SECOR
International Incorporated

February 17, 2000

ENVIRONMENTAL PROTECTION
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R0336

Mr. Barney M. Chan
Alameda County Health Care Services Agency
1131 Harbor Bay Parkway
Alameda, California 94502-6577

RE: REVISED RBCA EVALUATION, SAN FRANCISCO FRENCH BREAD FACILITY, 580 JULIE ANN WAY, OAKLAND, CALIFORNIA, FOR THE METZ BAKING COMPANY.

Dear Mr. Chan,

In response to your letter to Mr. Christopher Rants dated December 21, 1999 (Attachment 1), we have revised the Tier 1 and Tier 2 Risk-Based Corrective Action (RBCA) Evaluation for 580 Julie Ann Way, Oakland, California 94621 (the Site) by adding the following analytical soil data collected from the Site:

- Data collected on June 19, 1991 from soil borings: SB-A; SB-B; SB-C; SB-D; SB-E; SB-F; and

- Data collected on November 12, 1993 from soil borings: SB-G; SB-H; SB-I; SB-J; SB-K; SB-L; SB-M.

The revised soil data set is presented in Table A-1 (Attachment 3) and the results of a "revised" risk assessment are presented herein. In addition, an incorrect link between spreadsheets was discovered in the original RBCA submitted to your agency in December 1999. This letter therefore addresses the following two issues:

I. Incorrect link in the December 7th 1999 RBCA; and
II. Incorporating the 1991 and 1993 soil data results into the revised RBCA.

Each of these sections is discussed in detail below.

I. Incorrect Link in the December 7th 1999 RBCA

Upon review of our initial work, we detected an incorrect link between the data tables used to estimate benzene and MTBE concentrations in air (Appendix B) and the exposure point concentration table (Table 4-5). This error resulted in an underestimation of health impacts associated with groundwater vapor inhalation (both the hypothetical onsite indoor commercial worker and construction worker) and the inhalation of vapors from soil (indoor commercial worker only). As a result, we have revised the appropriate tables and text to reflect this correction. **Replacement pages are provided in Attachment 2 of this letter.** It is important to note, that although the HIs and cancer risks are higher the previously reported, the conclusions of the original RBCA evaluation (SECOR, 1999) do not change as:

1390 Willow Pass Road Suite 360, Concord, CA 94520-5250 (925) 686-9780 (925) 686-3099 Fax www.secor.com

- Only the estimated HI and lifetime excess cancer risk for the hypothetical onsite construction worker receptor are at or exceed agency threshold levels of concern (estimated HI and cancer risk of 5 and 1×10^{-5}, respectively); and

- Benzene is the only Site-related chemical associated with the majority of the estimated HI and cancer risk for either of the two hypothetical human receptors evaluated in the RBCA.

In addition, the Oakland Zoning Department has verified that the Site and its surrounding area are designated for heavy industrial (M-40) use only (SECOR, 2000). For this reason, an evaluation of any residential exposure scenarios is not considered relevant for this Site.

II. Incorporating the 1991 and 1993 Soil Data Results into the Revised RBCA

Using the same methodology described in our December 7th RBCA, inclusion of the above-listed data results in higher HIs and cancer risks than those previously estimated and summarized in the December 7, 1999 RBCA submitted to your department. The revised HI and cancer risk estimates for the two hypothetical human receptors are summarized below and all tables related to this evaluation are in Attachment 3 of this letter.

Hypothetical Onsite Indoor Commercial Worker Receptor

As originally evaluated in the SECOR RBCA (SECOR, 1999), the HI and cancer risk for the hypothetical onsite indoor commercial worker receptor were 0.08 and 5×10^{-6} respectively (Table 4-7 of Attachment 2). With the addition of the June 1991 and November 1993 soil data, the revised HI and cancer risk for this receptor are 0.2 and 1×10^{-5}, respectively (Table 4-7 of Attachment 3). The additional soil data results in a higher cancer risk estimate for this receptor equal to the CalEPA threshold level of concern (1×10^{-5}; California Health and Welfare Agency, 1988). Estimated HIs under both the original and the revised scenario are below the USEPA (1989) threshold level of concern (1). multipathway

Hypothetical Onsite Construction Worker Receptor

As originally evaluated, the HI and cancer risk for the hypothetical onsite indoor commercial worker receptor were 5 and 1×10^{-5}, respectively (Table 4-7 of Attachment 2). With the addition of the June 1991 and November 1993 soil data, the revised HI and cancer risk for this receptor are 20 and 5×10^{-5}, respectively (Table 4-7 of Attachment 3). Under both the original and the revised scenarios, the HI and cancer risk exceed the USEPA (1989) and CalEPA (California Health and Welfare Agency, 1988) threshold levels of concern for noncancer effects (1) and cancer risks (10^{-5}).

Soil Screening Target Levels

Under both the original and revised case, benzene remains the only Site-related chemical associated with the majority of the estimated HI and cancer risk for both the hypothetical onsite indoor commercial worker and the onsite construction worker receptor. The soil and groundwater site-specific target levels (SSTLs) for benzene remain 2 milligrams per kilogram (mg/kg) and 0.16 milligrams per liter (mg/L), respectively (SECOR, 1999).

Actual versus Estimated Impacts

The results of RBCA (under both the original and revised scenarios) is based on the following key conservative assumptions:

- COPCs at the Site are present at the historical maximum detected concentrations;
- COPCs are present at concentrations equivalent to those observed as far back as 1991 (i.e., no degradation has occurred); and
- An office building will be located directly over the highest concentrations of benzene detected.

Because it is unlikely that any of the above listed conditions exist, actual health impacts at the Site are (very) likely to be lower than those estimated in this RBCA.

Risk Management Plan

Based on the evaluation of the additional soil samples, the Risk Management Plan presented in the original RBCA (SECOR, 1999) addresses potential exposure risks to onsite construction workers and, therefore, does not require revision.

If you have any questions regarding the information provided in this letter, please feel free to contact either Daniel Lee or Mark Stelljes (925-686-9780).

Sincerely,

Daniel Lee, M.P.H.
Senior Risk Assessment Scientist

Mark E. Stelljes

Mark Stelljes, PhD.
Principal Toxicologist

Rosemary Wood for
William E. Brasher, P.E.
Project Manager

cc: Christopher Rants, Metz Baking Company
Dave Graves, Interstate Brands

References

California Health and Welfare Agency (HWA), 1988. California Code of Regulations, Division 2, Chapter 3, California State Drinking Water and Toxic Enforcement Action of 1989. Article 8, Section 12711 et. Seq.

SECOR International Inc., 1999. Tier I and Tier II Risk-Based Corrective Action Evaluation. Metz Baking Company, 580 Julie Ann Way Oakland, CA. SECOR Project No. 005.02811.005.

SECOR International Inc., 2000. Correspondence between Bill Brasher and the Oakland Zoning Department. February 2.

United States Environmental Protection Agency (USEPA), 1989. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A), Interim Final. Office of Emergency and Remedial Response, Washington, D.C., EPA/540/1-89/002, July.

ATTACHMENT 1

LETTER FROM BARNEY M. CHAN TO CHRISTOPHER RANTS,

DECEMBER 21, 1999

ALAMEDA COUNTY
HEALTH CARE SERVICES
AGENCY
DAVID J. KEARS, Agency Director

ENVIRONMENTAL HEALTH SERVICES
ENVIRONMENTAL PROTECTION
1131 Harbor Bay Parkway
Alameda, CA 94502-6577
(510) 567-6700
(510) 337-9432

December 21, 1999
StID #4008

Mr. Christopher Rants
P.O. Box 448
Sioux City, Iowa, 51102

Re: Tier 1 and Tier 2 RBCA Evaluation for 580 Julie Ann Way, Oakland CA 94621

Dear Mr. Rants:

Our office has received and reviewed the December 7, 1999 Tier I and Tier II RBCA Evaluation prepared by SECOR International (SECOR), your consultant. I have also spoken with Mr. Brasher regarding my concerns. The general approach taken in this evaluation is acceptable, however, it appears that the soil data has not included two soil samples, SB-F @7' and SB-G@ 5.5', both of which reported elevated benzene concentrations at 28 and 24 ppm, respectively. You should include these data points in your evaluation and issue an addendum or justify why these data points are not valid.

In addition, although the site is not foreseen to be residential in the future, please verify the property's zoning. Should residential be possible, please include either a residential exposure in the RBCA evaluation or make note of the need to evaluate this exposure pathway if future land use changes. This notice should be included in the Risk Management Plan.

Please provide your written response to these items within 45 days or no later than February 8, 2000.

You may contact me at (510) 567-6765 if you have any questions.

Sincerely,

Barney M. Chan

Barney M. Chan
Hazardous Materials Specialist

C: B. Chan, files
Mr. K. Krantz, Interstate Brands West, 580 Julie Ann Way, Oakland CA 94621
✓ Mr. Willliam Brasher, SECOR International Inc., 360 22nd St., Oakland 94612-3019

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ATTACHMENT 2

REPLACEMENT PAGES FOR THE DECEMBER 7^{TH} 1999 RBCA

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Ettinger (1991). Chemical concentrations in outdoor air were estimated using the box model as described by USEPA, 1991; Dobbins, 1979, and CalEPA 1994a. All modeling inputs, outputs, and equations used to estimate chemical concentrations in indoor and outdoor air are presented in Appendix B. All EPCs used in this assessment are summarized in Table 4-5.

EPCs were then combined with intake/exposure factors to estimate daily doses. These doses were then used to estimate noncancer effects (hazard quotients [HQs] for individual chemicals and hazard indices [HIs] for multichemical and multipathway exposures) and cancer risks based on the methods outlined by USEPA (1989). Daily doses are summarized in Appendix C for the hypothetical onsite indoor commercial worker receptor and in Appendix D for the hypothetical onsite construction worker receptor. The daily dose resulting from dermal exposure to chemicals in groundwater requires development of an absorbed dose, which is different from the dose estimates derived for the ingestion and inhalation exposure pathways. The absorbed dose (DA_{event}) for each chemical in groundwater was calculated using methods consistent with USEPA (1992) which are summarized in Table 4-6. These DA_{event} terms are then used in the exposure equations as summarized in Appendix D.

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4.5 RESULTS OF THE TIER II EVALUATION

This section summarizes the results of the Tier II RBCA for the hypothetical onsite indoor commercial worker (Section 4.5.1) and onsite construction worker receptor (Section 4.5.2).

4.5.1 Hypothetical Onsite Indoor Commercial Worker Receptor

The estimated noncancer multipathway HI and the total excess cancer risk for this hypothetical receptor are 0.08 and 5 x 10^{-6}, respectively. In both cases, these values are well below the USEPA and CalEPA threshold levels of 1 (USEPA, 1989; CalEPA, 1992). The cancer risk is also below the State of California's threshold level of 1 x 10^{-5} for workers (California Health and Welfare Agency, 1988). Pathway-specific HIs and cancer risks estimated for this receptor are summarized in Table 4-7. Individual and chemical-specific HQs and cancer risks are provided in Appendix C.

4.5.2 Hypothetical Onsite Construction Worker Receptor

The estimated noncancer multipathway HI and the total excess cancer risk for this hypothetical receptor are 5 and 1 x 10^{-5}, respectively. The HI exceeds the USEPA and CalEPA threshold level of 1 (USEPA, 1989; CalEPA, 1992). The cancer risk estimate is equal to the California cancer risk threshold of 1 x 10^{-5} for workers (California, 1988). Exposures associated with the inhalation of benzene vapors emanating from soil (Table D-4) and dermal contact with benzene in groundwater (Table D-5) account for virtually

Table 4-5.
Exposure Point Concentrations for the Chemicals Evaluated Under the Tier II RBCA Evaluation[a]
Metz Baking Company Risk-Based Corrective Action Evaluation
580 Julie Ann Way
Oakland, California
Project No. 005.02811.002

COPC	Construction Worker Receptor					Indoor Commercial Worker Receptor	
			Outdoor Air			Indoor Air	
	Soil (mg/kg)[b]	Groundwater (mg/L)[c]	From Soil (mg/m³)[d]	From Groundwater (mg/m³)	Dust-in-Air (mg/m³)	From Soil (mg/m³)	From Groundwater (mg/m³)
Volatile Organic Compounds							
Benzene	5.1	0.270	6 15E-02	3 77E-03	--[f]	7 20E-04	1 12E-03
Methyl Tert Butyl Ether	--	0.060	--	8 86E-05	--	--	3 50E-04
Semi-Volatile Organic Compounds							
Naphthalene	NSC[e]	0 26	--	--	--		
2-Methylnaphthalene	3.6	0.093	--	--	2.74E-09		

Footnotes:

[a] These outdoor and indoor air concentrations account for concentrations of chemicals of potential concern (COPCs) in either soil or groundwater. In all cases vapor fluxes were estimated separately for COPCs detected in both soil and groundwater.

[b] mg/kg = milligrams per kilogram.

[c] mg/L = milligrams per liter.

[d] mg/m^3 = milligrams per cubic meter.

[e] Chemical not identified as a COPC for this medium.

[f] Not applicable for this chemical and medium

Table 4-7.
Summary of Noncancer Adverse Health Effects and Excess Cancer Risks for Hypothetical Onsite Receptors
Metz Baking Company Risk-Based Corrective Action Evaluation
580 Julie Ann Way
Oakland, California
Project No. 005.02811.002

Exposure Pathway	Hypothetical Potential Receptors			
			Onsite	
	Indoor Commercial Worker Receptor		Onsite Construction Worker Receptor	
	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Soil				
Incidental Ingestion of Soil	- -[a]	- -	3 E-03	1 E-08
Dermal Contact with Soil	- -	- -	8 E-04	4 E-09
Inhalation of Fugitive Dust	- -	- -	2 E-16	- -
Inhalation of Vapors Emanating from Soil	3 E-02	2 E-06	3 E+00	7 E-06
Multipathway Total for Soil	**3 E-02**	**2 E-06**	**3 E+00**	**7 E-06**
Groundwater				
Dermal Contact with Groundwater	- -	- -	2 E+00	7 E-06
Inhalation of Vapors Emanating From Groundwater	5 E-02	3 E-06	2 E-01	4 E-07
Multipathway Total for Groundwater	**5 E-02**	**3 E-06**	**2 E+00**	**8 E-06**
Total Multipathway	**8 E-02**	**5 E-06**	**5 E+00**	**1 E-05**

for 5ppm Benzene
revised [illegible] data

Footnote:
[a] "- -" = Not applicable.

Table C-1. Risk Characterization for the Hypothetical Onsite Indoor Commercial Worker Receptor Inhalation of Chemical Vapors Volatilizing from Soil Metz Baking Company Risk-Based Corrective Action Evaluation 580 Julie Ann Way Oakland, California Project No. 005.02811.002

Pathway: Inhalation of Chemical Vapors Volatilizing from Soil[a]

Chronic Daily Intake (CDI)[b] = (Cas_in x InR x ET x EF x ED) / (BW x AT)

Chemical	Noncarcinogenic Effects			Carcinogenic Effects		
	CDI (mg/kg-day)[c]	Inhalation Reference Dose (RfDi) (mg/kg-day)	Hazard Quotient (HQ) (unitless)	CDI (mg/kg-day)	Inhalation Slope Factor (SFi) $(mg/kg\text{-}day)^{-1}$	Excess Cancer Risk (unitless)
Volatile Organic Compounds						
Benzene	5.6E-05	1.7E-03	3 E-02	2.0E-05	1.0E-01	2 E-06
		Total Hazard Index =	3 E-02	**Total Excess Cancer Risk =**		2 E-06

Footnotes:

[a] For the purposes of this assessment, it is assumed that this receptor will be exposed to chemical vapors volatilizing from the subsurface soil.

[b] Refer to Table 4-1 for explanation of acronyms used in equation.

[c] mg/kg-day = milligrams per kilogram body weight per day.

[d] "- -" = Not applicable.

Table C-2. Risk Characterization for the Hypothetical Onsite Indoor Commercial Worker Receptor Inhalation of Chemical Vapors Volatilizing from Groundwater Metz Baking Company Risk-Based Corrective Action Evaluation 580 Julie Ann Way Oakland, California Project No. 005.02811.002

Pathway: Inhalation of Chemical Vapors Volatilizing from Groundwater[a]

Chronic Daily Intake (CDI)[b] = (Cas_in x InR x ET x EF x ED) / (BW x AT)

Chemical	Noncarcinogenic Effects			Carcinogenic Effects		
	CDI (mg/kg-day)[c]	Inhalation Reference Dose (RfDi) (mg/kg-day)	Hazard Quotient (HQ) (unitless)	CDI (mg/kg-day)	Inhalation Slope Factor (SFi) $(mg/kg\text{-}day)^{-1}$	Excess Cancer Risk (unitless)
Volatile Organic Compounds						
Benzene	8.8E-05	1.7E-03	5 E-02	3.1E-05	1.0E-01	3 E-06
Methyl-tert-butyl ether	2.7E-05	8.0E-01	3 E-05	9.8E-06	- -	- -
		Total Hazard Index =	5 E-02		**Total Excess Cancer Risk =**	3 E-06

Footnotes:

[a] For the purposes of this assessment, it is assumed that this receptor will be exposed to chemical vapors volatilizing from groundwater up through the subsurface soil.

[b] Refer to Table 4-1 for explanation of acronyms used in equation.

[c] mg/kg-day = milligrams per kilogram body weight per day.

[d] "- -" = Not applicable.

Table D-5. Risk Characterization for the Hypothetical Onsite Outdoor Construction Worker Receptor Dermal Contact with Groundwater Metz Baking Company Risk-Based Corrective Action Evaluation 580 Julie Ann Way Oakland, California Project No. 005.02811.002

Pathway: Dermal Contact with Groundwater

Chronic Daily Intake (CDI)[a] = (DAevent_gw x SA x EF x ED) / (BW x AT)

Chemical	Noncarcinogenic Effects			Carcinogenic Effects		
	CDI (mg/kg-day)[b]	Subchronic Oral Reference Dose (RfDo) (mg/kg-day)	Hazard Quotient (HQ) (unitless)	CDI (mg/kg-day)	Oral Slope Factor (SFo) $(mg/kg\text{-}day)^{-1}$	Excess Cancer Risk (unitless)
Volatile Organic Compounds						
Benzene	5.1E-03	3.0E-03	2 E+00	7.3E-05	1.0E-01	7 E-06
Methyl-tert-butyl ether	1.8E-04	8.0E-01	2 E-04	2.5E-06	- -e	- -
Semi-Volatile Organic Compounds						
Naphthalene	3.0E-03	2.0E-01	1 E-02	4.2E-05	- -	- -
2-Methylnaphthalene	1.1E-03	2.0E-01	5 E-03	1.5E-05	- -	- -
		Total Hazard Index =	2 E+00	**Total Excess Cancer Risk =**		7 E-06

Footnotes:

[a] Refer to Table 4-1 for explanation of acronyms used in equation.

[b] mg/kg-day = milligrams per kilogram body weight per day.

[c] "- -" = Not applicable.

Table D-6. Risk Characterization for the
Hypothetical Onsite Outdoor Construction Worker Receptor
Inhalation of Chemical Vapors Volatilizing from Groundwater
Metz Baking Company Risk-Based Corrective Action Evaluation
580 Julie Ann Way
Oakland, California
Project No. 005.02811.002

Pathway: Inhalation of Chemical Vapors Volatilizing from Groundwater

Chronic Daily Intake (CDI)[a] = (Caw_out x InR x ET x EF x ED) / (BW x AT)

Chemical	Noncarcinogenic Effects			Carcinogenic Effects		
	CDI (mg/kg-day)[b]	Subchronic Inhalation Reference Dose (RfDi) (mg/kg-day)	Hazard Quotient (HQ) (unitless)	CDI (mg/kg-day)	Inhalation Slope Factor (SFi) (mg/kg-day)$^{-1}$	Excess Cancer Risk (unitless)
Volatile Organic Compounds						
Benzene	2.9E-04	1.7E-03	0.172254905	4.2E-06	1.0E-01	4.18333E-07
Methyl-tert-butyl ether	6.9E-06	8.0E-01	8.61193E-06	9.8E-08	- -	- -
		Total Hazard Index =	2 E-01		**Total Excess Cancer Risk =**	4 E-07

Footnotes:

[a] Refer to Table 4-1 for explanation of acronyms used in equation.

[b] mg/kg-day = milligrams per kilogram body weight per day.

ATTACHMENT 3
REVISED TABLES REFLECTING THE INCLUSION OF SOIL DATA COLLECTED IN JUNE 1991 AND NOVEMBER 1993

NOTE:

FOR DIRECT COMPARISON PURPOSES, TABLE NUMBERS OF MATERIALS IN ATTACHMENT 3 ARE IDENTICAL TO THOSE PRESENTED IN THE DECEMBER 7TH RBCA

TABLE A-1-New Soil Data
SOIL ANALYTICAL RESULTS
tz Baking Company Risk-Based Corrective Action Evaluation
580 Julie Ann Way
Oakland, California
Project No. 005 02811 002

	Benzene		Toluene		Ethylbenzene		Xylenes		MTBE[e]		TOC[f]		PAH[g]	Naphthalene	2-Methylnaphthalene	Di-n-Butylphthalate
	0 17	0 17	0 03	0 03	1 3	1.3	0.84	0 84						3 3	3 6	0 76
	0 13	0 13	0 02	0 02	0.57	0 57	1 8	1 8								
	ND	0 0025	ND	0 0025	ND	0 0025	0 01	0.01								
	ND	0 0025	0 049	0 049	0 046	0.046	0 072	0 072								
	2 1	2.1	ND	0 31	ND	0.31	1 2	1 2	ND	0 31			ND[i]			
	ND	0 0025	ND	0 0025	ND	0 0025	ND	0.0025	ND	0.0025			ND[i]			
	ND	0 0025	ND	0.0025	ND	0 0025	ND	0.0025	ND	0 0025	6,220	6,220	ND[i]			
											7,310	7,310				
											778	778				
0	5 1	5 1	1 4	1 4	3 3	3.3	12	12								
00	0 75	0 75	0 084	1 4	0 35	0 35	0.35	0.35								
7	1 1	1 1	0 17	0.17	0 48	0 48	1 3	1 3								
8	0 75	0 75	0 010	0 010	0 043	0 043	0 063	0 063								
0	0 034	0.034	ND	0 005	0 10	0 10	0.22	0 22								
00	0 59	0 59	0 59	0 59	0 38	0 38	1 2	1 2								
	3	3														
	3	3														
	1	1														
	1	1														
	0 02	0 02														
	28	28														
4	0 098	0 098	0 031	0.031	ND	0 0025	ND	0 0025								
00	24	24	4.9	4.9	58	58	230	230								
30	0 006	0 003	0 099	0.099	0 14	0.14	0 17	0 17								
30	0 2	0 2	0 072	0 072	0 11	0.11	0 45	0 45								
00	ND	0.0025	0.14	0 14	ND	0.0025	ND	0 0025								
70	ND	0.0025	0.049	0.049	ND	0.0025	ND	0 0025								
00	ND	0.0025	0.065	0 065	ND	0.0025	ND	0 0025								
90	ND	0 0025	0 24	0 24	ND	0 0025	0 010	0 010								
00	ND	0.0025	1.3	1 3	ND	0 0025	0 008	0 008								
	28		**5**		**58**		**230**		**ND**			**7310.00**	**0.00**	**3.3**	**3.6**	**0.76**
	0 006		**0.02**		**0.043**		**0.008**		**ND**					**3.3**	**3.6**	
	1.192		**0 335**		**0.809**		**1.732**		**ND**			**4769 33**		**3.3**	**3.6**	**0.76**

Table 4-5-New Soil Data.
Exposure Point Concentrations for the Chemicals Evaluated Under the Tier II RBCA Evaluation[a]
Metz Baking Company Risk-Based Corrective Action Evaluation
580 Julie Ann Way
Oakland, California
Project No. 005.02811.002

	Construction Worker Receptor					Indoor Commercial Worker Receptor	
			Outdoor Air			Indoor Air	
COPC	Soil (mg/kg)[b]	Groundwater (mg/L)[c]	From Soil (mg/m³)[d]	From Groundwater (mg/m³)	Dust-in-Air (mg/m³)	From Soil (mg/m³)	From Groundwater (mg/m³)
Volatile Organic Compounds							
Benzene	28	0.270	3.38E-01	3.77E-03	- -[f]	3 95E-03	1.12E-03
Methyl Tert Butyl Ether	- -	0 060	- -	8.86E-05	- -	- -	3.50E-04
Semi-Volatile Organic Compounds							
Naphthalene	NSC[a]	0 26	- -	- -	- -		
2-Methylnaphthalene	3.6	0.093	- -	- -	2.74E-09		

Footnotes:

[a] These outdoor and indoor air concentrations account for concentrations of chemicals of potential concern (COPCs) in either soil or groundwater. In all cases vapor fluxes were estimated separately for COPCs detected in both soil and groundwater.

[b] mg/kg = milligrams per kilogram.

[c] mg/L = milligrams per liter.

[d] mg/m^3 = milligrams per cubic meter.

[e] Chemical not identified as a COPC for this medium.

[f] Not applicable for this chemical and medium

Table 4-7-New Soil Data.
Summary of Noncancer Adverse Health Effects and Excess Cancer Risks for Hypothetical Onsite Receptors
Metz Baking Company Risk-Based Corrective Action Evaluation
580 Julie Ann Way
Oakland, California
Project No. 005.02811.002

Exposure Pathway	Hypothetical Potential Receptors			
			Onsite	
	Indoor Commercial Worker Receptor		Onsite Construction Worker Receptor	
	Hazard Index	Cancer Risk	Hazard Index	Cancer Risk
Soil				
Incidental Ingestion of Soil	- -[a]	- -	2 E-02	7 E-08
Dermal Contact with Soil	- -	- -	5 E-03	2 E-08
Inhalation of Fugitive Dust	- -	- -	2 E-16	- -
Inhalation of Vapors Emanating from Soil	2 E-01	1 E-05	2 E+01	4 E-05
Multipathway Total for Soil	**2.E-01**	**1.E-05**	**2.E+01**	**4.E-05**
Groundwater				
Dermal Contact with Groundwater	- -	- -	2.E+00	7.E-06
Inhalation of Vapors Emanating From Groundwater	5 E-02	3.E-06	2.E-01	4.E-07
Multipathway Total for Groundwater	**5.E-02**	**3.E-06**	**2.E+00**	**8.E-06**
Total Multipathway	**2.E-01**	**1.E-05**	**2.E+01**	**5.E-05**

Footnote:
[a] "- -" = Not applicable.

Table C-1-New Soil Data. Risk Characterization for the Hypothetical Onsite Indoor Commercial Worker Receptor Inhalation of Chemical Vapors Volatilizing from Soil *Metz Baking Company Risk-Based Corrective Action Evaluation* 580 Julie Ann Way Oakland, California Project No. 005.02811.002

Pathway: Inhalation of Chemical Vapors Volatilizing from Soil[a]

Chronic Daily Intake (CDI)[b] = (Cas_in x InR x ET x EF x ED) / (BW x AT)

Chemical	Noncarcinogenic Effects			Carcinogenic Effects		
	CDI (mg/kg-day)[c]	Inhalation Reference Dose (RfDi) (mg/kg-day)	Hazard Quotient (HQ) (unitless)	CDI (mg/kg-day)	Inhalation Slope Factor (SFi) $(mg/kg\text{-}day)^{-1}$	Excess Cancer Risk (unitless)
Volatile Organic Compounds						
Benzene	3.1E-04	1.7E-03	2 E-01	1.1E-04	1.0E-01	1 E-05
		Total Hazard Index =	2 E-01		Total Excess Cancer Risk =	1 E-05

Footnotes:

[a] For the purposes of this assessment, it is assumed that this receptor will be exposed to chemical vapors volatilizing from the subsurface soil.

[b] Refer to Table 4-1 for explanation of acronyms used in equation.

[c] mg/kg-day = milligrams per kilogram body weight per day.

[d] "- -" = Not applicable.

Table C-2-New Soil Data. Risk Characterization for the Hypothetical Onsite Indoor Commercial Worker Receptor Inhalation of Chemical Vapors Volatilizing from Groundwater *Metz Baking Company* Risk-Based Corrective Action Evaluation 580 Julie Ann Way Oakland, California Project No. 005.02811.002

Pathway: Inhalation of Chemical Vapors Volatilizing from Groundwater[a]

Chronic Daily Intake (CDI)[b] = (Cas_in x InR x ET x EF x ED) / (BW x AT)

Chemical	Noncarcinogenic Effects			Carcinogenic Effects		
	CDI (mg/kg-day)[c]	**Inhalation Reference Dose (RfDi)** (mg/kg-day)	**Hazard Quotient (HQ)** (unitless)	**CDI** (mg/kg-day)	**Inhalation Slope Factor (SFi)** $(mg/kg\text{-}day)^{-1}$	**Excess Cancer Risk** (unitless)
Volatile Organic Compounds						
Benzene	8.8E-05	1.7E-03	5 E-02	3.1E-05	1.0E-01	3 E-06
Methyl-tert-butyl ether	2.7E-05	8.0E-01	3 E-05	9.8E-06	- -	- -
		Total Hazard Index =	5 E-02		**Total Excess Cancer Risk =**	3 E-06

Footnotes:

[a] For the purposes of this assessment, it is assumed that this receptor will be exposed to chemical vapors volatilizing from groundwater up through the subsurface soil.

[b] Refer to Table 4-1 for explanation of acronyms used in equation.

[c] mg/kg-day = milligrams per kilogram body weight per day.

[d] "- -" = Not applicable.

Table D-5-New Soil Data. Risk Characterization for the Hypothetical Onsite Outdoor Construction Worker Receptor Dermal Contact with Groundwater Metz Baking Company Risk-Based Corrective Action Evaluation 580 Julie Ann Way Oakland, California Project No. 005.02811.002

Pathway: Dermal Contact with Groundwater

Chronic Daily Intake (CDI)[a] = (DAevent_gw x SA x EF x ED) / (BW x AT)

Chemical	Noncarcinogenic Effects			Carcinogenic Effects		
	CDI (mg/kg-day)[b]	Subchronic Oral Reference Dose (RfDo) (mg/kg-day)	Hazard Quotient (HQ) (unitless)	CDI (mg/kg-day)	Oral Slope Factor (SFo) $(mg/kg\text{-}day)^{-1}$	Excess Cancer Risk (unitless)
Volatile Organic Compounds						
Benzene	5.1E-03	3.0E-03	2 E+00	7.3E-05	1.0E-01	7 E-06
Methyl-tert-butyl ether	1.8E-04	8.0E-01	2 E-04	2.5E-06	- -e	- -
Semi-Volatile Organic Compounds						
Naphthalene	3.0E-03	2.0E-01	1 E-02	4.2E-05	- -	- -
2-Methylnaphthalene	1.1E-03	2.0E-01	5 E-03	1.5E-05	- -	- -
		Total Hazard Index =	2 E+00		**Total Excess Cancer Risk =**	7 E-06

Footnotes:

[a] Refer to Table 4-1 for explanation of acronyms used in equation.

[b] mg/kg-day = milligrams per kilogram body weight per day.

[c] "- -" = Not applicable.

Table D-6-New Soil Data. Risk Characterization for the Hypothetical Onsite Outdoor Construction Worker Receptor Inhalation of Chemical Vapors Volatilizing from Groundwater Metz Baking Company Risk-Based Corrective Action Evaluation 580 Julie Ann Way *Oakland, California* Project No. 005.02811.002

Pathway: Inhalation of Chemical Vapors Volatilizing from Groundwater

Chronic Daily Intake (CDI)[a] = (Caw_out x InR x ET x EF x ED) / (BW x AT)

Chemical	Noncarcinogenic Effects			Carcinogenic Effects		
	CDI (mg/kg-day)[b]	Subchronic Inhalation Reference Dose (RfDi) (mg/kg-day)	Hazard Quotient (HQ) (unitless)	CDI (mg/kg-day)	Inhalation Slope Factor (SFi) $(mg/kg\text{-}day)^{-1}$	Excess Cancer Risk (unitless)
<u>**Volatile Organic Compounds**</u>						
Benzene	2.9E-04	1.7E-03	0.172254905	4.2E-06	1.0E-01	4.18333E-07
Methyl-tert-butyl ether	6.9E-06	8.0E-01	8.61193E-06	9.8E-08	- -	- -
		Total Hazard Index =	2 E-01		**Total Excess Cancer Risk =**	4 E-07

Footnotes:

[a] Refer to Table 4-1 for explanation of acronyms used in equation.

[b] mg/kg-day = milligrams per kilogram body weight per day.

Table B-1. New Soil Data

Vapor Flux from Soil at Soil Surface for the Hypothetical Onsite Indoor Commercial Worker Receptor [a]

Metz Baking Company Risk-Based Corrective Action Evaluation

580 Julie Ann Way

Oakland, California

Project No. 005.02811.002

Parameter definition	Units	Symbol	Benzene
Maximum detected concentration in soil[b]	mg/kg	C_s	28.0
Air-filled porosity [c]	--	θ_a	0.28
Water-filled porosity [c]	--	θ_w	0.15
Total soil porosity [c,d]	--	n	0 43
Chemical diffusivity in air [c]	cm^2/sec	D_i	8.80E-02
Dimensionless Henry's Law constant [c]	--	H'	2 28E-01
Chemical diffusivity in water [c]	cm^2/sec	D_w	9.80E-06
Dry soil bulk density [c]	g/cm^3	ρ_b	1.50
Soil particle density [c]	g/cm^3	ρ_s	2 65
Soil organic carbon partition coefficient [c]	cm^3/g	K_{oc}	3 07E+03
Fraction of organic carbon in soil [c]	g/g	f_{oc}	0.006
Soil-water partition coefficient [e]	cm^3/g	K_d	1.84E+01
Exposure interval [f]	secs	T	7.88E+08
Apparent diffusivity[g]	cm^2/sec	D_A	5.78E-05
Vapor flux at soil surface from shallow soils[g]	**mg/m^2-sec**	**F**	**1.28E-04**

Footnotes:

[a] Chemical vapor flux at soil surface from volatilization is based on Jury et al (1984) model, as described in Soil Screening Guidance User's Guide (USEPA, 1996c)

[b] From Table 4-5.

[c] Chemical and default soil properties were obtained from USEPA Soil Screening Guidance User's Guide (USEPA, 1996c)

[d] $(1 - (\rho_b / \rho_s))$

[e] $K_{oc} \times f_{oc}$

[f] Represents the number of seconds in 25 years of exposure

[g] $[(\theta_a^{10/3} \times D_i \times H' + \theta_w^{10/3} \times D_w) / n^2] / (\rho_b \times K_d + \theta_w + \theta_a \times H')$.

[h] $[C_s \times ((2 \times \rho_b \times D_A) / (3\ 14 \times D_A \times T)^{1/2} \times 10^{-4}))] \times 0\ 001$ kg soil/g soil

References:

Jury, W.A., W J Farmer, and W F Spencer 1984. Behavior Assessment Model for Trace Organics in Soil: II Chemical Classification and Parameter Sensitivity J Environ. Qual. 13(4):567-572

Mackay, D , W Y Shiu, and K C Ma 1992. Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals, Vol I, Monoaromatic Hydrocarbons, Chlorobenzenes, and PCBs Lewis Publishers, Inc , Chelsea, Michigan

Mackay, D , W Y Shiu, and K C Ma 1993. Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals, Vol. III, Volatile Organic Compounds. Lewis Publishers, Inc., Chelsea, Michigan

USEPA. 1996c Soil Screening Guidance User's Guide

Table B-2. New Soil Data
Estimated Indoor Chemical Vapor Air Concentrations
from Soil for the Hypothetical Onsite Indoor Commercial Worker Receptor[a]
Metz Baking Company Risk-Based Corrective Action Evaluation
580 Julie Ann Way
Oakland, California
Project No. 005.02811.002

Parameter Definition	Units[b]	Symbol	Benzene
Estimated vapor flux at soil surface from soil[c]	mg/sec-m²	F	1.28E-04
Aerial fraction of cracks in concrete slab-on-grade foundation[d]	--	Fc	1 00E-02
Sensitivity of crack fraction to vapor retardation[e]	--	Sc	5.00E-01
Adjusted vapor flux at building floor surface[f]	mg/sec-m²	F"	2.57E-06
Volumetric flow rate for infiltration air per unit area[g]	L/sec-m²	Q	6 49E-01
Unit conversion factor	m³/L	CF	1.00E-03
Volumetric flow rate for infiltration air per unit area[h]	m³/sec-m²	Q'	6.49E-04
Concentration of chemical in indoor air[i]	mg/m³	C_{in}	3.95E-03

Footnotes:

[a] Model for estimating chemical vapors in indoor air from ASTM, 1995, Wadden and Scheff, 1983; Johnson and Ettinger, 1991.

[b] mg/sec-m² = milligrams per second per square meter; L/sec-m² = liters per second per square meter, m³/L = cubic meters per liter; m³/sec-m² = cubic meters per second per square meter; mg/m³ = milligrams per cubic meter.

[c] From Table B-1.

[d] Default value from ASTM, 1995.

[e] Based on Johnson and Ettinger (1991) for medium permeability vadose soils The vadose soil type is characterized as "sandy silty clays" (SECOR, 1

[f] (F' x [Fc/ Sc]).

[g] Value based on the average of ASHRAE's reported range of 0.75 to 2 cfm/ft², which was multiplied by 0.472 to obtain a value of 0.649

[h] (Q x CF).

[i] (F" / Q').

References:

American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). 1999. ASHRAE Handbook Heating, Ventilating, and Air

American Society for Testing and Materials (ASTM) 1995. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites. Designation E 1739-95.American Society for Testing and Materials, West Conshohocken, PA. November.

Johnson and Ettinger. 1991. Heuristic Model for Predicting the Intrusion Rate of Contaminated Vapors into Buildings P.C Johnson and R A. Ettinger, Environ. Sci. Technol.25 1445-1452.

SECOR International, Inc. 1999. Quarterly Groundwater Monitoring Report for First Quarter 1999, 580 Julie Ann Way, Oakland, CA,

Wadden and Scheff. 1983. Air Quality Models Chapter 6 in Indoor Air Pollution. R A. Wadden and P.A. Scheff, J Wiley & Sons, Interscience

American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). 1989 ASHRAE Standard Ventilation for Acceptable Indoor Air Quality. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., Atlanta, GA. ASHRAE 62-1989.

Table B-3. New Soil Data
Estimated Vapor Flux at Soil Surface for Hypothetical Onsite Construction Worker Receptor [a]
Metz Baking Company Risk-Based Corrective Action Evaluation
580 Julie Ann Way
Oakland, California
Project No. 005.02811.002

Parameter definition	Units	Symbol	Benzene
Maximum Detected Concentration in soil [b]	mg/kg	C_s	28.0
Air-filled porosity [c]	--	θ_a	0.28
Water-filled porosity [d]	--	θ_w	0.15
Total soil porosity [e,f]	--	n	0.43
Chemical diffusivity in air [c]	cm^2/sec	D_i	8.80E-02
Dimensionless Henry's Law constant [c]	--	H'	2.28E-01
Chemical diffusivity in water [c]	cm^2/sec	D_w	9.80E-06
Dry soil bulk density [c]	g/cm^3	ρ_b	1.50
Soil particle density [c]	g/cm^3	ρ_s	2.65
Soil organic carbon partition coefficient [c]	cm^3/g	K_{oc}	3.07E+03
Fraction of organic carbon in soil [c]	g/g	f_{oc}	0.006
Soil-water partition coefficient [e]	cm^3/g	K_d	1.84E+01
Exposure interval [f]	secs	T	3.15E+07
Apparent diffusivity [g]	cm^2/sec	D_A	5.78E-05
Vapor flux at soil surface [h]	**mg/m^2-sec**	F	**6.42E-04**
Agitation factor [j]	--	AF	37
Adjusted vapor flux at soil surface from shallow soils [k]	**mg/m^2-sec**	F'	**2.37E-02**

Footnotes:

[a] Chemical vapor flux at soil surface from volatilization is based on Jury et al (1984) model, as described in Soil Screening Guidance. User's Guide (USEPA, 1996c).

[b] From Table 4-5.

[c] Chemical and default soil properties were obtained from USEPA Soil Screening Guidance User's Guide (USEPA, 1996c),

[d] $(1 - (\rho_b / \rho_s))$

[e] $K_{oc} \times f_{oc}$

[f] Represents the number of seconds in 1 year of exposure.

[g] $[(\theta_a^{10/3} \times D_i \times H' + \theta_w^{10/3} \times D_w) / n^2] / (\rho_b \times K_d + \theta_w + \theta_a \times H')$

[h] $[C_s \times ((2 \times \rho_b \times D_A) / (3.14 \times D_A \times T)^{1/2} \times 10^{-4}))] \times 0.001$ kg soil/g soil

[i] The average agitation factor of 37 was used to represent construction worker soil handling (USEPA, 1989a).

[j] (AF x F)

References:

Jury, W.A., W J. Farmer, and W.F. Spencer. 1984. Behavior Assessment Model for Trace Organics in Soil. II. Chemical Classification and Parameter Sensitivity. J. Environ. Qual. 13(4).567-572.

Mackay, D., W.Y. Shiu, and K.C. Ma. 1992. Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals, Vol. I, Monoaromatic Hydrocarbons, Chlorobenzenes, and PCBs. Lewis Publishers, Inc , Chelsea, Michigan.

Mackay, D., W.Y Shiu, and K.C. Ma. 1993. Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals, Vol III, Volatile Organic Compounds. Lewis Publishers, Inc , Chelsea, Michigan.

USEPA. 1988. Superfund Exposure Assessment Manual.

USEPA. 1989a. Air/Superfund National Technical Guidance Study Series, Vol. III - Estimation of Air Emissions from Cleanup Activities at Superfund Sites

USEPA. 1996c. Soil Screening Guidance: User's Guide.

Table B-4. New Soil Data
Concentration in Ambient Air from Soils
for the Hypothetical Onsite Construction Worker Receptor[a]

Metz Baking Company Risk-Based Corrective Action Evaluation
580 Julie Ann Way
Oakland, California
Project No. 005.02811.002

Parameter definition	Units	Symbol	Benzene
Adjusted vapor flux at soil surface from shallow soils [b]	mg/sec-m^2	F'	2.37E-02
Area of source [c]	m^2	A	80
Length dimension perpendicular to the wind [d]	m	LS	12.5
Wind speed [e]	m/sec	V	0.225
Ambient air mixing zone [f]	m	MH	2
Concentration of chemical in ambient air [g]	**mg/m^3**	**C_a**	**3.38E-01**

Footnotes:

[a] Concentration in ambient air is evaluated based on the model described in the Preliminary Endangerment Assessment Guidance Manual (California,1994).

[b] Based on adjusted vapor flux at soil surface for the construction worker receptor (Table B-3).

[c] Based on the excavated area of the UST area, 21ft x 41ft (SECOR, 1999).

[d] Estimated based on the area of impacted area (former location of USTs) - 21 ft x 41 ft. Using a conversion factor of 0 305, 41 ft is equal to 12

[e] Estimated based on the largest impacted area assessed, assuming wind direction is west to east. This includes a stagnation factor for the expected lower winds in a trench.

[f] Default value for California (1994).

[g] (F x A) / (LS x V x MH)

References:

California. 1994 Preliminary Endangerment Assessment Guidance Manual. State of California Environmental Protection Agency,

Table B-5. New Soil Data

Emissions of Chemical Vapors from Groundwater for the Hypothetical Onsite Indoor Commercial Worker Receptor[a]

Metz Baking Company Risk-Based Corrective Action Evaluation

580 Julie Ann Way

Oakland, California

Project No. 005.02811.002

Parameter Definition	Units	Symbol	Benzene	Methyl-tert-Butyl Ether
Groundwater concentration[b]	ug/l	Cp	270	60
Temperature of groundwater	degsK	T	293	293
Gas constant	atm-m^3/mole-degK	R	0.000082	0.000082
Dimensionless Henry's Law constant[c]	ug/l//ug/l	H'	2.28E-01	4.22E-01
Soil gas concentration[d]	ug/l	Cm	6.16E+01	2.53E+01
Air diffusion coefficient[c]	cm^2/sec	Di	1.04E-01	7.90E-02
Unit conversion factor	mg-l/ug-cm^3	CF1	1.00E-06	1.00E-06
Soil gas concentration[e]	mg/cm^3	Cm'	6.16E-05	2.53E-05
Air-filled soil porosity[f]	--	Pa	0.28	0.28
Total soil porosity[f]	--	Pt	0.43	0.43
Depth of soil cover[g]	cm	L	140.8176	140.8176
Estimated flux rate at soil surface[h]	mg/cm^2-sec	F	3.63E-09	1.14E-09
Unit conversion factor	cm^2/m^2	CF2	1.00E+04	1.00E+04
Estimated flux rate at soil surface[i]	mg/m^2-sec	F	3.63E-05	1.14E-05

Footnotes:

[a] Model from Karimi et al., 1987, based on Shen's model (Shen, 1981; USEPA, 1988).

[b] Maximum detected chemical concentration. From Table 4-5.

[c] Values from USEPA (1996).

[d] H' x Cp

[e] Cm x CF1

[f] Default screening values (California, 1994).

[g] Average based on SECOR's reported range of 3.52 to 5.79 feet below ground surface (SECOR, 1999)

[h] [(Di)(Cm')(Pa^3.333/Pt^2)]/L

[i] F x CF2

References:

California. 1994. Preliminary endangerment assessment guidance manual. State of California Environmental Protection Agency,

Karimi et al. 1987. Vapor-Phase Diffusion of Benzene in Soil. A.A. Karimi, W.J. Farmer, and M.M. Cliath, J. Environ. Qual. 16(1): 38-43.

SECOR International, Inc. 1999. Quarterly Groundwater Monitoring Report for First Quarter 1999, 580 Julie Ann Way, Oakland, CA, ST ID #4008, for Metz Baking Company. May 20.

Shen. 1981. Estimating Hazardous Air Emissions from Disposal Sites. T.T. Shen, Poll. Engin. 13(8): 31-34.

USEPA. 1988. Superfund exposure assessment manual. U.S. Environmental Protection Agency, Office of Remedial Response, Washington, D.C., EPA/540/1-88/001. April.

USEPA. 1996. Soil Screening Guidance: User's Guide. United States Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington D.C., Publication 9355.4-23, July.

Table B-6. New Soil Data

Estimated Indoor Chemical Vapor Air Concentrations for the Onsite Indoor Commercial Worker Receptor[a]

Metz Baking Company Risk-Based Corrective Action Evaluation

580 Julie Ann Way

Oakland, California

Project No. 005.02811.002

Parameter Definition	Units [b]	Symbol	Benzene	Methyl-tert-Butyl Ether
Estimated vapor flux at soil surface from groundwater volatilization[c]	mg/sec-m^2	F	3.63E-05	1.14E-05
Aerial fraction of cracks in concrete slab-on-grade foundation [d]	- -	Fc	1.00E-02	1.00E-02
Sensitivity of crack fraction to vapor retardation[e]	–	Sc	5.00E-01	5.00E-01
Adjusted vapor flux at building floor surface[f]	mg/sec-m^2	F'	7.27E-07	2.27E-07
Volumetric flow rate for infiltration air per unit area[g]	L/sec-m^2	Q	6.49E-01	6.49E-01
Unit conversion factor	m^3/L	CF	1.00E-03	1.00E-03
Volumetric flow rate for infiltration air per unit area[h]	m^3/sec-m^2	Q'	6.49E-04	6.49E-04
Concentration of chemical in indoor air[i]	mg/m^3	C_{in}	1.12E-03	3.50E-04

Footnotes:

[a] Model for estimating chemical vapors in indoor air from ASTM, 1995; Wadden and Scheff, 1983; Johnson and Ettinger, 1991.

[b] mg/sec-m^2 = milligrams per second per square meter; L/sec-m^2 = liters per second per square meter; m^3/L = cubic meters per liter; m^3/sec-m^2 = cubic meters per second per square meter; mg/m^3 = milligrams per cubic meter.

[c] From Table B-5.

[d] Default value from ASTM, 1995.

[e] Based on Johnson and Ettinger (1991) for medium permeability vadose soils. The vadose soil type at the site can be characterized as "sandy silty clays".

[f] (F x [Fc/ Sc]).

[g] Refer to Footnote g from Table B-2.

[h] (Q x CF).

[i] (F" / Q').

References:

American Society for Testing and Materials (ASTM). 1995. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites. Designation E 1739-95.American Society for Testing and Materials, West Conshohocken, PA. November.

Johnson and Ettinger. 1991. Heuristic Model for Predicting the Intrusion Rate of Contaminated Vapors into Buildings. P.C. Johnson and R.A. Ettinger, Environ. Sci. Technol.25: 1445-1452.

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Table B-7. New Soil Data

Estimated Chemical Vapor Flux from Groundwater for the Hypothetical Onsite Construction Worker Receptor

Onsite Construction Worker Receptor[a]

Metz Baking Company Risk-Based Corrective Action Evaluation

580 Julie Ann Way

Oakland, California

Project No. 005.02811.002

Parameter definition	Units[b]	Symbol	Benzene	Methyl-tert-Butyl Ether
Groundwater concentration [c]	ug/L	Cp	270	60
Dimensionless Henry's Law constant[d]	ug/L//ug/L	H'	2 28E-01	2.20E-02
Soil gas concentration[e]	ug/L	Cm	6.16E+01	1 32E+00
Air diffusion coefficient[d]	cm^2/sec	Di	7 20E-02	7.90E-02
Unit conversion factor	ng-L/ug-cm3	CF1	1.00E-06	1 00E-06
Soil gas concentration[f]	mg/cm^3	Cm'	6.16E-05	1.32E-06
Air-filled soil porosity[g]	--	Pa	2.80E-01	2.80E-01
Total soil porosity [g]	--	Pt	0.43	0.43
Depth of soil cover [h]	cm	L	30	30
Estimated flux rate at soil surface[i]	mg/cm^2-sec	F	1.13E-08	2 66E-10
Unit conversion factor	cm^2/m^2	CF2	1.00E+04	1.00E+04
Estimated vapor flux at soil surface from groundwater volatilization[j]	mg/m^2-sec	F'	1.13E-04	2.66E-06

Footnotes:

[a] Model from Karimi et al., 1987; based on Shen's model (Shen, 1981; USEPA, 1988).

[b] ug = micrograms; L = liters; cm = centimeters, sec = seconds, m = meters; mg = milligrams; g = grams; kg = kilogram

[c] Maximum detected concentration as reported in Table 4-5.

[d] USEPA (1996)

[e] H' x Cp.

[f] Cm x CF1

[g] Default ASTM, 1995.

[h] Corressponds to one foot of vadose zone.

[i] *[(Di)(Cm')(Pa^3.333/Pt^2)]/L*

[j] F x CF2

References:

Karimi et al. 1987. Vapor-Phase Diffusion of Benzene in Soil. A.A Karimi, W.J. Farmer, and M.M. Cliath, J. Environ. Qual 16(1): 38-43.

Shen. 1981. Estimating Hazardous Air Emissions from Disposal Sites. T T Shen, Poll. Engin 13(8). 31-34

USEPA. 1988. Superfund exposure assessment manual. U.S Environmental Protection Agency, Office of Remedial Response, Washington, D.C., EPA/540/1-88/001. April.

USEPA. 1996. *Soil Screening Guidance: User's Guide. United States Environmental Protection Agency, Office of Solid Waste and Emergency* Response, Washington D.C., Publication 9355.4-23, July.

Table B-8. New Soil Data

Estimated Outdoor Chemical Vapor Air Concentrations for the Onsite Construction Worker Receptor[a]

Metz Baking Company Risk-Based Corrective Action Evaluation

580 Julie Ann Way

Oakland, California

Project No. 005.02811.002

Parameter definition	Units[b]	Symbol	Benzene	Methyl-tert-Butyl Ether
Estimated vapor flux at soil surface from groundwater volatilization[c]	mg/sec-m^2	F	1.13E-04	2.66E-06
Length of emissions source[d]	m	d	15	15
Site wind speed[e]	m/sec	u_s	2.25	2.25
Trench wind speed stagnation factor[f]	--	Tf	0.1	0.1
Trench wind speed[g]	m/sec	u	0.225	0.225
Air mixing zone height[e]	m	h	2	2
Air concentration of vapor[h]	mg/m^3	Ca	3.77E-03	8.86E-05

Footnotes:

[a] Model based on box model (USEPA, 1991; Dobbins, 1979; California, 1994).

[b] mg = milligrams; sec = seconds; m = meters.

[c] From Table B-7.

[d] Assumed dimension of trench prallel to predominant wind direction.

[e] Standard default assumption for box model (USEPA, 1991; California, 1994).

[f] Assumed stagnation factor for below ground trench.

[g] u_s x Tf.

[h] (F x d)/(u x h).

References:

California. 1994. Preliminary endangerment assessment guidance manual. State of California Environmental Protection Agency, Department of Toxic Substances Control. January.

Dobbins. 1979. Dispersion of Pollutants- Reacting Components and Unsteady Flows. Chapter 11 in Atmospheric Motion and Air Pollution, R.A. Dobbins, John Wiley and Sons, New York.

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