Combined Remedies Address Chlorinated Solvent Impacts at an Industrial Site

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Background/Objectives. An industrial property utilized chlorinated solvents for equipment maintenance from the 1950s to 1970s. Past operations resulted in multiple source areas and it is suspected that chlorinated solvents were discharged to drain pipes into a former settling pond in one particular area. The site is still active with existing utilities and various structures. Contamination has been confirmed in both the unsaturated and saturated zones through high density characterization activities (depths of 8 feet to 46 feet with depth to groundwater at 15 feet). Trichloroethylene (TCE) concentrations have been detected in groundwater at a maximum concentration of 730 mg/L and in soils up to 6,800 mg/kg.
The primary objectives were to reduce the concentration of TCE in the unsaturated soil to less than 125 mg/Kg in the source area and reduce TCE in groundwater at the property boundary to less than 0.005 mg/L TCE. The site geology consists of several feet of fill material (asphalt, concrete, fill soil, etc.) underlain by a sequence of silt, clay, sand, and limestone.

Approach/Activities. In order to develop a high-density conceptual site model (CSM), a high resolution remedial design characterization (RDC) was performed that consisted of 26 soil borings and the collection of 186 discrete soil samples. In addition, 31 micro wells were installed; groundwater samples from discrete intervals based on soil and hydraulic profiling data were also collected. A combined remedial strategy of unsaturated soil in situ mixing and installation of a permeable reactive barrier (PRB) via direct push was implemented based on the findings of the RDC.
Soil blending was performed utilizing chemical oxidation (sodium permanganate) to treat the unsaturated TCE impacts exceeding an average 1,100 mg/Kg (maximum of 6,800 mg/Kg). A total of 2,300 cubic yards of unsaturated soil were treated. Activated carbon impregnated with reactive iron was injected into the saturated zone as part of a pilot test to demonstrate the reduction of TCE and its' daughter products. Twenty-eight direct push injection points were installed with the injection zone spanning from 26 to 46 ft below ground surface. Monitoring well clusters within and downgradient of the PRB were utilized to evaluate the effectiveness of the pilot test.

Results/Lessons Learned. Multiple remedial technologies were successfully combined to reduce elevated TCE concentrations in the unsaturated soil and groundwater to the site cleanup goals of 125 mg/Kg and 0.005 mg/L TCE, respectively. Development of a high resolution CSM was integral to the design optimization, remedy selection, and client expectation management.