A Geology Focused approach at Three Industrial Sites to Enhance Conceptual Site Models and Remedial Design

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Background/Objectives. A geology focused approach to remediation site management, from the development of the conceptual site model (CSM) to subsequent selection, design and implementation of the remedy, increases the efficiency, reduces uncertainties, and improves the likelihood of achieving site goals. Too often the heterogeneities inherent to the subsurface are not adequately accounted for in the CSM leading to inefficiencies and suboptimal performance of the site remedy. Examples of the effectiveness of the geology-focused approach will be presented for three industrial sites, two in Southern California and one in Minnesota. These sites are impacted with chlorinated solvents, gasoline, and pentachlorophenol/diesel, respectively.

Approach/Activities. At each of these sites, investigation and monitoring activities have been ongoing for extended periods of time, with several pilot tests conducted and full scale remedies at various stages of design implementation. Prior to implementing the remedial design, a geology-based approach was implemented by evaluating a combination of historical boring logs and high-resolution data (CPT, MIP, HPT), which were then verified by detailed geological logging of new cores and environmental sequence stratigraphy (ESS) methods. These were used to create enhanced CSMs and identify high-flux zones in three dimensions. Hydrological and chemical data were then used to develop models of the site contaminant plume and focus the remedial design, technology testing, and full-scale implementation.

Results/Lessons Learned. At the petroleum site, two discrete high-flux zones were identified, corresponding to a continuous geology of fine to medium poorly-graded sand. These are underlain by interbeds of silt, sandy silt, and silty sand, which grade finer with depth. Pilot-scale testing demonstrated the ability of aerobic bioremediation using biosparging to reduce the mass discharge along the boundary by 99%. A full-scale biosparging system, with automated pulsing and flow control, was consequently designed to protect the entire boundary and is currently pending construction.

At the PCP/diesel site, high flux zones and confining layers, corresponding to glacial and fluvial deposits, were delineated at high resolution and the extent of the downgradient plume characterized in three dimensions. Pilot studies evaluating in situ chemical oxidation (ISCO) had previously been conducted. The revised CSM will be utilized in the design of the full scale remedy in late 2017/early 2018.

At the chlorinated site, five discrete high-flux zones were identified corresponding to a geology of estuary, fluvial, and near shore marine deposits of fine to medium sand with occasional coarse sand sequences. Each discrete zone is underlain by a confining unit of 5 to 10 feet in thickness. Many of the historical wells had been installed not with regard to this geological interpretation. New monitoring wells were installed into high-flux zones to characterize each zone's chemical and hydrological properties, resulting in data that was significantly different with regards to the nature and extent of the groundwater plume and hydraulic conductivities. Hydraulic recirculation was selected as the boundary remedy with enhanced anaerobic bioremediation amendments to treat the source area.