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GROUND WATER AND ECOSYSTEMS RESTORATION RESEARCH

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Enhanced Source Removal

Background

Nonaqueous-phase liquids (NAPLs), especially those that are denser than water (dense nonaqueous-phase liquids [DNAPLs]) and that tend to migrate vertically downward in the subsurface, have proven to be very recalcitrant to traditional remediation approaches. Because of the relatively small areal extent, the large contaminant mass, and the extremely long-term impact of DNAPL source zones, the potential pay-off of source removal can be very high. This has motivated the search for alternative source remediation technologies offering enhanced rates of cleanup.

Several alternative methods for in situ extraction or destruction of NAPLs have been proposed. These include the use of remedial fluids or thermal energy to facilitate the dissolution, mobilization, or volatilization of NAPLs; and the use of oxidatants to degrade the organic contaminants.

Objectives

- Assess and compare the performance of a variety of in situ source remediation technologies in carefully monitored pilot-scale field tests
- Develop a scientifically defensible database that can be used to evaluate their efficacy and robustness
- Identify remaining technical impediments to the implementation of these technologies

Approach

The project involved the side-by-side evaluation of innovative source removal techniques at two field sites representing different hydogeological and contaminant conditions. The first study site is Operable Unit 1 at Hill Air Force Base, Utah. This is a sand and gravel aquifer contaminated with a chemically complex light nonaqueous-phase liquid (LNAPL) present as a predominantly immobile residual phase. The demonstrations were conducted in the vicinity of two chemical disposal pits used during the 1940s and 1950s for disposal of a variety of wastes, including aviation fuels and chlorinated solvents. The pits are downgradient from a former fire-training area that may have contributed unextinguished fuels and combustion by-products. Wastes from these and other potential sources had intermingled to form the complex LNAPL mixture, which was the target for these demonstrations.

The second technology demonstration site is located at the Dover National Test Site (DNTS), Dover Air Force Base, Delaware. Two physically and hydraulically isolated test cells were constructed in order to contain contaminants and remedial fluids used in the technology demonstrations and to permit accurate mass balance calculations. Each test cell was equipped with an extensive network of wells and monitoring points. Five enhanced source-removal technologies are being evaluated at the DNTS. These are co-solvent solubilization, air sparging/soil vapor extraction, surfactant solubilization, complex sugar flush, and co-solvent mobilization.

Accomplishments

All field demonstrations have been completed. Final project reports are under preparation.

Selected Publications

Brooks, M.C., M.D. Annable, P.S.C. Rao, K. Hatfield, J.W. Jawitz, W.R. Wise, A.L. Wood, and C.G. Enfield. (2004). "Controlled Release, Blind Test of DNAPL Remediation by Ethanol Flushing." *J. Contamin. Hydrol*., 69, 3-4: 281–297.

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Brooks, M.C., M.D. Annable, P.S.C. Rao, K. Hatfield, J.W. Jawitz, W.R. Wise, A.L. Wood, and C.G. Enfield. (2002). "Controlled Release, Blind Tests of DNAPL Characterization Using Partitioning Tracers." *J. Contamin. Hydrol*., 59: 187–210.

Wood, A.L. and C.G. Enfield. Enhanced Source Removal (ZIP) (133 MB) (EPA/600/C-99/002) September 1999

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