PFAS Concentrations in Groundwater Reduced to below Drinking Water Standards at a Former Michigan Manufacturing Facility

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Background/Objectives. In 2019, per- and polyfluoroalkyl substances (PFAS) were detected in groundwater samples collected from a former manufacturing facility at concentrations that were as high as 1,000 nano grams per liter (ng/L), which exceed the United States Environmental Protection Agency drinking water advisory limit of 70 ng/L. PFAS is an emerging contaminant at many industrial facilities and is associated with a family of thousands of chemicals that are known for their risk to human health and the environment. The project facility was a manufacturer of cable and hose reels and was suspected of having used PFAS-containing materials in coating the finished products for corrosion resistance. Following subsequent groundwater sample events, the PFAS impacts were identified migrating off-site toward areas in proximity of residential wells. Several remedial options were evaluated, but ultimately a strategy using the in situ application of colloidal activated carbon (CAC) to enhance the adsorption and natural attenuation of PFAS was selected. CAC comprises of very fine particles of activated carbon suspended in polymer that can be injected into the subsurface under low pressure. After injection, the CAC binds to the aquifer matrix and serves as an in situ filter to remove PFAS from groundwater as it encounters the activated carbon particles. The treatment occurred within the highest impacted areas of the sand aquifer between 20-40 feet below ground surface or until the underling clay layer was encountered. A field pilot test, groundwater flux mapping, and advanced plume modeling was conducted prior to the full-scale application. The desired remedial objective was to achieve the applicable Michigan drinking water standards, specifically for perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) of 8 ng/L and 16 ng/L, respectively, in groundwater downgradient of the treated area.

Approach/Activities. The approach to achieve the remedial goals was to install an in situ permeable reactive barrier (PRB) perpendicular to groundwater flow transecting the PFAS plume. Prior to the full-scale project, several steps were taken to obtain more information for the remediation planning phase. A pilot test was implemented to evaluate whether the CAC can be effectively distributed in the subsurface and remove the PFAS below the drinking water standards. The pilot test consisted of a small PRB placed approximately 30 feet upgradient of the performance well, several post-application borings for placement validation, followed by nearly two years of groundwater monitoring. Vertical groundwater flow mapping was conducted to determine subtle changes in the permeability of the aquifer. The mapping results along with advanced plume modeling were used to determine the final remedial design. Based on these steps, the full-scale approach consisted of 240 feet PRB where over 37,000 gallons of CAC solution was injected via direct push technology (DPT) into 96 injection points. Throughout the application process, field placement validation steps, consisting of several pre- and post-injection soil cores and piezometers, were used to observe and refine the CAC distribution.

Results/Lessons Learned. PFOA and PFOS groundwater concentrations were reduced >97% to below the laboratory detection limits and the applicable drinking water standards, and were downgradient of the treatment PRB. Post injection performance monitoring data from the full-scale application, along with results from the placement validation steps, and lessons learned will be shared.