Risk-Based Corrective Action (RBCA) Modeling

FORMER PACO PUMPS FACILITY
9201 San Leandro Street
Oakland, California

March 16, 1998

Report Prepared for:

PACO PUMPS, INC.
16801 Greenspoint Park Drive, Suite 355
Houston, Texas 77060

Risk-Based Corrective Action
(RBCA) Modeling
Former Paco Pumps Facility
9201 San Leandro Street
Oakland, California

Jonas and Associates Inc. Job No. PCO-220

Prepared by:

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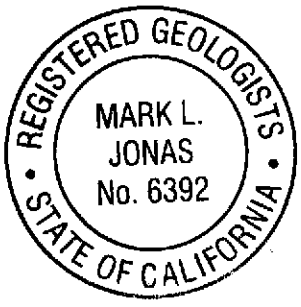

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Former Paco Pumps Facility
9201 San Leandro Street
Oakland, California

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Prepared for:

Paco Pumps, Inc.
Houston, Texas
(281) 775-1697

Prepared by:

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Former Paco Pumps Facility
9201 San Leandro Street
Oakland, California

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Risk-Based Corrective Action
(RBCA) Modeling

Former Paco Pumps Facility
9201 San Leandro Street, Oakland, California
March 16, 1998

1.0 INTRODUCTION

Jonas and Associates Inc. (J&A) has been retained by Paco Pumps, Inc. (Paco Pumps) to perform Risk-Based Corrective Action (RBCA) modeling for their former facility located at 9201 San Leandro Street, in Oakland, California 94603. The methodology and calculations for RBCA modeling conforms with ASTM E-1739 "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites". Risk from air exposure from volatile organics detected in groundwater under a building located downgradient of a former gasoline underground storage tank (UST) was estimated using a RBCA Spreadsheet System (GSI, 1997). Indoor commercial air exposure inside the building was calculated for benzene, toluene, ethyl benzene, and total xylenes (BTEX). These volatile organics are apparently associated with a former gasoline UST. RBCA modeling of the former Paco Pumps site was performed for consideration of regulatory closure.

Groundwater at the former Paco Pumps site has been characterized since 1992, as presented in reports identified in Section 4.0 References. Sixteen rounds of groundwater samples have been collected and analyzed. Four boreholes were drilled using a geoprobe inside the building located downgradient from a former UST. Groundwater from each borehole was sampled and analyzed. Soil collected from one borehole was analyzed for various parameters required in the RBCA model. The RBCA characterization of on-site groundwater quality was based on four rounds of groundwater monitoring well samples and the results of samples collected from the four boreholes.

PACO Pumps' environmental representative for this project is Mr. John Lilla {(281) 775-1697}. The lead agency for this project is the Alameda County Health Care Services Agency, Department of Environmental Health, Hazardous Division (Alameda County Health Services). The address of Alameda County Health Services is 1131 Harbor Bay Parkway, 2nd Floor, Alameda, California 94502. The agency representative is Ms. Eva Chu {(510) 567-6762}.

1.1 Site Description

The former PACO Pumps facility presented in this report is located at 9201 San Leandro Street, in Oakland, California. Prior to May 1992, PACO Pumps had an active facility at this location. The facility contained a manufacturing, engineering, and storage building, a purchasing and data processing building, a warehouse, a welding shop, employee parking, and outside storage. Apparently, the property also had two

underground tanks used for the storage of gasoline. The property is largely secured by a Cyclone fence and gates. PACO Pumps closed this facility and removed its equipment. Currently, this property is owned by a local company which primarily uses it to pack and warehouse glassware.

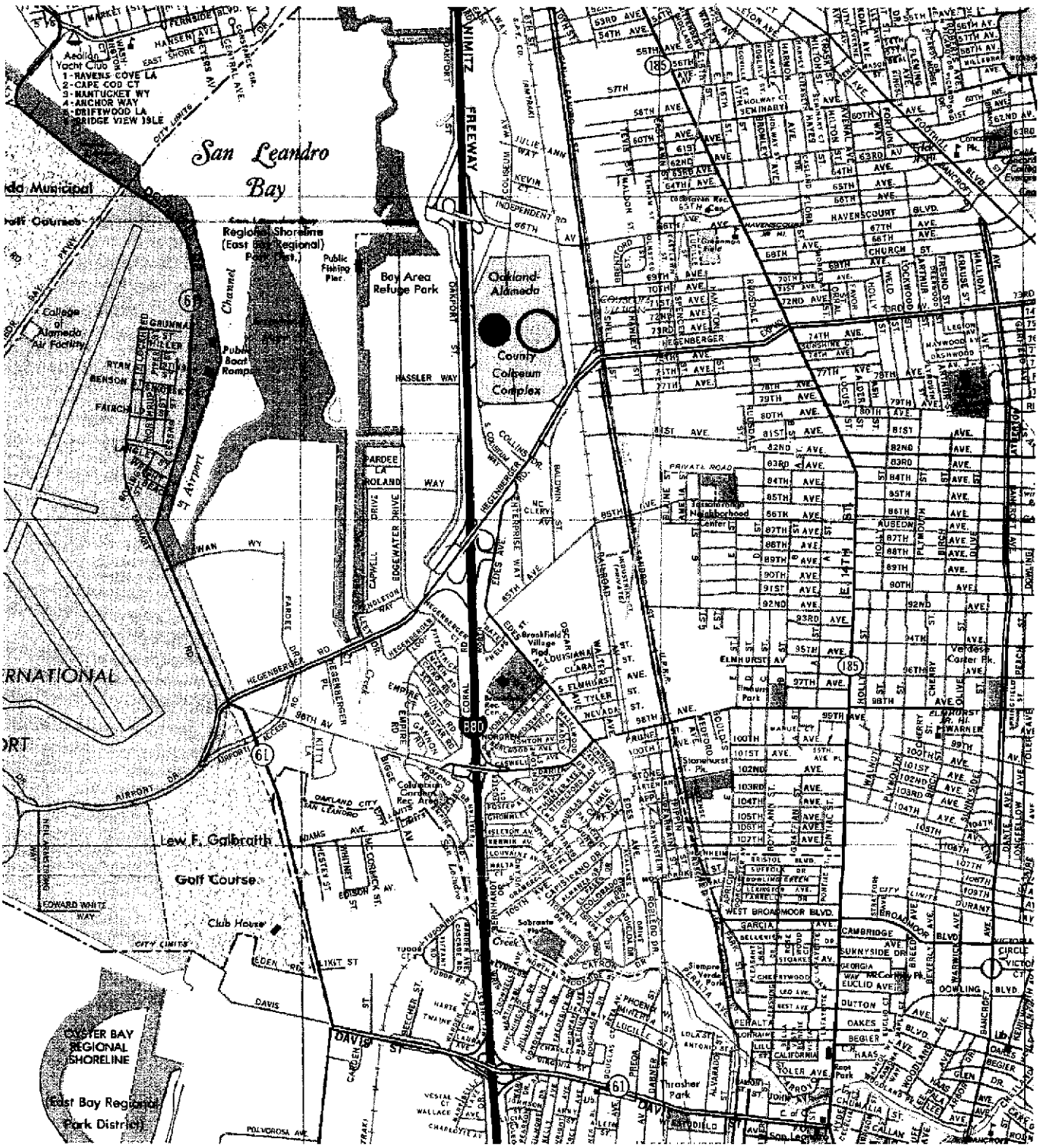
The regional location of the property is presented in Figure 1. The facility is located in Township 2 South, Range 3 West, Section 22, Mount Diablo Baseline and Meridian. The land is essentially flat. Groundwater quality is relatively poor due to its proximity to the San Francisco Bay.

1.2 Scope of Report

This "Risk-Based Corrective Action (RBCA) Modeling" report is presented in four sections and one appendix. Section 1, Introduction, provides a brief description of the site and the scope of the report. Section 2, RBCA Modeling, presents the methodologies and results associated with Risk-Based Corrective Action modeling. Section 3, Conclusions, present the findings of the RBCA modeling effort. Section 4, References, cites various documents relevant to the site.

The appendix of the report presents RBCA simulation documentation using area-weighted averages for BTEX detected in groundwater under the building located downgradient from a former gasoline UST.

PACO PUMPS (former)
9201 San Leandro Street



Regional Location

Former PACO PUMPS
9201 San Leandro Street
Oakland, California

1" = 1/2 mile

Figure 1

Drawing Number: PCO220-Fig1

2.0 RBCA MODELING

Risked-Based Corrective Action (RBCA) modeling is accepted by Alameda County Health Care Services Agency to determine risk associated with exposure pathways. RBCA methodology and calculations are defined in ASTM E-1739 "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites." To perform these calculations a RBCA Spreadsheet System (version 1.0.1) by Groundwater Services Inc (GSI) was used. The RBCA Spreadsheet System consists of a series of linked worksheets in Microsoft Excel 97. Risk assessment procedures employed by the GSI RBCA Spreadsheet System are also consistent with U.S. EPA guidelines.

2.1 RBCA Modeling Simulations

To characterize potential commercial air exposure risk from on-site groundwater contamination the area-weighted average of the maximum BTEX concentration detected in the latest four sampling rounds from monitoring well 9MW3 and 9MW5, and the BTEX results from groundwater samples collected from Boreholes B1, B2, B3, and B4. Figure 2 identifies the locations of the monitoring wells 9MW3 and 9MW5, the four boreholes, and the location of the former UST. Table 1 and Figure 3 present a summary of constituents and concentrations used for the RBCA modeling effort. For those Table 1 constituents which were not detected a concentration representing half the detection limit was used. Indoor commercial air exposure for BTEX was evaluated with respect to carcinogenic risk and the non-carcinogenic hazard quotient.

Following is a summary of the RBCA modeling simulation used for analyzing indoor commercial air exposure risk from groundwater contamination:

Area-Weighted Average of Maximum Concentrations, Indoor Air Exposure

The RBCA simulation used existing data to characterize conditions under the facility building located downgradient of the former gasoline UST. To characterize groundwater under the building four groundwater sampling rounds for monitoring wells 9MW3 and 9MW5 were used along with groundwater sampling results for Boreholes B1, B2, B3, and B4. A soil sample collected from Borehole B1 was analyzed for site-specific parameter used in the RBCA model. Table 1, Summary of Concentrations Used in RBCA Model, presents the analytical results used for the RBCA model. The maximum concentration from the latest four sampling rounds for the monitoring wells and the results of groundwater analysis for the four boreholes were spatially averaged using an area-weight averaging technique. Section 2.2, Area-Weighted Averaging, presents the method to determine the spatial average of groundwater quality under the building. The area-weighted average of benzene, toluene, ethyl benzene, and total xylenes concentrations were used to determine a representative concentration of each of these constituents. Representative groundwater concentrations were used in the RBCA model to determine indoor air commercial exposure with respect to carcinogenic and non-carcinogenic risk.

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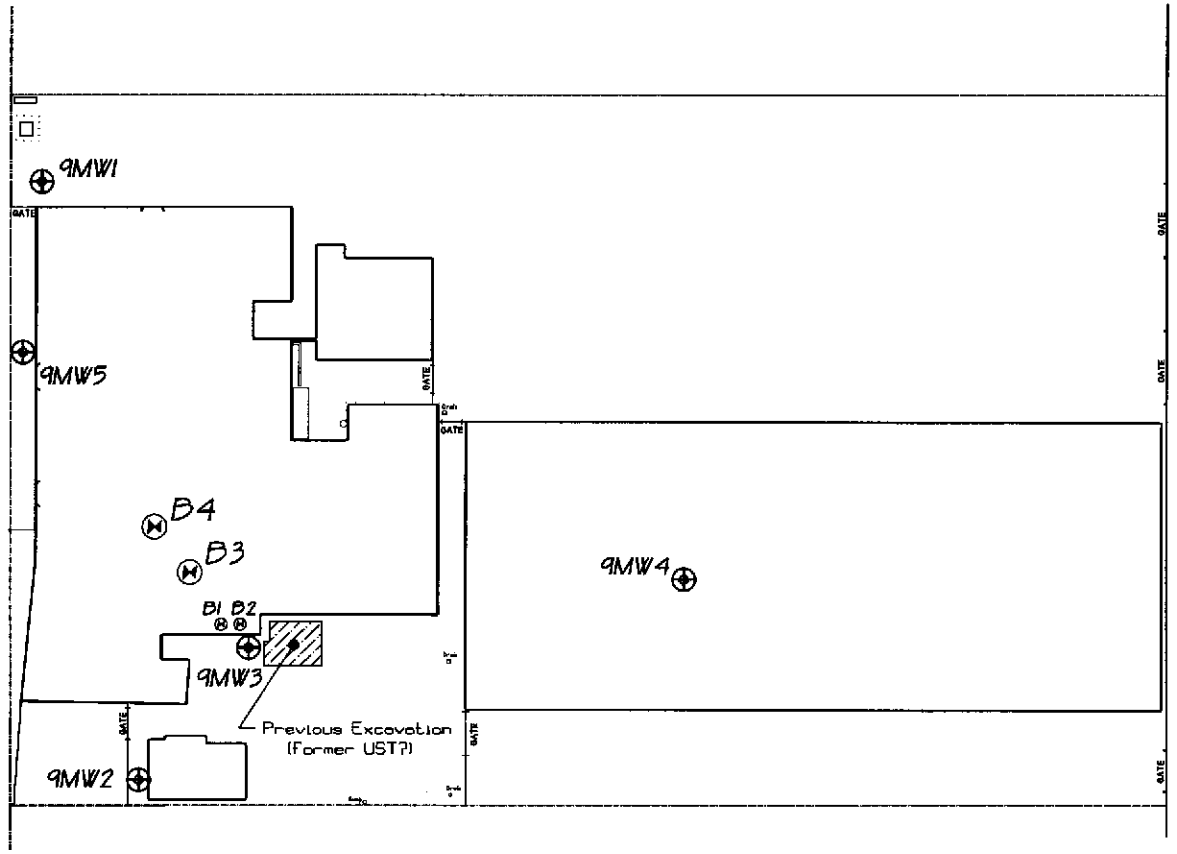
Figure 2



Legend:

⊕ Monitoring Well

Ⓜ Geoprobe Sampling Location

Scale

50 0 50 100 Feet

Facility and Groundwater Sampling Locations

Former PACO PUMPS
9201 San Leandro Street
Oakland, California

Prepared by
JONAS & ASSOCIATES INC.

Date: 2-16-1998 Locations Approx.	Figure 2	Drawing Number PCO220-2/98:F2

Table 1

Summary of Concentrations Used in RBCA Model
Former Paco Pumps Facility

Well/ Geoprobe Borehole	Sampling Round & Date	Analytes {mg/L}						
		TPH-Gasoline	Benzene	Toluene	Ethyl Benzene	Total Xylene	MTBE	VOCs (except BTEX)
9MW3	Round Thirteen (5/23/96)	**4.300**	**3.200**	**0.350**	**0.072**	**0.074**	-	ND
	Round Fourteen (11/4/96)	**4.500**	**2.100**	**0.130**	**0.061**	**0.039**	-	ND
	Round Fifteen (5/13/97)	**10.000**	**4.800**	**0.530**	**0.100**	**0.092**	ND(0.100)	ND
	Round Sixteen (1/26/98)	**12.000**	**5.000**	**0.250**	**0.091**	**0.100**	-	ND
9MW5	Round Eight (2/8/95)	ND(0.050)	ND(0.0005)	ND(0.0005)	ND(0.0005)	ND(0.0005)	-	ND
	Round Ten (8/9/95)	ND(0.05)	ND(0.0005)	ND(0.0005)	ND(0.0005)	ND(0.0005)	-	ND
	Round Twelve (2/29/96)	ND(0.05)	**0.0006**	ND(0.0005)	ND(0.0005)	ND(0.0005)	-	ND
	Round Fifteen (5/13/97)	ND(0.05)	ND(0.0005)	ND(0.0005)	ND(0.0005)	ND(0.0005)	-	ND
B1	Geoprobe (2/3/97)	**31.000**	**7.100**	**4.100**	**0.520**	**1.400**	-	-
B2	Geoprobe (2/3/97)	**41.000**	**14.000**	**2.600**	**0.740**	**1.700**	-	-
B3	Geoprobe (2/2/98)	**1.400**	**0.310**	**0.0099**	**0.027**	**0.056**	-	-
B4	Geoprobe (2/2/98)	ND(0.050)	ND(0.0005)	ND(0.0005)	ND(0.0005)	ND(0.0005)	-	-

Geoprobe	Sampling Date	Moisture Content	Dry Density	Porosity	Organic Content	Specific Gravity
B1-5.5' (Soil)	1/31/97	**25.3%**	**95.4 pcf**	**42.8%**	**2.9%**	**2.67**

Legend: TPH: Total Petroleum Hydrocarbons
ND(0.050): Not Detected above Detection Limit
MTBE: Methyl Tertiary Butyl Ether
VOCs: Volatile Organic Compounds (per EPA Method 8010A)

Figure 3

Drawing Number PCO220-2/98:F3

Drawn by M.L.J. 2-16-1998

9MW5 (GW)

Results of Last Four Sampling Rounds:

(mg/L)	2/8/95	8/9/95	2/29/96	5/13/97
TPH-Gasoline	ND(0.05)	ND(0.05)	ND(0.05)	ND(0.05)
Benzene	ND(0.0005)	ND(0.0005)	0.0006	ND(0.0005)
Toluene	ND(0.0005)	ND(0.0005)	ND(0.0005)	ND(0.0005)
Ethyl Benzene	ND(0.0005)	ND(0.0005)	ND(0.0005)	ND(0.0005)
Total Xylenes	ND(0.0005)	ND(0.0005)	ND(0.0005)	ND(0.0005)
VOCs (8010A) (except BTEX)	ND	ND	ND	ND

B3 (GW)

2/2/98 Sampling Results:

(mg/L)	
TPH-Gasoline	1.400
Benzene	0.310
Toluene	0.0099
Ethyl Benzene	0.027
Total Xylenes	0.056

B1 (GW)

2/3/97 Sampling Results:

(mg/L)	
TPH-Gasoline	31.000
Benzene	7.100
Toluene	4.100
Ethyl Benzene	0.520
Total Xylenes	1.400

B1-5.5' (Soil)

1/31/97 Sampling Results:

Moisture Content	25.3%
Dry Density	95.4 pcf
Porosity	42.8%
Organic Content	2.9%
Specific Gravity	2.67

B4 (GW)

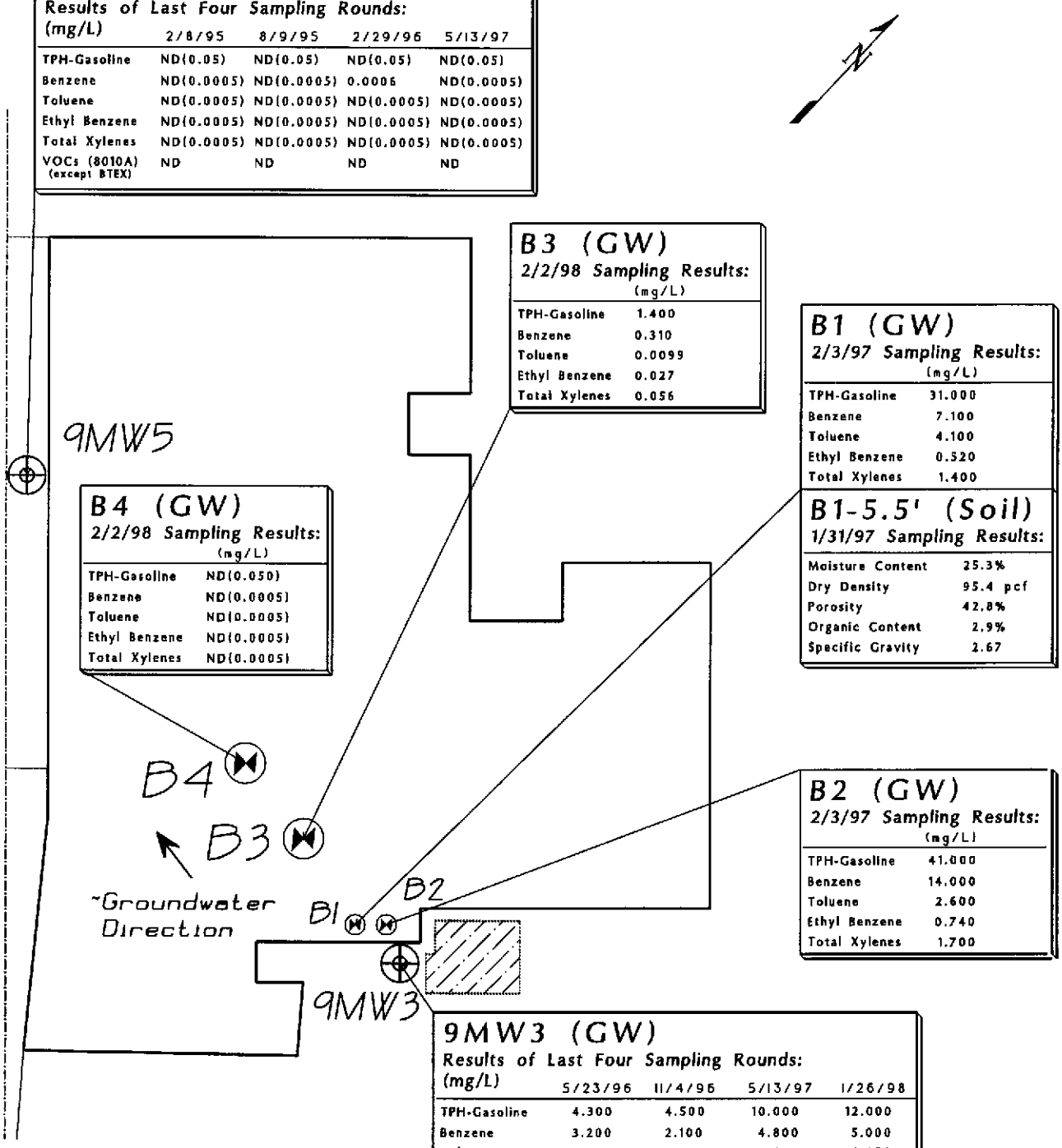
2/2/98 Sampling Results:

(mg/L)	
TPH-Gasoline	ND(0.050)
Benzene	ND(0.0005)
Toluene	ND(0.0005)
Ethyl Benzene	ND(0.0005)
Total Xylenes	ND(0.0005)

B2 (GW)

2/3/97 Sampling Results:

(mg/L)	
TPH-Gasoline	41.000
Benzene	14.000
Toluene	2.600
Ethyl Benzene	0.740
Total Xylenes	1.700



9MW3 (GW)

Results of Last Four Sampling Rounds:

(mg/L)	5/23/96	11/4/96	5/13/97	1/26/98
TPH-Gasoline	4.300	4.500	10.000	12.000
Benzene	3.200	2.100	4.800	5.000
Toluene	0.350	0.130	0.530	0.250
Ethyl Benzene	0.072	0.061	0.100	0.091
Total Xylenes	0.074	0.039	0.092	0.100
MTBE	-	-	ND(0.100)	-
VOCs (8010A) (except BTEX)	ND	ND	ND	ND

Legend:

- Monitoring Well
- Geoprobe Sampling Location
- Previous Excavation (UST?)

Scale: 25 0 25 50 Feet

Sampling Results for RBCA Model

Former PACO PUMPS
9201 San Leandro Street
Oakland, California

Prepared by
JONAS & ASSOCIATES INC.

Date: 2-16-1998
Locations Approx.

Figure 3

Drawing Number PCO220-2/98:F3

2.2 Area-Weighted Averaging

Area-weighted averaging is a statistical method to calculate representative BTEX concentrations within groundwater under the facility building located downgradient from a former gasoline UST. The method uses the distribution of existing data to determine a spatial average concentration of a chemical of concern (Isaaks & Srivastava, 1989).

The governing equation is a follows:

$$Concentration_{rep} = \sum_{i=1}^{n} \frac{A_i}{A_t} \times V_i$$

where: $Concentration_{rep}$ = Representative Concentration in Total Area A_t
n = Number of Data Points
A_i = Area of Polygon for Value V_i
A_t = Total Area
V_i = Value in Polygon

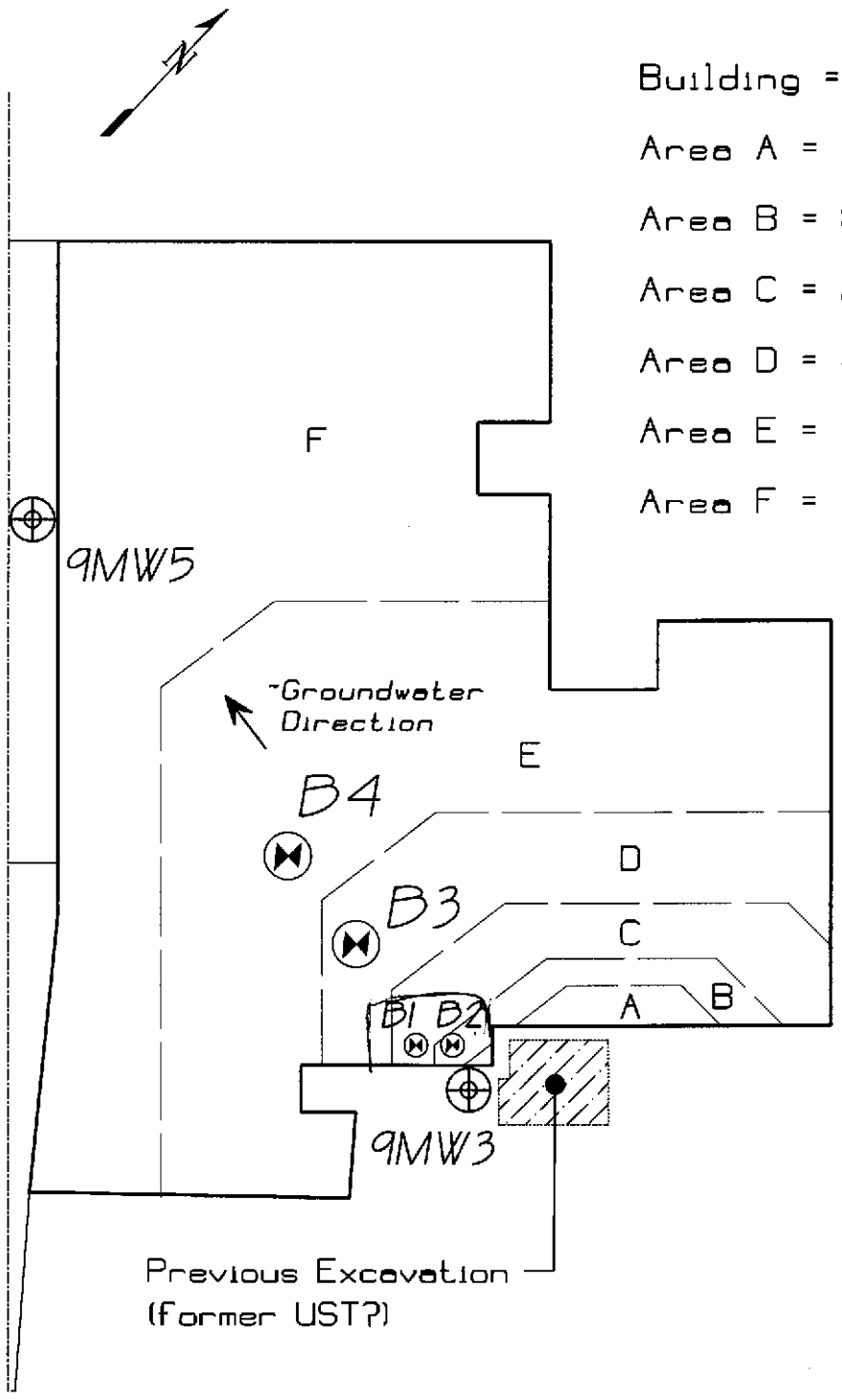
Figure 4 presents the polygons and groundwater sampling points downgradient from the former UST excavation. This figure also presents the area of each polygon (A_i) and the total area within the building (A_t).

The following Table 2 provides representative concentrations for the detected chemicals presented in Table 1 and Figure 3. Maximum concentrations were used for the last four samples collected from monitoring wells 9MW3 and 9MW5. For averaging purposes when a concentration is not detected (ND) a value of half the detection limit was used.

Figure 4

Drawing Number PCO220-2/98:F4

Drawn by M.L.J. 2-16-1998



Legend:

⊕ Monitoring Well

⋈ Geoprobe Sampling Location

Scale

25 0 25 50 Feet

Area-Weighted Average

Former PACO PUMPS
9201 San Leandro Street
Oakland, California

Prepared by
JONAS & ASSOCIATES INC.

Date: 2-16-1998 Locations Approx.	Figure 4	Drawing Number PCO220-2/98:F4

Table 2

Representative Concentrations Using Spatial Averaging
Former Paco Pumps Facility

BENZENE:

Chemical of Concern	Sampling Point	V_i (mg/L)	A_i/A_t	$Concentration_{rep}$
$Benzene_{maximum}$	9MW3	5.000	493 ft^3 / 40,075 ft^3	
	9MW5	0.0006	17,708 ft^3 / 40,075 ft^3	
	B1	7.100	2,452 ft^3 / 40,075 ft^3	
	B2	14.000	875 ft^3 / 40,075 ft^3	
	B3	0.310	4,286 ft^3 / 40,075 ft^3	
	B4	0.00025[1]	14,261 ft^3 / 40,075 ft^3	
				0.8352 mg/L

TOLUENE:

Chemical of Concern	Sampling Point	V_i (mg/L)	A_i/A_t	$Concentration_{rep}$
$Toluene_{maximum}$	9MW3	0.530	493 ft^3 / 40,075 ft^3	
	9MW5	0.00025[1]	17,708 ft^3 / 40,075 ft^3	
	B1	4.100	2,452 ft^3 / 40,075 ft^3	
	B2	2.600	875 ft^3 / 40,075 ft^3	
	B3	0.0099	4,286 ft^3 / 40,075 ft^3	
	B4	0.00025[1]	14,261 ft^3 / 40,075 ft^3	
				0.3155 mg/L

ETHYL BENZENE:

Chemical of Concern	Sampling Point	V_i (mg/L)	A_i/A_t	$Concentration_{rep}$
$Ethyl\ Benzene_{maximum}$	9MW3	0.100	493 ft^3 / 40,075 ft^3	
	9MW5	0.00025[1]	17,708 ft^3 / 40,075 ft^3	
	B1	0.520	2,452 ft^3 / 40,075 ft^3	
	B2	0.740	875 ft^3 / 40,075 ft^3	
	B3	0.027	4,286 ft^3 / 40,075 ft^3	
	B4	0.00025[1]	14,261 ft^3 / 40,075 ft^3	
				0.0523 mg/L

TOTAL XYLENES:

Chemical of Concern	Sampling Point	V_i (mg/L)	A_i/A_t	$Concentration_{rep}$
$Total\ Xylenes_{maximum}$	9MW3	0.100	493 ft^3 / 40,075 ft^3	
	9MW5	0.00025[1]	17,708 ft^3 / 40,075 ft^3	
	B1	1.400	2,452 ft^3 / 40,075 ft^3	
	B2	1.700	875 ft^3 / 40,075 ft^3	
	B3	0.056	4,286 ft^3 / 40,075 ft^3	
	B4	0.00025[1]	14,261 ft^3 / 40,075 ft^3	
				0.1302 mg/L

note: 1/ One-half Detection Limit.

2.3 RBCA Modeling Results

The RBCA modeling effort used area-weighted averaging from groundwater samples collected from monitoring wells 9MW3 and 9MW5, and results from samples collected from four boreholes. The following Table 3 presents the findings of the RBCA modeling simulations with respect to carcinogenic risk and non-carcinogenic hazard quotient associated with indoor commercial air exposure from groundwater contamination.

Table 3
Summary of RBCA Modeling Results

RBCA Simulation	Indoor Air Commercial Exposure Carcinogenic Risk	Exceeds $1(10)^{-5}$ Carcinogenic Risk	Indoor Air Commercial Exposure Hazardous Quotient	Exceeds $1(10)^{0}$ Hazard Quotient
Area-Weighted Average of Maximum Concentrations Four Rounds Monitoring Wells 9MW3 and 9MW5 and Boreholes B1, B2, B3, and B4.	$8.0(10)^{-6}$	No	$4.6(10)^{-1}$ to $5.9(10)^{-5}$	No

As seen in the results presented in the appendix and summarized in Table 3, the highest carcinogenic risk determined by the RBCA model is below the target risk limit of $1(10)^{-5}$. The carcinogen modeled was benzene. Ethyl benzene, toluene, and total xylenes are non-carcinogens. The non-carcinogens also did not exceed the target hazard quotient of 1. Based on these considerations, the area-weighted average of BTEX does not poise a significant commercial risk from indoor air exposure within the building located downgradient from the former gasoline UST .

3.0 CONCLUSIONS

Following are conclusions from the RBCA modeling effort presented in this report:

1/ Based on the RBCA modeling effort for the sampling rounds simulated, carcinogenic risk did not exceed $1(10)^{-5}$ for indoor commercial air exposure from groundwater contamination.

2/ Based on the RBCA modeling effort for the sampling rounds simulated, non-carcinogenic risk did not exceed the target hazard quotient of 1 for indoor commercial air exposure from groundwater contamination.

3/ Area-weighted average concentrations of BTEX in groundwater does not poise a significant risk with respect to indoor commercial air exposure.

4.0 REFERENCES

Alameda County Health Care Services Agency, 1994, letter titled "Workplan Approval for PACO Pumps, 9201 San Leandro St. Oakland 94603", November 1, 1994 letter.

_____, 1996, letter titled "ORC at 9201 San Leandro St, Oakland, CA.", May 22, 1996 letter to Newflo.

_____, 1996, letter titled "Soil Borings at 9201 San Leandro Street, Oakland, CA", December 12, 1996 letter to PCC Flow Technologies.

_____, 1997, letter titled "Workplan Approval for 9201 San Leandro St., Oakland, CA", January 27, 1997 letter to PCC Flow Technologies.

_____, 1997, letter titled "Workplan Approval for 9201 San Leandro St., Oakland, CA", October 2, 1997 letter to PCC Flow Technologies.

American Society for Testing and Materials (ASTM), 1996. "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites", Designation: E 1739-95e1, December 1996.

California Department of Water Resources, 1982. "Phase I Water Well Survey, Proposed Oakland Inner Harbor Deepening Project, Central District", September 1982.

Groundwater Services, Inc. (GSI), 1997. Tier 2 RBCA Tool Kit with RBCA Spreadsheet System (Version 1.0.1).

Isaaks, E.H., and Srivastava, R.M., 1989. "Applied Geostatistics", Oxford University Press.

Jonas & Associates Inc., 1992. "Site Characterization Report and Work Plan, PACO Pumps, 9201 San Leandro Street, Oakland, California", October 16, 1992.

_____, 1993. "First Quarterly Status Report, PACO Pumps, 9201 San Leandro Street, Oakland, California", February 24, 1993.

_____, 1993. "Groundwater Monitoring Report, Sampling Round One, Two, and Three, PACO Pumps, 9201 San Leandro Street, Oakland, California", December 10, 1993.

_____, 1994. "Groundwater Monitoring Report, Sampling Round One Through Four, PACO Pumps, 9201 San Leandro Street, Oakland, California", April 15, 1994.

_____, 1994. "Work Plan, Installation of Monitoring Well 9MW5, PACO Pumps, 9201 San Leandro Street, Oakland, California", June 13, 1994.

_____, 1994. "Groundwater Monitoring Report, Sampling Round Five, PACO Pumps, 9201 San Leandro Street, Oakland, California", June 28, 1994.

_____, 1994. "Groundwater Monitoring Report, Sampling Round Six, PACO Pumps, 9201 San Leandro Street, Oakland, California", August 24, 1994.

_____, 1994. "Groundwater Monitoring Report, Sampling Round Seven, PACO Pumps, 9201 San Leandro Street, Oakland, California", November 22, 1994

_____, 1995. "Groundwater Monitoring Report, Sampling Round Eight, PACO Pumps, 9201 San Leandro Street, Oakland, California", March 20, 1995.

_____, 1995. "Groundwater Monitoring Report, Sampling Round Nine and Ten, PACO Pumps, 9201 San Leandro Street, Oakland, California", October 15, 1995.

_____, 1995. "Groundwater Monitoring Report, Sampling Round Eleven, PACO Pumps, 9201 San Leandro Street, Oakland, California", February 23, 1995.

_____, 1996. "Groundwater Monitoring Report, Sampling Round Twelve, PACO Pumps, 9201 San Leandro Street, Oakland, California", May 20, 1996.

_____, 1996. "Groundwater Monitoring Report, Sampling Round Thirteen, PACO Pumps, 9201 San Leandro Street, Oakland, California", July 2, 1996.

_____, 1996. "Groundwater Monitoring Report, Sampling Round Thirteen, PACO Pumps, 9201 San Leandro Street, Oakland, California", July 2, 1996.

_____, 1996. "Groundwater Monitoring Report, Sampling Round Fourteen, PACO Pumps, 9201 San Leandro Street, Oakland, California", December 4, 1996.

_____, 1997. "Work Plan for Soil and Groundwater Characterization, Former PACO Pumps, 9201 San Leandro Street, Oakland, California", January 22, 1997.

_____, 1997. "Soil and Groundwater Sampling and Analysis, Former PACO Pumps, 9201 San Leandro Street, Oakland, California", April 1, 1997.

_____, 1997. "Groundwater Monitoring Report, Sampling Round Fifteen, Former PACO Pumps, 9201 San Leandro Street, Oakland, California", July 25, 1997.

_____, 1997. "Work Plan For Further Groundwater Characterization, Former Paco Pumps, 9201 San Leandro Street, Oakland, California', July 28, 1997.

_____, 1998. "Groundwater Monitoring Report, Sampling Round Sixteen, Former PACO Pumps, 9201 San Leandro Street, Oakland, California", March 1998.

_____, 1998. "B3 and B4 Groundwater Sampling and Results, Former PACO Pumps, 9201 San Leandro Street, Oakland, California", March 1998.

Subsurface Consultants Inc., 1992. "Soil Contamination Assessment Drum Storage Areas, St. Vincent DePaul Distribution Center, 9234 San Leandro Street, Oakland, California", December 16, 1992.

Appendix A

Maximum Concentrations
Indoor Air Exposure
RBCA Simulation

Site Name: Former Paco Pumps
Site Location: 9201 San Leandro St., Oakland, CA

Completed By: Mark Jonas, R.G.
Date Completed: 2/23/1998

CUMULATIVE RISK WORKSHEET

Cumulative Target Risk: 1.0E-5 Target Hazard Index: 1.0E+0

ON-SITE RECEPTORS

CONSTITUENTS OF CONCERN		Outdoor Air:		Indoor Air: Commercial Exposure Target Risk: 1.0E-5 / 1.0E-5	Target HQ: 1.0E+0	Soil:		Groundwater:	
CAS No.	Name	Carcinogenic Risk	Hazard Quotient	Carcinogenic Risk	Hazard Quotient	Carcinogenic Risk	Hazard Quotient	Carcinogenic Risk	Hazard Quotient
71-43-2	Benzene	NA	NA	8.0E-6	4.6E-1	NA	NA	NA	NA
100-41-4	Ethylbenzene	NA	NA		1.9E-4	NA	NA	NA	NA
108-88-3	Toluene	NA	NA		2.7E-3	NA	NA	NA	NA
1330-20-7	Xylene (mixed isomers)	NA	NA		5.9E-5	NA	NA	NA	NA
Cumulative Values:		**0.0E+0**	**0.0E+0**	**8.0E-6**	**4.6E-1**	**0.0E+0**	**0.0E+0**	**0.0E+0**	**0.0E+0**

■ indicates risk level exceeding target risk

Software: GSI RBCA Spreadsheet
Version: 1.0.1

Serial: G-451-KUX-984

REPRESENTATIVE COC CONCENTRATIONS IN SOURCE MEDIA

(Complete the following table)

CONSTITUENT	Representative COC Concentration in Groundwater		in Surface Soil		in Subsurface Soil	
	value (mg/L)	note	value (mg/kg)	note	value (mg/kg)	note
Benzene	8.4E-1	max				
Ethylbenzene	5.2E-2	max				
Toluene	3.2E-1	max				
Xylene (mixed isomers)	1.3E-1	max				

Site Name: Former Paco Pumps
Site Location: 9201 San Leandro St., Oakland, CA

Completed By: Mark Jonas, R.G.
Date Completed: 2/23/1998

Site Name: Former Paco Pumps | Site Location: 9201 San Leandro St., Oakland, CA | Completed By: Mark Jonas, R.G. | Date Completed: 2/23/1998 | 2 OF 4

TIER 2 PATHWAY RISK CALCULATION

INDOOR AIR EXPOSURE PATHWAYS ■ = UNCHECKED IF PATHWAYS ARE ACTIVE

Constituents of Concern	(1) EPA Classification	CARCINOGENIC RISK: (2) Total Carcinogenic Intake Rate (mg/kg/day) On-Site	Commercial	(3) Inhalation Slope Factor (mg/kg-day)^-1	(4) Individual COC Risk (2) x (3) On-Site	Commercial	TOXIC EFFECTS: (5) Total Toxicant Intake Rate (mg/kg/day) On-Site	Commercial	(6) Inhalation Reference Dose (mg/kg-day)	(7) Individual COC Hazard Quotient (5) / (6) On-Site	Commercial
Benzene	A		2.8E-4	2.9E-2		8.0E-6		7.7E-4	1.7E-3		4.6E-1
Ethylbenzene	D							5.4E-5	2.9E-1		1.9E-4
Toluene	D							3.0E-4	1.1E-1		2.7E-3
Xylene (mixed isomers)	D							1.2E-4	2.0E+0		5.9E-5

Total Pathway Carcinogenic Risk = 0.0E+0 | 8.0E-6

Total Pathway Hazard Index = 0.0E+0 | 4.8E-1

Site Name: Former Paco Pumps | Site Location: 9201 San Leandro St., Oakland | Completed By: Mark Jones, R.G. | Date Completed: 2/23/1998 | 5 OF 9

TIER 2 EXPOSURE CONCENTRATION AND INTAKE CALCULATION

INDOOR AIR EXPOSURE PATHWAYS — ■ CHECKED IF PATHWAY IS ACTIVE

GROUNDWATER: VAPOR INTRUSION TO BUILDINGS Constituents of Concern	Exposure Concentration 1) Source Medium Groundwater Conc. (mg/L)	2) NAF Value (m^3/L) Receptor On-Site Commercial	3) Exposure Medium Indoor Air: POE Conc. (mg/m^3) (1) / (2) On-Site Commercial	4) Exposure Multiplier ((IRxEFxED)/(BWxAT) (m^3/kg-day) On-Site Commercial	5) Average Daily Intake Rate (mg/kg-day) (3) X (4) On-Site Commercial	TOTAL PATHWAY INTAKE (mg/kg-day) *(Sum intake values from subsurface & groundwater routes.)* On-Site Commercial
Benzene	8.4E-1	2.1E+2	4.0E-3	7.0E-2	2.8E-4	2.8E-4
Ethylbenzene	5.2E-2	1.9E+2	2.8E-4	2.0E-1	5.4E-5	5.4E-5
Toluene	3.2E-1	2.0E+2	1.6E-3	2.0E-1	3.0E-4	3.0E-4
Xylene (mixed isomers)	1.3E-1	2.2E+2	6.0E-4	2.0E-1	1.2E-4	1.2E-4

NOTE:
ABS = Dermal absorption factor (dim)
AF = Adherance factor (mg/cm^2)
AT = Averaging time (days)
BW = Body weight (kg)
CF = Units conversion factor
ED = Exposure duration (yrs)
EF = Exposure frequencey (days/yr)
ET = Exposure time (hrs/day)
IR = Inhalation rate (m^3/day)
POE = Point of exposure
SA = Skin exposure area (cm^2/day)

RBCA CHEMICAL DATABASE

Physical Property Data

CAS Number	Constituent	type	Molecular Weight (g/mole) MW	ref	Diffusion Coefficients In air (cm2/s) Dair	ref	In water (cm2/s) Dwat	ref	log (Koc) or log(Kd) (@ 20 - 25 C) log(l/kg)	ref	Henry's Law Constant (@ 20 - 25 C) (atm-m3) mol	(unitless)	ref	Vapor Pressure (@ 20 - 25 C) (mm Hg)	ref	Solubility (@ 20 - 25 C) (mg/L)	ref	acid pKa	base pKb	ref
71-43-2	Benzene	A	78.1	5	9.30E-02	A	1.10E-05	A	1.58	A	5.29E-03	2.20E-01	A	9.52E+01	4	1.75E+03	A			
100-41-4	Ethylbenzene	A	106.2	5	7.60E-02	A	8.50E-06	A	1.98	A	7.69E-03	3.20E-01	A	1.00E+01	4	1.52E+02	5			
108-88-3	Toluene	A	92.4	5	8.50E-02	A	9.40E-06	A	2.13	A	6.25E-03	2.60E-01	A	3.00E+01	4	5.15E+02	29			
1330-20-7	Xylene (mixed isomers)	A	106.2	5	7.20E-02	A	8.50E-06	A	2.38	A	6.97E-03	2.90E-01	A	7.00E+00	4	1.98E+02	5			

Site Name: Former Paco Pumps Site Location: 9201 San Leandro St., Oa Completed By: Mark Jonas, R.G. Date Completed: 2/23/1998

Software version: 1.0.1

RBCA CHEMICAL DATABASE

Toxicity Data

CAS Number	Constituent	Reference Dose (mg/kg/day) Oral RfD_oral	ref	Inhalation RfD_inhal	ref	Slope Factors 1/(mg/kg/day) Oral SF_oral	ref	Inhalation SF_inhal	ref	EPA Weight of Evidence	Is Constituent Carcinogenic ?
71-43-2	Benzene	-		1.70E-03	R	2.90E-02	A	2.90E-02	A	A	TRUE
100-41-4	Ethylbenzene	1.00E-01	A	2.86E-01	A	-		-		D	FALSE
108-88-3	Toluene	2.00E-01	A,R	1.14E-01	A,R	-		-		D	FALSE
1330-20-7	Xylene (mixed isomers)	2.00E+00	A,R	2.00E+00	A	-		-		D	FALSE

Site Name: Former Paco Pumps Site Location: 9201 San Leandro St., (Completed By: Mark Jonas, R.G. Date Completed: 2/23/1998

Software version: 1.0.1

RBCA CHEMICAL DATABASE

Miscellaneous Chemical Data

CAS Number	Constituent	Maximum Contaminant Level MCL (mg/L)	Maximum Contaminant Level reference	Permissible Exposure Limit PEL/TLV (mg/m3)	PEL/TLV ref	Relative Absorption Factors Oral	Relative Absorption Factors Dermal	Detection Limits Groundwater (mg/L)	Groundwater ref	Detection Limits Soil (mg/kg)	Soil ref	Half Life (First-Order Decay) (days) Saturated	Half Life (First-Order Decay) (days) Unsaturated	Half Life ref
71-43-2	Benzene	5.00E-03	52 FR 25690	3.20E+00	OSHA	1	0.5	0.002	C	0.005	S	720	720	H
100-41-4	Ethylbenzene	7.00E-01	56 FR 3526 (30 Jan 91)	4.34E+02	ACGIH	1	0.5	0.002	C	0.005	S	228	228	H
108-88-3	Toluene	1.00E+00	56 FR 3526 (30 Jan 91)	1.47E+02	ACGIH	1	0.5	0.002	C	0.005	S	28	28	H
1330-20-7	Xylene (mixed isomers)	1.00E+01	56 FR 3526 (30 Jan 91)	4.34E+02	ACGIH	1	0.5	0.005	C	0.005	S	360	360	H

Site Name: Former Paco Pumps Site Location: 9201 San Leandro St., Oakland, CA Completed By: Mark Jonas, R.G. Date Completed: 2/23/1998

Software version: 1.0.1

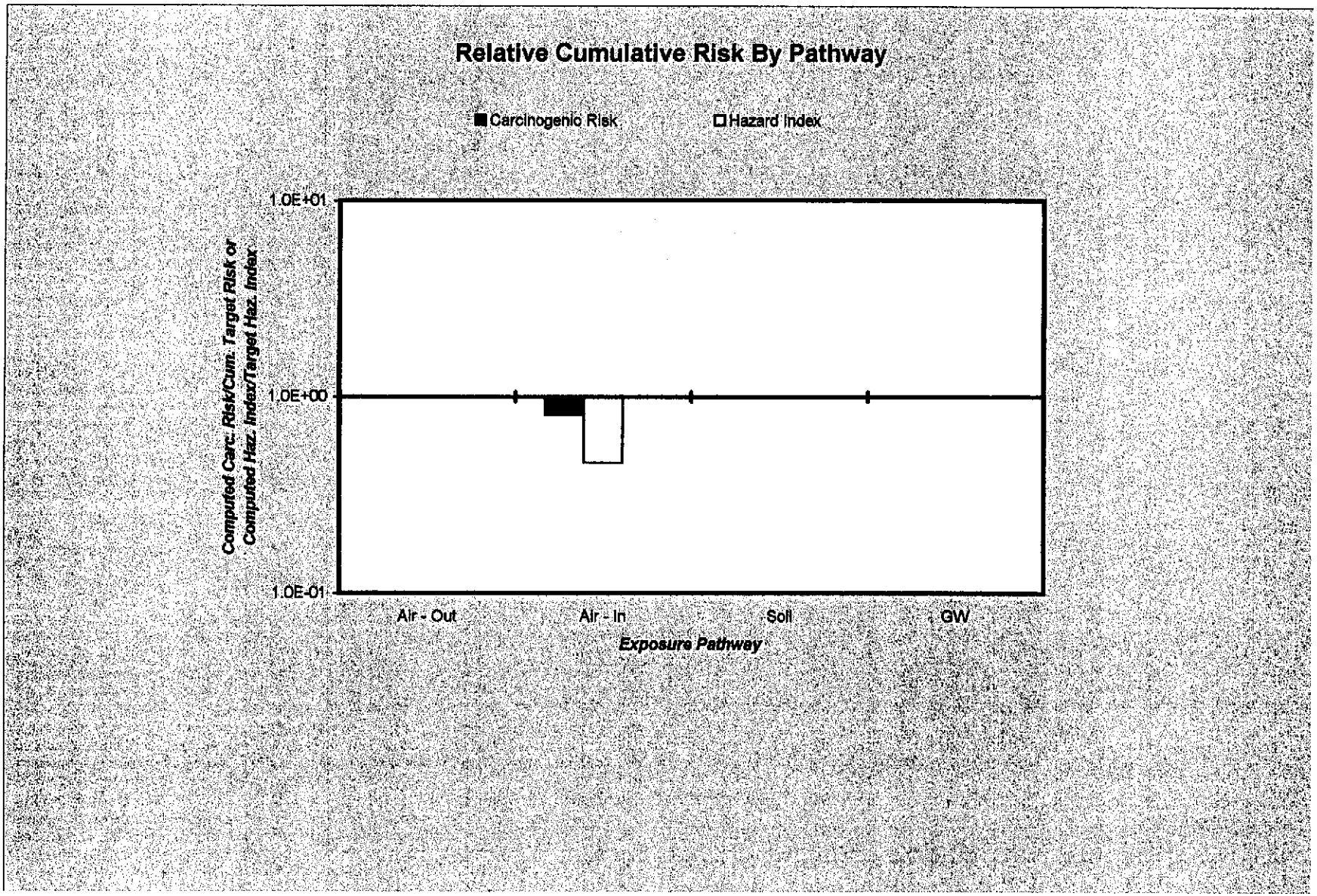
RBCA SITE ASSESSMENT	Tier 2 Worksheet 8.3

Site Name: Former Paco Pumps
Site Location: 9201 San Leandro St., Oakland, CA

Completed By: Mark Jonas, R.G.
Date Completed: 2/23/1998

TIER 2 BASELINE RISK SUMMARY TABLE

	BASELINE CARCINOGENIC RISK					BASELINE TOXIC EFFECTS				
	Individual COC Risk		Cumulative COC Risk		Risk Limit(s) Exceeded?	Hazard Quotient		Hazard Index		Toxicity Limit(s) Exceeded?
EXPOSURE PATHWAY	Maximum Value	Target Risk	Total Value	Target Risk		Maximum Value	Applicable Limit	Total Value	Applicable Limit	
OUTDOOR AIR EXPOSURE PATHWAYS										
Complete:	NC	1.0E-5	NC	1.0E-5		NC	1.0E+0	NC	1.0E+0	
INDOOR AIR EXPOSURE PATHWAYS										
Complete:	8.0E-6	1.0E-5	8.0E-6	1.0E-5	☐	4.6E-1	1.0E+0	4.6E-1	1.0E+0	☐
SOIL EXPOSURE PATHWAYS										
Complete:	NC	1.0E-5	NC	1.0E-5		NC	1.0E+0	NC	1.0E+0	
GROUNDWATER EXPOSURE PATHWAYS										
Complete:	NC	1.0E-5	NC	1.0E-5		NC	1.0E+0	NC	1.0E+0	
CRITICAL EXPOSURE PATHWAY (Selected Maximum Values From Complete Pathways)										
	8.0E-6	1.0E-5	8.0E-6	1.0E-5	☐	4.6E-1	1.0E+0	4.6E-1	1.0E+0	☐


Relative Cumulative Risk By Pathway
Carcinogenic Risk
Hazard Index
1.0E+01
1.0E+00
1.0E-01
Computed Carc. Risk/Cum. Target Risk or
Computed Haz. Index/Target Haz. Index
Air - Out
Air - In
Soil
GW
Exposure Pathway

RBCA TIER 1/TIER 2 EVALUATION

Output Table 1

Site Name: Former Paco Pumps | Job Identification: PCO-220 | Software: GSI RBCA Spreadsheet
Site Location: 9201 San Leandro St., Oakland | Date Completed: 2/23/98 | Version: 1.0.1
Completed By: Mark Jonas, R.G.

NOTE: values which differ from Tier 1 default values are shown in bold italics and underlined.

Exposure Parameter	Definition (Units)	Residential Adult	Residential (1-6yrs)	Residential (1-16 yrs)	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
ATc	Averaging time for carcinogens (yr)	70				
ATn	Averaging time for non-carcinogens (yr)	30	6	16	25	1
BW	Body Weight (kg)	70	15	35	70	
ED	Exposure Duration (yr)	30	6	16	25	1
t	Averaging time for vapor flux (yr)	30			25	1
EF	Exposure Frequency (days/yr)	350			250	180
EF.Derm	Exposure Frequency for dermal exposure	350			250	
IRgw	Ingestion Rate of Water (L/day)	2			1	
IRs	Ingestion Rate of Soil (mg/day)	100	200		50	100
IRadj	Adjusted soil Ing. rate (mg-yr/kg-d)	1.1E+02			9.4E+01	
IRa.in	Inhalation rate indoor (m^3/day)	15			20	
IRa.out	Inhalation rate outdoor (m^3/day)	20			20	10
SA	Skin surface area (dermal) (cm^2)	5.8E+03		2.0E+03	5.8E+03	5.8E+03
SAadj	Adjusted dermal area (cm^2-yr/kg)	2.1E+03			1.7E+03	
M	Soil to Skin adherence factor	1				
AAFs	Age adjustment on soil ingestion	FALSE			FALSE	
AAFd	Age adjustment on skin surface area	FALSE			FALSE	
tox	Use EPA tox data for air (or PEL based)?	TRUE				
gwMCL?	Use MCL as exposure limit in groundwater?	FALSE				

Matrix of Exposed Persons to Complete Exposure Pathways		Residential	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
Outdoor Air Pathways:				
SS.v	Volatiles and Particulates from Surface Soils	FALSE	FALSE	FALSE
S.v	Volatilization from Subsurface Soils	FALSE	FALSE	
GW.v	Volatilization from Groundwater	FALSE	FALSE	
Indoor Air Pathways:				
S.b	Vapors from Subsurface Soils	FALSE	FALSE	
GW.b	Vapors from Groundwater	FALSE	TRUE	
Soil Pathways:				
SS.d	Direct Ingestion and Dermal Contact	FALSE	FALSE	FALSE
Groundwater Pathways:				
GW.l	Groundwater Ingestion	FALSE	FALSE	
S.l	Leaching to Groundwater from all Soils	FALSE	FALSE	

Matrix of Receptor Distance and Location On- or Off-Site		Residential Distance	Residential On-Site	Commercial/Industrial Distance	Commercial/Industrial On-Site
GW	Groundwater receptor (cm)		FALSE		FALSE
S	Inhalation receptor (cm)		FALSE		FALSE

Matrix of Target Risks		Individual	Cumulative
TRab	Target Risk (class A&B carcinogens)	***1.0E-05***	***1.0E-05***
TRc	Target Risk (class C carcinogens)	1.0E-05	
THQ	Target Hazard Quotient	1.0E+00	1.0E+00
Opt	Calculation Option (1, 2, or 3)	3	
Tier	RBCA Tier	2	

Surface Parameters	Definition (Units)	Residential	Constrctn
A	Contaminated soil area (cm^2)	2.2E+06	1.0E+06
W	Length of affect. soil parallel to wind (cm)	1.5E+03	1.0E+03
W.gw	Length of affect. soil parallel to groundwater (cm	1.5E+03	
Uair	Ambient air velocity in mixing zone (cm/s)	2.3E+02	
delta	Air mixing zone height (cm)	2.0E+02	
Lss	Thickness of affected surface soils (cm)	1.0E+02	
Pe	Particulate areal emission rate (g/cm^2/s)	6.9E-14	

Groundwater	Definition (Units)	Value
delta.gw	Groundwater mixing zone depth (cm)	***2.6E+02***
I	Groundwater Infiltration rate (cm/yr)	3.0E+01
Ugw	Groundwater Darcy velocity (cm/yr)	***1.4E+01***
Ugw.tr	Groundwater seepage velocity (cm/yr)	***3.3E+01***
Ks	Saturated hydraulic conductivity(cm/s)	1.0E-04
grad	Groundwater gradient (cm/cm)	4.5E-03
Sw	Width of groundwater source zone (cm)	
Sd	Depth of groundwater source zone (cm)	
phi.eff	Effective porosity in water-bearing unit	4.3E-01
foc.sat	Fraction organic carbon in water-bearing unit	1.0E-03
BIO?	Is bioattenuation considered?	FALSE
BC	Biodegradation Capacity (mg/L)	

Soil	Definition (Units)	Value		
hc	Capillary zone thickness (cm)	***6.1E+00***		
hv	Vadose zone thickness (cm)	***2.5E+02***		
rho	Soil density (g/cm^3)	***1.5***		
foc	Fraction of organic carbon in vadose zone	***0.029***		
phi	Soil porosity in vadose zone	***0.428***		
Lgw	Depth to groundwater (cm)	***2.6E+02***		
Ls	Depth to top of affected subsurface soil (cm)	1.0E+02		
Lsubs	Thickness of affected subsurface soils (cm)	2.0E+02		
pH	Soil/groundwater pH	6.5		
		capillary	vadose	foundation
phi.w	Volumetric water content	***0.385***	0.108	0.12
phi.a	Volumetric air content	***0.043***	***0.32***	0.28

Building	Definition (Units)	Residential	Commercial
Lb	Building volume/area ratio (cm)	2.0E+02	3.0E+02
ER	Building air exchange rate (s^-1)	1.4E-04	2.3E-04
Lcrk	Foundation crack thickness (cm)	1.5E+01	
eta	Foundation crack fraction	***0.005***	

Transport Parameters	Definition (Units)	Residential	Commercial
Groundwater			
ax	Longitudinal dispersivity (cm)		
ay	Transverse dispersivity (cm)		
az	Vertical dispersivity (cm)		
Vapor			
dcy	Transverse dispersion coefficient (cm)		
dcz	Vertical dispersion coefficient (cm)		