Updates to DEQ's Vapor Intrusion Approach

Agencies & Consultants Listening Session

Conrad Barry, Franziska Landes, Erin McDonnell, Mike Poulsen and Blair Paulik Aguilar

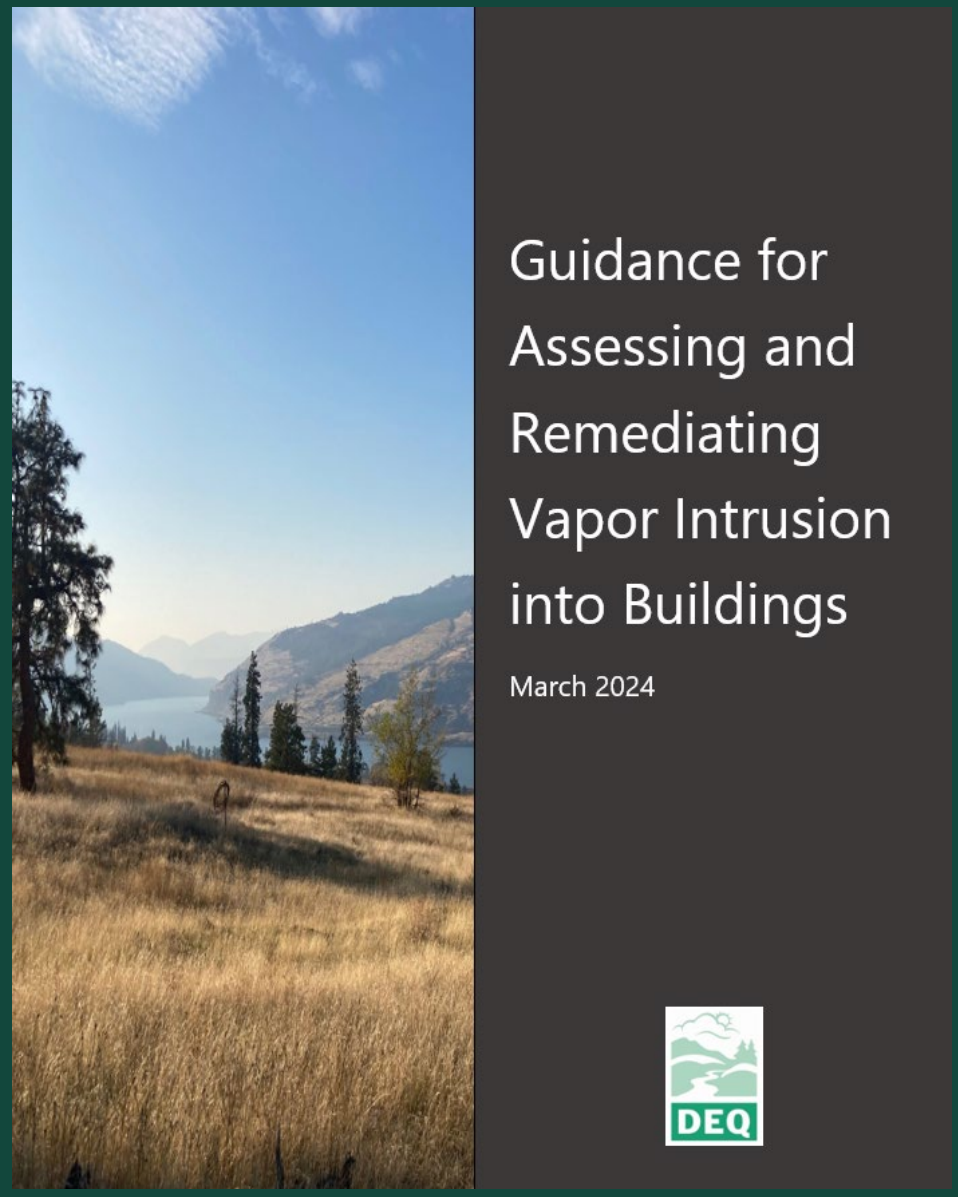
April 17, 2024

Welcome and Introductions

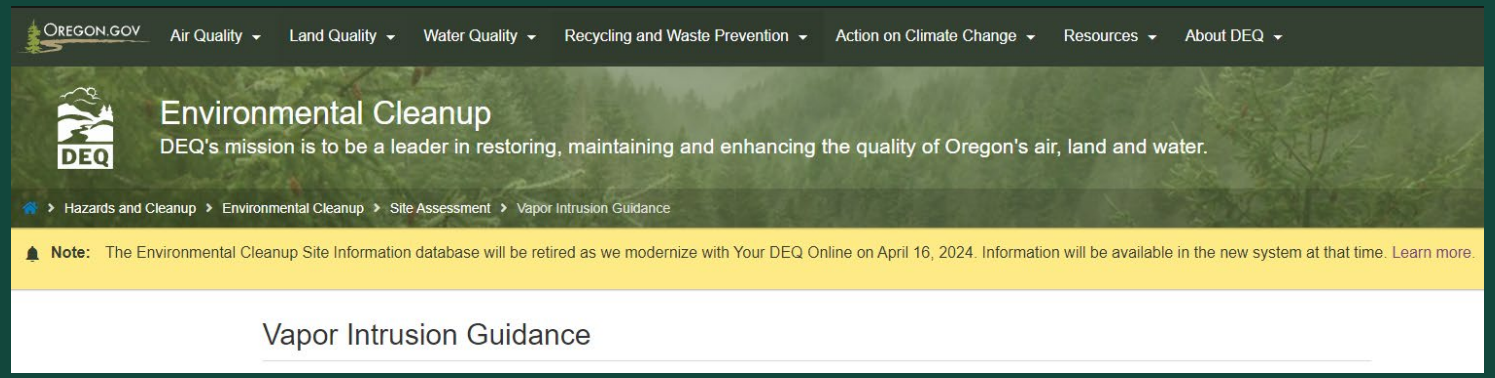
DEQ's mission: to be a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water.

Session Outline

- Housekeeping
- Overview of guidance status and updates
  - Background
  - HOT updates
  - VI acute and chronic risk-based concentrations (RBCs)
  - Remediation and performance monitoring
  - Hot spot updates
  - Public review period & listening sessions
- Listening and Q&A



Housekeeping



- Thank you for attending
- Recording today
  - Slides will be posted on our website

- Feedback and questions
  - Share questions in the chat
  - Time at the end today for listening and Q&A
  - To provide input after the presentation today: VIWorkGroup@deq.oregon.gov

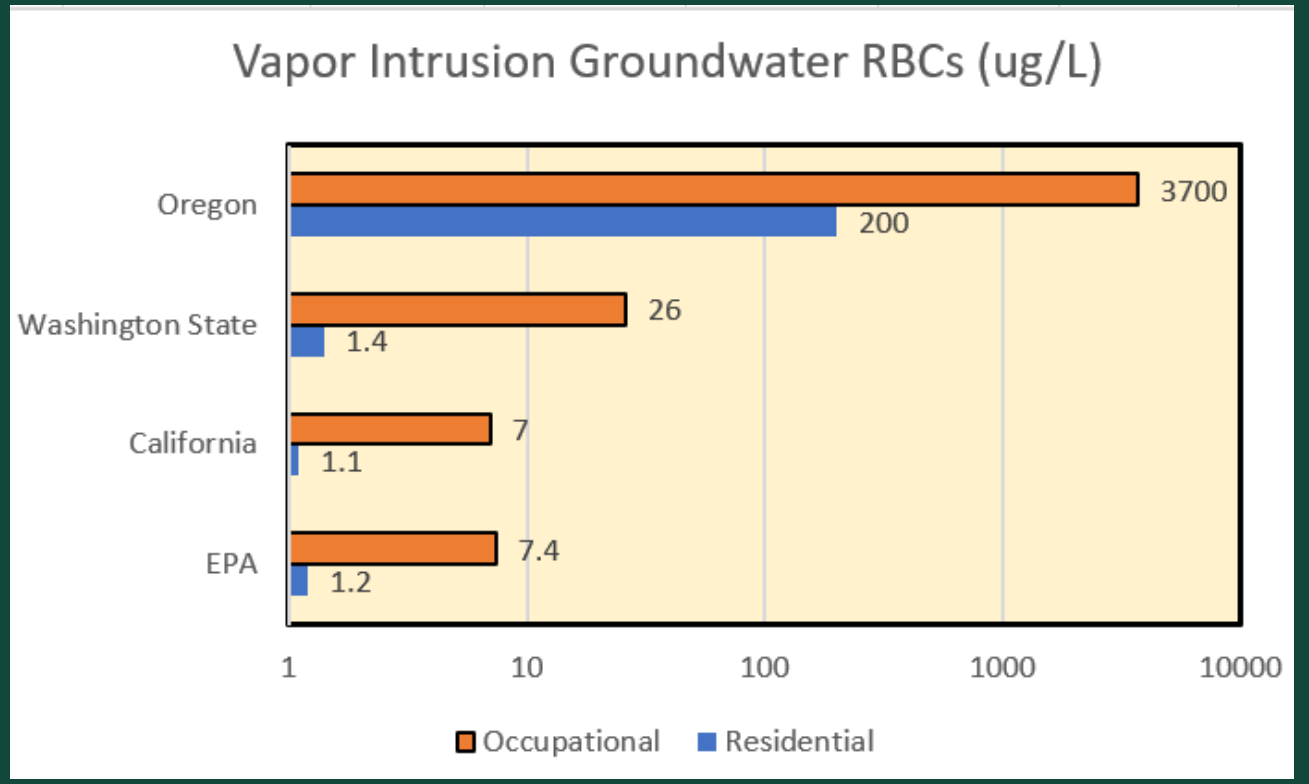
Timeline for Final Guidance 2024

- Draft guidance and revised RBCs posted on website March 2024
  - **For use immediately**
- 90-day public review period until May 31, 2024

DEQ

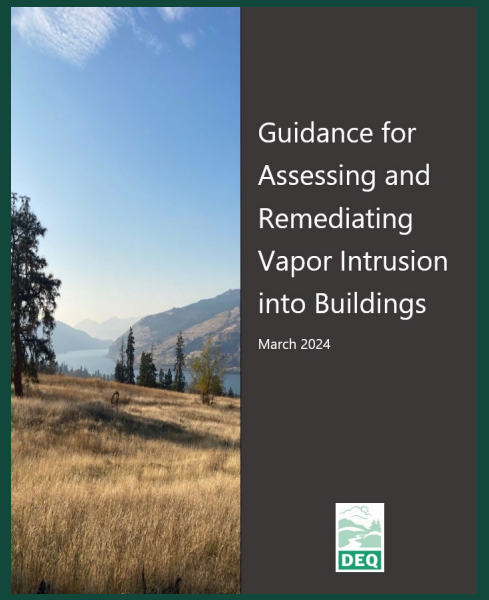
Reasons for Updating Guidance

- Vapor intrusion is one of the most commonly complete exposure pathways with building occupants frequently unaware of exposure
- Align screening methods and risk-based concentrations (RBCs) with latest science and ensure they are adequately protective, particularly for chlorinated solvents
- Improve quality and consistency of decision making at VI sites



Overview of VI Guidance

1. Introduction
2. VI Conceptual Site Model
3. VI Evaluation Process
4. VI Sampling and Analysis
5. VI Risk-Based Concentrations
6. VI Remediation and Mitigation
7. Community Engagement



Appendices

A. Response Matrix for Indoor Air
B. Heating Oil Tank Sites
C. Development of RBCs
D. Other Agency Response to TCE
E. Managing Air Discharges from Remedial Systems
F. Engineering Review of VI Mitigation

DEQ

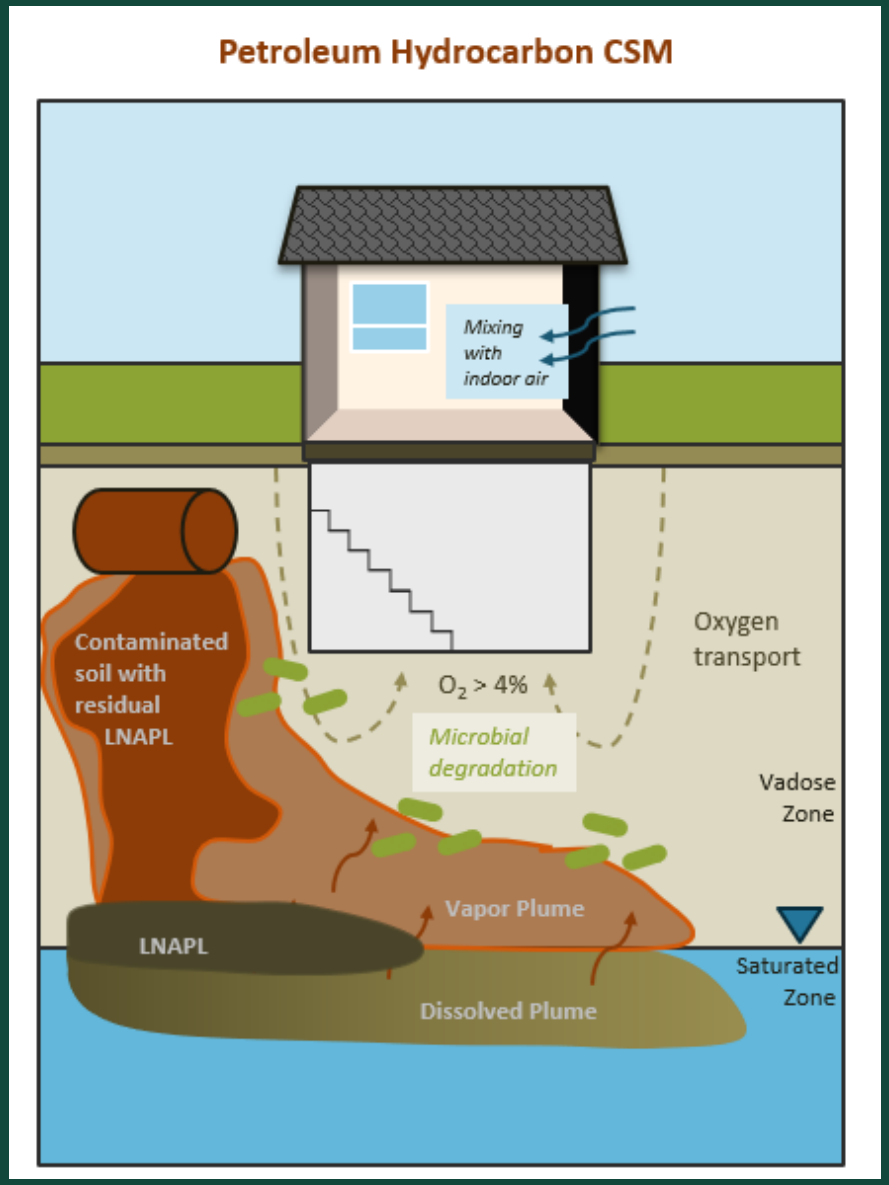
Major Updates

Already implemented

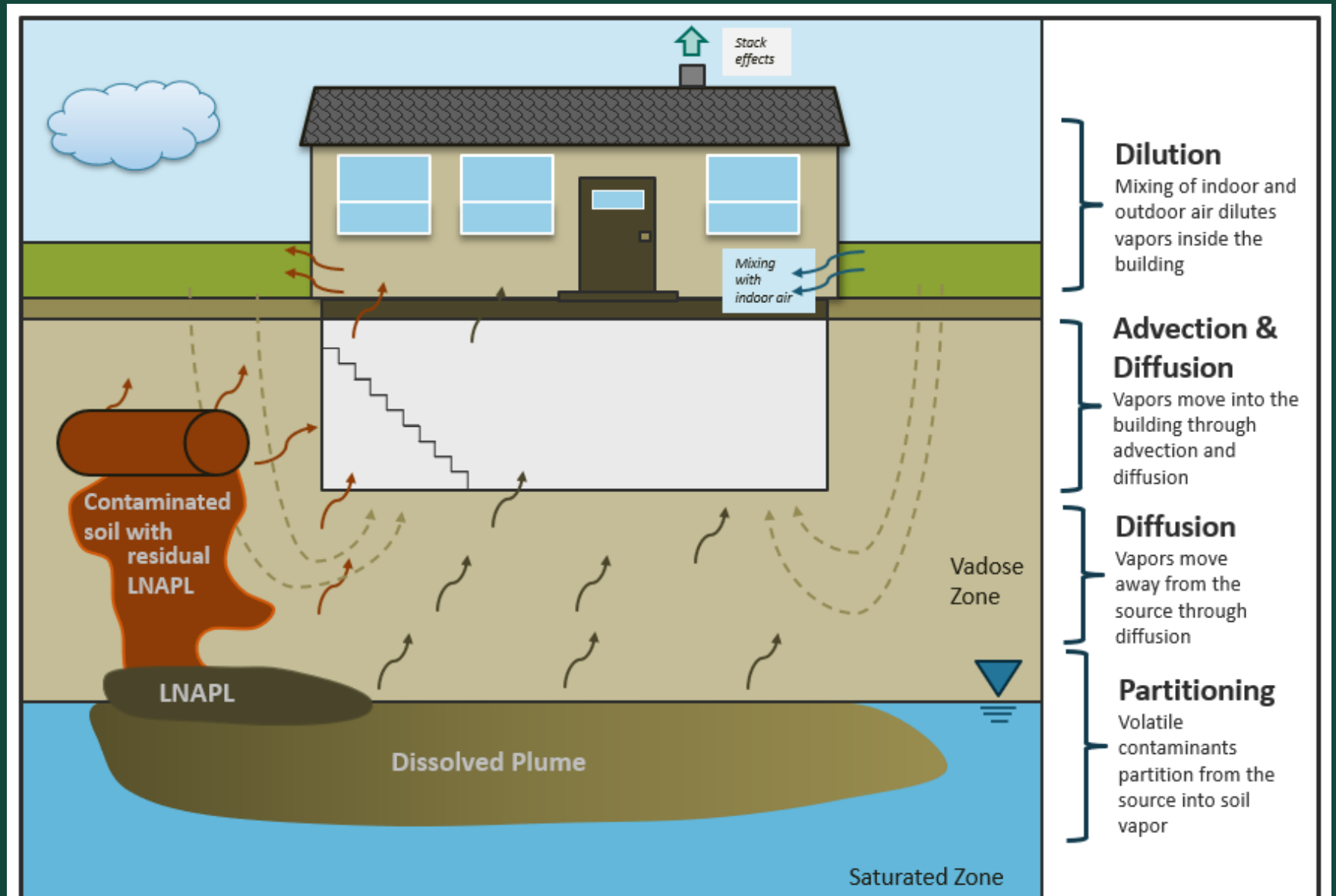
- Lower RBCs due to change in Attenuation Factors (AF)
- Updated and expanded RBCs
- Elimination of soil and urban residential RBCs; addition of acute RBCs

In revised VI Guidance

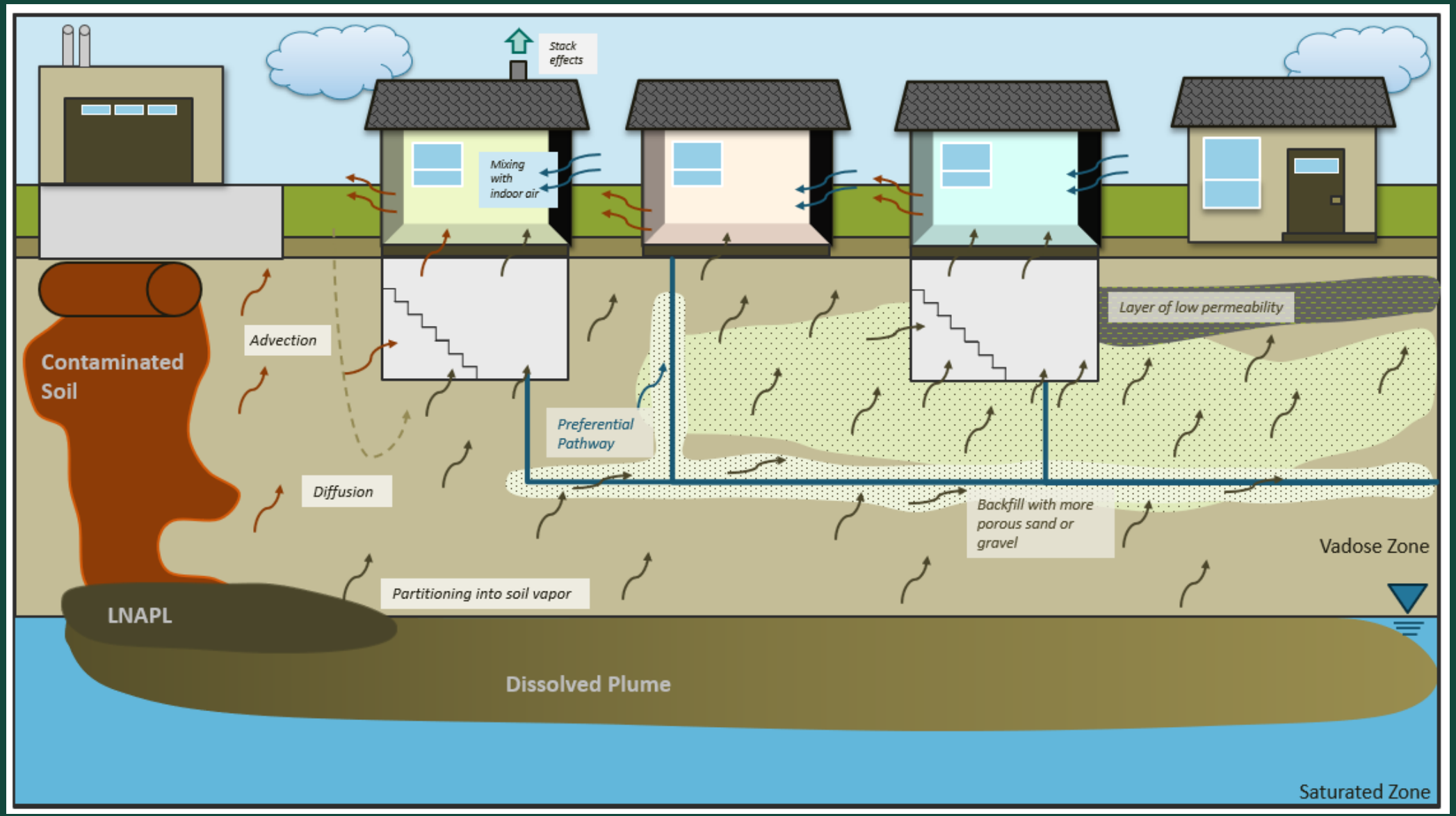
- Response-matrix for indoor air concentrations exceeding RBCs
- Greater emphasis on delineating subsurface vapor plumes
- Descriptions and expectations of mitigation systems and performance monitoring
- Additional tools for investigating VI sites
- Recommendations for community engagement
- Consideration of petroleum biodegradation



VI Conceptual Site Model (Section 2)



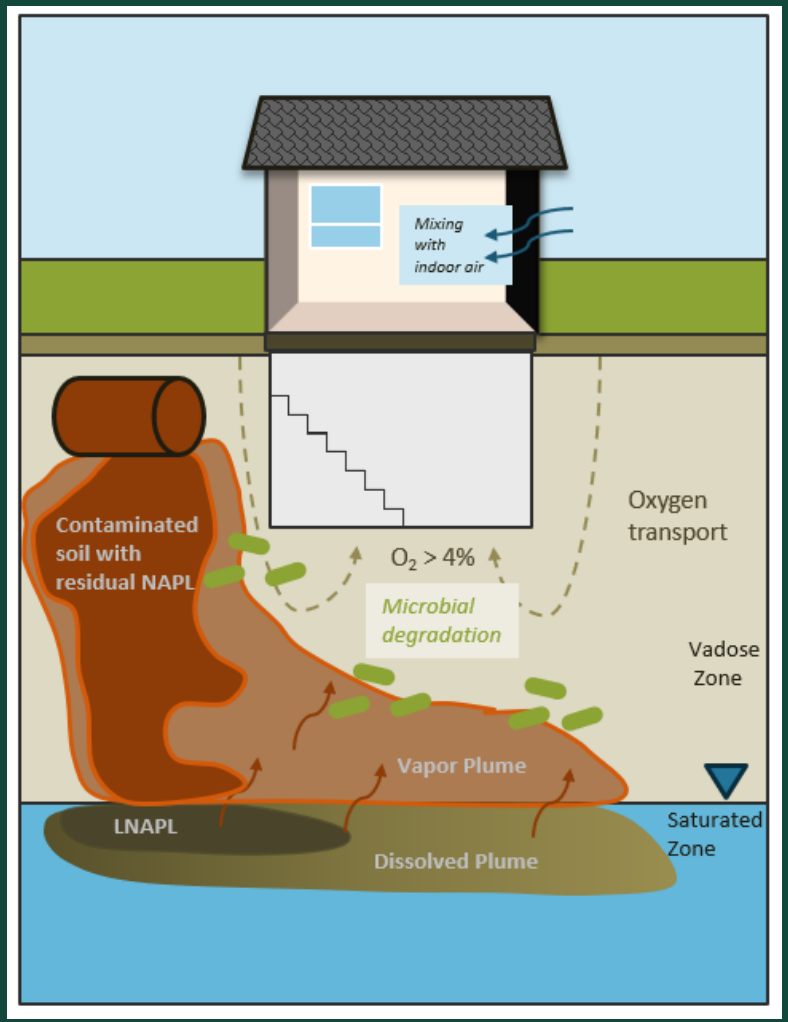
Vapor Migration & Transport, Building Considerations



DEQ

Site Characterization Expectations

- VI Conceptual Site Model – narrative and graphical with refinement
  - Inclusion of biodegradation at petroleum sites
  - Vertical and lateral inclusion zones (distance to structure)
- Routine collection of soil vapor data at potential VI sites
- Shallow and deep soil vapor and delineation of vapor plumes



DEQ

Soil Data and VI Pathway

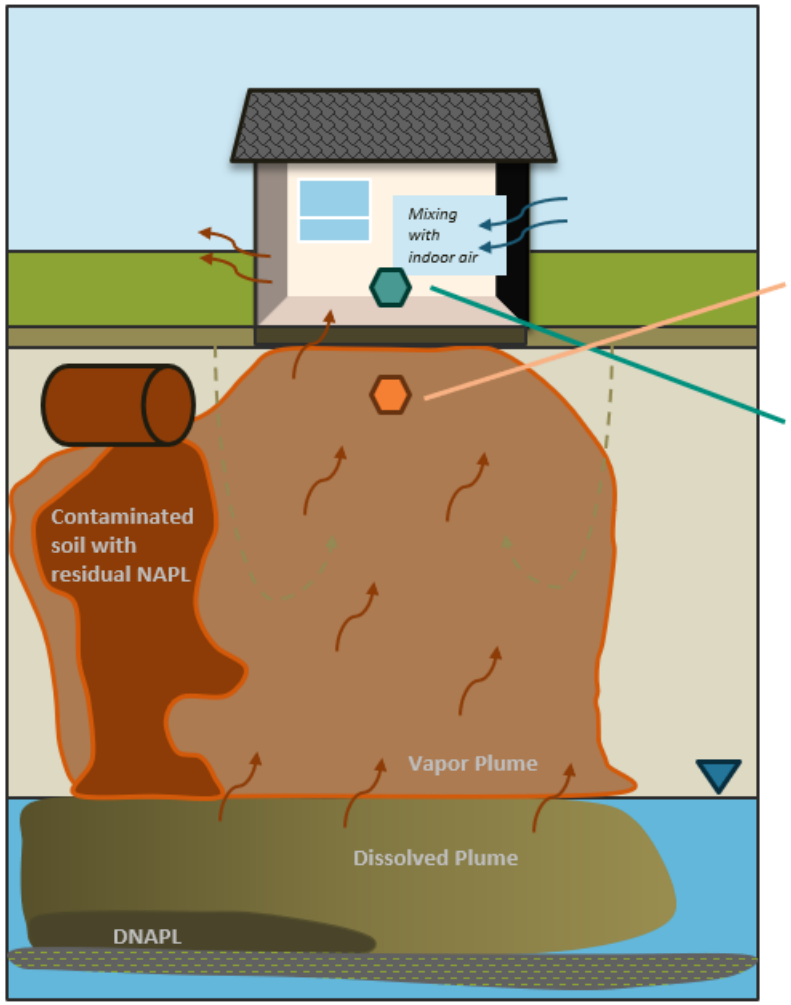
Eliminated for VI Risk Screening

- Soil is generally an unreliable indicator of VI Risk due to:
  - Soil heterogeneities and distribution of contamination
  - Sample size/amount
  - Analytical detection limits for chlorinated compounds
  - Biodegradation of total petroleum hydrocarbons (TPH)

Continued Uses

- Delineating source areas to locate soil vapor sampling points
- Characterizing chemical composition of a source
- Evaluating source area treatment and remedial progress
- HOT generic remedy and Soil matrix certifications

Attenuation Factors



$$AF = \frac{Conc_{Soil\ Vapor}}{Conc_{Indoor\ Air}}$$

Basis for VI RBCs:

$$RBC_{SV} = RBC_{IA} * AF$$

Attenuation factors relate the contaminant level in subsurface vapors to a measured or predicted concentration in indoor air

- Function of subsurface conditions, meteorological conditions, building design and ventilation
- Constantly changes in passively or semi-passively ventilated buildings
- Highly variable from building to building, difficult to predict

DEQ

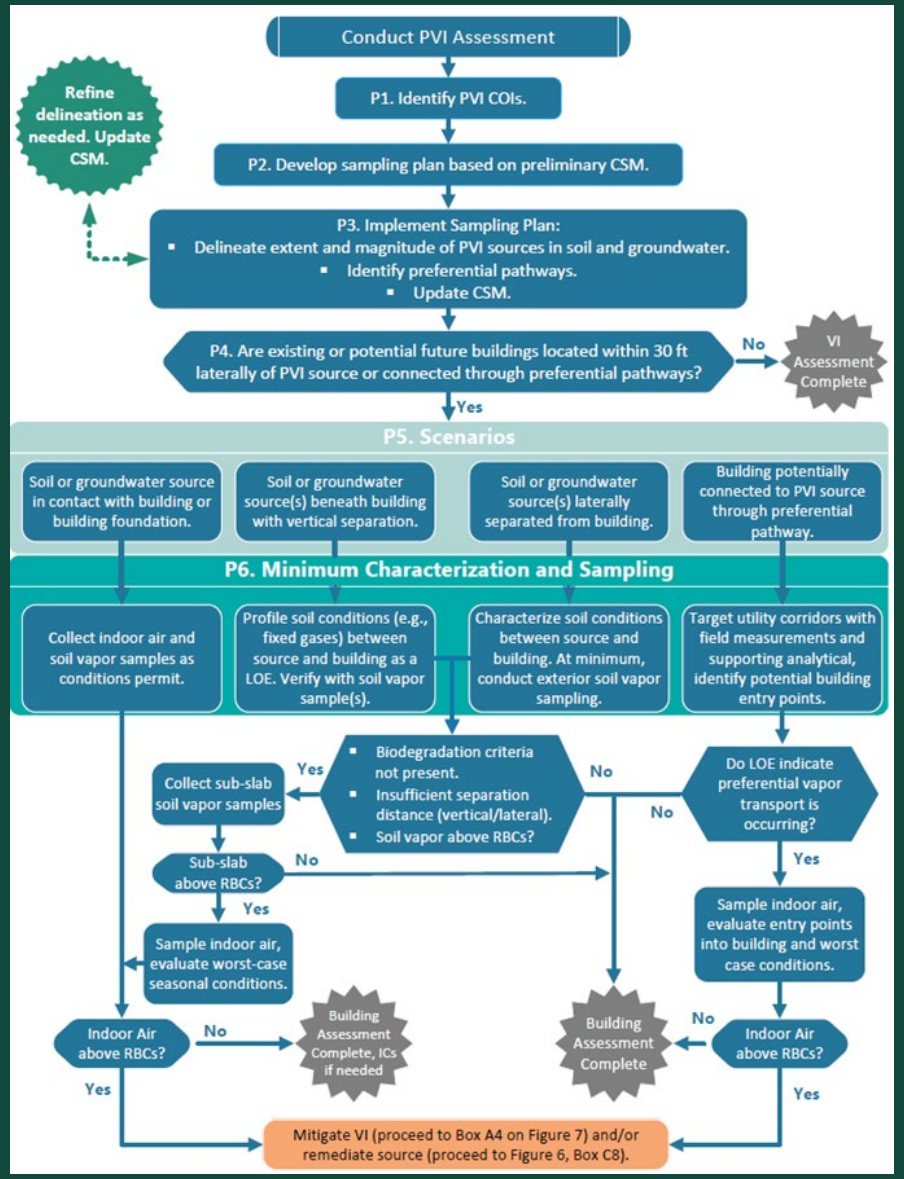
Attenuation Factor Update

- RBCs updated based on empirically derived attenuation factors (AF)
  - Consistent with EPA and other states
  - Substantial decrease in RBCs
  - Previously, DEQ was using outdated version of Johnson & Edinger Model, generates higher attenuation factors than those supported by empirical data (EPA Database)

Media	Oregon	Washington
Soil Gas	33x (0.03)	0.03
Groundwater	1000x (0.001)	0.001

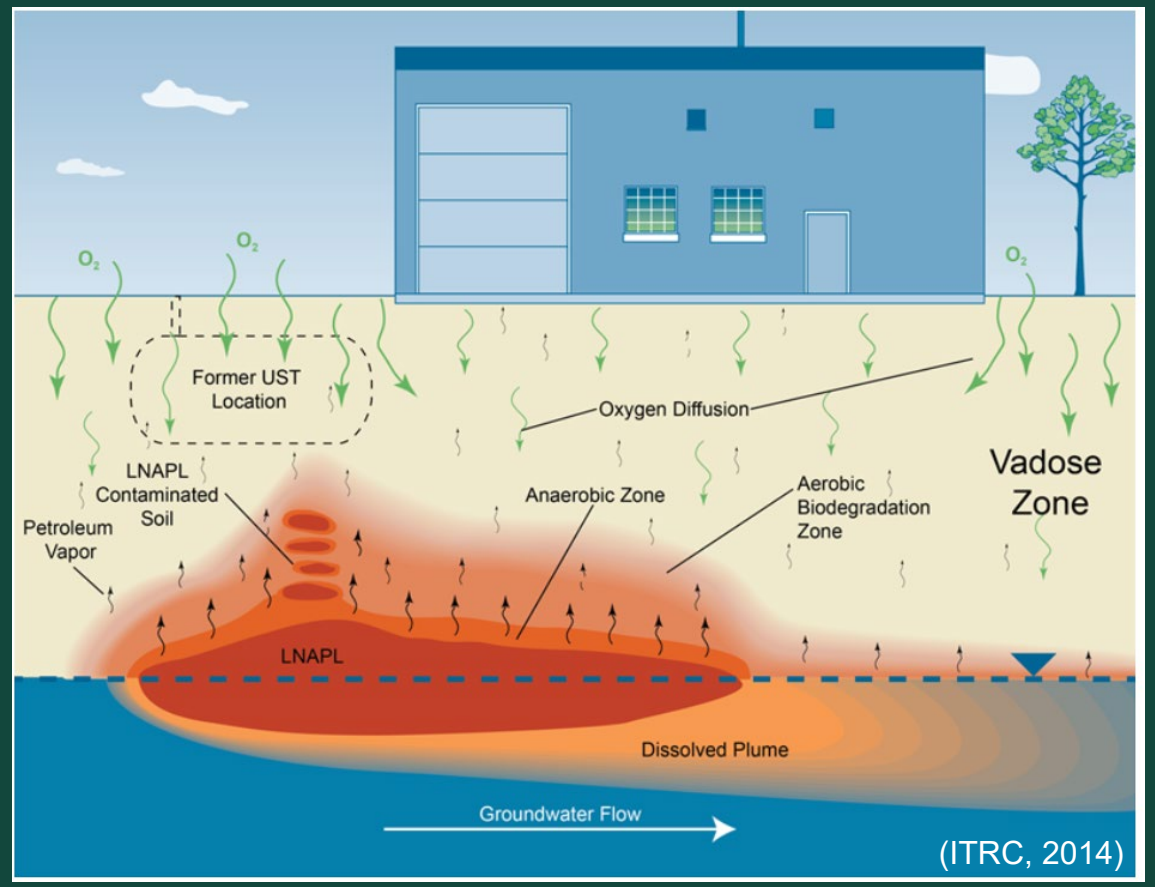
Vapor Intrusion Evaluation Process (Section 3)

- Separate flow charts for chlorinated VI, petroleum VI, residential heating oil tanks, and performance monitoring
- Accompanying narrative explanation of process steps
- VI soil RBCs triggering soil vapor sampling are replaced with Level II soil matrix standards (80 ppm Gx, 500 ppm Dx)
- Biodegradation considerations included for petroleum VI and heating oil tank sites

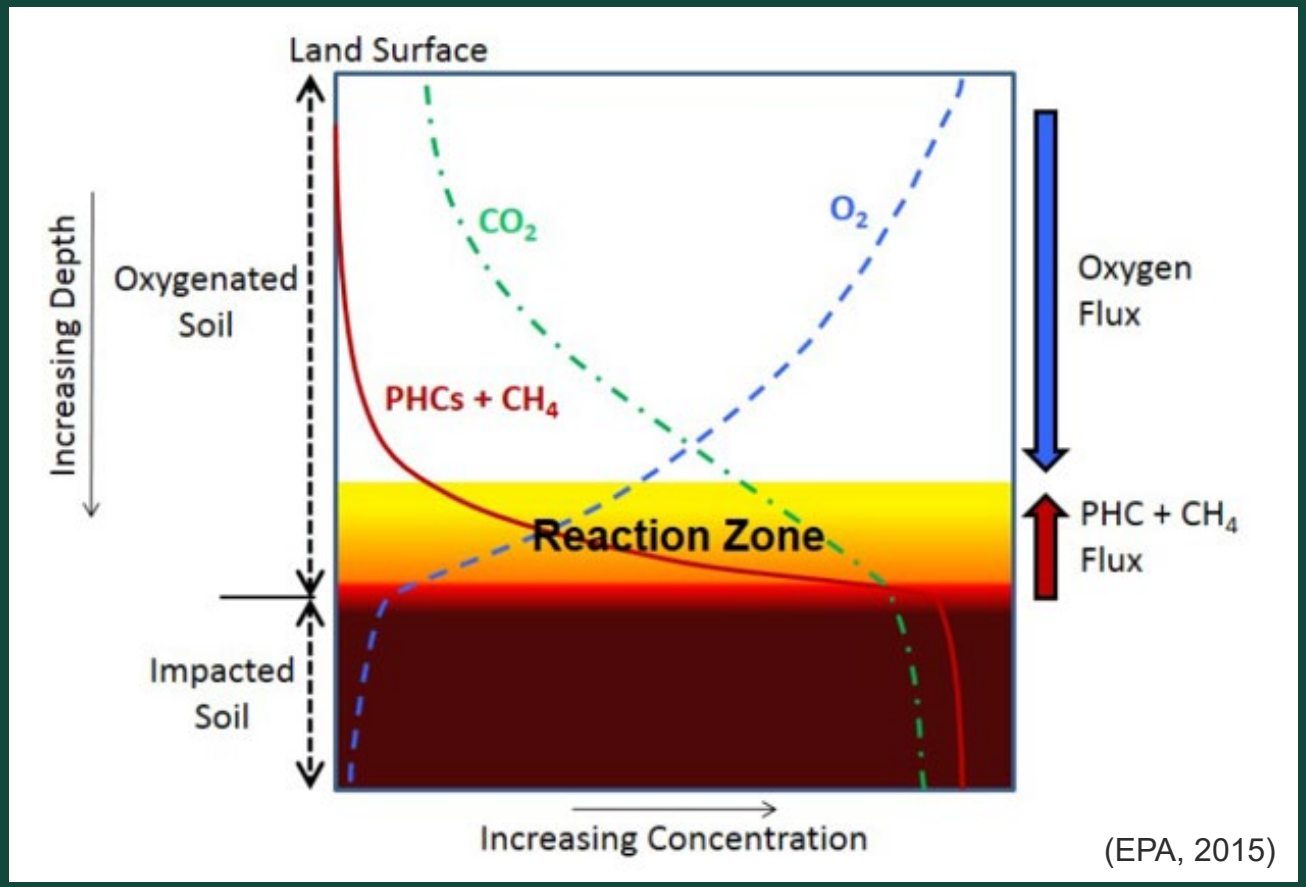


DEQ

Petroleum hydrocarbon sites



Logging boreholes for conditions conducive to biodegradations



Developing vertical concentration profiles of contaminants and fixed gases (O_2, CO_2, CH_4)

DEQ

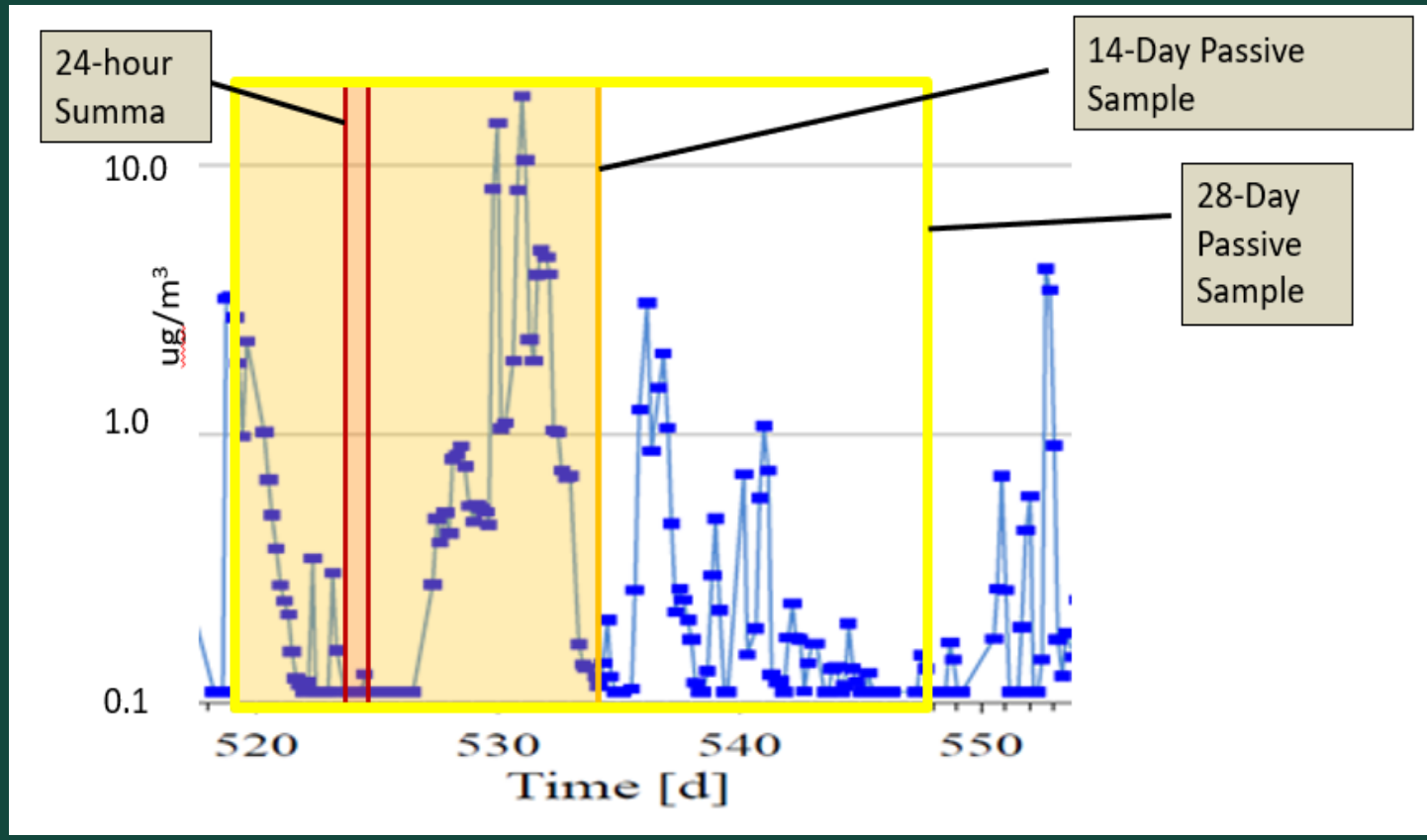
Sampling and Analysis (Section 4)

- Time, frequency, duration, analytical methods, and QA/QC
- Soil, groundwater, soil vapor sampling
- Indoor air sampling
  - Background sources of VOCs
  - Temporal variability
  - Barometric pressure changes

TO-15
TO-17

Indoor Air Sampling (Section 4.2)

- Greater reliance on long-term passive sampling for characterizing indoor air levels at non-petroleum sites
- Consideration of acute exposure effects (*e.g.* TCE) and the need for higher resolution indoor air sampling
- Response matrix for indoor air exceedances – time-frame expectations for addressing unacceptable risk
- Inclusion of TPH as a routine indoor air contaminant of interest at petroleum VI sites



Additional Tools for VI Investigations

- Measurement of cross-slab differential pressures: to provide context for indoor air measurements
- Landfill gas – GEM analyzers for fixed gasses (O_2, CO_2, CH_4) to establish biodegradation
- Real-time GC-MS analysis of air samples: locating vapor entry points, monitoring temporal variability
- Radon measurements for determining building specific attenuation factors

DEQ

Heating Oil Tanks (HOT) (Appendix B)

Goals for new plan

- Protective
- Incorporates multiple lines of evidence and latest science
- Fits within project timelines
- Scope of work isn’t cost prohibitive

Differences between HOT & PVI sites

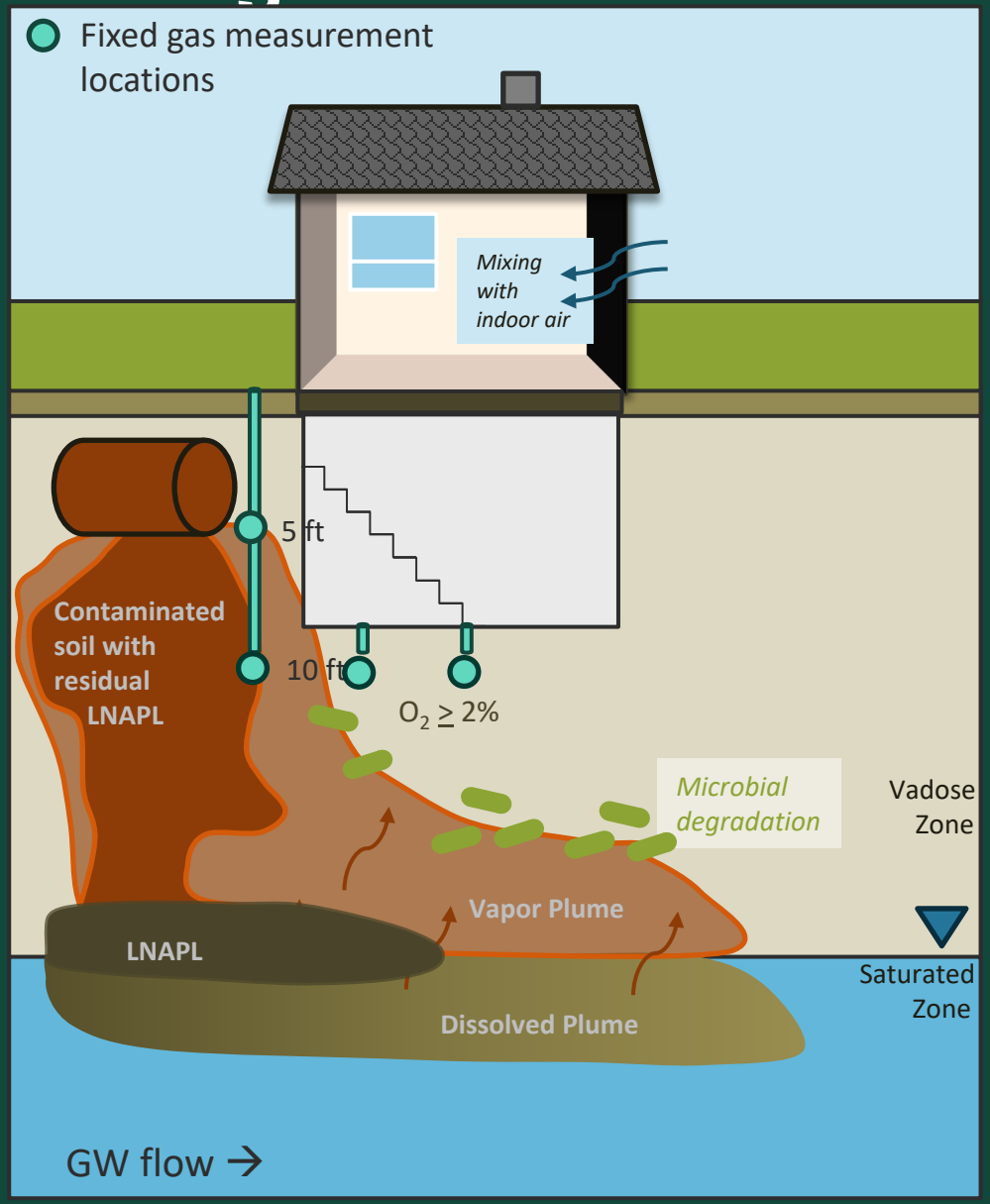
Heating Oil Tanks represent sites:

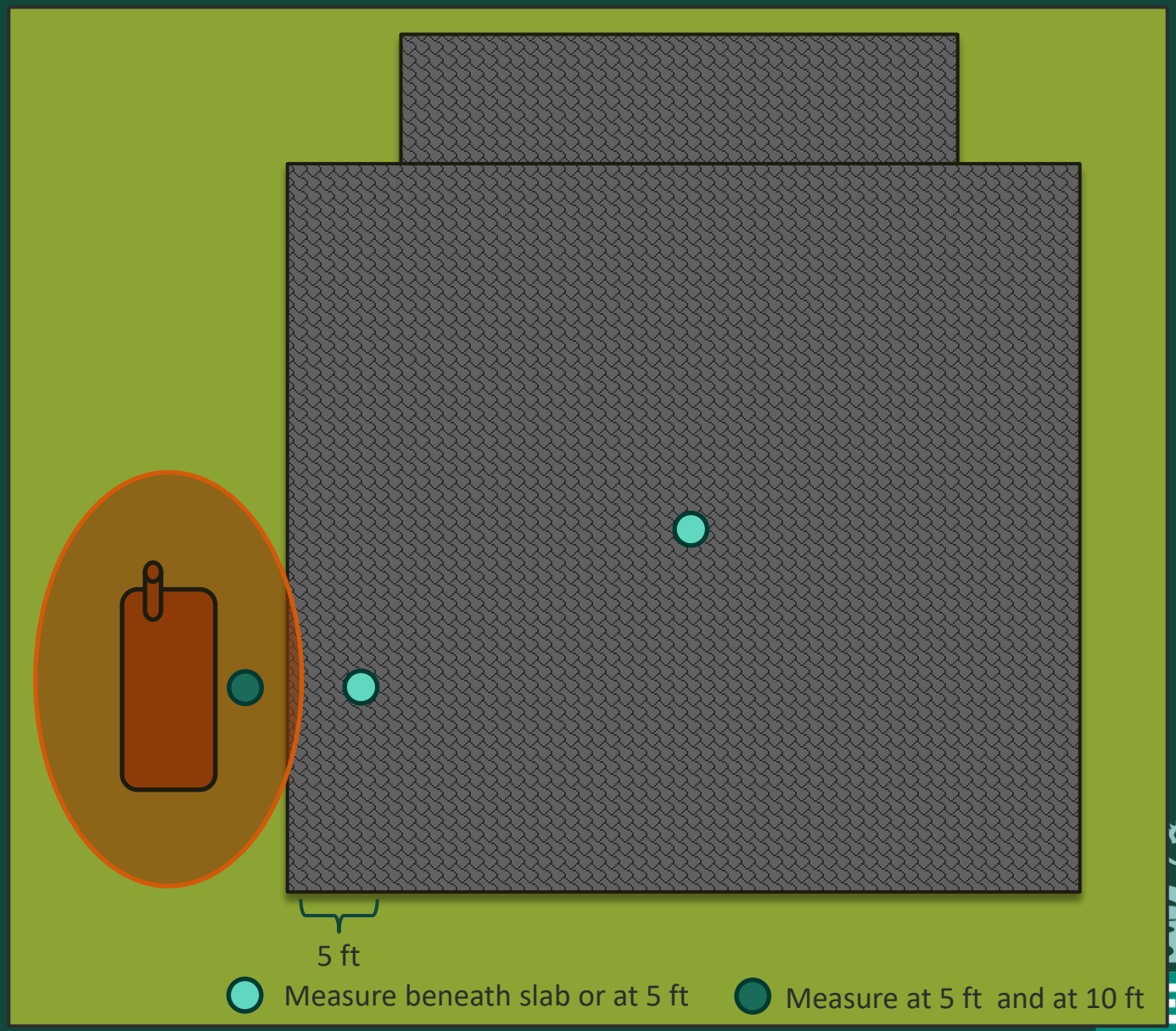
- With well known contamination sources (Diesel); usually not comingled
- With a lower VI risk than other sources (heavier hydrocarbons)
- With residential sources – smaller in volume but closer to the home
- With a soil plume that normally does not extend beneath the entire structure

Differences from LUST:

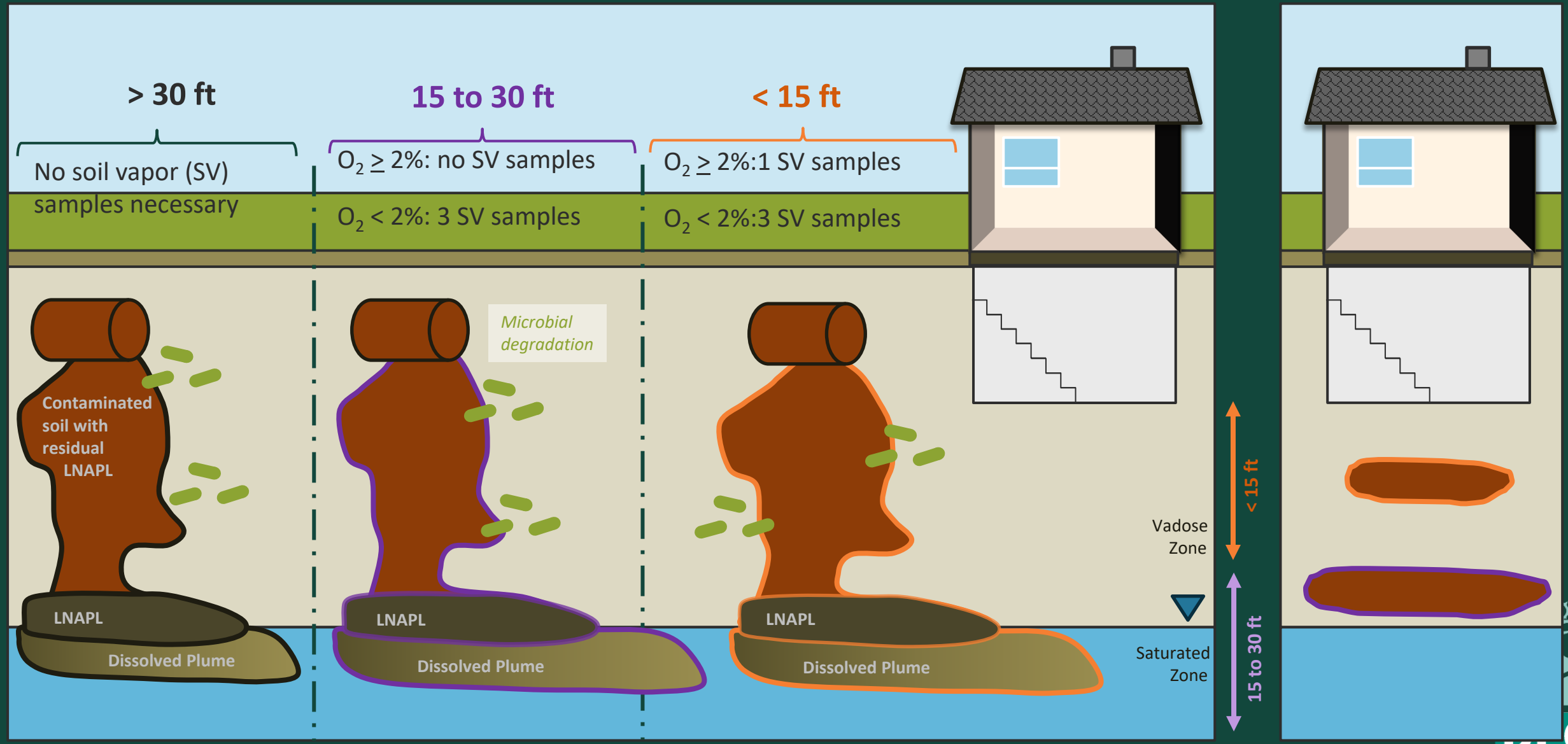
- Have set biodegradation criteria for HOT sites based on oxygen percentages from field measurements
- Have sampling schemes dependent on fixed gas measurements and distance from plume
- Averaging soil vapor samples at sites where vapor plume is shown to not extend beneath whole building.

Field measurements for fixed gas (O_2, CO_2, CH_4) to establish biodegradation





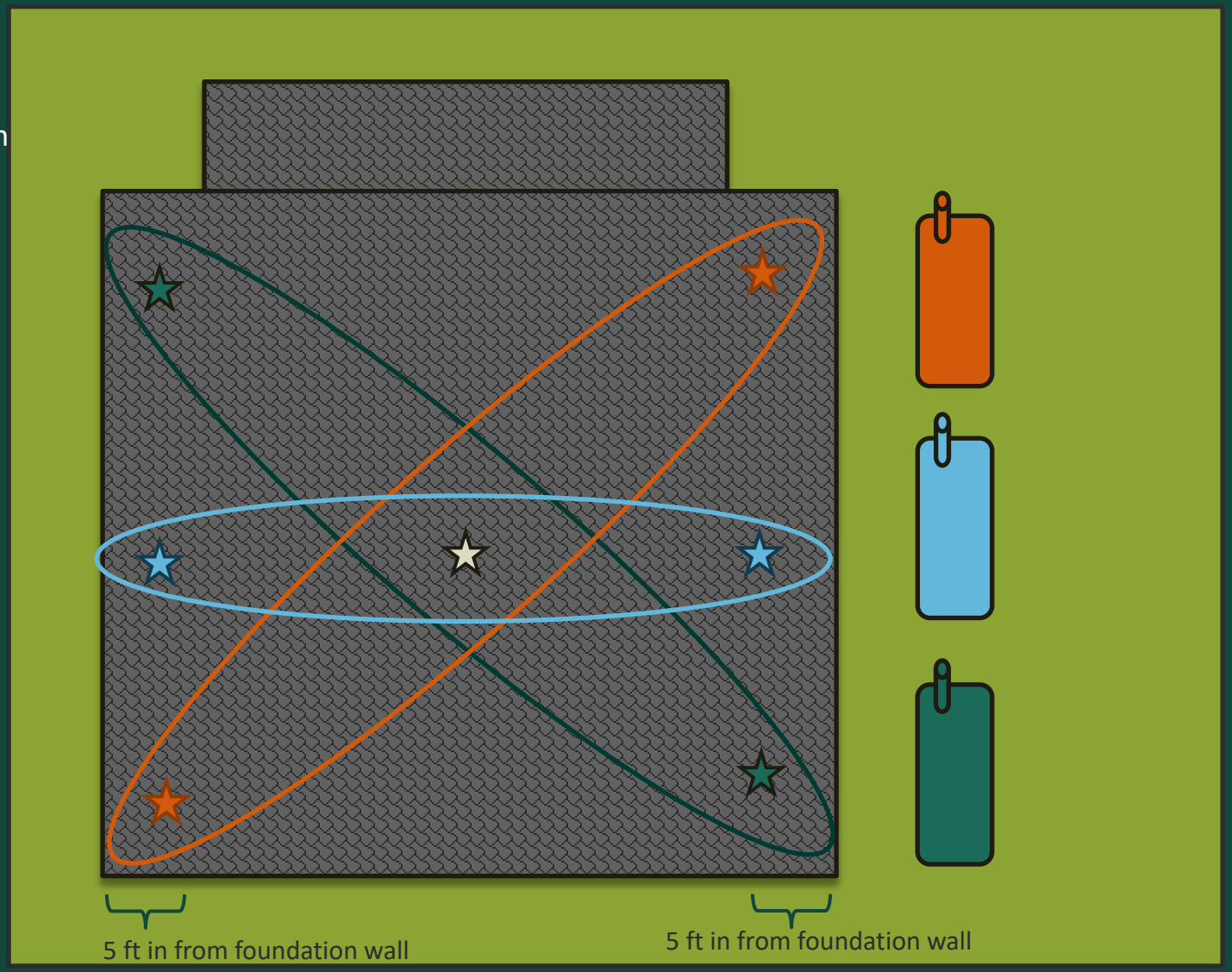
Soil vapor (SV) sampling with lateral distance to soil source



Averaging soil vapor results at certain HOT sites

★ Sample location based on tank location

★ Sample for all scenarios



When can I average the three samples?

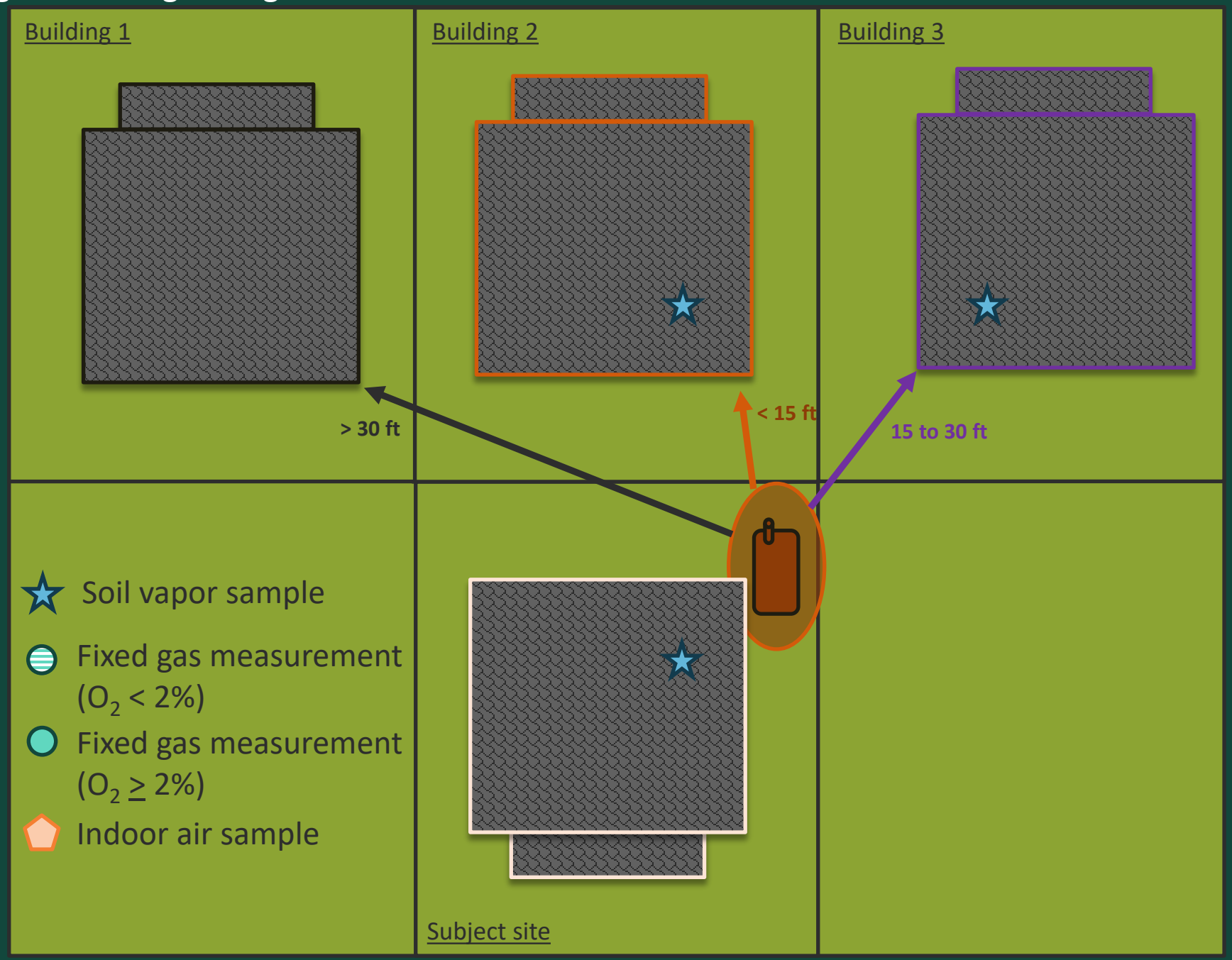
- When your soil vapor results show the plume is under only part of the structure, not the whole structure

When I can't average what do I do?

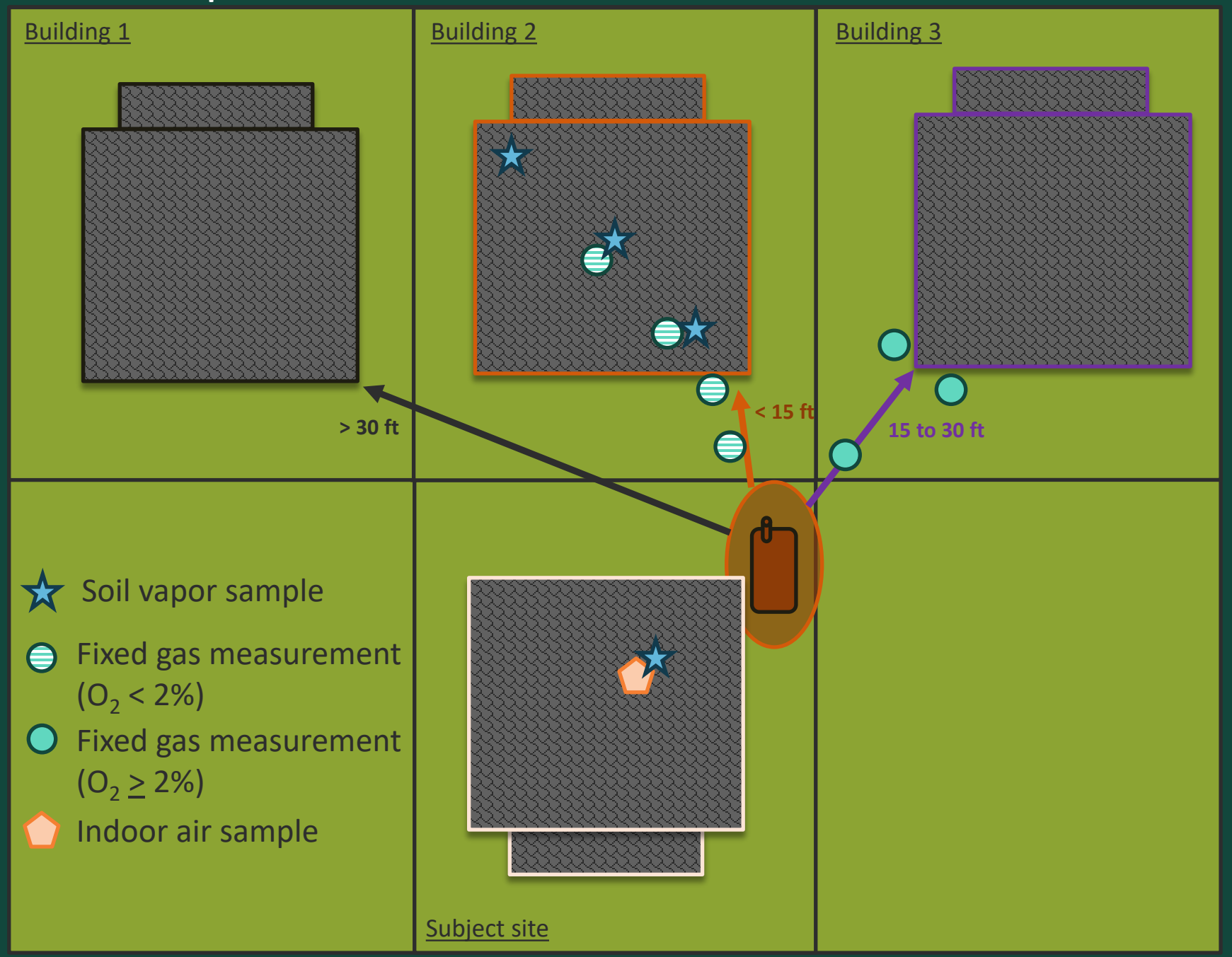
- You compare the highest soil vapor result direct to the RBCs

DEQ

HOT investigations using 2010 guidance



2024 Draft Guidance Example



Vapor Intrusion Risk-Based Evaluation (Section 5)

VI Risk-Based Concentrations

- Published on DEQ website in June 2023
  - RBCair → RBCsv and RBCwi using attenuation factors
  - Not a conceptual change for RBCsv; new AFs
  - Bigger impact for RBCwi because of different approach for groundwater and new AFs
  - No more RBCsi; No more default urban residential
  - Acute RBCs for short-term exposure
- March 2024 updates based on EPA's Nov. 2023 RSLs
  - To be updated annually in January

Risk-Based Concentrations Spreadsheet

	A	B	H	I	K	M
1	**Residential Vapor Intrusion RBCs**					
3						
4	**Chemical**	**CAS Numb**	**RBCair ($\mu g/m^3$)**	**Toxicity Basis**	**RBCsv ($\mu g/m^3$)**	**RBCwi ($\mu g/L$)**
857	Trichloroethylene	79-01-6	0.48	CA	16	2.1
908						
909	**Generic TPH**					
910	Gasoline		300		10,000	120
911	Diesel/Heating Oil		100		3300	400
912	Mineral Insulating Oil		140		4700	360

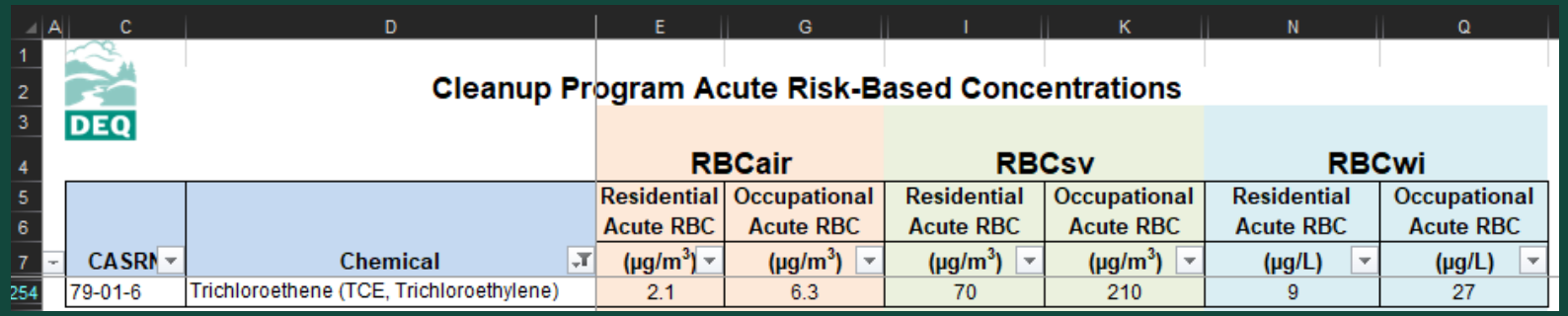
Interactive VI RBC spreadsheet (based on EPA VISL)

Most chronic RBC_{sv} values lower by a factor of 6

Bigger impact for RBC_{wi} because of different approach for groundwater and new AFs (lower by factors of 50 to 1000)

DEQ

Acute RBCs



Cleanup Program Acute Risk-Based Concentrations

			RBCair		RBCsv		RBCwi	
	CASRN	Chemical	Residential Acute RBC ($\mu g/m^3$)	Occupational Acute RBC ($\mu g/m^3$)	Residential Acute RBC ($\mu g/m^3$)	Occupational Acute RBC ($\mu g/m^3$)	Residential Acute RBC ($\mu g/L$)	Occupational Acute RBC ($\mu g/L$)
254	79-01-6	Trichloroethene (TCE, Trichloroethylene)	2.1	6.3	70	210	9	27

Site Exposure Scenario	TCE Indoor Air Action Level ($\mu g/m^3$)	TCE Subslab Soil Gas Screening Level ($\mu g/m^3$)	TCE Groundwater Screening Level ($\mu g/L$)
OR Residential	2.1	70	9.2
WA Unrestricted/ Residential	2.0	67	8.6
OR Commercial	6.3	210	27
WA Workplace Commercial and Industrial	7.5	250	32

- Acute RBC_{air} based on Cleaner Air Oregon
  - 100 chemicals
- Very important for chemicals like TCE with developmental effects
- Consistent with EPA and Washington

Responses to Acute and Chronic Exceedances

Indoor Air Concentration (Attributed to VI)[a] – Acute Exposure[1]			
No Data	**≤ acute RBCair**	**> acute RBCair to ≤ 3 x acute RBCair[e]**	**> 3 x acute RBCair[e]**
Monitor Initiate sub-slab and/or indoor air sampling if vapor intrusion is suspected.	**Monitor/ No Action** Use LOEs to determine need for additional sampling.	**Accelerated Response** • Evaluate and implement interim mitigation measures[b] within a few weeks. • Confirm effectiveness through monitoring. • Public outreach recommended.[d]	**Urgent Response** • Evaluate and implement interim mitigation measures[b,c] within a few days. • Confirm effectiveness through monitoring. • Public outreach recommended.[d]
Indoor Air Concentration (Attributed to VI)[a] – Chronic Exposure			
No Data	**≤ chronic RBCair**	**Noncancer:** **> chronic RBCair to ≤ 3x chronic RBCair[e]** **Cancer:** **> chronic RBCair to ≤ 10x chronic RBCair[e]**	**Noncancer:** **> 3x chronic RBCair[e]** **Cancer:** **> 10 x chronic RBCair[e]**
Monitor Initiate sub-slab and/or indoor air sampling if vapor intrusion is suspected.	**Monitor/ NoAction** Use LOEs to determine need for additional sampling.	**Accelerated Response** • Evaluate and implement interim mitigation measures[b] in a reasonable timeframe (e.g., 6 months). • Confirm effectiveness through monitoring. • Public outreach recommended.[d]	**Urgent Response** • Evaluate and implement interim mitigation measures[a,b] within a month. • Confirm effectiveness through monitoring. • Public outreach recommended.[d]

Appendix A

Based on recommendations from EPA Region 10, EPA Region 9, and Washington Ecology

DEQ

Mitigation, Remediation, and Performance Monitoring (Section 6)

Remedial Methods and Performance Monitoring

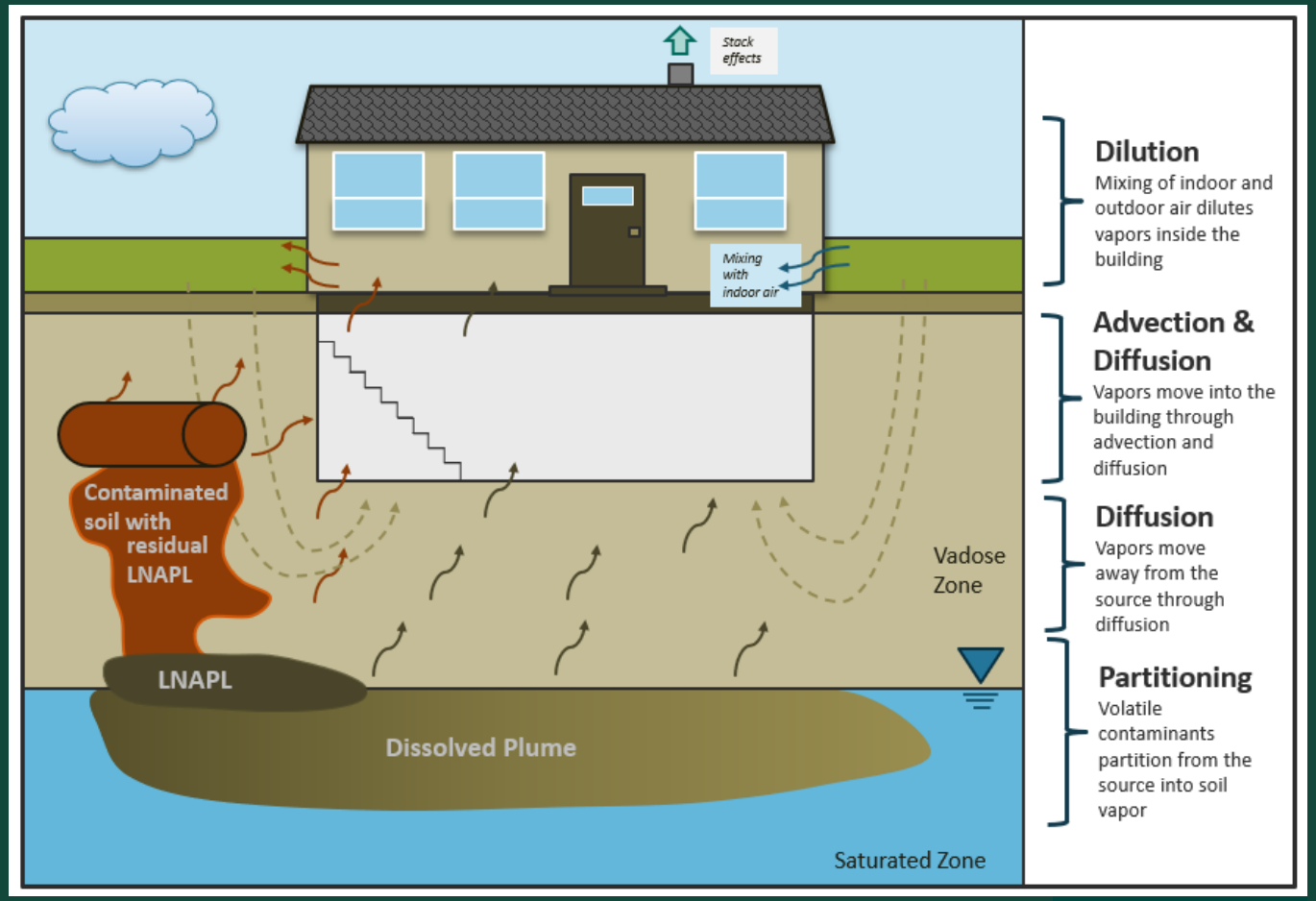
- Remediation and/or Mitigation
- Prompt, Early/Interim or Final Remedies
- Technologies and Design Considerations
- Performance Monitoring
- Plans and Documentation
- Definition of ECs and ICs
- Professional Registrants and Certifications

Engage your Engineer!

DEQ

VI Remediation and Mitigation

- Engineer Controls to Protect Human Health
- Address unacceptable VI risk
- Or mitigate inferred current risk until additional data available
- VI sources may require remediation
- Strategy often a combination of technologies
- Plans (e.g., FS/CAP) provided to DEQ in advance for review/approval
- Adequate characterization of problem and good CSM is still important!



VI Remediation and Mitigation*

Remediation reduces/removes VI sources

- Excavation, SVE, groundwater remediation, etc.
- Preference to remove/treat hot spots
- Minimize the need to manage sources long-term to protect public health

Mitigation can provide immediate protection to building occupants

- Interrupts VI pathway at/near building
- No source depletion
- May be necessary for many years

***DEQ does not require specific mitigation or remedial techniques, but instead asks for an appropriate evaluation (CAP or FS) and a remedy proposal for its review and approval**

DEQ

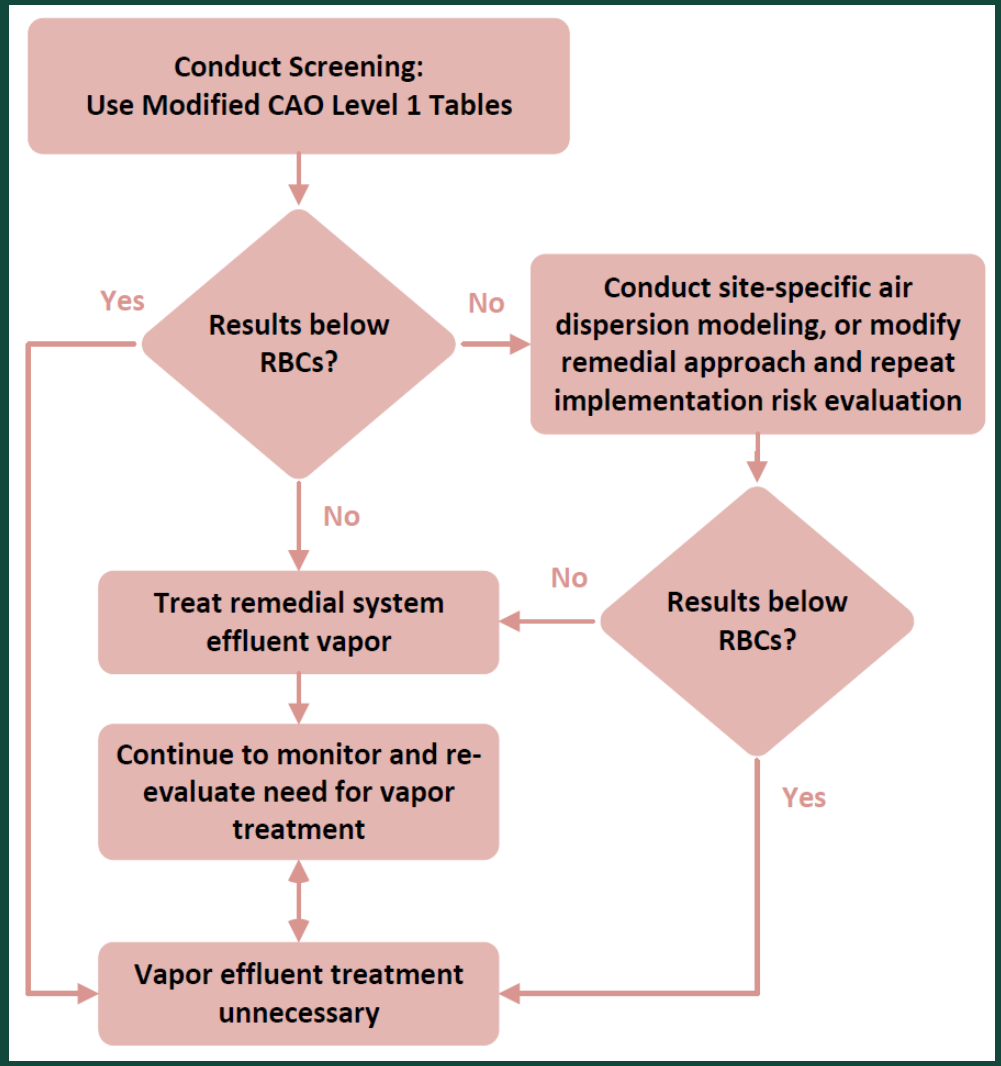
Mitigation Technologies

Immediate	Typically Target Building Interior: Increase Ventilation, **Building Pressurization** (e.g., HVAC), Indoor Air Treatment, Preferential Pathway Sealing, Administrative
Passive	**Vapor Barrier**, Sub-Slab Venting, Building Design, Interceptor Trench, Preferential Pathway Prevention (Coatings/Sealants, Utility Collars), Aerated Floors
Active	**Sub-Slab Depressurization (SSD)**, Sub-Membrane Depressurization (SMD), Sub-Slab Ventilation (SSV), Vapor Pits, Aerated Floors

DEQ

Guidance for Managing Hazardous Substance Air Discharges from Remedial Systems

- **Updated** – Appendix E
- Incorporates CAO modeling protocol representative of air dispersion and risk-based exposure scenarios.
- Default screening approach uses Level 1 simple "look-up" table developed for DEQ's CAO Program, modified to include Cleanup RBCs.
- Site-specific air dispersion model still an option:
  - To further evaluate risk when fail initial screening or model assumptions not applicable for site.
  - Inform Remedial Design.
- Include DEQ Engineer on review team.



Performance Monitoring – Early Scoping

- Critical piece to demonstrate what's installed works
- Support remedial selection and design
- Clear, quantifiable and obtainable data quality objectives (e.g., reductions in indoor air and sub-slab concentrations)
- Minimum demonstration period, scale up or down as needed
- Technology reliability to demonstrate mitigation
- Other considerations: source, building use and age, site complexity

DEQ

Strong Lines of Evidence of VI Mitigation

Indoor Air	Indoor concentrations are below RBCs
Differential Pressure	Negative pressure (e.g., < indoor air) and sustained across the building sub-slab (or lateral extent vapor plume)
Sub-Slab	Reduction of sub-slab concentrations below RBCs

DEQ

Another Flowchart

Step 1. Conduct Performance Monitoring

-Collect Multiple Lines of Evidence

-Indoor Air, Sub-slab, Differential Pressure

-Adequate Frequency and Duration

-Subsurface Normalized, Worst-Case Scenarios, Seasonal Variations

Step 2. Primary Performance Objective: Indoor Air Acceptable?

-Yes, proceed to Step 3

-No, augment strategy and repeat performance monitoring

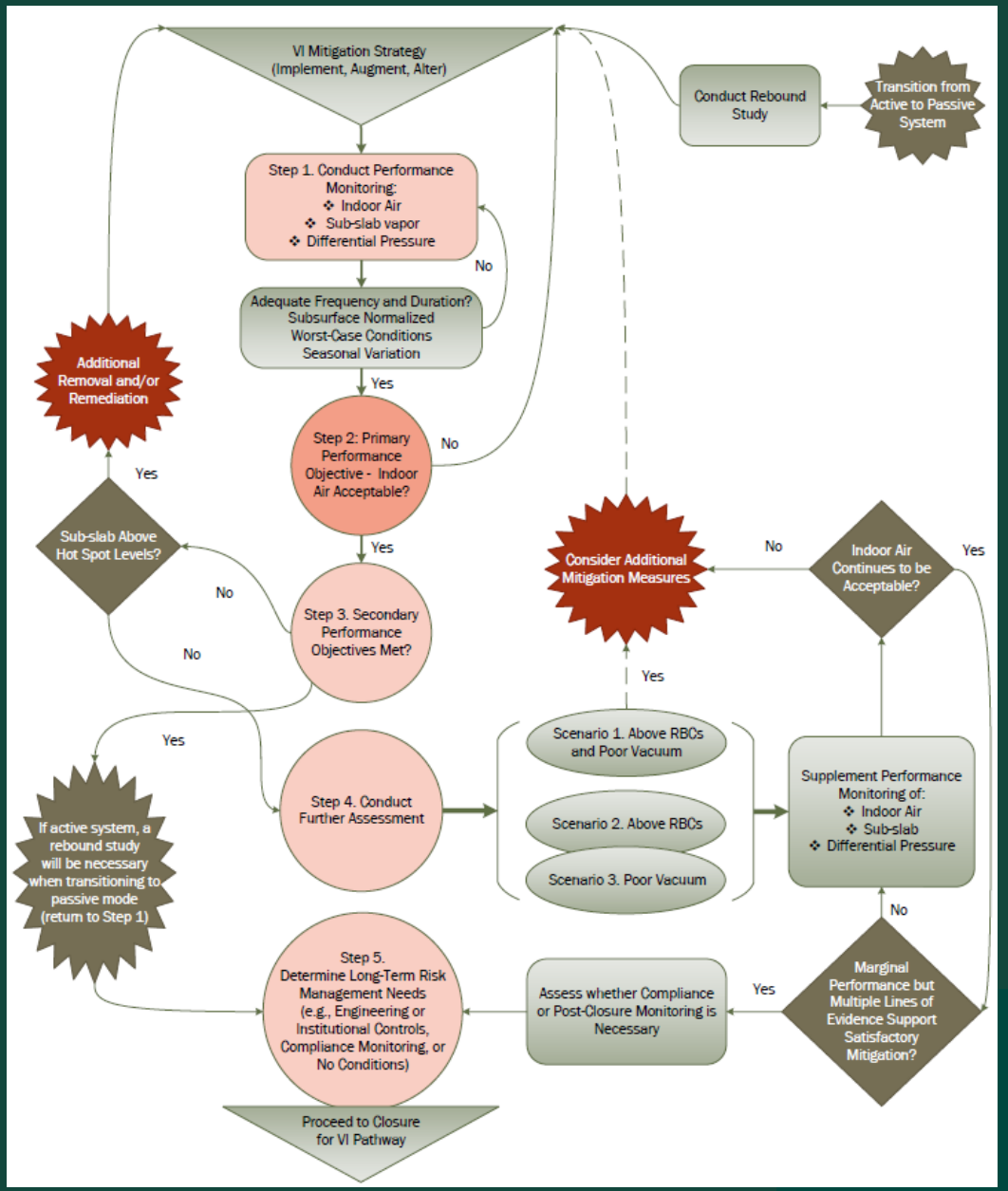
Step 3. Secondary Performance Metrics Met?

-Yes, proceed to closure (Step 5)

-No, proceed to Step 4: Conduct Further Assessment, to better support "adequate" mitigation and inform risk management long-term

Step 5. Determine Long-term Risk Management Needs for Closure

-Engineering or Institutional Controls, Compliance Monitoring, or None



Other Considerations

Plans and Documentation

- Work plans, studies, summary reports, O&M plans
- Scaled up or down, consolidated based on project complexity
- Assessments conducted and related plans prepared by qualified environmental professionals

ECs and ICs

- Definition: Mechanisms for managing exposure risks when contaminants remain present at levels of concern
- Conditions documented with property (e.g., EES)
- Reasonable ICs and examples

Professional Requirements

- Regulations governing practice of Engineering and Geology
- Report submittals and design documents to DEQ
- Professional qualifications and accountability are necessary to ensure quality work that protects Oregonians

DEQ

Hot Spot Update

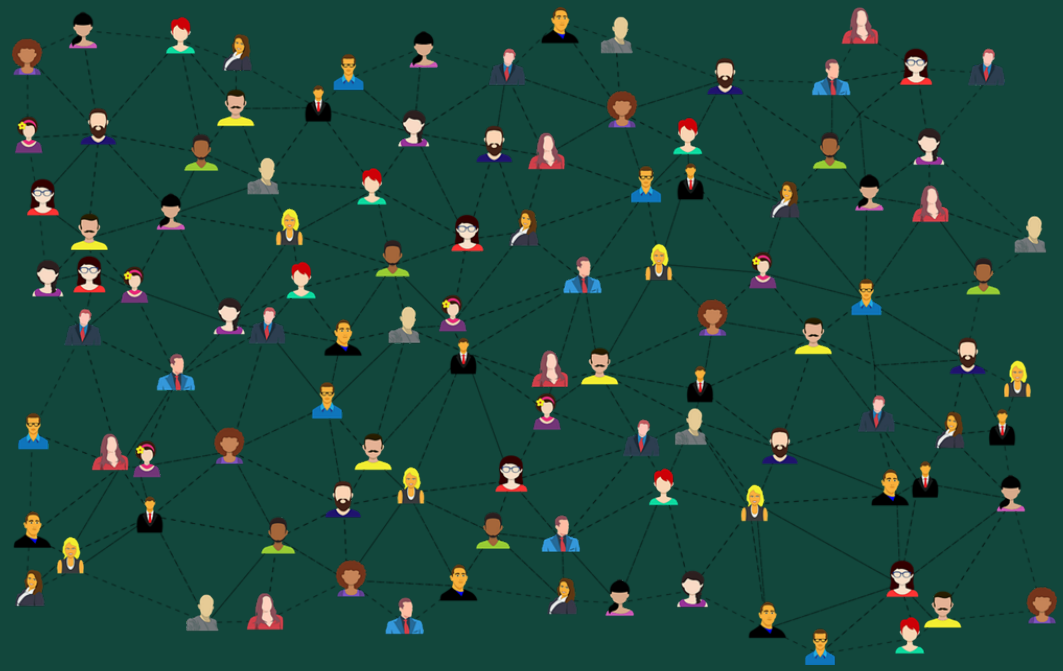
Hot spots for Vapor Intrusion

- Indoor air
  - Response matrix (Appendix A)
  - ***DEQ's preference is for hot spots to be evaluated in the subsurface***
- Soil vapor
  - Reliably contained?
    - If yes, there is a hot spot if the concentrations exceed the risk multipliers (10x for noncancer, 100x for cancer)
    - If no, there is a hot spot if there is an RBC exceedance, without a multiplier
- Groundwater
  - Evaluate potential hot spots in soil vapor associated with contaminants volatilizing from groundwater

Public Review Period & Next Steps

Community Engagement (Section 7)

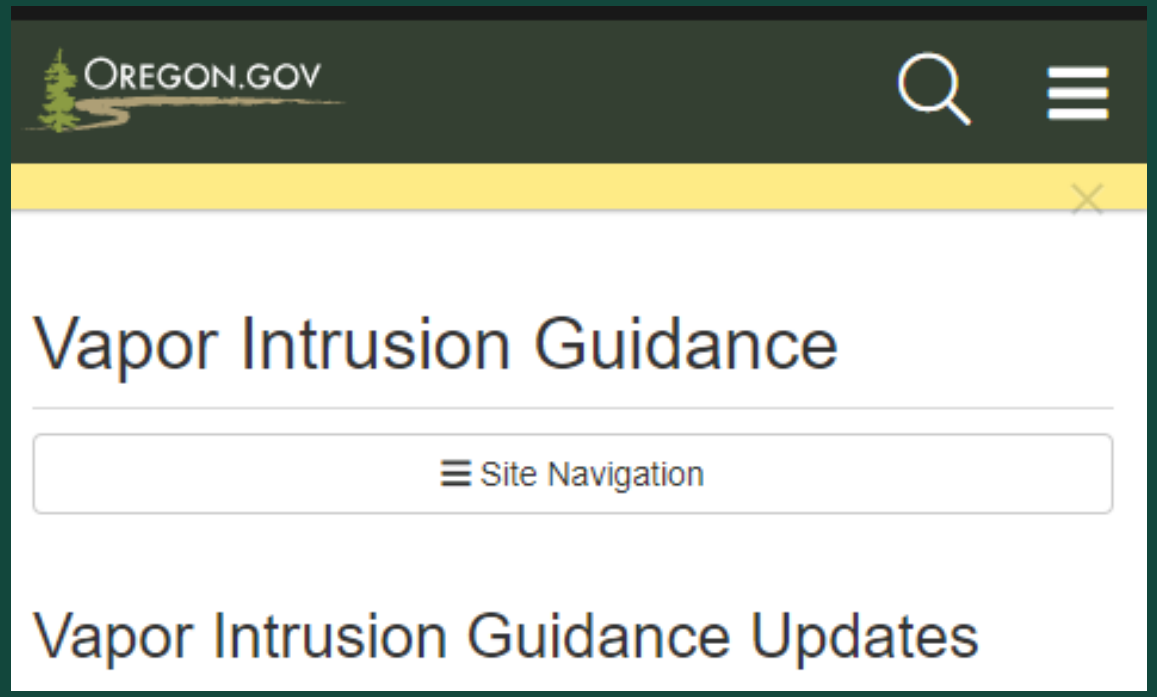
- Proactively and effectively engaging communities impacted by VI risks early on and throughout the process
  - VI is one of the most common exposure pathways and can represent imminent risk to human health
- Clear and open communication is key to establishing trust and collaborative working relationships
  - Set expectations, openly answer questions and respond to concerns
- Multiple references by EPA, ITRC, Washington Dept of Ecology



Public Review Period

Informal public review period: March 1-May 31, 2024

- Not a formal public comment period



Where to find help during transition?

- DEQ: *https://www.oregon.gov/deq/hazards-and-cleanup/env-cleanup/pages/vapor-intrusion.aspx*
- EPA: *https://www.epa.gov/vaporintrusion*
- ITRC: https://itrcweb.org/teams/training/vapor-intrusion-mitigation-training
- Your DEQ Team and *VIworkgroup@deq.oregon.gov*

Thank you

Reach out to the VI team at *VIworkgroup@deq.oregon.gov*