In Situ Treatment of a NAPL Source Zone Using Combined ISCO, Air Sparging, and SVE to Achieve Regulatory Closure

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Background/Objectives. Trichloroethene (TCE), 1,1,1-trichloroethane (TCA), toluene, xylene, and chlorinated benzenes were released from waste drums that were buried at a former non-permitted landfill in Massachusetts. Non-aqueous phase liquid (NAPL) was identified in the former disposal area following the drum removal. Geosyntec conducted a detailed site investigation over a 35-acre area including the installation of monitoring wells at more than 80 locations and sampling of soil, groundwater, surface water, sediment, soil gas, and indoor air. The investigation confirmed that dissolved phase constituents of potential concern (COPCs) were being transported via advection in shallow groundwater from the NAPL source zone and discharging to a nearby wetland, resulting in sediment contamination above ecological screening values. A plume of TCE in shallow groundwater migrating more than one-half mile from the disposal area led to the potential for vapor intrusion at residential and commercial buildings downgradient of the Site. In the former disposal area, total concentrations of COPCs in groundwater exceeded 150 parts per million, with individual COPC concentrations in excess of state regulatory limits.

Approach/Activities. Geosyntec designed and implemented a remedy consisting of in-situ chemical oxidation (ISCO) using ozone combined with air sparging and soil vapor extraction (SVE) to target COPC impacts above and below the water table. The full-scale remedy operated from November 2010 through July 2013 employing over 150 injection and extraction wells and 100 pounds per day of ozone production capacity to target a total treatment area of 10,000 square feet. Geosyntec used real-time remote monitoring data from an automated soil gas sampling system and the results from passive soil gas sampling, combined with conventional groundwater monitoring data, to optimize the treatment process. Catalyzed hydrogen peroxide (CHP) injections were completed in December 2012 and February 2013 to supplement the continuous ozone injections in areas with recalcitrant contamination. The primary metric used for verifying remedy effectiveness was mass discharge of volatile organic compounds (VOCs) from the treatment area as calculated using the Transect Method. Geosyntec implemented four years of post-treatment monitoring of groundwater, surface water, and wetland sediment to demonstrate that source area treatment had sufficiently reduced concentrations in downgradient areas to allow for regulatory closure.

Results/Lessons Learned. Four years after the completion of source area treatment, the mass discharge of COPCs in groundwater from the source area remains 80% below the pre-treatment level. Reductions in downgradient groundwater concentrations have eliminated the need for continued vapor intrusion mitigation at three buildings where sub-slab depressurization systems had been installed and operated since 2013. In 2016, closure was achieved for a large portion of the Site downgradient of the treatment area where COPC concentrations are below risk-based regulatory limits. The remainder of the Site is expected to achieve regulatory closure in 2018.