DIALOGUE

Vapor Intrusion: The State of the Science and the Law

Summary

Vapor intrusion—migration of volatile chemicals from contaminated groundwater or soil into an overlying building—is now part of nearly every site investigation and many real estate transactions. As the science of vapor intrusion continues to evolve and states continue to update their guidance, professionals involved in vapor intrusion sites need to stay on top of it all. What is the process for a vapor intrusion investigation? What is the science behind such an investigation? How will these new regulations influence such investigations? On September 6, 2012, ELI convened an expert panel to discuss the science of vapor intrusion, how vapor intrusion investigations are completed, new and anticipated guidance and regulations at the state and federal levels, and case studies of various vapor intrusion investigations.

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Richard Kapuscinski, Office of Superfund Remediation and Technology Innovation, U.S. EPA
Megan Conlon McCulloch, Partner, Honigman Miller Schwartz and Cohn
Christopher M. Roe, Partner, Fox Rothschild LLP
Lenny Siegel, Executive Director, Center for Public Environmental Oversight

Mark Distler: Good day, everybody, and thank you for inviting me and our panelists here to speak with you about the ever-evolving phenomena of soil vapor intrusion (VI). We have a panel of experts who are living and breathing this issue. Our objective today is to tell you about the issues anyone should know when they're assisting, performing, or evaluating VI investigations.

Our first speaker is Dr. Richard Kapuscinski. He's with the EPA's [U.S. Environmental Protection Agency's] Office of Superfund Remediation and Technology Innovation, where he's been leading the Agency-wide effort to prepare the final guidance for VI assessment and mitigation. He has 30 years of professional experience as an environmental engineer, previously as a consultant to the regulated community for 20 years, primarily in the areas of site remediation and risk assessment pursuant to RCRA [Resource Conservation and Recovery Act][1] and CERCLA [Comprehensive Environmental Response, Compensation, and Liability Act].[2]

Our second speaker is Lenny Siegel. Lenny has been the executive director of the Center for Public Environmental Oversight since 1994. He is one of the environmental movement's leading experts on both military facility contamination and the VI pathway. He serves on numerous advisory and technical committees, including the California Brownfield Reuse Advisory Group.

Christopher M. Roe is a partner with Fox Rothschild, where he advises clients on the acquisition, disposition of businesses and assets, and redevelopment of brownfield sites. He counsels clients on emerging health and safety, air, water, and waste compliance issues, including nanotechnology, recycling, and take-back and reuse issues, and assists clients in evaluating and communicating about environmental risks.

Megan Conlon McCulloch is a partner with Honigman Miller Schwartz and Cohn. She has experience in assisting clients in federal and state superfund proceedings, counseling clients on environmental compliance issues, and assisting clients with environmental cleanups. She also assists developer clients with obtaining brownfield redevelopment incentives, including tax increment financing reimbursements and tax credits, and represents clients in real estate transactions with environmental concerns.

I assume that everybody here knows what VI is, so I'm going to give you a really brief overview. I'm going to give you some idea what typically is done for VI investigations. What I want you to walk away with is that we have these screening levels, and how we dissect screening levels from background levels and indoors. Also, I'm going to leave you some federal guidance and tool links that you could use going forward.

VI usually starts with contaminated groundwater, usually with volatile compounds. These are compounds that want to be vapors and they want to be air, but they're in water. They want to volatilize, and they want to go into the

Editors' Note: PowerPoint presentations referenced in this seminar may be viewed and downloaded here: http://www.eli.org/Seminars/event.cfm?eventid=731.

1. 42 U.S.C. §§6901-6992k, ELR Stat. RCRA §§1001-11011.
2. 42 U.S.C. §§9601-9675, ELR Stat. CERCLA §§101-405.

soil spaces above them. They move through the soil as soil vapor, just like radon does. Radon sometimes gets up to the bottom of a building where it basically stops, unless it finds some way to get inside, because it continually wants to go to the atmosphere.

The perched water table can actually prevent vapors from migrating to the surface. If you're doing an investigation, like maybe you're collecting soil vapor above that perched water table next to that house, you might think that there's nothing here. But if you go down below that perched water table in the soil, then you will find it. Knowing your site's model, the conceptual model, the stratigraphy of the site is extremely important.

Sometimes, you need to know the utility corridors because soil vapors move not just vertically, but they also move horizontally in preferential pathways. Utility corridors, for instance, have highly porous material that vapors will trail a long distance. As a matter of fact, I completed an investigation two years ago where we found vapor a mile away from the source in the sewer corridor. It certainly appeared in an area of multiple soil vapor sources, commingled plumes of groundwater. You also need to differentiate whose soil vapor is whose. You need to know everybody's soil vapor sources and not just your own. Vapor will spread through the soil and mingle with other soil vapor; there is always background soil vapor.

There are levels of BTEX [benzene, toluene, ethylbenzene, and xylenes] everywhere. I've never seen a soil vapor sample that didn't have something in it, mostly from vehicles in highways and in roads. Keep in mind that although buildings will pull in air from below, they will also breathe out. I found contamination inside a building from products used inside. It actually ended up in this sub-slab below the basement as the air blows back into the soil from indoors. Keep that in mind too.

You may say, I know my site model. I know I'm directly above a contaminated plume. It's very likely I don't need to do an investigation. I'm just going to mitigate this house. That's the good thing about it. Just like radon, the mitigation is very simple. Like radon, it's basically a highly engineered radon system.

Most of the time, I find that clients do want to investigate, so they may start with the soil vapor sampling either at the property boundary or near the building, just to make sure that we do have soil vapor or that contaminate—that one compound—that's in the groundwater is actually existing in soil vapor at least. Oftentimes, we even go indoors where we'll collect a paired sample of sub-slab vapor and indoor air. Certainly, when you're going inside, you want to do a chemical inventory.

In any sort of chemical handling and storage, certainly in commercial and industrial buildings, we do these investigations. We'll find stuff indoors from indoor sources, and not necessarily from VI. What we have outside usually finds its way inside. So, there's always something outside. I've never seen an outdoor air sampling come back totally non-detect, and I usually see it indoors.

So, let's compare to make sure that what we're seeing in their indoor air samples is not associated with indoor sources or outdoor sources. Let's see if they really are VIs. When we differentiate those, we then compare that to risk-based criteria. A lot of states have their own guideline values or screening levels. EPA has regional screen levels. Here's the link for that.

In the case of VI, OSHA's [the Occupational Health and Safety Administration's] permissible exposure levels [PELs] are not applicable to VI in every state, but they have that. If you're using the chemical inside that plant, then OSHA applies. But if it's inside because of VI, the OSHA PELs don't apply. You have to go to your guideline or screen levels instead. Some states actually allow you to do a site-specific human-health risk assessment. In some cases, the guideline values are based on 24 hours a day, 70 years. The site-specific would give you lower exposure duration.

You decide on what to do next. It depends on the results. Hopefully, it's an NFA [no further action]. Sometimes, you need to mitigate or monitor, which is to collect additional samples. If conditions may change in the future, VI may occur. Sometimes, you have to remove the indoor source and resample. Sometimes, the slab is so competent that all you really need to do is make routine inspections of that.

If you mitigate, you have to keep in mind that you'll probably have to do indoor air sampling at least once. There certainly would be routine inspections of that system and repairs. Sometimes, you have to do electrical reimbursement to a property owner.

Take a look at residential screening levels. Some have residential, some have nonresidential, but they kind of range from one to even as high as eight. Pennsylvania has got some of the higher ones. Region 3 RSLs [regional screening levels] recently have been updated. Mostly, state guidance predates the toxicity assessment that was redone in September 11, so just kind of a note there. Keep that in mind, you have one to almost eight.

The latest EPA study says that one through eight is within the realm of possibility of actually being there anyway from indoor sources. They're extremely difficult, especially when it comes to tetrachloroethylene (PCE). We find that a lot more than PCE indoors just from dry-cleaned clothes. That, oftentimes, you have like three for that or more. But on average it's like five or six indoors just for your background levels. Again, the point here is that you really have to differentiate VI from background.

I'll just point out that the previous RSL for PCE was 0.4, and now it went up to 9.4. That's going to cause some VI site owners some angst on whether they need to go back to their systems that they installed based on a lower level and relook at this. This is actually an issue right now that many of my clients are considering.

Trichloroethylene (TCE) actually went down. It went from 1.2 in the residential exposure to 0.43. Again, some changes here. Toxicity changes, certainly—we'll probably hear more from Rich on this. It certainly is evolving science as well, so we, in VI, need to evolve with that.

The 2002 guidance is being finalized. The OIG [Office of Inspector General] came out and said we want you to finalize it. Since then, EPA, actually since 2012, has a wave of resources on its website that really helps the practitioner.

Richard Kapuscinski: VI is a significant issue for the EPA Office of Solid Waste and Emergency Response. There are a few hundred sites with sub-surface contamination and VI potential that are subject to Superfund, RCRA corrective action, brownfield redevelopment, or underground storage tank [UST] programs, which is the universe of OSWER's [Office of Solid Waste and Emergency Response's] land restoration programs.

Today, I'd like to provide some insight and information regarding why assessment and decisionmaking for VI can be complicated, independent of whether the site is subject to a federal statute or not. I'll then conclude with a few brief remarks about EPA's final VI guidance.

The insight I want to convey and support with this graph and the next two graphs is that VI processes can be highly variable over time and between locations.[3] This graph, which is data intense and a little bit geeky, admittedly, reports indoor air concentrations for TCE in six buildings collected at six different times over a 10-month period. Note the top line, which is dark blue. It shows that TCE concentrations vary from a low of about 2, which happens to be in September, to a high of approximately 80 in this one building, which is a high-to-low difference of about 40 times. The other buildings also exhibit time-variable concentrations, and two of them are greater than 2 micrograms per cubic meter [ug/m^3] for a substantial portion of the sampling period. Unfortunately, even though we have six data points for each of these buildings, we don't have data from multiple years, which would allow us to put these data in some context and in particular to evaluate whether these variations are primarily due to seasonal effects or whether on average the concentrations increase or decrease after February 2001, which is the end of the data we have here. We would want, in general, to know these answers to be able to judge whether the long-term average concentration, say over a multi-year period, exceeds the threshold that Mark alluded to, based on cancer risk.

This next graph also demonstrates that VI processes can be highly variable over time and between locations. Like the previous graph, this one reports concentrations of TCE in six buildings at six different times over a 10-month period. In this particular case, the location in which samples are collected is immediately below the building foundation. That's referred to as sub-slab soil gas. Note the dark brown line, which is at the top over most of the chart. It shows that for this one building, TCE concentrations in the sub-slab vary from a low near about 100 to a high of about 10,000, which is a 100-fold difference. Again, although we have a lot of data shown here, we don't have data from multiple years, which would allow us to put these data in some long-term context, which would be helpful for estimating long-term average concentration.

This third and last slide addressing variability is different than the last two in a couple of important regards. One is the previous two slides were about one site and six buildings. This is about many buildings at each of 12 sites. The point of this is primarily to indicate that the kind of variability I described before is not just that one site, but in fact this is something that we see inherently in VI investigations.

There are many causes, factors that contribute to variability, and some of them are identified here. The non-uniform distribution of vapor sources and their non-uniform migration in the subsurface contribute to concentration differences between locations. Meteorological conditions also contribute variability over time, including within a day. Your own personal experience can speak to that, i.e., weather as a source of variability, when you consider how wind speed and direction, for example, can vary over a day pretty dramatically and certainly between days. The building's conditions are important as well. Although a building's structural condition may persist for a prolonged period, there may be seasonal and shorter term changes in operation. For example, ventilation, heating, and cooling impact entry of soil gas from the subsurface into indoor air spaces.

Some of the key implications of variability that I've noted are listed here. I think, first and foremost, it reinforces the historic practice of assessing VI on a building-by-building basis. Secondly, a single indoor air or subsurface sample by itself has limited information value. That can be particularly problematic in the context of schedules for most real estate transactions, for example. As a result of the second bullet, most guidances, including the final VI guidance that will be issued, will recommend collecting multiple samples and certainly other lines of evidence, for example geological information. Mark made reference to the importance of understanding that, as well as other aspects of what is called the conceptual site model. The idea is that we don't look at any one sample result by itself, but instead consider it together and weigh it in the context of other data as well. Thereby, we can increase our confidence in decisionmaking.

Lenny Siegel will talk further in a few moments about long-term monitoring. I'll just note here that as a result of the time-variable indoor air concentrations, a short-term investigation of indoor air quality, for example a single, one-day sample, or even a time-average sample over a couple of days, will generally not be sufficient to support a conclusion of NFA. Consider, for example, the slides that we showed at the outset—with a single sample, one would not have really any idea of where you are [along the sequence of time-varying indoor air concentrations]. Are you at the bottom of that low end of what might be experienced in a building or at a high end?

To ensure protectiveness of human health, early action, also known as preemptive mitigation, generally may be an

3. *See* Richard Kapuscinski powerpoint, OSWER's Final Vapor Intrusion Guidance, An Overview, at http://www.eli.org/Seminars/event.cfm?eventid=731.

appropriate approach to consider for buildings with potential VI. The reasons for this include that mitigation typically is very effective, and it's a certain means of protecting human health, which is cost-effective for many buildings. As Mark indicated, we have a lot of experience mitigating radon, and mitigating VI follows directly from that experience and from those engineering methods. Secondly, comprehensive investigation of VI can entail prolonged study periods. During that time period, building occupants may be exposed. We may prefer not to have them exposed. Putting all this together, it may then be appropriate to implement building mitigation as an interim measure whenever there's a reasonable initial basis to believe that VI is occurring or may occur due to subsurface contamination. And, likewise, many building owners consider installing and operating mitigation systems in newly constructed buildings that are located in areas of vapor sources in the subsurface rather than allow the building to be occupied, and then allow VI to occur, and then go about studying it.

Finally, a few words about EPA's final VI guidance—we've made substantial progress on this document during the past year. I thank Mark for his kind words about the resources that we've put on the web in that short period of time. The release of this guidance is expected soon, but I don't have an exact date for this audience currently.

There are no plans to provide the current internal draft for public review or comment. The docket has been open since 2002 to receive comments. EPA considers that the extensive and substantive public comments that have been received in that period, and in particular, over the last two years, adequately reflect the divergent views of key stakeholders that include community groups as well as the regulating community.

The final VI guidance is intended for use at any site being evaluated by EPA, EPA's brownfield grantees, or state agencies with a delegated authority to implement CERCLA or RCRA in instances where VI arising from subsurface contamination may be a potential concern.

In my opinion, when the final guidance is issued, it is not likely to have a significant impact on sites currently undergoing VI investigations, because the current draft and what I expect to see issued final largely reflects current practice. The current draft does include a presumption for EPA to sample whenever there's evidence of a release of vapor-forming chemicals to the subsurface environment. In this regard, it highlights an important difference between this guidance and practice for real estate transactions, where the ASTM [American Society for Testing and Materials] guide, for example, does not necessarily, absolutely require that sampling be conducted.

Lenny Siegel: I work with communities all over the country, people who are impacted by VI or the threat of VI. While there are some people who don't want to hear anything about contamination in their homes, they're worried about their property values. For example, a lot of people pay very close attention to the sampling results that they've gotten. They are the ones who flag for me these issues that VI sampling, particularly indoor air but also sub-slab, varies enormously over both time and space.

What community people have been telling me is that there needs to be more frequent sampling. You can't just go once or twice a year and say: "Ah, your air is safe, or your air is dirty." Rich has already talked about the temporal variability. It's not just month-to-month or year-to-year. It can be daily as atmospheric conditions change. It can also occur because somebody drills a hole in the floor or there's been settling or an earthquake and there's been a crack in the slab of major proportions. People are aware of that, and they want to make sure that the sampling that's done accurately reflects their long-term exposures.

But there's a new wrinkle in EPA's IRIS [integrated risk information system] assessment for TCE. They found that at a fairly low level, 2 mcg/m^3, that TCE exposure may cause cardiac birth defects. The significance of that, according to the toxicologists for Region 9 EPA and California, is that you're no longer talking about a 30-year or a 70-year exposure period; you're talking about an exposure period that may be three weeks or as short as one day for a pregnant woman. Therefore, if you take a sample once a year, you may miss the time where a woman is pregnant. She may not know she's pregnant in the first trimester, and she may be exposed to an unacceptable level. So, there's a need to adjust sampling strategies for TCE to catch peak exposures to protect the most vulnerable, the pregnant woman whose child may be born with a cardiac birth defect. This is not fully resolved at EPA headquarters. They are reviewing the proposal by EPA Region 9 for short-term exposure thresholds, but it's something that I think is coming that our sampling strategies have to reflect.

Finally, even if you do preemptive mitigation or if you do mitigation as a result of sampling, you still need to sample in the long run to make sure the systems are working. You typically will do more-frequent inspection or monitoring of the sub-slab depressurization system to make sure that it's working, that the pressure differentials are proper. Communities insist that indoor air be sampled, that you do a direct measure of exposures. People would prefer to know that on a continuing basis, rather than once a year or once every five years. So, post-mitigation monitoring is a combination of pressure testing and indoor air sampling.

One more important thing about preemptive mitigation is a lot of builders will build passive systems into their structures. It's much cheaper to put pipes underneath the building before you put up the building, but not put in fans to ventilate, so it creates the depressurization underneath until they know it's necessary. So, one important use of monitoring in the long run is to determine whether or not you actually have to install fans and run them, because most states will say, if you've got a passive system in place and indoor air concentrations are low, you don't have to do that, but they're triggered if the monitoring shows there's a need to take action.

There are a number of technologies that exist or are on the horizon for doing real-time or near real-time sampling. Near real-time means you get a result every few seconds or every several minutes. Real-time means continuous sampling. EPA's TAGA bus, the Trace Atmospheric Gas Analyzer, is a triple mass spectrometer, and it can monitor two different analytes on a continuous basis. One of the things we've learned from some of the communities who've had that done at their houses, they can actually sit in the van while the tube that's connected to the sensor is moved around their house and see the results in real time.

The GC/MS, the Gas Chromatograph-Mass Spectrometer, is typically a suitcase-size device that does near real-time sampling. It's like the TAGA. It remains expensive, but it is used at a number of sites. If you're looking for a lot of samples in the same area over a short period of time, you can get less-expensive sampling than by having Summa Canisters trying to do the same thing.

What's really exciting is that there are a couple of technologies out there. One of them I'm familiar with is the University of Michigan's. It's a micro-GC. They actually have a column that's on a chip. It's a two-meter column on a tiny chip. It's been proven on a bench scale to do the kind of sampling we need for VI in indoor air as well as in soil gas, but it's not commercially available at this point. They're trying to commercialize it. There's another sort of iPhone app-based system that Arizona State is working on. Everybody says that they're just on the horizon, and we're still waiting. So, this is something that could provide the kind of sampling that we're looking for.

There are some other technologies here in California where I am. There's a laser spectrometer that's being tested at Moffett Field. But the key thing for all of these technologies that use a chip or a small sensor is that they could save a lot of time and money in the long run if they're hooked up to sensing networks, wireless or Wi-Fi, and the Internet.

I have on my roof some solar panels that are connected by Wi-Fi to my Internet router. So, anywhere in the world, I can monitor the solar output from my roof, and the same idea applies to these sensors. If the sensors can do real-time or near real-time sampling, you don't have to go out to the site with equipment, knock on the door, clear out the house, and do all these things to get results. You can just do it by having somebody sit at a computer monitor or having the computer do the monitoring itself.

To develop these emerging technologies, you're looking at several requirements. First, the size has to be small enough so you can park it in somebody's basement. It needs to be able to sample frequently enough to catch the variations over time. In my book, it needs to be as cheap as using Summa Canisters on a periodic basis, or it's not going to happen. It needs to have the capability to communicate wirelessly or by Wi-Fi or even by cable to the Internet. It needs to be accurate. It needs to be at a low enough level to catch the levels of concern that we have. When you get down to TCE at 0.43 mcg/m^3, that's a very low level; it can be done, but it's not easy. You can't just use a photo ionization detector that records data at about 1,000 times that level. It has to be reliable. Make sure it's going to work over the long run, because this is equipment that you want to park in somebody's basement and have it generate data for years on end without having to go out and maintain them.

There are other benefits to real-time and near real-time sampling devices that can be used to identify pathways. I know that the EPA TAGA bus has been used in this way. They point the tube to the corner between the slab and the wall. They find that it needs to be sealed. They can find out that a utility vault at a commercial building is the source of contamination that's getting into the building. So, that's a very valuable use, besides overcoming the temporal variability.

You can also use it to determine what the background source is. You point it in the closet and you find out whether the dry-cleaned clothes are generating the problem. You can point it into the garage and find out whether somebody's got gun cleaner there or an old can of WD-40 or plastic cement that contains TCE. That's rather important because these background sources can totally confound a study. It's very common for indoor sources to generate the same levels of contamination that VI does.

Not only is this important for the VI study, but it's also important for the residents. If they find out that their dry-cleaned clothes are exposing them to unsafe levels of PCE or their gun cleaner is exposing them to TCE, they can get rid of those compounds. They can go to a dry cleaner that's using a more modern form of cleaning solvent. So, it's valuable to protect people.

Finally, the transparency: people love to see the data, the current data on what they're being exposed to in their house. I mentioned my friend in Hopewell Junction, New York, who sat on the van and watched the numbers. She didn't have to wait for three months to get a 200-page report to find out whether she was at risk and her family was at risk. She could tell while the sampling was being done.

One of the reasons this is important at this point as EPA finalizes its guidance is that these technologies, particularly the chip-sized and iPhone-sized devices for continuous and near continuous sampling, are not yet commercially available. We need some direction from EPA as well as the states to say this is the way we want to sample in the future. With that kind of interest, that kind of requirement, I think these technologies will be commercialized. If it's an optional thing that people do because it's fun, then it won't happen.

So, we have a chicken and egg situation. We know we can't totally require real-time sampling now, but we need to establish a requirement that will drive the commercialization, and particularly making these devices cost-effective when used via sensing networks, so that we have basically instrumented communities where we can measure people's exposure on an ongoing basis in order to protect them.

Christopher Roe: I'm coming at this from a different point of view, I think, than the last two speakers in particular. My practice for the last nine years has involved helping clients work through VI investigations related to contamination for which they have responsibility in multiple jurisdictions. Before getting into my formal presentation, I'd like to highlight some of the unique aspects of VI that create challenges from a legal counselor's point of view.

First, as you already heard from the other speakers, this is complex science that is evolving as we speak. The complexity and change create uncertainty about whether conclusions reached now about a VI pathway or associated risk will remain valid into the future. The uncertainty about basic scientific and regulatory conclusions is not easy to counsel your clients through.

Second, we're gathering unprecedented data in terms of location and the extremely low detection levels involved. As you heard from what Lenny is describing and what Rich and Mark described, we're now gathering data from the air in indoor spaces where there traditionally hasn't been a lot of similar data gathered. In addition, we are gathering this data at low detection levels that are simply unprecedented. In a VI investigation, the numbers that we're looking at to determine whether an unacceptable risk of cancer exists from TCE, for example, as you saw from one of Mark's slides, are below what are considered background levels for TCE in many jurisdictions. And, in these indoor spaces, the source of the contaminants detected can be VI, but it also could be a source within the building itself.

Final preliminary point: the media that we're gathering the data from presents unique concerns from a lawyer's point of view in that it is an intimate and immediate media for potential receptors—the breathing air of people in their homes or in their offices. There is a real potential that the results generated can cause concern to be raised. Lenny described someone getting a continuous readout of the low levels of contaminants in the breathing air of their homes. My reaction is that that kind of information may be very hard for most of us to process.

In my experience, one of the real challenges in all of this is understanding and communicating what the data mean—and whether or not the low levels that are detected can be reasonably interpreted and translated to real risk in a way that makes sense to people. Many of us are going to be afraid of any amount of chemical that is in our breathing air. Perhaps, that view does not give people enough credit, but as lawyers, we need to consider the fears that can be raised when chemical data like this is gathered from the air of indoor spaces.

The science and guidance are evolving. It's great what Rich and EPA are doing in terms of the information EPA has put out over the last year on VI. Final EPA headquarters guidance on VI will be a very good thing from the point of view of someone involved with VI investigations, because it is my experience that even within EPA regions, the consensus about what sampling is sufficient to satisfy EPA's view of an adequate investigation is something that is still a moving target.

So, in my presentation, I will discuss three areas where lawyers can support clients with potential responsibility for VI: *assessing sites* to identify where VI may need to be considered; *considering the risks*, including potential exposures, financial implications, such as need the need for additional cleanup cost reserves, legal risks like orders, regulatory obligations and claims, and reputational risk with employees and communities; and *managing risks* in investigation and remediation projects.

The first area, assessing sites, means helping the client understand what VI might mean with regard to the properties it is responsible for—for example, the known contaminated sites or the historic manufacturing sites that have not been evaluated for volatile contaminants. This is a key process that we as lawyers can help with, and basically, it involves asking the technical team questions. Often we're dealing with smart people and folks who have been dealing with remediation problems at their sites for a long time. However, VI can cause a site that has progressed without incident for years to become a significant problem. Planning and exit strategies may need to change. So basically, the legal support in this area is to make sure that the technical folks have run through some of the basics of when a VI issue might arise, such as the types and levels of contaminants at the sites for which they have responsibility or that they own.

If there is a volatile contaminant present at a client's site, there is other information that you will want to know in providing legal counsel, including whether the site is currently owned by the client, or is the site something they used to lease or own?

Also, in evaluating the overall risk to a client from VI, it can be worth considering whether the client owned or leased locations in the past where it operated very similar manufacturing facilities to one where it has found it has a VI issue now. It is at least worth considering whether these formerly owned or operated sites might come back to visit.

Third-party sites, such as waste disposal sites where multiple parties are involved, can be evaluated as well. The VI risks may be a less immediate issue for your individual client at these sites, though the issue may need to be addressed by the PRP [potentially responsible party] group.

The remediation status of a client's sites is another factor in the assessment, though closed sites do not necessarily mean that VI will not be an issue. We had a site that was deemed closed in 1999 under the Massachusetts Contingency Plan and then was reopened in 2010. In that case, because of VI, we needed to get back into a site that we no longer owned or had any contractual right to enter. We ended up needing to sample in homes related to the site in a community that our client had not been part of for more than 10 years. So, the "closed" status of a site is something that generally means that there is less risk of the site coming back and needing to be addressed, but your client should know that a site that it considers closed may not stay

closed or should not continue to be considered closed for planning or decisionmaking purposes.

If there's an ongoing investigation or remediation, if your client's sites are subject to five-year remedy reviews, for example, questions you as a counselor should ask include whether VI has been evaluated previously, and if so, when and under what guidance or criteria? I have experience with sites where the responsible parties conducted a VI investigation as recently as 2008 based on soil and water numbers and got a signoff from the Agency that VI should not be a further concern. Now, the Agency has come back and said we need another "line of evidence"—actual indoor air sampling—before we will be satisfied that VI is not an issue. Even a site that has had some kind of "closure" as to the VI issue in the past can be "reopened."

In assessing the current remediation strategy with a client, it is important to understand that a remediation strategy that makes sense where there is no perceived risk associated with leaving contaminant in the groundwater to degrade over time through natural processes now may have legal and other risks associated with it. Typically, for sites where there is solvent in groundwater, for example, it is really impossible to remove the contaminant, even in 10, or 20, maybe 30 years, through pumping and treating groundwater. Quite reasonably, the client may have developed a strategy of moving toward natural attenuation, and shutting down the pump-and-treat technology where the inefficiency of that technology as a cleanup mechanism has become clear.

But VI may—not necessarily does—change that evaluation. The client needs to consider VI because an active pump-and-treat system, no matter how inefficient it may be in removing contaminants—may be doing things like containment of a plume that might otherwise migrate to offsite areas where VI might occur. So, the remediation strategy for the site, particularly where there is an offsite condition, may need to be revisited based on VI. Also, as to the source site itself, consideration should be given to whether there is a planned use change or ownership change. These events may be triggers for VI evaluation. A potential buyer is now more likely to be aware about VI. If a buyer sees that the kinds of contaminants that could cause VI are present, they may do what your client hasn't done so far, which is to look at the issue hard.

I have seen a great deal of inconsistency in the degree that clients have looked at their sites for VI risk. It seems to depend a lot on the state the property is located in, and how aggressively the issues have been looked at generally in the particular jurisdiction.

Once a client has looked at their sites and understood that one or more may justify a harder look at VI, the next step I will talk about is identifying and considering what risks there are, so we can provide advice to help the client manage or avoid those risks.

Employee exposure, for example, is one type of risk. And we need to keep in mind that there may be contractors or others who are present full-time in the client's workplace. More and more often, I see that clients are contracting out basic facilities work and similar functions that are not core to their business operations.

As to the OSHA issue that was discussed earlier, I would not say that OSHA doesn't apply. I believe Mark was talking about what numbers would apply in a VI investigation, and whether you can use the OSHA PEL numbers—which tend to be so much higher than the VI guidance numbers—in conducting a VI investigation in a workplace where there are employees who are potentially exposed. There is room for debate about this issue, but environmental regulatory agencies and guidance generally set risk-based indoor air screening levels that they require be applied to determine whether unacceptable levels of VI are occurring.

And, in fact, there are federal OSHA rules, and there may be applicable state rules, that require employers to provide employees with information about exposure sampling in their workplaces that may be triggered by VI investigations. In other words, the indoor air sampling does need to be evaluated as data within the workplace about employee exposures.

Financial risks, for the purposes of this discussion, let's put into two categories. First, there are cleanup and investigation costs, and generally these are more manageable in that they may be more easily estimated and accounted for. Once your client does understand its sites, the technical experts can often come up with projected investigation, cleanup, or mitigation costs. Keep in mind that higher costs due to the need for VI investigation, cleanup, or mitigation may raise the cost of a site, and this might have implications for public company disclosures or for cleanup reserves.

The second type of financial risk is the risk of potential claims for property damage or personal injury, for example. The costs related to potential claims likely will not be estimable.

Some legal risks are cleanup-related, such as cleanup orders or reopeners. There are also regulatory requirements that may be triggered by the presence of volatile contaminants in the subsurface or indoor air, for example, from new rules that require the evaluation of VI or, as I mentioned, the provision of exposure-related information to employees.

Finally, claims are being made against companies who are alleged to be responsible for VI. We have been tracking as many of these cases as we can to understand the nature of the claims that are out there.

Among the themes of the cases filed are that the responsible party has somehow hidden important information from the community about groundwater contamination under a neighborhood, for example, by not disclosing vapor risk before now. There are allegations being made that the responsible party has done this purposefully or in a fraudulent way. This type of theme may be pursued because of statute-of-limitations obstacles, or to provide a basis for punitive damages.

The fact is that responsible parties may have communicated about risk, and done risk assessment associated with a site for years, without considering VI as a significant risk pathway. Now, all of a sudden, long after risk assessments concluded that the community is not at risk, you may be talking to residents about PCE in the indoor air of their living rooms. That significant change in understanding about whether any exposure may be going on is part of what these property damage and personal injury claims are about. We all need to keep this in mind when we are advising clients on how they communicate to the community about risk evaluations. Reputation is important to most clients, and it is important to consider in VI investigations. A long-known-about contaminated groundwater plume associated with a former client manufacturing site may become relevant to a client's current image in the community or even among its own employees, if vapors from that plume are found to be present in homes or residences.

So, what do you do to manage all of these considerations in advising a client responsible for conducting a VI investigation? First, you need expert help in this area.

I've worked with Mark's firm, and they and other firms who do this stay on top of VI issues because, as you've heard, there is a lot going on. There is evolving guidance, and it may be a little unfair to say, but many of the regulators seem to be making decisions as they go about how many samples need to be taken, whether sampling should be under normal conditions or with HVAC systems on or off, whether grab samples ever will be required and if they are, whether they can be fairly compared to the screening values.

It is key that your environmental consultant is on top of these things because they will need to help advise you about what it makes sense to do. They also need to understand the new resources, for example, that EPA has been making available. It is extremely helpful to have a set of background data issued by a government agency so that when you are reporting to office workers that they have a level of PCE in their building, you can put it in the context of what a recognized background number is. At least this gives you the ability to put the data in a real-world context. Otherwise, the data is just going to be scary to many homeowners or office workers who are now being told that they are breathing air that contains a chemical.

So, your consultant needs to be aware of what is out there, and what is coming out. Second, principled decisionmaking is essential in a context like this where everyone involved is making judgments as they go about the basic science and legal requirements. In my experience, what works is to work constructively with the Agency about what sampling is appropriate and where, and that sort of thing. But you have to understand that both your client and the Agency may be second-guessed later, and that the decisions may need to be shown, in hindsight, as having been made in a principled way. So, if your client makes a decision to take another round of sampling or to forgo a round of sampling, for example, it is important that they can articulate a principled basis for that decision and to apply that principle consistently, if possible.

Communication is key in any VI investigation, in particular because you are going into people's homes, you are going into workplaces. There's just a lot of interaction with people, and getting expert communications advice is also a very good idea.

Megan Conlon McCulloch: I'm going to approach the topic from an even different perspective, and that is the perspective of what do you do with the VI issue in a real estate transaction.

There are two common scenarios where this can occur. One is in a brownfield redevelopment context where a developer is looking at a site. It may be a former industrial site and there are known or highly suspected on-site soil and groundwater impacts. The second scenario is when you're going through a commercial property purchase where you might have a former dry cleaner or a gas station either on site or nearby.

A lot of the considerations for a brownfield redevelopment site actually fit better with the kind of considerations discussed in Chris' talk. The brownfield developer needs to develop a strategy for addressing the known impacts, which includes investigating the site and coming up with a plan to make it suitable for the intended use. Additionally, the developer must evaluate whether the strategy can be implemented in a cost-effective and protective manner, such that the project makes economic sense.

From the commercial property purchase perspective, oftentimes what comes up during environmental due diligence can be a little bit surprising. You may not have known that there was a former dry cleaner on-site or that there was a gas station on-site or that there is one nearby. The question then becomes, how does that discovery affect the deal and what do you do with that information?

When you're doing environmental due diligence during a real estate transaction, the purpose is to identify and quantify environmental risks to enable informed risk assumption allocation. Basically, that's just a fancy way for saying what are the risks of taking on this property? How shall we allocate those risks between the buyer and the seller?

Another reason for doing your environmental due diligence is to conduct all appropriate inquiries as part of obtaining liability protection under CERCLA. There are also many states that have similar requirements so that you can obtain protection from liability underneath the state equivalent of a Superfund law.

The last kind of purpose is to better understand the site conditions and potential due care obligations. So, what do you need to do to make the property safe for the people who are going to be coming onto the property? People who come on the property may include your employees, lessees, lessees' employees, and the public.

When you're doing your environmental due diligence, you oftentimes do a Phase I environmental site assessment. You need to understand the scope and the exclusions of

the Phase I environmental site assessment and where VI fits into Phase I ESAs [environmental site assessments] and environmental due diligence.

There has been some controversy in the way that the ASTM Phase I standard currently is written. Currently, indoor air is excluded from the scope. There has been discussion over whether that means VI is also excluded. Right now, ASTM is working on a revision to the standard to make it clear that indoor air, when they're talking about the indoor air exclusion from the Phase I scope, is *not* meant to include VI issues that are from the release of a hazardous substance nearby. So, the ASTM Phase I indoor air exclusion would be for building-related issues, such as formaldehyde off gassing from the carpet in your office building or something like that, and not to a VI issue created by the release of a hazardous substance outside the building.

Your due diligence would often include a Phase II ESA, if necessary. You also would need to check state law to make sure that there are not further steps beyond a Phase I or II ESA you need to take to protect your client from liability. For example, in the state of Michigan, beyond the Phase I, if it turned out that there was a potential issue at the site, you would want to file a baseline environmental assessment and also a due care plan. Next slide please.

The role of VI guidance in real estate transactions is a little bit varied. ITRC's [Interstate Technology and Regulatory Council's] 2007 guidance, a lot of state guidance, and the EPA VI guidance that is coming out are very much focused on RCRA, CERCLA, brownfield sites, sites where you may or may not have a responsible party involved, but these are sites where there is some kind of an active remedial investigation ongoing or underway.

You've listened to Rich's talk and heard about the concerns with the variability in the sampling and the timing of the sampling. That can start to creep its way into the real estate context as well. ASTM has two guidances. The 1527 is their Phase I ESA, which is designed for real estate transactions. They have their 2600 guidance that is not an ASTM standard but is guidance. It's on vapor encroachment screening. It's supposed to be complementary to the Phase I ESA.

The 2600 guidance document is still a little bit problematic. They had an earlier version of it that they withdrew and replaced with the current version of it. But this vapor encroachment screening that ASTM has designed has a Tier 1 screen, which is similar to the Phase I ESA where you would take historical information and other kinds of readily available information, and decide whether a vapor encroachment condition may exist.

There are four possible outcomes of that Tier 1 screen: VEC exists; it likely exists; it cannot be ruled out; or it can be ruled out. So, three of the four of those—exists, likely exists, cannot be ruled out—would push you down into the Tier 2 screening, which may involve sampling. Next slide, please.

Now, this becomes very complicated from a deal-time line perspective. Most real estate transactions, the deals, they want to move quickly. Usually, you can get your Phase I ESA done relatively quickly. If you need to do a Phase II, you can go out and take your soil or your groundwater samples. But as you've heard Rich, Mark, and Lenny talk about, the variability in sampling and this hesitancy over a single snapshot in time as not being reflective of on-site conditions can be very problematic from a deal-time line perspective.

Most deals will not wait for you to go out and take four quarters of sampling. So, that can complicate the purchase agreement issues in terms of what kinds of reps and warranties the seller is willing to make; what kind of indemnities there need to be; what kind of post-closing cleanup obligations there need to be. That uncertainty, too, and that variability in dealing with the VI issues can make it more difficult to get your lender comfortable with the situation as well. So, at the end of the day, it's very important to have a very strong consulting team put together to help you and your client work through these issues.

In the deal context, you have to know when to fold them and when to walk away. When to fold them is when you want to go to a presumptive mitigation, rather than spending a lot of additional time and money on the investigation. There are situations where it can make a lot of sense just to decide that while there may or may not be a VI issue here, but there's the likelihood of it, rather than spending time and money and maybe losing the deal over it, we're going to go ahead and put in a vapor mitigation system on the building.

There are also times when it's appropriate to walk away. If the client doesn't have time to get the lender comfortable, if the magnitude of a potential issue is such that there are concerns that a vapor mitigation system may not be sufficient, or there's not money available to put in a vapor mitigation system, or if the client has other options, it may be time to walk away from that particular property.

I had a pro bono client that had been looking at purchasing a building they had been occupying for a headquarters for its nonprofit community organization group. They had been able to get funding to do Phase I and Phase II ESAs. But when it came time to finally do additional investigation into a potential VI situation or to mitigate the building, there was no money to do that. So, we helped that client find an alternative location, because that ended up to be a better option for them.

Mark Distler: Our first question is for Rich: Will EPA be issuing a companion guidance document to deal with petroleum VI issues? What is the status of this companion document?

Richard Kapuscinski: It has been reviewed internally under the same time line as the final VI guide. Just by way of clarification, the companion guide is for UST sites. The final VI guide will address petroleum hydrocarbons also for non-UST settings.

Mark Distler: Megan and Chris: Can you describe your experience as to how states are handling issuing NFA or completion letters for VI issues, like post-mitigation? How do you counsel clients to handle regulatory uncertainty for states that are not issuing such letters?

Christopher Roe: In Pennsylvania, recently, where I am, a regulation was put in place that requires the evaluation of vapor in our Act 2 program. Our Act 2 program is a voluntary cleanup program by which you can get the equivalent of an NFA, maybe even better, a release of liability. The VI issue has been incorporated into that evaluation of whether or not you qualify for the Act 2 signoff. And Act 2 signoffs are becoming commonly required for brownfields property transactions as a commercial matter here in Pennsylvania.

If your release is based on some kind of mitigation, then it would have to be incorporated into something that is enforceable under the Uniform Environmental Covenants Act. Mitigation is great, but as a remedy component, it usually requires a legal component, like a deed restriction or a covenant.

Megan Conlon McCulloch: In the state of Michigan, the state has not actually granted very many NFAs for any issue, let alone VI. They're starting to really look at how to move forward and get NFAs out there. So, in the state of Michigan, we're kind of playing catch-up with the rest of the country in terms of even getting the NFAs on the "easier to deal with sites."

Mark Distler: My experience is no NFAs to responsible parties. We're giving completion letters to property owners when they install mitigation systems basically saying that your system is working. It's something that they can pass on to the next property owner if they ever sell.

Lenny Siegel: I want to add that many states, like New York and California, don't consider mitigation a completion of the responsibility of the party, that remediation may still be necessary, removal of the source.

Mark Distler: We have a couple of questions on the OSHA PELs. Chris is correct, you know, when I was talking about that OSHA doesn't apply; only when you are using a chemical in that facility and you have an OSHA program does it obviously apply for that facility. If you have it coming into your facility through soil vapor, then the screening levels are the ones that apply to those, for that indoor concentration.

This question is, how can a regulatory agency that hasn't yet released a guidance on VI, and there are no state-specific regulations, prove to the regulated community that OSHA PELs do not apply? Is this written somewhere that can be cited?

Christopher Roe: For example, in California, the DTSC [Department of Toxic Substances Control] guidance specifically says that you cannot rely on an OSHA PEL when you're doing a VI investigation. I don't think it really has been tested about whether OSHA could somehow enforce a standard like a VI screening value under the General Duty Clause or some other provision, which says that you can't put your employees at unreasonable risk. But it is not a simple issue, the relationship between OSHA PELs and VI numbers.

Lenny Siegel: I think it's key to understand that these guidance documents, whether they be EPA's pending guidance or the state guidance, are just tools .The requirements are built into the statutes and regulations.

Mark Distler: Rich, your thoughts on when or if the VI will be added to the HRS, the hazard ranking system?

Richard Kapuscinski: This pertains to listing of Superfund sites for VI pathway. I'm not personally involved with that, but I don't expect any development this calendar year; no public development this calendar year.

Lenny Siegel: But there is a proposed rule out. It was published in the *Federal Register* over a year ago, I think.

Richard Kapuscinski: Correct. [EPA requested comments regarding the potential addition of the VI pathway to the HRS in a January 31, 2011, *Federal Register* notice.]

Lenny Siegel: But there is a proposed roll out. It was published in the *Federal Register* over a year ago, I think.

Richard Kapuscinski: Correct.

Mark Distler: Thanks, Rich. Do any of us have experience with carbon monoxide gas migration through the ground intruding—methane, carbon monoxide?

Lenny Siegel: The only experience I have is the school site in New York City that had confirmed VI. But the health complaints from the students seemed like they were more likely a result of carbon monoxide. What I concluded was that the poor ventilation at the school was causing both VI and basically bad indoor air. So, buildings should be well-ventilated, and those that aren't can have carbon monoxide problems and VI.

Christopher Roe: In doing VI sampling in underground garages, we've run into not so much that we're looking for carbon monoxide, but that the ventilation systems designed to keep the apartments above the garage safe also mitigate the VI issue. So, we're not directly looking for it, but considering the same kind of remedial or mitigation strategy.

Lenny Siegel: Well, podium construction, such as underground garages, is often considered a mitigation strategy for VI, but then you have to deal with the fumes from the cars.

Mark Distler: What kind of deed restrictions are applicable for VI?

Christopher Roe: We have a covenant in California for a site where the requirement is that before a residential structure is built over a certain area of one of our sites, VI analysis will have to be done in a covenant in California. In Pennsylvania, if there's mitigation that is part of getting a signoff from the state, then, as I said before, you need to put it in an environmental covenant.

Megan Conlon McCulloch: We have a site in Michigan now. It's an industrial site, and part of the restrictive covenant is that there are no residential uses allowed. And if there are future industrial buildings built on site, they must have vapor mitigation systems installed.

Lenny Siegel: One of the challenges that we found is that property owners often do not agree to access, to allow their homes, their buildings, to be sampled. There is often a need for some kind of institutional control to notify future residential purchasers that this is part of a VI study area, but it was never sampled because there's no data.

Mark Distler: Who should pay for peace of mind associated with real-time or near-time monitoring? Continuous reads from people's homes with remote sensing could have confounding factors, like a spike if someone's use of a gun cleaner is not risk associated with release of hazardous substance, protecting people from the gun cleaner, the dry-cleaned clothes is not the responsibility of the responsible party. So, how does real-time monitoring, given the potential for many confounding factors, fit into our risk management framework?

Lenny Siegel: Whether or not you have real-time monitoring, the potential for background sources that create health risks is an issue. It's important that any VI investigation or mitigation response include education, so that people are in a position to understand the risks that they face and to address those that they're responsible for.

While you will get some people who will always want to blame their problems on somebody else, I found a lot of people who will respond when they find out it's something that they've been doing. So, education is the key answer. But yeah, there will be people who will misuse the information.