

Time Efficient & Cost Effective Vapor Intrusion Assessments: A Case History

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This presentation focuses on issues that need to be considered in order to conduct time efficient and cost effective vapor intrusion assessments. It includes a recent case history of a vapor intrusion investigation at a strip mall that was completed within 30 days in order to meet an escrow deadline.

Lecture notes are at the bottom of each slide so that if played out as a hard-copy, the presentation can be a useful reference document.

Fundamental Problems

- Vapor Intrusion is Tricky & Sticky
 - Regulations inconsistent & contradictory
 - Very site-specific
 - Generally takes lots of time
- General Lack of Expertise
 - Consultant, regulator, subs, public
 - Needlessly doing things (wrong levels)
- Ultra-Conservative Levels Means More Sites
 - 100x-1000x lower than soil & water MCLs
 - Can't use soil data

Vapor intrusion risk assessments are complicated by a variety of factors or fundamental problems.

1. Inconsistent and contradictory regulations coupled with site-specific conditions make the process complicated and slow.
2. Vapors and vapor intrusion are a new area for most environmental professionals. A general lack of expertise among regulators, consultants, subcontractors and the public often results in things being done incorrectly (e.g., program design or sampling or analysis) or in a lot of work being done needlessly (using incorrect screening levels).
3. Ultra-conservative risk based screening levels results in few sites screening out and the vast majority screen in.

Allowable Soil Gas Levels (Benzene 1e-6 Risk)

State	Alpha	1/Alpha	Fail Level (ug/m ³)
NH	0.002	500	150
CA-DTSC	0.002	500	42
CT	0.0013	770	192
NJ (Subslab)	0.05	200	60
EPA Q4	0.1	10	3.1
EPA Q5	0.002	500	155
EPA Q6	0.1	10	3.1

A summary of the alpha factor and corresponding acceptable soil gas levels for various States and the EPA draft guidance shows large variation and illustrates the main point: the levels are variable from State to State and even within the EPA guidance itself. This is an example of how “tricky” vapor intrusion assessments can be.

Newest Changes (2007)

EPA OSWER VI Guidance

- Tier 1: **Primary** Screening
 - Q1: VOCs present?
 - Q2: Near buildings?
 - Q3: Immediate concern?
- Tier 2: Source Screening
 - Generic screening using near-source samples
- Tier 3: Pathway (Building) Assessment
 - Multiple lines of evidence outside (sg & gw)
 - Must go inside???

Further illustration of the trickiness and complexity of vapor intrusion assessments is illustrated by the changes currently being considered by the EPA. Few sites would screen out at Tier 2. Tier 3 requires multiple lines of evidence to stay outdoors otherwise indoor sampling (sub-slab or indoor air) would be necessary.

DRAFT Exterior Decision Matrix		Concentration in Groundwater		
		Well above level of concern	Around level of concern	Well below level of concern
Concentration in Soil Gas	Well above level of concern	Interior sampling or mitigation	Possible vadose source; Interior sampling or mitigation	Possible vadose source; Interior sampling or mitigation
	Around level of concern	Interior sampling or mitigation	Interior sampling or mitigation	Possible vadose source; Interior sampling or mitigation
	Well below level of concern	Consider geologic setting ¹ , verification sampling in select locations	Consider geologic setting ¹ , verification sampling in select locations	NFA unless nearby property has unacceptable risks (verification, monitoring)
¹ Review subsurface stratigraphy, depth to water, to determine presence, integrity, effectiveness of geologic barriers to vapor migration.				

This matrix was one idea drafted by EPA for vapor intrusion assessment using only exterior data. As you can see, the “categories” are very subjective and there is only one box that does not require any further action in this matrix. If you play this “vapor intrusion bingo”, you lose on 8 out of 9 of the squares. Fortunately, this has been derailed by the office of OMB at least for the time being.

Beware The CHHSLs

How do the CHHSLs differ from cleanup standards?

The CHHSLs presented in the lookup tables are NOT regulatory "cleanup standards". Use of the CHHSLs and this document is voluntary on the part of those who choose to use them. At sites where cleanup of contaminated soils to levels at or below the CHHSLs would be costly, the time and effort to develop more site-specific cleanup may be desired. At sites where the extent of contaminated soil is limited or the timeframe available to carry out cleanup actions is very short, use of the CHHSLs as final soil cleanup standards may be cost-beneficial. However, this would require the concurrence of both the responsible party and the overseeing regulatory agency and can only be done after a full evaluation of site conditions and other potential environmental concerns. Regulatory agencies cannot be compelled to use the CHHSLs as final cleanup standards for a contaminated property.

The California Human Health Screening Levels (CHHSLs) illustrate the confusion in the vapor intrusion world and how consultants and regulators misapply them. This text, extracted from the document itself, clearly states that they are NOT regulatory cleanup standards and they are to be used voluntarily unless BOTH parties concur to use them. However most CA regulators are insisting they be met and most consultants are acquiescing to their demands to the detriment of their clients

Table 2. California Human Health Screening Levels for Indoor Air and Soil Gas

Chemical	¹ Indoor Air Human Health Screening Levels (µg/m ³)		² Shallow Soil Gas Human Health Screening Levels (Vapor Intrusion) (µg/m ³)	
	Residential Land Use	Commercial/Industrial Land Use Only	Residential Land Use	Commercial/Industrial Land Use Only
Benzene	8.40 E-02	1.41 E-01	3.62 E+01	1.22 E+02
Carbon Tetrachloride	5.79 E-02	9.73 E-02	2.51 E+01	8.46 E+01
1,2-Dichloroethane	1.16 E-01	1.95 E-01	4.96 E+01	1.67 E+02
<i>cis</i> -1,2-Dichloroethylene	3.65 E+01	5.11 E+01	1.59 E+04	4.44 E+04
<i>trans</i> -1,2-Dichloroethylene	7.30 E+01	1.02 E+02	3.19 E+04	8.87 E+04
Ethylbenzene	Postponed ³	Postponed ³	Postponed ³	Postponed ³
Mercury, elemental	9.40 E-02	1.31 E-01	4.45 E+01	1.25 E+02
Methyl tert-Butyl Ether	9.35 E+00	1.57 E+01	4.00 E+03	1.34 E+04
Naphthalene	7.20 E-02	1.20 E-01	3.19 E+01	1.06 E+02
Tetrachloroethylene	4.12 E-01	6.93 E-01	1.80 E+02	6.03 E+02
Tetraethyl Lead	3.65 E-04	5.11 E-04	2.06 E-01	5.78 E-01
Toluene	3.13 E+02	4.38 E+02	1.35 E+05	3.78 E+05
1,1,1-Trichloroethane	2.29 E+03	3.21 E+03	9.91 E+05	2.79 E+06
Trichloroethylene	1.22 E+00	2.04 E+00	5.28 E+02	1.77 E+03
Vinyl Chloride	3.11 E-02	5.24 E-02	1.33 E+01	4.48 E+01
<i>m</i> -Xylene	7.30 E+02	1.02 E+03	3.19 E+05	8.87 E+05
<i>o</i> -Xylene	7.30 E+02	1.02 E+03	3.15 E+05 ⁴	8.79 E+05 ⁴
<i>p</i> -Xylene	7.30 E+02	1.02 E+03	3.17 E+05	8.87 E+05

Reference: Appendix 1, OEHHA Target Indoor Air Concentrations and Soil-Gas Screening Numbers for Existing Buildings under Residential and Industrial/Commercial land uses.

Notes:

1. "Residential Land Use" screening levels generally considered adequate for other sensitive uses (e.g., day-care centers, hospitals, etc.). Commercial/industrial properties should be evaluated using both residential and commercial/industrial CHHSLs. A deed restriction that prohibits use of the property for sensitive purposes may be required at sites that are evaluated and/or remediated under a commercial/industrial land use scenario only.

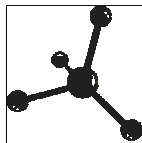
Calculation of cumulative risk may be required at sites where multiple contaminants with similar health effects are present. Carcinogens: CHHSLs based on target cancer risk of 10⁻⁶. Cal/EPA cancer slope factors used when available. Noncarcinogens: CHHSLs based on target hazard quotient of 1.0.

2. Soil Gas: Screening levels based on soil gas data collected <1.5 meters (five feet) below a building foundation or the ground surface. Intended for evaluation of potential vapor intrusion into buildings and subsequent impacts to indoor-air. Soil gas data should be collected and evaluated at all sites with significant areas of VOC-impacted soil. Screening levels also apply to sites that overlie plumes of VOC-impacted groundwater.

3. Calculation of a screening number for the chemical has been postponed (pp) until the toxicity criterion currently being developed by OEHHA is published as a final document.

4. Representative Screening Numbers for mixed xylenes. The representative value for mixed xylenes is based on the calculated lowest one amongst the three isomers.

The infamous CHHSLs. These are easy for regulators and consultants to use because they don't need to think. But they are extremely conservative and require much more time and cost to achieve than is necessary.



Acceptable Soil Gas Levels

(Benzene 1e-6 risk, residential, 5' bgs)

State	Alpha	1/Alpha	Fail Level (ug/m ³)
CHHSLs			37
DTSC – S5	0.002	500	42
DTSC – S6	Model	1000	95
EPA Q5	0.002	500	155
SD-DEH	Model	11,000	900



This table gives a summary of the acceptable soil gas level (the “fail level”) for a 5 foot deep soil gas sample for different CA agencies. Note the large difference in the allowable levels based upon the agency.

The DTSC – S5 refers to Step 5 in their guidance where a default alpha is used. The DTSC – S6 refers to step 6 where a DTSC custom version of the J-E model is allowed.

The difference between 37 and 95 requires a much more expensive analytical method (TO-15 vs. 8260) and oftentimes many more samples.

Screen-Out More Sites By:

- Adopt More Reasonable Distance Criteria
- Using Correct Risk Level
 - 1 in 1 million: Residences, Schools, Hosp
 - 1 in 100,000: Commercial Settings (cumulative)
 - 1 in 10,000: Acute (mitigate immediately)
- Adopting More Realistic Exposure Times
 - Workplace: 8 hrs/day, 250 days/yr, 25 yrs (5x)
 - School: 8 hrs/day, 180 days/yr, 6 yrs (30x)
 - Hospital: 24 hrs/day, 1 yr (30x)

More sites will be screened out if more realistic screening criteria are used such as more realistic exposure times, especially for schools and hospitals, and adopting more reasonable risk criteria. For insurance companies, reasonable screening of sites prior to offering coverage is necessary for loss control/prevention and is also necessary for minimizing claim losses.

Reopen Sites?

- NY: Point Rating System
- CA – Proposed

Some States have decided to reopen sites to assess the VI pathway. NY has done so and come up with a rating scheme to decide which sites to reopen first.

The California assembly passed a bill that requires the listing of all sites that may have a vapor intrusion potential. This also means sites that have been closed. The bill was not signed by the Governor in September 2006.

Who's next?

CA Bill 422

Monday October 15, 2007, California Governor Arnold Schwarznegger signed into law Assembly Bill 422:

"This bill would require that the exposure assessment of any health or ecological risk assessment prepared in conjunction with a response action taken or approved pursuant to the California Superfund Act include the development of reasonable maximum estimates of exposure to volatile organic compounds that may enter structures that are on the site or that are proposed to be constructed on the site and may cause exposure due to accumulation of those volatile organic compounds in the indoor air of those structures."

CA just passed AB422. The ramifications are still unclear, but at a minimum this bill empowers the State Water Boards to require vapor intrusion and risk assessments. This will mean more sites will have to be assessed for vapor intrusion.

Ingredients for Efficient VI Assessments

- Investigatory Approach
- Determine Correct Screening Levels
- Sampling & Analysis Issues
- Supplemental Tools
- Accounting for Bioattenuation

This part of the presentation will focus on practical approaches and strategies for assessing the vapor intrusion to save time and money. The keys to do this are to choose the proper approach, determine the correct screening level, sample & analyze correctly and efficiently, know when and how to use supplemental assessment tools, and to know how to play the bioattenuation card for petroleum hydrocarbons.

Key Issues for Efficient VI Investigations

- Experience of the Collector/Consultant
 - Have they done this before?
 - Do they understand RBSLs?
 - Quality/experience of field staff? Sr or Jr?
- Get Enough Data Near/Around/Under
- Legal Perspective
 - How conservative to be?
 - When to not acquiesce?

The most important ingredient for cost effective and efficient VI investigations is the experience of the person/firm doing the collection. Is the collection being done by a firm that has prior experience? Is it a routine part of their services or an occasional part? Do they put experienced people in the field who can think or junior staff who aren't well versed? This applies to the consultant and their subcontractors.

Soil gas, like soil, is not homogenous in most cases. So you need enough data to give decent coverage near, around, or under the receptor. Simpler collection systems with small volumes are advantageous as there is less to go wrong and enable higher production per day (20+ samples per day). Less expensive analytical methods (8021, 8260) enable more analyses for reasonable cost. Real-time data can be extremely helpful to track soil gas contamination laterally and vertically.

Legal considerations often dictate what additional work needs to be done at what standards.

All of these issues affect the investigation progress and hence the cost you end up paying (the ultimate bottom line).

Which Method to Use?

- Indoor Air Sampling
- Predictive Modeling
- Measure Flux Directly
- Soil Gas Sampling
- Supplemental Tools/Data

A variety of methods can be used to assess the vapor intrusion pathway. All have pros & cons.

Approach Generalizations

- Indoor Air
 - Always find something: prove innocence
 - Multiple sampling rounds: time hog
- Groundwater Data
 - Overpredicts Risk
- Soil Gas Data
 - Transfer rate unknown
- Sub-slab Soil Gas Data
 - Transfer rate unknown
 - Attorney time

Each investigatory approach has pros and cons that must be considered before choosing the one to use at a site.

Indoor Air Measurement

- Pros:
 - Actual indoor concentration
- Cons:
 - Where from?
 - Time: often more than one event required
 - No control
 - Snapshot, limited data points
 - False positives

Measuring indoor air might seem to be the most direct and simplest approach, but it has its share of problems. The biggest problem is you will always find something and in most cases it is not from vapor intrusion, but from background sources of contaminants. Many commonly used household products contain some of the target compounds of concern. For example, benzene from gasoline, PCE from dry cleaned clothes, TCA from degreasing cleaners. In addition, the protocols are laborious, intrusive, offer little control, are expensive, and often require multiple sampling events over periods of months. However, this method may still be the method of choice if the contaminant of concern is not one commonly found in household products (e.g., 1,1 DCE).

New Advance for Indoor Air: On-site TO-15 Scan/SIM

- Simultaneous Scan/SIM mode enables
<10 ug/m³ for All VOCs &
< 2 ug/m³ for subset of compounds.
- Only 2cc of Sample. Eliminates Hardware
- Real-time Analysis in Structures: Control!
- Already in CA

New equipment allows on-site TO-15 analyses. New GC/MS equipment enables simultaneous Scan/SIM mode meaning you can measure for all VOCs (>60 compounds) at DLs < 10 ug/m³ while simultaneously measuring for a subset of compounds at lower detection levels (<2 ug/m³). Only 2 cc of sample are required for analysis, so much of the sampling hardware can be eliminated, reducing chances of false positives.

This capability enables real-time analysis of indoor air in structures. This mitigates many of the problems with conventional indoor air sampling.

Soil Gas Measurement

- Pros:
 - Representative of Subsurface Processes
 - Higher Acceptable Levels (RBSLs)
 - Relatively Inexpensive
 - Can Give Real-time Results
- Cons:
 - Transfer Rate Unknown
 - Spatial Variation Causing Fits
 - Protocols still debated

Measurement of soil gas is by far the most preferred approach around the country. Actual soil gas data are reflective of subsurface properties, are less expensive than indoor air measurements, and allow real-time results. The risk-based levels are also higher so there is less chance to be chasing blanks.

There are some drawbacks, including the lack of knowledge of the transfer rate, very restrictive fail levels for sub-slab data, spatial variability, and debate over how & where to collect samples.

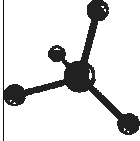
Which Soil Gas Method?

- Active?
- Passive? (qualitative)
- Flux Chambers? (limited use)

Active method most often employed for VI

There are three types of soil gas methods. Active refers to actively withdrawing vapor out of the ground. It gives quantitative values. Passive refers to burying an adsorbent in the ground and letting the vapors passively contact and adsorb onto the collector. It does not give quantitative data and hence can not be used for risk applications, except for screening. Surface flux chambers were discussed previously.

The active method is the one most applicable to risk assessments.



Soil Gas VOC Analysis (TO-15 or 8260 or 8021)

- All Methods Give Reliable Results
- Detection Level Discriminator
 - TO Methods: <1 to 10 ug/m³ \$200-\$300
 - 8260 SIM: 10 to 50 ug/m³ \$100-\$150
 - 8021: 5 to 25 ug/m³ \$75 to \$100
- On-Site Analysis
 - Extremely Helpful for VI
 - Minimizes False Positives



A variety of analytical methods are available to measure soil gas samples. No federal guidance document exists specifying any one. Methods 8021 and 8260 are soil & water methods but give accurate results for soil gas samples at detection levels above 10 ug/m³. The toxic organic methods (TO) are designed for ambient air samples, so they give accurate results for soil gas samples at much lower detection levels. The TO methods require extensive hardware and are far more expensive.

The criteria for selection should be which method(s) reach the required detection limits.

On-site data are extremely useful to ensure that the samples do not have tracer/leak levels above acceptable levels, provide real-time data for decision making, and to validate detections seen in the off-site data. If measured values are high, then the on-site methods (8021, 8260) are more appropriate to use than the ultra-sensitive TO methods. If on-site values are low or below detection, then the samples can be measured off-site by the TO methods.

Supplemental Tools/Data (to Aid in VI Assessments)

- Site Specific Alpha Using Radon
 - Increases allowable levels by 10 to 100x
 - Inexpensive
 - Agency acceptance growing
- Indoor Air Ventilation Rate
 - Factor of 2 to 50. <\$1,000 per determination.
- Real-Time, Continuous Analyzers
 - Can sort out noise/scatter

If the soil gas levels exceed the agency allowable levels, there are some other inexpensive tools/data that can be used to determine if the levels are actually ok . These tools/data have much more influence on the resulting risk than measurement of soil porosity and cost about the same.

Radon can be used to determine a site-specific transfer rate that may be 10 to 100 times lower than the default value in the agency guidance.

Tracers can be used to measure the room ventilation rates and may give values 2 to 50 times higher than the default value in the agency guidance, especially for commercial sites.

Real-time continuous analyzers collect a lot of data at low cost and can be used to determine spatial variability in soil gas values, monitor temporal variations in indoor air or soil gas values, locate preferential pathways into structures, or sort out background scatter.

Practical Strategies

(Things to Do)

- Stay Within EPA Q5
- Collect Enough Data
- Use Radon for Slab-Specific Alpha
- Measure Ventilation Rate
- HCs: Use Bioattenuation Nomograph
- Use Finite Source Model
- Check Your Units!!!!!!!!!!!!!!

Some things you want to do to minimize your pain when you are assessing this risk pathway.

Practical Strategies

(Things Not to Do)

- Don't Trust Regulator for SG RBSLs
- Don't Report at TO-15 DLs
- Don't Report Any & All Compounds
- Beware Indoor Air
- Don't Spend Much \$ on Soil Properties
- Don't Assume $1 \text{ ppbv} = 1 \text{ ug/L}$

Some things you don't want to do if you want to minimize you and your client's pain.

VI Case History

Summary of Steps

- Step 1: Have Site Conceptual Model
- Step 2: What Agency/Group Has Oversight?
- Step 3: Calculate Risk from Pre-existing Data
- Step 4: Choose Assessment Method
- Step 5: Determine Screening (Fail) Levels
- Step 6: Design Sampling Program
- Step 7: Collect & Interpret Data
- Step 8: Use Other Tools

Here are the steps to follow for assessing the vapor intrusion pathway at a site. We will apply these to a case history of an active gasoline station in an urban location with residential receptors and an on-site convenience store.

VI Case History

Step 1: Brief Site Conceptual Model

- Strip Mall with Dry Cleaner
- Commercial receptors, no residences
- Contaminated soil, no soil gas data
- Lithology: sandy soil, GW ~ 30'
- Does Acute Risk Exist?
- Property Being Refinanced – needed answer within 30 days

A real case history to demonstrate the vapor intrusion assessment process for a typical gasoline station site:

Step 1: Brief site conceptual model. Key information required:

- What types of contaminants at what concentrations in what media?
- Is contamination well defined?
- What types of receptors (houses, retail, commercial industrial) and what structure type (slab, basement, crawlspace)?
- What is location of contaminant relative to structure?
- Is the Risk Acute?

VI Case History

Step 2: What Agency/Group Has Oversight?

- San Diego County
 - Relatively lax re vapor intrusion
- EPA & CA-EPA VI Criteria More Stringent
- No Attorneys, Citizen Groups

Step 2: What Agency are you dealing with? San Diego county's vapor intrusion policy uses very lenient criteria. EPA and CA-EPA's vapor intrusion policies are much more conservative. The bank didn't want to own a potential future problem, so it was decided to use CA-EPA criteria.

VI Case History

Step 3: Calculate Risk from Existing Data

- From Lookup Tables (CHHSL)
- From Default Alpha
- From Spreadsheet/Model

Only preexisting data was soil data: not applicable for vapor intrusion assessments, but high values indicated a likely problem

Step 3: Use any existing groundwater or soil gas data to compare to risk based screening levels. Use either the agency's screening levels, default alpha method, or the J-E spreadsheet if allowed.

In this case, the only applicable pre-existing data were soil data. Soil data are not considered to be reliable for quantitative risk assessments, however the high values indicated contamination at levels likely to exceed allowable levels for vapor intrusion.

VI Case History

Step 4: Choose Assessment Method

- Dry Cleaner Air May be Recirculated
- Various Stores Have Own Products
- Source Likely PCE Vapor Cloud
- Highest Levels Likely Under Slab
- All Receptors Commercial

Sub-Slab Soil Gas Data Best Method

Step 4: Determine what type of data are best to collect to assess the pathway. Strip malls often share a common HVAC system so dry cleaner air can be piped into neighboring businesses. Various retailers all had their own products contributing to indoor air. So, indoor air not likely to be a good option. PCE at dry cleaners often enters into the vadose zone as a dense vapor from the washer unit, and then the vapor cloud then moves laterally under the slab. So, the highest levels were likely to be immediately beneath the slab. Hence, sub-slab sampling the best method to use.

VI Case History

Step 5: Determine SG Screening Levels

- Using Default Parameters:
 - Allowable indoor air residential level: 0.41 ug/m^3
 - For commercial receptors use 100,000 risk
 - Allowable indoor commercial level = 4.1 ug/m^3
 - Adjust for exposure time: $4.1 * 5 = 20 \text{ ug/m}^3$
 - Allowable subslab conc = $20/0.01 = 2000 \text{ ug/m}^3$

Step 5: Determine the soil gas screening levels so that the proper analytical method is employed and real-time decisions can be made if measured levels are acceptable. For this site, we used CA-EPA's target levels, default vapor intrusion parameters, and vapor intrusion spreadsheets.

VI Case History

Step 6: Design Soil Gas Program

- Underneath Adjoining Businesses
- At Property Line Towards Rear
- Measure VOCs on-site by 8260
- Add More Locations as Needed

Step 6: Design the soil gas analytical & sampling program. Because it was unknown how many neighboring tenants were affected and real-time data were available, the approach was to test the tenant spaces in a step-wise fashion moving away from the dry cleaner. Also, to ensure contamination was not possibly impacting residences to the south, soil gas was measured at 5' deep at the southern property line.

VI Case History

Step 7: Collect & Interpret Data

- Values Under Tenant Spaces:
 - >2000 ug/m³ at dry cleaner & 2 adjoining tenants
 - < 2000 ug/m³ under other businesses
- Values Along Sewer > 2000 ug/m³
- Values at Property Line < 100 ug/m³

Step 7. Collect & Interpret Data. Seven tenant spaces were sampled on each side of the dry cleaner. Only under the dry cleaner and the two immediate neighboring tenants did sub-slab PCE levels exceed the 2000 ug/m³ target level. So, does an immediate risk exist under these tenants and if so do they need to be notified?

VI Case History

Step 8: What Next? (Use Other Tools)

- Radon Data for Slab Attenuation
 - Shows attenuation factor 10 times higher
 - Increases acceptable level to 20,000 ug/m³
- Measure Ventilation Rate
 - Showed 5 times higher ventilation
 - Increases allowable levels to 100,000 ug/m³

(CHHSL: 600 ug/m³; 333x lower!)

Step 8: Use other tools or data to decide if the values >2000 ug/m³ are a potential problem.

Radon data was collected under the slabs under the two adjoining tenants to determine the transfer rate through the slab. The measured value was at least 10 times lower than the default value in the CA-EPA guidance. The effect is that the allowable sub-slab concentration could be 10 times higher than the 2000 ug/m³ screening value or 20,000 ug/m³.

Ventilation rate was measured in the adjoining tenatn spaces and found to be ~ 5 times faster than the default value in the CA-EPA guidance. This increases the allowed sub-slab concentration by another 5 times.

The cumulative effect of these other “tools” is a factor of 50 increase in the 2000 ug/m³ screening level to 100,000 ug/m³, 333 times higher than the ultra-conservative CA-CHHSL value of ~600 ug/m³.

For the on-site store, ensure you have calculated the proper risk level. Collect samples around the store just below the pavement or sub-slab. If

VI Case History

Conclusions

- Dry Cleaner Needs Remediation
 - PCE no longer used
 - Sub-slab depressurization system installed
 - System likely to remove values under adjoining businesses
- Funds Appropriated to Cover These Costs
- Bank Makes Loan

Conclusions:

The soil gas and soil under the dry cleaner needed to be remediated, but there was no immediate risk since OSHA regulations apply to the dry cleaner. Since the PCE only exceeded the 2000 ug/m³ level over a small distance (~50' radius) and the contamination was most likely a vapor cloud, a sub-slab depressurization system would likely reediate the contamination in a reasonable amount of time.

So, although the measured levels under the dry cleaner and adjoining businesses were hundreds of times higher than default regulatory levels, it was concluded that the site could be adequately cleaned up to face any future risk by an agency or future buyer.

The loan was funded.

VI Documents

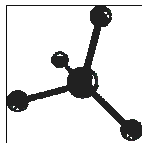
- Overview of SV Methods (www.handpmg.com)
 - LustLine Part 1 - Active Soil Gas Method, 2002
 - LustLine Part 2 - Flux Chamber Method, 2003
 - LustLine Part 3 - FAQs October, 2004
 - LustLine Part 4 – More Q&A, Summer 2006
- Regulatory Guidance
 - ITRC VI Guidance (www.itrcweb.org)
 - Robin Davis Lustline Article on Bioattenuation (Lustline March 2006, www.neiwpcc.org)

A summary of existing documents on soil gas methods can be found at these locations:

VI Websites & Links

- www.handpmg.com
 - Soil gas information
 - SOPs for soil gas, flux chambers, more
 - Other site assessment methods
- www.itrcweb.org
- www.api.org
- [http:iavi.rti.org](http://iavi.rti.org)

Useful vapor intrusion websites.



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