



Vapor Intrusion — A New and Challenging Issue

By: Jeffrey Bolin, *The Dragun Corporation*, and Arthur Siegal, *Jaffe, Raitt, Heuer & Weiss, P.C.*

Executive Summary

Vapor intrusion (VI) occurs when chemical contaminants in soil or groundwater contaminate a gas and migrate into an overlying building, whether that is a place of business or a home. VI has become an increasingly important issue in environmental assessments, as is evidenced by new governmental guidance with respect to evaluating VI, and increasing lawsuits against businesses and property owners alleging exposure to contaminated vapors. This article provides an overview of what VI is, governmental criteria and guidance relating to VI, sampling methods used to determine if there is a VI problem, and methods of responding to VI.



Jeff Bolin is the Vice President of Technical Operations at The Dragun Corporation. He manages and oversees the consulting, litigation support, engineering, environmental compliance, remedial investigation, and remediation

operations of the corporation in the United States and Canada. Jeff has over 30 years of experience in environmental project management; consulting and litigation support with attorneys; financial institutions; and industrial, municipal, and commercial clients.



Arthur Siegal is a partner at Jaffe, Raitt, Heuer & Weiss, P.C. and heads the firm's Environmental and Energy practice group. He has over 25 years of environmental law experience, representing clients in dealings with, and litigation regarding, State and Federal environmental laws, regulations and regulators. Arthur is a 1986

cum laude graduate of the University of Michigan Law School. The Jaffe firm has offices in Southfield, Detroit, Ann Arbor, Philadelphia and Florida.

Introduction

For years, the focus of environmental cleanups and liability has been on protection of groundwater. That focus is shifting to include vapor intrusion (VI), particularly of solvent and gasoline vapors, and there will be a whole host of new factors and issues to address in real property acquisition, financing and remediation. Dry cleaners, gas stations and any manufacturer using volatile solvents is a likely suspect for a VI issue.

The principles behind VI are complicated, involving chemical vapor pressures, Henry's Law, diffusion, concentration differentials and gradients, advection, geology, hydrogeology, crack densities, stack effect and many other relatively boring scientific factors.

Regardless of whether you paid attention in science class, vapor intrusion for owners, tenants and lawyers is real and has far reaching business implications. From property transactions to site remediation and closures (or more importantly site "reopeners"), VI is very likely to play a key due care role in business deals and property management. Further, the real and potential impact to property use, building use, and adjoining property could result in increased litigation with third parties and regulatory agencies.

What is Vapor Intrusion and Why is it Important

Vapor intrusion occurs when a chemical contaminant in soil or groundwater enters the soil gas above the water table and migrates into an overlying building. While this may sound simple, it is quite complex, both technically and legally.

Other environmental issues such as soil contamination may have been "safely" at a site "next door." A plume of contaminated groundwater may have migrated below a property, out of sight. People tended to have a sense of security because they weren't digging the dirt or drinking groundwater. Vapor intrusion, on the other hand, has become increasingly important to environmental assessments because it is quite literally at the front door and inside homes and places of business. Vapor intrusion raises questions such as

- Is the air in my house or workspace safe?
- Will this harm me or my children, my tenants or employees?
- Will I be able to sell my building and for what price?

These questions are packed with emotion and not easily answered.

The Science of Vapor Intrusion

Many factors drive the migration of a chemical into soil gas and ultimately to "intrude" into a building. Understanding the main driving forces is paramount in determining cause and effect, appropriate mitigation, and cleanup levels.

The two main scientific forces at work are *diffusion* and *advection*. Diffusion is often the initial factor governing chemicals moving in soil gas through unsaturated soil via concentration gradients (higher to lower). Typically, the closer the “contaminated” soil gas gets to a building, advection tends to dominate often via pressure differentials and more permeable materials (the building zone of influence).

Additionally, the VI process is affected by factors such as barometric pressure, seasonality, soil type, soil moisture, the depth to the water table, the concentration and properties of the chemical of concern. In some cases, the nature of the contaminants and the soils and thickness of the groundwater itself may lead to vapor intrusion into a structure being either more or less likely.

A building influences the intrusion of contaminated vapors by “trapping” the soil gas under the building. Once trapped, contaminated vapors are “pulled” into the building through cracks and other entry points (e.g., sumps, utilities, etc.) via pressure differentials created inside the building due to heating and cooling, warm air rising in the building, and the effect of wind around the building (the “stack effect”).

Understanding the VI process, the influencing factors, and the nuances of each will be critical to properly counsel clients (technically and legally) with respect to investigation, risk, and mitigation.

Litigation Risks

While the appellate track record on the issue of VI is developing, there have been many lawsuits indicating the future of litigation on this issue. They largely result from suits by neighbors against former users of hazardous chemicals seeking recovery of either remedial expenses,¹ or property damages.² Personal injury claims are also surfacing.

In Mississippi, in 2010, a jury reportedly awarded \$17 million to five women who claimed that their children were harmed in utero by leaded gasoline fumes. In 2011, a federal district court approved an \$8.1 million settlement of a class action by 124 families against Kraft Foods alleging pollution from a nearby factory contaminated groundwater and caused vapor intrusion in their homes.³

Perhaps the most chilling case is a 2010 decision from the U.S. District Court for Nevada, *Voggenthaler v Maryland Square, LLC*.⁴ In *Voggenthaler*, plaintiffs, (residential homeowners) sued

In Mississippi, in 2010, a jury reportedly awarded \$17 million to five women who claimed that their children were harmed in utero by leaded gasoline fumes. In 2011, a federal district court approved an \$8.1 million settlement of a class action by 124 families against Kraft Foods alleging pollution from a nearby factory contaminated groundwater and caused vapor intrusion in their homes.

a dry cleaner and the past and present owners of the shopping center from which the dry cleaner tenant had released contamination. The contamination had migrated under the neighboring homes raising concerns regarding soil vapor infiltration. The shopping center owners sought summary judgment excusing them from liability.

The district court denied the motion, holding that because the shopping center had owned and operated the below-ground drain pipes and lines beneath the

dry cleaners, that meant the shopping center owners had “contributed” to the disposal and handling of PCE (dry cleaning solvent) at the shopping center. Amazingly, the court focused on the fact that the lease was structured such that the landlord received “a financial advantage . . . [by] receiv[ing] a percentage of the dry cleaning operation’s over the counter sales.”

The case was reversed and remanded in part on appeal on other grounds,⁵ including a failure to allow the final owner in the chain to correct deficiencies in an affidavit regarding its pre-acquisition due diligence and relating to that owner’s argument that it should not be held liable under the federal Resource Conservation and Recovery Act⁶ as it did not buy the shopping center until after the dry cleaners had ceased operations. The appellate court did not address the surprisingly broad liability pronouncement based solely on ownership of a shopping center.

Governmental Criteria and Regulatory Guidance

As understanding of the VI mechanism is still developing, regulators are taking diverse and varied approaches. The USEPA, Interstate Technology and Regulatory Council (ITRC), and ASTM have all studied the process and have generated guidance documents. It will be critical to understand in which arena you and your client are “playing” as the rules may be different.

The U.S. Department of Housing and Urban Development’s Multifamily Accelerated Processing (MAP) (which establishes national standards for approved lenders to submit loan applications for Federal Housing Administration (FHA) multifamily mortgage insurance) has included since 2009, a requirement that a Phase I environmental site assessment (ESA) must include an initial vapor

encroachment screen to determine if vapors potentially occur in the subsurface below existing and/or proposed structures.⁷

The USEPA released new guidance for the evaluation of vapor intrusion in November of 2012,⁸ and the Michigan Department of Environmental Quality (MDEQ) provided its guidance document in May of this year.⁹ Other states are also generating guidance documents, while some are deferring to the USEPA. The MDEQ's guidance applies when some previously adopted generic standards are exceeded and when there are pathways which might be outside the MDEQ generic baseline assumptions (e.g., when impacted groundwater is shallow and near foundations and basements). The MDEQ guidance includes the following steps:

1. Evaluating existing information to determine if the vapor pathway is of concern;
2. If it is, and there are buildings nearby, assess the risk and whether response actions are needed;
3. In some cases, conduct a building-specific investigation to evaluate the risks posed by the contaminants;
4. Conduct response actions, if necessary, which may include remedial actions or other mitigation measures.

In some cases, the MDEQ guidance has action standards far more stringent than it had previously adopted in its generic cleanup standards.

ASTM's guidance documents are also of note. In June of 2010, ASTM, an international standards organization, published its *Standard Guide for Vapor Encroachment Screening on Property Involved in Real Estate Transactions*, ASTM E2600-10. This guide includes two tiers; the first tier is directing an evaluation of known or suspected sources of contamination near a subject property.

The second tier uses readily available information regarding the contaminated media (soil and/or groundwater) to predict if vapors may migrate to the property in question. ASTM is also preparing to release a new guidance document relating to the preparation of Phase I ESA, ASTM E1527-13 and, reportedly, this new standard also directs vapor migration be considered during environmental due diligence.

The EPA's draft guidance is more complex and requires more than MDEQ's guidance — including more vapor intrusion assessment; building mitigation and subsurface remediation; preemptive mitigation (Early Action); and community outreach and involvement.

Sampling Methods/Issues — How Do You Know You Have a Problem?

The vapor intrusion pathway is complex and is influenced by many factors. Identifying sources and their relationship to buildings is often first looked at by developing a conceptual site model (CSM). The CSM provides an integrated interpretation of the: (1) site geology and hydrogeology; (2) contaminant source type and concentration; (3) relative distances (vertical and horizontal) of the source and the building; (4) the building type and characteristics (e.g., basement, slab-on-grade, multi-level, integrity of slab, sumps, etc.); and (5) the building use.

Once a potential source and potential receptor have been identified, determining whether the vapor intrusion pathway is complete is often an iterative sampling process. Although Michigan still has default cleanup criteria for soil and groundwater and the potential for vapor intrusion,¹⁰ these have become less reliable as an "off ramp" for the need to further evaluate the vapor intrusion pathway. Michigan, as noted above, as well as many other states, is opting toward a more conservative "multiple lines of evi-

dence" approach. These multiple lines of evidence rely more on actual sample data and less on fate and transport modeling. Sampling can include one or all of the following depending on the level of certainty deemed appropriate: soil gas; sub-slab soil gas; and indoor air.

Soil Gas Sampling. Gasses in the soil are evaluated in the vadose (unsaturated) zone in and around the source and the building(s) in question. Depths to be sampled vary by site conditions. For example, if the building in question has a basement, the soil gas monitoring point(s) should be installed at or near the floor depth of the basement. Regardless, soil gas monitoring points are always installed above the water table.

Sub-Slab Sampling. Due to the nature of the "trapping" of soil gas by a building's slab, sub-slab soil gas samples are thought to indicate whether the VI pathway is truly relevant on a case-by-case basis. There are no hard and fast rules as to how many sample points are appropriate. Locations and frequency of sample points should take into account the purpose of the data, the building size and characteristics, the source and its size and proximity to the building, and the subsurface conditions.

Indoor Air Sampling. Indoor air samples are often collected following the collection of soil gas or sub-slab samples when the results indicate an indoor air quality risk. Collection of representative indoor air samples can be complicated by many factors including background interferences (e.g., building materials, common household cleaners and products, paints and paint related solvents, etc.), duplicating "typical" building conditions (e.g., HVAC operation), and seasonality. Often, ambient air samples are collected from outside the building as a "blank" or "background" sample for comparison to the indoor air results. It may also be necessary to conduct multiple

rounds of sampling to reflect seasonal effects on the vapor intrusion process. Such sampling needs to be carefully evaluated and compared to various standards to ensure its usefulness.

Ultimately, the level of effort and the steps taken to evaluate the vapor intrusion potential and risk will be site specific. Whether looking at a property transaction, site closure, potential long-term obligations (e.g., due care), or potential off-site exposure, each will likely require a different level of investigation.

Mitigation and Closure — Methods and Monitoring

As previously discussed, the potential for vapor intrusion and a completed VI pathway exists when there are (1) volatile contaminants in the soil gas, (2) routes of entry for the contaminated soil gas to enter the building, (3) advective conditions to pull the contaminated soil gas into the building, and (4) human occupancy in the building.

Intervening or removing any of these conditions to prevent human exposure would mitigate the concern. Remediation of the source eliminates the need for mitigation. When mitigation is required, a remedy or combination of remedies must be selected, implemented, operated and maintained until the vapor source is eliminated. Whether a VI situation requires mitigation or remediation is site-specific and depends on numerous factors. Similarly, the selection of a mitigation method or remedial activity or some combination is also site-specific and depends on site goals. Remedial approaches generally include source remediation, institutional controls and building controls.

Source Remediation. Source remedies address the source of vapors (soil and groundwater contamination), rather than controlling the entry of vapors into buildings. This includes removing and/or treating the source. Source remediation

is a more permanent solution to vapor intrusion, while institutional or building control remedies are considered to be short-term or interim measures. These short-term measures are often implemented until the long-term remedy is complete.

Institutional Controls. Institutional controls are legal mechanisms such as restrictive covenants, zoning restrictions, prohibition of groundwater extraction or subsurface activity (e.g., excavation), and requirements for new construction (e.g., vapor barriers, sub-slab systems).

Building Controls. These are generally broken into passive or active methods.¹¹

Passive barriers (vapor barriers) are materials or structures (often layers of plastic) installed below a building to physically block the entry of vapors. These systems are often selected when they can be installed during new construction.

Passive venting involves the design and implementation of a preferential venting layer below the floor slab to allow and direct soil gas to move laterally beyond the building footprint under natural diffusion gradients (resulting from the buildup of soil gas below the building) or pressure (thermal or wind-created) gradients. This allows the system to effectively function automatically. As with passive barriers, these systems are often installed during new construction.

Active methods of controlling VI fall mainly into four categories: Sub-slab depressurization (SSD); Submembrane depressurization (SMD), Sub-slab pressurization (SSP); and positive building pressure.

- SSD is widely used because it can be relatively easily implemented at existing buildings. SSD is a form of soil vapor extraction (SVE) but instead of being focused on mass reduction of a source, it is engineered to pull vapors from below the slab via a vacuum

(greater than the stack effect into the building) such that the vapors do not enter the building. Instead vapors are typically vented above the building roof line.

- SMD is similar to SSD, however, it is used where there is no slab (i.e., a building with a crawl space). A membrane is used as a surrogate for a slab and a vacuum (depressurization) draws gasses from the soil below the membrane.
- SSP systems are the opposite of SSD systems. SSP uses blowers to push air into the soil or venting layer below the slab instead of drawing it out under a vacuum. The force of the air beneath the slab pushes the contaminated vapors to the outer edges of the building where it vents to the ambient air. Precautions should be taken so that contaminated vapors are not inadvertently reintroduced into the building through other pathways (HVAC systems, open windows, etc.).
- Another method of preventing vapors from entering the building is to create a positive pressure in the building interior (relative to the sub-slab). This is typically accomplished by modifying the HVAC system of the building. This creates a “bubble effect” that prevents vapor intrusion.

Note that these methods will require monitoring and operations and maintenance to ensure proper system operation and that the desired goals are being met. Many regulating agencies require alarms and other safety mechanisms in case of system failure.

Potential Reopener of Closed Sites/BEA Sites

After contaminated property has been cleaned, property owners typically and understandably want governmental

assurance that there will be no further pursuit of remedial action. In short, one wants certainty that the work is completed. This documentation usually takes the form of a No Further Action letter, a Certificate of Completion or a Covenant Not to Sue. However, it is rare to receive an unconditional release of liability or closure. Nearly all governmental environmental authority makes use of “reopeners,” contract qualifiers that allow the government to demand additional cleanup of a site under circumstances such as:

- Imminent and substantial endangerment to the public health and environment;
- Certificate obtained through fraud or misrepresentation;
- A discovery that the cleanup criteria were not, in fact, met;
- Previously undiscovered contamination, 42 USC § 9622(f)(6)(A); and
- New contamination or a change in condition that exacerbates contamination.

Additionally, it is common for states to reserve the right to reopen remediation projects if there are changes in laws that require cleanup to different levels than prior laws, although some states will relieve developers of brownfields properties from liability for changes in the law to encourage redevelopment.¹² The concept is that if the previously approved remedy is no longer believed to be protective of human health and/or the environment, a reopener is appropriate.

A 2003 study by The Environmental Law Institute and Cleveland State University found that less than one percent of completed brownfields cleanups are reopened.¹³

Michigan’s Baseline Environmental Assessment (BEA) program, as adopted

in 1995, requires a non-labile owner or operator of a contaminated property to exercise due care including mitigating unacceptable exposure to hazardous substances allowing the facility to be used “in a manner that protects the public health and safety.”¹⁴ MDEQ and some lenders have reportedly begun reading the new MDEQ closure guidance to possibly mandate expensive remedial-type investigations and cleanups¹⁵ — something, until now, a BEA largely allowed owners and operators to avoid. The recent change in focus on VI is such a large paradigm shift relating to protection of public health that any site with volatile contamination already closed or acquired under Michigan law could be subject to an expensive reopener. Residential sites or the potential for residential exposure likely would be the focus of any reopener evaluation.

Conclusion

For the last 15+ years, lawyers have largely believed that if contamination met the state standards for protection of groundwater, financing, sales and/or occupancy of the site was not an issue. While those standards remain in effect, the recent focus on vapor intrusion raises a whole host of new technical and legal issues for counsel to contend with and on which to advise their clients. Vapor intrusion has far reaching implications in the business world and counsel will need excellent technical support to minimize their client’s risk and expense and/or in responding to this new concern.

Endnotes

1. See, e.g., *CAEUSA, Inc v Triple Cities Metal Finishing Corp*, No 3:11-CV-0711-LEK/DEP (ND NY); *United States v Apex Oil Co, Inc*, 579 F3d 734 (CA 7, 2009).
2. *Aiken v General Electric Co*, 2008 NY Slip Op 09527 (App Div 3rd Dept, Dec 4, 2008) (holding a question of fact as to when a three-year statute of limitations began to run when residents had no knowledge of vapor intrusion); *Baker v Chevron*, Nos 11-4369, 12-3995 (SD Ohio, Aug 2, 2013); *Forest Park*

- Nat Bank & Trust v Ditchfield*, 881 F Supp2d 949 (ND Ill, 2012).
3. *Stoll v Kraft Foods Global Inc*, No 1:09-cv-00364 (SD Ind, May 20, 2011); *Ball v Bayard Pump & Tank Co, Inc*, 67 A3d 759 (Penn, 2013); *Ivory v International Business Machines*, 37 Misc3d 1221(A) (2012); *First Property Group, Ltd v Behr Dayton Thermal Products LLC*, No 3:08-CV-329 (SD Ohio, 2011).
4. 2010 WL 2947296.
5. 2013 WL 3839330 (CA 9, July 2013).
6. 42 USC 6901, et seq.
7. <http://archives.hud.gov/offices/hsg/mfh/map/chapt9.pdf>.
8. *OSWER Final Guidance for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Sources to Indoor Air (External Review Draft)*, U.S. Environmental Protection Agency Office of Solid Waste and Emergency Response, April 2013.
9. *Guidance Document for the Vapor Intrusion Pathway, May 2013, MDEQ Remediation and Redevelopment Division*.
10. https://www.michigan.gov/deq/0,1607,7-135-3311_4109_9846_30022-101581--,00.html. Of particular note, these cleanup standards and the rules authorizing them will be repealed as of December 31, 2013. 2012 PA 446. Reports are that MDEQ is working feverishly on a replacement set of rules and cleanup standards.
11. While the focus of this article is VI of volatile organic compounds, these methods can also be used with the mitigation of radon gas.
12. See, e.g., 52 FR 28038 (July 27, 1987).
13. See Robert A. Simons et al., “Quantifying Long-Term Environmental Regulatory Risk for Brownfields: Are Reopeners Really an Issue?” quoted in David A. Dana, “State Brownfields Programs as a Laboratory of Democracy?,” NYU Law Journal, February 1, 2006, p. 96.
14. MCL 324.20107a(1)(b).
15. These unexpected potential obligations may be subject to challenge under the Michigan Administrative Procedures Act, MCL 24.201, et seq. as not legally enforceable. However, the outcome of such a challenge is uncertain.