Where's Waldo: Finding Injected Amendments and Estimating Radius of Influence at a Former Retail Station in Rural Kentucky

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Background/Objectives. Key to in situ remediation is the ability to ensure contact of injectate and contaminant of interest. Limited excavation studies have been conducted to characterize injectate distribution. To date no studies have comprehensively characterized the distribution of injected carbon materials using extensive soil core logging. The subject site is a former petrol retail station. Two tanks were closed in-place under the building canopy. The balance of the UST system was removed. BOS 200®, manufactured by Remediation Products was selected for remediation of residual hydrocarbon contamination in soil and groundwater. Roughly 26,000 lbs of BOS 200 was injected throughout the impacted area in the late spring of 2017.

Residual soils are 15 to 20 feet deep overlying Upper Mississippian Aged Salem and Warsaw limestones. The residual soil profile consists of silty and sandy clays with chert. Chert layers, where present and laterally extensive, often act as secondary porosity features within the residual soil profile, and can be the most transmissive features in the saturated formation. The soils are soft to wet below approximately 6 to 8 feet below ground surface (bgs).

Injections were completed using hydraulic fracturing with a positive displacement pump at a volumetric flow rate of approximately 35 gpm. Injection tooling was driven to specific depths with injections spaced about every 2 feet vertically within the impacted horizon.

Approach/Activities. BOS 200 is based on activated carbon and has the appearance of black flour (320 mesh). Prepared slurries of this product contain small amounts of various nutrients dissolved in the aqueous phase and these compounds can readily be observed in the groundwater. The activated carbon is not soluble however being black, it is relatively easy to see in subsurface soils. About one month after injection work was completed, 11 continuous soil borings were advanced next to existing site monitoring wells and an additional 28 borings were advanced throughout the treated area. A pair of 1-inch piezometer PVC wells were installed at each of the additional twenty-eight locations; one shallow screen to test the upper portion of the aquifer and the second well deep for testing of the deeper portion of the aquifer.

All wells were sampled and analyzed for anions and VOCs to evaluate distribution of injectate. The continuous soil cores were carefully inspected visually for presence of BOS 200 and logged for lithology. Selected samples of suspected BOS 200 were analyzed to confirm its identification as containing activated carbon. Finally, a survey was performed to accurately define locations for all soil borings, monitoring wells and their respective elevations.

Results/Lessons Learned. Over 70 percent of the monitoring wells were installed post-injection. The groundwater anion signature provides a gross indication for distribution of the aqueous injectate fraction. This combined with seams or zones of BOS 200 identified and located within each of the 37 soil borings resulted in a data dense description of injectate distribution. The distribution, conceptual model will be useful for understanding performance over time and vetting of the injection tooling and technique used for installation of the BOS 200.