Demonstration and Validation of the Horizontal Reactive Media Treatment Well (HRX Well®) for Passive In Situ Remediation

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Background/Objectives. A new in situ remediation concept termed a Horizontal Reactive Media Treatment Well (HRX Well®) is presented that utilizes horizontal wells filled with reactive media to passively treat contaminated groundwater in situ. The approach involves the use of large-diameter directionally-drilled horizontal wells filled with solid reactive media generally installed parallel to the direction of groundwater flow. The design leverages natural "flow-focusing" behavior induced by the engineered contrast in hydraulic conductivity between the high in-well reactive media and the ambient aquifer hydraulic conductivity to passively capture and treat proportionally large volumes of groundwater within the well. Clean groundwater then exits the horizontal well along its down-gradient sections. Many different types of solid reactive media are already available (e.g., zero valent iron [ZVI], activated carbon, biodegradable particulate organic matter (e.g., mulch), ion exchange resins, zeolite, apatite, chitin). Therefore, this concept could be used to address a wide range of contaminants. The approach requires no above-ground treatment or footprint and requires limited ongoing maintenance.

Approach/Activities. Three-dimensional flow and transport simulations were completed to assess the general hydraulic performance, capture zones, residence times, effects of aquifer heterogeneity, and treatment effectiveness of the HRX Well® concept. Based on these results, a series of three-dimensional laboratory- and meso-scale physical tests (i.e., tank tests) were completed where high-resolution head, flow velocity, and water quality data were collected utilizing manometers, sampling ports, and tracers. The results of these tests further demonstrate the concept, quantify ZVI reactivity and the required residence times, confirm model predictions, and provide the basis for the field-scale implementation in early 2018.

Results/Lessons Learned. This presentation will discuss in detail the results of the modeling, tank tests, and field-scale implementation. In general, the results demonstrate that capture and treatment widths of up to tens of feet can be achieved for many aquifer settings, and that reductions in down-gradient concentrations and contaminant mass flux are nearly immediate. Furthermore, the results confirm that the HRX Well® concept addresses many of the challenges/limitations inherent to remediation, including: (1) costs and time requirements associated with hydraulic containment; (2) delivery of injected reagent-based strategies in complex hydrostratigraphy; and (3) up-front costs and long-term hydraulics in flow-through permeable reactive barrier (PRB) treatment schemes. For many sites, it is increasingly recognized that contaminant mass flux and discharge may represent the most appropriate measure of plume strength and potential migration risk, and therefore remedial objectives and technologies focusing primarily on long-term mass discharge reduction will be increasingly favored. The HRX Well® concept is particularly well-suited for sites where long-term mass discharge control is a primary performance objective.