Natural Source Zone Depletion of Waste Oil Residuals and Other Constituents at a Superfund Site

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Background/Objectives. The Bridgeport Rental and Oil Services (BROS) Superfund Site is located in Gloucester County, New Jersey. The Site is comprised of the BROS property, where first sand mining and then waste oil recycling and related activities occurred, and surrounding subsurface areas where chemicals of concern (COCs) that originated on the BROS property are now found. Extensive light, non-aqueous phase liquid (LNAPL) residuals remain throughout the subsurface of the BROS Property at and below the water table to a considerable depth (greater than 20 feet) in some locations. In 2002, the United States Environmental Protection Agency (USEPA) estimated that approximately 40,500 gallons of LNAPL might be recoverable. In 2006, the Phase 2 Feasibility Study (FS) estimated that a much larger volume of unrecoverable (residual) LNAPL remain at the Site (BROS TC, 2006b), largely below the water table. The objective of this paper is to evaluate natural source zone depletion in relation to other remedial actions taken in the last nine years.

Approach/Activities. The conceptual site model (CSM) developed for the Site establishes a framework to understand the relationship between LNAPL residuals and COCs contained therein, the site geology and hydrogeology and potential exposure routes pathways. An adaptive, phased approach was implemented to address soil, shallow groundwater, air (vapor intrusion) and LNAPL media at the BROS Site. An alternative site cover, including phytoremediation, was constructed to minimize contaminant movement and promote LNAPL recovery where practical. Bioslurping (augmented with LNAPL skimming recovery methods) to recover LNAPL, remove volatile organic compounds (VOCs) from soil, stimulate in situ biodegradation of organic COCs, and remove and treat groundwater in contact with free and residual LNAPL was implemented in an adaptive manner at the Site (ongoing [ELM, 2012]). Ultraviolet induced fluorescence (UVIF) techniques were used to pre-characterize LNAPL distribution and maximize the efficacy of bioslurping (i.e., identify locations where there was a relatively greater probability of recovering LNAPL).

Results/Lessons Learned. After several years of bioslurping operations, a transmissivity evaluation was conducted to measure the recoverability of remaining LNAPL. Transmissivity evaluations showed that active LNAPL recovery was both impracticable and inefficient. Transmissivity data in conjunction with diminishing returns of LNAPL recovery resulted in an evaluation of the transition from the bioslurping operations and verify natural source zone depletion (NSZD) rates at the Site.

Routine performance monitoring and waste characterization data at the BROS Site indicate the LNAPL and COCs are not mobile and slowly decreasing. NSZD is reducing concentrations of COCs in residual LNAPL available for contribution to shallow groundwater and the total amount of residual LNAPL, thereby resulting in a decrease in COCs in shallow groundwater. More specifically, both aerobic and anaerobic degradation (methanogenetic) processes are reducing the LNAPL mass at the BROS Site as indicated by detection of increasing methane concentrations evaluated during the in situ respirometry performed during a previous study conducted at the Site, as well as dissolved methane in groundwater. To further evaluate NSZD, carbon traps were deployed across the Site in the Fall of 2017 and the results are being evaluated to develop a better understanding of natural degradation rates at the Site.