Design and Implementation of a Groundwater Remediation System for PFAS Compounds through Modification of Existing Remedial Infrastructure

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Background. For several decades, the Air National Guard (ANG) has been proactively addressing environmental issues discovered at Vermont ANG in South Burlington, Vermont, through its Installation Restoration Program (IRP). Final remedies for petroleum- and solvent-based contamination have been implemented, with several IRP sites approaching closure status. In 2015, CH2M conducted a preliminary assessment (PA) for per- and poly-fluoroalkyl substances (PFAS) and identified six sites for follow-up site investigations. One of these sites included IRP Site 1, a former fire training area where aqueous film-forming foam (AFFF) was used in fire training activities until 1980. IRP Site 1 previously contained other petroleum and solvent compounds that have been addressed through installation and operation of an air sparge/soil vapor extraction system.

In March 2016, PFAS, including perfluorooctanoic acid (PFOA) at 9,300 parts per trillion (ppt) and perfluorooctane sulfonate (PFOS) at 38,000 ppt were detected in groundwater in a collection trench sump at IRP Site 1. The levels of PFOA and PFOS combined exceeded the state's groundwater enforcement standard of 20 parts-per-trillion (ppt); both compounds are regulated as hazardous waste in Vermont.

Approach. ANG implemented a time-critical removal action (TCRA) to design and install a groundwater treatment system at IRP Site 1. Design objectives included maintaining operations of a groundwater collection trench to minimize downgradient migration of PFOS- and PFOA-contaminated groundwater, and reinjecting treated water back into the subsurface at IRP Site 1 using current infrastructure to the extent practicable.

CH2M designed a groundwater treatment system that included an equalization basin, transfer pumps, bag filtration, and anthracite-based granular activated carbon (GAC) beds to treat a daily average flow of 1.5 gallons per minute (gpm) and a maximum flow of 3.5 gpm. Design criteria for flow and concentration were developed based on historic data and GAC design was based on carbon adsorption modeling.

Results/Lessons Learned. Under the TCRA approach, the design was completed within 42 days of notice to proceed, equipment arrived on site 57 days after expedited design review by Vermont Department of Environmental Conservation, and the system has been fully functional since August 3, 2017. Results indicate the system is performing as designed, with effluent concentrations of PFOS and PFOA below the regulatory threshold of 20 ppt. Breakthrough is currently being monitored after the lead and lag GAC vessels; once it is observed, GAC will be replaced. The cost effectiveness of GAC is driven by the frequency of changeouts, which have proven at other sites to be more frequent than predicted by standard isotherm modeling. CH2M will use operational data, as well as bench-testing information from our other US DoD testing projects to evaluate various GAC types (coconut-based, anthracite-based) to arrive at the most cost-effective long-term approach for the ANG.