

# RECENT CHANGES IN CALIFORNIA'S VAPOR INTRUSION GUIDANCE

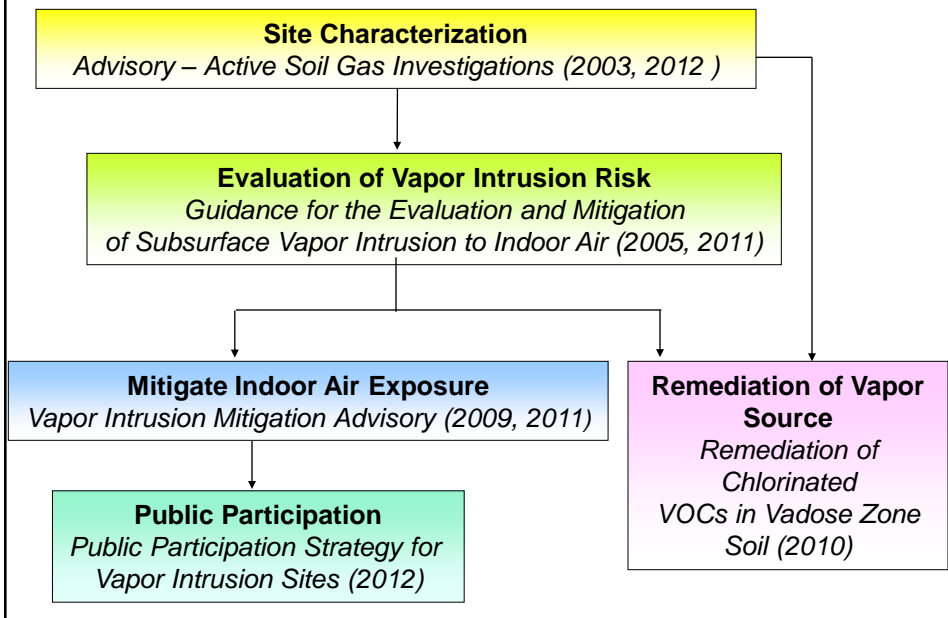
***Professional Environmental Marketing Association***

Dan Gallagher  
Department of Toxic Substances Control  
California Environmental Protection Agency

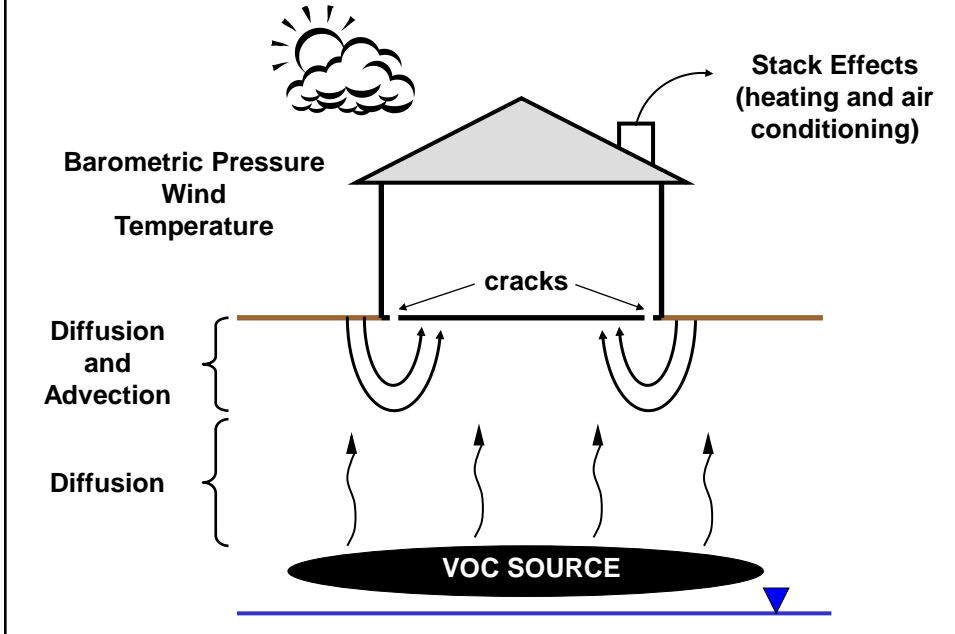


January 15, 2013

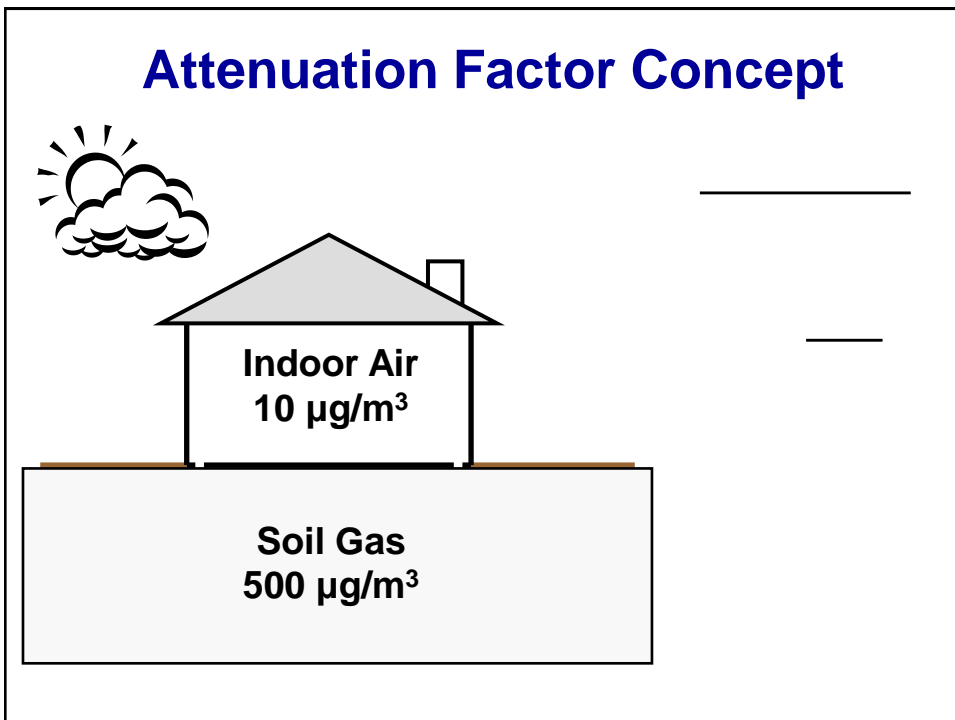
## DTSC Guidance Documents



# Vapor Intrusion – Conceptual Model



# Attenuation Factor Concept



## **DTSC Tiered Approach**

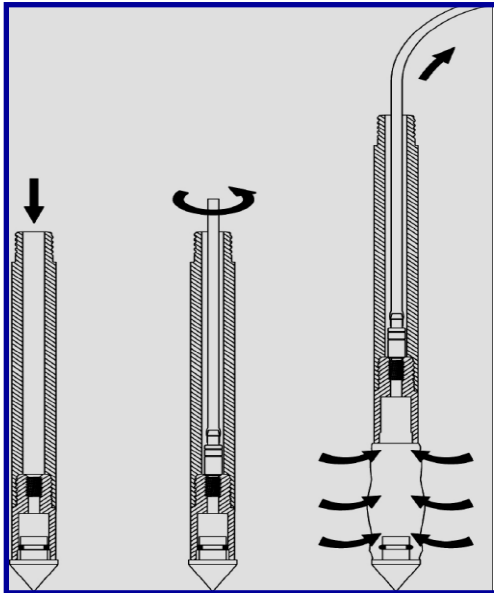
- 1. Exposure Pathway Complete?**
  - Building and volatile chemical present?
- 2. Preliminary Screening**
  - California Human Health Screening Levels
- 3. Site-Specific Screening**
  - Subslab sampling
  - Fate and transport modeling
  - In-situ measurements

## **Soil Gas Sampling**

### **REVISIONS FOR 2012 GUIDANCE**

- **Don't use low density polyethylene tubing**
- **Longer equilibration times before sampling**
- **Don't exceed 100 inches of water when sampling**
- **Shut-in testing recommended**
- **Tedlar bag holding time = six hours**

# Post-Run Tubing

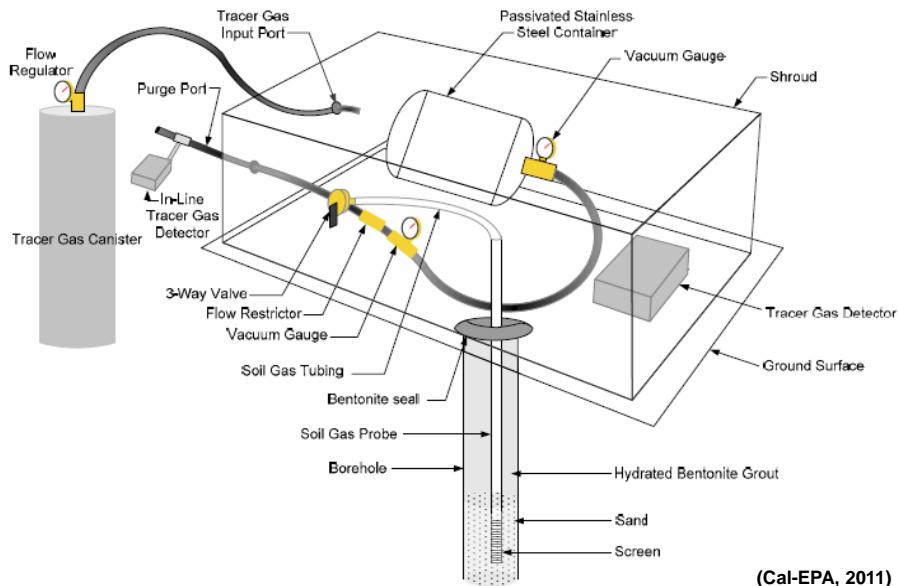


(McAlary, 2006)



(Hartman, 2007)

# Soil Gas Sampling - Shroud

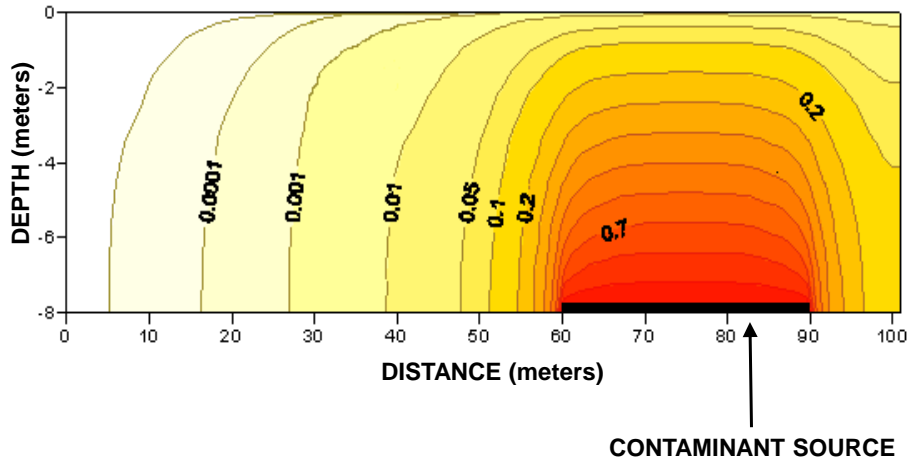


(Cal-EPA, 2011)

# Soil Gas Modeling

## Theoretical Distribution of Soil Gas Above a Subsurface Contaminant Source

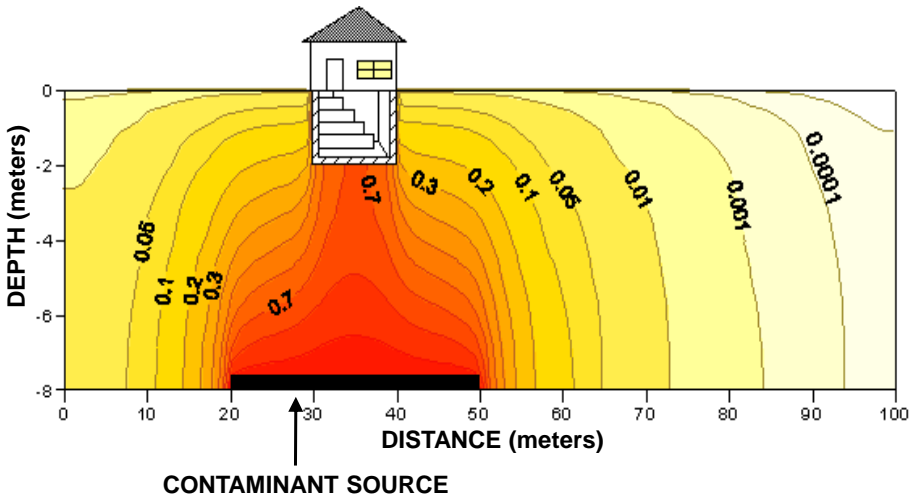
Modified from Johnson and Abreu (AEHS Conference 2005)



# Soil Gas Modeling

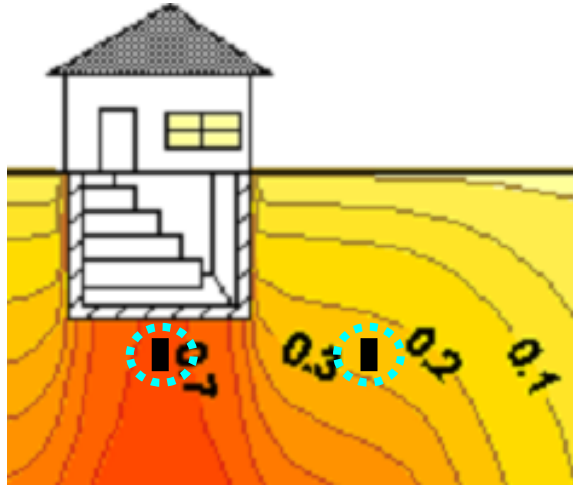
## Theoretical Distribution of Soil Gas Above a Subsurface Contaminant Source With a Building

Modified from Johnson and Abreu (AEHS Conference 2005)



## Soil Gas Sampling Depths

Differences in “open-field” and “under-building” soil gas concentrations



Higher concentrations are observed under buildings

## Installation of Permanent Probes

- When soil gas plumes have migrated under buildings
- Evaluate whether contamination has reached steady-state
- Evaluate temporal contaminant trends
- Soil gas grab samples yield an irregular distribution of contamination
- Evaluate the effectiveness of SVE systems

## Soil Effective Diffusion Coefficient ( $D_{\text{eff}}$ )

Millington and Quirk (1961)

$$D_{\text{eff}} = D_a \left( \frac{\theta_a^{3.33}}{n^2} \right)$$

- $D_a$  = diffusion coefficient in air  
 $\theta_a$  = volumetric air content  
 $n$  = total porosity

## Site-Specific Modeling

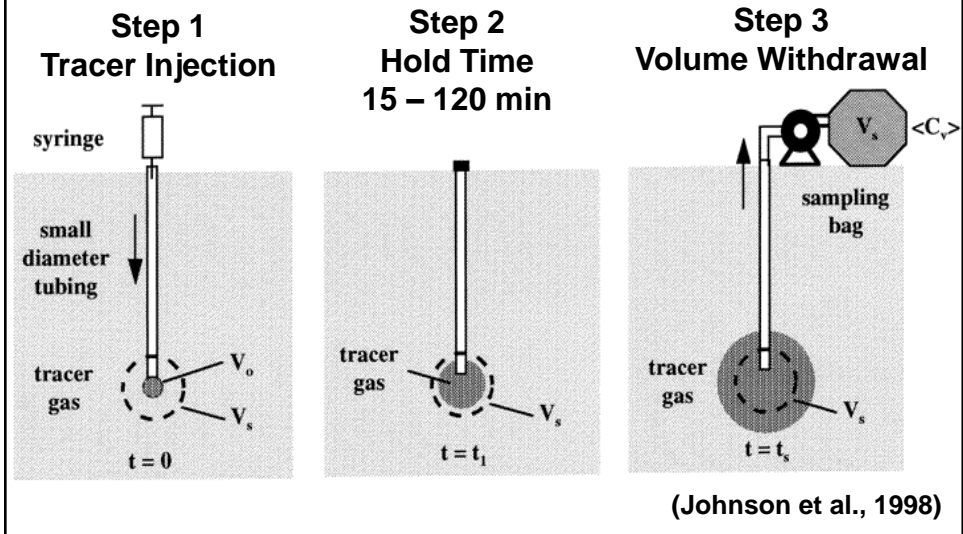
### Determination of Physical Properties

- Grain Size Distribution
- Geotechnical Laboratory Analysis
- In-Situ Measurements

**NEED STATISTICALLY  
ROBUST DATA SET**

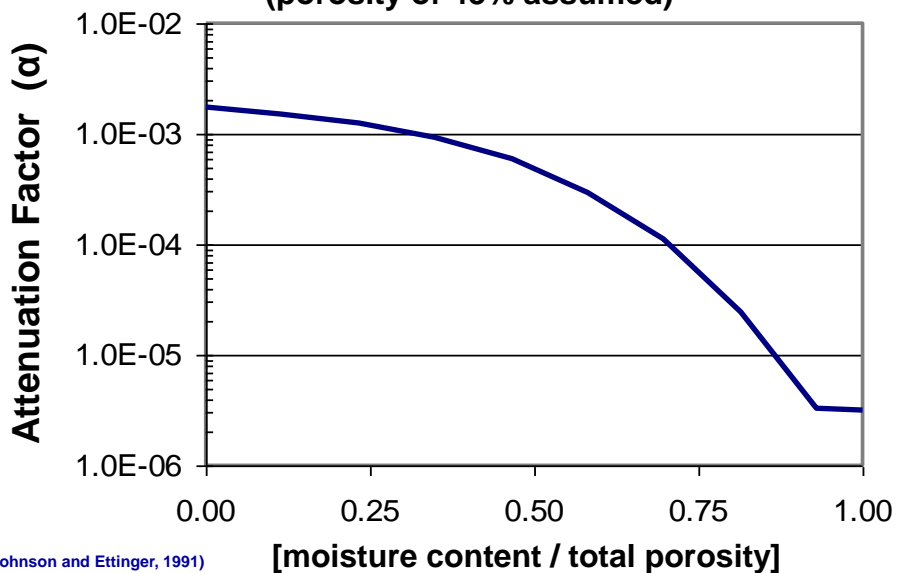


# In-Situ Measurement of Effective Diffusion Coefficient



## Sensitivity of Input Parameters

Volumetric Moisture Content of the Soil  
(porosity of 43% assumed)



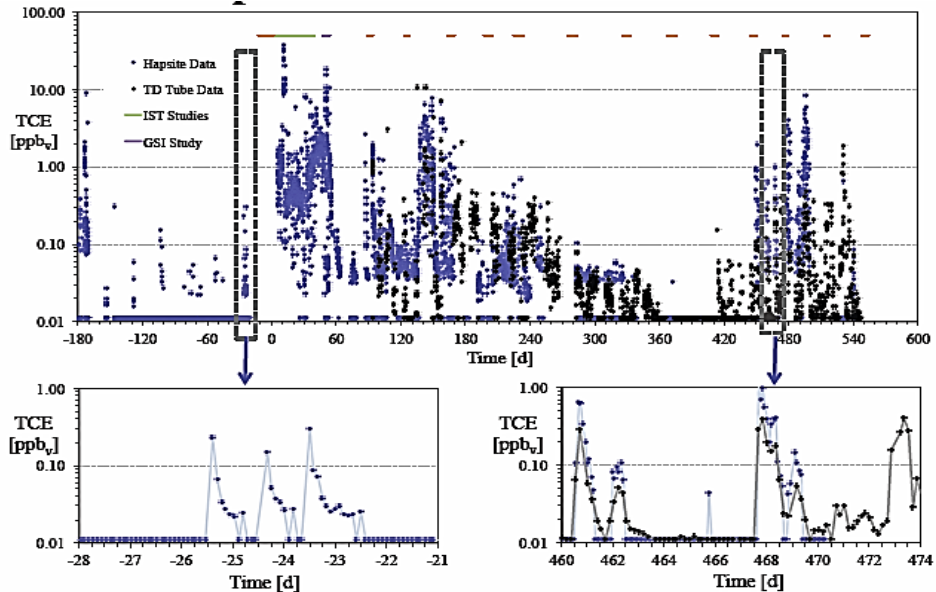
# Indoor Air Testing



Six Liter Summa Canister

## Temporal Trends in Indoor Air

OFFSITE HOME OVER CONTAMINATED GROUNDWATER NEAR HILL AF BASE



(Johnson et al., 2012: AEHS Conference)

## New Sampling Approaches

Automatic Thermal Desorption (ATD) Tube



SKC Ultra II



Waterloo  
Membrane  
Sampler

Radiello Sampler



3M OVM 3500

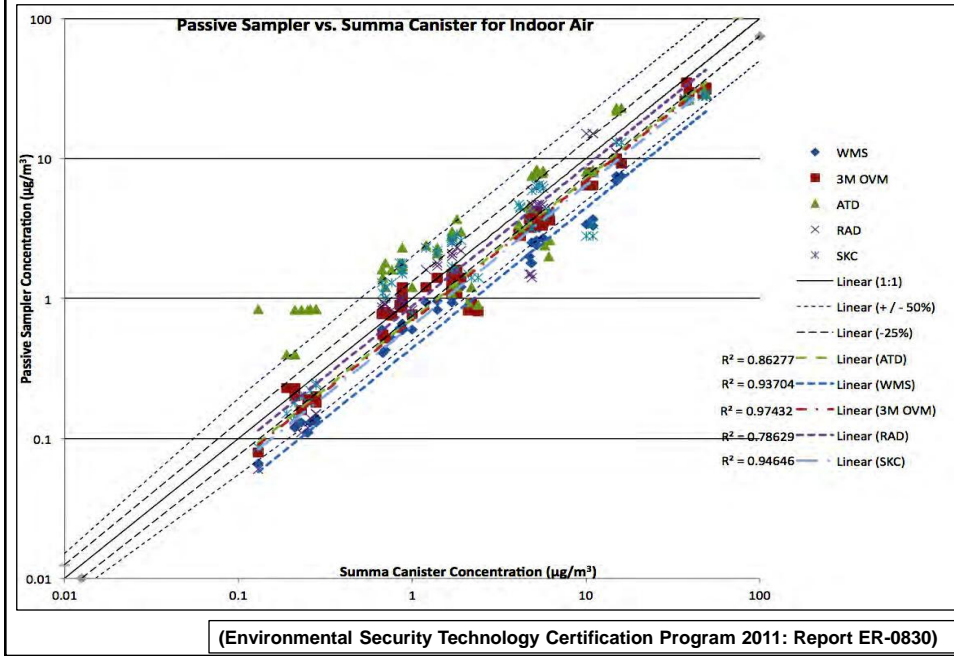
## Sorbent Concentration Calculation

$$C = \left( \frac{M}{Q t} \right)$$



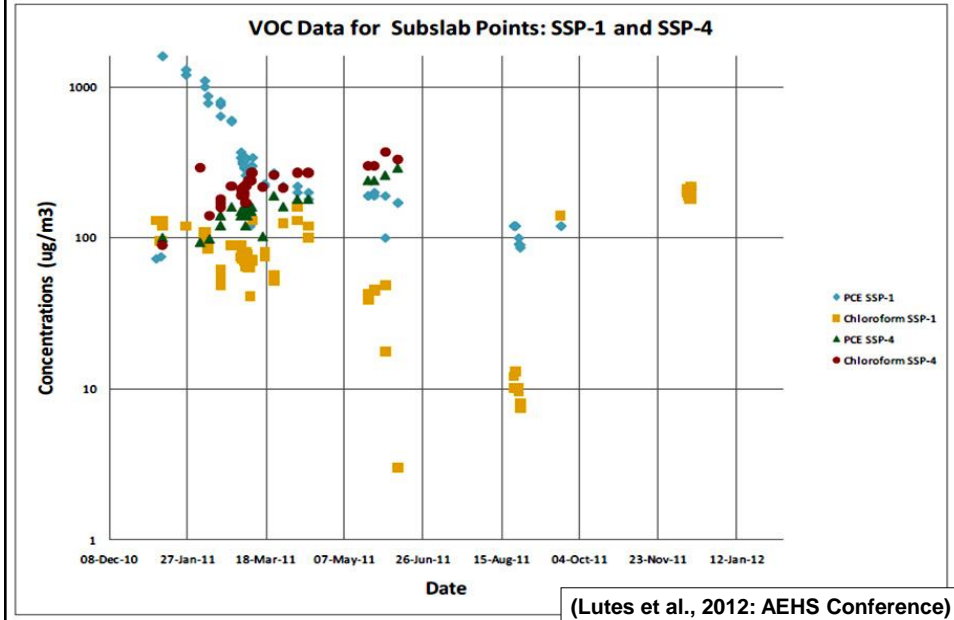
- C** = concentration in air
- M** = mass of analyte on sorbent
- t** = exposure time
- Q** = experimentally measured sampling rate

## Passive vs Active Indoor Air Correlation



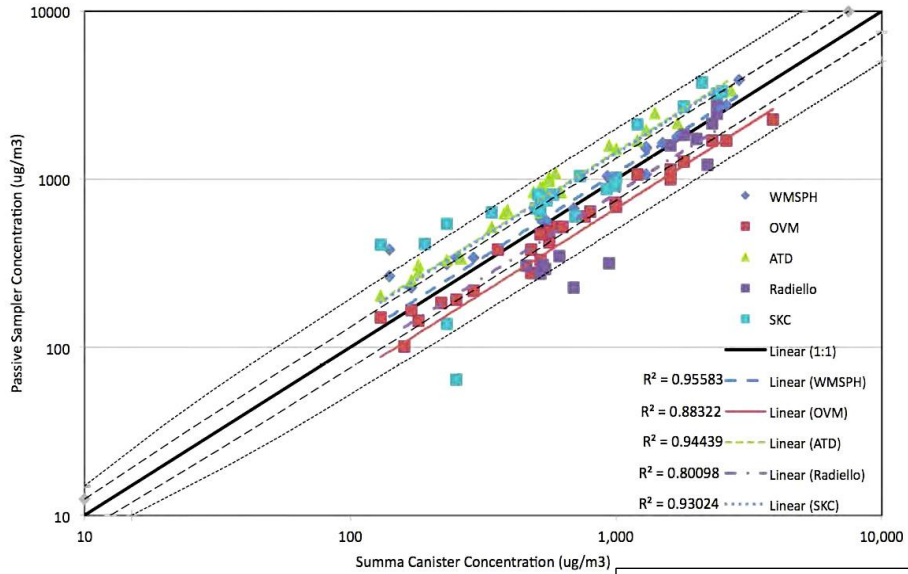
## Subslab Soil Gas Trends

INDIANAPOLIS HOME NEAR DRY CLEANERS: PCE and CHLOROFORM



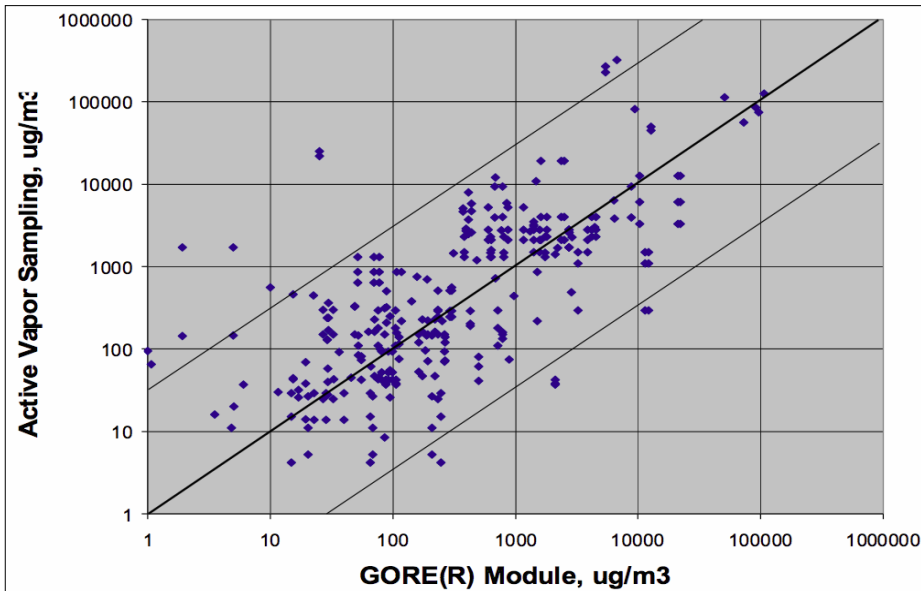
# Passive vs Active Soil Gas Correlation

Passive Soil Gas Samples Versus Summa Canisters



(ESTCP 2011: Report ER-0830)

# Passive Soil Gas: Gore 2010



[http://events.awma.org/education/Posters/Final/Whetzel\\_Poster.pdf](http://events.awma.org/education/Posters/Final/Whetzel_Poster.pdf)

## Active vs Passive Indoor Air Sampling

<b>Summa Canister</b>	<b>Passive Sorbent</b>
Used in U. S.	Used in Europe
Specific analyte list and deployment time	Sorbent type, geometry, and deployment chemical specific
Shorter time-integrated sample (8 – 24 hours)	Longer time-integrated sample (2 - 14 days)
Higher cost	Lower cost
Very visible – homeowner cautious	Less intrusive – better acceptance
Bulky – expensive to ship	Small – inexpensive to ship

(A. Lee; USEPA 2010)

## Continuous Soil Gas Monitoring

- Concentration, temperature and pressure
- Data: download or telemetry
- Frequency: two minutes to daily
- Three month battery life
- VOC detection limit = 100 ppm



**GasClam®**

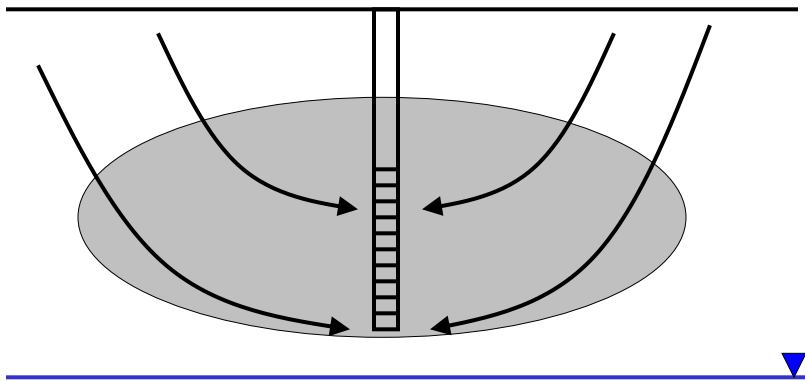
## Vapor Pin™: Subslab Sampling



Cox-Colvin & Associates

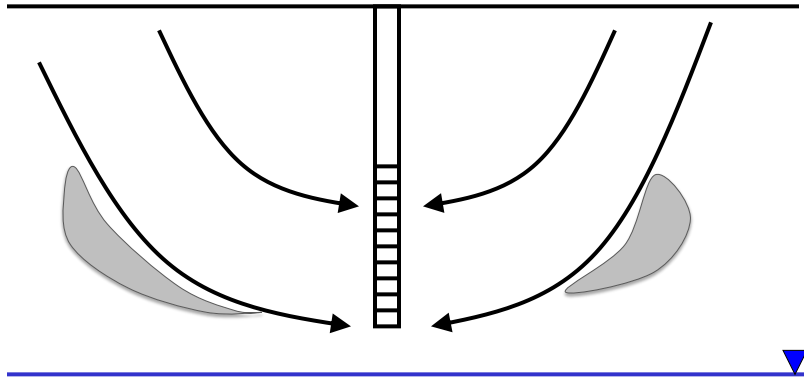
## Post-Remediation Soil Gas Sampling

### Soil Vapor Extraction Operation

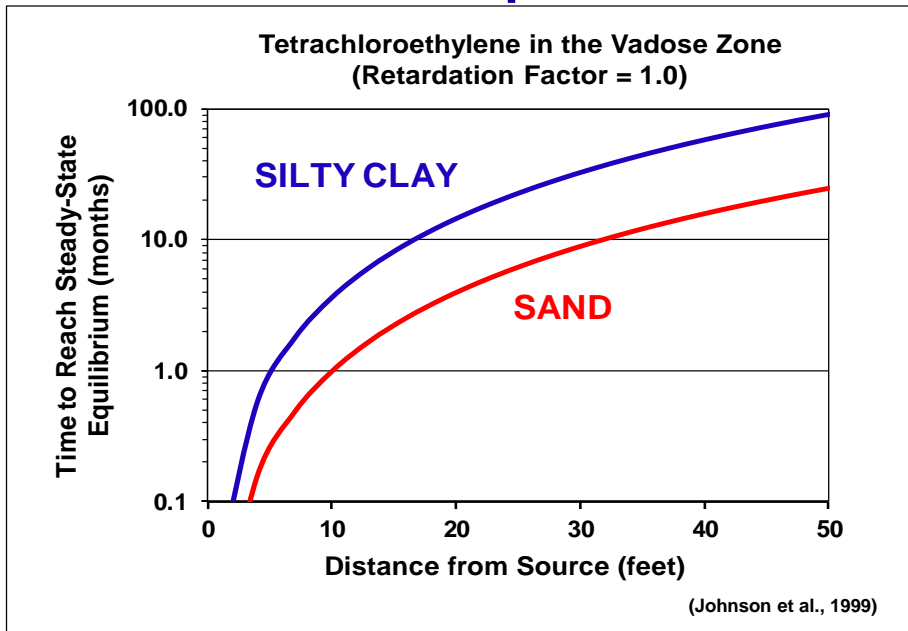


# Post-Remediation Soil Gas Sampling

## Soil Vapor Extraction Operation



## Evaluation of Vapor Rebound



## **Interstate Technology Regulatory Council Early Announcement of Class**

Title of 2-Day Classroom Training:

### **Evaluating LNAPL Remedial Technologies for Achieving Project Goals – A Science-Based Approach**



Scheduled for early October in Southern CA

Email [training@itrcweb.org](mailto:training@itrcweb.org) to receive an email when  
more information is available