



**U.S. EPA “State of VI Science” Workshop
Selecting Sampling Strategies for Efficient & Economical Vapor Intrusion
Site Assessment & Long-Term Management – forming Soil Gas Safe
Communities**

**State and Regional Vapor Intrusion Site Assessment Guidance
(As of Fall 2022)**

Chris Lutes and Laurent Levy, Jacobs

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Objectives

- Assess the current state of practice for soil gas intrusion (SGI) sampling
- Collecting data on typical number and timing of samples for VI decisions,
- Evaluate decision criterion being used to make the management decisions (e.g. to mitigate or not?)

Sources as of Fall 2022

Current state of practice for SGI sampling in the U.S. evaluated using:

- SGI guidance document published by U.S. state regulatory agencies or U.S. federal agencies or departments (e.g., EPA (2015), ITRC (2007) EPA regions, ATSDR, DoD)
- State guidance (most states have guidance either in standalone form or as part of cleanup program guidance; a few have nothing)
- EPA Regional guidance, training, QAPPs etc. (emphasis on post 2015)
- Previous comparative studies of regulatory guidance (e.g., Levy et al., 2019; Eklund et al., 2018; Rolph et al., 2012)

Information Summarized

- Expected number of indoor air and/or soil gas sampling events and timing during the calendar year
- Other sampling guidelines and recommendations as appropriate (e.g., differential temperature guidelines, radon, other ITS)
- Specifics related to HVAC and heating system operation during sampling, if any
- Risk management decision type and criteria (indoor air/soil gas matrix approach, soil gas only, indoor air only, risk levels, variations in exposure duration or toxicity if any)

Number of Sample Locations and Rounds – Indoor Air

- **Indoor air: most states say one in the basement and one on the first floor and two or more rounds.**
- Most states allude to seasonal variability or worst-case conditions
- A few jurisdictions specifically suggest more rounds:
 - Maine mentions quarterly;
 - Mass. wants 2-4 rounds for sensitive receptors,
 - Michigan requires 3 to 4 rounds depending on subslab results
 - Washington calls for 3 active samples for short term exposure, or 2 multiweek passive
 - Wisconsin requires 3 times for residential, 2-3 times for schools, daycare and mixed use
 - Region VII calls for one year of quarterly samples
- A few jurisdictions allow one round with caveats
 - NJ allows one round if under worst case conditions
 - Ohio allows one round if under worst case conditions and subslab below screening level
 - NC allows one round if results are an order of magnitude below screening level

Number of Sample Locations and Rounds – Soil gas

- Most states emphasize subslab over shallow external
- Number of locations in a residence varies considerably, often based on square footage
 - One (or more) – DE, IN (if paired with IA), Region V
 - Two (or more) – CA, IN (w/o IA), LA (allows external), MI, OH, OR, PA
 - Three – AK, MT, NH, EPA (2015)
 - Two to four – MA
 - Three to six for footprint less than 2000 square feet – Region IX
 - Table or formula based on square footage – GA, MN, NJ, NC, TN, WI
- Most states call for multiple rounds, most make some reference to seasonality, several reference water levels

Roles of Radon in State and Regional Guidance

- Can be used for building specific attenuation factor – CA, GA, IN, NC, WI
- Can be used for sample timing – MT
- Can be used as line of evidence for attribution – NC, OR, WA, EPA 2015
- Can be used for worst case sample locations – VT
- Caution about applicability – Region IX

Roles of Pressure in Guidance Documents

- Barometric Pressure
 - Influence on soil gas sampling timing – LA, MA
 - Should be measured/reported - OR
- Differential Pressure
 - Line of evidence – CA, ME, NJ, WA, ITRC, EPA 2015
 - For source attribution – NJ, ITRC
 - For understanding HVAC influence – NY, NC, OH, OR
 - For sample timing – ME, MT, NH, WA, WY, EPA 2015
 - Should be measured during evaluation – MA, MN, Region 2, EPA 2015

Roles of HVAC in Guidance Documents re Sampling

- Recognized factor in seasonal variability in many states
- Recognized factor thus in timing seasonal sampling in many states
- Operating normally during sampling – CA, Missouri, NY, NC, PA, WI, WY, Region V
- Turn off for indoor sampling –DE, LA (if not recirc)
- Test both on and off (at least in commercial) - CA, VT, Region IX, (EPA, 2015 may imply this)
- Sample subslab when HVAC not in use - HI
- Evaluate as part of CSM or with respect to sample timing– GA, HI, NJ, NY, OH, OR, WY

Current Risk Management Decision Type and Criteria

- A variety of decision types and criteria
 - Many states consider indoor air a strong line of evidence.
 - A number of states (and Region 5) emphasize the role of indoor air and soil gas (exterior and subslab) in mitigation decision making (matrix approach).
 - Some state emphasize soil gas and deemphasize indoor air.
- Exposure Considerations:
 - Full-time exposure typically assumed.
 - Scenarios (residential or commercial/industrial) based on current use of building.
- Target Risk Levels
 - cancer risk, typically = 1×10^{-6} (or 1×10^{-5}) to 1×10^{-4}
 - noncancer hazard index, typically = 1; immediate response at HI=3 generally
- Toxicity Values: USEPA, with a few states (e.g., California, Illinois, Mass) using their own values or sources that are used in conjunction with USEPA values.

Some States Emphasize Soil Gas in Decisions Over Indoor Air

- **MI:** *"because of the variation and potential for indoor air samples to be influenced by ambient air sources, decisions regarding potential risk and completion of response actions must be weighted toward the sub-slab soil gas sampling results".*
- **WI:** *"Response actions for vapor intrusion are required primarily based on sub-slab vapor concentrations, but the timing for vapor mitigation can take into account other factors."
"If the results from sub-slab vapor samples are at or over vapor risk screening levels, then interruption or mitigation of the vapor exposure pathway is required per Wis. Admin § NR 726.05."*
- **TN:** *"collect soil gas data and use it as the primary line of evidence to assess the VI pathway". "It is unrealistic to expect a building slab to remain static over time, and it is impractical to control or monitor the integrity of a slab for decades, as is sometimes proposed. Therefore, current favorable indoor air monitoring results cannot be extrapolated into the future with any certainty"*
- **IL:** *"Indoor air samples are highly susceptible to bias from occupant sources.... Sample collection is also invasive, requiring site evaluators to obtain access to indoor space. For these reasons, TACO does not contain a table of indoor air remediation objectives and the use of indoor air data to demonstrate compliance is limited to a Tier 3 evaluation"*
- **LA:** emphasizes soil gas and requires state permission before doing indoor air sampling

Many States and Regions Use a Soil Gas and Indoor Air Matrix

- Many use soil gas vs. indoor air matrix-type approaches to evaluate MLE (NY – example below, NH),
- A conservative subslab concentration requires mitigation regardless of any VOC indoor air data.
- EPA regions 2, 4 and 5 also use matrix approaches.

Soil Vapor/Indoor Air Matrix A
May 2017

Analytes Assigned:
Trichloroethene (TCE), *cis*-1,2-Dichloroethene (c12-DCE), 1,1-Dichloroethene (11-DCE), Carbon Tetrachloride

SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m ³)	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m ³)		
	< 0.2	0.2 to < 1	1 and above
< 6	1. No further action	2. No Further Action	3. IDENTIFY SOURCE(S) and RESAMPLE or MITIGATE
6 to < 60	4. No further action	5. MONITOR	6. MITIGATE
60 and above	7. MITIGATE	8. MITIGATE	9. MITIGATE

Discussion: EPA (2015) Manages the Risk of False Negatives/Positives with These Key Concepts

1. Seeking “concordance” from Multiple Lines of Evidence (MLE)
2. Requiring decisions to be made based on “reasonable maximum exposure (RME)... “the lower portion of the high end of the exposure distribution; conceptually, above the 90th percentile exposure but less than the 98th percentile exposure.”
3. Calling for the use of differential pressure measurements to determine if conditions are likely to provide RME
4. Suggesting the use of long-term time integrated indoor air samples
5. “Background” vapor sources are managed by limiting analysis target list, building survey; subslab to indoor air comparisons = “multiple paired samples”

The first two concepts are much less prevalent/explicit in state guidance documents, which suggests that states may be managing the risk of false negatives with other strategies, such as decision making with a strong emphasis on subslab soil gas data. States that do use MLE as EPA suggests do so with decision matrices of SS/IA.

What Can We Learn from the Diversity in State Policies?

- *“A single courageous State may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country.”*
 - Louis Brandeis, 1932; <https://www.law.cornell.edu/supremecourt/text/285/262>
- *“Jefferson said the states are the laboratories of democracy. But the problem is, nobody reads the lab reports. We've got every state trying to reinvent everything. I was struck even more so after this trip how little exchange there is among states that are coping with exactly the same issues.”*
 - Angus King, 2011; <https://libquotes.com/angus-king/quote/lbw0e5w>

For further Information

Christopher.lutes@jacobs.com

References

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- Rolph, Christine G., Valerie E. Torres, and John W. Everett. "The Volatile World of Vapor Intrusion: Understanding Vapor Intrusion Regulation and the Potential for Litigation." *Pace Env'tl. L. Rev.* 30 (2012), i.