MTBE: An Innovative Remedial Strategy for an Old Contaminant of Concern

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Background/Objectives. Methyl tertiary butyl ether (MTBE), once an emerging contaminant and of much interest to regulators, researchers, and remedial practitioners, has now taken a back seat to some of the more recent emerging contaminants; however, MTBE contamination continues to be widespread at sites throughout the country. While MTBE is extremely miscible in water and has a higher affinity for the liquid-phase than the vapor-phase, MTBE has a relatively high vapor pressure, making it amenable to pneumatic remedial technologies. Although currently being addressed via a groundwater containment barrier system to prevent further downgradient migration, imagine an MTBE plume with concentrations indicative of non-aqueous phase liquid (NAPL) in nearly stagnant groundwater in a weathered bedrock formation. The subject site was recently reevaluated – a series of pilot tests were completed in addition to subsequent three-dimensional (3D) computational pneumatic modeling to design a full-scale multi-phase extraction (MPE) remedial system. While groundwater concentrations of MTBE are elevated, vapor concentrations are also extremely high, suggesting that a majority of the residual mass of MTBE is trapped within a large smear zone resulting from the current and historic dewatering efforts, as well as the seasonally variable water table. The remedial design, as a result, needed to address the vapor-phase, sorbed-phase, dissolved-phase, and possible residual NAPL-phase impacts in order to effectively remediate the site.

Approach/Activities. Due to the slow recharge rate of the site groundwater and relatively high vapor concentrations present in the vadose zone, the effectiveness of a conventional containment trench was limited. Following a series of pilot tests to confirm the feasibility of MPE, Langan completed a number of 3D pneumatic modeling simulations to further vet and ultimately design a full-scale MPE system. Using the modeling software SVAIR™ (SoilVision Systems, Ltd.), Langan was able to develop a site-specific 3D model, accounting for the drastic site topography, weathered bedrock lithology, and seasonally variable vadose zone, among other site-specific characteristics. Using the operational data of the existing containment trench system, as well as the recently completed pilot test data, the model was calibrated to the observed subsurface pneumatic characteristics of the site. The ability to mimic the observed pneumatic conditions at the site provided a higher level of confidence in the final design model outputs. Following calibration of the model, a number of model simulations and sensitivity analyses were completed to develop and demonstrate the remedial design required to effectively and efficiently address the remaining MTBE contamination in all four phases.

Results/Lessons Learned. In order to effectively address the vapor-phase and sorbed-phase contamination and enhance mass transfer from the liquid-phase to the vapor-phase, approximately 1,000 pore volume air/vapor exchanges per year within the radius of influence (ROI) of each extraction well were determined to be required. Through the use of the 3D model, Langan was able to predict the number of achievable pore volume exchanges in the target treatment area based on the number of extraction wells, air flow rate per extraction well, and the varying depth of the vadose zone across the target treatment area. In addition, to address the potential NAPL impacts and to further enhance the smear zone remediation, a dewatering component was included in the system design. This presentation will demonstrate the importance of the 3D pneumatic model in sizing the proposed vacuum enhanced MPE system

as well as demonstrating its effectiveness. The innovative and site-specific design considerations that were included to further enhance the performance of the proposed vacuum enhanced MPE system will also be presented.