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Concluding a Steam Injection Remediation Project at a DNAPL Source Zone at the Savannah River Site

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Background: Multiple subsurface DNAPL source zones served as latent sources for the extensive groundwater plume within the A/M Area of the Savannah River Site. Between 1952 and 1978 over 3.53 million pounds of TCE, PCE and 1,1,1-TCA were released to the environment at multiple use and discharge locations. While the use and discharge locations are well defined and small, the releases have resulted in a dissolved phase plume that extends over 1,600 acres. The M-Area Settling Basin received over half of the solvent discharges, and was emptied and closed in 1991 with a Resource Conservation and Recovery Act (RCRA) cap. In 1991, DNAPL was found in an adjacent water table well 140 feet below ground. A successful demonstration of steam injection at a nearby site removed 70,000 pounds of solvent. This technology was selected to remediate the DNAPL source zone at the settling basin.

Approach/Activities: Based on comprehensive characterization data, the identified treatment area was a three acre footprint with target depths of 45 to 165 feet. The site is unconsolidated sand, silt, and clay typical of a shallow marine depositional environments and the water table is located at a depth of 150 feet. The remediation system included sixty-three vertical and angled steam injection wells, a thermal monitoring system, 29 soil vapor extraction wells fully screened across the vadose zone, four dual phase extraction wells that extended into the water table, two existing groundwater recovery wells near the area, and a horizontal vapor extraction well that stretched over 300 feet underneath the footprint of the closed settling basin.

Construction of the system began in early 2004 and operation began in August 2005. Steam was applied to the deep vadose zone first, then progressed to the aquifer zone, and followed with the mid-vadose zone. Multiple steam strategies were utilized to enhance mass removal and concluded in 2009. Soil vapor extraction is ongoing, with residual temperatures in the deep low permeability zones still exceeding 150° F. To date over 400,000 pounds of VOCs have been removed.

Results/Lessons Learned: The target temperatures were met within the first 10 months of steaming and almost 75% of the mass removed to date was removed within the first 18 months of operation. Heating the subsurface increased mass removal rates from groundwater outside the target zone in both the water table aquifer and the deeper aquifer, which experienced a conductive temperature increase of over 30°F. Assessment of vapor concentrations in the target zone has allowed for abandonment of one-third of the extraction wells and conversion of another third of the extraction wells to passive solar operated vapor extraction equipment. The collection of post-treatment soil data demonstrated significant reduction in soil concentration, including removal of DNAPL that was present in several soil cores prior to treatment.