An Innovative and Cost-Effective Approach to DNAPL Removal from Sediment Deposits in the Tittabawassee River

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Background/Objectives. The Dow Chemical Company was founded in the late 1890s in Midland, Michigan, along the Tittabawassee River. Prior to the implementation of wastewater treatment systems, historical operations led to the release of dense non-aqueous phase liquid (DNAPL) into the River, resulting in DNAPL accumulation in the immediate vicinity of the Midland Plant. Beginning in the 1930s, Dow controlled wastewater discharges to the Tittabawassee River through wastewater treatment technologies, including biological wastewater treatment plants, treatment ponds, sand filters, and clarifiers, thus improving river conditions. Source control activities included the construction of a revetment system that creates a complete barrier around the plant, preventing the migration of untreated groundwater and surface water to the river. While investigating the potential for sediment contamination, DNAPL was identified under the sediment bed, overlying a low permeability till deposit. The EPA, which oversees clean-up actions under Superfund, required Dow to develop a plan to delineate and remove the DNAPL at three locations in the River.

Approach/Activities. Dow's project team, following an evaluation of alternatives using the Engineering Evaluations Cost Analysis process, developed a phased delineation and removal plan that involved designing and constructing specialized equipment to install and implement DNAPL removal without any sediment excavation or exposure of DNAPL to the environment, thus avoiding potential ecological risks associated with remedy implementation. The free phase DNAPL was removed using recovery wells installed through the sandy sediment and into the low permeability till. These in-river extraction wells also served as monitoring wells to evaluate the DNAPL recovery. Approximately 380 wells were installed for this project. Removal frequency and volume was tracked for each well, and the information was used in real time to optimize recovery. Following the removal of free phase DNAPL, the residual DNAPL deposit areas were contained using sheet pile walls and an impermeable cap.

Results/Lessons Learned. The DNAPL deposits were delineated as part of and concurrent with the removal process, saving significant time (i.e., at least one field season) and costs. This was accomplished by locating "low points" in the till layer, using physical and geophysical tools, to identify and locate DNAPL pools—probing and step out sampling and extraction from the low points successfully targeted and removed free phase DNAPL from the river. The DNAPL was safely containerized, such that it was never exposed to the environment, resulting in a very safe removal process. In total, more than 4,200 gallons (16,000 liters) of DNAPL were removed safely during 10 months of operation over 2 construction seasons, and treated at Dow's waste incinerator in Midland, Michigan. The successful DNAPL removal program allowed the EPA and the Michigan Department of Environmental Quality to approve the in situ containment remedy for the residual DNAPL. Dow has received a Notice of Completion of Work for that segment of the site. This project demonstrates the use of an innovative and cost-effective approach to addressing mobile contamination in sediment beds.