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Combined Active and Passive Treatment of Large, Dilute PCE Plume

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Background/Objectives. A large, dilute tetrachloroethene (PCE) plume is being managed using a combination of active remediation, natural attenuation, and institutional controls (ICs) at an active solvent recycling center located in Texas. The facility was built in 1975, and historical operations resulted in PCE impacts to a shallow groundwater unit. PCE and degradation products currently extend to adjoining properties. The area in which PCE concentrations exceed the maximum concentration limit (MCL) is approximately 40 acres. While monitoring and potential receptor surveys indicated that the plume does not pose a threat to human health and the environment, a strategy combining PCE treatment, natural attenuation, and ICs was identified as means to reduce the lifecycle cost of environmental management.

Approach/Activities. The industrial facility will continue to be operational, so use of ICs and industrial standards will be used to complete corrective action for on-site areas. However, the use of ICs is not practicable in off-site areas, some of which are zoned agricultural or residential. Therefore remediation with in-situ bioremediation (ISB) was implemented to expedite attainment of MCLs in off-site areas. ISB was selected because it leverages natural attenuation processes that were already active, and because ISB treatment processes may continue for years after injection without additional intervention. The goals of ISB treatment were to reduce PCE mass loading from the source to the plume, and to create biological treatment zones perpendicular to groundwater flow at the property line, mid-point of plume, and leading edge of the plume. ISB was implemented with a combined emulsified oil and lactate amendment at the pilot scale in 2014. Pilot test data and REMChlor modeling were used to design the full-scale system that was implemented in 2015.

Results/Lessons Learned. The ISB pilot test results indicated 99% PCE treatment and evidence of complete degradation of by-products. In addition, pilot test monitoring data indicated that the footprint of the treatment zone expanded at least 30 feet into downgradient areas, allowing an “inject-and-drift” biobarrier approach. The initial full-scale design was for source treatment and a single biobarrier along the facility property line. REMChlor modeling was used to estimate cleanup timeframes in downgradient areas after remediation. Because of PCE desorption and back-diffusion, treatment to MCLs at the facility property line would not result in attainment of MCLs at downgradient locations within the desired timeframe. Therefore, the full-scale system was expanded to include two downgradient biobarriers, one near the mid-point of the plume and one at the leading edge. The full-scale ISB system was constructed with 33 injection wells installed in summer 2015. Approximately 150,000 gallons of a 3% emulsified oil and lactate bioremediation amendment was injected. The results of injection will be monitored through the ongoing semiannual groundwater sampling program that was already in place. The cost of ISB treatment is approximately $3/yd^3 for system construction. Based on available data, passive treatment is expected to continue until approximately 2017, with possible re-injection of bioamendment in 2017 and 2019. This planned project phasing is consistent with a combined passive/active approach leveraging natural processes and institutional controls.