LNAPL Remediation Combining Mobile Dual-Phase Extraction with Concurrent Injection of a Carbon-Based Amendment

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Background/ Objectives. The project site is a 1950s-era Air Force tank farm. Leaks from tanks and piping resulted in petroleum contamination of soil and groundwater. A layer of petroleum light non-aqueous phase liquid (LNAPL) and a “smear zone” are a continuing source of dissolved contamination to groundwater. The objective of this project is to perform treatability studies to facilitate treatment of free phase LNAPL and residually entrapped or sorbed mass.

Approach/ Activities. The concept for this treatability study was to capitalize, in an accelerated fashion, on combining aggressive petroleum mass removal (free product and dissolved phase) by mobile dual-phase extraction (mDPE) with an innovative, in situ approach for promoting natural attenuation of residually entrapped mass. Use of remedial amendments alone in the cleanup of free-phase product is not an option due to the requirement of continuous emplacement events (many, regularly scheduled applications) to meet/exceed contaminant mass. Alternatively, physical extraction of free-phase product is often conducted initially; with remedial amendments injected subsequently as a polishing stage. Free-phase product removal as an initial step is, however, a time-consuming process for satisfying site cleanup goals and performance metrics.
This concept involves physical removal of LNAPL and dissolved-phase mass by an aggressive mDPE approach for recovery of the free or mobile petroleum fraction not bound to soil grains (or interstitial water) as a result of surface tension, capillary forces, or sorption mechanisms. Following free-phase recovery, continued use of mDPE was simultaneously employed to further recover contaminant mass (dissolved-phase) and to maximize in situ emplacement of remedial amendment. The remedial amendment selected to treat residually trapped mass was based on findings of bench-scale testing comparing the effectiveness of several commercially available products for enhancing in situ destruction. Chemicals of Concern (COCs) include BTEX, trimethylbenzene compounds and methylene chloride. Injectable carbon combined with chemical oxidants and oxygen-generating compounds (COGAC™) was selected based on optimal bench removal/reduction/destruction efficiencies. Over this 1-acre site, 48 extraction points were installed with 167 surrounding injection points in a systematic grid fashion. The mDPE was conducted concurrently with injection, just beyond the typical radius of influence. Over 15 pounds of amendment (for each pound of contaminant mass) was injected and evenly distributed throughout the treatment area. The placement of injection and extraction points was designed and field adjusted to achieve hydraulic capture and control.

Results/ Lessons Learned. Amendment distribution was vastly improved by combining mDPE vacuum (at extraction points) with amendment injection (at nearby injection points); thereby increasing sweep efficiency of amendment delivery through promotion of enhanced pressure gradients. Visual observations, collection of cores at injection points, and daily monitoring of the location, movement, and thickness of LNAPL were observed. Concurrent implementation of mDPE and injection of COGAC™ resulted in effective distribution of the amendment throughout

the smear zone area and near-complete elimination of measurable free phase LNAPL. Results presented will elaborate on these findings as well as other performance metrics.