Developing a Site Conceptual Model: The Influence of Deep Building Foundations on Contaminant Transport

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Background/Objectives. The Site is located within the coastal plain of North Carolina and includes a 190-foot tall concrete grain mill and silo. Chlorinated volatile organic compounds (CVOCs) including tetrachloroethene (PCE) and PCE degradation products were detected in the surficial aquifer above applicable standards during a UST investigation. PCE was also detected in water supply wells screened in the underlying Black Creek Aquifer despite the presence of a laterally continuous clay confining layer. Additional investigations detected carbon tetrachloride (CT) and CT degradation products in the Black Creek Aquifer. The source and migration pathways of PCE and CT were unknown. The Black Creek Aquifer plume displayed a bi-model geometry that was not consistent with the direction of groundwater flow. To determine the release area and fate of PCE in the surficial aquifer and PCE/CT and Black Creek Aquifer a remedial investigation (RI) was conducted at the site.

Approach/Activities. The hydrogeologic conceptual site model (CSM) was developed using multiple lines of evidence including historical documents, interviews, scientific literature, direct sampling, measurements, and observations. Multi-depth groundwater samples were collected using direct-push technology (DPT) and sonic drilling methods and field screened to rapidly delineate the horizontal and vertical extent of the plume in surficial aquifer and Black Creek Aquifer. Shallow pore water samples were collected from surface water drainage features to identify areas where dissolved CVOC plumes in groundwater are discharging to surface water.

Results/Lessons Learned. The distribution and degradation of compounds detected in the surficial aquifer and the Black Creek Aquifer differ significantly which indicates two different release areas. The CVOC plume in the surficial aquifer is commingled with dissolved petroleum compounds related to a former underground storage tank basin. The dissolved petroleum plume does not extend to the Black Creek Aquifer which resulted in different PCE to degradation product ratios in the surficial aquifer (1:2) and Black Creek Aquifer (30:1). Mill employees reported that the concrete forms used to construct the Mill#1/Silo were cleaned in the area of the former UST basin and coincide with the highest concentrations of CVOCs in the surficial aquifer. The Black Creek Aquifer plume has a bimodal orientation of one long axis parallel to groundwater flow and a second perpendicular axis due to influence from a water supply well. The PCE and CT plumes in the Black Creek Aquifer display a similar bimodal orientation indicating they originated from the same source (i.e. Mill#1/Silo). The migration of PCE/CT below the confining layer is possible due to the Mill#1/Silo deep timber pile foundations that extend approximately 60 feet below land surface. The elongated and narrow geometry of the Black Creek Aquifer plume is atypical of most plumes in the coastal plain. The long axis of the plume aligns with an off-site agricultural drainage ditch that cuts through the confining layer exposing sands from the Black Creek Aquifer. Agricultural drainage systems influence near-surface groundwater flow and provide a preferential pathway for groundwater to discharge into surface water.