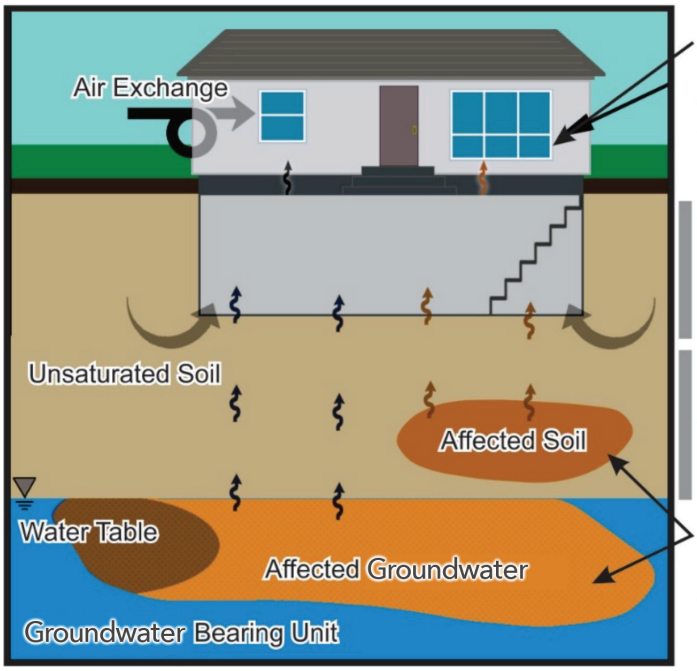
NESDI
Vapor Intrusion
Investments

CASE STUDY:

Vapor Intrusion at Navy Environmental Restoration Sites

Conventional (Standard VI)



Vapor intrusion (VI) is the migration of volatile, or vapor-forming, chemicals from the subsurface into the indoor air of an overlying building. Vapor intrusion was first identified through investigations into sources of radon in indoor air. While radon is formed in the subsurface through natural processes, man-made chemicals that have contaminated soil and/or groundwater can also intrude into indoor air. These chemicals include:

- Volatile organic compounds (VOC) like trichloroethylene (TCE) and tetrachloroethylene (PCE) (chlorinated solvents used for industrial degreasing)
- Semi-volatile organic compounds like naphthalene (an insecticide)
- Petroleum hydrocarbons
- Elemental mercury

Vapors in the subsurface can migrate vertically through pore spaces in soil and enter a building through cracks in the foundation and/or openings for utility lines. Sanitary sewers, utility tunnels and other underground conduits (termed "preferential pathways") can carry vapors laterally to buildings that are not directly above the source of vapors. Once vapors enter indoor air, they can accumulate to concentrations that are harmful to the health of building occupants. Some chemicals like methane and petroleum compounds may also pose an explosion risk at high concentrations. Vapor intrusion mitigation typically involves improving building ventilation, preventing vapor entry into the building, and/or treating source areas.

Navy installations, particularly Naval Air Stations, are especially vulnerable to vapor intrusion due to subsurface

contamination resulting from the legacy use of chlorinated solvents for aircraft maintenance and the underground storage of petroleum fuels. Furthermore, many buildings on Navy installations, such as those constructed for temporary use during World War II and later converted to permanent use, are not constructed to prevent vapor entry.

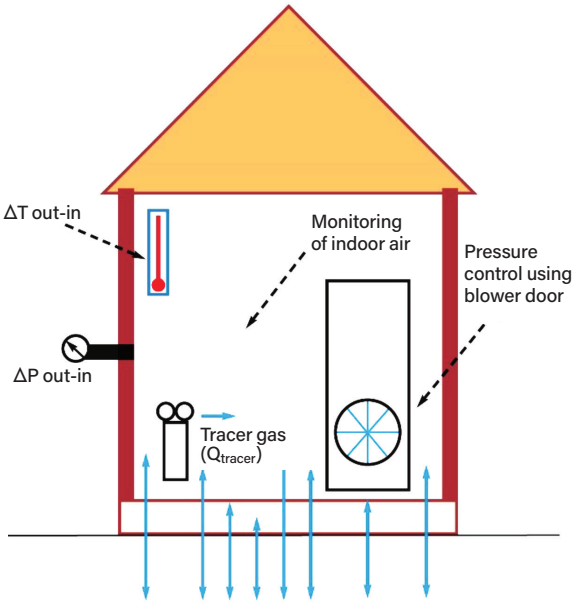
Vapor intrusion can add significant costs to the environmental restoration process and place logistical burdens (e.g., relocation of building occupants) on mission-critical activities. The following projects sponsored by the NESDI program are addressing these concerns and highlighted below.

Addressing Temporal Variability in Industrial Buildings during Vapor Intrusion Assessments

PI: Travis Lewis, project no. 554

This project is a follow-on to NESDI project no. 476 (A Quantitative Decision Framework for Assessing Navy Vapor Intrusion Sites) which involved compiling data from Navy sites impacted by VI into a database. These data were analyzed to determine the influence of geologic factors and building parameters on VI and to develop a quantitative decision framework for assessing VI at Navy sites accordingly.

Current regulatory guidance assumes that temporal variability of indoor air concentrations of VOCs at industrial/commercial buildings is similar to that of single-family homes and therefore requires multiple sampling events at different locations and different points in time. However, investigations utilizing the VI decision framework developed through NESDI project no. 476 showed that indoor air concentrations may be significantly less temporally variable at Navy industrial buildings than in single-family homes.



Using pressure control to induce near worst case VI conditions in industrial/commercial buildings.

This follow-on project validated that finding and demonstrated an alternative sampling technique that involves manipulating indoor air pressure (building pressure cycling) to temporarily induce a near-worst-case vapor intrusion scenario for sampling purposes. This technique provides sampling results that are more representative of VI conditions at a site and more defensible to regulators than results from traditional techniques involving the collection of multiple samples over time.

Evaluation of Various Real-Time Monitors to Accelerate On-Site Analysis of Vapor Intrusion

PI: Chris Patterson, project no. 568

Traditional indoor air and sub-slab soil gas sampling requires shipping samples to a laboratory for analysis which can add significant time delays to a VI investigation. On-site analysis of air samples provides real-time results, allowing for a more rapid and accurate determination of VI pathways (i.e., fewer false positives from indoor sources) and more rapid implementation and verification of interim mitigation measures.

A number of COTS instruments including this one are being demonstrated and validated to identify the most reliable device for the mobile analysis of indoor air and soil gas samples. (Photo Credit: Travis Lewis)

The HAPSITE® Gas Chromatograph/Mass Spectrometer (GC/MS) is the standard instrument for on-site analysis of air samples. However, this device requires significant training to calibrate and troubleshoot mechanical errors. The objective of this project is to validate one or more commercially available off-the-shelf (COTS) instruments as alternatives to the HAPSITE® GC/MS. Four alternative instruments have been chosen for demonstration and benchtop evaluation of these instruments is currently underway.

Innovative Active Carbon Filters to Address Vapor Intrusion within Industrial/Commercial Buildings

PI: Kirsten Marble, project no. 571

When trichloroethylene concentrations in indoor air exceed rapid action levels, a building must be evacuated to protect the health of the occupants. Such evacuations are costly and can interrupt mission-critical operations.

The objective of this project is to demonstrate and validate an air purifying system that removes TCE from indoor air and can be integrated into a building's HVAC system. Two types of air filter media and one TCE destruction technology have been selected for demonstration. Benchtop evaluation of these technologies is currently in progress.

The implementation of these technologies will allow occupants to safely remain in buildings impacted by VI and will reduce the cost of VI mitigation which typically involves significant infrastructure modifications and costly increases in ventilation rates.

Carbon filter used for indoor air filtration.
(Photo Credit: Austin Air)

About the NESDI Program

The NESDI program is the Navy's environmental research and development demonstration and validation program, sponsored by the Chief of Naval Operations Energy and Environmental Readiness Division and managed by the Naval Facilities Engineering Systems Command from the Engineering and Expeditionary Warfare Center in Port Hueneme, CA.

The mission of the program is to provide solutions by demonstrating, validating and integrating innovative technologies, processes and materials and by filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Navy readiness and lethality.

Visit the program's public website at https://epl.navfac.navy.mil/NESDI for more information.

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