

SOIL VAPOUR WEBINAR

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CSAP

Society of Contaminated
Sites Approved Professionals
of British Columbia

WEBINAR INFORMATION

- The Webinar consists of a Adobe Connect website portal which was supplied to you as a link and where the presentations can be viewed.
- Should you wish, your computer speakers can be used to hear the presentation.
- Should you not be able to hear the presentation please also dial in to the conference call line supplied to you (please note your line will be muted) Phone Number 1-855-747-8824 - PASSWORD 728369.
- Questions should be typed in in the chatbox and will be answered by the presenters.

OBJECTIVES

- Discuss common vapour issues and questions from Performance Assessments and Detailed Screenings.
- Review new aspects of vapour guidance (TG 4 and P22).

COMMON ISSUES IDENTIFIED DURING DS and PA

- The following slides review common issues that are identified during Detailed Screenings and/or Performance Assessments.

TG 4 COMMON ISSUE: REFINEMENT

- TG4 still includes *Table 1: Substances for which vapour PCOC refinement is permitted* (“gasoline and diesel PCOCs”).

Substance	Substance	Substance
benzene	isopropylbenzene	trimethylbenzene, 1,2,4-
butadiene, 1,3-	MTBE	toluene
dibromoethane, 1,2-	methylcyclohexane	xylene, total
dichloroethane, 1,2-	n-hexane	VPHv
n-decane	naphthalene	
ethylbenzene	trimethylbenzene, 1,3,5-	

- The list of PCOCs in Table 1 has not changed.
- Although there have been presentations on refinement in the past, there is still confusion re: the refinement step.
- If the substances listed in Table 1 are ND at an APEC, they can be removed as vapour PCOCs at that APEC.
- Refinement for Table 1 substances can be done regardless of the source (i.e., they do not have to be sourced from gasoline and diesel).
- For example, if the vapour PCOC was only naphthalene, associated with fill APEC.

TG 4 COMMON ISSUE: REFINEMENT (Cont)

- Refinement is not permitted for substances not included in Table 1 of TG 4 (e.g., vinyl chloride and other chlorinated VOCs).
- Common example noted in PAs is waste oil tanks/service bays/dry cleaner APECs and their PCOCs (e.g. chlorinated solvents).
- Even if all soil and groundwater concentrations of non-Table 1 vapour parameters are ND, the vapour refinement step cannot be used
- Submissions have been found deficient in PAs for this issue.
- There have been cases where this issue was flagged in a DS and the submission was further reviewed by the PAC (i.e., potential for NRPA).

COMMON ISSUE: VAPOUR CSMs

- Any report with a vapour assessment (vapour sampling, modelling, refinement) should have a vapour conceptual site model (CSM).
- Based on Performance Assessments - still not the case.
- Can be text, dwg or both. Sometimes a very simple CSM is fine.
- What were you assessing (on or offsite APECs, which PCOCs, shallow or deep source) and what are the exposure pathways/receptors?
- Instrument for current or current/future scenarios? Probable and reasonable future land uses of affected lands must be assessed.
- Building or just outdoor? Future building across the entire Site, part?
- All of the above can affect how you selected VAFs per MW.

COMMON ISSUE: SCH B, CLAUSE 1

The instrument template says the following:

*<Use the next four paragraphs **if vapour attenuation factors were applied to vapour** data to meet a standard at the site.>*

- The documents listed in Schedule D indicate that vapour attenuation factors were applied to meet <a> Contaminated Sites Regulation <numerical> <and> <or> <risk-based> standard<s> at <and adjacent to> the site. These vapour attenuation factors were selected based on assumptions about the structures, locations and depths of <buildings> existing or expected at the site. These assumptions include the following:

<Insert specifics listed as (a), (b), (c), etc. For example,

COMMON ISSUE: SVA ASSUMPTIONS LISTED IN DOCS

- Detailed Screeners routinely spot differences in the vapour assumptions explained on the SoSC (section 4.4 footnotes) and draft instrument, Sched B Clause 1 vapour assumptions (i.e., from the PSI/DSI).
- During a PA, technical reports are reviewed in addition to SoSCs and draft instruments.
- All documents should consistently present the vapour assumptions used in the PSI/DSI. For example, a new future land use (e.g. building below grade) that has not been assessed in the reports should not be listed on the instrument.
- **The application should flow from the report CSM to the selection of VAFs in tables, to report conclusions that then match SoSC and instrument Schedule B, Clause 1 wording.**

COMMON ISSUE: SCH B, CLAUSE 1 (OTHER)

- Indoor air sampling limits future buildings at the site and must be captured in Sch B, Clause 1 conditions.
- For example, if you have only evaluated vapour quality at the site via indoor air sampling of an existing building, then your instrument can not be for future buildings (i.e., can only be for the current building).

POST OMNIBUS CHANGES TO VAPOUR GUIDANCE AND STANDARDS

- Pre Nov 1 2017 guidance for SVA was included in Tech Guidance 4.
- CSR Schedule 11 vapour standards for : AL/RL/PL, CL and IL only.
- Post Nov 1, guidance for SVA in TG4 and P22 (new).
- VAFs have been moved from TG4 to P22.
- CSR Schedule 3.3 vapour standards for: AL/RL/PL, CL, IL and Parkade Use.

PROTOCOL 22: APPLICATION OF VAFs TO CHARACTERIZE VAPOUR CONTAMINATION

- Protocol 22 came into effect Nov 1, 2017.
- The vertical VAFs previously included in TG4 are now included in P22.
- Introduced new vapour attenuation adjustment divisors (AADs):
 - Parkade AAD;
 - Biodegradation AAD; and,
 - Lateral AAD.

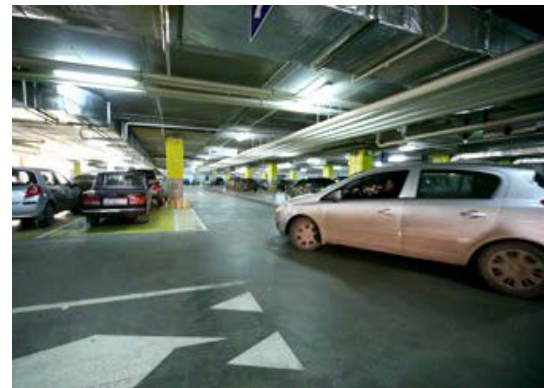
PROTOCOL 22: USE OF THE AADs

Use of Vertical VAFs Modified by AAD:

- To estimate vapour substance concentrations in the breathing zone from vapour concentrations measured in subsurface or subslab vapour:
- $$C_{V-I} = C_{V-SS} * \alpha_I / AAD$$
$$C_{V-O} = C_{V-SS} * \alpha_O / AAD$$
- Where C_{V-I} and C_{V-O} ($\mu\text{g}/\text{m}^3$) are the estimated substance concentrations in indoor and outdoor vapour, respectively; C_{V-SS} ($\mu\text{g}/\text{m}^3$) is the measured or estimated substance concentration in subsurface or subslab vapour; α_I and α_O (unitless) are the default indoor (I) and outdoor (O) vertical VAFs; and AAD is the attenuation adjustment divisor (unitless).

PARKADES

“**Parkade**” means an enclosed building, storey of a building or other construction used for the **parking of multiple motor vehicles**, but does not include the parking of motor vehicles associated with a single residence.



PARKADES

- Post Omnibus Revisions to SVA for Parkades:
 - CSR Sch 3.3 Vapour Standards for Parkade Use
 - P22 Vertical VAFs for Parkades and relaxed precluding condition for groundwater contact
 - PAAD

PARKADES

- CSR Sch 3.3 Parkade Use Standards: derivation of standards considers reduced exposure term for a parkade receptor.
 - $ET = 0.125$ (versus $ET=1.0$ for AL/RL/PL);
 - Assumes 1 hour a day, 5 days a week + 8 hours a day, 2 days a week

PARKADES

- Parkade use column added, Parkade VAFs equal to AL/UP/RL
- Precluding conditions (revised):
*Groundwater is in contact with the foundation slab at any time of the year, or there is active pumping or drawdown of groundwater at the site, with the exception of **parkades** built to equivalent or better: 2012 or later BC Building Codes.*

Table 1. Vertical VAFs

Sample Location	Sample Depth ^{2,3,4}	Vertical VAF (α_i, α_o) ¹			
		Outdoor Exposure (α_o)	Indoor Exposure (α_i)		
			Agricultural, Urban Park, Residential Use	Commercial, Industrial Use	Parkade Use
Below unlined crawlspace, earthen basement, or wooden ⁵ basement	0.45 to 5 m	-	1.0 x 10 ⁻¹		-
Sub-slab ⁶	-	-	2.0 x 10 ⁻²		
In preferential flow pathway ⁷	-	1.0 x 10 ⁻⁴	2.0 x 10 ⁻²		
	< 1.0 m ⁸	1.0 x 10 ⁻⁴	2.0 x 10 ⁻²		
	1.0 m	1.5 x 10 ⁻⁶	2.8 x 10 ⁻³	3.7 x 10 ⁻⁴	2.8 x 10 ⁻³
	1.5 m	1.2 x 10 ⁻⁶	2.3 x 10 ⁻³	3.4 x 10 ⁻⁴	2.3 x 10 ⁻³
	2.0 m	9.2 x 10 ⁻⁷	2.0 x 10 ⁻³	3.1 x 10 ⁻⁴	2.0 x 10 ⁻³

PROTOCOL 22: PAAD

Conditions:

- Parkade beneath the entire footprint of the building.
- Can only be applied in conjunction with sub-slab VAF:

$$C_{V-I} = C_{V-SS} * 0.02/PAAD$$

- Use of PAAD constitutes risk management for vapours and therefore can only be used in a risk-based submission.
- Technical Guidance 4 “Risk Management Using Mechanical Ventilation” outlines requirements.

PROTOCOL 22: PAAD

Technical Guidance 4 – Risk Management Requirements when PAAD is used:

- Mechanical ventilation systems increase air-exchange rates within a parkade → engineered control.
- When PAAD used need a risk control requiring the operation of the ventilation system.
- The following must be included with the risk-based application:
 - An AP statement that the goals and objectives of ventilation system will mitigate risk; and
 - A description of the ventilation system signed and stamped by a PEng, and a statement of assurance confirming that the system will achieve its design objectives.

PROTOCOL 22: BAAD

- ENV permits a 10-fold adjustment of the vertical VAFs for biodegradation for select aerobically biodegradable substances listed in Table 2 of Protocol 22:
 - BAAD = 10
 - Limited list of substances, considers 2015 US EPA OUST [reference 6 in P22]. Note, same list as 10 m lateral exclusion zone in TG4.

Substance	Substance	Substance
benzene	methylcyclohexane	trimethylbenzene, 1,2,4-
n-decane	n-hexane	toluene
ethylbenzene	naphthalene	xylenes, total
isopropylbenzene	trimethylbenzene, 1,3,5-	VPHv

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isopropylbenzene	trimethylbenzene, 1,3,5-	VPHv

PROTOCOL 22: BAAD

- The BAAD may only be used when “biologically active soil” underlies the entire extent of the breathing zone(s) under evaluation.
- Definition based on 2015 US EPA OUST [reference 6 in Protocol 22]; found in Procedure 8:

biologically active soil means soil that has the capability to support the growth and survival of aerobic microorganisms such that aerobic biodegradation of contaminants can occur. Biologically active soil must not contain detectable concentrations of substances listed in CSR Schedule 3.3. The following geologic materials do not qualify as biologically active:

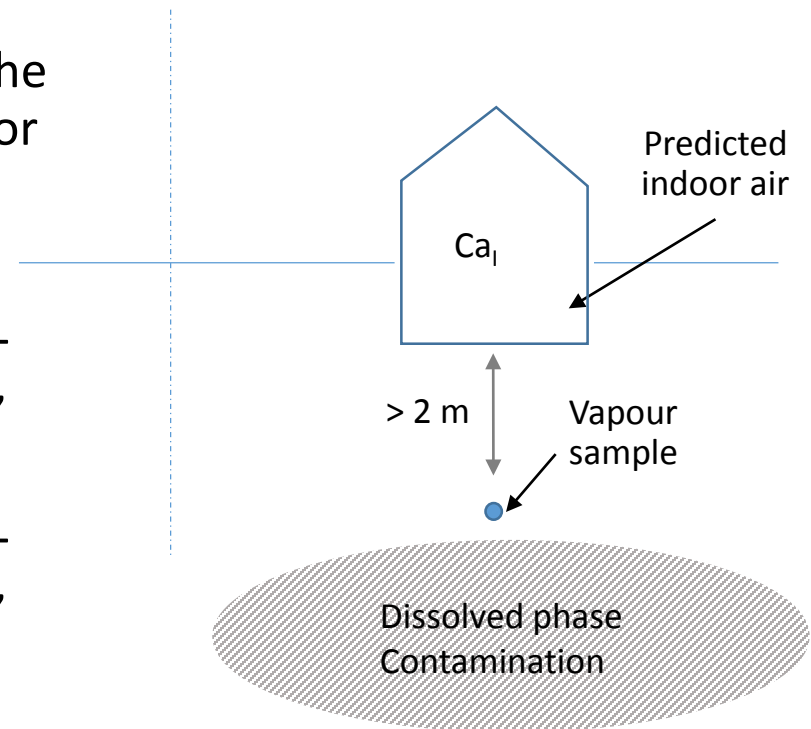
1. coarse sand and gravel with low silt, clay and organic matter content, and a moisture content that is less than two percent;
2. fractured, faulted, or jointed consolidated rock; or consolidated rock with solution channels (i.e., karst).

Soil samples must be collected and analyzed for soil moisture, which must be greater than two percent to indicate a biologically active soil.

PROTOCOL 22: BAAD EXAMPLE

- The vertical separation distance between the vapour source and the building foundation is either 2 m or 5 m of biologically active soil depending on source strength:
 - 2 m = VHw6-10 is $< 15,000 \mu\text{g/L}$ and EPHw10-19 is $< 5,000 \mu\text{g/L}$, and NAPL is not present;
 - 5 m = VHw6-10 is $> 15,000 \mu\text{g/L}$ and EPHw10-19 is $> 5,000 \mu\text{g/L}$, or NAPL is present.

Please see this restriction as well as others in Protocol 22



PROTOCOL 22: LAAD

- Protocol 22 permits adjustment of the vertical VAFs where the target breathing zone is offset laterally from the vapour sampling point, subject to conditions.
- Based on a review of modelling studies and empirical data showing that current vertical VAFs could also be applied in the lateral direction and are predicted to be conservative.
- LAAD = three look-up tables (Table 3 of Protocol 22) for:
 - outdoor exposure;
 - indoor exposure – AL/UP/RL/Parkade;
 - indoor exposure – CL/IL.

PROTOCOL 22: LAAD TABLE 3B

B. Indoor exposure – Agricultural/urban park/residential and parkade uses

	Indoor Exposure - AL/UP/RL LAAD ^{1,2}									
Sample depth ³ (m)	Lateral offset distance ^{4,5} (m)									
	1.0	1.5	2.0	3.0	5.0	7.0	10.0	15.0	20.0	30.0
≤ 1.0	1	1	1	2	3	3	5	7	8	10
1.5		1	1	1	2	3	4	5	7	10
2.0			1	1	2	2	3	5	6	9
3.0				1	1	2	3	4	5	7
5.0					1	1	2	3	3	5
7.0						1	1	2	3	4
10.0							1	1	2	3
15.0								1	1	2
20.0									1	1
30.0										1

PROTOCOL 22: LAAD TABLE 3B (cont.)

B. Indoor exposure – Agricultural/urban park/residential and parkade uses

Example with 7 m deep soil vapour well and lateral distance of 20 m to offsite building (RL):

LAAD = 3

Sample depth ³ (m)	Indoor Exposure - AL/UP/RL LAAD ^{1,2}									
	Lateral offset distance ^{4,5} (m)									
	1.0	1.5	2.0	3.0	5.0	7.0	10.0	15.0	20.0	30.0
≤ 1.0	1	1	1	2	3	3	5	7	8	10
1.5		1	1	1	2	3	4	5	7	10
2.0			1	1	2	2	3	5	6	9
3.0				1	1	2	3	4	5	7
5.0					1	1	2	3	3	5
7.0						1	1	2	3	4
10.0							1	1	2	3
15.0								1	1	2
20.0									1	1
30.0										1

PROTOCOL 22: CONDITIONS FOR USING LAAD

- The measured or predicted vapour concentration in indoor or outdoor air at the point of measurement is less than or equal to 10 times the vapour standard of the Regulation;
- The point of application of the LAADs (i.e. the point at which subsurface or sub-slab vapours have been characterized) must in all cases be beyond the vapour source in soil or groundwater (i.e., at the boundary of detectable concentrations in soil and groundwater); and
- The contaminant plume must be stable or decreasing in concentration and extent.

Please see these conditions as well as others in Protocol 22

REMAINING SLIDES ARE Q&A FROM FALL CSAP PROD – MAYBE
REVIEW IF TIME

Question 8 (Numeric)

Is it possible to have no Schedule B conditions on a Certificate of Compliance in situations where vapour assessments have been conducted?

- a. Yes
- b. No

Question 8 (Numeric) - Answer

Is it possible to have no Schedule B conditions on a Certificate of Compliance in situations where vapour assessments have been conducted?

- a. Yes
- b. No

Answer (a) – Yes, as long as no attenuation factors were applied.

Question 10 (Numeric)

Groundwater at a site is located at 1.5 m below grade; vapours have been collected just above the groundwater table. The site is currently vacant, and development plans include a residential building with a one level basement to be used for storage. The building will be built according to the 2012 BC Building Code. What Protocol 22 Vapour Attenuation Factor is applicable for the estimation of indoor air concentrations?

- a. The sub-slab VAF of 0.02
- b. The 1.0 m VAF of 2.8E-03
- c. No attenuation factors can be applied to predict indoor air concentrations

Question 10 (Numeric) - Answer

Groundwater at a site is located at 1.5 m below grade; vapours have been collected just above the groundwater table. The site is currently vacant, and development plans include a residential building with a one level basement to be used for storage. The building will be built according to the 2012 BC Building Code. What Protocol 22 Vapour Attenuation Factor is applicable for the estimation of indoor air concentrations?

- a. The sub-slab VAF of 0.02
- b. The 1.0 m VAF of 2.8E-03
- c. No attenuation factors can be applied to predict indoor air concentrations

Answer (c) – No attenuation factors can be applied. The precluding conditions regarding groundwater contact with the slab and active pumping or drawdown of the water table only apply for parkades built to the 2012 Building Code or later.

Question 12 (Risk)

The following is true regarding the Parkade Attenuation Adjustment Divisor:

- a. It is based on an increased air exchange rate associated with a parkade ventilation system
- b. It can only be used in conjunction with the sub-slab VAF
- c. It can only be used in a risk assessment
- d. Use of the PAAD is considered to be risk management of vapours
- e. All of the above
- f. None or some of the above

Question 12 (Risk) - Answer

The following is true regarding the Parkade Attenuation Adjustment Divisor:

- a. It is based on an increased air exchange rate associated with a parkade ventilation system
- b. It can only be used in conjunction with the sub-slab VAF
- c. It can only be used in a risk assessment
- d. Use of the PAAD is considered to be risk management of vapours
- e. All of the above
- f. None or some of the above

Answer (e) – All of the above.

Question 13 (Risk)

Can a Standards AP review/make a submission that has used the PADD?

- a. No, the PAAD can only be used in a risk assessment, and therefore only a Risk AP can review/make a submission that uses the PAAD
- b. Yes, Standards AP can review/make a submission that has used the PAAD if attenuated vapour meets the numerical standards, and it is used in an SLRA
- c. No, a Standards AP cannot review/make a submission that involves risk management of vapour

Question 13 (Risk) - Answer

Can a Standards AP review/make a submission that has used the PADD?

- a. No, the PAAD can only be used in a risk assessment, and therefore only a Risk AP can review/make a submission that uses the PAAD
- b. Yes, Standards AP can review/make a submission that has used the PAAD if attenuated vapour meets the numerical standards, and it is used in an SLRA
- c. No, a Standards AP cannot review/make a submission that involves risk management of vapour

Answer (b) – TG 4 indicates that at sites where vapour contamination is risk-managed to meet the CSR numerical standards, and where no risk assessment is conducted other than P13 SLRA, that a submission can be reviewed/made by a Standards AP.

THANK YOU FOR YOUR PARTICIPATION

Please look for information on our upcoming
webinar:
“ XXXXXXX XXXXXXX XXXXXX XXX ”