Optimizing a Uranium Sediment and Groundwater Remedy through Cost-Effective Investigation, Three-Dimensional Modeling, and Geologic Interpretation

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Background/Objectives. A 500+ acre, former mixed oxide and uranium fuel production facility is in the latter stages of decommissioning in accordance with an operating license issued by the US Nuclear Regulatory Commission (NRC). Uranium, nitrate, and fluoride impacts in groundwater are being remediated in several areas of the site to facilitate NRC license termination. Information obtained from groundwater extraction and injection pilot studies conducted in 2017 confirmed the need to optimize groundwater remedies at two site areas. The first area, referred to as Burial Area 1 (BA1), is characterized by high concentrations of uranium in a heterogeneous geologic setting. The complex lithology and contaminant distribution in this area posed significant technical challenges and cost and schedule uncertainties, particularly since this area will drive the schedule for the overall site remediation campaign. The second area, referred to as the 1206 Drainage, is characterized by high concentrations of uranium in saturated sediments within a valley fill setting. In-place remediation of the uranium-impacted sediments was deemed infeasible due to significant cost and schedule implications.

Approach/Activities. A high-resolution site characterization (HRSC) effort was conducted in BA1 to provide the geologic, hydrogeologic (permeability), and concentration data needed to refine the conceptual site model (CSM). The HRSC results identified a relatively thin, semi-continuous sand channel deposit surrounded, vertically and horizontally, by silt and clay rich gully fill deposits. HRSC also identified the channel deposit as the primary medium for contaminant storage and transport. The Environmental Sequence Stratigraphy (ESS) process was used to map the channel deposit in three dimensions and calculate the transmissive porosity of the area to be remediated.
In the 1206 Drainage area, a low-cost, expedited sampling and analysis effort that included three-dimensional visualization (3DV) and volume calculation tools was used to develop a remediation alternative consisting of excavation and on-site treatment of approximately 2,100 cubic yards of sediment. Another 5,500 cubic yards of sediment will be remediated in situ via pump and treat combined with water re-injection. This approach is expected to significantly improve remediation performance and reduce risks and uncertainties associated with cost and schedule.

Results/Lessons Learned. The BA1 optimization effort demonstrated the importance of an accurate CSM and geology-based remediation design approach. Without the ESS analysis and associated transmissive porosity estimation, achievable groundwater recovery rates would have been significantly overestimated. Using the refined CSM, groundwater extraction and injection trenches were designed to maximize interconnection of the buried sand channel deposits, thereby enhancing effectiveness and sustainability. The 1206 Drainage design optimization successfully aggregated and analyzed new and historical investigation data using GIS and 3DV tools to develop an economical and sustainable sediment remediation solution. These relatively inexpensive optimization efforts are expected to significantly improve remediation performance and reduce risks and uncertainties associated with cost and schedule. The presentation will include depictions of subsurface conditions, including ESS-enhanced cross-sections, dynamic 3DV images, conceptual remediation designs, cost data, and project photos.