THE BUZZ

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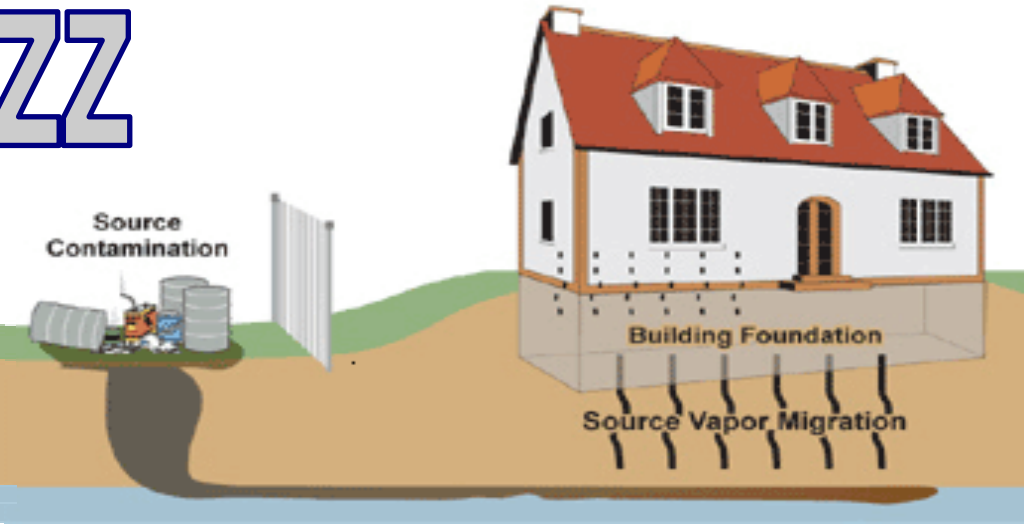


Vapor Intrusion—The Environmental Media du Jour

By Michael A. Lesakowski

On the cover . . .

Generalized schematic of the pathway for subsurface vapor intrusion into indoor air.

Soil vapor intrusion is a hot topic related to brownfields and other environmentally-impaired sites. Soil vapor intrusion (VI) refers to the process by which volatile organic compounds (VOCs) migrate from subsurface sources into the indoor airspace of buildings. VI and related health concerns has spurred new regulatory guidance from the United States Environmental Protection Agency (USEPA), the New York State Department of Environmental Conservation (NYSDEC) and the New York State Department of Health (NYSDOH). The American Society of Testing and Materials (ASTM) also recently released a vapor intrusion assessment standard as a component of environmental due diligence for property transactions. This article provides: an overview of the fate and transport of VOCs in the subsurface environment; a summary of the new ASTM assessment standard and New York VI regulatory guidance; and, a discussion of VI investigations and VI mitigation measures. The scope of this article does not address the broader topic of soil and groundwater remediation.

Fate and Transport of VOCs in the Subsurface Environment

VOCs are a relatively common class of environmental contaminants typically found in soils and groundwater from spills or releases of petroleum or solvents associated with gas stations, automotive repair shops, dry cleaners, machine shops, salvage yards, and certain industrial manufacturing facilities (e.g. computer chip and electronic components). The primary focus of current New York regulatory guidance is upon the chlorinated solvents due to their common use, potential carcinogenicity and persistence in the subsurface environment. These chlorinated solvents (cVOCs) are heavier than water, exhibit relatively low solubility in water and therefore can exist in aqueous phase (dissolved in groundwater) or as dense non-aqueous phase liquid (DNAPL) in saturated or unsaturated soil. Even more common VOCs are the petroleum hydrocarbons; benzene, toluene, ethylbenzene and xylenes (BTEX) constituents in particular. While the petroleum VOCs are more prevalent due to their common

(Continued on page 2)

usage they are readily biodegradable and therefore less persistent in the subsurface environment; they are generally considered less of a threat to human health, and therefore are not currently subject to specific VI mitigation criteria in New York.

Chlorinated VOC plume released from industrial site through residential area.

VOCs migrate from spills or releases (source areas) downward through soil and into groundwater. Upon reaching the water table the VOCs then begin to dissolve and migrate by advection (mixing) and diffusion creating a contaminant plume that disperses both laterally and vertically from the source area. The figure to the right illustrates the lateral extent of a cVOC groundwater plume at the former AVM Superfund Site in Gowanda, NY where Benchmark implemented a design-build interim remedial measure (IRM) for the industrial site owner under the Voluntary Cleanup Program.

DNAPL, or pure product, may adsorb to saturated and unsaturated soil particles as globules or migrate downward by gravity and accumulate upon less permeable soil or rock strata. DNAPL, when present, acts a continuing source of dissolved VOCs to groundwater.

The VOCs, by definition, exhibit high vapor pressures. In other words, they partition (volatilize) from liquid to gaseous phase at atmospheric temperature and pressure. As such, VOCs in unsaturated soils and dissolved in groundwater concentrate in gaseous phase in the soil pores and the VOC-laden soil vapor spreads upward toward the ground surface and into overlying and adjacent structures through cracks, seams and penetrations (e.g. sumps, drains, pipes) in basement walls or floors and/or through utility conduits (see cover). The dense vapors tend to accumulate under basements and slab-on-grade construction as well as in basements and crawl spaces and subsequently, under certain circumstances, into indoor air where people may be adversely exposed through inhalation. The migration of volatile chemicals into buildings is often facilitated by negative indoor pressure conditions (relative to the building exterior) resulting from water heater or furnace vents, kitchen or bathroom fans, and/or fireplaces. Concentrations of VOCs in indoor air tend to be higher during the heating season when windows and doors are closed.

Redfield and IBM-Endicott: The VI Wake-Up Call

Until recently, vapor intrusion was not widely recognized as a relevant human health risk exposure pathway. Two high-profile industrial manufacturing sites, the Redfield Site in Denver, Colorado and the former IBM site in Endicott, New York changed that. Elevated concentrations of cVOCs were discovered within the indoor air at numerous residences and businesses both near and far from the subject manufacturing properties. The source of the contamination was traced back to expansive groundwater contaminant plumes emanating from the manufacturing facilities where large quantities of the solvents were historically used. Extensive environmental testing at these sites provided valuable insight into the VI phenomenon and provided a platform for pioneering testing protocols and mitigation measures now widely accepted by regulators and environmental consultants. EnviroGroup Limited was involved in these pioneering VI efforts at the Redfield site. Benchmark and TurnKey are currently collaborating with Envirogroup on a large-scale VI project in Upstate NY.

Every Environmental Issue Needs Regulatory Guidance

In November 2002, the United States Environmental Protection Agency (USEPA) issued a "Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soil." That document sets forth a tiered investigative approach: preliminary screening to determine whether a potential for vapor intrusion exists based upon subsurface conditions; use of modeling to predict indoor air concentration based upon measured concentrations of target chemicals in soil and groundwater to compare to target indoor air concentrations derived from lifetime exposure cancer risks; and a site-specific assessment of vapor migration and the potential for human exposure.

In October 2006, NYSDOH published "Guidance for Evaluating Soil Vapor Intrusion in New York State." This guidance document has become the primary reference for environmental professionals conducting soil gas, sub-slab vapor and/or indoor air investigations in New York. Perhaps the most important components of this document are the contaminant matrices, which determine if mitigating measures are required to protect structures from VI based upon contaminant concentrations in sub-slab soil vapor and indoor air samples. Current NYSDOH contaminant matrices only address seven cVOCs (carbon tetrachloride, trichloroethene, tetra(per) chloroethene, vinyl chloride, 1,1-dichloroethene, cis-1,2-dichloroethene and 1,1,1 trichloroethane). Nevertheless, the NYSDOH recommends their Guidance should be used when evaluating VI at chlorinated and non-chlorinated VOC-impacted sites, including petroleum spill and manufactured gas sites. Several other states have adopted guidance or regulations for petroleum VOCs as well. We anticipate that NYSDOH will likely expand their VI contaminant matrices to include certain petroleum and other VOCs in the future.

The NYSDEC is responsible for the investigation and remediation of brownfield, Superfund, petroleum spill and other environmentally-impaired sites throughout the State. NYSDEC Program Policy DER-13 (2006) requires the soil vapor intrusion pathway be evaluated at all completed, current and future remedial sites in New York. NYSDEC follows the NYSDOH guidance and works collaboratively with NYSDOH at sites with potential vapor intrusion issues. NYSDOH generally has the final say in decisions regarding the need for VI mitigation.

(Continued on page 4)

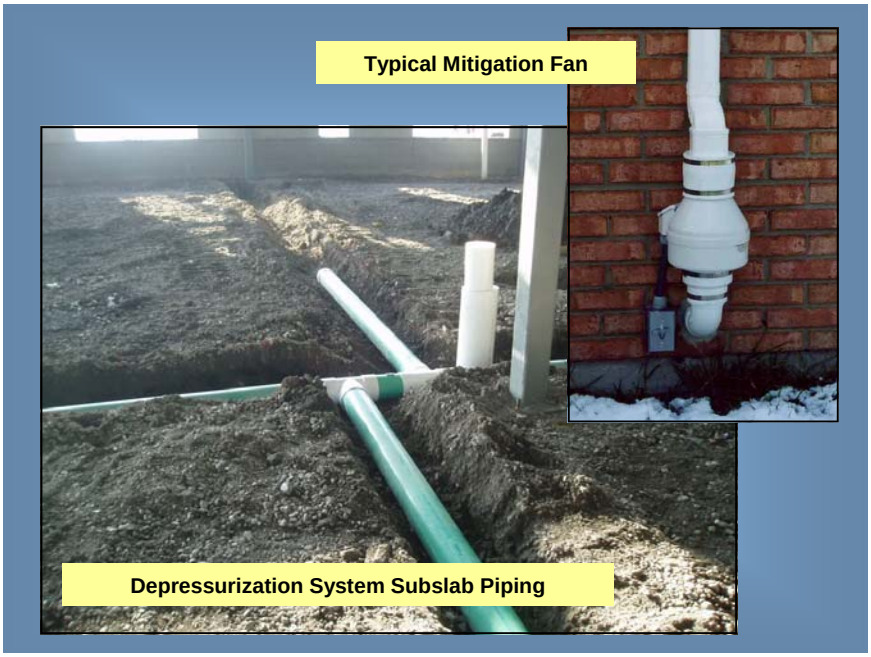
In March 2008 ASTM published "Standard Practice for Assessment of Vapor Intrusion into Structures on Property Involved in Real Estate Transactions." The stated purpose of that practice is *"to define good commercial and customary practice in the United States of America for conducting vapor intrusion assessment on a property parcel involved in a real estate transaction with respect to chemicals of concern that may migrate as vapors into existing or planned structures on a property due to contaminated soil and groundwater on the property or within close proximity to the property".* The standard is intended to provide a tiered screening process to be used by environmental professionals in conjunction with Phase I Environmental Site Assessments. The first step is to conduct a screening evaluation to determine if there is a potential for vapor intrusion. If a VI concern is identified, the next step is further investigation to determine if the vapor intrusion exposure pathway is complete and whether it poses unacceptable health risks. If the unacceptable health risks are identified, the standard identifies mitigation alternatives that can be implemented. The ASTM standard practice does not provide specific technical guidance, policies or requirements for vapor intrusion investigations or mitigation measures. In New York, the NYSDOH guidance document is used for those purposes.

VI Investigations

Vapor intrusion investigations are site-specific and vary in scope, but typically include soil gas (outside buildings), sub-slab vapor (beneath buildings), indoor air and ambient outdoor air samples. Soil gas samples are collected from shallow hand- or machine augured borings. Sub-slab vapor samples are collected from holes hammer-drilled through the concrete. Indoor and ambient air samples are collected directly from the atmosphere. All these gaseous samples are drawn by vacuum into specially-prepared metal canisters equipped with a regulator. Samples are collected from residential, commercial, and industrial buildings over an 8 or 24-hour time periods representative of typical exposure periods in a commercial or residential setting, respectively. VI investigations are now routinely performed as integral elements of Phase II Environmental Site Assessments at commercial and industrial properties and as part of remedial investigations at brownfields, inactive hazardous waste disposal sites, or former manufactured gas sites where chlorinated solvents or petroleum VOCs were known or suspected to have been stored, produced or where these compounds have been detected in site groundwater or soil. Benchmark and TurnKey have performed VI investigations and evaluated, designed and installed VI mitigation measures at over 20 commercial, industrial and residential sites. We own all the specialized field equipment to perform VI investigations in accordance with NYSDOH Guidance.

VI Mitigation Measures

Mitigation measures may be appropriate to minimize current or potential intrusion of VOCs into residential, commercial and industrial building air space. When one or more of the seven cVOCs currently addressed by the NYSDOH decision matrices, are detected in basement, crawlspace or first-floor living quarters at concentrations above 1-30 micrograms per cubic meter (varies by compound) and/or when sub-slab vapor concentrations exceed 10-50 times (representative of typical attenuation factor) those indoor air criterion (again varying by compound) then VI mitigation is deemed by NYSDOH to be required.



The most effective mitigation measures involve sealing infiltration points and actively managing the pressure inside the structure. Occasionally, there may be site-specific or building-specific conditions where HVAC modification, room pressurization, vapor barriers or passive ventilation systems may be appropriate. In conjunction with sealing potential vapor entry points, an active sub-slab depressurization (ASD) system is the preferred method for buildings with a basement slab or slab-on-grade foundation. An ASD system uses a fan-powered vent and piping to draw vapors from the soil beneath the building's concrete slab and discharging them to the outside atmosphere (away from doors, windows and HVAC systems). This results in a lower sub-slab air pressure relative to the indoor air, thus preventing infiltration of sub-slab vapor into the building. These ASD systems are very similar in design and function as those routinely used for radon mitigation.

For new buildings on sites with potential vapor intrusion concerns, ASD systems can be designed and incorporated into the architectural plans at relative low cost and ease of installation. Retrofitting ASD systems into existing buildings is a bit more complex with more variables and unknowns (e.g., the type, permeability and connectivity of the sub-slab soil or gravel media) that affect the number and placement of vents and the possible need to install pipe and/or gravel collection laterals. Benchmark has designed and installed such ASD systems in new and existing structures, provided operation and maintenance training, troubleshooting, and certification of system performance.

Do you have a comment or question about an article in ***The BUZZ****? Do you have a suggestion for a future issue? Would you like to share something about your company here?*
Please feel free to share your thoughts with us at Jamoscati@turnkeyllc.com.
The BUZZ is now available electronically! If you would like to receive this newsletter via e-mail, let us know! Thank you!

Fast-Tracking pH Control

By - Thomas H. Forbes, P.E. and Walter J. Meisner, P.E.

PVS Chemical Solutions, Inc. operates a sulfuric acid and sulfur products manufacturing facility in Buffalo, NY with shell-and-tube heat exchangers used for post-reaction cooling on the sulfuric acid line. The heat exchangers operate in an open-loop arrangement, with up to 3500 gallons per minute (gpm) non-contact cooling water obtained from Lake Erie and discharged to the Buffalo River. Due to potential for leaks of sulfuric acid from the heat exchanger tubing, cooling water pH can rapidly drop below acceptable discharge limits, resulting in SPDES permit violation, if not immediately detected and isolated.

In recent years, the company upgraded its instrumentation and control by installed conductivity sensors and other production monitors to more precisely identify acid leaks and shut down the associated heat exchanger. Manual neutralization of the cooling water was concurrently undertaken to mitigate pH excursions. However, the potential for infrequent short term excursion persisted. To further increase the reliability of the existing pH control system and better protect against discharge limit excursions, PVS engaged Benchmark to design and install an automated cooling water pH neutralization system.

Design-Build Approach

Substantial completion of the constructed system was required within a three-month time period. Benchmark's fast-tracked design-build approach incorporated several features to increase reliability and provide key cost-savings including:

- Modification and reuse of an existing steel tank and catwalk/agitator support to serve as the primary pH adjustment vessel, saving significant time and expense for new tank fabrication.
- Procurement and use of used piping for pH cooling water return line feeds and discharges to and from the neutralization tank, and employment of a "bottom-in, top-out" piping arrangement to mitigate short-circuiting of low pH cooling water through the tank and inducement of counter-current flow to reduce mechanical mixing and related energy use.
- Use of an existing, active soda ash line to serve as neutralizing agent. This eliminated the need to procure and register a new chemical bulk storage vessel for a separate neutralizing chemical, required no additional pumping equipment, and better assures immediate chemical delivery upon low pH alarm.
- Use of dual pH controllers to allow feed-forward/feedback pH monitoring on the individual cooling water return lines and at two separate points on the post-adjusted cooling water.

The project was completed on time and on budget, with the re-engineered design saving tens of thousands of dollars in capital cost. Startup testing has demonstrated that the system will quickly and reliably react to neutralize low pH cooling waters.

Steel Winds Blows Over Former Bethlehem Steel Lackawanna Works *and the Scene is* Electric!

By Paul H. Werthman, P.E.

If you live or work in downtown Buffalo or the southtowns, you've seen or heard about the windmills on of the former Bethlehem Steel Plant located in Lackawanna, NY. Nearly 25 years ago when the Bethlehem Steel Manufacturing operations ceased, a lot of western New Yorkers lost their livelihood and the local economy has never fully recovered. Others were not so sad to see those smokestacks stop belching pollutants into the western New York sky.

Last June, construction of a new electric power generation facility was completed along the northeastern shore of Lake Erie ushering in a new era at the former inactive 1,100-acre brownfield site. The strong winds blowing unfettered over the Lake spin three 165-feet long fiberglass blades that sit atop each of the eight massive steel columns that rise some 250 feet above the slag bluff just north of Smokes Creek. This "wind farm", referred to as "Steel Winds I", produces a nominal 20 megawatts of electricity without a single pound of greenhouse gases, or other emissions; enough sustainable electrical energy to power approximately 6,000 households. You may have even purchased and used some of the very electrons produced by this new facility, as the developers BQ Energy, LLC and UPC Wind Management, LLC transmit their electric power to the commercial grid at market prices. Steel Winds I is believed to be the first, if not the largest, urban wind farm in North America.

TurnKey and Benchmark played prominent roles in this project. We assisted the site owner, Tecumseh Redevelopment Inc. negotiate a long-term land lease with the developers. We also assisted the site owners and developer apply for and secure participation in the NYS Brownfield Cleanup Program; performed the Brownfield site investigation; provided planning, design and construction-phase services for access roads, utilities and wind tower site work. We provided a fast-tracked design-build cover (see before and after photos above) and in-situ enhanced biological remediation of localized groundwater impacts to secure their Certification of Completion by December 31, 2007.

We are currently providing post-remediation operations maintenance and monitoring of remedial measures and working with the site owners, developers and community on the planning of additional 17 wind towers on the site. You may have noticed the windmills being disassembled and more recently being put back into service. As literally the first commercial installation of the Liberty II model, manufactured by Clipper Wind Power, these units have experienced some mechanical issues with their massive gear boxes and some structural issues with the blades that the manufacturer has now remedied. All eight units have been repaired and are back in service.

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Benchmark and Turnkey are full service environmental engineering and service companies. We specialize in design/build/operate project delivery for: water/wastewater collection and treatment; landfills; investigation, remediation, and redevelopment of environmentally impaired sites; air emission permitting and controls; recreational facilities; and energy conservation and development. We are licensed in NY, OH, PA and MI and serve the steel, chemical, electric power, electronics manufacturing, waste management, real estate development, petroleum and natural gas, metal finishing industrial, municipal and legal clients from coast to coast.

Inside this Issue . . .

THE BUZZ WORD

NYS Brownfield Cleanup On Hold

When former Governor Spitzer departed Albany last month, so did his proposed changes to the Brownfield Cleanup Program (BCP). Many of the proposed changes featured in Issue 8 of THE BUZZ were advocated by the current NYSDEC administration. However, the State Budget issued on April 10th, 2008 did not address BCP revisions and enacted a 90-day moratorium on new Brownfield Cleanup Programs. Action by the Legislature is anticipated by the end of June 2008 session. **Stay tuned!**