, MTBE and TPH as Gasoline

Sample Name:	Method Blank	Units:	ug/L (ppb)
Lab Code:	S980526-WB1	Basis:	NA
Test Notes:			

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	5/26/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	5/26/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	5/26/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	5/26/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	5/26/98	ND	
Methyl *tert*-Butyl Ether	EPA 5030	8020	3	1	NA	5/26/98	ND	

1S22/020597p

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client:	ARCO Products Company	**Service Request:**	S9801258
Project:	21775-302.003/TO#22312.00/RAT8/4931 OAKLAND	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA

BTEX, MTBE and TPH as Gasoline

Sample Name:	Method Blank	Units:	ug/L (ppb)
Lab Code:	S980527-WB1	Basis:	NA
Test Notes:			

Analyte	Prep Method	Analysis Method	MRL	Dilution Factor	Date Extracted	Date Analyzed	Result	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	50	1	NA	5/27/98	ND	
Benzene	EPA 5030	8020	0.5	1	NA	5/27/98	ND	
Toluene	EPA 5030	8020	0.5	1	NA	5/27/98	ND	
Ethylbenzene	EPA 5030	8020	0.5	1	NA	5/27/98	ND	
Xylenes, Total	EPA 5030	8020	0.5	1	NA	5/27/98	ND	
Methyl *tert*-Butyl Ether	EPA 5030	8020	3	1	NA	5/27/98	ND	

1S22/020597p

APPENDIX A

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: ARCO Products Company
Project: 21775-302.003/TO#22312.00/RAT8/4931 OAKLAND
Sample Matrix: Water

Service Request: S9801258
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: NA

Surrogate Recovery Summary
BTEX, MTBE and TPH as Gasoline

Prep Method: EPA 5030
Analysis Method: 8020 CA/LUFT

Units: PERCENT
Basis: NA

Sample Name	Lab Code	Test Notes	Percent Recovery 4-Bromofluorobenzene	Percent Recovery a,a,a-Trifluorotoluene
A-3(17')	S9801258-001		104	94
A-5(25')	S9801258-002		110	99
A-6(25')	S9801258-003		83	80
A-7(22')	S9801258-004		88	84
A-8(22')	S9801258-005		106	110
A-9(38')	S9801258-006		103	105
A-2(19')	S9801258-007		101	103
A-4(20')	S9801258-008		110	83
A-11(29')	S9801258-009		90	74
A-12(30')	S9801258-010		81	104 B1
BATCH QC	S9801278-007MS		98	108
BATCH QC	S9801278-007DMS		96	107
Method Blank	S980523-WB1		100	112
Method Blank	S980523-WB2		90	93
Method Blank	S980526-WB1		100	105
Method Blank	S980527-WB1		100	103
CAS Acceptance Limits:			69-116	69-116

B1 The surrogate used for this sample was 4-Bromofluorobenzene.

SUR2/020397p

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: ARCO Products Company
Project: 21775-302.003/TO#22312.00/RAT8/4931 OAKLAND
Sample Matrix Water

Service Request: S9801258
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 5/24/98

Matrix Spike/Duplicate Matrix Spike Summary
TPH as Gasoline

Sample Name: BATCH QC
Lab Code: S9801278-007MS, S9801278-007DMS
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	MRL	Spike Level MS	Spike Level DMS	Sample Result	Spike Result MS	Spike Result DMS	Percent Recovery MS	Percent Recovery DMS	CAS Acceptance Limits	Relative Percent Difference	Result Notes
Gasoline	EPA 5030	CA/LUFT	50	250	250	ND	240	240	96	96	75-135	<1	

DMS/020597p

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: ARCO Products Company
Project: 21775-302.003/TO#22312.00/RAT8/4931 OAKLAND

Service Request: 89801258
Date Analyzed: 5/23/98

Initial Calibration Verification (ICV) Summary
BTEX, MTBE and TPH as Gasoline

Sample Name: ICV
Lab Code: ICV1
Test Notes:

Units: ug/L (ppb)
Basis: NA

ICV Source:

Analyte	Prep Method	Analysis Method	True Value	Result	CAS Percent Recovery Acceptance Limits	Percent Recovery	Result Notes
TPH as Gasoline	EPA 5030	CA/LUFT	250	270	90-110	108	
Benzene	EPA 5030	8020	25	23	85-115	92	
Toluene	EPA 5030	8020	25	23	85-115	92	
Ethylbenzene	EPA 5030	8020	25	23	85-115	92	
Xylenes, Total	EPA 5030	8020	75	70	85-115	93	
Methyl *tert*-Butyl Ether	EPA 5030	8020	25	24	85-115	96	

ICV/032196

TPH/BTEX PC F

ARCO Products Company
Division of Atlantic/Richfield Company

Task Order No. 7232.00

Chain of Custody

ARCO Facility no. 4931	City (Facility) Oakland	Project manager (Consultant) Glen Vondervoen	Laboratory Name CAS
ARCO engineer [redacted] Paul Supple	Telephone no. (ARCO)	Telephone no. (Consultant) (408) 453-7300	Fax no. (Consultant) (408) 437-9526
Consultant name EMCON	Address (Consultant) 144-A Mayhew Way, Walnut Creek, CA		Contract Number

Method of shipment: Sampler will deliver

Special Detection Limit/reporting: Lowest Possible

Special QA/QC: As Normal

Remarks: RAT 8 2-40ml HCl VOAs 21775-302.003

Lab Number: 59801258

Turnaround Time:
- Priority Rush 1 Business Day ☐
- Rush 2 Business Days ☐
- Expedited 5 Business Days ☐
- Standard 10 Business Days ☒ Due 6/3/98

Sample I.D.	Lab no.	Container no.	Matrix: Soil	Matrix: Water	Matrix: Other	Preservation: Ice	Preservation: Acid	Sampling date	Sampling time	BTEX 602/EPA 8020	BTEX/TPH indicate EPA M602/8020/8015	TPH Modified 8015 Gas ☐ Diesel ☐	Oil and Grease 413.1 ☐ 413.2 ☐	TPH EPA 418.1/SM 503E	EPA 601/8010	EPA 624/8240	EPA 625/8270	TCLP Semi Metals ☐ VOA ☐ VOA ☐	CAM Metals EPA 6010/7000 TTLC ☐ STLC ☐	Lead Org/DHS ☐ Lead EPA 7420/7421 ☐
A-3(17')	1	2		X		X	HCl	5-19-98	1023		X									
A-5(25')	2								1043		X									
A-6(25')	3								1102		X									
A-7(22')	4								1117		X									
A-8(22')	5								1145		X									
A-9(38')	6								1220		X									
A-2(15')	7								1245		X									
A-4(20')	8								1310		X									
A-11(29')	9								1332		X									
A-12(30')	10	↓		↓		↓	↓	↓	1350		X									
A-13( )									=	no samples taken										

Condition of sample:

Temperature received:

Relinquished by sampler: Manuel L. Gallegos	Date 5-20-98	Time 0800	Received by: 5/20/98 9:38 AM
Relinquished by	Date	Time	Received by
Relinquished by	Date	Time	Received by laboratory / Date / Time

Distribution: White Copy – Laboratory: Canary Copy – ARCO Environmental Engineering: Pink Copy – Consultant

R11/03

APPENDIX C

FIELD DATA SHEETS

EMCON - Groundwater Sampling and Analysis Request Form

PROJECT NAME : **ARCO STATION 4931**
731 W. MacArthur Blvd. Oakland, CA

Sampling Project # : **21775-302.003**
Reporting Project #: **?**
OWT Project #: **71048**
Project Manager: **Glen Vanderveen**

DATE REQUESTED : **19-May-98**

Groundwater Monitoring Instructions	Treatment System Instructions
Quarterly Monitoring - Third Month of the Quarter Perform a water level survey prior to sampling (see ARCO SOP) **Well survey points are top of well boxes.** **Purge three (3) casing volumes.** **All lids are extremely difficult to open, bring a crowbar and a large screwdriver.** AR-1, 2, & 3 have 1 inch PVC casings in box for water level measurement. Sample ID's on the C-O-C and the sample bottles must include the depth at which the sample was collected [i.e. MW-1 (30)]	**Lisle Rath Pager # (408) 798-2928**

Site Contact: ? Site Phone: ? Well Locks: ?

Well ID or Source	Casing Diameter (inches)	Casing Length (feet)	Top of Screen (feet)
A-3	4.0	19.3	
A-5	3.0	24.0	
A-6	3.0	25.0	
A-7	~~3.0~~ 3.0	22.6	
A-8	~~4.0~~ 3.0	20.0	
A-9	6.0	38.0	
A-2	4.0	19.0	
A-4	4.0	19.6	
A-11			
A-12			
A-13			

Above wells in indicated order

Analyses Requested

Depth to Water

Depth to Floating Product

Floating Product Thickness

Total Depth

Well Integrity

asphalted over

Dissolved Oxygen
(Field Measurement)

TPHG/ BTEX/ MTBE by (EPA 8020)
(Fill 2- 40ml HCL VOAs)

If depth to water is below the top of the screen take a grab sample. If the water level is above the top of the screen purge as normal.

Laboratory Instructions:
Provide lowest detection limits possible.
Please use the EMCON Reporting Project Number (?) on the CAR.

ND = None Detected IP = Intermitent Product

FIELD REPORT
DEPTH TO WATER / FLOATING PRODUCT SURVEY

PROJECT # : 21775-302.003 STATION ADDRESS : 731 W. MacArthur Blvd. Oakland, CA DATE : 5/19/98

ARCO STATION # : 4931 FIELD TECHNICIAN : Chris Chaco/ Manuel Gallegos DAY : Tuesday

DTW Order	WELL ID	Well Box Seal	Well Lid Secure	Gasket Present	Lock Number	Type Of Well Cap	FIRST DEPTH TO WATER (feet)	SECOND DEPTH TO WATER (feet)	DEPTH TO FLOATING PRODUCT (feet)	FLOATING PRODUCT THICKNESS (feet)	WELL TOTAL DEPTH (feet)	COMMENTS
1	A-3	OK	G-5	NO	2357	LWC	9.00	9.00	ND	NR	17.1	
2	A-5	OK	G-5	NO	2357	LWC	9.31	9.31	ND	NR	25.5	needs new G-5 LID ASAP!
3	A-6	OK	G-5	NO	2357	LWC	8.27	8.27	ND	NR	25.4	
4	A-7	OK	G-5	NO	2357	LWC	8.85	8.85	ND	NR	22.8	
5	A-8	OK	Vault	OK	None	Slip	8.78	8.78	ND	NR	22.1	
6	A-9	OK	Vault	OK	None	Slip	8.35	8.35	ND	NR	38.5	
7	A-2	OK	G-5	NO	2357	LWC	4.82	4.82	ND	NR	19.7	
8	A-4	OK	G-5	NO	2357	LWC	9.04	9.04	ND	NR	20.2	
9	A-11	OK	G-5	NO	None	LWC	9.10	9.10	ND	NR	29.9	
10	A-12	OK	G-5	NO	None	LWC	9.15	9.15	ND	NR	30.4	
11	A-13											

SURVEY POINTS ARE TOP OF WELL BOXES

WATER SAMPLE FIELD DATA SHEET

Rev 1/97

OWT

PROJECT NO 21775-302.003 | SAMPLE ID A-2 (19)
PURGED BY M. G. / C. C. | CLIENT NAME ARCO # 4931
SAMPLED BY ↓ | LOCATION OAKLAND, CA

TYPE Groundwater X Surface Water ____ Leachate ____ Other ____

CASING DIAMETER (inches) 2 ____ 3 ____ 4 X 4 5 ____ 6 ____ Other ____

CASING ELEVATION (feet/MSL)	NR	VOLUME IN CASING (gal)	9.72
DEPTH OF WELL (feet)	19.7	CALCULATED PURGE (gal)	29.16
DEPTH OF WATER (feet)	4.82	ACTUAL PURGE VOL (gal)	15.0

DATE PURGED 5-19-98 | END PURGE 1239
DATE SAMPLED ↓ | SAMPLING TIME 1245

TIME (2400 HR)	VOLUME (gal)	pH (units)	E C (µmhos/cm@25°c)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
1234	10.0	6.50	460	65.0	BRN	HEAVY
	well	DRY @	15.0 gallons		↓	↓
1245	Recharge	6.61	482	66.2		

OTHER DO = 1.30 ODOR none NR (COBALT 0-100) NR (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e FB-1, XDUP-1) N/R

PURGING EQUIPMENT

____ 2" Bladder Pump ____ Bailer (Teflon)
____ Centrifugal Pump ✓ Bailer (PVC)
____ Submersible Pump ____ Bailer (Stainless Steel)
____ Well Wizard™ ____ Dedicated
Other ____

SAMPLING EQUIPMENT

____ 2" Bladder Pump X Bailer (Teflon)
____ Bomb Sampler ____ Bailer (Stainless Steel)
____ Dipper ____ Submersible Pump
____ Well Wizard™ ____ Dedicated
Other ____

WELL INTEGRITY OK LOCK. none

REMARKS All samples taken

pH, E C, Temp Meter Calibration Date 5/19/98 Time ____ Meter Serial No 87m
E C 1000 ____ / ____ pH 7 ____ / ____ pH 10 ____ / ____ pH 4 ____ / ____
Temperature °F ____

SIGNATURE [signature] REVIEWED BY [signature] PAGE 1 OF 11

WATER SAMPLE FIELD DATA SHEET

Rev 1/97

OWT

PROJECT NO 21775-302.003 | SAMPLE ID A-4(20')
PURGED BY M. G. / C. C. | CLIENT NAME ARCO # 4931
SAMPLED BY ↓ | LOCATION OAKLAND, CA

TYPE Groundwater X | Surface Water ____ | Leachate ____ | Other ____

CASING DIAMETER (inches) 2 ____ 3 ____ 4 ✓ 4.5 ____ 6 ____ Other ____

CASING ELEVATION (feet/MSL)	N/R	VOLUME IN CASING (gal.)	7.27
DEPTH OF WELL (feet)	20.2	CALCULATED PURGE (gal.)	21.83
DEPTH OF WATER (feet)	9.06	ACTUAL PURGE VOL (gal.)	11.0

DATE PURGED 5-19-98 | END PURGE 1305
DATE SAMPLED ↓ | SAMPLING TIME 1310

TIME (2400 HR)	VOLUME (gal.)	pH (units)	E.C (µmhos/cm@25°c)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
~~1300~~ 1303	7.5	6.55	1338	67.2	Cloudy	mod
	well	dry at	11.0	gallons		
1310	recharge	6.62	1224	67.3	Cloudy/Gry	mod

OTHER DO = 1.28 | ODOR Strong | NR (COBALT 0-100) | NR (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1) N/R

PURGING EQUIPMENT

- ____ 2" Bladder Pump
- ✓ Centrifugal Pump
- ____ Submersible Pump
- ____ Well Wizard™
- ____ Bailer (Teflon)
- ____ Bailer (PVC)
- ____ Bailer (Stainless Steel)
- ____ Dedicated
- Other ____

SAMPLING EQUIPMENT

- ____ 2" Bladder Pump
- ____ Bomb Sampler
- ____ Dipper
- ____ Well Wizard™
- X Bailer (Teflon)
- ____ Bailer (Stainless Steel)
- ____ Submersible Pump
- ____ Dedicated
- Other ____

WELL INTEGRITY: OK. | LOCK Monic.

REMARKS: all samples taken

pH, E C, Temp Meter Calibration Date 5/19/98 | Time ____ | Meter Serial No 87M

EC 1000 ____ / ____ | pH 7 ____ / ____ | pH 10 ____ / ____ | pH 4 ____ / ____

Temperature °F ____

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WATER SAMPLE FIELD DATA SHEET

Rev 1/97

OWT

PROJECT NO 21775-302.003 | SAMPLE ID A-3 (17')
PURGED BY M. G. / C. C. | CLIENT NAME ARCO # 4931
SAMPLED BY ↓ | LOCATION OAKLAND, CA

TYPE Groundwater X | Surface Water ____ | Leachate ____ | Other ____

CASING DIAMETER (inches) 2 ____ 3 ____ 4 ✓ 4.5 ____ 6 ____ Other ____

CASING ELEVATION (feet/MSL)	NR	VOLUME IN CASING (gal)	5.29
DEPTH OF WELL (feet)	17.1	CALCULATED PURGE (gal)	15.87
DEPTH OF WATER (feet)	9.00	ACTUAL PURGE VOL (gal)	5.5

DATE PURGED 5-19-98 | END PURGE 1019
DATE SAMPLED ↓ | SAMPLING TIME 1023

TIME (2400 HR)	VOLUME (gal)	pH (units)	E.C (µmhos/cm@25°c)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
1018	5.5	6.26	779	65.1	BRN	Heavy
	~~Flow~~	well Dry · at		5.5 gallons		
	Flow					
1023	Recharge	6.39	750	65.2	↓	

OTHER: DO = 4.60 | ODOR none | NR (COBALT 0-100) | NR (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1): NR

PURGING EQUIPMENT

____ 2" Bladder Pump | ____ Bailer (Teflon)
____ Centrifugal Pump | ✓ Bailer (PVC)
____ Submersible Pump | ____ Bailer (Stainless Steel)
____ Well Wizard™ | ____ Dedicated
Other: ____

SAMPLING EQUIPMENT

____ 2" Bladder Pump | X Bailer (Teflon)
____ Bomb Sampler | ____ Bailer (Stainless Steel)
____ Dipper | ____ Submersible Pump
____ Well Wizard™ | ____ Dedicated
Other ____

WELL INTEGRITY OK | LOCK: none

REMARKS: All samples taken

pH, E C, Temp Meter Calibration Date 5/19/98 | Time 09:50 | Meter Serial No ~~[illegible]~~ 872
E C 1000 994 / 1000 | pH 7 715 / 700 | pH 10 989 / 1000 | pH 4 378 / 400
Temperature °F 62.5

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WATER SAMPLE FIELD DATA SHEET

Rev 1/97

OWT

PROJECT NO 21775-302.003 | SAMPLE ID A-5 (25')
PURGED BY M.G./C.C. | CLIENT NAME ARCO# 4931
SAMPLED BY ↓ | LOCATION OAKLAND, CA

TYPE Groundwater X | Surface Water ____ | Leachate ____ | Other ____

CASING DIAMETER (inches) 2 ____ | 3 ✓ | 4 ____ | 4.5 ____ | 6 ____ | Other ____

CASING ELEVATION (feet/MSL)	NR	VOLUME IN CASING (gal.)	5.78
DEPTH OF WELL (feet)	25.5	CALCULATED PURGE (gal.)	17.34
DEPTH OF WATER (feet)	9.31	ACTUAL PURGE VOL (gal.)	17.5

DATE PURGED 5-19-98 | END PURGE 1039
DATE SAMPLED ↓ | SAMPLING TIME 1043

TIME (2400 HR)	VOLUME (gal.)	pH (units)	E.C (µmhos/cm@25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
1036	6.0	6.41	1148	66.5	BRN	Heavy
1037	12.0	6.52	1135	66.8	↓	↓
1039	17.5	6.60	1042	66.9		

OTHER DO = 2.48 | ODOR moderate | NR (COBALT 0-100) | NR (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1) NR

PURGING EQUIPMENT

____ 2" Bladder Pump | ____ Bailer (Teflon)
____ Centrifugal Pump | ✓ Bailer (PVC)
____ Submersible Pump | ____ Bailer (Stainless Steel)
____ Well Wizard™ | ____ Dedicated
Other ____

SAMPLING EQUIPMENT

____ 2" Bladder Pump | X Bailer (Teflon)
____ Bomb Sampler | ____ Bailer (Stainless Steel)
____ Dipper | ____ Submersible Pump
____ Well Wizard™ | ____ Dedicated
Other ____

WELL INTEGRITY: needs new well bio-G-5 cracked | LOCK. none

REMARKS: All samples taken

pH, E C, Temp Meter Calibration Date 5/19/98 | Time ____ | Meter Serial No 87m

E C 1000 ____ / ____ | pH 7 ____ / ____ | pH 10 ____ / ____ | pH 4 ____ / ____

Temperature °F ____

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WATER SAMPLE FIELD DATA SHEET

Rev 1/97

OWT

PROJECT NO 21775-302.003 | SAMPLE ID A-6 (25')
PURGED BY M. G. / C. C. | CLIENT NAME ARCO # 4931
SAMPLED BY ↓ | LOCATION OAKLAND, CA

TYPE Groundwater X | Surface Water ___ | Leachate ___ | Other ___

CASING DIAMETER (inches) 2 ___ | 3 ✓ | 4 ___ | 4.5 ___ | 6 ___ | Other ___

CASING ELEVATION (feet/MSL)	NR	VOLUME IN CASING (gal.)	6.28
DEPTH OF WELL (feet)	25.4	CALCULATED PURGE (gal.)	18.84
DEPTH OF WATER (feet)	8.27	ACTUAL PURGE VOL (gal.)	19.0

DATE PURGED 5-19-98 | END PURGE 1059
DATE SAMPLED ↓ | SAMPLING TIME 1102

TIME (2400 HR)	VOLUME (gal.)	pH (units)	E C (µmhos/cm@25°c)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
1055	6.5	6.82	559	67.1	BRN	Heavy
1056	13.0	6.76	601	66.9	↓	↓
1059	19.0	6.74	609	66.9	↓	

OTHER DO = 2.16 | ODOR none | NR (COBALT 0-100) | NR (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1) NR

PURGING EQUIPMENT

___ 2" Bladder Pump | ___ Bailer (Teflon)
___ Centrifugal Pump | ✓ Bailer (PVC)
___ Submersible Pump | ___ Bailer (Stainless Steel)
___ Well Wizard™ | ___ Dedicated
Other ___

SAMPLING EQUIPMENT

___ 2" Bladder Pump | X Bailer (Teflon)
___ Bomb Sampler | ___ Bailer (Stainless Steel)
___ Dipper | ___ Submersible Pump
___ Well Wizard™ | ___ Dedicated
Other ___

WELL INTEGRITY OK | LOCK None

REMARKS All Samples taken

pH, E C, Temp Meter Calibration Date 5/19/98 | Time ___ | Meter Serial No 87M

E C 1000 ___ / ___ | pH 7 ___ / ___ | pH 10 ___ / ___ | pH 4 ___ / ___

Temperature °F ___

SIGNATURE [signature] | REVIEWED BY [signature] | PAGE 5 OF 11

WATER SAMPLE FIELD DATA SHEET

Rev 1/97

OWT

PROJECT NO 21775-302.003 | SAMPLE ID A-7(22')
PURGED BY M. G. / C. C. | CLIENT NAME ARCO# 4931
SAMPLED BY ↓ | LOCATION OAKLAND, CA

TYPE Groundwater X | Surface Water ____ | Leachate ____ | Other ____

CASING DIAMETER (inches) 2 ____ 3 X 4 ____ 4.5 ____ 6 ____ Other ____

CASING ELEVATION (feet/MSL)	NR	VOLUME IN CASING (gal.)	5.11
DEPTH OF WELL (feet)	22.8	CALCULATED PURGE (gal.)	15.34
DEPTH OF WATER (feet)	8.85	ACTUAL PURGE VOL (gal.)	15.5

DATE PURGED 5-19-98 | END PURGE 1114
DATE SAMPLED ↓ | SAMPLING TIME 1117

TIME (2400 HR)	VOLUME (gal.)	pH (units)	E.C (µmhos/cm@25°c)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
1110	5.5	6.86	394	66.2	BRN	Heavy
1112	10.5	6.82	470	66.5		
1114	15.5	6.80	490	66.5	↓	↓

OTHER: DO = 1.82 | ODOR none | NR (COBALT 0-100) | NR (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e FB-1, XDUP-1): NR

PURGING EQUIPMENT

____ 2" Bladder Pump | ____ Bailer (Teflon)
____ Centrifugal Pump | ✓ Bailer (PVC)
____ Submersible Pump | ____ Bailer (Stainless Steel)
____ Well Wizard™ | ____ Dedicated
Other ____

SAMPLING EQUIPMENT

____ 2" Bladder Pump | X Bailer (Teflon)
____ Bomb Sampler | ____ Bailer (Stainless Steel)
____ Dipper | ____ Submersible Pump
____ Well Wizard™ | ____ Dedicated
Other ____

WELL INTEGRITY: OK | LOCK Locked

REMARKS: All samples taken

pH, E C, Temp Meter Calibration Date 5/19/98 | Time ____ | Meter Serial No 867M
E C 1000 ____ / ____ | pH 7 ____ / ____ | pH 10 ____ / ____ | pH 4 ____ / ____
Temperature °F ____

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WATER SAMPLE FIELD DATA SHEET

Rev 1/97

OWT

PROJECT NO 21775-302.003 | SAMPLE ID A-8(22')
PURGED BY M.G./C.C. | CLIENT NAME ARCO # 4931
SAMPLED BY ↓ | LOCATION OAKLAND, CA

TYPE Groundwater X | Surface Water ____ | Leachate ____ | Other ____

CASING DIAMETER (inches) 2 ____ | 3 X | 4 ____ | 4.5 ____ | 6 ____ | Other ____

CASING ELEVATION (feet/MSL)	NR	VOLUME IN CASING (gal)	4.88
DEPTH OF WELL (feet)	22.1	CALCULATED PURGE (gal)	14.65
DEPTH OF WATER (feet)	8.78	ACTUAL PURGE VOL (gal)	8.0

DATE PURGED 5-19-98 | END PURGE 1141
DATE SAMPLED ↓ | SAMPLING TIME 1145

TIME (2400 HR)	VOLUME (gal)	pH (units)	E C (µmhos/cm@25°c)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
1139	5.0	6.69	1080	65.4	GRY/BRN	Heavy
	well	D.W. Gal	8.0	Gallons		
1145	Recharge	6.78	1274	66.9	clr	clr

OTHER DO=1.36 | ODOR Strong | NR (COBALT 0-100) | NR (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1) N/R

PURGING EQUIPMENT

____ 2" Bladder Pump | ____ Bailer (Teflon)
____ Centrifugal Pump | ✓ Bailer (PVC)
____ Submersible Pump | ____ Bailer (Stainless Steel)
____ Well Wizard™ | ____ Dedicated
Other ____

SAMPLING EQUIPMENT

____ 2" Bladder Pump | X Bailer (Teflon)
____ Bomb Sampler | ____ Bailer (Stainless Steel)
____ Dipper | ____ Submersible Pump
____ Well Wizard™ | ____ Dedicated
Other ____

WELL INTEGRITY: OK | LOCK none

REMARKS: All samples taken

pH, E C, Temp Meter Calibration Date 5/19/98 | Time ____ | Meter Serial No 87M

E C 1000 ____ / ____ | pH 7 ____ / ____ | pH 10 ____ / ____ | pH 4 ____ / ____

Temperature °F ____

SIGNATURE [signature] | REVIEWED BY NA | PAGE 7 OF 11

WATER SAMPLE FIELD DATA SHEET

Rev 1/97

OWT

PROJECT NO 21775-302.003 | SAMPLE ID A-G(38')
PURGED BY M.G./C.C. | CLIENT NAME ARCO # 4931
SAMPLED BY ↓ | LOCATION OAKLAND, CA

TYPE Groundwater X | Surface Water ____ | Leachate ____ | Other ____

CASING DIAMETER (inches) 2 ____ 3 ____ 4 ____ 4.5 ____ 6 X Other ____

CASING ELEVATION (feet/MSL)	NR	VOLUME IN CASING (gal)	44.32
DEPTH OF WELL (feet)	38.5	CALCULATED PURGE (gal)	132.96
DEPTH OF WATER (feet)	8.35	ACTUAL PURGE VOL (gal)	133.0

DATE PURGED 5-19-98 | END PURGE 1217
DATE SAMPLED ↓ | SAMPLING TIME 1220

TIME (2400 HR)	VOLUME (gal)	pH (units)	E C (µmhos/cm@25°c)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
1205	44.5	6.92	647	66.5	cloudy	light
1211	89.0	6.80	641	66.9	clear	clear
1217	133.0	6.78	641	66.7	"	"

OTHER DO = 1.27 | ODOR none | NR (COBALT 0-100) | NR (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1) NR

PURGING EQUIPMENT

____ 2" Bladder Pump
X Centrifugal Pump
____ Submersible Pump
____ Well Wizard™
____ Bailer (Teflon)
____ Bailer (PVC)
____ Bailer (Stainless Steel)
____ Dedicated
Other ____

SAMPLING EQUIPMENT

____ 2" Bladder Pump
____ Bomb Sampler
____ Dipper
____ Well Wizard™
X Bailer (Teflon)
____ Bailer (Stainless Steel)
____ Submersible Pump
____ Dedicated
Other ____

WELL INTEGRITY: OK | LOCK none

REMARKS: All samples taken

pH, E C, Temp Meter Calibration Date 5/19/98 | Time ____ | Meter Serial No 67M
E C 1000 ____ / ____ | pH 7 ____ / ____ | pH 10 ____ / ____ | pH 4 ____ / ____
Temperature °F ____

SIGNATURE [signature] | REVIEWED BY [signature] | PAGE 8 OF 11

WATER SAMPLE FIELD DATA SHEET

Rev 1/97

OWT

PROJECT NO 21775-302.003 | SAMPLE ID A-11 (29')
PURGED BY M.G./C.C. | CLIENT NAME ARCO # 4931
SAMPLED BY ↓ | LOCATION OAKLAND, CA

TYPE Groundwater X | Surface Water ____ | Leachate ____ | Other ____

CASING DIAMETER (inches) 2 ____ 3 X 4 ____ 4.5 ____ 6 ____ Other ____

CASING ELEVATION (feet/MSL)	NR	VOLUME IN CASING (gal)	7.51
DEPTH OF WELL (feet)	29.9	CALCULATED PURGE (gal)	22.55
DEPTH OF WATER (feet)	9.40	ACTUAL PURGE VOL (gal)	23.0

DATE PURGED 5-19-98 | END PURGE 1328
DATE SAMPLED ↓ | SAMPLING TIME 1332

TIME (2400 HR)	VOLUME (gal)	pH (units)	E.C (µmhos/cm@25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
1325	8.0	6.87	693	67.6	cloudy	mod
1326	15.5	6.83	651	68.5	cloudy	mod
1328	23.0	6.82	642	68.7	"	"

OTHER: DO = 1.47 | ODOR moderate | NR (COBALT 0-100) | NR (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1) NR

PURGING EQUIPMENT

____ 2" Bladder Pump | ____ Bailer (Teflon)
____ Centrifugal Pump | ✓ Bailer (PVC)
____ Submersible Pump | ____ Bailer (Stainless Steel)
____ Well Wizard™ | ____ Dedicated
Other ____

SAMPLING EQUIPMENT

____ 2" Bladder Pump | X Bailer (Teflon)
____ Bomb Sampler | ____ Bailer (Stainless Steel)
____ Dipper | ____ Submersible Pump
____ Well Wizard™ | ____ Dedicated
Other ____

WELL INTEGRITY OK | LOCK. NONE

REMARKS: All samples taken

pH, E C, Temp Meter Calibration Date 5/19/98 | Time ____ | Meter Serial No 87M
E C 1000 ____ / ____ | pH 7 ____ / ____ | pH 10 ____ / ____ | pH 4 ____ / ____
Temperature °F ____

SIGNATURE [signature] | REVIEWED BY [signature] | PAGE 9 OF 11

WATER SAMPLE FIELD DATA SHEET

Rev 1/97

OWT

PROJECT NO 21775-302.003 | SAMPLE ID A-12(30')
PURGED BY M.G./C.C. | CLIENT NAME ARCO# 4931
SAMPLED BY ↓ | LOCATION OAKLAND, CA

TYPE Groundwater X Surface Water ___ Leachate ___ Other ___

CASING DIAMETER (inches) 2 ___ 3 ✓ 4 ___ 4.5 ___ 6 ___ Other ___

CASING ELEVATION (feet/MSL)	NR	VOLUME IN CASING (gal)	7.79
DEPTH OF WELL (feet)	30.4	CALCULATED PURGE (gal)	23.37
DEPTH OF WATER (feet)	9.15	ACTUAL PURGE VOL (gal)	23.5

DATE PURGED 5-19-98 | END PURGE 1346
DATE SAMPLED ↓ | SAMPLING TIME 1350

TIME (2400 HR)	VOLUME (gal)	pH (units)	E C (µmhos/cm@25°c)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
1341	8.0	6.88	576	68.1	cloudy	moo
1344	16.0	6.78	611	67.9		
1346	23.5	6.83	651	68.4	↓	↓

OTHER DO = 1.13 | ODOR slight | NR (COBALT 0-100) | NR (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1) NR

PURGING EQUIPMENT

___ 2" Bladder Pump | ___ Bailer (Teflon)
✓ Centrifugal Pump | ___ Bailer (PVC)
___ Submersible Pump | ___ Bailer (Stainless Steel)
___ Well Wizard™ | ___ Dedicated
Other ___

SAMPLING EQUIPMENT

___ 2" Bladder Pump | X Bailer (Teflon)
___ Bomb Sampler | ___ Bailer (Stainless Steel)
___ Dipper | ___ Submersible Pump
___ Well Wizard™ | ___ Dedicated
Other ___

WELL INTEGRITY OK | LOCK none

REMARKS All samples taken

pH, E C, Temp Meter Calibration Date 5/19/98 | Time ___ | Meter Serial No 87m
E C 1000 ___ / ___ | pH 7 ___ / ___ | pH 10 ___ / ___ | pH 4 ___ / ___
Temperature °F ___

SIGNATURE [signature] | REVIEWED BY [signature] | PAGE 10 OF 11

WATER SAMPLE FIELD DATA SHEET

Rev 1/97

OWT

PROJECT NO 21775-302.003 SAMPLE ID A-13
PURGED BY M. G. / C. C. CLIENT NAME ARCO # 4931
SAMPLED BY ↓ LOCATION OAKLAND, CA

TYPE Groundwater X Surface Water ____ Leachate ____ Other ____
CASING DIAMETER (inches) 2 ____ 3 ____ 4 ____ 4.5 ____ 6 ____ Other ____

CASING ELEVATION (feet/MSL) NR VOLUME IN CASING (gal.) ____
DEPTH OF WELL (feet) ____ CALCULATED PURGE (gal.) ____
DEPTH OF WATER (feet) ____ ACTUAL PURGE VOL (gal.) ____

DATE PURGED 5-19-98 END PURGE ____
DATE SAMPLED ↓ SAMPLING TIME ____

TIME (2400 HR)	VOLUME (gal.)	pH (units)	E C (µmhos/cm@25°c)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
NO Samples	Taken			Well	Point	Over

OTHER DO= ODOR ____ NR (COBALT 0-100) NR (NTU 0-200)

FIELD QC SAMPLES COLLECTED AT THIS WELL (i.e. FB-1, XDUP-1) NR

PURGING EQUIPMENT

____ 2" Bladder Pump ____ Bailer (Teflon)
____ Centrifugal Pump ____ Bailer (PVC)
____ Submersible Pump ____ Bailer (Stainless Steel)
____ Well Wizard™ ____ Dedicated
Other ____

SAMPLING EQUIPMENT

____ 2" Bladder Pump X Bailer (Teflon)
____ Bomb Sampler ____ Bailer (Stainless Steel)
____ Dipper ____ Submersible Pump
____ Well Wizard™ ____ Dedicated
Other ____

WELL INTEGRITY ____ LOCK ____

REMARKS: All Samples Taken

pH, E C, Temp Meter Calibration Date 5/19/98 Time ____ Meter Serial No ____
E C 1000 ____ / ____ pH 7 ____ / ____ pH 10 ____ / ____ pH 4 ____ / ____
Temperature °F ____

SIGNATURE [signature] REVIEWED BY [signature] PAGE 11 OF 11

ARCO Products Company
Division of Atlantic/Richfield Company

Chain of Custody

Task Order No. 7320 OC

ARCO Facility no. 4931	City (Facility) Oakland	Project manager (Consultant) Glen Vandeveen	Laboratory name
ARCO engineer Paul Supple	Telephone no. (ARCO)	Telephone no. (Consultant) (408) 453-7300	Fax no. (Consultant) (408) 437-9526
Consultant name EMCON		Address (Consultant) 1921 Ringwood Ave, San Jose, CA	Contract number

Method of shipment

Special detection Limit/reporting

Special instructions

Remarks

Lab Number

Turnaround Time

Priority Rush 1 Business Day

Rush 2 Business Days

Expedited 5 Business Days

Standard 10 Business Days

Sample I.D.	Lab no.	Container no.	Matrix: Soil	Matrix: Water	Matrix: Other	Preservation: Ice	Preservation: Acid	Sampling date	Sampling time	BTEX EPA 8020 / EPA 602 / EPA 8020 / EPA 8021	TPH as Gas EPA 5030 / EPA 8015 Gas ☐ Diesel ☐	Oil and Grease (413.1) ☐ (413.2) ☐	TPH EPA 418.1/SM 5300E	EPA 601/8010	EPA 624/8240	EPA 625/8270	TCLP Semi Metals ☐ VOA ☐ VOA ☐	CAM Metals EPA 6010/7000 ☐TTLC ☐STLC	Lead Org/DHS ☐ Lead EPA 7420/7421 ☐		
A-3(17')		2		X		X	HCl	5-19-98	1023	X											
A-5(25')									1043	X											
A-4(25')									1102	X											
A-7(22')									1117	X											
A-8(22')									1145	X											
A-9(23')									1220	X											
A-2(15')									1245	X											
A-4(20')									1310	X											
A-11(25')									1332	X											
A-12(30')									1350	X											
A-13( )									—	No Sample taken											

Condition of sample:

Temperature received:

	Date	Time		Date	Time
Relinquished by sampler: Manuel J. Gallegos	5-20-98	0800	Received by:	5/20/98	9:38 AM
Relinquished by:	Date	Time	Received by:		
Relinquished by:	Date	Time	Received by laboratory:	Date	Time

Distribution: White Copy – Laboratory: Canary Copy – ARCO Environmental Engineering: Pink Copy – Consultant

APPENDIX D

REMEDIAL SYSTEM PERFORMANCE SUMMARY

APPENDIX D

REMEDIAL SYSTEM PERFORMANCE SUMMARY

GWE System

Groundwater extraction (GWE) was conducted intermittently between November 10, 1992, and July 5, 1995. The GWE system was comprised of electric GWE pumps in Wells A-9, AR-1, AR-2, and AR-3, and three 1,500-pound granular activated carbon vessels arranged in series. The GWE system was permitted by East Bay Municipal Utility District Permit Account Number 502-62131. Based on Alameda County Health Care Services Agency authorization that GWE at the site was no longer required, the permit was relinquished during the second quarter 1996. Overall, 4.6 million gallons of groundwater were extracted and less than 0.06 gallon of benzene removed. Please refer to the Second Quarter 1997 Groundwater Monitoring Report for historical GWE system performance and analytical data.

Intrinsic Bioremediation Evaluation

At the request of ARCO, intrinsic bioremediation indicator parameters (bioparameters) were monitored during the fourth quarter 1996 groundwater monitoring event. Groundwater samples from Wells A-4, A-8, and A-12 were analyzed for biological oxygen demand (BOD), carbon dioxide (CO_2), chemical oxygen demand (COD), methane, nitrate, sulfate, dissolved oxygen (DO), and ferrous iron. Wells A-4 and A-8 are located within the plume; Well A-12 is located outside the plume. Based on analysis of the collected data, intrinsic bioremediation was active at the site. Please refer to the First Quarter 1997 Groundwater Monitoring Report for details.