

Building Pressure Cycling to Document Due Care Compliance in Brownfields Redevelopment

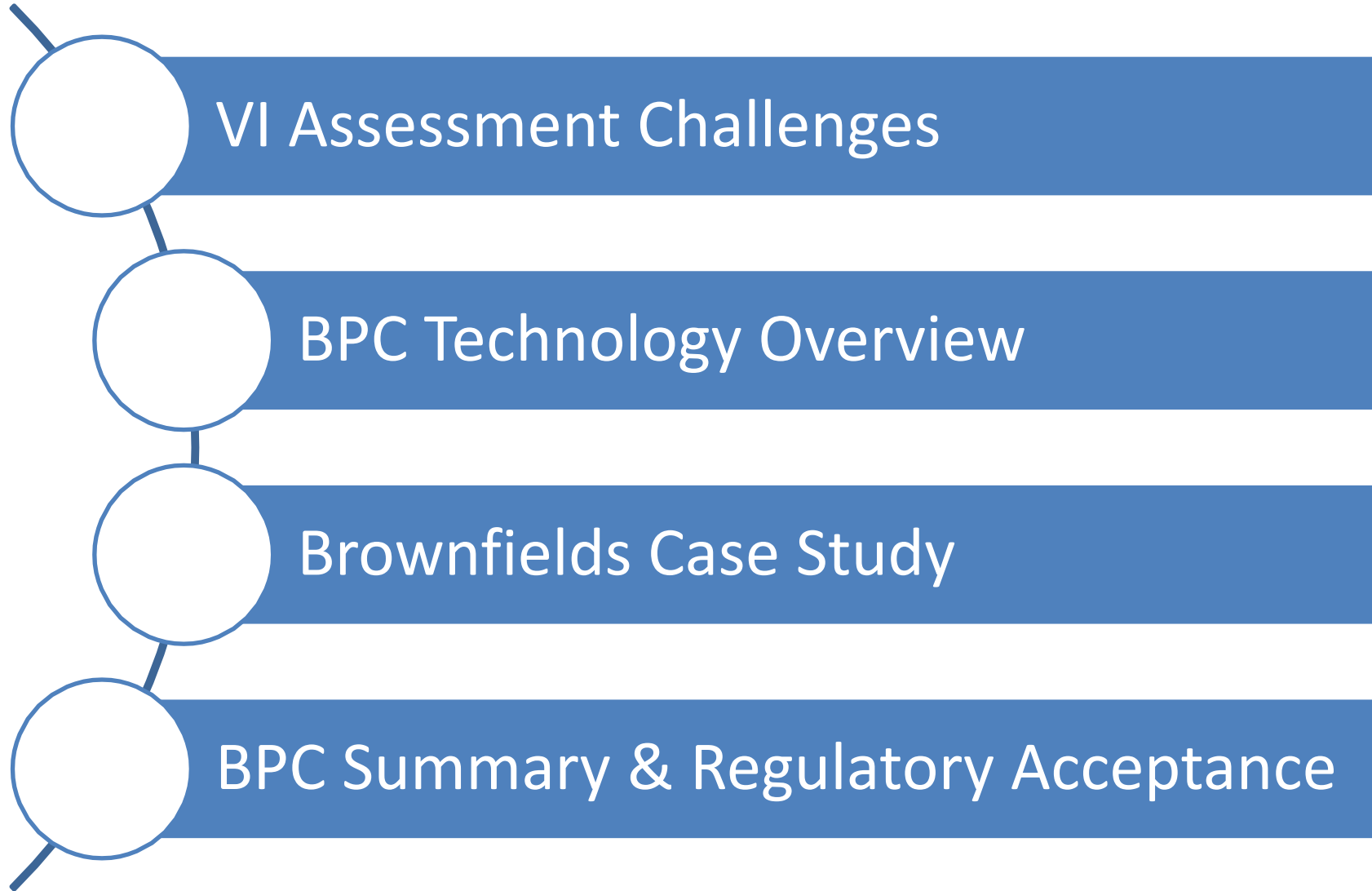
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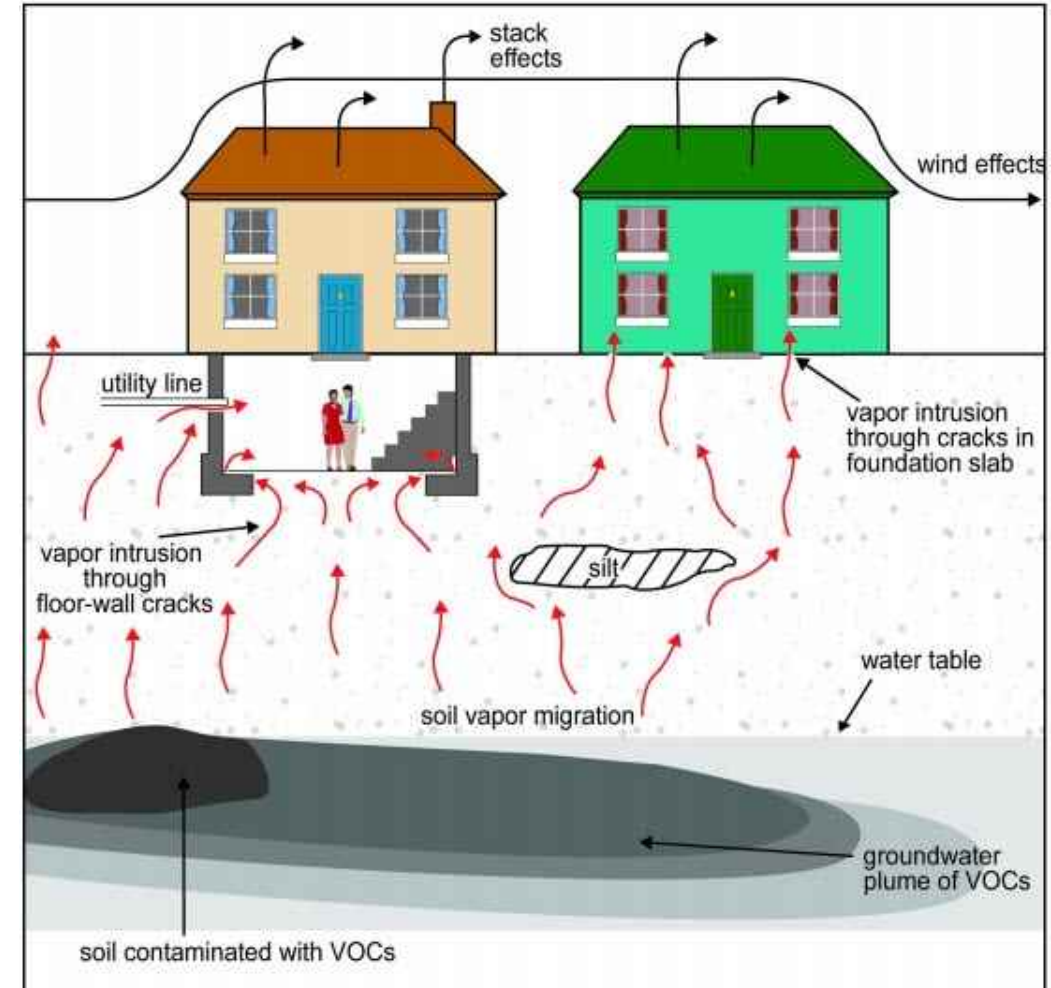
Geosyntec 
consultants



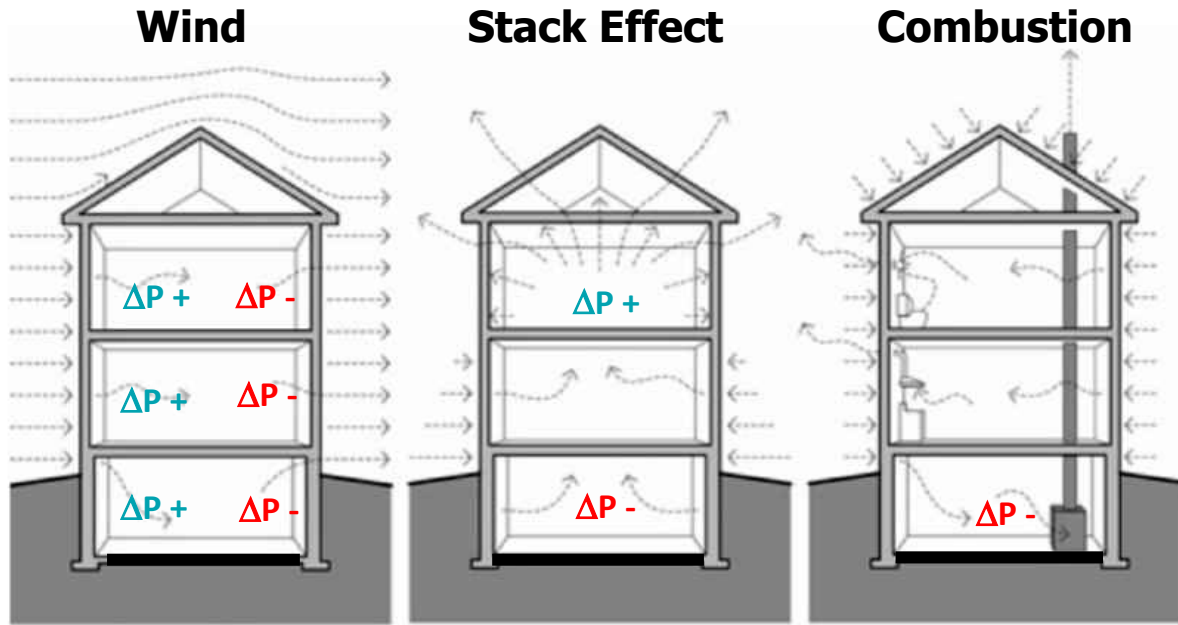


VI Assessment Challenges

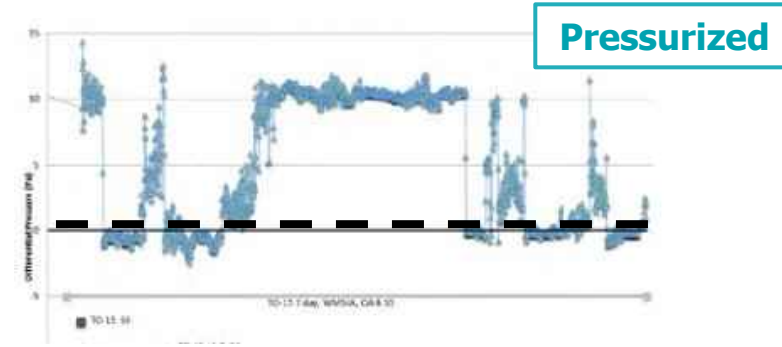
- Temporal Variability
- Spatial Variability
- Background and Ambient Chemical source
- Preferential and Conduit VI Pathways
- Timeframe and Assessment Window
- Sensitive or Disadvantaged Populations



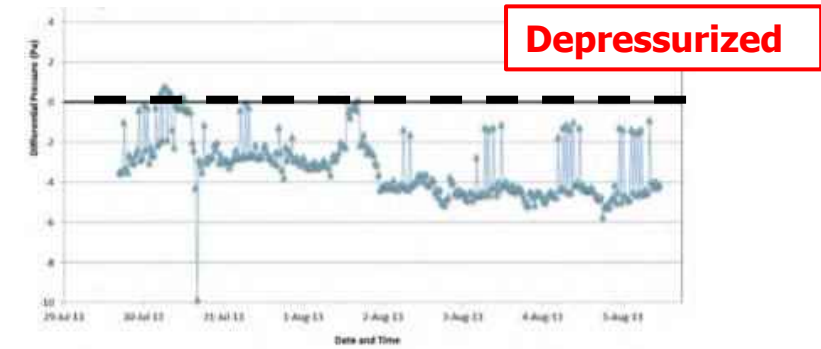
Differential Pressure and VI



+
ΔP
-



+
ΔP
-

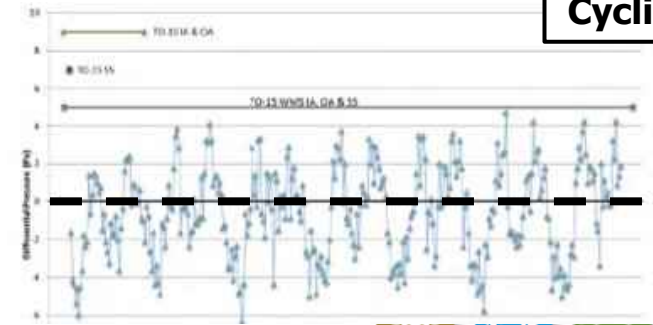


$\Delta P = \text{Building Pressure} - \text{Exterior Pressure}$

ΔP_{ss} characterizes building susceptibility to subsurface vapor entry ($-\Delta P_{ss} = VI$)

Cyclic

+
ΔP
-



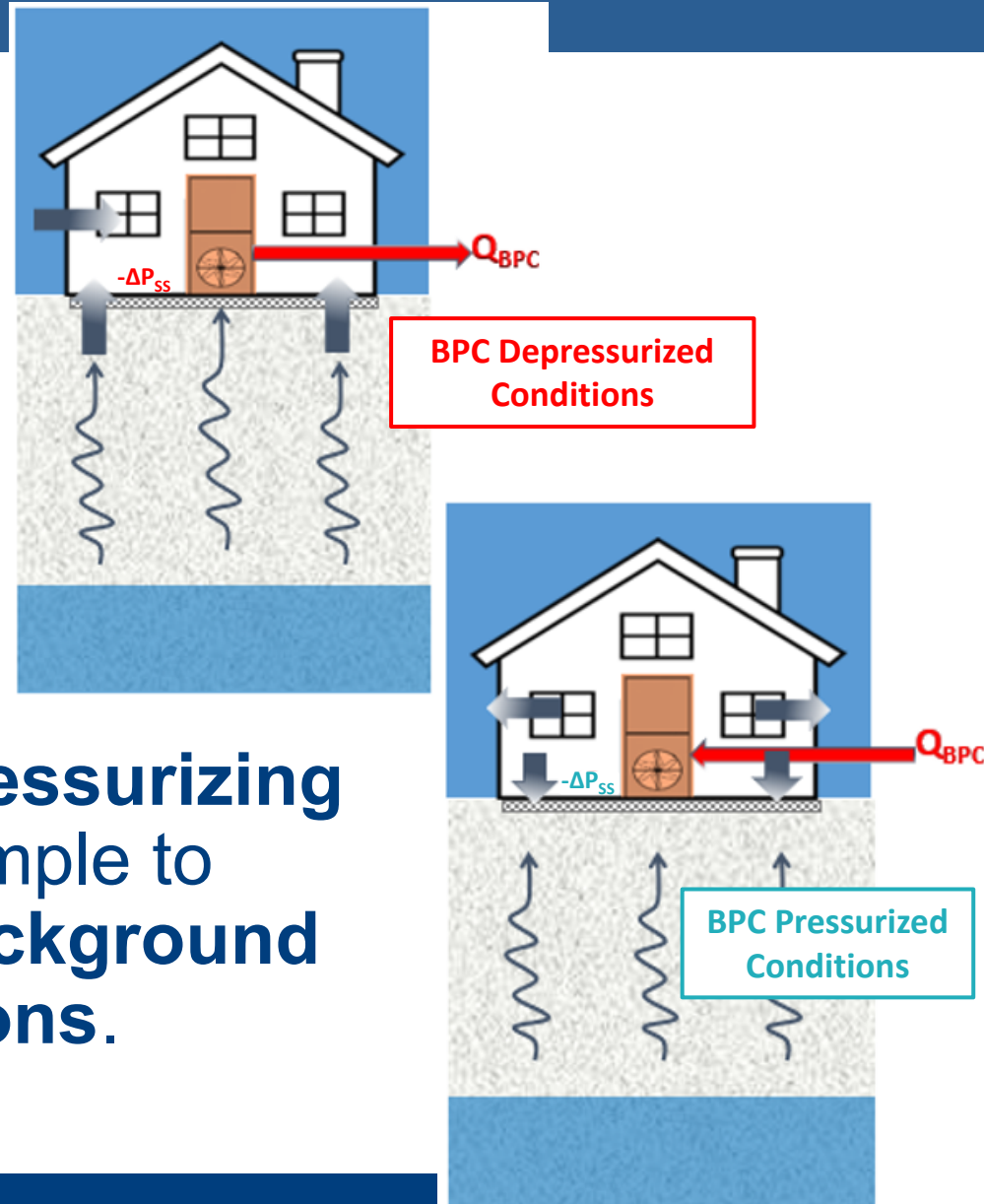
Building Pressure Cycling (BPC) Overview



- Induce VI by depressurizing building and sample to characterize VI impacts

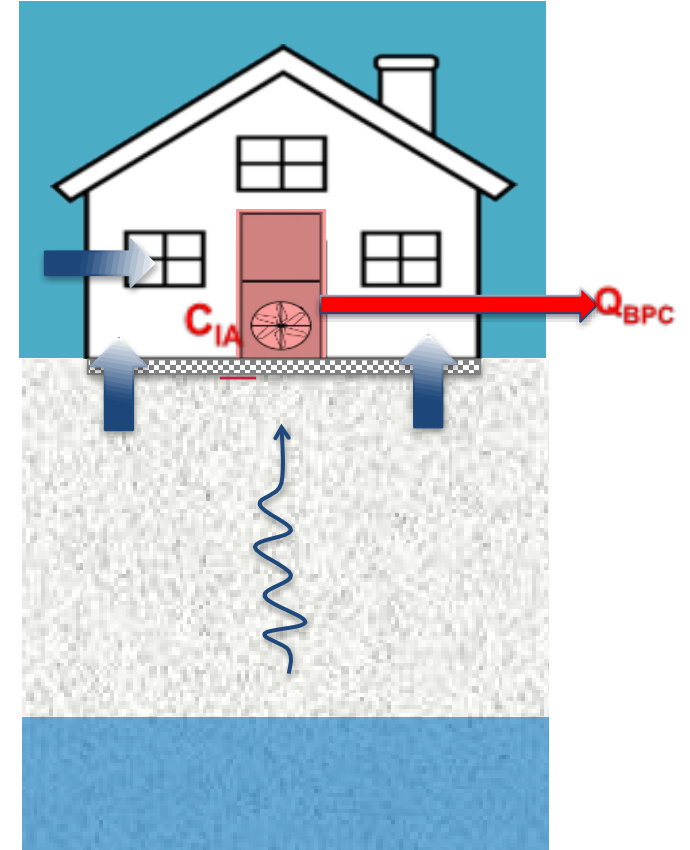


- Inhibit VI by pressurizing building and sample to characterize background source emissions.



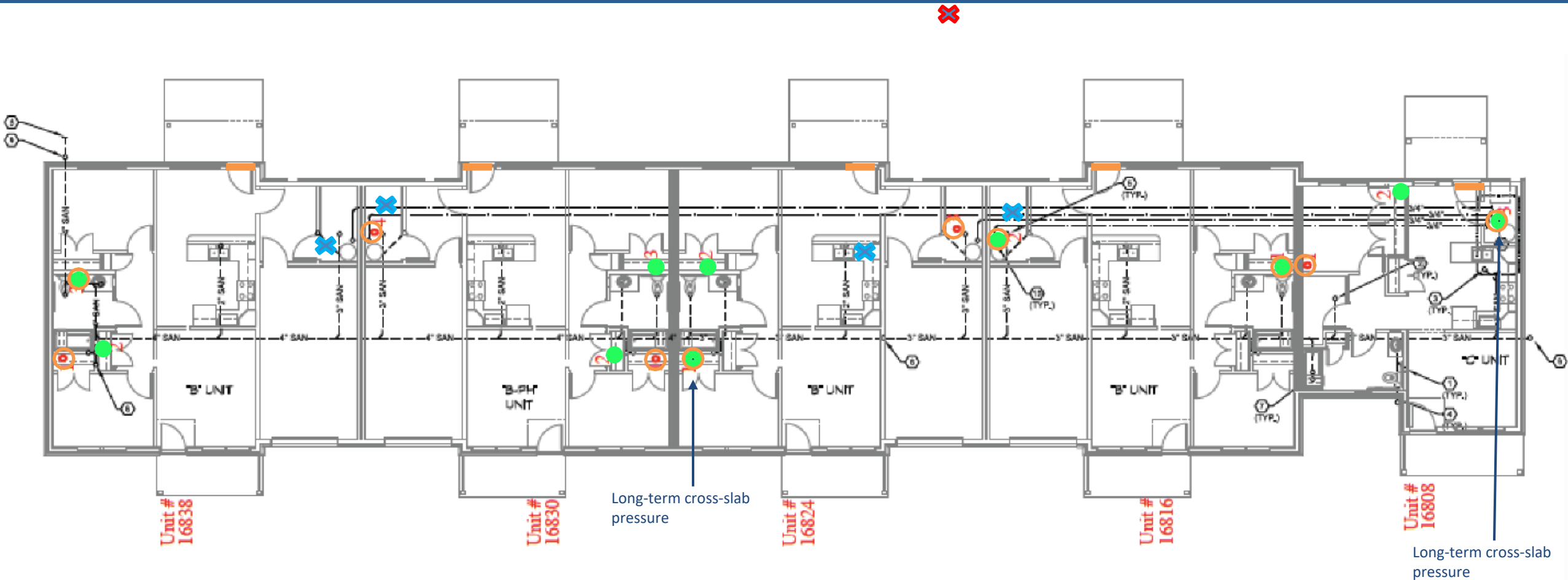
Case Study: Reducing VI Uncertainty in Short Timeframe, BPC in Detroit, MI

- Brownfield redevelopment
- Low-income housing development
- Potential for complete VI pathway
- Needed documentation of due care compliance



- Residential development in Detroit
- Polycyclic aromatic hydrocarbons (PAHs), potentially indicative of a vapor intrusion concern, detected in soil and soil gas beneath planned footprint for 5-unit building
- Existing passive mitigation system
- Quarterly sub-slab sampling for one year is a conventional approach, but multiple stakeholders were interested in an accelerated assessment

Testing Configuration



- Sub-slab Sampling Location
- Multi-day cross-slab pressure
- OA Sampling Location
- Blower Door Setup
- BPC cross-slab pressure
- × 24-hr IA Sampling Location

Sealing Potential Openings

- Range Vent



- Dryer Vent



- Bathroom Fan



- Attic Hatch

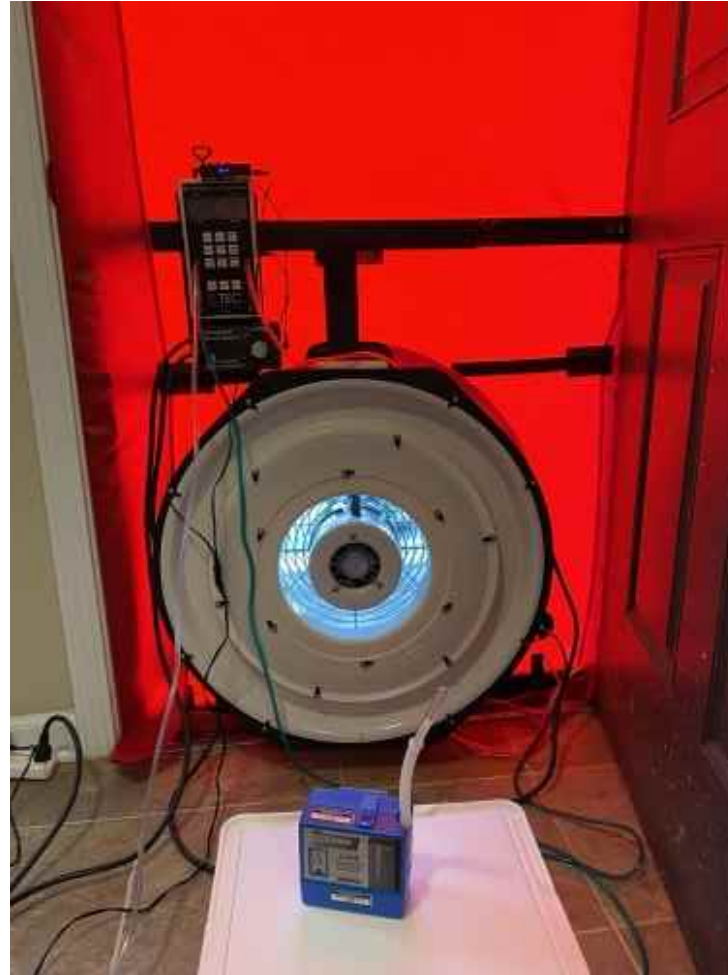


Blower Door during BPC

- Baseline



- Depressurization



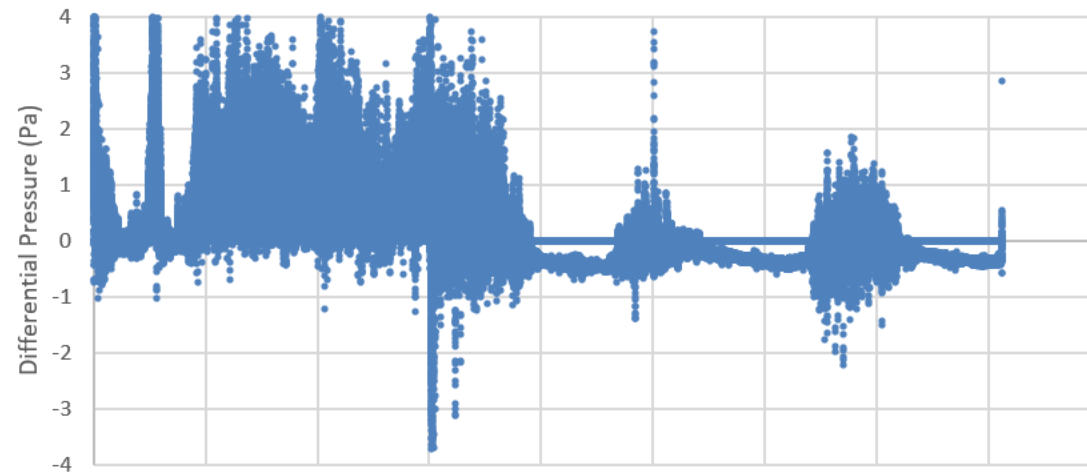
- Pressurization



Long-Term Baseline Cross-Slab Pressure

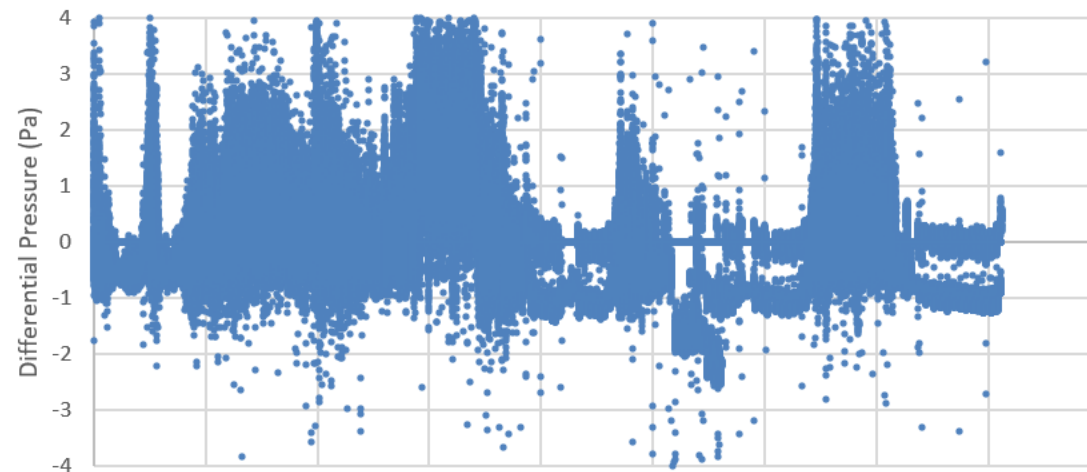


Middle Unit



Average	0.17
Min	-4.58
25th Percentile	-0.31
Median	-0.07
75th Percentile	0.48
Max	15.11

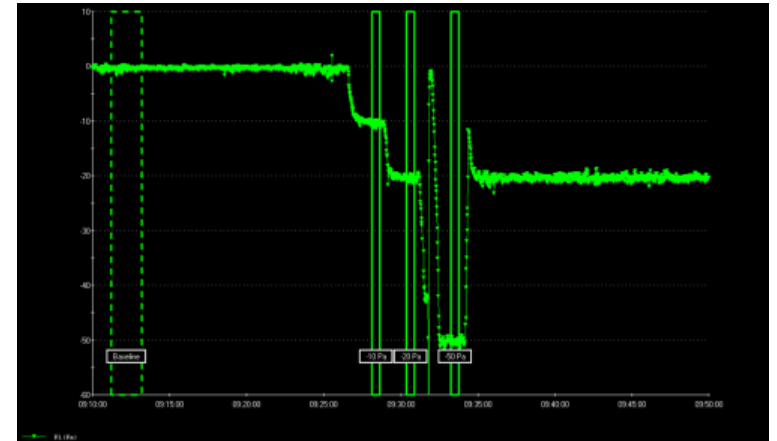
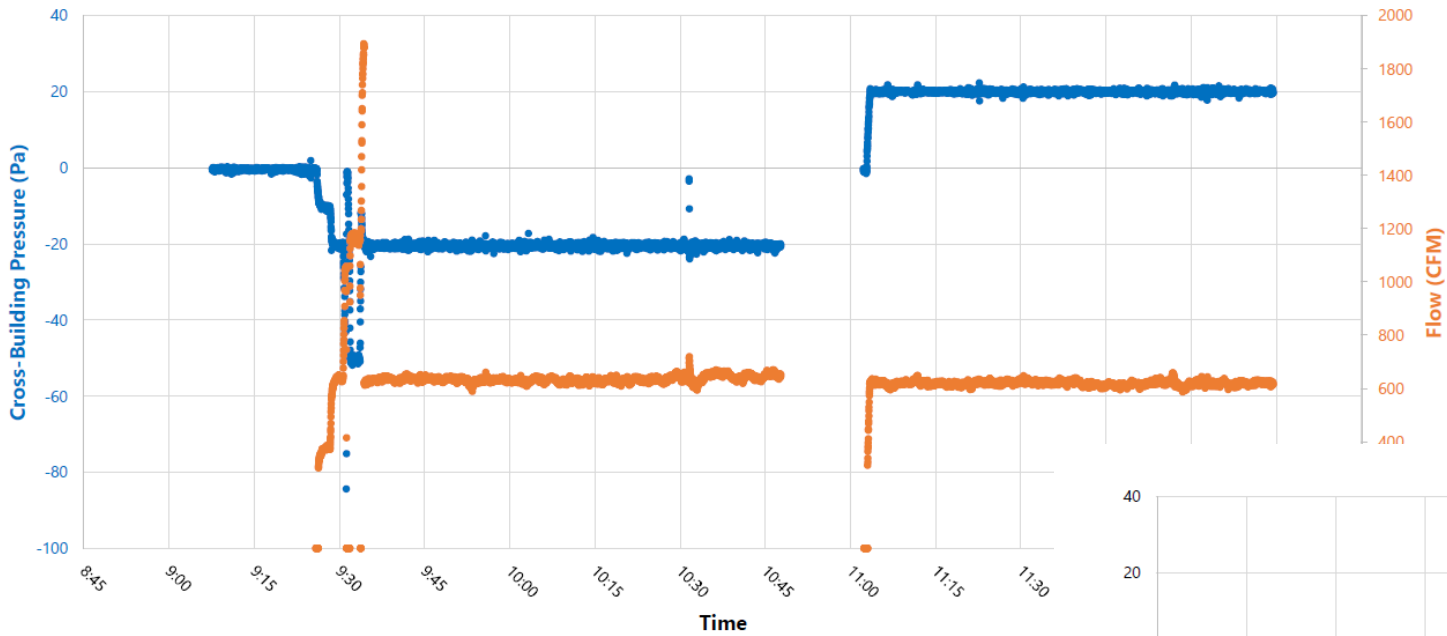
End Unit



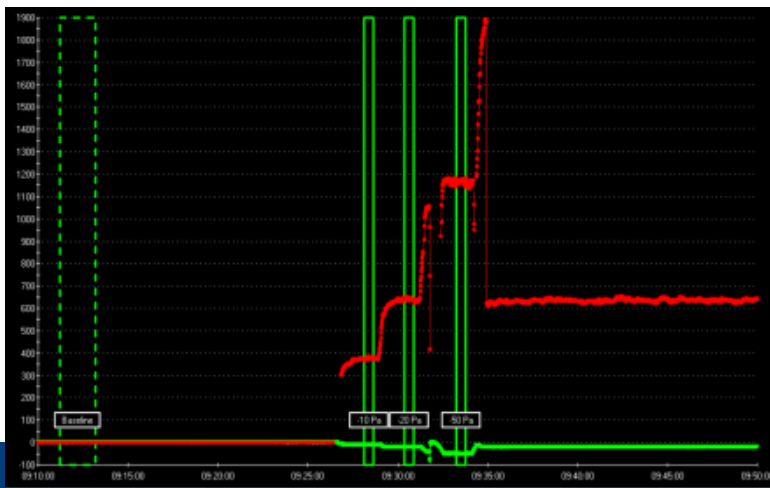
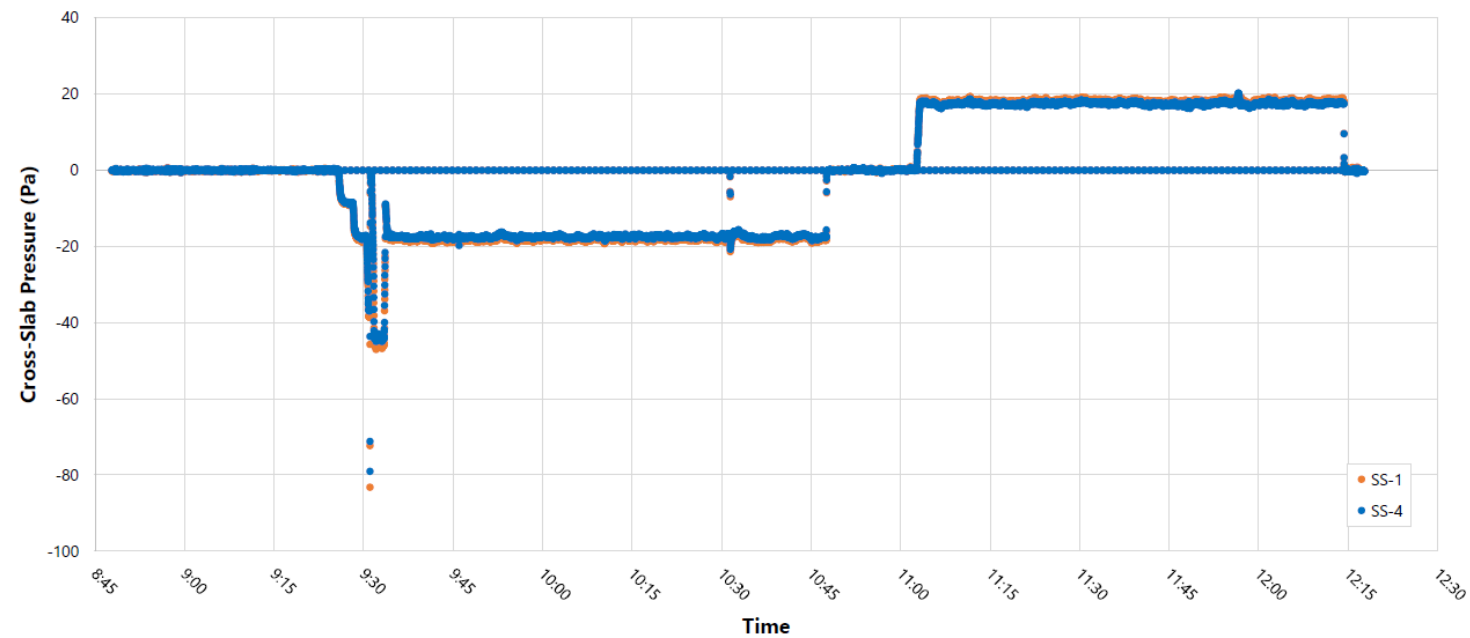
Average	-0.23
Min	-5.37
25th Percentile	-0.84
Median	-0.34
75th Percentile	0.19
Max	11.36

BPC Physical Data

Cross-Building Pressure & Flow - 9/24/2020



Cross-Slab Pressure - 9/24/2020



- 24-hour IA & BPC IA (Baseline, -20 Pa, +20 Pa)
 - < Reporting Limits (RLs) in all samples
 - RLs < 50% of AAC
- Sub-slab
 - < RLs in all samples
 - RLs < 10% of VISLs
- Attenuation Factor (based on screening-level radon data)
 - Site-specific attenuation factor ~ 0.007 (conservative because based on radon)
 - $\sim 5x$ greater attenuation than EPA default
 - Indicates competent slab

- **No unacceptable risk to residents from vapor intrusion under:**
 - Any naturally occurring seasonal conditions
 - Any operational configuration of any existing vent fans or hoods, heating, ventilation or air conditioning units.

- **Pressure set to -20 Pa**
 - Average natural pressures -0.23 to 0.17; minimum natural pressure -5.37
 - **At least 4X protectiveness factor**
- **SS Reporting Limit**
 - 10% or less of VISL; **at least 10X protectiveness factor**
 - COCs not detected in all 10 SS samples, indicating lack of source
- **IA Reporting Limit**
 - 50% or less of AAC; **at least 2X protectiveness factor**
- **Site-specific Attenuation Factor**
 - AF of 0.007; **~5X protectiveness factor** over EPA default attenuation

*Note, quarterly SS/IA results representative only of conditions on four discrete sampling days and may not be representative of future conditions. **BPC gives greater assurance of future protectiveness.***



BPC Summary: Achieve Project-Specific Goals

Reduce Temporal Variability



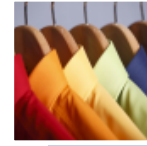
- Simulate pressure worst-case to account for all weather conditions
- Depressurized results found to vary less than 2x (US DoD research, demonstration project ER201503)

Reduce Spatial Variability



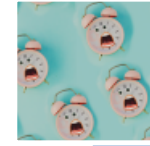
- Integration of IA through single discharge (fan)
- Subslab depressurization draws vapors through potential cracks

Identify Background Sources or Preferential Pathways



- Sample VOCs in IA under pressurized conditions (VI “turned off”) to estimate background
- Mass flux to identify short-circuiting

Conduct Investigation in Rapid Timeframe



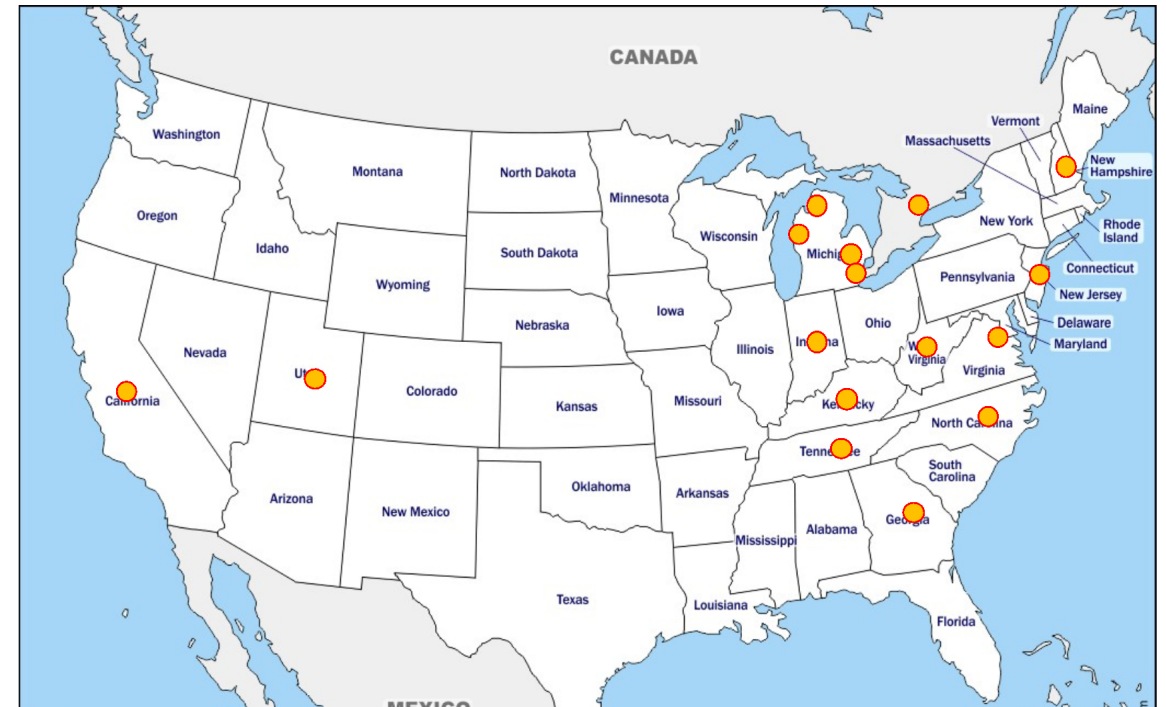
- Can be conducted in ½-1 day in most buildings
- Physical and chemical data MLE collected simultaneously

Avoid or reduce long-term monitoring requirements and allow quicker defensible decision making



Regulatory Acceptance

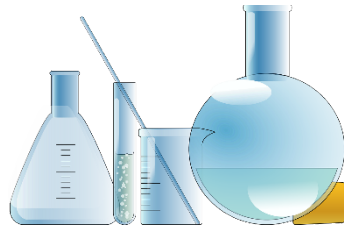
- Included in VI Guidance
 - California
 - Georgia
 - Indiana
 - Michigan
 - New Jersey
 - Washington
- 2015 EPA Guidance and 2007 ITRC Guidance emphasizes the importance of monitoring pressure differential in VI





- Real Estate Transactions

- Environmental due diligence
- Liability assessment



- Environmental site investigation



- Remedy performance evaluation

Thank you!

Questions?



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