Delineating and Treating 1,4-Dioxane and VOCs at the Nuclear Metals, Inc. Superfund Site

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Background/Objectives. The Nuclear Metals, Inc. (NMI) Superfund Site is located in Concord, Massachusetts. Starting in 1958, NMI performed research and development in high-temperature metallurgy and nuclear fuel elements; then in the mid-1970s, shifted to large-scale production of depleted uranium (DU) penetrators and other DU products, beryllium parts, and metal powders. The Site was placed on the National Priorities List on June 14, 2001. The Remedial Investigation/Feasibility Study (RI/FS) was performed from 2003 to 2014, focusing on the nature and extent of soil, sediment, groundwater and surface water contamination on the 46-acre NMI parcel and surrounding areas. Laboratory analytical and regulatory limits for 1,4-dioxane were established and then decreased during the RI/FS. EPA selected a $125-million remedy for the Site in a 2015 Record of Decision (ROD). Increasing 1,4-dioxane concentrations at a nearby municipal production well resulted in the ROD including a non-time-critical removal action (NTCRA) to expedite hydraulic containment and ex situ treatment of 1,4-dioxane and VOCs.

Approach/Activities. The RI delineated 1,4-dioxane in groundwater to risk-based levels of 6.1, then 0.67, and finally 0.46 µg/L, as method detection levels dropped from 50 to 5, then 0.5 and finally 0.15 µg/L. After EPA issued the Proposed Plan that specified a 1,4-dioxane cleanup level of 0.46 µg/L and that proposed a NTCRA, supplementary plume delineation used sonic drilling and profiling to complete delineation and install 30 additional monitoring wells at 14 locations (targeting multiple depths). Groundwater elevations monitored during a planned shutdown of the municipal well better established the area of its influence. A pumping well was installed and tested after the NTCRA AOC became effective in 2016. A temporary treatment system using bag filters and GAC (repurposed from a prior Site NTCRA) was installed and started operating in May 2017; the temporary system has provided containment of the plume up gradient of the municipal well while a final ex-situ treatment approach is determined, designed, and installed. A treatability study to determine the Best Demonstrated/Best Available Technology (BDT/BACT) for 1,4-dioxane was performed using criteria of effectiveness, implementability, and cost; as well as environmental footprint metrics such as material usage, waste generation, and energy, air and water impacts. The treatability study incorporated a field pilot study of an innovative advanced oxidation technology.

Results/Lessons Learned. Delineation used established methods, with work plans generated and field work performed in an expedited manner with regulatory agency assistance. Close coordination with the municipal water authority maximized data collection and interpretation, aiding in selection of the optimum extraction location. An existing system was re-configured and installed, expediting start of hydraulic containment and thereby minimizing further impact to the municipal supply well. Operation of the temporary system has allowed recognition of issues with nitrogen gas ebullition and iron fouling to be incorporated into the design considerations for the final treatment system. The field pilot showed highly effective and efficient treatment of 1,4-dioxane. The final treatment system is expected to be operational in Winter-Spring 2018.