



Project Information: A combined In Situ Thermal Remediation approach utilizing In Situ Thermal Desorption (ISTD) and Steam Enhanced Extraction (SEE) was implemented at a former vapor degreasing facility and leach pit at Arnold Air Force Base in Tullahoma, TN (Solid Waste Management Unit 10 [SWMU-10]). An estimated 31,000 gallons of chlorinated solvents (primarily PCE) were disposed of at SWMU-10, posing a regional risk to groundwater.

Subsurface Geology/Hydrogeology: Permeability in the target treatment zone (TTZ) differed by at least three orders of magnitude. The shallow aquifer consists of a silty sand/silty gravel layer encountered roughly 15 to 20 ft bgs and extending to approximately 40 ft bgs. The intermediate aquifer is a source of drinking water in the region and consists of gravelly clay/clayey gravel, with the gravel content increasing with depth, including a highly permeable rubble layer approximately 5-10 ft thick above the bedrock surface. The intermediate aquifer is present from approximately 40 ft bgs, and extends to the top of the limestone bedrock located at approximately 85 ft bgs.

Project Goals: The primary goals of the remedial action were to remove dense non-aqueous phase liquid (DNAPL) from the source zone, and to reduce solvent-based contaminant mass flux from the source area to the downgradient intermediate aquifer.

Project Approach: Shallow aquifer heating was accomplished with thermal conduction heaters installed to depths of 50 to 65 ft bgs, while intermediate aquifer heating was achieved by steam injection in the basal gravel/upper bedrock zone at 80-90 ft bgs. Extraction wells completed between 45 and 90 ft bgs in and around the TTZ maintained hydraulic and pneumatic control. The TTZ encompassed an area of approximately 27,360 ft² and a volume of 66,700 yd³ with various treatment depths ranging from 50 to 90 ft bgs.

Project Results: After 7 months of operation, soil and groundwater sample results showed that PCE concentrations in the eastern portion of the Site were below the performance standards. However, in the western portion of the Site, sample results were above the performance standards due to an unidentified water source creating cooling in the shallow zone. The project team enhanced the western zone treatment system by intercepting the water inflow with extraction sumps and boundary trenches, reconfiguring heating to target the cooler shallow soils, and by adding insulation to the vapor cap to minimize surface heat loss. After a total of 16 months of system operation, approximately 165,000 pounds of chlorinated VOCs (primarily PCE) were removed from the TTZ.