Attenuation of a Chlorinated Solvent Plume Expedited by Underground Construction

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Background/Objectives. Perchloroethene (PCE) released from a former drycleaner contaminated a glaciofluvial aquifer in an urban watershed in New England. During remedial investigation work and remediation feasibility studies, a new building was built with underground space that employed a low-permeability concrete diaphragm wall (slurry wall). The building spanned the full width of the plume and the walls were founded in glaciomarine and glacial till soils, well below the base of the glaciofluvial aquifer. A hydraulic containment system was installed upgradient of the building to contain the plume and prevent potential lateral displacement of the plume.

Post-construction groundwater monitoring revealed a rapid decline in PCE concentrations downgradient of the slurry wall, such that concentrations of PCE and its daughter products dropped from part-per-million levels (around 50 mg/L in places) to below the state cleanup criteria (5 µg/L) shortly after completing the slurry wall.

Approach/Activities. The presentation will describe the site stratigraphy and hydrogeology, and its influence on the extent, fate, and transport of chlorinated solvents at the site. The plume was concentrated near the bottom of the glaciofluvial aquifer because of the isotropic, uniform nature of the formation, and downward vertical gradients. Groundwater flow velocity of around 1 ft /day and fractional organic carbon values of 0.2% or less result in a plume that responds dynamically to changes in the flow regime and migrates with minimal retardation. With the slurry wall in place, and the upgradient head of the plume contained by recovery wells, the leading edge of the plume was quickly attenuated as clean groundwater migrated into the plume limits from upgradient areas, reducing chlorinated-solvent concentrations to below their respective cleanup criteria within approximately two years.

The aquifer is underlain by fine-grained glaciomarine soils with chlorinated solvents due to forward diffusion from the glaciofluvial aquifer. Back-diffusion from these soils to the glaciofluvial aquifer has been documented in other areas of the watershed; however, as the plume in the glaciofluvial aquifer migrated, flow in the aquifer far exceeded the mass flux from the glaciomarine soils, as chlorinated-solvent concentrations continued to decline to below their respective cleanup criteria in the glaciofluvial aquifer. Results of modeling that evaluated the influence of vertical gradients and other parameters on diffusion rates will be presented.

Results/Lessons Learned. Building a slurry wall across the chlorinated solvent plume isolated the source area from the plume's leading edge, allowing chlorinated solvents to be quickly attenuated as flow paths were altered, drawing in clean upgradient groundwater. The results are a good example of how effective isolation or containment of source areas can expedite cleanup of chlorinated solvents in clean, granular soils that have minimal organic carbon and ample recharge supporting flow through the aquifer.