Using Soil Gas Concentration Mapping to Predict Soil Vapor Extraction Radius of Influence Variances and Optimize Remedial System Design

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Background/Objectives. Soil vapor extraction (SVE) is one of the oldest and most commonly used technologies for the remediation of subsurface soils impacted by a release of volatile organic compounds (VOCs). Vapor phase VOCs often migrate great distances through the interconnected pore spaces (mobile or effective porosity) in the unconsolidated, vadose zone soils. Currently, vapor intrusion (VI) exposure risks have been linked to large soil gas plumes emanating from these vary same VOC source area soils, increasing the need for soil gas investigation, delineation, and remediation activities. While soil gas concentration data has often been used to help define off-site areas in need of VI screening, the mapping of soil gas plumes may also provide valuable insight into the area-wide vacuum propagation tendencies of SVE systems. Four sites with chlorinated solvent releases, extensive soil gas investigations, and active SVE systems were evaluated to determine if soil gas plume mapping could be used as a pre-design tool to help optimize the design of SVE systems and aid in the characterization of the site.

Approach/Activities. Pre-remediation soil gas data were evaluated to assess the VOC concentrations in the source area and off-site locations as well as influence from groundwater plume off-gassing, vertical characteristics, and to determine the uniform or asymmetric properties of the soil gas plume. Vadose zone soil descriptions, grain size analysis, average moisture content, and soil VOC concentrations were also evaluated to determine the influence of those parameters on the plume concentrations and extents. SVE pilot testing data was assessed to determine the initial radius if influence (ROI) shape and average design ROI used for full-scale SVE system design. Full-scale SVE system ROI data was plotted against the soil gas plume concentration plume to evaluate the correlation of the vacuum propagation to the soil gas plume shape.

Results/Lessons Learned. The result of this assessment indicates that the subsurface factors responsible for influencing the soil gas plume migration play a significant role in dictating the direction and extents of vacuum propagation during SVE application. These findings indicate that it may be possible to use existing site data to help refine the SVE system design in off-site areas or areas of the site not included in the SVE pilot test. Being able to understand vacuum propagation tendencies prior to system installation will have the benefit of optimizing and minimizing extraction well placement and conveyance piping installation costs, reducing equipment size, focusing remedial efforts to areas of highest need, and reducing system life-cycle costs.