From Vapor Intrusion to Mitigation: A Status Review of the Current Practice

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Background/Objectives: The issue of intrusion of contaminated soil gas into occupied buildings has gained much attention in the environmental remediation and brownfields industries and scientific community. With a better understanding of the risks and the improved sampling and detection methodologies, the regulatory framework has become more stringent and widespread. Complex sub-slab environments and the different fate and partitioning behavior of various contaminants have necessitated the development of innovative vapor intrusion assessment tools and mitigation strategies. Due to the complexity of potential vapor intrusion pathways, significant challenges arise when developing a strategy to manage and mitigate vapor intrusion at contaminated sites.

Approach/Activities: Researchers and environmental practitioners have become more involved in the development of regulatory guidance documents related to vapor intrusion – this provides an experienced and pragmatic approach to developing guidance. Implementation of many of the innovative site assessment methods and tools referenced in guidance to properly detect and characterize the potential for vapor intrusion is becoming a common practice. Whether it is for the application of a specific sampling methodology, the conductance of a soil vapor fate and transport model, or the development of a conceptual site model, professionals can now better ensure that the potential for vapor intrusion is accurately understood and assessed on a project-specific basis. When developing a vapor mitigation strategy for a site, a variety of vapor mitigation approaches are evaluated, considering the site-specific conditions. Through the use of well-established pneumatic principles and protocols used to design soil vapor extraction systems such as pilot testing, pneumatic modeling, well construction manipulation, system interlocks, and manifold instrumentation, vapor mitigation systems can be more precisely designed, more cost effectively constructed, and more optimally operated.

Results/Lessons Learned: This presentation will review industry leading practices in all arenas of vapor intrusion mitigation through the showcase of the following case studies:

- Two full-scale sub-slab depressurization systems (SSDS) were designed and implemented at a New York State Brownfields Cleanup Program redevelopment site situated adjacent to the Gowanus Canal. The systems were designed for the two proposed multi-story buildings to address the elevated sub-slab soil vapor concentrations of gasoline and BTEX compounds resulting from the historic industrial use and petroleum releases at the site. Because of the planned residential use of the new buildings, all system infrastructure was uniquely installed below the finished grade of the building structural slab.
- A full-scale SSDS was installed and operated to address the elevated sub-slab soil vapor concentrations of tetrachloroethylene (PCE) and trichloroethylene (TCE). The system targeted three separate basement areas, each with different air intrinsic permeability. The central system was designed such that the number of vapor extraction points and required vacuum and air flow rates could be uniquely controlled for each basement.
- A full-scale SSDS was implemented in an existing building with a granite bedrock slab-on-grade foundation. Upon start-up in March 2013, the system influent PCE and total VOC vapor concentrations were observed to be 2,100 µg/m^3 and 4,277 µg/m^3,

respectively, and were observed to decline to 441 µg/m^3 and 783 µg/m^3, respectively, in only 3 months (June 2013).

- An innovative full-scale SSDS was designed for a site with several constraints, including a shallow water table, a sub-slab silty clay formation, and anisotropic geologic conditions. Through site-specific design elements, such as adjustable manifold piping and control interlocks, complete vacuum propagation was achieved, while preventing the collection of any groundwater.