Design, Installation and Performance Monitoring of Three ZVI PRBs

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Background/Objectives. The site is a former manufacturing facility located in southeastern Michigan and encompasses approximately one square mile. The eastern portion of the site had a former test track that has been redeveloped into a residential neighborhood. Three significant TCE plumes are present, one has migrated off-site onto a residential property and the other two are approaching the property boundary. The two largest TCE plumes are over a half mile long. The primary objective is to prevent off-site migration of the TCE plumes.
The primary objective was met by installing a zero valent iron (ZVI) permeable reactive barrier (PRB) at the downgradient edge of each of the three significant TCE plumes.

Approach/Activities. A wide range of subsurface site characterization methods were utilized to create an accurate conceptual site model (CSM). A feasibility study was completed based on the results of the CSM. The feasibility study selected a passive remedy consisting of the installation of three PRBs to prevent off-site migration of the TCE plumes.
The design of the PRBs was initiated by laboratory treatability testing performed to select the optimum reactive media and determine the minimum hydraulic retention time (HRT). Groundwater contaminant transport modeling was completed to select the proper location for each PRB and confirm the PRB would meet the HRT. Pre-design investigations were performed to fill any data gaps and to provide enough information to properly design the PRBs. Design parameters for the PRBs consisted of a 2 foot wide trench, 35 feet deep that varied from 300 feet long to over 1,000 feet long. The ZVI/sand ratio was a minimum of 15 percent ZVI by weight.
Installation of the PRBs was completed utilizing a one-pass trencher (continuous trenching method) to accurately and efficiently install the PRBs by simultaneously excavating and backfilling without an open trench. An Elkin Hi-Tech Volumetric Mixer was used to meet the precise mixing goals for the ZVI/sand mix. Dewatering points were installed on the upgradient side of the PRBs due to the shallow water table. The extracted water was re-injected into the ZVI/sand delivery box to help slurry the mix into the trench. Any additional water beyond the needs of the slurry were pumped to the ground surface upgradient of the PRB. Trenching spoils were sampled utilizing incremental sampling techniques. Results were below applicable criteria; therefore, soils were spread onsite rather than being transported to an off-site landfill. No operations and maintenance is required due to the passive remedy selected. Only performance monitoring is required. Performance monitoring has been completed on a quarterly basis since 2014.

Results/Lessons Learned. The PRBs were successfully installed in 2013 and 2014. The continuous trenching method utilized to install the PRBs was the most effective and most cost efficient method. The PRBs were installed for less than $1MM each, a significant project savings compared to the $65MM to $90MM remediation estimate prepared by the local unit of government. Performance monitoring data obtained from over three years of monitoring documents that the PRBs are functioning as intended. TCE levels downgradient of the PRBs are now below the treatment goal of 5 micrograms per liter.