ENGEO INCORPORATED

GEOTECHNICAL
ENVIRONMENTAL
WATER RESOURCES
CONSTRUCTION SERVICES

Project No.
9450.001.000

August 8, 2012

Mr. Andy Byde
Braddock & Logan Services, Inc.
4155 Blackhawk Plaza Circle, Suite 201
Danville, CA 94506

Subject: 345 Los Coches Street
Milpitas, California

VAPOR INTRUSION RISK ASSESSMENT

Dear Mr. Byde:

ENGEO is pleased the attached *Vapor Intrusion Risk Assessment* report dated June 28, 2012, prepared by SLR Corporation and ENGEO, for the subject site (Site) in Milpitas, California. The current site development consists of a single-story vacant commercial building that was formerly used as a technology manufacturing facility. Former tenants apparently include Read-Rite and Scion Photonics.

A previous phase II site assessment prepared by ENGEO in May 2012 identified some volatile organic compounds (VOCs) in sub-slab vapor at low concentrations. This risk assessment was prepared to confirm the noted VOCs do not pose a risk for future residential development.

Based on the vapor intrusion evaluation conducted, the potential indoor inhalation risks to future residents do not exceed levels of regulatory concern, given the reported chemical concentrations. No further environmental investigations are recommended for the Site.

We appreciate the opportunity to be of continued service for this project. If you have any further questions please contact us.

Sincerely,

ENGEO Incorporated

Shawn Munger, CHG
sm/jam/jf

Julia A. Moriarty, GE

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June 28, 2012

Mr. Shawn Munger
ENGEO Incorporated
2213 Plaza Drive
Rocklin, CA 95765

Vapor Intrusion Risk Assessment
345 Los Coches Street, Milpitas, California

Dear Shawn:

This letter presents a vapor intrusion risk assessment (RA) for chemicals detected in soil gas and subslab vapors at the former JDS Uniphase facility located at 345 Los Coches Street in Milpitas, California (the site). The site consists of a main building containing film service areas, a chemistry lab, an acid waste storage area, a maintenance shop, other facility operations areas, a concrete lined trench, and a cafeteria, as well as several outbuildings used for chemical storage, with paved parking and landscaped areas. The site is bordered by commercial/industrial complexes to the north, east and south, and by railroad tracks and additional commercial/industrial complexes to the west. The vapor intrusion RA was conducted in support of the proposed future redevelopment of the property as single-family detached homes; therefore, the RA focused on residential exposures. Since residential exposures are typically greater than other exposures, protection of residential land use will also be protective of other types of exposures (e.g., commercial and construction workers, landscape worker).

BACKGROUND

Initial Phase I investigation activities identified detections of volatile organic chemicals (VOCs), semi-volatile organic chemicals (SVOCs), and metals in soil and grab groundwater samples. Soil concentrations for some analytes were above screening levels for the protection of groundwater, and some groundwater grab sample concentrations exceeded maximum contaminant levels (MCLs) for drinking water (ENGEO, 2012 and AMEC, 2011). VOCs were also detected in soil gas samples collected outside the building footprint (AMEC, 2011). One soil gas concentration of benzene was just below the California Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) for residential land use, and was above the residential California Human Health Screening Level (CHHSL). Based on the Phase I investigation, ENGEO concluded that past industrial activities at the site resulted in releases of hazardous substances to the subsurface (ENGEO, 2012), and an additional subsurface evaluation was conducted earlier this year.

The Phase II assessment conducted by ENGEO (2012) included additional vapor evaluation focusing on subslab samples from six locations beneath the building. Additional groundwater sampling was also conducted. The results were similar to those from the Phase I assessment in that some concentrations exceeded regulatory-based screening levels. Pentachlorophenol was detected in groundwater at concentrations above the MCL, and arsenic was present at the MCL. Concentrations of several VOCs in subslab vapors were also above screening levels (ENGEO, 2012).

This RA evaluates only potential risks from vapor intrusion. Other exposure pathways may also be present at the site. A conceptual site model (CSM) was therefore developed to identify

additional potential exposure pathways that were not quantified in the RA. The CSM is described in the following section.

CONCEPTUAL SITE MODEL

A CSM was developed for the site to identify potential exposure pathways for hypothetical current and future receptors. The current land use at the site is commercial/industrial, and future redevelopment as single-family homes is proposed. Potential receptors therefore include current/future commercial workers and future residents, as well as future construction workers who could be present during redevelopment. Unpaved areas at the site are currently landscaped and future redevelopment may include additional landscaping; a current/future gardener receptor was therefore also identified. Groundwater in the area is currently designated for municipal use (RWQCB, 2011); it was therefore assumed for CSM development that groundwater beneath the site could be used domestically, including as a drinking water source.

The CSM is presented as a schematic diagram and is provided on Figure 1 (Attachment A). The CSM identifies potentially complete exposure pathways, which are further designated as significant and insignificant. Significant pathways represent those pathways that are expected to contribute the majority of receptor exposure. Insignificant pathways may also be complete, but are expected to contribute only minor exposure relative to significant pathways.

All potential exposure pathways are shown on Figure 1. Potentially complete and significant exposure pathways are summarized below for each receptor.

- Current/Future Commercial Worker
    - Groundwater ingestion
    - Inhalation of subsurface vapors in indoor air

- Future Construction Worker
    - Soil ingestion
    - Dermal soil contact

- Future Gardener
    - Soil ingestion
    - Dermal soil contact

- Future Resident
    - Groundwater ingestion
    - Dermal groundwater contact (domestic use)
    - Inhalation of subsurface vapors in indoor air.

As is evident from this list, inhalation of subsurface vapors in indoor air represents a complete and potentially significant exposure pathway for the commercial worker and resident receptors. As discussed above, only residential inhalation exposure was evaluated herein since indoor air exposures are typically higher for residents than for commercial workers. Both the construction worker and gardener are outdoors receptors; vapor intrusion does not apply to either of these potential receptors.

DATA EVALUATION AND COPC IDENTIFICATION

In 2011, AMEC collected four soil gas samples (plus one duplicate) from depths of 6.5 to 11 feet below ground surface (fbgs) from locations across the site and outside the main building footprint (AMEC, 2011). The duplicate sample was collected from location SVP4; results for all but one analyte were nondetect in the parent sample, and the single detected analyte (tetrahydrofuran) had a higher concentration in the duplicate sample. Duplicate sample results were therefore conservatively used to represent location SVP4 in this evaluation. Results for one sample (SVP1) were rejected due to leaks in the sampling train. This sample was therefore excluded from the data evaluation. A total of 21 VOCs were detected in at least one of the remaining three samples. Eleven VOCs (acetone, benzene, carbon disulfide, ethylbenzene, 4-ethyltoluene, propylbenzene, 1,2,4-trimethylbenzene [TMB], 1,3,5-TMB, toluene, m,p-xylene, and o-xylene) were detected in all three samples. Five VOCs (cyclohexane, heptane, hexane, 4-methyl-2-pentanone, and tetrahydrofuran) were detected in two samples, and cis-1,2-dichloroethylene, cumene, methyl ethyl ketone (MEK), methyl tert-butyl ether (MTBE), and 1,1,1-trichloroethane [1,1,1-TCA]) were each detected in one sample.

The detected concentrations were compared with RWQCB soil gas ESLs for protection of indoor inhalation by residents (RWQCB, 2008), and with California Environmental Protection Agency (CalEPA) Office of Environmental Health Hazard Assessment (OEHHA) residential CHHSLs (CalEPA, 2005; updated on their website through September 23, 2010). VOCs with maximum concentrations exceeding screening levels or without available screening values were identified as chemicals of potential concern (COPCs) for evaluation in the vapor intrusion RA. This comparison and the resulting soil gas COPCs are shown on Table 1 (tables are provided as Attachment B).

As shown on Table 1, the maximum detected concentration of benzene exceeded the residential CHHSL and was essentially equal to the ESL. Neither ESLs nor CHHSLs were available for carbon disulfide, cumene, cyclohexane, 4-ethyltoluene, heptane, hexane, propylbenzene, 1,2,4-TMB, 1,3,5-TMB, or tetrahydrofuran. These 11 VOCs were therefore identified as COPCs in soil gas and were further evaluated in the vapor intrusion RA. Maximum concentrations of all other detected VOCs were below both ESLs and CHHSLs and were not further evaluated.

In 2012, ENGEO collected six subslab vapor samples from beneath the main building at the site (ENGEO, 2012). A total of seven chemicals (benzene, chloroform, ethylbenzene, tetrachloroethene [PCE], toluene, 1,1,1-TCA, and 1,2,4-TMB) were detected in at least one subslab sample. No chemical was detected in all subslab samples. Chloroform and ethylbenzene were most frequently detected (five samples each), while toluene was detected in four samples. 1,2,4-TMB was detected in two samples, and benzene, PCE, and 1,1,1-TCA were each detected in only one sample. Two chemicals detected in subslab vapors (chloroform and PCE) were not detected in the 2011 soil gas samples. Concentrations of other chemicals detected in subslab samples were lower than those in soil gas, with the exceptions of ethylbenzene and toluene. The assessment report (ENGEO, 2012) indicates that chloroform and ethylbenzene may be associated with the fill beneath the building.

As shown on Table 2, all subslab concentrations were below residential soil gas ESLs and CHHSLs protective of indoor air.

Based on empirical data, the Department of Toxic Substances Control (DTSC) Vapor Intrusion

Guidance (CalEPA, 2011) recommends an attenuation factor of 0.05 when using subslab samples to evaluate vapor intrusion for buildings where the attenuation factor is not known. Indoor air ESLs for chemicals detected in subslab samples were therefore divided by 0.05, and the adjusted ESLs were used as an additional screening tool to identify COPCs in subslab vapors. This additional comparison is also shown on Table 2 (as "adjusted ESL").

As shown on Table 2, three chemicals (benzene, chloroform, and ethylbenzene) had subslab concentrations greater than the adjusted indoor air ESLs. No ESL was available for 1,2,4-TMB. These four chemicals were therefore identified as subslab COPCs and further evaluated in the vapor intrusion modeling.

VAPOR INTRUSION MODELING

Soil gas COPCs were further evaluated using the soil gas version of the Johnson and Ettinger (J&E) spreadsheet model developed by DTSC. The J&E model is not available for four chemicals that were identified as soil gas COPCs based on a lack of available screening levels (cyclohexane, 4-ethyltoluene, heptane, and tetrahydrofuran); these four COPCs are not expected to contribute significantly to overall risk and hazard estimates and were therefore not further evaluated. For the remaining seven soil gas COPCs, the most recent version of the model workbook, "SG-SCREEN EPA version 2.0, 04/03 Interim Final 12/04, last modified 12/6/11" was used to conduct the modeling. Default values for residential homes were used for the 2011 data, in combination with the following site-specific parameters:

- Soil type (clay, based on the description of site lithology corresponding to soil gas sampling depths [AMEC, 2011]); and
- Soil gas sampling depth below grade (sample-specific depths from AMEC [2011] were used, corresponding to the depths of the concentrations used for the modeling).

For subslab sampling, the four COPCs (benzene, chloroform, ethylbenzene, and 1,2,4-TMB) were further evaluated using the DTSC-modified J&E model with two additional site-specific parameters:

- Soil type (sand, based on the presence of fill composed of clayey gravel and sand beneath the slab [AMEC, 2011]), and
- Soil gas sampling depth below grade (conservatively estimated as 1 centimeter, value designed to eliminate soil effects on the indoor air estimates).

For soil gas data, exposure point concentrations (EPCs) were derived as follows. The maximum detected concentration of each COPC was used if that concentration resulted in the highest risk and hazard estimates based on the J&E modeling. Since soil gas samples were collected at different depths, the highest concentration was not always associated with the highest risk estimate. This was the case for one soil gas COPC (benzene); for benzene the second-highest detected concentration of 74 $\mu g/m^3$ at location SVP3 (6.5 fbgs) was used as the EPC since this concentration and sample depth produced higher risk and hazard estimates than the maximum concentration of 83 $\mu g/m^3$ detected at SVP2 (9 fbgs). For other soil gas COPCs, the maximum detected concentrations were identified as the input concentrations for J&E modeling.

For subslab samples, the maximum detected concentration was used as the EPC for each

COPC.

EPCs for soil gas and subslab vapors are shown on Tables 3 and 4, respectively. The selection of EPCs for the J&E modeling was conservatively designed to identify the highest risk and hazard estimates based on detected chemical concentrations in soil gas and subslab samples.

All J&E modeling runs are provided in the Appendix (Attachment C) and summarized in Tables 3 and 4 for the soil gas and subslab datasets, respectively.

RESULTS AND DISCUSSION

Results are presented and discussed in two ways. First, subslab J&E modeling results are discussed, then the J&E results for the soil gas data from 2011 are presented and discussed. Based on the DTSC Vapor Intrusion Guidance (CalEPA, 2011), subslab data are preferable to soil gas data when evaluating potential vapor intrusion since subsurface modeling of soil gas can be eliminated as a variable. Therefore, subslab data were evaluated first as the primary line of evidence in this assessment. Site-wide soil gas data are then discussed as additional weight-of-evidence in interpreting the results.

Subslab J&E Modeling

Based on the screening evaluation (Table 2), the maximum concentrations of benzene, chloroform, and ethylbenzene in subslab samples exceeded their respective adjusted indoor air ESLs, and 1,2,4-TMB was identified as a COPC based on the lack of available screening levels. The J&E model was used to estimate a lifetime excess cancer risk (LECR) and non-cancer hazard quotient for each chemical, and the results were summed to produce a total LECR and hazard index (HI) based on the subslab vapor COPCs. As shown in Table 4, when summed across the four COPCs, the cumulative LECR and HI estimates were 0.003 and $1x10^{-6}$, respectively. Neither the HI nor the LECR exceeded the respective regulatory target levels of 1 and $1x10^{-6}$. Therefore, based solely on evaluation of subslab data from beneath the main building at the site and J&E modeling, potential cancer risks and non-cancer hazards are below levels of concern to human health.

Soil Gas J&E Evaluation

Benzene, carbon disulfide, cumene, hexane, propylbenzene, 1,2,4-TMB, and 1,3,5-TMB were further evaluated in soil gas using the J&E model, as previously discussed. Results are presented in Table 3.

Similar to the subslab evaluation, the results of the soil gas J&E modeling indicate that neither non-cancer hazards nor cancer risks exceed the respective target levels of 1 and $1x10^{-6}$. The cumulative LECR and HI estimates across all seven COPCs based on the modeling were $4x10^{-7}$ and 0.008, respectively. Therefore, adverse effects to human health under the proposed future land use are not anticipated at the reported concentrations.

CONCLUSIONS

Based on the vapor intrusion evaluation conducted herein using both soil gas and subslab vapor data, we conclude that potential indoor inhalation risks to future residents do not exceed levels

of regulatory concern based on the reported chemical concentrations.

Please contact us with any questions or comments at (425) 402-8800.

Sincerely,
SLR International Corporation

Amanda Bailey, M.S.
Associate Risk Assessment Scientist

Attachments:

A: Figure
B: Tables
C: Appendix (J&E Modeling)

REFERENCES

AMEC. 2011. Summary of Results: Subsurface Investigation Activities, 345 Los Coches Street, Milpitas, California. Letter Report to Ms. Sheba Challenger, iStar Real Estate Services. September 21.

California Environmental Protection Agency (CalEPA). 2011. Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air (Vapor Intrusion Guidance). Department of Toxic Substances Control (DTSC). Final. October.

California Environmental Protection Agency (CalEPA). 2005. Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil. Office of Environmental Health Hazard Assessment (OEHHA). November 2004. January 2005 Revision. Updated through 9/23/10 at: http://oehha.ca.gov/risk/chhsltable.html#table3

California Regional Water Quality Control Board (RWQCB), San Francisco Bay Region. 2011. San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan). Available online at: http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/basinplan/web/docs/BP_all_chapters.pdf

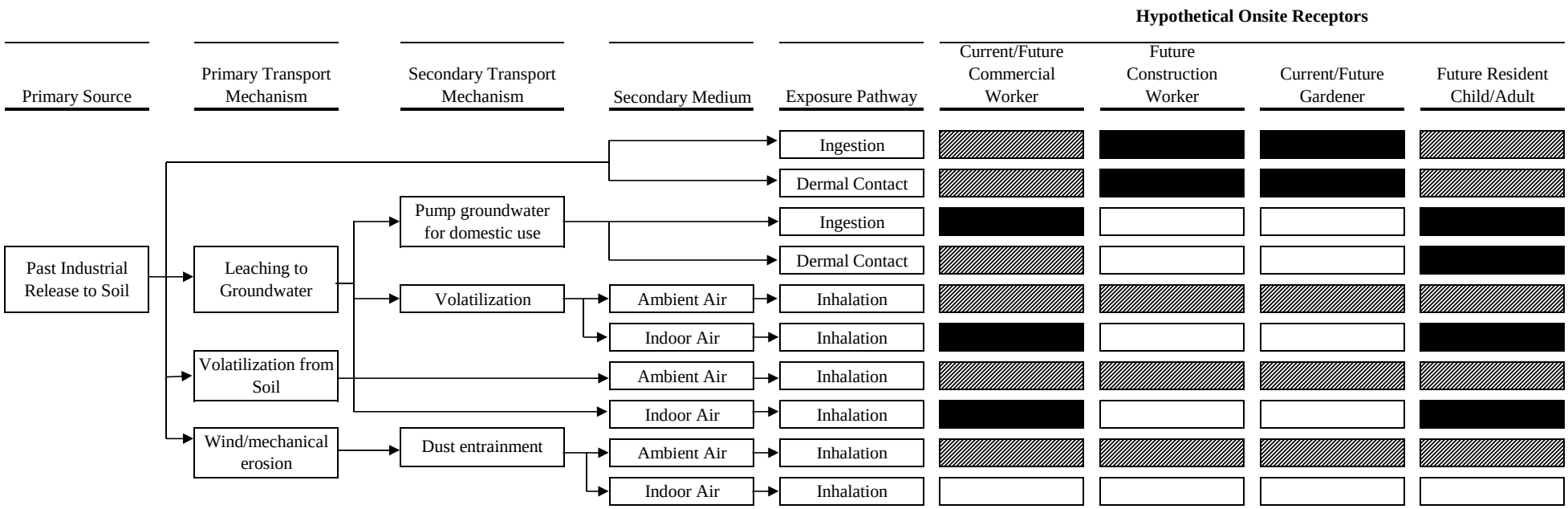
California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB). 2008. Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater. Interim Final. November 2007 (Revised May 2008).

ENGEO. 2012. 345 Los Coches Street, Milpitas, California, Subslab Vapor Intrusion and Groundwater Assessment. Letter Report to Mr. Andrew Boyd, Braddock and Logan Services, Inc. May 15.

ATTACHMENT A

FIGURE

Figure 1
Conceptual Site Model Diagram
Vapor Intrusion Risk Assessment
345 Los Coches Street
Milpitas, California



Receptor may be exposed via this route, so exposure pathway considered potentially complete.

Receptor may be exposed via this route, so pathway is considered potentially complete. However, exposure likely insignificant relative to other complete pathways.

Pathway is incomplete.

ATTACHMENT B

TABLES

Table 1
Identification of Chemicals of Potential Concern
Soil Gas
Vapor Intrusion Risk Assessment
345 Los Coches Street, Milpitas, California

Analyte[a]	Max[b]	Soil Gas ESL[c]	Soil Gas CHHSL[d]	COPC[e] (ESL)?	COPC[e] (CHHSL)?	COPC?[e]
	($\mu g/m^3$)					
Acetone	320	660,000	NA	No	NA	No
Benzene	**83**	84	**36**	No	**Yes**	**Yes**
Carbon Disulfide	**350**	NA	NA	NA	NA	**Yes**
cis-1,2-Dichloroethylene	6.3	7,300	16,000	No	No	No
Cumene	**6**	NA	NA	NA	NA	**Yes**
Cyclohexane	**32**	NA	NA	NA	NA	**Yes**
Ethylbenzene	55	980	420	No	No	No
4-Ethyltoluene	**88**	NA	NA	NA	NA	**Yes**
Heptane	**69**	NA	NA	NA	NA	**Yes**
Hexane	**47**	NA	NA	NA	NA	**Yes**
Methyl Ethyl Ketone	74	1,000,000	NA	No	NA	No
4-Methyl-2-Pentanone	17	630,000	NA	No	NA	No
Methyl tert-Butyl Ether	23	9,400	4,000	No	No	No
Propylbenzene	**15**	NA	NA	NA	NA	**Yes**
1,1,1-Trichloroethane	12	460,000	990,000	No	No	No
1,2,4-Trimethylbenzene	**86**	NA	NA	NA	NA	**Yes**
1,3,5-Trimethylbenzene	**36**	NA	NA	NA	NA	**Yes**
Tetrahydrofuran	**380**	NA	NA	NA	NA	**Yes**
Toluene	170	63,000	140,000	No	No	No
m,p-Xylene	200	21,000	320,000	No	No	No
o-Xylene	56	21,000	320,000	No	No	No

COPCs are identified in bold font.

Abbreviations:
Max: maximum
ESL: environmental screening level
CHHSL: California human health screening level
$\mu g/m^3$: micrograms per cubic meter
COPC: chemical of potential concern
NA: not available/not applicable

Footnotes:
[a]Only detected analytes are shown.
[b]Maximum detected concentrations from AMEC (2011).
[c]Residential ESLs for shallow soil gas (RWQCB, 2008).
[d]Residential soil gas screening numbers from CalEPA (2005, updated through 9/23/10), for buildings without engi
[e]Analyte was identified as a COPC if the maximum was greater than the screening level, or if no screening level w

References:

California Environmental Protection Agency (CalEPA). 2005. Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil. Office of Environmental Health Hazard Assessment (OEHHA). November 2004. January 2005 Revision. Updated through 9/23/10 at: http://oehha.ca.gov/risk/chhsltable.html#table3

California Regional Water Quality Control Board (RWQCB), San Francisco Bay Region. 2008. Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater. Interim Final. November 2007 (Revised May 2008).

AMEC. 2011. Summary of Results: Subsurface Investigation Activities, 345 Los Coches Street, Milpitas, Califor Letter Report to Ms. Sheba Challenger, iStar Real Estate Services. September 21.

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Table 2
Identification of Chemicals of Potential Concern
Subslab Vapors
Vapor Intrusion Risk Assessment
345 Los Coches Street, Milpitas, California

Analyte[a]	Max[b]	Soil Gas ESL[c]	Soil Gas CHHSL[d]	Indoor Air ESL[e]	COPC[f] (ESL)?	COPC[f] (CHHSL)?	COPC[f] (Adjusted ESL)?	COPC?[f]
	($\mu g/m^3$)							
Benzene	**1.92**	84	36	**1.68**	No	No	**Yes**	**Yes**
Chloroform	**44.7**	460	NA	**9.2**	No	NA	**Yes**	**Yes**
Ethylbenzene	**407**	980	420	**19.6**	No	No	**Yes**	**Yes**
Tetrachloroethene	6.19	410	180	8.2	No	No	No	No
Toluene	681	63,000	140,000	1260	No	No	No	No
1,1,1-Trichloroethane	5.56	460,000	990,000	9200	No	No	No	No
1,2,4-Trimethylbenzene	**3.23**	NA	NA	NA	NA	NA	NA	**Yes**

COPCs are identified in bold font.

Abbreviations:
Max: maximum
ESL: environmental screening level
CHHSL: California human health screening level
$\mu g/m^3$: micrograms per cubic meter
COPC: chemical of potential concern
NA: not available/not applicable

Footnotes:
[a]Only detected analytes are shown.
[b]Maximum detected concentrations from ENGEO (2012).
[c]Residential ESLs for shallow soil gas (RWQCB, 2008).
[d]Residential soil gas screening numbers from CalEPA (2005, updated through 9/23/10), for buildings without engineered fill.
[e]Residential ESLs for indoor air (RWQCB, 2008), adjusted using an attenuation factor of 0.05 (i.e., multiplied by 20).
[f]Analyte was identified as a COPC if the maximum was greater than the screening level, or if no screening level was available.

References:
California Environmental Protection Agency (CalEPA). 2005. Human-Exposure-Based Screening Numbers Developed to Aid Estimation of Cleanup Costs for Contaminated Soil. Office of Environmental Health Hazard Assessment (OEHHA). November 2004. January 2005 Revision. Updated through 9/23/10 at: http://oehha.ca.gov/risk/chhsltable.html#table3
California Regional Water Quality Control Board (RWQCB), San Francisco Bay Region. 2008. Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater. Interim Final. November 2007 (Revised May 2008).
ENGEO. 2012. 345 Los Coches Street, Milpitas, California, Subslab Vapor Intrusion and Groundwater Assessment. Letter Report to Mr. Andrew Boyd, Braddock and Logan Services, Inc. May 15.

Table 3
Soil Gas Johnson & Ettinger Evaluation
Vapor Intrusion Risk Assessment
345 Los Coches Street, Milpitas, California

COPC	Concentration ($\mu g/m^3$)	Sample Location	Sample Depth (fbgs)	LECR[a]	HQ[a]
Benzene	74	SVP3	6.5	4.3E-07	0.0012
Carbon Disulfide	350	SVP3	6.5	NA	0.00027
Cumene	6	SVP3	6.5	NA	0.0000055
Hexane	47	SVP3	6.5	NA	0.000057
Propylbenzene	15	SVP3	6.5	NA	0.000037
1,2,4-Trimethylbenzene	86	SVP3	6.5	NA	0.0043
1,3,5-Trimethylbenzene	36	SVP3	6.5	NA	0.0021
				Total LECR[b]	**Total HI[c]**
				4E-07	0.008

Abbreviations:
COPC: chemical of potential concern
$\mu g/m^3$: micrograms per cubic meter
fbgs: feet below ground surface
LECR: lifetime excess cancer risk
HQ: hazard quotient
HI: hazard index

Footnotes:
[a]Calculated using CalEPA-modified Johnson and Ettinger screening model for soil gas.
[b]Pathway-specific total LECR = sum of chemical-specific LECRs.
[c]Pathway-specific HI = sum of chemical-specific HQs.

Table 4
Subslab Vapor Johnson & Ettinger Evaluation
Vapor Intrusion Risk Assessment
345 Los Coches Street, Milpitas, California

COPC	Concentration ($\mu g/m^3$)	Sample Location	LECR[a]	HQ[a]
Benzene	1.92	V6	5.6E-08	0.00015
Chloroform	44.7	V6	2.4E-07	0.00035
Ethylbenzene	407	V2	1.0E-06	0.00095
1,2,4-Trimethylbenzene	3.23	V3	NA	0.0011
			Total LECR[b]	**Total HI[c]**
			1E-06	0.003

Abbreviations:
COPC: chemical of potential concern
$\mu g/m^3$: micrograms per cubic meter
LECR: lifetime excess cancer risk
HQ: hazard quotient
HI: hazard index

Footnotes:
[a]Calculated using CalEPA-modified Johnson and Ettinger screening model for soil gas.
[b]Pathway-specific total LECR = sum of chemical-specific LECRs.
[c]Pathway-specific HI = sum of chemical-specific HQs.

ATTACHMENT C

APPENDIX

J&E MODELING RUNS

SG-SCREEN
PA Version 2.0; 04/

Reset to Defaults

DTSC
Vapor Intrusion Guidance
Interim Final 12/04
(last modified 12/6/2011)

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
71432	1.92E+00			Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	16	24	S		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
S	1.66	0.375	0.054	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
1	0.321	0.003	1.02E-07	0.998	1.01E-07	4,000	1.92E+00	3.39E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Diffusion path length, L_d (cm)
1.00E+06	5.00E-03	15	7,977	5.29E-03	2.17E-01	1.80E-04	1.42E-02	1

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)
15	1.92E+00	1.25	8.33E+01	1.42E-02	5.00E+03	1.22E+05	2.44E-03	4.69E-03

Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
2.9E-05	3.0E-02

END

RESULTS SHEET

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
5.6E-08	1.5E-04

MESSAGE SUMMARY BELOW:

END

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Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
67663	4.47E+01			Chloroform

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	16	24	S		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
S	1.66	0.375	0.054	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
1	0.321	0.003	1.02E-07	0.998	1.01E-07	4,000	4.47E+01	3.39E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Diffusion path length, L_d (cm)
1.00E+06	5.00E-03	15	7,407	3.51E-03	1.44E-01	1.80E-04	1.68E-02	1

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)
15	4.47E+01	1.25	8.33E+01	1.68E-02	5.00E+03	2.02E+04	2.45E-03	1.09E-01

Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
5.3E-06	3.0E-01

END

RESULTS SHEET

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
2.4E-07	3.5E-04

MESSAGE SUMMARY BELOW:

END

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Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
100414	4.07E+02			Ethylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	16	24	S		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
S	1.66	0.375	0.054	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
1	0.321	0.003	1.02E-07	0.998	1.01E-07	4,000	4.07E+02	3.39E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Diffusion path length, L_d (cm)
1.00E+06	5.00E-03	15	9,994	7.43E-03	3.05E-01	1.80E-04	1.21E-02	1

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)
15	4.07E+02	1.25	8.33E+01	1.21E-02	5.00E+03	9.33E+05	2.44E-03	9.94E-01

Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
2.5E-06	1.0E+00

END

RESULTS SHEET

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.0E-06	9.5E-04

MESSAGE SUMMARY BELOW:

END

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Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
95636	3.23E+00			1,2,4-Trimethylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	16	24	S		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
S	1.66	0.375	0.054	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
1	0.321	0.003	1.02E-07	0.998	1.01E-07	4,000	3.23E+00	3.39E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Diffusion path length, L_d (cm)
1.00E+06	5.00E-03	15	11,516	5.76E-03	2.36E-01	1.80E-04	9.80E-03	1

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)
15	3.23E+00	1.25	8.33E+01	9.80E-03	5.00E+03	2.45E+07	2.44E-03	7.88E-03

Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	7.0E-03

END

RESULTS SHEET

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	1.1E-03

MESSAGE SUMMARY BELOW:

END

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Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
71432	7.40E+01			Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	198.12	24	C		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
C	1.43	0.459	0.215	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
183.12	0.244	0.324	2.32E-09	0.821	1.90E-09	4,000	7.40E+01	3.39E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Diffusion path length, L_d (cm)
1.00E+06	5.00E-03	15	7,977	5.29E-03	2.17E-01	1.80E-04	3.81E-03	183.12

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)
15	7.40E+01	1.25	8.33E+01	3.81E-03	5.00E+03	9.87E+18	4.91E-04	3.64E-02

Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
2.9E-05	3.0E-02

END

RESULTS SHEET

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
4.3E-07	1.2E-03

MESSAGE SUMMARY BELOW:

END

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ENTER Chemical CAS No. (numbers only, no dashes)	Soil Gas Concentration Data: ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
75150	3.50E+02			Carbon disulfide

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	198.12	24	C		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
C	1.43	0.459	0.215	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
183.12	0.244	0.324	2.32E-09	0.821	1.90E-09	4,000	3.50E+02	3.39E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Diffusion path length, L_d (cm)
1.00E+06	5.00E-03	15	6,572	2.91E-02	1.19E+00	1.80E-04	4.50E-03	183.12

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)
15	3.50E+02	1.25	8.33E+01	4.50E-03	5.00E+03	1.19E+16	5.60E-04	1.96E-01

Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	7.0E-01

END

RESULTS SHEET

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	2.7E-04

MESSAGE SUMMARY BELOW:

END

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Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
98828	6.00E+00			Cumene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	198.12	24	C		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
C	1.43	0.459	0.215	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
183.12	0.244	0.324	2.32E-09	0.821	1.90E-09	4,000	6.00E+00	3.39E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Diffusion path length, L_d (cm)
1.00E+06	5.00E-03	15	12,447	1.08E+00	4.42E+01	1.80E-04	2.81E-03	183.12

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)
15	6.00E+00	1.25	8.33E+01	2.81E-03	5.00E+03	5.30E+25	3.83E-04	2.30E-03

Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	4.0E-01

END

RESULTS SHEET

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	5.5E-06

MESSAGE SUMMARY BELOW:

END

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Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
110543	4.70E+01			Hexane

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	198.12	24	C		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
C	1.43	0.459	0.215	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
183.12	0.244	0.324	2.32E-09	0.821	1.90E-09	4,000	4.70E+01	3.39E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Diffusion path length, L_d (cm)
1.00E+06	5.00E-03	15	7,549	1.59E+00	6.53E+01	1.80E-04	8.66E-03	183.12

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)
15	4.70E+01	1.25	8.33E+01	8.66E-03	5.00E+03	2.29E+08	8.90E-04	4.18E-02

Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	7.0E-01

END

RESULTS SHEET

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	5.7E-05

MESSAGE SUMMARY BELOW:

END

SG-SCREEN
PA Version 2.0; 04/

Reset to Defaults

DTSC
Vapor Intrusion Guidance
Interim Final 12/04
(last modified 12/6/2011)

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
103651	1.50E+01			n-Propylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	198.12	24	C		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
C	1.43	0.459	0.215	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
183.12	0.244	0.324	2.32E-09	0.821	1.90E-09	4,000	1.50E+01	3.39E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Diffusion path length, L_d (cm)
1.00E+06	5.00E-03	15	11,186	1.00E-02	4.10E-01	1.80E-04	2.60E-03	183.12

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)
15	1.50E+01	1.25	8.33E+01	2.60E-03	5.00E+03	6.54E+27	3.58E-04	5.37E-03

Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	1.4E-01

END

RESULTS SHEET

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	3.7E-05

MESSAGE SUMMARY BELOW:

MESSAGE: Risk/HQ or risk-based soil concentration is based on a route-to-route extrapolation.

END

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Reset to Defaults

DTSC
Vapor Intrusion Guidance
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Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
95636	8.60E+01			1,2,4-Trimethylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	198.12	24	C		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
C	1.43	0.459	0.215	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
183.12	0.244	0.324	2.32E-09	0.821	1.90E-09	4,000	8.60E+01	3.39E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Diffusion path length, L_d (cm)
1.00E+06	5.00E-03	15	11,516	5.76E-03	2.36E-01	1.80E-04	2.62E-03	183.12

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)
15	8.60E+01	1.25	8.33E+01	2.62E-03	5.00E+03	3.82E+27	3.61E-04	3.10E-02

Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	7.0E-03

END

RESULTS SHEET

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	4.3E-03

MESSAGE SUMMARY BELOW:

END

SG-SCREEN
PA Version 2.0; 04/

Reset to Defaults

DTSC
Vapor Intrusion Guidance
Interim Final 12/04
(last modified 12/6/2011)

Soil Gas Concentration Data

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Soil gas conc., C_g ($\mu g/m^3$)	OR	ENTER Soil gas conc., C_g (ppmv)	Chemical
108678	3.60E+01			1,3,5-Trimethylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	198.12	24	C		

MORE ↓

ENTER Vandose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
C	1.43	0.459	0.215	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
70	30	30	350

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Soil gas conc. ($\mu g/m^3$)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
183.12	0.244	0.324	2.32E-09	0.821	1.90E-09	4,000	3.60E+01	3.39E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Diffusion path length, L_d (cm)
1.00E+06	5.00E-03	15	11,495	5.50E-03	2.25E-01	1.80E-04	2.61E-03	183.12

Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)
15	3.60E+01	1.25	8.33E+01	2.61E-03	5.00E+03	5.80E+27	3.59E-04	1.29E-02

Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
NA	6.0E-03

END

RESULTS SHEET

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	2.1E-03

MESSAGE SUMMARY BELOW:

END