



LOT 3873

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March 14, 2000
Project 791641

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

Re: Quarterly Groundwater Monitoring Results and Remediation System Performance
Evaluation Report, Fourth Quarter 1999, for ARCO Service Station No. 0771,
Located at 899 Rincon Avenue, Livermore, California

Dear Mr. Supple:

Pinnacle Environmental Solutions, a member of The IT Group (Pinnacle), is submitting the attached report which presents the results of the fourth quarter 1999 groundwater monitoring program at ARCO Products Company (ARCO) Service Station No. 0771, located at 899 Rincon Avenue, Livermore, California. An operation and performance summary for the site's interim soil-vapor extraction (SVE) and air-bubbling systems is also presented. The monitoring program complies with the Alameda County Health Care Services Agency (ACHCSA) requirements regarding underground tank investigations.

Please call if you have questions.

Sincerely,

Pinnacle

Glen VanderVeen
Project Manager

Dan Easter, R.G. 5722
Project Geologist

Attachment: Quarterly Groundwater Monitoring Report, Fourth Quarter 1999

cc: Susan Hugo, ACHCSA
Danielle Stefani, City of Livermore Fire Dept.

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ENVIRONMENTAL
PROTECTION

Date: March 14, 2000**ARCO QUARTERLY GROUNDWATER MONITORING REPORT**

Station No.: 771 Address: 899 Rincon Avenue, Livermore, California
 Pinnacle Project No.: 791641
 ARCO Environmental Engineer/Phone No.: Paul Supple /(925) 299-8891
 Pinnacle Project Manager/Phone No.: Glen VanderVeen /(510) 740-5807
 Primary Agency/Regulatory ID No.: ACHCSA

WORK PERFORMED THIS QUARTER (FOURTH - 1999):

1. Prepared and submitted quarterly groundwater monitoring report for third quarter 1999.
2. Performed quarterly groundwater monitoring and sampling for fourth quarter 1999.
3. Repaired compressor and restarted air-bubbling system.
4. Shut down air-bubbling system on 12/20/99 per the ARCO Y2K program.

WORK PROPOSED FOR NEXT QUARTER (FIRST - 2000):

1. Prepare and submit quarterly groundwater monitoring report for fourth quarter 1999.
2. Perform quarterly groundwater monitoring and sampling for first quarter 2000.
3. Continue operation of air-bubbling system.

QUARTERLY MONITORING:

Current Phase of Project: Quarterly Groundwater Monitoring and Operation and Maintenance of Remediation Systems.
Soil Vapor Extraction (SVE) system was shut down on 10-10-95 due to low hydrocarbon concentrations in extracted vapor.
Air bubbling system pulses hourly at 1 to 2 scfm per well in wells VW-1, MW-1, MW-2, MW-4, MW-5, MW-7, and RW-1.

Frequency of Sampling: Annual (1st Quarter): MW-4, MW-7, MW-9, MW-10, RW-1
Semi-Annual (1st/3rd Quarter): MW-8, MW-11
Quarterly: MW-1, MW-2, MW-3, MW-5, MW-6
Monthly (SVE)

Frequency of Monitoring: Quarterly (groundwater), Monthly (SVE and air-bubbling systems)

Is Floating Product (FP) Present On-site: Yes No

Cumulative FP Recovered to Date: 3.06 gallons, Wells MW-1, MW-2, and MW-5
 FP Recovered This Quarter: None (FP was last recovered in 1992.)
 Bulk Soil Removed to Date: 1,700 cubic yards of TPH-impacted soil
 Bulk Soil Removed This Quarter: None
 Water Wells or Surface Waters
 Within 2000 ft., impacted by site: None
 Current Remediation Techniques: Enhanced Bioremediation (Air-Bubbling)
 Average Depth to Groundwater: 31.4 feet
 Groundwater Flow Direction and Gradient
 (Average): 0.06 ft/ft toward north-northeast

ATTACHMENTS:

- Table 1 - Historical Groundwater Elevation and Analytical Data, Petroleum Hydrocarbons and Their Constituents
- Table 2 - Groundwater Flow Direction and Gradient
- Figure 1 - Groundwater Analytical Summary Map
- Figure 2 - Groundwater Elevation Contour Map
- Appendix A - Sampling and Analysis Procedures
- Appendix B - Certified Analytical Reports and Chain-of-Custody Documentation
- Appendix C - Field Data Sheets

Table 1
Historical Groundwater Elevation and Analytical Data
Petroleum Hydrocarbons and Their Constituents
1995 - Present**

ARCO Service Station 771
899 Rincon Avenue, Livermore, California

Well Designation	Water Level Field Date	Top of Casing Elevation	Depth to Water	Groundwater Elevation	Floating Product Thickness	Water Sample Field Date	TPHG LUFT Method	Benzene EPA 8021B*	Toluene EPA 8021B*	Ethylbenzene EPA 8021B*	Total Xylenes EPA 8021B*	MTBE EPA 8021B*	MTBE EPA 8240	TPHD LUFT Method	TRPH EPA 418.1	Dissolved Oxygen	Purged/Not Purged
		ft-MSL	feet	ft-MSL	feet		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	(P/NP)
MW-1	03-20-95	451.73	24.50	427.23	ND	03-20-95	90,000	1,800	1,100	1,000	5,600	--	--	--	--		
MW-1	06-02-95	451.73	25.60	426.13	ND	06-03-95	81,000	2,000	1,400	990	4,600	--	--	--	--		
MW-1	08-23-95	451.73	29.04	422.69	ND	08-23-95	44,000	2,400	1,900	670	3,800	<300	--	--	--		
MW-1	12-04-95	451.73	31.31	420.42	ND	12-04-95	22,000	870	660	390	2,200	--	100	--	--		
MW-1	02-20-96	451.73	22.26	429.47	ND	02-20-96	21,000	1,500	1,200	650	3,500	<300	--	--	--		
MW-1	05-15-96	451.73	23.42	428.31	ND	05-15-96	36,000	3,000	2,500	960	5,700	<250	--	--	--		
MW-1	08-13-96	451.73	26.83	424.90	ND	08-13-96	19,000	730	580	450	2,500	<200	--	--	--		
MW-1	11-13-96	451.73	31.05	420.68	ND	11-13-96	6,600	47	16	74	160	<30	--	--	--		
MW-1	03-26-97	451.73	26.29	425.44	ND	03-27-97	1,900	100	55	37	200	<30	--	--	--		
MW-1	05-15-97	451.73	28.65	423.08	ND	05-15-97	16,000	490	250	250	1,100	<120	--	--	--		
MW-1	08-26-97	451.73	31.53	420.20	ND	08-26-97	190	7	3	6	25	<3	--	--	--		
MW-1	11-05-97	451.73	33.93	417.80	ND	11-05-97	63	1	<0.5	1	2	29	--	--	--		
MW-1	02-18-98	451.73	20.46	431.27	ND	02-18-98	23,000	1,500	610	550	3,000	<120	--	--	--		
MW-1	05-20-98	451.73	23.84	427.89	ND	05-21-98	50,000	4,400	1,900	1,400	80,000	<300	--	--	--		
MW-1	07-30-98	451.73	26.94	424.79	ND	07-30-98	150	<0.5	<0.5	<0.5	2	<3	--	--	--	8.7	P
MW-1	10-29-98	451.73	32.58	419.15	ND	10-29-98	<50	<0.5	<0.5	<0.5	2	<3	--	--	--	2.0	NP
MW-1	03-16-99	451.73	26.20	425.53	ND	03-16-99	3,200	160	32	89	390	270	--	--	--	2.0	P
MW-1	05-05-99	451.73	27.57	424.16	ND	05-05-99	3,600	140	46	76	290	170	--	--	--	11.65	P
MW-1	08-26-99	451.73	30.25	421.48	ND	08-26-99	3,200	210	29	100	220	120	--	--	--	1.43	P
MW-1	12-03-99	451.73	32.70	419.03	ND	12-03-99	53	<0.5	<0.5	<0.5	1	<3	--	--	--	2.12	NP
MW-2	03-20-95	449.49	20.27	429.22	ND	03-20-95	54,000	2,600	1,600	1,200	7,600	--	--	--	--		
MW-2	06-02-95	449.49	22.32	427.17	ND	06-03-95	37,000	2,200	800	980	4,800	--	--	--	--		

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1995 - Present**

ARCO Service Station 771
899 Rincon Avenue, Livermore, California

Well Designation	Water Level Field Date	Top of Casing Elevation	Depth to Water	Groundwater Elevation	Floating Product Thickness	Water Sample Field Date	TPHG LUFT Method	Benzene	Toluene	Ethylbenzene	Total Xylenes	MTBE	MTBE	TPHD	TRPH	Dissolved Oxygen	Purged/Not Purged
								EPA 8021B*	EPA 8021B*	EPA 8021B*	EPA 8021B*	EPA 8021B*	EPA 8240	EPA 418.1	mg/L	(P/NP)	
		ft-MSL	feet	ft-MSL	feet		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	
MW-2	08-23-95	449.49	25.69	423.80	ND	08-23-95	65,000	1,100	310	840	3,000	<500	--	--	--		
MW-2	12-04-95	449.49	28.52	420.97	ND	12-04-95	19,000	680	150	410	1,600	--	--	--	--		
MW-2	02-20-96	449.49	19.00	430.49	ND	02-20-96	22,000	1,200	240	590	2,200	<300	--	--	--		
MW-2	05-15-96	449.49	20.03	429.46	ND	05-15-96	25,000	1,200	240	610	2,100	<300	--	--	--		
MW-2	08-13-96	449.49	24.44	425.05	ND	08-13-96	19,000	640	110	420	1,200	<300	--	--	--		
MW-2	11-13-96	449.49	28.42	421.07	ND	11-13-96	15,000	260	52	220	640	<200	--	--	--		
MW-2	03-26-97	449.49	22.98	426.51	ND	03-27-97	17,000	580	120	360	980	<120	--	--	--		
MW-2	05-15-97	449.49	25.40	424.09	ND	05-15-97	18,000	420	63	340	730	<120	--	--	--		
MW-2	08-26-97	449.49	28.38	421.11	ND	08-26-97	5,300	210	26	140	270	<120	--	--	--		
MW-2	11-05-97	449.49	31.93	417.56	ND	11-05-97	560	42	3	7	9	<40	--	--	--		
MW-2	02-18-98	449.49	16.87	432.62	ND	02-18-98	18,000	710	120	480	1,100	130	--	--	--		
MW-2	05-20-98	449.49	20.29	429.20	ND	05-21-98	16,000	480	72	440	1,100	<120	--	--	--		
MW-2	07-30-98	449.49	23.51	425.98	ND	07-30-98	9,700	240	33	210	490	<120	--	--	--	9.2	P
MW-2	10-29-98	449.49	30.08	419.41	ND	10-29-98	58	<0.5	<0.5	<0.5	1	<3	--	--	--	1.0	NP
MW-2	03-16-99	449.49	23.22	426.27	ND	03-16-99	4,700	120	13	90	220	60	--	--	--	2.0	P
MW-2	05-05-99	449.49	24.05	425.44	ND	05-05-99	5,500	58	7.1	58	98	17	--	--	--	9.09	P
MW-2	08-26-99	449.49	26.44	423.05	ND	08-26-99	3,700	55	11	60	64	26	--	--	--	1.90	P
MW-2	12-03-99	449.49	30.15	419.34	ND	12-03-99	130	<0.5	<0.5	0.7	1.8	<3	--	--	--	1.96	NP
MW-3	03-20-95	450.28	22.19	428.09	ND	03-20-95	94	<0.5	<0.5	<0.5	<0.5	--	--	--	--		
MW-3	06-02-95	450.28	23.28	427.00	ND	06-02-95	72	<0.5	<0.5	<0.5	<0.5	--	--	--	--		
MW-3	08-23-95	450.28	26.55	423.73	ND	08-23-95	98	<0.5	<0.5	<0.6	1	<3	--	--	--		
MW-3	12-04-95	450.28	29.52	420.76	ND	12-04-95	<50	<0.5	<0.5	<0.5	<0.5	--	--	--	--		

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		ft-MSL	feet	ft-MSL	feet		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	(P/NP)
MW-3	02-20-96	450.28	19.83	430.45	ND	02-20-96	130	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-3	05-15-96	450.28	21.03	429.25	ND	05-15-96	120	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-3	08-13-96	450.28	25.67	424.61	ND	08-13-96	<50	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-3	11-13-96	450.28	21.57	428.71	ND	11-13-96	<50	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-3	03-26-97	450.28	24.15	426.13	ND	03-26-97	<50	1	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-3	05-15-97	450.28	26.85	423.43	ND	05-15-97	<50	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-3	08-26-97	450.28	30.07	420.21	ND	08-26-97	<50	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-3	11-05-97	450.28	32.46	417.82	ND	11-05-97	<50	<0.5	1	<0.5	<0.5	<0.5	--	--	--	--	
MW-3	02-18-98	450.28	17.82	432.46	ND	02-18-98	<50	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-3	05-20-98	450.28	21.41	428.87	ND	05-20-98	<50	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	--	
MW-3	07-30-98	450.28	26.41	423.87	ND	07-30-98	<50	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	9.6	P
MW-3	10-29-98	450.28	31.33	418.95	ND	10-29-98	<50	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	1.0	P
MW-3	03-16-99	450.28	24.61	425.67	ND	03-16-99	<50	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--	1.0	P
MW-3	05-05-99	450.28	25.75	424.53	ND	05-05-99	140	<0.5	<0.5	0.6	<0.5	<0.5	--	--	--	4.43	P
MW-3	08-26-99	450.28	28.49	421.79	ND	08-26-99	80	0.6	0.6	0.6	1	<0.5	--	--	--	1.69	P
MW-3	12-03-99	450.28	31.45	418.83	ND	12-03-99	<50	<0.5	<0.5	<0.5	<1	<0.5	--	--	--	2.26	P
MW-4	03-20-95	451.09	22.68	428.41	ND	03-20-95	12,000	1,000	100	450	700	--	--	--	--	--	
MW-4	06-02-95	451.09	24.41	426.68	ND	06-02-95	9,000	850	56	380	430	--	--	--	--	--	
MW-4	08-23-95	451.09	27.72	423.37	ND	08-23-95	5,300	400	25	240	170	<100	--	--	--	--	
MW-4	12-04-95	451.09	29.85	421.24	ND	12-04-95	6,700	100	<10	90	38	--	--	--	--	--	
MW-4	02-20-96	451.09	21.16	429.93	ND	02-20-96	7,000	360	22	180	160	<70	--	--	--	--	
MW-4	05-15-96	451.09	22.18	428.91	ND	05-15-96	Not sampled: well sampled annually, during the first quarter										

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Well Designation	Water Level Field Date	Top of Casing Elevation ft-MSL	Depth to Water feet	Groundwater Elevation ft-MSL	Floating Product Thickness feet	Water Sample Field Date	TPHG LUFT Method µg/L	Benzene EPA 8021B* µg/L	Toluene EPA 8021B* µg/L	Ethylbenzene EPA 8021B* µg/L	Total Xylenes EPA 8021B* µg/L	MTBE EPA 8021B* µg/L	MTBE EPA 8240 µg/L	TPHD LUFT Method µg/L	TRPH EPA 418.1 mg/L	Dissolved Oxygen mg/L	Purged/ Not Purged (P/NP)
MW-4	08-13-96	451.09	26.20	424.89	ND	08-13-96	Not sampled: well sampled annually, during the first quarter										
MW-4	11-13-96	451.09	29.72	421.37	ND	11-13-96	Not sampled: well sampled annually, during the first quarter										
MW-4	03-26-97	451.09	21.86	429.23	ND	03-27-97	8,900	390	33	200	250	<70	--	--	--		
MW-4	05-15-97	451.09	26.92	424.17	ND	05-15-97	Not sampled: well sampled annually, during the first quarter										
MW-4	08-26-97	451.09	29.30	421.79	ND	08-26-97	Not sampled: well sampled annually, during the first quarter										
MW-4	11-05-97	451.09	32.14	418.95	ND	11-05-97	Not sampled: well sampled annually, during the first quarter										
MW-4	02-18-98	451.09	19.30	431.79	ND	02-18-98	5,300	220	19	160	130	120	--	--	--		
MW-4	05-20-98	451.09	22.40	428.69	ND	05-21-98	Not sampled: well sampled annually, during the first quarter										
MW-4	07-30-98	451.09	25.74	425.35	ND	07-30-98	Not sampled: well sampled annually, during the first quarter										
MW-4	10-29-98	451.09	31.26	419.83	ND	10-29-98	Not sampled: well sampled annually, during the first quarter										
MW-4	03-16-99	451.09	25.05	426.04	ND	03-16-99	1,900	49	<5	43	<5	82	--	--	--	1.5	P
MW-4	05-05-99	451.09	26.15	424.94	ND	05-05-99	Not sampled: well sampled annually, during the first quarter										
MW-4	08-26-99	451.09	28.60	422.49	ND	08-26-99	Not sampled: well sampled annually, during the first quarter										
MW-4	12-03-99	451.09	31.53	419.56	ND	12-03-99	Not sampled: well sampled annually, during the first quarter										
MW-5	03-20-95	451.40	23.20	428.20	ND	03-20-95	26,000	1,300	180	890	2,900	--	--	--	--		
MW-5	06-02-95	451.40	24.80	426.60	ND	06-02-95	39,000	940	160	740	1,900	--	--	--	--		
MW-5	08-23-95	451.40	28.10	423.30	ND	08-23-95	14,000	490	74	250	890	<300	--	--	--		
MW-5	12-04-95	451.40	29.83	421.57	ND	12-04-95	7,600	230	13	61	80	--	--	--	--		
MW-5	02-20-96	451.40	21.63	429.77	ND	02-20-96	4,300	220	12	45	130	<50	--	--	--		
MW-5	05-15-96	451.40	22.87	428.53	ND	05-15-96	2,200	380	17	58	84	<40	--	--	--		
MW-5	08-13-96	451.40	26.48	424.92	ND	08-13-96	1,700	150	16	24	35	47	--	--	--		
MW-5	11-13-96	451.40	29.68	421.72	ND	11-13-96	850	150	11	19	37	66	--	--	--		

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Well Designation	Water Level Field Date	Top of Casing Elevation	Depth to Water	Groundwater Elevation	Floating Product Thickness	Water Sample Field Date	TPHC LUFT Method	Benzene EPA 8021B*	Toluene EPA 8021B*	Ethylbenzene EPA 8021B*	Total Xylenes EPA 8021B*	MTBE EPA 8021B*	MTBE EPA 8240	TPHD LUFT Method	TRPH EPA 418.1	Dissolved Oxygen	Purged/ Not Purged
		ft-MSL	feet	ft-MSL	feet		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	(P/NP)
MW-5	03-26-97	451.40	25.14	426.26	ND	03-26-97	2,400	440	21	79	210	68	--	--	--		
MW-5	05-15-97	451.40	27.38	424.02	ND	05-15-97	3,900	510	19	140	240	48	--	--	--		
MW-5	08-26-97	451.40	29.89	421.51	ND	08-26-97	76	5	<0.5	2	2	9	--	--	--		
MW-5	11-05-97	451.40	32.57	418.83	ND	11-05-97	63	1	<0.5	<0.5	1	34	--	--	--		
MW-5	02-18-98	451.40	19.99	431.41	ND	02-18-98	6,200	630	70	320	640	320	--	--	--		
MW-5	05-20-98	451.40	23.21	428.19	ND	05-20-98	2,300	340	21	110	140	62	--	--	--		
MW-5	07-30-98	451.40	26.19	425.21	ND	07-30-98	<50	1	<0.5	1	1	<3	--	--	--	8.8	P
MW-5	10-29-98	451.40	31.92	419.48	ND	10-29-98	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	2.0	NP
MW-5	03-16-99	451.40	25.80	425.60	ND	03-16-99	1,300	170	8	59	65	120	--	--	--	2.0	P
MW-5	05-05-99	451.40	27.09	424.31	ND	05-05-99	320	31	1.1	13	13	19	--	--	--	12.09	P
MW-5	08-26-99	451.40	29.67	421.73	ND	08-26-99	260	13	1.7	4.2	6.3	150	--	--	--	1.31	P
MW-5	12-03-99	451.40	NM	NM	--	12-03-99	Not surveyed: well inaccessible										
MW-6	03-20-95	451.37	25.19	426.18	ND	03-20-95	2,600	210	87	82	140	--	--	2,000		2	
MW-6	06-02-95	451.37	25.75	425.62	ND	06-02-95	1,600	55	8	40	26	--	--	1,200		1	
MW-6	08-23-95	451.37	29.53	421.84	ND	08-23-95	1,400	42	3	36	13	<20	--	530		2	
MW-6	12-04-95	451.37	32.28	419.09	ND	12-04-95	2,500	52	6	59	13	--	--	1,100		2	
MW-6	02-20-96	451.37	22.27	429.10	ND	02-20-96	2,500	120	16	73	12	<30	--	--		2	
MW-6	05-15-96	451.37	23.86	427.51	ND	05-15-96	2,000	71	6	47	25	<15	--	--	--		
MW-6	08-13-96	451.37	28.55	422.82	ND	08-13-96	3,800	91	8	69	25	<20	--	--	--		
MW-6	11-13-96	451.37	32.04	419.33	ND	11-13-96	1,900	55	3	55	9	16	--	--	--		
MW-6	03-26-97	451.37	26.84	424.53	ND	03-26-97	1,800	51	5	32	15	<30	--	--	--		
MW-6	05-15-97	451.37	29.58	421.79	ND	05-15-97	2,400	46	3	29	9	<12	--	--	--		

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Well Designation	Water Level Field Date	Top of Casing Elevation	Depth to Water	Groundwater Elevation	Floating Product Thickness	Water Sample Field Date	TPHG LUFT Method	Benzene EPA 8021B*	Toluene EPA 8021B*	Ethylbenzene EPA 8021B*	Total Xylenes EPA 8021B*	MTBE EPA 8021B*	MTBE EPA 8240	TPHD LUFT Method	TRPH EPA 418.1	Dissolved Oxygen	Purged/Not Purged
		ft-MSL	feet	ft-MSL	feet		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	(P/NP)
MW-6	08-26-97	451.37	32.67	418.70	ND	08-26-97	1,400	61	6	33	10	<12	--	--	--		
MW-6	11-05-97	451.37	34.62	416.75	ND	11-05-97	690	29	3	18	3	9	--	--	--		
MW-6	02-18-98	451.37	20.09	431.28	ND	02-18-98	1,800	74	5	24	12	19	--	--	--		
MW-6	05-20-98	451.37	24.05	427.32	ND	05-20-98	1,900	280	4	31	16	9	--	--	--		
MW-6	07-30-98	451.37	28.72	422.65	ND	07-30-98	2,300	110	7	36	20	<15	--	--	--	NM	P
MW-6	10-29-98	451.37	32.77	418.60	ND	10-29-98	2,500	14	13	17	12	<12	--	--	--	1.0	P
MW-6	03-16-99	451.37	26.45	424.92	ND	03-16-99	1,200	65	4	27	13	18	--	--	--	0.5	P
MW-6	05-05-99	451.37	27.86	423.51	ND	05-05-99	2,200	53	4	26	6	25	--	--	--	5.59	P
MW-6	08-26-99	451.37	30.49	420.88	ND	08-26-99	1,100	11	6	10	4	13	--	--	--	2.35	P
MW-6	12-03-99	451.37	32.35	419.02	ND	12-03-99	370	<0.5	<0.5	0.8	<1	4	--	--	--	2.36	P
MW-7	03-20-95	450.33	22.07	428.26	ND	03-20-95	31,000	2,300	400	620	2,900	--	--	--	--		
MW-7	06-02-95	450.33	23.42	426.91	ND	06-03-95	40,000	1,400	280	610	2,400	--	--	--	--		
MW-7	08-23-95	450.33	27.13	423.20	ND	08-23-95	25,000	1,400	200	600	1,600	350	--	--	--		
MW-7	12-04-95	450.33	29.45	420.88	ND	12-04-95	23,000	1,100	74	490	720	--	--	--	--		
MW-7	02-20-96	450.33	20.25	430.08	ND	02-20-96	39,000	1,200	140	640	1,800	<400	--	--	--		
MW-7	05-15-96	450.33	21.38	428.95	ND	05-15-96	Not sampled: well sampled annually, during the first quarter										
MW-7	08-13-96	450.33	25.52	424.81	ND	08-13-96	Not sampled: well sampled annually, during the first quarter										
MW-7	11-13-96	450.33	29.38	420.95	ND	11-13-96	Not sampled: well sampled annually, during the first quarter										
MW-7	03-26-97	450.33	24.36	425.97	ND	03-27-97	35,000	1,100	180	460	1,700	<300	--	--	--		
MW-7	05-15-97	450.33	26.90	423.43	ND	05-15-97	Not sampled: well sampled annually, during the first quarter										
MW-7	08-26-97	450.33	30.21	420.12	ND	08-26-97	Not sampled: well sampled annually, during the first quarter										
MW-7	11-05-97	450.33	32.49	417.84	ND	11-05-97	Not sampled: well sampled annually, during the first quarter										

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Well Designation	Water Level Field Date	Top of Casing Elevation	Depth to Water	Groundwater Elevation	Floating Product Thickness	Water Sample Field Date	TPHG LUFT Method	Benzene EPA 8021B*	Toluene EPA 8021B*	Ethylbenzene EPA 8021B*	Total Xylenes EPA 8021B*	MTBE EPA 8021B*	MTBE EPA 8240	TPHD LUFT Method	TRPH EPA 418.1	Dissolved Oxygen	Purged/Not Purged
		ft-MSL	feet	ft-MSL	feet		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	(P/NP)
MW-7	02-18-98	450.33	18.10	432.23	ND	02-18-98	19,000	1,100	120	460	1,700	240	--	--	--		
MW-7	05-20-98	450.33	21.68	428.65	ND	05-21-98	Not sampled: well sampled annually, during the first quarter										
MW-7	07-30-98	450.33	26.07	424.26	ND	07-30-98	Not sampled: well sampled annually, during the first quarter										
MW-7	10-29-98	450.33	31.13	419.20	ND	10-29-98	Not sampled: well sampled annually, during the first quarter										
MW-7	03-16-99	450.33	24.45	425.88	ND	03-16-99	8,600	430	51	200	680	<120	--	--	--	1.5	P
MW-7	05-05-99	450.33	25.84	424.49	ND	05-05-99	Not sampled: well sampled annually, during the first quarter										
MW-7	08-26-99	450.33	28.28	422.05	ND	08-26-99	Not sampled: well sampled annually, during the first quarter										
MW-7	12-03-99	450.33	31.57	418.76	ND	12-03-99	Not sampled: well sampled annually, during the first quarter										
MW-8	03-20-95	449.43	24.75	424.68	ND	03-20-95	<50	<0.5	<0.5	<0.5	<0.5	--	--	--	--		
MW-8	06-02-95	449.43	24.95	424.48	ND	06-02-95	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-8	08-23-95	449.43	30.94	418.49	ND	08-23-95	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--		
MW-8	12-04-95	449.43	31.99	417.44	ND	12-04-95	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-8	02-20-96	449.43	21.13	428.30	ND	02-20-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--		
MW-8	05-15-96	449.43	21.96	427.47	ND	05-15-96	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-8	08-13-96	449.43	30.20	419.23	ND	08-13-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--		
MW-8	11-13-96	449.43	33.24	416.19	ND	11-13-96	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-8	03-26-97	449.43	26.85	422.58	ND	03-26-97	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--		
MW-8	05-15-97	449.43	29.69	419.74	ND	05-15-97	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-8	08-26-97	449.43	34.00	415.43	ND	08-26-97	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--		
MW-8	11-05-97	449.43	35.94	413.49	ND	11-05-97	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-8	02-18-98	449.43	18.18	431.25	ND	02-18-98	<50	1	1	<0.5	1	<3	--	--	--		
MW-8	05-20-98	449.43	22.85	426.58	ND	05-20-98	Not sampled: well sampled semi-annually, during the first and third quarters										

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Well Designation	Water Level Field Date	Top of Casing Elevation	Depth to Water	Groundwater Elevation	Floating Product Thickness	Water Sample Field Date	TPHG LUFT Method	Benzene EPA 8021B*	Toluene EPA 8021B*	Ethylbenzene EPA 8021B*	Total Xylenes EPA 8021B*	MTBE EPA 8021B*	MTBE EPA 8240	TPHD LUFT Method	TRPH EPA 418.1	Dissolved Oxygen	Purged/ Not Purged
MW-8	07-30-98	449.43	30.31	419.12	ND	07-30-98	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	8.2	NP
MW-8	10-29-98	449.43	35.88	413.55	ND	10-29-98	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-8	03-16-99	449.43	28.50	420.93	ND	03-16-99	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	1.0	NP
MW-8	05-05-99	449.43	29.76	419.67	ND	05-05-99	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-8	08-26-99	449.43	33.51	415.92	ND	08-26-99	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	4.93	P
MW-8	12-03-99	449.43	35.83	413.60	ND	12-03-99	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-9	03-20-95	449.21	19.11	430.10	ND	03-20-95	<50	<0.5	<0.5	<0.5	<0.5	--	--	--	--	--	--
MW-9	06-02-95	449.21	21.23	427.98	ND	06-02-95	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-9	08-23-95	449.21	24.33	424.88	ND	08-23-95	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	--	--
MW-9	12-04-95	449.21	27.90	421.31	ND	12-04-95	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-9	02-20-96	449.21	17.86	431.35	ND	02-20-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	--	--
MW-9	05-15-96	449.21	18.69	430.52	ND	05-15-96	Not sampled: well sampled annually, during the first quarter										
MW-9	08-13-96	449.21	24.17	425.04	ND	08-13-96	Not sampled: well sampled annually, during the first quarter										
MW-9	11-13-96	449.21	28.01	421.20	ND	11-13-96	Not sampled: well sampled annually, during the first quarter										
MW-9	03-26-97	449.21	22.58	426.63	ND	03-26-97	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	--	--
MW-9	05-15-97	449.21	25.12	424.09	ND	05-15-97	Not sampled: well sampled annually, during the first quarter										
MW-9	08-26-97	449.21	28.28	420.93	ND	08-26-97	Not sampled: well sampled annually, during the first quarter										
MW-9	11-05-97	449.21	31.18	418.03	ND	11-05-97	Not sampled: well sampled annually, during the first quarter										
MW-9	02-18-98	449.21	16.03	433.18	ND	02-18-98	<50	1	1	<0.5	1	<3	--	--	--	--	--
MW-9	05-20-98	449.21	19.31	429.90	ND	05-20-98	Not sampled: well sampled annually, during the first quarter										
MW-9	07-30-98	449.21	24.90	424.31	ND	07-30-98	Not sampled: well sampled annually, during the first quarter										
MW-9	10-29-98	449.21	30.08	419.13	ND	10-29-98	Not sampled: well sampled annually, during the first quarter										

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Well Designation	Water Level Field Date	Top of Casing Elevation	Depth to Water	Groundwater Elevation	Floating Product Thickness	Water Sample Field Date	TPHG LUFT Method	Benzene EPA 8021B*	Toluene EPA 8021B*	Ethylbenzene EPA 8021B*	Total Xylenes EPA 8021B*	MTBE EPA 8021B*	MTBE EPA 8240	TPHD LUFT Method	TRPH EPA 418.1	Dissolved Oxygen	Purged/ Not Purged	
		ft-MSL	feet	ft-MSL	feet													
MW-9	03-16-99	449.21	22.68	426.53	ND	03-16-99	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	1.0	P	
MW-9	05-05-99	449.21	23.82	425.39	ND	05-05-99	Not sampled: well sampled annually, during the first quarter											
MW-9	08-26-99	449.21	26.57	422.64	ND	08-26-99	Not sampled: well sampled annually, during the first quarter										5.08	
MW-9	12-03-99	449.21	NM	NM	--	12-03-99	Not surveyed: well inaccessible											
MW-10	03-20-95	449.22	20.96	428.26	ND	03-20-95	Not sampled: well sampled annually, during the third quarter											
MW-10	06-02-95	449.22	22.15	427.07	ND	06-02-95	Not sampled: well sampled annually, during the third quarter											
MW-10	08-23-95	449.22	24.47	424.75	ND	08-23-95	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--			
MW-10	12-04-95	449.22	26.97	422.25	ND	12-04-95	Not sampled: well sampled annually, during the third quarter											
MW-10	02-20-96	449.22	18.40	430.82	ND	02-20-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--			
MW-10	05-15-96	449.22	NM	NM	--	05-15-96	Not surveyed: vehicle was parked on well											
MW-10	08-13-96	449.22	23.70	425.52	ND	08-13-96	Not sampled: well sampled annually, during the first quarter											
MW-10	11-13-96	449.22	27.15	422.07	ND	11-13-96	Not sampled: well sampled annually, during the first quarter											
MW-10	03-26-97	449.22	22.23	426.99	ND	03-26-97	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--			
MW-10	05-15-97	449.22	24.57	424.65	ND	05-15-97	Not sampled: well sampled annually, during the first quarter											
MW-10	08-26-97	449.22	27.62	421.60	ND	08-26-97	Not sampled: well sampled annually, during the first quarter											
MW-10	11-05-97	449.22	30.79	418.43	ND	11-05-97	Not sampled: well sampled annually, during the first quarter											
MW-10	02-18-98	449.22	NM	NM	--	02-18-98	Not sampled: car parked on well											
MW-10	05-20-98	449.22	NM	NM	--	05-20-98	Not sampled: well sampled annually, during the first quarter											
MW-10	07-30-98	449.22	23.90	425.32	ND	07-30-98	Not sampled: well sampled annually, during the first quarter											
MW-10	10-29-98	449.22	30.55	418.67	ND	10-29-98	Not sampled: well sampled annually, during the first quarter											
MW-10	03-16-99	449.22	23.05	426.17	ND	03-16-99	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	1.0	P	
MW-10	05-05-99	449.22	24.00	425.22	ND	05-05-99	Not sampled: well sampled annually, during the first quarter											

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MW-10	08-26-99	449.22	26.50	422.72	ND	08-26-99	Not sampled: well sampled annually, during the first quarter									5.15	
MW-10	12-03-99	449.22	30.80	418.42	ND	12-03-99	Not sampled: well sampled annually, during the first quarter										
MW-11	03-20-95	448.02	25.02	423.00	ND	03-20-95	<50	<0.5	<0.5	<0.5	<0.5	--	--	--	--		
MW-11	06-02-95	448.02	23.82	424.20	ND	06-02-95	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-11	08-23-95	448.02	30.15	417.87	ND	08-23-95	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--		
MW-11	12-04-95	448.02	31.63	416.39	ND	12-04-95	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-11	02-20-96	448.02	20.94	427.08	ND	02-20-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--		
MW-11	05-15-96	448.02	23.03	424.99	ND	05-15-96	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-11	08-13-96	448.02	29.19	418.83	ND	08-13-96	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--		
MW-11	11-13-96	448.02	31.96	416.06	ND	11-13-96	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-11	03-26-97	448.02	26.61	421.41	ND	03-26-97	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--		
MW-11	05-15-97	448.02	29.39	418.63	ND	05-15-97	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-11	08-26-97	448.02	33.47	414.55	ND	08-26-97	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--		
MW-11	11-05-97	448.02	35.12	412.90	ND	11-05-97	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-11	02-18-98	448.02	18.03	429.99	ND	02-18-98	<50	<0.5	<0.5	<0.5	1	<3	--	--	--		
MW-11	05-20-98	448.02	23.00	425.02	ND	05-20-98	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-11	07-30-98	448.02	29.30	418.72	ND	07-30-98	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	5.6	P
MW-11	10-29-98	448.02	34.47	413.55	ND	10-29-98	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-11	03-16-99	448.02	27.88	420.14	ND	03-16-99	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	1.0	P
MW-11	05-05-99	448.02	26.85	421.17	ND	05-05-99	Not sampled: well sampled semi-annually, during the first and third quarters										
MW-11	08-26-99	448.02	32.74	415.28	ND	08-26-99	<50	<0.5	<0.5	<0.5	<0.5	<3	--	--	--	4.59	P
MW-11	12-03-99	448.02	34.70	413.32	ND	12-03-99	Not sampled: well sampled semi-annually, during the first and third quarters										

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		ft-MSL	feet	ft-MSL	feet		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L	(P/NP)
RW-1	03-20-95	451.67	23.76	427.91	ND	03-20-95	15,000	1,000	140	310	950	--	--	--	--		
RW-1	06-02-95	451.67	25.12	426.55	ND	06-02-95	12,000	1,300	280	420	1,100	--	--	--	--		
RW-1	08-23-95	451.67	28.80	422.87	ND	08-23-95	8,200	520	190	240	610	<50	--	--	--		
RW-1	12-04-95	451.67	31.15	420.52	ND	12-04-95	2,600	140	59	83	210	--	--	--	--		
RW-1	02-20-96	451.67	21.45	430.22	ND	02-20-96	6,300	410	160	180	650	<40	--	--	--		
RW-1	05-15-96	451.67	22.97	428.70	ND	05-15-96	Not sampled: well sampled annually, during the first quarter										
RW-1	08-13-96	451.67	24.74	426.93	ND	08-13-96	Not sampled: well sampled annually, during the first quarter										
RW-1	11-13-96	451.67	30.69	420.98	ND	11-13-96	Not sampled: well sampled annually, during the first quarter										
RW-1	03-26-97	451.67	25.69	425.98	ND	03-26-97	500	57	3	6	18	54	--	--	--		
RW-1	05-15-97	451.67	28.19	423.48	ND	05-15-97	Not sampled: well sampled annually, during the first quarter										
RW-1	08-26-97	451.67	31.21	420.46	ND	08-26-97	Not sampled: well sampled annually, during the first quarter										
RW-1	11-05-97	451.67	33.67	418.00	ND	11-05-97	Not sampled: well sampled annually, during the first quarter										
RW-1	02-18-98	451.67	20.14	431.53	ND	02-18-98	9,400	200	70	190	710	<60	--	--	--		
RW-1	05-20-98	451.67	23.43	428.24	ND	05-20-98	Not sampled: well sampled annually, during the first quarter										
RW-1	07-30-98	451.67	27.42	424.25	ND	07-30-98	Not sampled: well sampled annually, during the first quarter										
RW-1	10-29-98	451.67	32.47	419.20	ND	10-29-98	Not sampled: well sampled annually, during the first quarter										
RW-1	03-16-99	451.67	25.45	426.22	ND	03-16-99	1,100	140	19	45	83	530	--	--	--	1.0	NP
RW-1	05-05-99	451.67	27.23	424.44	ND	05-05-99	Not sampled: well sampled annually, during the first quarter										
RW-1	08-26-99	451.67	29.98	421.69	ND	08-26-99	Not sampled: well sampled annually, during the first quarter										
RW-1	12-03-99	451.67	32.38	419.29	ND	12-03-99	Not sampled: well sampled annually, during the first quarter										

Table 1
Historical Groundwater Elevation and Analytical Data
Petroleum Hydrocarbons and Their Constituents
1995 - Present**

ARCO Service Station 771
899 Rincon Avenue, Livermore, California

Well Designation	Water Level Field Date	Top of Casing Elevation ft-MSL	Depth to Water feet	Groundwater Elevation ft-MSL	Floating Product Thickness feet	Water Sample Field Date	TPHG LUFT Method µg/L	Benzene EPA 8021B* µg/L	Toluene EPA 8021B* µg/L	Ethylbenzene EPA 8021B* µg/L	Total Xylenes EPA 8021B* µg/L	MTBE EPA 8021B* µg/L	MTBE EPA 8240 µg/L	TPHD LUFT Method µg/L	TRPH EPA 418.1 mg/L	Dissolved Oxygen mg/L	Purged/ Not Purged (P/NP)
ft-MSL: elevation in feet, relative to mean sea level TPHG: total petroleum hydrocarbons as gasoline, California DHS LUFT Method MTBE: Methyl tert-butyl ether EPA: United States Environmental Protection Agency *: EPA method 8020 prior to 12/03/99 TPHD: total petroleum hydrocarbons as diesel, California DHS LUFT Method TRPH: total recoverable petroleum hydrocarbons µg/L: micrograms per liter mg/L: milligrams per liter ND: none detected NM: not measured -: not analyzed or not applicable <: less than laboratory detection limit stated to the right **: For previous historical groundwater elevation and analytical data please refer to <i>Fourth Quarter 1995 Groundwater Monitoring Program Results and Remediation System Performance Evaluation Report, ARCO Service Station 771, Livermore, California, (EMCON, March 1, 1996).</i>																	

Table 2
Groundwater Flow Direction and Gradient
1995 - Present

ARCO Service Station 771
899 Rincon Avenue, Livermore, California

Date Measured	Average Flow Direction	Average Hydraulic Gradient
03-20-95	Northwest	0.03
06-02-95	North-Northwest	0.014
08-23-95	North-Northwest	0.03
12-04-95	North-Northwest	0.03
02-20-96	Northwest	0.016
05-15-96	Northwest	0.024
08-13-96	North-Northwest	0.03
11-13-96	North-Northwest	0.031
03-26-97	North-Northwest	0.044
05-15-97	North-Northwest	0.031
08-26-97	North-Northwest	0.042
11-05-97	North-Northwest	0.03
02-18-98	Northwest	0.01
05-20-98	Northwest	0.03
07-30-98	North	0.04
10-29-98	North	0.005
03-16-99	North-Northwest	0.03
05-05-99	North	0.04
08-26-99	North-Northwest	0.05
12-03-99	North-Northeast	0.06

PROJECT NUMBER 791641

DRAWN BY K. Black 2-7-00



MW-11 (NS)

MW-8 (NS)

PINE ST.

APPROX. PROPERTY LINE

MW-6 (370/<0.5/4)

MW-3 (<50/<0.5/<3)

STATION BUILDING

RW-1 (NS)

MW-7 (NS)

MW-1 (53/<0.5/<3)

MW-5 (NS)

MW-4 (NS)

MW-2 (130/<0.5/<3)

MW-9 (NS)

RINCON AVENUE

MW-10 (NS)

EXPLANATION

● Groundwater monitoring well

○ Former underground gasoline storage tank

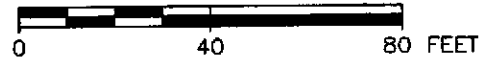
○ Existing underground gasoline storage tank

(53/<0.5/<3) Concentration of total petroleum hydrocarbons as gasoline (TPHG), benzene, and MTBE in groundwater (ug/L); samples collected 12/3/99

< Not detected at or above the indicated laboratory detection limit

NS Not sampled

SCALE



ARCO PRODUCTS COMPANY
SERVICE STATION 771

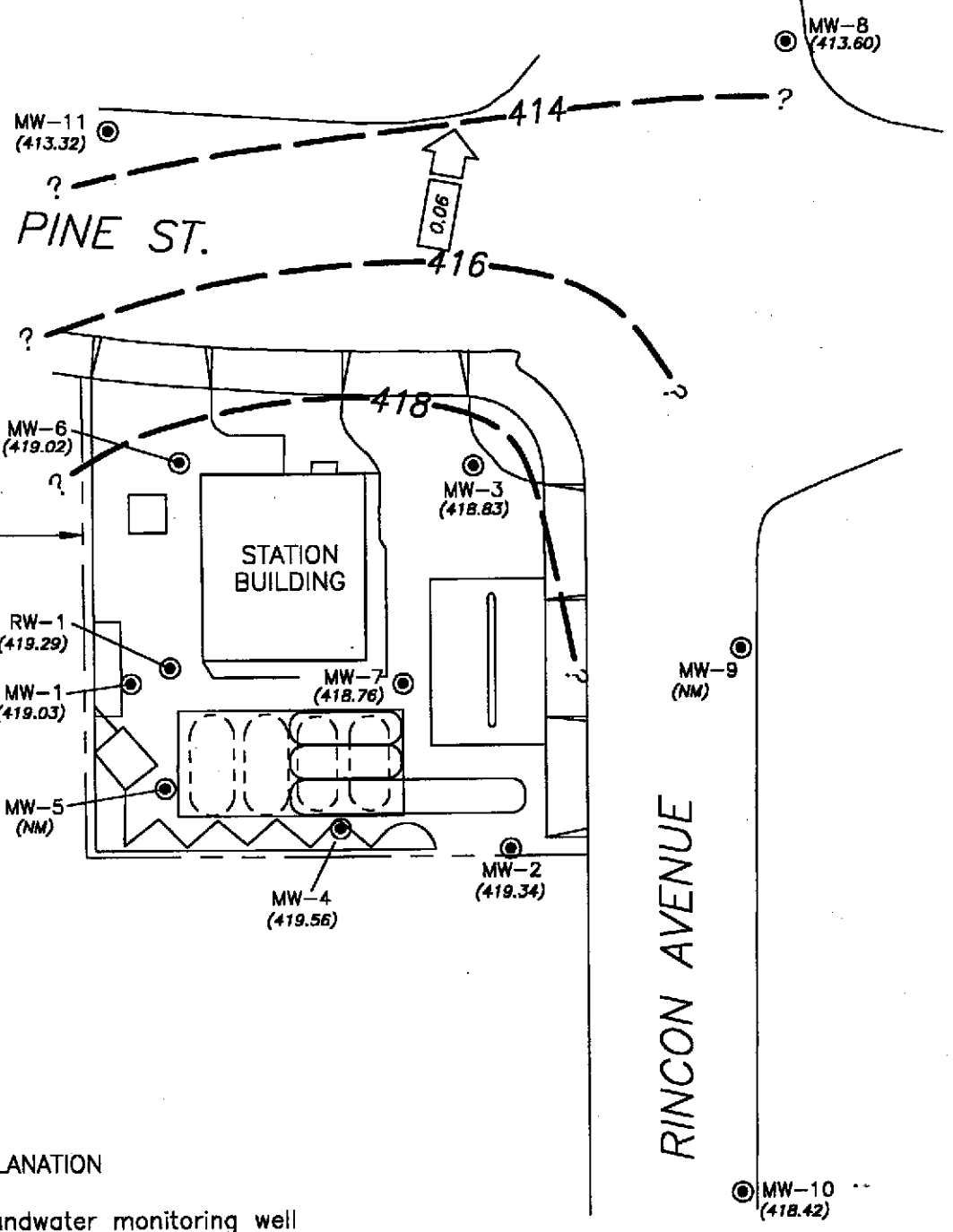
FIGURE 1
GROUNDWATER ANALYTICAL SUMMARY
FOURTH QUARTER 1999

899 RINCON AVENUE
LIVERMORE, CALIFORNIA

PROJECT NUMBER 791641
 DRAWN BY K. Black 2-7-00



APPROX. PROPERTY LINE



EXPLANATION

● Groundwater monitoring well

○ Former underground gasoline storage tank

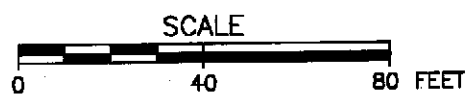
○ Existing underground gasoline storage tank

(419.56) Groundwater elevation (Ft.-MSL); measured 12/3/99

? --- Groundwater elevation contour (Ft.-MSL)

← Approximate direction of groundwater flow showing gradient

(NM) Not measured



ARCO PRODUCTS COMPANY
 SERVICE STATION 771

FIGURE 2
 GROUNDWATER ELEVATION CONTOURS
 FOURTH QUARTER 1999
 899 RINCON AVENUE
 LIVERMORE, CALIFORNIA

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 IT's San Jose or Sacramento office location for temporary storage. IT 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 IT 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 IT to an ARCO-approved laboratory by courier or taken directly to the laboratory by the environmental sampler. Sample shipments from IT 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 IT 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

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:

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

where:

P = calculated purge volume (gallons)

$\pi = 3.14$

r = radius of well casing in feet

h = height of water column in feet

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

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.

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.

MONITORING WELL PURGING PROTOCOL

FIGURE

A-1

WATER SAMPLE FIELD DATA SHEET

PROJECT NO: _____
 PURGED BY: _____
 SAMPLED BY: _____

SAMPLE ID: _____
 CLIENT NAME: _____
 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

SAMPLING EQUIPMENT

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

_____ 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 _____

APPENDIX B

**CERTIFIED ANALYTICAL REPORTS,
AND CHAIN-OF-CUSTODY DOCUMENTATION**



December 17, 1999

Service Request No.: S9903834

Mr. Glen Vanderveen
IT/EMCON
2201 Broadway, Suite 101
Oakland, CA 94612

RE: TO#24118.00/RAT8/771 LIVERMORE

Dear Mr. Vanderveen:

Enclosed are the results of the sample(s) submitted to our laboratory on December 3, 1999. All analyses were performed in accordance with our laboratory's quality assurance program. Results are intended to be considered in their entirety and apply to the sample(s) analyzed. Columbia Analytical Services is not responsible for use of less than the complete report. Signature of this CAS Analytical Report confirms that pages 2 through 10, following, have been thoroughly reviewed and approved for release.

Columbia Analytical Services is certified for environmental analyses by the California Department of Health Services (certificate number: 2352, expiration: January 31, 2001).

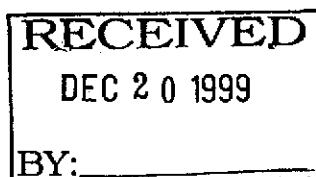
If you have any questions, please call me at (408) 748-9700.

Respectfully submitted,

Columbia Analytical Services, Inc.

Bernadette Troncales
Project Chemist

Greg Jordan
Laboratory Director



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
Project: TO#24118.00/RAT8/771 LIVERMORE
Sample Matrix: Water

Service Request: S9903834
Date Collected: 12/3/99
Date Received: 12/3/99

BTEX, MTBE and TPH as Gasoline

Sample Name: MW-3(39)
Lab Code: S9903834-001
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	1	NA	12/9/99	ND	
Benzene	EPA 5030	8021B	0.5	1	NA	12/9/99	ND	
Toluene	EPA 5030	8021B	0.5	1	NA	12/9/99	ND	
Ethylbenzene	EPA 5030	8021B	0.5	1	NA	12/9/99	ND	
Xylenes, Total	EPA 5030	8021B	1	1	NA	12/9/99	ND	
Methyl tert-Butyl Ether	EPA 5030	8021B	3	1	NA	12/9/99	ND	

Approved By: _____



Date: _____

12/17/99

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: TO#24118.00/RAT8/771 LIVERMORE
Sample Matrix: Water

Service Request: S9903834
Date Collected: 12/3/99
Date Received: 12/3/99

BTEX, MTBE and TPH as Gasoline

Sample Name: MW-2(31)
Lab Code: S9903834-002
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	1	NA	12/9/99	130	
Benzene	EPA 5030	8021B	0.5	1	NA	12/9/99	ND	
Toluene	EPA 5030	8021B	0.5	1	NA	12/9/99	ND	
Ethylbenzene	EPA 5030	8021B	0.5	1	NA	12/9/99	0.7	
Xylenes, Total	EPA 5030	8021B	1	1	NA	12/9/99	1.8	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8021B	3	1	NA	12/9/99	ND	

Approved By: _____

Handwritten signature

Date: _____

12/10/99

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: TO#24118.00/RAT8/771 LIVERMORE
Sample Matrix: Water

Service Request: S9903834
Date Collected: 12/3/99
Date Received: 12/3/99

BTEX, MTBE and TPH as Gasoline

Sample Name: MW-6(43)
Lab Code: S9903834-003
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	1	NA	12/9/99	370	
Benzene	EPA 5030	8021B	0.5	1	NA	12/9/99	ND	
Toluene	EPA 5030	8021B	0.5	1	NA	12/9/99	ND	
Ethylbenzene	EPA 5030	8021B	0.5	1	NA	12/9/99	0.8	
Xylenes, Total	EPA 5030	8021B	1	1	NA	12/9/99	ND	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8021B	3	1	NA	12/9/99	4	

Approved By: _____

[Signature]

Date: _____

[Signature]

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: TO#24118.00/RAT8/771 LIVERMORE
Sample Matrix: Water

Service Request: S9903834
Date Collected: 12/3/99
Date Received: 12/3/99

BTEX, MTBE and TPH as Gasoline

Sample Name: MW-1(33)
Lab Code: S9903834-004
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	1	NA	12/9/99	53	
Benzene	EPA 5030	8021B	0.5	1	NA	12/9/99	ND	
Toluene	EPA 5030	8021B	0.5	1	NA	12/9/99	ND	
Ethylbenzene	EPA 5030	8021B	0.5	1	NA	12/9/99	ND	
Xylenes, Total	EPA 5030	8021B	1	1	NA	12/9/99	1	
Methyl <i>tert</i> -Butyl Ether	EPA 5030	8021B	3	1	NA	12/9/99	ND	

Approved By: _____



Date: _____



COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client: ARCO Products Company
Project: TO#24118.00/RAT8/771 LIVERMORE
Sample Matrix: Water

Service Request: S9903834
Date Collected: NA
Date Received: NA

BTEX, MTBE and TPH as Gasoline

Sample Name: Method Blank
Lab Code: S991209-WB1
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	1	NA	12/9/99	ND	
Benzene	EPA 5030	8021B	0.5	1	NA	12/9/99	ND	
Toluene	EPA 5030	8021B	0.5	1	NA	12/9/99	ND	
Ethylbenzene	EPA 5030	8021B	0.5	1	NA	12/9/99	ND	
Xylenes, Total	EPA 5030	8021B	1	1	NA	12/9/99	ND	
Methyl tert -Butyl Ether	EPA 5030	8021B	3	1	NA	12/9/99	ND	

Approved By: _____

PUT

Date: _____

12/17/99

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: ARCO Products Company
Project: TO#24118.00/RAT8/771 LIVERMORE
Sample Matrix: Water

Service Request: S9903834
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: 8021B CA/LUFT

Units: PERCENT
Basis: NA

Sample Name	Lab Code	Test Notes	Percent Recovery	
			4-Bromofluorobenzene	a,a,a-Trifluorotoluene
MW-3(39)	S9903834-001		94	106
MW-2(31)	S9903834-002		92	109
MW-6(43)	S9903834-003		88	127
MW-1(33)	S9903834-004		97	101
MW-3(39)	S9903834-001MS		94	126
MW-3(39)	S9903834-001DMS		90	120
Method Blank	S991209-WB1		104	92
Lab Control Sample	S991209-LCS		92	122

CAS Acceptance Limits: 69-116 72-139

Approved By: _____  Date: 12/17/99

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: ARCO Products Company
Project: TO#24118.00/RAT8/771 LIVERMORE
Sample Matrix: Water

Service Request: S9903834
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 12/9/99

Matrix Spike/Duplicate Matrix Spike Summary
 BTEX and TPH as Gasoline

Sample Name: MW-3(39) Units: ug/L (ppb)
Lab Code: S9903834-001MS, S9903834-001DMS Basis: NA
Test Notes:

Analyte	Prep Method	Analysis Method	MRL	Percent Recovery								CAS Acceptance Limits	Relative Percent Difference
				Spike Level		Sample Result	Spike Result						
				MS	DMS		MS	DMS	MS	DMS			
Benzene	EPA 5030	8021B	0.5	25	25	ND	25	25	100	100	75-135	<1	
Toluene	EPA 5030	8021B	0.5	25	25	ND	24	23	96	92	73-136	4	
Ethylbenzene	EPA 5030	8021B	0.5	25	25	ND	25	25	100	100	69-142	<1	
Gasoline	EPA 5030	CA/LUFT	50	250	250	ND	260	260	104	104	75-135	<1	

Approved By: _____



Date: _____

12/17/99

COLUMBIA ANALYTICAL SERVICES, INC.

QA/QC Report

Client: ARCO Products Company
Project: TO#24118.00/RAT8/771 LIVERMORE
LCS Matrix: Water

Service Request: S9903834
Date Collected: NA
Date Received: NA
Date Extracted: NA
Date Analyzed: 12/9/99

Laboratory Control Sample Summary
 BTEX and TPH as Gasoline

Sample Name: Lab Control Sample
Lab Code: S991209-LCS
Test Notes:

Units: ug/L (ppb)
Basis: NA

Analyte	Prep Method	Analysis Method	True Value	Result	Percent Recovery	CAS	Result Notes
						Percent Recovery Acceptance Limits	
Benzene	EPA 5030	8021B	25	25	100	75-135	
Toluene	EPA 5030	8021B	25	23	92	73-136	
Ethylbenzene	EPA 5030	8021B	25	24	96	69-142	
Gasoline	EPA 5030	CA/LUFT	250	240	96	75-135	

Approved By: _____ *PT* Date: 12/17/99

ARCO Products Company 

Division of AtlanticRichfieldCompany

Task Order No. **Z4118.00**

S990 3834

Chain of Custody

ARCO Facility no. 0771	City (Facility) Livermore	Project manager (Consultant) Glenn VanderKoen	Laboratory name CAS
ARCO engineer Paul Supple	Telephone no. (ARCO)	Telephone no. (Consultant) (408) 453-7300	Contract number
Consultant name Emcon	Address (Consultant) 1921 Ringwood Ave. San Jose, CA 95131		

Sample I.D.	Lab no.	Container no.	Matrix			Preservation		Sampling date	Sampling time	BTEX 602/EPA 8020	EPA 1631/TPH EPA 1631/TPH EPA 1631/TPH EPA 1631/TPH	TPH Modified 8015 Gas <input type="checkbox"/> Diesel <input type="checkbox"/>	Oil and Grease 413.1 <input type="checkbox"/> 413.2 <input type="checkbox"/>	TPH EPA 418.1/SM503E	EPA 601/8010	EPA 624/8240	EPA 625/8270	TCLP Metals <input type="checkbox"/> VOA <input type="checkbox"/> VOA <input type="checkbox"/>	Semi Metals EPA 8010/7000 TTL <input type="checkbox"/> STLC <input type="checkbox"/>	Lead Org. DHS Lead EPA 7420/7421 <input type="checkbox"/>	Method of shipment	
			Soil	Water	Other	Ice	Acid															
MW-3 (39)	2	①	X			X	HCL	12-3-99	1010		X										Sampler will deliver	
MW-2 (31)	2	②	X			X	HCL		0900		X										Lowest possible.	
MW-6 (43)	2	③	X			X	HCL		1035		X											
MW-1 (32)	2	④	X			X	HCL		0940		X											
MW-5 (-)	2	⑤	X			X	HCL	✓			X	No samples taken										Special QA/QC
																					Special detection Limit/reporting	
																					Special QA/QC	
																					Remarks	
																					RAT 8	
																					2-40ml HCL	
																					VOAS	
																					#792208	
																					Lab number	
																					Turnaround time	
																					Priority Rush 1 Business Day <input type="checkbox"/>	
																					Rush 2 Business Days <input type="checkbox"/>	
																					Expedited 5 Business Days <input type="checkbox"/>	
																					Standard 10 Business Days <input checked="" type="checkbox"/>	

Condition of sample:				Temperature received: DOE: 12/17/99 R11 D3-0			
Relinquished by sampler <i>[Signature]</i>	Date 12/3/99	Time 1:20	Received by <i>[Signature]</i>	Date 12/3/99	Time 1:20		
Relinquished by	Date	Time	Received by laboratory	Date	Time		

APPENDIX C
FIELD DATA SHEETS

FIELD REPORT
DEPTH TO WATER/FLOATING PRODUCT SURVEY

PROJECT # : 792208

STATION ADDRESS : 899 Rincon Avenue, Livermore

DATE : 3-Dec-99

ARCO STATION # : 0771

FIELD TECHNICIAN : MANUEL GALLEGOS

DAY : Friday

DTW Order	WELL ID	Well Box Seal Condition	Type Of Well Lid	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	MW-10	OK	15/16"	YES	ARCO	LWC	30.80	30.80			36.1	
2	MW-9	IL	15/16"	NO	ARCO	LWC	IL					Car parked on well
3	MW-11	OK	15/16"	YES	ARCO	LWC	31.70	31.70			38.4	needs new box
4	MW-8	OK	15/16"	NO	ARCO	LWC	35.83	35.83			41.2	
5	MW-4	OK	3/4"	NO	3900 NONE	LWC	31.53	31.53			40.9	put 3900 lock on well
6	MW-7	OK	3/4"	NO	NONE	SLIP	31.07	31.07			39.2	
7	RW-1	OK	T-bar	YES	NONE	SLIP	32.38	32.38			39.3	
8	MW-3	OK	15/16"	YES	ARCO	LWC	31.45	31.45			39.3	
9	MW-2	OK	3/4"	NO	3900 NONE	LWC	30.15	30.15			37.6	put 3900 lock on well
10	MW-6	OK	15/16"	YES	3900	LWC	32.35	32.35			43.3	put 3900 lock on well
11	MW-1	OK	3/4"	NO	3900	LWC	32.70	32.70			36.2	put 3900 lock on well
12	MW-5	IL	3/4"	NO	NONE	SLIP	IL					Car parked on well
13	VW-1	OK	3/4"	NO	NONE	LWC	27.35	27.35			27.9	

SURVEY POINTS ARE TOP OF WELL CASINGS

RECEIVED

JAN 12 2000

RV. _____

WATER SAMPLE FIELD DATA SHEET

Rev. 1/97



EMCON

PROJECT NO: 792208

SAMPLE ID: MW-1(33)

PURGED BY: Manuel Gallegos

CLIENT NAME: ARCO #0771

SAMPLED BY: Manuel Gallegos

LOCATION: Livermore, California

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

CASING ELEVATION (feet/MSL): N/A VOLUME IN CASING (gal.): AIR
 DEPTH OF WELL (feet): 36.2 CALCULATED PURGE (gal.): _____
 DEPTH OF WATER (feet): 32.70 ACTUAL PURGE VOL. (gal.): ↓

DATE PURGED: _____ END PURGE: _____
 DATE SAMPLED: 12-3-99 SAMPLING TIME: 0940

TIME (2400 HR)	VOLUME (gal.)	pH (units)	E.C. (µmhos/cm@25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>0940</u>	<u>GRAB</u>	<u>8.79</u>	<u>902</u>	<u>62.1</u>	<u>clear</u>	<u>clear</u>

OTHER: Dissolved Oxygen= 2.12 ODOR: none N/A N/A
(COBALT 0-100) (NTU 0-200)

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

PURGING EQUIPMENT

SAMPLING EQUIPMENT

<u> </u> 2" Bladder Pump	<u> </u> Bailer (Teflon)	<u> </u> 2" Bladder Pump	<u> </u> Bailer (Teflon)
<u> </u> Centrifugal Pump	<u> </u> Bailer (PVC)	<u> </u> Bomb Sampler	<u> </u> Bailer (Stainless Steel)
<u> </u> Submersible Pump	<u> </u> Bailer (Stainless Steel)	<u> </u> Dipper	<u> </u> Submersible Pump
<u> </u> Well Wizard [®]	<u> </u> Dedicated	<u> </u> Well Wizard [®]	<u> </u> Dedicated **
Other: _____		Other: <u>Disposable Bailer</u>	

WELL INTEGRITY: OK LOCK: 3900

REMARKS: all samples taken

pH, E.C., Temp. Meter Calibration: Date: 12/3/99 Time: _____ Meter Serial No.: 8771

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

Temperature °F _____

SIGNATURE: [Signature] REVIEWED BY: [Signature] PAGE 1 OF 5

WATER SAMPLE FIELD DATA SHEET

Rev. 1/97



PROJECT NO: 792208
 PURGED BY: Manuel Gallegos
 SAMPLED BY: Manuel Gallegos

SAMPLE ID: MW-2(31')
 CLIENT NAME: ARCO #0771
 LOCATION: Livermore, California

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

CASING ELEVATION (feet/MSL): N/A VOLUME IN CASING (gal.): N/A
 DEPTH OF WELL (feet): 37.6 CALCULATED PURGE (gal.):
 DEPTH OF WATER (feet): 30.15 ACTUAL PURGE VOL. (gal.):

DATE PURGED: END PURGE:
 DATE SAMPLED: 12-3-99 SAMPLING TIME: 0900

TIME (2400 HR)	VOLUME (gal.)	pH (units)	E.C. (µmhos/cm @ 25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>0900</u>	<u>Clear</u>	<u>7.94</u>	<u>866</u>	<u>62.3</u>	<u>Clear</u>	<u>Clear</u>

OTHER: Dissolved Oxygen = 1.96 ODOR: None N/A N/A
(COBALT 0-100) (NTU 0-200)

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

PURGING EQUIPMENT		SAMPLING EQUIPMENT	
<input checked="" type="checkbox"/> 2" Bladder Pump	<input type="checkbox"/> Bailer (Teflon)	<input type="checkbox"/> 2" Bladder Pump	<input type="checkbox"/> Bailer (Teflon)
<input type="checkbox"/> Centrifugal Pump	<input type="checkbox"/> Bailer (PVC)	<input type="checkbox"/> Bomb Sampler	<input type="checkbox"/> Bailer (Stainless Steel)
<input type="checkbox"/> Submersible Pump	<input type="checkbox"/> Bailer (Stainless Steel)	<input type="checkbox"/> Dipper	<input type="checkbox"/> Submersible Pump
<input type="checkbox"/> Well Wizard [®]	<input type="checkbox"/> Dedicated	<input type="checkbox"/> Well Wizard [®]	<input type="checkbox"/> Dedicated
Other: <u> </u>		Other: <u>Disposible Bailer</u>	

WELL INTEGRITY: OK LOCK: 3900

REMARKS: all samples taken

pH, E.C., Temp. Meter Calibration: Date: 12/3/99 Time: 0845 Meter Serial No.: 87M
 E.C. 1000 1078/1000 pH 7 703 | 700 pH 10 999 | 1000 pH 4 578/400
 Temperature °F 64.2
 SIGNATURE: Manuel Gallegos REVIEWED BY: PAGE 2 OF 5

WATER SAMPLE FIELD DATA SHEET

Rev. 1/97



EMCON

PROJECT NO: 792208

SAMPLE ID: MW-3(39)

PURGED BY: Manuel Gallegos

CLIENT NAME: ARCO #0771

SAMPLED BY: Manuel Gallegos

LOCATION: Livermore, California

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

CASING ELEVATION (feet/MSL): N/A VOLUME IN CASING (gal.): 5.12
 DEPTH OF WELL (feet): 39.3 CALCULATED PURGE (gal.): 15.38
 DEPTH OF WATER (feet): 31.45 ACTUAL PURGE VOL. (gal.): 18.5

DATE PURGED: 12-3-99 END PURGE: 1004
 DATE SAMPLED: ↓ SAMPLING TIME: 1010

TIME (2400 HR)	VOLUME (gal.)	pH (units)	E.C. (µmhos/cm@25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>1000</u>	<u>5.8</u>	<u>7.26</u>	<u>1020</u>	<u>61.5</u>	<u>664</u>	<u>clear</u>
<u>1002</u>	<u>10.5</u>	<u>7.16</u>	<u>1133</u>	<u>63.2</u>	<u>"</u>	<u>"</u>
<u>1004</u>	<u>Well 1504 at</u>		<u>12.0</u>	<u>gallon</u>	<u>"</u>	<u>"</u>
<u>1010</u>	<u>recharge</u>	<u>7.12</u>	<u>1106</u>	<u>64.1</u>	<u>"</u>	<u>"</u>

OTHER: Dissolved Oxygen= 2.24 ODOR: none N/A N/A
(COBALT 0-100) (NTU 0-200)

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

PURGING EQUIPMENT

SAMPLING EQUIPMENT

2" Bladder Pump Bailer (Teflon) 2" Bladder Pump Bailer (Teflon)
 Centrifugal Pump Bailer (PVC) Bomb Sampler Bailer (Stainless Steel)
 Submersible Pump Bailer (Stainless Steel) Dipper Submersible Pump
 Well Wizard[®] Dedicated Well Wizard[®] Dedicated **
 Other: _____ Other: Disposable Bailer

WELL INTEGRITY: OK LOCK: AR

REMARKS: all samples taken

pH, E.C., Temp. Meter Calibration: Date: 12/3/99 Tune: _____ Meter Serial No.: 877A
 E.C. 1000 1 pH 7 1 pH 10 1 pH 4 1

Temperature °F _____
 SIGNATURE: Manuel Gallegos REVIEWED BY: [Signature] PAGE 3 OF 5

WATER SAMPLE FIELD DATA SHEET

Rev. 1/97



EMCON

PROJECT NO : 792208

SAMPLE ID : MW-5 ()

PURGED BY : Manuel Gallegos

CLIENT NAME : ARCO #0771

SAMPLED BY : Manuel Gallegos

LOCATION : Livermore, California

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

CASING ELEVATION (feet/MSL) : N/A VOLUME IN CASING (gal.) : N/A
 DEPTH OF WELL (feet) : ↓ CALCULATED PURGE (gal.) : ↓
 DEPTH OF WATER (feet) : ↓ ACTUAL PURGE VOL. (gal.) : ↓

DATE PURGED : 12-3-99 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)
<u>Car parked on top of well, no samples.</u>						

OTHER: Dissolved Oxygen= ODOR: _____ N/A N/A
(COBALT 0-100) (NTU 0-200)

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

PURGING EQUIPMENT	SAMPLING EQUIPMENT
<u> </u> 2" Bladder Pump <u> </u> Bailer (Teflon)	<u> </u> 2" Bladder Pump <u> </u> Bailer (Teflon)
<u> </u> Centrifugal Pump <u> </u> Bailer (PVC)	<u> </u> Bomb Sampler <u> </u> Bailer (Stainless Steel)
<u> </u> Submersible Pump <u> </u> Bailer (Stainless Steel)	<u> </u> Dipper <u> </u> Submersible Pump
<u> </u> Well Wizard [®] <u> </u> Dedicated	<u> </u> Well Wizard [®] <u> </u> Dedicated **
Other: _____	Other: <u>Disposable Bailer</u>

WELL INTEGRITY: HR LOCK: _____

REMARKS: HR

pH, E.C., Temp. Meter Calibration: Date: _____ Time: _____ Meter Serial No.: 8705
 E.C. 1000 / _____ pH 7 / _____ pH 10 / _____ pH 4 / _____

Temperature °F _____
 SIGNATURE: [Signature] REVIEWED BY: [Signature] PAGE 4 OF 5

WATER SAMPLE FIELD DATA SHEET

Rev. 1/97



EMCON

PROJECT NO : 792208

SAMPLE ID : MW-6(13')

PURGED BY : Manuel Gallegos

CLIENT NAME : ARCO #0771

SAMPLED BY : Manuel Gallegos

LOCATION : Livermore, California

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

CASING ELEVATION (feet/MSL) : N/A VOLUME IN CASING (gal.) : 7.15
 DEPTH OF WELL (feet) : 43.3 CALCULATED PURGE (gal.) : 21.46
 DEPTH OF WATER (feet) : 32.35 ACTUAL PURGE VOL. (gal.) : 16.0

DATE PURGED : 12-3-99 END PURGE : - 1027
 DATE SAMPLED : ↓ SAMPLING TIME : 1035

TIME (2400 HR)	VOLUME (gal.)	pH (units)	E.C. (µmhos/cm@25°C)	TEMPERATURE (°F)	COLOR (visual)	TURBIDITY (visual)
<u>1023</u>	<u>7.5</u>	<u>6.99</u>	<u>940</u>	<u>62.1</u>	<u>Clear</u>	<u>Clear</u>
<u>1025</u>	<u>15.0</u>	<u>7.04</u>	<u>1013</u>	<u>63.8</u>	<u>"</u>	<u>"</u>
	<u>well</u>	<u>Dry @</u>	<u>16.0</u>	<u>gallons</u>	<u>↓</u>	<u>↓</u>
<u>1035</u>	<u>recharge</u>	<u>7.12</u>	<u>1090</u>	<u>63.8</u>	<u>↓</u>	<u>↓</u>

OTHER: Dissolved Oxygen= 2.36 ODOR: None N/A N/A
(COBALT 0-100) (NTU 0-200)

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

PURGING EQUIPMENT

SAMPLING EQUIPMENT

<input type="checkbox"/> 2" Bladder Pump	<input type="checkbox"/> Bailer (Teflon)	<input type="checkbox"/> 2" Bladder Pump	<input type="checkbox"/> Bailer (Teflon)
<input type="checkbox"/> Centrifugal Pump	<input type="checkbox"/> Bailer (PVC)	<input type="checkbox"/> Bomb Sampler	<input type="checkbox"/> Bailer (Stainless Steel)
<input checked="" type="checkbox"/> Submersible Pump	<input type="checkbox"/> Bailer (Stainless Steel)	<input type="checkbox"/> Dipper	<input type="checkbox"/> Submersible Pump
<input type="checkbox"/> Well Wizard [®]	<input type="checkbox"/> Dedicated	<input type="checkbox"/> Well Wizard [®]	<input type="checkbox"/> Dedicated ..
Other: _____		Other: <u>Disposable Bailer</u>	

WELL INTEGRITY: OK LOCK: 3900

REMARKS: all samples taken

pH, E.C., Temp. Meter Calibration: Date: 12/3/99 Time: _____ Meter Serial No.: 8711
 E.C. 1000 1 pH 7 1 pH 10 1 pH 4 1

Temperature °F _____
 SIGNATURE: Manuel Gallegos REVIEWED BY: [Signature] PAGE 5 OF 5

ARCO Facility no. <u>0771</u>	City (Facility) <u>Livermore</u>	Project manager (Consultant) <u>Glenn VanderVeek</u>	Laboratory name <u>CAS</u>
ARCO engineer <u>Paul Supple</u>	Telephone no. (ARCO)	Telephone no. (Consultant) <u>(408) (153-7300)</u>	Contract number
Consultant name <u>Emcon</u>	Address (Consultant) <u>1921 Ringwood Ave. San Jose, CA 95131</u>		
		Fax no. (Consultant) <u>(408) 2137-9526</u>	

Sample I.D.	Lab no.	Container no.	Matrix			Preservation		Sampling date	Sampling time	BTEX 602/EPA 9020	BTEX/TPH EPA Micro/923/9015	TPH Modified 8015 Gas <input type="checkbox"/> Diesel <input type="checkbox"/>	Oil and Grease 413.1 <input type="checkbox"/> 413.2 <input type="checkbox"/>	TPH EPA 418.1/SM503E	EPA 801/8010	EPA 624/8240	EPA 625/8270	TCLP Metals <input type="checkbox"/> VOA <input type="checkbox"/>	Semi Metals <input type="checkbox"/> VOA <input type="checkbox"/>	CAM Metals EPA 801/7000 TLC <input type="checkbox"/> STL <input type="checkbox"/>	Lead Org/DHS Lead EPA 7420/7421 <input type="checkbox"/>	
			Soil	Water	Other	Ice	Acid															
<u>mw-3 (39')</u>		<u>2</u>		<u>X</u>		<u>X</u>	<u>Hcl</u>	<u>12-3-99</u>	<u>1010</u>		<u>X</u>											
<u>mw-2 (31')</u>		<u>2</u>		<u>X</u>		<u>X</u>	<u>Hcl</u>		<u>0900</u>		<u>X</u>											
<u>mw-6 (43')</u>		<u>2</u>		<u>X</u>		<u>X</u>	<u>Hcl</u>		<u>1035</u>		<u>X</u>											
<u>mw-1 (38')</u>		<u>2</u>		<u>X</u>		<u>X</u>	<u>Hcl</u>		<u>0940</u>		<u>X</u>											
<u>mw-5 (-)</u>		<u>2</u>		<u>X</u>		<u>X</u>	<u>Hcl</u>	<u>✓</u>	<u>—</u>		<u>X</u>	<u>X10 samples taken</u>										

Method of shipment
Sampler will deliver

Special detection Limit/reporting
Lowest possible.

Special QA/QC
As Normal

Remarks
RAT 8
2-40 ml Hcl
VOAS

Lab number
H797208

Turnaround time

Priority Rush 1 Business Day

Rush 2 Business Days

Expedited 5 Business Days

Standard 10 Business Days

Condition of sample:	Temperature received:
Relinquished by sampler <u>[Signature]</u>	Date <u>12/3/99</u> Time <u>1:20</u>
Relinquished by	Received by <u>[Signature]</u> Date <u>12/3/99</u> Time <u>1:20</u>
Relinquished by	Received by laboratory
Date	Time
Date	Time