

Multiple Remediation Approaches Demonstrate Cumulative Effectiveness in Treating Tetrachloroethene

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The former Springvillia Dry Cleaners site used a tiered remediation approach to cost-effectively address significant residual tetrachloroethene (PCE) mass distributed across more than 80,000 cubic yards of soil and two aquifers. Five sequentially implemented remediation approaches were used to mitigate on-site and off-site risk and allowed for monitored attenuation after three years of aggressive treatment. This tiered approach maximized remediation effectiveness and long-term reliability while dramatically shortening timeframes by 20 years and reducing costs by \$2 million.

Initially, source area soil beneath the former cleaners was excavated and treated by *ex situ* soil vapor extraction. An infiltration gallery was installed in the source area excavation. Permanganate salts were injected to chemically oxidize residual contamination in the shallow aquifer in the vicinity of the source removal. Sub-slab soil vapor extraction was used temporarily to mitigate vapor intrusion risks posed by contamination remaining under the building until broader treatment could be completed.

Following initial source area work, *in situ* reductive bioremediation was implemented to address remaining site contamination. Based on the estimated treatment area pore volume of 4 million gallons, a groundwater recirculation system was used to deliver bioremediation amendments within a treatment cell and to maintain hydraulic control of the plume. During initial recirculation, PCE groundwater concentrations were observed up to 1,300 µg/L in the silty-sand shallow aquifer and 930 µg/L in the sandy-gravel intermediate aquifer. Due to the plume size, a “treat and hold” strategy was adopted to efficiently remediate the site in stages. A combination of CarBstrate™, complex lactates, and nutrients were recirculated to achieve initial PCE dechlorination, control biological fouling of injection locations, and improve amendment distribution across the shallow and intermediate depth treatment cells. Once PCE dechlorination within a treatment cell was largely complete, emulsified oil products were then deployed to maintain reductive activity and the recirculation treatment cell modified to address different areas.

Approximately 54,000 pounds of electron donor amendments were introduced during the 24 month recirculation system operation period and 6,300 pounds of emulsified oil concentrate were injected under the building’s concrete slab to ensure complete treatment of the shallow aquifer under the building. Project costs are anticipated to total \$1 million dollars for 3 years of aggressive remediation. Approximately 25 percent of project costs were to deliver amendment into the subsurface. Traditional pump and treat remediation, instead of reductive bioremediation, would have added an estimated \$2 million and 20 years to reach the monitored attenuation remedy stage.