From Characterization to Closure of a 1-mile Long TCE Plume

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Background/Objectives. Large plumes present a significant challenge for both characterization and remediation, and few large plumes are ever closed. We will illustrate how a high-resolution smart characterization approach to site investigation characterization resulted in rapid characterization of a one-mile long, 10 part per million (PPM) TCE plume. The site data were assembled into a three-dimensional digital conceptual site model to clearly demonstrate the site conditions. The strength of the conceptual site model through improved characterization demonstrated the plume does not pose a risk and site closure with no active remediation is pending in late 2017.

Approach/Activities. In the mid-2000s the buildings at the site property were demolished and site investigations began, which identified chlorinated solvents in soil and groundwater, the historical legacy of over 100 years of manufacturing operations. The team quickly identified that conventional site characterization with monitoring wells was missing the TCE plume in groundwater around the site. This provides a lesson in how monitoring wells have excellent precision but poor accuracy- the monitoring well network was providing highly precise, repeatable data, but the wells had been installed in arbitrary depth zones, and therefore did not provide representative data. A mass flux-based characterization was instead adopted, which consisted of mapping the aquifer permeability and contaminant mass in high resolution. The high-resolution smart characterization approach found a thin (<10 feet thick) TCE plume traveling at the base of the aquifer, with concentrations in the core greater than 10,000 µg/L. This plume is located deep in the aquifer, and is separated from shallow groundwater by over 30 feet of clean groundwater. A surprising finding from this investigation is that there are actually *four* different groundwater VOC plumes in the area surrounding the site, but the detailed characterization demonstrates that only one of these plumes is associated with the subject property. The site plume reaches an organic-rich floodplain approximately one mile downgradient of the property. At the groundwater-surface water interface (GSI), hundreds of additional characterization points were completed which demonstrated that the plume is naturally degrading by more than 99% due to the organic sediments. We will present a comprehensive overview of the project, with special emphasis dedicated to discussions of the site characterization tools employed (hydraulic profiling tool, Waterloo Profiling system, vertical aquifer profiling, whole-core saturated soil sampling, GSI Henry Sampling, etc.). Also, we will present the advanced data analysis and visualization methods employed on the project, including the use of an augmented reality platform to show the conceptual site model as a hologram during stakeholder meetings.

Results/Lessons Learned. The most significant finding from the high-resolution characterization is that human health and the environment could be protected largely using administrative methods. It is certain that this conclusion would not have been reached with traditional characterization methods. Therefore, this project also demonstrates the concept of *return on investigation*, or ROI. ROI is a concept recently developed in the environmental industry that frames site characterization as an investment which will lead to significant cost savings in cost to cleanup. The investment in high resolution site characterization was more than offset by closing the site without decades of active remediation, which the investigation demonstrated could be done in a protective manner.