RISK REVIEW
HARSCH INVESTMENT CORP.
SOUTH SHORE SHOPPING CENTER
ALAMEDA, CALIFORNIA

INTRODUCTION

Kleinfelder, Inc. (Kleinfelder) is pleased to submit this report, on behalf of Harsch Investment Corp. (Harsch), in response to the letter dated April 26, 1996 from Ms. Madhulla Logan, Alameda County Health Care Services Agency (ACHA) to Mr. Greg Baum of Harsch, and Mr. Murray Stevens of Kamur Industries, Inc. (Kamur) regarding "South Shore Shopping Center, located at Park Street and Shore Line Drive, Alameda, California." The letter specifies two actions for the above-referenced property.

This report is restricted to the first action item in the letter from Ms. Logan, and addresses only solvents and hydrocarbons detected in monitoring wells located in the south/south west half of the referenced property, in particular, monitoring well MW-7B. This report does not address the second action item regarding petroleum hydrocarbons detected in monitoring wells in the north/north east half of the site, especially monitoring well MW-24. Specifically, this report presents:

- Data from a recent investigation of soil at the location of monitoring well MW-7B;
- Results of an ecological risk assessment for solvents; and
- Results of a human health risk assessment for solvents and hydrocarbons.

This report is organized into several sections and appendices. The first section, "Hazard Identification," provides background information, analytical data for solvents and hydrocarbons, and historical activities addressing soil and groundwater conditions. Data from monitoring wells for the south/south west half of the site are summarized, including newly developed data from a recent Geoprobe™ adjacent to monitoring well MW-7B. Next, the potential for ecological risks to receptors in San Francisco Bay are addressed in the "Ecological Risk Assessment" section. Potential human health risks are addressed in the "Human Health Risk Assessment" section, and, finally, a summary and recommendations are provided.

Hazard Identification

Background

Historically, constituents of concern at the South Shore Shopping Center were released to the subsurface environment from three commercial sources 1) a Texaco service station, 2) a dry cleaner, and 3) a car wash The Texaco service station and the dry cleaner have

Comparison With Texaco Ecological Risk Assessment

Generally, the levels of chlorinated organics in all perimeter monitoring wells is similar to the levels of chlorinated organics in monitoring well MW-22. Since risks estimated based on the constituents in monitoring well MW-22 were several orders of magnitude below levels that would require additional investigation (i.e., a *conservative* ecorisk model showed *de minimus* risks), a similar conclusion is likely for the rest of the perimeter monitoring wells.

Comparison with San Francisco International Airport Cleanup Objectives

Table 3 provides the comparison of monitoring well data with the cleanup objectives established at the San Francisco International Airport for the protection of salt water, ecological receptors. These Tier 1 objectives were developed by the Regional Water Quality Control Board (RWQCB) using U.S. Environmental Protection Agency (U.S. EPA) ambient water quality criteria documents, California Water Quality Objectives for Saltwater Aquatic Life, and San Francisco Bay Region Basin Plan Shallow Water Effluent Limitation for Marine Water. The lowest values were selected from these documents to provide conservative Tier 1 objectives.

The RWQCB established five remediation management zones at the San Francisco Airport site for distinguishing different soil and groundwater cleanup objectives. The Salt Water Ecological Protection Remediation Management Zone (RMZ) was defined as an area between the mean high tide line and extending landward for a distance of 300 feet in areas within sensitive estuarine habitats. The RMZ Tier 1 objectives were developed for the protection of saltwater flora and fauna subjects "such that there is no acute or significant chronic toxicity affecting the species inhabiting the San Francisco Bay and sensitive and critical estuarine waters and wetlands.

The shoreline in Alameda along Shore Line Drive adjacent to the South Shore Shopping Center is a public beach, and is not indicated as a sensitive and/or critical habitat for San Francisco Bay area flora and/or fauna subjects. There is a bird sanctuary farther east along Shore Line Drive. However, evidence from monitoring well MW-22 (see Table 3) indicates that constituents are not migrating in that direction.

At the subject site, perimeter wells were placed around the former dry cleaners to determine if solvents were migrating toward the shoreline. As shown in Table 3, over 6 years of monitoring indicate that migration is not occurring from the source area (monitoring well MW-7/7B) to an intermediate monitoring point (MW-8), and then to the perimeter monitoring wells (MWs-14, 22, 15, 16, 17, 18) Furthermore, only one data point from the perimeter wells exceeds the Tier 1 value (PCE in monitoring well MW-14) However, between monitoring well MW-14 and the shore are monitoring wells MW-15 and MW-22, in which PCE has not been detected

been closed and their facilities removed from the site; the car wash has been relocated on the site.

This report focuses on the former dry cleaner, the location of which is now occupied by an asphalt covered parking lot. The former dry cleaner is responsible for past releases of dry cleaning solvents, particularly tetrachloroethylene (also called perchloroethylene, or PCE). When the dry cleaner was removed, the underlying soil containing solvents was excavated. Before the parking lot was constructed, the excavation was filled with clean soil, which resulted in verbally-communicated ACHA closure for the site.

Despite soil closure, solvents remain in the groundwater. Six years of monitoring on site and at perimeter monitoring wells has demonstrated that the solvents are apparently not migrating from the site, and may be slowly degrading *in situ*. In addition to solvents, petroleum hydrocarbons from neighboring sources have mingled with the groundwater beneath the former dry cleaner. Therefore, this risk assessment addresses both solvents and hydrocarbons.

Recent Investigation

At a meeting held April 24, 1996, at the South Shore Shopping Center between interested parties, Ms. Logan expressed concern that hydrocarbons had been detected at depth in monitoring well MW-7B, and requested an additional investigation of the shallow interface of the groundwater with the vadose zone. (Since gasoline is generally expected to be found at the "top" of a groundwater aquifer, the investigation was to ensure that gasoline had neither been missed during historical sampling events nor migrated on-site since monitoring well MW-7B was re-screened deeper in the aquifer.) In response to Ms. Logan's request, Harsch asked Kleinfelder to complete the requested investigation.

On May 21, 1996, Kleinfelder performed a limited investigation at the subject site. The investigation was performed in the Lyon's Restaurant parking lot located at the corner of Shoreline Drive and Park Avenue.

A groundwater sample was obtained using a Geoprobe™ operated by Gregg Drilling and Testing, Inc., under the observations of a Kleinfelder representative. The sample site was located in a planter box approximately ten feet northwest of monitoring well MW-7B. Prior to drilling, the depth to groundwater in monitoring well MW-7B was measured and recorded to indicate the expected groundwater elevation. The boring was advanced to a total depth of eight feet; groundwater was encountered at approximately five-and-a-half feet below ground surface (bgs) After the groundwater sample was collected, the boring was backfilled with cement grout

The groundwater sample was retrieved using a stainless steel bailer and was decanted into 40 milliliter bottles provided by the laboratory The sample bottles were properly capped, labeled and placed in an ice cooled chest The samples were transported under chain-of-

custody control to McCampbell Analytical, a laboratory certified by the State of California to perform the requested analysis.

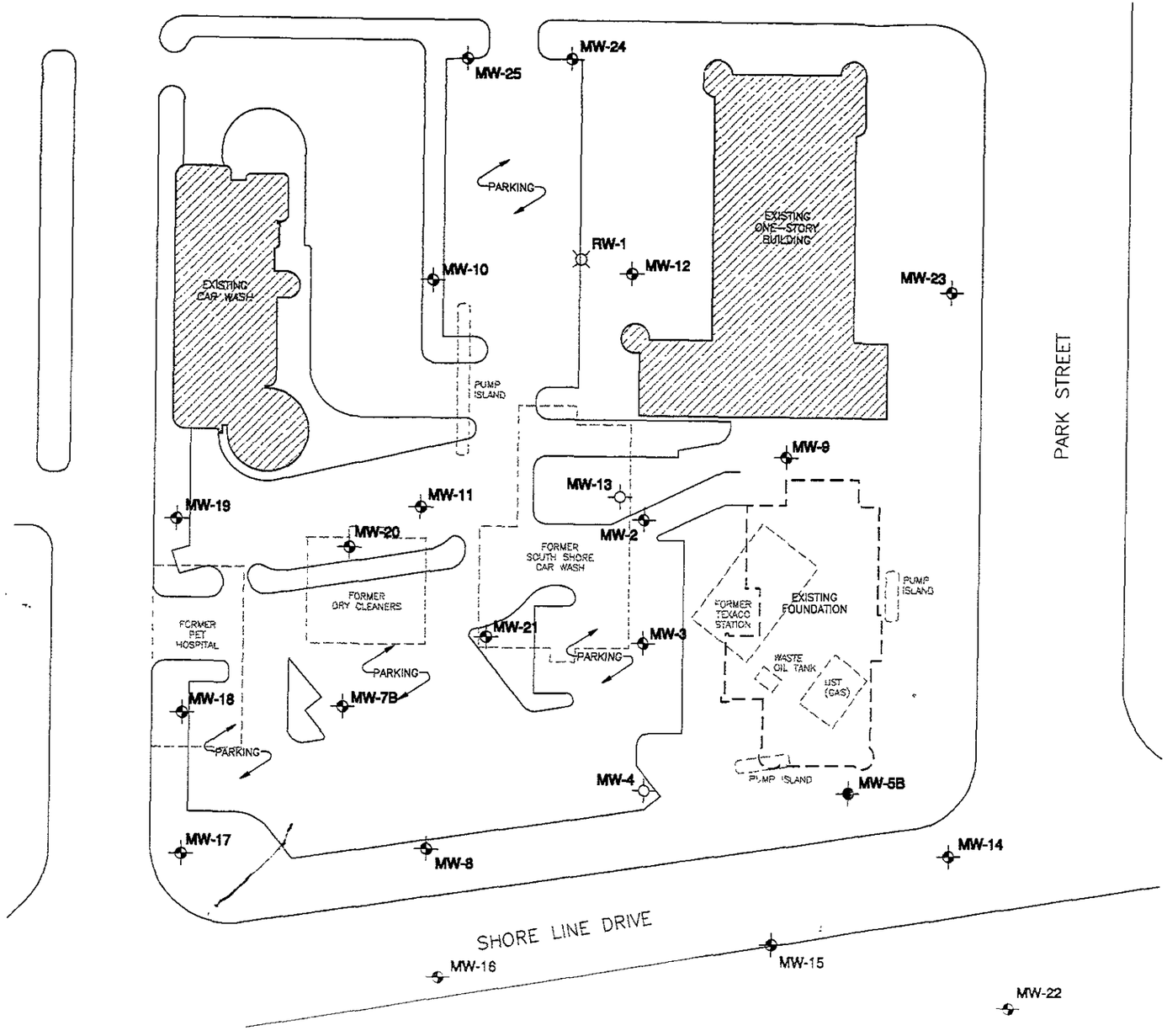
The sample was analyzed by U.S. Environmental Protection Agency (EPA) Method 8015 modified for total petroleum hydrocarbons quantified as gasoline (TPH-g) and benzene, toluene, ethylbenzene, and xylene (BTEX).

TPH-g and BTEX were not detected in the sample. A copy of the laboratory data sheet is included in Appendix 1.

Data Summary

This report covers the south/south west half of the property. As shown in Plate 1, this includes monitoring wells MW-2, MW-3, MW-5B, MW-7B, MW-8, MW-9, MW-11, MW-14, MW-15, MW-16, MW-17, MW-18, MW-19, MW-20, MW-21, and MW-22, and excludes monitoring wells MW-10, MW-12, MW-23, MW-24, and MW-25. Appendix 2 provides a compilation of all historical data collected from the above-referenced wells.

Table 1 provides the maximum detected values for chemicals of potential concern in the monitoring wells in the south/south west half of the site. Notably for the solvents, the relatively higher concentrations found near the source (as in monitoring well MW-7B) appear to fall off dramatically with distance from the source. Concentrations in monitoring well MW-8 are lower than concentrations in MW-7B; all perimeter monitoring wells are substantially lower than either monitoring wells MW-7 or MW-8.



LEGEND

- MONITORING WELL
- MONITORING/VAPOR EXTRACTION WELL
- RECOVERY WELL
- MONITORING WELL (DAMAGED)

50 0 50

APPROXIMATE SCALE (feet)

REFERENCE:
EVAX Technologies, Inc. "As-Built Site Map, 2375 Shore Line Drive, Alameda, California," dated 8-13-97

KLEINFELDER	SITE PLAN MARSCH SOUTH SHORE 2375 SHORE LINE DRIVE ALAMEDA, CALIFORNIA	FIGURE 1
DRAFTED BY: Sue DATE: 5-31-96		
CHECKED BY: E. Leach DATE: 6-19-96	PROJECT NO: 10-30030.1-003	

CAD FILE: H:\KA_PROJ\PLEAS\10300301\SITEPLAN.dwg dwg

Table 1: Maximum Detected Concentrations in Monitoring Wells Located in the South/Southwest Half of the South Shore Property

Chemical	Monitoring Well	Date	Maximum Detected Values (µg/L)
Benzene	MW-5B	Apr-91	1,300
Toluene	MW-5B	Apr-91	45
Ethylbenzene	MW-5B	Apr-91	370
Xylenes	MW-5B	Apr-91	100
1,2-dichloroethane (1,2-DCA)	MW-22	Feb-93	22
1,1-dichloroethylene (1,1-DCE)	MW-7B	Apr-94	5.8
cis-1,2-dichloroethylene (cis-1,2-DCE)	MW-7B	Nov-95	1,200
trans-1,2-dichloroethylene (trans-1,2-DCE)	MW-20	Apr-94	58
dichloroethylene ("DCE")[A]	MW-7B	Nov-90	440
tetrachloroethylene (PCE)	MW-7B	Jul-91	7,800
trichloroethylene (TCE)	MW-7B	Nov-95	1,200
Chloroform	MW-16	Apr-94	6.10
1,1,2-trichloroethane (1,1,2-TCA)	MW-7B	Jul-91	0.8
Bromoform	MW-7B	Jul-91	1.7
Chlorobenzene	MW-7B	Apr-94	31

µg/L = micrograms per liter

[A]"DCE" indicates 1,2-DCE that was not characterized for the cis and trans isomers.

Solvents are primarily represented by PCE and TCE. Although other solvents have been detected, only PCE and TCE have been consistently detected. These constituents are also present at relatively higher concentrations than the others. Concentrations of PCE and TCE in monitoring wells MW-7/7B are provided in Table 2.

Table 2: PCE and TCE in Monitoring Wells 7/7B (µg/L)

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
PCE	1900	1600	7800	5800	190	N/A	N/A	N/A	2100
TCE	520	200	660	540	12	N/A	N/A	N/A	1200
	N/A = Not Analyzed								

Pathway Screening

The pathway screening process summarized in this section was discussed at the meeting held on April 24, 1996, and consensus was established concerning the following points:

- Soil containing solvents was removed and replaced, and the site closed with regard to soil contamination Therefore, there are no exposure pathways for direct contact with soil by ecological or human receptors

- Groundwater pathways that typically produce 'high risk" exposures—such as direct contact and ingestion pathways—are not complete at this site. Therefore, the site is expected to be a relatively "low risk" site for groundwater.

- The only reasonably complete pathway for ecological exposure is via groundwater transport and emission into San Francisco Bay. Participants in the April 24 meeting discussed the fact that concentrations of solvents in perimeter monitoring wells are comparable to concentrations in monitoring well MW-22. The data from monitoring well MW-22 were used by Texaco to demonstrate that risks to ecological receptors in San Francisco Bay are negligible. This report updates and confirms those findings.

- The only reasonably complete pathway for human exposure to chlorinated organics from the former dry cleaning site and hydrocarbons from gasoline is inhalation of vapors emitted from groundwater and transported through the soil to the surface, where it must penetrate the asphalt surface of the parking lot.

- The ASTM 'Risk-Based Corrective Action" (RBCA) standard guide serves as a reasonable starting point for screening potential human health risks. Note: Even though the RBCA standard is specified for petroleum sites, its use herein was extended from the benzene application to include the solvents. RBCA has been applied to other solvent sites (Lynn Spence, personal communication).

- For preliminary screening, RBCA has two models that estimate emissions from groundwater through the vadose zone and into the air. One model estimates emissions through a bare soil surface into 'outdoor" air, where a 'box" model is used to disperse chemicals in the breathing zone. The other model estimates emissions through a building foundation into 'indoor" air. Since the subject site has an asphalt parking lot between the vadose zone and the 'outdoor" air, neither RBCA model is ideal for the problem. However, for preliminary screening, the first model is applied, understanding that omitting the barrier created by the asphalt surface makes this application *extremely* conservative.

The results of this pathway screening exercise were used to evaluate ecological and human health risks as described below.

Ecological Risks

The potential for adverse ecological risks at the site appear to be small. This conclusion is based on two comparisons 1) a comparison of all *perimeter* monitoring wells with the well (monitoring well MW-22) used in Texaco's ecological risk assessment, and 2) a comparison of monitoring well data with cleanup objectives used at the San Francisco International Airport for protection of salt water, ecological receptors

Monitoring wells MW-7B and MW-8 are located approximately 300 feet and 225 feet from the mean high tide level, respectively. This places monitoring well MW-7B at the limit of the RMZ established for the San Francisco Airport, and monitoring well MW-8 within the zone. Nevertheless, the conservative derivation of the Tier 1 cleanup objectives for the San Francisco Airport, as well as the attenuation factors evident at the South Shore Center (including the stability of the plume), indicate that the surveyed concentrations do not represent a threat to the flora and fauna of the adjacent Bay.

	Maximum Detected Values (µg/L) in Indicated Well								
	Source Well	Intermediate Well	Perimeter Wells						Ecological Tier 1
Chemical	7/7B	8	MW-14	MW-22	MW-15	MW-16	MW-17	MW-18	(µg/L)
Benzene	**190**	**92**	2.9	ND	ND	ND	ND	ND	71
Toluene	ND	ND	0.8	ND	ND	ND	ND	ND	5,000
Ethylbenzene	ND	ND	3.4	ND	ND	ND	ND	ND	43
Xylenes	27	ND	15	ND	ND	ND	ND	ND	2,200
1,2-DCA	ND	ND	9.7	22	ND	ND	ND	ND	99
1,1-DCE	5.8	ND	0.5	ND	ND	NA	NA	ND	3.2
cis-1,2-DCE	**1,200**	**44**	ND	ND	NA	ND	ND	NA	3
trans-1,2-DCE	**13**	**23**	ND	ND	ND	ND	ND	ND	3
"DCE"	440	11	ND	ND	NA	ND	ND	ND	n.a.
PCE	**7,800**	**70**	**16**	ND	ND	ND	2.4	1.4	7
TCE	**1,200**	57	0.4	ND	ND	ND	ND	ND	81
Chloroform	ND	ND	NA	0.65	NA	6.1	4	NA	470
1,1,2-TCA	0.8	ND	ND	NA	NA	NA	NA	NA	42
Bromoform	1.7	ND	ND	NA	NA	NA	NA	NA	n.a.
Chlorobenzene	31	ND	ND	ND	ND	ND	ND	ND	n.a.

[A]RBCA Tier 1 concentrations at the 10^{-5} risk level.

[B]RBCA Tier 1 concentrations at the 10^{-4} risk level.

n.a. = Not Available

ND = Not Detected

NA = Not Analyzed

why is benzene exc. in this table at 190 ppb max, but not exc. in the max benzene is 1,300 ppb

KLEINFELDER

RISK-BASED SCREENING LEVELS FOR HUMAN HEALTH RISK ASSESSMENT

Development of Risk-Based Screening Levels

Chemical-specific risk-based screening levels (RBSLs) were developed using the equations provided in ASTM's Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites (ASTM, 1995). Consistent with the pathway screening summary provided above, RBSLs were derived using the equations and parameters provided in Tables X2.2, and X2.4-X2.7, for the "groundwater to ambient (outdoor) vapors" pathway.

Table 3 provides the values calculated for chemicals of concern at the site. RBSLs were calculated at two risk management thresholds: 1) 1×10^{-5} and 2) 1×10^{-4}. These values represent probabilities that an individual exposed to a given chemical *under the specified assumptions* might develop cancer due to that exposure. The RBCA Tier 1 assumptions are quite conservative; that is, it is quite unlikely that any individual will experience the exposure conditions specified by the assumptions. The first threshold is routinely applied by ACHA to sites characterized by commercial land use. The second threshold is the upper value of the range between 1×10^{-6} and 1×10^{-4} within which the U.S. EPA specifies a need to consider risk management (i.e., risks less than 1×10^{-6} are considered *de minimus*; risks greater than 1×10^{-4} almost invariably require action). Complete derivation of the RBSLs is provided in Appendix 3.

Risk Screening

Table 3 compares the maximum detected values against the RBSLs. For every chemical except PCE, the maximum detected values were less than the chemical-specific RBSLs. Based on the conservative assumptions built into the RBSL algorithms, this suggests that ongoing commercial use of the property is unlikely to produce adverse health effects in humans visiting or working on the property.

Table 3: Comparison of maximum detected values with RBSLs

Chemical	Maximum Detected Values (µg/L)	RBSLs (µg/L) Tier 1 (10^{-5})[A]	Tier 1 (10^{-4})[B]
Benzene	1,300	170,340	1,703,401
Toluene	45		
Ethylbenzene	370		
Xylenes	100		
1,2-dichloroethane (1,2-DCA)	22	13,228	132,279
1,1-dichloroethylene (1,1-DCE)	5.8	125	1,246
cis-1,2-dichloroethylene (cis-1,2-DCE)	1,200		
trans-1,2-dichloroethylene (trans-1,2-DCE)	58		
dichloroethylene ("DCE")	440		
tetrachloroethylene (PCE)	7,800	5,499	54,994
trichloroethylene (TCE)	1,200	27,410	274,101
Chloroform	6.10	8,561	85,608
1,1,2-trichloroethane (1,1,2-TCA)	0.8		
Bromoform	1.7		
Chlorobenzene	31		

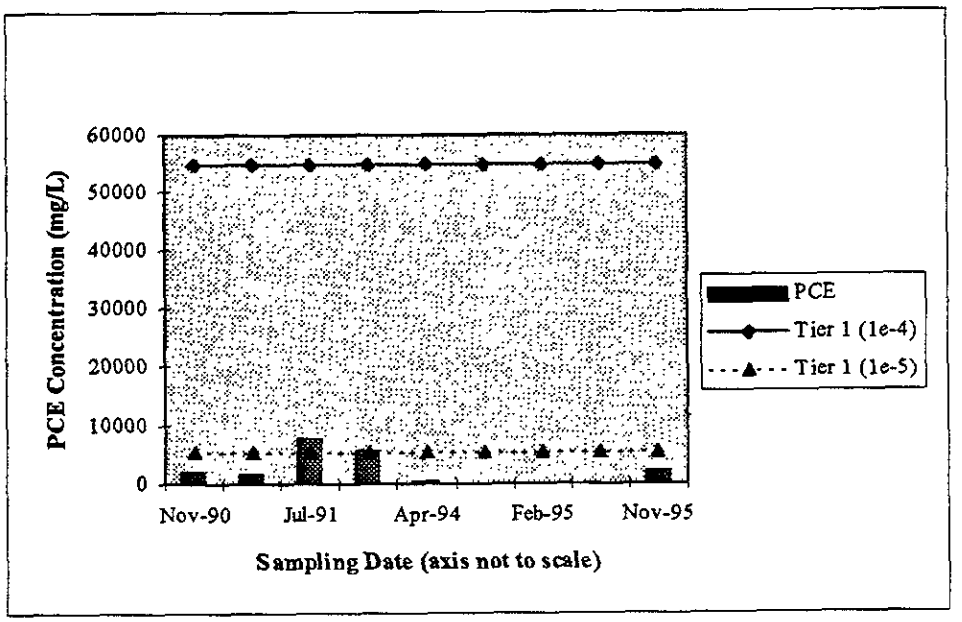
[A]RBCA Tier 1 concentrations at the 10^{-5} risk level.
[B]RBCA Tier 1 concentrations at the 10^{-4} risk level.

As shown in Table 4, PCE was detected at concentrations between the 1×10^{-5} and 1×10^{-4} RBSLs in two rounds of sampling; once in 1991 and again in 1993. Otherwise, PCE was below the 1×10^{-5} RBSL in samples from four other sampling events. Figure 2 shows the relationship of the measured PCE concentrations compared with RBSLs based on risk management thresholds set at 1×10^{-5} and 1×10^{-4}.

Table 4: PCE in monitoring well MW-7/7B relative to risk management thresholds

PCE Concentrations in Monitoring Well MW-7/7B relative to RBSLs	Sample Dates
[PCE] < RBSL at 1×10^{-5} (170,000 µg/L)	11/90, 4/91, 4/94, 11/95
RBSL at 1×10^{-5} < [PCE] < RBSL at 1×10^{-4}	7/91 & 2/93
[PCE] > RBSL at 1×10^{-4} (1,700,000 µg/L)	None

Figure 2: PCE against RBSLs over time



PCE concentrations at the site marginally failed the Tier 1 standard. However, mitigation of PCE by active remediation is unwarranted for the following reasons:

1. The RBCA Tier 1 equations, as applied, are extremely conservative. The model is sensitive to the assumptions regarding the volumetric air content of the capillary fringe and vadose zone soils, and total soil porosity (θ_{acap}, θ_{as} and θ_T, respectively). The default assumption represents conditions typical of dry, sandy soils, whereas dense or moist soils attenuate vapors quite efficiently. This means that soil conditions at the site, plus the paved surface, will substantially retard emissions (Spence, personal communication). Proceeding from Tier 1 to Tier 2 in the RBCA process will almost certainly demonstrate *de minimum* risks. Tier 2 calculations, however, would require the compilation of additional, site-specific data. The costs of collecting such data are not justified by these results.

2. The RBCA Tier 1 equations assume that exposure will be continuous throughout the duration of a 25-year period. This means that in order to produce an incremental increase in lifetime cancer risk at the 1×10^{-5} risk management threshold, the PCE concentration must remain at the RBSL for 25 years. Clearly, this is not happening. More often than not, PCE concentrations are below the threshold and when exceedances did occur, they occurred several years ago. Therefore, risk accumulated over a 25-year exposure period is likely to be less than 1×10^{-5}.

3. The exceedances are substantially less than the 1×10^{-4} threshold below which the U S EPA encourages risk management decisions considering, among other factors, cost In this case, marginal and brief exceedances of the 1×10^{-5} threshold do not appear to warrant expensive intervention to remediate the groundwater

Based on these considerations, solvents in the groundwater are unlikely to produce significant health risks, and may be left to naturally attenuate. Furthermore, the magnitude of the risks calculated using very conservative models does not justify remedial action.

SUMMARY AND RECOMMENDATIONS

Neither chlorinated organics from the former dry cleaner nor benzene from the former car wash site appear to present significant risks. This is to be expected given that impacted soil has been removed from the site.

Ecological risks appear to be mitigated by the pronounced attenuation between the source and the shoreline.

The potential for risks from exposure to vapors emitted from the groundwater through the soil and into the air after passing through paved surfaces appears to be negligibly low, given the conservative nature of the models applied.

Risks appear not to justify the expense of attempting to remediate chlorinated organics, which are intractable, or benzene, which can be expected to biodegrade. Therefore, no further action is recommended for the site.

Of related interest, in the April 24, 1996 meeting, ACHA expressed concern over the concentrations of TPH-g detected in monitoring well MW-24 (located in the north/northeast half of the site), and recommended either remediation or a risk assessment based on additional data. During the discussion, ACHA allowed that a risk-based concentration might justify modification of remedial action goal. The current remedial action goal is the MCL for benzene (1 µg/L). The RBSL for benzene presented herein is an appropriate risk-based concentration for the north/northeast half of the site, and deserves further consideration by ACHA. Although this report is specifically not intended to represent Kamur's plans for remedial action at the site, it is notable that benzene in monitoring wells MW-10, MW-12, MW-23, MW-24, and MW-25 does not exceed the RBSL calculated in this study.

LIMITATIONS

This report was prepared in general accordance with the accepted standard of practice which exists in Northern California at the time the investigation was performed. It should be recognized that definition and evaluation of environmental conditions is a difficult and inexact art. Judgements leading to conclusions and recommendations are generally made with an incomplete knowledge of the conditions present More extensive studies, including additional environmental investigations, can tend to reduce the inherent uncertainties associated with such studies If the Client wishes to reduce the uncertainty beyond the level associated with this study, Kleinfelder should be notified for additional consultation

Our firm has prepared this report for the Clients exclusive use for this particular project and in accordance with generally accepted engineering practices within the area at the time of our investigation. No other representations, expressed or implied, and no warranty or guarantee is included or intended.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both onsite and offsite) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

McCAMPBELL ANALYTICAL INC.
110 2nd Avenue South, #D7, Pacheco, CA 94553
Tele: 510-798-1620 Fax: 510-798-1622

Kleinfelder 7133 Koll Center Parkway; # 100 Pleasanton, CA 94566	Client Project ID: # 10-3003-01/004; Harsch	Date Sampled: 05/21/96
		Date Received: 05/21/96
	Client Contact: Alan Gibbs	Date Extracted: 05/21/96
	Client P.O: # R3633	Date Analyzed: 05/21/96

Gasoline Range (C6-C12) Volatile Hydrocarbons as Gasoline*, with BTEX*

EPA methods 5030, modified 8015, and 8020 or 602; California RWQCB (SF Bay Region) method GCFID(5030)

Lab ID	Client ID	Matrix	TPH(g)+	Benzene	Toluene	Ethylben-zene	Xylenes	% Rec. Surrogate
65329	Hydropunch	W	ND	ND	ND	ND	ND	98

Reporting Limit unless otherwise stated; ND means not detected above the reporting limit	W	50 ug/L	0.5	0.5	0.5	0.5
	S	1.0 mg/kg	0.005	0.005	0.005	0.005

*** water and vapor samples are reported in ug/L, soil samples in mg/kg, and all TCLP extracts in mg/L**

cluttered chromatogram: sample peak coelutes with surrogate peak

+ The following descriptions of the TPH chromatogram are cursory in nature and McCampbell Analytical is not responsible for their interpretation: a) unmodified or weakly modified gasoline is significant; b) heavier gasoline range compounds are significant(aged gasoline?), c) lighter gasoline range compounds (the most mobile fraction) are significant; d) gasoline range compounds having broad chromatographic peaks are significant, biologically altered gasoline?, e) TPH pattern that does not appear to be derived from gasoline (?); f) one to a few isolated peaks present; g) strongly aged gasoline or diesel range compounds are significant; h) lighter than water immiscible sheen is present; i) liquid sample that contains greater than ~ 5 vol % sediment; j) no recognizable pattern

DHS Certification No. 1644

Edward Hamilton, Lab Director

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QC REPORT FOR HYDROCARBON ANALYSES

Date: 05/21/96 Matrix: Water

Analyte	Concentration (ug/L) Sample (#65273)	MS	MSD	Amount Spiked	% Recovery MS	MSD	RPD
TPH (gas)	0.0	112.7	103.8	100.0	112.7	103.8	8.2
Benzene	0.0	11.5	11.1	10.0	115.0	111.0	3.5
Toluene	0.0	11.5	11.1	10.0	115.0	111.0	3.5
Ethyl Benzene	0.0	11.5	11.1	10.0	115.0	111.0	3.5
Xylenes	0.0	34.7	33.8	30.0	115.7	112.7	2.6
TPH (diesel)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TRPH (oil & grease)	0	21200	21700	23700	89	92	2.3

% Rec. = (MS - Sample) / Amount Spiked x 100

RPD = (MS - MSD) / (MS + MSD) x 2 x 100

6442 AKFX19

PROJ NO	PROJECT NAME
10-3003-01/04	Harsch
LP NO (CO NO): R3633	SAMPLERS (Signature/Number) KBR 3014

DATE MM DD YY	SAMPLE I.D. TIME HH MM SS	SAMPLE I.D.	NO. OF CONTAINERS	TPH-g + BTEX	REMARKS
X 5-21-96	10:00	Hydropunch	3		H_2O 65329

Note: VOAs are not preserved.

VOAs OAG TPH-D

ICE/T° ✓
GOOD CONDITION ✓
HEAD SPACE ABSENT ✓

PRESERVATIVE APPROPRIATE ✓
CONTAINERS ✓

Standard T.A.T.

Relinquished by (Signature)	Date/Time	Received by (Signature)
KBR	5-21-96 14:53	
Relinquished by (Signature)	Date/Time	Received by (Signature)
Relinquished by (Signature)	Date/Time	Received for Laboratory by (Signature)
	5/21/96 1530	

Send Results To
Attn: Alan Gibbs
KLEINFELDER
7133 KOLL CENTER PARKWAY
SUITE 100
PLEASANTON, CA 94566
(510) 484-1700

M 60 White - Sampler ... Return Copy To Shipper Pink - Lab Copy

MW-1

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene	ND	ND							
Toluene	ND	ND							
Ethylbenzene	ND	ND							
Xylenes	ND	ND							
1,2-DCA	ND	ND							
1,1-DCE	ND	ND							
cis-1,2-DCE	ND	ND							
trans-1,2-DCE									
"DCE"	ND	ND							
PCE	0.6	2.8							
TCE	ND	ND							
Chloroform									
1,1,2-TCA									
Bromoform									
Chlorobenzene									
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-2

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene	ND	ND	<0.4		<0.5				<0.5
Toluene	ND	ND	<0.3		<0.5				<0.5
Ethylbenzene	ND	ND	<0.3		<0.5				<0.5
Xylenes	ND	ND	<0.4		<0.5				<0.5
1,2-DCA	ND	ND	<0.3		<2				<0.5
1,1-DCE	ND	ND	<0.2		<2				
cis-1,2-DCE	ND	ND	<0.4						<0.5
trans-1,2-DCE			<0.4		<1				<0.5
"DCE"	ND	ND	<0.4						
PCE	ND	ND	<0.5		<1				<0.5
TCE	ND	ND	<0.3		<2				<0.5
Chloroform									<0.5
1,1,2-TCA			<0.6						
Bromoform			<0.7						
Chlorobenzene			<0.7		<1				
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-3

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene	ND	ND	<0.4		<0.5				<0.5
Toluene	0.5	ND	<0.3		<0.5				<0.5
Ethylbenzene	ND	ND	<0.3		<0.5				<0.5
Xylenes	ND	ND	<0.4		<0.5				<0.5
1,2-DCA	ND	ND	<0.3		<2				<0.5
1,1-DCE	ND	ND	<0.2		<2				
cis-1,2-DCE	ND	ND	<0.4						0.77
trans-1,2-DCE		ND	<0.4		<1				<0.5
"DCE"	ND		<0.4						
PCE	ND	3	<0.5		8.2				20
TCE	0.5	ND	<0.3		1.4				4
Chloroform									<0.5
1,1,2-TCA			<0.6						
Bromoform			<0.7						
Chlorobenzene			<0.7		<1				
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-5B

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene	800	1300	3.1	210	<0.5				
Toluene	12	45	3.7	4.2	<0.5				
Ethylbenzene	320	370	13	1.9	<0.5				
Xylenes	66	100	2.2	2	<0.5				
1,2-DCA	ND	ND	<0.3	0.4	<2				
1,1-DCE	ND	ND	<0.2		<2				
cis-1,2-DCE	ND	ND	<0.4						
trans-1,2-DCE			<0.4		14				
"DCE"	ND	ND	<0.4	5					
PCE	ND	ND	<0.5	ND	1.2				
TCE	ND	ND	<0.3	3.4	10				
Chloroform									
1,1,2-TCA			<0.6						
Bromoform			<0.7						
Chlorobenzene			<0.7	<1	<1				
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-7 & 7B

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene	ND	ND	NA	NA	190				1.1
Toluene	ND	ND	NA	NA	<0.5				<0.5
Ethylbenzene	ND	ND	NA	NA	<0.5				<0.5
Xylenes	ND	ND	NA	NA	27				1.9
1,2-DCA	ND	ND	<0.3	ND	<2				<50
1,1-DCE	ND	ND	4.6		5.8				
cis-1,2-DCE	440	90	170						1200
trans-1,2-DCE			2.6		13				<50
"DCE"	440	90	170	150					
PCE	1900	1600	7800	5800	190				2100
TCE	520	200	660	540	12				1200
Chloroform									<50
1,1,2-TCA			0.8						
Bromoform			1.7						
Chlorobenzene			4.8		31				
	Monitoring well MW-7B replaced monitoring well MW-7 after the 4/91sampling date.								
	MW-7B is deeper and screened lower than MW-7.								
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-8

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene	ND	ND	NA	NA	92				<0.5
Toluene	ND	ND	NA	NA	<0.5				<0.5
Ethylbenzene	ND	ND	NA	NA	<0.5				<0.5
Xylenes	ND	ND	NA	NA	<0.5				<0.5
1,2-DCA	ND	ND	<0.3	ND	<2				<0.5
1,1-DCE	ND	ND	<0.2		<2				
cis-1,2-DCE	1.2	6.8	11						44
trans-1,2-DCE			<0.4		23				1.9
"DCE"	1.2	6.8	11	9					
PCE	0.9	1.1	0.9	5	70				8
TCE	3	7.7	19	14	57				22
Chloroform									<0.5
1,1,2-TCA			<0.6						
Bromoform			<0.7						
Chlorobenzene			<0.7		<1				
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-9

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene	ND	ND	<0.4		520				1.8
Toluene	ND	ND	<0.3		2.8				5.6
Ethylbenzene	ND	ND	<0.3		35				1.1
Xylenes	ND	ND	<0.4		<0.5				5.8
1,2-DCA	ND	ND	<0.3		<2				<0.5
1,1-DCE	ND	ND	<0.2		<2				
cis-1,2-DCE	ND	ND	<0.4						<0.5
trans-1,2-DCE			<0.4		<1				<0.5
"DCE"	ND	ND	<0.4						
PCE	1.5	3.3	<0.5		<1				<0.5
TCE	ND	ND	<0.3		<2				<0.5
Chloroform									<0.5
1,1,2-TCA			<0.6						
Bromoform			<0.7						
Chlorobenzene			<0.7		<1				
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-10

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene				210	3600				82
Toluene				480	3200				22
Ethylbenzene				510	1200				37
Xylenes				1200	5300				47
1,2-DCA				ND	13				<0.5
1,1-DCE					<2				
cis-1,2-DCE									<0.5
trans-1,2-DCE					2				<0.5
"DCE"				ND					
PCE				ND	3.9				<0.5
TCE				9.5	<2				<0.5
Chloroform									<0.5
1,1,2-TCA									
Bromoform									
Chlorobenzene					<1				
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-11

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene				NA	<0.5				<0.5
Toluene				NA	<0.5				<0.5
Ethylbenzene				NA	<0.5				<0.5
Xylenes				NA	<0.5				<0.5
1,2-DCA				ND	<2				1.4
1,1-DCE					<2				
cis-1,2-DCE									<0.5
trans-1,2-DCE					1.5				<0.5
"DCE"				ND					
PCE				5.8	2.5				1.3
TCE				2	4.2				3
Chloroform									<0.5
1,1,2-TCA									
Bromoform									
Chlorobenzene					<1				
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-12

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	Feb-95	May-95	Nov-95
Benzene				620	1300	5200	1100	120	71	NA
Toluene				1900	6300	6200	6200	200	130	NA
Ethylbenzene				2200	1400	13000	2000	180	110	NA
Xylenes				6000	12000	22000	15000	710	200	NA
1,2-DCA				ND	<2	NA	<2		3	NA
1,1-DCE										
cis-1,2-DCE					NR	<0.5	<2		<0.5	NA
trans-1,2-DCE					<1	NA	<2		<0.5	NA
"DCE"				ND						
PCE				ND	1.9	NA	<2		<0.5	NA
TCE				2.4	<2	NA	<2		<0.5	NA
Chloroform					<1	NA	<2		<0.5	NA
1,1,2-TCA										
Bromoform										
Chlorobenzene					<1	NA	<2		<0.5	

Blank cells indicate that nothing was reported for the given chemical.
NA means the chemical was reported as "not analyzed."
ND means the chemical was analyzed, but "not detected."
The first "Feb-95" column is for sampling by the Mark Group; the second column is for sampling performed by Soil Tech Engineers (BTEX only).
< means the chemicals was analyzed and reported below the given detection limit.
NR means not reported by the laboratory.
"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.
All values in micrograms per liter.

MW-14

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene		2.9	0.8	ND	0.95	0.96				
Toluene		ND	0.8	ND	<0.5	<0.5				
Ethylbenzene		ND	<0.3	ND	3.3	3.4				
Xylenes		0.5	0.8	ND	15	15				
1,2-DCA		4.6	6.6	3.4	8.4	9.7				
1,1-DCE		0.5	<0.2		<2	<2				
cis-1,2-DCE		ND	<0.4							
trans-1,2-DCE			<0.4		<1	<1				
"DCE"		ND	<0.4	ND						
PCE		16	<0.5	ND	<1	<1				
TCE		0.4	<0.3	ND	<2	<2				
Chloroform										
1,1,2-TCA			<0.6							
Bromoform			<0.7							
Chlorobenzene			<0.7		<1	<1				
	Blank cells indicate that nothing was reported for the given chemical.									
	NA means the chemical was reported as "not analyzed."									
	ND means the chemical was analyzed, but "not detected."									
	< means the chemicals was analyzed and reported below the given detection limit.									
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.									
	All values in micrograms per liter.									

MW-15

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene				ND	<0.5				
Toluene				ND	<0.5				
Ethylbenzene				ND	<0.5				
Xylenes				ND	<0.5				
1,2-DCA				ND	<2				
1,1-DCE					<2				
cis-1,2-DCE									
trans-1,2-DCE					<1				
"DCE"				ND					
PCE				ND	<1				
TCE				ND	<2				
Chloroform									
1,1,2-TCA									
Bromoform									
Chlorobenzene					<1				
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-16

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene				ND	<0.5	<0.5	<0.5	<0.5	NA
Toluene				ND	<0.5	<0.5	<0.5	<0.5	NA
Ethylbenzene				ND	<0.5	<0.5	<0.5	<0.5	NA
Xylenes				ND	<0.5	<0.5	<0.5	<0.5	NA
1,2-DCA				ND	<2	<0.5	<0.5	<0.5	NA
1,1-DCE									
cis-1,2-DCE					NR	<0.5	<0.5	<0.5	NA
trans-1,2-DCE					<1	<0.5	<0.5	<0.5	NA
"DCE"				ND					
PCE				ND	<1	<0.5	<0.5	<0.5	NA
TCE				ND	<2	<0.5	<0.5	<0.5	NA
Chloroform					<1	6.1	<0.5	<0.5	NA
1,1,2-TCA									
Bromoform									
Chlorobenzene					<1	<0.5	<0.5	<0.5	
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-17

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene				NA	<0.5	<0.5	<0.5	<0.5	NA
Toluene				NA	<0.5	<0.5	<0.5	<0.5	NA
Ethylbenzene				NA	<0.5	<0.5	<0.5	<0.5	NA
Xylenes				NA	<0.5	<0.5	<0.5	<0.5	NA
1,2-DCA				ND	<2	<0.5	<0.5	<0.5	NA
1,1-DCE									
cis-1,2-DCE					NR	<0.5	<0.5	<0.5	NA
trans-1,2-DCE					<1	<0.5	<0.5	<0.5	NA
"DCE"				NA					
PCE				ND	2.4	<0.5	<0.5	<0.5	NA
TCE				ND	<2	<0.5	<0.5	<0.5	NA
Chloroform					<1	4	<0.5	<0.5	NA
1,1,2-TCA									
Bromoform									
Chlorobenzene					<1	<0.5	<0.5	<0.5	
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-18

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene				NA	<0.5				
Toluene				NA	<0.5				
Ethylbenzene				NA	<0.5				
Xylenes				NA	<0.5				
1,2-DCA				ND	<2				
1,1-DCE					<2				
cis-1,2-DCE									
trans-1,2-DCE					<1				
"DCE"				NA					
PCE				ND	1.4				
TCE				ND	<2				
Chloroform									
1,1,2-TCA									
Bromoform									
Chlorobenzene					<1				
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-19

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene				NA	<0.5	<0.5	<0.5	<0.5	NA
Toluene				NA	<0.5	<0.5	<0.5	<0.5	NA
Ethylbenzene				NA	<0.5	<0.5	<0.5	<0.5	NA
Xylenes				NA	<0.5	<0.5	<0.5	<0.5	NA
1,2-DCA				ND	<2	<0.5	<0.5	<0.5	NA
1,1-DCE									
cis-1,2-DCE					NR	<0.5	<0.5	<0.5	NA
trans-1,2-DCE					<1	<0.5	<0.5	<0.5	NA
"DCE"				NA					
PCE				ND	1.1	<0.5	<0.5	<0.5	NA
TCE				ND	<2	<0.5	<0.5	<0.5	NA
Chloroform					<1	4.6	<0.5	<0.5	NA
1,1,2-TCA									
Bromoform									
Chlorobenzene					<1	<0.5	<0.5	<0.5	
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-20

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene				NA	21				<0.5
Toluene				NA	<0.5				<0.5
Ethylbenzene				NA	<0.5				<0.5
Xylenes				NA	<0.5				<0.5
1,2-DCA				ND	<2				<0.5
1,1-DCE					<2				
cis-1,2-DCE									16
trans-1,2-DCE					58				0.81
"DCE"				NA					
PCE				ND	57				<0.5
TCE				ND	32				3.7
Chloroform									<0.5
1,1,2-TCA									
Bromoform									
Chlorobenzene					<1				
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-21

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene				NA	<0.5				<0.5
Toluene				NA	<0.5				<0.5
Ethylbenzene				NA	<0.5				<0.5
Xylenes				NA	<0.5				<0.5
1,2-DCA				ND	<2				<0.5
1,1-DCE					<2				
cis-1,2-DCE									<0.5
trans-1,2-DCE					<1				<0.5
"DCE"				NA					
PCE				ND	<1				<0.5
TCE				ND	<1				<0.5
Chloroform									<0.5
1,1,2-TCA									
Bromoform									
Chlorobenzene					<1				
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-22

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene				ND	<0.5	<0.5	<0.5	<0.5	NA
Toluene				ND	<0.5	<0.5	<0.5	<0.5	NA
Ethylbenzene				ND	<0.5	<0.5	<0.5	<0.5	NA
Xylenes				ND	<0.5	<0.5	<0.5	<0.5	NA
1,2-DCA				22	15	14	8.2	11	NA
1,1-DCE					<2				
cis-1,2-DCE					NR	<0.5	<0.5	<0.5	NA
trans-1,2-DCE					<1	<0.5	<0.5	<0.5	NA
"DCE"				ND					
PCE				ND	<1	<0.5	<0.5	<0.5	NA
TCE				ND	<2	<0.5	<0.5	<0.5	NA
Chloroform					<1	0.65	<0.5	<0.5	NA
1,1,2-TCA									
Bromoform									
Chlorobenzene					<1	<0.5	<0.5	<0.5	
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-23

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene				ND	<0.5				
Toluene				ND	<0.5				
Ethylbenzene				ND	<0.5				
Xylenes				ND	<0.5				
1,2-DCA				ND	<2	0.53	<0.5	0.99	NA
1,1-DCE									
cis-1,2-DCE					NR	<0.5	<0.5	<0.5	NA
trans-1,2-DCE					<1	<0.5	<0.5	<0.5	NA
"DCE"				ND					
PCE				ND	<1	<0.5	<0.5	<0.5	NA
TCE				ND	<2	<0.5	<0.5	<0.5	NA
Chloroform					<1	<0.5	<0.5	<0.5	NA
1,1,2-TCA									
Bromoform									
Chlorobenzene					<1	<0.5	<0.5	<0.5	
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

MW-24

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	Feb-95	May-95	Nov-95
Benzene				ND	<0.5		7700	53	71	NA
Toluene				ND	<0.5		1600	21	130	NA
Ethylbenzene				ND	<0.5		1200	20	110	NA
Xylenes				ND	<0.5		2100	46	200	NA
1,2-DCA				ND	<2		6.6		3	NA
1,1-DCE										
cis-1,2-DCE					NR		<0.5		1.1	1.1
trans-1,2-DCE					<1		<0.5		<0.5	<0.5
"DCE"				ND						
PCE				ND	I.9		<0.5		<0.5	<0.5
TCE				ND	<2		<0.5		<0.5	<0.5
Chloroform					<1		<0.5		<0.5	<0.5
1,1,2-TCA										
Bromoform										
Chlorobenzene					<1		<0.5		<0.5	
	Blank cells indicate that nothing was reported for the given chemical.									
	NA means the chemical was reported as "not analyzed."									
	ND means the chemical was analyzed, but "not detected."									
	The first "Feb-95" column is for sampling by the Mark Group; the second column									
	is for sampling performed by Soil Tech Engineers (BTEX only).									
	< means the chemicals was analyzed and reported below the given detection limit.									
	NR means not reported by the laboratory.									
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.									
	All values in micrograms per liter.									

MW-25

Chemical	Nov-90	Apr-91	Jul-91	Feb-93	Apr-94	Oct-94	Feb-95	May-95	Nov-95
Benzene				100	<0.5	<0.5			NA
Toluene				230	<0.5	<0.5			NA
Ethylbenzene				270	<0.5	<0.5			NA
Xylenes				500	<0.5	<1			NA
1,2-DCA				ND	9.3	5.2	NA	NA	NA
1,1-DCE									
cis-1,2-DCE					NR	<0.5	NA	NA	NA
trans-1,2-DCE					<1	<0.5	NA	NA	NA
"DCE"				ND					
PCE				ND	3.9	<0.5	NA	NA	NA
TCE				11	<2	<0.5	NA	NA	NA
Chloroform					<1	1.3	NA	NA	NA
1,1,2-TCA									
Bromoform									
Chlorobenzene					<1	<0.5	NA	NA	
	Blank cells indicate that nothing was reported for the given chemical.								
	NA means the chemical was reported as "not analyzed."								
	ND means the chemical was analyzed, but "not detected."								
	< means the chemicals was analyzed and reported below the given detection limit.								
	"DCE" means eithter total DCE, or DCE not differentiated into cis or trans isomers.								
	All values in micrograms per liter.								

APPENDIX 3
DERIVATION OF RISK-BASED SCREENING LEVELS (RBSLs)

1.0 Conversion Calculations for Henry's Law Constants

Henry's Law constants ("H") are required to complete the calculation of risk-based screening levels (RBSLs) as provided below. The value H is a sensitive parameter in modeling volatilization, since it can vary with temperature, pressure, and concentration. The best value for H in any given model is obtained by direct measurement under field conditions. For the South Shore Remediation project, H was not previously measured, so literature values were obtained for use in the screening assessment. The highest calculated values of H (shown in bold text) were used to derive the RBSLs.

Chemical	Units	H	Conversion Factor	Converted H (unitless)
Benzene	atm	230	7.38E-04	0.17
	atm-m3/mole	5.50E-03	41.0	**0.23**
PCE	atm	1035	7.38E-04	**0.76**
	atm-m3/mole	na	41.0	na
TCE	atm	544	7.38E-04	**0.40**
	atm-m3/mole	8.92E-03	41.0	0.37
1,2-DCA	atm	51	7.38E-04	0.04
	atm-m3/mole	1.10E-03	41.0	**0.05**
1,1-DCE	atm	1841	7.38E-04	**1.36**
	atm-m3/mole	1.50E-02	41.0	0.61
Chloroform	atm	171	7.38E-04	0.13
	atm-m3/mole	3.39E-03	41.0	**0.14**
1,1,2-TCA	atm	41	7.38E-04	0.03
	atm-m3/mole	1.18E-03	41.0	**0.05**
Bromoform	atm	35	7.38E-04	0.03
	atm-m3/mole	5.32E-04	41.0	0.02

References:
(1) ASTM. 1995. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites. American Society for Testing and Materials.
(2) CalTOX. 1995.
(3) Nyer, E.K. 1993. Practical Techniques for Groundwater and Soil Remediation. Lewis Publishers. p. 36.

2.0 Derivation of RBSLs

The following tables provide the values used to derive RBSLs at the risk management threshold of 1×10^{-5}. The equations used to complete the calculations are provided below.

Step 1: Calculate RBSL for inhalation of chemical vapors in air

From Table X2.2, Medium: Air

$$RBSL_{air}\left[\frac{\mu g}{m^3 - air}\right] = \frac{TR \times BW \times AT_c \times 365\frac{days}{years} \times 10^3 \frac{\mu g}{mg}}{SF_i \times IR_{air} \times EF \times ED}$$

Where:
- $RBSL_{air}$ = risk-based screening level for inhalation of vapors
- TR = target excess individual lifetime cancer risk (unitless)
- BW = adult body weight (kg)
- AT_c = averaging time for carcinogens (years)
- SF_i = inhalation cancer slope factor $(mg/kg\text{-}day)^{-1}$
- IR_{air} = daily outdoor inhalation rate (m^3/day)
- EF = exposure frequency (days/years)
- ED = exposure duration (years)

Using the equation provided above and the values provided in the following spreadsheets gives the RBSL for inhalation.

Step 2: Calculate RBSL for groundwater, assuming volatilization and transport of constituents through the vadose zone and emission at the ground surface followed by inhalation of chemical vapors from air

From Table X2.2, Medium: Groundwater, ambient (outdoor) vapor inhalation

$$RBSL_w\left[\frac{mg}{L-H_2O}\right]=\frac{RBSL_{air}\left[\frac{\mu g}{m^3-air}\right]}{VF_{wamb}}\times\times 10^3\,\frac{\mu g}{mg}$$

Where:
- $RBSL_w$ = risk-based screening level for inhalation of vapors that have migrated from the groundwater through the vadose zone to the soil surface and into the air
- $RBSL_{air}$ = given in Step 1 above
- VF_{wamb} = the cross-media volatilization factor from groundwater to ambient (outdoor) vapors (defined in Step 3, below)

Using this equation with gives the value in the box in the spreadsheet. This is the value of interest in this risk assessment.

Calculate VF_{wamb}

From Table X2.5:

$$VF_{wamb}\left[\frac{(mg/m^3-air)}{(mg/L\text{-}H_2O)}\right]=\frac{H}{1+\left[\frac{U_{air}\delta_{air}L_{GW}}{WD_{ws}^{eff}}\right]}\times 10^3\,\frac{L}{m^3}$$

Where:
- VF_{wamb} = the cross-media volatilization factor from groundwater to ambient (outdoor) vapors
- H = Henry's law constant [(cm^3-H_2O/cm^3-air)]
- U_{air} = wind speed above ground surface in ambient mixing zone (cm/s)
- d_{air} = ambient mixing zone height (cm)
- L_{GW} = depth to groundwater = h_{cap} + h_v (cm)
- W = Width of source area parallel to wind, or ground water flow direction (cm)
- D_{ws}^{eff} = effective diffusion coefficient between groundwater and soil surface (cm^2/s). See below.

Calculate D_{ws}^{eff}

$$D_{ws}^{eff}\left[\frac{cm^2}{s}\right] = \left(h_{cap} + h_v\right)\left[\frac{h_{cap}}{D_{cap}^{eff}} + \frac{h_v}{D_s^{eff}}\right]^{-1}$$

Where:

D_{ws}^{eff} = effective diffusion coefficient between groundwater and soil surface (cm^2/s)

h_{cap} = thickness of the capillary fringe (cm)

h_v = thickness of the vadose zone (cm)

D_{cap}^{eff} = effective diffusion through the capillary fringe (cm^2/s). See below.

D_s^{eff} = effective diffusion in soil based on vapor-phase concentration (cm^2/s). See below.

Calculate D_{cap}^{eff}

$$D_{cap}^{eff}\left[\frac{cm^2}{s}\right] = D^{air}\frac{\theta_{acap}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{wcap}^{3.33}}{\theta_T^2}$$

Where:

D_{cap}^{eff} = effective diffusion through the capillary fringe (cm^2/s)

D^{air} = diffusion coefficient in air (cm^2/s)

D^{wat} = diffusion coefficient in water (cm^2/s)

θ_{acap} = volumetric air content in capillary fringe soils [(cm^3-air/cm^3-soil)]

θ_{wcap} = volumetric water content in capillary fringe soils [(cm^3-H_2O/cm^3-soil)]

θ_T = total soil porosity [(cm^3/cm^3-soil)]

H = Henry's law constant [(cm^3-H_2O/cm^3-air)]

Calculate D_s^{eff}

$$D_s^{eff}\left[\frac{cm^2}{s}\right] = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

Where:

D_s^{eff} = effective diffusion through the capillary fringe (cm^2/s)
D^{air} = diffusion coefficient in air (cm^2/s)
D^{wat} = diffusion coefficient in water (cm^2/s)
θ_{as} = volumetric air content in vadose zone soils [(cm^3-air/cm^3-soil)]
θ_{ws} = volumetric water content in vadose zone soils [(cm^3-H_2O/cm^3-soil)]
θ_T = total soil porosity [(cm^3/cm^3-soil)]
H = Henry's law constant [(cm^3-H_2O/cm^3-air)]

RBSL, outdoor air, commercial land use										
Risk-Based Screening Level	$RBSL_{oa}$	µg/m³-air	2.61E+00	Diffusion coefficient in air	D_{air}	cm^2/s	6.60E-01	Cross-media volatilization factor	V_{vamb}	6.10E-04
Target excess individual lifetime cancer risk	TR	unitless	1.00E-05	Diffusion coefficient in water	D_{wat}	cm^2/s	8.80E-05	Effective diffusion coefficient in soil based on vapor-phase concentration	D_s	5.15E-02
Adult body weight	BW	kg	70	Henry's Law constant	H	cm^3-H_2O/cm^3-air	0.76	Effective diffusion coefficient through capillary fringe	D_{cap}	1.08E-04
Averaging time for carcinogens	AT_c	years	70	Thickness of capillary fringe	h_{cap}	cm	5	Effective diffusion coefficient between groundwater and soil surface	D_{as}	3.48E-03
Inhalation cancer slope factor	SF_I	$(mg/kg\text{-}day)^{-1}$	0.051	Thickness of vadose zone	h_v	cm	168	Risk-Based Screening Level, ambient air, inhalation, commercial exposure	$RBSL_{oah}$	2.61E+00
Inhalation rate	IR_{air}	m³/day	20	Depth to groundwater	L_{gw}	cm	173	Risk-Based Screening Level, groundwater to ambient air, commercial exposure	$RBSL_{gw\text{-}oah}$	5.50E+00
Exposure frequency	EF	days/year	250	Wind speed above ground surface in ambient mixing zone	U_{air}	cm/s	225			
Exposure duration	ED	years	25	Width of source area parallel to wind, or ground water flow direction	W	cm	1500			
				Ambient air mixing zone height	δ_{air}	cm	200			
				Volumetric air content in capillary fringe soils	θ_{acap}	cm^3-air/cm^3-soil	0.038			
				Volumetric air content in vadose zone soils	θ_{as}	cm^3-air/cm^3-soil	0.26			
				Total soil porosity	θ_T	cm^3/cm^3-soil	0.38			
				Volumetric water content in capillary fringe soils	θ_{wcap}	cm^3-H_2O/cm^3-soil	0.342			
				Volumetric water content in vadose zone soils	θ_{ws}	cm^3-H_2O/cm^3-soil	0.12			

RBSL, outdoor air, commercial land use										
Risk-Based Screening Level	$RBSL_{adn}$	µg/m³-*air*	8.42E+00	Diffusion coefficient in air	D_{air}	cm^2/s	0.68	Cross-media volatilization factor	V_{vamb}	3.07E-04
Target excess individual lifetime cancer risk	TR	unitless	1.00E-05	Diffusion coefficient in water	D_{wat}	cm^2/s	9.00E-05	Effective diffusion coefficient in soil based on vapor-phase concentration	D_s	5.31E-02
Adult body weight	BW	kg	70	Henry's Law constant	H	cm^3-H_2O/cm^3-*air*	0.37	Effective diffusion coefficient through capillary fringe	D_{cap}	1.35E-04
Averaging time for carcinogens	AT_c	years	70	Thickness of capillary fringe	h_{cap}	cm	5	Effective diffusion coefficient between groundwater and soil surface	D_{ws}	4.30E-03
Inhalation cancer slope factor	SF_i	(mg/kg-day)$^{-1}$	0.017	Thickness of vadose zone	h_v	cm	168	Risk-Based Screening Level, ambient air, inhalation, commercial exposure	$RBSL_{adn}$	8.42E+00
Inhalation rate	IR_{air}	m³/day	20	Depth to groundwater	L_{gw}	cm	173	Risk-Based Screening Level, groundwater to ambient air, commercial exposure	$RBSL_{gw-adn}$	2.74E+01
Exposure frequency	EF	days/year	250	Wind speed above ground surface in ambient mixing zone	U_{air}	cm/s	225			
Exposure duration	ED	years	25	Width of source area parallel to wind, or ground water flow direction	W	cm	1500			
				Ambient air mixing zone height	δ_{air}	cm	200			
				Volumetric air content in capillary fringe soils	θ_{acap}	cm^3-*air*/cm^3-*soil*	0.038			
				Volumetric air content in vadose zone soils	θ_{av}	cm^3-*air*/cm^3-*soil*	0.26			
				Total soil porosity	θ_T	cm^3/cm^3-*soil*	0.38			
				Volumetric water content in capillary fringe soils	θ_{wcap}	cm^3-H_2O/cm^3-*soil*	0.342			
				Volumetric water content in vadose zone soils	θ_{wv}	cm^3-H_2O/cm^3-*soil*	0.12			

RBSL, outdoor air, commercial land use										
Risk-Based Screening Level	$RBSL_{toh}$	µg/m³-air	4.93E+00	Diffusion coefficient in air	D_{air}	cm²/s	0.093	Cross-media volatilization factor	V_{vamb}	2.90E-05
Target excess individual lifetime cancer risk	TR	unitless	1.00E-05	Diffusion coefficient in water	D_{wat}	cm²/s	1.10E-05	Effective diffusion coefficient in soil based on vapor-phase concentration	D_s	7.26E-03
Adult body weight	BW	kg	70	Henry's Law constant	H	cm^3-H_2O/cm^3-air	0.22	Effective diffusion coefficient through capillary fringe	D_{cap}	2.17E-05
Averaging time for carcinogens	AT_c	years	70	Thickness of capillary fringe	h_{cap}	cm	5	Effective diffusion coefficient between groundwater and soil surface	D_{ws}	6.62E-04
Inhalation cancer slope factor	SF_i	$(mg/kg\text{-}day)^{-1}$	0.029	Thickness of vadose zone	h_v	cm	168	Risk-Based Screening Level, ambient air, inhalation, commercial exposure	$RBSL_{toh}$	4.93E+00
Inhalation rate	IR_{air}	m³/day	20	Depth to groundwater	L_{gw}	cm	173	Risk-Based Screening Level, groundwater to ambient air, commercial exposure	$RBSL_{gw\text{-}toh}$	1.70E+02
Exposure frequency	EF	days/year	250	Wind speed above ground surface in ambient mixing zone	U_{air}	cm/s	225			
Exposure duration	ED	years	25	Width of source area parallel to wind, or ground water flow direction	W	cm	1500			
				Ambient air mixing zone height	δ_{air}	cm	200			
				Volumetric air content in capillary fringe soils	θ_{acap}	cm^3-air/cm^3-soil	0.038			
				Volumetric air content in vadose zone soils	θ_{av}	cm^3-air/cm^3-soil	0.26			
				Total soil porosity	θ_T	cm^3/cm^3-soil	0.38			
				Volumetric water content in capillary fringe soils	θ_{wcap}	cm^3-H_2O/cm^3-soil	0.342			
				Volumetric water content in vadose zone soils	θ_{wv}	cm^3-H_2O/cm^3-soil	0.12			

RBSL, outdoor air, commercial land use										
Risk-Based Screening Level	$RBSL_{am}$	µg/m³-air	1.57E+00	Diffusion coefficient in air	D_{air}	cm²/s	0.74	Cross-media volatilization factor	V_{wamb}	1.19E-04
Target excess individual lifetime cancer risk	TR	unitless	1.00E-05	Diffusion coefficient in water	D_{wat}	cm²/s	9.70E-05	Effective diffusion coefficient in soil based on vapor-phase concentration	D_s	5.78E-02
Adult body weight	BW	kg	70	Henry's Law constant	H	cm^3-H_2O/cm^3-air	0.045	Effective diffusion coefficient through capillary fringe	D_{cap}	5.15E-04
Averaging time for carcinogens	AT_c	years	70	Thickness of capillary fringe	h_{cap}	cm	5	Effective diffusion coefficient between groundwater and soil surface	D_{ws}	1.37E-02
Inhalation cancer slope factor	SF_i	$(mg/kg\text{-}day)^{-1}$	0.091	Thickness of vadose zone	h_v	cm	168	Risk-Based Screening Level, ambient air, inhalation, commercial exposure	$RBSL_{am}$	1.57E+00
Inhalation rate	IR_{air}	m³/day	20	Depth to groundwater	L_{gw}	cm	173	Risk-Based Screening Level, groundwater to ambient air, commercial exposure	$RBSL_{gw\text{-}am}$	1.32E+01
Exposure frequency	EF	days/year	250	Wind speed above ground surface in ambient mixing zone	U_{air}	cm/s	225			
Exposure duration	ED	years	25	Width of source area parallel to wind, or ground water flow direction	W	cm	1500			
				Ambient air mixing zone height	δ_{air}	cm	200			
				Volumetric air content in capillary fringe soils	θ_{acap}	cm^3-air/cm^3-soil	0.038			
				Volumetric air content in vadose zone soils	θ_{av}	cm^3-air/cm^3-soil	0.26			
				Total soil porosity	θ_T	cm^3/cm^3-soil	0.38			
				Volumetric water content in capillary fringe soils	θ_{wcap}	cm^3-H_2O/cm^3-soil	0.342			
				Volumetric water content in vadose zone soils	θ_{wv}	cm^3-H_2O/cm^3-soil	0.12			

RBSL, outdoor air, commercial land use										
Risk-Based Screening Level	$RBSL_{oa}$	$\mu g/m^3$-air	1.19E-01	Diffusion coefficient in air	D_{air}	cm^2/s	0.77	Cross-media volatilization factor	$V_{transfer}$	9.57E-04
Target excess individual lifetime cancer risk	TR	unitless	1.00E-05	Diffusion coefficient in water	D_{wat}	cm^2/s	1.00E-04	Effective diffusion coefficient in soil based on vapor-phase concentration	D_s	6.01E-02
Adult body weight	BW	kg	70	Henry's Law constant	H	cm^3-H_2O/cm^3-air	1.34	Effective diffusion coefficient through capillary fringe	D_{cap}	1.14E-04
Averaging time for carcinogens	AT_c	years	70	Thickness of capillary fringe	h_{cap}	cm	5	Effective diffusion coefficient between groundwater and soil surface	D_{ws}	3.70E-03
Inhalation cancer slope factor	SF_i	$(mg/kg\text{-}day)^{-1}$	1.2	Thickness of vadose zone	h_v	cm	168	Risk-Based Screening Level, ambient air, inhalation, commercial exposure	$RBSL_{ioa}$	1.19E-01
Inhalation rate	IR_{air}	m^3/day	20	Depth to groundwater	L_{gw}	cm	173	Risk-Based Screening Level, groundwater to ambient air, commercial exposure	$RBSL_{gw\text{-}ioa}$	1.25E-01
Exposure frequency	EF	days/year	250	Wind speed above ground surface in ambient mixing zone	U_{air}	cm/s	225			
Exposure duration	ED	years	25	Width of source area parallel to wind, or ground water flow direction	W	cm	1500			
				Ambient air mixing zone height	δ_{air}	cm	200			
				Volumetric air content in capillary fringe soils	θ_{acap}	cm^3-air/cm^3-soil	0.038			
				Volumetric air content in vadose zone soils	θ_{as}	cm^3-air/cm^3-soil	0.26			
				Total soil porosity	θ_T	cm^3/cm^3-soil	0.38			
				Volumetric water content in capillary fringe soils	θ_{wcap}	cm^3-H_2O/cm^3-soil	0.342			
				Volumetric water content in vadose zone soils	θ_{ws}	cm^3-H_2O/cm^3-soil	0.12			

RBSL, outdoor air, commercial land use										
Risk-Based Screening Level	$RBSL_{oa}$	$\mu g/m^3$-*air*	1.77E+00	Diffusion coefficient in air	D_{air}	cm^2/s	0.77	Cross-media volatilization factor	V_{vamp}	2.06E-04
Target excess individual lifetime cancer risk	TR	unitless	1.00E-05	Diffusion coefficient in water	D_{wat}	cm^2/s	1.10E-04	Effective diffusion coefficient in soil based on vapor-phase concentration	D_s	6.01E-02
Adult body weight	BW	kg	70	Henry's Law constant	H	cm^3-H_2O/cm^3-*air*	0.14	Effective diffusion coefficient through capillary fringe	D_{cap}	2.62E-04
Averaging time for carcinogens	AT_c	years	70	Thickness of capillary fringe	h_{cap}	cm	5	Effective diffusion coefficient between groundwater and soil surface	D_{as}	7.64E-03
Inhalation cancer slope factor	SF_i	$(mg/kg\text{-}day)^{-1}$	0.081	Thickness of vadose zone	h_v	cm	168	Risk-Based Screening Level, ambient air, inhalation, commercial exposure	$RBSL_{oa}$	1.77E+00
Inhalation rate	IR_{air}	m^3/day	20	Depth to groundwater	L_{gw}	cm	173	Risk-Based Screening Level, groundwater to ambient air, commercial exposure	$RBSL_{gw\text{-}oa}$	8.58E+00
Exposure frequency	EF	days/year	250	Wind speed above ground surface in ambient mixing zone	U_{air}	cm/s	225			
Exposure duration	ED	years	25	Width of source area parallel to wind, or ground water flow direction	W	cm	1500			
				Ambient air mixing zone height	δ_{air}	cm	200			
				Volumetric air content in capillary fringe soils	θ_{acap}	cm^3-*air*/cm^3-*soil*	0.038			
				Volumetric air content in vadose zone soils	θ_{as}	cm^3-*air*/cm^3-*soil*	0.26			
				Total soil porosity	θ_T	cm^3/cm^3-*soil*	0.38			
				Volumetric water content in capillary fringe soils	θ_{wcap}	cm^3-H_2O/cm^3-*soil*	0.342			
				Volumetric water content in vadose zone soils	θ_{ws}	cm^3-H_2O/cm^3-*soil*	0.12			