



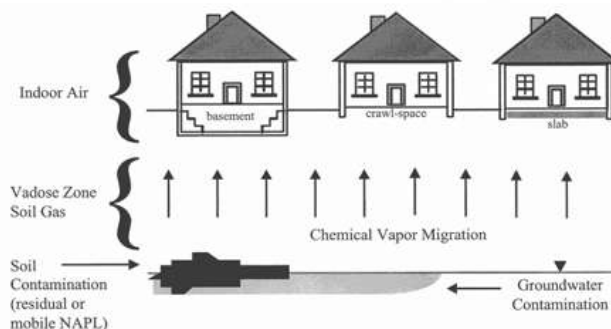
Guidance for Assessing and Remediating Vapor Intrusion in Buildings

Seth Sadofsky, Ph.D.
Remedial Action Specialist
Oregon Department of Environmental Quality

DEQ Guidance Development Team – Includes representatives of Cleanup, UST & HOT programs

Ann Levine, Bruce Giles, Rob Hood, Henning Larson, Mike Romero, Seth Sadofsky, Paul Siedel, Rebecca Wells-Albers

What is Vapor Intrusion?



Vapor Intrusion is the migration of volatile contaminants from subsurface into buildings

Impetus for Guidance Development



- Rapidly Evolving Field – Oregon guidance unchanged since 1996
- Availability of large EPA empirical database on attenuation factors
- Need for more comprehensive State guidance
- Experiences using Johnson and Ettinger Modeling
 - Sensitivity to site-specific inputs
 - Difficulty in measuring transport parameters
 - Cases of underprediction

Objectives of DEQ VI Guidance



- Move data collection closer to exposure points
- Clear decision points balanced with weight-of-evidence approach
- Provide guidelines at different phases while avoiding being overly prescriptive
- Augment with other guidance and publications (i.e. Mass. guidance on indoor air sampling)

Major Changes in Evaluation Framework



- No site-specific J&E Modeling
 - Site-specific attenuation factors reflected in subslab/indoor data relationship
- Soil gas/subslab become essential site data
- Use of generic soil gas/subslab attenuation factors
- Greater emphasis on indoor air data
 - Verification

Document Content

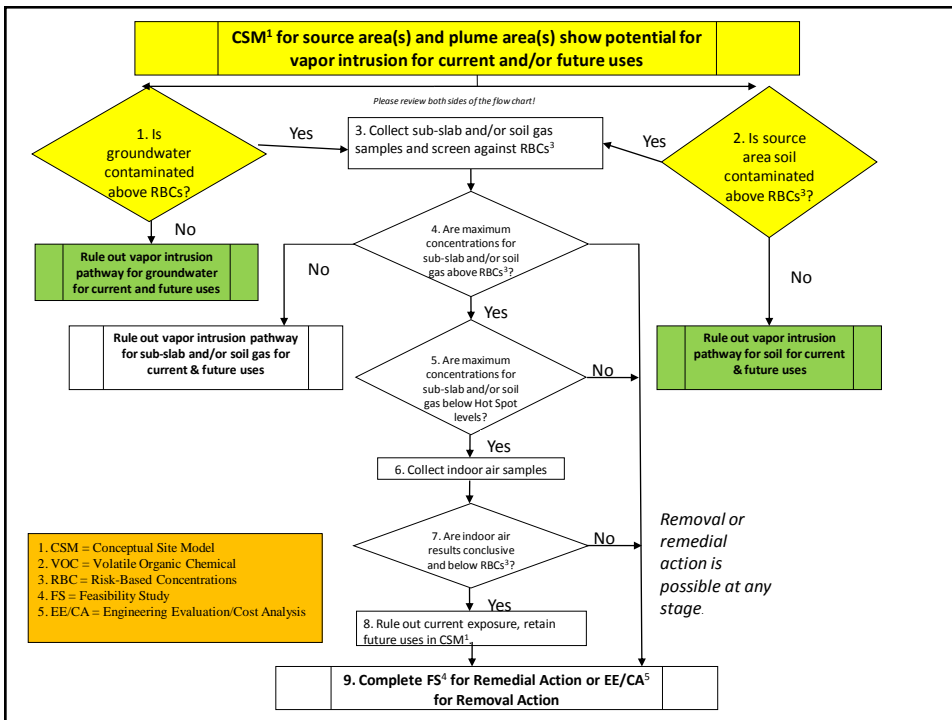


- **Defines: Contaminants w/ VI potential**
- **Includes: Flow chart for Evaluation Framework**
- **Specifies: Generic Attenuation Factors for Soil Gas**
- **Guidelines on:**
 - Bounding investigations, defining vapor plume extent
 - Sample locations, density, depth and frequency
 - Methods of sample collection
 - Methods of data analysis and interpretation
 - General mitigation options and performance evaluation
- **References**
- **Case Studies**

VI Contaminants of Interest (COI)



- Contaminants with $H > 10^{-5} \text{ atm}\cdot\text{m}^3\cdot\text{mol}^{-1}$
- Excludes methane
- Includes petroleum products within gasoline and diesel ranges
- Certain Pesticides and SVOCs



First Screening – Potential VI condition

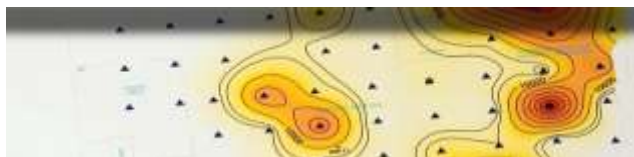


- Generic (RBDM) soil and groundwater RBCs retained for initial screening of VI risks from soil and groundwater
 - Derived from J&E Modelling
 - RBCs based on conservative conditions (e.g. air/water-filled porosity)
 - Generally screened against maximum concentrations measured at a site
- Default is occupied building (or future development) within 100 ft from soil and/or GW sources exceeding RBCs - derived from examination data, EPA Guidance, modeling research
- Can be adjusted based on site-specific data
 - Potentially increased for large, deep sources
 - Potentially decreased for small, shallow sources
 - Petroleum vs. HVOCs
 - Preferential pathways

Delineating the Vapor Plume



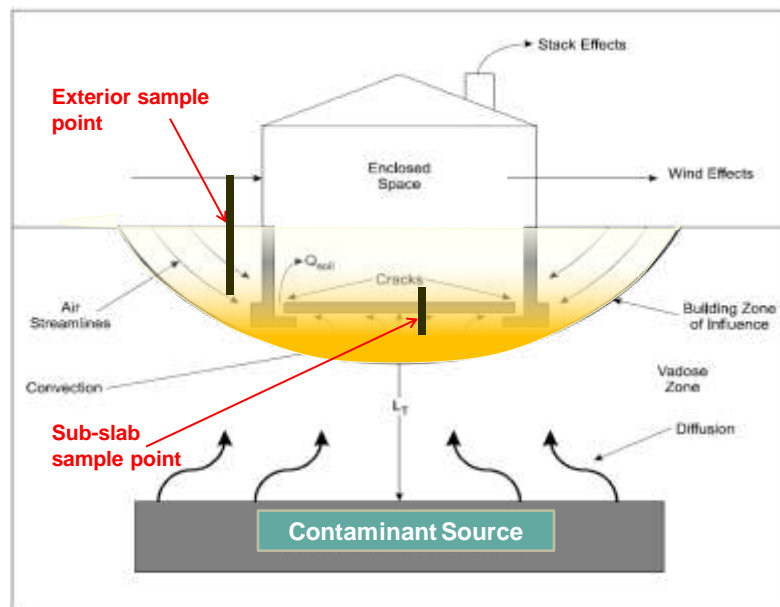
- Similar to groundwater plumes
- Geographic area exceeding soil gas RBCs
- Represents potential future risk, may be current risk
- Each structure or potential structure is a separate exposure/decision unit



Sample Depth



- Current Buildings - Preference for sub-slab (<1 ft below slab)
- Soil gas – 5ft deep
 - Should be used in buildings with crawl spaces, no attenuation assumed, future development with no current buildings
 - Generally below atmospheric exchange
 - Reduces short circuiting
 - Should always be above capillary fringe
 - Depth may not be feasible at some sites
- For below-grade construction – beneath deepest occupied or potentially occupied area



Attenuation Factor Concept



$$AF_{vi} = \frac{C_{sv}}{C_{ia}}$$

where:

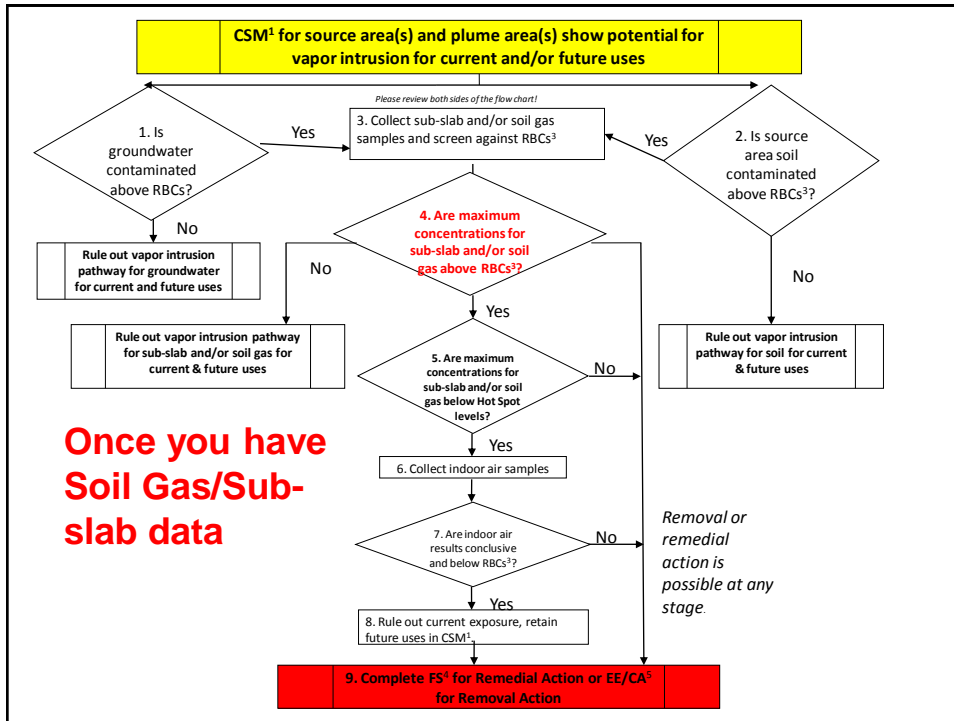
- AF_{vi} = Attenuation factor between soil vapor and indoor air, unitless
- C_{sv} = Concentration in soil vapor medium, ug/m³
- C_{ia} = Concentration in indoor air, ug/m³

Published Soil Gas and Sub-Slab RBCs are based on attenuation factors of 200 for residential structures and 1000 for Commercial structures

Screening with Soil Gas RBCs



- Typically compares maximum measured values for an exposure unit to soil gas RBCs, unless enough data for statistical estimation
- Appropriate application of attenuation factors depends on sample location/depth
- Hot Spots – defined as subsurface conc. >100x soil gas RBCs for carcinogens – preference for clean up



Indoor Air Sampling



- Conducted when subsurface investigation indicates RBCs exceeded
 - Except at active facilities w/ operational sources (gas stations, dry cleaners)
 - May be useful in making a decision about timing of an action
- At many sites becomes primary line of evidence
- Can be used to establish absence of current risk, unlikely that it addresses future risks
- *Crawl space sampling: No attenuation between crawl space and indoor air assumed.*

Mitigation



- If VI risks is identified - an FS (or CAP) should be prepared to evaluate remedies.
- This may include:
 - Site Wide Remedies
 - Institutional Controls
 - Engineering Controls
- Guidance does not prescribe technology or design
- Addressed primarily by reference to existing EPA guidance



Thank You for
Your Attention