INDOOR AIR QUALITY, RISK AND UNCERTAINTY: The "New" Risks of Vapor Intrusion

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INTRODUCTION

Uncertain risks present unique challenges to the law.[1] Unlike science, which can always defer judgment until more data are generated and uncertainties are reduced, law must often come to final decisions on uncertain risks that are indeterminate and contested.[2] A relatively new area of uncertain health and environmental risks, which often arise in the context of property transactions, is vapor intrusion. Although the potential for vapor intrusion has always been present on contaminated lands, it is only due to recent legal and policy changes that vapor intrusion evaluation has now become a part of almost every investigation of a potentially contaminated site, and many real estate transactions.[3] This article describes this emerging problem, and the challenges and liability risks it presents for environmental transactions and remediation.

Part I briefly describes what vapor intrusion is and how it is addressed as a technical issue. Part II describes the rapidly evolving legal response to vapor intrusion in the context of clean-up of contaminated sites and property transactions. Part III identifies eleven major issues of uncertainty relating to vapor intrusion, which is making this issue such an intractable and controversial legal, scientific and policy problem. Finally, Part IV provides some practical advice for dealing with the vapor intrusion issue.

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1. *See generally* Daniel A. Farber, *Uncertainty*, 99 GEO. L.J. 901 (2011).

2. *See* Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 596–97 (1993) ("[T]here are important differences between the quest for truth in the courtroom and the quest for truth in the laboratory. Scientific conclusions are subject to perpetual revision. Law, on the other hand, must resolve disputes finally and quickly.").

3. Mark Distler et al., *Vapor Intrusion: The State of the Science and the Law*, 43 ENVTL. L. REP. 10,005, 10,005 (2013).

I. THE PROBLEM OF VAPOR INTRUSION

Vapor intrusion ("VI") is the migration of chemical vapors from contaminated groundwater or soil into the breathing space of the overlying buildings. Volatile chemicals and petroleum products that spill or leak into soils or groundwater can generate vapors that can infiltrate buildings by moving through the soil and seeping through cracks or perforations in a building's floor or walls, or by entering through sewer lines and other openings.[4] These chemical vapors can then present a health risk to people breathing within the building, whether it is an industrial, commercial or residential facility.[5] Chemicals that often result in VI problems include gasoline, diesel fuel, dry cleaning solvents, industrial degreasers and other chemicals with high vapor pressure.[6] While the VI issue has received considerable recent attention, "[t]he magnitude of vapor intrusion as a national issue remains poorly understood."[7]

There are reasons to suspect that vapor intrusion into the indoor air of buildings may present the most significant risks from hazardous waste contamination.[8] These include the fact that people spend a large amount of time indoors,[9] inhalation is probably the most dangerous route of exposure for dosing the body, and that there are no practical ways to avoid exposure (unlike, for example, finding alternative sources of drinking water to avoid contaminated water).[10] Notwithstanding these red flags suggesting that vapor intrusion risks may be significant, the actual risks are likely to be highly variable and uncertain.

A key challenge presented by VI is how to accurately and economically identify buildings with a potential VI problem.[11] Actual monitoring of indoor air in every potentially affected building is usually not feasible, given that some contaminated sites may include hundreds or even thousands of buildings. Thus, some type of screening tool is required to prioritize

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4. U.S. ENVTL. PROT. AGENCY (EPA), SUPERFUND DIV., WHAT YOU SHOULD KNOW ABOUT THE PROBLEM OF VAPOR INTRUSION 1 (2012), *available at* http://www.epa.gov/region5/cleanup/tuchman/pdfs/tuchman-vi-fs.pdf.

5. Jill E. Johnston & Jacqueline MacDonald Gibson, *Screening Houses for Vapor Intrusion Risks: A Multiple Regression Analysis Approach*, 47 ENVTL. SCI. TECH. 5595, 5595 (2013).

6. EPA, *supra* note 4, at 1.

7. NAT'L RESEARCH COUNCIL, ALTERNATIVES FOR MANAGING THE NATION'S COMPLEX CONTAMINATED GROUNDWATER SITES 182 (2012).

8. Jeff Polubinski, *Adapting CERCLA to Address Vapor Intrusion by Amending the Hazard Ranking System*, 37 VT. L. REV. 467, 472–73 (2012).

9. NATI'L RESEARCH COUNCIL, *supra* note 7, at 180 (the average person spends twenty-one hours per day indoors).

10. Polubinski, *supra* note 8, at 472–73.

11. Johnston & Gibson, *supra* note 5, at 5595.

buildings for indoor monitoring and possibly some type of remediation.[12] This task is complicated by the many different factors that can affect the flow of vapors from soils or groundwater into overlying buildings.[13]

There are two general approaches to mitigating VI.[14] One approach is to better seal the building so less vapor intrudes into the interior, much like radon prevention programs seek to reduce radon entry into a building.[15] This can involve sealing cracks in the walls or floors of the building, installing indoor air vapor mitigation systems, or, in extreme cases, replacement of the slab or installation of liners.[16] The second approach is to remediate the source of the vapors by cleaning up the underlying contaminated groundwater or soils, a process that can take many years and therefore provides a permanent solution but also involves greater costs and delays.[17] In addition to existing buildings, VI is also a significant issue for many new buildings built on brownfields, which offers different mitigation options such as installing vapor barriers (sheets of "geomembrane" or strong plastic) beneath a building during construction.[18] Indeed, some communities such as Mountain View, California now require vapor mitigation in areas with suspected contamination as part of its building permit process.[19] The National Research Council recommended in a 2012 report that "[a]s a precautionary measure, vapor mitigation could be built into all new construction on or near known VOC [volatile organic compound] groundwater plumes."[20]

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12. *Id.*
13. *Id.* at 5596.
14. Reza S. Zarghamee et al., *Did EPA Overstep in Applying Soil Vapor Intrusion Guidance to Commercial Buildings?*, CLIENT ALERT (Pillsbury Winthrop Shaw Pittman LLP), Aug. 19, 2013, at 2, *available at* http://www.pillsburylaw.com/siteFiles/Publications/AlertAugust2013ELUNRSoilVaporIntrusion.pdf.
15. *Id.*
16. *Id.*
17. *Id.*
18. Pat Ware, *More Redevelopers Including Vapor Intrusion Mitigation in Their Projects, Report Says*, DAILY ENV'T REP. (BNA), Nov. 13, 2013 at A-14.
19. *Id.*
20. NAT'L RESEARCH COUNCIL, *supra* note 7, at 9.

II. LEGAL RESPONSE

Vapor intrusion has become increasingly important as a scientific, policy and legal issue over the past decade.[21] In November 2002, EPA's Office of Solid Waste and Emergency Response ("OSWER") released a draft guidance that provided the Agency's understanding and approach at that time to the VI issue.[22] The Agency recommended that the draft guidance be used as "a screening approach in implementing the RCRA and CERCLA programs," specifically at Resource Conservation and Recovery Act ("RCRA") Corrective Action sites, National Priorities List and Superfund Alternative sites under the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA"), and Brownfields sites. The following year, Congress enacted the Brownfields Revitalization and Environmental Restoration Act, which clarified and strengthened the criteria for "all appropriate inquiry" ("AAI") necessary to establish the innocent landowner defense under CERCLA (as well as applying the AAI criteria to a "bona fide prospective purchaser" and contiguous property owner' defenses). The AAI criteria clarified that parties must take reasonable steps in stopping continuing releases of hazardous substances, preventing future releases, and limiting human and environmental exposures to prior releases. This greater focus on the AAI criteria, including the requirement to minimize human exposures from contaminated sites, implicitly gave greater impetus to preventing exposures from VI.

The 2002 "draft" VI guidance remained in effect for over a decade until it was replaced in April 2013 with an "external review draft" of a "Final Guidance."[23] EPA took additional public comment on this draft of the "Final Guidance" through June 2013, and received 177 public comments on this document. The Agency has announced plans to issue a final "Final" guidance sometime in 2014.

Another VI action that the EPA is considering is to add VI to the Hazard Ranking System ("HRS"), the agency's scoring system for ranking sites for

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21. Steven L. Humphreys, *The Vapor Intrusion Rub: EPA's Adoption of ASTM's New Phase I Standard Muddies the Waters of CERCLA Liability Once Again*, 22 METROPOLITAN CORP. COUNS. 40, 40–41 (2014), *available at* http://metcc.epubxp.com/i/252388.

22. EPA, OSWER DRAFT GUIDANCE FOR EVALUATING THE VAPOR INTRUSION TO INDOOR AIR PATHWAY FROM GROUNDWATER AND SOILS (SUBSURFACE VAPOR INTRUSION GUIDANCE) 1 (2002) [hereinafter 2002 DRAFT GUIDANCE], *available at* http://www.epa.gov/epawaste/hazard/correctiveaction/eis/vapor/complete.pdf.

23. EPA, OSWER FINAL GUIDANCE FOR ASSESSING AND MITIGATING THE VAPOR INTRUSION PATHWAY FROM SUBSURFACE SOURCES TO INDOOR AIR (EXTERNAL REVIEW DRAFT) 1 (2013) [hereinafter 2013 DRAFT FINAL GUIDANCE], *available at* http://www.epa.gov/oswer/vaporintrusion/documents/vaporIntrusion-final-guidance-20130411-reviewdraft.pdf.

eligibility for the National Priorities List ("NPL"), which provides for federal clean-up funding. The HRS currently only considers other exposure pathways for ranking sites, and omitting VI exposures from this scoring system has the effect of excluding some of the highest risk sites from the NPL, which means that EPA cannot use remedial program funding to clean up these sites.[24] EPA has indicated its intention to add "subsurface intrusion," which primarily involves VI, to the HRS, and has conducted public outreach and initial analysis of such a measure, but has yet to publish a proposed rule.[25] If and when EPA adds VI to the HRS, the number of sites eligible for the NPL is expected to increase significantly.[26]

The legal significance of VI became even more pronounced in December 2013 when EPA legally adopted the new ASTM E1527-13 Standard Practice for Phase I Environmental Assessments as an acceptable method for complying with the AAI defense under CERCLA. This new ASTM standard for the first time makes VI assessment an explicit and separate requirement of the due diligence process for an environmental transaction.[27] Up until now, VI was not a specific, separate requirement for assessment in a Phase I study, and was included, if at all, as an adjunct risk of soil or water contamination.[28] According to an analysis by ASTM, only about twenty-two percent of Phase I consultants have been including VI risk in their assessments.[29] The new ASTM standard, as adopted by EPA, will now make VI assessment a mandatory and stand-alone topic for study in Phase I assessments.

Vapor intrusion has not been evaluated for many contaminated sites. For example, a 2012 National Research Council report calls attention to a large Superfund site in Phoenix, Arizona:

> For example, the Motorola 52nd Street semiconductor factory in Phoenix, Arizona, was placed on the NPL in 1984. There is continuing investigation of the high levels of TCE in the deep bedrock under the neighborhood immediately downgradient from

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24. GOV'T ACCOUNTABILITY OFFICE (GAO), SUPERFUND: EPA'S ESTIMATED COSTS TO REMEDIATE EXISTING SITES EXCEED CURRENT FUNDING LEVELS, AND MORE SITES ARE EXPECTED TO BE ADDED TO THE NATIONAL PRIORITIES LIST 31 (2010). The GAO found that due to the failure to include VI in the HRS, "some seriously contaminated hazardous waste sites with unacceptable humane exposure may not otherwise be cleaned up." *Id.* at 33.

25. Potential Addition of Vapor Intrusion Component to the Hazard Ranking System, 76 Fed. Reg. 5370, 5370 (Jan. 31, 2011); *Addition of Subsurface Intrusion (SsI) to the HRS*, EPA.GOV, http://www.epa.gov/superfund/sites/npl/hrsaddition.htm (last visited Apr. 6, 2014).

26. GAO, *supra* note 24, at 31.

27. Humphreys, *supra* note 21, at 40.

28. *Id.*

29. *Id.*

> the plant, but Arizona's Department of Environmental Quality—lead agency for that operable unit—has not evaluated potential vapor intrusion under the moderate income, predominantly Latino neighborhood, despite repeated requests from community leaders. Only in 2010 did EPA Region 9 announce a vapor intrusion investigation and form a Community Information Group to oversee it.[30]

The growing regulatory interest and requirements for VI suggest that this and other contaminated sites are likely to be soon evaluated or re-evaluated for VI problems, an action that is likely to result in considerable cost, uncertainty and controversy.

III. UNCERTAINTIES

Intrusion of potentially hazardous chemical vapors into the indoor breathing space of building residents or employees as a result of contamination of soil or water under the building is an important risk to identify and attempt to mitigate for both safety and legal reasons. But the new recognition of this potential problem will create additional complexities and challenges for property transactions. The defining characteristic of the VI issue is the broad new uncertainties it introduces into commercial property and other real estate transactions, contaminated property clean-ups and brownfields redevelopment.[31] These uncertainties are many-fold.

First, there are uncertainties about the overall approach and methodology a party must or may use to assess potential vapor intrusion risks. When must a party measure the concentrations and flows of gases under a structure? When must it conduct air sampling within the building itself? There are no clear rules or guidance on these types of questions. There are thousands of potentially contaminated sites in the United States that may present VI concerns, but the number of such sites that present significant risks that should be evaluated is unknown.[32] Under EPA's 2002 draft guidance, the primary method for assessing VI was modeling based on the results of sub-slab gas measurements or soil or groundwater sampling, but the 2013 "draft final" EPA guidance suggests that such modeling may be

30. NAT'L RESEARCH COUNCIL, *supra* note 7, at 182.

31. *See* Christine G. Rolph et al., *The 'Volatile' World of Vapor Intrusion: Understanding Vapor Intrusion Regulation and the Potential for Litigation*, 30 PACE ENVTL. L. REV. 107, 108 (2012).

32. NAT'L RESEARCH COUNCIL, *supra* note 7, at 181.

inadequate and indoor air sampling may be required.[33] EPA, like many states previously, has adopted a "multiple lines of evidence" approach in which a party must undertake an initial "screening" level assessment of soil and water contamination and proceed to more direct VI air monitoring tests if certain criteria are exceeded.[34] But there is no assurance that such judgments will stand-up in subsequent regulatory enforcement or civil litigation.[35] And even if the general approach is acceptable, numerous other uncertainties are encountered, as enumerated below.

Second, there are uncertainties about the nature, location and magnitude of sub-surface plumes that may give rise to VI concerns.[36] Characterizing underground plumes always involves some uncertainty but has become a well-established technique. VI adds extra uncertainties because not only the movement and toxicity of the waste must be predicted, but also the volatility of the chemicals in the waste and the soil conditions under specific buildings become relevant. Moreover, vapor plumes do not necessarily follow groundwater plumes, and other factors such as the existence of underground utility corridors can further complicate prediction of vapor travel.[37] Other complications, such as a perched water aquifer, a body of water that is "perched" above the main water level due to impermeable rock, may mask the vapors present under a soil sampling site, even though those vapors may eventually escape from under the water body and cause a problem.[38]

Third, there are uncertainties about the extent of penetration and concentration of vapors that may accumulate in a building from the underground chemicals. Unexplained temporal variations in vapor intrusion levels from a given plume contribute to the uncertainty and unpredictability of in-building vapor levels.[39] A variety of environmental factors can affect the likelihood and rate of vapor intrusion from a given underground plume of toxic substances, including atmospheric pressure, precipitation, and wind conditions.[40] Differences in building type and construction (e.g., foundation type) can also affect vapor entry and ambient levels, while differences in the spatial variations and characteristics of the contaminated soil and

33. 2013 DRAFT FINAL GUIDANCE, *supra* note 23, at 45–81.

34. Humphreys, *supra* note 21, at 41.

35. *Id.*

36. NAT'L RESEARCH COUNCIL, *supra* note 7, at 226 ("Vapor intrusion from groundwater plumes with chlorinated solvents is especially challenging to characterize, partly because such plumes can vary widely in size.").

37. Distler et al., *supra* note 3, at 10,006.

38. *Id.*

39. NAT'L RESEARCH COUNCIL, *supra* note 7, at 227.

40. Johnston & Gibson, *supra* note 5, at 5598–99.

groundwater (e.g., soil type and groundwater depth) can also have major effects on vapor release.[41] Heating, ventilation and cooling ("HVAC") systems within a building can also affect volatized chemical concentrations within a building, such as by creating negative pressure within a building that draws vapors under the structure into the inner space of a building.[42] Taken together, these variables can affect the attenuation factor used to predict the indoor levels of vapor resulting from a specified concentration of contamination in soil or water by up to five orders of magnitude.[43]

Fourth, there are measurement errors and confounding factors that make objective measurement of vapor concentrations in a building unreliable and uncertain.[44] For example, household chemicals such as cleaning products, air fresheners, paints, new carpeting and furniture, and dry cleaned clothing can interfere with sampling results in residences.[45] Chemicals used in manufacturing, processing or even cleaning can likewise interfere with sampling in business facilities.[46] Due to such factors, a single indoor sample has very little reliability, but must be sampled multiple times over a longer period of time to give an accurate estimate of indoor concentrations.[47] This requirement for testing over a prolonged period of time creates a timing problem for residential purchases and other transactions that are on a tight schedule.[48]

Fifth, there are uncertainties about the health risks from whatever levels of chemical vapors do intrude into a building. Human risk assessment from chemical exposures face many uncertainties, including the number of people exposed, the level of exposure, the effects of different chemical vapors across different exposure levels, the inter-actions between exposures to different chemicals at the same time, and individual susceptibilities due to age, pregnancy, nutritional deficiencies, disease and health status, and genetics.[49]

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41. *Id.* at 5596.

42. N.Y. STATE DEP'T OF HEALTH, GUIDANCE FOR EVALUATING SOIL VAPOR INTRUSION IN THE STATE OF NEW YORK 1 (2006), *available at* http://www.health.ny.gov/environmental/investigations/soil_gas/svi_guidance/docs/svi_main.pdf.

43. Johnston & Gibson, *supra* note 5, at 5597.

44. Distler et al., *supra* note 3, at 10,007; Zarghamee et al., *supra* note 14, at 3.

45. EPA, *supra* note 4, at 2. One estimate is that over 2000 household products have the potential to emit solvents into indoor air. NAT'L RESEARCH COUNCIL, *supra* note 7, at 227.

46. Distler et al., *supra* note 3, at 10,006.

47. *Id.* at 10,007.

48. *Id.* at 10,006.

49. *See generally* NAT'L RESEARCH COUNCIL, SCIENCE AND JUDGMENT IN RISK ASSESSMENT 188–223 (1994).

Sixth, there are uncertainties about the ongoing duty of a property owner to mitigate the risks of VI. For example, if VI risks are discovered during a transactional environmental assessment, is a full assessment and mitigation required? Under the CERCLA bona fide prospective purchaser defense, EPA's 2003 "common elements guidance" specifies that an innocent purchaser relying on the AAI defense will not be required, as "a general matter," to undertake the full remediation that would be required of a responsible party.[50] However, this guidance does not address VI risks, and unlike ongoing soil and water contamination that may not present a direct risk to the occupants of a property, VI does involve direct and ongoing exposure of the building occupants.[51] It is therefore unclear what EPA and courts would require the innocent purchaser to do to further investigate and remediate any discovered VI risks. Even greater uncertainty exists about the duty of a contiguous landowner with buildings presenting potential VI risks from a release on a neighboring property.[52]

Seventh, there are novel uncertainties created by VI with regard to public perceptions and risk communication. Unlike other aspects of transactions and clean-ups involving contaminated soils and water, VI requires direct sampling inside of residents' homes and direct interactions with homeowners instead of underground sampling of soils and groundwater at industrial sites or publicly accessible areas.[53] Residents of a home where experts need to enter and monitor exposures can understandably be alarmed by such activities and require careful risk communication to prevent needlessly alarming them while at the same time avoiding unsupported reassurances that may later turn out to be incorrect. In addition, indoor air sampling of residences can also create privacy concerns.[54] States such as California and New Jersey have now published risk communication manuals specifically for vapor intrusion sites.

Eighth, there are uncertainties about which regulatory agency, statute and standards apply to a particular VI problem. There is first an issue of whether the Occupational Safety and Health Administration ("OSHA") or EPA has jurisdiction over indoor air issues. OSHA standards tend to be less protective than EPA standards, often by several orders of magnitude,[55] so the question of which agencies' standards apply can be outcome

50. Humphreys, *supra* note 21, at 41.

51. *Id.*

52. *Id.*

53. Ellen A. Ivens, *Risk Communication Strategy at a Vapor Intrusion Site: A Case Study*, J. RISK & CRISIS COMM. (Sept. 24, 2013), http://www.journalriskcrisis.com/risk-communication-strategy-at-a-vapor-intrusion-site-a-case-study/.

54. Rolph et al., *supra* note 31, at 109.

55. Zarghamee et al., *supra* note 14, at 3.

determinative in some cases.[56] In its 2002 draft guidance, EPA stated that OSHA would have lead authority to deal with VI issues in industrial buildings and "other workplaces."[57] In its 2013 guidance, however, EPA has apparently shifted its position and states that it has the authority "to protect the public and workers' health in nonresidential settings where hazardous vapors may be intruding into occupied buildings from vapor intrusion."[58]

If EPA indeed has jurisdiction over VI risks in a particular building, there is remaining uncertainty about applicable statutory and regulatory requirements. Under RCRA, for example, EPA may bring a lawsuit against any entity that is responsible for hazardous waste that "may present an imminent and substantial endangerment to health or the environment."[59] Court decisions applying this "substantial endangerment" provision to VI situations have been inconsistent and unpredictable.[60] Alternatively, there may be a duty to mitigate the VI risks under the "continuing obligations" requirement of an AAI defense under CERCLA.[61]

Ninth, there are additional uncertainties about state standards that may apply to a VI situation. For the past decade, the federal government has left remediation of VI primarily to the states under their site remediation programs.[62] Most states have adopted their own requirements or standards for VI.[63] These guidances tend to be non-binding and take different approaches for assessing and mitigating VI risks.[64] In states without explicit guidance, parties must use their own best judgment and apply draft EPA criteria and/or other non-mandatory guidance documents, which open up such parties to second-guessing in subsequent regulatory or litigation

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56. Rolph et al., *supra* note 31, at 113–14.

57. 2002 DRAFT GUIDANCE, *supra* note 22, at 3.

58. 2013 DRAFT FINAL GUIDANCE, *supra* note 23, at 5, 37.

59. 42 U.S.C. § 6973 (2012).

60. *See* Polubinski, *supra* note 8, at 480–81; Rolph et al., *supra* note 31, at 122–30; *see, e.g.*, Grace Christian Fellowship v. KJG Invs. Inc., No. 07-C-0348, 2009 WL 2460990 (E.D. Wis. Aug. 7, 2009); United States v. Apex Oil Co., No. 05-CV-242-DRH, 2008 WL 2945402 (S.D. Ill. July 28, 2008) (finding imminent and substantial risk).

61. Humphreys, *supra* note 21, at 41; *see, e.g.*, Voggenthaler v. Maryland Square L.L.C., 724 F.3d 1050, 1063–64 (9th Cir. 2013) (holding that subsequent purchaser of contaminated property may be held liable under CERCLA for vapor intrusion mitigation and clean-up if it failed to comply with AAI requirements).

62. Humphreys, *supra* note 21, at 41.

63. According to one source, thirty states have adopted their own VI guidance or standards. Rolph et al., *supra* note 31, at 120. According to another source, only four states have not adopted their own standards—Nevada, New Mexico, North Dakota and Arkansas. Zarghamee et al., *supra* note 14, at 2.

64. *See* Humphreys, *supra* note 21, at 41; Polubinski, *supra* note 8, at 474–77; Rolph et al., *supra* note 31, at 121.

actions.[65] There are other influential guidances from organizations such as the Interstate Technology & Regulatory Council ("ITRC") and the American Society for Testing and Materials ("ASTM"). In the opinion of one set of experts, "the myriad of available documents may generate more confusion than clarity."[66]

Tenth, VI creates uncertainties about the final closure of any cleaned-up contaminated site. Under the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), EPA or states may require removal or remediation of wastes that may create VI concerns.[67] A contributor to the uncertainty about VI is the delayed discovery rule that provides that the statute of limitations for CERCLA does not start to run until the plaintiff "knew (or reasonably should have known)" that personal injury or property damages were caused by hazard waste.[68] This delayed discovery rule preempts any state law with an earlier start date for the statute of limitations, so sites that have obtained closure from regulators may still be subject to future VI lawsuits.[69] Concern has all been raised that states themselves will re-open hazardous waste sites that have had final closure,[70] although a 2007 survey of states found that only two states (Maine and New York) had reopened closed sites to investigate VI concerns.[71]

Eleventh, there is uncertainty about liability in private lawsuits brought as citizen suits under statutes such as RCRA or CERCLA or as common law toxic tort lawsuits. Again, the outcomes in the relatively small number of lawsuits that have been decided to date are inconsistent.[72] One factor that appears to be important in many cases, both for liability generally but also the potential availability of punitive damages, is the extent to which relevant exposure and health information was purposefully or fraudulently not disclosed to affected residents.[73] This provides another argument for appropriate and prompt disclosure to potentially affected residents.

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65. Humphreys, *supra* note 21, at 41.

66. Rolph et al., *supra* note 31, at 121.

67. *See* Action Mfg. Co. v. Simon Wrecking Co., 428 F. Supp. 2d 288, 332 (E.D. Pa. 2006).

68. 42 U.S.C. § 9658(b)(4)(A) (2012); *see* Rolph et al., *supra* note 31, at 112–13.

69. Rolph et al., *supra* note 31, at 113.

70. *Id.* at 107.

71. Interstate Tech. & Regulatory Council, *ITRC State Survey: Re-Visiting "Closed" Site for Vapor Intrusion Concerns* (2007), *available at* http://www.itrcweb.org/Documents/ReOpeningCasesVIStateSurveyOct07sh.pdf. New York, for example, has made a deliberate policy decision to retroactively evaluate hazardous waste sites that have previously been closed for vapor intrusion risks. *See* Polubinski, *supra* note 8, at 477.

72. Rolph et al., *supra* note 31, at 133–37.

73. Distler et al., *supra* note 3, at 10,011.

IV. CONCLUSION

Vapor intrusion is not a new problem, as contaminated soils and ground water have likely intruded into indoor air for as long as there has been hazardous waste contamination.[74] But it is a newly recognized problem, and one that is likely to get much more attention going forward. The explicit incorporation of VI into the new ASTM standard for AAI, EPA's new guidance for vapor intrusion, and the Agency's pending incorporation of VI into the hazard ranking system for CERCLA will ensure that VI becomes a much more important priority in future property transactions and clean-ups. Given that VI will likely present a greater direct exposure and risk to citizens than the other routes of exposure from many contaminated waste sites, this increased emphasis on VI is an appropriate and overdue development. At the same time, because VI involves great uncertainty about the magnitude of risk, invokes the fear and risk perceptions of residents whose children and other family members are potentially being exposed to hazardous vapors, and presents a promising source of large new revenues to plaintiffs lawyers and environmental consultants, it is a certainty that there will be some exaggerated risks and demands relating to VI.

For all these reasons, both valid and not, VI is likely to increase the uncertainty, costs, and liability and enforcement risks associated with property ownership and transfer. While it is certainly prudent to recognize and try to minimize VI risks to building occupants, the lack of clear, reasonable standards and criteria, along with shifting scientific and legal expectations, will likely make this issue messy, controversial, and burdensome in the upcoming years.[75] Parties will need to proactively understand and address potential VI risk issues to try to minimize unwanted and unnecessary costs and delays in property transactions. While many difficult challenges will be faced, such as the need to disclose highly uncertain information about potentially hazardous exposures to the occupants of affected buildings, failure to proactively address and communicate the risks of vapor intrusion may do more harm than good.

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74. *See* NAT'L RESEARCH COUNCIL, *supra* note 7, at 180 ("Although not 'new' in that it has been increasingly recognized over the last ten years, the vapor intrusion pathway is of particular interest with respect to subsurface contamination.").

75. Distler et al., *supra* note 3, at 10,010.