The Use of Adaptive Management Approaches in Support of Remedial Design/Remedial Action at Two Superfund Sites

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Background/Objectives. Adaptive management principles can be used throughout the entire life cycle of remediation projects, from initial site characterization, through remedial design (RD), and throughout remedial action (RA) implementation. This presentation will discuss the application of adaptive management in support of RD/RA at two Superfund sites.

Approach/Activities.
The first is the Bountiful/Woods Cross Operable Unit 1 site, which is contaminated with TCE and its daughter products. The site includes a source area with solvent concentrations approaching 100 mg/L and a diffuse plume that stretches nearly one mile downgradient through a mixed residential, commercial, and industrial area. The contamination is present within the shallow aquifer [down to approximately 80 ft below ground surface (bgs)], consisting of interbedded sands, silts, clays, and gravels. The ROD-selected remedy is chemical and/or biological in situ treatment along with monitored natural attenuation (MNA), but it allowed for flexibility in design and implementation based on observed site conditions.

The original remedy concept was in situ bioremediation (ISB) with emulsified oil injections using a grid pattern of wells in the source area, and three biobarriers in the downgradient plume. Extensive characterization using membrane interface probe and direct push soil and groundwater sampling was conducted to refine placement of injection wells and screened intervals. The findings from these activities were invaluable, as it was determined that contamination extended more than 30 ft deeper than expected based on the original conceptual site model (CSM). Furthermore, whereas the highest concentrations were thought to be 2 to 3 mg/L, the deeper zone had concentrations approaching 100 mg/L, and concentrations of 2 to 3 mg/L extended a significant distance downgradient. Based on these findings and in keeping with an adaptive approach, the RD was updated to address this previously undiscovered deeper contamination. As the RA has progressed, adaptive management has been used to guide remedy installation and operation.

The second site is the Commerce Street Plume Superfund Site in Williston, VT. This site is contaminated with TCE and daughter products beneath a mixed-use area. The ROD-selected remedy for this site features in situ chemical oxidation for TCE concentrations greater than 50 mg/L, ISB where TCE is greater than 0.5 mg/L but less than 50 mg/L, and MNA where TCE is less than 0.5 mg/L. A comprehensive pre-design characterization program is being implemented using high resolution profiling tools [specifically the membrane interface probe/hydraulic profiling tool (MiHPT) and Waterloo Advanced Profiling System (APS)], vertically discrete soil/groundwater sampling, and onsite laboratory analysis. This intensive pre-RD characterization program is being coupled with 3-D visualization to update the CSM in real time in order to guide subsequent portions of the investigation. This pre-RD characterization has provided a detailed understanding of site lithologies and hydraulic properties, the overall extent of contamination, and the architecture of the source area. The updated CSM is critical for design of the ISCO and ISB remedy components.

Results/Lessons Learned. Overall, the use of near real-time data generated during pre-RD activities to refine the CSM at both of these sites has minimized the need for time consuming changes to the decision documents and streamlined successful remediation of the site.