Three Decades of Remediation at the CDOT Materials Testing Laboratory Remediation Project: A Model for Adaptive Management

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Background/Objectives. Nearly three decades ago, dense non-aqueous phase liquid (DNAPL) and total concentrations of 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethene (1,1,-DCE), trichloroethene (TCE), 1,4-dioxane, and other compounds in excess of 100 milligrams per liter were identified and targeted for treatment at the Colorado Department of Transportation's (CDOT's) former Materials Testing Laboratory (MTL) facility in Denver, Colorado. The associated groundwater plume extended more than 2,000 feet off-site in a fractured bedrock aquifer, flowing under numerous single- and multi-family residents.

Approach/Activities. For approximately 13 years (1998-2011), the source zone and downgradient groundwater plume were actively treated utilizing a variety of technologies. Specifically, pump-and-treat, soil vapor extraction (SVE), enhanced aerobic bioremediation (AB), and enhanced reductive dechlorination (ERD) were employed in different areas of the site and in various phases of the remedial lifecycle. About a year ago a low-temperature solar powered thermal system was installed to further enhance contaminant hydrolysis and biological treatment rates in the source area. Indoor air monitoring and active mitigation activities were performed for more than 100 residences.

Results/Lessons Learned. The project lifecycle highlights the value in remedial designs with inherent flexibility and operating remedies with a focus on continuous performance assessment and system optimization. For example, after several years of operation it became clear that the AB system was effective, but, based on new pilot test results, site-wide conversion of the groundwater treatment system from an aerobic to an anaerobic biodegradation remedy would result in a faster cleanup pace; consequently the AB system was converted to a full-scale ERD system in early 2009. Performance of the full-scale ERD system has matched, and in some cases significantly exceeded, expectations developed from the ERD pilot test. Overall, the remediation actions have been very successful; more than 90% of the VOC mass in the off-site plume has been destroyed and long-term concentration trends confirm that 1,4-dioxane is naturally attenuating. Consequently, active remediation was terminated in the off-site area in 2013, and no significant rebound has been observed. Concentrations in the source area have been reduced by several orders of magnitude and contaminant mass flux has been dramatically reduced, allowing the shutdown of the source-zone hydraulic capture system in 2011. Source-zone contaminant concentrations continue to decrease, and it is anticipated that active treatment across the entire site will be considered complete by 2020. The overall lifecycle of this project highlights the importance of actively optimizing multi-component full-scale remedies, and adapting the remedial strategy based on observed remedial performance, and new developments in remediation technologies.