AGENDA
ARCO STATION 608
ACHCSA, RWQCB, ARCO, PACIFIC MEETING
MAY 9, 1995

DRAFT

I. INTRODUCTION

A. Attendees

B. Purpose of meeting
   1. Resolve remaining issues and questions regarding RIFS
   2. Gain approval of RIFS

II. BIODEGRADATION

A. Evidence for plume stabilization and/or recession
   1. On-going source removed (soils data)
   2. Declining concentrations in outlying wells

B. Evidence for biodegradation

C. Consideration of oxygen-releasing compounds

III. ADDITIONAL RISK ASSESSMENT

IV. GROUNDWATER MANAGEMENT PLAN ✓ monitor HC + risk (20 yrs) RI/FS, contingency plan

V. DOMESTIC IRRIGATION WELLS ✓

A. Consideration of future pumping - management plan

B. Public participation and notification - addendum part of RI/FS

VI. SUMMARY

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Table 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 5,1 993)

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-L/g-mL
MWa	=	29	g/mole

Solution: Csv = 6.08E-02 ug/mL

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Table 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 SEASOIL:

$$P = -\left(Da \times \left((n - m)^{10/3} / n^2 \right) \times (Catm - Csv) / L \right) \times CF$$

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:

$$V = (A \times H \times ARR)$$

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

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Table 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:

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

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	=	5,436.2	cu. m/day

Solution:

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

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Table 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:

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

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)

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Table 2
Inhalation of Benzene Vapor in Enclosed Space
Children 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 5,1 993)

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]
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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

DRAFT

Table 2 (continued)
Inhalation of Benzene Vapor in Enclosed Space
Children Exposure

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Determine Benzene Flux Across Soil Surface

Using SEASOIL:

$$P = -(Da \times ((n - m)^{10/3} / n^2) \times (Catm - Csv) / L) \times CF$$

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:

$$V = (A \times H \times ARR)$$

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 2 (continued)
Inhalation of Benzene Vapor in Enclosed Space
Children 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:

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

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)

DRAFT

Table 2 (continued)
Inhalation of Benzene Vapor in Enclosed Space
Children Exposure

ARCO Service Station 0608
17601 Hesperian Boulevard
San Lorenzo, California

Determine Carcinogenic Health Risk to Benzene Vapor in Enclosed Space

Equation:

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

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)

1.5×10^{-7}

Topics to cover at meeting (May 9, 1995 at 1:00 P.M.) **Page 1**
w/ARCO and Pacific regarding
ARCO Service Station
17601 Hesparian Blvd., San Lorenzo

1. **Risk Assessment** (including indoor air calculations using concentrations found in MW8 & MW10.)

What purpose does the risk assessment serve?

- Evidence to show that there has not been a significant risk to residents in this area due to contamination to gw?
- Evidence to support that there is no health & safety risks, based on historical data, and therefore, it is now ok for residents to use their domestic irrigation wells?
- Health & safety guidance for a "Groundwater Management Plan" to establish "trigger concentrations" for domestic irrigations wells and monitoring wells? If so, how and who will determine?

2. **Evidence to show plume stabilization/recession?**

Model presented in RI/FS. Should this model be used to support that stabilization/recession will occur within the next 2 years?

How much does the biodegradation rate affect plume migration in this model? Based on discussions with Mark Jonas, Marco Lobasccio, and the paper discussed below, fate and transport modelling should also be run where biodegradation is not a factor. This does not mean that we do not believe biodegradation is not occurring, it allows us to see (quantify) how much we are relying on it to influence plume recession.

3. **Quantitative evidence to support that natural attenuation (including biodegradation) is occurring and to what extent it is occurring.**

   - See/discuss paper "Proposed Air Force Guidelines for Successfully Supporting the Intrinsic Remediation (Natural Attenuation) Option at Fuel Hydrocarbon Contaminated Sites"

     We haven't seen site specific data, within plume and background, in regard to TOC, dissolved O2, NO3-, SO4-, Fe2+, etc.

   - Could this paper be used as a guidance document for this case? Should the Management Plan for Alternative 2 include quantitative analysis to show that

4. **The five proposed Remedial Action Alternatives (RAA) do not propose remediation strategies for off-site hot spots, i.e. MW8 & MW10.** It seems appropriate that we look at the feasibility of best available technologies to reduce concentrations in this area of the plume. (E.g. vacuum pumping MW8 & 10, ORC etc.)

5. **Fate of domestic irrigation wells within plume boundaries?**

   RAA #2 allows for residents to begin pumping.

   -Need to discuss data, risks, ethics, and public notification.

6. **Public participation**

- How to approach? See Article 7/ Mass mailing notification for meeting and then mass mailing to outlining issues/plans discussed in meeting with a time period for residents to respond.

- Should we require deed notifications for residents who have domestic irrigation wells? Should we have ARCO pay to have these wells destroyed to avoid deed notifications?

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 meeting with ACHCSA and RWQCB. A copy of the minutes for this meeting 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, institutional controls for groundwater off site, and groundwater extraction on site. This alternative allows pumping of offsite domestic irrigation wells, See 7-2

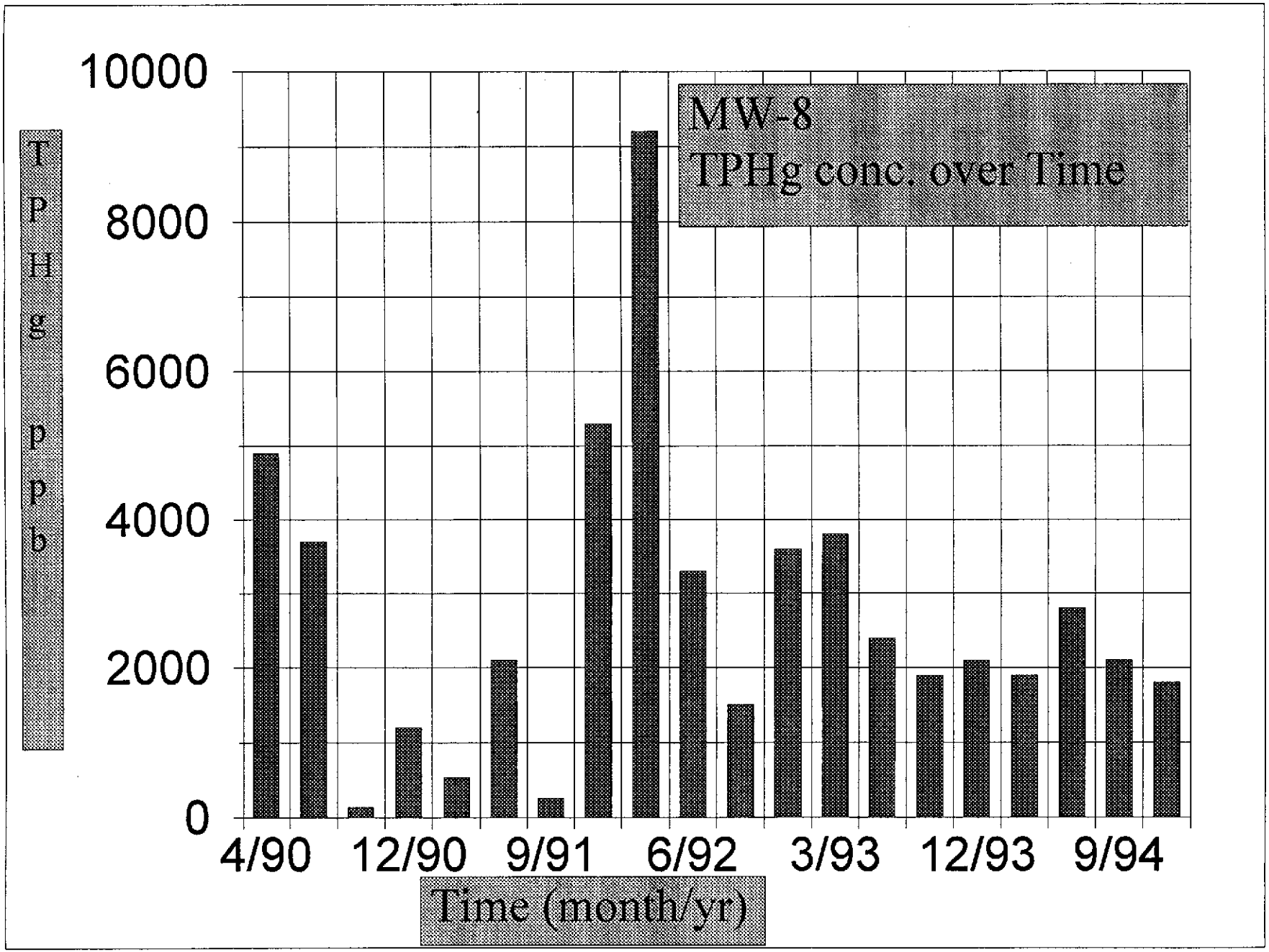
3. Alternative 3: No action for soil; institutional controls for groundwater off site, biosparging groundwater on site.

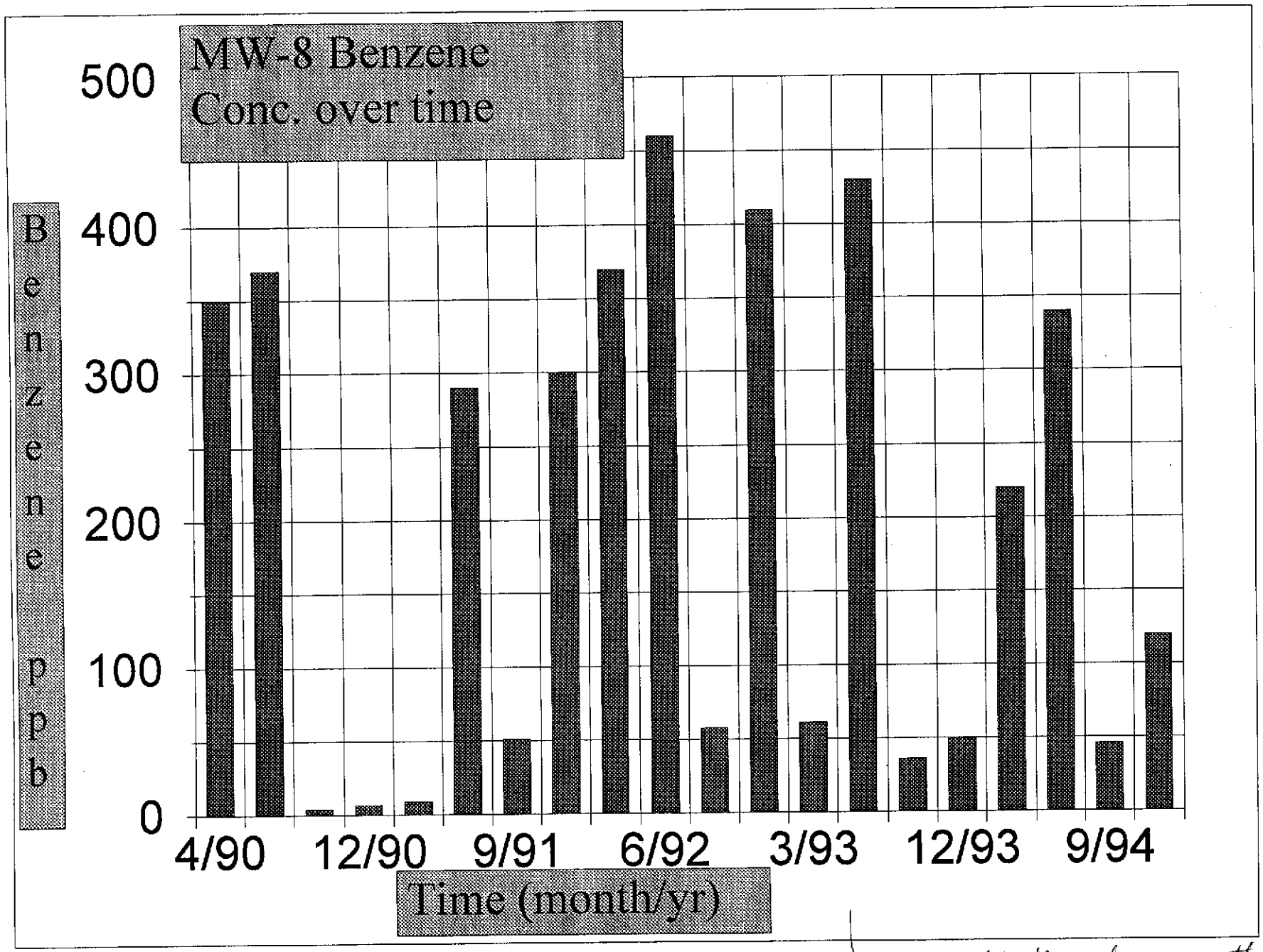
4. Alternative 4: Soil vapor extraction of soil on site, institutional controls for groundwater off site, air sparging and groundwater extraction on site.

Additionally, the following remedial action alternative has been developed since the July 8, 1994 meeting for consideration.

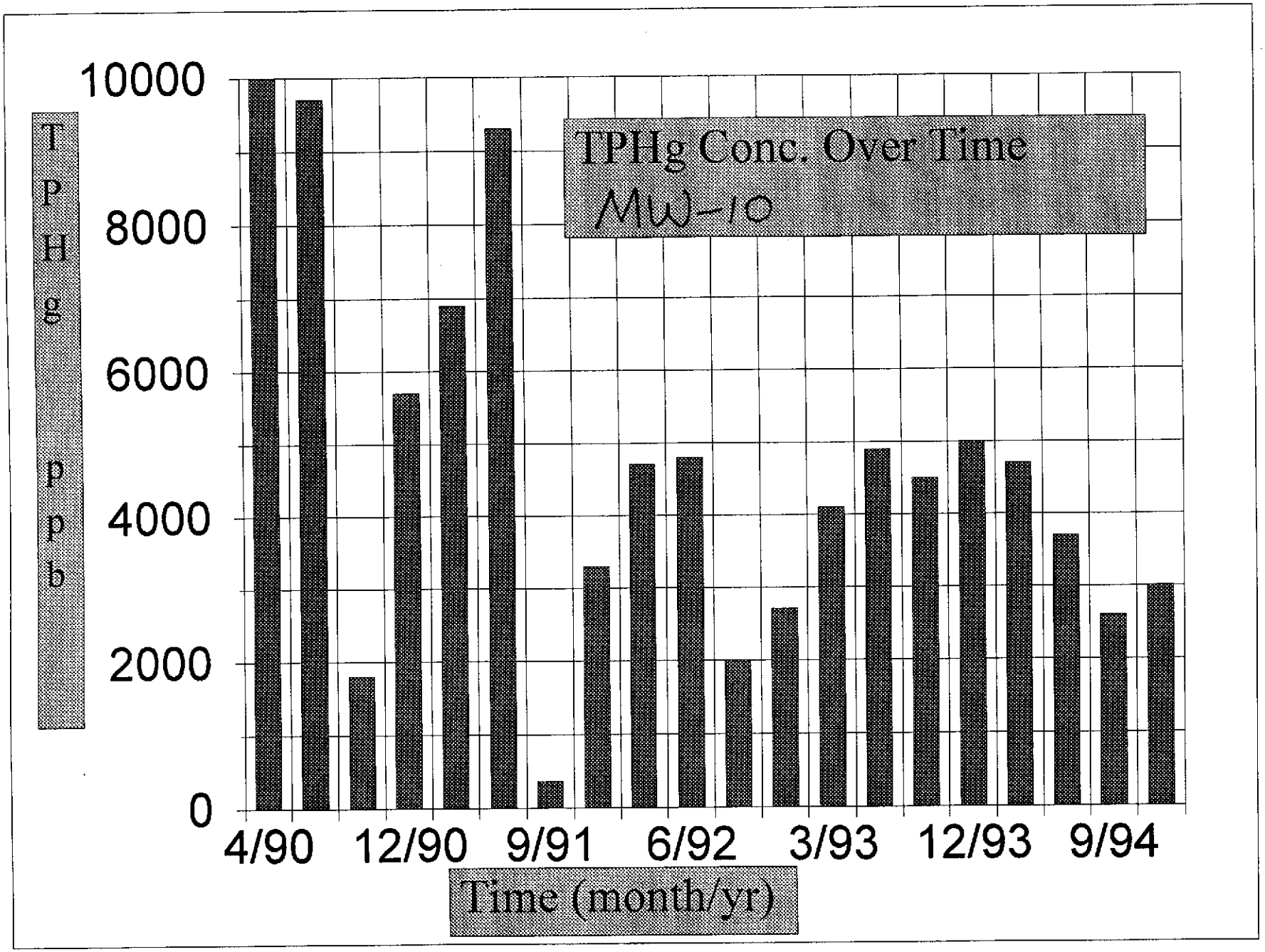
5. Alternative 5: Excavation of soil on site, institutional controls for groundwater off site, and groundwater extraction on site.

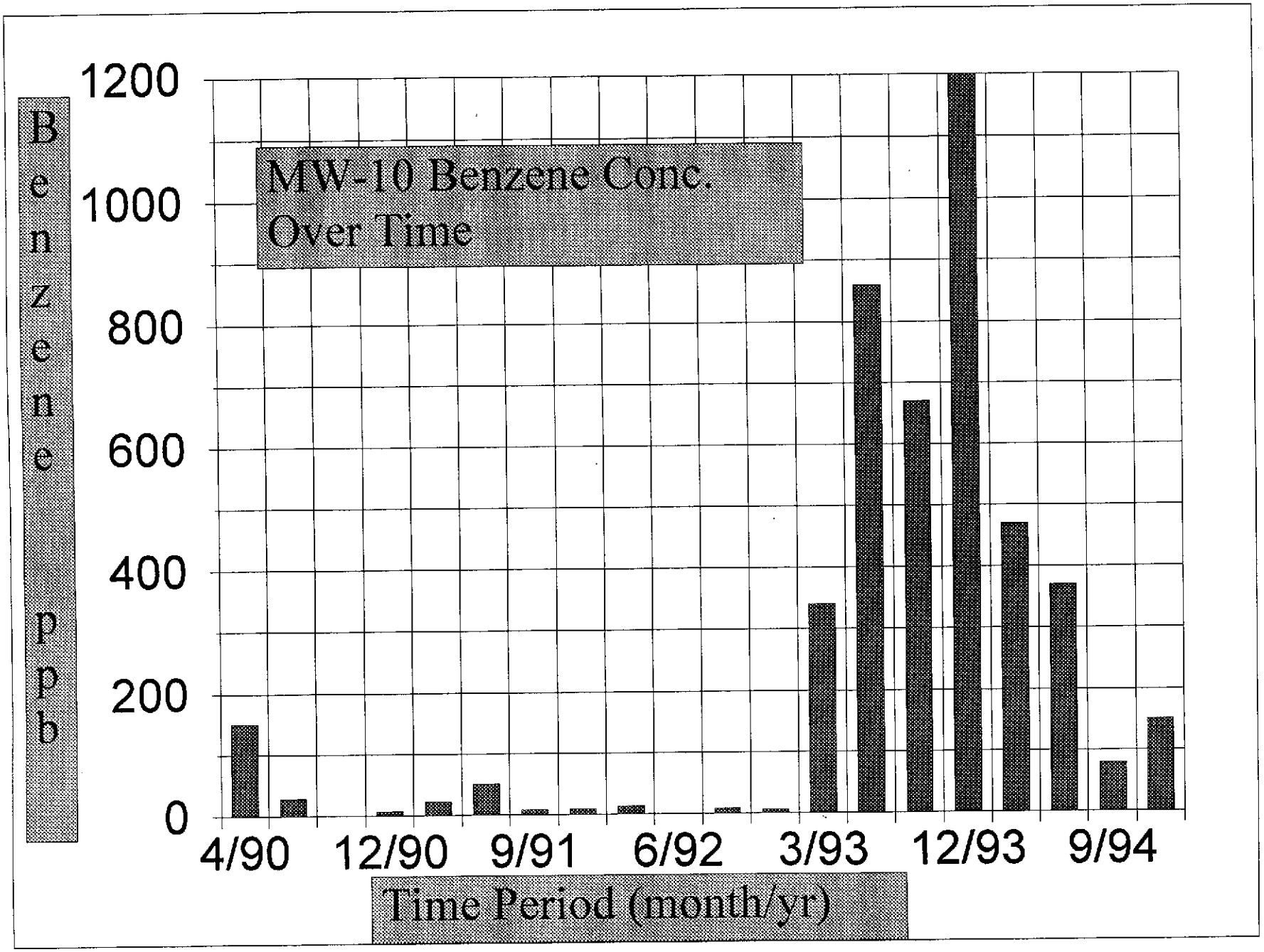
As approved during the July 8, 1994 meeting with ACHCSA and the RWQCB, all of the alternatives apply institutional controls to the off-site groundwater, except for Alternative 1. Institutional controls consist of a groundwater management plan which includes regular groundwater monitoring and sampling, 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 revising the November 22, 1993 risk assessment in the event that future COC concentrations exceed the concentrations used in the risk assessment. The revised potential health risk would be estimated using a COC concentration represented by the 95 percent upper confidence limit of the average.

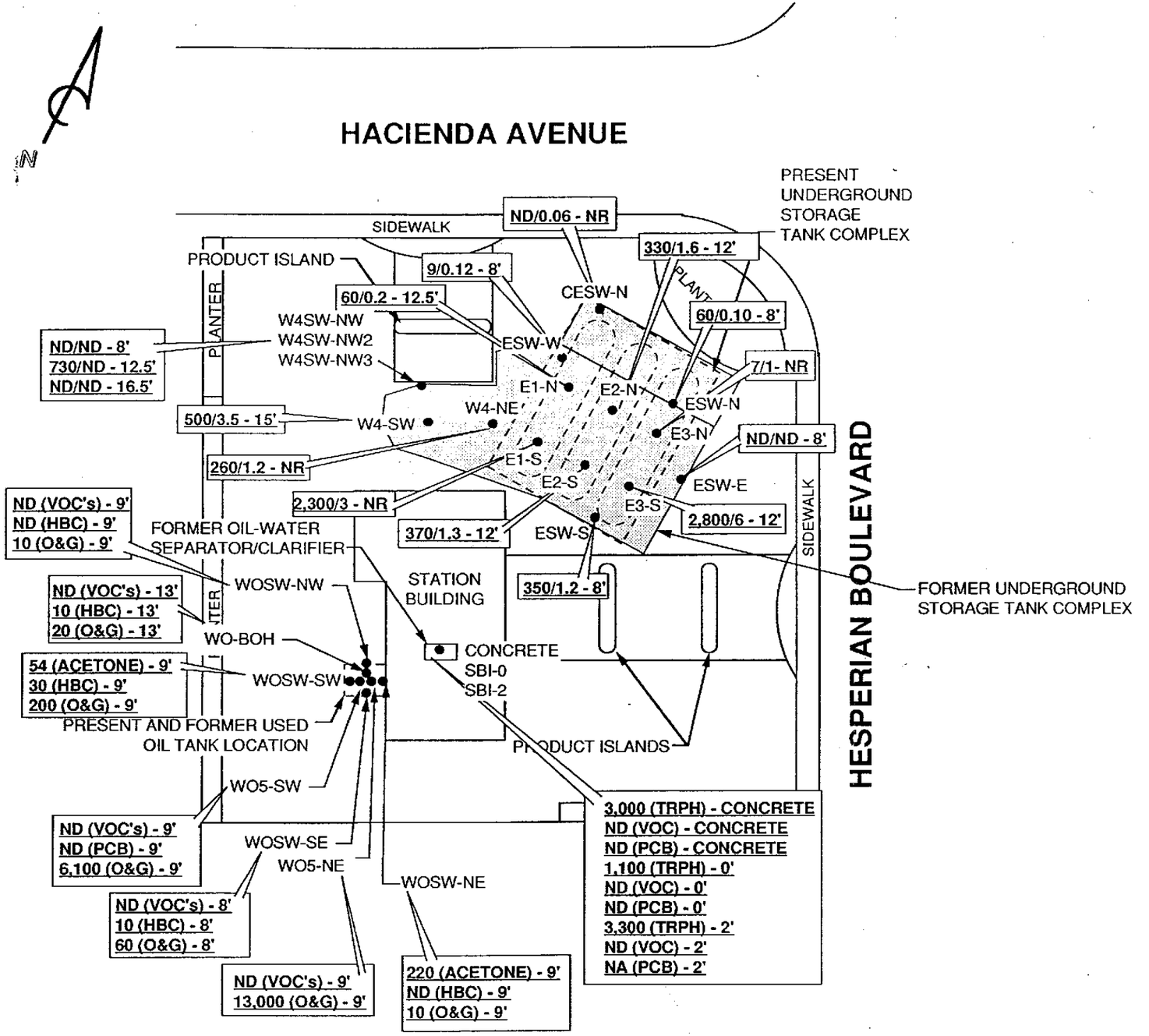

MW-8
TPHg conc. over Time
TPHg ppb
10000
8000
6000
4000
2000
0
4/90
12/90
9/91
6/92
3/93
12/93
9/94
Time (month/yr)



does this flux have something to do w/ gw extraction well operation


TPHg Conc. Over Time
MW-10
TPHg ppb
10000
8000
6000
4000
2000
0
4/90
12/90
9/91
6/92
3/93
12/93
9/94
Time (month/yr)


MW-10 Benzene Conc.
Over Time
Benzene ppb
1200
1000
800
600
400
200
0
4/90
12/90
9/91
6/92
3/93
12/93
9/94
Time Period (month/yr)



LEGEND

E2-N ● SOIL SAMPLE LOCATION AND DESIGNATION

60/0.10 - 8' TPH-GASOLINE/BENZENE CONCENTRATON IN PARTS PER MILLION (ppm), AT DEPTH INDICATED IN FEET

(O&G) - INDICATES OIL and GREASE CONCENTRATION IN ppm
(HBC) - INDICATES HIGH BOILING HYDROCARBONS IN ppm
(PCB) - INDICATES POLYCHLORINATED BIPHENYLS IN ppm
(VOC's) - INDICATES VOLATILE ORGANIC COMPOUNDS IN ppm
(TRPH) - INDICATES TOTAL RECOVERABLE PETROLEUM HYDROCARBONS IN ppm.

ND NOT DETECTED

NR NOT RECORDED

Date: 6/88

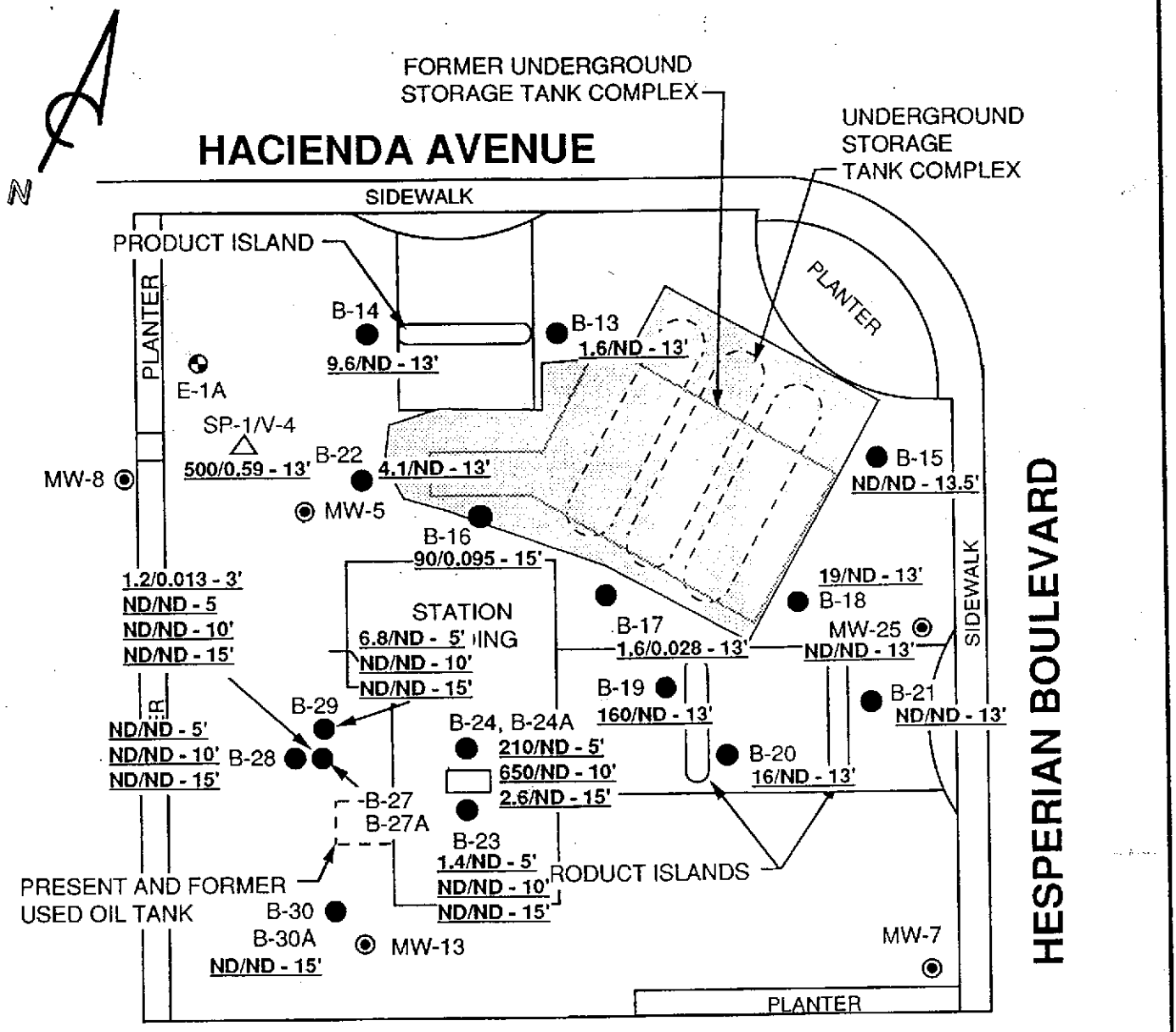
PACIFIC ENVIRONMENTAL GROUP, INC.

SCALE
0 30 60 FEET

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

SOIL ANALYTICAL RESULTS MAP - TANK EXCAVATION

FIGURE 4
PROJECT: 330-006.3C



LEGEND

MW-25 ◉ GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION

E-1A ◔ GROUNDWATER EXTRACTION WELL LOCATION AND DESIGNATION

SP-1/V-4 △ DUAL COMPLETION AIR SPARGING/SOIL VAPOR EXTRACTION WELL LOCATION AND DESIGNATION

B-16 ● SOIL BORING LOCATION AND DESIGNATION

16/ND - 13' TPH-g/BENZENE CONCENTRATIONS IN SOIL, IN PARTS PER MILLION AT DEPTH INDICATED IN FEET

ND NOT DETECTED

Date? 1993

SCALE

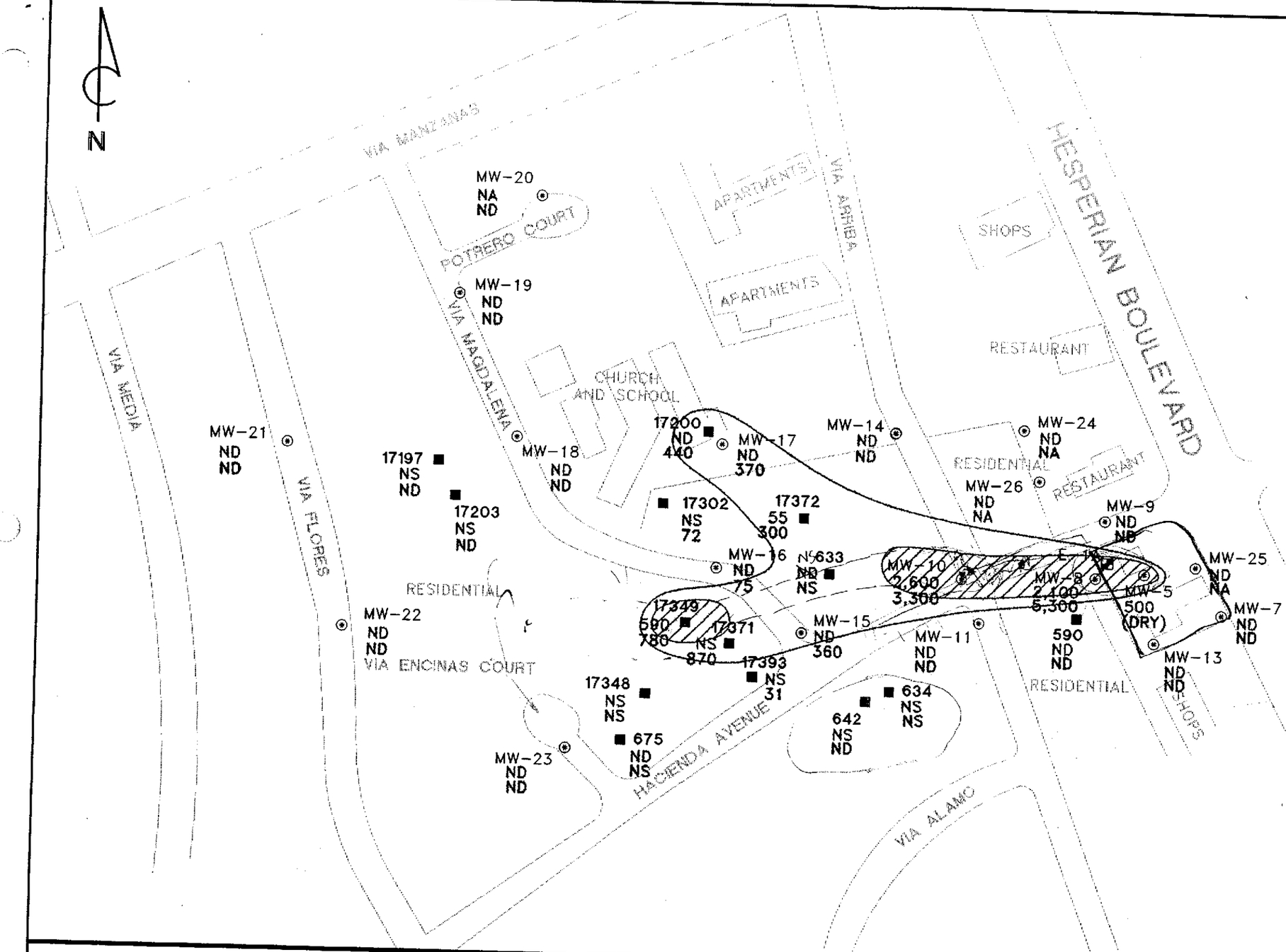
0 30 60 FEET

PACIFIC ENVIRONMENTAL GROUP, INC.

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

ON-SITE SOIL ANALYTICAL RESULTS MAP

FIGURE: 5
PROJECT: 330-006.3C



LEGEND

MW-7 ⊙ GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION

E-1A ■ GROUNDWATER EXTRACTION WELL LOCATION AND DESIGNATION

590 ■ DOMESTIC IRRIGATION WELL LOCATION AND DESIGNATION

55 TPH-g CONCENTRATION IN GROUNDWATER, IN PARTS PER BILLION (ppb), FALL 1994 (9-94)

300 TPH-g CONCENTRATION IN GROUNDWATER, IN PARTS PER BILLION (ppb), FALL 1991 (9-91 to 12-91)

—100— TPH-g CONCENTRATION CONTOUR IN ppb, FALL 1994, (9-94)

—100— TPH-g CONCENTRATION CONTOUR IN ppb, FALL 1994, (9-91 to 12-91)

ND NOT DETECTED

NA NOT AVAILABLE

NS NOT SAMPLED

PACIFIC ENVIRONMENTAL GROUP, INC.

SCALE

0 150 300 FEET

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

GENERALIZED EXTENT OF TPH-g IN GROUNDWATER

FIGURE: 11

PROJECT: 330-006.3C

N

VIA MANZANAS

MW-20
NA
ND

POTRERO COURT

MW-19
ND
ND

VIA MAGDALENA

APARTMENTS

VIA ARRIBA

APARTMENTS

SHOPS

HESPERIAN BOULEVARD

RESTAURANT

CHURCH AND SCHOOL

VIA MEDIA

VIA FLORES

MW-21
ND
ND

17197
NS
ND

MW-18
ND
ND

17200
ND
2.7

MW-17
ND
2.6

MW-14
ND
ND

MW-24
ND
NA

RESIDENTIAL

RESTAURANT

MW-26
ND
NA

MW-9
ND
ND

17203
NS
ND

17302
NS
0.64

17372
ND
5.5

MW-16
ND
ND

633
ND
NS

E-1A

MW-10
79
9.2

MW-8
46
300

MW-5
18
(DRY)

MW-25
ND
NA

MW-7
ND
ND

RESIDENTIAL

MW-22
ND
ND

VIA ENCINAS COURT

17349
1.8
13

17371
NS
9.0

MW-15
ND
ND

17393
NS
ND

MW-11
ND
ND

590
ND
ND

MW-13
ND
ND

SHOPS

17348
NS
NS

675
ND
NS

642
NS
ND

634
NS
NS

HACIENDA AVENUE

MW-23
ND
ND

VIA ALAMO

RESIDENTIAL

O - pumping

LEGEND

MW-7 ⊙ GROUNDWATER MONITORING WELL LOCATION AND DESIGNATION

E-1A ■ GROUNDWATER EXTRACTION WELL LOCATION AND DESIGNATION

590 ■ DOMESTIC IRRIGATION WELL LOCATION AND DESIGNATION

1.8 BENZENE CONCENTRATION IN GROUNDWATER, IN PARTS PER BILLION (ppb), FALL 1994 (9-94)

13 BENZENE CONCENTRATION IN GROUNDWATER, IN PARTS PER BILLION (ppb), FALL 1991 (9-91 to 12-91)

—ND— BENZENE CONCENTRATION CONTOUR IN ppb, FALL 1994, (9-94)

—ND— BENZENE CONCENTRATION CONTOUR IN ppb, FALL 1994, (9-91 to 12-91)

ND NOT DETECTED

NA NOT AVAILABLE

NS NOT SAMPLED

PACIFIC ENVIRONMENTAL GROUP, INC.

SCALE
0 150 300 FEET

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

GENERALIZED EXTENT OF BENZENE IN GROUNDWATER

FIGURE:
12
PROJECT:
330-006.3C