

# EPA's Final Vapor Intrusion Guidance

EPA/AEHS Vapor Intrusion Workshop

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## Presentation Organization & Scope

- Overview of EPA's vapor intrusion guidance
- OSWER VI Guide
  - Development, purpose, and scope
  - Summary of selected content and key recommendations, including:
    - Definitions of 'background' and 'pre-emptive mitigation'
    - Role of conceptual site models and relationship to 'multiple lines of evidence'
    - Risk management and response actions

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## I. Overview of EPA VI Guidance

- EPA's vapor intrusion guidance is comprised of two guides, published in June 2015, which supersede and replace EPA's 2002 draft guidance.
  - Guide for petroleum releases from *underground storage tanks sites*.
  - Guide for all other sites within EPA's jurisdiction (e.g., Superfund, RCRA corrective action facilities)

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### ***Technical Guide For Addressing Petroleum Vapor Intrusion At Leaking Underground Storage Tank Sites***

EPA 510-R-15-001

June 2015

<http://www.epa.gov/ust/technical-guide-addressing-petroleum-vapor-intrusion-leaking-underground-storage-tank-sites>

This document is intended for use at any site subject to petroleum contamination from underground storage tanks where vapor intrusion may be of potential concern ("OUST PVI Guide").

It is applicable to both residential and non-residential settings (e.g., commercial and industrial).

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## ***OSWER Technical Guide For Assessing And Mitigating The Vapor Intrusion Pathway From Subsurface Vapor Sources To Indoor Air***

OSWER Publication 9200.2-154 (June 2015)

<https://www.epa.gov/vaporintrusion/technical-guide-assessing-and-mitigating-vapor-intrusion-pathway-subsurface-vapor>

This document is intended for use at any site being evaluated pursuant to CERCLA or the corrective action provisions of RCRA, where vapor intrusion may be of potential concern (“OSWER VI Guide”).

It is also intended for use by EPA’s brownfield grantees, where vapor intrusion may be of potential concern.

It is applicable to both residential and non-residential settings (e.g., commercial and industrial).

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## **II(A). Highlights of Development Process for OSWER VI Guide**

- Consensus-oriented, cross-EPA process to prepare and vet the Guide (2012 to 2014)
- Public review draft (mid-2013)
- Inter-agency review per Executive Order 12866 (September 2014 to June 2015)
- Also considered numerous comments in docket (2002-2013), research publications, and guides from other entities

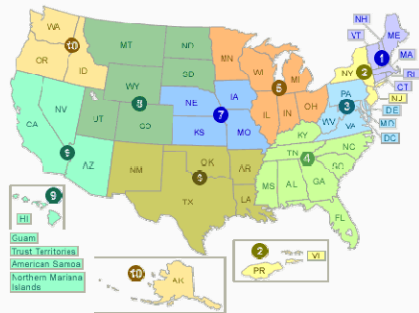
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## II(B). Purpose of OSWER VI Guide



- Promote enhanced approaches and national consistency for addressing vapor intrusion at contaminated sites within EPA's jurisdiction { § 1.3}

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## II(C). Scope of OSWER VI Guide { § 1.3}

- Considers full range of “vapor-forming chemicals” at pertinent sites
  - Chlorinated solvents (e.g., PCE, TCE)
  - Petroleum hydrocarbons such as benzene, trimethylbenzenes
  - Hydrophobic compounds that also meet the volatility and toxicity criteria (e.g., some PCBs, some pesticides)

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## Scope of OSWER VI Guide { § 1.3} (continued)

- Not intended to alter existing requirements among OSWER's land cleanup programs; for example, about
  - Development (e.g., evaluation of alternatives, cleanup levels), selection, and documentation of cleanup plans, or
  - Periodic post-construction review to ensure protection of human health and the environment.

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## Scope of OSWER VI Guide { § 1.3} (continued)

- EPA recommends that tribal agencies and delegated state agencies consider this Technical Guide when implementing their respective programs for vapor intrusion assessment and mitigation.

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## II(D). Organization & Scope of OSWER VI Guide

- Executive summary identifies key recommendations
- Glossary identifies key terms
- Major sections devoted to
  - Preliminary analysis (initial site assessment)
  - Site investigation
  - Community involvement and risk communication
  - Response actions (remediation, mitigation, ICs)

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OSWER VI Guide: Introduction

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### III(A). How is 'Background' Defined?

- Refers to a vapor-forming chemical(s) or location(s) that is(are) not influenced by the releases from a site to the environment
- Concentrations in ambient air are not considered background when influenced by site-related releases



### III(A). What Are Some Implications of 'Background'? (continued)

- Identify and remove indoor sources to extent possible during an interior investigation
- Generally limit chemical analyses of subslab soil gas and indoor and outdoor air to those vapor-forming chemicals known or reasonably expected to be present in the subsurface environment { § 6.4 and 6.3.5}



### III(A). How is 'Background' Considered?

(continued)

- Recommended methods are described to account for 'background' contributions to indoor air concentrations { § 6.3.5}
- If background vapor sources are found to be primarily responsible for indoor air concentrations, then response actions for vapor intrusion would generally not be warranted for current conditions { § 7.4.2}

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### Accounting for Background with Multiple Lines of Sampling Evidence { § 6.3.5}

Vapor-forming Chemical in Groundwater	Subslab Soil Gas Conc., $C_{ss}$ ( $\mu\text{g}/\text{m}^3$ )	Indoor Air, Conc., $C_{ia}$ ( $\mu\text{g}/\text{m}^3$ )	Outdoor Air Conc., $C_{oa}$ ( $\mu\text{g}/\text{m}^3$ )	Ratio of $C_{ss}$ to $C_{ia}$
VFCA	1	0.65	0.75	1.5
VFCB	33,000	26	0.18	1,300
VFCC	5,200	5.8	0.14	900
VFCD	15,000	15	0.51	1,000

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Hypothetical (Corrected) Example from OSWER VI Guide

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Questions



Answers

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OSWER VI Guide: Background

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### III(B). Non-residential Buildings { § 1.2}

- The sources of EPA authority and requirements for addressing subsurface vapor intrusion are the relevant statutes and regulations, which include
  - CERCLA as amended
  - RCRA, as amended
- EPA's authority and responsibilities are distinct and different from those of OSHA.

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### III(B). Non-residential Buildings { § 4 }

(continued)

- When making decisions pertaining to VI, consider
  - Characteristics of potentially exposed populations
  - Vapor contributions from background sources
  - Existing or planned engineering controls that address workplace inhalation exposures and their scope



### III(B). Non-residential Buildings { § 7.4.3 }

(continued)

- EPA does not recommend using OSHA's PELs (or TLVs) for purposes of:
  - assessing human health risk posed to workers by the vapor intrusion pathway; or
  - supporting final “no-further-action” determinations for vapor intrusion arising in nonresidential buildings.



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OSWER VI Guide: Non-residential Buildings

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### III(C). Risk Management: Key Recommendations

- EPA recommends that OSWER programs make the risk management determination to take response action(s) consistent with their statutes and regulations and considering existing program guidance { § 7.4.1} .
- Consider reasonably expected future conditions, in addition to current conditions { § 3.2 and 7.4.1}

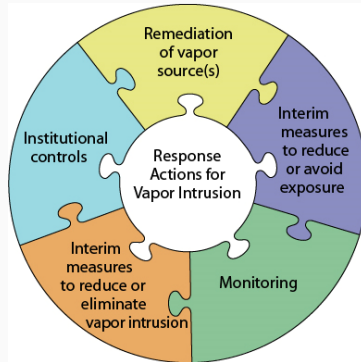
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### III(C). Risk Management for the VI Pathway { § 3.3, 7.7, and 8} (continued)



- Typically entails
  - combination of response actions and
  - notification and risk communication to building occupants and owners, in addition to ICs



### III(C). Response Actions: Key Recommendations { § 8.1} (continued)

- When vapor intrusion has been determined to pose unacceptable human health risks, aim to achieve a permanent remedy by eliminating or substantially reducing the level(s) of vapor-forming chemical(s) in the subsurface source medium
- Engineered exposure controls are considered only interim action, although they can provide effective human health protection and may become part of a final cleanup plan



### III(C). Response Actions: Key Recommendations { § 8.7} (continued)

- EPA generally recommends developing and documenting termination criteria
  - Numeric cleanup levels for subsurface media
  - Criteria for demonstrating attainment
- Termination of remediation, mitigation, and monitoring activities will be contingent upon demonstrating that subsurface cleanup levels have been attained, which is sustainable.

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### III(D). What is 'Pre-emptive Mitigation'? { § 3.3 and 7.8}

- For an existing building(s),
  - Implement mitigation of the vapor intrusion pathway as an early action, even though all pertinent lines of evidence have not yet been completely developed

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### III(D). What is 'Pre-emptive Mitigation'? { § 3.3 and 7.8} (continued)

- For a building(s) to be constructed in areas of vapor-forming subsurface contamination,
  - Install, operate, and monitor mitigation systems rather than allow vapor intrusion (if any) to occur

*Note: A wider array of approaches and technical options is typically available to mitigate or avoid vapor intrusion for new buildings, compared to existing buildings.*

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OSWER VI Guide: Risk Management and Response Actions

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### III(E1). Vapor Intrusion Investigations: Overview of Recommended Approaches

- Flexible framework for planning and conducting investigations to evaluate sites and buildings, rather than a prescriptive universal process



### III(E2). Vapor Intrusion Assessments: Multiple Lines of Evidence

- Generally assess the vapor intrusion pathway by collecting, weighing, and evaluating multiple lines of evidence, particularly when no-further-action decisions are to be supported



### III(E2). Lines of Evidence: Definition (continued)

- Facts or other information, useful for forming a conclusion or judgment
- May be categorized into
  - scientific realms (e.g., geology, biology, physics) or
  - investigatory objectives (e.g., characterize vapor migration routes)

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### III(E2). Multiple Lines of Evidence (continued)



**Image Source:** Physics Stack Exchange  
[<http://physics.stackexchange.com>]

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- EPA recommends the appropriate use and evaluation (“weighing”) of multiple lines of evidence for determining, for example
  - whether the vapor intrusion pathway is complete or not,
  - whether any elevated levels of contaminants in indoor air are likely caused by subsurface vapor intrusion versus an indoor source or an ambient (outdoor) air source.

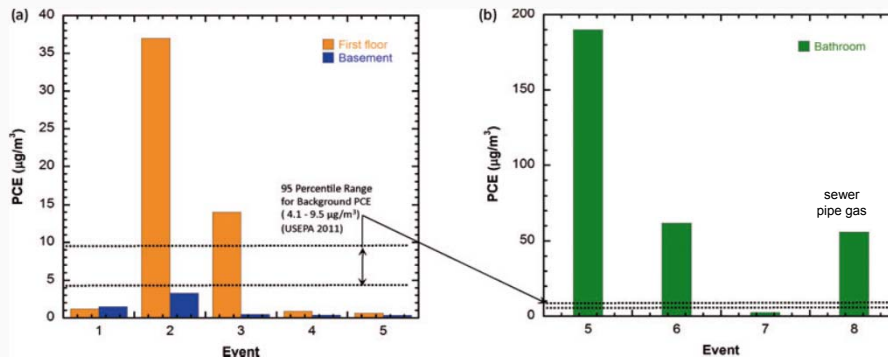
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## Weighing Lines of Evidence, Example #1

(continued)



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Source: Pennell et al. [2013]

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Potential Categories of Evidence for Demonstrating That the Vapor Intrusion Pathway Is and Will Remain Incomplete

### Vapor Source Strength

See Sections 2.1 and 6.3.1

Source Conc. < Medium-specific VISLs and Source Stable or Shrinking

### Vadose Zone Geology

See Sections 2.2 and 6.3.2

Horizontal and Laterally Extensive Fine-Grained Layers Demonstrated

### Vadose Zone Hydrology

See Sections 2.2 and 6.3.2

Horizontal and Laterally Extensive Layers of High Moisture Content Demonstrated

### Vadose Zone Biochemistry

See Sections 2.2 and 6.3.2

Biodegradation Demonstrated to Significantly Attenuate Vapor Migration Over Laterally Extensive Area

Significant characterization of the vadose zone may be necessary to demonstrate that the hydrologic, geologic, or biochemical features are laterally extensive compared to the size of the building or the extent of contamination.

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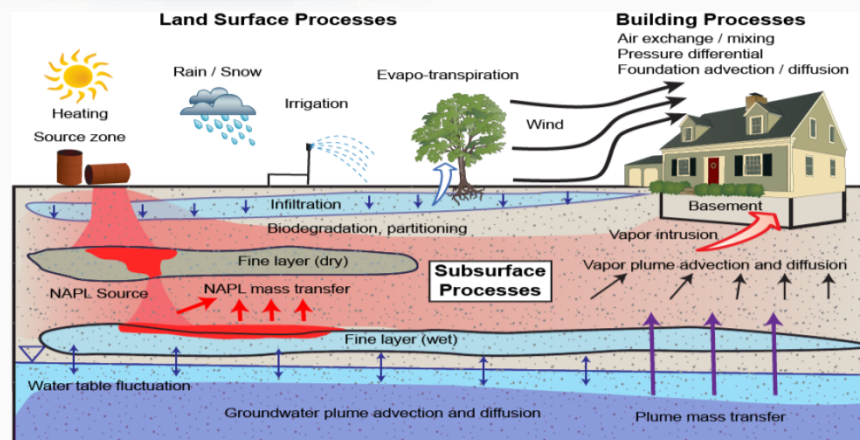
## Weighing Multiple Lines of Evidence (continued)

- Additional examples cited in the OSWER VI Guide {e.g., § 7.2 and 7.3}
  - underscore the importance of developing an adequate Conceptual Site Model (CSM); and
  - illustrate why EPA generally recommends that the vapor intrusion pathway not be deemed incomplete based upon any single line of evidence.

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*Conceptual Model of Soil Vapor Intrusion Pathway*

SOURCE: Illangasekare et al. [2014], SERDP Project ER-1687 Report Figure 1-1

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### III(E3). Conceptual Site Models: Key Recommendations (continued)

- Consider the presence of ‘preferential migration routes’ and ‘significant openings’ that could facilitate vapor migration to greater distances and at higher concentrations than otherwise expected
  - Naturally occurring (e.g., fractures and macropores)
  - Anthropogenic (e.g., sewers, utility vaults, drains)

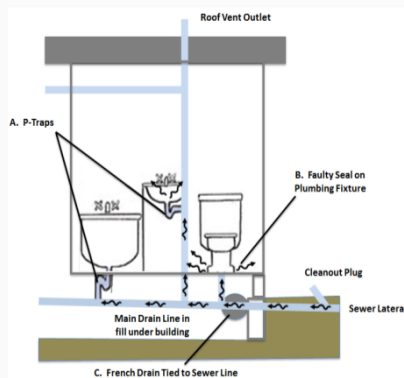
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### III(E3). Conceptual Site Models: Key Recommendations (continued) (continued)

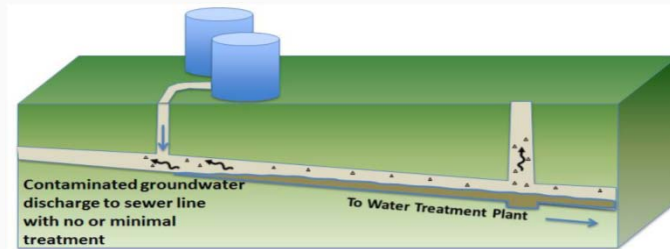
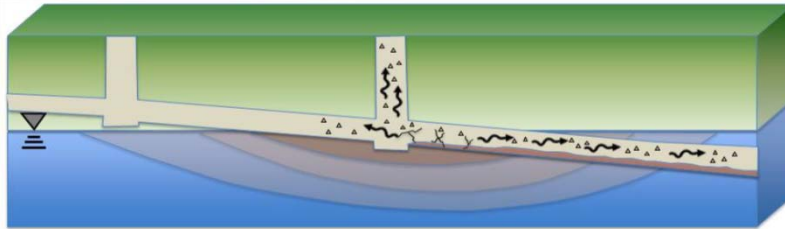


- Recognize that site-related vapors can enter a building from ‘conduit gas intrusion’, if and when present in sewer or drain lines or utility tunnels, as well as ‘soil gas intrusion’

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Image Source: McHugh & Beckley [2015]

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December 2015

### Example Scenarios for Contamination of Sewers

SOURCE: McHugh & Beckley [2015]

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### III(E3). Conceptual Site Models: Key Recommendations (continued)

- Recognize that site-related vapors can enter a building from ambient air infiltration, as well as 'soil gas intrusion'
- Recognize that vapor intrusion is not the sole human exposure pathway that may warrant consideration

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OSWER VI Guide: MLEs & Conceptual Site Models

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### III(F). What's "Missing"?

- Prescriptive sampling plans, considering variability
  - Number, types, and duration of samples
  - Timing of sampling
- Recommended attenuation factors for screening large commercial and industrial buildings

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### III(G). What “Else”?

- As resources allow, EPA intends
  - Additional public training and outreach about the OSWER VI Guide in 2016
  - Periodic updates to the VISL Calculator to incorporate new, chemical-specific info
  - Continued monitoring of pertinent research, publications, and developments (e.g., SERDP/ESTCP)

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### III(G). What “Else”? (continued)

- Proposed addition of subsurface intrusion to the Hazard Ranking System
  - Notice in *Federal Register* Vol. 81, No. 39 (Monday, February 29, 2016)
  - Public comments solicited through April 29, 2016 (Docket ID No. EPA–HQ–SFUND–2010–1086)
  - <http://www.epa.gov/superfund/hrs-subsurface-intrusion> for additional info (e.g., FAQs)

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OSWER VI Guide: Wrap-up

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