Actionable Science for Communities

Research to Support LUST Program Planning and Backlog Reduction SHC Task 3.62.3

Jim Weaver, Task Lead, National Risk Management Research Lab

Problem Summary & Decision Context

Approximately 600,000 underground storage tanks are regulated by EPA. Leaks are common and, despite cleanup of more than 436,000 releases, there is a backlog of some 78,000 releases awaiting cleanup. Resource competition suggests the need for prioritization of site cleanups and better understanding of the factors influencing the subsurface contaminant distribution.

Fuel releases result in two major exposure pathways: drinking water and indoor air.

- Water from private domestic wells, which are not subject to regulation by the safe drinking water act and are largely not tested.
- Vapors from the subsurface can migrate upward, possibly to contaminate indoor air.

Program Planning:

As private domestic wells are unregulated, their locations are not known on a state-wide or national basis. Determining areas of high density of private domestic well use and co-located underground storage tanks is intended to help prioritize clean up resources.

Backlog Reduction:

Leaking Underground Storage Tank (LUST) Sites have been determined to remain open for several reasons, including

- unassessed potential of vapor intrusion
- poor understanding of source (i.e., fuel) distribution and plume lifetime

Task Overview

Task 3.62.3 includes elements that address the two main thrusts of program planning and backlog reduction.

Program planning:

Methods have been developed to estimate areas with high reliance on private domestic wells and correlate them to known locations of underground storage tanks. The private well estimation method is based on United States census data combined with state-agency records. This approach is used for several reasons: drilling prior to formation of, and limitations in well-log reporting to state agencies; decentralized and non-electronic records; and inability for comprehensive accessing of public water supplier records. A pilot study using Oklahoma data was used for proof-of-concept, (Figure 1), and later extended to the whole U.S.

Planned work addresses the development of a plume transport tool to provide estimates of the extent of contamination from LUST sites.

Backlog Reduction:

Vapor intrusion or the threat of vapor intrusion may prevent site closure. ORD developed a model called PVIScreen to add a line of evidence for site assessment, as noted in the EPA petroleum vapor intrusion guidance (Technical Guide for Addressing Petroleum Vapor Intrusion at Leaking Underground Storage Tank Sites EPA/501-R-15-001). Because of a variety of technical and administrative factors, indoor air sampling is not typically performed. (For example, ambient air and household products may contain the same petroleum hydrocarbon constituents. Agencies cannot require sampling of privately-owned buildings.) An appropriately designed and applied model can add to the lines-of-evidence that can confirm or rule out vapor intrusion. PVIScreen includes multi-component assessment, uncertainty analysis, and various source data inputs to provide a defensible modeling-based line-of-evidence (Figure 2).

Lack of understanding of plume formation and fuel source behavior may prevent site closure. The next phase of the task is to address the leaching of constituents from fuel and the formation of contaminant plumes by:

- summarizing gasoline composition datasets covering the U.S (Figure 3).
- developing a new conceptual/numerical model for leaching of gasoline based on ORD field studies (Figure 4).
- performing a suite of controlled laboratory experiments to test the revised conceptualization (Figure 5).

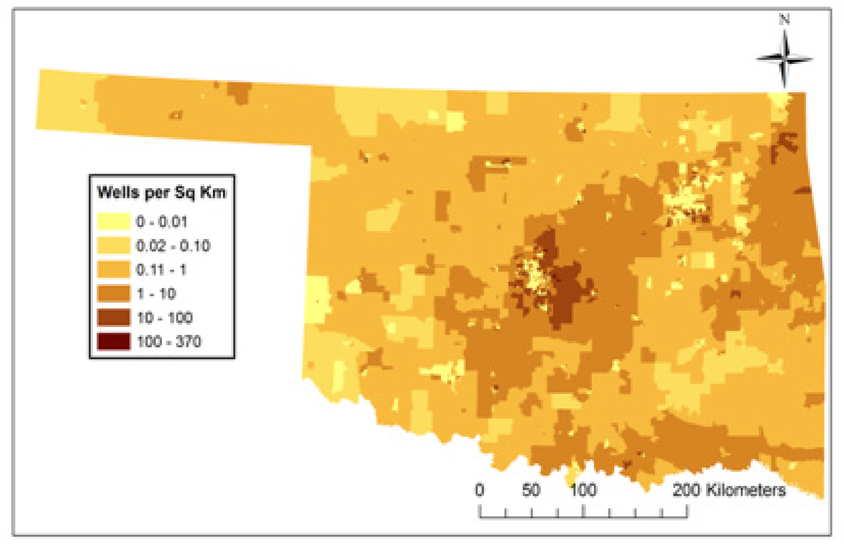

Figure 1. Estimated private domestic well density (PDW) for the Oklahoma pilot study. Highest density of PDW use located in a ring around Oklahoma City. A similar ring does not exist around Tulsa, because of the lack of a major aquifer.

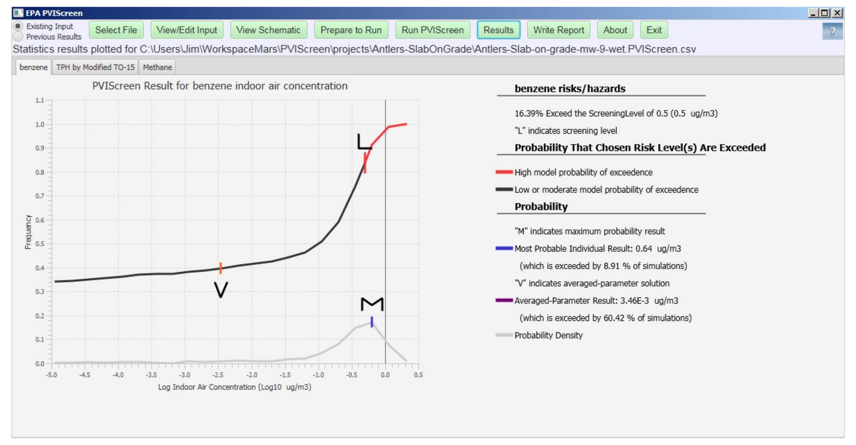

Figure 2. PVIScreen output containing the cumulative frequency/probability of the indoor air concentration and a tabular presentation of key results. The presence of the red-colored curve indicates likely vapor intrusion.

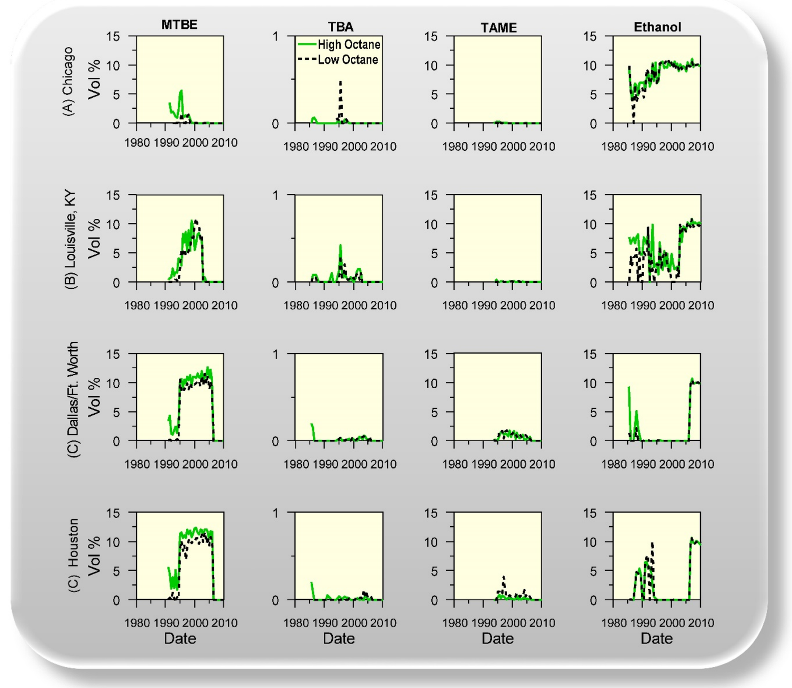

Figure 3. Prior work summarized gasoline composition from around the U.S. through 2010. This example showed the benzene, methyl tert butyl ether (MTBE), tert amyl methyl ether (TAME), and ethanol content for four cities using reformulated gasoline from ca 1985 to 2010. Additional data sets will be sought to summarize and extend this type of results through 2015.

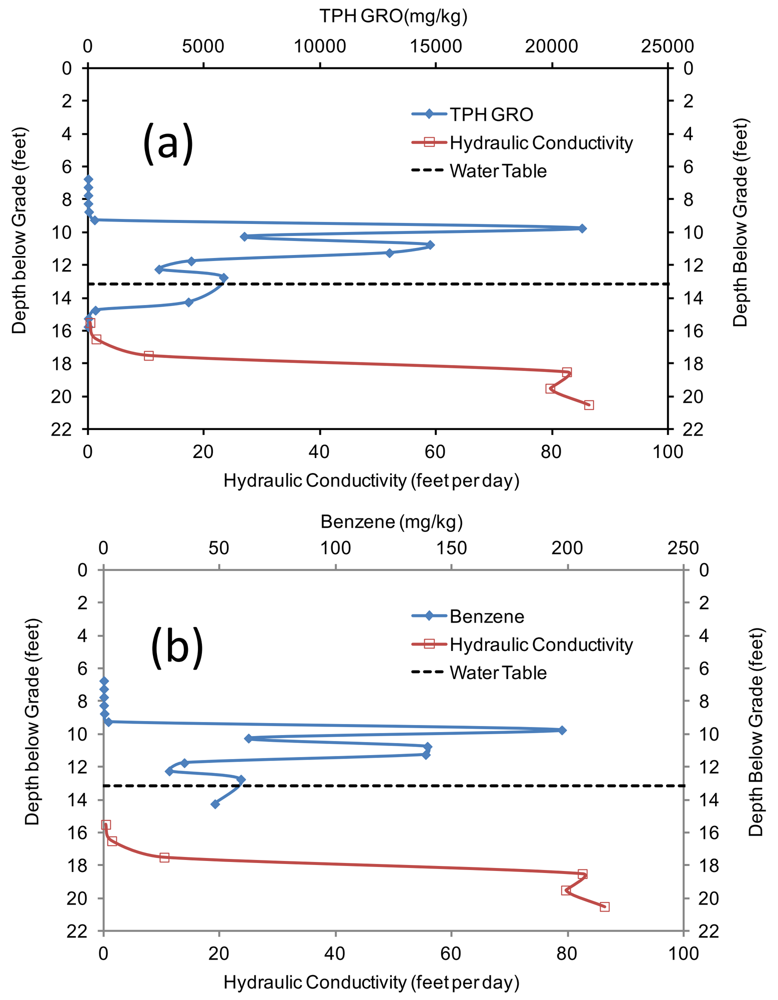

Figure 4. Distribution of TPH (panel a) and benzene (panel b) and hydraulic conductivity with depth below land surface at a gasoline release site in Golden, OK (from Wilson et al., 2012). These distributions illustrate that the trapped gasoline resides above the elevation of the water table and the contaminants move downward by diffusion to the water table. These conceptualizations are not considered in models used for LUST site management.

Figure 5. A sand tank is being prepared to generate model test data.

Accomplishments

- Developed private domestic well estimates for Oklahoma and extended methodology for the entire U.S. (publications submitted).
- Contributed to development of the Agency's vapor intrusion guidance, writing sections, and participating in technical workgroups.
- Completed PVIScreen model user's guide: Petroleum Vapor Intrusion Modeling Assessment with PVI Screen, EPA/600/R-16/175.
- Presented PVIScreen workshops for regional, state and tribal audiences.

Future Directions

- The future direction of the task is to combine the various elements into an assessment system that includes a mapping component, modeling of vapor intrusion and ground water contaminant plumes. The models would be coupled and run within an uncertainty analysis framework.
- Advanced instrumentation for site characterization using direct-push instrumentation, developed by the private sector, can potentially define hydrocarbon source terms in real time. Coupling our modeling and analysis software to these instruments would provide for near real time assessment to be performed.