EPA-RCRA* perspectives on: Environmental Justice & Citizen Scientists (with ITS) – Spatial

- **Spatial** variability
  - Environmental Justice
  - Citizen Scientist
- **Long-term Monitoring** (of <u>all</u> buildings 'at risk' for **VI**)
- '**Soil Gas Safe**' **Communities**

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Addressing:
Two Basic Tenets of Environmental Justice

- 1) Equal protection
  - from 'risky' exposures*
    - Re: Temporal variability

- 2) **Equal access to participation**
  - meaningful (representation) in risk decisions
    - Re: **Spatial** variability

    - Theme: *Minimizing the Opportunities for **In**justice* (in exposures)

*Subject to regulatory (e.g., RCRA) authority for Corrective Action

Equal access to participate in risk decisions?

- Buildings are typically-selected for sampling based on 'authoritative' opinions:
  - Only a fraction of bldgs. selected for sampling allow RP/rep. access
- Selected buildings are commonly assumed to represent all un-sampled buildings
- Only if 'nearby' buildings were found to be 'unacceptable'*… unselected bldgs.
  - Thus, many un-selected buildings will never be tested
- Community member's who's buildings are 'at risk', but are Not sampled,
- have little to 'no standing' or influence on risk decisions; because:
  - Have difficulty providing 'more-authoritative' opinions/input, e.g., why they should be sampled, etc.
  - i.e., without some e.g., building-specific evidence (measurements)

*due to Temporal variability – impacts the assessment of Spatial variability

Anyone who has seen continuously-measured (real time) Radon levels in their building

- Can **See:** If & when their building is subject to soil gas intrusion, or not:
  - Every day (and hour) is different & a large **range of variation** can indicate Soil gas Intrusion (SGI) is turning 'on & off'
  - A building's soil-gas intrusion 'behavior' varies; & the **% of time Rn is 'elevated'** (>>min.) can indicate the % of time soil-gas intrusion is occurring
  - Continuously recorded Rn levels can tell how elevated SGI was when a chemical indoor sample was collected, relative to the baseline distribution of SGI by Rn
    - i.e., **If the chemical sample represents an elevated portion of the SGI distribution, or Not**

Conceptual – Transitioning from Traditions: & How Citizen Scientists' (w/ ITS) can improve VI

- RPs will continue to select some 'representative' bldgs. for sampling
- Citizen Scientist can begin measuring ITS in any bldg. 'at risk'
  - Bldgs. not selected for sampling – can petition for inclusion **with** ITS **evidence**
- RP can continue to collect some traditional samples to: Confirm current exposures; or Deny 'unacceptable' exposures (for all past & future)
- In bldgs. with baseline ITS/SGI distributions, what a chemical sample represents can be seen in the context of the SGI 'on or off' distribution

Long-Term Monitoring (& Mitigation, as needed)

- Some samples may be collected during 'unacceptable' VI conditions
  - Confirming current/on-going 'unacceptable' exposures
- Physical controls reducing SGI are used 'mitigate' these exposures
  - Typical physical controls of SGI, such as SSDS, reduce SGI by ≥100x
  - Long-term monitoring the effectiveness of mitigation is approp. & expected*
- Bldgs. not selected for sampling, or sampled infrequently, **may have VI**
  - e.g., low freq. of samples > screen (e.g., **0/4**) mis-interpreted as being '**safe**'
  - Environmental & Building conditions for VI vary over years-decades
- Long Term Stewardship (LTS) is appropriate for **all** bldgs. 'at risk' of VI

*ITRC, 2020

Long Term Stewardship w/ Equity for All

- All bldgs. 'at risk' could have Long-Term Monitoring* to show they remain 'as safe' **as** mitigated buildings, for as long as VI source remains
  - Continuous Long-term monitoring **of ITS** could be used to monitor both mitigated & non-mitigated bldgs.;
    - To ensure that soil gas intrusion does **not** become '**relatively elevated**' above that building's-specific baseline distribution – due to …
- Using same ITS criteria for '**elevated SGI**' in 'at risk' & mitigated bldgs.
  - Could trigger re-assessments using chemical sampling for either case;
    - Results from random/convenience or seasonal chem. sampling events could be retrospectively assessed by comparison w/ simultaneous ITS & its baseline distribution
  - Alternatively, buildings documented **overlying/proximate to VI source** & documented to have **elevated rates of SGI**, could be **mitigated**, responsibly

*with ITS, +

Would One more chemical indoor air sample provide on-going confidence in exposures?

- At some point the community &/or RP is going to ask the question above:
  - e.g., when they learn/realize that for some small-number sampling events:
- Typical total $ cost of one residential indoor air sample* (e.g., ~$2000)
  - Approximates
- Typical total cost of installing mitigation system to cut VI pathway**

- Benefits of 'cutting' the soil-gas intrusion pathway (incl. CVOC vapors)
  - Far exceeds that from one additional chemical sample (i.e., one point in T & S)
    - &
  - Minor operational costs provide **on-going confidence** in exposure protection

*scheduling, access, clearing indoor prod., placement, collection, analysis, interpretation, & reporting to occupants & regulators

**if costs for problematic installations ~ costs of problematic sampling (e.g., difficult to find indoor sources, etc)

The Science is Clear
Prevention of Soil Gas Intrusion is Beneficial

- Soil-Gas[vapor] Intrusion (SGI):
  - Happens - inevitable natural processes (*if* building designs allow it)
  - **Degrades Indoor Air Quality**
    - Methane, carbon dioxide, possibly carbon monoxide
    - **Radon**, moisture/mold(s)
    - **Chemical** vapors (e.g., chlorinated solvents, …)
      - Industrial sources, dry cleaners, some retail, domestic …)
    - Other chemicals (spilled/used, pesticides, fuels incl. additives, … & soon PFAS!)
- Yet with relatively inexpensive* 'Mitigation' (e.g., sub-slab depressurization)
  - ***All*** soil-gas exposures can be virtually eliminated (>100x reductions)
    - i.e., reduced to the levels in outdoor air

* Relative to any, or on-going, chemical-specific monitoring

Communities* could collaborate with the RP; to seek a '**Soil Gas Safe Community**' designation

- The science is clear - **Soil gas does not improve indoor air quality** (& < is better)
- Issues that can prevent adoption of Soil Gas mitigation:
  - Misunderstanding of the science of VI & health impacts (chronic & sub-chronic risks)
  - **Stigma** & **isolation** individual homes (as if somehow uniquely impacted/undesirable)
- Efforts to address non-scientific issues:

  - **Accurately Label area Risks** Soil Gas Intrusion
  - **Accurately Label Actions** Soil-Gas Mitigation
  - **Validate LEED credits** For homes with controls for all '**ground contaminants**'
    - Soil gas is not natural in indoor air
    - LEEDesigns to avoid it in new construction (& existing bldgs.)

  - **Certify '<u>Soil-Gas Safe Communities'</u>** Bronze level (**>50% buildings**) '**Soil Gas Safe**' reputation**

- **Goal** - Change cultural understanding so that:
  - **Keeping Soil-Gas out of Indoor Air** is commonly understood as **Universally Desirable**:
  - VI Communities can more easily work w/ PRPs *towards mutually beneficial solutions*
  - **The more people who prevent/control Soil Gas Intrusion the better for everyone**

*Particularly with Citizen Scientists **with evidence**

**to be piloted by EPA

Review & Summary

EPA-RCRA perspectives on: Environmental Justice & Citizen Scientists (with ITS)

- **VI** = **Temporal** & **Spatial** variability – Many opportunities for **in**equities
  - **Environmental Justice** – many bldgs. screened out (w/o evidence) [bldg.-specific]
  - **Citizen Scientist** (with ITS measurements) – can participate in risk decisions w/ “
  - **Long-term Monitoring** (of **all** buildings ‘at risk’) – can ensure exposure equity (S&T)
  - **‘Soil Gas Safe Communities’** – Celebrates avoidance of all Soil-Gas Intrusion (SGI)
    - **Minimizes opportunities for injustices in exposures** - for populations most likely near CVI sites;
    - i.e., those with disproportionate number of young families with children, who are culturally diverse & economically challenged!

Here frequent sampling of all buildings 'at risk' shows **little** Spatial variability* (most impacted)

Groundwater plume largely mapped by **indoor air results**, later confirmed by groundwater wells

&

'Two clean house' (indoor air) rule (& plume confirmed by GW wells) to stop expanding investigation

Indoor air results, identified paleo-channel for groundwater flow

Bedrock ridge excluded shallow groundwater preventing VI in some homes

How often Is perceived Spatial variability (e.g., spotty mitigation) an artifact of infrequent & low probability sampling results? = Opportunities for In-justice in exposures

Redfield site near Denver CO Graphic from Enviro-Group, Ltd.

1,1 DCE – Dichloroethylene

If you look for low enough concentrations (DCE is 'unique tracer' of Groundwater) frequently, **Proximity** to a source appears to 'determine' its presence in indoor air (VI 'completeness')

* Relative to levels of concern

THANK YOU

- PS – we are continuing work to perfect the ITS correlations w/ cVOCs