Advancing Environmental Solutions

Vapor Intrusion Mitigation

VIM-1, 2021

Session 1 (of 2)

Sponsored by: Interstate Technology & Regulatory Council (www.itrcweb.org)
Hosted by: US EPA Clean Up Information Network (www.clu-in.org)

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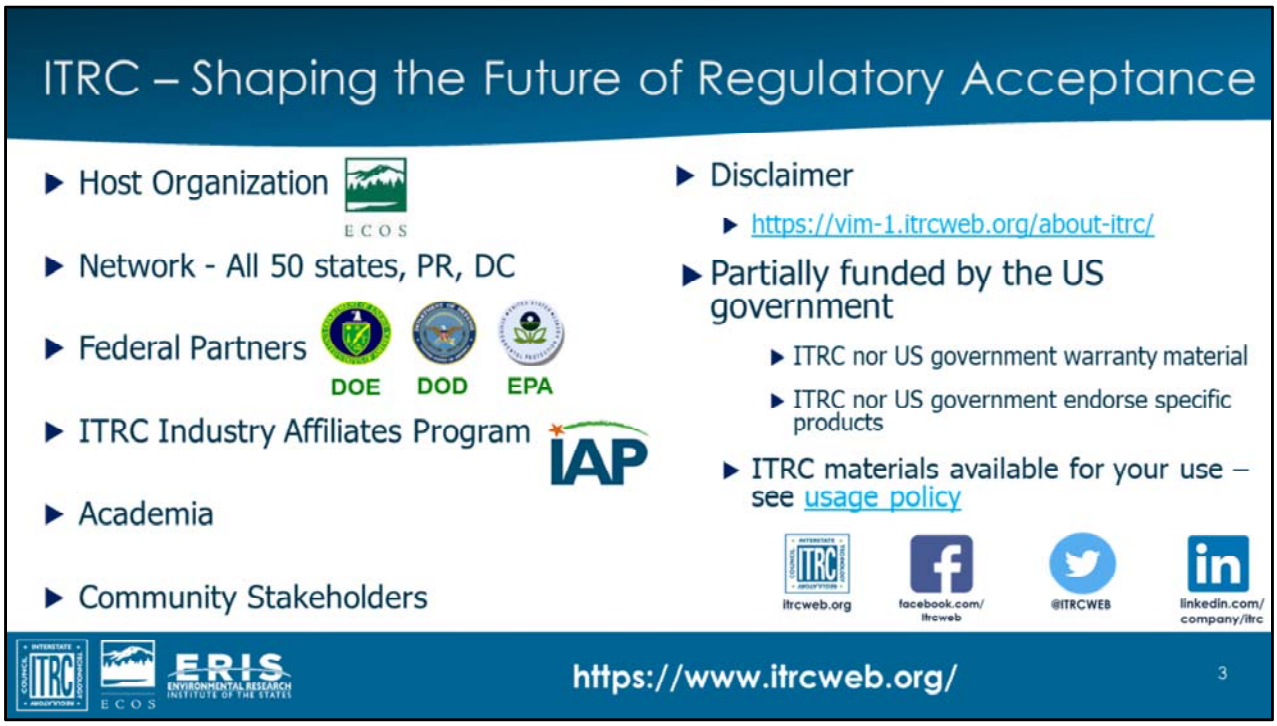
- Recording for On Demand Viewing

- Course Information and Materials: https://clu-in.org/conf/itrc/vim-1/

- Technical difficulties? Use Q&A Pod

- Certificate of Course Completion



The Interstate Technology and Regulatory Council (ITRC) is a state-led coalition of regulators, industry experts, citizen stakeholders, academia and federal partners that work to achieve regulatory acceptance of environmental technologies and innovative approaches. ITRC consists of all 50 states (and Puerto Rico and the District of Columbia) that work to break down barriers and reduce compliance costs, making it easier to use new technologies and helping states maximize resources. ITRC brings together a diverse mix of environmental experts and stakeholders from both the public and private sectors to broaden and deepen technical knowledge and advance the regulatory acceptance of environmental technologies. Together, we're building the environmental community's ability to expedite quality decision making while protecting human health and the environment. With our network of organizations and individuals throughout the environmental community, ITRC is a unique catalyst for dialogue between regulators and the regulated community.

For a state to be a member of ITRC their environmental agency must designate a State Point of Contact. To find out who your State POC is check out the "contacts" section at www.itrcweb.org. Also, click on "membership" to learn how you can become a member of an ITRC Technical Team.

TRAINER BIOS:

Matt Williams is a Vapor Intrusion Specialist for the development and implementation of methods used to investigate and assess vapor intrusion issues for the Remediation and Redevelopment Division of the Michigan Department of Environment, Great Lakes, and Energy (EGLE). He is a Geologist, with more than 18 years of experience in both the public and private sectors, working on a wide variety of projects across the United States. He has drafted several guidance documents and standard operating procedures for EGLE. Additionally, he has given numerous training seminars and talks on soil gas methods and vapor intrusion for stakeholder groups and consultants. He co-led the ITRC 2-day classroom training on Petroleum Vapor Intrusion and is a trainer in both the 2-day classroom and Internet-based training. More recently, he has served as a Team Leader for ITRC Vapor Intrusion Mitigation Training (VIMT) Team. Mr. Williams earned a Bachelor of Science degree in Geology, from Central Michigan University, in 1993.

Lila Beckley is a Senior Geologist at GSI Environmental, Inc., in Austin, Texas, with more than 25 years of experience in the environmental field. Since joining GSI in 2007, she has been involved with numerous environmental assessments, litigation support, and other projects. Vapor intrusion is one of her focus areas. She has conducted VI research, investigation, and mitigation programs at sites around the U.S.; developed investigation protocols, guidance, and training; and authored peer-reviewed journal articles. Prior to joining GSI, Lila worked in remediation programs at the Texas Commission on Environmental Quality, in various roles ranging from project to program management.

Laurent Levy is a senior technologist at Jacobs. His primary role is to develop client site strategies and cleanup solutions within Jacobs' vapor intrusion practice. Laurent has over fifteen years of experience working on a variety of topics, including vapor intrusion investigations and risk assessments, subsurface environmental investigations and cleanup, contaminant fate and transport studies, environmental due diligence, and environmental litigation support. Laurent holds an undergraduate degree from the Ecole Centrale Paris, as well as a Ph.D. in Civil and Environmental Engineering from the Massachusetts Institute of Technology (MIT). He is a registered Professional Engineer in Massachusetts.

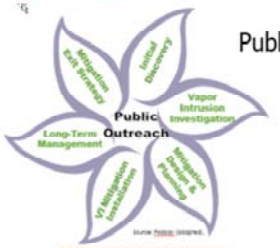
Eric Blodgett is a Senior Environmental Engineer with Barr Engineering Co. in Minneapolis, Minnesota. Mr. Blodgett has 15 years of experience in environmental engineering and consulting. His focus is on vapor intrusion, and his experience includes developing investigative work plans and reports; conducting, overseeing, and providing training on soil vapor sampling methodologies; and designing and overseeing the installation of vapor intrusion mitigation systems. Eric has applied his vapor intrusion expertise across the United States at voluntary, Superfund, petroleum, and landfill sites. Mr. Blodgett received his Bachelor of Chemical Engineering from the University of Minnesota Twin Cities, in 2004, and is a licensed professional engineer in Minnesota and Iowa.

Dr. Sigrida Reinis is an Associate with Langan Engineering and Environmental Services, and lives and works in Oakland, California. She holds Bachelor of Science, Masters of Engineering, and Doctoral degrees, in Civil Engineering, from the University of California at Berkeley. Sigrida is a Professional Engineer in the States of California and North Dakota, and a licensed General Engineering Contractor in California. With over 20 years of design and construction oversight experience, Sigrida is the technical leader of the gas and vapor intrusion mitigation and monitoring practice for Langan in California. In addition, Sigrida leads the probabilistic cost estimating and decision analysis practice for Langan nationwide. She also has prepared and provided peer reviews of the full spectrum of technical documents related to the remediation of redevelopment of brownfield sites and municipal solid waste landfills. Additionally, she has provided litigation support and expert witness services for both construction and environmental engineering projects.

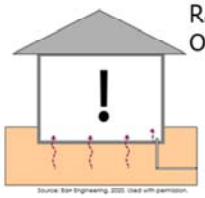
Jennifer Borski transitioned to the Vapor Intrusion Team Leader position with the Wisconsin Department of Natural Resources (WDNR) in June 2019. She leads the state's Drycleaner and Vapor Intrusion Team (DVIT) within the Remediation and Redevelopment (RR) Program. The team works to identify policy issues, develop guidance and provide training regarding the vapor intrusion pathway and state's Dry Cleaner Environmental Response Program. Jennifer also serves as the WDNR's liaison with the Wisconsin Department of Health Services related to vapor intrusion issues. Prior to June 2019, Jennifer served WDNR for 20 years as a Hydrogeologist in the RR Program regulating the investigation, remediation and redevelopment of contaminated properties in east-central Wisconsin. Jennifer graduated from the University of Wisconsin - Eau Claire, in 1996, with a Bachelor of Science degree in Geology and Mathematics.

Today's Training Topics

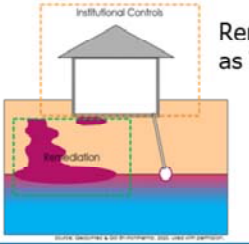
Conceptual Site Models for VI Mitigation



Public Outreach during VI Mitigation



Rapid Response and Ventilation Outreach Materials



Remediation and Institutional Controls as VIM Outreach Materials

What You Should Learn

- Background on the VIM Training team
- Overview of available documentation
- How access the mitigation strategies information
- Identify the sections that will be discussed in today's session

Not Covered in the VIM Training

- Emergency response actions – Immediately contact first responders if
  - Reports of strong petroleum odors
  - Evidence of combustible, explosive, or oxygen-deficient conditions inside the building
- Methane mitigation or hazardous substances that have a high explosive potential
- Radon

Figure from ITRC Petroleum Vapor Intrusion: Fundamentals of Screening, Investigation, and Management (2014).

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Does not cover emergency response actions related and assumes that all emergency situations have been handled

Contact first responders immediately if there are strong petroleum odors or evidence of, or reasons to suspect, combustible, explosive, or oxygen-deficient conditions inside the building.

Methane mitigation or hazardous substances that have a high explosive potential when present are also not addressed

Emerging Technologies Outreach Materials

Capture technologies and strategies that are not exclusively "mitigation" or "remediation"

- Aerobic Vapor Migration Barriers (AVMBs) create an aerobic biobarrier for petroleum vapors
- Placeholder for inclusion of emerging technologies in the future

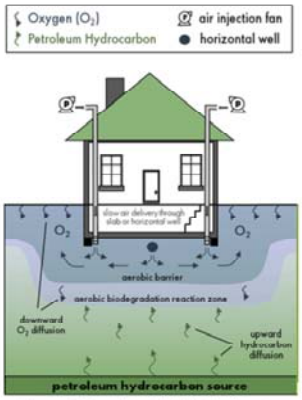

Figure 1 from the AVMB Technology Information Sheet.

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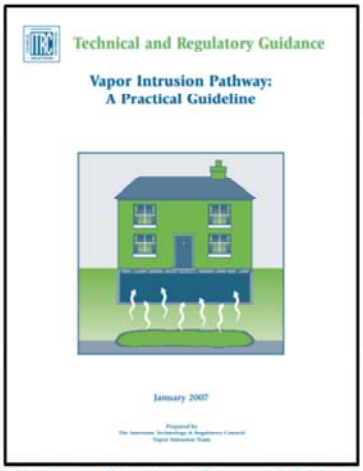
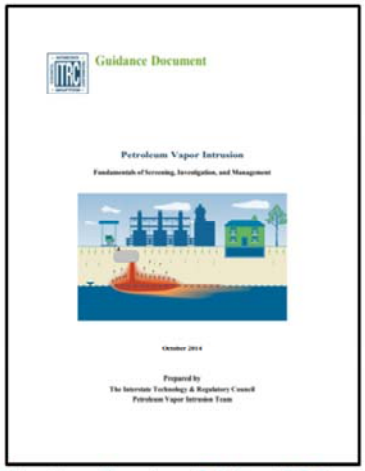
AVMB is implemented via injection of atmospheric air at ultra-low pressures (< 0.5" H_20) below a building foundation

Vapor Intrusion Mitigation (VIM) Training Team Background

- Previous ITRC guidance documents focused on investigative process
- Multiple requests for "…additional details and training on mitigation"



https://www.itrcweb.org/Documents/VI-1.pdf



https://www.itrcweb.org/PetroleumVI-Guidance

What is Vapor Intrusion (VI)

- Contaminants in soil and groundwater can volatilize into soil gas
- VI occurs when these vapors migrate upward into overlying buildings and contaminate indoor air
- If present at sufficiently high concentrations:
  - These vapors may present a threat to the health and safety of building occupants

Source: ITRC Petroleum Vapor Intrusion Guidance (PVI-1, 2014)

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"What is Vapor Intrusion" or VI and why we are here so that there is a common understanding of what it is.

First it requires contaminants or hazardous substances to be released into soil and groundwater that can volatilize into soil gas.

Vapor Intrusion occurs when these vapors migrate upward into overlying buildings and contaminate indoor air.

It requires soil for vapors to migrate and diffuse through

If present at sufficiently high concentrations, these vapors may present a threat to the health and safety of building occupants.

Also, quickly **mention preferential pathways**

Different Types of Vapor Intrusion

- Chlorinated Vapor Intrusion (CVI) which addresses chlorinated compounds

Source: ITRC Vapor Intrusion Pathway: A Practical Guideline (VI-1, 2007)

- Petroleum Vapor Intrusion (PVI) is a subset of VI that deals exclusively with petroleum hydrocarbon (PHC) contaminants

Source: ITRC Petroleum Vapor Intrusion Guidance (PVI-1, 2014)

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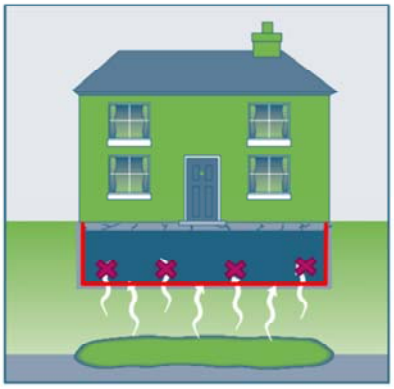
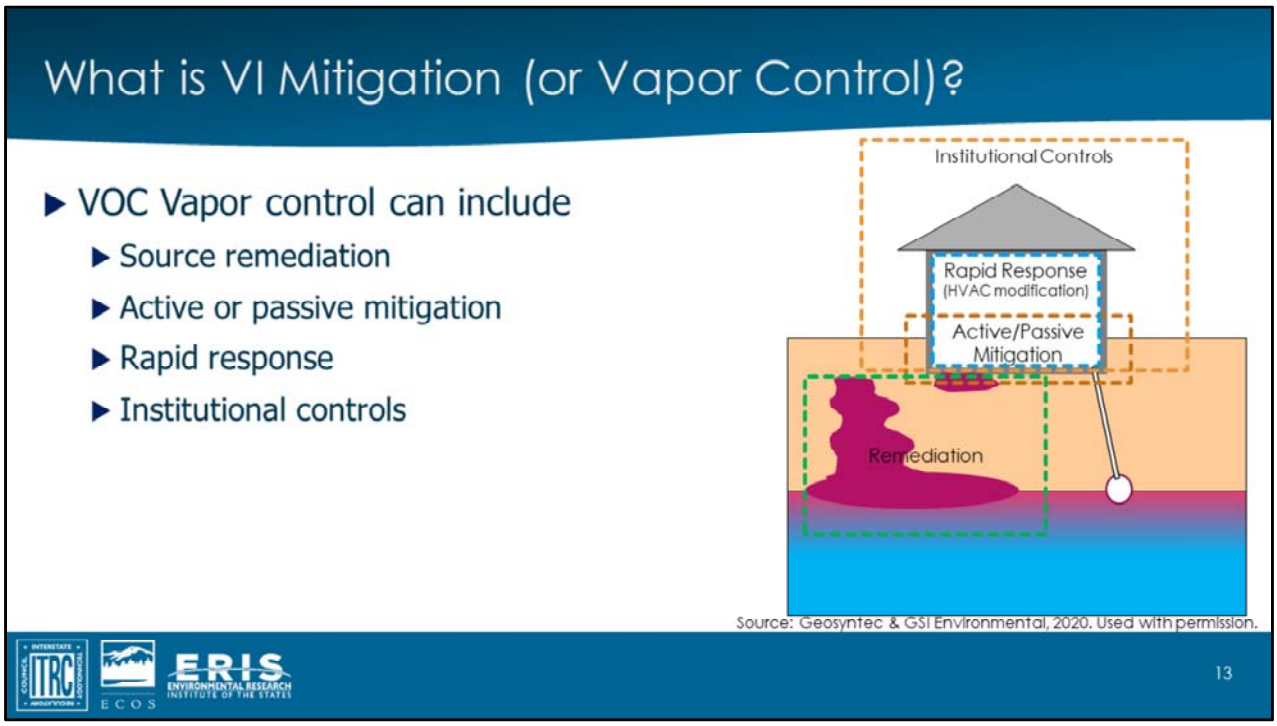
There are generally considered 2 specific types of vapor intrusion Chlorinated Vapor Intrusion (CVI) which addresses chlorinated compounds and Petroleum Vapor Intrusion (PVI) is a subset of VI that deals exclusively with petroleum hydrocarbon (PHC) contaminants

Understanding the differences between each is critical as there may be different mitigation strategies for each type of vapor intrusion

VI Mitigation (VIM)

- Implemented to reduce indoor air contaminants due to VI below applicable action or screening levels
- Accomplished by
  - Modifying the VI pathway to reduce the mass flux of contaminants entering the building
  - Reducing indoor air contaminant concentrations by removal or dilution

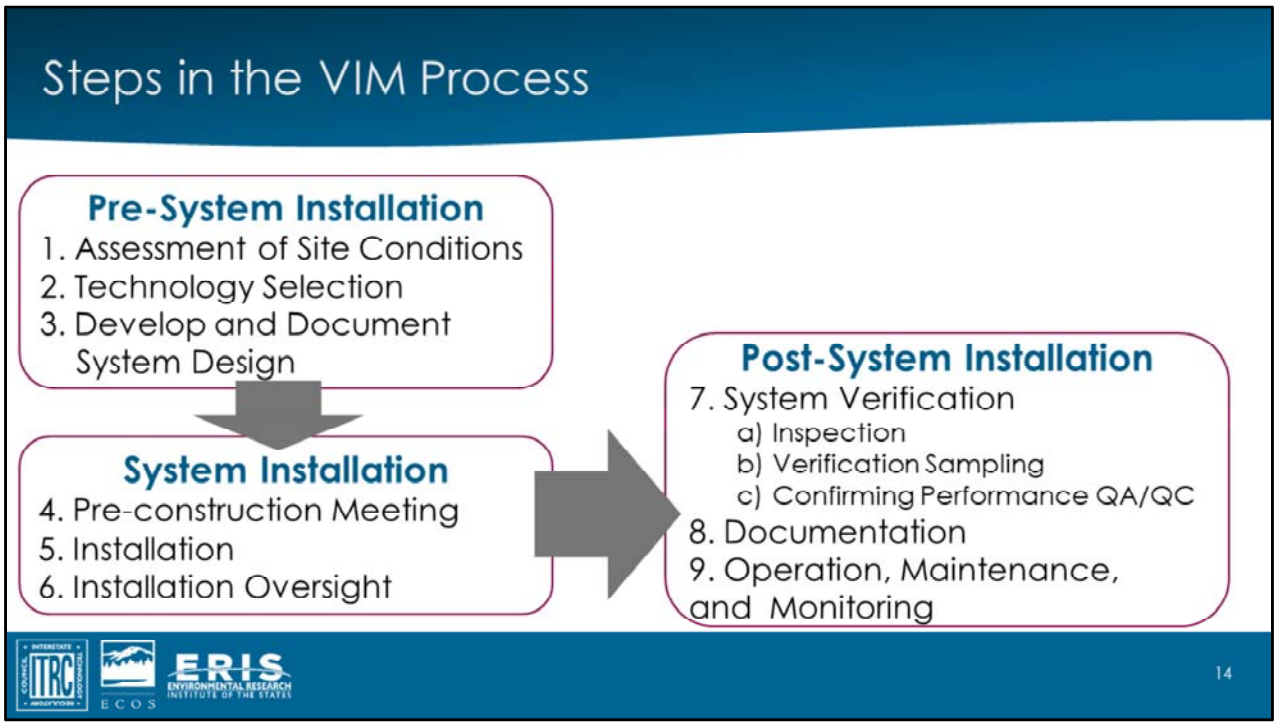




Multiple different mitigation strategies which is also called vapor control

Environmental remediation **(CLICK)** which address the contamination at the source
Building mitigation measures **(CLICK)** which typically involve active and passive mitigation
Rapid Response **(CLICK)** which is employed to quickly address known or potential vapor intrusion until longer term remedies can be implemented
Institutional controls (ICs) **(CLICK)** which are tools used to restrict different types of development or event the development itself

You will learn about the tools for each today and when appropriate each of these methods can be designed to reduce or prevent VI from occurring


Steps in the VIM Process
Pre-System Installation
1. Assessment of Site Conditions
2. Technology Selection
3. Develop and Document System Design
System Installation
4. Pre-construction Meeting
5. Installation
6. Installation Oversight
Post-System Installation
7. System Verification
a) Inspection
b) Verification Sampling
c) Confirming Performance QA/QC
8. Documentation
9. Operation, Maintenance, and Monitoring
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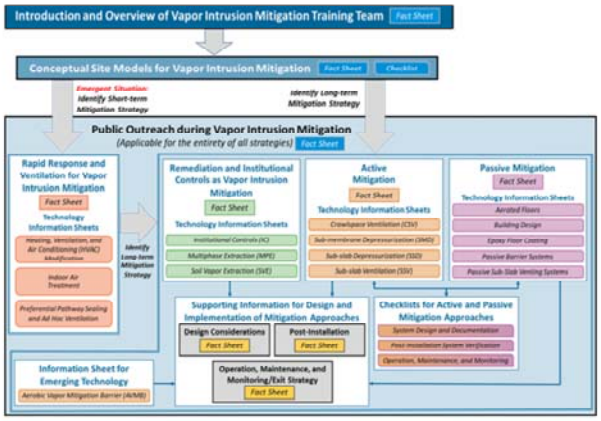
ITRC VIM Webpage

- Interactive Directory
- Fact Sheets
- Technology Information Sheets
- Flow Chart for VIM CSM Development (Figure 2-1)
- Considerations and impacts of various VIM approaches
- Checklists
- Additional information



https://vim-1.itrcweb.org/

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Supporting Information:

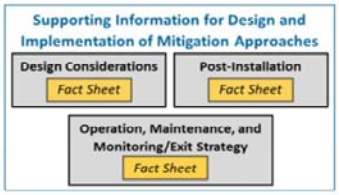
Design Considerations; Post-Installation; and Operation, Maintenance, and Monitoring/Exit Strategy

Checklists for Active and Passive Mitigation:

System Design and Documentation; Post-Installation System Verification, and Operation, Maintenance, and Monitoring

***NOTE THAT checklists for active and passive are covered in their respective modules, not as a separate module

Process Fact Sheet Rating System



Category

Principal consideration

Subject matter

Ratings provided by mitigation "type"

Design consideration	Active approaches	Passive approaches	Remediation	Rapid response
VI CSM considerations				
Vapor source and concentration				
Vapor source and concentration	●	●	●	◐
Geology and hydrogeology				
Subgrade soil type	●	◒	●	◒
Depth to groundwater/high water conditions	●	●	●	◐

Key | High impact ● | Medium impact ◐ | Low impact ◒ | Not applicable —

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Process Fact Sheet Narrative

Supporting Information for Design and Implementation of Mitigation Approaches

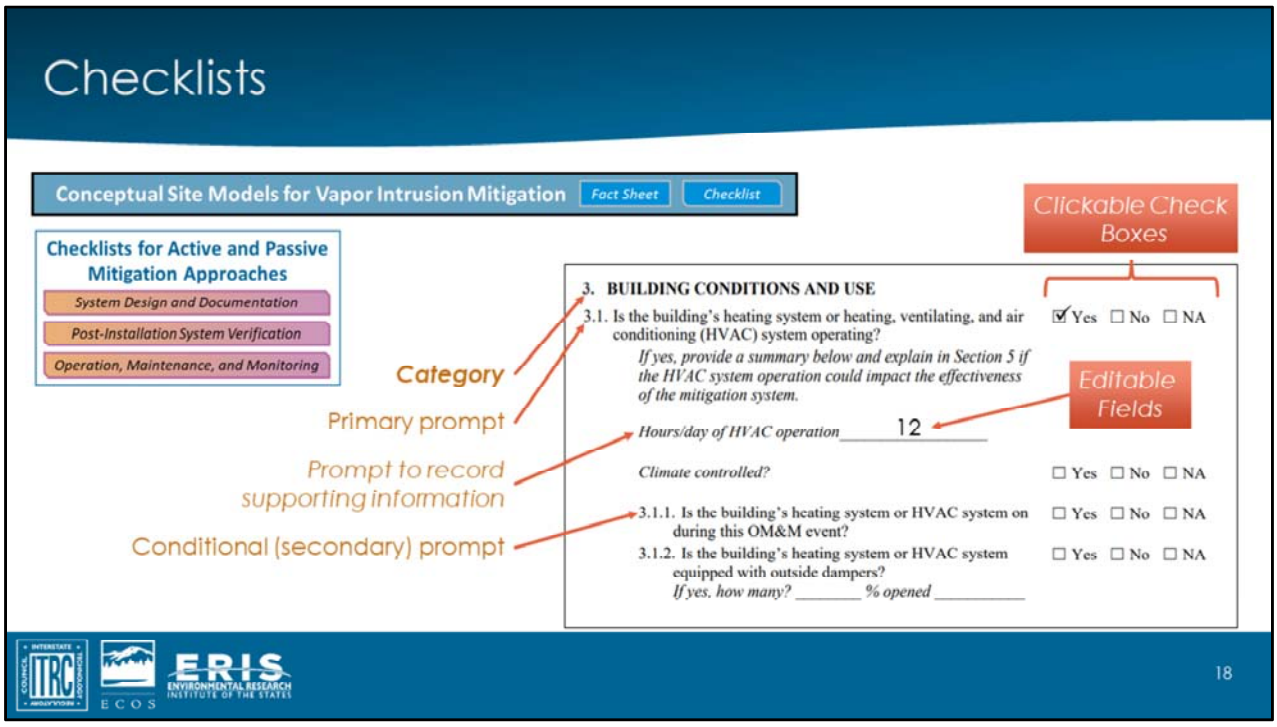
- Design Considerations — *Fact Sheet*
- Post-Installation — *Fact Sheet*
- Operation, Maintenance, and Monitoring/Exit Strategy — *Fact Sheet*

Design consideration	Active approaches	Passive approaches	Remediation	Rapid response
VI CSM considerations				
Vapor source and concentration				
Vapor source and concentration	●	●	●	◐
Geology and hydrogeology				
Subgrade soil type	●	◒	●	◒
Depth to groundwater/high water conditions	●	●	●	◐

Key | High impact ● | Medium impact ◐ | Low impact ◒ | Not applicable –

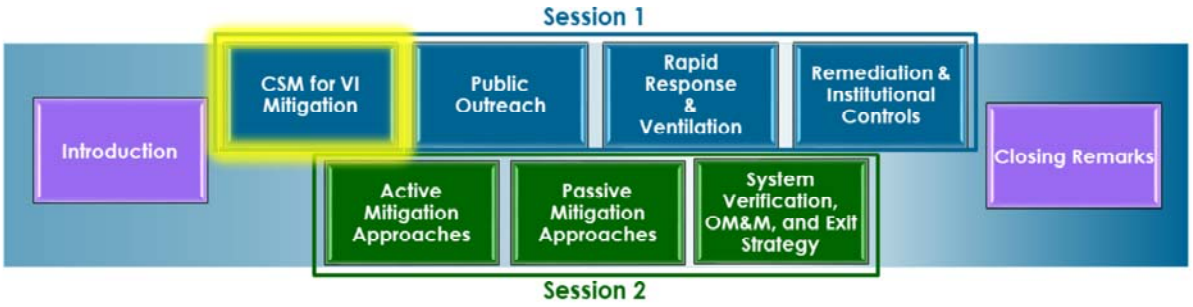
Subgrade Soil Type: In most cases, the properties of soils immediately adjacent to the building (e.g., below the slab or next to foundation walls and footings) have the greatest impact on active mitigation technologies that require the movement of air and/or the propagation of vacuum below the slab. Soil type plays a major consideration for active mitigation strategies and makes some remediation technologies difficult to implement. For a more detailed description of methods to test and mathematically model the sub-slab permeability and transmissivity see (McAlary et al., 2018 ⇨). See Section J.2.5 of ***Appendix J in the 2014 ITRC PVI document*** (ITRC, 2014 ⇨) for more information on the consideration of soil type in active mitigation.

Active Mitigation	**High Impact:** Permeability of the sub-slab fill material and underlying soil controls the pressure field extension (PFE) and air flow rates and, therefore, the degree to which sub-slab depressurization (SSD) and sub-slab ventilation (SSV) contribute to indoor air quality protection. This affects the spacing of suction points and fan size required to induce and maintain the negative pressure field beneath the structure.
Passive Mitigation	**Low Impact:** Passive mitigation systems typically incorporate a permeable layer beneath barriers and around vent piping in new construction. It may not be feasible to incorporate a permeable layer beneath an existing building. Therefore, passive venting systems function best in soils that are highly permeable when retrofitting an existing building.
Environmental Remediation Technology	**High Impact:** Remediation technologies require the characterization of soils beyond the subsurface to evaluate the effectiveness of the proposed technology. MPE and SVE are generally not applicable to low-permeability soils.
Rapid Response	**Low Impact:** Rapid responses typically include ventilation changes, indoor air treatment, or other efforts that are focused inside the building, therefore sub-slab conditions are not relevant.



Note that forms are fillable and can be downloaded from the VIM-1 website to be used in the field/office

Coming Up Next…



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Conceptual Site Models for Vapor Intrusion Mitigation

Source: Geosyntec & GSI Environmental, 2020. Used with permission.

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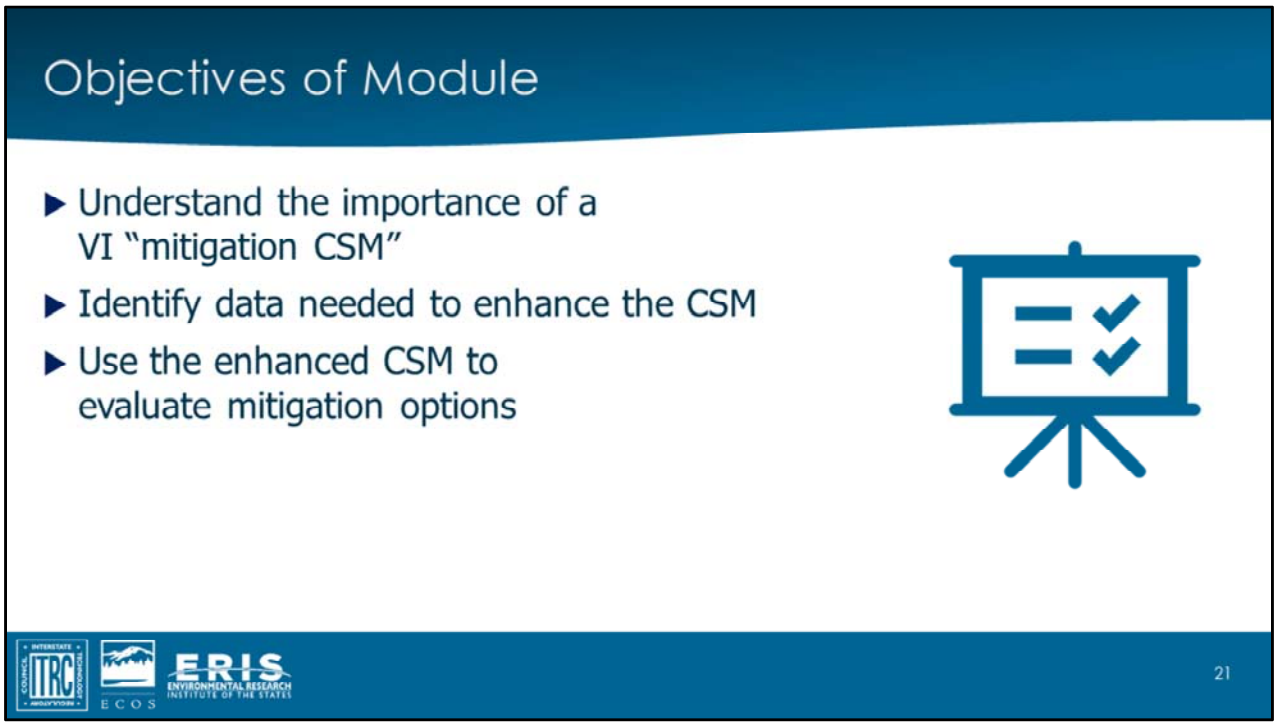
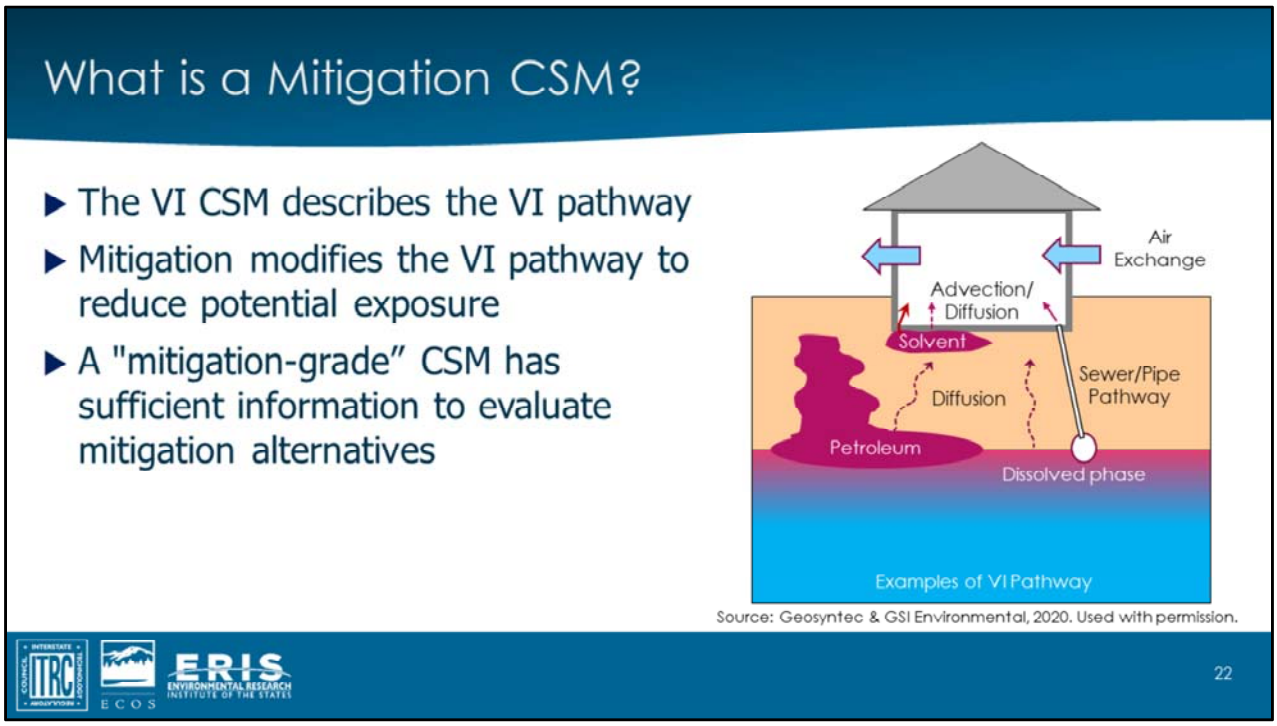
Welcome to the CSM for VI Mitigation training module



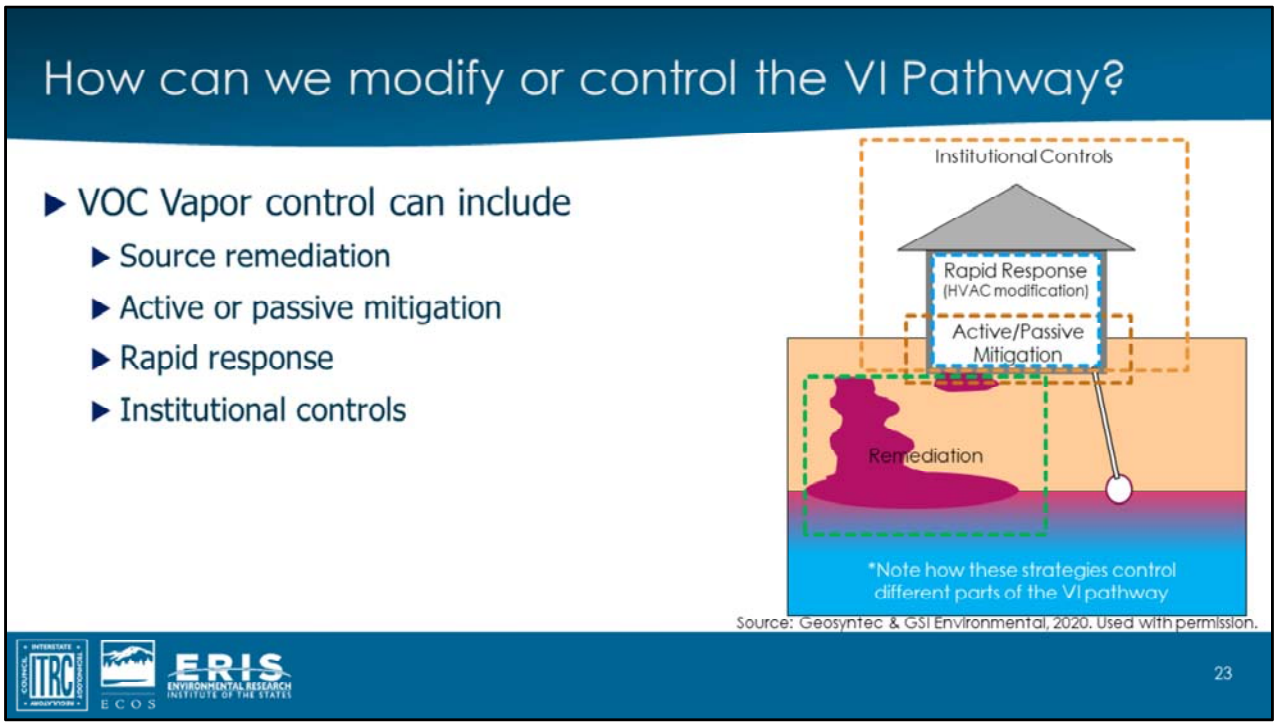
In this module, we'll be discussing what a VI mitigation CSM is, and why it's important. We'll also introduce data and tools you can use to develop the CSM and show how the Mitigation CSM fits into the mitigation evaluation and design process.



What is a “mitigation CSM”? Why is it important?

- The VI CSM describes the VI pathway.
  - Source – transport processes – building/receptors that may be impacted
  - It’s typically developed during investigation phase to determine if the VI pathway is complete and whether mitigation is required.
- Mitigation modifies one or more portions of the VI pathway to reduce concentrations and/or the potential for exposure.
  - If you think of mitigation as modifying the VI pathway, you are more likely to select an approach that works, and understand how it works
- However, the initial VI CSM might not provide enough detail to select an appropriate mitigation approach
  - Additional information may be needed to enhance the CSM so that mitigation alternatives can be evaluated.
  - We are calling this enhanced CSM the “mitigation

Key Point: This training module covers how to enhance the CSM sufficiently to support mitigation decision-making

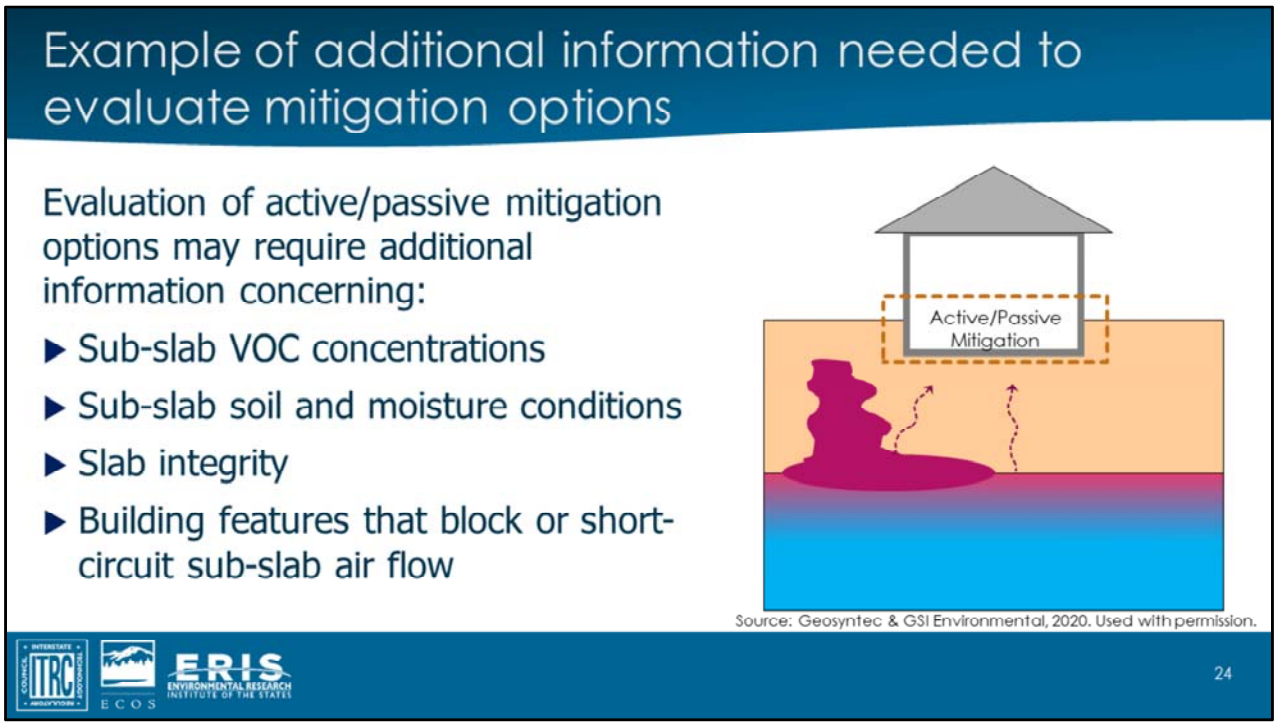


So how can mitigation alternatives modify or control the VI pathway to reduce concentrations or exposure?

- The Mitigation CSM helps us understand points along the VI pathway. Depending on the situation, we can consider alternatives that modify different parts of the VI pathway, such as
- Removal or treatment of the vapor source, usually a longer-term component of an overall mitigation strategy,
- Controlling the rate at which vapors can enter the building, by either active systems (such as sub-slab depressurization) or passive systems (such as use of barriers alone)
- We can also reduce concentrations in the building through ventilation or indoor air treatment, often considered “rapid response” actions
- And we can sometimes use Institutional Controls to restrict certain uses, such as residential, or require operation of mitigation systems, as a component of our mitigation approach

Note that this training module focuses on mitigation. Refer to the remediation training module and fact sheet regarding removal/treatment of the VOC vapor source.

Key point – each approach reduces the potential for exposure due to VI by controlling a different portion of the VI pathway; boxes on the figure correspond to different fact sheets.

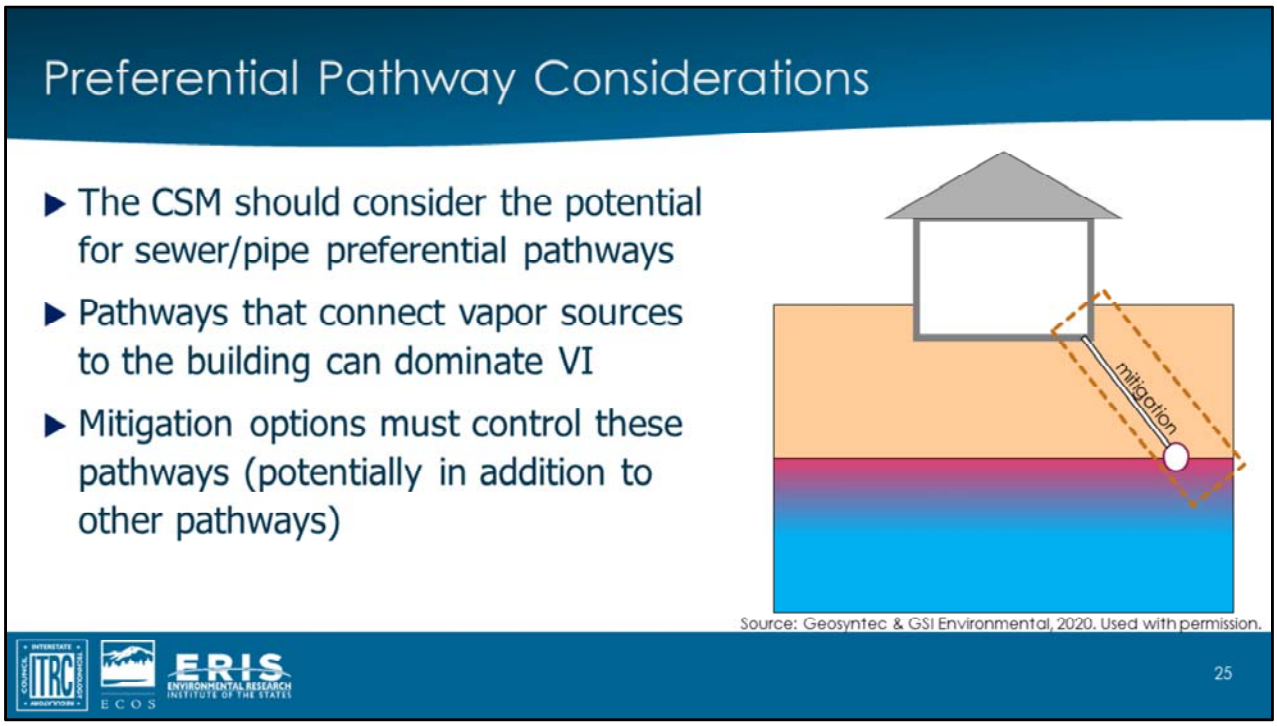


For example, consider a situation where active or passive building control options might be a possibility:

Additional information will likely be need on slab and sub-slab conditions to evaluate these options, such as….

- **Sub-slab VOC concentrations**, which can affect the degree of control required, and the potential for diffusion of VOCs through the slab, in addition to vapor flow through cracks
- **Sub-slab soil and vapor moisture conditions**, which can affect the extent to which air flow and negative pressures can be induced below the slab
- **Slab integrity**, which can affect the ability to extend negative pressures below the slab
- **Building features that block or short-circuit sub-slab air flow**, which also affects our ability to extend negative pressures below the slab

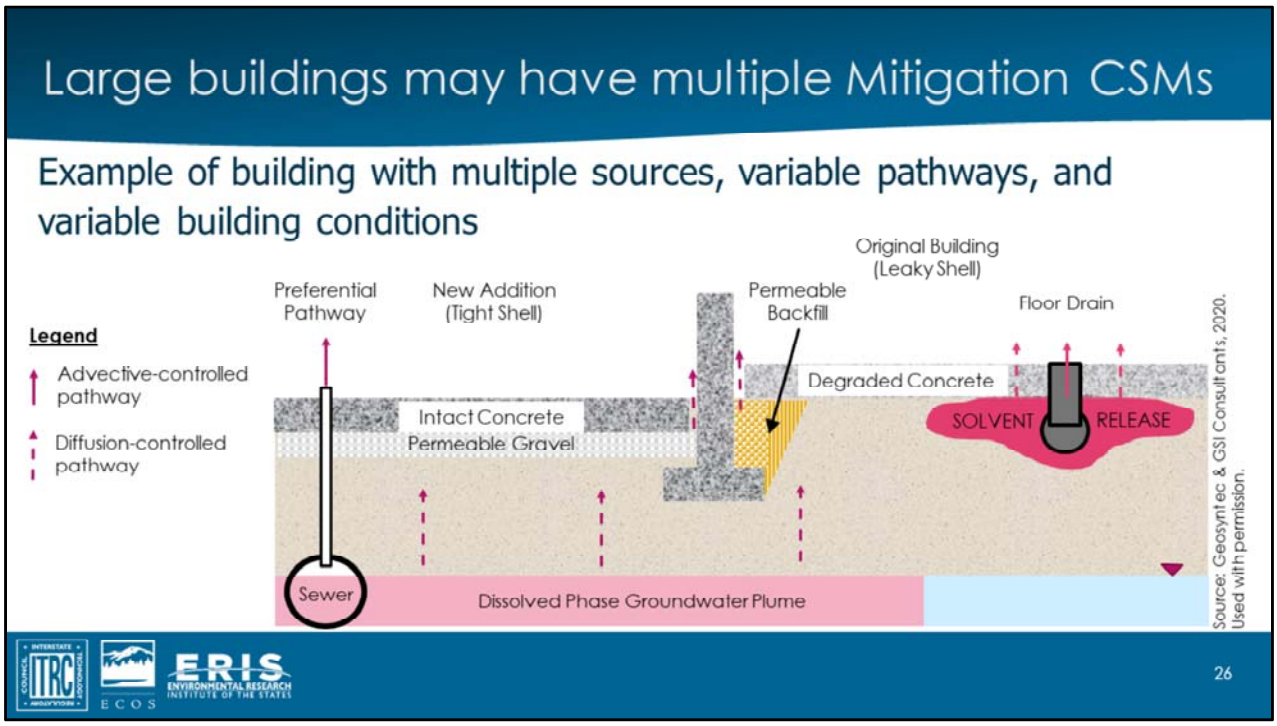
Key Point: Some or all of this information might not have been part of the original VI CSM used to determine that the VI pathway was a concern.



As another example, preferential pathways, might play an important role in both the potential for VI and mitigation requirements.

- Open pipes that directly connect the building foundations or interior with a source of vapors, such as an impacted sewer, are of particular concern.
- Such pathways can dominate VI in some cases. If so, mitigation options must address these preferential pathways.
  - for example, sub-slab depressurization, a common mitigation approach, might not be sufficient, or even the right approach in some cases.
  - Potential actions, depending on the situation, might include filling dry p-traps, sealing the pipe, adding check valves, or other actions

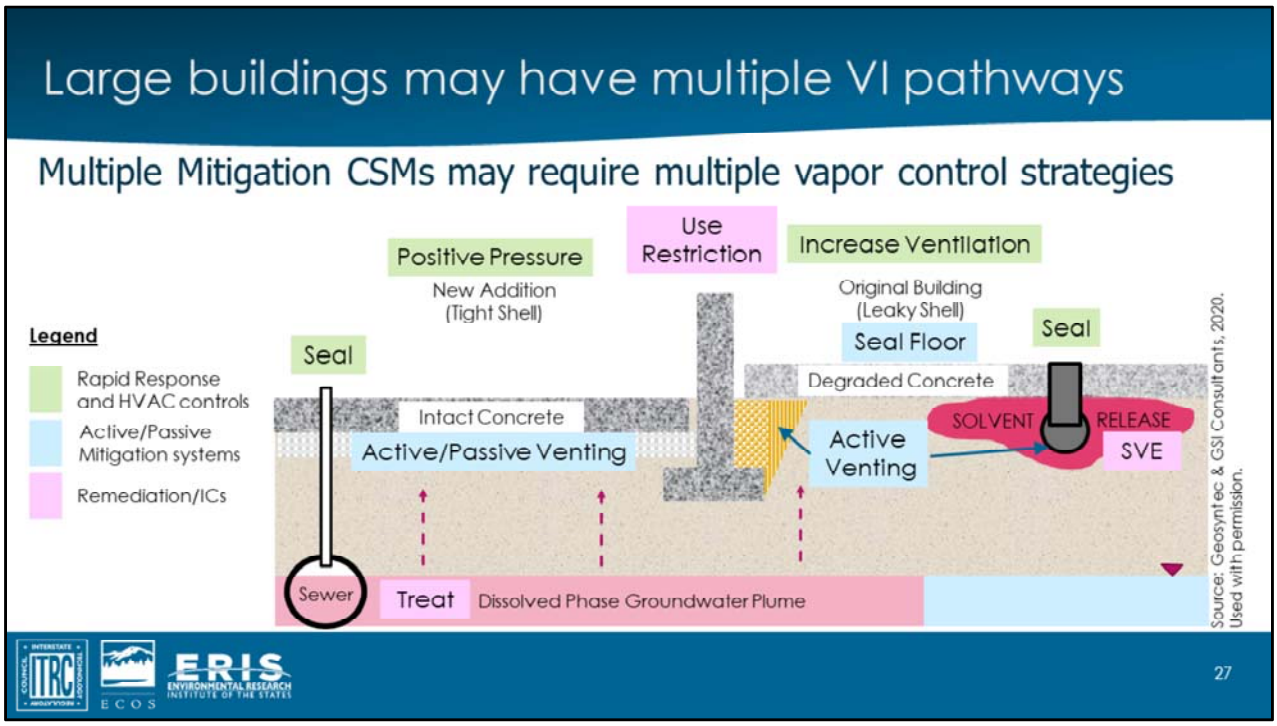
Key point: Preferential pathways can be a critical component of the VI pathway requiring control – therefore, they must be addressed by the mitigation CSM.



What about large, complicated buildings?

The need to understand the VI CSM is even more important, because of the potential for multiple sources and variable conditions.

- In this example, we have a dissolved phase source causing vapors that must diffuse through relatively low permeability soils, and DNAPL that impacted soils right below the slab, likely due to a spill and leaky floor drains. We also have preferential pathways, resulting in advective flow of vapors directly from source to the building.
- We have a new and old addition to the building, with intact and degraded concrete slabs, respectively, and different subslab materials.
- And the new addition is relatively tight, while the original building is leaky.



So how does this this CSM information affect our mitigation options?

- We might seal the preferential pathways as a rapid response action.
- If HVAC technologies appropriate, then positive pressure might work better in the new, tighter addition, while ventilation might work better in the original building.
- Where and how you would apply SSD or SSV would be affected by the gravel layer in the new building, and lack of gravel in the old.
- And remediation of the GW plume and DNAPL might be considered as long-term solutions, with ICs to restrict certain uses in the meantime.

Knowledge Check

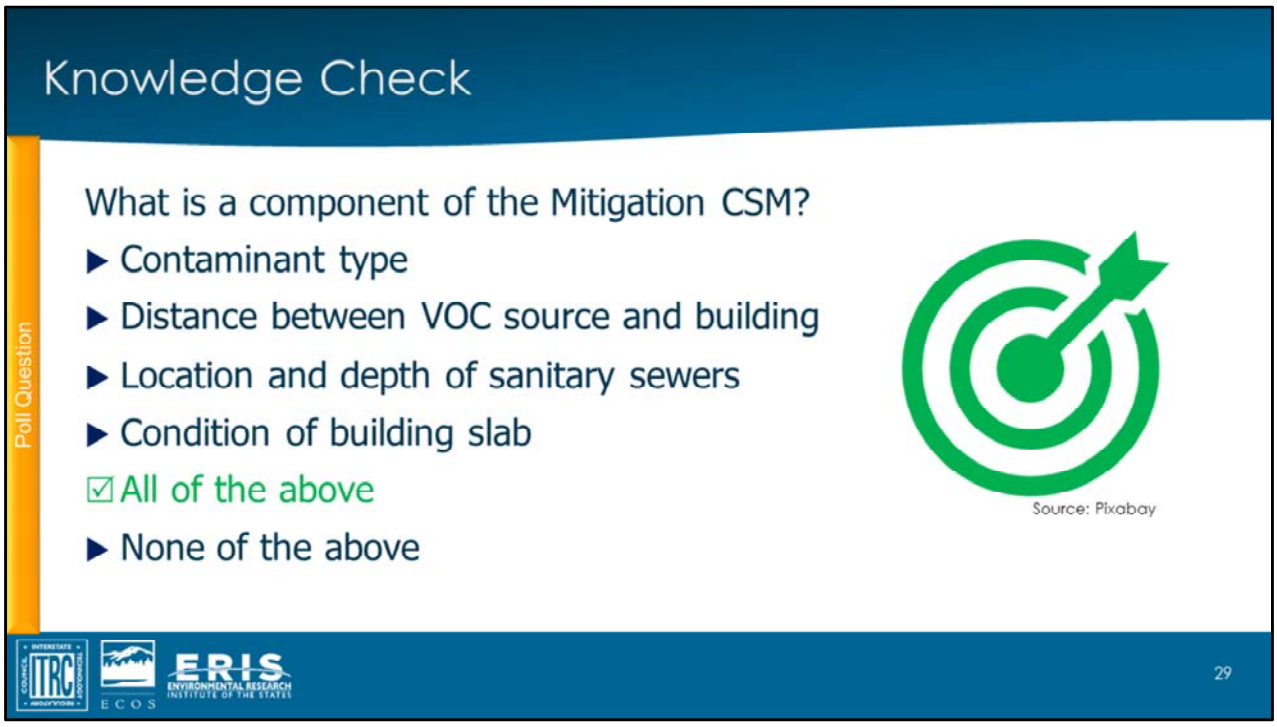
Poll Question

What is a component of the Mitigation CSM?

- Contaminant type
- Distance between VOC source and building
- Location and depth of sanitary sewers
- Condition of building slab
- All of the above
- None of the above

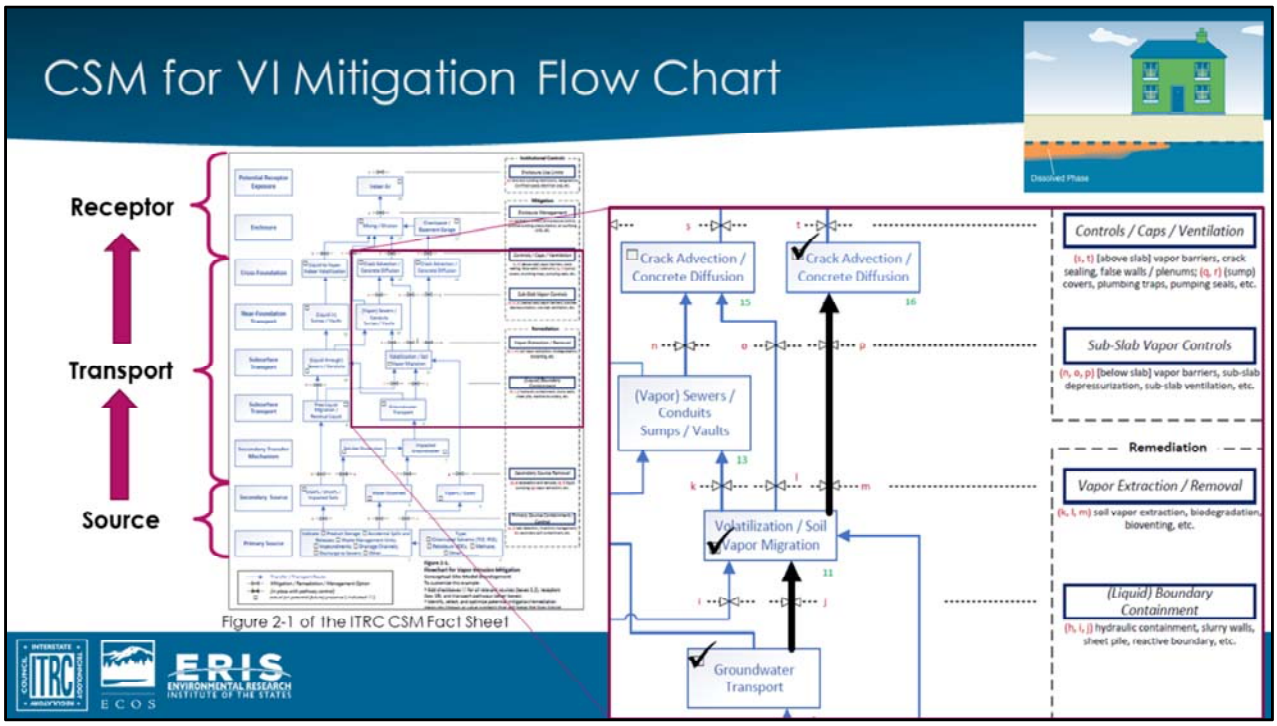
Image source: Pixabay

Knowledge Check



Answer: all of the above

Rationale: the CSM is a conceptual description of the entire VI pathway occurring at the building of interest, i.e., from source to receptor



- The flowchart is a tool to help organize site information relating to the CSM. It also summarizes types of remediation or mitigation approaches that can be applied at different points along the VI pathway.

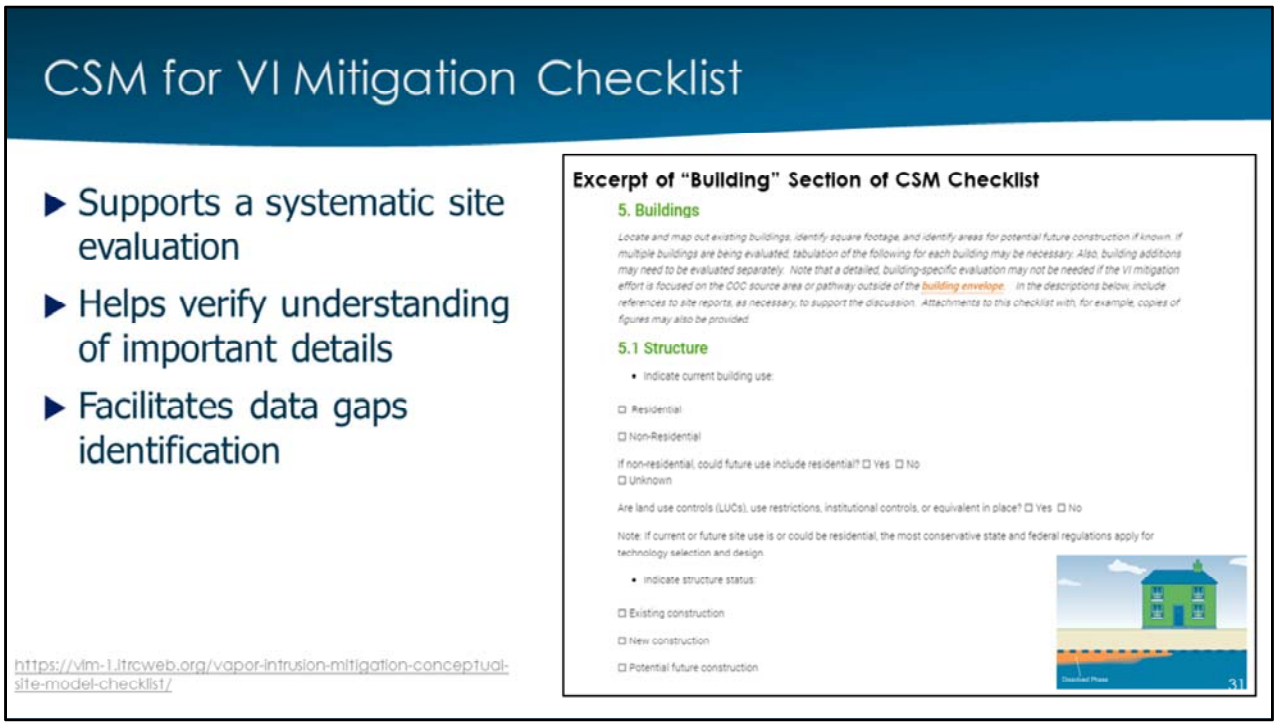
- The flowchart is in the CSM factsheet on the ITRC VI mitigation website.
https://vim-1.itrcweb.org/conceptual-site-models-for-vapor-intrusion-mitigation-fact-sheet/

- The flowchart captures the 3 key elements of the CSM in one diagram: source, transport, and receptor. The source part of the diagram is at the bottom and the receptor part is at the top to mirror VI occurring from the subsurface into the building.

- A set of boxes represents different components of the CSM linked with a set of arrows and valves. For instance (example shown), if CSM indicates that VI is occurring from groundwater:
  - VOCs dissolved in groundwater volatilize
  - VOCs migrate upward by diffusion in soil gas within the vadose zone
  - VOCs enter the building via either concrete diffusion or advection through a crack (or a combination of both)

- Each of these valves represent a mean of cutting off the VI pathway. For example:
  - Valve “p” would stop vapor entry into the building by implementing a subslab vapor controls, including vapor barrier, subslab depressurization, or subslab ventilation (active and passive mitigation modules)
  - Valve “m” would stop soil gas upward migration by vapor extraction/removal, including soil vapor extraction, biodegradation or bioventing (remediation module)

-In summary, the flowchart can help you determine on the basis of the CSM for a particular building what remediation or mitigation options are available in your toolbox to address vapor intrusion.



- The checklist is another tool to help develop the mitigation CSM. Its purpose is to help guide mitigation planning.

- The checklist is available on the ITRC VI mitigation guidance website. https://vim-1.itrcweb.org/vapor-intrusion-mitigation-conceptual-site-model-checklist/

- The checklist highlights important factors that should be considered for different elements of the VI pathway.

- The checklist assumes that VI characterization has been completed and it has been determined that mitigation is necessary.

- The checklist can help further identify key considerations of the CSM relating to VI mitigation and help support evaluation of mitigation alternatives.

- Mitigation goals are at the beginning of the checklist to help the user focus on site features that are relevant to development of a mitigation plan to meet those goals.

- The next sections of the checklist follow the same organization as the flowchart (source, transport, and receptor). The users can fill in the sections that are appropriate to their situation. For instance:

-If source remediation is the goal, then the building details may not be important.

-If building mitigation is the goal, then the "building" section of the checklist should be completed.

Knowledge Check

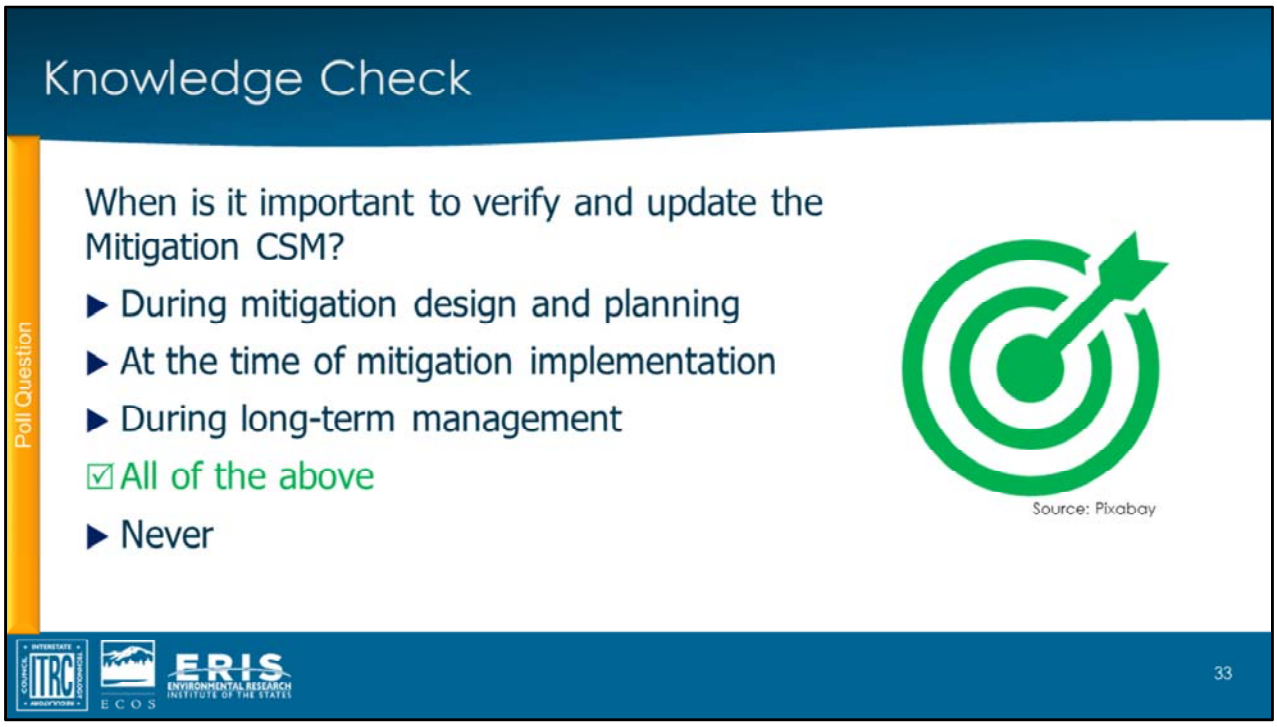
Poll Question

When is it important to verify and update the Mitigation CSM?

- During mitigation design and planning
- At the time of mitigation implementation
- During long-term management
- All of the above
- Never

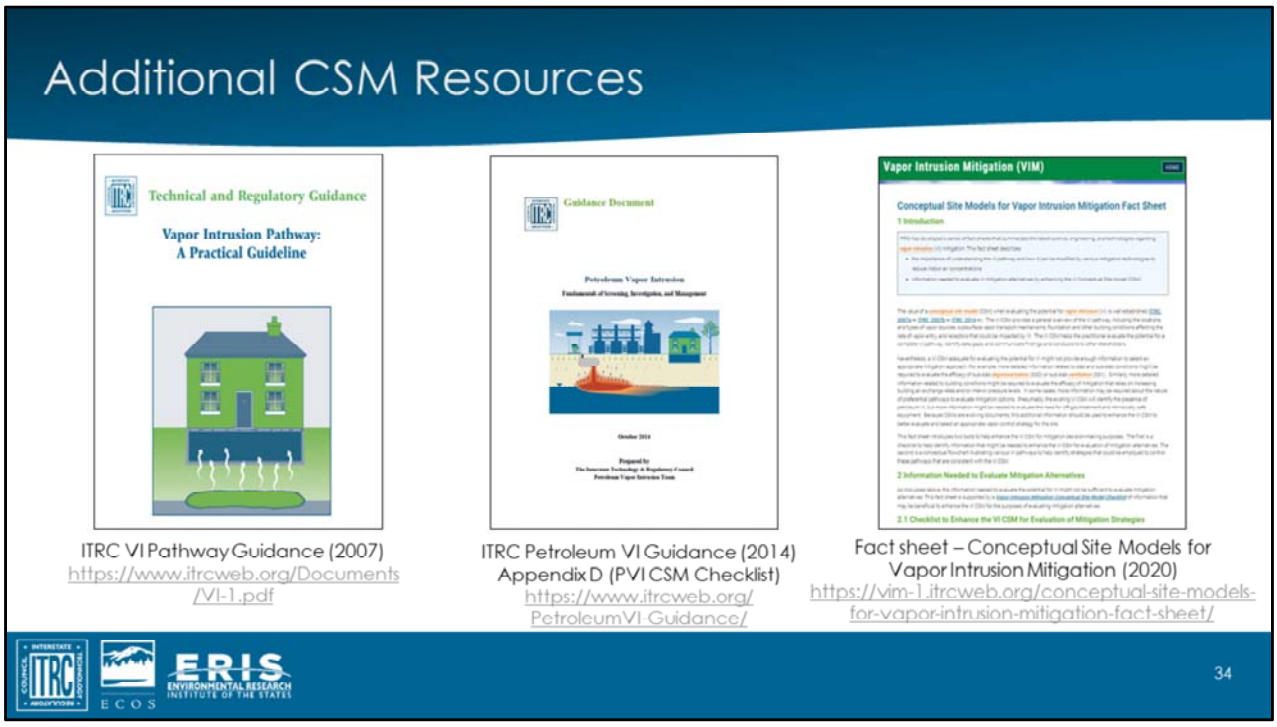
Image source: Pixabay

Knowledge Check



Answer: all of the above

Rationale: The CSM needs to be continuously reevaluated throughout the lifecycle of the project.

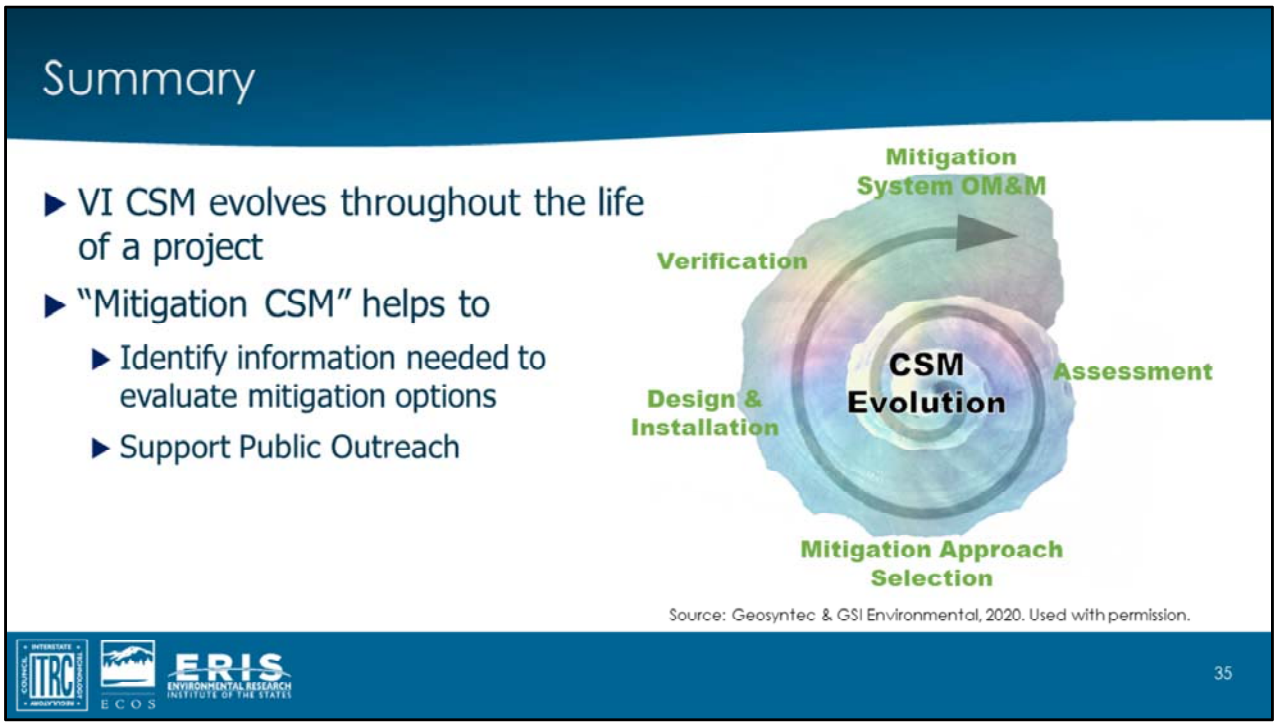


Additional resources that explore the vapor intrusion CSM.

- 2007 ITRC VI guidance
https://www.itrcweb.org/Guidance/ListDocuments?TopicID=28&SubTopicID=39

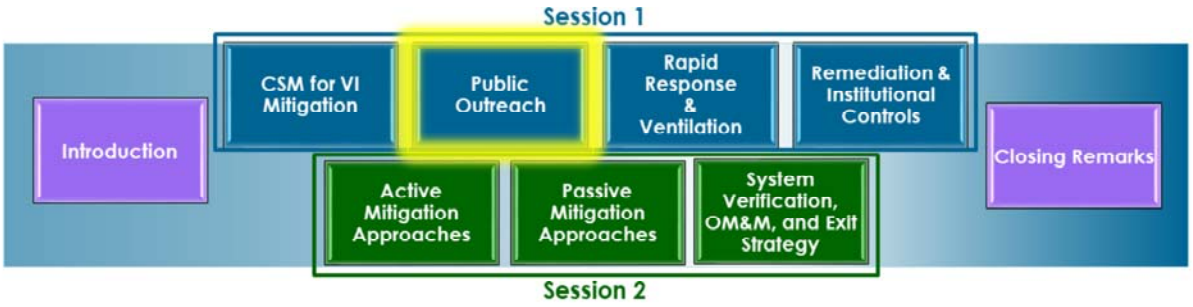
- 2014 ITRC petroleum VI guidance (PVI guidance), including petroleum VI CSM checklist at Appendix D
https://www.itrcweb.org/Guidance/ListDocuments?TopicID=28&SubTopicID=48

- CSM for VI mitigation on the ITRC VI mitigation website
https://vim-1.itrcweb.org/conceptual-site-models-for-vapor-intrusion-mitigation-subgroup-training-materials/



- The VI CSM developed during site characterization should continue to evolve as you consider and develop plans for mitigation
- The Tools can help (tech sheet, checklist, flow chart). VI CSMs that use the checklist and flowchart should allow more thorough identification of the specific VI pathways relevant to the site/building as well as options for successful vapor control strategies. Note: These tools address commonly encountered scenarios. While they may not include every possibility, they will help you think about the mitigation CSM in a more systematic way.
- The Mitigation CSM can also support public outreach, i.e., use the tools to help explain the mitigation approach, and how/why it should work

Coming Up Next…



Advancing Environmental Solutions

Public Outreach During Vapor Intrusion Mitigation (VIM)

Source: Pixabay

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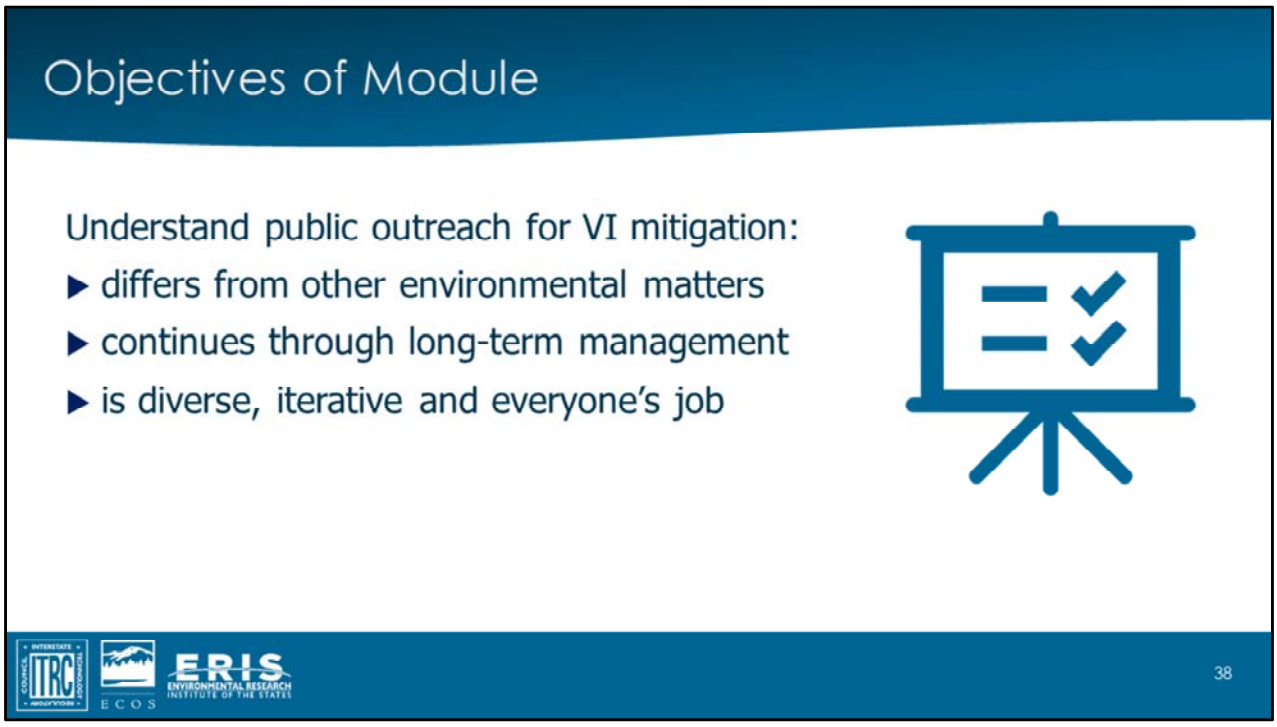
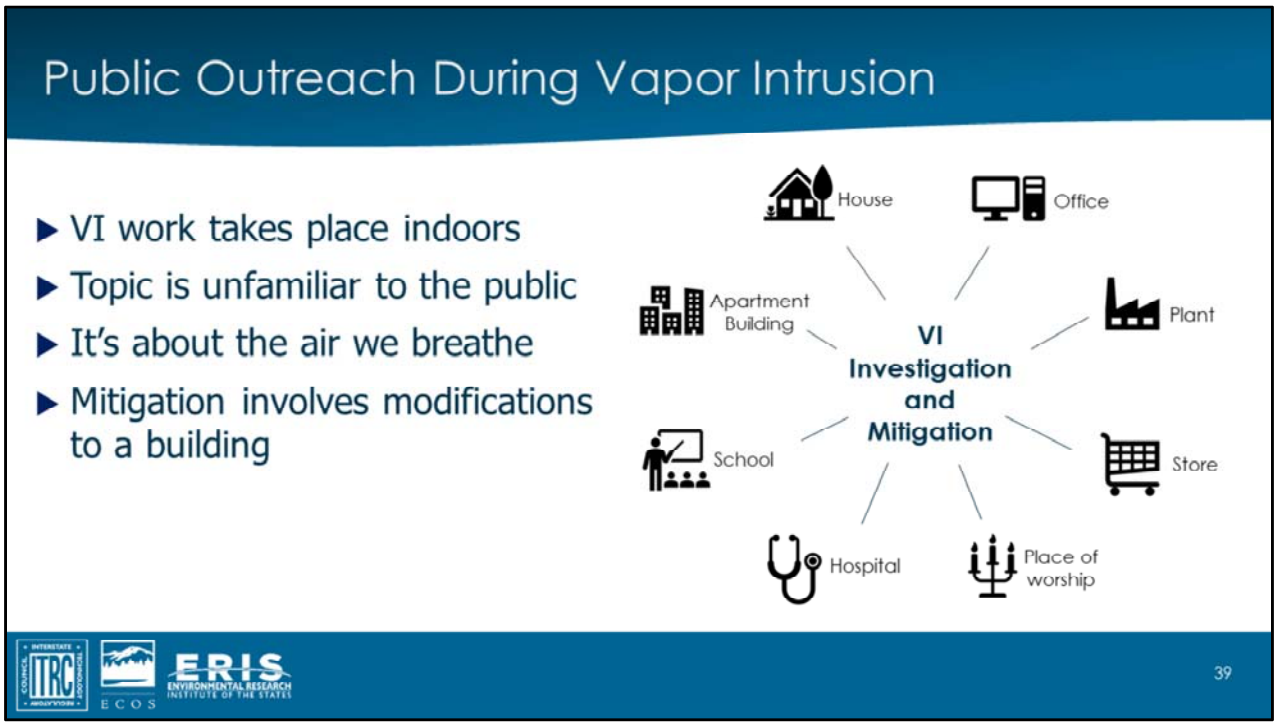


After completing this module, we hope you will understand that

public outreach can be different from other types of environmental outreach. There are a number of great risk/ public outreach documents available. For our document, we tried to focus on how public outreach may be different for vapor intrusion and vapor mitigation projects.

Outreach is necessary before mitigation and continues throughout the project into long-term management and the exit strategy. We have our own fact sheet but also a small section in each of the vapor mitigation fact sheets to emphasize this.

Public outreach requires diverse approaches, must be repeated in a variety of ways and is everyone's job.



Let's talk about some of the ways that vapor intrusion outreach may be different.

One of the first big differences is the bulk of investigations take place inside. You're not drilling a hole in the yard- you're drilling a hole in a place where people work or live. It's intrusive which needs to be discussed in conversations with affected individuals. Completing mitigation and continued LTS depends on continued access to inside of people's homes and workplaces. Recognize what you're asking is a big deal so it's important to build a relationship.

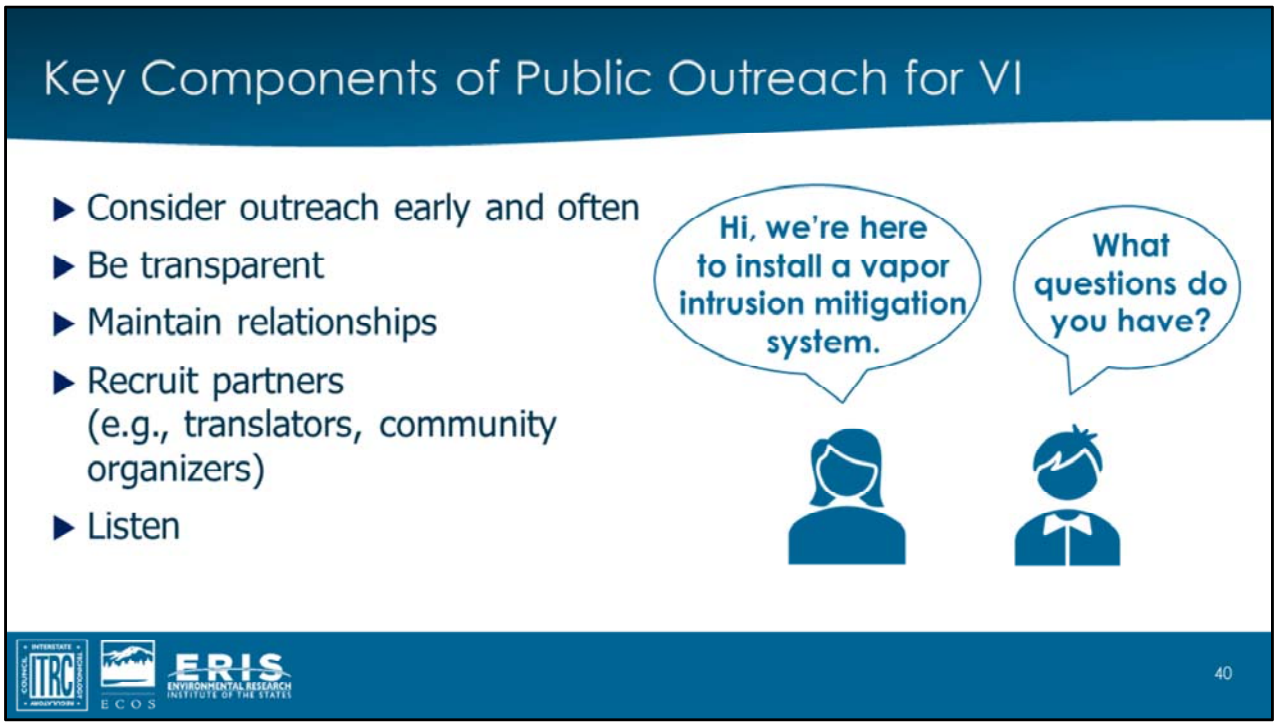
Vapor Intrusion is also generally more unfamiliar to most people than other environmental issues. VI is relatively new and hasn't gotten the press that many other environmental issues have. Likely going to have more things to explain to help people understand what is happening.

Most importantly, it's about the air that we breathe which can cause a lot of added anxiety. For example, we have a choice about whether or not to turn the tap on. We cannot choose to not breathe. This additional loss of control can cause a lot of added anxiety. While we can't tell people how to feel, we need to understand the added anxiety when having conversations. Be proactive in your communication to help people feel as comfortable as possible.

Another thing to think about is that vapor mitigation involves permanent building modifications. Holes in the floor, pipes running up the structure, a fan that will run continuously maybe for a long time.

We've included a matrix of concerns and listed these and other topics as a resource for you.

All drawings from Microsoft Icons (see Insert Menu)



Let's talk a little about the comprehensive nature of vapor mitigation outreach and some key components.

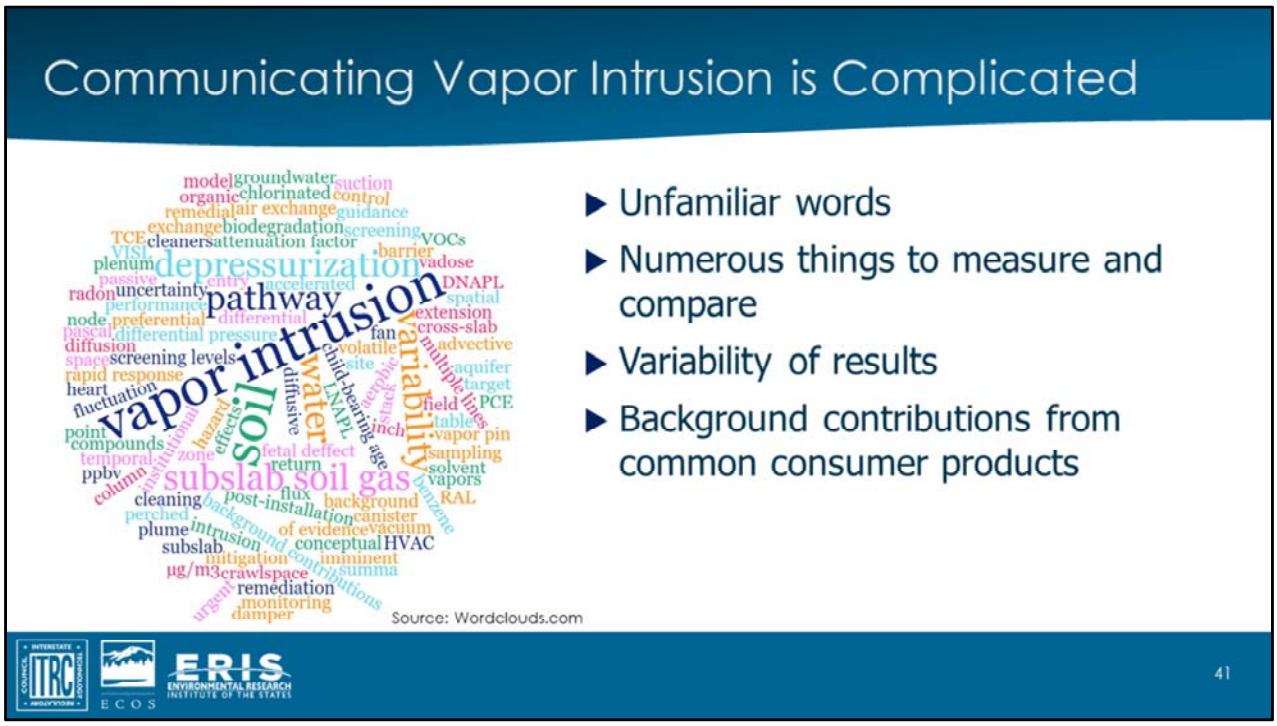
As with all projects, outreach needs to be considered early and often. Public outreach is often an afterthought, but this is not a good strategy.

Transparency is important. Since it's so unfamiliar to most people, occupants and owners will need a larger amount of information for VI work than other environmental work. Transparency builds trust so when additional questions arise, answers can be given from a reputable source (you).

Relationships need to be maintained to ensure continued access and cooperation. Routine communications in informal settings (e.g., kitchen table conversations) may be needed to maintain those relationships to ensure continued access.

Depending on the community, partners or intermediaries may be needed to assist with translating and gaining trust and access and it may be especially important in environmental justice communities where owners and occupants may not have the time or resources to be educated on environmental issues or may not feel empowered to ask questions. It's important to make sure that they understand what is happening and that mitigation projects address their needs.

Above all listen. Listening to the concerns of the building owners and occupants is a key part of the communication. While our document attempts to help you prepare for what concerns might be, it's not a substitute for determining what people on your site care about.



Unfamiliar words- Intrusion, Mitigation, pressure field extension- these are not words that people are familiar with and it may take them longer to process information. You may need to spend more time communicating with owners and occupants and you're definitely going to want to leave something with them so they know how to ask questions they think of later.

And it's not just the words- vapor work has numerous things to measure and compare. Many of the things we measure won't cause human health issues, they're triggers to look at indoor air. For example sub slab, soil gas, maybe your state uses GW SLs to trigger investigations. Affected parties can look at a publicly available screening level table and see they're above sub-slab but not consider that they're not breathing that air. It's key to incorporate explanations of the different samples preferably from the beginning.

Variability can be orders of magnitude. The data is typically variable (spatially and temporally). Interpreting it is challenging even for environmental professionals. Communicating a clear message is necessary.

Background contributions from common consumer products can muddy the water. It's complicated to explain an elevated concentration related to a background source. It's important to clarify that we don't regulate these sources and defer to the local health departments.

While at the VI mitigation stage, we are generally past this part of complication, but it's important to emphasize that potential confusion and frustration can carry forward into the mitigation phase if not adequately addressed during the investigation.

Image prepared by L. Levy for ITRC using Wordcloud.com
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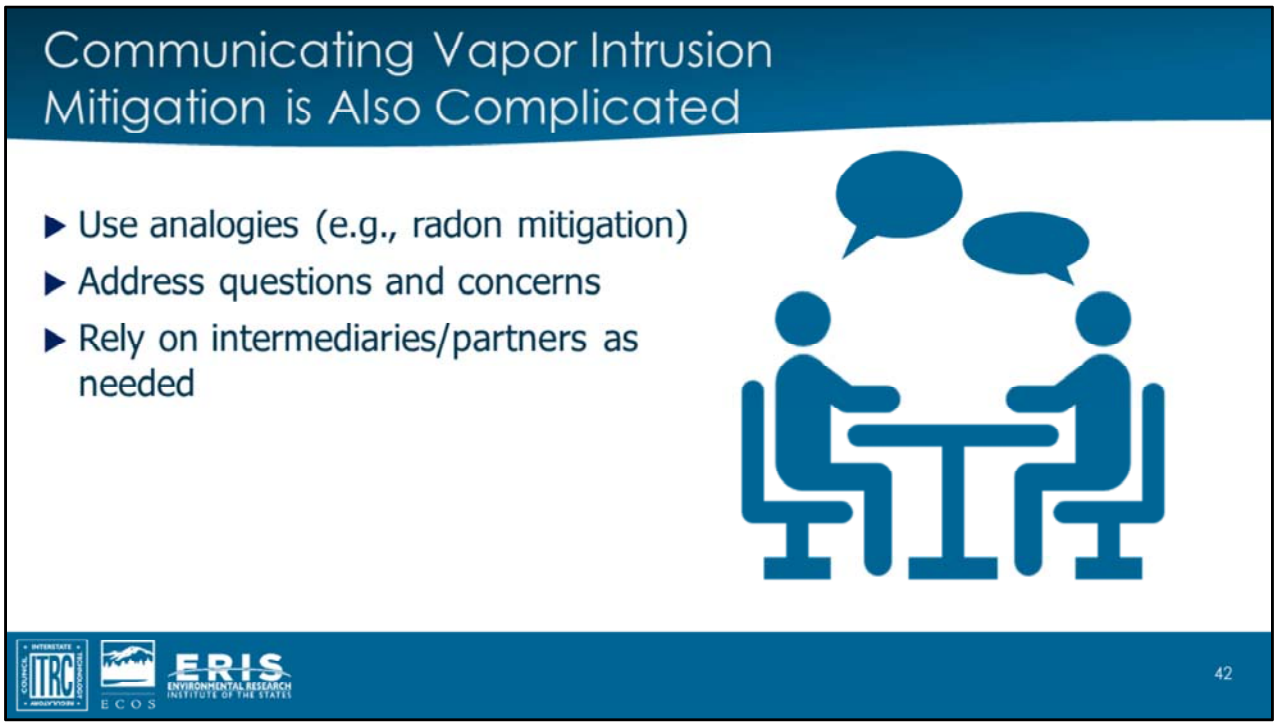
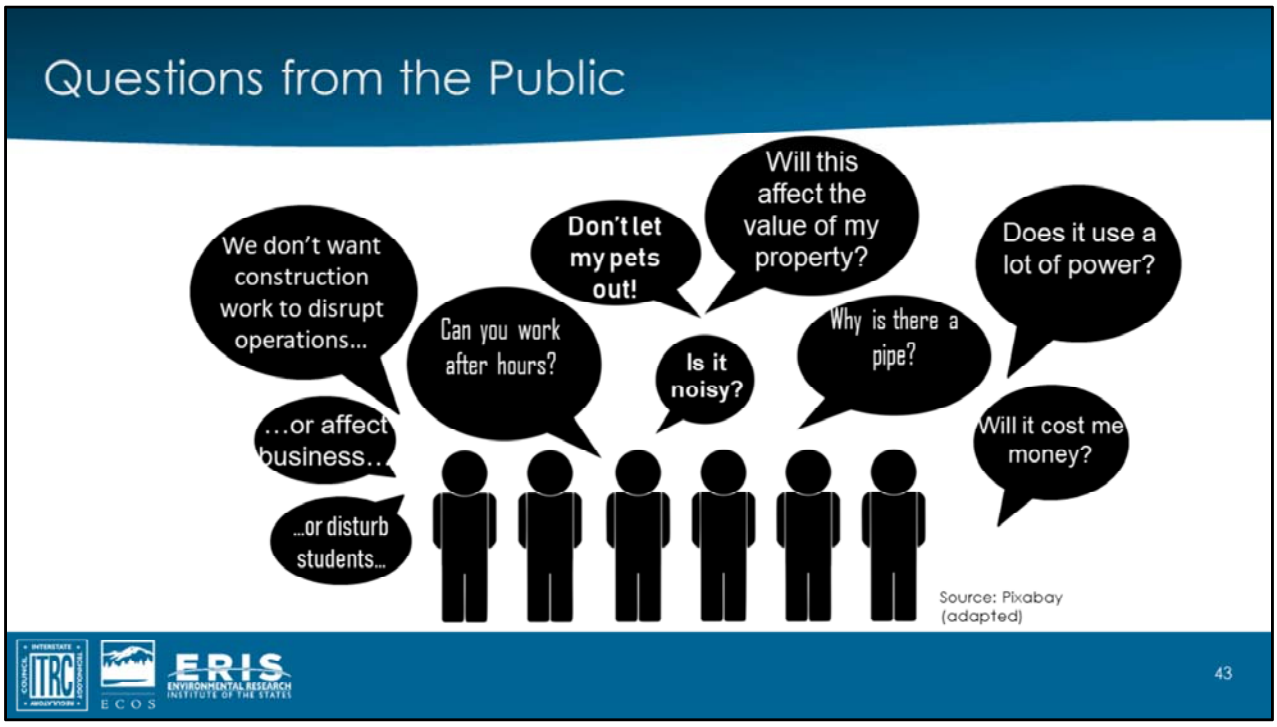


Vapor mitigation communication is complicated.

Use analogies. You can try telling people that we're going to install a fan that forms an invisible pressure barrier beneath your building to protect you- but it probably won't be helpful. Many people are familiar with radon mitigation or have at least heard of it. We've listed some states' guidance in document as a resource for you; many of them are aimed at the public and explain systems in a way that is helpful.

Listen to concerns and address them

Partner up. Rely on specialized department of health staff or doctors for health communication. As the document points out, it's important to include people like local health officials and others in your outreach plan so they're available if questions arise.



As you move through the VI investigation into mitigation, the questions become less about the mechanics of vapor intrusion and more about logistics and property values.

People may worry that their schedule or their time may be disrupted; what's my electric bill, how loud will this be, who is going to pay for this? The document incorporates possible concerns into a matrix. A simple fact sheet may help address may of these questions. Others can be addressed by simply being responsive- for example maybe you can hide that ugly pipe with a false chimney. Regardless of the concerns, they are important to the building owners and occupants and must be addressed. This maintains the trust and cooperation already established.

Cartoon source (added some bubbles and captions):
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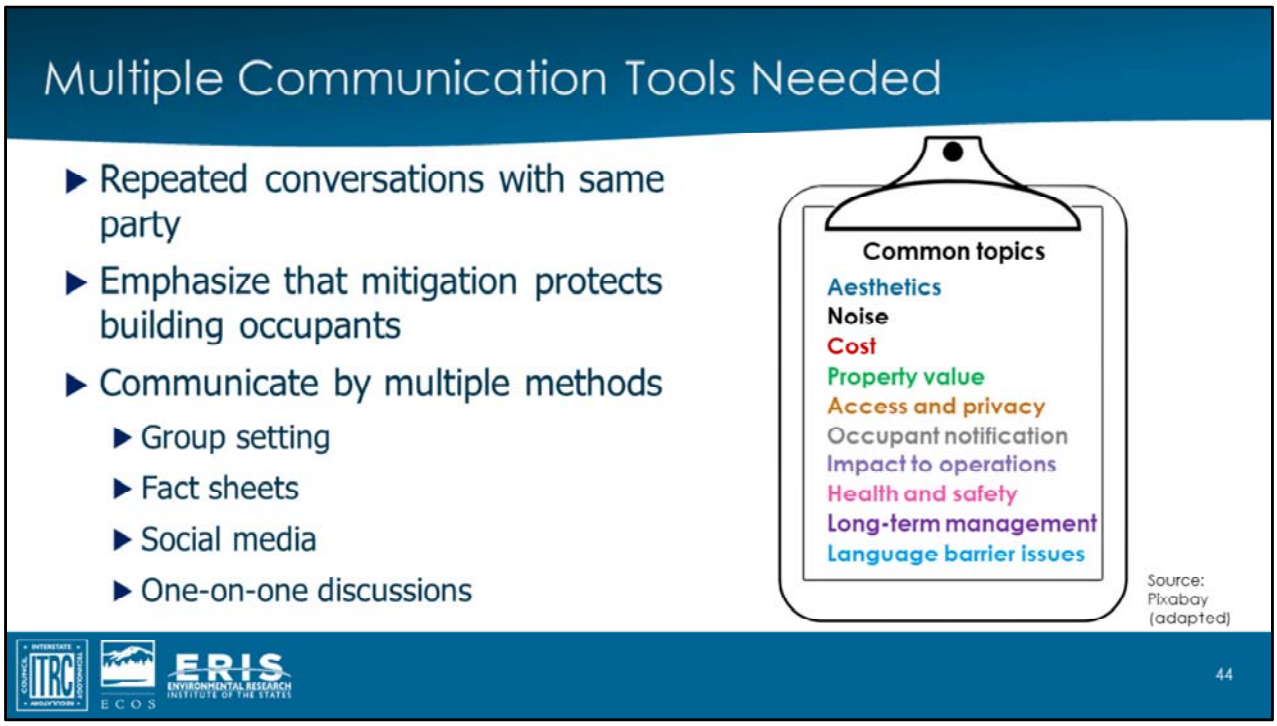

As your project progresses, you might have

Repeated conversations with the same party as the nature of questions change

Remember to emphasize that the reason for the mitigation is to protect people's health.

Use multiple methods of communication. Group settings and one on one discussions both have a place. Remember, mitigation specific questions will arise that people might not have had the wherewithal to think of during initial outreach when concerns about health were high and everything was unfamiliar- so leaving a fact sheet with contact info is a great idea. Social media and dedicated internet sites are also great resources to reach people.

Finally, we need to realize that communication is everyone's job. Vapor mitigation projects have a lot of moving parts and a lot of people involved. Every interaction matters- and perception matters. Consider that mitigation field personnel and designers will be interacting with people in their houses and they're not trained communicators. Every stakeholder plays a role in communication.

Also be mindful of situations where the occupant is not the owner. The resident might not have all of the information given to the owner or vise versa. It is the consultant's responsibility to inform the mitigator and field personnel what can be shared while at the property and who to direct occupants to for additional information. This coordination needs to take place in advance of mobilizing to the

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Cartoon source: https://pixabay.com/vectors/teachers-meeting-books-reading-23820/
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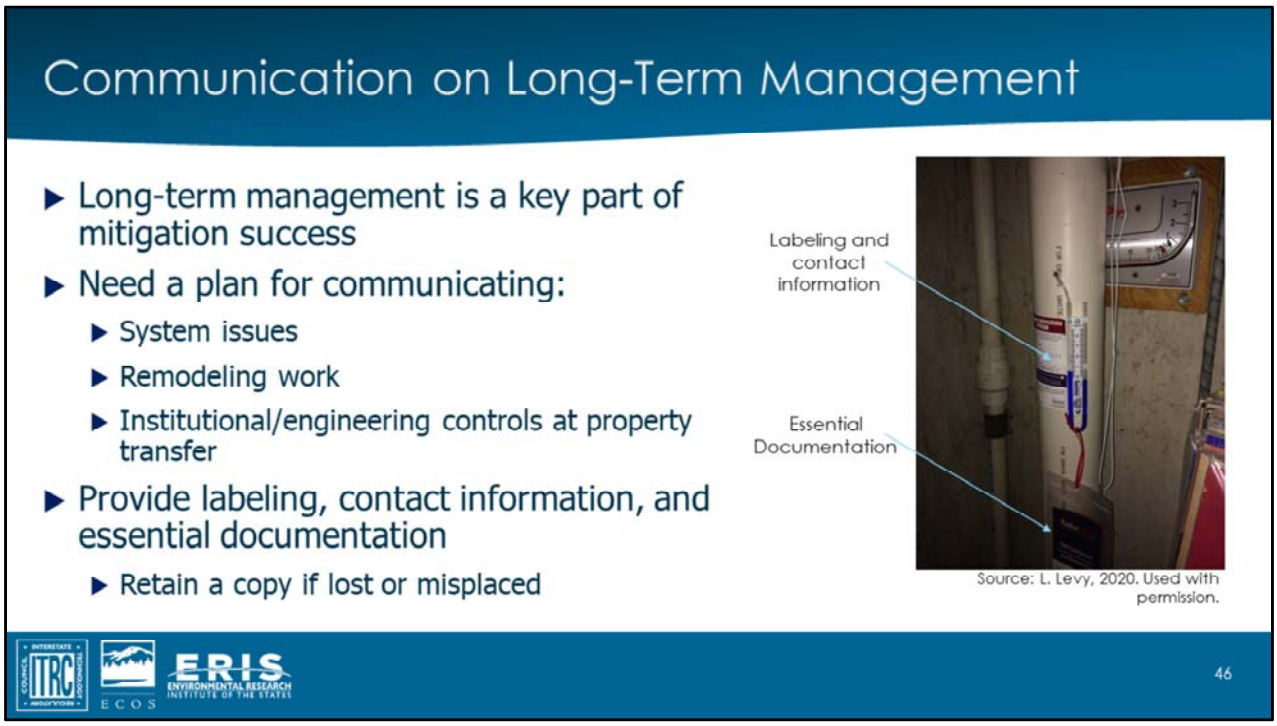

Long term management is a key part of mitigation success- want to make sure your system continues to work. We can't simply hand over a manual to the owner or occupant and hope for the best. Different states will have different methods of addressing long term management and it may not always be the responsible party. So you'll need a plan communicating how to address system issues, changes to the structure, institutional or engineering controls at property transfers.

One of the best ways to encourage longevity of critical information, is to tie it to the system:

-labeling with contact information on a sticker,

-tie the manual to the system,

-include the closure letter and/or a copy of the administrative controls that clarify responsibility for the long-term operation and maintenance of the system.

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For Photo – Documentation includes Information, manual, and/or closure letter & admin controls attached to system

Photo taken by L. Levy who grants authorization to ITRC.
Note that photo was previously published in A&WMA EM Magazine but L. Levy retains copyright

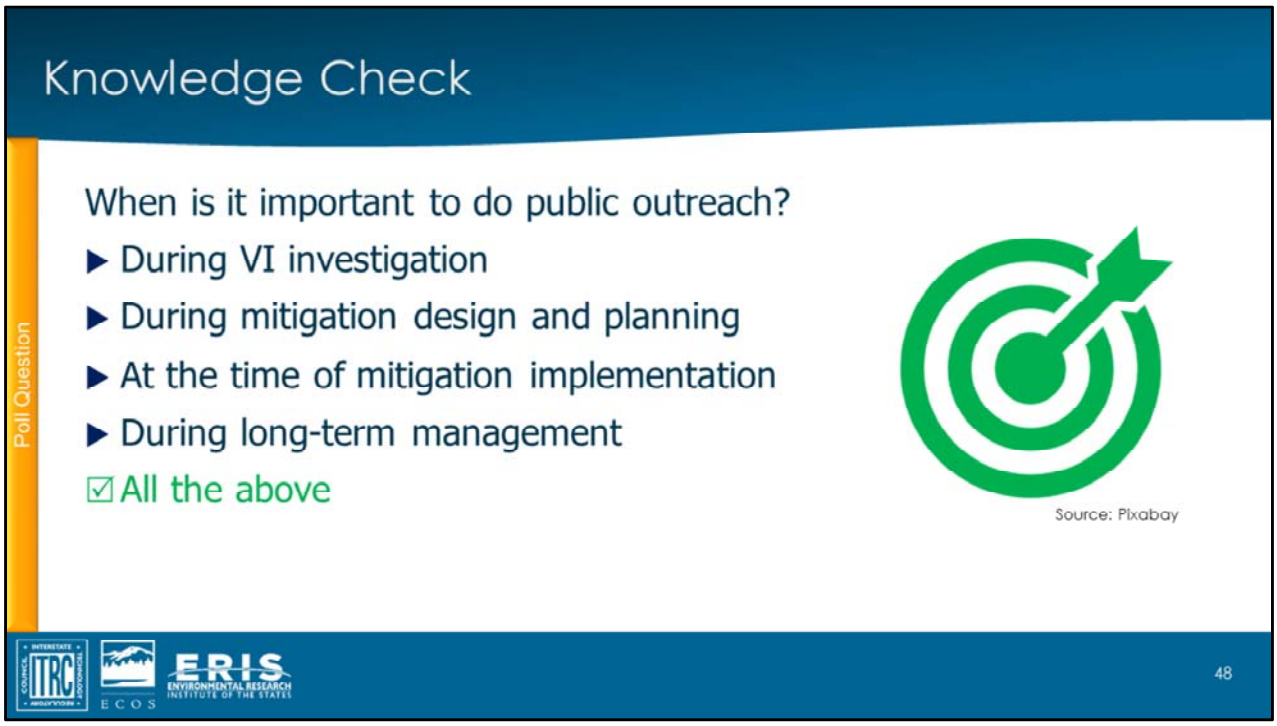
Knowledge Check

Poll Question

When is it important to do public outreach?

- During VI investigation
- During mitigation design and planning
- At the time of mitigation implementation
- During long-term management
- All the above

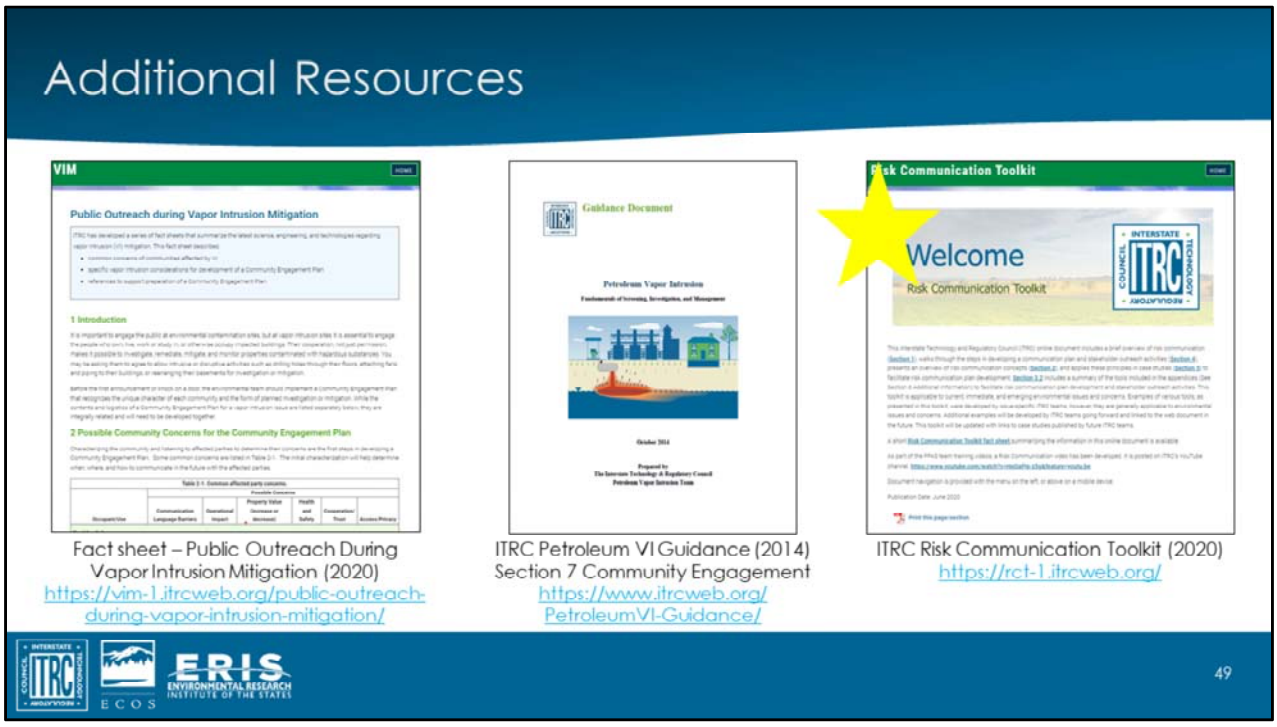
Image source: Pixabay



The correct answer is “all of the above”.

As stated at the beginning of the module, public outreach needs to begin at the vapor intrusion investigation phase. Although that is not the focus of the fact sheet, it is an important point to remember.

The next three bullets are things we’ve talked about how while the reason/ focus of outreach may change as the project progresses, the need is continual. This includes making sure that the right people are educated and engaged in the long-term management of the system. If the system isn’t maintained because of inadequate communication on the management plan, there is no point in installing it in the first place.



As stated at the start of this section, public outreach has a separate fact sheet. It focuses on the difference with public outreach for vapor intrusion than other environmental work.

Another good resource is the ITRC PVI Guide from 2014 that includes a detailed section on Community Engagement. (Section 7 ITRC PVI 2014)

Additionally, ITRC published a Risk Communication Toolkit in June 2020. This is a great resource that dives deep into the complexities and strategies for successfully communicating with the public on health risk from environmental contamination. The Risk Communication Toolkit is not specific to vapor intrusion but is directly applicable.

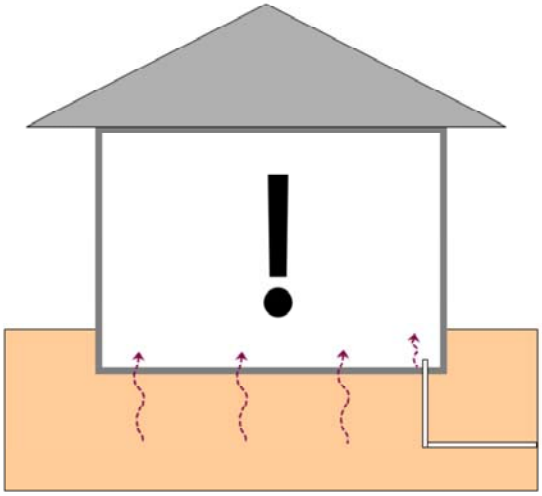
More resources are also included in the Public Outreach Fact Sheet (e.g., FDA Plain Language Principles)

Question & Answer Break

Source: Pixabay

Advancing Environmental Solutions

Rapid Response for Vapor Intrusion Mitigation



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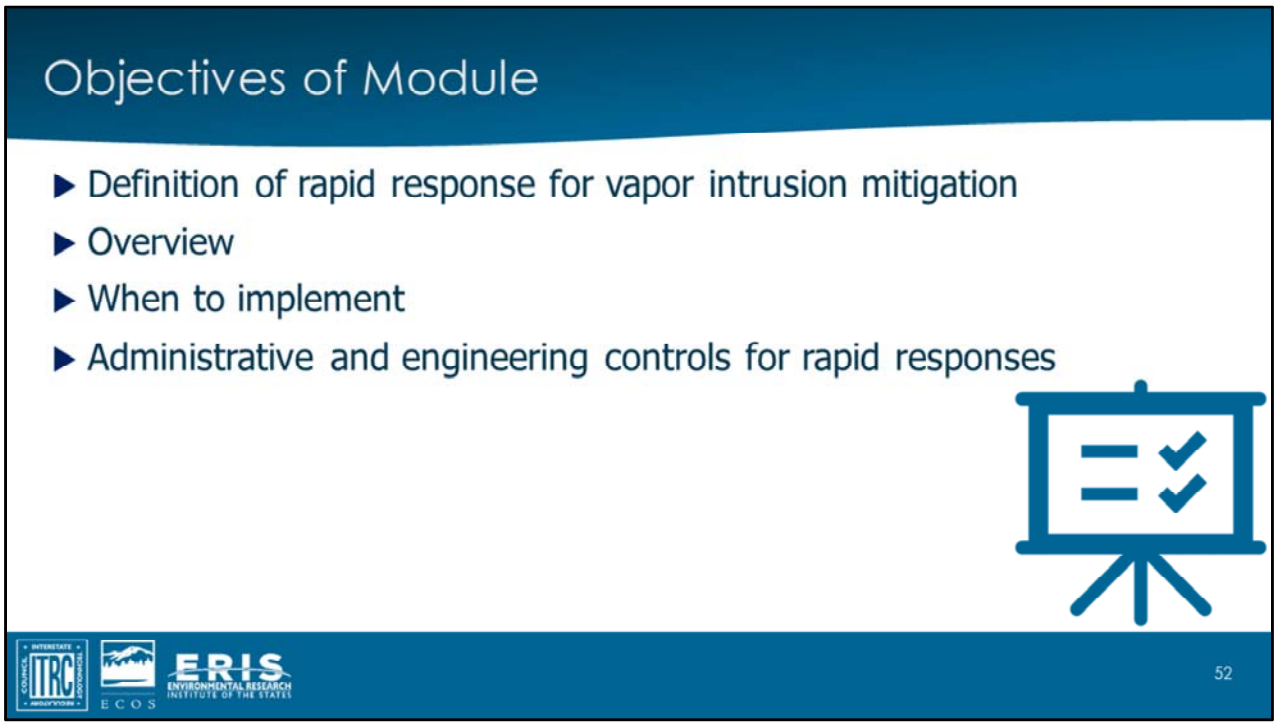
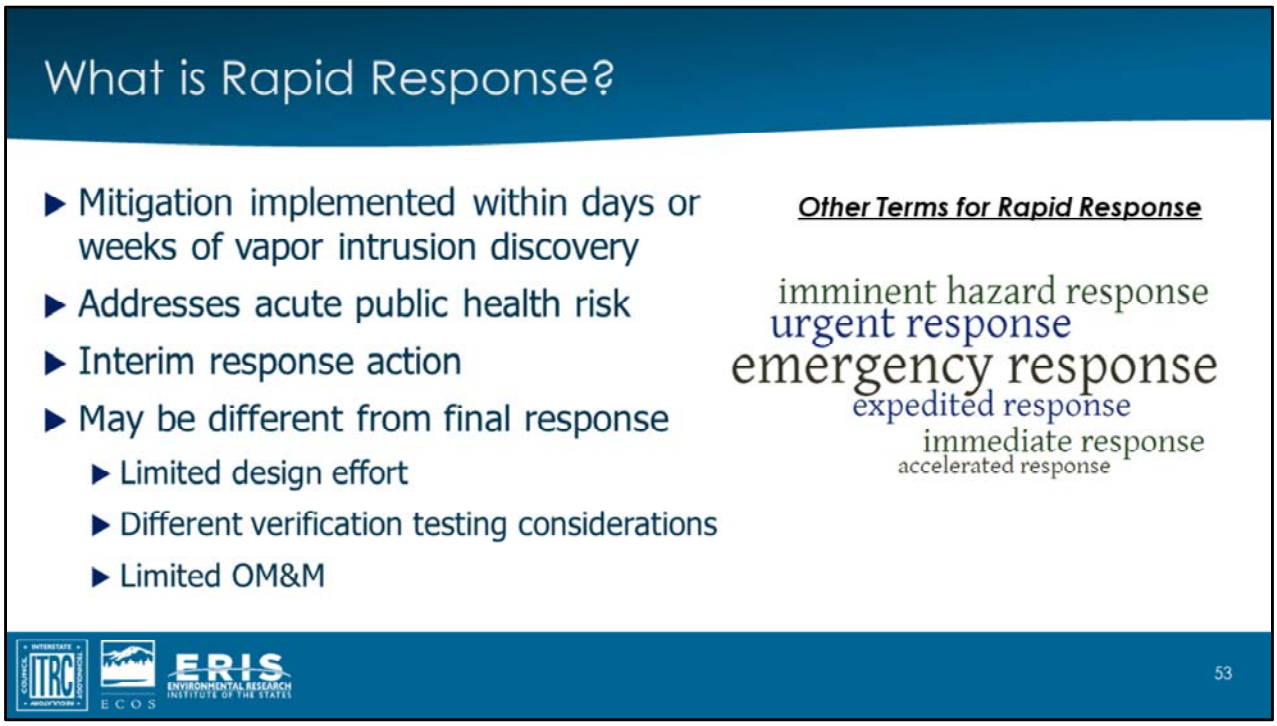


Three key ideas:

(1) What a rapid response is and how it differs from a long-term vapor intrusion mitigation strategy

(2) Be able to recognize the conditions for which a rapid response is appropriate.

(3) Be familiar with the administrative and engineering controls that are available, including preferential pathway sealing and ad hoc ventilation, indoor air treatment, and HVAC modification.



Rapid response is an interim VI mitigation approach that may be appropriate, under certain conditions (e.g., high contaminant concentrations and sensitive populations present), prior to implementing a long-term mitigation strategy.

For the purposes of this presentation, a rapid response is one that could be easily implemented and verified on a timescale of days to weeks.

The main purpose of a rapid response is to address acute risk. Trichloroethylene (or TCE), for example, is one of the most common compounds seen as presenting an acute risk from exposure via vapor intrusion.

A rapid response is considered an interim response action because it can be implemented prior to the final mitigation strategy. A long-term mitigation strategy (for example, SSD) typically takes longer to design and implement but is more effective in addressing the remaining source of VOCs. Though in many circumstances a rapid response efforts, such as crack sealing, can supplement a permanent mitigation strategy.

The requirement for a rapid response can vary significantly from state to state and between regulatory programs. The criteria that may trigger the need for a rapid response and the timeframe that qualifies a response as “rapid” also vary between jurisdictions.

Lastly, the terminology used to describe a rapid response can vary but common factors are (1) an acute risk is present and (2) an interim action is needed before to long-term mitigation can be implemented.

What is not covered in these presentations

- Emergency response actions – Immediately contact first responders if
  - Reports of strong petroleum odors
  - Evidence of combustible, explosive, or oxygen-deficient conditions inside the building
- Methane mitigation or hazardous substances that have a high explosive potential
- Radon

Source: ITRC Petroleum VI Guidance (2014)

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The scope of this presentation is limited to scenarios where there may be an acute risk to human health from chemical VI and does not include “emergency” situations (i.e., “call 911” situations).

If these conditions are believed to be present, first responders should be contacted immediately. Other related topics that are not addressed in this presentation include methane and radon mitigation.

Knowledge Check

Poll Question

Which of these scenarios could warrant a rapid response?

A. Petroleum vapor intrusion has been documented in a vacant gas station
B. High levels of TCE have been detected in sub-slab soil gas at maternity clinic
C. TCE levels have been detected slightly above state vapor intrusion action levels at an occupied commercial building
D. Benzene has been detected at high levels in soil gas at a vacant lot planned for redevelopment

Image source: Pixabay

Knowledge Check

Poll Question

Which of these scenarios could warrant a rapid response?

A. Petroleum vapor intrusion has been documented in a vacant gas station

B. High levels of TCE have been detected in sub-slab soil gas at maternity clinic

C. PCE levels have been detected slightly above state vapor intrusion action levels at an occupied commercial building

D. Benzene has been detected at high levels in soil gas at a vacant lot planned for redevelopment

Source: Pixabay

Rapid Response & Ventilation Fact and Tech Sheets

- Defines what is a rapid response and when to implement
- Lists administrative and engineering controls for rapid responses

https://vim-1.itrcweb.org/rapid-response-ventilation-for-vapor-intrusion-mitigation-fact-sheet/

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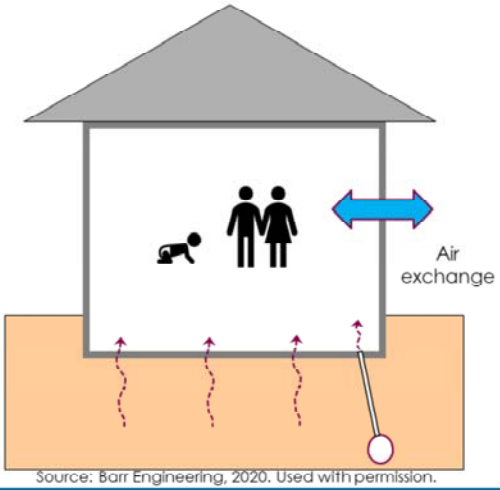
In addition to the vapor intrusion mitigation training, there are a variety materials available on ITRC's website. For rapid response there is a fact sheet and three tech sheets.

The fact sheet provides an overview of rapid response and a brief description of the administrative and engineering controls available for rapid response.

The three tech sheets provide detailed information about the three engineering controls available for rapid response which we will discuss in the following slides.

Rapid Response Focused on Structure and Occupants

- Building occupants
- Preferential pathways
- Building pressure
- Air exchange rate



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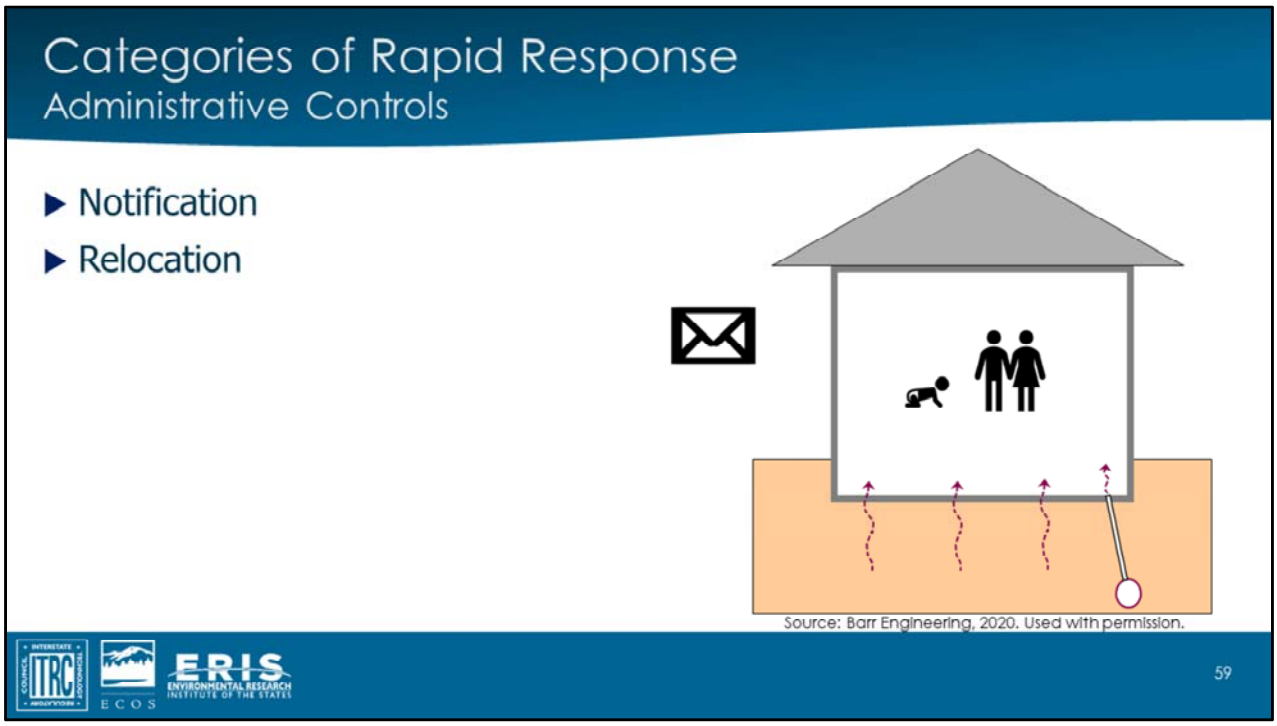
We just went through the broad CSM for all mitigation approaches.

Long-term mitigation approaches often focus on the building structure, the sub-slab zone below the structure, and the contaminant sources.

However, rapid responses are focused primarily inside the building and on its occupants which is where rapid responses play out.

Elements of the CSM that are important for rapid response are the building occupants, preferential pathways, and building pressure and air exchange rate.

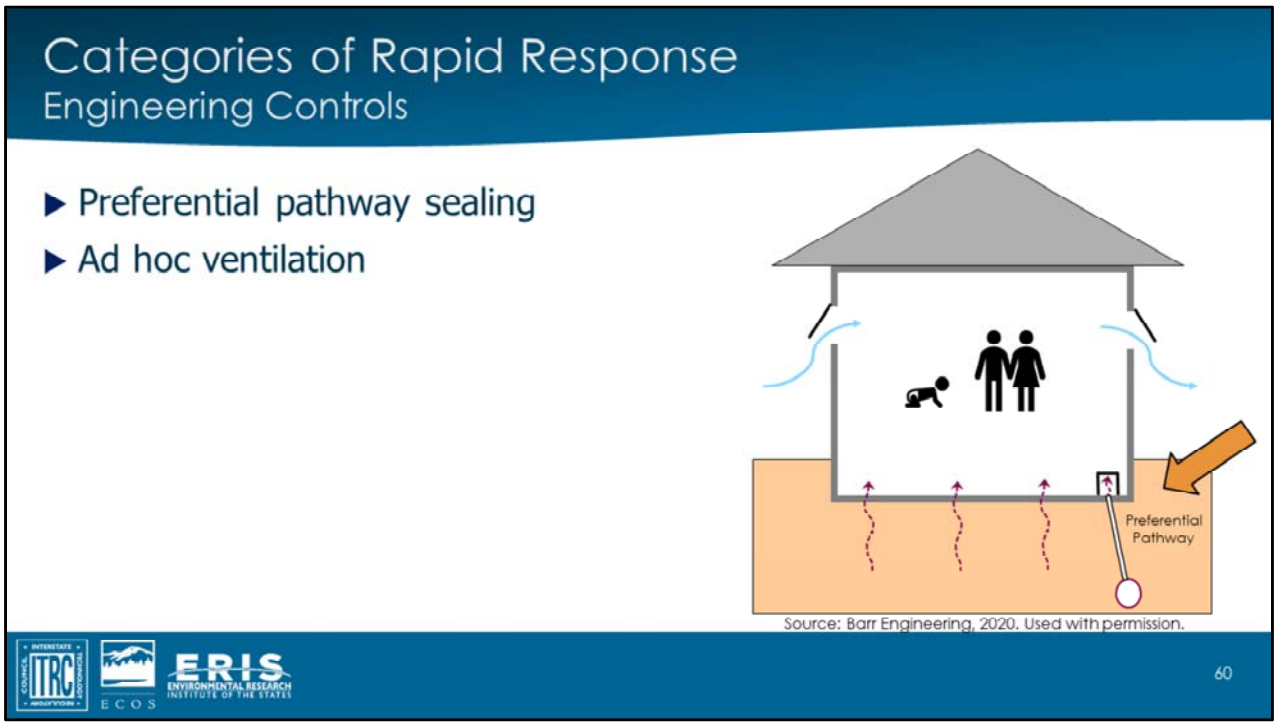


At a high level, rapid responses can be grouped into two categories: administrative controls and engineering controls. The first category, administrative controls.

[click] Notification is simply providing the building occupant with information. This could be general vapor intrusion 101-style factsheets or it could also be more site-specific if that information is available and relevant. Consider partnering with local health agencies to coordinate notification efforts.

[click] Relocation is simply removing occupants from the structure where vapor intrusion is occurring. Relocation is a fairly drastic measure and is not common. However, it may be prudent in specific situations where contaminant concentrations are unusually high or sensitive populations are present.

Putting single family home residents in a hotel often comes to mind with relocation, but it could also include moving people to a different part of a building or limiting the amount of time or sensitive populations from a specific area.



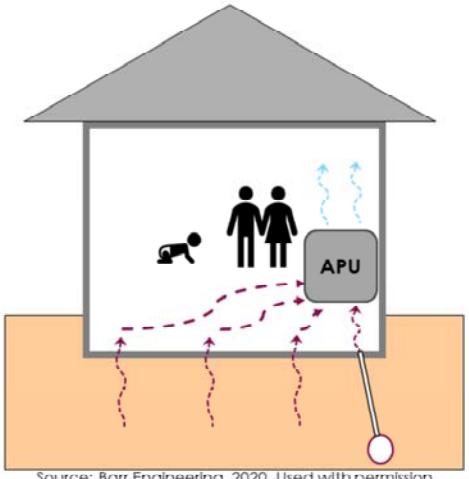
The other category of rapid response measure for vapor intrusion mitigation is engineering controls. Engineering controls are physical changes that are made to the building or the way building systems function to limit or eliminate occupant exposure to contaminants entering the building via vapor intrusion. This presentation focuses on three technologies that can be implemented rapidly to mitigate vapor intrusion.

The first technology is actually two grouped together, they are preferential pathway sealing and ad hoc ventilation.

[click] Preferential pathway sealing involves closing or sealing large openings in the building envelop that allow vapors to enter the building, while ad hoc ventilation [click] involves increasing the air exchange rate within the building by opening windows or doors.

Categories of Rapid Response
Engineering Controls

- Preferential pathway sealing
- Ad hoc ventilation
- Indoor air treatment



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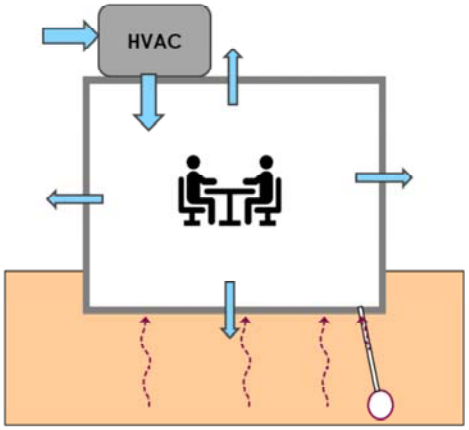
The second rapid response engineering control technology is indoor air treatment.

This involves deploying an air purifying unit, or APU, to reduce concentrations of contaminants in indoor air quickly.

Categories of Rapid Response
Engineering Controls

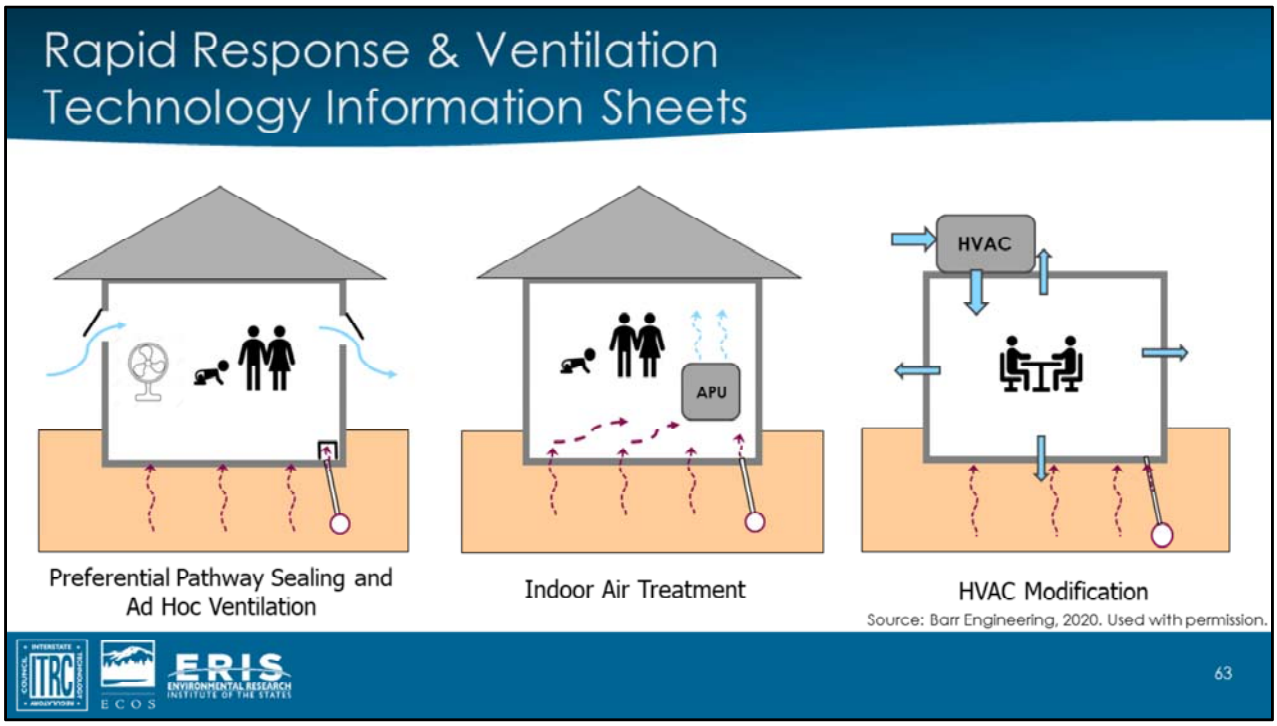
- Preferential pathway sealing
- Ad hoc ventilation
- Indoor air treatment
- HVAC modification



Source: Barr Engineering. 2020. Used with permission.

Lastly, there is HVAC modification.

HVAC modification involves changing the way the building is ventilated or pressurized to dilute the concentration of contaminants in indoor and/or prevent vapors from entering the building.



The second half of this presentation will focus on the three engineering control technologies I just described: preferential pathway sealing and ad hoc ventilation, indoor air treatment, and HVAC modification.

For each of these technologies we will give a brief overview, list the key components of each technology, and provide some additional considerations for each technology.

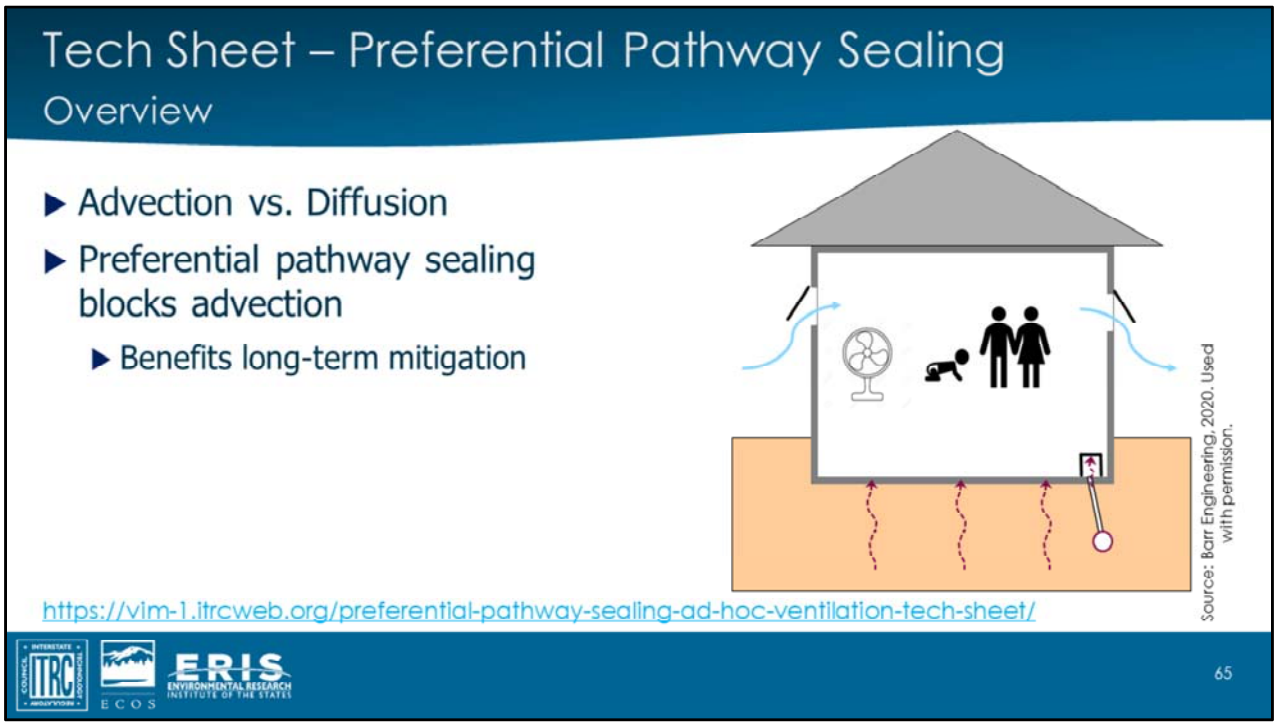
Poll

Poll Question

Which of these administrative and engineering controls have you implemented or seen implemented? (Check all that apply)

A. Notification
B. Relocation
C. Preferential Pathway Sealing and Ad Hoc Ventilation
D. Indoor Air Treatment
E. HVAC Modification

Source: Clipartmax.com



When we are thinking about how vapors enter a building and pass through the building envelope, we need to consider two mechanisms: diffusion and advection.

Diffusion is the slow process of vapor-phase contaminants migrating from areas of high concentration to lower concentration.

Advection is the transport of vapor-phase contaminants via air flow. Advection is driven by pressure and can account for the majority of contaminant flux into building, especially when there are large openings or preferential pathways for flow to occur.

The purpose of preferential pathway sealing is to directly block those pathways that allow for flow into the building.

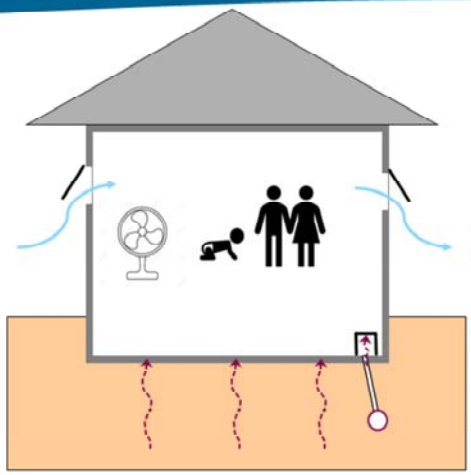
These openings can include floor cracks, gaps around utility penetrations or at foundation walls, open sumps or land drains, and areas where the slab significantly damaged or deteriorated.

Blocking these openings is typically very low-cost and provides a high return for reducing vapor entry into the building.

Tech Sheet – Ad Hoc Ventilation

Overview

- Ad hoc ventilation = dilution
  - Weather dependent



Source: Barr Engineering, 2020. Used with permission.

https://vim-1.itrcweb.org/preferential-pathway-sealing-ad-hoc-ventilation-tech-sheet/

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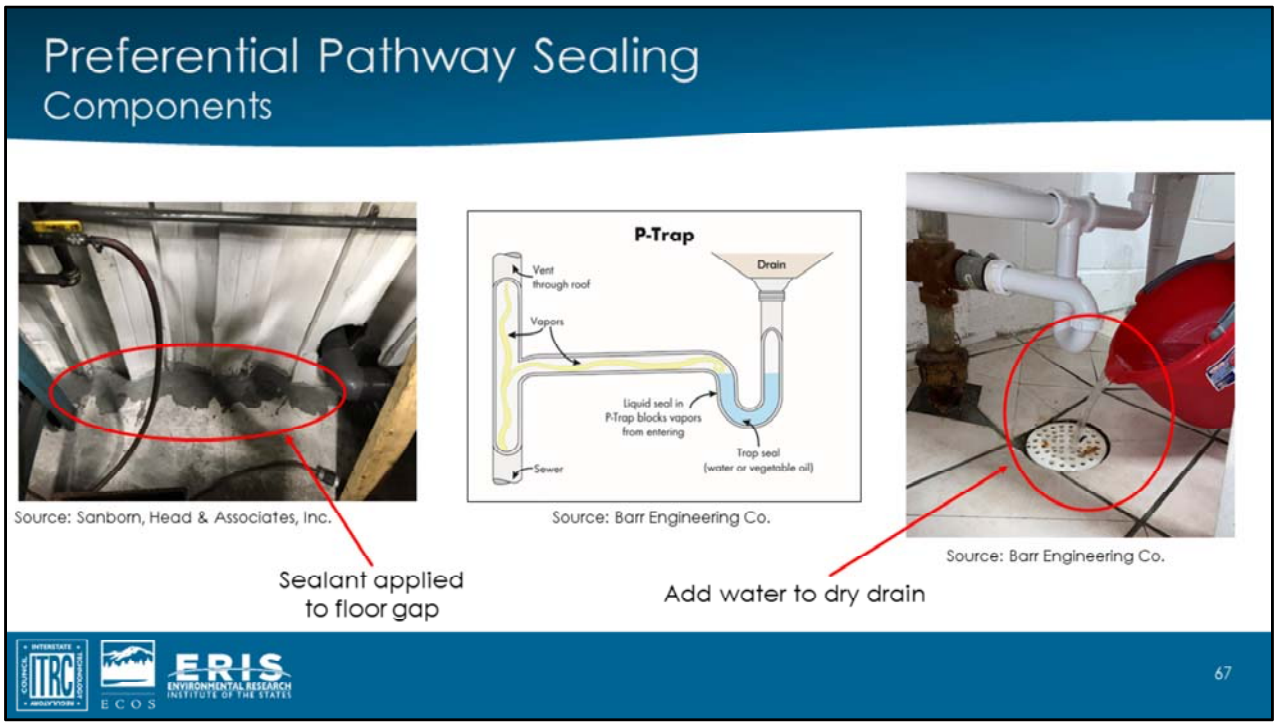
Opening windows and doors can increase the air exchange with for a building thereby diluting the concentration of contaminants in indoor air.



The general components of preferential pathway sealing include caulks and sealants that can be applied to cracks, gaps, and around utility penetrations.

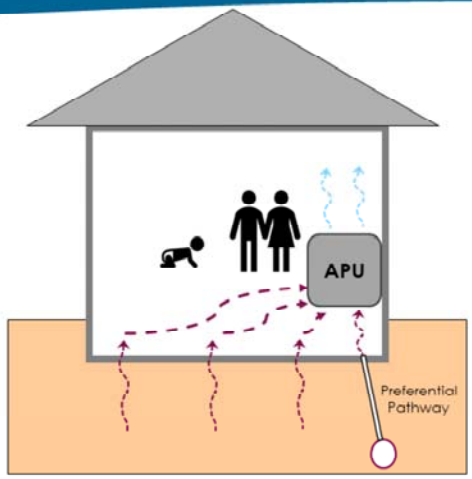
Attention should be paid to the material properties of the sealant (e.g. flexible, non-shrinking), whether it contains VOCs that could affect indoor air sampling results, and if the area needs special preparation before applying.

Off the shelf and "made on the fly" covers can be placed over larger openings like sumps or holes in a slab.

Dry drains or p-traps can be filled with water, or vegetable oil for infrequently used drains because it doesn't evaporate.

Tech Sheet – Indoor Air Treatment
Overview

- Implemented via air purifying units (APUs)
- Treats air inside building
- Subject to human interference



https://vim-1.itrcweb.org/indoor-air-treatment-tech-sheet/

Source: Barr Engineering, 2020. Used with permission.

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Indoor air treatment is implemented by deploying air purifying units, APUs, inside a building or in the area of suspected vapor entry.

APUs work by pulling air in, treating it, then discharging it back into the building.

However, one limitation to the use of APUs is that they are subject to human interference, for example if a tenant turns it off or moves it independently without authorization.

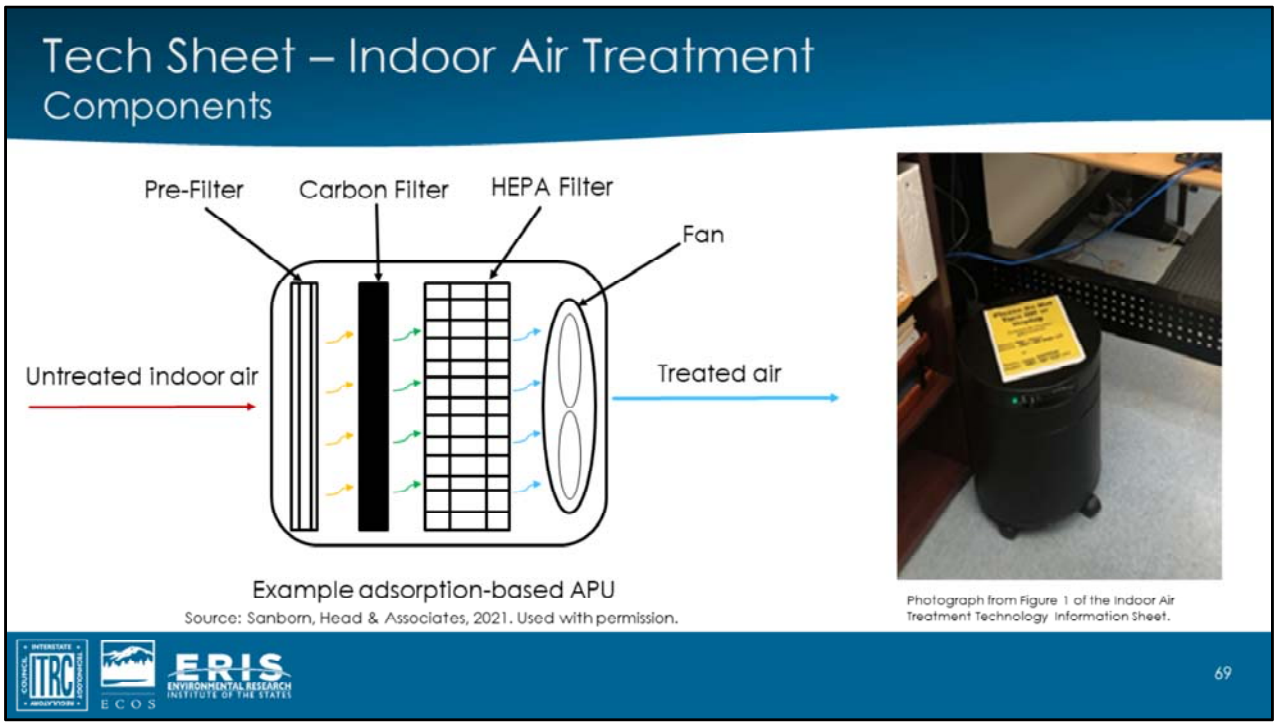


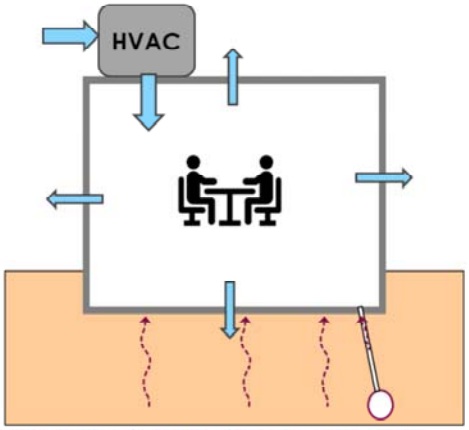
Diagram of a typical adsorption-based APU with carbon as the filter media.

The untreated indoor air is drawn into the unit via an internal fan, passes through a series of filter units (or other media or processes based on the target contaminate) to remove the chemicals and particulates, and then exits the unit as treated air. This is a photo of an typical APU that is generally readily available.

The two most important considerations for selecting and sizing APUs is (1) the chemicals you are trying to remove and (2) the size of the space where they are deployed. May need multiple APUs.

Tech Sheet – HVAC Modification
Overview

- Increase air exchange rate
- Increase building pressure
- Most suitable for commercial/industrial buildings
- Can supplement other mitigation methods



https://vim-1.itrcweb.org/heating-ventilation-and-air-conditioning-hvac-modification-tech-sheet/

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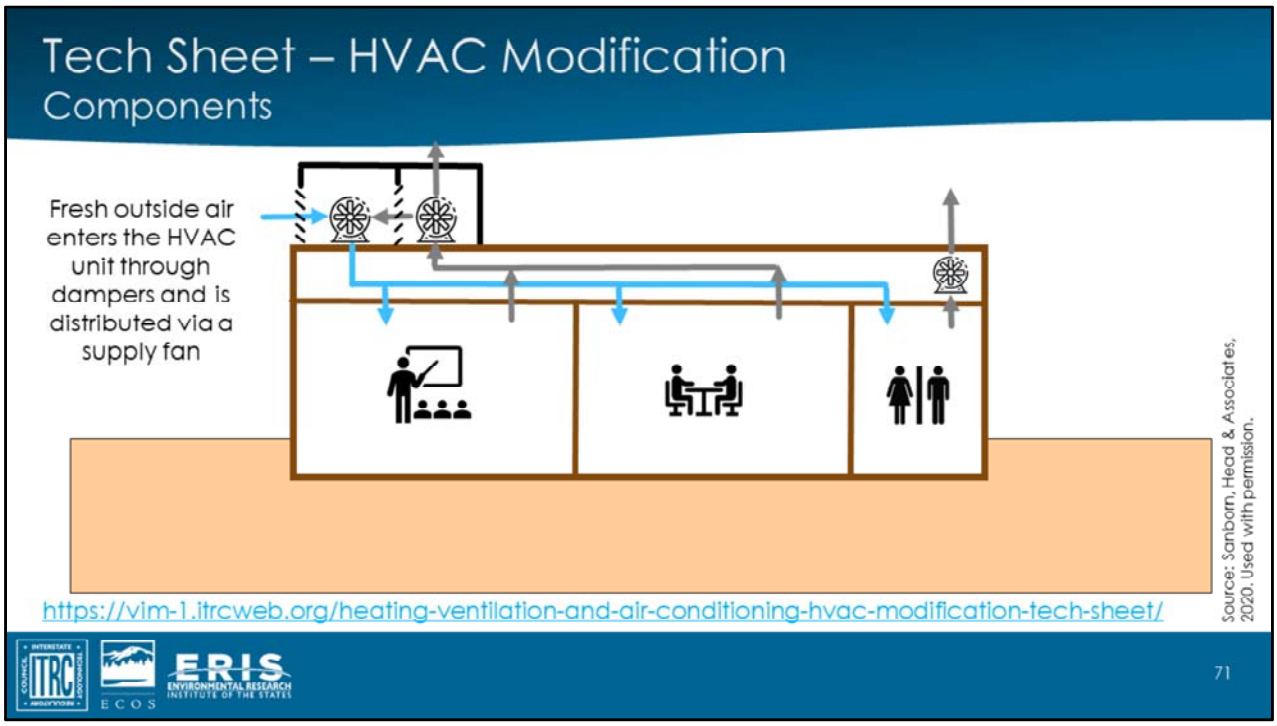
HVAC modification is the third and last technology we will discuss and it involves changing the way the HVAC system operates to increase the amount of fresh air that is coming into the building and/or increase the building pressure to prevent vapors from entering the building.

The technology can be implemented for a rapid response but has also been shown to function as a long-term mitigation strategy as well, especially when supplemented with other VI mitigation methods, such as preferential pathway sealing or a subslab depressurization or venting system.

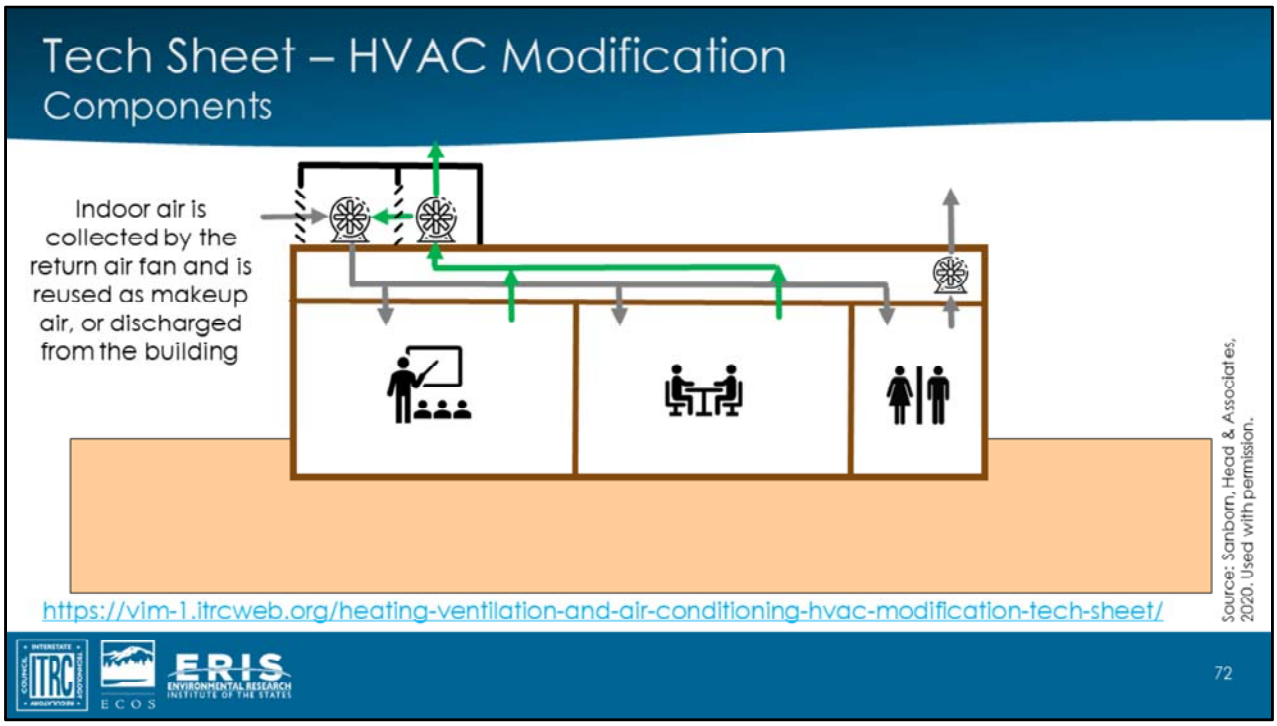
This technology is best suited to larger commercial or industrial buildings that have fairly sophisticated HVAC systems. The use of HVAC modification is not generally applicable to residential buildings.



This diagram shows the basic elements of a typical HVAC system.

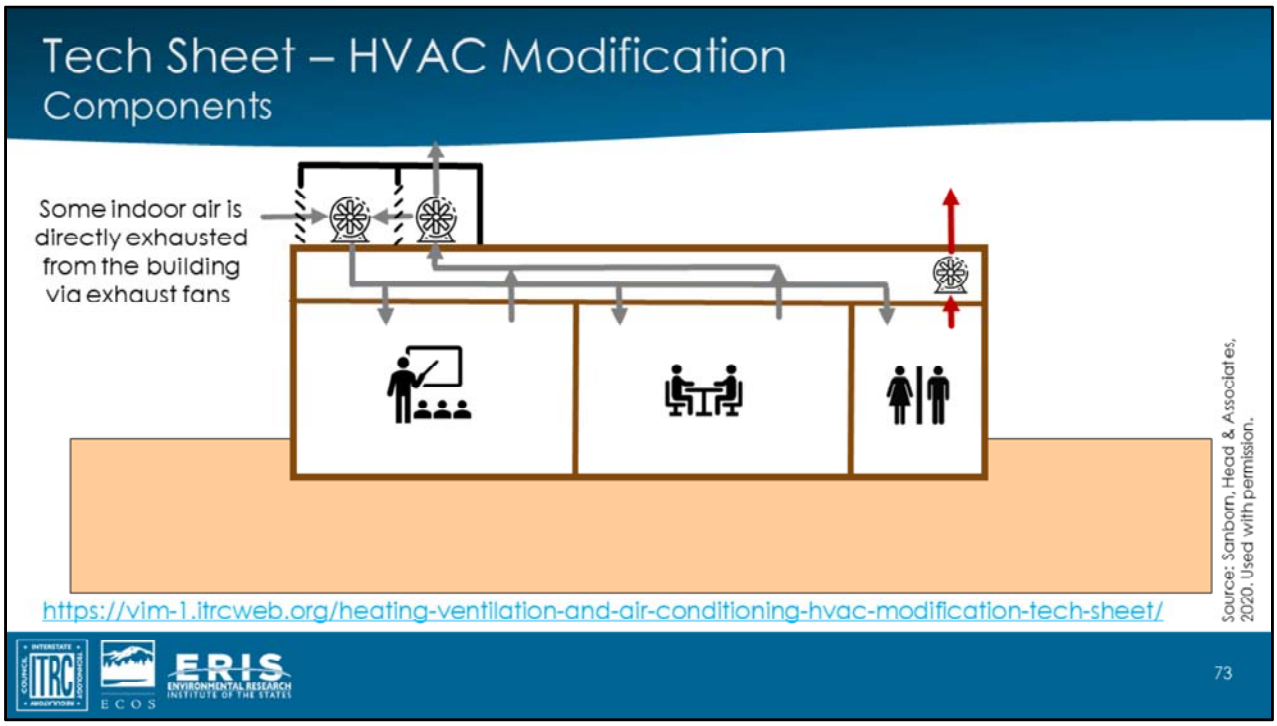
First, outside air enters the system through adjustable dampers. The outside air then gets filtered and conditioned for either heating or cooling. A supply fan or air handling unit then supplies energy to push the conditioned air (shown in blue here) through the air supply ducts to deliver it to the occupied spaces.

Increasing the speed of the supply fan increases the amount of fresh, which can either increase the air exchange rate, or pressurize the building to suppress VI, depending on the amount of air leaving the occupied spaces.



Air from the occupied building space is removed and conveyed through return air ducts via a return air fan, shown here in green. Return air is either sent back to the supply air fan through dampers as makeup air to start the process over again, or is discharged out of the building completely.

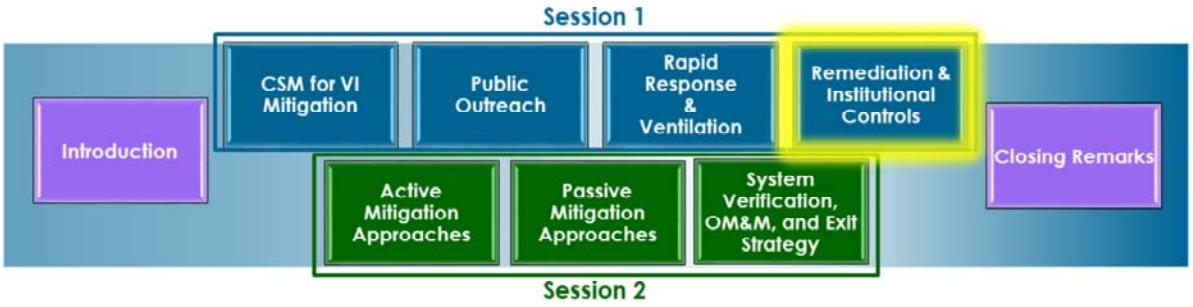
To increase the air exchange rate, the speed of the return air fan must also be increased with the supply fan. To implement building pressurization, the speed of the return air fan would be decreased as the supply fan speed increases, pressurizing the building in relation to the subslab or preferential pathways.



In addition, exhaust fans may be present such as a bath fan or vent hood. These fans directly remove air from the building and discharge it outside, shown here in red. Exhaust fans can be adjusted similar to the return air fans to either increase or decrease the removal rate of indoor air to either increase air exchange rate, or assist in pressurizing the building.

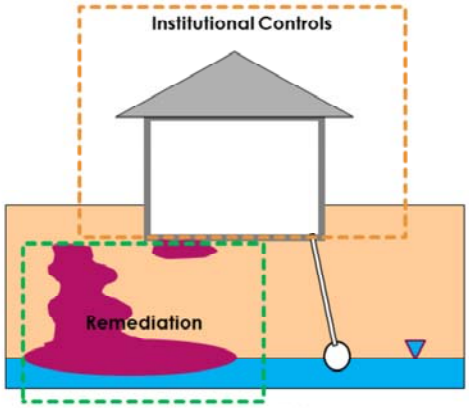
Real life HVAC systems can be more complicated than this so it's important to enlist facility staff and a licensed HVAC contractor or mechanical engineer to ensure that HVAC modifications don't end up exacerbating vapor intrusion conditions.

Coming Up Next…



ADVANCED ENVIRONMENTAL SOLUTIONS

Environmental Remediation & Institutional Controls



Source: Geosyntec & GSI Environmental, 2020. Used with permission.

- This module covers environmental remediation and institutional controls as they relate to VI mitigation.
- The goal is to provide an overview of how certain remediation technologies can also serve as VI mitigation, and to provide an introduction to Institutional Controls. This will help in the evaluation of the applicability of these methods to VI sites.
- The training content in this module is based on three ITRC Fact Sheets, described in more detail in the presentation.

Objectives of Module

- Difference between remediation and mitigation
- Description of two soil vapor remediation methods that address vapor intrusion (VI)
- Introduction to institutional controls (IC)

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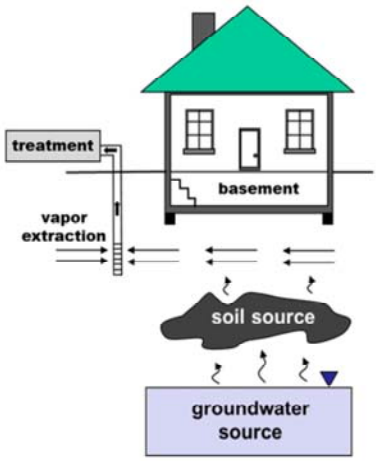
- The presentation discusses the differences (and similarities) between remediation and VI mitigation, provides description of two remediation methods that can also serve as VI mitigation, and introduces the institutional controls.
- At the end of today's presentation, the listener should be familiar with the remediation/mitigation technologies and ICs, as well as with key evaluation criteria to determine whether any of these are appropriate for your site.

Remediation vs. Mitigation

REMEDIATION

- Reduce mass in the source medium: soil, groundwater, or free phase
- Site-wide
- Longer-term installation, i.e., months



Source: Shell Global Solutions (US) Inc.
Used with permission.

MITIGATION

- Limit or prevent exposure at some point along the VI pathway
- Building-specific
- Shorter-term installation, i.e., weeks
- May also provide a remediation benefit

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- There are similarities between the remediation and VI mitigation; the difference is sometimes the mater of degree. However, some basic differences can be identified.
- Typical goal of remediation: Remove, destroy, or encapsulate contaminant mass, in all affected media, wherever needed on the site, possibly also off-site.
- Remediation typically takes months, often several years to achieve remediation objectives. It is frequently site-wide
- Goal of mitigation: To partially or fully interrupt the VI pathways that may exist. Frequently building-specific
- Mitigation may be implemented in a matter of weeks, although it make take longer, maybe several months, to see results.
- Remediation/Mitigation may include the same elements. For example, remediation may also include addressing exposure

Remediation as Mitigation
Remediation Technologies for the Vadose Zone

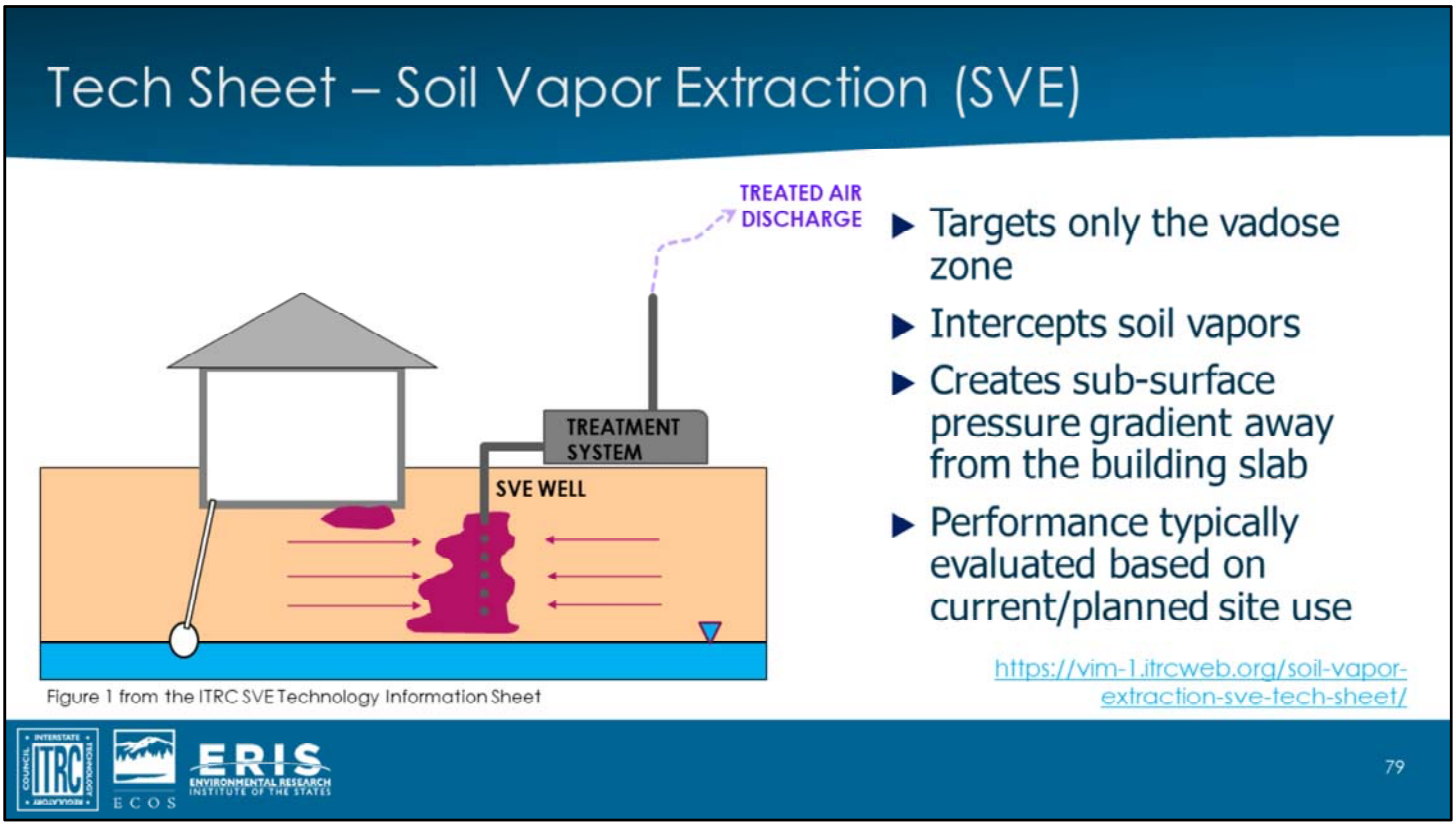
- Targeted COCs: Hydrocarbon and chlorinated solvent vapors
  - Gas/vapor in the vadose zone, and exposure pathway drive the human health risk
  - Mitigation addresses the pathway, remediation can address both
  - Applicable remediation technologies: SVE and MPE

See SVE and MPE Tech Sheets.

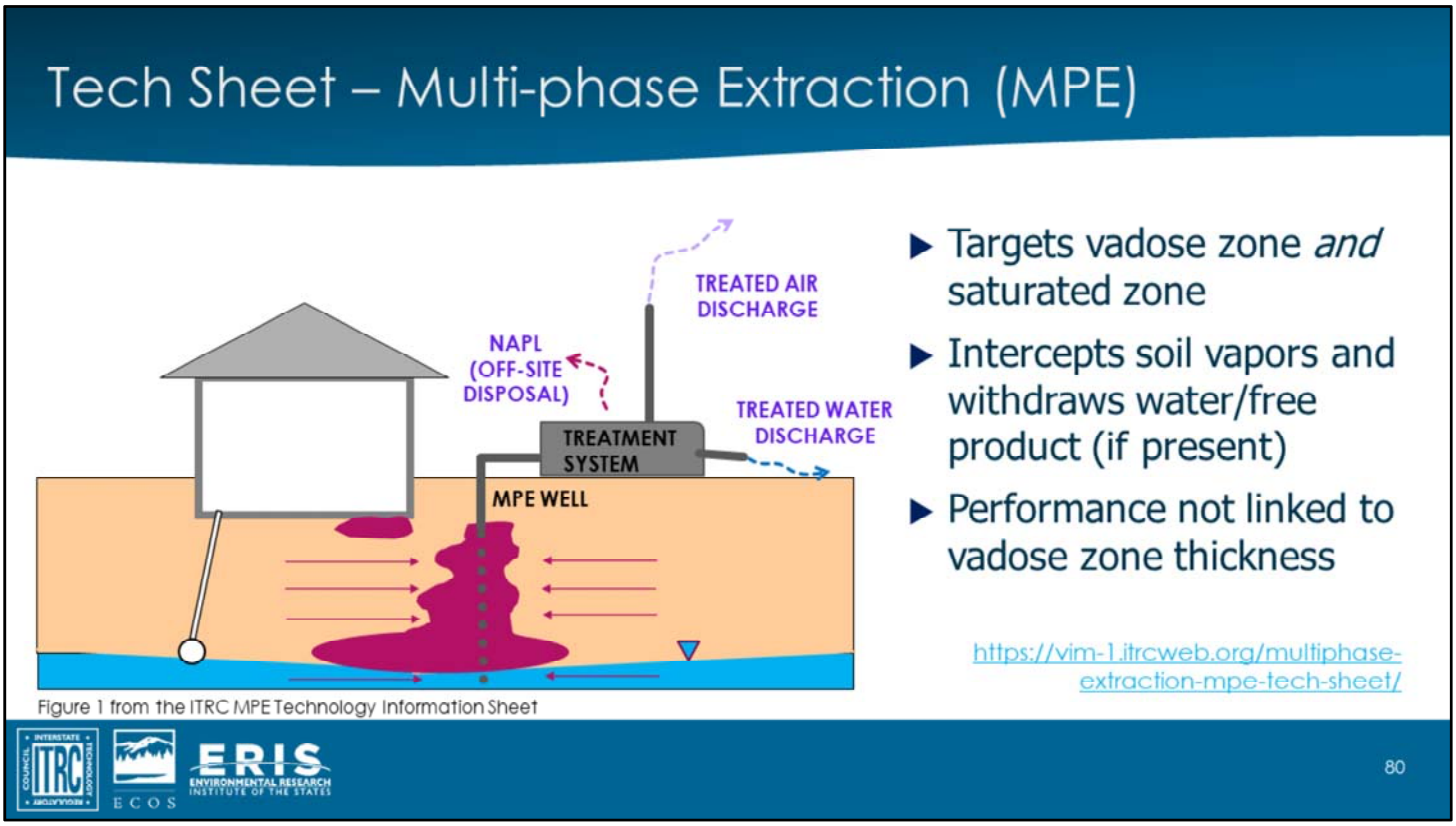
https://vim-1.itrcweb.org/soil-vapor-extraction-sve-tech-sheet/

https://vim-1.itrcweb.org/multiphase-extraction-mpe-tech-sheet/

- The presence of hydrocarbon vapors, and an exposure pathway drive the human health risk related to VI.
- Reducing the COC concentrations or interrupting the exposure pathway reduces the health risk.
- Mitigation works by interrupting the pathway, remediation can address both the pathway and COC concentrations (SVE, MPE). For additional information, see the SVE and MPE Technology Information Sheets.
- Additional consideration: Some source remediation technologies that are not specifically intended to affect soil vapor may influence operation of VI mitigation systems, either positively or adversely. Examples: technologies that produce soil vapor (e.g. ISCO, thermal) or redirect the flow of soil gas (e.g. capping) may result in an increase in VI in nearby structures. Technologies that reduce the COC concentration (e.g. plume capture resulting in plume collapse) may shorten the time required to continue the VI mitigation.

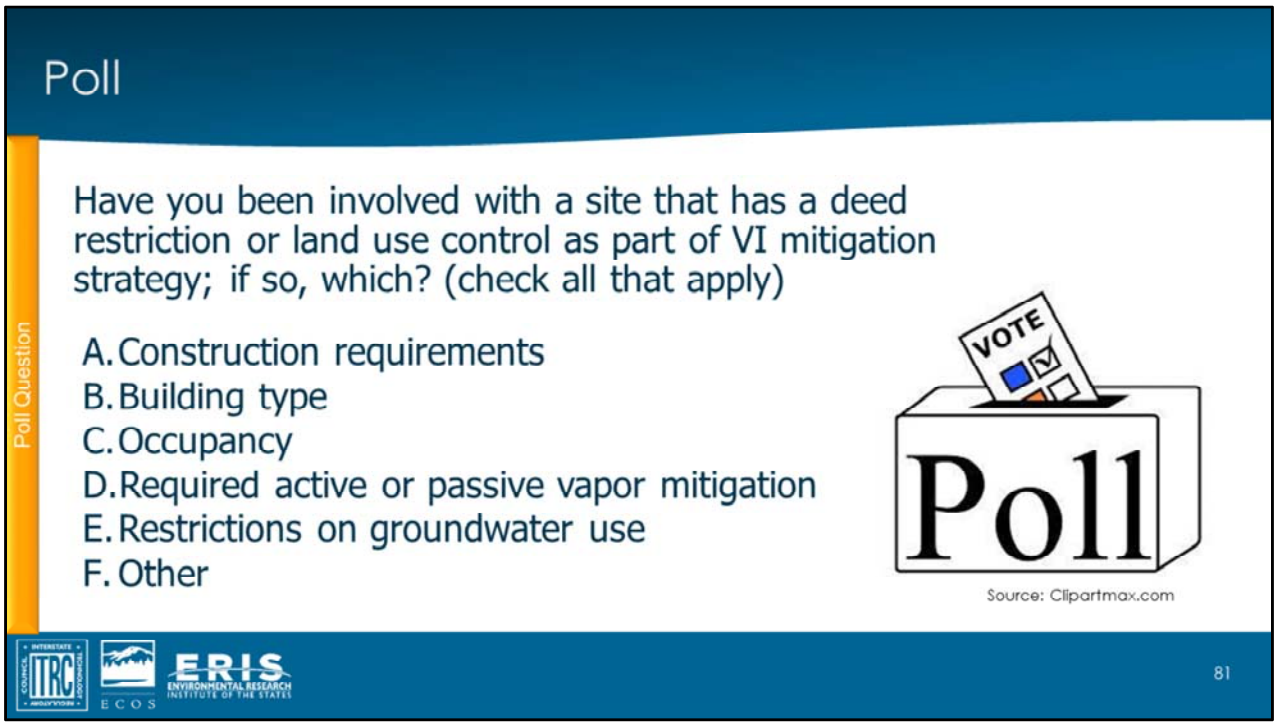


- Refer to the ITRC SVE Technology Sheet
- SVE provides both source remediation and VI mitigation
- VI mitigation mechanism is similar to that of the SSDS
- Design Considerations
  - Source areas – see also CSM module
  - Structure layout – new or existing? Basement or slab on grade? Ground cover?
  - Groundwater elevation – must have a vadose zone of sufficient thickness and permeability for SVE to work well.
- Applicability of SVE for VI mitigation
  - Small sites (single building) → mobile or repurposed system → rapid deployment
  - SVE may also be implemented on larger, multi-building sites; however, it takes longer to implement as is not applicable as VI mitigation.
- Components and Operation
  - SVE wells/trenches
  - Mechanical extraction, i.e., blower
  - Vapor treatment equipment (if required)
  - Low permeability surface cover (optional) – increases efficiency
  - Air supply wells (optional) – increases "flushing" rate
- It is important to consider the exit strategy – remediation exit strategy may be different than that of the VI mitigation



- Refer to the ITRC SVE Technology Sheet
- MPE provides both source remediation and VI mitigation
- VI mitigation mechanism is the same as that of SVE; however, it can address both sat. And unsat. zones
- Design Considerations
  - Source areas – see also CSM module
  - Structure layout – new or existing? Basement or slab on grade? Ground cover?
  - Groundwater elevation – MPE lowers groundwater table → increase unsaturated zone, improve extraction effectiveness.
- Applicability of MPE for VI mitigation
  - Small sites (single building) → mobile or repurposed system → rapid deployment; larger sites will require more extraction points and a larger treatment system.
  - Need sufficient permeability for vapor/liquid extraction and groundwater drawdown, but can overcome the limitation of SVE systems by temporarily increasing the thickness of the vadose zone.
- Components and Operation
  - Soil vapor and liquid extraction wells/trenches
  - Mechanical extraction
    - Single or dual pump – because have vapor and water
  - Vapor, water, and potentially NAPL treatment equipment (if required)
  - Low permeability surface cover (optional)
  - Air supply wells (optional)

It is important to consider the exit strategy – remediation exit strategy may be different than that of the VI mitigation



- Now we will move to the topic of ICs.
- More detailed information is presented in the ITRC ICs Technology Sheet; here we'll provide a brief overview.
- Quick poll: Have you been involved with a site that has a deed restriction or LUC in place as part of a VI mitigation strategy?
    - You may select any/all answers that apply.
    - [PA NOTE: EG's removed from slide but noted below so you can read them instead]

A. Construction requirements
    - e.g., soil and groundwater handling procedures

B. Building type
    - e.g., prohibit single-family homes

C. Occupancy
    - e.g., prohibit daycare on ground level

- [Wait for poll results to stabilize; comment on outcome.]

Tech Sheet – Institutional Controls (IC)

Source: ITRC Long Term Contaminant Management Using Institutional Controls Guidance

https://vim-1.itrcweb.org/institutional-controls-ic-tech-sheet/

- Long-term measures that provide:
  - Protection from exposure to contaminants
  - Assurance that VI mitigation system will be maintained
- Applied alone or in combination with other remedies

Government controls: Zoning ordinances, groundwater use or drilling limitations, land development regulations, etc.
Proprietary controls: Private agreement between landowner and outside party that "run with the land"
Enforcement mechanisms: Government agency-issued permits, administrative orders, etc.
Informational devices: Provide information about risks from site COCs

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- Goals of ICs
  - Limit exposure to site contaminants
  - Reduce risk
  - Assure that VI mitigation will be maintained
- Types of ICs
  - Government controls
    - Rely on regulatory powers
    - Zoning ordinances, groundwater use or drilling limitations, land development regulations, etc.
  - Proprietary controls
    - Private agreement between landowner and outside party
    - "run with the land"
    - Typically restrict use of the property
  - Enforcement mechanisms
    - Government agency-issued **permits**, administrative orders, etc.
    - Enforceable by state or federal agencies
    - Typically do not "run with the land"
  - Informational devices
    - Provide information about risks from site COCs, e.g.,
      Deed notices, state registries (e.g., GeoTracker, Envirostor), advisories, signs, community participation (CERCLA)
    - Generally not legally enforceable

Knowledge Check

Poll Question

When might you consider implementing ICs?

A. Remediated site that includes a passive venting system
B. Remediated site that includes an active venting system
C. Potential future land development
D. All of the above
E. None of the above

Source: Pixabay

Knowledge Check

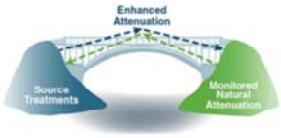
Poll Question

When might you consider implementing ICs?

A. Remediated site that includes a passive venting system
B. Remediated site that includes an active venting system
C. Potential future land development
☑ All of the above
E. None of the above

Source: Pixabay

Additional ITRC Resources



- "DNAPL Source Reduction: Facing the Challenge" (DNAPLs-2, 2002)
- "Enhanced Attenuation: Chlorinated Organics" (EACO-1, 2008)
- "Enhanced In-Situ Bioremediation of Chlorinated Solvents in Groundwater" (ISB-6, 1998)
- "In-Situ Chemical Oxidation of Contaminated Soil & Groundwater" (ISCO-2, 2005)
- "Evaluating LNAPL Remedial Technologies for Achieving Project Goals" (LNAPL-2, 2009)
- "Long Term Management Using Institutional Controls" (IC-1, 2016)

We would like to hear back from you today so please be sure to fill out the online feedback form that's linked on this last slide. You can also access the feedback form by clicking Feedback in the related links section and then clicking browse to. Filling out the feedback form and certifying that you participated will allow you to receive a certificate of completion.

If you need further clarification on the answers or would like to ask more questions, feel free to email us at training@itrcweb.org and we will follow up with our trainers to get your questions answered.

As a reminder, ITRC archives all its training classes, so if you find that you have additional time or looking for additional training opportunities, please visit Clu-In and the archived trainings to see if there are other courses that might interest you.