Characterizing Contaminant Transport in a Dual Aquifer System with Significant Intervening Vadose Zone Flow for Remedy Selection

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Background/Objectives. The hydrogeologic conditions at an EPA Superfund site involve both an overburden and bedrock aquifer impacted with chlorinated volatile organic compounds. The overburden aquifer is the more highly impacted aquifer and is a continuing source to the bedrock aquifer. However, the two are generally separated by 30 to 40 feet of vadose zone. Primary pathways in the saturated bedrock aquifer are gently-dipping bedding plane partings. These fractured bedding units extend above the bedrock aquifer to the base of the perched but perennial overburden aquifer. Groundwater percolating through fractured units in the vadose zone had been documented with downhole video and analytical sampling; however, it was unknown if percolation was occurring only as wetting waves, or if fully saturated discrete fracture zones connected the aquifers. The understanding of the hydraulic relationship between the aquifers is paramount in developing an effective remedy.

Approach/Activities. A high-resolution conceptual site model (CSM) was further developed by implementing a 72-hour pumping test. The objectives of the pumping test were to refine the existing bedrock hydrostratigraphic model, determine orientation and extent of pumping influences, identify the hydraulic connection between the bedrock and overburden aquifers, and define an appropriate remedy for the site. The aquifer test consisted of four phases; a period of background monitoring, a step-rate test, a constant-rate test, and recovery response monitoring. A network of 34 monitoring wells, including 21 bedrock wells and 13 overburden wells, were instrumented with pressure transducers during all four phases of the aquifer test.

Results/Lessons Learned. Analysis of the pumping test data was performed through curve matching techniques in Aqtesolv, and 3D and 2D representation of head change over time at the pumping well and monitoring points. Aquifer parameters were estimated for both the pumped and un-pumped bedrock water-bearing zones. Further development of the CSM informed remedy design for commingled plumes from various stakeholders across this multiple property site. Validation of the new CSM included various communications with all stakeholders and modification to the regulatory framework, and will result in developing an appropriate groundwater remedy for both the bedrock and overburden aquifer.