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Title: Lessons Learned and Innovations Developed during Pilot Study Operations of a DNAPL Recovery System

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Key Topic: Innovative Remediation Technologies

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Client Name: WEC Business Services, LLC

Project Name: North Shore Gas South Plant MGP

Project Location: Waukegan, Illinois

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ABSTRACT

Background/Objectives:

A 6-acre DNAPL body was identified adjacent to a former MGP and within approximately 200 feet of surface water. Potentially recoverable DNAPL was delineated on property owned by the utility, the city, railroad, local port district, and an aerospace coating manufacturer. In consideration of property ownership constraints, the United States Environmental Protection Agency (USEPA) issued an interim Record of Decision (ROD) to recover as much DNAPL as practicable. The ROD specified a physically enhanced recovery approach that involved groundwater extraction, treatment, and reinjection to facilitate migration and recovery of DNAPL. Initial plans involved implementation of the system on all properties in one mobilization. This approach would have included construction of a 150-gallon per minute groundwater treatment plant, 40 vertical wells, four horizontal wells, and related infrastructure. Given the complexities of long-term DNAPL recovery and in consideration of third-party property owner concerns, the project team implemented construction in two phases with the first phase focused on utility-owned property and serving as a pilot study. The goal of the pilot study was to validate design assumptions, evaluate material and component specifications, optimize groundwater treatment plant operations, and refine construction methodologies prior to expanding to third-party property. The objective of this presentation is to demonstrate how a DNAPL recovery pilot study was used to optimize system design and construction prior to completing work on third-party properties.

Approach/Activities:

The pilot study was completed on utility-owned property, allowing greater flexibility on construction approaches and modifications to system operations. During pilot study development, key design and operation criteria were identified and a strategy was developed to validate those criteria during pilot study execution. The pilot study consisted of repurposing three existing vertical wells; and installation of three new vertical wells, a horizontal injection well, and a rented groundwater treatment plant. Throughout operations, key system components were evaluated to optimize full-scale design. In addition, systematic modification of operations was completed to inform full-scale operational criteria. Operational modifications included batch and continuous pumping of DNAPL recovery pumps, constant and pulse pumping of groundwater extraction pumps, and modification of heat trace settings.

Results/Lessons Learned:

The pilot study system operated between April and November 2020. From a design perspective, the pilot study identified the need for an alternate groundwater extraction pump, clarified selection of preferred DNAPL recovery pump, and confirmed the need for heat trace to facilitate conveyance of recovered DNAPL. From an operational perspective, multiple approaches to system operations were implemented, including passive recovery, pulsed pumping, and maximum gradient. The pilot study demonstrated that pulsed groundwater extraction was four times more effective at recovery of DNAPL and reduced influent treatment plant flow by approximately 50%. After several months of operations, DNAPL recovery rates declined indicating DNAPL recovery was nearing maximum extent practical.

Dissolved phase concentrations in surrounding wells remained slightly above regulatory objectives. Ramboll completed research and development activities to determine if there were low-cost ways to modify system operations to recovery remaining DNAPL. These research and development activities led to development of a customized vibration-enhanced recovery tool. After identification of the optimal frequency, DNAPL recovery rates the test well increased by over 300%. Based on the successes in Ramboll's modification to system operations, the regulatory agency requested inclusion of these approaches in the full-scale system.

Aspect of Work that Relates to Sustainability:

Ramboll advocated for the opportunity to control system operations. Doing so identified alternate approaches to system operations that decreased water treatment needs by 50%, resulting in a comparable reduction in electrical consumption and water treatment plant chemical consumption. In addition, vibration-enhanced recovery aided in recovery of residualized NAPL, thereby reducing the likelihood that a subsequent active remediation will be required to address dissolved phase impacts.