WHITEPAPER

Vapor Intrusion:

How to Ensure Environmental Compliance

OMEGA ENVIRONMENTAL

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INTRODUCTION: WHAT IS VAPOR INTRUSION?

For a long time, no one paid much attention to the possibility of vapor intrusion—the migration of volatile chemical vapors from contaminated soil or groundwater into indoor air through cracks in overlying building foundations and other openings. Today it is the subject of growing research and concern.

Vapor intrusion can occur anywhere volatile organic compounds (VOCs) have been deposited subsurface into the soil or groundwater, either through spills or through a practice of dumping industrial waste into drains or sewers. While soil and other surfaces were once thought to create an impermeable barrier to the vapors formed by such compounds, the reality is much more troubling.

Subsurface vapor plumes can travel for miles in multiple directions from the source of a spill, following a wide variety of routes for reaching indoor air, from cracks and joints in slabs and foundations to pockets and gaps around plumbing fixtures and utility lines.

Exposure to the vapors created by VOCs—including trichloroethylene (TCE), a widely used chemical used in the dry cleaning process, gasoline and petroleum, degreasing chemicals, polychlorinated biphenyls (PCBs) and certain pesticides—creates a serious risk to human health, including cancers. Without intervention, such vapors can travel far from the source of the original contamination, threatening ground water, soil and indoor air quality in a widening path of risk.

While it may go undetected for years, the likelihood of vapor intrusion at any particular building increases dramatically in the vicinity of sites used for dry cleaning operations, gas stations, and industrial businesses that have used vapor-forming chemicals.

This whitepaper will discuss the causes and potential health and environmental effects of vapor intrusion, as well as best practices for assessment and mitigation.

WHITEPAPER HIGHLIGHTS

- Determining who is at risk
- How to identify vapor intrusion
- Health consequences posed
- Best practices for vapor intrusion assessment
- How to choose the right environmental partner

WHO IS AT RISK FROM VAPOR INTRUSION

Leaking chemicals or improper disposal of dangerous substances can lead to vapor intrusion. When a volatile organic compound (VOC) leaks into the subsurface, the liquid will travel downward but in its vapor state, the chemical will drift upward along the path of least resistance. Depending on the subsurface material, vapors may remain locked beneath the surface for a period of time. They can also travel along groundwater pathways. But an opening in the foundation or slab of a building above can create a pathway for the vapors to rise and find their way into indoor air through openings around pipes or cracks in the foundation. In California, frequent earthquakes and tremors are a common source of such cracks and fissures.

Flooding also contributes to the problem. The soil shrinks when it dries and expands when it is wet. The moisture in the soil can put pressure on a foundation and cause it to crack. When the cracks open, the chemical vapor trapped in the subsurface can move upward and contaminate indoor air.

SUBSTANCES THAT CONTRIBUTE TO VAPOR INTRUSION PATHWAYS

According to the Environmental Protection Agency, vapor-forming chemicals can include:

- Volatile organic compounds (VOCs) such as trichloroethylene, a dry cleaning chemical and benzene, a component in gasoline
- Select semi-volatile organic compounds (SVOCs) such as naphthalene, used in the production of PVC (polyvinyl chloride) plastic, dyes, resins, lubricants, fuels and pesticides
- Elemental mercury found in thermometers, streetlights, fluorescent lamps and advertising signs
- Some polychlorinated biphenyls (PCBs), used in electrical equipment such as capacitors and transformers
- Certain pesticides

In recent years, there has been a shift in regulatory concerns resulting in part from a study that found that vapor intrusion from trichloroethylene (TCE, an industrial solvent) and perchloroethylene (PCE/Perc, a dry cleaning fluid) caused birth defects in the children of pregnant women exposed to the chemicals following an industrial spill.

The study showed an increase in low birth weight, cardiac defects, oral clefts and neural tube defects in the children of women exposed to the vapor while pregnant, according to the National Institutes of Health.

Studies demonstrating adverse health effects in pregnant women exposed to vapor intrusion resulted in increased regulations from governing bodies such as California Environmental Protection Agency (Cal EPA) and the National Institute for Occupational Safety and Health (NIOSH). Emerging research on the effects of vapor intrusion has brought about new guidelines which lowered the allowable concentrations of these chemicals in indoor air.

HOW TO IDENTIFY VAPOR INTRUSION

Often the problem is discovered when a developer decides to remodel or sell a building and is required by lenders to conduct a Phase 1 environmental inspection. During the Phase 1 process, inspectors will research the history of the property to determine if the site was ever used for a business with a high risk of contaminated soil or groundwater, or if the site is near such a location.

High risk uses include:

- Chemical processing plants
- Landfills
- Warehouses used for chemical storage
- Train yards
- Dry cleaners
- Gas stations
- Coal gasification pants
- Printers
- Automobile repair shops
- Electroplating operations

If a potential issue is identified, testing may be performed as part of a Phase 2 environmental site assessment to discover if any chemical residue is trapped under the building in the soil in and around the property. An indoor air quality assessment may also be conducted as part of the Phase 2 assessment.

Prior to the 1980s, the risk of chemicals in the soil making their way into the indoor air was not well understood. Disasters like the Love Canal in the late 1970s and the discovery of radon gas beneath a Pennsylvania home in the 1980s led researchers to begin looking at the way that certain chemicals in soil, groundwater and sewers could reach indoor air through vapor intrusion.

Businesses that store or use hazardous materials are most likely to be affected by vapor intrusion, as well as businesses occupying sites previously used for such purposes. The older the building, the more likely the effect. While rules around the use and disposal of chemicals have become stricter, indoor air quality can be affected by decades-old practices like dumping chemicals into drains or sinks, spills that accumulated over years, or deteriorating underground storage tanks.

That is one of the reasons a Phase 1 environmental assessment includes a historical survey. Such assessments can sometimes reveal documentation of spills or the use of storage tanks, in addition to documenting any high-risk uses and work practices.

HEALTH CONSEQUENCES POSED BY VAPOR INTRUSION

Vapor intrusion poses a significant human health risk and can cause severe consequences.

Long term exposure to some VOCs is linked to certain cancers, as well as damage to the liver, kidneys and central nervous system, according to the National Institute of Environmental Health Sciences. Short term inhalation exposure to VOCs can cause headaches, nausea, dizziness and memory problems.

A suspiciously high incidence of cancer in children living in the path of an aging industrial site in Johnson County, Indiana led to testing that recently revealed a spreading plume of TCE in the groundwater and vapor intrusion into homes and the air around a nearby sewer, where levels were found to be 250 times in excess of state limits.

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The case has put a spotlight on the Trump administration's efforts to roll back restrictions on TCE, as well as on the hazards of leaving vapor intrusion inadequately addressed. Despite a subsequent owner's decades-long effort to pump out contaminated groundwater at the site, the EPA found a plume of contamination in November 2018 that stretched for more than a mile, according to The New York Times.

Such highly mobile pathways of contamination create enormous risk around delays in cleanup response as the number of people affected may increase over time.

BEST PRACTICES FOR VAPOR INTRUSION ASSESSMENT

A Phase 1 environmental site assessment begins with a review of the historical record to determine how a property has been used over the years. If there is evidence that hazardous chemicals were in use and may have migrated into the subsurface, the industry best practice is to conduct an initial test of the soil at various depths. Probes that extend to depths of 5, 10 and 15 feet for example, are used to test the soil for evidence of contamination.

If chemicals are found, additional soil testing is done in a horizontal pattern to determine the extent of contamination. Ground water testing is also conducted, and if the results are positive for contamination, the owner is required to report it to the California Water Quality Control Board and/or the Department of Toxic Substance Control. Either agency can step in to lead and direct the cleanup.

Remediation can include a variety of methods, including soil removal and vapor extraction.

CASE IN POINT: THE SAN PEDRO REMEDIATION PROJECT

Omega Environmental recently undertook a remediation project in San Pedro, California where the owner wanted to remodel a shopping center. During the Phase 1 environmental assessment stage, it was determined that a dry cleaner had operated in the shopping center for 40 years, leaving behind a TCE-laden chemical plume that had traveled beneath neighboring businesses, under the parking lot and toward a residential area behind the property.

The contamination was found at a depth of 15 feet into the soil, just five feet from the groundwater table below.

The owners knew that they had to move fast to protect workers and the community. Omega installed vacuum pumps underground to extract the vapors. Initially, a section of soil 40-feet long and 20-feet wide was excavated and sent to a

facility for recycling and disposal. The vapor was vacuum extracted out of the soil, which was then processed through carbon filters to reduce the concentration of the toxic gas to a non-detectable concentration.

It's a painstaking level of diligence, with little room for error.

"You have to remove the source to get desirable results," said Khalid Mahmood, a project engineer with Omega Environmental with over three decades of experience in environmental assessment and hazardous waste site investigations.

"If you don't remove it, you could be treating the problem for years," Mahmood said.

In keeping with strict state and federal regulatory requirements, the groundwater contamination was reported to government authorities who oversaw the cleanup. It took three years to complete, but given the magnitude of the problem, it would not have been unusual for a such a project to take five to 10 years to reach closure.

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FINDING THE RIGHT PARTNER TO MANAGE SUSPECTED VAPOR INTRUSION

Choosing the right company for assessment and remediation is a critical step. Experience can mean the difference between a safe and effective solution and a tedious and expensive process.

Here are a few qualifications to consider in the search for an environmental assessment and remediation partner for managing vapor intrusion:

- **Ask for references:** look for a firm that has the respect of both construction industry professionals and the ability to work smoothly with regulatory officials
- **Check for Experience:** look for a firm whose staff has a strong mix of both scientific expertise and construction industry credentials and extensive experience in assessing and managing vapor intrusion
- **Review Certifications**: a commitment to continuing education and professional certification is the industry standard. Make sure the firm you hire measures up
- **Consider the Range of Services Offered**: if you are looking for a partner to handle whatever your assessment unearths, make sure you contract with a firm that has experience across the landscape, from assessment through planning and remediation

Managing the environmental aspects of a project where vapor intrusion is an issue is a complex undertaking with big consequences for processes that fall short of the highest standards for safety and efficacy. By partnering with a company you can trust, you can meet your responsibility to health and safety as well as your obligation to your stakeholders.

ABOUT OMEGA ENVIRONMENTAL

Ensure environmental compliance and the safety of you employees, customers and the general public with Omega Environmental's 24/7 assessment, consulting and remediation services. Omega conducts phase 1, 2 and 3 environmental site assessments and hazardous material evaluations to determine your exposure to asbestos, mold, moisture, lead, PCBs, and other hazardous materials. Omega identifies what you need to remediate as quickly and cost-effectively as possible so that you are compliant with EPA, OSHA, Cal/OSHA, SCAQMD, and internal compliance policies. Omega oversees third-party hazardous material remediation and can provide these services directly to ensure the job is done right. More: **www.omegaenv.com**