

Proposal for
VERIFIABLE [on-going] PROTECTION from
CONTAMINATED **SOIL GAS/VAPOR** INTRUSION
while SCIENTIFIC UNDERSTANDING EVOLVES
(aka ‘**Operationalizing** VI Protection’ in RCRA’s Environmental Indicators)



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Disclaimer: *The views expressed in this presentation are those of the authors and do not necessarily represent the views or policies of the U.S. EPA.*

Previous Title:

VERIFIABLE PROTECTION ...

Summary:

Contaminated soil gas/vapor intrusion (SG/VI) exposure is too complex and variable for typical 'one-time' assessments [at the point of exposure in indoor air], as too often shown to be NOT-protective.

Weakness:

'Verifiable Protection' approach relied too heavily on Monitoring to maintain protection, endlessly into the future.

Today's Presentation

Vapor Intrusion at a Crossroads

'Catch' or Prevent?

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Public Health Perspective

- We should not be expending more resources
 - **Assessing** problems
 - than
 - **Reducing** them

Resources for Addressing VI are Limited,

- Time
 - Regulators, Responsible Parties, Communities at Risk
- \$\$
 - For addressing/reducing this Risk
- Access to private spaces
- Tolerance for public being at risk of Exposure

How much longer (can we/should we) go on the way we are?

- Expending significant amounts of Resources
- Trying to 'Catch' Unacceptable Exposures
 - In Samples
 - With high variations across both **Space & Time**
 - Which is very difficult, costly, & challenging technically & socially (e.g., access)
 - With 'practical' amounts of sampling typically **Under-estimates** risks/exposure
 - **Mis-informing** the public that they are 'safe' when they are as likely not to be
- & On occasion we do 'catch' unacceptable exposures (if they are commonly present) & then
- Only address/mitigate/reduce risks to a single or few buildings

Assessing VI Pathway to a Building is Complicated

- Many different Conceptual Site Models – Source to Bldgs.
 - With many Naturally varying factors **over space and time**
- Many sites with varying types of Preferential Pathways
 - Natural
 - Human made
 - Combined human influenced/enhanced Natural pathways
- Many different routes from vapor sources *to* building(s)
 - These **vary across Space and Time**, as various conditions change and/or interact
 - So near-bldg./sub-slab conc. Can **vary across both Space & Time**

Assessing VI route/portal into a building is complicated

- Likely **varies across both Space and Time**
- So, we don't often sample all rooms, &
 - Portion of the **building/room *impacted* by VI and Sampled can vary over time**
 - Just by the active portal of entry alone

Testing Effectiveness of Current Indoor Sampling

In One-bldg. studies (No Spatial variability), i.e., Only Temporal variability with & w/o continuous *Indicators & Tracers* (I&T) guiding IA sampling times

• Ranking Effectiveness of different Sample Scheduling strategies¹

Goals of sampling = Using Max. # of 4 samples ²	90 th %ile dist. Short-term	50 th %ile of total exposure ³ Long-term	Summary	
• Low radon (Rn), Tracer, Do NOT sample Now	19%	32%	Lowest	4
• Random [commonly used method]	35%	48%	Low	5
• Seasonal (ONLY winter/heating)	67%	84%	Better	
• I&T (Rn) guided times (any season)	65%	86%	Better	
• I&T (Rn) guided times (ONLY winter/heating) ⁶	89%	98%	Best	

¹ Ranking **simplified** ~results of sampling in 12 bldgs./zones in Fig. 2 & 3 **Lutes et al.** (*Sample Scheduling ...*) submitted for pub.

² Using max. not in explicit in most guidance (but RAGS), typically too few samples to calculate 95UCL, so **should be common?**

³ Used in instead of 95UCL of Mean in our study, since better for VI, but Not in guidance, so how common?

⁴ Two-edged sword – un-RP could use to **avoid detection of VI** (we recommend occupants be aware of/monitor their bldg. Rn)

⁵ Majority of cases provides **mis-information** reporting ‘all safe’ when they are **Not**

⁶ Possibly due to longer pathway from source of VOC needing sustained period of high intrusion relative to nearby Rn ₉

Interim Summary

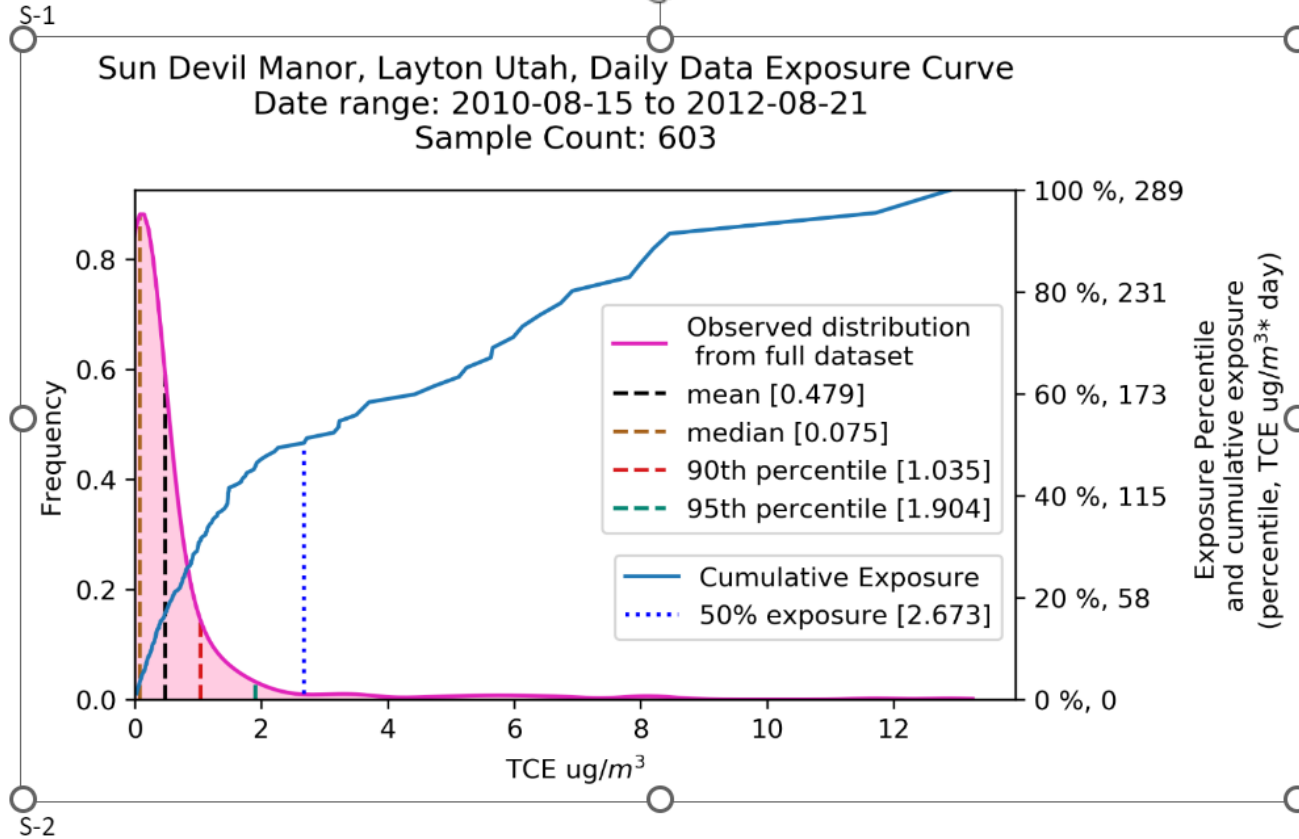
- **Given one or more *long-lasting* subsurface vapor sources**, near Bldgs.;
 - Over Time, as many factors/features that can, will vary over time, (e.g., as pressures, winds, temperature, soil moisture, water tables falling, etc. ...) and **can interact and combine to create 'shorter' and more effective VI entry pathways into some bldgs. at some time(s).**
- **It is only a matter of** (unpredictable) **time**,
 - That **VI favorable conditions** can align and produce higher conc. (unacceptable) VI
 - And the evidence we have shows 'peak events' are 'rare' but important driver of Exposure
- Finally, It **appears Impossible/incorrect** that we should try to **Monitor**:
 - **Subsurface** (at all locations & times) to **catch** unacceptable conc.
 - **Indoor air** at all bldgs. at risk of VI, at all times, to **catch** unacceptable Exposure conc.

None of the Resources expended on Assessment, Reduce any Exposures or Risks

- We can't possibly monitor all these locations and factors continuously for as long as vapor contamination remains nearby (typically a long time),
 - **Unless** we humans **Do something to change how long that contamination remains**, proximate to occupied buildings and a risk for VI
- How could this happen?
 - We could follow the successful approaches used for other contaminated media, like Groundwater, etc., and begin to focus our resources on THE CONTAMINATED MEDIA **controlling the migration and removing the contamination** from the media
 - (e.g., **consider Soil Gas as an environmental media** that should NOT be contaminated)
- That is, To **Prevent** exposures;
 - both obviously- & potentially-unacceptable (if it 'costs' too much to 'catch' it)

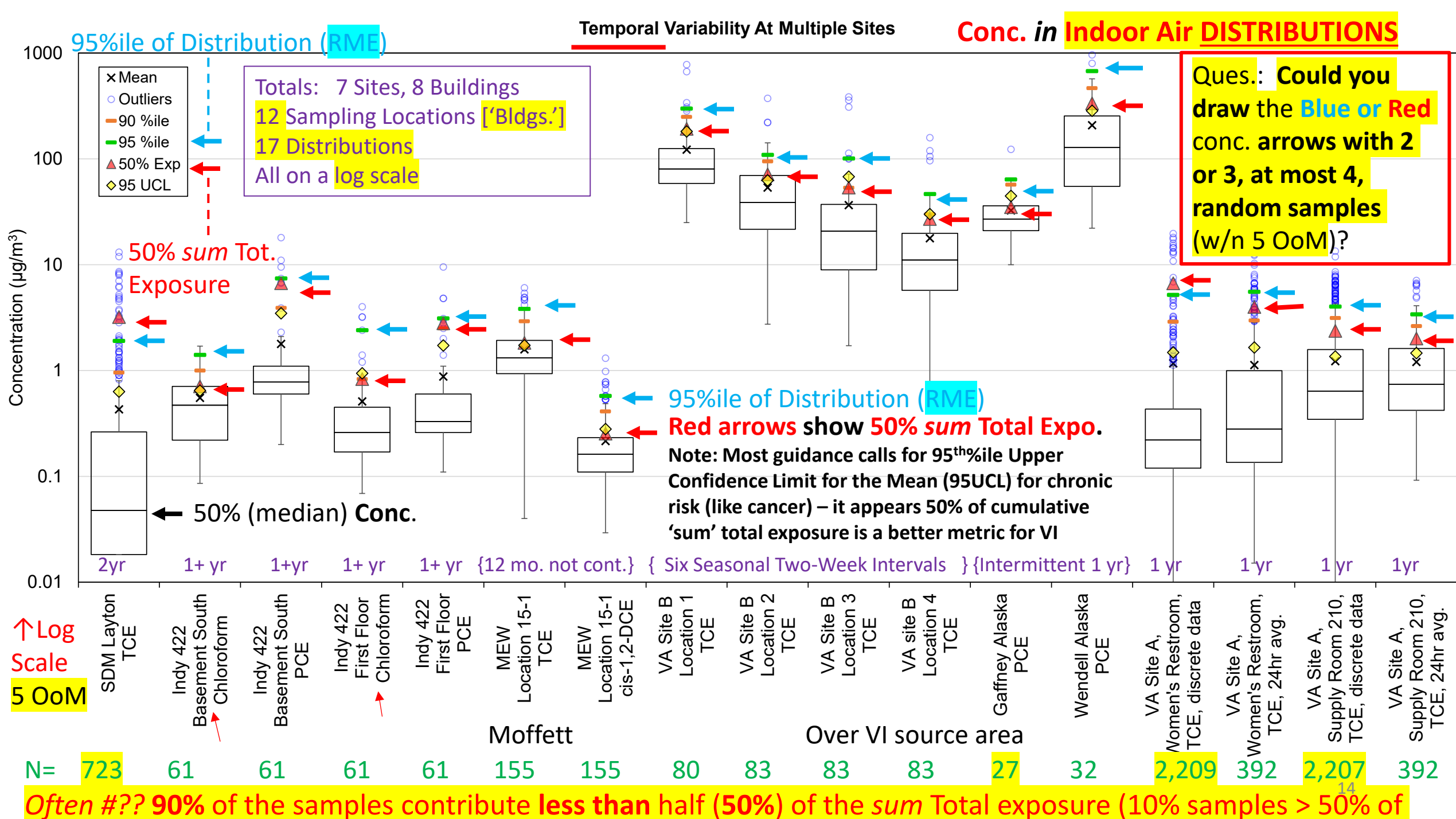
Reasonable **M**aximum **E**xposures (~95%) implies a high level of confidence in Exposure decisions

- RME is a common goal for other contaminated media, e.g., ground-water, etc. AND the goal in USEPA's 2015 Technical VIG
- But any practical/typical amount of indoor air sampling (e.g., 2 – 4 samples) cannot provide that high of a level of confidence,
- Primarily because we now know that VI commonly/typically forms a **log-normal** conc. **distribution** in indoor air, and **many more samples are likely needed** to define the high-conc. Peak events that can determine both the high-end conc. for short-term risk effects as well as more of the total exposure than would occur over the rest of the year



Search





Attaining an RME/high level confidence in Exposure decisions May still be possible: via a ‘Separation Distance’ concept

- ‘Separation Distance’
 - Distance between vapor contaminated media (in conc. capable risking the health of the occupants of nearby buildings), and the physical location of the nearby buildings
- We are currently exploring a DRAFT approach:
 - ***Monitoring the Separation Distance between >VISL* Conc. & Occupied Buildings***
 - *VISL (**V**apor **I**ntrusion **S**creening **L**evels) are those developed by regulatory authorities for **soil gas, soil, groundwater & conduits/sewers**** or those based on site/community-specific evidence/observations with the goal of 95% confidence in **preventing** unacceptable VI exposures
 - ** research on adequate separation distances for conduits/pipes is needed, “for us”

Draft Concepts of a Plan for a Possible 'Separation Distance' Approach

- Document:
 - Extent of >VISL conc. in soil gas/conduits/soil/GW *possibly from release of concern* &
 - Distances between >VISL conc. nearest occupied buildings (in all directions)
 - Shortest **horizontal & vertical** distances
- Risks warrant Immediate action?
 - Existing, or New, occupied bldgs. located on/within >VISL conc. soil gas should have building-specific, or multi-bldg./area wide, vapor intrusion **prevention controls** (e.g., SSDS/SVE) as interim protection, but their "0" Separation Distance from >VISL conc. would be tracked to monitor the eventual removal and cleanup of the vapor contamination

Continued *Draft*

'Separation Distance' Approach

- Is the extent of >VISL conc. in soil gas/conduits/GW continuing to expand?
 - If Yes, controlling the migration is a priority
- Do the individual building Separation Distances, and statistics, show:
 - **Separation Distance** between >VISL conc. in soil gas and Occupied Bldgs. **Increasing** over time?
 - i.e., Is the **area of vapor contamination** of most concern for VI exposures **is Reducing**?

Continued *Draft*

'Separation Distance' Approach

- *If:*
 - Individual building **Separation Distances**, and statistics, show:
 - **Separation Distance** between >VISL conc. in soil gas and Occupied Bldgs. Is **NOT Increasing** over time
 - For **all** Bldgs.
 - Unless individual bldgs. have been documented to have an “**incomplete**” VI pathway
 - i.e., Vapor COCs are Not Detectable/significant* in typical 2-4 indoor air samples
 - i.e., the **area of vapor contamination** *of most concern for VI exposures* is **NOT Reducing?**
- Apply **more aggressive cleanup** to increase the Separation Distance; or

*Indoor air Conc. <1/100 of indoor air health-risk-based criteria (**HRBC**)

Continued *Draft*

'Separation Distance' Approach

- Apply more aggressive cleanup ..., OR:
 - Conduct **sufficient on-going indoor air sampling** to show:
 - The **95thile conc.** of the documented log-normal dist., & **50th% total annual exposure** in indoor air,
 - **Do Not exceed** the indoor air health-risk-based criteria (**HRBC**)
 - For **Each** current (and Future) occupied **building** for **as long as >VISL conc. remains**
 - i.e., **Continue** the **cleanup** of the vapor-forming contamination (e.g., > VISL conc.) by increasing the Separation Distance between all occupied buildings **until** the **Cleanup** is **Completed**

Questions, Comments, Advice?