PACIFIC
ENVIRONMENTAL
GROUP INC.

ENVIRONMENTAL
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June 28, 1995
Project 330-006.3E

Ms. Amy Leech
Department of Environmental Health
Environmental Protection Division
Alameda County Health Care Services Agency
1131 Harbor Bay Parkway, Suite 250
Alameda, California 94502-6577

Re: Work Plan and RI/FS Supplemental Information
ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Dear Ms. Leech:

On behalf of ARCO Products Company (ARCO), Pacific Environmental Group, Inc. (PACIFIC) has prepared this letter in response to our May 9, 1995 meeting between Alameda County Health Care Services Agency (ACHCSA), Regional Water Quality Control Board (RWQCB), ARCO, and PACIFIC regarding the site referenced above. In accordance with the May 9, 1995 meeting minutes (PACIFIC, May 24, 1995), this letter presents the following items:

- Results of recent groundwater biodegradation feasibility testing.
- Work plan for enhancing intrinsic bioremediation.
- Results of an additional risk assessment evaluation.
- Revisions to the Remedial Investigation/Feasibility Study (RI/FS) (PACIFIC, November 22, 1994).
- Future work/issues.

Each of these items is discussed below.

The purpose of this letter is to provide sufficient information to obtain ACHCSA approval of the intrinsic bioremediation work plan and revised RI/FS. It is ARCO's goal to proceed with implementation of the intrinsic bioremediation enhancement program and the RI/FS-recommended remedial action as quickly as possible. However, to expedite the process, we wish to point out that it is not necessary for these two items to be approved simultaneously. We request that the intrinsic bioremediation enhancement program be approved as soon as possible so that it can be implemented in July 1995. We also request that the RI/FS be approved in August 1995 in order to implement the approved remedial action and provide community notification in a timely manner.

GROUNDWATER BIODEGRADATION TESTING

PACIFIC conducted an *in-situ* groundwater bioremediation baseline study during the second quarter 1995. The three objectives and methodology to achieve each objective are discussed below.

1. **To improve the understanding of the factors that control the biodegradation of dissolved petroleum hydrocarbons in groundwater.** PACIFIC reviewed published technical case studies. These studies identified and described the nature of the groundwater parameters that are intrinsic indicators of *in-situ* groundwater bioremediation. The studies indicate that the extent of aerobic biodegradation of petroleum hydrocarbons is generally controlled by the amount of hydrocarbon present, the rate of oxygen transfer in the subsurface, and the background oxygen content of the groundwater. Further, hydrocarbon biodegradation is essentially an oxidation/reduction reaction where the hydrocarbons are oxidized (donates electrons) and oxygen is reduced (accepts electrons). Other compounds can act as electron acceptors, including nitrate, sulfate, and ferrous iron; however, oxygen is the favored electron acceptor in this process. As a result of the biodegradation process, the studies have shown that concentrations of the electron acceptors decrease below expected background levels. The indicator compounds with the expected concentration ranges for background and biodegradation conditions, based on literature review, are presented in Table 1. The studies reviewed are referenced at the end of this letter and served as the basis for the field testing portion of this study.

2. **To establish baseline concentrations for the groundwater parameters that are indicators of intrinsic bioremediation.** PACIFIC collected additional groundwater samples from the monitoring and domestic irrigation wells sampled during the second quarter 1995 groundwater monitoring and sampling event. The samples were analyzed by PACIFIC in the field for color, odor, pH, electrical conductivity, oxidation/reduction potential, temperature, turbidity, hydrogen sulfide, dissolved oxygen, and ferrous iron. Groundwater samples were also submitted to Sequoia Analytical for analyses of sulfate, nitrate calculated as nitrate, total petroleum hydrocarbons

calculated as gasoline (TPH-g), and benzene, toluene, ethylbenzene, and total xylenes (BTEX compounds). The results of field and laboratory analyses are presented in Table 1. The results of dissolved oxygen analyses are shown on Figure 1. The certified analytical reports, chain-of-custody documentation, and field testing procedures are presented as Attachment A.

3. **To identify and recommend strategies to enhance the intrinsic biodegradation process.** Based on the results of field and laboratory sampling, PACIFIC found that dissolved oxygen is generally a limiting factor in wells impacted by dissolved petroleum hydrocarbons. Additionally, in the wells where dissolved oxygen levels are below background, the nitrate calculated as nitrate concentrations are also lower than background. This finding confirms intrinsic biodegradation is occurring as nitrate is the next favorable electron acceptor utilized once dissolved oxygen is depleted. Based on these findings, PACIFIC recommends enhancing the intrinsic bioremediation occurring at the site by elevating the dissolved oxygen concentrations within the plume. A work plan for increasing dissolved oxygen levels and to continue monitoring the biodegradation process is presented in the next section.

WORK PLAN FOR ENHANCING INTRINSIC BIOREMEDIATION

This brief work plan was prepared to describe procedures to enhance the intrinsic bioremediation in groundwater that is occurring at the site. This work plan proposes a dissolved oxygen enhancement program and a groundwater monitoring program to evaluate the performance of the dissolved oxygen enhancement. A work plan overview, proposed scope of work, report, and schedule follow.

Overview

PACIFIC proposes to conduct a pilot study to determine if enhancement of dissolved oxygen concentrations is feasible at the site. Oxygen releasing compounds (ORC) will be placed into selected existing wells to increase the dissolved oxygen concentrations in the areas of Wells MW-8 and MW-10 (Figure 1).

Wells SP-1 and SP-2 will be used as the ORC-containing wells. These wells were selected because of their proximity to nearby groundwater monitoring wells.
Wells E-1A and MW-8 will serve as the downgradient observation wells for Well SP-1. Well MW-10 will serve as the nearby observation well for Well SP-2. If performance groundwater monitoring indicates that dissolved oxygen concentrations increase in the downgradient observation wells, PACIFIC will continue the dissolved oxygen enhancement program using ORC in the monitoring and homeowner wells impacted by petroleum hydrocarbons. ORC is a formulation of very fine, insoluble magnesium peroxide

that releases oxygen at a slow, controlled rate when hydrated. ORC product literature is presented as Attachment B. ORC will be used through the remainder of 1995 following a successful pilot study, then its use will be reevaluated.

Dissolved Oxygen Enhancement and Performance Monitoring

The dissolved oxygen enhancement and performance monitoring program will consist of the following.

- ORC will be placed into Wells SP-1 and SP-2. ORC is available in fabric bags, known as socks. The ORC socks will be placed throughout the screened interval in each well.
- Wells E-1A and MW-8 will serve as the downgradient observation well for Well SP-1. Well E-1A is an operational groundwater extraction well at the site. For the purposes of this pilot study, this well will be shutdown on a conditional basis, otherwise the oxygen emanating from Well SP-1 will preferentially migrate to, and be extracted by Well E-1A. Short-term cessation of groundwater extraction will also allow PACIFIC to evaluate the affect on the migration of the dissolved petroleum hydrocarbon plume. If quarterly groundwater monitoring data indicates that dissolved petroleum hydrocarbons are migrating off site, PACIFIC is willing to resume groundwater extraction. In the event quarterly groundwater monitoring data indicates that dissolved petroleum hydrocarbons are not migrating off site, or if the data is inconclusive, the groundwater extraction system will remain shutdown until data supports its reactivation. Cessation of groundwater extraction will also allow oxygen and nutrient rich groundwater to flow downgradient from site in to the area of Wells MW-8 and MW-10.
- Well MW-10 will serve as the nearby observation well for Well SP-2.
- The dissolved oxygen concentration in ORC and observation monitoring wells will be measured on a monthly basis.

→ ? i,e
EA-1, MW8,
MW10 w/ SP-1 &
SP-2

- During the fourth quarter 1995 groundwater monitoring and sampling event, PACIFIC will repeat the baseline groundwater biodegradation study that was completed in June 1995 (discussed above) in the ORC and selected upgradient and downgradient wells. The results of the follow-up study will be compared to the baseline data.

Reporting

A summary of the enhancement program will be included in the third quarter 1995 groundwater monitoring report, if applicable. The summary will describe the field procedures and results of dissolved oxygen monitoring.

A summary of the final results of the dissolved oxygen enhancement program will be included in the fourth quarter 1995 groundwater monitoring report for the site. The report will include a discussion of the enhancement program, a comparison of dissolved oxygen levels and petroleum hydrocarbon concentrations, any difficulties encountered using ORC, and certified analytical reports and chain-of-custody documentation. The report will also include discussion of the effects on the petroleum hydrocarbon plume following shutdown of Well E-1A. Based on these results, PACIFIC will provide a recommendation to continue the program for another calendar year, or to discontinue the dissolved oxygen enhancement program.

Schedule

PACIFIC proposes to begin the dissolved oxygen enhancement program within 10 working days of written approval of this work plan from ACHCSA, or as quickly as ORC can be obtained from the supplier. The program will continue through 1995, as described above.

ADDITIONAL RISK ASSESSMENT EVALUATION

At the request of ACHCSA in April 1995, PACIFIC evaluated the potential health risk to residents from inhalation of soil vapor in an enclosed space, or house. The objective of this evaluation was to determine the potential health risk resulting from inhalation of volatilized benzene which could migrate from the groundwater surface through the overlying soil and into houses. PACIFIC used the methodology that was approved by ACHCSA in November 1993 to determine benzene volatilization and the resulting pollutant flux across the ground surface. A box model representing a house was then used; the key parameters, like area of the residence, crack factor, and air recirculation rate, were provided by Dr. Ravi Arulanantham of the RWQCB. Based on this methodology, PACIFIC determined that the potential carcinogenic health risk from this additional exposure pathway is 5.8×10^{-6} for children and 1.5×10^{-7} for adults. At these levels, no adverse health effects would be expected to occur.

The methodology, assumptions, and results of this evaluation were presented at the May 9, 1995 meeting between ACHCSA, RWQCB, ARCO, and PACIFIC. At that time, Dr. Arulanantham approved this evaluation and requested written submittal of the results. The methodology, assumptions, and results of this evaluation are provided in Appendix C as Tables C-1 and C-2. It is our understanding from the May 9, 1995 meeting that Dr. Arulanantham verbally approved this evaluation during the May 9, 1995 meeting and that ACHCSA will approve this evaluation with approval of the revised RI/FS.

RI/FS REVISIONS

PACIFIC has updated the RI/FS with additional data collected since November 1993 and the supplemental information presented in this letter. The RI/FS text revisions are presented as Attachment D. The main revisions of the RI/FS include the presentation of the results for the groundwater biodegradation testing and additional risk assessment evaluation, and the modifications to Alternative 2 suggested by ACHSCA. The RI/FS tables, figures, and appendices will be updated, as appropriate, for the final submittal. Text revision marks were used to facilitate your review; inserted text is marked using a double-underline and deleted text is marked using a strikethrough. All revisions are marked with a vertical revision line located on the right margin of the page for quick reference.

As agreed in the May 9, 1995, once approval of the RI/FS revisions is received, a complete bound copy of the revised RI/FS will be submitted to replace the RI/FS (PACIFIC, November 22, 1994) that is currently on file with ACHCSA.

FUTURE WORK/ISSUES

The following items will be implemented according to the schedule described below once ACHCSA approves of the work plan for enhancing intrinsic bioremediation and the RI/FS revisions.

Activity	Date
ACHCSA Approval of the Work Plan and RI/FS Revisions	July 1995
Approved RI/FS Submittal to ACHCSA	August 1995
ACHCSA Final Approval of RI/FS Community Notification Implementation of RI/FS Recommended Remedial Action	September 1995
Groundwater Management Plan Submittal to ACHCSA	November 1995
Reevaluation of Enhanced In-situ Bioremediation Program	January 1996

If you have any questions regarding this letter, please call.

Sincerely,

Pacific Environmental Group, Inc.

Keith Winemiller
Project Engineer

Debra J. Moser
Project Manager
CEG 1293

REGISTERED GEOLOGIST
DEBRA J. MOSER
No. 1293
CERTIFIED
ENGINEERING
GEOLOGIST
8/16/96
STATE OF CALIFORNIA

REFERENCES

Bianchi-Mosquera, Gino C., Allen-King, Richelle M., and Mackay, Douglas M., *Enhanced Degradation of Dissolved Benzene and Toluene Using Solid Oxygen Releasing Compound*, Ground Water Monitoring and Remediation, Volume 14, Number 1, Winter 1994.

Borden, Robert C., Gomez, Carlos A., and Becker, Mark T., *Geochemical Indicators of Intrinsic Bioremediation, Ground Water*, Volume 33, Number 2, March-April 1995.

McAllister, P. M. and Chiang, C. Y., *A Practical Approach to Evaluating Natural Attenuation of Contaminants in Ground Water*, Ground Water Monitoring and Remediation, Volume 14, Number 2, Spring 1994.

McAllister, P. M. and Chiang, C. Y., *Evaluation of Natural Attenuation of Petroleum Hydrocarbons in Groundwater*, Presented at CoBioRem Conference, Lansing Michigan.

Mobil EHSD, Princeton, and Stoneybrook Laboratories, *A Practical Approach to Evaluating Intrinsic Bioremediation of Petroleum Hydrocarbons in Groundwater*, November 1994.

Pacific Environmental Group, Inc., *Remedial Investigation/Feasibility Study, ARCO Service Station, 17601 Hesperian Boulevard, San Lorenzo, California*, November 22, 1994.

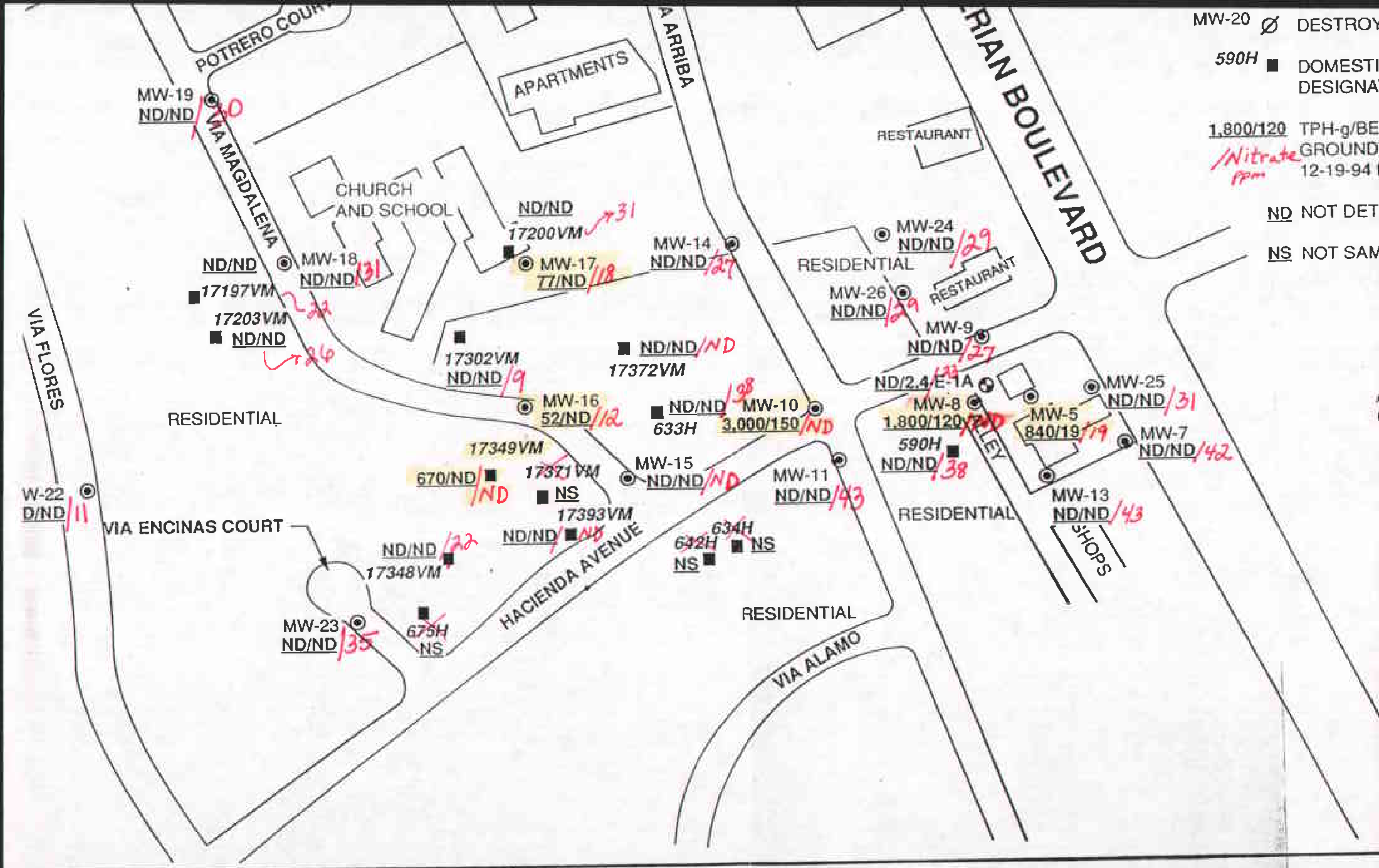
Pacific Environmental Group, Inc., *Meeting Minutes, May 9, 1995, Memorandum, ARCO Service Station 0608, 17601 Hesperian Boulevard, San Lorenzo, California*, May 24, 1995.

Salanitro, Joseph P., *The Role of Bioattenuation in the Management of Aromatic Hydrocarbon Plumes in Aquifers*, Ground Water Monitoring and Remediation, Volume 13, Number 4, Fall 1993.

United States Department of Commerce, National Technical Information Service, *Water Quality Criteria, Second Edition*, California Institute of Technology, Pasadena, California, July 1978.

Attachments:
Table 1 - Groundwater Biodegradation Study Field and Laboratory Data
Figure 1 - Dissolved Oxygen Results
Attachment A - Certified Analytical Reports, Chain-of-Custody Documentation, and Field Testing Procedures
Attachment B - Oxygen Release Compound Product Literature
Attachment C - Inhalation of Benzene Vapor in an Enclosed Space - Methodology, Assumptions, and Results
Attachment D - RI/FS Revisions

cc: Ms. Juliett Shin, Alameda County Health Care Services Agency
Mr. Kevin Graves, Regional Water Quality Control Board
Dr. Ravi Arulanantham, Regional Water Quality Control Board
Mr. Michael Whelan, ARCO Products Company
Mr. Chris Winsor, ARCO Products Company



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IENTAL
INC.

APPROXIMATE SCALE
0 150 300 FEET

ARCO SERVICE STATION 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

TPH-g/BENZENE CONCENTRATION MAP

Table 1
Groundwater Biodegradation Study Field and Laboratory Data

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

		Field Analyses										Laboratory Analyses			
Well	Sample Date	Color	Odor	pH (units)	Electrical Conductivity (millimhos)	Oxidation Reduction Potential (millivolts)	Temperature (degrees C)	Turbidity (NTU)	Hydrogen Sulfide (mg/L)	Dissolved Oxygen (mg/L)	Ferrous Iron (mg/L)	Nitrate as Nitrate (mg/L)	Sulfate (mg/L)	TPH-g (µg/L)	Benzene (µg/L)
Background Range (Approximate)		NA	NA	6.5 to 8.0	<1,000	-400 to +200	10.0 to 20.0	<250	~0	>1.0	>0	>1.0	>5.0	<50	<0.50
Approximate Range Indicating Biodegradation		NA	NA	6.5 to 8.0	<1,000	-400 to +200	10.0 to 20.0	<250	~0	< 1.0	~0	<1.0	< 5.0	>50	>0.50
590 H	05/26/95	Clear	None	7.37	2,360	-95	20.5	9.51	0.0	6.0	0.0	38	70	<50	<0.50
633 H	05/31/95	Clear	None	7.09	1,295	-72	18.9	17.85	0.0	1.0	0.2	38	61	<50	0.93
634 H	05/31/95	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
642 H	05/31/95	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
675 H	05/31/95	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
17197 VM	05/31/95	Clear	None	7.37	1,333	-149	19.0	7.44	0.0	2.0	0.8	22	45	<50	<0.50
17200 VM	05/30/95	Brown	None	7.49	1,365	-185	19.8	30.40	0.0	1.0	0.2	31	67	<50	<0.50
17203 VM	05/31/95	Brown	None	7.21	1,236	-168	18.3	35.10	0.0	1.0	0.1	26	48	<50	<0.50
17302 VM	05/31/95	Clear	None	7.41	1,193	-159	18.6	8.83	0.0	2.0	0.1	9	58	<50	<0.50
17348 VE	05/30/95	Brown	None	7.28	1,423	-113	22.5	>200	0.0	2.0	0.6	22	85	<50	<0.50
17349 VM	05/31/95	Clear	Moderate	7.02	1,190	-226	19.3	15.11	0.0	1.0	0.5	<0.10	15	890	<0.50
17371 VM	05/31/95	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 1 (continued)

Groundwater Biodegradation Study Field and Laboratory Data

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

		Field Analyses											Laboratory Analyses			
Well	Sample Date	Color	Odor	pH (units)	Electrical Conductivity (millimhos)	Oxidation Reduction Potential (millivolts)	Temperature (degrees C)	Turbidity (NTU)	Hydrogen Sulfide (mg/L)	Dissolved Oxygen (mg/L)	Ferrous Iron (mg/L)		Nitrate as Nitrate (mg/L)	Sulfate (mg/L)	TPH-g (µg/L)	Benzene (µg/L)
17372 VM	05/31/95	Clear	None	7.09	1,371	-227	19.5	11.25	0.0	1.0	0.1		<0.10	100	60	<0.50
17393 VM	05/31/95	Brown	None	7.40	1,508	-228	19.9	18.13	0.0	1.0	0.1		33	74	<50	<0.50
MW-5	06/01/95	Brown	Faint	7.10	1,400	-119	20.2	98.85	0.0	2.0	*		19	<0.1	750	13.0
MW-7	06/01/95	Brown	None	7.11	1,156	-99	20.7	43.27	0.0	*	*		42	68	<50	<0.50
MW-8	06/01/95	Brown	Strong	7.09	1,071	-199	20.4	29.00	0.0	1.0	0.1		<0.10	33	810	5.2
MW-9	06/01/95	Brown	None	7.27	1,191	-117	20.6	>200	0.0	*	*		27	67	<50	<0.50
MW-10	06/01/95	Clear	Moderate	7.00	1,301	-199	18.0	9.28	0.0	1.0	0.2		<0.10	8.1	1,100	<1.2
MW-11	06/01/95	Brown	None	7.15	1,275	-152	18.0	55.40	0.0	1.0	0.1		43	75	<50	<0.50
E-1A	06/01/95	Clear	None	7.63	1,340	-155	20.4	8.50	0.0	2.0	0.1		23	54	680	4.9
MW-13	06/01/95	Brown	None	7.23	1,247	-104	21.2	>200	0.0	*	*		43	66	<50	<0.50
MW-14	06/01/95	Brown	None	7.09	1,223	-185	18.9	32.93	0.0	1.0	0.0		27	62	<50	<0.50
MW-15	05/31/95	Brown	None	6.98	1,336	-230	20.2	39.70	0.0	1.0	0.2		<0.10	73	<50	<0.50
MW-16	05/31/95	Brown	None	7.43	1,135	-188	20.2	51.67	0.0	2.0	0.1		12	41	52	<0.50
MW-17	05/30/95	Clear	None	7.25	1,351	-126	18.8	16.82	0.0	1.0	0.2		18	58	93	1.0
MW-18	05/30/95	Clear	None	7.04	1,401	-136	20.3	14.39	0.0	1.0	0.2		31	57	<50	<0.50

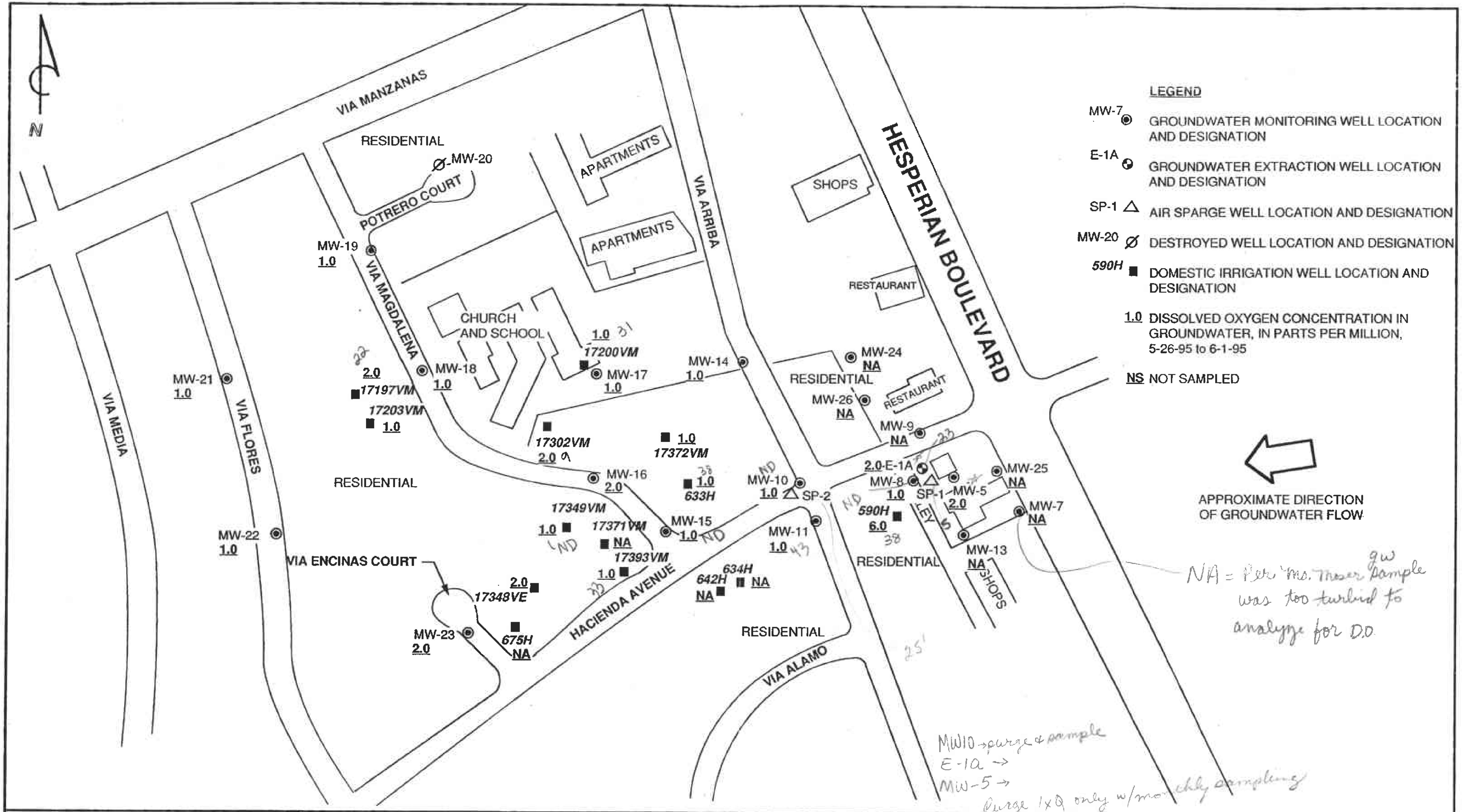
Table 1 (continued)

Groundwater Biodegradation Study Field and Laboratory Data

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

		Field Analyses										**Laboratory Analyses**			
Well	Sample Date	Color	Odor	pH (units)	Electrical Conductivity (millimhos)	Oxidation Reduction Potential (millivolts)	Temperature (degrees C)	Turbidity (NTU)	Hydrogen Sulfide (mg/L)	Dissolved Oxygen (mg/L)	Ferrous Iron (mg/L)	Nitrate as Nitrate (mg/L)	Sulfate (mg/L)	TPH-g (µg/L)	Benzene (µg/L)
MW-19	05/30/95	Clear	None	7.52	1,466	-167	19.5	25.43	0.0	1.0	0.2	30	63	<50	<0.50
MW-21	05/30/95	Clear	None	7.34	1,294	-149	19.9	17.39	0.0	1.0	0.1	42	56	<50	<0.50
MW-22	05/30/95	Clear	None	7.28	1,118	-150	18.9	13.30	0.0	1.0	0.2	11	80	<50	<0.50
MW-23	05/30/95	Brown	None	7.25	1,353	-98	20.1	84.40	0.0	2.0	0.2	35	74	<50	<0.50
MW-24	06/01/95	Brown	None	6.66	1,280	-91	21.4	>200	0.0	*	*	29	58	<50	<0.50
MW-25	06/01/95	Brown	None	7.23	1,222	-76	19.5	>200	0.0	*	*	31	73	<50	<0.50
MW-26	06/01/95	Brown	Faint	7.13	1,261	-92	22.4	>200	0.0	*	*	29	62	<50	<0.50

NTU = Nepholemetric turbidity unit
mg/L = Milligrams per liter
µg/L = Micrograms per liter
TPH-g = Total petroleum hydrocarbons calculated as gasoline
* = High sample turbidity prevented colorimetric analysis
NA = Not available or not applicable due to well blockage, inoperable pump, or not authorized by well owner to sample
Note: The sulfate and nitrate samples for Well 17348 VE were lost at the laboratory. The well was resampled for these analyses on June 2, 1995.
Note: Recorded values represent an average of one to three samples.



NA = Per Ms. Moser gw sample was too turbid to analyze for D.O

MW10 → purge & sample
E-1a →
MW-5 →
Purge 1xQ only w/monthly sampling

PACIFIC ENVIRONMENTAL GROUP, INC.

APPROXIMATE SCALE
0 150 300 FEET

ARCO SERVICE STATION 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

DISSOLVED OXYGEN RESULTS MAP

FIGURE:
1
PROJECT:
330-006.3E

ATTACHMENT A

LABORATORY CERTIFIED ANALYTICAL REPORTS, CHAIN-OF-CUSTODY DOCUMENTATION, AND FIELD TESTING PROCEDURES

Sequoia
Analytical

680 Chesapeake Drive Redwood City, CA 94063 (415) 364-9600 FAX (415) 364-9233
404 N. Wiget Lane Walnut Creek, CA 94598 (510) 988-9600 FAX (510) 988-9673
819 Striker Avenue, Suite 8 Sacramento, CA 95834 (916) 921-9600 FAX (916) 921-0100

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Lab Proj. ID: 9505L35

Sampled: 05/26/95
Received: 05/31/95
Analyzed: see below
Reported: 06/12/95

LABORATORY ANALYSIS

Lab No: 9505L35-01
Sample Desc : **LIQUID,590H**

Analyte	Units	Date Analyzed	Detection Limit	Sample Results
Nitrate as Nitrate	mg/L	06/01/95	0.10	38
Sulfate	mg/L	06/01/95	0.10	70

RECEIVED
JUN 15 1995
PACIFIC ENVIRONMENTAL GROUP, INC.

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
roject Manager

Sequoia
Analytical

680 Chesapeake Drive	Redwood City, CA 94063	(415) 364-9600	FAX (415) 364-9233
404 N. Wiget Lane	Walnut Creek, CA 94598	(510) 988-9600	FAX (510) 988-9673
819 Striker Avenue, Suite 8	Sacramento, CA 95834	(916) 921-9600	FAX (916) 921-0100

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608, San Lorenzo

Lab Proj. ID: 9506031

Sampled: 05/31/95
Received: 06/01/95
Analyzed: see below

Reported: 06/13/95

LABORATORY ANALYSIS

nalyte	Units	Date Analyzed	Detection Limit	Sample Results
ab No: 9506031-01				
Sample Desc : **LIQUID,633H**				
Nitrate as Nitrate	**mg/L**	**06/02/95**	**0.10**	**38**
Sulfate	**mg/L**	**06/02/95**	**0.10**	**61**
Lab No: 9506031-02				
Sample Desc : **LIQUID,17197VM**				
Nitrate as Nitrate	**mg/L**	**06/02/95**	**0.10**	**22**
Sulfate	**mg/L**	**06/02/95**	**0.10**	**45**
ab No: 9506031-03				
Sample Desc : **LIQUID,17203VM**				
Nitrate as Nitrate	**mg/L**	**06/02/95**	**0.10**	**26**
Sulfate	**mg/L**	**06/02/95**	**0.10**	**48**
Lab No: 9506031-04				
Sample Desc : **LIQUID,17302VM**				
Nitrate as Nitrate	**mg/L**	**06/02/95**	**0.10**	**9.0**
Sulfate	**mg/L**	**06/02/95**	**0.10**	**58**
ab No: 9506031-05				
Sample Desc : **LIQUID,17349VM**				
Nitrate as Nitrate	mg/L	06/02/95	0.10	N.D.
Sulfate	**mg/L**	**06/02/95**	**0.10**	**15**
Lab No: 9506031-06				
Sample Desc : **LIQUID,17372VM**				
Nitrate as Nitrate	mg/L	06/02/95	0.10	N.D.
Sulfate	**mg/L**	**06/02/95**	**0.10**	**100**

alytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

een Manning
oject Manager

Sequoia Analytical

680 Chesapeake Drive Redwood City, CA 94063 (415) 364-9600 FAX (415) 364-9233
404 N. Wiget Lane Walnut Creek, CA 94598 (510) 988-9600 FAX (510) 988-9673
819 Striker Avenue, Suite 8 Sacramento, CA 95834 (916) 921-9600 FAX (916) 921-0100

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608, San Lorenzo
Lab Proj. ID: 9506031

Sampled: 05/31/95
Received: 06/01/95
Analyzed: see below
Reported: 06/13/95

LABORATORY ANALYSIS

Analyte	Units	Date Analyzed	Detection Limit	Sample Results
ab No: 9506031-07 Sample Desc : **LIQUID,17393VM**				
Nitrate as Nitrate	**mg/L**	**06/02/95**	**0.10**	**33**
Sulfate	**mg/L**	**06/02/95**	**0.10**	**74**
Lab No: 9506031-08 Sample Desc : **LIQUID,MW-15**				
Nitrate as Nitrate	mg/L	06/02/95	0.10	N.D.
Sulfate	**mg/L**	**06/02/95**	**0.10**	**73**
ab No: 9506031-09 Sample Desc : **LIQUID,MW-16**				
Nitrate as Nitrate	**mg/L**	**06/02/95**	**0.10**	**12**
Sulfate	**mg/L**	**06/02/95**	**0.10**	**41**

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

een Manning
oject Manager

Pacific Environmental Group 2025 Gateway Place, Suite 440 San Jose, CA 95110	Client Proj. ID: 330-006.2G/0608,San Lorenzo Lab Proj. ID: 9505L35	Sampled: 05/30/95 Received: 05/31/95 Analyzed: see below
Attention: Maree Doden		Reported: 06/12/95

LABORATORY ANALYSIS

Analyte	Units	Date Analyzed	Detection Limit	Sample Results
Lab No: 9505L35-02 Sample Desc : LIQUID,17200 VM				
Nitrate as Nitrate	mg/L	06/01/95	0.10	31
Sulfate	mg/L	06/01/95	0.10	67
Lab No: 9505L35-04 Sample Desc : LIQUID,MW-17				
Nitrate as Nitrate	mg/L	06/01/95	0.10	18
Sulfate	mg/L	06/01/95	0.10	58
Lab No: 9505L35-05 Sample Desc : LIQUID,MW-18				
Nitrate as Nitrate	mg/L	06/01/95	0.10	31
Sulfate	mg/L	06/01/95	0.10	57
Lab No: 9505L35-06 Sample Desc : LIQUID,MW-19				
Nitrate as Nitrate	mg/L	06/01/95	0.10	30
Sulfate	mg/L	06/01/95	0.10	63
Lab No: 9505L35-07 Sample Desc : LIQUID,MW-21				
Nitrate as Nitrate	mg/L	06/01/95	0.10	42
Sulfate	mg/L	06/01/95	0.10	56
Lab No: 9505L35-08 Sample Desc : LIQUID,MW-22				
Nitrate as Nitrate	mg/L	06/01/95	0.10	11
Sulfate	mg/L	06/01/95	0.10	80

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
oject Manager

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo

Lab Proj. ID: 9505L35

Sampled: 05/30/95
Received: 05/31/95
Analyzed: see below

Reported: 06/12/95

LABORATORY ANALYSIS

Analyte	Units	Date Analyzed	Detection Limit	Sample Results
Lab No: 9505L35-09 Sample Desc : **LIQUID,MW-23**				
Nitrate as Nitrate	**mg/L**	**06/01/95**	**0.10**	**35**
Sulfate	**mg/L**	**06/01/95**	**0.10**	**74**

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Lab Proj. ID: 9506075

Sampled: 06/01/95
Received: 06/02/95
Analyzed: see below
Reported: 06/13/95

LABORATORY ANALYSIS

nalyte	Units	Date Analyzed	Detection Limit	Sample Results
ab No: 9506075-01 Sample Desc : **LIQUID,MW-5**				
Nitrate as Nitrate	mg/L	06/03/95	0.10	N.D.
Sulfate	**mg/L**	**06/03/95**	**0.10**	**19**
Lab No: 9506075-02 Sample Desc : **LIQUID,MW-7**				
Nitrate as Nitrate	**mg/L**	**06/03/95**	**0.10**	**42**
Sulfate	**mg/L**	**06/03/95**	**0.10**	**68**
ab No: 9506075-03 Sample Desc : **LIQUID,MW-8**				
Nitrate as Nitrate	mg/L	06/03/95	0.10	N.D.
Sulfate	**mg/L**	**06/03/95**	**0.10**	**33**
Lab No: 9506075-04 Sample Desc : **LIQUID,MW-9**				
Nitrate as Nitrate	**mg/L**	**06/03/95**	**0.10**	**27**
Sulfate	**mg/L**	**06/03/95**	**0.10**	**67**
ab No: 9506075-05 Sample Desc : **LIQUID,MW-10**				
Nitrate as Nitrate	mg/L	06/03/95	0.10	N.D.
Sulfate	**mg/L**	**06/03/95**	**0.10**	**8.1**
Lab No: 9506075-06 Sample Desc : **LIQUID,MW-11**				
Nitrate as Nitrate	**mg/L**	**06/03/95**	**0.10**	**43**
Sulfate	**mg/L**	**06/03/95**	**0.10**	**75**

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

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San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Lab Proj. ID: 9506075

Sampled: 06/01/95
Received: 06/02/95
Analyzed: see below
Reported: 06/13/95

LABORATORY ANALYSIS

Analyte	Units	Date Analyzed	Detection Limit	Sample Results
Lab No: 9506075-07 Sample Desc : LIQUID,MW-13				
Nitrate as Nitrate	mg/L	06/03/95	0.10	43
Sulfate	mg/L	06/03/95	0.10	66
Lab No: 9506075-08 Sample Desc : LIQUID,MW-14				
Nitrate as Nitrate	mg/L	06/03/95	0.10	27
Sulfate	mg/L	06/03/95	0.10	62
Lab No: 9506075-09 Sample Desc : LIQUID,MW-24				
Nitrate as Nitrate	mg/L	06/03/95	0.10	29
Sulfate	mg/L	06/03/95	0.10	58
Lab No: 9506075-10 Sample Desc : LIQUID,MW-25				
Nitrate as Nitrate	mg/L	06/03/95	0.10	31
Sulfate	mg/L	06/03/95	0.10	73
Lab No: 9506075-11 Sample Desc : LIQUID,MW-26				
Nitrate as Nitrate	mg/L	06/03/95	0.10	29
Sulfate	mg/L	06/03/95	0.10	62
Lab No: 9506075-12 Sample Desc : LIQUID,E1-A				
Nitrate as Nitrate	mg/L	06/03/95	0.10	23
Sulfate	mg/L	06/03/95	0.10	54

nalytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

ileen Manning
roject Manager

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: 590H
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9505L35-01

Sampled: 05/26/95
Received: 05/31/95

Analyzed: 06/05/95
Reported: 06/12/95

QC Batch Number: GC060595BTEX20A
Instrument ID: GCHP20

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	104

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

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Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608, San Lorenzo
Sample Descript: 633H
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506031-01

Sampled: 05/31/95
Received: 06/01/95
Analyzed: 06/05/95
Reported: 06/13/95

C Batch Number: GC060595BTEX20A
strument ID: GCHP20

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	**0.50**	**0.93**
Toluene	**0.50**	**2.4**
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	**0.50**	**14**
Chromatogram Pattern:		

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	91

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

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acific Environmental Group
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an Jose, CA 95110

ttention: Maree Doden

Client Proj. ID: 330-006.2G/0608, San Lorenzo
Sample Descript: 17197VM
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506031-02

Sampled: 05/31/95
Received: 06/01/95
Analyzed: 06/05/95
Reported: 06/13/95

C Batch Number: GC060595BTEX20A
strument ID: GCHP20

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

nalyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
enzene	0.50	N.D.
oluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
hromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
rifluorotoluene	70	130	89

nalytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

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Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: 17200 VM
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9505L35-02

Sampled: 05/30/95
Received: 05/31/95

Analyzed: 06/05/95
Reported: 06/12/95

QC Batch Number: GC060595BTEX20A
nstrument ID: GCHP20

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	**Detection Limit ug/L**	**Sample Results ug/L**
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	93

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

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roject Manager

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Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608, San Lorenzo
Sample Descript: 17203VM
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506031-03

Sampled: 05/31/95
Received: 06/01/95
Analyzed: 06/05/95
Reported: 06/13/95

QC Batch Number: GC060595BTEX20A
strument ID: GCHP20

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	88

nalytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

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ttention: Maree Doden

Client Proj. ID: 330-006.2G/0608, San Lorenzo
Sample Descript: 17302VM
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506031-04

Sampled: 05/31/95
Received: 06/01/95

Analyzed: 06/05/95
Reported: 06/13/95

QC Batch Number: GC060595BTEX20A
strument ID: GCHP20

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
oluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	87

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

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Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608, San Lorenzo
Sample Descript: 17349VM
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506031-05

Sampled: 05/31/95
Received: 06/01/95
Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060695BTEX17A
strument ID: GCHP17

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	**200**	**890**
Benzene	2.0	N.D.
Toluene	2.0	N.D.
Ethyl Benzene	**2.0**	**4.3**
Xylenes (Total)	**2.0**	**22**
Chromatogram Pattern:		**Gas**

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	110

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

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Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608, San Lorenzo
Sample Descript: 17372VM
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506031-06

Sampled: 05/31/95
Received: 06/01/95
Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060595BTEX20A
strument ID: GCHP20

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	**50**	**60**
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		
Unidentified HC		**<C8**

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	91

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
oject Manager

Pacific Environmental Group
2025 Gateway Place, Suite 440
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Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608, San Lorenzo
Sample Descript: 17393VM
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506031-07

Sampled: 05/31/95
Received: 06/01/95
Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060595BTEX20A
strument ID: GCHP20

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
oluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	87

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

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oject Manager

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Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: MW-5
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506075-01

Sampled: 06/01/95
Received: 06/02/95

Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060695BTEX03A
nstrument ID: GCHP03

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	**50**	**750**
Benzene	**0.50**	**13**
Toluene	0.50	N.D.
Ethyl Benzene	**0.50**	**1.1**
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		
Weathered Gas		**C6-C12**

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	108

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
roject Manager

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Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: MW-7
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506075-02

Sampled: 06/01/95
Received: 06/02/95

Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060695BTEX03A
nstrument ID: GCHP03

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	99

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

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Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: MW-8
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506075-03

Sampled: 06/01/95
Received: 06/02/95

Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060695BTEX03A
strument ID: GCHP03

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	**50**	**810**
Benzene	**0.50**	**5.2**
Toluene	0.50	N.D.
Ethyl Benzene	**0.50**	**0.69**
Xylenes (Total)	**0.50**	**0.71**
Gas & Unidentified HC		**<C8**

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	83

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
roject Manager

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2025 Gateway Place, Suite 440
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Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: MW-9
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506075-04

Sampled: 06/01/95
Received: 06/02/95
Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060695BTEX03A
nstrument ID: GCHP03

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	**Detection Limit ug/L**	**Sample Results ug/L**
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	99

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
roject Manager

Sequoia Analytical

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404 N. Wiget Lane Walnut Creek, CA 94598 (510) 988-9600 FAX (510) 988-9673
819 Striker Avenue, Suite 8 Sacramento, CA 95834 (916) 921-9600 FAX (916) 921-0100

Pacific Environmental Group 2025 Gateway Place, Suite 440 San Jose, CA 95110 Attention: Maree Doden	Client Proj. ID: 330-006.2G/0608,San Lorenzo Sample Descript: MW-10 Matrix: LIQUID Analysis Method: 8015Mod/8020 Lab Number: 9506075-05	Sampled: 06/01/95 Received: 06/02/95 Analyzed: 06/06/95 Reported: 06/13/95

QC Batch Number: GC060695BTEX17A
strument ID: GCHP17

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	**125**	**1100**
Benzene	1.2	N.D.
Toluene	1.2	N.D.
Ethyl Benzene	1.2	N.D.
Xylenes (Total)	1.2	N.D.
Gas & Unidentified HC		**>C12**

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	91

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
oject Manager

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: MW-11
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506075-06

Sampled: 06/01/95
Received: 06/02/95

Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060695BTEX03A
nstrument ID: GCHP03

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	96

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: E1-A
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506075-12

Sampled: 06/01/95
Received: 06/02/95

Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060695BTEX17A
nstrument ID: GCHP17

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	**Detection Limit ug/L**	**Sample Results ug/L**
TPPH as Gas	**50**	**680**
Benzene	**0.50**	**4.9**
Toluene	0.50	N.D.
Ethyl Benzene	**0.50**	**18**
Xylenes (Total)	**0.50**	**2.4**
Chromatogram Pattern:		**Gas**

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	100

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
roject Manager

Pacific Environmental Group	Client Proj. ID: 330-006.2G/0608,San Lorenzo	Sampled: 06/01/95
2025 Gateway Place, Suite 440	Sample Descript: MW-13	Received: 06/02/95
San Jose, CA 95110	Matrix: LIQUID	
	Analysis Method: 8015Mod/8020	Analyzed: 06/06/95
Attention: Maree Doden	Lab Number: 9506075-07	Reported: 06/13/95

QC Batch Number: GC060695BTEX03A
nstrument ID: GCHP03

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	**Detection Limit ug/L**	**Sample Results ug/L**
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	96

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
roject Manager

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: MW-14
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506075-08

Sampled: 06/01/95
Received: 06/02/95

Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060695BTEX03A
strument ID: GCHP03

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	88

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608, San Lorenzo
Sample Descript: MW-15
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506031-08

Sampled: 05/31/95
Received: 06/01/95
Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060595BTEX20A
strument ID: GCHP20

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	88

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
Project Manager

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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608, San Lorenzo
Sample Descript: MW-16
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506031-09

Sampled: 05/31/95
Received: 06/01/95

Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060595BTEX20A
strument ID: GCHP20

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	**50**	**52**
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		
Unidentified HC		**<C8**

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	85

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
roject Manager

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: MW-17
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9505L35-04

Sampled: 05/30/95
Received: 05/31/95

Analyzed: 06/05/95
Reported: 06/12/95

QC Batch Number: GC060595BTEX20A
nstrument ID: GCHP20

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	**50**	**93**
Benzene	**0.50**	**1.0**
Toluene	0.50	N.D.
Ethyl Benzene	**0.50**	**1.2**
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		**Gas**

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	116

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
oject Manager

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: MW-18
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9505L35-05

Sampled: 05/30/95
Received: 05/31/95

Analyzed: 06/05/95
Reported: 06/12/95

QC Batch Number: GC060595BTEX20A
nstrument ID: GCHP20

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	99

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
roject Manager

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: MW-19
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9505L35-06

Sampled: 05/30/95
Received: 05/31/95
Analyzed: 06/05/95
Reported: 06/12/95

QC Batch Number: GC060595BTEX20A
nstrument ID: GCHP20

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	**Detection Limit ug/L**	**Sample Results ug/L**
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	97

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
roject Manager

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: MW-21
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9505L35-07

Sampled: 05/30/95
Received: 05/31/95
Analyzed: 06/05/95
Reported: 06/12/95

QC Batch Number: GC060595BTEX17A
nstrument ID: GCHP17

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	100

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
roject Manager

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: MW-22
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9505L35-08

Sampled: 05/30/95
Received: 05/31/95

Analyzed: 06/05/95
Reported: 06/12/95

QC Batch Number: GC060595BTEX17A
Instrument ID: GCHP17

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	98

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

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Pacific Environmental Group	Client Proj. ID: 330-006.2G/0608,San Lorenzo	Sampled: 05/30/95
2025 Gateway Place, Suite 440	Sample Descript: MW-23	Received: 05/31/95
San Jose, CA 95110	Matrix: LIQUID	
	Analysis Method: 8015Mod/8020	Analyzed: 06/05/95
Attention: Maree Doden	Lab Number: 9505L35-09	Reported: 06/12/95

QC Batch Number: GC060595BTEX17A
nstrument ID: GCHP17

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	86

Analytes reported as N.D. were not present above the stated limit of detection.

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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: MW-24
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506075-09

Sampled: 06/01/95
Received: 06/02/95

Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060695BTEX03A
nstrument ID: GCHP03

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	**Detection Limit ug/L**	**Sample Results ug/L**
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	**Control Limits %**		**% Recovery**
Trifluorotoluene	70	130	91

Analytes reported as N.D. were not present above the stated limit of detection.

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819 Striker Avenue, Suite 8 Sacramento, CA 95834 (916) 921-9600 FAX (916) 921-0100

Pacific Environmental Group	Client Proj. ID: 330-006.2G/0608,San Lorenzo	Sampled: 06/01/95
2025 Gateway Place, Suite 440	Sample Descript: MW-25	Received: 06/02/95
San Jose, CA 95110	Matrix: LIQUID	
	Analysis Method: 8015Mod/8020	Analyzed: 06/06/95
Attention: Maree Doden	Lab Number: 9506075-10	Reported: 06/13/95

QC Batch Number: GC060695BTEX03A
strument ID: GCHP03

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	90

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
roject Manager

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: MW-26
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506075-11

Sampled: 06/01/95
Received: 06/02/95
Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060695BTEX02A
strument ID: GCHP02

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	101

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
roject Manager

Sequoia
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RECEIVED
JUN 16 1995
ACIFIC ENVIRONMENTAL GROUP, INC

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Project: 330-006.2G/0608, San Lorenzo

Enclosed are the results from samples received at Sequoia Analytical on June 1, 1995. The requested analyses are listed below:

SAMPLE #	SAMPLE DESCRIPTION	DATE OF COLLECTION	TEST METHOD
950603101	LIQUID, 633H	5/31/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950603102	LIQUID, 17197VM	5/31/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950603103	LIQUID, 17203VM	5/31/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950603104	LIQUID, 17302VM	5/31/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950603105	LIQUID, 17349VM	5/31/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950603106	LIQUID, 17372VM	5/31/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950603107	LIQUID, 17393VM	5/31/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950603108	LIQUID, MW-15	5/31/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950603109	LIQUID, MW-16	5/31/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950603110	LIQUID, TB-2	5/31/95	TPHGB Purgeable TPH/BTEX

Sequoia
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Please contact me if you have any questions. In the meantime, thank you for the opportunity to work with you on this project.

Very truly yours,

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

Bruce Fletcher
Quality Assurance Department

Sequoia Analytical
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RECEIVED
JUN 19 1995
PACIFIC ENVIRONMENTAL GROUP, INC.

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Project: 330-006.2G/0608, San Lorenzo

Enclosed are the results from samples received at Sequoia Analytical on June 2, 1995. The requested analyses are listed below:

SAMPLE #	SAMPLE DESCRIPTION	DATE OF COLLECTION	TEST METHOD
950607501	LIQUID, MW-5	6/1/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950607502	LIQUID, MW-7	6/1/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950607503	LIQUID, MW-8	6/1/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950607504	LIQUID, MW-9	6/1/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950607505	LIQUID, MW-10	6/1/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950607506	LIQUID, MW-11	6/1/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950607507	LIQUID, MW-13	6/1/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950607508	LIQUID, MW-14	6/1/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950607509	LIQUID, MW-24	6/1/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950607510	LIQUID, MW-25	6/1/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950607511	LIQUID, MW-26	6/1/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX

SAMPLE #	SAMPLE DESCRIPTION	DATE OF COLLECTION	TEST METHOD
950607512	LIQUID, E1-A	6/1/95	Nitrate Sulfate TPHGB Purgeable TPH/BTEX
950607513	LIQUID, TB-3	6/1/95	TPHGB Purgeable TPH/BTEX

Please contact me if you have any questions. In the meantime, thank you for the opportunity to work with you on this project.

Very truly yours,

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

Bucia Fletcher
Quality Assurance Department

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: TB-3
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9506075-13

Sampled: 06/01/95
Received: 06/02/95

Analyzed: 06/06/95
Reported: 06/13/95

QC Batch Number: GC060695BTEX02A
nstrument ID: GCHP02

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	102

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
roject Manager

Sequoia
Analytical

680 Chesapeake Drive Redwood City, CA 94063 (415) 364-9600 FAX (415) 364-9233
404 N. Wiget Lane Walnut Creek, CA 94598 (510) 988-9600 FAX (510) 988-9673
819 Striker Avenue, Suite 8 Sacramento, CA 95834 (916) 921-9600 FAX (916) 921-0100

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Client Project ID: 330-006.2G/0608, San Lorenzo
Matrix: LIQUID
Work Order #: 9506075 01-04
Reported: Jun 16, 1995

QUALITY CONTROL DATA REPORT

Analyte:	Nitrate	Sulfate
QC Batch#:	IN0603953000ACB	IN0603953000ACB
Analy. Method:	EPA 300.0	EPA 300.0
Prep. Method:	N.A.	N.A.
Analyst:	S. Flynn	S. Flynn
MS/MSD #:	950607504	950607504
Sample Conc.:	51	99
Prepared Date:	6/3/95	6/3/95
Analyzed Date:	6/3/95	6/3/95
Instrument I.D.#:	INIC1	INIC1
Conc. Spiked:	100 mg/L	100 mg/L
Result:	140	190
MS % Recovery:	89	91
Dup. Result:	140	180
MSD % Recov.:	89	81
RPD:	0.0	5.4
RPD Limit:	0-30	0-30
LCS #:		
Prepared Date:		
Analyzed Date:		
Instrument I.D.#:		
Conc. Spiked:		
LCS Result:		
LCS % Recov.:		
MS/MSD LCS Control Limits	70-130	70-130

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

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

Please Note:
The LCS is a control sample of known, interferent-free matrix that is analyzed using the same reagents, preparation, and analytical methods employed for the samples. The matrix spike is an aliquot of sample fortified with known quantities of specific compounds and subjected to the entire analytical procedure. If the recovery of analytes from the matrix spike does not fall within specified control limits due to matrix interference, the LCS recovery is to be used to validate the batch.

** MS = Matrix Spike, MSD = MS Duplicate, RPD = Relative % Difference

Sequoia Analytical

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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Client Project ID: 330-006.2G/0608, San Lorenzo
Matrix: LIQUID
Work Order #: 9506075 05-12
Reported: Jun 16, 1995

QUALITY CONTROL DATA REPORT

Analyte:	Nitrate	Sulfate
QC Batch#:	In0603953000ACC	IN0603953000ACB
Analy. Method:	EPA 300.0	EPA 300.0
Prep. Method:	N.A.	N.A.
Analyst:	S. Flynn	S. Flynn
MS/MSD #:	950607509	950607509
Sample Conc.:	51	91
Prepared Date:	6/3/95	6/3/95
Analyzed Date:	6/3/95	6/3/95
Instrument I.D.#:	INIC1	INIC1
Conc. Spiked:	100 mg/L	100 mg/L
Result:	140	180
MS % Recovery:	89	89
Dup. Result:	130	180
MSD % Recov.:	79	89
RPD:	7.4	0.0
RPD Limit:	0-30	0-30
LCS #:		
Prepared Date:		
Analyzed Date:		
Instrument I.D.#:		
Conc. Spiked:		
LCS Result:		
LCS % Recov.:		
MS/MSD LCS Control Limits	70-130	70-130

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

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

Please Note:
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Sequoia
Analytical

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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Client Project ID: 330-006.2G/0608, San Lorenzo
Matrix: LIQUID
Work Order #: 9506075 11, 13
Reported: Jun 16, 1995

QUALITY CONTROL DATA REPORT

Analyte:	Benzene	Toluene	Ethyl Benzene	Xylenes
QC Batch#:	GC060695BTEX02A	GC060695BTEX02A	GC060695BTEX02A	GC060695BTEX02A
Analy. Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Prep. Method:	EPA 5030	EPA 5030	EPA 5030	EPA 5030
Analyst:	J. Minkel	J. Minkel	J. Minkel	J. Minkel
MS/MSD #:	950603102	950603102	950603102	950603102
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Prepared Date:	6/6/95	6/6/95	6/6/95	6/6/95
Analyzed Date:	6/6/95	6/6/95	6/6/95	6/6/95
Instrument I.D.#:	GCHP2	GCHP2	GCHP2	GCHP2
Conc. Spiked:	10 µg/L	10 µg/L	10 µg/L	30 µg/L
Result:	9.5	9.5	9.5	29
MS % Recovery:	95	95	95	97
Dup. Result:	10	10	10	30
MSD % Recov.:	100	100	100	100
RPD:	5.1	5.1	5.1	3.4
RPD Limit:	0-50	0-50	0-50	0-50

LCS #:				
Prepared Date:				
Analyzed Date:				
Instrument I.D.#:				
Conc. Spiked:				
LCS Result:				
LCS % Recov.:				

MS/MSD LCS Control Limits	71-133	72-128	72-130	71-120

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

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

Please Note:
The LCS is a control sample of known, interferent-free matrix that is analyzed using the same reagents, preparation, and analytical methods employed for the samples. The matrix spike is an aliquot of sample fortified with known quantities of specific compounds and subjected to the entire analytical procedure. If the recovery of analytes from the matrix spike does not fall within specified control limits due to matrix interference, the LCS recovery is to be used to validate the batch.

** MS=Matrix Spike, MSD=MS Duplicate, RPD=Relative % Difference

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Client Project ID: 330-006.2G/0608, San Lorenzo
Matrix: LIQUID
Work Order #: 9506075 01-04, 06-10
Reported: Jun 16, 1995

QUALITY CONTROL DATA REPORT

Analyte:	Benzene	Toluene	Ethyl Benzene	Xylenes
QC Batch#:	GC060695BTEX03A	GC060695BTEX03A	GC060695BTEX03A	GC060695BTEX03A
Analy. Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Prep. Method:	EPA 5030	EPA 5030	EPA 5030	EPA 5030
Analyst:	J. Minkel	J. Minkel	J. Minkel	J. Minkel
MS/MSD #:	950603103	950603103	950603103	950603103
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Prepared Date:	6/6/95	6/6/95	6/6/95	6/6/95
Analyzed Date:	6/6/95	6/6/95	6/6/95	6/6/95
Instrument I.D.#:	GCHP3	GCHP3	GCHP3	GCHP3
Conc. Spiked:	10 μg/L	10 μg/L	10 μg/L	30 μg/L
Result:	8.3	8.0	9.3	27
MS % Recovery:	83	80	93	90
Dup. Result:	8.7	8.4	10	29
MSD % Recov.:	87	84	100	97
RPD:	4.7	4.9	7.3	7.1
RPD Limit:	0-50	0-50	0-50	0-50
LCS #:				
Prepared Date:				
Analyzed Date:				
Instrument I.D.#:				
Conc. Spiked:				
LCS Result:				
LCS % Recov.:				
MS/MSD LCS Control Limits	71-133	72-128	72-130	71-120

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

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

Please Note:
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Sequoia Analytical

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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Client Project ID: 330-006.2G/0608, San Lorenzo
Matrix: LIQUID

Work Order #: 9506075 05

Reported: Jun 16, 1995

QUALITY CONTROL DATA REPORT

Analyte:	Benzene	Toluene	Ethyl Benzene	Xylenes
QC Batch#:	GC060695BTEX17A	GC060695BTEX17A	GC060695BTEX17A	GC060695BTEX17A
Analy. Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Prep. Method:	EPA 5030	EPA 5030	EPA 5030	EPA 5030
Analyst:	J. Minkel	J. Minkel	J. Minkel	J. Minkel
MS/MSD #:	950603102	950603102	950603102	950603102
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Prepared Date:	6/6/95	6/6/95	6/6/95	6/6/95
Analyzed Date:	6/6/95	6/6/95	6/6/95	6/6/95
Instrument I.D.#:	GCHP17	GCHP17	GCHP17	GCHP17
Conc. Spiked:	10 µg/L	10 µg/L	10 µg/L	30 µg/L
Result:	8.9	8.5	8.4	25
MS % Recovery:	89	85	84	83
Dup. Result:	7.8	7.9	7.9	24
MSD % Recov.:	78	79	79	80
RPD:	13	7.3	6.1	4.1
RPD Limit:	0-50	0-50	0-50	0-50
LCS #:				
Prepared Date:				
Analyzed Date:				
Instrument I.D.#:				
Conc. Spiked:				
LCS Result:				
LCS % Recov.:				
MS/MSD LCS Control Limits	71-133	72-128	72-130	71-120

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

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

Please Note:
The LCS is a control sample of known, interferent-free matrix that is analyzed using the same reagents, preparation, and analytical methods employed for the samples. The matrix spike is an aliquot of sample fortified with known quantities of specific compounds and subjected to the entire analytical procedure. If the recovery of analytes from the matrix spike does not fall within specified control limits due to matrix interference, the LCS recovery is to be used to validate the batch.

** MS = Matrix Spike, MSD = MS Duplicate, RPD = Relative % Difference

SEQUOIA ANALYTICAL SAMPLE RECEIPT LOG

CLIENT NAME: PEG/Arco
REC. BY (PRINT): KF
WORKORDER: 9506075
DATE OF LOG-IN: 6/2/95

CIRCLE THE APPROPRIATE RESPONSE

1. Custody Seal(s) Present / [✓ Absent]
   Intact / Broken*
2. Custody Seal Nos.: Put in Remarks Section
3. Chain-of-Custody Records: [✓ Present] / Absent*
4. Traffic Reports or Packing List: Present / [✓ Absent]
5. Airbill: Airbill / Sticker
   Present / [✓ Absent]
6. Airbill No.:
7. Sample Tags: [✓ Present] / Absent*
   Sample Tag Nos.: [✓ Listed] / Not Listed on Chain-of-Custody
8. Sample Condition: [✓ Intact] / Broken* / Leaking*
9. Does information on custody reports, traffic reports and sample tags agree? [✓ Yes] / No*
10. Proper preservatives used: [✓ Yes] / No*
11. Date Rec. at Lab: 6/2/95
12. Temp. Rec. at Lab: 14°C
13. Time Rec. at Lab: 1210

LAB SAMPLE #	DASH #	CLIENT IDENTIFICATION	CONTAINER DESCRIPTION	SAMPLE MATRIX	DATE SAMP.	REMARKS: CONDITION(ETC.)
01	A-C	MW-5	3 Voa's	Liq	6/1/95	
	D	↓	1LP			
02	A-D	MW-7	Same			
03		-8				
04		-9				
05		-10				
06		-11				
07		-13				
08		-14				
09		-24				
10		-25				
11		-26				
12	↓	G1-A	↓			
13	AB	TB-3	2Voa's	↓	↓	

M 6/2/95

* If Circled, contact Project manager and attach record of resolution

Revision 3/21/95

Page ____ of ____

[redacted]

ARCO Products Company Division of AtlanticRichfieldCompany 330-006.2G **Task Order No.** 1707600 in ust

ARCO Facility no. 0608	City (Facility) SAN LORENZO		Project manager (Consultant) KELLY BROWN		Laboratory name SEQUOIA
ARCO engineer MIKE WHELAN		Telephone no. (ARCO)	Telephone no. (Consultant) 441-7500	Fax no. (Consultant) 441-7539	Contract number 07-073
Consultant name PACIFIC ENVIRONMENTAL GROUP		Address (Consultant) 2025 GATEWAY PLACE #440 SAN JOSE, CA 95110			

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 GAS EPA M602/8020/8015	TPH Modified 8015 Gas ☐ Diesel ☐	Oil and Grease 413.1 ☐ 413.2 ☐	TPH EPA 418.1/SM503E	EPA 601/8010	EPA 624/8240	EPA 625/8270	TCLP Metals ☐ VOA ☐ Semi VOA ☐	CAM Metals EPA 6010/7000 TTLC ☐ STLC ☐	Lead Org./DHS ☐ Lead EPA 7420/7421 ☐	SULFATE	NITRATE
MW-5	-	3		X		X	HCL	6-1-95	1305		X											
MW-7	-								1150													
MW-8	-								1235													
MW-9	-								1125													
MW-10	-								1025													
MW-11	-								1040													
MW-13	-								1205													
MW-14	-								1000													
MW-24	-								1105													
MW-25	-								1135													
MW-26	-								1055													
EI-A	-	↓					↓		1325		↓											
MW-5	-	1					NP		1305												X	X
MW-7	-	1					NP		1150												X	X
MW-8	-	1					NP		1235												X	X
MW-9	-	1		↓		↓	NP		1125												X	X

Method of shipment
COURIER

Special detection Limit/reporting

Special QA/QC

Remarks
1 of 2
last batch

Lab number
9506075

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	Date 6-2-95	Time 800	Received by M Doden	6/2/95	0800
Relinquished by M Doden	Date 6/2/95	Time 10:40	Received by		
Relinquished by	Date 6-2	Time 12:00	Received by laboratory	Date 6/2/95	Time 1210

Distribution: White copy — Laboratory; Canary copy — ARCO Environmental Engineering; Pink copy — Consultant
APC-3292 (2-91)

ARCO Products Company 33000626 **Task Order No.** 120600

Division of AtlanticRichfieldCompany

Chain of Custody

ARCO Facility no. 0608	City (Facility) SANLORENZO	Project manager (Consultant) KELLY BROWN	Laboratory name SEQUOIA
ARCO engineer MIKE WHELAN	Telephone no. (ARCO)	Telephone no. (Consultant) 441-7500 / Fax no. (Consultant) 441-7539	Contract number 07-073
Consultant name PACIFIC ENVIRONMENTAL GROUP		Address (Consultant) 2025 GATEWAY PLACE #440 SAN JOSE, CA 9510	

Sample I.D.	Lab no.	Container no.	Matrix Soil	 Water	 Other	Preservation Ice	 Acid	Sampling date	Sampling time	BTEX 602/EPA 8020	BTEX/TPH EPA M602/8020/8015	TPH Modified 8015 Gas ☐ Diesel ☐	Oil and Grease 413.1 ☐ 413.2 ☐	TPH EPA 418.1/SM503E	EPA 601/8010	EPA 624/8240	EPA 625/8270	TCLP Metals ☐ VOA ☐ Semi VOA ☐	CAM Metals EPA 6010/7000 TTLC ☐ STLC ☐	Lead Org./DHS ☐ Lead EPA 7420/7421 ☐	SULFATE	NITRATE
MW-10		1		X		X	NP	6-1-95	1025												X	X
MW-11		1							1040												X	X
MW-13		1							1205												X	X
MW-14		1							1000												X	X
MW-24		1							1105												X	X
MW-25		1							1135												X	X
MW-26		1							1055												X	X
EI-A		1							1325												X	X
TB-3		2					HCL	6-1-95	NA		X											

Method of shipment: COURIER

Special detection Limit/reporting

Special QA/QC

Remarks: 2 of 2

last batch

Lab number: 9506075

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	Date 6-2-95	Time 800	Received by M Doden	6/2/95	0800
Relinquished by M Doden	Date 6/2/95	Time 10:40	Received by		
Relinquished by	Date 6-2	Time 12:00	Received by laboratory	Date 6/2/95	Time 1210

Distribution: White copy — Laboratory; Canary copy — ARCO Environmental Engineering; Pink copy — Consultant

APC-3292 (2-91)

Sequoia
Analytical

680 Chesapeake Drive Redwood City, CA 94063 (415) 364-9600 FAX (415) 364-9233
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819 Striker Avenue, Suite 8 Sacramento, CA 95834 (916) 921-9600 FAX (916) 921-0100

RECEIVED
JUN 19 1995
PACIFIC ENVIRONMENTAL GROUP, INC.

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Project: 330-006.2G/0608, San Lorenzo

Enclosed are the results from samples received at Sequoia Analytical on June 2, 1995. The requested analyses are listed below:

SAMPLE #	SAMPLE DESCRIPTION	DATE OF COLLECTION	TEST METHOD
950610801	LIQUID, 17348VE	6/2/95	Nitrate Sulfate

Please contact me if you have any questions. In the meantime, thank you for the opportunity to work with you on this project.

Very truly yours,

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

Quality Assurance Department

Sequoia Analytical

680 Chesapeake Drive Redwood City, CA 94063 (415) 364-9600 FAX (415) 364-9233
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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Lab Proj. ID: 9506108

Sampled: 06/02/95
Received: 06/02/95
Analyzed: see below
Reported: 06/14/95

LABORATORY ANALYSIS

Lab No: 9506108-01
Sample Desc : **LIQUID,17348VE**

Analyte	Units	Date Analyzed	Detection Limit	Sample Results
Nitrate as Nitrate	mg/L	06/03/95	0.10	22
Sulfate	mg/L	06/03/95	0.10	85

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL - ELAP #1210

ileen Manning
roject Manager

Sequoia
Analytical

680 Chesapeake Drive Redwood City, CA 94063 (415) 364-9600 FAX (415) 364-9233
404 N. Wiget Lane Walnut Creek, CA 94598 (510) 988-9600 FAX (510) 988-9673
819 Striker Avenue, Suite 8 Sacramento, CA 95834 (916) 921-9600 FAX (916) 921-0100

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Client Project ID: 330-006.2G/0608, San Lorenzo
Matrix: Liquid
Work Order #: 9506108 01
Reported: Jun 16, 1995

QUALITY CONTROL DATA REPORT

Analyte:	Nitrate	Sulfate
QC Batch#:	IN0603953000ACB	IN0603953000ACB
Analy. Method:	EPA 300.0	EPA 300.0
Prep. Method:	N.A.	N.A.
Analyst:	S. Flynn	S. Flynn
MS/MSD #:	950607504	950607504
Sample Conc.:	51	99
Prepared Date:	6/3/95	6/3/95
Analyzed Date:	6/3/95	6/3/95
Instrument I.D.#:	INIC1	INIC1
Conc. Spiked:	100 mg/L	100 mg/L
Result:	140	190
MS % Recovery:	89	91
Dup. Result:	140	180
MSD % Recov.:	89	81
RPD:	0.0	5.4
RPD Limit:	0-30	0-30

LCS #:		
Prepared Date:		
Analyzed Date:		
Instrument I.D.#:		
Conc. Spiked:		
LCS Result:		
LCS % Recov.:		

MS/MSD LCS Control Limits	70-130	70-130

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

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

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SEQUOIA ANALYTICAL SAMPLE RECEIPT LOG

CLIENT NAME: PEG
REC. BY (PRINT): LKrause
WORKORDER: 95/06
DATE OF LOG-IN: 6-3-95

CIRCLE THE APPROPRIATE RESPONSE

1. Custody Seal(s) Present / [✓ Absent]
Intact / Broken*
2. Custody Seal Nos.: Put In Remarks Section
3. Chain-of-Custody Records: [✓ Present] / Absent*
4. Traffic Reports or Packing List: Present / [✓ Absent]
5. Airbill: Airbill / Sticker
Present / [✓ Absent]
6. Airbill No.:
7. Sample Tags: [✓ Present] / Absent*
Sample Tag Nos.: [✓ Listed] / Not Listed on Chain-of-Custody
8. Sample Condition: [✓ Intact] / Broken* / Leaking*
9. Does information on custody reports, traffic reports and sample tags agree? [✓ Yes] / No*
10. Proper preservatives used: [✓ Yes] / No*
11. Date Rec. at Lab: 6/2/95
12. Temp. Rec. at Lab: 14°C
13. Time Rec. at Lab: 1545

LAB SAMPLE #	DASH #	CLIENT IDENTIFICATION	CONTAINER DESCRIPTION	SAMPLE MATRIX	DATE SAMP.	REMARKS: CONDITION(ETC.)
1	a	17348VE	1L plain	liq	6/2	

6/2

* If Circled, contact Project manager and attach record of resolution

Revision 3/21/95

Page 1 of 1

ARCO Products Company ◆ 33000626 **Task Order No.** 1707600

Division of AtlanticRichfieldCompany

Chain of Custody

ARCO Facility no. 0608

City (Facility) SAN LORENZO

Project manager (Consultant) KELLY BROWN

Laboratory name SEQUOIA

ARCO engineer MIKE WHELAN

Telephone no. (ARCO)

Telephone no. (Consultant) 441-7500

Fax no. (Consultant) 441-7539

Contract number 07-073

Consultant name PACIFIC ENVIRONMENTAL GROUP

Address (Consultant) 2025 GATEWAY PLACE SUITE 440 SAN JOSE, CA 95110

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 EPA M602/8020/8015	TPH Modified 8015 Gas ☐ Diesel ☐	Oil and Grease 413.1 ☐ 413.2 ☐	TPH EPA 418.1/SM503E	EPA 601/8010	EPA 624/8240	EPA 625/8270	TCLP Metals ☐ VOA ☐ Semi VOA ☐	CAM Metals EPA 6010/7000 TTLC ☐ STLC ☐	Lead Org./DHS ☐ Lead EPA 7420/7421 ☐	SULFATE	NITRATE
17348VE		1		X		X	NP	6-2-95	1500												X	X

Method of shipment

Special detection Limit/reporting

Special QA/QC

Remarks 1 of 1

Lab number 9506108

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 — Date 6-2-95 — Time 1545

Received by

Relinquished by — Date — Time

Received by

Relinquished by — Date — Time

Received by laboratory — Date 6/2/95 — Time 1545

Distribution: White copy — Laboratory; Canary copy — ARCO Environmental Engineering; Pink copy — Consultant

APC-3292 (2-91)

Sequoia
Analytical

680 Chesapeake Drive Redwood City, CA 94063 (415) 364-9600 FAX (415) 364-9233
404 N. Wiget Lane Walnut Creek, CA 94598 (510) 988-9600 FAX (510) 988-9673
819 Striker Avenue, Suite 8 Sacramento, CA 95834 (916) 921-9600 FAX (916) 921-0100

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110

Attention: Maree Doden

Client Proj. ID: 330-006.2G/0608,San Lorenzo
Sample Descript: TB
Matrix: LIQUID
Analysis Method: 8015Mod/8020
Lab Number: 9505L35-10

Sampled: 05/26/95
Received: 05/31/95
Analyzed: 06/05/95
Reported: 06/12/95

QC Batch Number: GC060595BTEX17A
nstrument ID: GCHP17

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

Analyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
Benzene	0.50	N.D.
Toluene	0.50	N.D.
Ethyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
Chromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	88

Analytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

Eileen Manning
roject Manager

Sequoia
Analytical

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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Client Project ID: 330-006.2G/0608, San Lorenzo
Matrix: LIQUID

Work Order #: 9505L35 -01-06

Reported: Jun 13, 1995

QUALITY CONTROL DATA REPORT

Analyte:	Benzene	Toluene	Ethyl Benzene	Xylenes
QC Batch#:	GC060595BTEX20A	GC060595BTEX20A	GC060595BTEX20A	GC060595BTEX20A
Analy. Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Prep. Method:	EPA 5030	EPA 5030	EPA 5030	EPA 5030
Analyst:	J. Minkel	J. Minkel	J. Minkel	J. Minkel
MS/MSD #:	950519004	950519004	950519004	950519004
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Prepared Date:	6/5/95	6/5/95	6/5/95	6/5/95
Analyzed Date:	6/5/95	6/5/95	6/5/95	6/5/95
Instrument I.D.#:	GCHP20	GCHP20	GCHP20	GCHP20
Conc. Spiked:	10 μg/L	10 μg/L	10 μg/L	30 μg/L
Result:	11	11	11	32
MS % Recovery:	110	110	110	107
Dup. Result:	11	11	10	30
MSD % Recov.:	110	110	100	100
RPD:	0.0	0.0	9.5	6.5
RPD Limit:	0-50	0-50	0-50	0-50

LCS #:

Prepared Date:
Analyzed Date:
Instrument I.D.#:
Conc. Spiked:

LCS Result:
LCS % Recov.:

MS/MSD LCS Control Limits	71-133	72-128	72-130	71-120

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

Please Note:
The LCS is a control sample of known, interferent-free matrix that is analyzed using the same reagents, preparation, and analytical methods employed for the samples. The matrix spike is an aliquot of sample fortified with known quantities of specific compounds and subjected to the entire analytical procedure. If the recovery of analytes from the matrix spike does not fall within specified control limits due to matrix interference, the LCS recovery is to be used to validate the batch.

** MS=Matrix Spike, MSD=MS Duplicate, RPD=Relative % Difference

Sequoia
Analytical

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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Client Project ID: 330-006.2G/0608, San Lorenzo
Matrix: LIQUID
Work Order #: 9505L35-07- 10
Reported: Jun 13, 1995

QUALITY CONTROL DATA REPORT

Analyte:	Benzene	Toluene	Ethyl Benzene	Xylenes
QC Batch#:	GC060595BTEX17A	GC060595BTEX17A	GC060595BTEX17A	GC060595BTEX17A
Analy. Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Prep. Method:	EPA 5030	EPA 5030	EPA 5030	EPA 5030
Analyst:	J. Minkel	J. Minkel	J. Minkel	J. Minkel
MS/MSD #:	950519002	950519002	950519002	950519002
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Prepared Date:	6/5/95	6/5/95	6/5/95	6/5/95
Analyzed Date:	6/5/95	6/5/95	6/5/95	6/5/95
Instrument I.D.#:	GCHP17	GCHP17	GCHP17	GCHP17
Conc. Spiked:	10 µg/L	10 µg/L	10 µg/L	30 µg/L
Result:	10	10	10	30
MS % Recovery:	100	100	100	100
Dup. Result:	9.8	9.8	9.8	29
MSD % Recov.:	98	98	98	97
RPD:	2.0	2.0	2.0	3.4
RPD Limit:	0-50	0-50	0-50	0-50

LCS #:

Prepared Date:
Analyzed Date:
Instrument I.D.#:
Conc. Spiked:

LCS Result:
LCS % Recov.:

MS/MSD LCS Control Limits	71-133	72-128	72-130	71-120

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

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Sequoia Analytical

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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Client Project ID: 330-006.2G/0608, San Lorenzo
Matrix: LIQUID
Work Order #: 9505L35-02, 04, 05, 06, 07
Reported: Jun 13, 1995

QUALITY CONTROL DATA REPORT

Analyte:	Nitrate	Sulfate
QC Batch#:	IN0601953000ACC	IN0601953000ACC
Analy. Method:	EPA 300.0	EPA 300.0
Prep. Method:	N.A.	N.A.
Analyst:	S. Flynn	S. Flynn
MS/MSD #:	9505L3507	9505L3507
Sample Conc.:	63	92
Prepared Date:	6/1/95	6/1/95
Analyzed Date:	6/1/95	6/1/95
Instrument I.D.#:	INIC1	INIC1
Conc. Spiked:	100 mg/L	100 mg/L
Result:	150	180
MS % Recovery:	87	88
Dup. Result:	150	170
MSD % Recov.:	87	78
RPD:	0.0	5.7
RPD Limit:	0-30	0-30

LCS #:		
Prepared Date:		
Analyzed Date:		
Instrument I.D.#:		
Conc. Spiked:		
LCS Result:		
LCS % Recov.:		

MS/MSD LCS Control Limits	70-130	70-130

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

Please Note:
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** MS=Matrix Spike, MSD=MS Duplicate, RPD=Relative % Difference

Sequoia
Analytical

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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Client Project ID: 330-006.2G/0608, San Lorenzo
Matrix: LIQUID

Work Order #: 9505L35-01, 03, 08, 09

Reported: Jun 13, 1995

QUALITY CONTROL DATA REPORT

Analyte:	Nitrate	Sulfate
QC Batch#:	IN0601953000ACD	IN0601953000ACD
Analy. Method:	EPA 300.0	EPA 300.0
Prep. Method:	N.A.	N.A.
Analyst:	S. Flynn	S. Flynn
MS/MSD #:	9505L3503	9505L3503
Sample Conc.:	62	100
Prepared Date:	6/1/95	6/1/95
Analyzed Date:	6/1/95	6/1/95
Instrument I.D.#:	~~INIC1~~	INIC1
Conc. Spiked:	100 mg/L	100 mg/L
Result:	150	190
MS % Recovery:	88	90
Dup. Result:	150	190
MSD % Recov.:	88	90
RPD:	0.0	0.0
RPD Limit:	0-30	0-30
LCS #:		
Prepared Date:		
Analyzed Date:		
Instrument I.D.#:		
Conc. Spiked:		
LCS Result:		
LCS % Recov.:		
MS/MSD LCS Control Limits	70-130	70-130

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

Please Note:
The LCS is a control sample of known, interferent-free matrix that is analyzed using the same reagents, preparation, and analytical methods employed for the samples. The matrix spike is an aliquot of sample fortified with known quantities of specific compounds and subjected to the entire analytical procedure. If the recovery of analytes from the matrix spike does not fall within specified control limits due to matrix interference, the LCS recovery is to be used to validate the batch.

** MS=Matrix Spike, MSD=MS Duplicate, RPD=Relative % Difference

SEQUOIA ANALYTICAL SAMPLE RECEIPT LOG

CLIENT NAME: PEG
REC. BY (PRINT): LKrause
WORKORDER: 9505L35
DATE OF LOG-IN: 6/1/95

CIRCLE THE APPROPRIATE RESPONSE

1. Custody Seal(s) Present / [✓ Absent]
   Intact / Broken*
2. Custody Seal Nos.: Put in Remarks Section
3. Chain-of-Custody Records: [✓ Present] / Absent*
4. Traffic Reports or Packing List: Present / [✓ Absent]
5. Airbill: Airbill / Sticker
   Present / [✓ Absent]
6. Airbill No.:
7. Sample Tags: [✓ Present] / Absent*
   Sample Tag Nos.: [✓ Listed] / Not Listed on Chain-of-Custody
8. Sample Condition: [✓ Intact] / Broken* / Leaking*
9. Does information on custody reports, traffic reports and sample tags agree? [✓ Yes] / No*
10. Proper preservatives used: [✓ Yes] / No*
11. Date Rec. at Lab: 5/31/95
12. Temp. Rec. at Lab: 14°C
13. Time Rec. at Lab: 1230

LAB SAMPLE #	DASH #	CLIENT IDENTIFICATION	CONTAINER DESCRIPTION	SAMPLE MATRIX	DATE SAMP.	REMARKS: CONDITION(ETC.)
1	a-d	590H	3voa	liq	5/26	
	↓		1L plain	↓	↓	
2	Same	17200 VM	3voa		5/30	
	↓		1L plain		↓	
3		17348 VM	3voa			
			1L plain			
4		MW-17	3voa			
			1L plain			
5		MW-18	3voa			
			1L plain			
6		MW-19	3voa			
			1L plain			
7		MW-21	3voa			
			1L plain			
8		MW-22	3voa			6-1-95
			1L plain			C.T. [illegible]
9		MW-23	3voa			+2 TB 5/2[illegible]/95
↓	↓		1L plain	↓	↓	[illegible]
				5/31		

*if Circled, contact Project manager and attach record of resolution

Revision 3/21/95

Page 1 of 1

ARCO Products Company 330-006.26 **Task Order No.** 1707600 9505L35 **Chain of Custody**
Division of AtlanticRichfieldCompany

ARCO Facility no. 0608	City (Facility) SAN LORENZO	Project manager (Consultant) KELLY BROWN	
ARCO engineer MIKE WHELAN	Telephone no. (ARCO)	Telephone no. (Consultant) 441-7500	Fax no. (Consultant) (408)441-7539
Consultant name PACIFIC ENVIRONMENTAL GROUP	Address (Consultant) 2025 GATEWAY PLACE, SAN JOSE, CA 95110		

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 4/AS EPA M602/8020/8015	TPH Modified 8015 Gas ☐ Diesel ☐	Oil and Grease 413.1 ☐ 413.2 ☐	TPH EPA 418.1/SM503E	EPA 601/8010	EPA 624/8240	EPA 625/8270	TCLP Metals ☐ VOA ☐ Semi VOA ☐	CAM Metals EPA 6010/7000 TTLC ☐ STLC ☐	Lead Org./DHS ☐ Lead EPA 7420/7421 ☐	SULFATE	NITRATE
590H		3		X		X	HCL	5-26-95	1400		X								1			
17200VM		↓		↓		↓	↓	5-30-95	1510		↓								2			
17348VM		↓		↓		↓	↓	↓	1145		↓								3			
MW-17		↓		↓		↓	↓	↓	1445		↓								4			
MW-18		↓		↓		↓	↓	↓	1550		↓								5			
MW-19		↓		↓		↓	↓	↓	1420		↓								6			
MW-21		↓		↓		↓	↓	↓	1300		↓								7			
MW-22		↓		↓		↓	↓	↓	1240		↓								8			
MW-23		↓		↓		↓	↓	↓	1220		↓								9			
590H		2		↓		↓	NP	5/26/95	~~1400~~ 1430 EM										1		X	X
17200VM		2		↓		↓	↓	5/30/95	1510										2		X	X
~~1734BVM~~		↓		↓		↓	↓	↓	~~1145~~										~~3~~		~~X~~	~~X~~
MW-17		↓		↓		↓	↓	↓	1445								EM		4		X	X
MW-18		↓		↓		↓	↓	↓	1550										5		X	X
MW-19		↓		↓		↓	↓	↓	1420										6		X	X
MW-21		↓		↓		↓	↓	↓	1300										7		X	X

Laboratory name SEQUOIA

Contract number 07-073

Method of shipment COURIER

Special detection Limit/reporting

Special QA/QC

Remarks
1st batch
1 of 2 pgs

Lab number 9505L35

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	Date 5-31-95	Time 730	Received by	5/31/95	0730
Relinquished by	Date 5/31/95	Time 11:45	Received by	5/31	11:45
Relinquished by	Date 5/31	Time 12:30	Received by laboratory	Date 5/31/95	Time 1230

Distribution: White copy — Laboratory; Canary copy — ARCO Environmental Engineering; Pink copy — Consultant
APC-3292 (2-91)

ARCO Products Company ◆ 13000-26 **Task Order No.** 1707600 9505L35 **Chain of Custody**
Division of AtlanticRichfieldCompany

ARCO Facility no. 0608
City (Facility) SANLORENZO
Project manager (Consultant) KELLY BROWN
Laboratory name SEQUOIA
ARCO engineer MIKE WHELAN
Telephone no. (ARCO)
Telephone no. (Consultant) 441-7500
Fax no. (Consultant) 441-7539
Contract number 07-073
Consultant name PACIFIC ENVIRONMENTAL GROUP
Address (Consultant) 2025 GATEWAY PLACE, SANJOSE, CA 95110

Sample I.D.	Lab no.	Container no.	Matrix			Preservation		Sampling date	Sampling time	BTEX 602/EPA 8020	BTEX/TPH GAS EPA M602/8020/8015	TPH Modified 8015 Gas ☐ Diesel ☐	Oil and Grease 413.1 ☐ 413.2 ☐	TPH EPA 418.1/SM503E	EPA 601/8010	EPA 624/8240	EPA 625/8270	TCLP Metals ☐ VOA ☐ Semi VOA ☐	CAM Metals EPA 6010/7000 TTLC ☐ STLC ☐	Lead Org./DHS ☐ Lead EPA 7420/7421 ☐	SULFATE	NITRATE
			Soil	Water	Other	Ice	Acid															
MW-22		1		X		X	NP	5-30-95	1240										8		X	X
MW-23		1		X		X	NP	5-30-95	1220										9		X	X
TB-1		2		X		X	HCL	5-26-95	NA		X								10			

Method of shipment
COURIER

Special detection Limit/reporting

Special QA/QC

Remarks

2 of 2 pgs

Lab number
9505L35

Turnaround time
~~Priority Rush 1 Business Day ☒~~ NB
Rush 2 Business Days ☐
Expedited 5 Business Days ☐
Standard 10 Business Days ☒

Condition of sample:
Temperature received:

Relinquished by sampler	Date 5-31-95	Time 730	Received by N Doden	5/31/95 0730	
Relinquished by N Doden	Date 5/31/95	Time 11:00	Received by	5/31/95	
Relinquished by	Date 5/31	Time 12:30	Received by laboratory	Date 5/31/95	Time 1230

Distribution: White copy — Laboratory; Canary copy — ARCO Environmental Engineering; Pink copy — Consultant

Sequoia
Analytical

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819 Striker Avenue, Suite 8 Sacramento, CA 95834 (916) 921-9600 FAX (916) 921-0100

acific Environmental Group	Client Proj. ID: 330-006.2G/0608, San Lorenzo	Sampled:
2025 Gateway Place, Suite 440	Sample Descript: TB-2	Received: 06/01/95
San Jose, CA 95110	Matrix: LIQUID	
	Analysis Method: 8015Mod/8020	Analyzed: 06/05/95
ttention: Maree Doden	Lab Number: 9506031-10	Reported: 06/13/95

)C Batch Number: GC060595BTEX21A
trument ID: GCHP21

Total Purgeable Petroleum Hydrocarbons (TPPH) with BTEX

nalyte	Detection Limit ug/L	Sample Results ug/L
TPPH as Gas	50	N.D.
enzene	0.50	N.D.
oluene	0.50	N.D.
thyl Benzene	0.50	N.D.
Xylenes (Total)	0.50	N.D.
hromatogram Pattern:		

Surrogates	Control Limits %		% Recovery
Trifluorotoluene	70	130	95

nalytes reported as N.D. were not present above the stated limit of detection.

EQUOIA ANALYTICAL - ELAP #1210

ileen Manning
oject Manager

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Client Project ID: 330-006.2G/0608, San Lorenzo
Matrix: LIQUID
Work Order #: 9506031 01-09
Reported: Jun 15, 1995

QUALITY CONTROL DATA REPORT

Analyte:	Nitrate	Sulfate
QC Batch#:	IN0602953000ACB	IN0602953000ACB
Analy. Method:	EPA 300.0	EPA 300.0
Prep. Method:	N.A.	N.A.
Analyst:	S. Flynn	S. Flynn
MS/MSD #:	950603109	950603109
Sample Conc.:	N.D.	41
Prepared Date:	6/2/95	6/2/95
Analyzed Date:	6/2/95	6/2/95
Instrument I.D.#:	INIC1	INIC1
Conc. Spiked:	10 mg/L	10 mg/L
Result:	20	50
MS % Recovery:	80	90
Dup. Result:	21	50
MSD % Recov.:	90	90
RPD:	4.9	0.0
RPD Limit:	0-30	0-30

LCS #:		
Prepared Date:		
Analyzed Date:		
Instrument I.D.#:		
Conc. Spiked:		
LCS Result:		
LCS % Recov.:		

MS/MSD LCS Control Limits	70-130	70-130

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

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Client Project ID: 330-006.2G/0608, San Lorenzo
Matrix: LIQUID
Work Order #: 9506031 01-04, 06-09
Reported: Jun 15, 1995

QUALITY CONTROL DATA REPORT

Analyte:	Benzene	Toluene	Ethyl Benzene	Xylenes
QC Batch#:	GC060595BTEX20A	GC060595BTEX20A	GC060595BTEX20A	GC060595BTEX20A
Analy. Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Prep. Method:	EPA 5030	EPA 5030	EPA 5030	EPA 5030
Analyst:	J. Minkel	J. Minkel	J. Minkel	J. Minkel
MS/MSD #:	950519004	950519004	950519004	950519004
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Prepared Date:	6/5/95	6/5/95	6/5/95	6/5/95
Analyzed Date:	6/5/95	6/5/95	6/5/95	6/5/95
Instrument I.D.#:	GCHP20	GCHP20	GCHP20	GCHP20
Conc. Spiked:	10 µg/L	10 µg/L	10 µg/L	30 µg/L
Result:	110	11	11	32
MS % Recovery:	1100	110	110	107
Dup. Result:	11	11	10	30
MSD % Recov.:	110	110	100	100
RPD:	164	0.0	9.5	6.5
RPD Limit:	0-50	0-50	0-50	0-50
LCS #:				
Prepared Date:				
Analyzed Date:				
Instrument I.D.#:				
Conc. Spiked:				
LCS Result:				
LCS % Recov.:				
MS/MSD LCS Control Limits	71-133	72-128	72-130	71-120

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

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

Please Note:
The LCS is a control sample of known, interferent-free matrix that is analyzed using the same reagents, preparation, and analytical methods employed for the samples. The matrix spike is an aliquot of sample fortified with known quantities of specific compounds and subjected to the entire analytical procedure. If the recovery of analytes from the matrix spike does not fall within specified control limits due to matrix interference, the LCS recovery is to be used to validate the batch.

** MS = Matrix Spike, MSD = MS Duplicate, RPD = Relative % Difference

Sequoia
Analytical

680 Chesapeake Drive | Redwood City, CA 94063 | (415) 364-9600 | FAX (415) 364-9233
404 N. Wiget Lane | Walnut Creek, CA 94598 | (510) 988-9600 | FAX (510) 988-9673
819 Striker Avenue, Suite 8 | Sacramento, CA 95834 | (916) 921-9600 | FAX (916) 921-0100

Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Client Project ID: 330-006.2G/0608, San Lorenzo
Matrix: LIQUID
Work Order #: 9506031 05
Reported: Jun 15, 1995

QUALITY CONTROL DATA REPORT

Analyte:	Benzene	Toluene	Ethyl Benzene	Xylenes
QC Batch#:	GC060695BTEX17A	GC060695BTEX17A	GC060695BTEX17A	GC060695BTEX17A
Analy. Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Prep. Method:	EPA 5030	EPA 5030	EPA 5030	EPA 5030
Analyst:	J. Minkel	J. Minkel	J. Minkel	J. Minkel
MS/MSD #:	950603102	950603102	950603102	950603102
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Prepared Date:	6/6/95	6/6/95	6/6/95	6/6/95
Analyzed Date:	6/6/95	6/6/95	6/6/95	6/6/95
Instrument I.D.#:	GCHP17	GCHP17	GCHP17	GCHP17
Conc. Spiked:	10 µg/L	10 µg/L	10 µg/L	30 µg/L
Result:	8.9	8.5	8.4	25
MS % Recovery:	89	85	84	83
Dup. Result:	7.8	7.9	7.9	24
MSD % Recov.:	78	79	79	80
RPD:	13	7.3	6.1	4.1
RPD Limit:	0-50	0-50	0-50	0-50
LCS #:				
Prepared Date:				
Analyzed Date:				
Instrument I.D.#:				
Conc. Spiked:				
LCS Result:				
LCS % Recov.:				
MS/MSD LCS Control Limits	71-133	72-128	72-130	71-120

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

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

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Pacific Environmental Group
2025 Gateway Place, Suite 440
San Jose, CA 95110
Attention: Maree Doden

Client Project ID: 330-006.2G/0608, San Lorenzo
Matrix: LIQUID

Work Order #: 9506031 10

Reported: Jun 15, 1995

QUALITY CONTROL DATA REPORT

Analyte:	Benzene	Toluene	Ethyl Benzene	Xylenes
QC Batch#:	GC060595BTEX21A	GC060595BTEX21A	GC060595BTEX21A	GC060595BTEX21A
Analy. Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Prep. Method:	EPA 5030	EPA 5030	EPA 5030	EPA 5030
Analyst:	J. Minkel	J. Minkel	J. Minkel	J. Minkel
MS/MSD #:	950519004	950519004	950519004	950519004
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Prepared Date:	6/5/95	6/5/95	6/5/95	6/5/95
Analyzed Date:	6/5/95	6/5/95	6/5/95	6/5/95
Instrument I.D.#:	GCHP21	GCHP21	GCHP21	GCHP21
Conc. Spiked:	10 µg/L	10 µg/L	10 µg/L	30 µg/L
Result:	9.4	9.2	9.2	28
MS % Recovery:	94	92	92	93
Dup. Result:	8.7	8.6	8.5	26
MSD % Recov.:	87	86	86	87
RPD:	7.7	6.7	7.9	7.4
RPD Limit:	0-50	0-50	0-50	0-50

LCS #:

Prepared Date:
Analyzed Date:
Instrument I.D.#:
Conc. Spiked:

LCS Result:
LCS % Recov.:

MS/MSD LCS Control Limits	71-133	72-128	72-130	71-120

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

SEQUOIA ANALYTICAL

Eileen A. Manning
Project Manager

Please Note:
The LCS is a control sample of known, interferent-free matrix that is analyzed using the same reagents, preparation, and analytical methods employed for the samples. The matrix spike is an aliquot of sample fortified with known quantities of specific compounds and subjected to the entire analytical procedure. If the recovery of analytes from the matrix spike does not fall within specified control limits due to matrix interference, the LCS recovery is to be used to validate the batch.

** MS=Matrix Spike, MSD=MS Duplicate, RPD=Relative % Difference

SEQUOIA ANALYTICAL SAMPLE RECEIPT LOG

CLIENT NAME: PEG / ARCO (330-006.2G)
REC. BY (PRINT): M. YONG
WORKORDER: 9506031
DATE OF LOG-IN: 6/1/95

CIRCLE THE APPROPRIATE RESPONSE

1. Custody Seal(s) Present / [✓ Absent]
   Intact / Broken*
2. Custody Seal Nos.: Put in Remarks Section
3. Chain-of-Custody Records: [✓ Present] / Absent*
4. Traffic Reports or Packing List: Present / [✓ Absent]
5. Airbill: Airbill / Sticker
   Present / [✓ Absent]
6. Airbill No.:
7. Sample Tags: [✓ Present] / Absent*
   Sample Tag Nos.: [✓ Listed] / Not Listed on Chain-of-Custody
8. Sample Condition: [✓ Intact] / Broken* / Leaking*
9. Does information on custody reports, traffic reports and sample tags agree? [✓ Yes] / No*
10. Proper preservatives used: SWD [✓ Yes] / No*
11. Date Rec. at Lab: 6/1/95
12. Temp. Rec. at Lab: 10°C
13. Time Rec. at Lab: 1156

LAB SAMPLE #	DASH #	CLIENT IDENTIFICATION	CONTAINER DESCRIPTION	SAMPLE MATRIX	DATE SAMP.	REMARKS: CONDITION(ETC.)
1	ABD	633H	VOA (3)	L	5/31/95	
	C	"	1LP			
2	A-D	17197VM	same			
3		17203VM	same			
4		17302VM	same			
5		17349 VM	same			
6		17372VM	same			
7		17393VM	same			
8		MW-15	same			
9		MW-16	same			
10	AB	TB-2	VOA (2)			

6/1/95

* If Circled, contact Project manager and attach record of resolution

Revision 3/21/95

Page 1 of 1

ARCO Products Company [redacted] 3300626 **Task Order No.** 1707600

Division of AtlanticRichfieldCompany

ARCO Facility no. 0608	City (Facility) SAN LORENZO	Project manager (Consultant) KELLY BROWN	Laboratory name SEQUOIA
ARCO engineer MIKE WHELAN	Telephone no. (ARCO)	Telephone no. (Consultant) 441-7500 / Fax no. (Consultant) 441-7539	Contract number 07-073
Consultant name PACIFIC ENVIRONMENTAL GROUP		Address (Consultant) 2025 GATEWAY PLACE #440 SAN JOSE, CA	

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 GAS EPA M602/8020/8015	TPH Modified 8015 Gas ☐ Diesel ☐	Oil and Grease 413.1 ☐ 413.2 ☐	TPH EPA 418.1/SM503E	EPA 601/8010	EPA 624/8240	EPA 625/8270	TCLP Metals ☐ VOA ☐ Semi VOA ☐	CAM Metals EPA 6010/7000 TTLC ☐ STLC ☐	Lead Org./DHS ☐ Lead EPA 7420/7421 ☐	SULFATE	NITRATE
633H	1	3		X		X	HCL	5-31-95	1230		X											
17197VM	2	↓		↓		↓	↓	↓	1005		↓											
17203VM	3	↓		↓		↓	↓	↓	1025		↓											
17302VM	4	↓		↓		↓	↓	↓	1100		↓											
17349VM	5	↓		↓		↓	↓	↓	1135		↓											
17372VM	6	↓		↓		↓	↓	↓	1250		↓											
17393VM	7	↓		↓		↓	↓	↓	1340		↓											
MW-15	8	↓		↓		↓	↓	↓	1315		↓											
MW-16	9	↓		↓		↓	↓	↓	1200		↓											
TB-2	10	2		↓		↓	↓	↓	NA		↓											
633H	1	1		↓		↓	NP	↓	1230												X	X
17197VM	2	↓		↓		↓	↓	↓	1005												X	X
17203VM	3	↓		↓		↓	↓	↓	1025												X	X
17302VM	4	↓		↓		↓	↓	↓	1100												X	X
17349VM	5	↓		↓		↓	↓	↓	1135												X	X
17372VM	6	↓		↓		↓	↓	↓	1250												X	X

Method of shipment: COURIER

Special detection Limit/reporting: 9506031

Special QA/QC:

Remarks: 1 of 2

2nd batch

Lab number:

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	Date 6-1-95	Time 730	Received by M Doden 6/1/95 0825
Relinquished by M Doden	Date 6/1/95	Time 11:00	Received by
Relinquished by	Date 6-1	Time 11:50	Received by laboratory / Date 6/1/95 / Time 1156

Distribution: White copy — Laboratory; Canary copy — ARCO Environmental Engineering; Pink copy — Consultant

APC-3292 (2-91)

ARCO Products Company 330-0062G **Task Order No.** 1707600 **Chain of Custody**

Division of AtlanticRichfieldCompany

ARCO Facility no. 0608	City (Facility) SAN LORENZO	Project manager (Consultant) KELLY BROWN	Laboratory name SEQUOIA
ARCO engineer MIKE WHELAN	Telephone no. (ARCO)	Telephone no. (Consultant) 441-7500	Fax no. (Consultant) 441-7539
Consultant name PACIFIC ENVIRONMENTAL GROUP	Address (Consultant) 2025 GATEWAY PLACE #440 SAN JOSE, CA 95110		Contract number 07-073

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 EPA M602/8020/8015	TPH Modified 8015 Gas ☐ Diesel ☐	Oil and Grease 413.1 ☐ 413.2 ☐	TPH EPA 418.1/SM503E	EPA 601/8010	EPA 624/8240	EPA 625/8270	TCLP Metals ☐ VOA ☐ Semi VOA ☐	CAM Metals EPA 6010/7000 TTLC ☐ STLC ☐	Lead Org./DHS ☐ Lead EPA 7420/7421 ☐	SULFATE	NITRATE
17393VM	7	1		X		X	NP	5-31-95	1340												X	X
MW-15	8	↓		↓		↓	↓	↓	1315												X	X
MW-16	9	↓		↓		↓	↓	↓	1200												X	X

Method of shipment
COURIER

Special detection Limit/reporting
9506031

Special QA/QC

Remarks
2 OF 2

Lab number

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	Date 6-1-95	Time 730	Received by	6/1/95	0815
Relinquished by	Date 6/1/95	Time 11:00	Received by		
Relinquished by	Date 6-1	Time 11:50	Received by laboratory	Date 6/1/95	Time 1156

Distribution: White copy — Laboratory; Canary copy — ARCO Environmental Engineering; Pink copy — Consultant
APC-3292 (2-91)

DISSOLVED OXYGEN TEST KIT
Model OX-2P
Cat. No. 1469-00

HACH

To ensure accurate results please read carefully before proceeding.

If dissolved oxygen is to be determined in sewage, pretreatment with Copper Sulfate-Sulfamic Acid Solution is required. *See pretreatment items in Replacements* and write for instructions on their use.

A more sensitive test can be performed using Starch Indicator Solution, Cat. No. 349-37. This solution is not included in the kit but may be ordered from Hach Company. *See Replacements.* To use, titrate the sample until the color just begins to change from yellow-brown to light yellow. Add two drops of Starch Indicator Solution. Continue the titration as indicated in the instructions, counting the drops of Sodium Thiosulfate Standard Solution used until the sample changes from blue to colorless.

WARNING: The chemicals in this kit may be hazardous to the health and safety of the user if inappropriately handled. Please read all warnings carefully before performing the test and use appropriate safety equipment.

HACH COMPANY, P.O. BOX 389, LOVELAND, COLORADO 80539
TELEPHONE: WITHIN U.S. 800-227-4224, OUTSIDE U.S. 303-669-3050, TELEX: 160840

High Range Test Instructions

1. Fill the Dissolved Oxygen bottle (round bottle with glass stopper) with the water to be tested by allowing the water to overflow the bottle for two or three minutes. To avoid trapping air bubbles in the bottle incline the bottle slightly and insert the stopper with a quick thrust. This will force air bubbles out. If bubbles become trapped in the bottle in Steps 2 or 4 the sample should be discarded before repeating the test.
2. Use the clippers to open one Dissolved Oxygen 1 Reagent Powder Pillow and one Dissolved Oxygen 2 Reagent Powder Pillow. Add the contents of each of the pillows to the bottle. Stopper the bottle carefully to exclude air bubbles. Grip the bottle and stopper firmly; shake vigorously to mix. A flocculant (floc) precipitate will be formed. If oxygen is present in the sample the precipitate will be brownish orange in color. A small amount of powdered reagent may remain stuck to the bottom of the bottle. This will not affect the test results.
3. Allow the sample to stand until the floc has settled halfway in the bottle, leaving the upper half of the sample clear. Shake the bottle again. Again let it stand until the upper half of the sample is clear. Note the floc will not settle in samples with high concentrations of chloride, such as sea water. No interference with the test results will occur as long as the sample is allowed to stand for four or five minutes.
4. Use the clippers to open one Dissolved Oxygen 3 Reagent Powder Pillow. Remove the stopper from the bottle and add the contents of the pillow. Carefully restopper the bottle and shake to mix. The floc will dissolve and a yellow color will develop if oxygen is present.
5. Fill the plastic measuring tube level full of the sample prepared in Steps 1 through 4. Pour the sample into the square mixing bottle.
6. Add Sodium Thiosulfate Standard Solution drop by drop to the mixing bottle, swirling to mix after each drop. Hold the dropper vertically above the bottle and count each drop as it is added. Continue to add drops until the sample changes from yellow to colorless.
7. Each drop used to bring about the color change in Step 6 is equal to 1 mg/L of dissolved oxygen (DO).

Low Range Test Instructions

If the result of the Step 7 is very low (3 mg/L or less) it is advisable to obtain a more sensitive test. To do so:

1. Use the prepared sample left from Step 4 in the High Range Test. Pour off the contents of the DO Bottle until the level just reaches the mark (30 mL) on the bottle.
2. Add Sodium Thiosulfate Standard Solution drop by drop directly to the Do bottle. Count each drop as it is added and swirl the bottle constantly to mix while adding the titrant. Continue to add drops until the sample changes from yellow to colorless.
3. Each drop of PAO Standard Solution used to bring about the color change in Step 2 is equal to 0.2 mg/L dissolved oxygen.

REPLACEMENTS

Cat. No.	Description	Unit
981-99	Dissolved Oxygen 1 Reagent Powder Pillows	pkg/100
982-99	Dissolved Oxygen 2 Reagent Powder Pillows	pkg/100
987-99	Dissolved Oxygen 3 Reagent Powder Pillows	pkg/100
24089-37	Sodium Thiosulfate, Stabilized, Standard Solution, 0.0109N	118 mL (4 oz) MDB*
1909-02	Bottle, Dissolved Oxygen, glass-stoppered	each
439-06	Bottle, square, mixing	pkg/6
968-00	Clippers	each
1909-01	Stopper, for dissolved oxygen bottle	each
438-00	Tube, measuring 5.83 mL	each
357-37	Copper Sulfate-Sulfamic Acid Solution APHA (not included in kit)	118 mL (4 oz) MDB*
349-37	Starch Indicator Solution (not included in kit)	118 mL (4 oz) MDB*
1949-00	Cylinder, graduated, 500 mL (not included in kit)	each
1864-41	Siphon (not included in kit)	each
7134-00	Tubing (not included in kit)	each

*Marked Dropping Bottle

MADE IN U.S.A. 1/90

HYDROGEN SULFIDE TEST KIT
Range 0-5 mg/L as Hydrogen Sulfide
Model HS-C
Cat. No. 25378-00

HACH

To ensure accurate results, read carefully before proceeding.

The test for hydrogen sulfide should be performed on water which has been freshly pumped. If the water has been aerated or allowed to stand before testing, much, if not all, of the hydrogen sulfide will be lost through aeration and oxidation.

Test Instructions

1. Fill the sample bottle to the 100 mL mark with the water to be tested for hydrogen sulfide.

WARNING: ***The chemicals in this kit may be hazardous to the health and safety of the user if inappropriately handled. Please read all warnings before performing the test and use appropriate safety equipment.***

HACH COMPANY, P.O. BOX 389. LOVELAND, COLORADO 80539
TELEPHONE: WITHIN U.S. 800-227-4224, OUTSIDE U.S. 303-669-3050, TELEX: 160840

2. Place a circle of Hydrogen Sulfide Test Paper inside the cap of the sample bottle being careful to avoid wetting the paper. (See Note A)
3. Add two (2) Alka-Seltzer tablets to the water sample and immediately screw the cap on the bottle until tight. (See Note B)
4. Allow approximately two (2) minutes to allow the tablets to dissolve and effervescence to subside. Remove the test paper and compare the color of the test paper with the color chart provided.

NOTE A: The test paper circles should be a very pale blue. Slight variations in the color of the test paper are expected, and will not affect the results of the test.

NOTE B: Only Alka-Seltzer Antacid® (in the gold package) without aspirin or non-aspirin can be used in this test. All other formulations of Alka-Seltzer® will not provide correct results due to the generation of excess pressure.

Replacements

Cat. No.	Description	Unit
14533-00	Alka Seltzer w/o aspirin foil wrapped pkg 18x2	each
25379-00	Hydrogen Sulfide Test Chart	each
25377-33	Hydrogen Sulfide Test Papers	pkg/100
25328-00	Hydrogen Sulfide Bottle w/cap	each

2/92
Made in U.S.A.

IRON, TOTAL

Range: 0.0-0.20 mg/L and 0.0-1.20 mg/L

TPTZ Iron Reagent Method

Model IR-21

Cat. No. 22993-00

HACH

Introduction

To ensure accurate results please read carefully before proceeding.

Iron in the sample, including precipitated or suspended iron such as rust, is converted to the ferrous state. A deep blue-purple color develops in the presence of ferrous iron. Hach combines the reducing agent and indicator for total iron analysis in a single powder formulation.

Deposits of iron on glassware may interfere with the results of this test. To avoid such interference presoak or rinse glassware with a 1:1 Hydrochloric Acid Solution, followed by rinsing with demineralized water. The first determination of total iron using new glassware may give slightly high results. This is due to iron deposits being leached from the glass.

Copper, cobalt, chromium and mercury may interfere with the results of this test, giving slightly high results.

WARNING: The chemicals in this kit may be hazardous to the health and safety of the user if inappropriately handled. Please read all warnings before performing the test and use appropriate safety equipment.

HACH COMPANY, P.O. BOX 389. LOVELAND, COLORADO 80539
TELEPHONE: WITHIN U.S. 800-227-4224, OUTSIDE U.S. 303-669-3050, TELEX: 160840

This test requires the generation of a reagent blank. To prepare a reagent blank, fill the clean graduated vial to the 25-mL mark with demineralized water and add the contents of one TPTZ Iron Reagent Powder Pillow. Swirl immediately to mix. The untreated water sample may have a color or turbidity greater than the generated reagent blank. If so, use the untreated water sample in place of the generated reagent blank.

Iron Test Instructions: Low Range (0-0.20 mg/L)

1. Fill the clean graduated vial to the 25-mL mark with the water to be tested.
2. Use the clippers to open one TPTZ Iron Reagent Powder Pillow. Add the contents of the pillow to the sample and swirl immediately to mix.
3. A blue color will develop if iron is present. Allow three minutes for full color development.
4. Fill one sample tube to the line underlining "Cat. 1730-00" with the prepared sample. This will be approximately 15 mL. If not using 1730 tubes, fill to the line found at approximately 3 inches up from the bottom of the tube.
5. Place the lengthwise viewing adapter in the comparator as shown in Figure 1.
6. Place the tube of prepared water sample into the comparator opening labeled Prepared Sample Position in Figure 1.
7. Fill the other sample tube with untreated water or a reagent blank to the line underlining "Cat. 1730-00". Insert this tube into the comparator opening labeled Clear Sample Position in Figure 1.

---

8. Hold the comparator with the tube tops pointing to a window or light source as in Figure 1a. View through the openings in the front of the comparator. When viewing, use care to not spill samples from unstoppered tubes.
9. Rotate the disc to obtain a color match. Read the mg/L total iron (Fe) through the scale window on the "end view" scale.

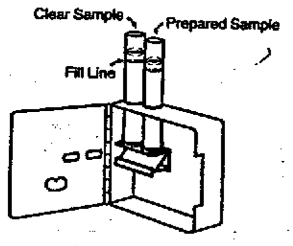

FIGURE 1

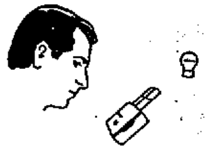

FIGURE 1a

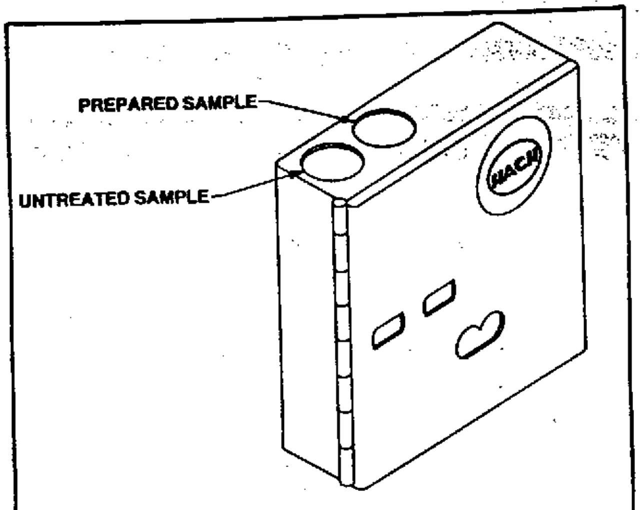

Figure 2.

REPLACEMENTS

Cat. No.	Description	Unit
22756-68	TPTZ Iron Reagent Pillows	25/box
968-00	Clippers	each
1732-00	Color Comparator	each
22990-00	Color Disc (TPTZ, Iron)	each
1730-00	Color Viewing Tube	each
24122-01	Lengthwise Viewing Adapter	each
14480-00	Stopper, Hollow No. 0	pkg/6
2193-00	Vial, graduated	each
14175-14	Iron Standard Solution, 100 mg/L Fe (not included in kit)	118 mL (4 oz
14254-10	Iron Standard, 50 mg Fe/L, Voluette® Ampule (not included in kit)	16/pkg

Reagent accuracy should be checked periodically. To do this, prepare a 1.0-mg/L iron standard solution by pipetting 1.00 mL of Iron Standard Solution, 100 mg/L as Fe, Cat. No. 14175-14, into a 100-mL volumetric flask; then dilute that solution to the mark with iron-free demineralized water. Alternatively, using the TenSette™ Pipet, add 0.5 mL of a Voluette Ampule for Iron, 50 mg/L as Fe, into a 25-mL volumetric flask and dilute to volume with demineralized water. Follow the instructions for the High Range Test, using this solution instead of a water sample. The standard solution should be prepared fresh before each use.

Iron Standard Solutions are not included as part of this kit but may be ordered from Hach Company. *See Replacements.*

Voluette and TenSette are Hach Company trademarks.

1/90
MADE IN U.S.A.

GENERAL DESCRIPTION

The YSI 3560 Water Quality Monitoring System

The rugged YSI 3560 Water Quality Monitoring System is primarily designed to be used in the field with a well or surface water pump, but use with a bailer, in the laboratory, or the like, is also possible. The 3560 system consists of a YSI 3500 Water Quality Monitor, a YSI 3510 Temperature Probe, a YSI 3520 Flow-Through Conductivity Cell, a YSI 3530 pH Electrode, a YSI 3550 Sample Chamber Assembly, a YSI 3565 Sample Cup Pack and assorted fittings. Other components, described below, are available as optional accessories.

As water is pumped through the system, temperature, conductivity, temperature compensated conductivity, pH, temperature compensated pH, and millivolts can all be measured. It is possible to make stable readings of the fluids running through the sample chamber in as little as two minutes. The constant monitoring of these values will help determine when a representative sample of the aquifer has been obtained. The system is designed for simple assembly and disassembly to facilitate frequent sensor calibration and easy cleaning.

The YSI Model 3500 Water Quality Monitor

The YSI 3500 Water Quality Monitor is an integral part of the 3560 system. This instrument allows the user to visually monitor three parameters simultaneously by means of three 1/2" LCD displays. The recorder output allows simultaneous recording of four parameters. The monitor is housed in a yellow molded ABS plastic case which has been tested to military specifications for shock and vibration. The 3500 uses 6 alkaline D cells which will power it for a minimum of 1400 hours. When BAT is shown on any of the displays, it is time for battery replacement.

An on/off switch controls power to the instrument. A second function switch controls each of the three ranges of conductivity and automatically temperature compensated conductivity as indicated on the middle display. The displayed values are read out in millimho/cm (mS/cm). When a temperature probe is attached, temperature is read out constantly in °C on the top display and temperature compensated conductivity can be measured, automatically corrected to 25°C. This correction uses a temperature coefficient recommended in "Official Methods of Analysis of the Association of Official Analytical Chemists", Ed. Sidney Williams, 14th edition, 1984, Arlington, Va. This temperature coefficient of 2%/°C is calculated by the formula:

$$\text{Compensated Conductivity} = \frac{\text{Uncompensated Conductivity}}{[(P/4\%)(0.04T-1)]+1}$$

T = temperature in °C
P = temperature coefficient in %

A third function switch controls the bottom display which shows manually temperature compensated pH, or automatically temperature compensated pH, in either pH units or in millivolts (mV). Both of the temperature compensated pH functions use a temperature coefficient of .335%/°C. The mV function is designed to work with optional electrodes such as the YSI 3540 ORP Electrode. It may be used with most ion specific electrodes that meet the 3500 input specifications.

The YSI Model 3510 Temperature Probe

The YSI 3510 Temperature Probe can be used as either a Temperature/ATC Conductivity Probe or as a pH ATC Probe when attached appropriately to the YSI 3500 Water Quality Monitor. It is usable over a temperature range of -5 to 50°C with an accuracy of ±.2°C. The polyurethane cable is three feet long and is terminated at one end with a watertight MS connector. A YSI Thermilinear® thermistor is mounted in a stainless steel sheath.

The YSI Model 3520 Flow-Through Conductivity Cell

The YSI 3520 Flow-Through Conductivity Cell is an integral conductivity cell of rigid and durable chlorinated polyvinyl chloride (CPVC). A three foot polyurethane jacketed cable is attached to the cell body with a bend relief. A watertight MS type connector terminates the cable.

Two electrodes measure conductivity. The cell response time is 10 seconds for 95% reading of conductivity changes. Accurate measurements can be made with a flow rate up to 1.5 gallons per minute. The conductivity cell constant is K = 5.0/cm.

The YSI Model 3530 pH Electrode Assembly

The YSI 3530 pH Electrode Assembly has been designed for YSI for use with the YSI 3560 Water Quality Monitoring System, but it may be used equally well with other pH measuring systems that have similar specification requirements. The 3530 has a rugged 5.5 inch long polymer body designed to withstand demanding field and laboratory use. The silver/silver chloride reference electrode and silver working electrode are sealed in a 4 molar potassium chloride gel to eliminate the need to add filling solution; a porous Teflon® junction is used to maximize electrode life. The 3530 comes with a 36 inch long cable, a black BNC cover and a black end cap for easy visual distinction. The unit is shipped in a soaker bottle containing pH 4.0 buffer. It is important that the electrode be immersed in the buffer solution to prevent the electrode from drying out in storage or transport.

The YSI Model 3540 ORP Electrode Assembly

The YSI 3540 ORP Electrode Assembly has been designed for YSI for use with the YSI 3560 Water Quality Monitoring System, but it may be used equally as well with other ORP measuring systems that have similar specification requirements. The 3540 has a rugged 5.5 inch long polymer body designed to withstand demanding field and laboratory use. The silver/silver chloride reference electrode and platinum working electrode are sealed in a 4 molar potassium chloride gel to eliminate the need to add filling solution; a porous Teflon Circle R junction is used to maximize electrode life. The 3540 comes with a 36 inch long black cable, a yellow BNC cover and a yellow end cap for easy visual distinction.

The electrode assembly is shipped in a soaker bottle containing pH 4.0 buffer. It is important that the electrode be immersed in the buffer solution to prevent the electrode from drying out in storage or transport.

The YSI Model 3682 Zobell Solution

This is a reference solution used to verify the performance characteristics of redox potential cells such as the YSI 3540 ORP Electrode Assembly.

The YSI Model 3550 Sample Chamber Assembly

The YSI 3550 Sample Chamber Assembly is an integral part of the YSI 3560 Water Quality Monitoring System. It is designed to be attached to a pump outlet but can be used equally well as a non-flowing sample chamber. It is designed to hold up to five sensors and to provide inlet and outlet ports for fluid movement through the chamber. It provides good mixing of fluids so residual sample will not be a problem. The clear acrylic sides of the chamber permits observation of fluid flow.

Two gaskets keep fluids from leaking around the sensor mounting plate and base assemblies, while two o-rings in each of the sensor ports provide excellent seals. The sensor mounting plate is permanently marked to indicate the location of each sensor. This sample chamber holds approximately one liter. See Figure 1.

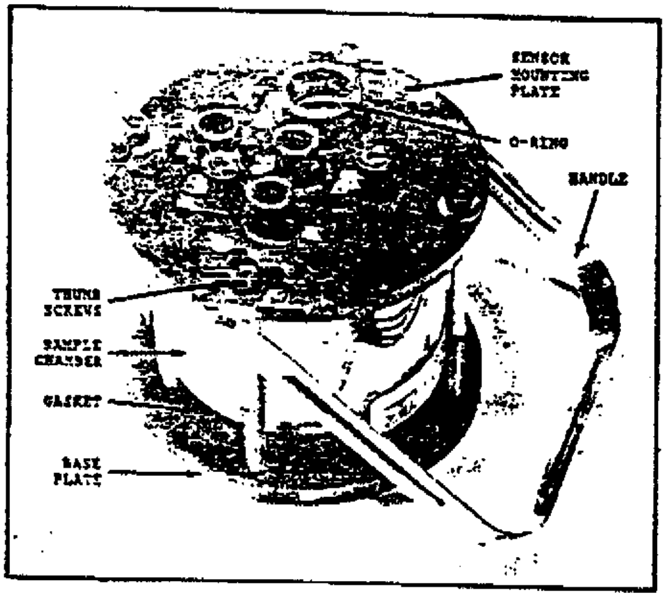

Figure 1. The YSI Model 3550 Sample Chamber Assembly

The YSI Model 3555 Sample Chamber Maintenance Kit

The YSI Model 3555 Sample Chamber Maintenance Kit is designed to provide all the o-rings, gaskets and tools necessary to perform the prescribed annual maintenance on the 3550 Sample Chamber Assembly.

The YSI Model 3565 Sample Cup Pack

The YSI Model 3565 Sample Cup Pack consists of five boxes of 100 each 50 ml polypropylene sample cups. Each box comes with velcro strips for easy installation to most surfaces. The 50 ml size is ideal for use with the 3560 system to minimize the consumption of buffers and standards used in routine calibration procedures.

The YSI Model 3570 Recorder Interface Cable

The YSI 3570 Recorder Interface Cable Assembly has four leads and a common conductor, terminated with a PVC molded connector. The 1/4 inch diameter, 10 foot long polyurethane jacketed cable provides the interface between the YSI Model 3500 Water Quality Monitor and whatever data logging or data recording device is in use. The watertight MS connector is pinned out as follows:

Pin A - Green Conductor - mV
Pin B - White Conductor - pH
Pin C - Gray Conductor - Common
Pin D - Red Conductor - mS/cm
Pin E - Black Conductor - °C

The YSI Model 3580 Carrying Case

The YSI Model 3580 Carrying Case is constructed of yellow polyethylene outer shells and has a yellow ABS insert which holds the 3560 system in place for carrying and provides a convenient working platform for the system in use. All metal parts are either plated or anodized to resist corrosion in the harshest environments. Two stays and a continuous hinge give the case rugged strength and durability. Two locks assure that it will stay closed in transit; tie-down straps keep the components secure from movement or damage. Up to four bottles of calibrator solutions can be put into the cavity in the lid for easy access and safe storage away from the instrument. A recess in the lid of the case is provided for convenient mounting of a 3565 Sample Cup Pack box.

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No. 3300062G

Date: 5-26-95 **Well No.** 590H

Homeowner Well Address: 590 HACIENDA
SAN LORENZO

Sampler: J MINNIER

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1418	1.5	5.0	CLR	NONE	7.48	3000	-068	20.7	6	10.06
1420	1.5	10 GAL	CLR	NONE	7.32	2080	-071	20.7	6	8.26
1423	1.5	15.0	CLR	NONE	7.30	2000	to -145 AT END	20.7	5	10.26
	Total Purge	15 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1440	0.0	6	0	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No. 3300062C

Date: 5-31-95 Well No. 633H

Homeowner Well Address: 633 HACIENDA

Sampler: J. Monnier

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1218	15.0	5.0	CLR	NONE	7.35	1340	-197	18.9	0.5	14.83
1221	1.50	10.0	CLR	NONE	7.10	1303	-205	18.9	1.0	20.61
1225	1.5	15.0	CLR	NONE	6.93	1243	-207	19.0	1.0	18.11
	Total Purge	15.0 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1230	0.0	1.0	0.2	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 5-31-95 **Well No.** 17197VM

Homeowner Well Address: 17197VIAMAGDELENA

Sampler: J.Mo[illegible]

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
938	1.5	5.0	CLR	NONE	7.70	1525	-138	19.4	1.5	6.86
942	1.5	10.0	CLR	NONE	7.30	1245	-152	19.1	1.5	8.41
946	1.5	15.0	CLR	NONE	7.11	1229	-157	18.4	1.5	7.06
	Total Purge	150 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1000	0.0	~~0.08~~ 2.0	0.08	

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FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 5-30-95 **Well No.** 17200VM

Homeowner Well Address: 17200 VMAGOMENA

Sampler:

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1454	1.5	6.5	BRN	NONE	7.64	1371	-166	19.2	2.5	45.3
1458	1.5	13.0	BRN	NONE	7.47	1330	-186	18.3	2.0	23.7
1502	1.5	19.5	BRN	NONE	7.34	1383	-203	21.8	2.0	22.2
	Total Purge	19.5 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1509	0.0	1.0	0.18	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 5-31-95 Well No. 17203VM

Homeowner Well Address: 17203 [illegible]

Sampler: J. M[illegible]

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1013	1.5	5.0	BRN	NONE	7.58	1244	-144	18.1	1.0	48.9
1017	1.5	10.0	BRN	NONE	7.05	1236	-172	18.3	1.0	26.8
1022	1.5	15.0	BRN	NONE	6.99	1228	-188	18.4	2.5	29.6
	Total Purge	15 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1020	0.0	1.0	0.10	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 5-31-95 **Well No.** 17302VM

Homeowner Well Address: 17302VM

Sampler: J. Mhana

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1044	1.5	5.0	CLR	NONE	7.61	1201	-117	18.9	1.5	12.46
1048	1.5	5.0	CLR	NONE	7.22	1188	-132	18.5	1.5	8.04
1051	1.5	5.0	CLR	NONE	7.40	1190	-169	18.6	2.0	6.00
	Total Purge	15.0 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1055	0.0	2.0	0.10	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No. 3300062G

Date: 5-30-95 **Well No.** 17348VE

Homeowner Well Address: 17348 VIA ENCINAS

Sampler: JM

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1121	1.5	2.0	BRN	NONE	7.50	1451	-108	20.7	3.0	>200
1124	1.0	4.0	BRN	NONE	7.09	1361	-121	23.1	3.5	>200
1127	1.5	6.0	BRN	NONE	7.24	1458	-111	23.6	2.5	>200
	Total Purge	6.0 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1135	0.0	2.0	0.60	

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FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 5-31-95 **Well No.** 17349VM

Homeowner Well Address: 17349 Via Magdalena

Sampler: J. Marme

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1119	1.5	5.0	CLR	MOD	7.50	1220	-215	70.1(F)	1.5	11.61
1122	1.5	5.0	CLR	MOD	6.78	1179	-232	65.9F	1.0	15.62
1126	1.5	5.0	CLR	MOD	6.79	1170	-230	65.8	1.0	18.11
								-12.7°C		
								-12.5°C		
								72.5°F		
	Total Purge	15.0 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1135	0.0	1.0	0.50	

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FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 5-31-95 **Well No.** 17372VM

Homeowner Well Address: 17372 Via Mag.

Sampler: J.

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1240	1.5	5.0	CLR	NONE	7.47	1373	-215	20.0	1.5	11.62
1243	1.5	10.0	CLR	NONE	6.93	1410	-225	19.5	1.5	12.06
1247	1.5	15.0	CLR	NONE	6.88	1329	-240	19.0	1.5	10.08
	Total Purge	15.0 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1255	0.0	1.0	0.10	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 5-21-95 Well No. 17393 Vm

Homeowner Well Address: 17393 VIA MAG[illegible]

Sampler: J. MOWNER

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1328	1.5	6.0	BRN	NONE	7.70	1679	-183	20.7	3.5	232
1332	1.5	12.0	BRN	NONE	7.29	1447	-234	19.5	1.5	16.11
1336	1.5	18.0	BRN	NONE	7.20	1398	-266	19.6	1.5	15.08
	Total Purge	180 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1345	0.0	1.0	0.1	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No. 33000626

Date: 6-1-95 **Well No.** MW-5

Homeowner Well Address: 17601 HESPERIAN

Sampler: J. Manning

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1211	1.5	1.5	BRN	FAINT	709	1410	-117	20.2	3.0	111.4
1213	1.5	3.0	BRN	FAINT	7.10	1390	-121	20.2	3.0	86.8
		← DRY AT 3.0 GALLONS →								
	Total Purge	3.0 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1305	0.0	2.0		

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 6-1-95 **Well No.** MW-7

Homeowner Well Address: 17601 HESPERIAN

Sampler: J. Manning

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1142	1.5	3.0	BRN	None	7.28	1068	-104	21.6	?	39.6
1144	1.5	6.0	BRN	None	7.04	1195	-92	20.6	?	46.1
1147	1.5	9.0	BRN	None	7.02	1205	-100	19.9	?	44.1
			(?) TURBIDITY TOO HIGH FOR READINGS							
	Total Purge	9.0 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1150	0.0	?	?	

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FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 6-1-95 **Well No.** MW-8

Homeowner Well Address: 17661 HESPERIAN

Sampler: J-Manning

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1221	1.5	4.5	BRN	HM	7.60	1107	-183	20.3	1.0	40.1
1224	1.5	9.0	BRN	HM	6.92	1029	-201	20.5	1.0	26.8
1228	1.5	13.5	BRN	HM	6.75	1077	-212	20.5	1.0	20.1
	Total Purge	13.5 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1030	0.0	1.0	0.10	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 6-1-95 **Well No.** MW-9

Homeowner Well Address: Popeyes Chicken

Sampler: J Monnar

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1112	1.5	3.5	BRN	None	7.60	1179	-126	20.4	?	>200
1115	1.5	7.0	BRN	None	7.09	1216	-110	21.1	?	>200
1118	1.5	10.5	BRN	None	7.11	1179	-114	20.2	?	>200
			(?)	TOO MUCH SILT TO TAKE READINGS						
	Total Purge	10.5 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1125	0.0	?	?	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 6-1-95 **Well No.** MW-10

Homeowner Well Address: 7499 VIA NARVIA

Sampler: J. Manner

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1013	1.5	4.5	CLR	MOD ~~[illegible]~~	7.41	1329	-161	17.7	2.0	11.90
1016	1.5	9.0	CLR	MOD ~~NONE~~	6.96	1315	-203	18.2	1.5	8.31
1020	1.5	13.5	CLR	MOD ~~NONE~~	6.64	1258	-232	18.2	1.5	7.64
	Total Purge	13.5 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1025	0.0	1.0	0.2	

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FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 6-1-95 **Well No.** MW-11

Homeowner Well Address: 17503 VIA [illegible]

Sampler: O-[illegible]

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1033	1.5	3.5	BRN	NONE	7.35	1304	-133	17.9	1.0	11.6
1035	1.5	7.0	BRN	NONE	7.09	1244	-154	18.0	1.5	30.5
1037	1.5	10.5	CLR	NONE	7.01	1277	-169	18.0	1.0	24.1
	Total Purge	10.5 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1041	0.0	1.0	0.1	

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FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 6-1-95 **Well No.** E1-A

Homeowner Well Address: 17601 Hesperian

Sampler: T. Manner

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1317	1.5	5.0	CLR	NONE	7.99	1366	-143	20.6	1.5	6.82
1318	1.5	10.0	CLR	NONE	7.40	1321	-155	20.4	3.5	8.61
1320	1.5	150	CLR	NONE	7.51	1333	-166	20.3	2.0	10.08
	Total Purge	15.0 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
~~0~~1330	0.0	2.0	0.1	

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FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 6-1-95 **Well No.** MW-13

Homeowner Well Address: 17601 HESPERIAN

Sampler:

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1156	1.5	4.0	BRN	NONE	7.78	1232	-056	20.3	?	>200
1158	1.5	8.0	BRN	NONE	6.99	1259	-115	21.9	?	>200
1200	1.5	12.0	BRN	NONE	6.93	1251	-142	21.3	?	>200
			(?)	TURBIDITY TOO HEAVY FOR READINGS						
	Total Purge	120 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1205	0.0	?	?	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 6-1-95 **Well No.** MW-14

Homeowner Well Address: 17491 VIA ARRISA

Sampler: O. Monnay

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
948	1.5	5.5	BRN	NONE	706	1247	-162	19.0	1.0	68.6
952	1.5	11.0	BRN	NONE	7.07	1201	-184	18.8	1.5	19.1
956	1.5	16.5	BRN	NONE	713	1222	-209	18.8	~~0.8~~ 1.0	11.1
	Total Purge	16.5 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1005	0.0	1.0	0.0	

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FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 5-31-95 **Well No.** MW-15

Homeowner Well Address: 633H

Sampler:

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1314	1.5	5.0	BRN	NONE	7.10	1369	-197	20.4	1.5	61.4
1308	1.5	10.0	BRN	NONE	6.93	1321	-243	20.1	1.5	28.6
1311	1.8	15.0	BRN	NONE	6.90	1318	-250	20.1	1.5	29.1
	Total Purge	15.0 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1310	0.0	~~1.5~~ 1.0 ~~2.0~~	0.20	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 5-31-95 **Well No.** MW-16

Homeowner Well Address: 17326 Via [illegible]

Sampler:

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1149	1.5	4.5	BRN	NONE	7.53	1167	-172	20.2	3.0	110.8
1151	1.5	9.0	BRN	NONE	7.62	1131	-189	20.6	2.5	24.1
1155	1.5	13.5	BRN	NONE	7.15	1106	-202	19.8	2.5	20.1
	Total Purge	13.5 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1200	0.0	2.0	0.12	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 5-30-95 **Well No.** MW-17

Homeowner Well Address: ______________

Sampler: O. Monnika

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1429	1.5	4.5	CLR	NONE	7.39	1359	-109	19.1	2.5	16.94
1432	1.5	9.0	CLR	NONE	7.33	1358	-133	18.6	1.5	15.66
1435	1.5	13.5	CLR	NONE	7.03	1335	-136	18.6	1.5	17.86
	Total Purge	(gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1445	0.0	1.0	0.18	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 5-30-95 **Well No.** MW-15

Homeowner Well Address: 17197 V[illegible]

Sampler: [illegible]

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1524	1.5	4.50	CLR	None ~~CLR~~	7.04	1448	-123	20.3	1.5	14.26
1527	1.5	9.0	CLR	NONE	7.03	1420	-136	20.3	1.5	13.8
1531	1.5	13.5	CLR	NONE	7.05	1336	-149	20.3	1.5	15.11
	Total Purge	13.5 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1540	0.0	1.0	0.15	

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FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 5-30-95 **Well No.** MW-19

Homeowner Well Address: 17105 VIA MARO.

Sampler: J. Manwrez

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1401	1.5	4.5	CLR	NONE	7.78	1577	-160	19.4	1.5	28.3
1404	1.5	9.0	CLR	NONE	7.61	1416	-166	19.4	1.5	22.4
1407	1.5	13.5	CLR	NONE	717	1404	-176	19.6	1.5	25.6
	Total Purge	135 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1410	0.0	1.0	0.15	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: ______________ **Well No.** 21

Homeowner Well Address: 17127 VIA

Sampler: ______________

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1247	1.5	4.5	CLR	None	7.54	1398	-135	20.0	1.5	19.70
1250	1.5	9.0	CLR	NONE	7.32	1259	-148	19.7	1.0	16.61
1253	1.5	13.8	CLR	NONE	7.15	1228	-160	20.0	1.0	1586
	Total Purge	13.8 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1257	0.0	1.0	0.1	

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FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No. 33000626

Date: 5-30-95 **Well No.** MW-22

Homeowner Well Address: 17238 VIA FLORES

Sampler: J. Monnier

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1225	1.5	4.5	CLR	NONE	7.62	1148	-139	18.2	1.5	13.50
1228	1.5	9.0	CLR	NONE	7.15	1097	-151	18.8	1.5	14.31
1231	1.5	13.5	CLR	NONE	7.08	1110	-161	19.6	1.5	12.08
	Total Purge	13.5 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1235	0.0	1.0	.15	

FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 5-30-95 **Well No.** MW-23

Homeowner Well Address: 17347 VIAENCINAS

Sampler: J.M.

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1203	1.5	4.0	BRN	NONE	7.40	1469	-093	21.6	3.5	~~3.5~~ >200
1204	1.5	8.0	BRN	NONE	7.18	1395	-100	20.4	3.0	31.4
1206	1.5	12.0	BRN	NONE	7.18	1196	-102	18.3	3.0	21.8
	Total Purge	12.0 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1215	0.0	2.0	0.20	

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FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 6-1-98 **Well No.** MW-7Y

Homeowner Well Address: Popeyes CHICKEN

Sampler: J. Minner

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1101	1.5	1.5	BRN	NONE	6.31	1220	-065	20.6	?	>200
1102	1.5	3.0	BRN	NONE	6.80	1295	-093	21.6	?	>200
1103	1.5	4.5	BRN	NONE	6.86	1326	-115	22.1	?	>200
	Total Purge	4.5 (gal)								

(?) - UNABLE TO READ BECAUSE OF HIGH TURBIDITY

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1105	0.0	≥?	?	

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FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 6-1-95 **Well No.** MW-25

Homeowner Well Address: 17601 HESPERIAN

Sampler: T. M

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1130	1.5	2.0	BRN	NONE	7.52	1277	-058	19.0	?	>200
1131	1.5	4.0	BRN	NONE	7.16	1167	-079	19.7	?	>200
1132	1.5	6.0	BRN	NONE	7.02	1222	-091	19.9	?	>200
			?	TURBIDITY TOO HEAVY FOR READING						
	Total Purge	6.0 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1135	0.0	?	?	

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FIELD DATA SHEET
BIO-ATTENUATION STUDY
ARCO SERVICE STATION 0608
SAN LORENZO, CALIFORNIA

Pacific Project No.

Date: 6-1-95 **Well No.** MW-26

Homeowner Well Address: Popeyes Chicken

Sampler: J Moran

Comments:

Time (PST)	Flow Rate (gpm)	Purge Volume (gal)	Color	Odor	pH	Cond. (mmhos)	ORP (mvolts)	Temp. deg. C	Dissolved Oxygen (mg/l)	Turbidity (ntu)
1046	1.5	1.5	BRN	FAINT	7.58	1216	-066	22.2	6.0	>200
1047	1.5	3.0	BRN	FAINT	6.86	1297	-096	22.2	6.0	>200
1049	1.5	4.5	BRN	FAINT	6.96	1271	-115	22.9	6.0	>200
								*		
		* D.O. READINGS: NOT ACCURATE DUE TO HEAVY BRN WATER								
		AS WELL AS FERROUS IRON.								
	Total Purge	4.5 (gal)								

FIELD ANALYSIS WITH HACH KITS

Time (PST)	H_2S (mg/l)	Dissolved Oxygen (mg/l)	Ferrous Iron (mg/l)	Notes
1055	0.0	?	?	

ATTACHMENT B

OXYGEN RELEASE COMPOUND PRODUCT LITERATURE

REGENESIS

BIOREMEDIATION PRODUCTS

Oxygen Release Compound (ORC®)

ORC releases oxygen slowly to enhance bioremediation.

Oxygen Release Compound (ORC®)

Bioremediation—A Natural Process

Bioremediation is a process by which microorganisms degrade hazardous substances. For example, common bacteria can metabolically transform toxic petroleum products into carbon dioxide and water. Aerobic bioremediation requires oxygen, as well as moisture and commonly occurring nutrients.

There are several advantages to implementing a bioremediation system as compared to other technologies. Other remediation methods may simply transfer the contaminants to another medium which requires additional clean up. Excavation and transportation of the contaminant is often required. Bioremediation degrades contaminants on-site and can be more cost effective than other treatment technologies. The EPA actively promotes bioremediation as it is an ecologically sound, natural process.

Oxygen is often the limiting factor in aerobic bioremediation. Moisture and nutrients, such as phosphorus and nitrogen, are generally present in sufficient quantities. However, oxygen is rapidly consumed by microbes which thrive in an oxygen rich environment. Without adequate oxygen, contaminant degradation will slow and then stop. Thus, additional oxygen is needed to stimulate further microbial growth and activity.

Oxygen Release Compound, ORC

Oxygen Release Compound (ORC) is an innovative technology which enhances bioremediation. ORC is a patented formulation of a very fine, insoluble peroxygen that releases oxygen at a slow, controlled rate when hydrated. Its use has been demonstrated to increase the remediation of hydrocarbon contamination in soil and groundwater.

Features

- Magnesium peroxide compound is activated by moisture
- Patented technology controls and prolongs the release of oxygen
- Moderate pH levels are maintained
- Fine particle size has stable, long shelf life
- No external coating of product is required to control rate of oxygen release
- Pure oxygen source saturates water to higher levels than aeration

Benefits

- Provides a passive, low-cost, long-term oxygen source
- Does not generate harmful residue; environmentally safe
- Is perfect for in-situ remediation where other methods are impractical
- Will not disturb the hydraulics of the contaminated plume
- Does not volatilize pollutants
- Can be used as a redox control agent

ORC Technology

The product releases oxygen when it comes in contact with water as shown by the following equation:

$$MgO_2 + H_2O \rightarrow {}^1/_2O_2 \uparrow + Mg(OH)_2$$

ORC will stop releasing when dry and will again release when rehydrated. The by-products of the reaction are oxygen and magnesium hydroxide (Milk of Magnesia). ORC is environmentally safe to use.

Figure 1. Oxygen Release Profile of ORC

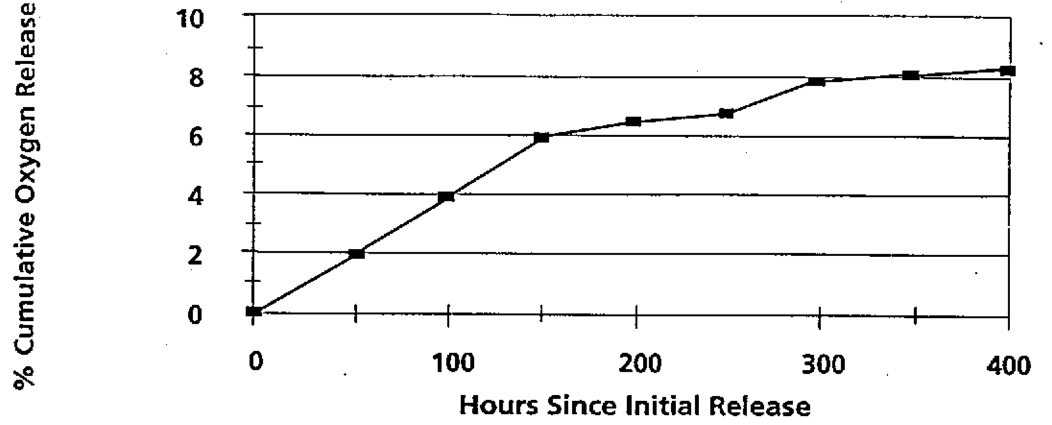


Figure 1 presents a typical release pattern for ORC. In general terms, the product releases up to 10% of the available oxygen in the first several hundred hours, followed by a release of an additional 10% every thousand hours. This translates to a longevity of about one year under static conditions.

ORC Application — The "Oxygen Barrier"

ORC should be considered for contaminated sites whenever aerobic bioremediation is the appropriate treatment technology. For application, ORC powder is mixed in a matrix such as Portland Cement or sand and then lowered into a well or trench in an inert filter sock. After the oxygen dissipates, the socks and spent ORC are removed from the ground and, if necessary, new charges of ORC may be added.

Figure 2. ORC Oxygen Barrier

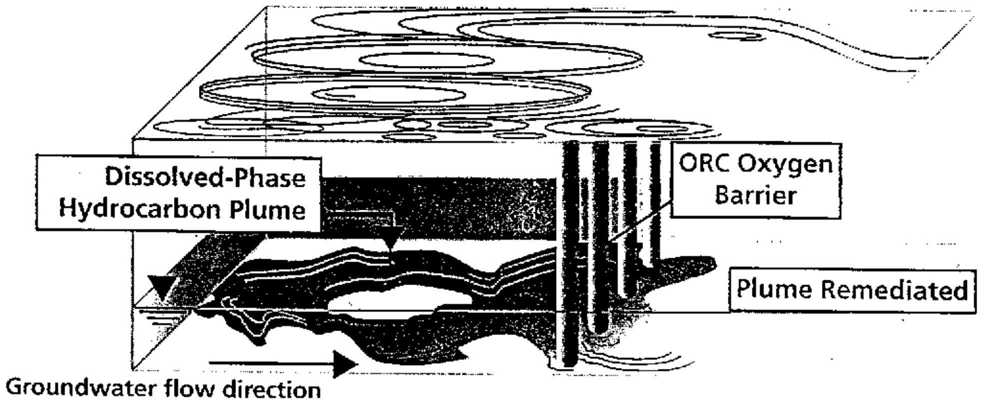
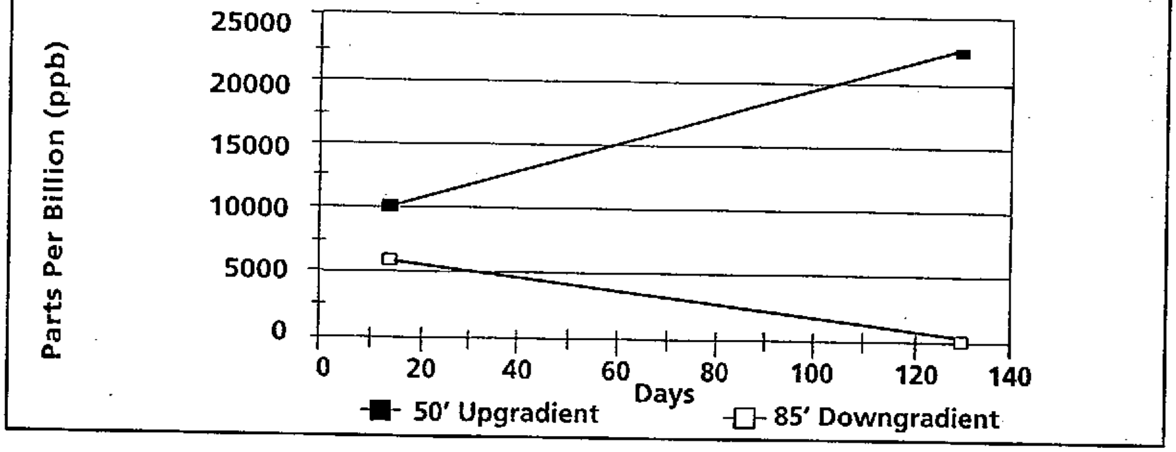


Figure 2 depicts the Oxygen Barrier concept which has been successfully demonstrated to significantly reduce BTEX levels.

Various applications of ORC can meet a wide range of remediation objectives. In ground water applications, ORC can be configured to form an Oxygen Barrier across a contaminated plume. A properly placed row of wells or a trench containing ORC will slowly release oxygen, enhance bioremediation, and cut off the plume in the oxygenated zone (see Figures 2 and 3). The Oxygen Barrier concept was successfully demonstrated at both the University of Waterloo and a site in North Carolina, dramatically remediating BTEX compounds downgradient from the Oxygen Barrier.

Figure 3. Total BTEX — Concentration Over Time



As Figure 3 indicates, while the contaminant source in the North Carolina study continually released increasing levels of BTEX, ORC successfully remediated the contamination downgradient from the "Oxygen Barrier."

Other ORC Applications

► Reduce Risk	Surround highly contaminated area with ORC for fast remediation
► Replace Other Methods	Turn off pump and treat, and use less expensive ORC for final remediation
► Compliment Other Methods	Supplement air sparging with ORC for hard-to-reach contamination
► Treat Soil	Mix ORC into biopiles or use in land farming for faster clean up
► Clean Up Remote Site	May be the best alternative in remote or inclement areas since ORC is a "passive" treatment system
► Control Odor	Successfully demonstrated to control odor in anaerobic impoundments

Please print clearly.

If you would like further information regarding Oxygen Release Compound (ORC®), please call (714) 443-3136 or complete and return this short information card.

A **REGENESIS** representative will contact you to discuss your remediation needs.

Name of Company ______________________

Name/Title ______________________

Address ______________________

City ______________________ State __________ Zip __________

Phone (   ) ______________________ Fax (   ) ______________________

Type of Company: ______________________

Remediation Needs: ______________________

ORC — Proven Effectiveness

Studies at several recognized private companies and universities proved that ORC releases oxygen, enhances microbial activity and promotes remediation. Subsequent field applications demonstrated that ORC was effective in promoting bioremediation under "real world" conditions.

- University of Waterloo (published, *Groundwater Monitoring and Remediation,* Winter 1994 edition) — conducted at the widely studied Borden Aquifer in Ontario, Canada. The study indicates that an Oxygen Barrier generated by ORC released significant amounts of dissolved oxygen (D.O.). It concluded that the enhancement of D.O. by ORC led to the biodegradation of at least 4 mg/L each of benzene and toluene.
- North Carolina Site (published, *Proceedings from the Second International Symposium on In Situ and On-Site Bioreclamation,* San Diego, CA, 1993) — study demonstrated that the use of ORC in an Oxygen Barrier dramatically reduced BTEX compounds downgradient from leaking gasoline UST.
- Alaska Site — A study was completed showing the effectiveness of ORC remediation as compared to air sparging. Sparge points fouled in the high iron environment and there was evidence of channeling — a problem common with this technology. ORC was effective in remediation and a full barrier was installed.
- New Mexico Site — The regulatory community showed interest in ORC barriers. From a single test well, remediation occurred downgradient in a wide dispersive pattern. A full barrier proposal was requested.

ORC vs. Other Remediation Technologies

ORC is a safe and effective remediation technology with many application advantages over other chemical oxygen sources, such as hydrogen peroxide and calcium peroxide. Because ORC is formulated to release a constant supply of oxygen over an extended period of time, replenishment is less frequent and more convenient. In addition, ORC's harmless by-products — oxygen and magnesium hydroxide — provide confidence in regulatory approval.

ORC can also provide cost and operational advantages over mechanical oxygen sources. In many circumstances, the cost of implementing an ORC remediation application can be substantially lower than a pump and treat or an air sparging system.

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postage.

REGENESIS BIOREMEDIATION PRODUCTS
27130 PASEO ESPADA STE A1407
SAN JUAN CAPISTRANO CA 92675-2758

Safety, Storage and Handling

ORC is an oxidizer. ORC should not come into contact with combustible materials. Though the material itself is not flammable, it can release oxygen to feed a fire. In the event of a fire, the area should be flooded with large volumes of water.

Since ORC can be mildly hazardous to human health, certain precautions should be taken when handling the material. Direct contact with the skin and eyes should be avoided, as irritation may occur. Rubber gloves and protective goggles should be worn as a preventative measure. Should contact with skin occur, wash immediately with soap and water. Flush eyes thoroughly and repeatedly for 15 minutes and contact a physician, if necessary.

Inhalation may also cause mild irritation to the lungs, nose, and throat, but should not result in significant, long-term hazard. A proper dust mask or breathing apparatus should be used when the product is handled in the powder form. If inhalation irritation occurs, move to a well ventilated space, or outside to fresh air.

ORC is a very stable compound. Though it is designed to release oxygen when in contact with water, it will remain stable at up to 3% moisture which facilitates storage. Storage areas should remain dry. Avoid areas with high humidity. Store the product away from combustible material. Keep containers closed when not in use.

REGENESIS—The Company

REGENESIS Bioremediation Products was formed to continue the development and marketing of ORC®. Oxygen Release Compound was first sold commercially in 1994 after three years of development. The inventors originally began working on a similar product used to facilitate the growth of plants in oxygen-poor soils. Formulations of ORC, more appropriate to bioremediation applications, were successfully tested in the laboratory and followed by several field demonstrations. The company is now in the commercialization phase, working with clients to meet their specific remediation needs.

The Scientific Advisory Board and the Board of Directors of **REGENESIS Bioremediation Products** are composed of recognized leaders from industry, academia and government.

For further information or technical assistance, please contact:

REGENESIS Bioremediation Products
27130A Paseo Espada, Suite 1407
San Juan Capistrano, CA 92675

(714) 443-3136 (Voice) (714) 443-3140 (Fax)

REGENESIS Bioremediation Products
Oxygen Release Compound (ORC®)
Price List for Groundwater Application

ORC Filter Sock Prices--ORC is carried in an inert matrix. The 50% wt. ~~ORC~~ mixture is contained in a filter sock, a diagram of which is shown below. The filter socks are priced as follows:

	Well Inside Diameter*		
ORC Filter Sock	6 inches	4 inches	2 inches
Price (ea.)	$45.00	$25.00	$10.00
Minimum Weight	11.8 lbs.	4.6 lbs.	1.0 lbs.
Approximate Height	12 inches	12 inches	12 inches
Approximate Diameter	5⅜"	3⅜"	1⅜"

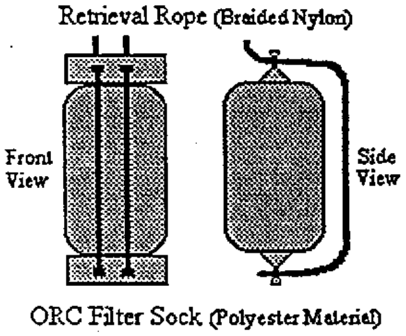
Pricing Example--The product should be placed through the verticle height of the contamination for optimal remediation. Thus, if the depth of contamination is 10 feet below the groundwater surface and six inch PVC wells are used, then the ORC Filter Sock cost per well is $450.00.

Minimum Order--$1000

Freight--FOB San Juan Capistrano, California

Payment Terms--Net 30 Days

ORC Filter Sock



Application--ORC filter socks are shipped in five gallon containers ready for installation into PVC casing. The containers weigh up to 40 pounds each. Included with the shipment are installation instructions, retrieval lines, safety handling instructions and rebate application card.

Rebate--A $1.50 rebate will be given for each 5 gallon container returned UPS freight collect. To receive credit on the next ORC order, the rebate application card must be completed and returned.

Other Terms and Conditions--Terms and Conditions for the purchase of ORC are shown on the reverse side.

Effective Date--This price list is effective for all orders received after February 1, 1995.

Order From--Regenesis Bioremediation Products (714)443-3136 phone
27130A Paseo Espada, Ste. 1407 (714)443-3140 fax
San Juan Capistrano, CA 92675

*Prices for other size well ORC filter socks are available upon request.

ATTACHMENT C

INHALATION OF BENZENE VAPOR IN AN ENCLOSED SPACE METHODOLOGY, ASSUMPTIONS, AND RESULTS

Table C-1
Inhalation of Benzene Vapor in Enclosed Space
Adult Exposure

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Determine benzene concentration in air at groundwater-air interface based on groundwater concentration. (Methodology from Modified Health Risk Assessment, October 5, 1993)

Using Henry's Law:

$$\mathrm{Csv} = \frac{[\,\mathrm{Hb} \times ((\,\mathrm{CWb} / \mathrm{MWb}\,) / (\,\mathrm{CWw} / \mathrm{MWw}\,)) / \mathrm{Pt}\,] \times \mathrm{D} \times \mathrm{MWb}}{\mathrm{MWa}} \times \mathrm{CF}$$

Where:
Csv = Benzene Concentration in Air at the Groundwater-Air Interface [micrograms/milliliter]
Hb = Henry's Law Coefficient (Benzene) [atmospheres]
CWb = Benzene Concentration in Groundwater (Well MW-10, March 16, 1993) [grams/liter]
MWb = Molecular Weight of Benzene [grams/mole]
CWw = Water Concentration in Groundwater [grams/liter]
MWw = Molecular Weight of Water [grams/mole]
Pt = Total Pressure [atmospheres]
D = Density of Subsurface Air (50 degrees F) [grams/liter]
CF = Conversion Factor [1,000 micrograms-liter/gram-milliliter]
MWa = Molecular Weight of Air [grams/mole]

Values:
Hb = 240 atm
CWb = 3.40E-04 g/L
MWb = 78.12 g/mole
CWw = 1,000 g/L
MWw = 18 g/mole
Pt = 1 atm
D = 1.2 g/L
CF = 1,000 ug-L/g-mL
MWa = 29 g/mole

Solution: Csv = 6.08E-02 ug/mL

Table C-1 (continued)

Inhalation of Benzene Vapor in Enclosed Space

Adult Exposure

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Determine Benzene Flux Across Soil Surface

Using SESOIL:

P = - (Da x ((n - m)^10/3) / n^2) x (Catm - Csv) / L) x CF

Where:
P = Pollutant Flux Across the Soil Surface [milligrams per square centimeter-second]
Da = Apparent Steady-State Benzene Diffusion Coefficient in Air [square centimeters/second]
n = Soil Porosity [fraction]
m = Soil Moisture [fraction]
Catm = Benzene Concentration in Air at the Surface [micrograms/milliliter]
Csv = Benzene Concentration in Air at the Groundwater-Air Interface [micrograms/milliliter]
L = Depth of Soil Cover [centimeters]
CF = Conversion Factor [milligrams-cubic centimeter/micrograms-milliliter]

Values:
Da = 0.077 sq.cm/s
n = 0.25
m = 0.2
Catm = 1.98E-03 ug/mL
Csv = 6.08E-02 ug/mL
L = 357.2 cm
CF = 0.001 mg-cu.cm/ug-mL

Solution: P = **9.34E-12 mg/sq.cm-s**

Determine Volume of Air in Enclosed Space (Per Day Basis)

Using Box Model:

V = (A x H x ARR)

Where:
V = Volume of Air in Enclosed Space [cubic meter]
A = Area of Enclosed Space [square meter]
H = Height of Enclosed Space [square meter]
ARR = Air Recirculation Rate [volumes/day]

Values:
A = 185.8 sq. m
H = 2.4 m
ARR = 12.0 volume/day

Solution: V = **5,438.2 cu. m/day**

Table C-1 (continued)

Inhalation of Benzene Vapor in Enclosed Space

Adult Exposure

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Determine Benzene Concentration in Enclosed Space (with Crack Factor range of 0.1 to 0.001)

Using Box Model:

$$\mathrm{Ces} = \frac{(\mathrm{P} \times \mathrm{CF} \times \mathrm{Cf} \times \mathrm{A})}{\mathrm{V}}$$

Where:

Ces = Benzene Concentration in Enclosed Space [milligrams/cubic meter]
P = Pollutant Flux Across the Soil Surface [milligrams per square centimeter-second]
CF = Conversion Factor [square centimeter-second/square meter-day]
Cf = Crack Factor [fraction]
A = Area of Enclosed Space [square meter]
V = Volume of Air in Enclosed Space [cubic meter/day]

Values:

P = 9.34E-12 mg/sq.cm-s
CF = 8.64E+08 sq.cm-s/sq.m-day
Cf = 0.1 (or) 0.001
A = 185.8 sq. m
V = 5,438.2 cu. m/day

Solution: **Ces** = **2.76E-05 mg/cu.m** (Cf = 0.1)
= **2.76E-07 mg/cu.m** (Cf = 0.001)

Table C-1 (continued)

Inhalation of Benzene Vapor in Enclosed Space

Adult Exposure

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Determine Carcinogenic Health Risk to Benzene Vapor in Enclosed Space

Equation:

$$\text{RISK} = \frac{(\text{Ces} \times \text{IR} \times \text{ET} \times \text{EF} \times \text{ED} \times \text{SF})}{\text{BW} \times \text{AT}}$$

Where:

RISK = Carcinogenic Health Risk
Ces = Benzene Concentration in Enclosed Space [milligrams/cubic meter]
IR = Inhalation Rate [cubic meters/hour]
ET = Exposure Time [hours/day]
EF = Exposure Frequency [days/year]
ED = Exposure Duration [years]
SF = Slope Factor [kilograms-day/milligram]
BW = Body Weight [kilograms]
AT = Averaging Time [days]

Values:

Ces = 2.76E-05 mg/cu.m (Crack Factor = 0.1)
= 2.76E-07 mg/cu.m (Crack Factor = 0.001)
IR = 0.83 cu.m/hour
ET = 15.36 hours/day
EF = 365 days/year
ED = 70 years
SF = 0.029 kg-day/mg
BW = 70 kilograms
AT = 25,550 days

Solution: RISK = **1.46E-07** **(Crack Factor = 0.1)**
= **1.46E-09** **(Crack Factor = 0.001)**

Table C-2

Inhalation of Benzene Vapor in Enclosed Space

Child Exposure

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Determine benzene concentration in air at groundwater-air interface based on groundwater concentration. (Methodology from Modified Health Risk Assessment, October 5, 1993)

Using Henry's Law:

$$Csv = \frac{[Hb \times ((CWb / MWb) / (CWw / MWw)) / Pt] \times D \times MWb}{MWa} \times CF$$

Where:

Csv = Benzene Concentration in Air at the Groundwater-Air Interface [micrograms/milliliter]
Hb = Henry's Law Coefficient (Benzene) [atmospheres]
CWb = Benzene Concentration in Groundwater (Well MW-10, March 16, 1993) [grams/liter]
MWb = Molecular Weight of Benzene [grams/mole]
CWw = Water Concentration in Groundwater [grams/liter]
MWw = Molecular Weight of Water [grams/mole]
Pt = Total Pressure [atmospheres]
D = Density of Subsurface Air (50 degrees F) [grams/liter]
CF = Conversion Factor [1,000 micrograms-liter/gram-milliliter]
MWa = Molecular Weight of Air [grams/mole]

Values:

Hb = 240 atm
CWb = 3.40E-04 g/L
MWb = 78.12 g/mole
CWw = 1,000 g/L
MWw = 18 g/mole
Pt = 1 atm
D = 1.2 g/L
CF = 1,000 ug-mL/g-L
MWa = 29 g/mole

Solution: Csv = 6.08E-02 ug/mL

Table C-2 (continued)

Inhalation of Benzene Vapor in Enclosed Space

Child Exposure

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Determine Benzene Flux Across Soil Surface

Using SESOIL:

P = - (Da x ((n - m)^10/3) / n^2) x (Catm - Csv) / L) x CF

Where:

P = Pollutant Flux Across the Soil Surface [milligrams per square centimeter]
Da = Apparent Steady-State Benzene Diffusion Coefficient in Air [square centimeters/second]
n = Soil Porosity [fraction]
m = Soil Moisture [fraction]
Catm = Benzene Concentration in Air at the Surface [micrograms/milliliter]
Csv = Benzene Concentration in Air at the Groundwater-Air Interface [micrograms/milliliter]
L = Depth of Soil Cover [centimeters]
CF = Conversion Factor [milligrams-cubic centimeter/micrograms-milliliter]

Values:

Da = 0.077 sq.cm/s
n = 0.25
m = 0.2
Catm = 1.98E-03 ug/mL
Csv = 6.08E-02 ug/mL
L = 357.2 cm
CF = 0.001 mg-cu.cm/ug-mL

Solution: **P = 9.34E-12 mg/sq.cm-s**

Determine Volume of Air in Enclosed Space (Per Day Basis)

Using Box Model:

V = (A x H x ARR)

Where:

V = Volume of Air in Enclosed Space [cubic meter]
A = Area of Enclosed Space [square meter]
H = Height of Enclosed Space [square meter]
ARR = Air Recirculation Rate [volumes/day]

Values:

A = 185.8 sq. m
H = 2.4 m
ARR = 12.0 volume/day

Solution: **V = 5,438.2 cu. m/day**

Table C-2 (continued)

Inhalation of Benzene Vapor in Enclosed Space

Child Exposure

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Determine Benzene Concentration in Enclosed Space (with Crack Factor range of 0.1 to 0.001)

Using Box Model:

$$\text{Ces} = \frac{(P \times CF \times Cf \times A)}{V}$$

Where:

Ces = Benzene Concentration in Enclosed Space [milligrams/cubic meter]
P = Pollutant Flux Across the Soil Surface [milligrams per square centimeter-second]
CF = Conversion Factor [square centimeter-second/square meter-day]
Cf = Crack Factor [fraction]
A = Area of Enclosed Space [square meter]
V = Volume of Air in Enclosed Space [cubic meter/day]

Values:

P = 9.34E-12 mg/sq.cm-s
CF = 8.64E+08 sq.cm-s/sq.m-day
Cf = 0.1 (or) 0.001
A = 185.8 sq. m
V = 5,438.2 cu. m

Solution: **Ces = 2.76E-05 mg/cu.m** (Cf = 0.1)
= 2.76E-07 mg/cu.m (Cf = 0.001)

Table C-2 (continued)

Inhalation of Benzene Vapor in Enclosed Space

Child Exposure

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Determine Carcinogenic Health Risk to Benzene Vapor in Enclosed Space

Equation:

$$\text{RISK} = \frac{(\text{Ces} \times \text{IR} \times \text{ET} \times \text{EF} \times \text{ED} \times \text{SF})}{\text{BW} \times \text{AT}}$$

Where:

RISK = Carcinogenic Health Risk
Ces = Benzene Concentration in Enclosed Space [milligrams/cubic meter]
IR = Inhalation Rate [cubic meters/hour]
ET = Exposure Time [hours/day]
EF = Exposure Frequency [days/year]
ED = Exposure Duration [years]
SF = Slope Factor [kilograms-day/milligram]
BW = Body Weight [kilograms]
AT = Averaging Time [days]

Values:

Ces = 2.76E-05 mg/cu.m (Crack Factor = 0.1)
= 2.76E-07 mg/cu.m (Crack Factor = 0.001)
IR = 0.83 cu.m/hour
ET = 15.36 hours/day
EF = 365 days/year
ED = 9 years
SF = 0.029 kg-day/mg
BW = 25 kilograms
AT = 25,550 days

Solution: RISK = **5.24E-08** **(Crack Factor = 0.1)**
= **5.24E-10** **(Crack Factor = 0.001)**

ATTACHMENT D

RI/FS REVISIONS

Remedial Investigation / Feasibility Study

ARCO Service Station 0608
17601 Hesperian Boulevard at Hacienda Avenue
San Lorenzo, California

Prepared for

ARCO Products Company

June 28, 1995~~November 22, 1994~~

Prepared by

Pacific Environmental Group, Inc.
2025 Gateway Place, Suite 440
San Jose, California 95110

Project 330-006.3C

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PROFESSIONAL CERTIFICATION
Remedial Investigation / Feasibility Study
ARCO Service Station 0608
San Lorenzo, California

ARCO Products Company
June 28, 1995~~November 22, 1994~~

Pacific Environmental Group, Inc. (PACIFIC) has prepared this Remedial Investigation/ Feasibility Study (RI/FS) for ARCO Service Station 0608, located at 17601 Hesperian Boulevard in San Lorenzo, California for ARCO Products Company. This RI/FS has been prepared by the staff of PACIFIC under the professional supervision of the Senior Geologist whose seal and signature appears hereon.

Debra Moser, CEG 1293
Senior Geologist/Project Manager

1.0 INTRODUCTION

1.1 Purpose of the Remedial Investigation/Feasibility Study

On behalf of ARCO Products Company (ARCO), Pacific Environmental Group, Inc. (PACIFIC) has prepared this remedial investigation/feasibility study (RI/FS) for the ARCO Service Station 0608, located at 17601 Hesperian Boulevard, San Lorenzo, California (hereafter called "the Site"). This RI/FS presents the finding of various investigations and studies conducted at the Site. Based on the findings of these investigations and studies, the RI/FS recommends the most appropriate remedial action alternative for Site cleanup. The recommended alternative complies with federal, state, and local policies, laws and regulations governing the cleanup of hazardous substance releases.

This RI/FS was prepared in accordance with the agreements outlined in the July 8, 1994 and May 9, 1995 meetings between Alameda County Health Care Services Agency (ACHCSA), San Francisco Bay Regional Water Quality Control Board (RWQCB), ARCO, and PACIFIC.

1.2 Summary of Previous Documents

Documents prepared for the Site by PACIFIC and utilized in the preparation of this RI/FS are listed below.

Work Plan with Tank Removal Results, ARCO Service Station 0608, 17601 Hesperian Boulevard, San Lorenzo, California, October 4, 1989.

Work Plan, Additional Investigation, ARCO Service Station 0608, 17601 Hesperian Boulevard, San Lorenzo, California, February 4, 1993.

Investigation Report, ARCO Service Station 0608, 17601 Hesperian Boulevard, San Lorenzo, California, July 27, 1993.

Proposed Methodology, Modified Health Risk Assessment, ARCO Service Station 0608, 17601 Hesperian Boulevard, San Lorenzo, California, July 27, 1993.

Result, Modified Health Risk Assessment, ARCO Service Station 0608, 17601 Hesperian Boulevard, San Lorenzo, California, October 5, 1993.

Feasibility Study, ARCO Service Station 0608, 17601 Hesperian Boulevard, San Lorenzo, California, October 12, 1993.

Addendum, Modified Health Risk Assessment, ARCO Service Station 0608, 17601 Hesperian Boulevard, San Lorenzo, California, November 8, 1993.

Meeting Minutes, July 8, 1994, Memorandum, ARCO Service Station 0608, 17601 Hesperian Boulevard, San Lorenzo, California, July 26, 1994.

Response to ACHCSA Letter, dated January 23, 1995, ARCO Service Station 0608, 17601 Hesperian Boulevard, San Lorenzo, California, March 7, 1995.

Meeting Minutes, May 9, 1995, Memorandum, ARCO Service Station 0608, 17601 Hesperian Boulevard, San Lorenzo, California, May 24, 1995.

Work Plan and RI/FS Supplemental Information, ARCO Service Station 0608, 17601 Hesperian Boulevard, San Lorenzo, California, June 28, 1995.

Quarterly *Report - Second Quarter 1995~~Third Quarter 1994~~, ARCO Service Station 0608, 17601 Hesperian Boulevard, San Lorenzo, California*, issuance pending.

The full citation for all references is provided in the reference section of this report.

1.3 Site Identification

The Site is occupied by ARCO and is located at 17601 Hesperian Boulevard in the City of San Lorenzo, County of Alameda, California (Figures 1 and 2). The Site comprises approximately 0.5 acres and is used as a gasoline retail and service station. The Site is bounded on the north by Hacienda Avenue, to the east by Hesperian Boulevard, to the south by retail shops, and to the west by an alley.

1.4 Scope of the RI/FS

The scope of the RI/FS encompasses the following tasks:

- Present a description of the Site's characteristics, the events that led to the contamination, and the investigations, studies, and work that have been accomplished in cleaning up the Site (interim remedial actions).
- Summarize the remedial investigation findings, health and safety risks, and effects of the contamination.
- Summarize the feasibility study of remedial alternatives for cleaning up the soil and groundwater.

- Recommend the final remedial action, along with an explanation of the Environmental Protection Agency (EPA) criteria as the basis for the selection and rejection of the alternative(s).
- Present an implementation schedule for the recommended remedial actions.

1.5 Organization of the RI/FS

This RI/FS addresses each of the scope items listed above. This information is presented as follows:

Section 1.0: Introduction

Section 2.0: Background and History

This section addresses the Site's characteristics and history of investigations and cleanup activities. It also summarizes the remedial investigation findings and reports on feasibility testing for remedial alternatives including soil vapor extraction, air sparging, and soil bioremediation.

Section 3.0: Groundwater Fate and Transport Modeling Results

This section addresses the feasibility of natural biodegradation of hydrocarbons in groundwater as a remedial alternative.

Section 4.0: Modified Health Risk Assessment

This section describes the health and safety risks and effects of the hydrocarbons in soil and groundwater at the site.

Section 5.0: Remedial Action Objectives

This section describes remedial action objectives for soil and groundwater at the site.

Section 6.0: Remedial Action Alternative Development and Evaluation

This section describes the criteria for evaluating remedial action alternatives, and applies those criteria to five alternatives.

Section 7.0: Recommended Remedial Action Alternative

This section recommends a remedial action alternative, and justifies the recommendation based on the criteria presented in Section 6.0.

Section 8.0: Implementation Schedule

An implementation schedule is presented in Section 8.0.

Included as appendices are the following:

- Groundwater Fate and Transport Modeling Results (Appendix A).
- Modified Health Risk Assessment Results (Appendix B).
- July 8, 1994 and May 9, 1995 Meetings Minutes (Appendix C).

2.0 BACKGROUND AND HISTORY

2.1 Site Description

The Site is an operating service station located at 17601 Hesperian Boulevard in San Lorenzo, California (Figure 1). The fueling facility formerly included three 6,000-gallon (two unleaded gasoline and one regular gasoline) tanks located in a common excavation, and one adjacent 6,000-gallon tank (super unleaded gasoline) located in the northeast portion of the Site. A 550-gallon tank located southwest of the station building was used to store used oil. All underground storage tanks (USTs) were removed in June 1988, and were replaced with three 12,000-gallon gasoline tanks in the location of the former UST complex, and one used oil tank in the same location as the former used oil tank. Land use in the vicinity of the Site is primarily commercial and residential.

2.2 Previous Investigations

Investigations have been conducted at the Site by Emcon Associates (Emcon) in June 1985, Applied GeoSystems (AGS) in January 1988, Gettler-Ryan/EA in August 1992, and PACIFIC from April 1988 to the present. Analytical data collected during previous investigations is summarized on Tables 1 through 9. All borings, wells, and sample locations described in the following paragraphs are shown on Figures 2 through 8.

2.2.1 Pretank Replacement Investigations

Emcon drilled four on-site exploratory soil borings (A-A through A-D), installed one ground-water monitoring well (A-1), and collected selected soil samples for laboratory analysis in January 1985.

- Soil samples collected from borings drilled by Emcon, located adjacent to the UST complex, at depths ranging from 5-1/2 to 14 feet below ground surface (bgs), contained total volatile hydrocarbons calculated as gasoline (TVH-g) at concentrations ranging from 880 to 2,800 parts per million (ppm). Two soil samples collected from a boring located adjacent the used oil tank, at depths of 8-1/2 and 12 feet bgs, contained oil and grease at concentrations of 10,000 and 9,500 ppm, respectively.

- A groundwater sample collected from Well A-1 contained gasoline and benzene concentrations of 32,000 and 1,000 parts per billion (ppb), respectively.

AGS drilled four on-site exploratory soil borings (B-1 through B-4), converted two of the borings (B-1 and B-2) to groundwater monitoring wells (MW-1 and MW-5, respectively), and collected selected soil samples for laboratory analysis during January 1988. During field activities, AGS also discovered two additional undocumented on-site wells, and designated them as Wells MW-3 and MW-4.

- Soil samples collected from borings drilled by AGS, near the former UST complex, at depths ranging from 5 to 11 feet bgs, contained TVH-g at concentrations ranging from non-detectable levels to 10 ppm. A soil sample collected from the boring for Well MW-1, located adjacent the used oil tank, at a depth of 11 feet bgs, contained non-detectable levels of TVH and total oil and grease.

2.2.2 Tank Replacement Activities

During UST removal activities in June 1988, PACIFIC collected soil samples from beneath four gasoline USTs and one used oil tank, and from each side wall of both UST excavations. In addition, three groundwater samples were collected from beneath the gasoline fuel tanks. During tank removal activities, Wells MW-1 and MW-2 were destroyed and another undocumented on-site groundwater well was found, and designated as Well MW-6 and later as Well E-1. Three vadose monitoring wells (V-1 through V-3) were installed during tank replacement activities at the Site.

- During tank removal activities, soil samples collected by PACIFIC from beneath the USTs, at depths ranging from 12 to 15 feet bgs, contained total petroleum hydrocarbons calculated as gasoline (TPH-g) at concentrations ranging from 7 to 2,800 ppm. Side wall soil samples collected from each side of the UST excavation, at a depth of 8 feet bgs, contained TPH-g concentrations ranging from non-detectable levels to 350 ppm.

- Based on comparison of soil data for samples collected above the capillary fringe during the tank replacement and overexcavation activities, the majority of hydrocarbon mass in soil has been removed. PACIFIC estimates that approximately 96 percent of the hydrocarbon mass in the area of the former underground tank complex, and 98 percent of the hydrocarbon mass in the area of the used oil tank has been removed.

- Concentrations of TPH-g and benzene in groundwater samples collected from beneath the USTs ranged from 8,200 to 22,000 ppb, and 440 to

1,900 ppb, respectively. A separate-phase hydrocarbon (SPH) sheen was noted on groundwater in both the UST and used oil tank excavations.

- Two soil samples collected from beneath the used oil tank, at a depth of 9 feet bgs, contained total oil and grease at concentrations of 6,100 and 13,000 ppm. In addition, five soil samples collected from the excavation sidewalls and bottom were analyzed for volatile organic compounds (VOCs). Acetone was detected in the northeast and southwest sidewall samples at concentrations of 220 and 54 ppm, respectively. No other VOCs were detected in any soil sample analyzed. A soil sample collected from the bottom of the excavation, at a depth of 13 feet, contained total oil and grease at a concentration of 20 ppm. Side wall soil samples, collected at depths from 8 to 9 feet bgs, contained oil and grease concentrations ranging from 10 to 200 ppm. High boiling hydrocarbons ranged from non-detectable levels to 30 ppm.

Oil-Water Separator/Clarifier. On March 26, 1992, Gettler-Ryan, Inc. (GR) and EA Engineering, Science and Technology, Inc. (EA) performed services during closure of an oil-water separator/clarifier (clarifier) located at the Site. The clarifier was formerly located within the service bay of the station building.

- Four soil samples were collected during the closure of the clarifier, and consisted of a concrete sample, concrete/soil interface sample, and soil samples from 2 and 5 feet bgs. Total recoverable petroleum hydrocarbons were detected in the concrete, concrete/soil interface and 2-foot samples at 3,000, 1,000 and 3,300 ppm, respectively. VOCs, SVOCs, Toxicity Characteristic Leaching Procedures (TCLP - volatiles, metals, and semi-volatiles), and California Assessment Metals (CAM 17 metals) were not detected in any soil sample analyzed.

2.2.3 Additional Site Assessment

PACIFIC performed a soil gas survey at the Site during February 1989. Nineteen soil gas probes were installed on and off site at depth intervals ranging from 7 to 8 feet bgs and 10 to 11 feet bgs.

- Soil vapors collected from probes during the soil gas survey indicated total hydrocarbons ranging from non-detectable levels to 130 ppm. Concentrations of benzene ranged from non-detectable levels to 390 ppm. The highest concentrations were noted in the northwest portion of the Site, extending off site towards the west. These results were used to select locations for groundwater monitoring wells installed in 1990.

In November 1989, PACIFIC performed aquifer testing at the Site. A step discharge test was performed in a previously installed, 8-inch diameter, corrugated steel cased well (MW-6/E-1).

- Based on the results of the step-discharge test, it was estimated that the aquifer underlying the Site has a specific capacity of approximately 2.45 gallons per minute per foot (gpm/ft), and could sustain a yield of 17 gallons per minute (gpm) with 7 feet of drawdown. These values were approximate since well construction details were not known.

In July 1990, PACIFIC abandoned the on-site undocumented Wells MW-3, MW-4, and MW-6/E-1. Between March 1990 and November 1991, PACIFIC installed the following wells: on-site groundwater extraction Well E-1A (MW-12), on-site groundwater monitoring Wells MW-7 and MW-13, and off-site groundwater monitoring Wells MW-8 through MW-11, and MW-14 though MW-23. Soil samples for laboratory analysis were submitted from the borings for Wells MW-8 and MW-9.

- Soil samples collected from the borings for off-site Wells MW-8 and MW-9, at depths of 11-1/2 and 10-1/2 feet bgs, respectively, contained non-detectable levels of TPH-g.
- Concentrations of TPH-g in groundwater has ranged from non-detectable levels to 1,100,000 ppb (March 29, 1990). The maximum concentration was found in Well MW-3. Benzene concentrations have ranged from non-detectable levels to 13,000 ppb. The highest concentrations of TPH-g and benzene have been noted in on-site wells in the northwestern portion of the Site. SPH have been measured in Well MW-4 at a maximum thickness of 0.01 foot (March 29, 1990).
- Groundwater samples from Well MW-12 were analyzed for VOCs and CAM 17 metals. The only detections were benzene at 3 μg/L, and barium at 0.13 mg/L.

2.2.4 Domestic Irrigation Well Assessment

PACIFIC documented the location and use of 14 domestic irrigation wells downgradient of the Site (Figure 10). Preliminary sampling of the domestic irrigation wells was performed by PACIFIC between September and November 1991. Additional sampling events were performed by PACIFIC in October and December 1992. During the 1991 and 1992 sampling events, several wells contained inoperable pumps or were inaccessible; therefore, no groundwater samples were collected from these wells. Based on the analytical results of the initial sampling event, PACIFIC performed a preliminary risk assessment to determine if a risk to human health existed as a result of benzene noted in groundwater. The results of PACIFIC's risk assessment were documented in a letter to ACHCSA dated March 13, 1992 and are summarized below.

- Concentrations of TPH-g in groundwater collected from the domestic irrigation wells during the 1991 sampling event ranged from non-detectable levels to 780 ppb. Benzene was detected in groundwater at concentrations ranging from non-detectable levels to 13 ppb.
- During the November 22, 1992 sampling event, TPH-g was detected at concentrations ranging from non-detectable levels to 2,200 ppb. Benzene ranged between non-detectable levels and less than 5 ppb.
- During the December 1992 sampling event, TPH-g was detected at concentrations ranging from non-detectable levels to 1,500 ppb. Benzene ranged from non-detectable levels to 14 ppb.
- Results of the risk assessment indicate estimated human health risks due to ingestion and dermal absorption of groundwater were from 4.46×10^{-6} to 1.08×10^{-5}, and 2.01×10^{-6} to 3.47×10^{-6}, respectively.

In a letter dated June 5, 1992, ACHCSA requested a more comprehensive assessment. PACIFIC subsequently modified the risk assessment in cooperation with ACHCSA. The modified risk assessment was approved by ACHCSA in November 1993. In April 1995, ACHCSA requested that an additional exposure pathway, inhalation of benzene in an enclosed space, be evaluated. The results of the modified health risk assessment and subsequent evaluation are ~~, and is~~ summarized in Section 4.0 and presented as Appendix B.

Beginning in 1993, ARCO contacted these wellowners to request: (1) authorization to collect quarterly groundwater samples from the domestic irrigation well located on their properties, and (2) agreement to discontinue operation of the domestic irrigation wells until ARCO's investigation is complete. The majority of wellowners have agreed to both requests. The table below summarizes wellowner cooperation, as of June 1995.

Well Identification/ Address	Well Designation for Sampling Purposes	Authorized Quarterly Sampling	Discontinued Well Use
590 Hacienda Avenue	590 H	Yes	Yes
633 Hacienda Avenue	633 H	Yes	Yes
634 Hacienda Avenue	634 H	*	*
642 Hacienda Avenue	642 H	Yes~~No~~	Yes~~No~~
675 Hacienda Avenue	675 H	Yes	Yes
17197 Via Magdalena	17197 VM	Yes	Yes
17200 Via Magdalena	17200 VM	Yes	Yes
17203 Via Magdalena	17203 VM	Yes	Yes

17302 Via Magdalena	17302 VM	Yes	No
17348 Via Encinas	17348 VE	Yes	Yes
17349 Via Magdalena	17349 VM	Yes	Yes
17371 Via Magdalena	17371 VM	No	No
17372 Via Magdalena	17372 VM	Yes	No
17393 Via Magdalena	17393 VM	Yes	Yes

* = Well cannot be sampled or used due to blockage

As shown above, currently, ~~11~~ 12 of the 14 wellowners have authorized ARCO to collect quarterly groundwater samples from their domestic irrigation wells. ~~Two~~One of the wellowners has~~ve~~ refused ARCO sampling authorization and the remaining well, Well 634 H, cannot be physically sampled. However, groundwater samples have been collected at some point from all domestic irrigation wells, except Well 634 H. Table 3 summarizes the analytical results for all domestic irrigation wells. The wells which ARCO is currently authorized to sample should be adequate for monitoring purposes. The ~~two~~ well~~s~~ which ARCO does not have authorization to sample, Well~~s 642 H and~~ 17371 VM, is~~are~~ not likely to affect the overall monitoring results. This is because~~: (1) petroleum hydrocarbons have never been detected during seven previous sampling events in Well 642 H, and (2)~~ data for Well 17371 VM could be approximated if necessary using Wells 17349 VM and 17393 VM, which are located approximately 50 feet upgradient and downgradient of Well 17371 VM, respectively.

ARCO currently reimburses ~~9~~10 of the 14 wellowners for using municipally-supplied water for irrigation purposes. ~~Four~~Three of the wellowners have refused to discontinue operating their wells, and the remaining well cannot be physically used at this time. ARCO will continue to reimburse the wellowners who have agreed to discontinue well use through December 1995.

2.2.5 Interim Remediation

In 1991, ARCO installed a groundwater extraction and treatment system at the Site. The groundwater remediation system began continuous operation on October 15, 1991. The treatment system uses three granular activated carbon (GAC) vessels to treat the influent groundwater stream before it is discharged into the sanitary sewer. The carbon vessels are arranged in series with valving to permit bed order rotation. This allows for the primary vessel to become the secondary vessel after the carbon has been renewed. Sample ports are located at the treatment system influent, effluent, the mid-point between the carbon vessels, and at each individual well head. A sanitary sewer discharge permit was obtained from the Oro Loma Sanitary District on April 4, 1991. The updated permit is effective through April 4, 1995.

In order to evaluate treatment system performance, PACIFIC monitors water levels, instantaneous and average flow rates, and samples the influent and effluent of the treatment system for TPH-g, benzene, toluene, ethylbenzene, and xylenes (BTEX compounds), on a monthly basis. The effluent sample is also analyzed for arsenic, as requested by the Oro Loma Sanitary District.

- Based on the remedial performance evaluation documented in PACIFIC's ~~August 17, 1994~~ May 5, 1995 quarterly report, the groundwater treatment system has extracted approximately ~~3,665,988~~4,183,908 gallons of groundwater at an average pumping rate of ~~2.9~~2.0 gpm. A total of ~~3.9 gallons~~4.2 pounds of dissolved TPH-g, and ~~0.04 gallon~~ 0.3 pound of dissolved benzene have been recovered since the beginning of operation.

2.3 Remedial Investigation

To address the comments in ACHCSA June 5, 1992 letter regarding PACIFIC's risk assessment, PACIFIC performed additional data collection on July 22, 1992. Additional data collected included groundwater analysis for drinking water quality standards from domestic irrigation Wells 17349 VM and 17203 VM, and air monitoring for volatile benzene concentrations from four selected locations and at the domestic irrigation Well 17349 VM. Drinking water quality analyses were performed to determine if local shallow groundwater met California drinking water standards, and air monitoring was performed to gain site-specific data on benzene occurrence in the atmosphere.

- Analysis of groundwater samples collected from domestic irrigation wells indicated odor at 50 units, color ranging between 5 and 20 units and turbidity ranging between 9 and 8.6 Nephelometric Turbidity Units (NTU). These values indicate that that groundwater generally does not meet secondary drinking water standards.
- During air monitoring at selected locations across the Site and vicinity, volatile benzene concentrations were found to range between 2.1 and 9.6 micrograms per cubic meter ($\mu g/m^3$). The highest concentrations were noted at the corner of Hacienda Avenue and Hesperian Boulevard (6.8 $\mu g/m^3$) and the corner of Hacienda Avenue and Via Magdalena (9.6 $\mu g/m^3$). These levels are likely attributable to exhaust fumes from regional automobile traffic. For reference, the National Institute for Occupational Safety and Health (NIOSH) Threshold Limit Value-Time Weighted Average (TLV-TWA) for benzene is 0.1 ppm, or 319 $\mu g/m^3$. This value represents the concentration for a normal 8-hour work day and 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day, without adverse effects.

As requested by ACHCSA, additional analyses for groundwater samples collected from Well MW-8, including VOCs, SVOCs, and metals, were performed during the fourth quarter 1992 groundwater monitoring event. Well MW-8 is located approximately downgradient from the former used oil tank.

- Additional analysis performed on groundwater samples collected from Well MW-8 indicated non-detectable levels of VOCs. However, semi-volatile organic compounds (SVOCs) were detected including: acenaphthene, dibenzofuran, fluorene, 2-methylnaphthalene, naphthalene, and phenanthrene. In addition, arsenic, barium, and zinc were detected.

In March and April 1993, PACIFIC performed an exploratory soil boring program. Nineteen on-site and twenty off-site soil borings were taken. The borings were drilled to: (1) further define the lateral and vertical extent of the subsurface channel deposits, (2) define the lateral extent of petroleum hydrocarbons in historical capillary fringe zone across the Site, (3) define the lateral and vertical extent of hydrocarbons in soils adjacent to the former oil-water clarifier and adjacent to the former used oil tank, and (4) collect soil samples for physical and biological testing pertinent to the risk assessment and remedial alternative portions of the remedial investigation.

The following is a summary of the findings for this investigation:

- Soils encountered underlying the Site consisted primarily of surficial clays and silts to a depth of approximately 11 feet bgs. Coarse-grained deposits consisting of clayey sand, silty sand, and sand, ranging in thickness from 1/2 foot to 3 feet, were noted in most borings between the approximate depths of 4 to 15 feet bgs, underlain by clays to the total depth explored 22-1/2 feet bgs. The coarse-grained deposits may represent channel deposits and apparently trend in an east-west direction, increasing in thickness from north to south. Cross-sections A-A' and B-B' (Figure 8) illustrate subsurface conditions.

- Organic vapor concentrations ranged from non-detectable levels to 190 ppm. The highest concentrations were noted within the historical capillary fringe zone (9 to 14 feet bgs) and in the vicinity of the former clarifier and former used oil tank.

- TPH-g was detected in the historical capillary fringe zone at concentrations ranging from 1.6 ppm in Boring B-17 to 650 ppm in Boring B-24. Benzene was detected in the capillary fringe zone at concentrations ranging from 0.010 ppm in Boring B-9 to 0.59 ppm in Boring SP-1/V-4. The highest concentrations of TPH-g (greater than 100 ppm) were noted from on-site soil borings located in the vicinity of the former clarifier, western product island adjacent to the station building, and west of the former UST complex. Only one off-site boring had TPH-g greater than 100 ppm.

- In the vicinity of the former clarifier, oil and grease, CAM metals, SVOCs, and halogenated volatile organic compounds (HVOCs) were detected. Oil and grease were detected at concentrations of 950 ppm at 4 to 6 feet bgs, and 1,900 ppm at 9 to 11 feet bgs, and were not detected at 14 to 16 feet bgs. CAM metals including antimony, arsenic, barium, chromium, cobalt, copper, nickel, vanadium, and zinc were detected in soil samples submitted for analysis. SVOCs and HVOCs detected included: 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-methylnaphthalene, naphthalene, and bis(2-ethylhexyl)phthalate. All concentrations were significantly below CCR Title 22 TTLC levels.
- In the vicinity of the former used oil tank, oil and grease were detected only in Boring B-27 at a concentration of 240 ppm at 2 to 3 feet bgs. All other soil samples analyzed from Borings B-27, B-27A, B-28, B-29, B-30, and B-30A had non-detectable levels of oil and grease. The above listed CAM metals were also detected in soil samples from Borings B-27A and B-30. No SVOCs or HVOCs were detected in any soil samples from Borings B-27 and B-30.

In March 1993, PACIFIC drilled and installed three groundwater monitoring wells (MW-24 through MW-26) to: (1) provide delineation of petroleum hydrocarbon-impacted groundwater in the upgradient (east) and crossgradient (north) directions, and (2) further define the lateral and vertical extent of the subsurface channel deposit. These wells have been monitored on a quarterly basis. At the same time, two dual completion air sparging and soil vapor extraction wells (SP-1/V-4 and SP-2/V-5) were installed on and off site to: (1) further define the lateral and vertical extent of the subsurface channel deposit, (2) collect samples for physical testing pertinent to the risk assessment portion of the remedial investigation, (3) provide vertical and lateral characterization of hydrocarbons in soils, and (4) provide installations to perform air sparging and SVE feasibility tests at the Site. The following was concluded:

- The coarse-grained deposits consisting of clayey sands, silty sands, and sands are relatively thin and extensive, and underlie a broad area across the Site. These coarse-grained deposits are interpreted as channel deposits, and include the historical and present capillary fringe zone; they are defined to the north, but not as well defined to the south. Additionally, the channel deposits increase in thickness from north to south. These channel deposits are more areally extensive than hydrocarbons noted in soil and groundwater, and therefore do not appear to define a preferential path for the downgradient transport of hydrocarbons in groundwater.

- The hydrocarbon plume in groundwater extends off site toward the west and is very localized in extent (Figure 9). The plume extends toward the domestic irrigation wells which have a history of pumping. Additionally, concentrations of hydrocarbons in groundwater off site in the area of the domestic irrigation wells are generally relatively low or non-detect.
- In the vicinity of the Site, the highest hydrocarbon concentrations in groundwater are noted in Wells MW-8 and MW-10, directly downgradient (west) of the Site.
- Based on current data, PACIFIC concludes that the sand channel is a factor in hydrocarbon migration, but that other factors also may have influenced hydrocarbon migration to the current plume configuration. These factors may include local variations in channel thickness, depth, and permeability, and pumping of domestic irrigation wells.

2.4 Feasibility Studies

2.4.1 Aquifer Testing

During the week of March 29, 1993, PACIFIC performed aquifer testing at the Site to determine the hydraulic characteristics of the shallow water-bearing zone both on and off site. This testing was intended to update the previous aquifer testing by using wells with known construction and nearby observations wells. The testing consisted of step-discharge tests in Wells E-1A and MW-10. In addition to the pumping tests, slug tests were performed in Wells MW-14 and MW-23. The shallow, unconfined aquifer appears to be capable of producing 2 to 4 gpm, or more, in the vicinity of the Site. A computer model was employed to determine the radius of groundwater capture for this Site. The model is called AqModel (O'Neill, 1990), and is distributed by WellWare of Davis, California. The time-dependent head distribution from which the capture zone was determined is based on the Theis analytical solution for flow to a pumping well. The capture zones thus determined have a radius of approximately 30 to 40 feet for Well E-1A, and approximately 70 to 80 feet for Well MW-10.

2.4.2 Air Sparge Testing

PACIFIC conducted an off-site air sparge test on May 4, 1993 and an on-site air sparge test on May 5, 1993. The objective of conducting air sparge testing was to determine the feasibility of using this technology at the Site. Given the observed radius of sparge influence (less than 16 feet) and changes in VOCs, dissolved oxygen (DO), and helium concentrations, PACIFIC concluded that the feasibility of using air sparge technology on or off site is limited.

2.4.3 Soil Vapor Extraction Testing

PACIFIC conducted an off-site soil vapor extraction test on April 29, 1993 and an on-site soil vapor extraction test on April 30, 1993. The objective of conducting a soil vapor extraction test was to determine the feasibility of using soil vapor extraction technology at the Site. The data for both tests indicated that the vacuum application limit was restricted to a radial boundary which did not encompass the nearest monitoring point. By fitting field data from the off-site test to the steady-state radial flow equation, the effective radius of influence (Re) was determined to be 9.5 feet. Given the estimated flow rate and extraction well spacing requirements, PACIFIC concluded that the feasibility of using soil vapor extraction technology on or off site is limited.

2.4.4 *In-situ* Soil Bioremediation Testing

PACIFIC initiated an off-site *in-situ* soil bioremediation feasibility test on March 9, 1993. The objective of testing was to evaluate the feasibility of using *in-situ* bioremediation technology at the Site. A description of results and conclusions ~~is~~are presented below.

- Ammonia and phosphate were not detected in any sample. Nitrate was not detected in any sample, except for sample B-11 at a concentration of 2.4 ppm. Elevated concentrations of potassium, calcium, magnesium, and iron were detected in all samples.
- Moisture content and pH concentrations were within the normal range to support microbiological growth.
- Normal levels of heterotrophic plate count organisms should be in the 10^5 to 10^6 colony forming units per gram (CFU/g) range. The results of the heterotrophic plate counts showed levels that are below normal, which ranged from non-detected (less than 10^3) to 6.2×10^4 CFU/g.
- The fluorescent *Pseudomonas* and hydrocarbon degraders levels should be in the 10^3 and 10^5 CFU/g range, respectively, if natural biodegradation is occurring in soils. Fluorescent *Pseudomonas* were not detected in any sample. Hydrocarbon degraders were not detected in any sample, except for sample B-11 at a concentration of 4.0×10^3 CFU/g.

Based on the results, insignificant natural bioremediation of hydrocarbons is taking place in the soils at this time. However, the biodegradation rate may be limited by the low concentrations of petroleum hydrocarbons. Bioremediation could be enhanced by nutrient addition; however, further column testing was not performed.

2.4.5 *In-situ* Groundwater Bioremediation Testing

PACIFIC conducted an *in-situ* groundwater bioremediation baseline study between May 26 and June 1, 1995. The objectives of study were (1) to improve the understanding of the factors that control the biodegradation of dissolved petroleum hydrocarbons in groundwater, (2) to establish baseline concentrations for the groundwater parameters, including dissolved oxygen and oxidation/reduction potential, that are indicators of intrinsic bioremediation, and (3) to identify and recommend strategies to enhance the intrinsic biodegradation process. A description of results and conclusions are presented below.

- Dissolved oxygen concentrations were generally low within the area and the former area of dissolved petroleum hydrocarbon impacted groundwater.
- Dissolved oxygen appears to be a limiting factor in wells impacted by dissolved petroleum hydrocarbons.
- In the wells where dissolved oxygen levels are below background levels, the nitrate calculated as nitrate concentrations were also found to be lower than background conditions. This finding confirms intrinsic biodegradation is occurring as nitrate is the next favorable electron acceptor utilized once dissolved oxygen is depleted.
- PACIFIC proposed to conduct a pilot study for enhancing intrinsic bioremediation. The study includes a dissolved oxygen enhancement program and a groundwater monitoring program to evaluate the performance of the dissolved oxygen enhancement. The results of the study will be included in the fourth quarter 1995 groundwater monitoring report for the site.

Could be

Also, could be lack of hydrocarbon degraders

what is background?

3.0 GROUNDWATER FATE AND TRANSPORT MODELING RESULTS

3.1 Modeling

To supplement the feasibility studies conducted previously, PACIFIC conducted groundwater fate and transport modeling to examine and predict effects of biodegradation of hydrocarbons in the groundwater. Benzene was selected as the optimum constituent for modeling, for the following reasons: (1) benzene represents the highest toxicity and lowest action levels of the BTEX compounds, and (2) decay rates and other physical characteristics for benzene are available from published literature (see references).

PACIFIC performed fate and transport modeling using two widely accepted finite-difference numerical models. The objective of the modeling was to evaluate dissolved benzene transport under conditions likely to be found in the on- and off-site subsurface, including the effects of: (1) pumping of off- and on-site shallow wells, and (2) potential biodegradation of dissolved benzene. The overall goal of the modeling was to provide an estimate of the concentrations of dissolved benzene which might reasonably be expected in groundwater at potential receptors (domestic irrigation wells) downgradient from the Site over a period of 2 to 5 years from the present. Domestic irrigation Well 633 H is of key interest in this analysis because of its proximity to the existing plume.

The following discussion summarizes model selection, model grid and parameters, and model results. Figures, tables, and printed model output are presented as Appendix A.

3.1.1 Model Selection

Two models were used for this fate and transport study: (1) MODFLOW, and (2) MT3D. MODFLOW is a three-dimensional, finite-difference numerical model which simulates groundwater flow in aquifers (McDonald and Harbaugh, 1988). It is a widely used and accepted model employed by academic, industry, and government hydrogeologists to predict groundwater flow under various conditions. MODFLOW was used in this study to provide calculated groundwater elevations within the model grid area (for example, see Figures A-2, A-6, and A-7 in Appendix A), and thus provide the flow direction and gradient from which the groundwater velocity is calculated during transport modeling.

MT3D is a three-dimensional, finite-difference transport model which simulates advection, dispersion and chemical reactions of contaminants in groundwater systems (Zheng, 1992). MT3D is specifically designed to be used in conjunction with MODFLOW and is based on the same block-centered finite-difference grid, allowing simple passing of input and output between the two models.

The applicability and accuracy of MT3D for calculating contaminant transport has been verified by checking and comparing numerical solutions for simple problems where analytical solutions are also available (Zheng, 1992).

Modeling was facilitated by using MODELCAD$^{386\text{™}}$ (Rumbaugh, 1993), a user-friendly software package which allows integration of model design and data input, and model execution of both the models employed in this study. Modeling was performed using a microcomputer based on a 80486 microprocessor running at 33 MHz with 8 megabytes of random-access memory.

Printed model output for each of the scenarios discussed below is presented as Attachment 1 in Appendix A. Attachment 2 contains printed output of benzene concentrations observed in downgradient domestic irrigation wells. It should be noted that model output printed directly from the computer contains units as follows:

- Length - feet
- Time - days
- Volume - cubic feet
- Mass - pounds per cubic feet

In the figures in Appendix A, benzene concentration units are converted from pounds per cubic feet into micrograms per liter.

3.1.2 Model Grid

The model grid employed in this study covers a rectangular 1,200 foot by 1,700 foot area aligned so that the grid boundaries are parallel and perpendicular to the groundwater flow direction estimated from field measurements (Figure A-1, Appendix A). The Site is located centrally in the eastern third of the grid, with off-site wells located downgradient in the western two-thirds of the grid. Grid size was selected to provide detailed 25 foot by 25 foot coverage of grid nodes in the vicinity of the dissolved contaminant plume and immediately downgradient of the plume, and with grid edges located at a sufficient distance from pumped wells such that boundary effects should be negligible. Each model used in this study employs a block-centered approach to grid nodes.

3.1.3 Model Parameters

Aquifer Properties. Aquifer properties were obtained from field studies (PACIFIC, October 12, 1993 report; PACIFIC, March 1994 Groundwater Monitoring Report), and estimates based upon lithologies at the Site (Freeze and Cherry, 1979; PACIFIC, February 4, 1993). The following aquifer properties were used in the model simulations (see also, Table A-1, Appendix A):

Hydraulic conductivity:	6.5 to 40 feet day^{-1} (field data)
Storativity:	0.1 (estimate for unconfined conditions)
Porosity:	0.25 (estimate typical for Site lithology)
Saturated thickness:	14 feet (field studies)
Dispersivity (longitudinal):	10 feet (estimate [Anderson and Woessner, 1992])
Dispersivity (horizontal):	1 foot (estimate, see above)
Hydraulic gradient:	Variable, approximately 0.0027 feet per foot (field data)

Boundary and Initial Conditions. Boundary conditions include hydraulic head at grid edges, any grid locations where constant benzene concentrations are applicable, and the pumping conditions of on- and off-site wells. For this study, constant groundwater heads at grid edges were used (estimated from field data), and result in the approximate hydraulic gradient listed above (Figures A-2, A-6, and A-7, Appendix A).

The grid nodes which approximate the area where the former USTs existed on site have been set in the model so that there is a constant concentration of dissolved benzene at these nodes (330 micrograms per liter [µg/L] benzene). This boundary condition simulates constant input of benzene to groundwater from a soil source at the capillary fringe. This boundary condition would be applicable until soil remediation has completely removed the benzene source in the on-site subsurface.

Two combinations of pumping for off- and on-site wells were simulated:

- No on-site pumping and no pumping of off-site domestic irrigation wells (Scenario 1).
- On-site pumping at 3 gpm with pumping of off-site domestic irrigation wells (Scenario 2).

These two scenarios simulate the cases where wellowners pump their wells according the rates listed in Table A-1, Appendix A, and on-site control of dissolved benzene through pumping is either off or on. Steady-state flow conditions were employed throughout the interval of time simulated by the model, and domestic irrigation wells are assumed to be constantly pumping. An explanation of how pumping rates were derived for domestic irrigation wells is presented in Appendix A.

Initial Conditions. Initial conditions include the initial concentrations of dissolved benzene observed in groundwater at the Site and in the Site vicinity during first quarter 1994 groundwater monitoring (PACIFIC, March 1994). This includes a dissolved benzene plume which extends in a westerly direction from the Site to the vicinity of Well 633 H (Figure A-3, Appendix A). Initial hydraulic head conditions are input based upon extrapolation of the field measurements obtained during the first quarter 1994 monitoring program (Figure A-2). Steady-state hydraulic heads are calculated by MODFLOW for each individual model run using input such as initial head distribution and assigned pumping rates for the various wells.

Transport Properties. The model used for the Site includes advective transport of dissolved benzene including natural attenuation of benzene through dispersion and biodegradation. Retardation of dissolved benzene was not considered in these model scenarios in order to lend a more conservative nature to the transport evaluation and calculation of downgradient dissolved benzene concentrations. Dispersivity values used in the model are listed above under the discussion of aquifer properties.

Biodegradation rates for dissolved benzene in the model were estimated from a literature review of rates that are typical for shallow, fine sand, unconfined aquifers where dissolved oxygen is in excess of 2.0 milligrams per liter (mg/L) (see discussion below in Section 3.2). Rates of 110 day half-life and 250 day half-life were employed.

The parameter used in the model is known as the decay factor which is:

- decay factor (alpha) = ln (2) / half-life

The above range in half-life gives the following range in decay factor:

- 0.63 percent per day through 0.28 percent per day

Biodegradation under aerobic conditions where dissolved oxygen is in excess of 2.0 mg/L has rates that are typically around 0.63 percent per day (McAllister and Chiang, 1994; Salanitro, 1993). PACIFIC has determined that groundwater in the site vicinity has dissolved oxygen values that meet this criteria (see Section 3.2).

3.1.4 Model Results

Two basic modeling scenarios and one sensitivity study (with respect to biodegradation rate) were performed to evaluate the behavior of the dissolved benzene plume over the next 5 years:

- No pumping on site with no pumping of domestic irrigation wells (Scenario 1).
- Pumping on site with selected domestic irrigation wells pumping (Scenario 2).
- Scenario 2 with benzene half-life increased to 250 days (Sensitivity Study).

Scenario 1. Modeling runs were performed using the above parameters, specifically with the 110 day benzene half-life (the most reasonable choice based upon literature review - see above). The results for Scenario 1 can be summarized as follows:

- At time = 0 (March 1994), the dissolved benzene plume extends approximately 150 feet west of Well MW-10, but has not reached Well 633 H (Figure A-3, Appendix A).
- At time = 0 (March 1994), the concentrations of dissolved benzene within this plume range from non-detect at the boundary to as high as 470 µg/L at Well MW-10.
- At time = 1 year, the plume extends approximately 50 feet west of Well 633 H, but plume concentrations have diminished considerably, with the bulk of the plume remaining on site and concentrations ranging up to approximately 15 µg/L off site between Wells MW-10 and 633 H (Figures A-4 and A-13, Appendix A).
- At time = 2 years, the plume has achieved a steady-state configuration, extending from the Site to approximately 50 feet east of the intersection between Hacienda Avenue and Via Arriba (Figure A-5, Appendix A).

After approximately 2 years, the plume for this first scenario maintains its constant configuration because the two competing effects, biodegradation and constant source at the station, reach mass balance, resulting in no further migration of the plume beyond the above named intersection. As seen below in Scenario 2, on-site pumping will result in a smaller steady-state plume configuration with the leading plume edge closer to the Site, in spite of the effects of pumping of off-site domestic irrigation wells.

Scenario 2. The second scenario was performed using similar initial conditions, specifically with the 110 day benzene half-life, and employs pumping at 3 gpm at the on-site extraction well (E-1A) to control off-site migration of dissolved benzene originating at the former tank-pit area. In addition, selected downgradient domestic irrigation wells are pumping continuously at three times their effective pumping rates (see Table A-1 for individual rates).

Figure A-6, Appendix A, shows the groundwater elevation contours for the situation where only the on-site well is pumping at 3 gpm. This latter situation was used to calibrate the flow model, because it closely follows the existing data obtained from groundwater monitoring studies (PACIFIC, March 1994). The MODFLOW flow field used in Scenario 2 with the effects of pumping of domestic irrigation wells is shown on Figure A-7, Appendix A.

Results are summarized as follows:

- At time = 1 year, the plume extends from the Site to approximately 25 feet west of Well 633 H with concentrations in that well estimated to be between <1 and 17.7 μg/L at various times up to 1 year (Figures A-8 and A-14, Appendix A).
- At time = 2 years, the plume has achieved a steady-state configuration with benzene concentrations greater than 1 μg/L extending no further than 50 feet off site to the west (Figures A-9 and A-14, Appendix A).

This last result is similar to Scenario 1, except the extent of the plume is much smaller because of the on-site pumping and source control.

Sensitivity Study. The sensitivity study involved running the model under conditions similar to Scenario 2, except with a benzene half-life of 250 days instead of 110 days. This was performed in the interest of checking a more conservative decay scenario. It should be noted that literature review indicates that a half-life of 110 days is more likely representative of the benzene decay rate, forming the mean of rates that have been estimated to vary between 0.3 and 1.3 percent per day.

Results of the sensitivity study show similar characteristics to Scenario 2 (Figures A-10, A-11, and A-15, Appendix A), except that the plume stabilizes its configuration over a longer time (2 to 4 years) and in the beginning extends slightly further (between Well 633 H and the domestic irrigation wells immediately north of the intersection between Hacienda Avenue and Via Magdelena). The plume stabilizes its areal extent after 2 years, achieving a steady-state condition between source input of benzene and biodegradation at a point approximately 10 to 25 feet further to the west than in Scenario 2 (Figure A-12, Appendix A).

3.1.5 Summary of Modeling Results

Extent of Dissolved Benzene Plume. Benzene concentrations downgradient from the site have been estimated over a period from March 1994 to 5 years into the future from that date. The dissolved benzene plume shrinks to a stable configuration within 2 to 5 years, extending in the stable configuration from the site to as much as 100 feet downgradient from the site, but not west of Well MW-10.

Benzene Concentrations at Well 633 H. During the length of time modeled, the only domestic irrigation well which shows more than 1 μg/L dissolved benzene is Well 633 H. Figures A-13, A-14, and A-15 (Appendix A) show the behavior of benzene concentrations with time in Well 633 H. The computer output used to prepare these figures is presented as Attachment 2, Appendix A. Concentrations at that well range up to 17.7 μg/L (Figures A-13 and A-14, Appendix A) using the most reasonable estimate of half-life for benzene (110 days). At longer half-life (250 days), Well 633 H contains as much as 28.8 μg/L dissolved benzene (Figure A-15, Appendix A), although biodegradation and dispersion cause the plume to shrink back towards the Site after 2 years.

Pumping of On-site and Off-site Wells. Pumping on site from groundwater extraction Well E-1A (3 gpm) reduces the size of the stabilized benzene plume by as much as 100 linear feet along plume axis as compared with the Scenario 1 (no on-site pumping). Off-site pumping of domestic irrigation wells listed in Table A-1, Appendix A appears to not appreciably affect benzene migration. This is likely due to the competing effects of biodegradation which shrinks plume size, and the on-site pumping which occurs at a much greater rate than off-site pumping.

Comparison with Monitoring Data. PACIFIC's fate and transport model has been run using conservative parameters. The conservative nature of the model includes:

- Benzene half-life in the median range of values from the literature review.
- Pumping schedules for off-site wells assume 24-hour pumping all year.
- Permeabilities characteristic for sands (certain areas in the neighborhood likely show lower permeabilities than used in the model).

Because of the inherent inhomogeneities of the local stratigraphy, and the fact that certain parameters are estimated, the model will approximate conditions in the field, but will not always be 100 percent accurate. This is shown by comparison of third quarter 1994 monitoring data with model data predictions.

Analytical data from Well 633 H shows that benzene is not detected in groundwater from that well. The model would have predicted between 1 and 17 μg/L for Well 633 H. Conversely, Well MW-10 shows 79 µg/L benzene in groundwater which fits into the general model trend of a shrinking benzene plume (MW-10 contained 470 µg/L benzene in March 1994). In addition, Well 17349 VM yielded groundwater with 1.8 µg/L benzene, whereas the model would predict non-detectable amounts of benzene in groundwater from that well.

In general these monitoring results support the idea of plume shrinkage through natural attenuation. Even the value of 1.8 µg/L at Well 17349 VM is, taken over a period of the last 2 years, evidence for natural attenuation since groundwater there originally contained 13 µg/L benzene. The fact that groundwater from MW-10 is decreasing markedly in dissolved benzene lends strong support to the general model conclusion that the dissolved plume will, over a period of 1 to 2 years, attain a steady-state configuration centered on the site with its downgradient leading edge only 50 to 100 feet off site.

The following section describes additional information which indicates that biodegradation of petroleum hydrocarbons is occurring at the Site. strike

~~3.2 Biodegradation Evaluation~~

~~During the July 8, 1994 meeting, the RWQCB requested that a qualitative evaluation be performed to confirm that biodegradation of petroleum hydrocarbons is occurring in the groundwater at the Site. The evaluation below satisfies this request by: (1) identifying that biodegradation of petroleum hydrocarbons occurs naturally, (2) comparing the characteristics favorable to groundwater biodegradation of petroleum hydrocarbons to Site conditions, and (3) showing that hydrocarbon concentrations and extent have declined over the past 3 years.~~

~~The EPA states that biodegradation in the subsurface is common, and that:~~

> ~~"natural biorestoration does occur in the subsurface environment. Contaminants in solution as well as vapors in the unsaturated zone can be completely degraded or transformed to new compounds. Undoubtedly, thousands of contamination events are remediated naturally before the contamination reaches a point of detection" (EPA, 1990).~~

~~Further, the process of biodegradation results in the complete destruction of the petroleum hydrocarbon compounds by incorporating the carbon molecules into the biological structure or into the production of carbon dioxide. It has been shown that the rate of biodegradation is nutrient and oxygen dependent; however, microbiological organisms will continue to degrade petroleum hydrocarbons over a wide range of nutrient and oxygen conditions.~~

~~During the past decade studies have been performed at several gasoline service station sites to document that naturally occurring microbiological organisms reduce the volume and extent of hydrocarbon-impacted groundwater. In one study, natural bioremediation was evaluated as~~

~~an alternative to active remediation (Caldwell et al, 1992). In this case, several groundwater characteristics were measured and used to model the transport and biodegradation of the dissolved petroleum hydrocarbon plume. The modeling results were compared with the results of groundwater sampling and the study concluded that: (1) groundwater conditions at that site were favorable to biodegradation, and (2) natural biodegradation processes could be~~

~~constraining the plume and limiting off-site migration. The table below shows a comparison of the groundwater characteristics at the case study site where biodegradation was occurring and at the ARCO Site.~~

~~Groundwater Characteristic~~	~~Case Study~~	~~ARCO 0608~~
~~Dissolved Oxygen~~	~~1.35 mg/L~~	~~3.7 mg/L~~
~~Calcium~~	~~150 mg/L~~	~~120 mg/L~~
~~Iron~~	~~1.8 mg/L~~	~~0.8 mg/L~~
~~Magnesium~~	~~5.9 mg/L~~	~~40 mg/L~~
~~Manganese~~	~~Not detected~~	~~3.8 mg/L~~
~~Petroleum Hydrocarbons~~	~~ppm range~~	~~ppm/ppb range~~
~~Total dissolved solids, sulfates, chlorides, alkalinity, and pH were all in similar ranges.~~		

~~The groundwater characteristics at the Site are remarkably similar to those of the case study, where groundwater degradation was concluded to be occurring. Oxygen, which is generally regarded as the limiting factor for biodegradation, is sufficient to support biodegradation in the groundwater at the Site. The decrease in the size of the plume that was predicted in the case study model and confirmed through field testing parallels the decrease of hydrocarbon concentrations at the Site, is discussed below.~~

~~Observations during quarterly monitoring in the Site vicinity indicate that between 1991 and 1994, the areal extent of the dissolved TPH-g and benzene plumes decreased markedly (Figures 11 and 12). During the fall of 1991, for example, the benzene plume extended from the Site to as far west as Wells 17200 VM (2.7 µg/L benzene) and 17349 VM (13 µg/L benzene). By fall of 1993, the plume extended primarily from the Site to an undefined point west of Well MW-10 with an isolated concentration (13 µg/L benzene) in Well 17349 VM. By spring of 1994, the westernmost indication of the benzene plume's presence is at Well MW-10. This trend is also apparent on Table 2 for Monitoring Wells MW-15, MW-16, MW-17, and on Table 3 for domestic irrigation Wells 17200 VM, 17302 VM, 17349 VM, and 17372 VM. Although other factors, such as dilution, may be affecting the petroleum hydrocarbon groundwater plume, the results of this evaluation suggest that biodegradation of petroleum hydrocarbons is occurring in the groundwater at the Site.~~

4.0 MODIFIED HEALTH RISK ASSESSMENT

A Modified Health Risk Assessment (RA) was completed for the Site by PACIFIC in November 22, 1993, and approved by ACHCSA in November 1993. An evaluation of an additional potential exposure pathway was completed at the request of ACHCSA in April 1995. A summary of the methodology, results, and conclusions of that assessment are presented below. The results of this RA are also presented in Tables 10 and 11, and Appendix B.

4.1 Methodology

4.1.1 Objectives and Assumptions

The RA was an evaluation of the potential risks to human health and environment associated with exposure to the petroleum hydrocarbon chemicals found in soil vapor and groundwater at the Site; exposure to soil was not determined to be a complete exposure pathway. The modified health risk assessment provided health-conservative estimates of the individual lifetime excess carcinogenic and noncarcinogenic risks posed by the chemicals of concern (COCs) detected in these media. Exposure to the detected COCs was evaluated based on the current residential land use at the Site. The maximum COC concentrations detected in groundwater were used to determine chemical intake. These concentrations were assumed to remain constant during lifetime exposure. Risk-determination methodologies were based on specific guidance from ACHCSA, the EPA, and published literature. Potential health risk was determined using parameters based on site-specific data or worst-case assumptions, if unknown.

4.1.2 Chemicals of Concern

The first step in the modified health risk assessment was to identify the COCs. Petroleum hydrocarbons, quantitated as gasoline, were detected in the Site's soil, soil vapor, and groundwater. The principal components of gasoline, which are BTEX compounds, were selected as COCs.

4.1.3Toxicity Assessment

The toxicity of each chemical of potential concern was evaluated using dose-response estimates obtained from EPA sources. One of the COCs detected at the Site, benzene, is classified by the EPA as known human carcinogen. The remaining COCs are not classified as potential human carcinogens and have chronic health effects only. For each chemical, slope factors (SFs) or reference doses (RfDs) were obtained from EPA references and used in the RA. Slope factors and RfDs are toxicity values which are used to estimate potential health effects. Slope factors are used to estimate the risk of carcinogenic effects for specific chemicals, and RfDs estimate "threshold doses," or the amount of a chemical an individual could consume each day for a lifetime without adverse health effects. The units of SFs and RfDs are mg/kg day.

4.1.4 Exposure Assessment

A detailed exposure assessment was performed for the COCs. Potential exposures to the COCs were evaluated based on the current residential land use at the Site. Three potential routes of human exposure were identified. The ~~three~~four exposure scenarios are briefly described below.

- **Children Playing in Irrigating Groundwater:** This scenario assumes that children could play in extracted groundwater potentially containing dissolved petroleum hydrocarbons. As a consequence, children could be exposed to petroleum hydrocarbons via the inhalation, dermal contact, and ingestion exposure route pathways.
- **Adults Working or Resting Adjacent to Irrigating Groundwater:** This scenario assumes that adults will work or rest adjacent to extracted groundwater potentially containing dissolved petroleum hydrocarbons. As a consequence, adults could be exposed to petroleum hydrocarbons via the inhalation exposure route pathway.
- **Benzene Vapor Transport Through Soil (Outdoors):** This scenario assumes that dissolved petroleum hydrocarbons will volatilize from the groundwater, and that the vapor will migrate through the soil to the outdoor ground surface. As a consequence, children and adults could potentially be exposed while outdoors to soil vapors containing petroleum hydrocarbons via the inhalation exposure route pathway.
- **Benzene Vapor Transport Through Soil (Enclosed Space):** This scenario assumes that dissolved petroleum hydrocarbons will volatilize from the groundwater, and that the vapor will migrate through the soil to the

ground surface, then into homes through cracks in the floor and foundation. As a consequence, children and adults could potentially be exposed while in an enclosed space to soil vapors containing petroleum hydrocarbons via the inhalation exposure route pathway.

Quantitative exposure estimates were provided for each COC using various modeling strategies. Chemical concentrations in environmental media at points of human exposure, or exposure point concentrations (EPCs), were estimated. Based on the EPCs, Chronic Daily Intake (CDI) estimates were derived for each chemical and exposure pathway. CDI is a measure of chemical intake per kilogram of body weight per day (mg/kg-day) at a site. CDIs are used in the risk assessment to quantify carcinogenic and non-carcinogenic health effects for all exposure routes.

4.1.5 Risk Characterization

Potential risks were estimated by mathematically combining the CDI estimates with the dose-response health criteria. The carcinogenic risk estimate for a person exposed to a particular chemical via a particular exposure route is the product of the CDI for that exposure pathway and the SF for that particular chemical. Carcinogenic risk estimates are unitless estimates of the increased probability of tumor formation under the assumed conditions of exposure. In contrast, a noncarcinogenic risk estimate, termed an Health Hazard Index (HHI), is the ratio of the CDI to the RfD. An HHI of unity or greater indicates that noncarcinogenic adverse health effects may occur in an exposed population. Carcinogenic risk estimates and HHIs are summed across all chemicals to provide total risk estimates for a specific exposure route, and the totals for individual routes are summed to provide risk estimates for each exposure scenario.

4.2 Results

4.2.1 Carcinogenic Health Risk Results

The potential carcinogenic health risk to both child and adult residents is less than 1×10^{-6}, also known as the point of departure for risk management decisions. Risks which exceed this level generally indicates that a risk management strategy should be considered.

The potential carcinogenic health risk to child residents ranges from 4.3×10^{-7} to 8.5×10^{-7}. The majority of risk is attributable to inhalation of soil vapor, at 4.3×10^{-7}. The remaining risk ranges from 3.6×10^{-8} to 3.5×10^{-7} for dermal contact with irrigated groundwater, 1.4×10^{-9} to 2.0×10^{-8} for ingestion of irrigated groundwater, and 4.6×10^{-10} to 1.4×10^{-8} for inhalation of COCs from irrigated groundwater.

The potential carcinogenic health risk to adult residents ranges from 8.9×10^{-7} to 9.1×10^{-7}. The majority of risk is attributable to inhalation of soil vapor, at 8.9×10^{-7}. The remaining risk ranges from 1.3×10^{-9} to 4.0×10^{-8} for inhalation of COCs from irrigated groundwater.

4.2.2 Non-carcinogenic Health Risk Results

The potential non-carcinogenic health risk to both child and adult residents is less than 1, or unity. Risks which exceed this level generally indicate that a risk management strategy should be considered.

Non-carcinogenic health risk for child residents ranges from 4.4×10^{-1} to 4.5×10^{-1}. The majority of risk is attributable to inhalation of soil vapor. The remaining risk ranges from 4.4×10^{-7} to 2.7×10^{-4} for dermal contact with irrigated groundwater, 9.1×10^{-7} to 2.1×10^{-4} for ingestion of irrigated groundwater, and 8.2×10^{-5} to 5.4×10^{-3} for inhalation of COCs from irrigated groundwater.

The potential non-carcinogenic health risk to adult residents is 5.6×10^{-1}. The majority of risk is attributable to inhalation of soil vapor, at 5.6×10^{-1}. The remaining risk ranges from 6.2×10^{-6} to 4.0×10^{-3} for inhalation of COCs from irrigated groundwater.

4.3 Conclusions

Based on the results of the RA, the potential health risk to child and adult residents at the Site is below federal and state action levels. These levels range from 1×10^{-4} to 1×10^{-6} for carcinogenic risk and 1 for non-carcinogenic risk; the State of California Proposition 65 legislation sets the acceptable carcinogenic risk level at 1×10^{-5}. As a result, no adverse health effects would be expected to occur due to exposure to the COCs at the Site, based on the maximum hydrocarbon concentrations observed to date.

4.3.1 Sensitivity Analysis

The actual risk may be much lower than the calculated risk. This is because of existing mitigating factors and the conservative assumptions that were applied to several of the exposure pathways. Despite the following mitigating factors, the calculated risk does not exceed the regulatory benchmarks which would support a risk management strategy.

- The shallow aquifer is of low quality with respect to drinking water standards. Analysis of groundwater samples collected from two domestic irrigation water wells indicated odor at 50 units, color ranging from 5 to 20 units, and turbidity ranged from 8.6 to 9 NTU. These results suggest that the irrigated groundwater looks, smells, and tastes poorly. Thus, the ingestion rate is considered to be very conservative.

- Based on discussions with ACHCSA, exposure duration was considered to be lifetime (70 years), whereas it is generally accepted by EPA that exposure duration should range between 9 to 30 years. Because risk is a linear product of concentration and exposure, using this value more than doubled the calculated risk.

- Based on discussions with ACHCSA, potential health risk was determined using constant COC concentrations throughout the exposure period, whereas concentrations have been shown to decrease over time at the Site due to natural attenuation. The COC concentrations in all domestic irrigation water wells, except at 17349 VM, have been below detection limits during the past year. The COC concentrations at 17349 VM have been below or near detection limits during 1994. The COC concentrations at 17349 VM increased to a new historical maximum during the first quarter 1995, which coincided with increased groundwater elevations, then returned to below detection limits during the second quarter 1995~~the past year~~. Additionally, potential health risk was determined using the highest COC concentrations detected in each domestic irrigation well, rather than averaging the COC concentrations. As a result of using the historical maximum as a constant concentration throughout the exposure period, the calculated risk could be at least an order of magnitude greater than the actual risk.

- Potential health risk was determined assuming child and adult residents would play in, or work adjacent to the irrigating groundwater during every irrigation event throughout the year, regardless of seasonal conditions. Thus, exposure to COCs is considered to be very conservative.

- Based on discussions with ACHCSA, risk from inhalation of soil vapor was estimated assuming near-continuous exposure (approximately 15 hours per day for a lifetime) to the vapors originating from the area of Well MW-10, which has the highest COC concentrations off site. However, wellowners are not likely to be in the area of Well MW-10 on a continuous basis. If this model was revised to assume that the wellowners would be in the area of their domestic irrigation wells on a continuous basis, the actual risk would be at least an order of magnitude lower than the calculated risk.

5.0 REMEDIAL ACTION OBJECTIVES

5.1 Remedial Action Objectives

Remedial action objectives for soil and groundwater at the Site were developed considering a number of factors, primarily the type and the amount of chemical present, land use, the volume and location of affected soil, a subsurface environmental chemical fate and transport model, possible human and environmental receptors, and regulatory agency requirements. Based on these factors, the following remedial action objectives for the Site were identified:

- Reduce groundwater petroleum hydrocarbon concentrations to federal and state maximum contaminant levels (MCLs).
- Reduce soil petroleum hydrocarbon concentrations to 100 milligrams per kilogram (mg/kg) for TPH-g and 1 mg/kg for each BTEX compound.

6.0 REMEDIAL ACTION ALTERNATIVE DEVELOPMENT AND EVALUATION

6.1 Screening Criteria

EPA, through the National Contingency Plan, has required evaluation of nine criteria for selection of a remedial action. These criteria incorporate the six required by H&SC Section 25356.1 and provide a comprehensive evaluation framework that forms a basis for selecting an appropriate remedial action(s). These criteria were confirmed at the July 8, 1994 meeting. The nine criteria are:

1. Overall protection of human health and environment
2. Compliance with Applicable or Relevant and Appropriate Regulations (ARARs)
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume
5. Short-term effectiveness
6. Implementability
7. Cost
8. Regulatory agency acceptance
9. Community acceptance

The following sections briefly describe each screening criteria.

6.1.1 Overall Protection of Human Health and the Environment

An assessment of overall protection of human health and the environment was made for the Site based on the overall implications of other criteria. The combined evaluation of other criteria, particularly long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs, is considered.

6.1.2 Compliance with Applicable or Relevant and Appropriate Regulations

ARARs are applicable or relevant and appropriate requirements which are standards, criteria or limits promulgated under federal or state law. Potential ARARs for the Site were identified based on anticipated regulatory actions. The final determination of which requirements are ARARs will made by the lead regulatory agency, the ACHCSA. The terms "applicable" and "relevant and appropriate" are described in the National Contingency Plan as follows:

- **Applicable requirements** are those remedial standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site.
- **Relevant and appropriate requirements** are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a site, address problems or situations sufficiently similar to those encountered at the Site that their use is well suited to the particular site.

Additionally, nonpromulgated policy, advisories, or guidance documents issued by federal or state agencies may be considered when developing remediation levels necessary to protect public health and the environment, although they are not ARARs.

6.1.3 Long-Term Effectiveness and Permanence

This criterion addressed the results of remedial actions in terms of the risk remaining after response objectives have been met. The magnitude of risk remaining from untreated residuals was examined for both soil and groundwater. Control measures, such as monitoring and system maintenance, were examined on the bases of adequacy and reliability.

6.1.4 Reduction of Toxicity, Mobility, or Volume

This criterion established preference for alternatives that would produce permanent, significant reductions. The evaluation focused on the amount of chemicals destroyed or treated, the irreversibility of the treatment, and the type and quantity of residuals that would remain after treatment.

6.1.5 Short-Term Effectiveness

Short-term effectiveness refers to the effects of an alternative during the construction and implementation phases and prior to obtaining response objectives. Four major aspects of short-term effectiveness were used to evaluate each alternative: protection of the community, protection of workers, environmental impacts from construction and implementation, and the time required to achieve the objectives.

6.1.6 Implementability

This criterion covers three major categories of implementability: technical feasibility, administrative feasibility, and availability of support services and materials.

Technical feasibility refers to the ease of construction given the site constraints, the reliability of the technology, and the ability to monitor the effectiveness of an alternative. For example, if a technology were to require large, unobstructed space for implementation, this could present a hindrance to technical feasibility at a site with buildings, utility corridors, loading areas, parking, or traffic lanes. Technical feasibility also infers that the treatment must work despite limitations which are associated with a given soil or hydrogeologic condition.

Administrative feasibility refers to necessary coordination with other regulatory or local agencies. For example, if a groundwater extraction system were to discharge treated water to surface water, permits may be needed from several agencies having jurisdiction over the surface water.

Availability of support services and materials refers to the ability to provide diverse needs such as equipment, competitive bids, and trained personnel.

6.1.7 Cost

This criterion was used to assess capital and operations and maintenance (O&M) costs on a conceptual level only. Capital costs included direct costs, such as equipment, site development, and relocation expenses. Indirect costs included engineering, permits, and start-up costs. O&M costs included labor, materials, repairs, disposal, administrative fees, and reporting costs. Cost estimates were prepared for each alternative using present worth analysis, assuming a 5 percent inflation factor. Estimates were accurate to within +50 to -30 percent.

6.1.8 Regulatory Agency Acceptance

This criterion was used to assess the likelihood of acceptance of the various alternatives by regulatory agencies having jurisdiction over remedial actions.

6.1.9 Community Acceptance

Community acceptance addresses the issues and concerns the public may have to each of the alternatives.

6.2 Development of Remedial Action Alternatives

Several remedial action alternatives were developed based on the results of modeling, risk assessment, and feasibility studies conducted at the Site. These alternatives were presented and agreed upon during the July 8, 1994 and May 9, 1995 meetings with ACHCSA and RWQCB. A copy of the minutes for these~~this~~ meetings are provided as Appendix C. The remedial action alternatives which were approved for consideration during that meeting follow.

1. Alternative 1: No action for soil and groundwater.
2. Alternative 2: No action for soil, enhanced *in-situ* bioremediation and institutional controls for groundwater off site, and groundwater extraction on site.
3. Alternative 3: No action for soil; institutional controls for groundwater off site, biosparging groundwater on site.
4. Alternative 4: Soil vapor extraction of soil on site, institutional controls for groundwater off site, air sparging and groundwater extraction on site.

Additionally, the following remedial action alternative has been developed since the July 8, 1994 meeting for consideration.

5. Alternative 5: Excavation of soil on site, institutional controls for groundwater off site, and groundwater extraction on site.

As approved during the July 8, 1994 and May 9, 1995 meetings with ACHCSA and the RWQCB, all of the alternatives apply institutional controls to the off-site groundwater, except for Alternative 1. Institutional controls consist of a groundwater management plan which includes regular groundwater monitoring and sampling, and health risk evaluation. The current groundwater monitoring and sampling schedule would be maintained initially, but would be expected to be modified during the project life. The health risk evaluation would coincide with groundwater sampling and consists of updating~~revising~~ the November 22, 1993 and June 28, 1995 risk assessments in the event that future COC concentrations exceed the concentrations used in the risk assessments. The methodology to update~~revised~~ potential health risk would be identified in the groundwater management plan to be submitted for the site.~~estimated using a COC concentration represented by the 95 percent upper confidence limit of the average.~~

6.3 Detailed Analysis Of Remedial Action Alternatives

This section presents a comparative analysis of the five remedial alternatives against the nine evaluation criteria outlined in Section 6.1. To aid in this discussion, a summary of this comparative analysis is presented in Table 12.

6.3.1 Alternative 1: No Action for Soil and Groundwater

The no action alternative is required under CERCLA (EPA, 1988b) to provide a baseline to compare against other alternatives. Under this alternative, no further action would be taken to remediate groundwater and soil, and groundwater monitoring would be discontinued.

Protection of Human Health and Environment. Based on the results of the modeling and risk assessment, this alternative should be protective of human health and the environment. However, this alternative provides no monitoring data to evaluate protection of human health and the environment in the long term.

Compliance with ARARs. The concentrations of COCs in soil and groundwater presently exceed the remedial action goals established for the Site. On a long-term basis, these remedial goals would likely be met through natural attenuation and biodegradation.

Long-Term Effectiveness and Permanence. Theoretically this alternative would achieve soil and groundwater remedial goals through natural attenuation and biodegradation.

Reduction of Toxicity, Mobility, and Volume. This alternative would not actively reduce the toxicity, mobility, or volume of COCs in groundwater or soil in the near term. In fact, the mobility of the COCs in groundwater would likely increase with cessation of operation of the existing groundwater extraction system. In the long term, the toxicity and volume of COCs in soil and groundwater would likely be reduced through natural attenuation and biodegradation.

Short-Term Effectiveness. This alternative does not affect the COCs in the soil or groundwater at the Site in the short term. This alternative increases the mobility of the COCs without providing any monitoring data to evaluate long-term protection of human health and environment. There would be no hazards relating to implementation of this alternative which a safety plan could not adequately address (i.e. groundwater monitoring and treatment system demolition activities).

Implementability. This alternative is readily implementable.

Present Worth Cost. The cost of this alternative is estimated at $30,000 and is based on demolition of the existing groundwater monitoring wells and extraction and treatment system.

Regulatory Acceptance. This alternative is not likely to be accepted by the regulatory agencies because the alternative does not actively remediate and monitor VOC-impacted soil and groundwater at the Site.

Community Acceptance. Based on historical input from the similar communities, this alternative is not likely to be accepted by the public.

6.3.2 Alternative 2: No Action for Soil, Enhanced *In-situ* Bioremediation and Institutional Controls for Groundwater Off Site, Groundwater Extraction On Site

Alternative 2 consists of no action for soil, enhanced *in-situ* bioremediation and institutional controls for groundwater off site, and extraction of groundwater via one existing groundwater extraction well located on site. Enhanced in-situ bioremediation consists of a dissolved oxygen enhancement program and additional groundwater monitoring to evaluate the performance of dissolved oxygen enhancement. These two programs would be implemented in Summer 1995 with the approval of ACHCSA, and would continue through 1995. Oxygen Release Compounds (ORCs) would be used to increase dissolved oxygen concentrations. The enhancement program also includes conditional shutdown of Well E-1A through 1995. Cessation of groundwater extraction is necessary, otherwise the dissleved oxygen released by the ORC will preferentially migrate to, and be extracted by Well E-1A. Conditional cessation of groundwater extraction will also allow evaluation of the effects to the dissolved petroleum hydrocarbon plume migration. The proposed enhancement program outlines the criteria which would lead to resumption of groundwater extraction. If the enhancement program is successful, the program would be reevaluated each year for renewal. Institutional controls would be applied for up to approximately 20 years. Groundwater may~~would~~ be extracted for migration control purposes, depending on the results of the enhanced *in-situ* bioremediation pilot program, until field testing confirmed stabilization of the impacted groundwater plume; approximately 5 years or less, based on the groundwater fate and transport model (without enhanced bioremediation)~~, approximately 5 years~~. Extracted groundwater would be treated using the existing groundwater treatment system prior to discharge to the Oro Loma Sanitary Sewer District.

Protection of Human Health and Environment. This alternative would be protective of human health and the environment based on the results of the modeling and risk assessment. This alternative also provides monitoring data to evaluate protection of human health and the environment in the long term. Additionally, this alternative should reduce the actual exposure time of the population to the COCs.

Compliance with ARARs. The concentrations of COCs in soil and groundwater presently exceed the remedial action goals established for the Site. Although the remedial goals would likely be met through natural attenuation and enhanced or natural biodegradation over time, extraction of groundwater would reduce the time required to achieve the groundwater remedial goals. The no action component of this alternative would not meet the soil remedial goals for the Site in the short term. Proper operation and maintenance of the groundwater extraction and treatment system should satisfy the groundwater discharge permit requirements.

Long-Term Effectiveness and Permanence. Groundwater extraction offers migration control and permanent removal of the COCs from the groundwater. Enhanced *in-situ* bioremediation should increase the biodegradation rate of the dissolved petroleum hydrocarbons resulting in increased plume stabilization and reduction. Bioremediation of hydrocarbons also results in the permanent removal of COCs from the groundwater. The groundwater remedial goals would likely be achieved in less time as a result of enhanced *in-situ* bioremediation and groundwater extraction. This alternative does not address removal of the COCs from soil.

Reduction of Toxicity, Mobility, and Volume. Enhanced *in-situ* bioremediation and g~~G~~roundwater extraction should reduce the toxicity, mobility, and volume of the COCs in groundwater. Bioremediation destroys the COCs. h~~H~~owever, in the case of groundwater extraction, the COCs would be transferred to GAC for ultimate disposal or destruction through regeneration. The no action soil component of this alternative should gradually reduce the toxicity and volume of the COCs in soil over a long period of time; however, it would not affect the mobility of the COCs in soil.

Short-Term Effectiveness. Enhanced *in-situ* bioremediation should increase the biodegradation rate, thus reduce the COC concentrations, potential health risk, and extent of the COCs in groundwater. Groundwater extraction would use existing equipment, and exposure to additional sources of COCs (i.e. from discharge of treated groundwater) are considered negligible. Extraction of groundwater should inhibit additional COCs from migrating off site and reduce the time necessary to achieve the groundwater remedial action goals. There would be no hazards relating to implementation of this alternative which a safety plan and operation and maintenance plan could not adequately address.

Implementability. Enhanced *in-situ* bioremediation is a developing technology. However, enough information is presently available to enhance and evaluate intrinsic bioremediation. The proposed pilot study will determine the feasibility of this technology at the site. Groundwater extraction for migration control purposes does not pose technical difficulties, as the equipment is available and on site. Extraction of groundwater at the Site has been approved by the ACHCSA as an interim measure. There are no technical barriers to implementing the no action soil remediation component of this alternative.

Present Worth Cost. The cost of this alternative is estimated at $300,000~~$290,000~~ and includes dissolved oxygen enhancement, groundwater monitoring, operation and maintenance, and demolition costs.

Regulatory Acceptance. It is likely that this alternative would gain regulatory acceptance because ACHCSA and RWQCB suggested consideration of enhanced *in-situ* bioremediation and groundwater extraction has been successful as an interim measure and inhibits the migration of COCs off site, thus reducing the potential health risk and exposure duration to the exposed population. Additionally, this alternative provides monitoring data to evaluate protection of human health and the environment.

Community Acceptance. It is likely that this alternative would gain community acceptance because of the reasons discussed under regulatory acceptance.

6.3.3 Alternative 3: No Action for Soil, Institutional Controls for Groundwater Off Site, Biosparging Groundwater On Site

Alternative 3 consists of no action for soil, institutional controls for groundwater off site, and biosparging of groundwater on site. Institutional controls would be applied for approximately 15 years. Biosparging of on-site groundwater would be accomplished using five new sparge wells which would be operated for approximately 5 years. Biosparging should stimulate the biodegradation of the COCs in the groundwater and may inhibit or partially inhibit off-site migration of the COCs.

Protection of Human Health and Environment. This alternative would be protective of human health and the environment based on the results of the modeling and risk assessment. This alternative also provides monitoring data to evaluate protection of human health and the environment in the long term. Additionally, this alternative should reduce the actual exposure time of the population to the COCs.

Compliance with ARARs. The concentrations of COCs in soil and groundwater presently exceed the remedial action goals established for the Site. Although the remedial goals would likely be met through natural attenuation and biodegradation over time, biosparging on-site groundwater should reduce the time required to achieve the groundwater remedial goals. The no action component of this alternative would not meet the soil remedial action goals for the Site in the short term.

Long-Term Effectiveness and Permanence. Biosparging should increase the rate of COC biodegradation in the on-site groundwater. Biodegradation provides permanent destruction of the COCs from the groundwater and should achieve the groundwater remedial action goals in less time. A secondary benefit of biosparging could result in an increased biodegradation rate in the soil.

Reduction of Toxicity, Mobility, and Volume. Biosparging should reduce the toxicity and volume of the COCs in groundwater. Biosparging may reduce the mobility of COCs in groundwater by the creation of a hydraulic barrier, however this would need to be confirmed by field testing. The no action soil component of this alternative would gradually reduce the toxicity and volume of COCs in the soil over a long period of time; however, it should not affect the mobility of COCs in the soil.

Short-Term Effectiveness. Implementation of biosparging would require construction of a new remedial system. Exposure to additional sources of COCs is considered negligible, but is unknown. Biosparging could also result in the volatilization of the COCs in groundwater, thus potentially increasing the soil vapor inhalation health risk. Biosparging may inhibit off-site migration of COCs, however this would need to be confirmed by field testing. There would be no hazards relating to implementation of this alternative which a safety plan and operation and maintenance plan could not adequately address.

Implementability. Biosparging is a relatively new remedial technology, and no specific field studies have been conducted at the Site. Based on case studies of other sites, biosparging may be effective at the Site, but would need to be confirmed by field testing. Until confirmed, technical difficulties could occur which would increase the cost of the alternative. There are no known technical or administrative barriers to implementing this alternative and support services are readily available. An air discharge permit would not be required, however periodic air monitoring could be performed to evaluate system effectiveness and potential health risk due to inhalation of soil vapor.

Present Worth Cost. The cost of this alternative is estimated at $365,000 and includes additional field testing, capital and construction, groundwater monitoring, operation and maintenance, and demolition costs.

Regulatory Acceptance. It is unknown if this alternative would gain regulatory acceptance because biosparging may not prevent the COCs from migrating off site and could result in increased COC concentrations in the soil vapor. However, this alternative would provide monitoring data to evaluate protection of human health and the environment and reduce the time required to achieve the groundwater remedial goals.

Community Acceptance. It is unknown if this alternative would be accepted by the community given the reasons discussed in regulatory acceptance.

6.3.4 Alternative 4: Soil Vapor Extraction On Site, Institutional Controls for Groundwater Off Site, Air Sparging and Groundwater Extraction On Site

Alternative 4 consists of soil vapor extraction to remove VOCs from the on-site soil, institutional controls for groundwater off site, and air sparging and groundwater extraction for groundwater on site. A soil vapor extraction system consisting of approximately eight wells would be constructed on site and operated for less than 5 years. Extracted soil vapor would be treated using GAC prior to discharge to the atmosphere. An air discharge permit would be required from the Bay Area Air Quality Management District (BAAQMD). Institutional controls would be applied for approximately 10 years. An air sparging system consisting of approximately 10 wells would be constructed on site and operated in conjunction with the existing groundwater extraction and treatment system. Extracted groundwater would be treated using the existing groundwater treatment system and discharged to the Oro Loma Sanitary Sewer District. The combined air sparging/groundwater extraction and treatment system would be operated for approximately 5 years.

Protection of Human Health and Environment. This alternative would be protective of human health and the environment based on the results of the modeling and risk assessment. This alternative also provides monitoring data to evaluate protection of human health and the environment in the long term. Additionally, this alternative should reduce the actual exposure time of the population to the COCs.

Compliance with ARARs. The concentrations of COCs in soil and groundwater presently exceed the remedial action goals established for the Site. Although the remedial goals would likely be met through natural attenuation and biodegradation over time, soil vapor extraction, air sparging, and groundwater extraction would decrease the amount of time required to achieve the groundwater and soil remedial action goals. Proper operation and maintenance of this combined system should satisfy the air and groundwater discharge permits requirements.

Long-Term Effectiveness and Permanence. Air sparging should increase the rate of volatilization of COCs in the on-site groundwater. Volatilized COCs should be removed by the soil vapor extraction system, and COCs removed with extracted groundwater would be treated using GAC, which provides permanent removal of the COCs. This alternative should achieve the soil and groundwater remedial action goals in the least time.

Reduction of Toxicity, Mobility, and Volume. This alternative provides for the permanent removal of the COCs from the soil and groundwater, thereby achieving reductions in toxicity, mobility, and volume. However, the COCs would be transferred to GAC for ultimate disposal or destruction through regeneration.

Short-Term Effectiveness. A soil vapor extraction and air sparging system would require construction. Groundwater extraction would use existing equipment, and exposure to additional sources of COCs (i.e. from discharge of treated soil vapor and groundwater) are considered negligible. Air sparging and groundwater extraction should inhibit additional COCs from migrating off site and reduce the time necessary to achieve the groundwater remedial action goals. Soil vapor extraction should reduce the time necessary to achieve the soil remedial action goals and minimize the potential health risk due to volatilized COCs. There would be no hazards relating to implementation of this alternative which a safety plan and operation and maintenance plan could not adequately address.

Implementability. Groundwater extraction does not pose technical difficulties, as the equipment is available and on site. Extraction of groundwater at the Site has been approved by the ACHCSA as an interim measure. Soil vapor extraction and air sparging feasibility studies have been completed for the Site and indicate that these technologies are feasible, but are limited. As a result, technical difficulties are likely to occur which would increase the cost of the alternative. There are no technical or administrative barriers to implementing this alternative and support services are readily available.

Present Worth Cost. The cost of this alternative is estimated at $400,000 and includes additional field testing, capital and construction, groundwater monitoring, operation and maintenance, and demolition costs.

Regulatory Acceptance. It is likely that this alternative would gain regulatory acceptance because it is the most comprehensive approach, and groundwater extraction has been successful as an interim measure and inhibits the migration of COCs off site, thus reducing the potential health risk and exposure duration to the exposed population. Additionally, this alternative provides monitoring data to evaluate protection of human health and the environment.

Community Acceptance. It is likely that this alternative would gain community acceptance because of the reasons discussed under regulatory acceptance.

6.3.5 Alternative 5: Excavation of Soil On Site, Institutional Control for Groundwater Off Site, Groundwater Extraction On Site

Alternative 5 consists of excavation of the impacted on-site soil, institutional controls for groundwater off site, and groundwater extraction on site. The impacted on-site soil would be excavated to remove the remaining source material following demolition of the existing service station. Demolition of the service station would likely occur if and when ARCO's lease is not renewed. For comparison purposes, excavation was arbitrarily set to occur in 20 years. Institutional controls would be applied for approximately 20 years. The existing groundwater extraction and treatment system would be operated until the impacted soil is excavated. Extracted groundwater would be treated using the existing groundwater treatment system and discharged to the Oro Loma Sanitary Sewer District.

Protection of Human Health and Environment. This alternative would be protective of human health and the environment based on the results of the modeling and risk assessment. This alternative also provides monitoring data to evaluate protection of human health and the environment in the long term. Additionally, this alternative should reduce the actual exposure time of the population to the COCs.

Compliance with ARARs. The concentrations of COCs in the soil and groundwater presently exceed the remedial action goals established for the Site. Although the remedial goals would likely be met through natural attenuation and biodegradation over time, groundwater extraction decreases the amount of time required to achieve the remedial action goals for groundwater. Because renewal of ARCO's lease is an unknown factor, this alternative may or may not reduce the time required to achieve the remedial action goals for soil. Proper operation and maintenance of the system should satisfy the groundwater discharge permit requirements.

Long-Term Effectiveness and Permanence. Groundwater extraction offers permanent removal of the COCs from the groundwater. The groundwater remedial action goals would likely be achieved in less time as a result of groundwater extraction. Excavation of the impacted soil also offers permanent removal of the COCs from the Site.

Reduction of Toxicity, Mobility, and Volume. Groundwater extraction should reduce the toxicity, mobility, and volume of the COCs in groundwater. However, the COCs would be transferred to GAC for ultimate disposal or destruction through regeneration. Excavation of the impacted soil effectively reduces the toxicity, mobility, and volume of the COCs in the soil at the Site by transferring the COCs to another location.

Short-Term Effectiveness. Groundwater extraction would use existing equipment, and exposure to additional sources of COCs are considered negligible. Extraction of groundwater should inhibit additional COCs from migrating off site and reduce the time necessary to achieve the groundwater remedial action goals. The excavation of impacted soil is not likely to occur in the short term. There would be no hazards relating to implementation of this alternative which a safety plan and operation and maintenance plan could not adequately address.

Implementability. Groundwater extraction does not pose technical difficulties, as the equipment is available and on site. Extraction of groundwater at the Site has been approved by the ACHCSA as an interim measure. Excavation of the impacted soil would be contingent on ARCO's lease expiring and demolition of the service station. There are no technical barriers to implementing the no action soil remediation component of this alternative.

Present Worth Cost. The cost of this alternative is estimated at $485,000 and includes construction and soil disposal, groundwater monitoring, operation and maintenance, and demolition costs.

Regulatory Acceptance. It is likely that this alternative would gain regulatory acceptance because groundwater extraction has been successful as an interim measure and inhibits the migration of COCs off site, this reducing the potential health risk and exposure duration to the exposed population. Additionally, this alternative provides monitoring data to evaluate protection of human health and the environment and long-term removal of impacted on-site soils.

Community Acceptance. It is likely that this alternative would gain community acceptance because of the reasons discussed under regulatory acceptance.

6.4 Comparative Analysis of Remedial Action Alternatives

Each remedial alternative for the Site was compared on the basis of the nine detailed analysis criteria described in Section 6.1. These comparisons are summarized below.

Protection of Human Health and Environment: All of the alternatives are protective of human health and environment based on the results of the modeling and risk assessment. Unlike Alternative 1, Alternatives 2 through 5 provide monitoring data to evaluate protection of human health and the environment in the long term. Additionally, Alternatives 2 through 5 reduce the exposure time of the population to the COCs. Alternative 3 may increase the COC concentrations in the on-site soil vapor, thus increasing the potential health risk due to inhalation of soil vapor.

Compliance with ARARs: None of the alternatives immediately reduce the COC concentrations in the soil and groundwater to the remedial action goals. All of the alternatives should achieve the remedial action goals in the long term, with Alternative 1 requiring the longest time and Alternative 4 requiring the least time. However, the current COC concentrations are health protective which minimizes the necessity to achieve the remedial action goals in the short term.

Long-Term Effectiveness and Permanence: All of the alternatives are effective in the long term and are permanent. Alternative 1 requires the longest time and Alternative 4 requires the least time to achieve the remedial action goals. Alternatives 1 and 3 rely on natural attenuation and biodegradation to destroy the COCs, whereas Alternatives ~~2,~~ 4~~,~~ and 5 transfer the COCs to GAC for ultimate disposal or destruction by regeneration. Alternative 2 is a combination of COC destruction by biodegradation and transfer to GAC. Additionally, Alternative 5 transfers the location of the soil-based COCs from the Site to a disposal facility.

Reduction of Toxicity, Mobility, and Volume: Alternative 1 would not actively reduce the toxicity and volume of the COCs in the soil and groundwater, and would increase the mobility of the COCs in the groundwater. Alternatives 2, 4, and 5 reduce the toxicity, mobility, and volume of COCs in the groundwater. Alternatives 2 and 3 would not actively reduce the toxicity, mobility, and volume of COCs in the soil. Alternative 3 would reduce the toxicity and volume, and may reduce the mobility of COCs in the groundwater, but this would need to be confirmed by field testing. Alternatives 4 and 5 provide the greatest reduction of toxicity, mobility, and volume of COCs in the soil and groundwater. However, the soil component of Alternative 5 is not expected to be implemented in the short term.

Short-Term Effectiveness: Alternative 1 is not effective in the short term because it provides no monitoring data to evaluate potential health risk. This data is provided by Alternatives 2 through 5. Alternative 3 may increase the potential health risk to the exposed population in the short term due to the possibility of increased soil vapor migration.

Implementability: All of the alternatives are readily implementable, except Alternative 3 which may require further field testing to~~tor~~ evaluate its effectiveness at the Site. Alternatives 2 through 5 require discharge permits which are readily available. Additionally, Alternative 2 includes a pilot study to evaluate dissolved oxygen enhancement.

Present Worth Cost: Alternative 1 is the least costly at $30,000; Alternatives 2, 3, and 4 range from $300,000~~$290,000~~ to $400,000; Alternative 5 is the most costly at $485,000.

Regulatory Acceptance: Alternative 1 is not likely to gain regulatory acceptance because it does not actively remediate and monitor VOC-impacted soil and groundwater at the Site. Alternatives 2, 4, and 5 are likely to gain regulatory acceptance because they are health protective and actively reduce the concentrations of COCs in the soil and/or groundwater. Alternative 3 may not gain regulatory acceptance because it may not inhibit the COCs from migrating off site and could increase the potential health risk in the short term.

Community Acceptance. Alternative 1 is not likely to gain community acceptance because it does not actively remediate and monitor VOC-impacted soil and groundwater at the Site. Alternatives 2, 4, and 5 are likely to gain community acceptance because they are health protective and actively reduce the concentrations of COCs in the soil and/or groundwater. Alternative 3 may not gain community acceptance because it may not inhibit the COCs from migrating off site and could increase the potential health risk in the short term.

7.0 RECOMMENDED REMEDIAL ACTION ALTERNATIVE

7.1 Recommended Remedial Action Alternative

Based on the analysis of remedial action alternatives summarized in Section 6.5 and the results of the remedial investigation, feasibility testing, modeling, and modified health risk assessment, Alternative 2 is the recommended remedial action for the Site. Alternative 2 consists of no action for soil, enhanced *in-situ* bioremediation and institutional controls off site, and groundwater extraction on site.

Implementation of Alternative 2 would not result in active remedial of the impacted on-site soils. Instead, natural attenuation and biodegradation should reduce the COC concentrations in soil to the remedial action goals. This is expected to require a long period of time. Although the COCs in the soil are expected to further impact the on-site groundwater, operation of the existing groundwater extraction system should inhibit the COCs from migrating off site. Additionally, there are no complete pathways for exposure to impacted soil given present site use conditions.

Italics

Enhanced in-situ bioremediation consists of a dissolved oxygen enhancement program and additional groundwater monitoring to evaluate the performance of dissolved oxygen enhancement. These programs will be implemented in, and through 1995 with ACHCSA approval, then reevaluated on an annual basis. If successful, the increased dissolved oxygen concentrations will enhance the intrinsic bioremediation of the COCs in the groundwater. ~~Oxygen Release Compounds (ORCs)~~ would be used to increase dissolved oxygen concentrations. Additionally, Well E-1A will be shutdown on a conditional basis through 1995 to prevent preferential migration and removal of hydrogen peroxide from the onsite injection well. Conditional cessation of groundwater extraction will also allow evaluation of the effects on the dissolved petroleum hydrocarbon plume migration. At the end of 1995, PACIFIC will evaluate the performance of the enhancement program and effects of Well E-1A shutdown. If the enhancement program is successful, the program would continue and be reevaluated each calendar year for renewal. The results of, and recommendations to continue, discontinue, or expand this program would be included in the fourth quarter 1995 groundwater monitoring report for the site.

Capture and extraction of impacted groundwater may~~will~~ continue depending on the results of the bioremediation enhancement pilot program, using the existing groundwater extraction Well E-1A. Operation and maintenance activities will include monthly inspection and maintenance of the system by a trained technician. The technician will collect water samples, inspect all equipment and exposed piping and fittings, record system readings, and coordinate replacement of the GAC. Long-term treatment of the extracted groundwater would occur through the existing GAC treatment system. Treated groundwater would be discharged to the Oro Loma Sanitary Sewer District under the provisions of the existing discharge permit. The quality of the discharge water would be routinely tested to verify that it meets all discharge standards. Treatment system sampling and operational data would be reported to ACHCSA on a quarterly basis. Groundwater extraction for migration control purposes will continue until field data confirm that the impacted groundwater plume has stabilized; the groundwater fate and transport model suggests plume stabilization should occur in less than 5 years (without enhanced bioremediation)~~, approximately 5 years~~.

Monitoring and groundwater sampling of the monitoring wells and domestic irrigation water wells will continue in accordance with the ACHCSA-approved schedule. This schedule will be reviewed periodically and any proposed changes would be submitted to ACHCSA for its review and approval. All groundwater samples collected from the monitoring wells and domestic irrigation water wells would be analyzed by EPA Methods 8015 (modified) and 8020 for TPH-g and BTEX compounds. Evaluation of human health will coincide with groundwater sampling and consists of updating the potential health risk in the event that the COC concentrations exceed the concentrations used in the November 22, 1993 and June 28, 1995 modified health risk assessments. The methodology to update potential health risk would be identified in the groundwater management plan to be submitted for the site. Approval of this RI/FS would be conditional on ACHCSA approval of a groundwater management plan for the site. ~~In the event health risk is revised, the concentration, represented by the 95 percent upper confidence limit of the average, for the applicable well(s) would be used.~~ Results of all sampling and human health and environment evaluation would be reported to each wellowner and to the ACHCSA on a quarterly basis. In addition, each wellowner will receive results for their own well on a quarterly basis. The wellowners would be allowed to operate their domestic irrigation wells provided that the quarterly evaluation confirms protection of human health.

+ There is no evidence to show domestic pumping affects plume migration

Following approval of the RI/FS by ACHCSA, ARCO will prepare and submit a Fact Sheet to each wellowner. The Fact Sheet will describe the project in general terms, the results of previous investigations, feasibility studies, and risk assessments, and the approved remedial action. ARCO will also conduct meetings with individual wellowners upon their request to discuss the project in greater detail. If a meeting is requested, ARCO will coordinate with ACHCSA to allow a representative of ACHCSA to attend.

> More than well owners + need to review prior to sending out

7.2 Justification of Selected Remedial Action Alternative

Alternative 2 is recommended for the reasons outlined below.

1. **This alternative would be protective of human health and the environment**. Concentrations of COCs are presently health protective. This alternative also monitors protection of human health and the environment in the long term. Additionally, enhanced *in-situ* bioremediation and groundwater extraction will influence~~provide~~ hydrocarbon migration~~—control~~, thus reducing the exposure time of the population to the COCs.

2. **This alternative complies with ARARs**. Although the concentrations of COCs presently exceed the remedial action goals, these goals should be achieved through natural attenuation and enhanced or natural biodegradation processes. Enhanced *in-situ* bioremediation and e~~E~~xtraction of groundwater should decrease the time required to achieve the groundwater remedial action goals. Additionally, proper operation and maintenance of the system should satisfy all groundwater discharge requirements.

3. **This alternative provides long-term effectiveness and permanence.** This alternative would effectively contain and remove impacted groundwater from beneath the Site. Additionally, natural attenuation and biodegradation processes would result in the permanent destruction of VOCs in the soils beneath the Site.

4. **This alternative reduces toxicity, mobility, and volume of the COCs in groundwater**. Enhanced in-situ bioremediation and e~~E~~xtraction and treatment of groundwater by GAC provides for permanent removal of VOCs, thereby achieving reductions in toxicity, mobility, and volume. The no action component of this alternative should gradually reduce the toxicity and volume of the COCs in soil over a long period of time; however, it would not affect the mobility of COCs in the soil.

5. **The alternative provides short-term effectiveness**. Enhanced *in-situ* bioremediation should increase the biodegradation rate, thus reduce the COC concentrations, potential health risk, and extent of the COCs in groundwater. Using GAC to treat extracted groundwater does not produce air emissions. Provided that restricted access is maintained and the system is operated by trained personnel, exposure to residents and workers would be negligible. It is not expected that the public would be affected by system

operation and maintenance activities. Therefore, short-term impacts to human health and the environment would be very low. Additionally, this alternative is effective in the short term because it inhibits off-site migration of COCs until the impacted groundwater plume stabilizes in approximately 2 to 5 years.

6. **This alternative is implementable.** Although enhanced in-situ bioremediation is a developing technology, baseline groundwater testing has confirmed intrinsic bioremediation of groundwater is occurring at the site. PACIFIC will conduct a pilot study through 1995 to confirm implementability of this technology, which we expect will be successful. Groundwater extraction for migration control purposes, and treatment using GAC does not pose technical difficulties.

7. **This alternative is cost-effective.** This is the most cost-effective "active" remedial action alternative. The only alternative less costly is the no action alternative.

8. **This alternative is likely to be acceptable to the regulatory agencies.** This alternative is likely to gain regulatory acceptance because ACHCSA and RWQCB suggested consideration of enhanced *in-situ* bioremediation and groundwater extraction has been successful as an interim measure and inhibits the migration of COCs off site, thus reducing the potential health risk and exposure duration to the exposed population. Additionally, this alternative evaluates human health and the environment in the long term.

9. **This alternative is likely to be acceptable to the community.** This alternative is likely to gain regulatory acceptance because groundwater extraction has been successful as an interim measure and inhibits the migration of COCs off site, thus reducing the potential health risk and exposure duration to the exposed population. Additionally, this alternative evaluates human health and the environment in the long term.

7.3 Justification for Rejection of Alternatives

The rationale for rejection of the remaining four remedial action alternatives that were evaluated in Section 6.3 is presented in this section. The rejection of the remaining alternatives was based on effectiveness of the method, overall protection of human health and environment, cost, and the anticipated acceptance or rejection of the alternative by the regulatory agencies and the community. The alternatives, with a brief discussion of why each was rejected for Site remediation, are as follows:

- **Alternative 1: No Action for Soil or Groundwater.** Alternative 1 was rejected because: (1) it is not effective in the short or long term, (2) it does not monitor the protection of human health and environment in the long term, (3) it could result in additional off-site migration of the COCs, and (4) it may not be accepted by regulatory agencies or the community.
- **Alternative 3: No Action for Soil; Institutional Controls for Groundwater Off Site, Biosparging Groundwater On Site.** Alternative 3 was rejected because: (1) it may not inhibit the off-site migration of the COCs, (2) no field studies have been conducted to determine if biosparging would be effective at the Site, (3) it is more costly than the recommended alternative, and (4) it may not be accepted by regulatory agencies or the community.
- **Alternative 4: Soil Vapor Extraction of Soil On Site, Institutional Controls for Groundwater Off Site, Air Sparging, and Groundwater Extraction On Site.** Alternative 4 was rejected because: (1) field studies have shown that soil vapor extraction and air sparging have only limited feasibility at the Site, (2) it is much more disruptive to site activities than the recommended remedial alternative, and (3) it is more costly than the recommended alternative.
- **Alternative 5: Excavation of Soil On Site, Institutional Controls for Groundwater Off Site, and Groundwater Extraction On Site.** Alternative 5 was rejected because: (1) excavation is dependent on demolition of the service station which is not likely to occur in the short term, and (2) it is the most costly of all alternatives.

8.0 IMPLEMENTATION SCHEDULE

The proposed remedial action implementation schedule is as follows:

Activity	Date
Approved RI/FS Submittal to ACHCSA	August 1995~~November 1994~~
ACHCSA Approval of RI/FS Community Notification ~~Meeting~~	September~~February~~ 1995
Implementation of Remedial Action	September 1995
Groundwater Management Plan Submittal to ACHCSA	November~~February~~ 1995
Reevaluation of Enhanced *In-situ* Bioremediation Program (annually)	January 1996

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