AllWest

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April 16, 1996

Mr. Juliet Shin
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Alameda County Environmental Health Services
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Subject: **Risk Evaluation of Vapor Impact**
1055 Eastshore Highway, Albany, California
AllWest Project No. 95117.28

Dear Ms. Shin:

In accordance with your February 1, 1996 request, AllWest has evaluated the potential for human health impacts from gasoline vapors potentially emanating from groundwater at monitoring well MW-2. This letter report presents the findings of the evaluation.

I. Background Information

A gasoline underground storage tank (UST) was removed from the site in September 1992. Contaminated soils near the UST were excavated during the tank closure. Additional soil was excavated in October 1995.

Four groundwater monitoring wells were installed around the former UST pit between July 1994 and June 1995. Groundwater monitoring results indicate detectable concentrations of gasoline and BTEX in the well nearest to the former UST, MW-2. A generalized site plan showing the location of former UST and existing monitoring wells is attached.

In February 1996, the Alameda County Environmental Health Services requested that a risk assessment discussion be presented that would evaluate the risk of gasoline vapors that potentially could migrate into the building from MW-2. Alameda County suggested that a risk factor of 10^{-5} for commercial/industrial scenarios be used for the subject site.

II. Risk Evaluation Methodology

As suggested by Alameda County, this risk evaluation is based on the American Society for Testing and Materials (ASTM) standard E 1739-95, *Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* with a cancer risk of 10^{-5}. The ASTM standard describes a tier-approach to risk assessment. Tier 1 evaluations utilize non-site-specific exposure models to generate the most conservative Risk-Based Screening Levels (RBSL). For Tier 2 and 3 evaluations, site-specific models are used and more liberal screening values are produced. Since a Tier 1 screening is not site-specific, the ASTM standard provides a RBSL Look-Up Table, developed through the use of various generic exposure models. Tier 1 evaluations result in the most conservative assessment of risk and can be used to determine if additional study is necessary.

By adopting this look-up table screening process, AllWest designed the risk evaluation procedures as follow:

1. Modify the ASTM RBSL Look-Up Table value to represent a 10^{-5} cancer risk.
2. Review site groundwater monitoring data to select the appropriate contaminant concentrations for use in the evaluation.
3. Compare the selected contaminant concentration to the 10^{-5} RBSL to determine if the health risk has been exceeded.

Benzene is the only BTEX compound that has been identified as a human carcinogen and has an associated cancer risk value. The ASTM E 1739-95 Tier 1 RBSL Look-Up Table contains two sets of screening levels for benzene that were developed with risk factors of 10^{-4} and 10^{-6}. After reviewing the equations used for RBSL development contained in Appendices of the ASTM publication, AllWest determined that a linear relationship exists between the two sets of RBSL. Therefore, a 10^{-5} RBSL for benzene is formulated by linear interpolation of the published RBSL and presented in the table below. A copy of the ASTM look-up table and exposure equation is attached for your reference.

Exposure Pathway	Exposure Scenario	Target Level	Benzene Concentrations
Groundwater Volatilization to Outdoor Air	Commercial/Industrial	Cancer Risk = 10^{-5}	184 mg/L (ppm) 53.4 ppm
Groundwater Vapor Intrusion to Building	Commercial/Industrial	Cancer Risk = 10^{-5}	2.56 mg/L (ppm) 0.21 ppm

Actually Tier 1 using RBCA, the values should be

The relative health risk of the other three BTEX compounds is expressed in a chronic exposure hazard quotient (HQ). If an exposure level is less than the concentration level established at HQ equals to unity (HQ = 1), no chronic health hazard will occur. For groundwater vapor intrusion to a building under the commercial/industrial exposure scenario, the ASTM look-up table indicates no possible dissolved levels for ethylbenzene or xylene will exceed the hazard (HQ = 1)

value. Only toluene has an established HQ = 1 level of 300 mg/L (ppm) for chronic exposure hazard. Therefore, the risk evaluation for toluene will be assessed by comparing the site toluene concentration with the ASTM look-up table value.

III. Risk Evaluation Findings

Based on the groundwater monitoring data to date, the highest benzene concentration in well MW-2 is 920 μg/L (ppb). This concentration is 2.5 times lower than the established 10^{-5} RBSL for indoor air exposure and 200 times lower than the RBSL for outdoor air exposure.

The highest toluene concentration in MW-2 to date is 50 μg/L (ppb). This concentration is 6,000 times lower than the published RBSL. A table presenting the cumulative groundwater monitoring results is also attached for reference.

In conclusion, none of the contaminant concentrations detected in groundwater are significant enough to impact site occupant health. Since the Tier 1 evaluation results in the most conservative estimate of risk, no additional risk assessment evaluations are necessary. The source area at the site has been removed and the groundwater contamination level should decrease with time due to biodegradation. It is unlikely that future groundwater contaminant concentrations will exceed the RBSLs described above. Based on the available data and risk assessment results, we believe that no further remedial action is necessary.

Sincerely,

AllWest Environmental, Inc.

Long Ching, PE
Senior Project Manager

LC/bms

Attachment: Site Plan
ASTM Tier 1 RBSL Look-Up Table
ASTM RBSL Development Equations
Cumulative Groundwater Monitoring Results

cc: Mr. John Frank, Urban Retail Properties Co.
Mr. John Hahn, Sonnenschein Nath & Rosenthal

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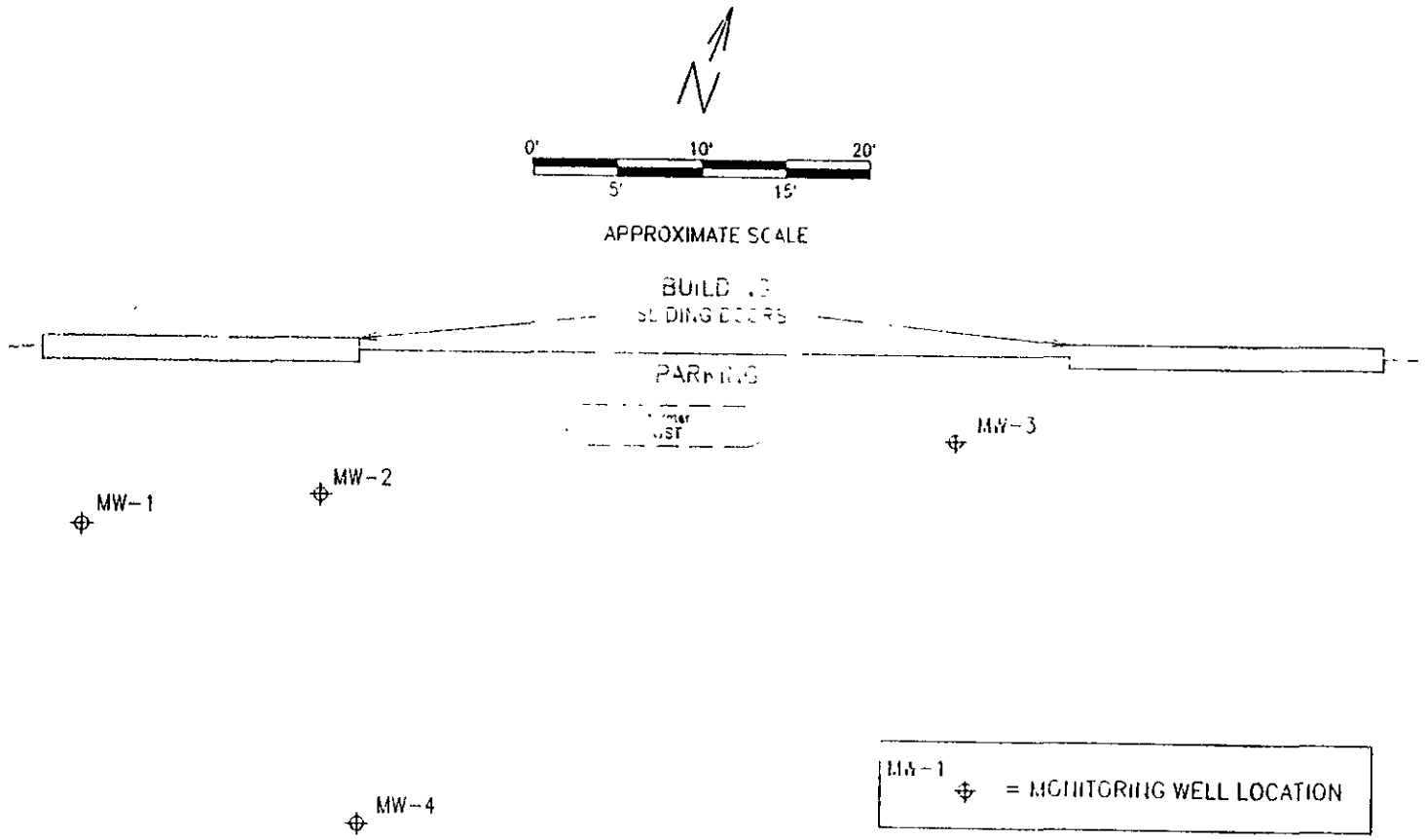

AllWest	April 1996	**Generalized Site Plan**	Project No. 95117.28	Figure 1
	1055 East Shore Highway Albany, California			Source *AllWest*

TABLE 4 Example Tier 1 Risk-Based Screening Level (RBSL) Look-Up Table

NOTE—This table is presented here only as an example set of Tier 1 RBSLs. It is not a list of proposed standards. The user should review all assumptions prior to using any of the values. Appendix X2 describes the basis of these values.

	Exposure Pathway	Receptor Scenario	Target Level	Benzene	Ethylbenzene	Toluene	Xylenes (mixed)	Naphthalene	Benzo(a)pyrene
AIR	Indoor Air Screening Levels for Inhalation Exposure (µg/m^3)	Residential	Cancer Risk = 1E-06	3.92E-01					1.86E-03
			Cancer Risk = 1E-04	3.92E+01					1.86E-01
			Chronic HQ = 1		1.39E+03	5.56E+02	9.73E+03	1.95E+01	
		Commercial/ Industrial	Cancer Risk = 1E-06	4.93E-01					2.35E-03
			Cancer Risk = 1E-04	4.93E+01					2.35E-01
			Chronic HQ = 1		1.46E+03	5.84E+02	1.02E+04	2.04E+01	
	Outdoor Air Screening Levels for Inhalation Exposure (µg/m^3)	Residential	Cancer Risk = 1E-06	2.94E-01					1.40E-03
			Cancer Risk = 1E-04	2.94E+01					1.40E-01
			Chronic HQ = 1		1.04E+03	4.17E+02	7.30E+03	1.46E+01	
		Commercial/ Industrial	Cancer Risk = 1E-06	4.93E-01					2.35E-03
			Cancer Risk = 1E-04	4.93E+01					2.35E-01
			Chronic HQ = 1		1.46E+03	5.84E+02	1.02E+04	2.04E+01	
	OSHA TWA PEL (µg/m^3)			3.20E+03	4.35E+05	7.53E+05	4.35E+05	5.00E+04	2.00E+02 [1]
	Mean Odor Detection Threshold (µg/m^3) [2]			1.95E+05		6.00E+03	8.70E+04	2.00E+02	
	National Indoor Background Concentration Range (µg/m^3) [3]			3.25E+00 - 2.15E+01	2.20E+00 - 9.70E+00	9.60E-01 - 2.91E+01	4.85E+00 - 4.76E+01		
SOIL	Soil - Volatilization to Outdoor Air (mg/kg)	Residential	Cancer Risk = 1E-06	2.72E-01					RES
			Cancer Risk = 1E-04	2.72E+01					RES
			Chronic HQ = 1		RES	RES	RES	RES	
		Commercial/ Industrial	Cancer Risk = 1E-06	4.57E-01					RES
			Cancer Risk = 1E-04	4.57E+01					RES
			Chronic HQ = 1		RES	RES	RES	RES	
	Soil - Vapor Intrusion from Soil to Buildings (mg/kg)	Residential	Cancer Risk = 1E-06	5.37E-03					RES
			Cancer Risk = 1E-04	5.37E-01					RES
			Chronic HQ = 1		3.46E+01	2.08E+01	RES	4.07E+01	
		Commercial/ Industrial	Cancer Risk = 1E-06	1.69E-02					RES
			Cancer Risk = 1E-04	1.69E+00					RES
			Chronic HQ = 1		9.08E+01	5.45E+01	RES	1.07E+02	
	Surficial Soil (0-3 ft.) Ingestion/ Dermal/ Inhalation (mg/kg)	Residential	Cancer Risk = 1E-06	5.82E+00					1.30E-01
			Cancer Risk = 1E-04	5.82E+02					1.30E+01
			Chronic HQ = 1		7.83E+03	1.33E+04	1.45E+05	9.77E+02	
		Commercial/ Industrial	Cancer Risk = 1E-06	1.00E+01					3.04E-01
			Cancer Risk = 1E-04	1.00E+03					3.04E+01
			Chronic HQ = 1		1.15E+04	1.87E+04	2.08E+05	1.50E+03	
	Soil - Leachate to Protect Groundwater Ingestion Target Level (mg/kg)	MCL's		2.93E-02	9.11E+00	1.77E+01	3.05E+02	N/A	9.42E+00
		Residential	Cancer Risk = 1E-06	1.72E-02					5.50E-01
			Cancer Risk = 1E-04	1.72E+00					RES
			Chronic HQ = 1		4.75E+01	1.29E+02	RES	2.29E+01	
		Commercial/ Industrial	Cancer Risk = 1E-06	5.78E-02					1.85E+00
			Cancer Risk = 1E-04	5.78E+00					RES
			Chronic HQ = 1		1.33E+02	3.61E+02	RES	6.42E+01	
GROUND WATER	Groundwater - Volatilization to Outdoor Air (mg/L)	Residential	Cancer Risk = 1E-06	1.10E+01					> S
			Cancer Risk = 1E-04	1.10E+03					> S
			Chronic HQ = 1		> S	> S	> S	> S	
		Commercial/ Industrial	Cancer Risk = 1E-06	1.84E+01					> S
			Cancer Risk = 1E-04	> S					> S
			Chronic HQ = 1		> S	> S	> S	> S	
	Groundwater Ingestion (mg/L)	MCL's		5.00E-03	7.00E-01	1.00E+00	1.00E+01	N/A	2.00E-04
		Residential	Cancer Risk = 1E-06	2.94E-03					1.17E-05
			Cancer Risk = 1E-04	2.94E-01					1.17E-03
			Chronic HQ = 1		3.65E+00	7.30E+00	7.30E+01	1.46E-01	
		Commercial/ Industrial	Cancer Risk = 1E-06	9.87E-03					3.92E-05
			Cancer Risk = 1E-04	9.87E-01					> S
			Chronic HQ = 1		1.02E+01	2.04E+01	> S	4.09E-01	
	Groundwater - Vapor Intrusion from Groundwater to Buildings (mg/L)	Residential	Cancer Risk = 1E-06	8.12E-02					> S
			Cancer Risk = 1E-04	8.12E+00					> S
			Chronic HQ = 1		> S	1.14E+02	> S	1.06E+01	
		Commercial/ Industrial	Cancer Risk = 1E-06	2.56E-01					> S
			Cancer Risk = 1E-04	2.56E+01					> S
			Chronic HQ = 1		> S	3.00E+02	> S	2.78E+01	

[A] As benzene soluble coal tar pitch volatiles.

[B] American Industrial Hygiene Association, *Odor Thresholds for Chemicals with Established Occupational Health Standards*, 1989.

[C] From: Shah and Singh, *Environmental Science Technology* Vol 22, No. 12; ATSDR, 1988, Toxilogical Profiles, U.S. Public Health Services, 1988, and Wallace, L. A., *Journal of Occupational Medicine*, Vol 28, No. 5, 1986.

[D] "RES"—selected risk level is not exceeded for pure compound present at any concentration.

[E] ">S"—selected risk level is not exceeded for all possible dissolved levels (≤ pure component solubility).

X2.1.2.5 Ingestion of surficial soil, inhalation of outdoor vapors and particulates emanating from surficial soils, and dermal absorption resulting from surficial soil contact with skin,

X2.1.2.6 Inhalation of outdoor vapors originating from hydrocarbons in subsurface soils,

X2.1.2.7 Inhalation of indoor vapors originating from subsurface hydrocarbons, and

X2.1.2.8 Ingestion of ground water impacted by leaching of dissolved hydrocarbons from subsurface soils.

X2.1.3 For the pathways considered, approaches used in this appendix are consistent with guidelines contained in Ref (1).

X2.1.4 The following development presented focuses only on human-health RBSLs for chronic (long-term) exposures.

X2.1.4.1 In the case of compounds that have been classified as carcinogens, the RBSLs are based on the general equation:

$$\textit{risk} = \textit{average lifetime intake}\ [\text{mg/kg-day}] \times \textit{potency factor}\ [\text{mg/kg-day}]^{-1}$$

where the intake depends on exposure parameters (ingestion rate, exposure duration, etc.), the source concentration, and transport rates between the source and receptor. The potency factor is selected after reviewing a number of sources, including the USEPA Integrated Risk Information System (IRIS) (6) database, USEPA Health Effects Assessment Summary Tables (HEAST), (7), and peer-reviewed sources.

TABLE X2.2 Equations Used to Develop Example Tier 1 Risk-Based Screening Level (RBSLs) Appearing in "Look-Up" Table X2.1—Carcinogenic Effects[A]

NOTE—See Tables X2.3 through X2.6 for definition of parameters.

Medium	Exposure Route	Risk-Based Screening Level (RBSL)
Air	Inhalation[B]	$RBSL_{air}\left[\frac{\mu g}{m^3\text{-}air}\right] = \frac{TR \times BW \times AT_c \times 365\ \frac{days}{years} \times 10^3\ \frac{\mu g}{mg}}{SF_i \times IR_{air} \times EF \times ED}$
Ground water	Ingestion (potable ground water supply only)[B]	$RBSL_w\left[\frac{mg}{L\text{-}H_2O}\right] = \frac{TR \times BW \times AT_c \times 365\ \frac{days}{years}}{SF_o \times IR_w \times EF \times ED}$
Ground water[C]	Enclosed-space (indoor) vapor inhalation[D]	$RBSL_w\left[\frac{mg}{L\text{-}H_2O}\right] = \frac{RBSL_{air}\left[\frac{\mu g}{m^3\text{-}air}\right]}{VF_{wesp}} \times 10^{-3}\ \frac{mg}{\mu g}$
Ground water[C]	Ambient (outdoor) vapor inhalation[D]	$RBSL_w\left[\frac{mg}{L\text{-}H_2O}\right] = \frac{RBSL_{air}\left[\frac{\mu g}{m^3\text{-}air}\right]}{VF_{wamb}} \times 10^{-3}\ \frac{mg}{\mu g}$
Surficial soil	Ingestion of soil, inhalation of vapors and particulates, and dermal contact[B]	$RBSL_s\left[\frac{\mu g}{kg\text{-}soil}\right] = \frac{TR \times BW \times AT_c \times 365\ \frac{days}{years}}{EF \times ED\left[\left(SF_o \times 10^{-6}\ \frac{kg}{mg} \times (IR_{soil} \times RAF_o + SA \times M \times RAF_d)\right) + (SF_i \times IR_{air} \times (VF_{as} + VF_p))\right]}$ For surficial and excavated soils (0 to 1 m)
Subsurface soil[C]	Ambient (outdoor) vapor inhalation[D]	$RBSL_s\left[\frac{mg}{kg\text{-}soil}\right] = \frac{RBSL_{air}\left[\frac{\mu g}{m^3\text{-}air}\right]}{VF_{samb}} \times 10^{-3}\ \frac{mg}{\mu g}$
Subsurface soil[C]	Enclosed space (indoor) vapor inhalation[D]	$RBSL_s\left[\frac{mg}{kg\text{-}soil}\right] = \frac{RBSL_{air}\left[\frac{\mu g}{m^3\text{-}air}\right]}{VF_{sesp}} \times 10^{-3}\ \frac{mg}{\mu g}$
Subsurface soil[C]	Leaching to ground water[D]	$RBSL_s\left[\frac{mg}{kg\text{-}soil}\right] = \frac{RBSL_{wt}\left[\frac{mg}{L\text{-}H_2O}\right]}{LF_{sw}}$

[A] Note that all RBSL values should be compared with thermodynamic partitioning limits, such as solubility levels, maximum vapor concentrations, etc. If a RBSL exceeds the relevant partitioning limit, this is an indication that the selected risk or hazard level will never be reached or exceeded for that chemical and the selected exposure scenario.

[B] Screening levels for these media based on other considerations (for example, aesthetic, background levels, environmental resource protection, etc.) can be derived with these equations by substituting the selected target level for $RBSL_{air}$ or $RBSL_w$ appearing in these equations.

[C] These equations are based on Ref (1).

[D] These equations simply define the "cross-media partitioning factors," VF_i and LF_{sw}.

TABLE 1

CUMULATIVE SUMMARY OF GROUNDWATER MONITORING RESULTS

1055 Eastshore Highway, Albany, California

Monitoring Well No. and Sampling Date	TPH-Gasoline	Benzene	Toluene	Ethylbenzene	Xylenes
MW-1					
6/23/94	ND (<50)	ND (<0.3)	0.60	2.5	9.0
6/29/95	ND (<50)	0.8	ND (<0.5)	1.3	3.2
9/7/95	ND (<50)	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)
12/20/95	ND (<50)	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)
3/22/96	ND (<50)	ND (<0.5)	2.5	ND (<0.5)	2.2
MW-2					
6/23/94	330	130	11.0	20.0	10.0
6/29/95	3,800	260	9.8	190	310
9/7/95	2,700	100	1.9	92	210
12/20/95	1,500	170	50	30	170
3/22/96	4,500	920	30	360	1,300
MW-3					
6/23/94	52.0	ND (<0.3)	ND (<0.3)	4.0	13.0
6/29/95	ND (<50)	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)
9/7/95	ND (<50)	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)
12/20/95	ND (<50)	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)
3/22/96	ND (<50)	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)
MW-4					
6/29/95	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)
9/7/95	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)
12/20/95	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)	ND (<0.5)
3/22/96	60	0.8	2.8	1.1	4.7

Notes: **All values are in µg/L, equivalent to parts per billion (ppb).**
ND stands for "non-detected" at or above the laboratory detection limit as indicated in parenthesis.
MW-4 installed June 1995.