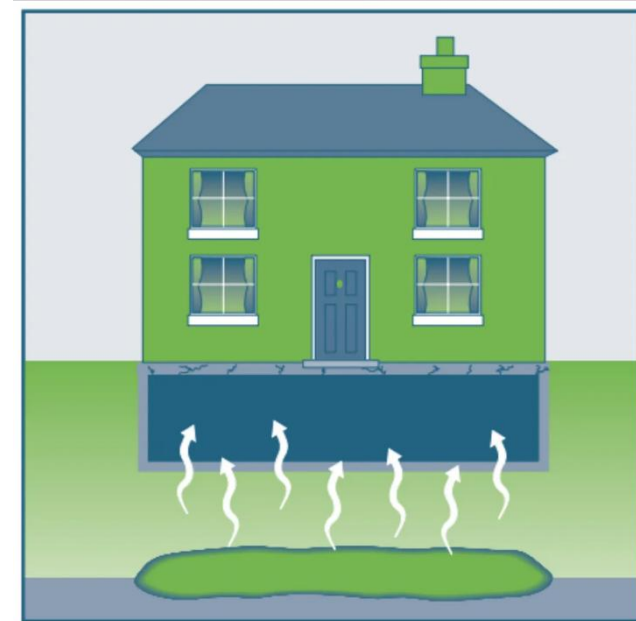


# Starting Soon: Vapor Intrusion 101 – Session 2

- ITRC Resources: <https://itrcweb.org/vapor-intrusion-toolkit/>
- CLU-IN Training Page: <https://clu-in.org/conf/itrc/VI-introductory/>



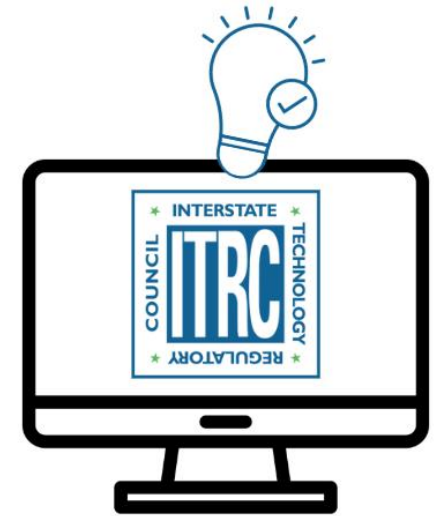
# Housekeeping

- This event is being recorded; Event will be available On Demand after the event at the main training page: <https://clu-in.org/conf/itrc/VI-introductory/>
- If you have technical difficulties, please use the Q&A Pod to request technical support
- Need confirmation of your participation today?
  - Fill out the online feedback form and check box for confirmation email and certificate

Check  
In!

Did you attend Session 1 of the Introductory training series?

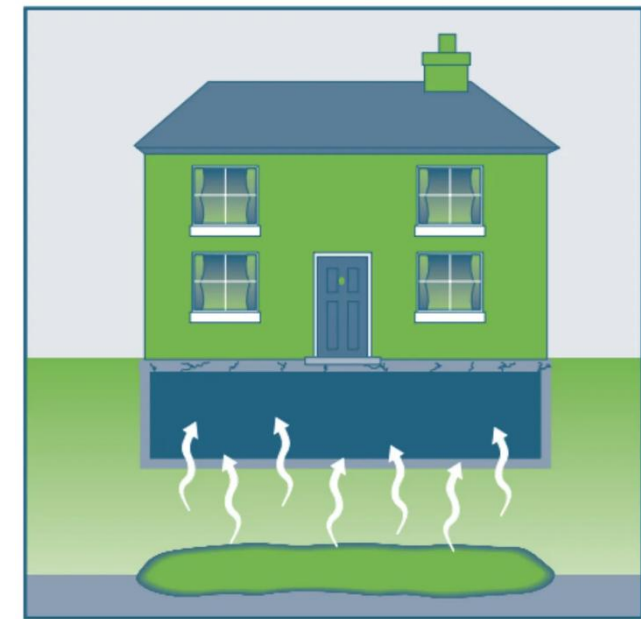
- Yes
- No





# Understanding Vapor Intrusion

## Introductory Concepts & Fundamentals A Two Part: Session 2



**Sponsored by:** Interstate Technology & Regulatory Council ([www.itrcweb.org](http://www.itrcweb.org))

**Hosted by:** US EPA Clean Up Information Network ([www.cluin.org](http://www.cluin.org))

# ITRC – Shaping the Future of Regulatory Acceptance

- Host Organization



- Network – States, PR, DC

- Federal Partners



DOE



DOD



EPA

- ITRC Industry Affiliates Program



- Academia

- Community Stakeholders

- Disclaimer

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# Meet the ITRC Trainers



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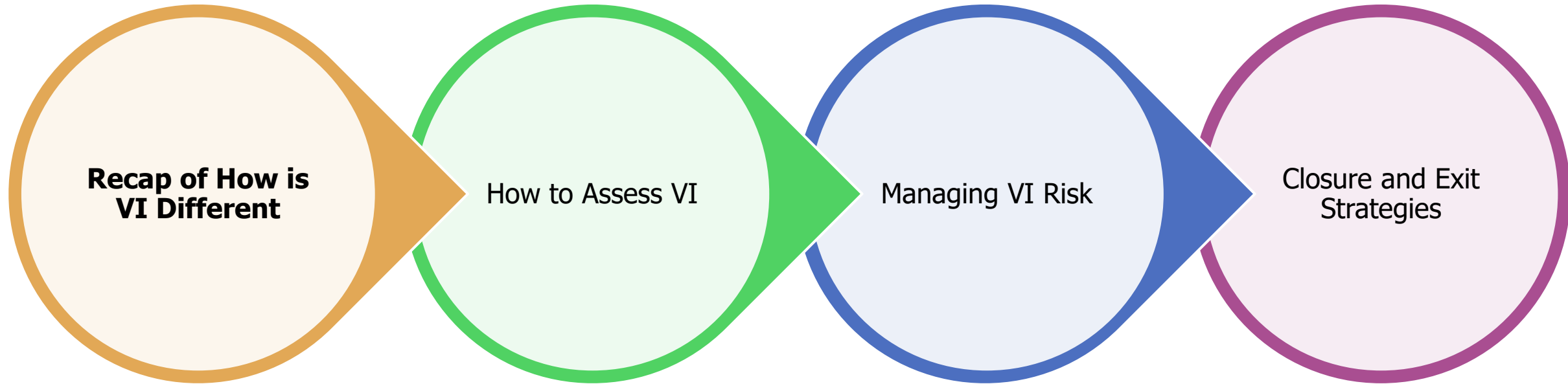


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# Training Roadmap



**Recap of How is  
VI Different**

How to Assess VI

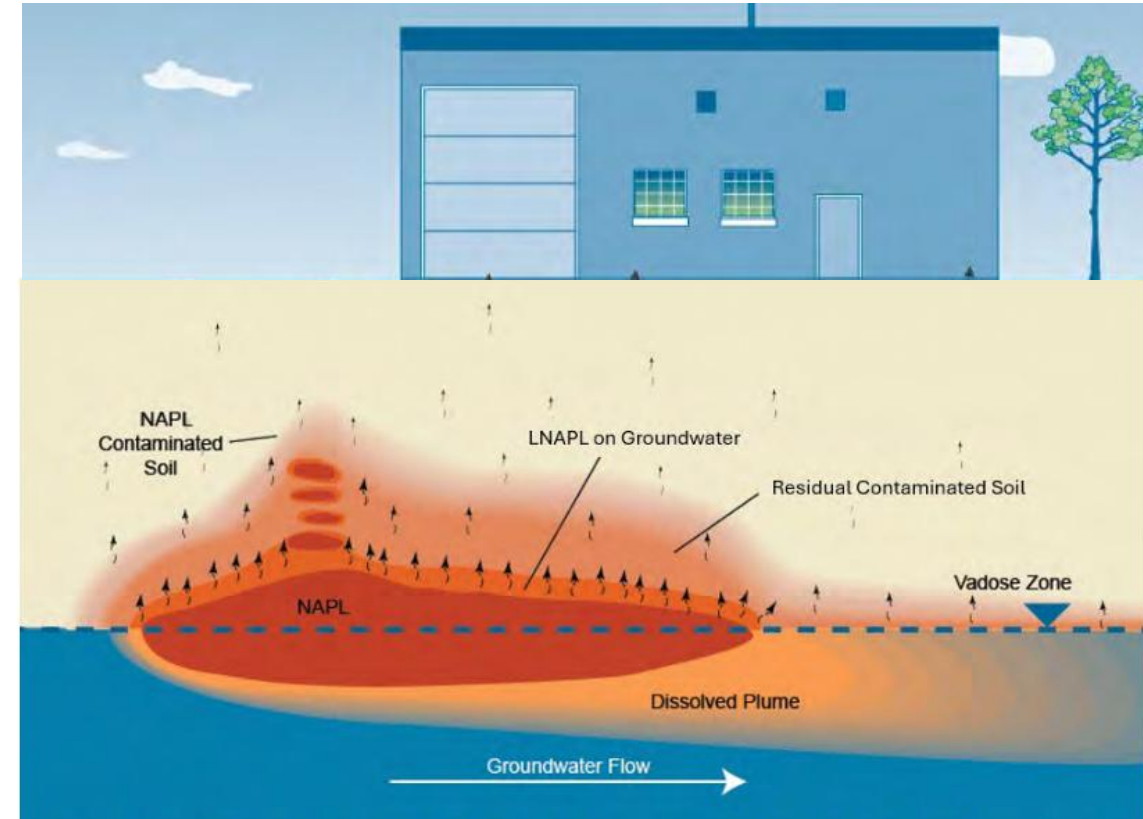
Managing VI Risk

Closure and Exit  
Strategies

# What is Vapor Intrusion?

Migration of vapor forming chemicals (VFCs) from a subsurface source into an overlying building that is occupied or could be in the future

- Subsurface source of VFCs that are sufficiently “toxic”
- Migration and transport
- Potential Building & Receptors



Source: Ryan Jones, Brown and Caldwell. Modified from VI Tech Reg Figure 2-1. Used with permission.

# General Overview of the Vapor Intrusion Strategy

## Community Engagement

### VI Project Stages

*Preliminary CSM*

Preliminary VI  
Exposure  
Assessment

*Baseline CSM*

*Characterization CSM*

*Design, Remediation and/or Mitigation and Post-Remedy CSM*

VI Assessment and Evaluation

VI Management

VI Component  
Completion at Site

### Project Exits

No VI Pathway:

No VI  
Component at  
Site

Building Screened Out

Managed VI Closure

Unrestricted VI  
Closure

# Variability in State Guidance with Vapor Intrusion

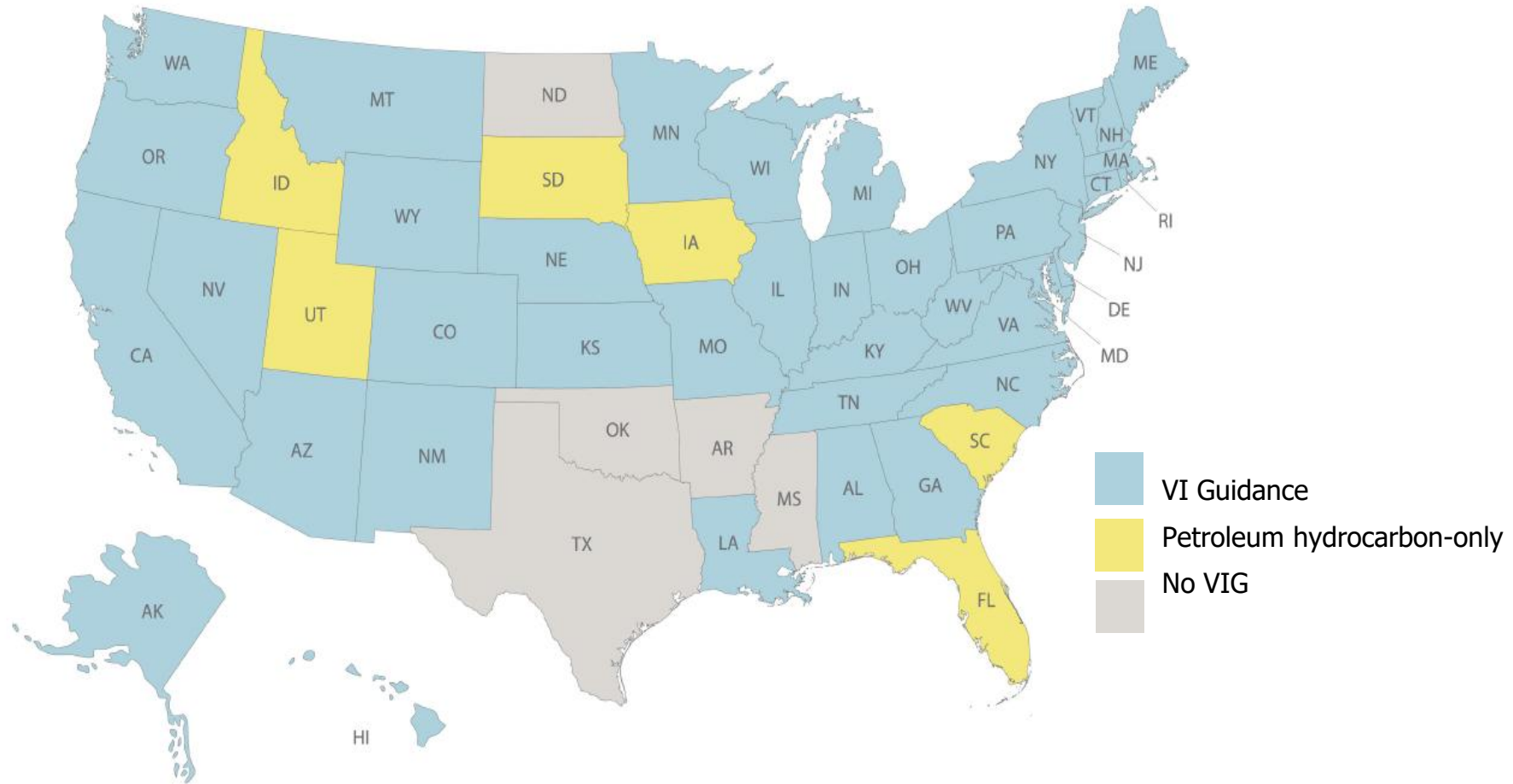


Figure 1. States with draft or final guidance or regulation as of April 2023.

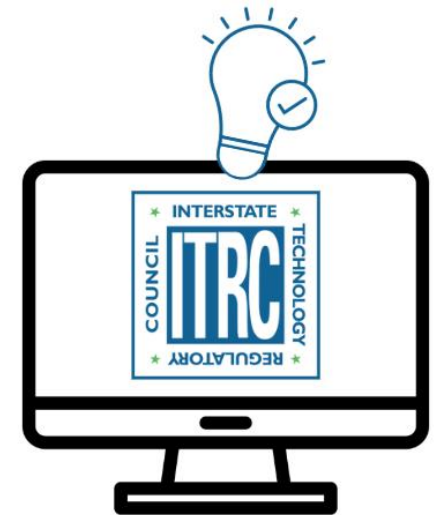
# Introduction of Common Acronyms for Vapor Intrusion

AER	Air Exchange Rate
AF	Attenuation Factor
CSM	Conceptual Site Model
LOEs	Lines of Evidence
MLE	Multiple Lines of Evidence
Non PHC	Non-Petroleum Hydrocarbons
PHC/PVI	Petroleum Hydrocarbons / Petroleum Vapor Intrusion
VFCs	Vapor Forming Chemicals
VI	Vapor Intrusion
VIPP	Vapor Intrusion Preferential Pathway

Check  
In!

What type of discipline are you representing?

- Regulator
- Health professional
- Environmental consultant
- Developer
- Legal
- Other



# What Makes Vapor Intrusion Unique?

## Unique Exposure Pathway

- Potential for involuntary exposure
- Low/conservative screening levels
- Groundwater concentrations even lower than drinking water standards may drive vapor intrusion assessments

## Variability Over Time

- Seasonal variability,
- Building use and operation changes over time
- Building dynamics change over time

## Complex Subsurface Transport

- Volatilization, advective, diffusion
- Building depressurization
- Preferential pathways

## Critical to Land Use

- Influences future site development
- Long-term management requirements

# Uniqueness Continues

## Sampling Equipment

- Evacuated canisters
- Sorbents
- Units ( $\mu\text{g}/\text{m}^3$ )

## Background Sources

- Cleaning supplies
- Paint
- Mowers / gas cans

## Stakeholder Comms

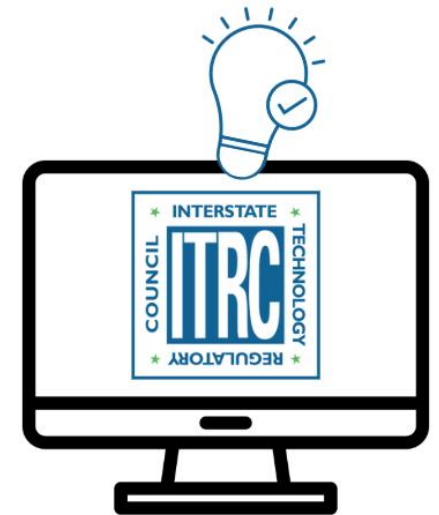
- Property owners / occupants
- Neighborhood
- State / local health

## Mitigation Partners

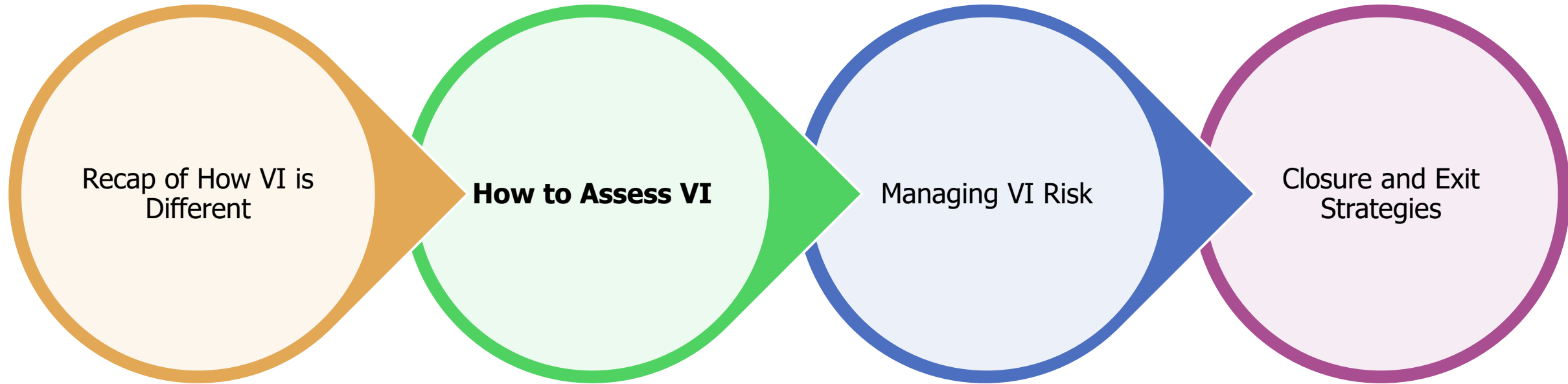
- Mitigator
- Electricians
- Plumbers

### Why is vapor intrusion considered a unique exposure pathway?

- A. People usually expect to be exposed
- B. Exposure mainly happens outdoors
- C. People can be exposed indoors without realizing it
- D. It only happens at industrial sites



# Training Roadmap



# Puzzle Pieces to the VI Conceptual Site Model

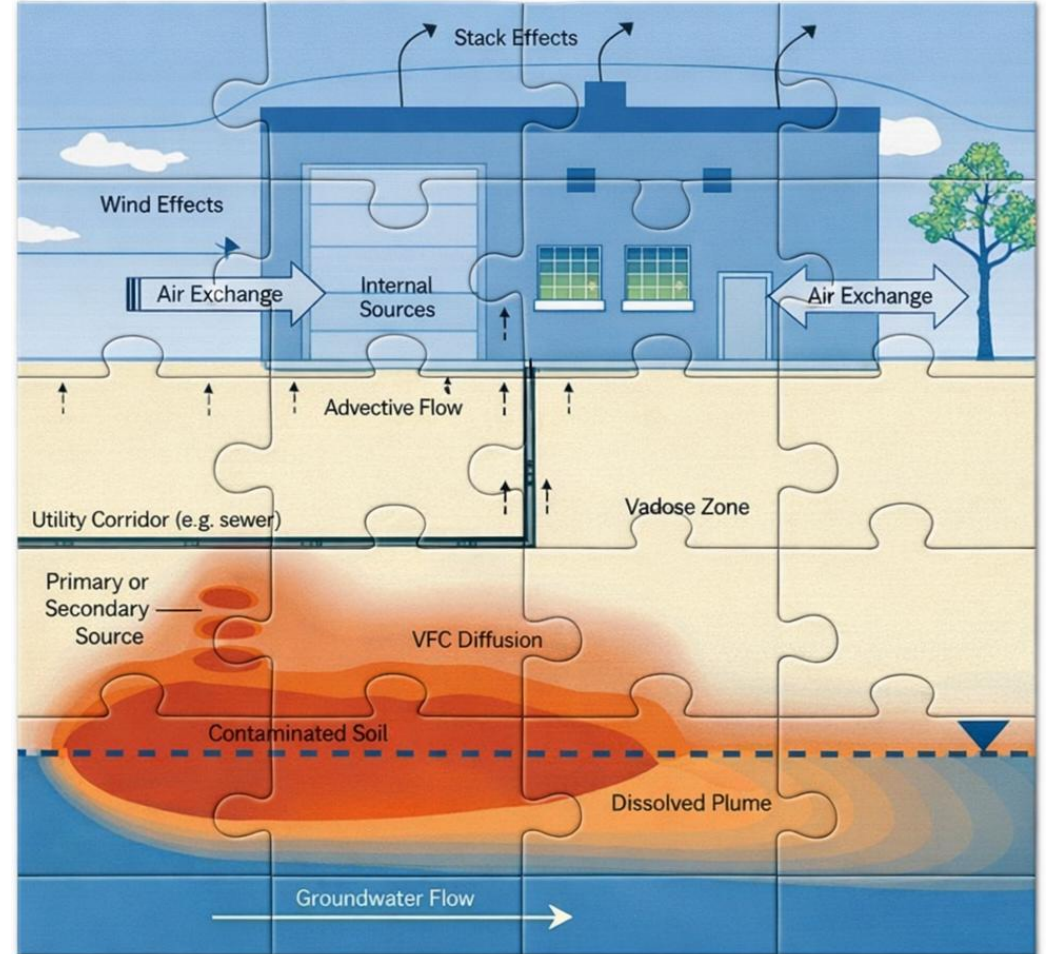
## Evolving Puzzle – What is known vs unknown

- Potential subsurface sources of vapor forming chemicals (VFCs)
- Define nature, extent, and fate
- Subsurface characteristics
- Building influences
- Potential receptors

Source  
Pathways  
Receptors



Foundation for  
evaluating  
transport, fate and  
potential exposure



**Figure 2-1. Conceptualized vapor intrusion pathway.**

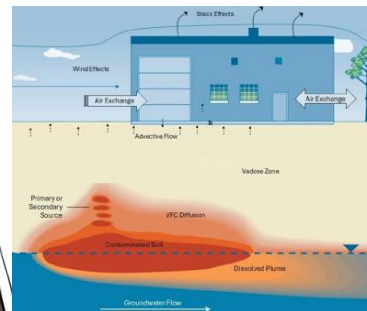
Source: Ryan Jones, Brown and Caldwell. Modified from ITRC VI Toolkit, Technical Guidance, Figure 2-1. Used with permission.

# What does multiple lines of evidence mean?

- Lines of Evidence (LOEs) – Pieces of data used to create your “site picture”
- Multiple Lines of Evidence (MLE) – Using multiple pieces of information to help create an understanding of a site and help answer a particular question

I’m the data you have or have collected from your site!

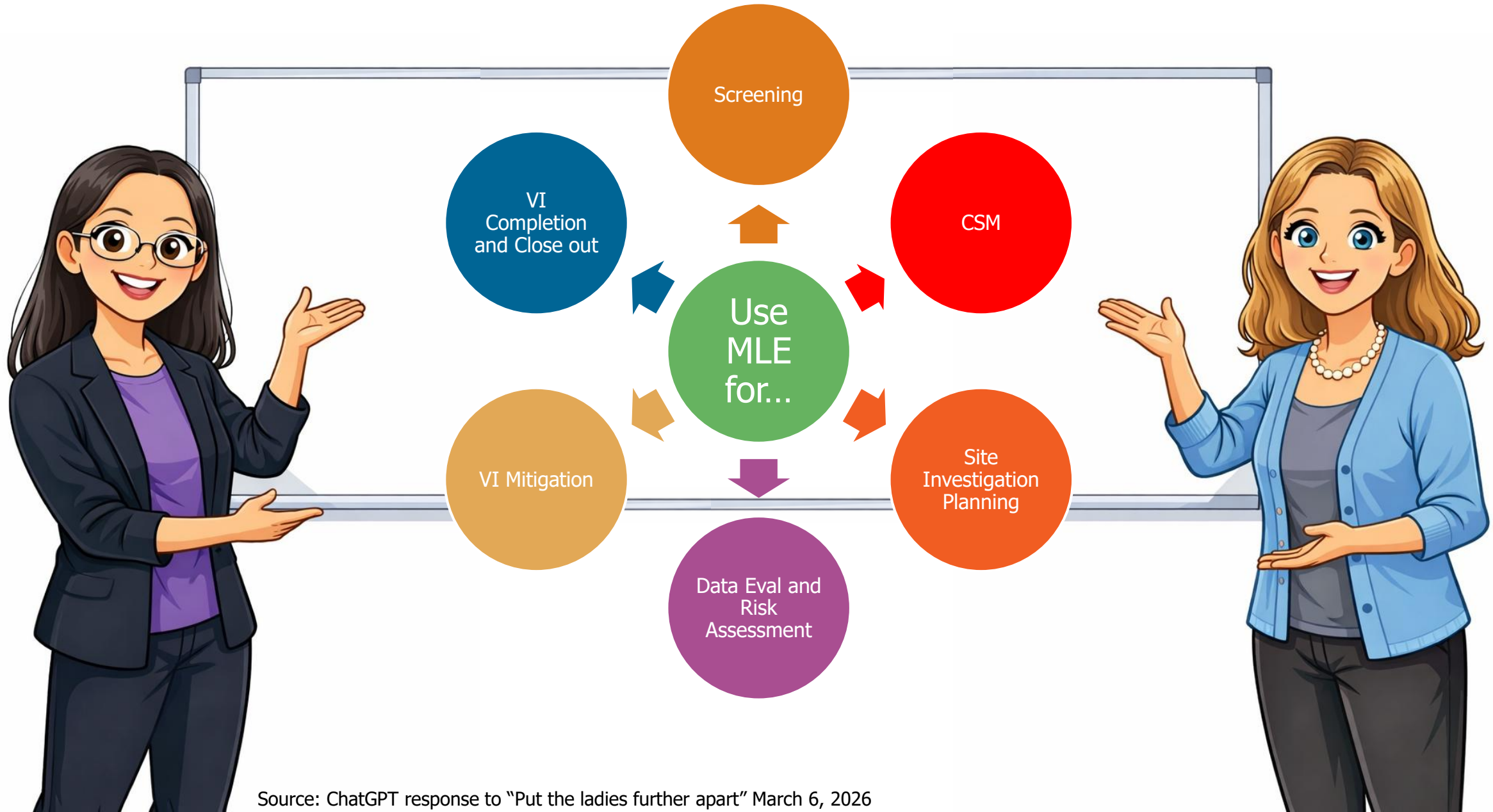
LOEs



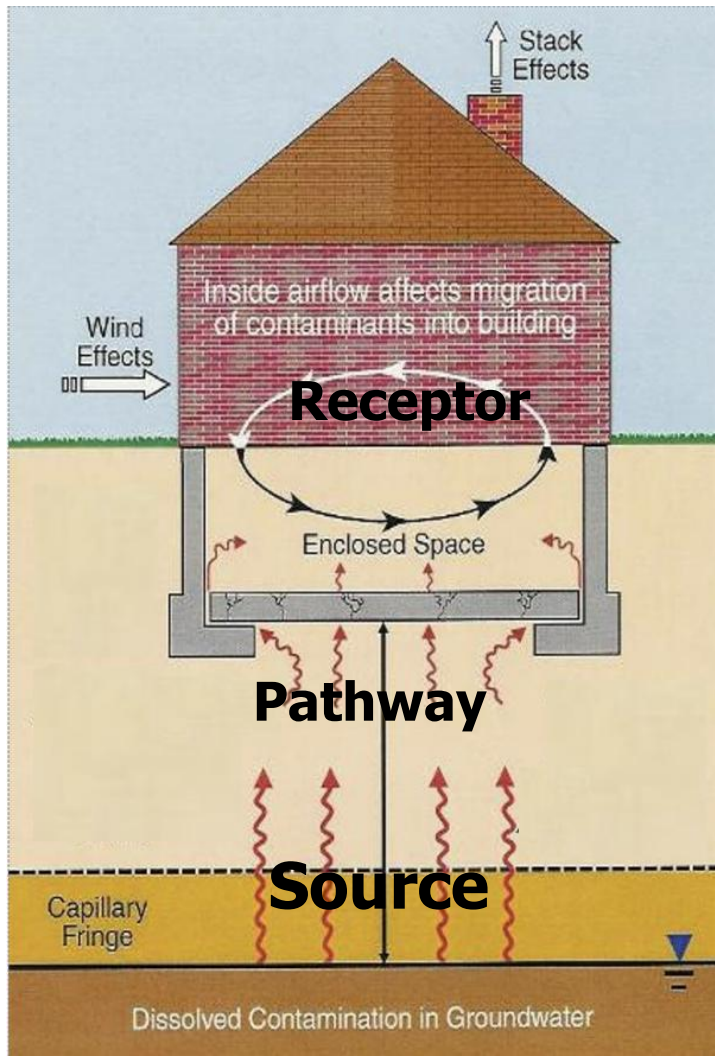
I’m the approach you use to bring all those pieces of data together to help answer your site question.

MLE

# Multiple Lines of Evidence (MLE) Approach



# Bottom Up Strategy



**Forensic and Supplemental data**

**Building vapor phase data**

**Vapor data under building**

**Building design information**

**Vapor fate and transport information**

**Vapor source data**

Source: ITRC VI Toolkit, Technical Guidance, Figure 2-10.

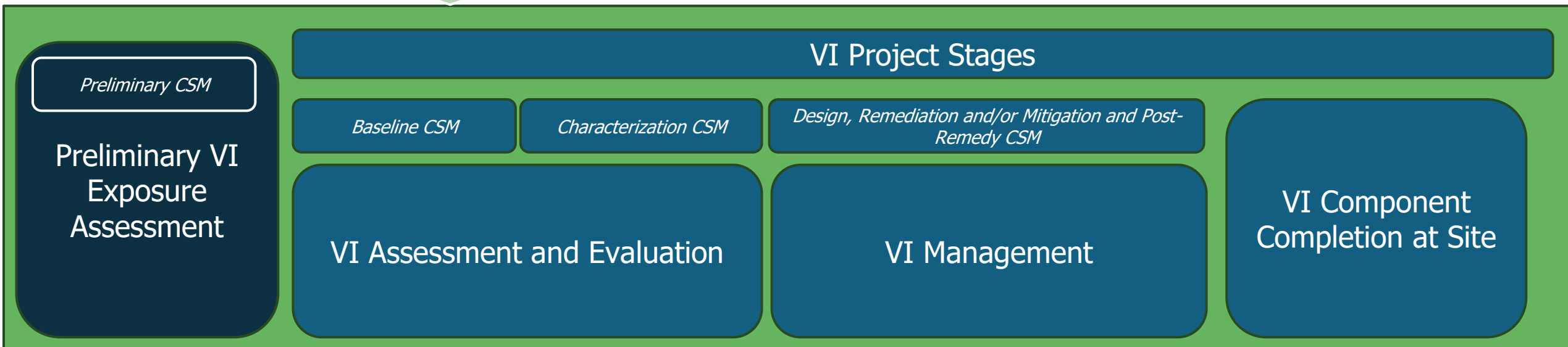
# Pathway Assessment Process

Conceptual Site Model = touchstone

- Organize your thoughts
- Identify data gaps and plan investigation
- Use to guide decision-making

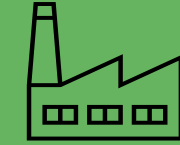
## **KEY POINTS:**

- Process can be iterative
- At every stage, consider:
  - Community engagement
  - Rapid response needed? If fire/explosion hazards or acute health risks
  - Potential exits from VI



# Motivations for Vapor Intrusion Assessments

- Assessments of nature & extent of contamination can be triggered by:
  - Spills/releases
  - Regulatory action
  - Property transactions/redevelopment activities
- **VI assessments may be just one part of broader environmental/cleanup projects**
- Common types of sites where VI might be evaluated
  - Industrial
  - Dry cleaners
  - Gas stations
- VI evaluation may include nearby off-site properties



Industrial Sites



Dry Cleaners



Gas Stations



Source: Lila Beckley, GSI Environmental. Modified from ITRC VI Toolkit, Technical Guidance, Figure 2-7. Used with permission.

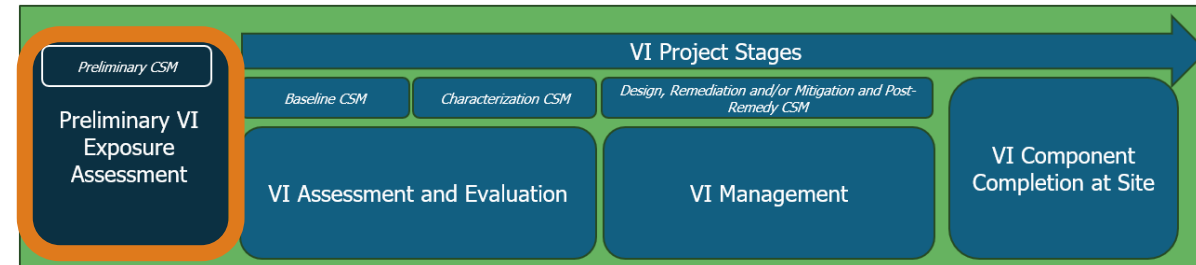
# Preliminary VI Exposure Assessment

- Initial filter to determine whether there is a potential for VI based on:
  - Presence of VFCs in the subsurface, which requires knowledge of current and historical chemical use
  - Presence of current and/or reasonably anticipated future land use and buildings.

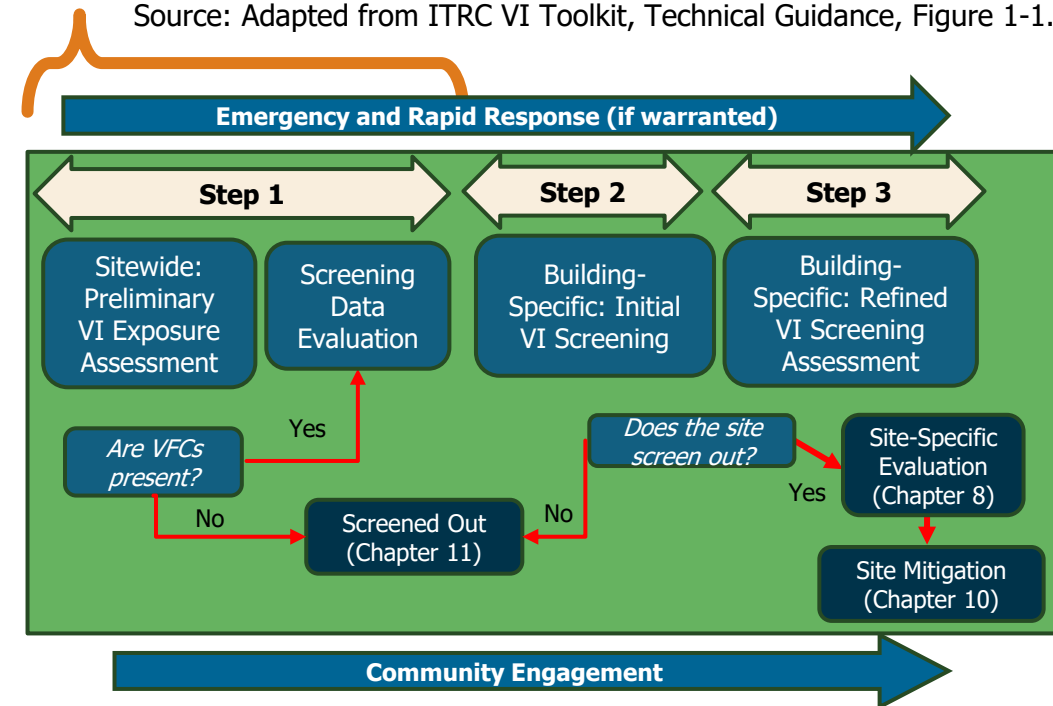
## **KEY POINT:**

If neither or only one of these conditions is present, then the site can be screened out from further VI evaluation.

If both of these conditions are present, then additional VI screening is needed.



Source: Adapted from ITRC VI Toolkit, Technical Guidance, Figure 1-1.



Source: Adapted from ITRC VI Toolkit, Technical Guidance, Figure 5-1.

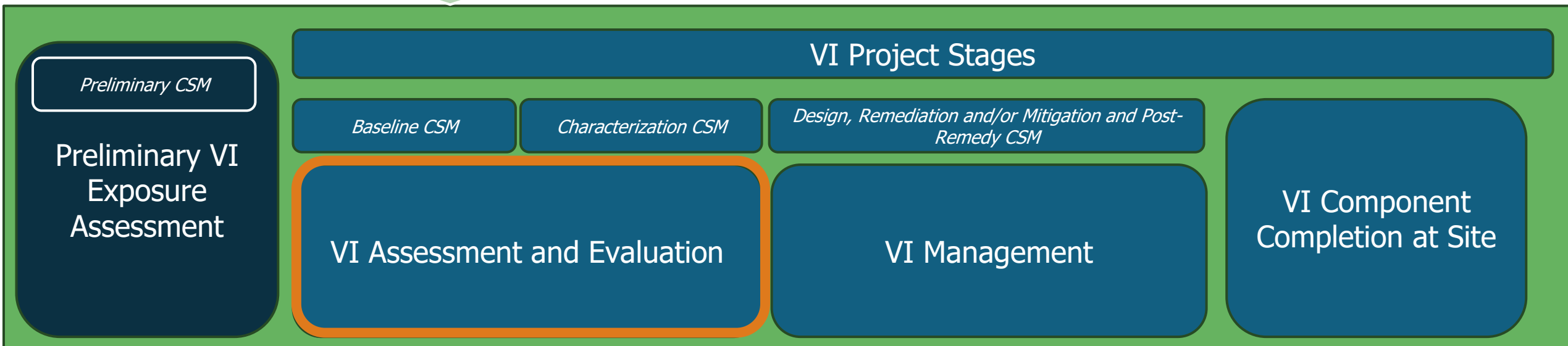
# Pathway Assessment Process

Conceptual Site Model = touchstone

- Organize your thoughts
- Identify data gaps and plan investigation
- Use to guide decision-making

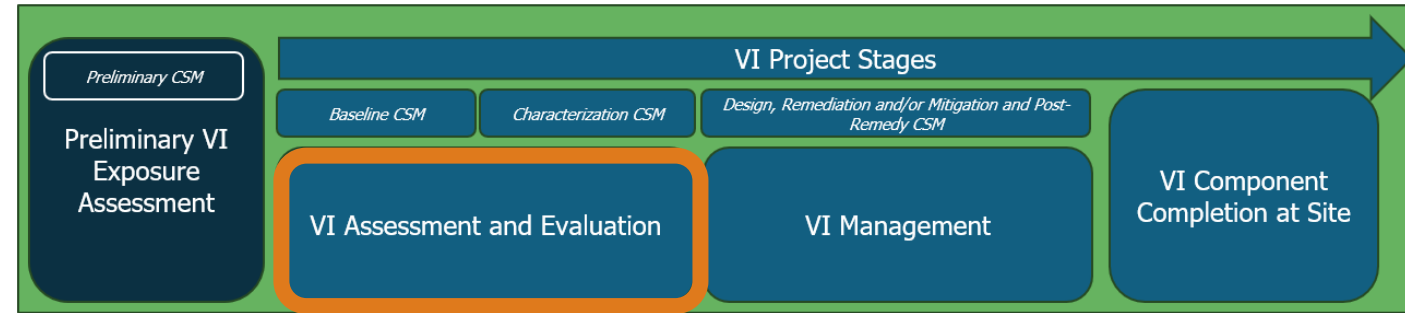
## **KEY POINTS:**

- Process can be iterative
- At every stage, consider:
  - Community engagement
  - Rapid response needed? If fire/explosion hazards or acute health risks
  - Potential exits from VI



# VI Assessment and Evaluation

- Series of investigations to characterize VI exposure pathway
- Process may be iterative
- Evaluate data against risk-based levels
- Collect data for MLE approach to CSM development



Source: Adapted from ITRC VI Toolkit, Technical Guidance, Figure 1-1.



Source: Beacon Environmental, Inc.  
Used with permission.

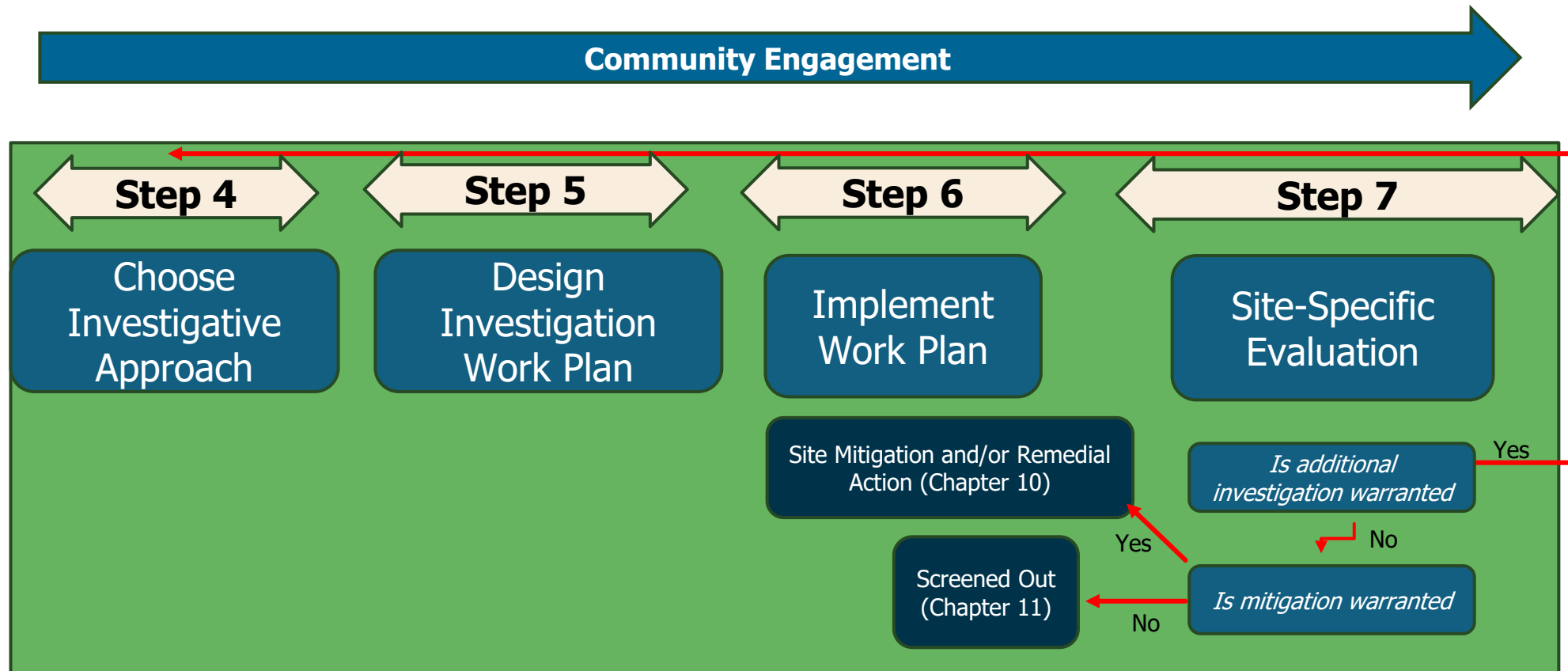


Source: California Department of Toxic  
Substances Control. Used with permission.



Source: California Department of Toxic  
Substances Control. Used with permission.

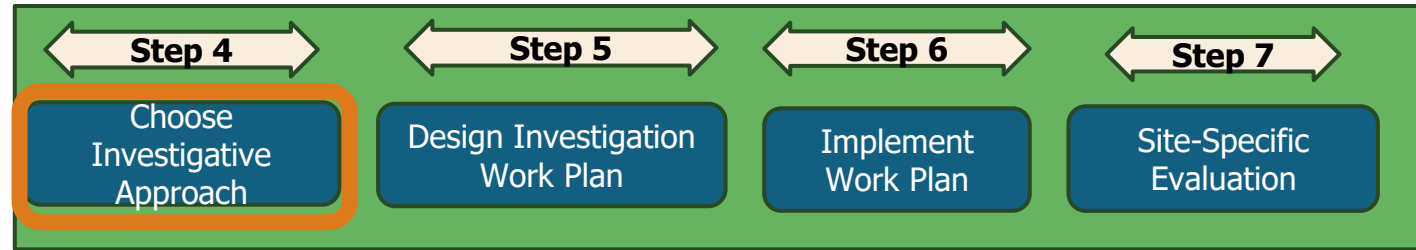
# VI Assessment and Evaluation



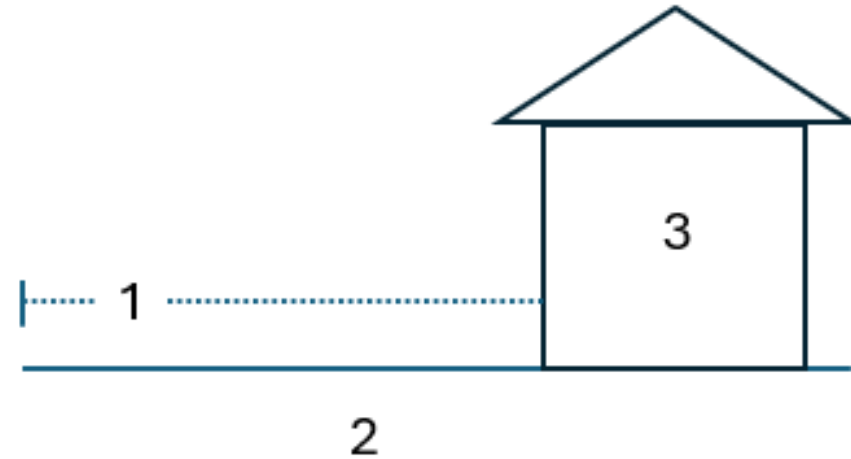
Source: Adapted from ITRC VI Toolkit, Technical Guidance, Figure 6-1.

# Step 4: Choosing Investigative Approach

- Guided by
  - Stage of CSM development
  - Project's Data Quality Objectives (DQO's)
- Which media to be investigated
- Progressive or Phased approach:
  - What areas need to be included?
    - Proximity to source (1)
    - Subsurface exterior to building (2)
    - Inside building to assess complete pathway (3)

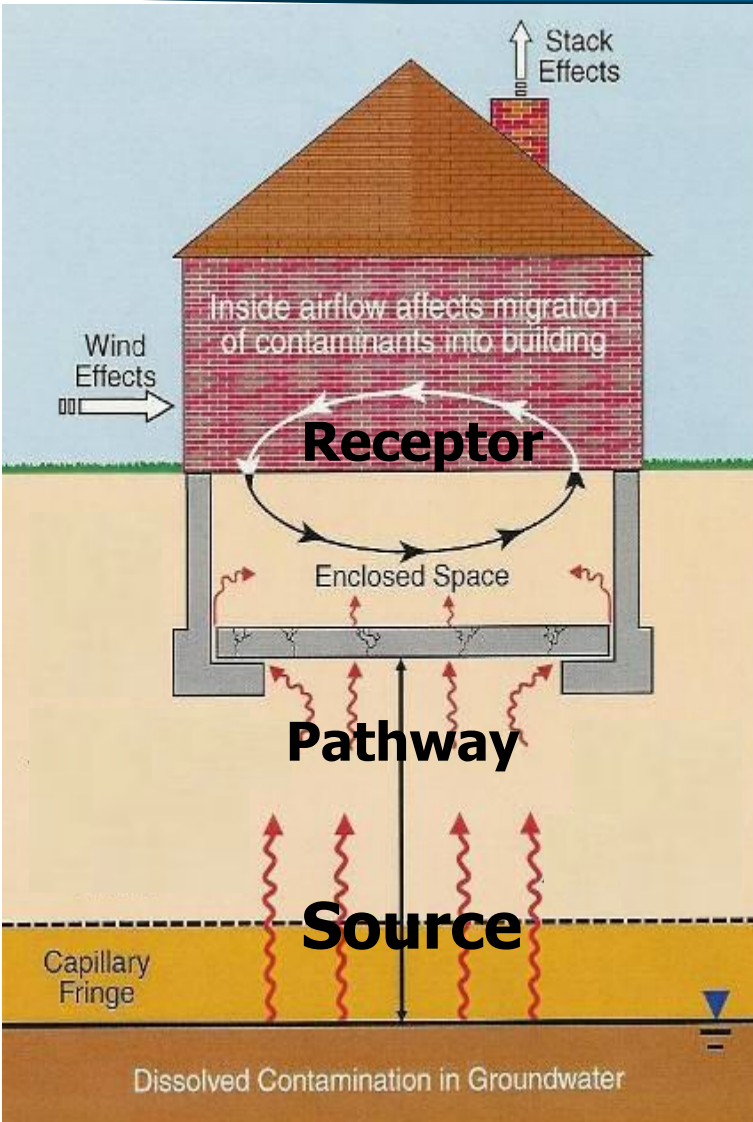


Source: Adapted from ITRC VI Toolkit, Technical Guidance, Figure 6-1.



Source: ITRC VI Toolkit, Technical Guidance, Figure 6-2.

# Step 4 Continued: Review VI CSM



## Site History

- Property use history and future land use
- Historical site investigation/remediation
- Any vapor mitigation

## Building Characteristics

- Building design
- Building use
- Building condition
- Ventilation features

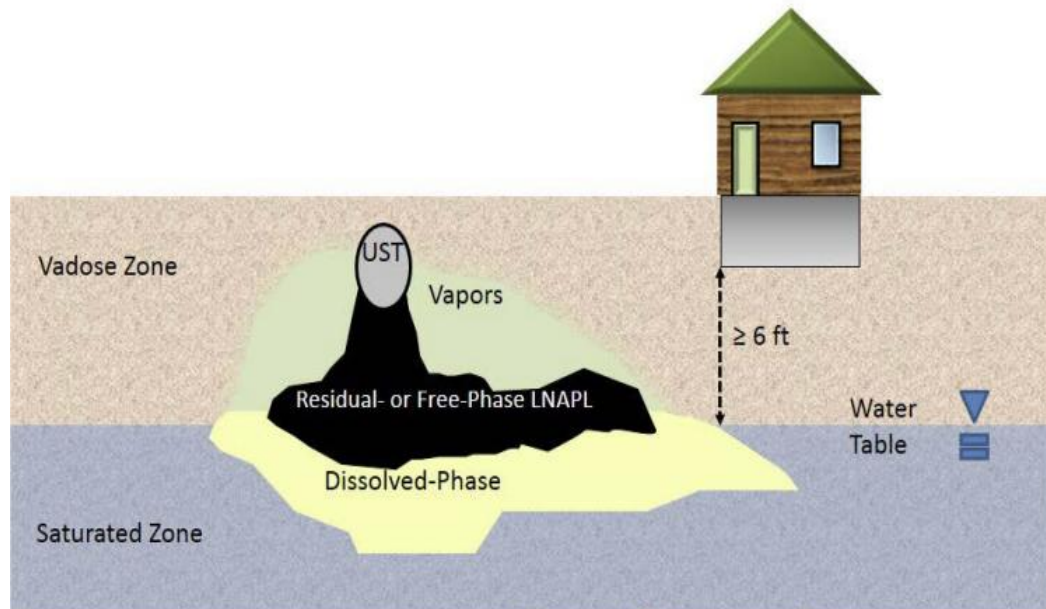
## Subsurface Conditions

- Groundwater
- Soil
- Soil type (low/high permeability zones)
- Utility lines

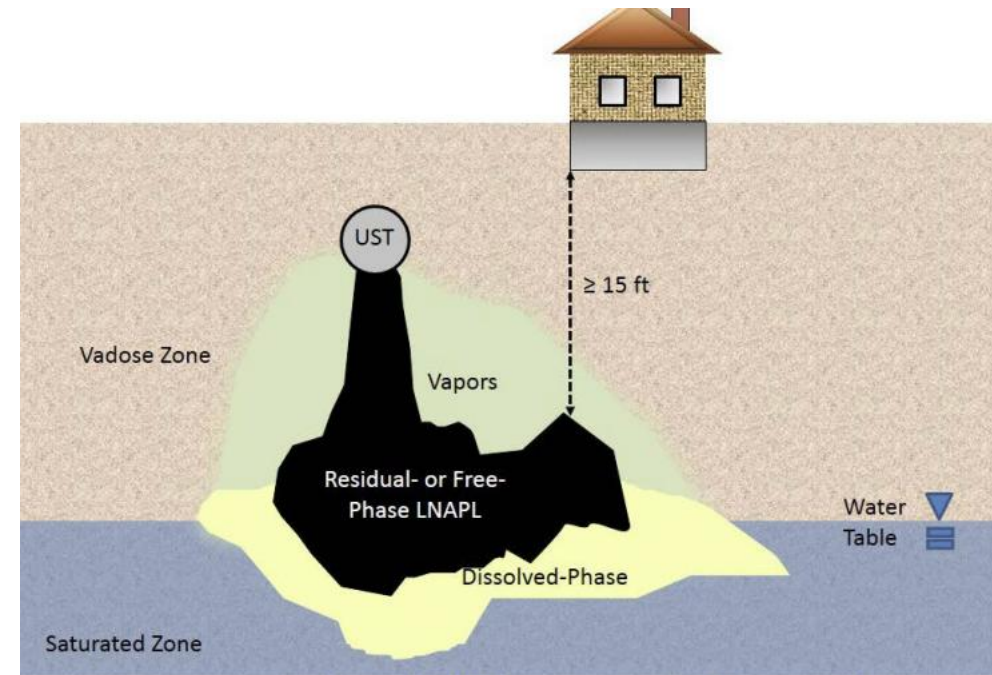
Source: ITRC VI Toolkit, Technical Guidance, Figure 2-10.

# Step 4: PVI-Specific Investigative Approach

- Petroleum hydrocarbons are easily degradable under aerobic conditions
- PVI investigations should start with “separation distance” approach
- Sites screened in or out based on vertical and lateral distances between the building and petroleum VFC sources



(a) Vertical separation distance for dissolved-phase source of PHCs.



(b) Vertical separation distance for LNAPL (residual or mobile phase) source of PHCs.

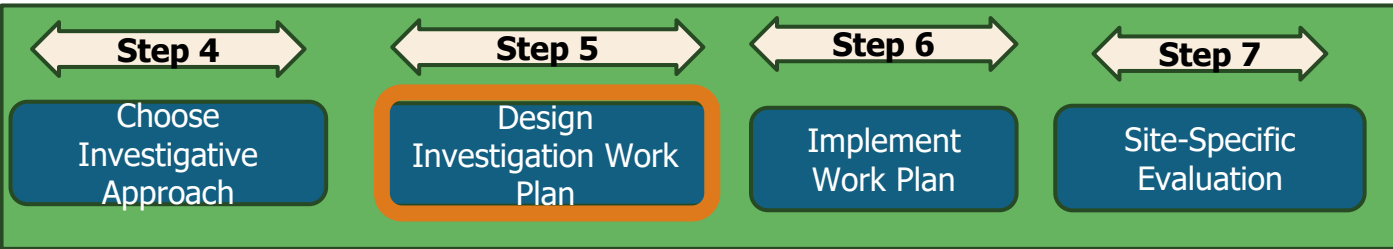
Source: USEPA PVI Guidance (2015)

# Step 4 Continued: Sample Media

Media	Advantages	Disadvantages
Soil	<ul style="list-style-type: none"> <li>• Lithology</li> <li>• Identification of NAPL</li> </ul>	<ul style="list-style-type: none"> <li>• Not typically used to assess VI</li> </ul>
Groundwater	<ul style="list-style-type: none"> <li>• Vertical delineation</li> <li>• Potential source identification</li> </ul>	<ul style="list-style-type: none"> <li>• May be weak predictor of VI exposure</li> <li>• Requires conservative assumptions</li> </ul>
Soil vapor	<ul style="list-style-type: none"> <li>• Commonly sampled</li> <li>• Attenuation factor (AF) used is more conservative than groundwater</li> <li>• Easy to collect</li> <li>• Fewer migration pathways</li> </ul>	<ul style="list-style-type: none"> <li>• Spatial variability</li> <li>• AF needed to estimate indoor air concentrations</li> </ul>
Sub-slab vapor	<ul style="list-style-type: none"> <li>• Commonly sampled</li> <li>• Fewest migration pathways</li> <li>• Easy to collect</li> </ul>	<ul style="list-style-type: none"> <li>• Can be intrusive</li> <li>• AF may be conservative</li> </ul>
Indoor/ outdoor air	<ul style="list-style-type: none"> <li>• Directly measures exposure concentrations</li> <li>• Easy to collect</li> </ul>	<ul style="list-style-type: none"> <li>• Can be intrusive</li> <li>• Background sources</li> <li>• Temporal/spatial variability</li> </ul>

VI Toolkit Table 6-1

# Step 5: Design Investigation Work Plan



- Identify all aspects of the investigation:
  - Data gaps
  - Sampling Locations
  - Screening levels
  - Address potential background sources
  - Sampling & Analysis Plan
  - Community outreach
- Draft Work Plan for regulatory approval



Source: Canva Free Image.

# Step 5 Continued: Data Gaps

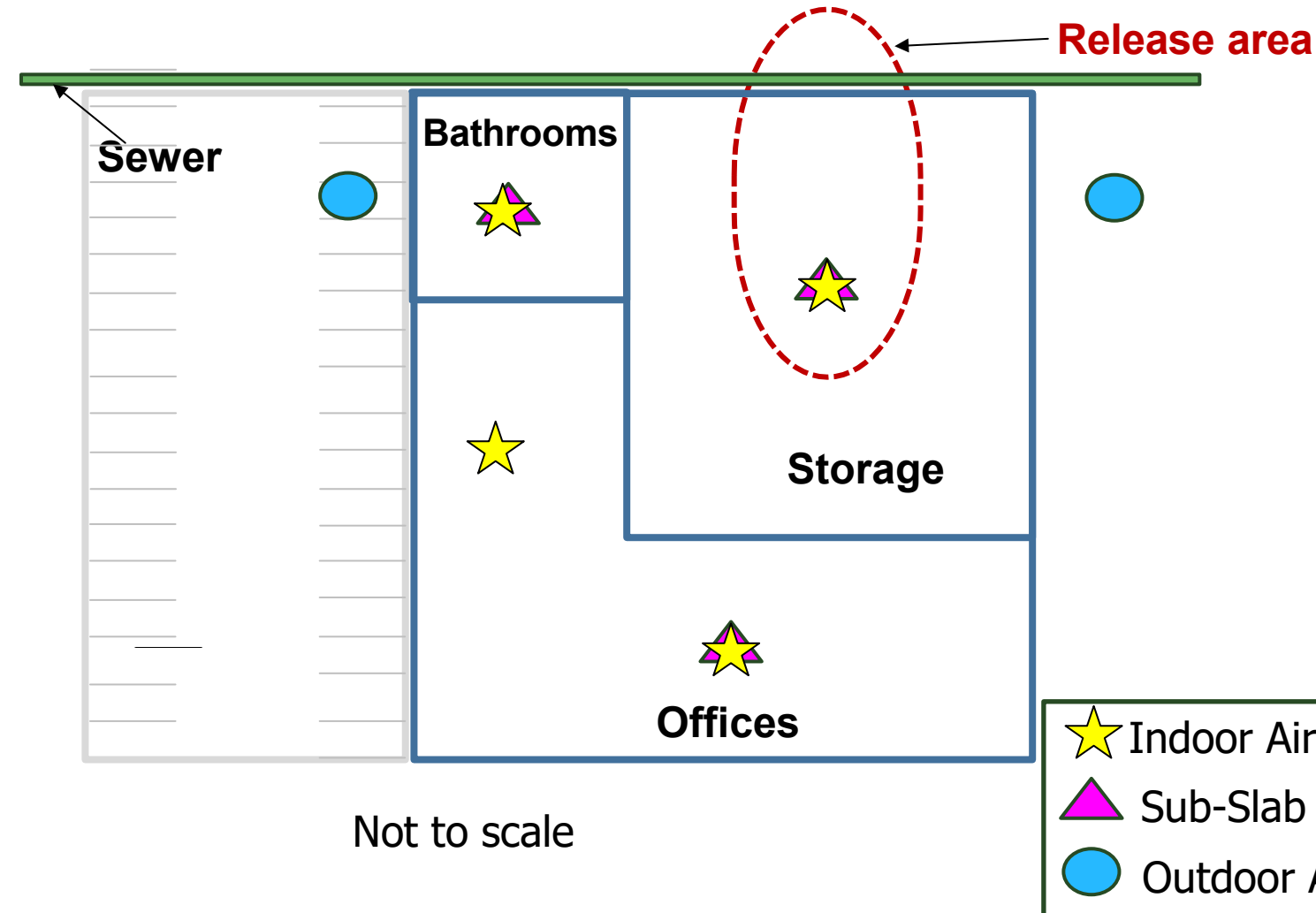
- Data gaps drive investigations
- Thoroughly identify
- Clearly state objectives
- Everything else is chosen to meet those objectives



Source: Wikipedia Commons.

# Investigation Design Example

## Office building



## Common IA/Sub-slab Sample Locations:

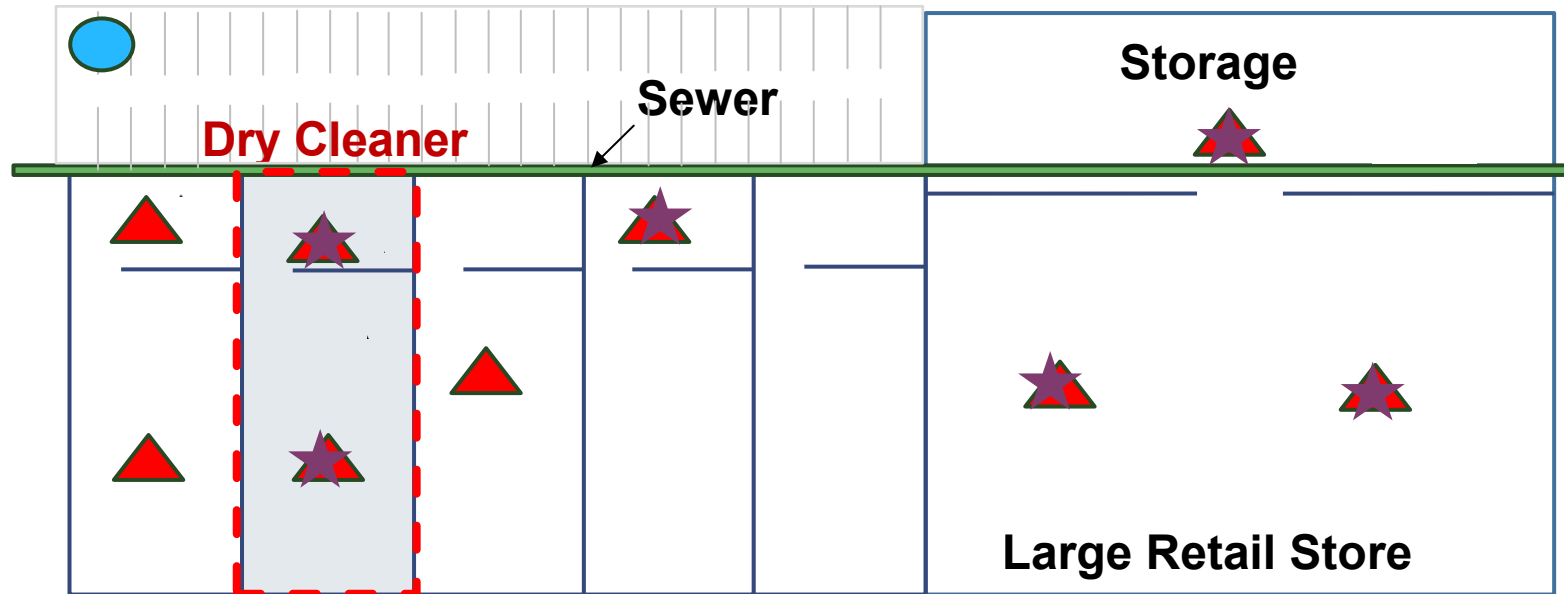
- Primary living/working areas
- Near suspected vapor entry points
- Near suspected maximum subsurface contamination

## Questions to Ask

- Are paired samples needed?
- Are outdoor locations needed?
- Do you have adequate coverage?

# Investigation Design Example

## Multi-unit commercial building



### Tenant spaces

#### **KEY POINT:**

Final sampling locations may get reduced for several reasons, such as site access. This is why communication between all stakeholders is important.

- ★ Indoor air
  - ▲ Sub-slab vapor
  - Outdoor Air
- Not to scale

### Common IA/Sub-slab Sample Locations:

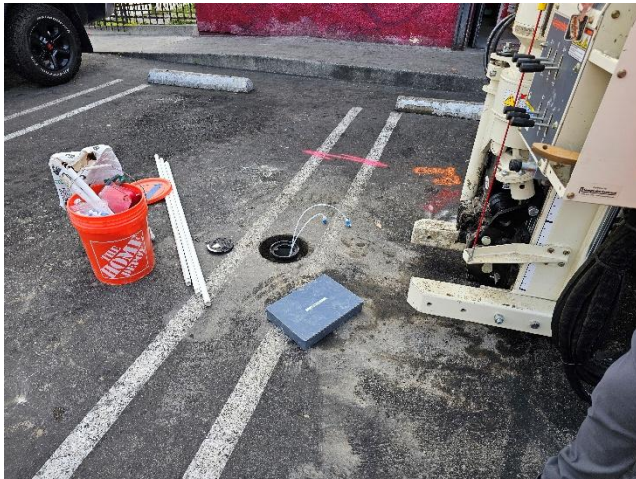
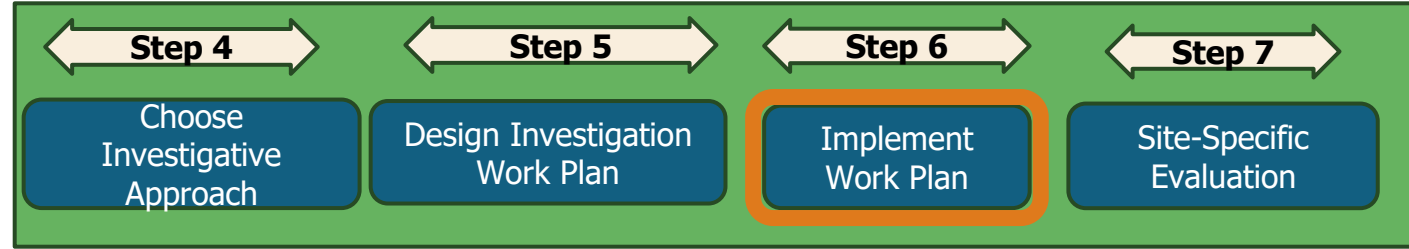
- Primary working areas
- Near suspected maximum subsurface contamination
- Near suspected vapor entry points

### Questions To Ask:

- What are the existing data gaps?
- Are paired samples needed?
- Are outdoor air samples needed?
- Do you have adequate coverage?
- Are desired locations realistic?

# Step 6: Implement Investigation

- This is the fieldwork where you collect all the LOE
- Always complete pre-field activities
- Maintain good communication



Source: California Department of Toxic Substances Control. Used with permission.



Source: California Department of Toxic Substances Control. Used with permission.



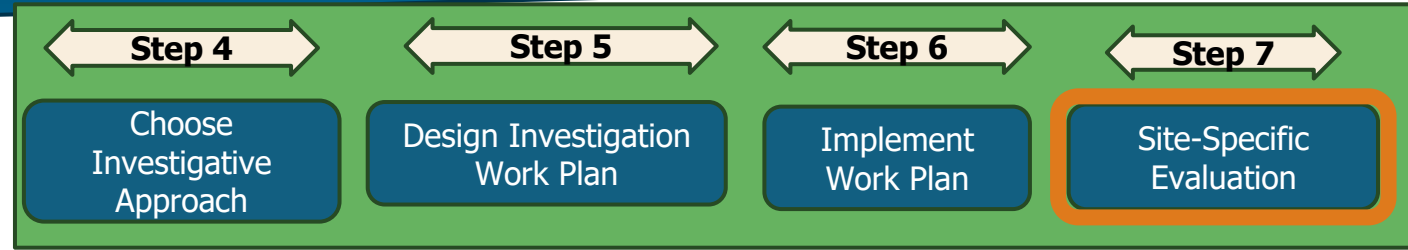
Source: Beacon Environmental, Inc. Used with permission.



Source: California Department of Toxic Substances Control. Used with permission.

# Step 7: Data Evaluation

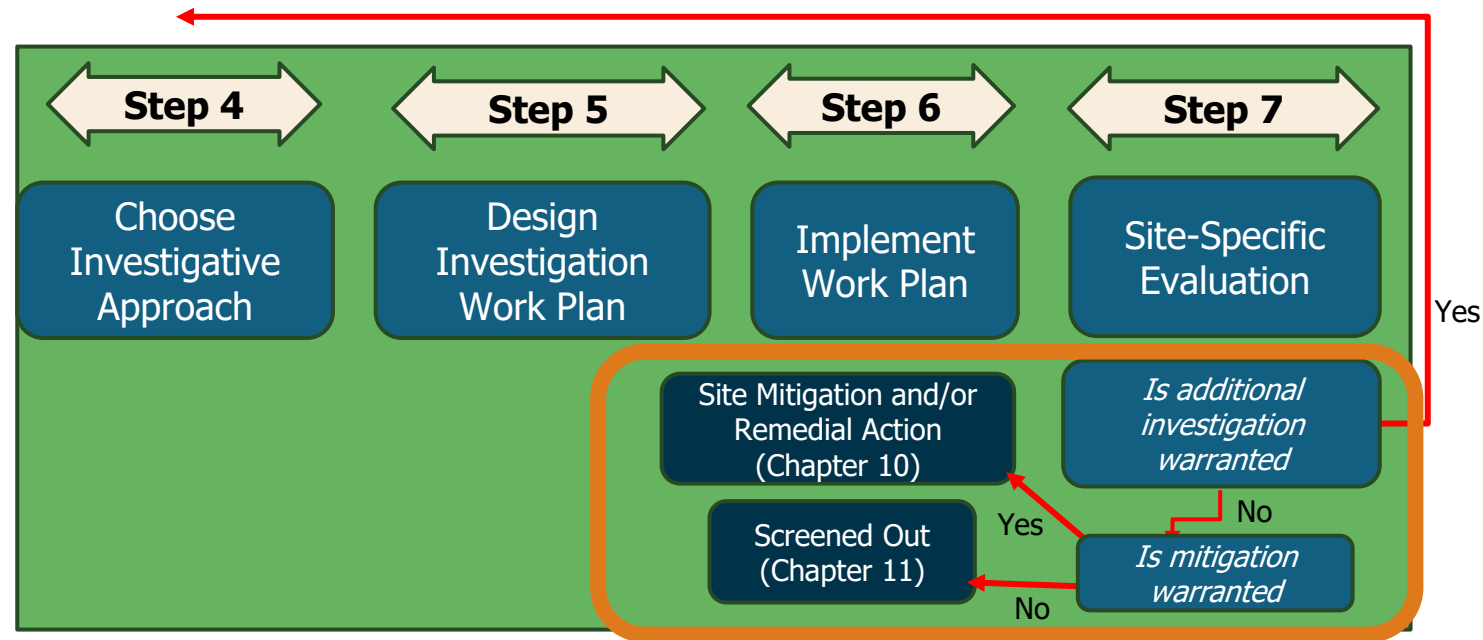
- Now evaluate the data that was collected
- Fit it into the CSM
- At this point, we will once again screen the site.
  - Could screen out
  - Could move to remedy
  - Could lead to further investigation



Source: Canva Free Image.

# Investigative Process

- If a site doesn't screen out or move to a remedy, steps 4-7 will repeat
- Further characterization
  - Collection of LOE
  - Refining CSM
  - Making data-driven risk decisions
- Until
  - Site screens out
  - Moves to remedy

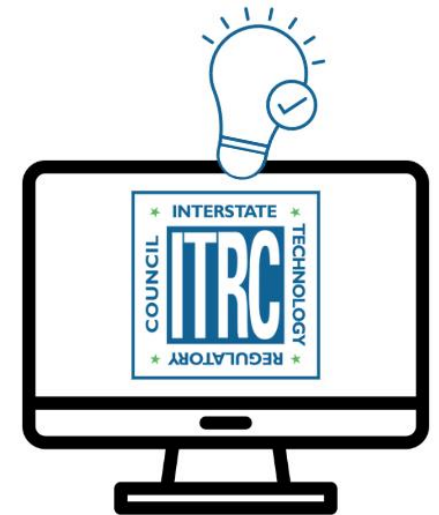


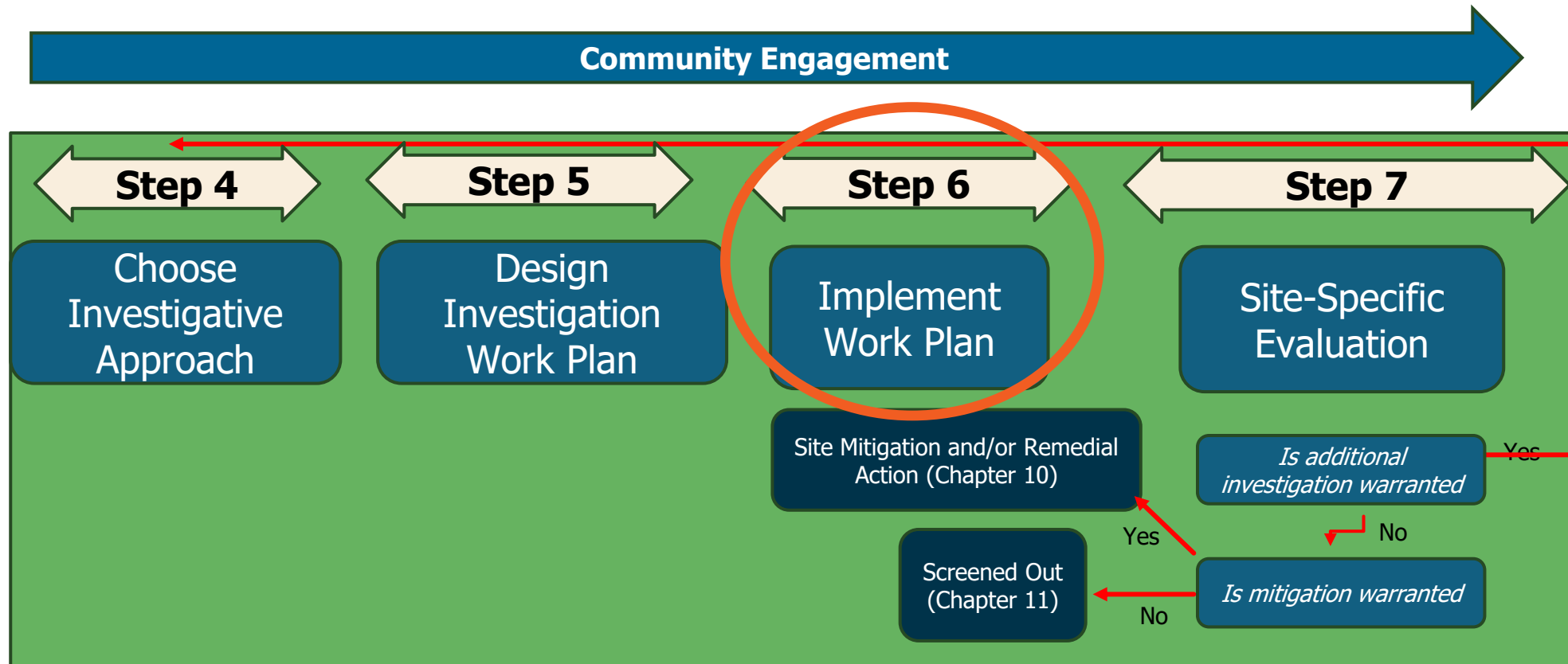
Source: Adapted from ITRC VI Toolkit, Technical Guidance, Figure 6-1.

See: [VI Tech Reg Chapters 10 and 11](#)

### What does “multiple lines of evidence” (MLE) mean in a VI evaluation?

- A. Using one strong dataset only
- B. Collecting many samples of the same type
- C. Combining different types of data to understand the site
- D. Only using indoor air results





Source: Adapted from ITRC VI Toolkit, Technical Guidance, Figure 6-1.

# VI Field Investigation



Source: Beacon Environmental, Inc. Used with permission.



Source: H&P Mobile Geochemistry. Used with permission.



Source: California Department of Toxic Substances Control. Used with permission.

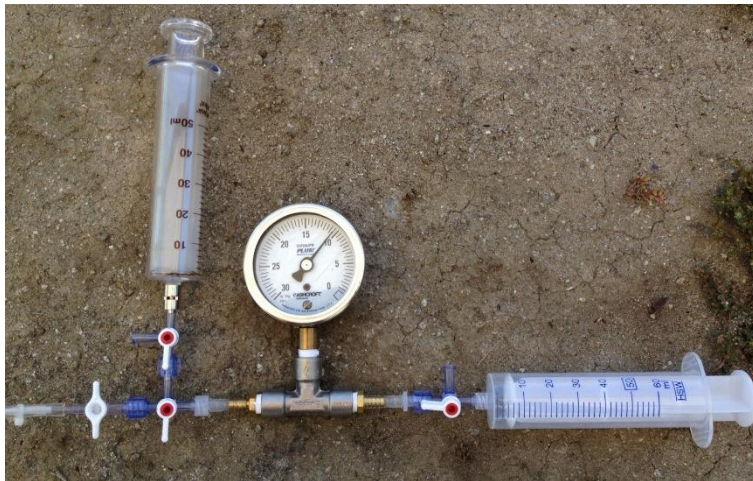


# Active Soil Vapor/Sub-Slab Vapor Sampling

- Most common sampling method
- Accepted by regulatory agencies for human health risk assessment
- Requires active mechanism to move vapor (vacuum, pump, or syringe)
- Requires drilling and installation of probe
- Requires purging and leak checking
- Typically collected in evacuated canisters or sorbent tubes
- Short sampling time (mins)



Source: California Department of Toxic Substances Control. Used with permission.



Source: H&P Mobile Enterprises. Used with Permission.



Source: Vapor Pin Enterprises, Inc. Used with Permission.



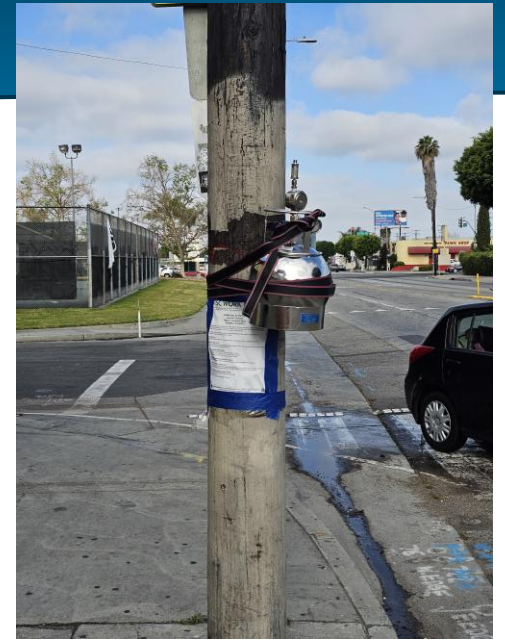
Source: California Department of Toxic Substances Control. Used with permission.

# Active Air Sampling

- Most common sampling method for indoor/outdoor air
- Accepted by regulatory agencies for human health risk assessment
- Requires active mechanism to move vapor (vacuum or pump)
- Simple sample placement (no purging or leak check)
- Typically collected in evacuated canisters or sorbent tubes
- Typical sampling time 8 or 24 hours



Source: Beacon Environmental. Used with permission.



Source: California Department of Toxic Substances Control. Used with permission.



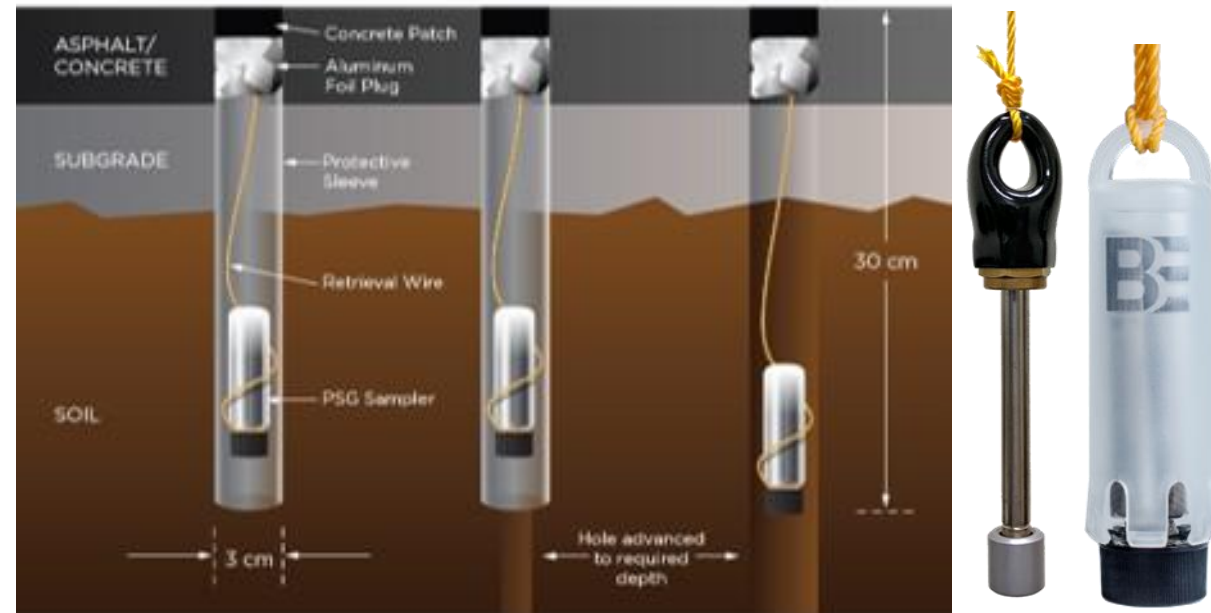
Source: California Department of Toxic Substances Control. Used with permission.

# Passive Vapor and Air Sampling

- Samples collected using sorbents
- Diffusion of VFCs without active mechanism
- Data meant to represent natural conditions
- Easy deployment and can be relatively less expensive
- Samples collect days to months
- Utility conduit sampling or low permeability soils
- Acceptance of data varies by state
- No fixed gas data



Source: ITRC, 2024. Used with permission.



Source: Beacon Environmental, Inc. Used with permission.

# Active and Passive Air and Vapor Sampling Procedures

Active and passive sampling procedures are well-established in several state and federal guidance documents.

## Some of these documents include:

- [VI Tech Reg Chapter 7](#)
- [VI Toolkit VI Soil Vapor Probe Installation Toolbox Fact Sheet](#)
- [EPA Vapor Intrusion Technical Guide](#)
- [ITRC Passive Guidance](#)
- [DTSC Soil Advisory](#)
- [New Jersey Guidance Document](#)
- [YouTube Playlist](#)



Source: California Department of Toxic Substances Control.  
Used with permission.

# Supplemental VI Investigation Tools

Supplemental VI investigation tools are often used in difficult situations to help:

- Distinguish between VI and background sources (CSIA, GC/ECD, TICs, VFC ratios, direct and building pressure patterns)
- Locate vapor entry points (e.g. Hapsite GC/MS, tracers, GC/ECD)

Supplemental VI investigation tools are less commonly used:

- Can be expensive; answers often derived more quickly
- May require specialized technical professionals to design sampling plan, field implementation, and data interpretation

Flux Chamber



Source: Eosense.io.  
Used with permission.

Hapsite GC/MS



Source: Inficon. Used with permission.

## Fact sheets developed by ITRC on supplemental tools:

[VI Toolkit VI Flux Chambers Fact Sheet](#)

[VI Toolkit High Volume Soil Sampling Fact Sheet](#)

[VI Toolkit Real Time Monitoring Fact Sheet](#)

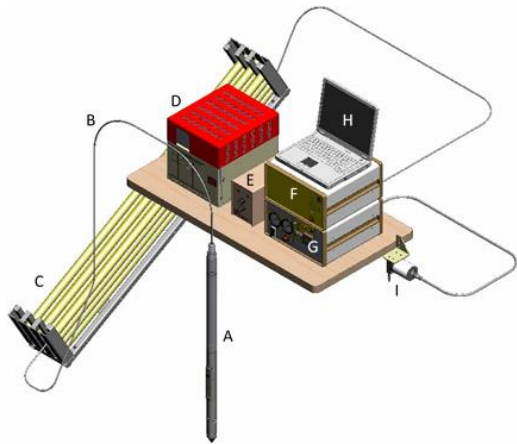
[VI Toolkit Pressure Monitoring Fact Sheet](#)

[VI Toolkit Tracers for Determination of Attenuation Factors and Ventilation Rates Fact Sheet](#)

# Supplemental VI Investigation Tools

Compound-Specific Isotope Analysis	Differentiate chemical sources
Tracers	Building-specific AFs and VI indicator
Building Pressure Manipulation	Differentiate IA sources
Real-Time Monitoring/Web Reporting	VFC entry points, indoor vs. VI sources, AFs
Flux Chambers	Capture chemical flux into buildings
High-Volume Sampling	Support CSM and design parameters
In-Situ Soil Profiling Tools	Vertical delineation and lithology

**Membrane Interface Hydraulic Profiling Tool (MIHPT)**



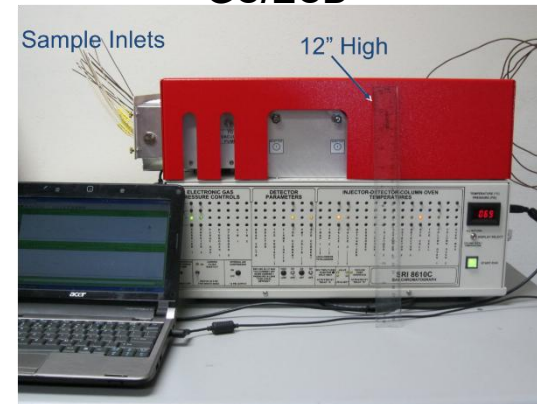
Source: ITRC, 2019. Used with permission.

**High-Volume Sampling**



Source: Geosyntec Consultants, 2023. Used with permission.

**Spatial-Temporal GC/ECD**



Source: VaporSafe, 2025. Used with permission.

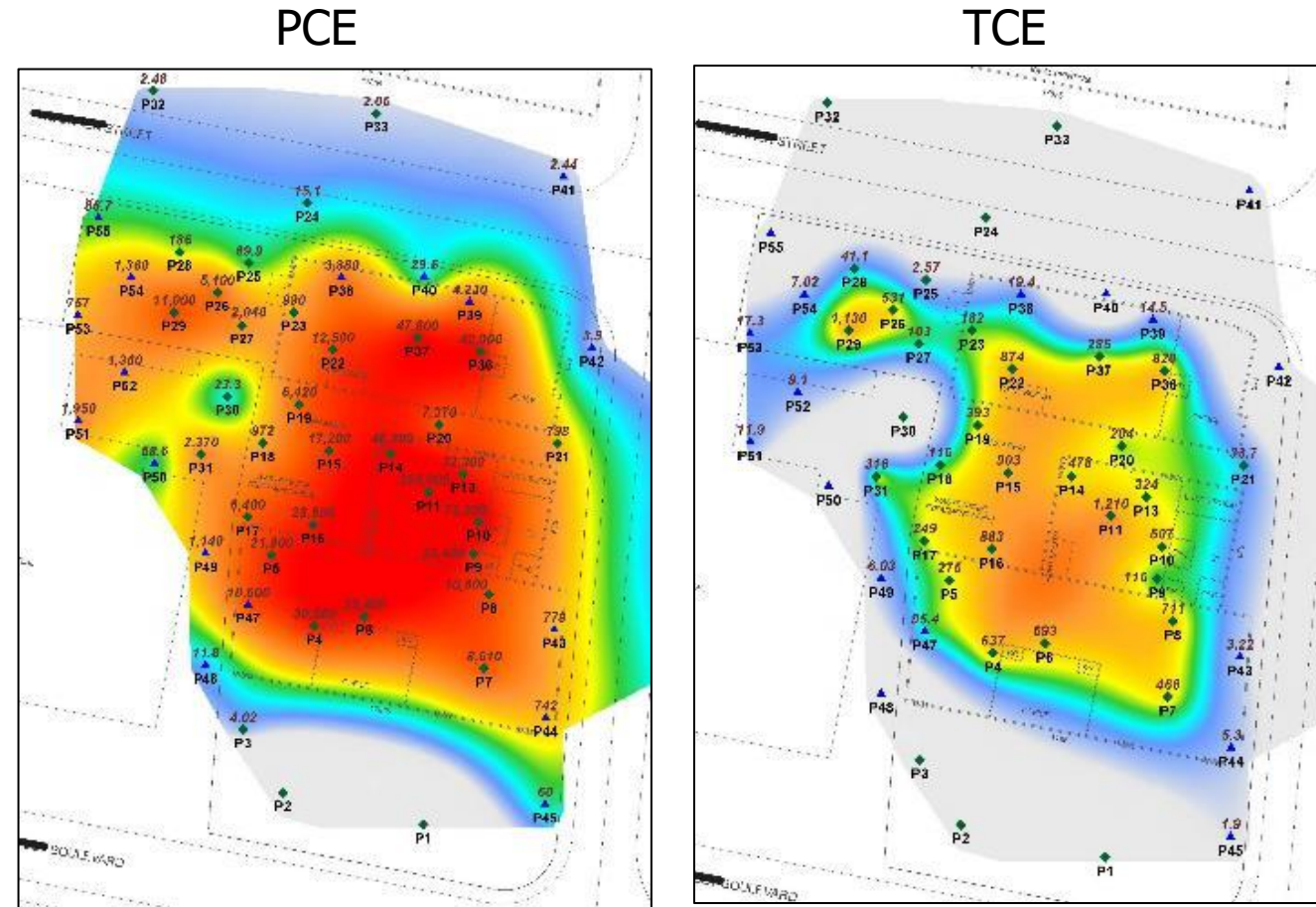
**Wireless Differential P**



Source: VaporSafe, 2025. Used with permission.

# Investigation Example

- Former industrial facility in Southern California
- Discovery data indicates PCE & TCE in soil vapor
- Passive soil vapor delineated lateral
- MIHPT delineated vertical
- Permanent soil vapor probes sampled using active methods
- Indoor air sampled using active methods
- Real-time monitoring identified preferential pathways

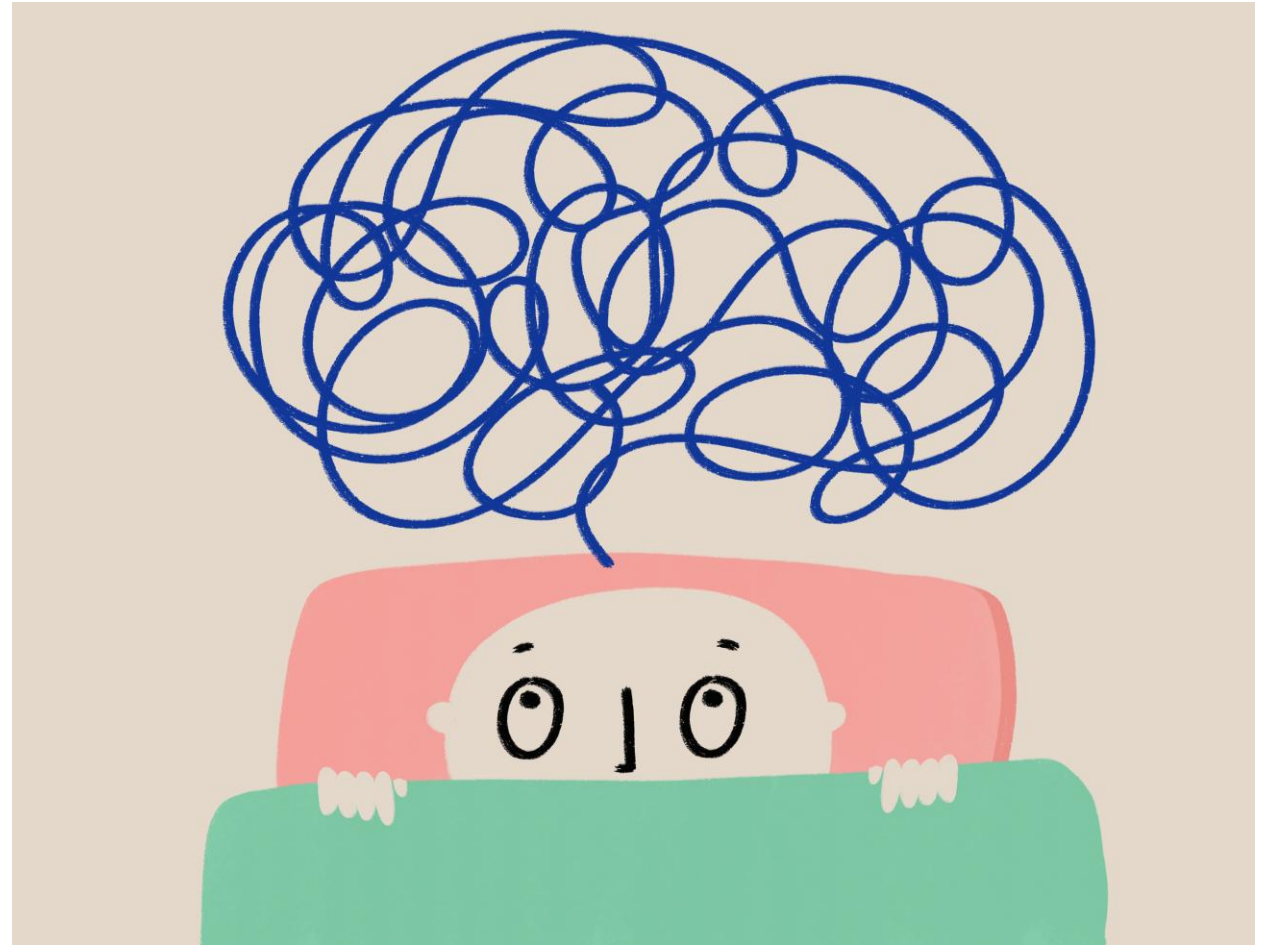


Source: California Department of Toxic Substances Control. Used with permission.

# Questions?



# Assessing Vapor Intrusion: Intrusion: Data Evaluation



Source: Pixabay  
(adapted)

# Portable Field Screening and Analysis

## Typical portable field tools/methods

- Non-chemical specific: hand-held PID/FID
- Chemical specific: some Frog (GC-PID), Hapsite GC-MS, and others

Advantages*	Limitations*
May be rapid and relatively easy to deploy	May only provide screening-level or diagnostic information
Compound-specific or a lump sum number	QA/QC requirements are method-specific and less standardized
Commonly used for quick field decision-making, MLEs or CSM refinement	May not be suitable for quantitative risk assessment or regulatory decision-making

\* Advantages and limitations are method specific



Source: Environmental Science and Technology. Used with permission.

# Laboratory Analysis

- Offsite fixed lab or onsite mobile lab
- Commonly used analytical methods: TO-15, TO-17, Modified 8260, TO-14 (with various detectors), ASTM-M1946

Advantages*	Limitations*
Quantitative and chemical-specific and defensible	May require proper sample collection, handling and shipment to certified lab
Approved methods with rigorous QA/QC lab procedure requirements	Turnaround time typically longer
Data suitable for risk assessment and regulatory decision-making	Clear communication with lab is often needed

\* Advantages and limitations are method specific

Source: H&P Mobile Geochemistry. Used with permission.



### **KEY POINT:**

Method selection is based on data objective, QA/QC requirements, target analyte list, regulatory screening values, locations

# Reviewing Sample Data

## Common questions to ask when reviewing:

1. Are the lab data analyzed consistent with chain of custody and sampling plan?
2. Any data indicating surface air leakage and how is that impacting data usability and/or data interpretation?
3. Any issues with QA/QC sample results: detections of chemical of concern in blanks, difference between duplicates is too large, etc.?
4. Is lab data flagging understood and reasonable?
5. Are units and unit conversions correct?
6. Are reporting limits too high, i.e., higher than risk-based screening values?



Source: Microsoft Copilot response to "Use the same cartoon person but make them look like they are thinking." March 7, 2026.

# Data Interpretation

Compare to the existing site CSM and ask:

1. Does this data fill the data gap in existing CSM and complete the VI CSM?
2. Is the data expected/unexpected based on existing CSM? If unexpected, why?

Compare to risk-based screening levels (generic or site-specific) and ask:

1. Does the data clearly indicate there is/is no potential VI risk?
2. Is the data ambiguous?
3. Need to have more data?

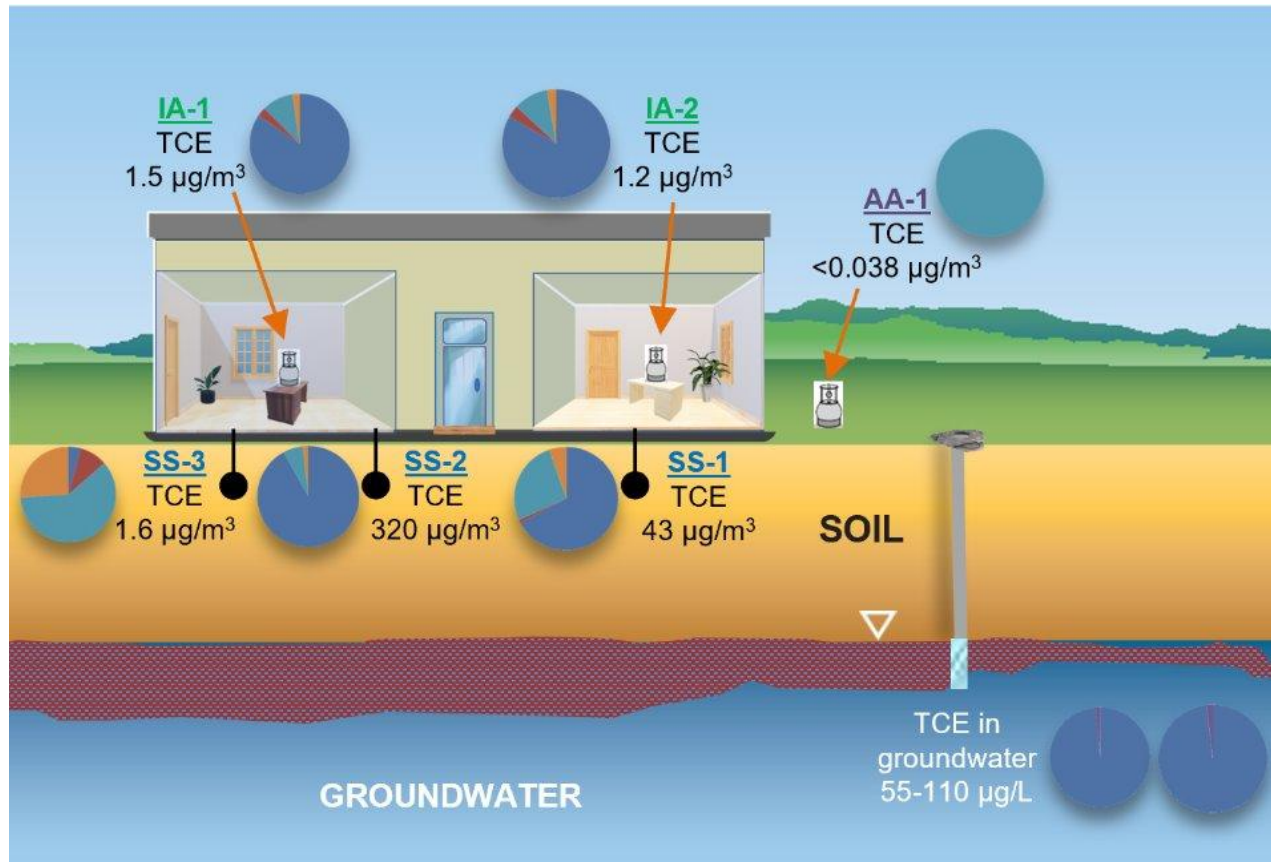
**This initial data interpretation effort can tell:**

1. Missing important pieces of data to draw conclusion, and/or
2. MLEs needed when data can't point to a clear conclusion using risk-based screening levels

# Data Interpretation-MLE Approach

## Piece all LOEs together to refine the CSM and make confident data-driven decisions on VI risks

- Is VI occurring at this site? If yes, is vapor intrusion mitigation needed?
- Will VI occur in the future?



- ✓ Components of the CSM (site history/use, geology, etc.)
- ✓ Building evaluation data (design, construction, chemical inventory)
- ✓ Media-specific concentrations compared to screening levels
- ✓ Data interpretation and forensics
  - ✓ Data trends
  - ✓ Spatial and temporal variability
  - ✓ Constituent ratios
  - ✓ Site specific attenuation factors
- ✓ Building pressure control tests
- ✓ Differential Pressure

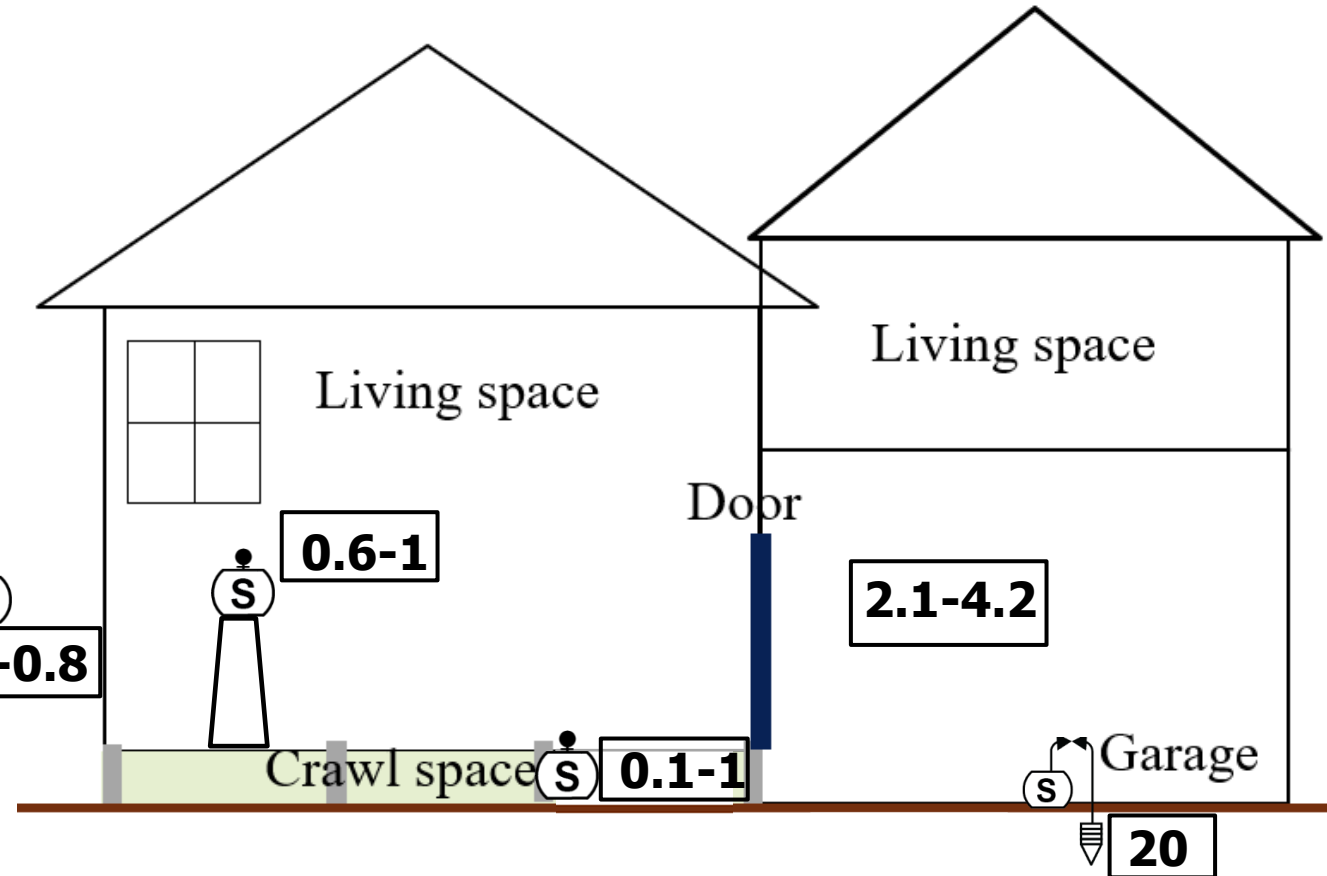
Source: Used with permission from Laura Trozzolo, Catherine Regan and Lila Beckley. Adapted from ESTCP Project ER-201119, (Beckley et al. 2013, Figure B.1.1).

See: [Fact Sheet - Multiple Lines of Evidence](#)

# Data Interpretation Example – MLE Approach

## Multiple VI investigations since 2013:




- No PVI preferential pathway identified
- Different season sampling showed consistent results
- Identifiable and removable IA sources removed



Is benzene in the living space and garage a result of VI or background?

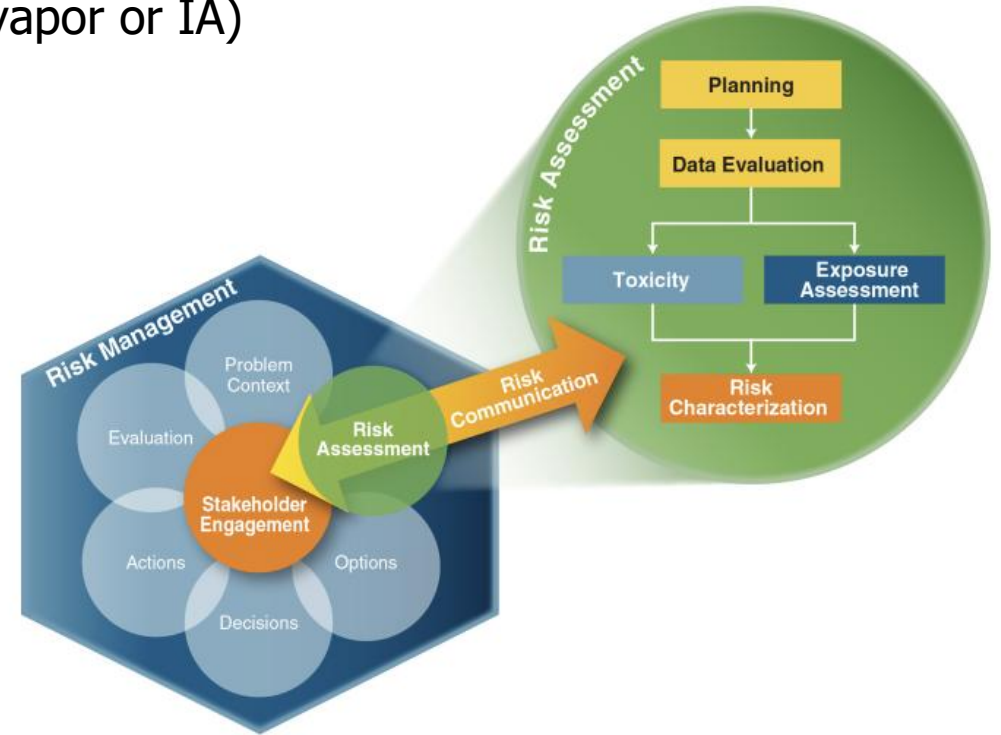
Benzene conc in  $\mu\text{g}/\text{m}^3$

# Is IA Benzene from Background Source?

List of LOE	LOE examined
Components of the CSM (site history/use, geology, etc.)	Supporting
Building evaluation data (design, construction, chemical inventory)	
Media-specific concentrations compared to screening levels	Neutral
Data interpretation and forensics	
✓ Data trends	Neutral
✓ Spatial and temporal variability	
✓ Constituent ratios	No data
✓ Site specific attenuation factors	
Building pressure control tests	No data
Differential Pressure	No data

# VI Risk Assessment –Use Screening Values

1. Risk-based concentrations calculated based on conservative assumptions in environmental media (e.g., groundwater, soil vapor or IA)
2. Different screening levels for  
Different chemicals (COCs)  
Different media (groundwater, soil vapor, IA)  
Different receptors (commercial workers, residents)
3. Comparing data collected  
Below screening level usually mean no further action needed  
Exceeding a screening level does **NOT** mean that there is a human health risk from VI, it means more information is needed



ITRC Risk-3 Guidance. Source: Adapted from Commission, Presidential/Congressional. 1997a.

# VI Risk Assessment – Calculate Risk

Calculate the risk based on exposure point concentration, i.e., indoor air concentrations.

Indoor air concentrations can be:

1. Directly measured
2. Derived from soil vapor, and/or groundwater using appropriate AFs
3. Derived from modeling (BioVapor or J&E)

Calculated risk for cancer and noncancer health effects are compared to agency-established screening risk thresholds

Example: USEPA Risk thresholds:

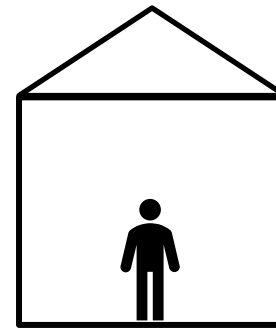
Cancer Risk:

- $> 1 \times 10^{-4}$  = Unacceptable Risk
- $< 1 \times 10^{-6}$  = Acceptable Risk
- In between = Evaluate Site Specific Considerations

Noncancer Risk (Hazard Quotient):

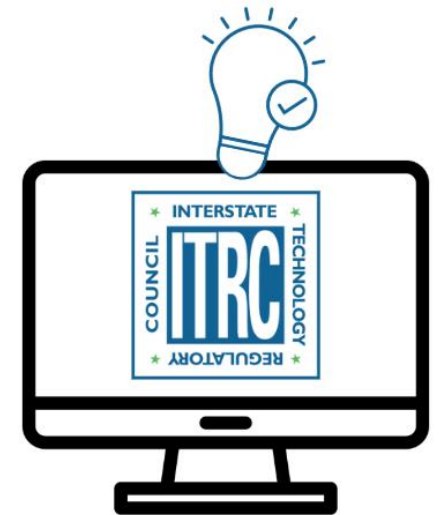
- $> 1$  = Unacceptable Risk

**Exposure x Toxicity = Risk**



### What does it usually mean if a VI screening level is exceeded?

- A. Immediate evacuation is required
- B. A health risk is confirmed
- C. More evaluation or information is needed
- D. The site can be closed



# Reinforce Iterative Process: Case Example

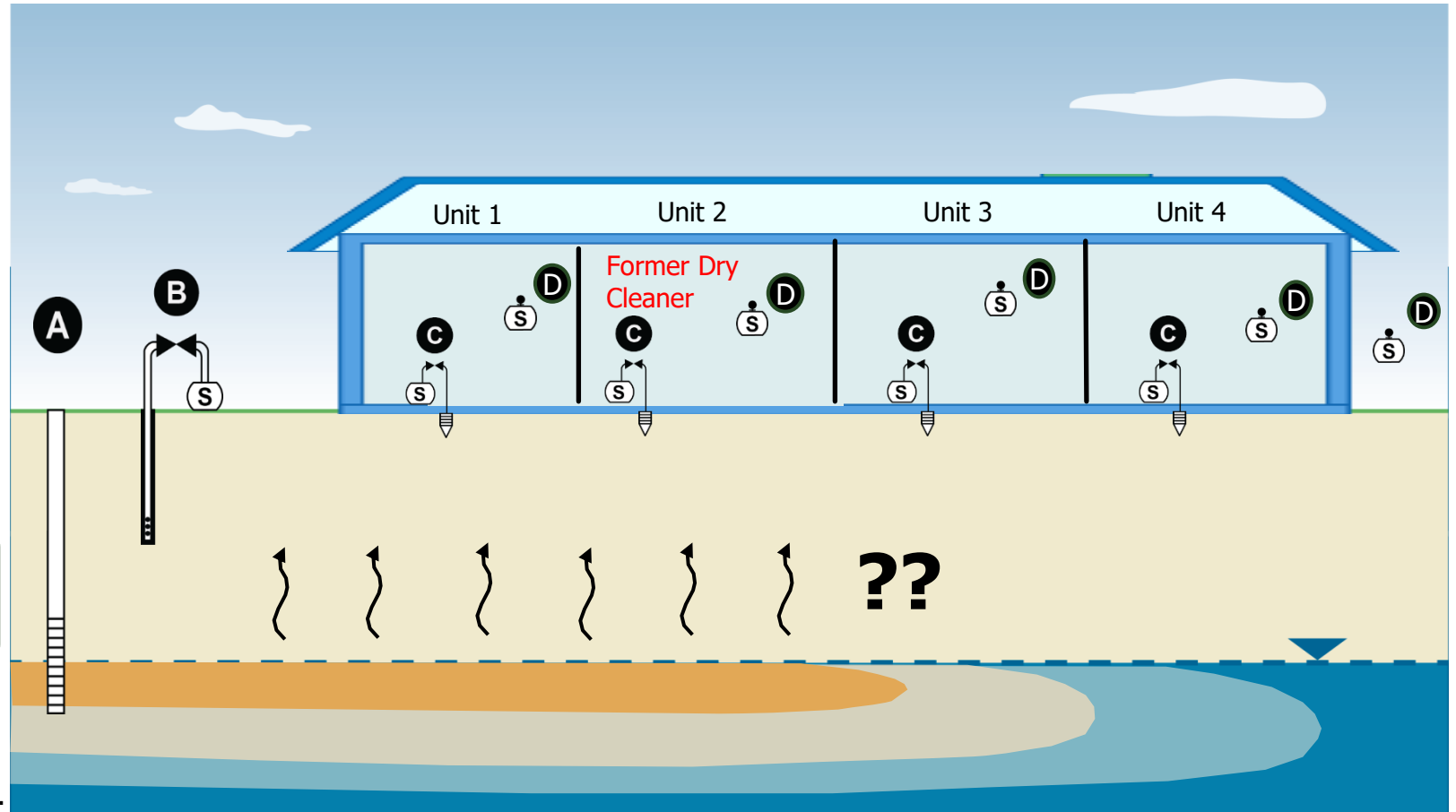
Question: Is VI pathway complete/potentially complete?

## Options for Testing the Pathway

- A** Groundwater Monitoring Well
- B** Soil Vapor Probe
- C** Sub-Slab Vapor Probe
- D** Indoor/Outdoor Sample
- S** Air or Vapor Sample Container

Not To Scale

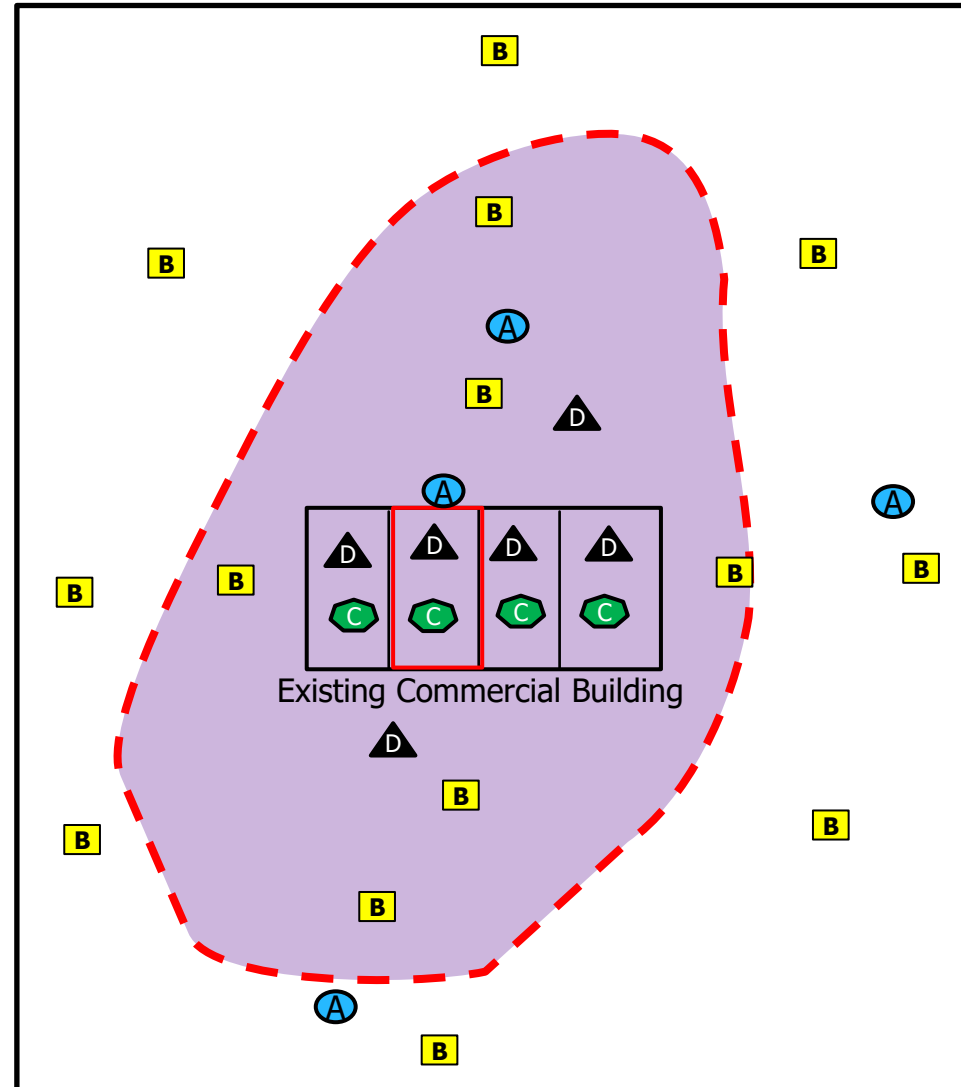
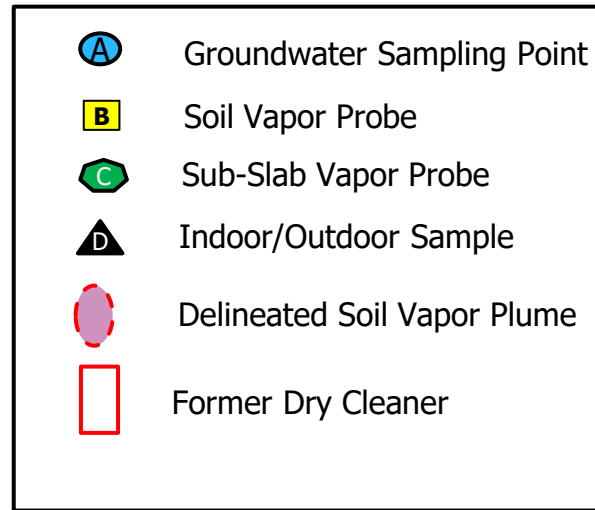
**KEY POINT:** Not all potential sample locations need to be tested.



Source: L. Beckley, GSI Environmental. Used with permission.

# Reinforce Iterative Process: Case Example

## Multi-Unit Commercial Building



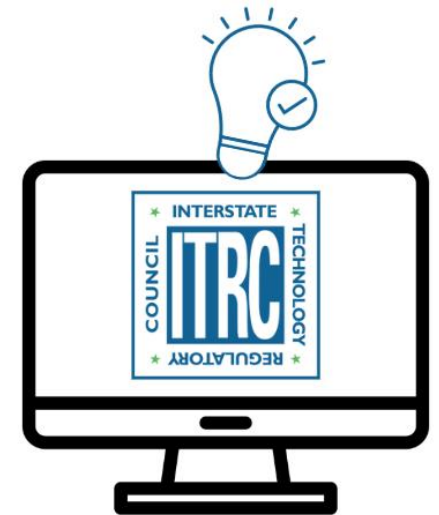
Not To Scale

Source: A. Leavitt, CalEPA/DTSC. Used with permission.

Check  
In!

## Which statement best describes the vapor intrusion assessment process?

- A. It follows a straight line and never changes
- B. It is often iterative and refined as new data are collected
- C. One round of sampling is usually enough
- D. Decisions are made before data are reviewed



# Assessment and Evaluation Summary

- Complex transport
- High variability
- Preferential pathways
- Conservative screening
- Ongoing activities & background sources



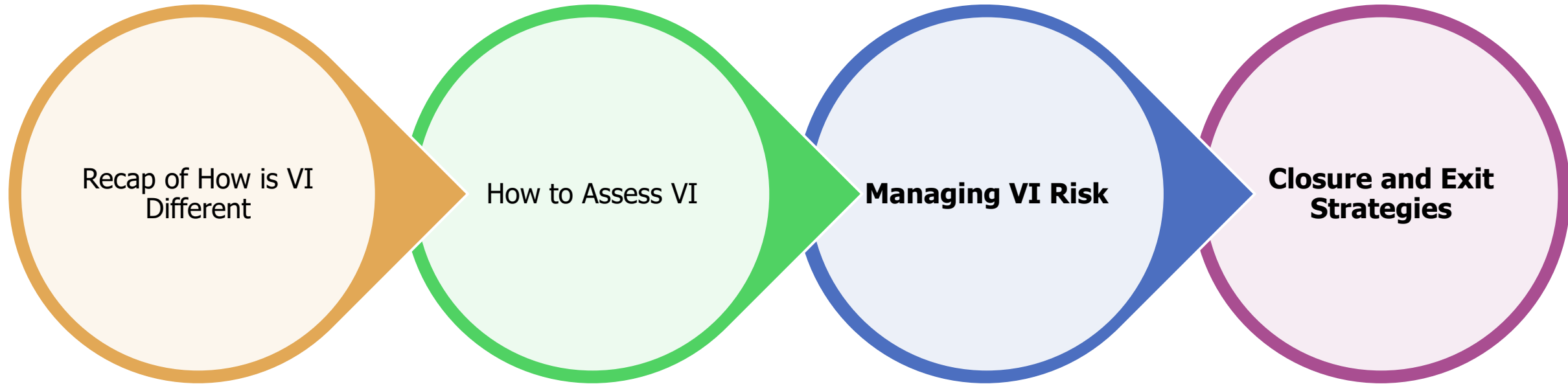
Investigation tools  
Data evaluation

- Access
- Public's understanding

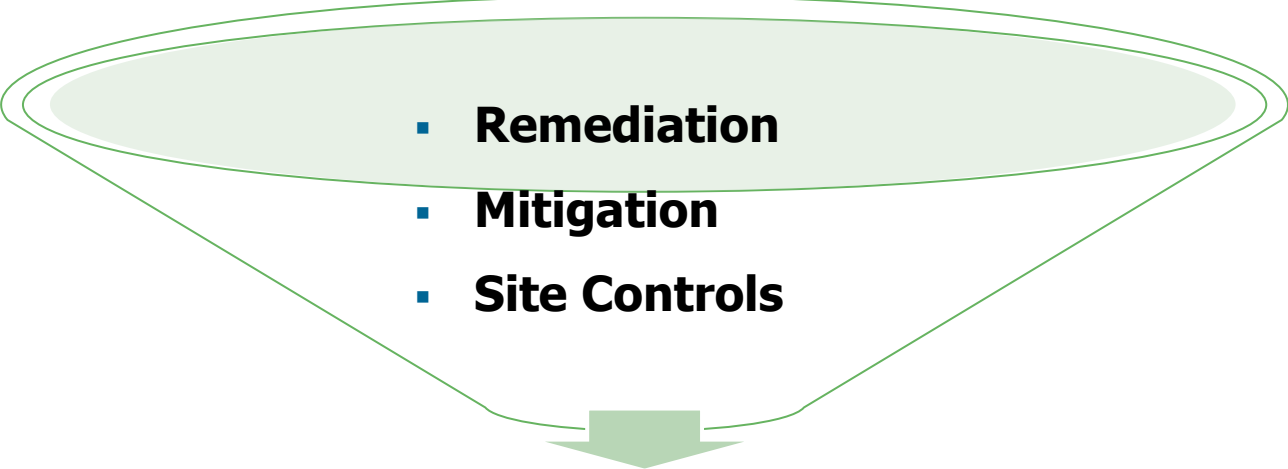


Community Engagement

# Training Roadmap



# Managing VI Risk

- 
- **Remediation**
  - **Mitigation**
  - **Site Controls**

**VI Protective Closure**

## **KEY POINTS:**

- Risk assessment determines site requirements.
- Liability tolerance, technical aspects and future site goals determine how requirements are met.
- State regulations differ on what is acceptable.

## VI Project Stages

*Preliminary CSM*

Preliminary VI  
Exposure  
Assessment

*Baseline CSM*

*Characterization CSM*

*Design, Remediation and/or Mitigation and Post-Remedy CSM*

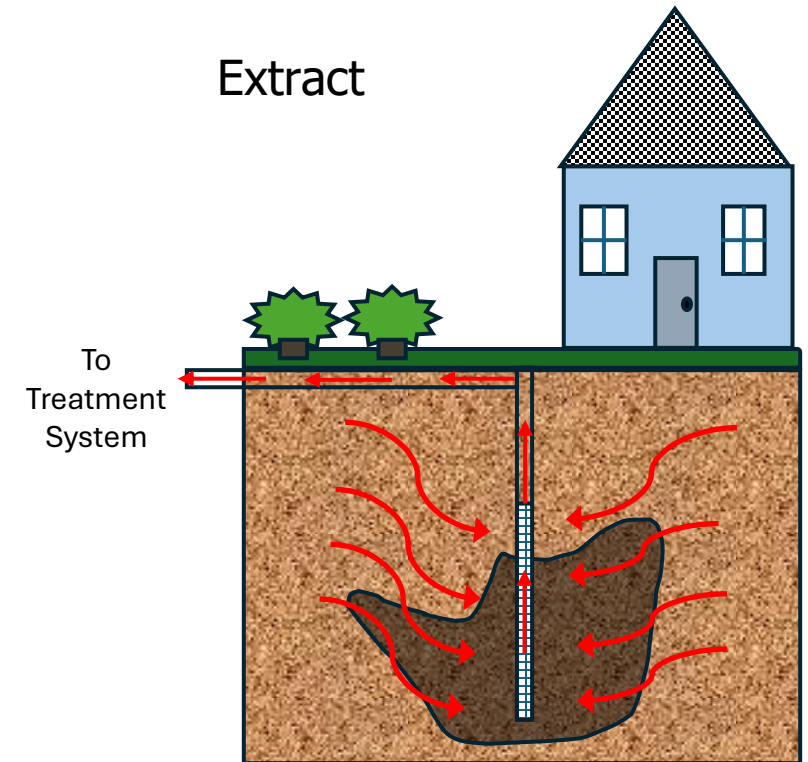
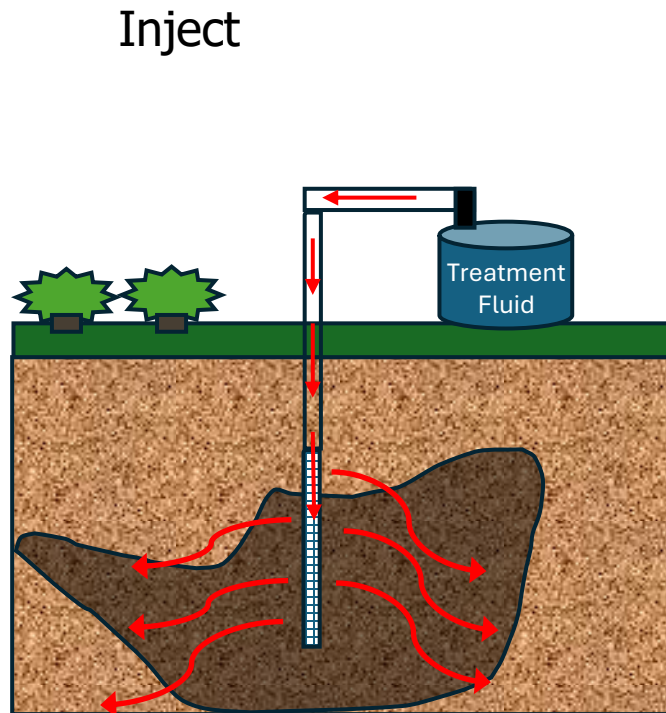
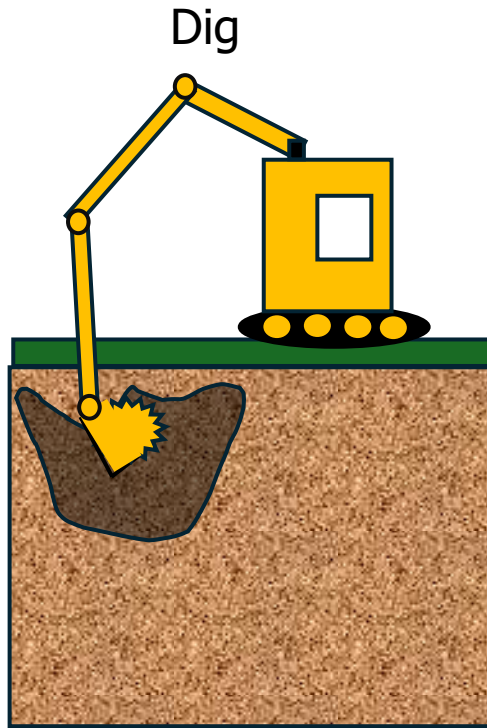
VI Assessment and Evaluation

VI Management

VI Component  
Completion at Site

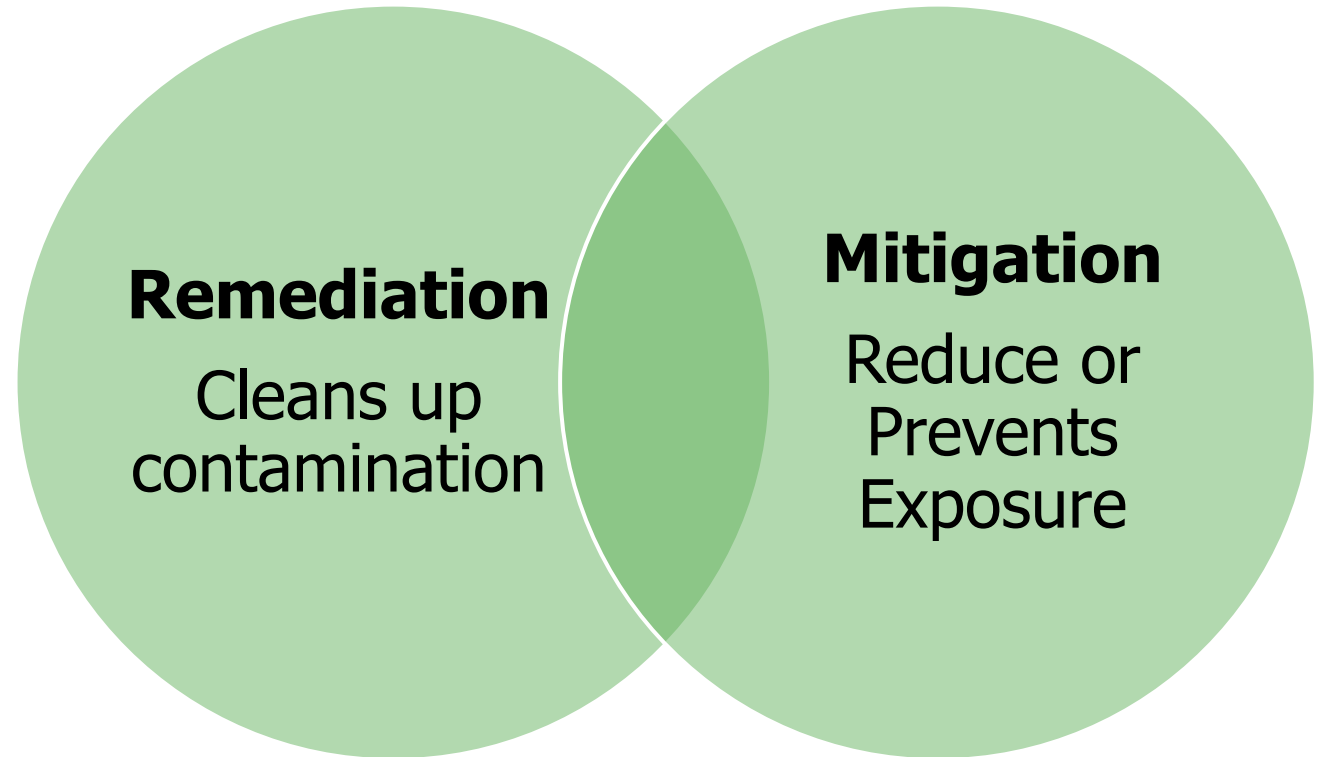
# Remediation

Remediation reduces contaminant mass.

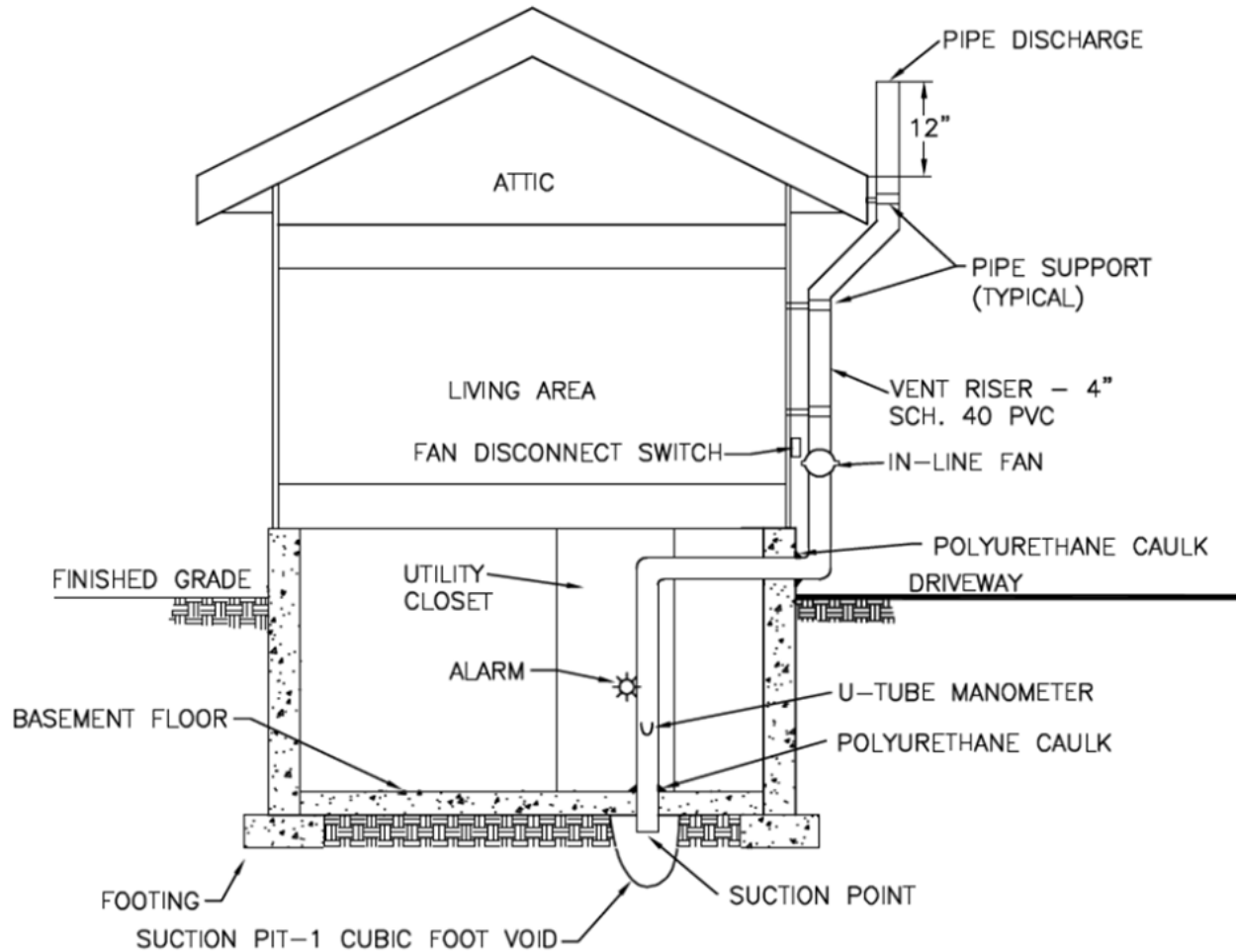


# Remediation vs Mitigation

- Requirement for remediation varies from state to state.
- Remediation generally has long timeframes.
- Mitigation can be completed relatively quickly.
- Many sites have mitigation as short term solution during long term remediation projects.



# Mitigation Systems



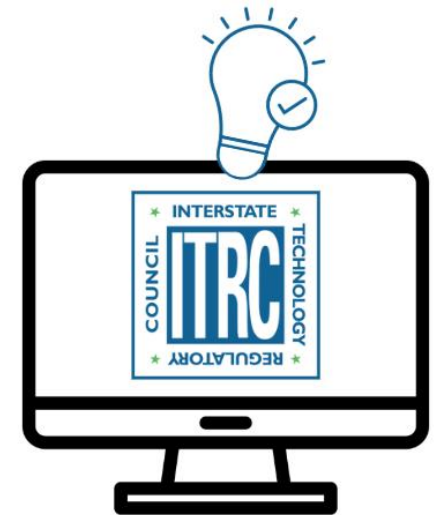
Source: Arcadis, 2025. Used with permission.

- Mitigation systems keep contamination from reaching indoor air at levels of concern.
- Criteria for requiring mitigation varies from state to state.
- Allowed type of mitigation varies from state to state.
- [Vapor Intrusion Remediation and Institutional Controls Fact Sheet](#) and other fact sheets.
- ITRC's [Vapor Intrusion Mitigation Training](#).

Check  
In!

## What is the main goal of vapor intrusion mitigation?

- A. Remove all contamination from soil and groundwater
- B. Prevent vapors from getting into buildings at levels of concern
- C. Replace remediation activities
- D. Eliminate regulatory oversight



# Land Use Controls

**Purpose:** Outline what must be done or not done at a property to protect from vapor intrusion

## Institutional Controls

Administrative or legal restrictions and requirements used to manage contamination by limiting land or resource use.

## Engineering Controls

Engineering Controls outline what must be done to make sure mitigation systems are functioning as intended.

Often require OM&M and Long-term stewardship responsibilities

- States have different requirements
- Controls frequently require action from someone other than the responsible party such as property owners or zoning boards

# Community Engagement



Source: Vecteezy.com (public meeting)

## Examples of critical pieces

- Identify stakeholders
- Establish trust
- Maintain relationships
- Understand & address concerns
- Document long-term agreements
- Document future expectations
- Document required controls



Source: Pixaby.com (handshake)

# What is Closure (Related to Vapor Intrusion)?

- Written recognition responsible party met state's requirements for responses to releases of contamination.
- Closure document names will vary by state: No Further Action (most common); Covenant not to Sue; Certificate of Completion; Comfort Letter
- May require continuing obligations from the responsible party or other stakeholders.
- Closure is the goal because it means a plan is in place to address potential harm to human health and the environment.



Source: Copilot, "Please draw a clipboard with a checklist on it. The three checklist items are Soil, Groundwater, and Vapor. Only vapor is checked." Generated on March 31<sup>st</sup>, 2026.

# General Overview of the Vapor Intrusion Strategy

## Community Engagement

### VI Project Stages

*Preliminary CSM*

Preliminary VI  
Exposure  
Assessment

*Baseline CSM*

*Characterization  
CSM*

*Design, Remediation and/or Mitigation  
and Post-Remedy CSM*

VI Assessment and Evaluation

VI Management

VI Component  
Completion at Site

### Project Exits

No VI  
Pathway:

No VI  
Component at  
Site

Building Screened Out

Managed VI Closure

Unrestricted VI  
Closure

Source: Adapted from ITRC VI Toolkit, Technical Guidance, Figure 1-1.

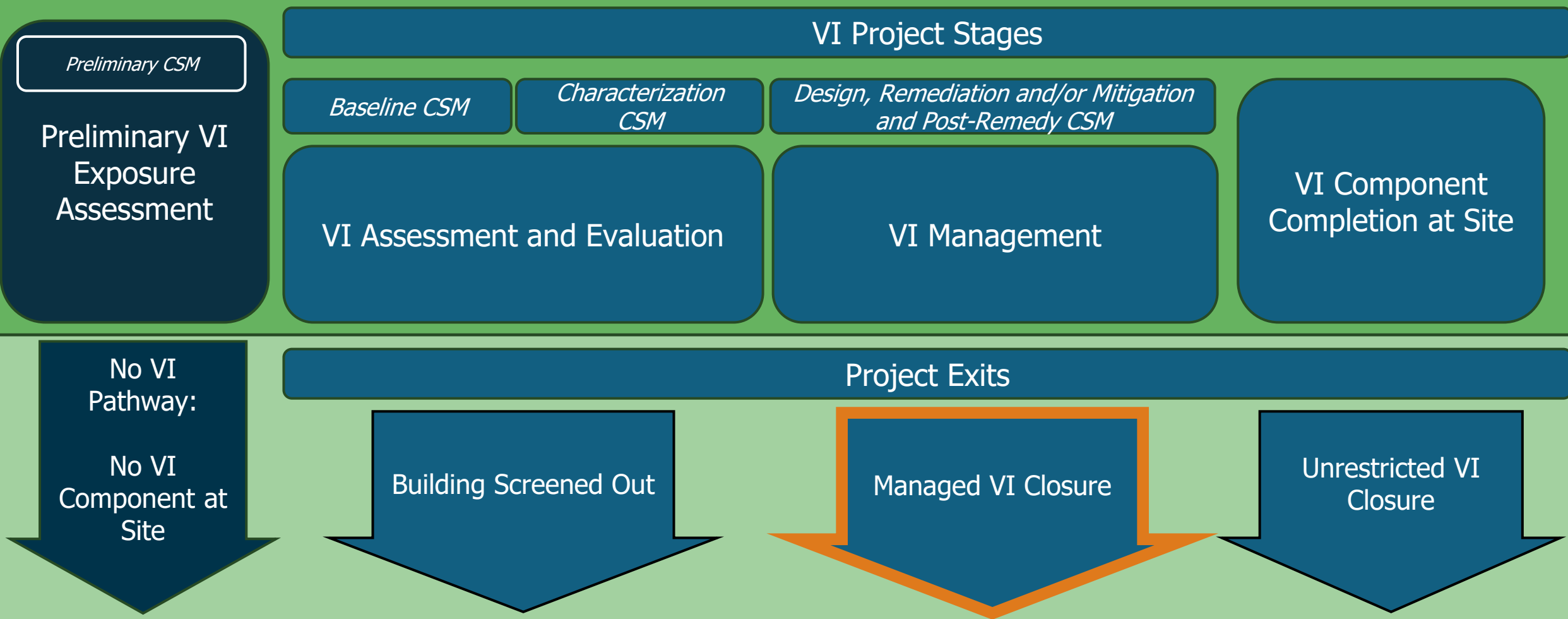
# Unrestricted Closure for Vapor Intrusion

- Unrestricted Closure means no continuing obligations
- May be quickly determined based on an initial screen out or may be based on substantial amount of data
- May be building or structure specific or may apply to whole site areas
- Unrestricted VI closure doesn't preclude restrictions for other pathways
  - For example, site may have a groundwater restriction.



# General Overview of the Vapor Intrusion Strategy

## Community Engagement



Source: Adapted from ITRC VI Toolkit, Technical Guidance, Figure 1-1.

# Managed VI Closure

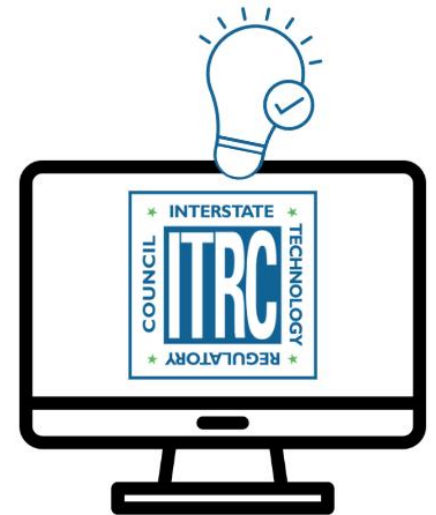
- Mitigation, remediation, land use controls or engineering controls have reduced risk to acceptable levels.
- Closure plans require documenting **present** and **future** responsibilities, so risk remains acceptable in the future.
- Legal and financial requirements must be documented both in the closure plan and with other entities.
- For example, proof that a deed restriction is filed with the county courthouse may be needed.



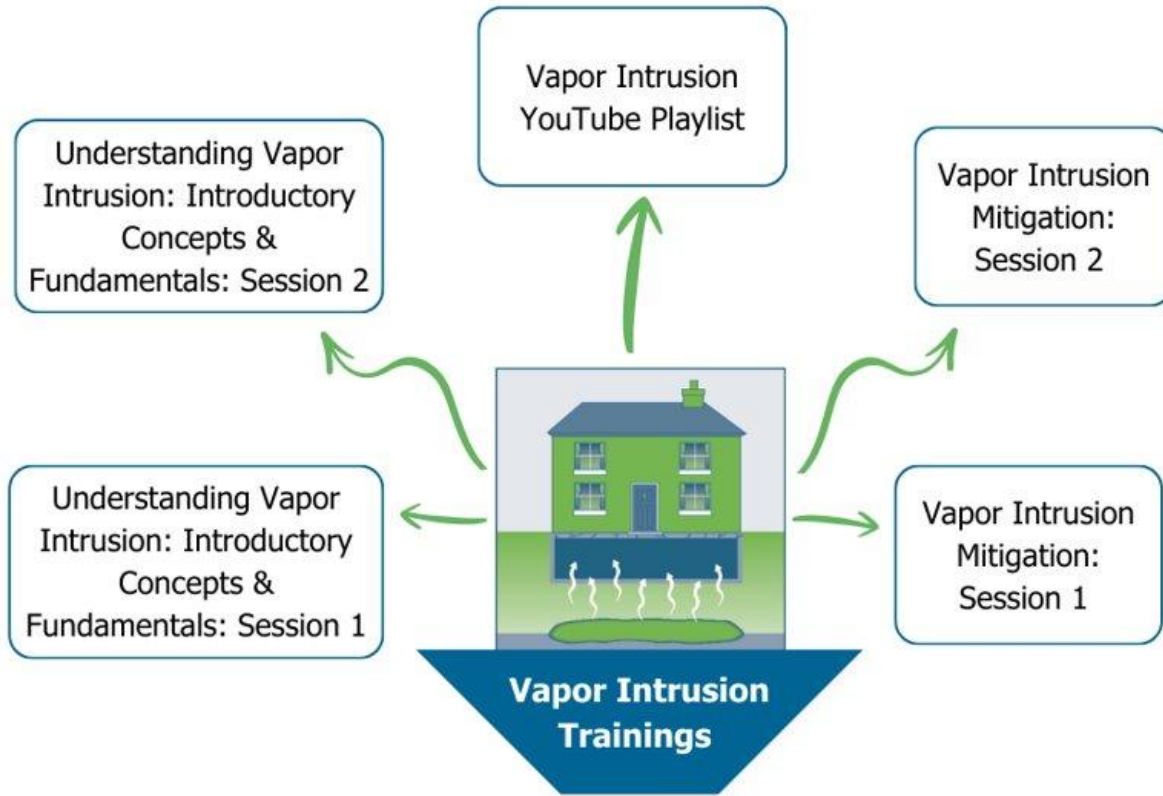
Source: Microsoft Copilot, Prompt: "emphasize a longer path into the sunset with a smaller cartoon person looking towards the sun" Generated on April 9<sup>th</sup>, 2026.

### What does “site closure” related to vapor intrusion usually mean?

- A. The regulatory agency agrees that vapor intrusion risks are addressed with an approved plan
- B. All contamination has been completely removed from the site
- C. The site no longer needs to be monitored by anyone
- D. No vapor intrusion was ever present at the site



# Vapor Intrusion Toolkit Internet Based Training



- [Understanding Vapor Intrusion -Introductory Concepts & Fundamentals - A Two-Part Series Training](#)
- [Vapor Intrusion YouTube Playlist](#)
- [Vapor Intrusion Mitigation \(VIM-1\) - A Two-Part Series Training](#)

# Thank you for attending!

Email further questions on today's session to:  
[itrc@itrcweb.org](mailto:itrc@itrcweb.org)

Feedback Form & Certificate of Completion:  
<https://clu-in.org/conf/itrc/VI-introductory/feedback.cfm>

Vapor Intrusion 101 Training:  
<https://clu-in.org/conf/itrc/VI-introductory/>

