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PRELIMINARY VAPOUR INTRUSION ASSESSMENT (VIA)

Beverley Assessment Area, South Australia

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REPORT

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Acronyms and Abbreviations

Abbreviation/Acronym	Definition
ASV	Active Soil Vapour (Sample or Sampling Point)
ATSDR	Agency for Toxic Substances and Disease Registry (US)
COI	Chemical of Interest
CSM	Conceptual Site Model
enHealth	National Environmental Health Council
EPA	Environment Protection Authority
HHRA	Human Health Risk Assessment
HI	Hazard Index; the sum of HQ
HQ	Hazard Quotient
LOR	Limit of Reporting
m bgl	Metres Below Ground Level
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NEPM (ASC)	National Environment Protection (Assessment of Site Contamination) Measure
NHMRC	National Health and Medical Research Council
NIOSH	National Institute for Occupational Safety and Health (USA)
PCE	Tetrachloroethene
PSV	Passive Soil Vapour (Sample or Sampling Point)
TCE	Trichloroethene
US EPA	United States Environmental Protection Agency
VHC	Volatile Halogenated Compound
VIA	Vapour Intrusion Assessment
WHO	World Health Organization

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1.0 INTRODUCTION

The South Australian Environment Protection Authority (SA EPA) engaged Golder Associates Pty Ltd (Golder) to conduct a groundwater and soil vapour investigation at targeted locations within a defined Assessment Area located in a portion of Beverley and Woodville South. The Assessment Area is centred around a former manufacturing facility on Pope Street, Beverley and contains numerous industrial and residential properties. The location of the Assessment Area is provided in Figure A1, Appendix A.

The primary objective of the investigation was to record concentrations of chemicals of interest (COI) within soil, groundwater, soil vapour and in ambient air at targeted locations within the Assessment Area. COI for the investigation included volatile organic compounds (VOC), with particular focus on the chlorinated hydrocarbons tetrachloroethene (PCE); trichloroethene (TCE); cis-1,2- and trans-1,2-dichloroethene (DCE), vinyl chloride and chloroform.

This data was used to undertake a vapour intrusion assessment (VIA) including modelling of potential vapour intrusion for property (building) types within the Assessment Area and estimation of site specific screening criteria for assessment of soil vapour and ambient air sampling results.

The outcome of the VIA was used to undertake a preliminary quantitative human health risk assessment (HHRA) for the COI identified by the results of the environmental sampling works and for the property (building) types identified in the Assessment Area. The methodology, results and conclusions of the HHRA have been provided under separate cover (Golder, 2015f).

This report presents the methodology, results and conclusions of the VIA.

2.0 SCOPE OF WORKS

The VIA was undertaken in general accordance with the proposed scope of work outlined in Golder's proposal *Beverley & Woodville South Groundwater and Soil Vapour Assessment* (ref. P1418522-001-P-Rev0), dated 28 January 2015. The scope of works included the following:

- Review of environmental investigation data including the observations and results of samples of groundwater, soil, soil vapour, crawl-space air, ambient (surface) air and indoor air.
- Review of observations regarding building types and land uses present within the Assessment Area and in particular the building foundation types.
- Identification of COI requiring assessment based on the results of environmental sampling works.
- Preparation of vapour migration and intrusion models in consideration of the site conditions (geology and hydrogeology) and in consideration of residential building types indicated to be present in the Assessment Area.
- Estimation of an attenuation factor (α) for the adopted COI for assessment of each vapour migration and intrusion pathway.
- Verification of estimated vapour attenuation factors against attenuation indicated by vapour concentrations reported during environmental investigation works. Revision and adjustment of the proposed vapour attenuation factors based on the results of the environmental investigation works.
- Estimation of vapour attenuation factors, in consideration of model results, site sample data and published generic attenuation factors, for application in the HHRA and assessment of potential for vapour concentrations to exceed management guidelines.

3.0 ASSESSMENT METHODOLOGY

The VIA was undertaken following the general principles and methodology as provided in the National Environment Protection (Assessment of Site Contamination) Measure 1999 (NEPC, 2013) and with reference to other applicable Australian guidance including the Guidelines for Assessing Human Health Risks from Environmental Hazards (enHealth, 2012). Where data or assessment parameters were not available from site investigation works or from Australian sources, reference was made to guidance issued by the United States EPA.

The outline approach followed for the VIA is presented in Figure 1 below.

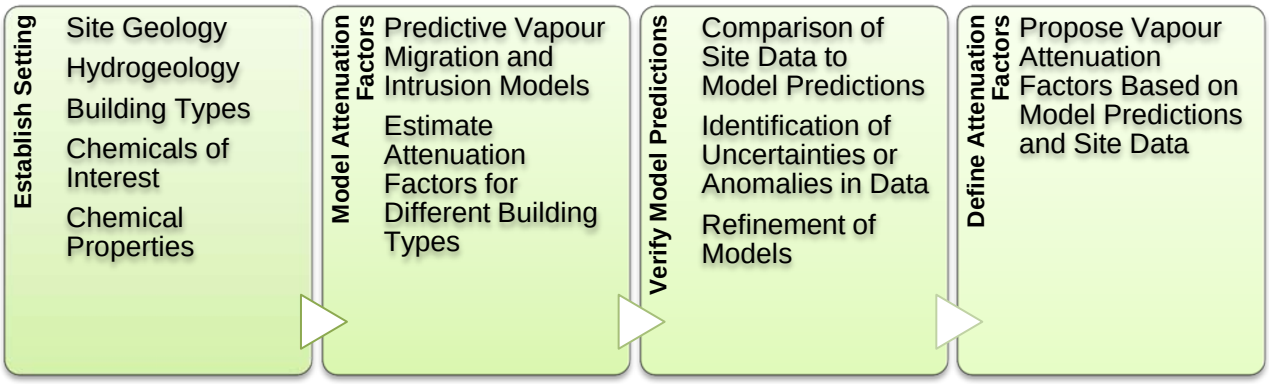

Figure 1: Vapour Intrusion Assessment - Outline Approach

The site investigation data used to complete the VIA was sourced from reports prepared for previous stages of investigation and sampling works (Golder 2015a, 2015b, 2015c, 2015d) and from the conceptual site model (CSM) compiled from these investigation works (Golder, 2015e).

In order to estimate the potential indoor air concentration of a volatile chemical identified in groundwater or soil vapour, an attenuation factor (designated "α") is required. The attenuation factor represents the change in concentration between the measured environmental location (such as a deep soil vapour sample) and the indoor air environment. The attenuation factor represents a number of different processes that may occur to reduce the concentration of the chemical, including biological degradation, dispersion, dilution and adsorption to soil particles. The routinely adopted approaches available to estimate the degree of attenuation are:

- Application of published generic attenuation factors derived from databases of site sampling results collated from a range of chemicals, geology and building types.
- Modelling of vapour migration using measured or estimated site specific soil and building parameters.
- Collection and analysis of groundwater, soil vapour and ambient air samples and estimation of attenuation factors based on inferred changes in measured concentrations at different points in the vapour migration pathway.

The methodology adopted for the VIA has included consideration of each of the three approaches noted above.

Based on the CSM, identified COI and property (building) types, predictive vapour intrusion models were prepared to estimate attenuation (migration) of volatile chemicals from soil vapour at different depths and from ambient air samples immediately below building structures (crawl space samples), into overlying buildings.

The estimated attenuation factors were then reviewed against the results of vapour sample analysis to assess the accuracy of the models.

The attenuation factors estimated by modelling and the attenuation factors inferred from the results of vapour sample analysis were then reviewed against published generic attenuation factors (obtained from multi-site databases), to assess consistency with conclusions from international data.

Proposed attenuation factors were then selected for use in the HHRA based on the review of the complete modelling and site investigation data set.

Whilst a multiple lines of evidence approach was used, the primary data used for the VIA and HHRA were the sample analysis results from shallow and medium depth soil vapour including sub slab samples (obtained from soil material immediately below the foundation concrete) and crawl space samples. These sample results represent the concentrations in closest proximity to receptors (overlying buildings) with a lower degree of uncertainty due to partitioning from groundwater and from migration through deeper soil profiles.

4.0 VAPOUR INTRUSION SETTING

4.1 Chemicals of Interest (COI)

The COI targeted for consideration within the Beverly Assessment Area were based upon the original scope request and included "*TCE and other chlorinated hydrocarbons*". Review of the results of soil, groundwater and soil vapour sampling indicated detection of the volatile chlorinated hydrocarbons (referred to as volatile halogenated compounds or VHC), as summarised in Table 1:

Table 1: Summary of Volatile Halogenated Compounds Detected in Media at Assessment Area

Volatile Halogenated Compounds	Groundwater	Soil	Active Soil Vapour
Tetrachloroethene (PCE)	☑	☐	☑
Trichloroethene (TCE)	☑	☐	☑
cis-1,2-dichloroethene	☑	☐	☑
trans-1,2-dichloroethene	☑	☐	☐
1,1-dichloroethene	☑	☐	☐
Vinyl chloride	☐	☐	☐
Chloroform	☑	☐	☑
1,1,2-trichloroethane	☑	☐	☐
1,2-dichloroethane	☑	☐	☐
1,2-dichloropropane	☑	☐	☐
Freon 11 (trichlorofluoromethane)	☐	☐	☑

☑ - Detected in Media; ☐ - Not Detected

Sample analysis results are presented in the Conceptual Site Model report (Golder, 2015d)

Passive soil vapour (PSV) samples were also obtained from shallow soil within the Assessment Area during the Stage 2 assessment works (Golder, 2015b).The objective of the PSV sampling was to assess the potential extent and spatial distribution of chemicals in soil vapour and to assist in the selection of future active soil vapour (ASV) sample locations. PSV sampling devices rely on understanding of the rate at which chemicals are adsorbed into the device and the assumption that absorption is continuous over the sampling duration. For soil vapour sampling, the area around the device may become 'starved' of vapour where the absorption rate is higher than the rate at which vapour is replenished or reduced absorption may occur due to obstruction by soil particles or soil moisture.

Golder considers the PSV data to be semi-quantitative due to potential for variability in absorption rates and efficiency, with a higher degree of uncertainty in reported concentrations in comparison with ASV data. Therefore the PSV data has not been used to define COI or concentrations of COI for the assessment.

Whilst a number of chlorinated hydrocarbons were detected in environmental samples, TCE represented the majority of detected VHC in any sample. TCE accounted for greater than 98% of total VHC reported in groundwater samples with the exception of well MW04 where is accounted for 88% of total VHC and cis-1,2-dichloroethene accounted for approximately 11% of total VHC.

In soil vapour, TCE typically accounted for greater than 97% of total VHC reported in ASV samples. With the exception of one ASV sample from location SV26-S, TCE accounted for greater than 87% of total VHC reported in all ASV samples and concentrations of TCE were at least one order of magnitude (factor of 10) higher than any other reported VHC. At location SV26-S, TCE accounted for 67% of total reported VHC. The only other VHC reported at location SV26-S was chloroform. Location SV26-S is inferred to be at the southern margin of the impacted area and the reported concentration of TCE was low relative to other ASV samples through the Assessment Area.

In consideration of the relative toxicity and volatility of the VHC reported in groundwater and soil vapour, and of the relative proportion of each VHC reported in environmental samples, TCE was indicated to be the primary driver of health risk for the Assessment Area. TCE was adopted as the COI for the VIA and HHRA. Golder anticipate that potential health risks due to other reported VHC will be lower than for TCE and, in consideration of the lower concentrations of other VHC, that assessment of TCE will also be sufficient to assess potential health risks due to the combined VHC mixture.

4.2 Review of Property (Building) Types

Review of the local land use patterns and building structures indicated that the Assessment Area is comprised of a mixture of commercial/industrial and residential property (Golder, 2015e). The primary land use of interest for the VIA was residential dwellings as these are anticipated to provide the most sensitive human health receptors based on age of occupants (i.e. young children), occupancy times (hours per day) and occupancy duration (years present within the Assessment Area).

The review indicated that residential buildings within the Assessment Area were typically single storey of between 40 to 100 years age. Predominantly brick and masonry construction buildings were observed although some timber or fibre/cement sheeting buildings are also anticipated to be present. Inspection of a selection of properties within the Assessment Area indicated timber suspended floors (crawl space) and concrete slab on grade foundations. Combination foundations with older crawl space constructions and newer slab on grade foundations as part of the same building were also reported.

A detailed inspection and review of the relative proportion (frequency) of building types in the Assessment Area was not undertaken. However, the primary construction types as noted in the review and adopted for the VIA were:

- Suspended timber floor with crawl space.
- Concrete slab on grade foundation.
- Combination foundation with both suspended timber floor and concrete slab on grade sections.

4.3 Geology and Hydrogeology

The geology and hydrogeology of the Assessment Area are summarised in the Conceptual Site Model report (Golder, 2015e). Local geology encountered during investigation works included gravely or clayey sand and sandy clay fill overlying natural soils. Natural material reported to comprise clay, sandy clay and clayey sand or silty clay.

Based on historic and recent investigations within the Assessment Area the shallow Quaternary deposit aquifer system (Q1) was encountered between 7.5 metres below ground level (m bgl) and 8.5 m bgl. Standing water levels measured in the shallow aquifer by Golder during May 2015 ranged from 7.1 to 8.4 m bgl. Groundwater flow direction was inferred to be to the west.

One-hundred and one soil samples were collected from boreholes across the Assessment Area during the Stage One investigation (Golder, 2015a) and submitted for analysis of moisture content. The data from this analysis are summarised by depth in Table 2.

Table 2: Summary of Soil Moisture Content Analysis

Sample depth (m bgl)	Average moisture content of soil samples (% mass)	Minimum moisture content of soil samples (% mass)	Maximum moisture content of soil samples (% mass)
0 – 1	13.7	8.4	19.4
1 – 2	18.5	11.5	35.1
2 – 3	19.0	11.8	31.8
3 – 4	18.8	9.3	27.9
4 – 5	16.3	10.1	20.7
5 – 6	23.5	13.7	31.5
6 – 7	22.9	16.7	34.6

Twenty-one soil samples were collected from boreholes across the Assessment Area and submitted for geotechnical analysis of bulk density, dry density and the average apparent particle density of the fraction less than 2.36 mm in diameter (APD 2.36). The data from these analyses are summarised by soil type in Table 3 and by depth in Table 4.

Table 3: Summary of Geotechnical Analysis by Soil Type

Soil type	Bulk Density (tonnes/m^3)	Dry Bulk Density (tonnes/m^3)	Apparent Particle Density APD 2.36 (g/cm^3)
Clayey sand	1.85	1.69	2.61
Sandy clay	1.87	1.55	2.74
Silty clay	1.61	1.39	2.73
Clay	1.97	1.56	2.77

Table 4: Summary of Geotechnical Analysis by Depth

Sample Depth (m bgl)	Bulk Density (tonnes/m^3)	Dry Bulk Density (tonnes/m^3)	Apparent Particle Density APD 2.36 (g/cm^3)
1 – 2	1.72	1.48	2.72
2 – 3	1.89	1.50	2.73
3 – 4	1.93	1.60	2.74
4 – 5	1.91	1.66	2.68
5 – 6	1.94	1.61	2.77
6 – 7	1.95	1.53	2.76

Adopted soil properties for vapour intrusion modelling were selected following review of the results from geotechnical testing of soil samples. The results of geotechnical testing indicated soil material at shallower depths (0 to 2 m bgl) to have (broadly) higher total porosity and lower moisture content than deeper soil. Near-surface soil vapour samples are anticipated to provide a more reliable estimate of vapour risks than deeper soil vapour samples and the near-surface soil profile is anticipated to be a primary controlling factor for migration and risk due to vapour arising from groundwater impacts. Adopted soil properties were therefore based on the results of geotechnical testing at depths from 0 to 1 m bgl and from 1 to 2 m bgl. The adopted soil properties are summarised in Table 5.

Table 5: Adopted Soil Properties for Vapour Intrusion Modelling

Adopted Soil Profile Depth Range (m bgl)	Minimum Moisture Content (% mass)	Adopted Moisture Content (% volume)	Dry Bulk Density (tonnes/m^3)	APD 2.36 (g/cm^3)	Estimated Porosity (unitless)
0 - 1	8.4	12.4	1.48	2.72	0.46
> 1	11.5	17.0	1.48	2.72	0.46

In Table 5, the volumetric moisture content was estimated from the minimum reported moisture content in soil samples (mass based) and assuming a dry density of 1.48 tonnes/m^3 based on soil testing results from 1 to 2 metres depth. The soil porosity was estimated from the dry bulk density and apparent particle density from soil testing results of samples from 1 to 2 metres depth. The adopted porosity value is anticipated to be conservative for deeper soil profiles with estimated values, based on testing results for soil from 2 to 7 metres depth ranging from 0.38 to 0.45.

5.0 VAPOUR INTRUSION MODEL

5.1 Model Used

Estimation of vapour attenuation factors for TCE was completed using the model prepared by the US EPA (2004). The US EPA vapour intrusion model was developed from the one-dimensional analytical solution to convective and diffusion movement of vapour published by Johnson and Ettinger (1991). The Johnson and Ettinger model has been widely reviewed and adopted by international agencies and was used in the development of petroleum hydrocarbon health screening levels (HSL) adopted in the NEPM (NEPC, 2013).

Review of the Johnson and Ettinger model was undertaken by CRC CARE (2009) and by Hers et al. (2003), and noted that the model was (broadly) conservative with a potential to over-estimate vapour levels. Whilst the CRC CARE (2009) review principally concerned petroleum hydrocarbon vapour, Golder consider the conclusions and the Hers et al. (2003) review to be applicable to other volatile organic chemicals including the VHC identified in the Assessment Area.

The model (US EPA, 2004), provides an estimate of the vapour attenuation factor (α), being the ratio of predicted vapour concentration in an overlying building to the vapour concentration in underlying soil.

5.2 Model Parameters Adopted

In addition to the soil properties noted in Section 4.3, a range of building-specific model parameters were adopted. Models were developed for the two primary building construction types observed in the Assessment Area, concrete slab on grade foundation and timber suspended floor with crawl space. For buildings with combinations of the two foundation types, the respective models would be applicable to each section of the building.

Golder note the Johnson and Ettinger model does not include the facility to directly model a crawl space foundation. The model was modified by selection of parameters to simulate the effects of a crawl space, including a foundation thickness of zero and assumption that the entire floor area was comprised of open ‘crack’. Some of the resulting parameters calculated by the model (Appendix B) are not realistic (such as soil vapour flow rate into the building). However, these parameters do not influence the resulting estimated attenuation factors. Further assessment of the vapour migration pathway for crawl space buildings was undertaken by reference to site sampling and analysis data (Section 6.2).

The building and other parameters adopted for the two model scenario are summarised in Table 6.

Table 6: Summary of Vapour Intrusion Model Parameters

Model Parameter	Adopted Value Slab on Grade Building	Adopted Value Crawl Space Building	Source
Building Length (m)	15	15	Within range for average floor areas, houses and other residential buildings (enHealth, 2012), and consistent with observations of buildings within the Assessment Area.
Building Width (m)	10	10	
Building Ceiling Height (m)	2.4	2.4	enHealth (2012) and consistent with or conservative (low) based on observations of buildings within the Assessment Area.
Foundation Slab Thickness (m)	0.1	0	AS 2870-2011 (2011) and consistent with CRC CARE (2011)
Foundation Depth Below Ground Surface (m)	0.1	0	Foundation slab thickness.
Air Exchange Rate (per hour)	0.6	0.6	enHealth (2012) and anticipated to be conservative (low) for older residential structures observed within the Assessment Area.
Foundation Crack Width (cm)	0.3	300	Wall to floor seam crack width. For slab on grade, adopted as 0.1% of total foundation area. For crawl space, adopted as 100% of foundation area.
Q_{SOIL} : $Q_{BUILDING}$ (unitless)	0.03	1	Ratio of vapour flow rate through foundation to air flow rate through building. For slab on grade, adopted value based on 95th percentile sub slab to indoor air attenuation factor from US EPA (2012) database considering all residential buildings. For crawl space, adopted on the assumption that crawl space and indoor air are in equilibrium and consistent with the 95th percentile attenuation factor of 0.9 for crawl space buildings from US EPA (2012).

As noted in Section 4.2, a detailed review of all buildings within the Assessment Area has not been completed. Residential buildings with basements or other below-ground accessible spaces (such as cellars) were generally not noted during environmental investigation works or at properties where targeted vapour sampling was undertaken. Vapour intrusion models for basement-type structures are anticipated to be highly property-specific and a generic scenario model would require a number of assumptions regarding construction and occupancy. Basement-type structures have not been considered in the VIA and a property specific assessment is recommended in the event that such properties are identified within the Assessment Area.

The adopted COI for the VIA is TCE in consideration of toxicity, volatility and reported concentrations in soil and groundwater in the Assessment Area in comparison with other chlorinated hydrocarbons.

The adopted properties of TCE for the vapour intrusion model are summarised in Table 7.

Table 7: Summary of Chemical Properties for Vapour Intrusion Model

Property	Adopted Value	Source
Chemical of Interest	TCE	Section 4.1
Molecular Weight (g/mol)	131.39	RAIS (2015)
Diffusivity in Air (cm2/s)	6.87E-02	RAIS (2015)
Diffusivity in Water (cm2/s)	1.02E-05	RAIS (2015)
Henry's Law Constant (atm m^3/mol)	9.85E-03	RAIS (2015) at 25 degrees C
Henry's Law Constant (unitless)	0.403	RAIS (2015) at 25 degrees C

The vapour intrusion model was developed for both concrete slab on grade foundation building type and for a timber suspended floor with crawl space building type. For each building type, the depth of the soil vapour 'source' was modelled to correspond with the approximate depths at which soil vapour samples had been obtained during site investigation works. Vapour instruction models were developed for each of the following building types and depths below ground surface:

- Slab on Grade Building: Sub Slab (0 m); 0.85 m; 1.85 m; 3.85 m; 6.35m.
- Crawl Space Building: 0.85 m; 1.85 m; 3.85 m; 6.35m.

The results of the model for each building and depth scenario are presented in the following section.

5.3 Model Results

The model input parameters and estimated vapour attenuation factor ("α") for each building type and depth scenario are provided in Appendix B.

A summary of the estimated vapour attenuation factor for each model scenario is provided in Table 8.

Table 8: Summary of Vapour Intrusion Model – Estimated Attenuation Factors

Soil Vapour Source Depth (m)	Estimated Vapour Attenuation Factor "α" (unitless) Concrete Slab on Grade	Estimated Vapour Attenuation Factor "α" (unitless) Timber Suspended Floor, Crawl Space
0 (Sub Slab)	2.6E-02	See Note Below
0.85	2.6E-03	2.5E-03
1.85	9.1E-04	9.0E-04
3.85	3.8E-04	3.8E-04
6.35	2.2E-04	2.2E-04

Note – An attenuation factor was not estimated for vapour from within a crawl space to overlying indoor air. The scenario assumed that crawl space and indoor air were in equilibrium and therefore that limited attenuation occurs (effectively α=1) through the suspended floor. In reality, a degree of attenuation is anticipated to occur. However, this will be subject to the specific condition of the suspended floor and nature of any floor covering or sealing.

6.0 VALIDATION OF VAPOUR INTRUSION MODEL

6.1 Consideration of Soil Vapour Sampling Data

The estimated vapour attenuation factors provided by the model (Table 8) indicate:

- Approximately one order of magnitude (factor of 10) greater attenuation from soil vapour at 0.85 m depth (α = 2.6E-03) compared with measured soil vapour at sub-slab depths (α = 2.6E-02)
- Approximately one additional order of magnitude (total factor of 100) greater attenuation from soil vapour at 3.85 m and 6.35 m depths (α = 3.8E-04 and 2.2E-04 respectively) compared with soil vapour at sub-slab depths (α = 2.6E-02)

Figures A2 and A3 in Appendix A provide a summary of reported soil vapour concentrations at different sample depths in the Assessment Area. The methodology and results of the sampling works have been reported under separate cover (Golder 2015a, 2015b, 2015c, 2015d). For clarity, where a sub slab sampling location did not have an associated deeper soil vapour sample, the sub slab sampling location has been excluded from Figures A2 and A3.

Table 9 provides a summary of the approximate attenuation between soil vapour at different depths, based upon both the modelled attenuation factors (from Table 8), and the results of soil vapour sample analysis (from Figures A2 and A3, Appendix A).

Table 9: Attenuation Factors with Depth – Vapour Intrusion Model and Soil Vapour Sample Results

Soil Vapour Depth Range (m)	Attenuation Between Soil Depths From Modelled "α" Values (unitless)	Attenuation Between Soil Depths From Soil Vapour Sample Results			
		No. of Data Pairs	Minimum (unitless)	Maximum (unitless)	Average (unitless)
0.85m to Sub Slab	0.10	11	0.03	0.68	0.37
1.85m to 0.85m	0.35	4	0.41	0.67	0.54
3.85m to 0.85m	0.15	9	0.02	0.44	0.22
3.85m to 1.85m	0.42	9	0.21	0.65	0.40
6.35m to 1.85m	0.24	3	0.03	0.41	0.19
6.35m to 3.85m	0.58	2	0.10	0.96	0.53

Modelled attenuation factors between soil layers taken as the difference between modelled "α" values at different soil source depths for the concrete slab on grade building type.
Attenuation values of 1 or greater in soil vapour sample results (3 data points) have been excluded from the listed values.

Review of soil vapour sampling data obtained from different depths indicated that:

- The degree of attenuation indicated by field sampling results range by an order of magnitude (i.e. between minimum and maximum values).
- The estimated attenuation between soil depths as indicated from the vapour intrusion model were comparable with the average attenuation values indicated by the results of soil vapour sampling with the exception of the 0.85 m to sub slab depth range.
- The estimated attenuation between 0.85 m depth and sub slab from the soil vapour model (0.10) was lower than the average attenuation indicated by soil vapour samples over the same depth range (0.37).
- Whilst the estimated attenuation between 0.85 m depth and sub slab from the soil vapour model (0.10) was within the range of values indicated from the soil vapour samples (0.03 to 0.68), adjustment of the attenuation factor (α) for soil vapour from a depth of 0.85 m was considered appropriate.

The estimated attenuation factor for soil vapour from a depth of 0.85 m to indoor air (both concrete slab on grade and suspended timber floor with crawl space scenario), was adjusted from 2.6E-03 (slab on grade) and 2.5E-03 (crawl space) to 1.0E-02 (both building types). The adjusted factor provides for an attenuation of 0.4 between soil vapour at 0.85 m and sub slab soil vapour, which is consistent with the average value reported from soil vapour sampling (0.37, Table 9).

6.2 Consideration of Indoor Air and Crawl Space Sampling Data

The results of indoor air and crawl space sampling works were reviewed in comparison with the vapour attenuation factors estimated from modelling. The following data sets, where appropriately located samples were available, were reviewed:

- Soil vapour sampling results from a depth of 0.85 m bgl (and 1.05 m bgl) were compared against crawl space air sampling results. Crawl space air sample results, obtained by active methods (vacuum canister) and by passive methods (sorbent media), were compared separately.
- Sub slab vapour sampling results were compared against indoor air samples from four properties.

Property-specific sampling data (sub slab, crawl space and indoor air), was only available from a selection of residential buildings (11 properties) within the Assessment Area. Therefore, data may not be representative of all building types and vapour conditions present within the Assessment Area. However, Golder consider the selected buildings to provide a representative sample of the vapour intrusion scenario in the area where the potential for vapour impacts was indicated by the results of groundwater sampling (Golder, 2015a) and a passive soil vapour assessment (Golder, 2015b).

Figure A4 in Appendix A provides a summary of reported soil vapour concentrations and associated crawl space concentrations (for suspended timber floor buildings), and a summary of sub slab vapour concentrations and associated indoor air concentrations (for slab on grade buildings). The estimated degree of attenuation between the respective subsurface (soil vapour or sub slab) concentrations and air (crawl space or indoor air) concentrations is noted in Figure A4 and summarised in Table 10.

Table 10: Attenuation Factors – Comparison of Model Estimates and Site Sampling Results

Source of Attenuation Factors	Estimated Attenuation Factors	
	Soil Vapour (0.85m Depth) to Crawl Space Air [A]	Sub Slab Soil Vapour (0m Depth) to Indoor Air
Model Estimated (Section 5.3)	2.5E-03	2.6E-02
Adjusted Model Estimated (Section 6.1)	1.0E-02	No Adjustment
Inferred from Sample Data (Active Air Sampler)	6.0E-03 to 2.2E-02 (Avg. 1.4E-02)	1.8E-04 to 1.1E-03 (Avg. 5.5E-04)
Inferred from Sample Data (Passive Air Sampler)	4.0E-03 to 1.9E-02 (Avg. 1.0E-02)	NA, All data via active sampling

Note – All attenuation factors are unitless.

A – An attenuation factor from soil vapour to a crawl space air was not modelled. As the attenuation factor from crawl space air to indoor air is assumed to be 1, the model soil vapour to indoor air attenuation factor has been adopted to estimate attenuation to both the crawl space air and indoor air.

Review of soil vapour, sub slab, crawl space and indoor air sampling data indicated that:

- The model estimated (and the adjusted model estimated) attenuation factors for soil vapour from 0.85 m depth to crawl space air (and therefore to indoor air) were consistent with the range of attenuation factors observed in sample results.
- The model estimated attenuation factor for sub slab vapour to indoor air was approximately 1 to 2 orders of magnitude (factor of 10 to 100) higher (more conservative) than the range of attenuation factors observed in sample results.

Whilst the results of sub slab soil vapour and indoor air sampling indicated that the modelled attenuation factor was conservative, no adjustment was made to the proposed attenuation factor. The sample analysis results were obtained from four properties in close proximity to each other and with similar concentrations of TCE reported sub slab soil vapour. For application of the attenuation factor to other properties and a wide range of concentrations of TCE, a degree of conservatism is appropriate to allow for potential variability in vapour behaviour.

6.3 Consideration of Published (Generic) Vapour Attenuation Factors

The US EPA has collated a database of soil vapour intrusion data including sample analysis results for soil vapour, sub slab, crawl space, basement and indoor air; petroleum hydrocarbons and chlorinated hydrocarbons; and for a range of building types. Review of the database indicated potential generic attenuation factors for migration of chlorinated hydrocarbons from soil vapour, sub slab vapour and crawl space air to indoor air (US EPA, 2012). Table 11 provides a summary of the 95th and 50th percentile attenuation factors from the US EPA database, and comparison with the attenuation factors estimated from the vapour intrusion model. Note that soil vapour data in the US EPA database is not classified according to depth below ground surface. A single attenuation factor is therefore presented for soil vapour at all depths (0.85 m bgl, 1.85 m bgl etc.)

Table 11: Attenuation Factors – Comparison of Model Estimates and US EPA Database

Soil Vapour Source Depth (m)	Model Estimated (Section 5.3)	Adjusted Model Estimated (Section 6.1)	US EPA Database 95th Percentile	US EPA Database 50th Percentile
Crawl Space	1[A]	1[A]	0.9	0.39
0 (Sub Slab)	2.6E-02	2.6E-02	3.0E-02	2.7E-03
0.85	2.5E-03	1.0E-02	3.0E-02 [B]	3.8E-03
1.85	9.0E-04	9.0E-04		
3.85	3.8E-04	3.8E-04		
6.35	2.2E-04	2.2E-04		

Note – All attenuation factors are unitless. Crawl space building type assumed except for sub slab pathway.

A – An attenuation factor from soil vapour to a crawl space air was not modelled. As the attenuation factor from crawl space air to indoor air is assumed to be 1, the model soil vapour to indoor air attenuation factor has been adopted to estimate attenuation to both the crawl space air and indoor air.

B – US EPA (2012) note the 95th percentile value for attenuation of soil vapour other than sub slab samples (i.e. deeper soil vapour) was higher (less attenuation) than the value for sub slab samples. The reason for higher soil vapour value was inferred to include the variability in the soil vapour database, which was significantly higher than the data for other vapour sources and potential variability in the soil vapour sampling methodology. The sub slab attenuation factor was therefore adopted for soil vapour at all depths (US EPA, 2015).

Review of the US EPA vapour intrusion database and comparison with the results of vapour intrusion modelling, indicated:

- The adopted crawl space to indoor air attenuation factor was consistent with 95th percentile value from the US EPA database.
- The modelled sub slab to indoor air attenuation factor was consistent with the 95th percentile value from the US EPA database.
- The adjusted 0.85 m depth soil vapour to indoor air attenuation factor was consistent with the proposed US EPA value for soil vapour, which is based on the sub slab attenuation factor.
- The modelled soil vapour to indoor air attenuation factors for other depths (1.85 m, 3.85 m, 6.35 m) were approximately two orders of magnitude (factor of 100) lower (more attenuation) that the proposed US EPA value for soil vapour.
- The modelled soil vapour to indoor air attenuation factors for other depths (1.85 m, 3.85 m, 6.35 m) were approximately one order of magnitude (factor of 10) lower (more attenuation) than the 50th percentile value for soil vapour from the US EPA database.

Whilst the modelled attenuation factors for soil vapour to indoor air at depths of 1.85 m and greater were lower (more attenuation) than both the proposed US EPA attenuation factor for soil vapour the 50th percentile value for soil vapour from the US EPA database, the US EPA database does not account for the depth below ground of samples and the data set was noted to incorporate a larger range of variability than that of other vapour sources (groundwater, sub slab and crawl space).

The modelled attenuation factors for soil vapour at depths greater than 0.85 m were consistent with the range of attenuation factors reported in the US EPA database (25th percentile of 6.0E-04 to 75th percentile of 2.7E-02).

As discussed in Section 6.1, the results of soil vapour sampling and analysis within the Assessment Area inferred the modelled soil vapour attenuation factors for depths greater than 0.85 m bgl were consistent with the attenuation observed in sample.

Based on the review of the modelled soil vapour attenuation factors; results of soil vapour sampling within the Assessment Area; and the US EPA vapour intrusion database, Golder considered that no further adjustment to the proposed attenuation factors was necessary.

7.0 UNCERTAINTY AND SENSITIVITY ASSESSMENT

All environmental sampling, modelling and assessment activities include a degree of uncertainty. The objective of any assessment process includes the understanding and minimisation of uncertainty in order to allow robust and defensible conclusions to be made.

Two primary areas of uncertainty are relevant to the VIA:

- The degree to which the field data is representative of conditions in the Assessment Area.
- The performance and accuracy of the vapour intrusion model.

Uncertainty in Field Data

Field sampling and assessment of geological parameters, including selection of samples, sampling methodology and recording of field observations was undertaken by experienced environmental scientist and engineering personnel. Over 100 soil samples were obtained for assessment of moisture content and 21 samples were obtained for assessment of geotechnical properties relevant to the vapour intrusion model.

Analysis of geotechnical parameters was undertaken by facilities holding NATA accreditation for the testing methods where available.

Field sampling and assessment of soil vapour, crawl space and indoor air was undertaken by experienced air sampling specialists and in accordance with NATA accreditation held for the sampling methods. Analysis of vapour and air sampling was undertaken by recognised local and international laboratory facilities

The location of soil vapour, sub slab, crawl space and indoor air samples was guided by:

- The results of groundwater investigation and sampling which indicated the approximate location of VHC compounds with the potential to generate a vapour intrusion risk.
- The results of a passive soil vapour survey (Golder, 2015b), undertaken to detect the presence of VHC in shallow soil and to infer the potential extent and position of higher concentrations of VHC. The results of the passive soil vapour survey were used to guide further targeted sampling works.
- The results of successive stages of assessment works (Golder 2015a, 2015b, 2015c, 2015d), which refined the understanding of the vapour intrusion conceptual site model and assisted in definition of the scope of successive stages of works.

Environmental conditions, including soil vapour, crawl space and indoor air conditions can change with time. Atmospheric conditions, including temperate, air pressure and wind can influence the migration of vapour.

Soil vapour and ambient air samples were obtained using a variety of methodologies including sampling over different durations. Crawl space samples were obtained using vacuum canisters over a period of approximately 24 hours and also by using passive sorbent samplers over a period of 7 or 8 days. The reported concentrations of TCE between the two sampling methods were comparable (Golder 2015b, 2015c). The comparison of sampling methods indicated that the adopted concentrations from either method were anticipated to be representative of the potential exposure conditions over periods of up to one week.

Repeat sampling of crawl space or indoor air locations at a later date has generally not been undertaken. The potential variability of vapour concentrations over time periods longer than one week is unknown.

Repeat sampling of five sub slab locations (SV08-P1, SV09-P1/P2, SV10-P1/P2) and ten soil vapour locations (SV01 to SV10) reported consistent concentrations of TCE. The results of the available repeat sampling indicate that the degree of variability over time for soil vapour and sub slab concentrations of TCE was low.

Uncertainty in Vapour Intrusion Model

The vapour intrusion model adopted for the VIA (Johnson and Ettinger, 1991), has been widely applied to vapour assessments in Australia and internationally, including by regulatory agencies such as US EPA.

Performance and sensitivity of the Johnson and Ettinger model has been reviewed on a number of occasions including by Johnson (2002), Hers et al. (2003) and CRC CARE (2009). The primary limitation of any model is the validity of the parameters used. Where possible, site-specific parameter values were adopted from the results of environmental and geotechnical investigation works. Where a range of potential parameter values were indicated, or where a parameter value was not known, either average or conservative values were adopted for the VIA.

Some of the critical parameters influencing the sensitivity of the Johnson and Ettinger model are the soil moisture content and the building air exchange rate (Johnson, 2002). In addition to the model being sensitive to these parameters, they are also factors that are anticipated to vary within the Assessment Area spatially and over time as follows:

- Soil moisture conditions will vary with depth, with soil type, with surface covering and (for near-surface soil layers) will also vary seasonally and over shorter time periods with rainfall events.
- Building air exchange rates will vary with building construction type, with resident occupancy patterns (such as whether present at home during the day), and with climate conditions (such as the use of open doors and windows during warmer weather and the use of air conditioning or heating systems).

The parameter values adopted for the VIA were based on the more conservative values inferred from geotechnical sampling data (soil moisture content) or conservative recommended guideline values based on studies of a range of building types (air exchange rate).

Whilst the adopted values for the VIA are considered to be both conservative and appropriate for the Assessment Area, a sensitivity assessment was completed to understand the potential effect of variability in these parameters. For the sensitivity assessment, the selected parameters were adjusted to higher and lower values from those adopted for the Assessment Area.

The vapour intrusion model for soil vapour from 1.85 m depth to indoor air (slab on grade foundation) was used for the sensitivity assessment as this scenario incorporates both soil and building properties. The adjusted vapour intrusion models are provided in Appendix C and a summary of the model reference identifications, adjusted parameters and resulting vapour attenuation factors is provided in Table 12.

Table 12: Sensitivity Assessment – Model Parameters and Adjusted Parameter Values

Vapour Intrusion Model Reference ID	Sensitivity Parameter Value	Change in Parameter Value from Baseline	Attenuation Factor	Change in Attenuation Factor
A3-	0.03	- 76 %	1.16E-03	+ 27.3 %
A2-	0.05	- 60 %	1.12E-03	+ 22.9 %
A1-	0.1	- 19 %	9.88E-04	+ 8.5 %
Baseline	Soil Moisture (0.124)	0	9.11E-04	0
A1+	0.148	+ 19 %	8.23E-04	- 9.7 %
A2+	0.198	+ 60 %	6.10E-04	- 33.0 %
A3+	0.218	+ 76 %	5.19E-04	- 43.0 %
B4-	0.1	- 83 %	4.74E-03	+ 420 %
B3-	0.2	- 67 %	2.58E-03	+ 183 %
B2-	0.3	- 50 %	1.77E-03	+ 94.3 %
B1-	0.45	- 25 %	1.20E-03	+ 31.7 %
Baseline	Air Exchange Rate (0.6)	0	9.11E-04	0
B1+	0.75	+ 25 %	7.33E-04	- 19.5 %
B2+	1	+ 67 %	5.53E-04	- 39.3 %
B3+	1.2	+ 100 %	4.62E-04	- 49.3 %

Note – All attenuation factors are unitless. Crawl space building type assumed except for sub slab pathway.

The sensitivity assessment in indicated that the vapour attenuation factor was sensitive to both soil moisture content and to building air exchange rate. The relationship between soil moisture and attenuation factor was approximately linear over the range of values assessed. Moderate (approximately 50%) change to the moisture content resulted in approximately 20% to 30% changes in the estimated attenuation factor. The range of moisture content anticipated for natural, near-surface soil in the Assessment Area was not expected to significantly influence the results of the vapour intrusion modelling.

The relationship between building air exchange rate and attenuation factor was indicated be exponential with attenuation factor being more sensitive to lower air exchange rates over the range of values assessed. The adopted air exchange rate (0.6 per hour) was anticipated to be conservative (low) for the occupied residential buildings indicated in the Assessment Area. A conservative air exchange rate value is considered appropriate for the VIA in order to account for the potential future construction of new buildings with higher degree of energy efficiency and therefore lower natural ventilation.

The adoption of conservative assumptions and parameters within various aspects of the VIA process can potentially lead to the effect where cumulative ‘factors of safety’ result in assessment outcomes that are unrealistic. However, for the assessment of environmental conditions, a higher level of cumulative conservatism is considered appropriate to address the uncertainties and variability within the Assessment Area.

8.0 CONCLUSIONS AND PROPOSED VAPOUR ATTENUATION FACTORS

The results of environmental investigation works reported the presence of volatile chlorinated compounds, principally TCE, in groundwater, soil vapour, crawl space air and indoor air within the Assessment Area.

The soil vapour to crawl space air and soil vapour to indoor air attenuation factors, estimated by use of an analytical model (US EPA, 2004) were consistent with the results of soil vapour and ambient air sampling from a selection of residential properties within the Assessment Area.

In consideration of the results of the vapour intrusion modelling and review of environmental sampling data, estimated soil vapour attenuation factors proposed for application within the Assessment Area are presented in Table 13. An attenuation factor for crawl space air to indoor air is also proposed based on review of published international data (US EPA, 2012).

Table 13: Proposed Vapour Attenuation Factors, Beverley Assessment Area

Vapour Source Location or Depth (m)	Proposed Vapour Attenuation Factor "α" (unitless)	
	Concrete Slab on Grade Foundation	Timber Suspended Floor, Crawl Space
Crawl Space	Not Applicable	1
0 (Sub Slab)	2.6E-02	Not Applicable
0.85	1.0E-02	1.0E-02
1.85	9.1E-04	9.0E-04
3.85	3.8E-04	3.8E-04
6.35	2.2E-04	2.2E-04

9.0 IMPORTANT INFORMATION

Your attention is drawn to the document titled - “Important Information Relating to this Report”, which is included in Appendix D of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Important Information document does not alter the obligations Golder Associates has under the contract between it and its client.

10.0 REFERENCES

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Report Signature Page

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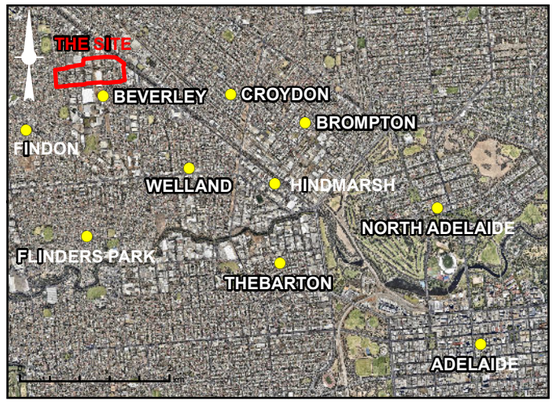
APPENDIX A

Figures

LOCATION MAP



LEGEND

Assessment Area

COPYRIGHT

1. Aerial image sourced from Nearmap Pty. Ltd, aerial dated 30.08.2015, sourced 09.09.2015.
2. Roads data sourced from DPTI, Department for Transport Energy and Infrastructure, South Australian Government, sourced http://www.dptiapps.com.au/dataportal/Roads.zip, sourced 19.06.2014.
3. Suburb data sourced from MapInfo StreetPro.

0 50 100 150 200 METRES

REFERENCE SCALE: 1:5,000 (at A3)

PROJECTION: GDA 1994 MGA Zone 54

CLIENT
ENVIRONMENT PROTECTION AUTHORITY

PROJECT
VAPOUR INTRUSION ASSESSMENT

TITLE
ASSESSMENT AREA LOCATION PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2015-09-22
PREPARED	KB
DESIGN	-
REVIEW	MP
APPROVED	JC

PROJECT No. 1418522 | CONTROL 021-R | Rev. 0 | FIGURE 1

Path: S:\Enviro Jobs\2014\1418522 - EPA Beverley GW and Soil Vapour Assessment\Project\Deliverable\Production Fig\021\14 18522-021-R-F0001-Rev0.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

FIGURE A2

SOIL VAPOUR AND BUILDING WITH SLAB ON GRADE / RAFT FOUNDATION
TCE CONCENTRATIONS - PART A
SAMPLING DATA FROM: APRIL 2015, JUNE 2015, JULY 2015

Figures in red italics indicate inferred attenuation factor between sample results over indicated depth range.

DEPTH BELOW SURFACE (m)	SV01	"α" BETWEEN DEPTHS	SV02	"α" BETWEEN DEPTHS	SV03	"α" BETWEEN DEPTHS	SV04	"α" BETWEEN DEPTHS	SV05	"α" BETWEEN DEPTHS	SV06	"α" BETWEEN DEPTHS	MODELLED ATTENUATION BETWEEN DEPTHS (unitless)	
SOIL VAPOUR - SUB-SLAB (µg/m³)														
0.00														
0.85			25000	3.85 to 0.85					57	3.85 to 0.85	150	3.85 to 0.85		
				0.21						*0.02*		*0.03*		0.85 m to SubSlab *0.1*
1.00														1.85 m to 0.85 m *0.35*
1.85			40000	36000	3.85 to 1.85	7000	5800	3.85 to 1.85					530	490	3.85 to 1.85
2.00					*0.43*			*NA (>1)*						*0.48*
					6.35 to 1.85			6.35 to 1.85						3.85 m to 1.85 m *0.42*
3.00					*0.41*			*0.12*						
SOIL VAPOUR (µg/m³) 3.85	78000	120000			93000	--	6.35 to 3.85	<7	--		3100	2800		5600	5500			1100	--	
4.00							*0.96*													6.35 m to 3.85 m *0.58*
5.00																				
6.00																				
6.35					97000	--		57000	--									33	--	
7.00																				
GROUNDWATER (mg/L)	0.46				2			2.7			0.32			2				0.029		
SAMPLE LOCATION ID	SV01 Apr-15 Jun-15	←			SV02 Apr-15 Jun-15			SV03 Apr-15 Jun-15			SV04 Apr-15 Jun-15	←		SV05 Apr-15 Jun-15	←			SV06 Apr-15 Jun-15			
SAMPLE IN PROXIMITY TO		SV28 Jul-15										SV24 Jul-15			SV18 Jul-15						
GROUNDWATER WELL IN PROXIMITY TO SV POINT	MW01 Apr-15				MW02 Apr-15			MW03 Apr-15			MW04 May-15			MW05 May-15				MW06 May-15			

FIGURE A3

SOIL VAPOUR AND BUILDING WITH SLAB ON GRADE / RAFT FOUNDATION
TCE CONCENTRATIONS - PART B
SAMPLING DATA FROM: APRIL 2015, JUNE 2015, JULY 2015

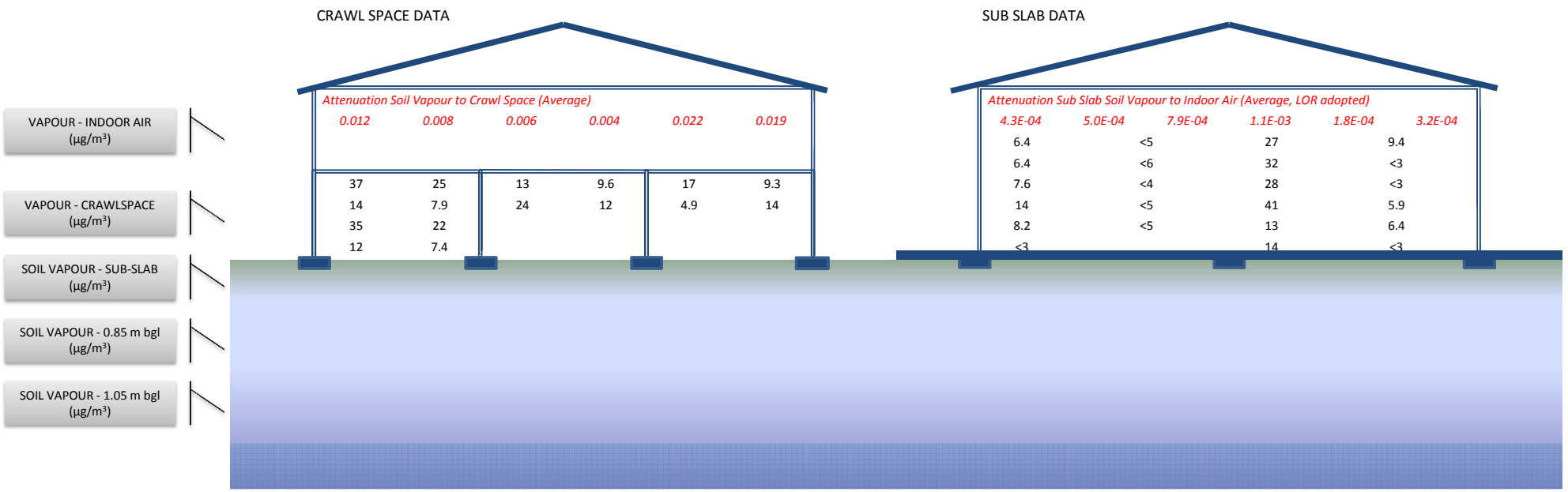
Figures in red italics indicate inferred attenuation factor between sample results over indicated depth range.

DEPTH BELOW SURFACE (m)		"α" BETWEEN DEPTHS		"α" BETWEEN DEPTHS		"α" BETWEEN DEPTHS		"α" BETWEEN DEPTHS		"α" BETWEEN DEPTHS		"α" BETWEEN DEPTHS		"α" BETWEEN DEPTHS		"α" BETWEEN DEPTHS	MODELLED ATTENUATION BETWEEN DEPTHS (unitless)	
SOIL VAPOUR - SUB-SLAB (µg/m³)																		
0.00				<6 / 31	-- / 22	0.85 to 0	1000 / 600	280 / 600	0.85 to 0	2100 / 2100	1600 / 1700	0.85 to 0						
						0.03			*0.42*			*0.68*					0.85 m to SubSlab	*0.1*
0.85				240	200	*0.13*	2400	1600	*0.25*	3100	2700	*0.68*	2000	1.85 to 0.85	360	1.85 to 0.85	12000	1.85 to 0.85	19000	1.85 to 0.85		
1.00						*0.11*			*0.18*			*0.59*		*0.41*		*NA (>1)*		*0.55*		*NA (>1)*	1.85 m to 0.85 m	*0.35*
1.85	69	68	3.85 to 1.85	<7	--		3600	--	*0.38*	6000	--	*0.63*	4900	3.85 to 0.85	290	3.85 to 0.85	22000	3.85 to 0.85	19000	3.85 to 0.85		
2.00			*0.26*						1.85 to 0.85			1.85 to 0.85		*0.09*		*0.33*		*0.32*		*0.37*	3.85 m to 1.85 m	*0.42*
			6.35 to 1.85						*0.67*			*0.52*		3.85 to 1.85		3.85 to 1.85		3.85 to 1.85		3.85 to 1.85		
3.00			*0.03*						3.85 to 0.85			3.85 to 0.85		*0.21*		*0.26*		*0.58*		*0.37*		
SOIL VAPOUR (µg/m³) 3.85	270	--	6.35 to 3.85	<7	--		5500	--	*0.44*	17000	--	*0.18*	23000		1100		38000		52000			
4.00			*0.10*						3.85 to 1.85			3.85 to 1.85									6.35 m to 3.85 m	*0.58*
									0.65			*0.35*										
5.00																						
6.00																						
6.35	2700	--																				
7.00																						
GROUNDWATER (mg/L)	0.11																					
SAMPLE LOCATION ID	SV07 Apr-15 / Jun-15		SV08 P1/P2 Apr-15 / Jun-15		SV09 P1/P2 Apr-15 / Jun-15		SV10 P1/P2 Apr-15 / Jun-15		SV19 Jul-15		SV20 Jul-15		SV21 Jul-15		SV22 Jun-15			
SAMPLE IN PROXIMITY TO																		
GROUNDWATER WELL IN PROXIMITY TO SV POINT	MW07 May-15		None		None		None		None		None		None		None			

FIGURE A4

REVIEW OF AIR SAMPLING DATA ATTENUATION FACTOR SUB SLAB, CRAWL SPACE, INDOOR AIR
TCE CONCENTRATIONS

Figures in red italics indicate inferred attenuation factor between sample results over indicated pathway.



SAMPLE LOCATION ID																	
PROPERTY:	Property 1		Property 2		Property 9				Property 5	Property 6		Property 7	Property 8				
SAMPLE ID:	SV09		SV10		SV29	SV30			3P	SV41-P	SV42-P	2P	1P	2P			
DATE: SVap	Apr/Jun 2015		Apr/Jun 2015		Aug-15	Aug-15			Aug-15	Aug-15	Aug-15	Aug-15	Aug-15	Aug-15			
DATE: Air	Active Air	Passive Air	Active Air	Passive Air	Active Air	Passive Air			Aug-Sep 15	Aug-Sep 15	Aug-Sep 15	Aug-Sep 15	Aug-Sep 15	Aug-Sep 15			

APPENDIX B

Vapour Intrusion Model Output

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

SAMPLE DEPTH: SubSlab
FOUNDATION: Slab on Grade

Reset to Defaults

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
10	11	20	11	0	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	0.148	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.6	108	3600	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
2.63E-02

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

SAMPLE DEPTH: 85 cm
FOUNDATION: Slab on Grade

Reset to Defaults

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
10	85	20	85	0	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.6	108	3600	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
2.61E-03

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

SAMPLE DEPTH: 185 cm
FOUNDATION: Slab on Grade

Reset to Defaults

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.6	108	3600	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
9.11E-04

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

SAMPLE DEPTH: 385 cm
FOUNDATION: Slab on Grade

Reset to Defaults

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
10	385	20	100	285	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.6	108	3600	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
3.82E-04

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

SAMPLE DEPTH: 635 cm
FOUNDATION: Slab on Grade

Reset to Defaults

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
10	635	20	100	535	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.6	108	3600	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
2.21E-04

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

SAMPLE DEPTH: 85 cm
FOUNDATION: Crawl Space

Reset to Defaults

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
0	85	20	85	0	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
0	1.00E-10	1500	1000	240	300	0.6	3600	3600	1

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	35	35	350

MORE ↓

RESULTS α (unitless)
2.52E-03

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

SAMPLE DEPTH: 185 cm
FOUNDATION: Crawl Space

Reset to Defaults

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
0	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
0	1.00E-10	1500	1000	240	300	0.6	3600	3600	1

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	35	35	350

MORE ↓

RESULTS α (unitless)
8.99E-04

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

SAMPLE DEPTH: 385 cm
FOUNDATION: Crawl Space

Reset to Defaults

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
0	385	20	100	285	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
0	1.00E-10	1500	1000	240	300	0.6	3600	3600	1

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	35	35	350

MORE ↓

RESULTS α (unitless)
3.80E-04

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

SAMPLE DEPTH: 635 cm
FOUNDATION: Crawl Space

Reset to Defaults

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
0	635	20	100	535	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
0	1.00E-10	1500	1000	240	300	0.6	3600	3600	1

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	35	35	350

MORE ↓

RESULTS α (unitless)
2.21E-04

END

APPENDIX C

Sensitivity Assessment – Vapour Intrusion Model Output

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

Reset to Defaults

SAMPLE DEPTH: 185 cm
FOUNDATION: Slab on Grade
MODEL ID: Baseline

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.6	108	3600	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
9.11E-04

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

Reset to Defaults

SAMPLE DEPTH: 185 cm | **MODEL ID:** A1 Minus

FOUNDATION: Slab on Grade

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.1	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.6	108	3600	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
9.88E-04

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

Reset to Defaults

SAMPLE DEPTH: 185 cm
FOUNDATION: Slab on Grade
MODEL ID: A2 Minus

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.05	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.6	108	3600	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
1.12E-03

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

Reset to Defaults

SAMPLE DEPTH: 185 cm
FOUNDATION: Slab on Grade
MODEL ID: A3 Minus

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.03	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.6	108	3600	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
1.16E-03

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

Reset to Defaults

SAMPLE DEPTH: 185 cm
FOUNDATION: Slab on Grade
MODEL ID: A1 Plus

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.148	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.6	108	3600	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
8.23E-04

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

Reset to Defaults

SAMPLE DEPTH: 185 cm
FOUNDATION: Slab on Grade
MODEL ID: A2 plus

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.198	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.6	108	3600	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
6.10E-04

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

Reset to Defaults

SAMPLE DEPTH: 185 cm
FOUNDATION: Slab on Grade
MODEL ID: A3 Plus

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.218	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.6	108	3600	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
5.19E-04

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

Reset to Defaults

SAMPLE DEPTH: 185 cm | **MODEL ID:** B1 Minus

FOUNDATION: Slab on Grade

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.45	81	2700	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
1.20E-03

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

Reset to Defaults

SAMPLE DEPTH: 185 cm | **MODEL ID:** B2 Minus

FOUNDATION: Slab on Grade

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.3	54	1800	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
1.77E-03

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

Reset to Defaults

SAMPLE DEPTH: 185 cm
FOUNDATION: Slab on Grade
MODEL ID: B3 Minus

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.2	36	1200	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
2.58E-03

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

Reset to Defaults

SAMPLE DEPTH: 185 cm
FOUNDATION: Slab on Grade
MODEL ID: B4 Minus

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Totals must add up to value of Ls (cell F24) Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.1	18	600	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
4.74E-03

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

Reset to Defaults

SAMPLE DEPTH: 185 cm
FOUNDATION: Slab on Grade
MODEL ID: B1 Plus

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	0.75	135	4500	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
7.33E-04

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

Reset to Defaults

SAMPLE DEPTH: 185 cm
FOUNDATION: Slab on Grade
MODEL ID: B2 Plus

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	1	180	6000	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
5.53E-04

END

DATA ENTRY SHEET

SG-ADV Version 3.1; 02/04

Reset to Defaults

SAMPLE DEPTH: 185 cm
FOUNDATION: Slab on Grade
MODEL ID: B3 Plus

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
79016	1.00E+00			Trichloroethylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Soil gas sampling depth below grade, L_s (cm)	ENTER Average soil temperature, T_S (^oC)	ENTER Thickness of soil stratum A, h_A (cm)	ENTER Thickness of soil stratum B, (Enter value or 0) h_B (cm)	ENTER Thickness of soil stratum C, (Enter value or 0) h_C (cm)	ENTER Soil stratum A SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined stratum A soil vapor permeability, k_v (cm^2)
			Totals must add up to value of Ls (cell F24)					
10	185	20	100	85	0	S		

MORE ↓

ENTER Stratum A SCS soil type (Lookup Soil Parameters)	ENTER Stratum A soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Stratum A soil total porosity, n^A (unitless)	ENTER Stratum A soil water-filled porosity, θ_w^A (cm^3/cm^3)	ENTER Stratum B SCS soil type (Lookup Soil Parameters)	ENTER Stratum B soil dry bulk density, ρ_b^B (g/cm^3)	ENTER Stratum B soil total porosity, n^B (unitless)	ENTER Stratum B soil water-filled porosity, θ_w^B (cm^3/cm^3)	ENTER Stratum C SCS soil type (Lookup Soil Parameters)	ENTER Stratum C soil dry bulk density, ρ_b^C (g/cm^3)	ENTER Stratum C soil total porosity, n^C (unitless)	ENTER Stratum C soil water-filled porosity, θ_w^C (cm^3/cm^3)
S	1.48	0.46	0.124	S	1.48	0.46	0.17	S	1.48	0.46	0.17

MORE ↓

ENTER Enclosed space floor thickness, L_{crack} (cm)	ENTER Soil-bldg. pressure differential, ΔP ($g/cm\text{-}s^2$)	ENTER Enclosed space floor length, L_B (cm)	ENTER Enclosed space floor width, W_B (cm)	ENTER Enclosed space height, H_B (cm)	ENTER Floor-wall seam crack width, w (cm)	ENTER Indoor air exchange rate, ER (1/h)	ENTER Average vapor flow rate into bldg. OR Leave blank to calculate Q_{soil} (L/m)	$Q_{building}$ (L/m)	$Q_{soil}/Q_{building}$ (unitless)
10	40	1500	1000	240	0.3	1.2	216	7200	0.03

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	35	35	350

MORE ↓

RESULTS α (unitless)
4.62E-04

END

APPENDIX D

Important Information Relating to this Report

IMPORTANT INFORMATION RELATING TO THIS REPORT

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

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Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

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