Evaluation and Remediation of a Large Commingled Dilute VOC Plume in Western Ohio: A Case Study

Craig A. Cox, CPG (Craig_Cox@CoxColvin.com)
(Cox-Colvin & Associates, Inc., Plain City, OH, USA)

Background/Objectives. In 1998, the detection of chlorinated volatile organic compounds (CVOCs) in a public well field led Ohio EPA to begin a search for potential sources. By 2002, as many as four different consultants, representing local industries, had identified a commingled plume extending a distance of 4 miles. The highly permeable, well oxygenated, federally-designated sole source aquifer has a hydraulic conductivity on the order of 1200 feet/day and a horizontal flow velocity estimated at 10 feet/day. By chance, most of the industries lay along a common groundwater flow path and had tended to use similar CVOCs. This situation complicated the issue of source identification and potential responsibility. The objective soon became source area identification and dissection of the commingled plume to assign ownership. Following plume delineation, the sources of CVOCs were addressed through a variety of source area remedial actions (some of which are still proceeding). A GAC treatment system was added to the public water system and affected domestic well owners were provided permanent connections to public water. The current objective is to monitor the return of groundwater quality to drinking water standards throughout the length of the plume.

Approach/Activities. Working in cooperation, the consultants shared regional-scale analytical results from hundreds of monitoring wells, domestic wells, production wells, temporary wells, and surface water samples to form a groundwater and surface water quality database. This database, established in the late 1990s, is still in use and updated frequently. Based on GIS analysis of contaminant ratios of tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, and 1,1,1-trichloroethane coupled with groundwater flow data the commingled plume was found to be sourced from at least six separate areas. Each responsible party chose remedial options based on their particular goals. The options included: excavation, in situ chemox (potassium permanganate) injection, in situ emulsified zero-valent iron injections, in situ thermal desorption, and air sparge/soil vapor extraction. The treatment option for the public well field was granular activated carbon. Monitoring of the plumes, which have responded positively to the source removal, continues.

Results/Lessons Learned. To date, four sources have been remediated and groundwater quality has improved dramatically. Periodic regional plume updates are performed to monitor progress. The use of contaminant ratios proved to be a very powerful tool in plume delineation. Other characterization techniques including compound specific isotope analysis are being used to learn more about the plumes before they are gone. The presence of cis-1,2-dichlorethene was key to locating source areas where anerobic conditions existed locally. Due to the very high hydraulic conductivity and associated groundwater flow velocities, in-plume groundwater treatment options including permeable reactive barriers, containment (pump and treat), recirculating wells, and the like proved infeasible.