# In Situ Bioremediation of Hexavalent Chromium, Perchlorate, and Chlorate in Saline Conditions: Bench-Scale Study to Field Implementation

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**Background/Objectives.** Groundwater beneath a former manufacturing facility was impacted with hexavalent chromium, perchlorate, and chlorate, among other contaminants. Total dissolved solids (TDS) in groundwater, consisting primarily of sulfate, perchlorate and chlorate were present at concentrations up to 20,000 mg/L. The groundwater impacts evaluated extended to approximately 54 feet below ground surface and were present within a shallow aquifer consisting of alluvial deposits and a deeper aquifer consisting interbedded fine-grained sediments and coarse-grained sediments. Tetra Tech was retained to evaluate the feasibility of, and the optimal approach, for achieving in situ reduction of these primary contaminants in groundwater.

This presentation will describe the approach taken to evaluate to evaluate the optimal approach to achieve in situ reduction of the contaminants in groundwater using bench-scale and field testing.

**Approach/Activities.** Tetra Tech worked closely with the University of Nevada Las Vegas (UNLV) to conduct bench-scale studies, consisting of microcosm and column tests, to determine the most appropriate carbon substrate amendments, evaluate carbon substrate dosage, determine carbon substrate persistence, evaluate the impact of carbon substrate type on degradation kinetics, and evaluate the impact of pH on degradation kinetics. Using the results of the bench-scale studies, Tetra Tech implemented a field study to demonstrate the effectiveness at the Site and obtain site-specific parameters for determining the costs for full-scale implementation. During the field study, carbon substrates, including a carbon substrate obtained from a nearby manufacturing facility, and nutrients were injected into the shallow and deep aquifers. Groundwater monitoring were conducted over a period of 62 weeks following the initial injection event to evaluate the effectiveness of the carbon substrate injection events and changes in geochemical conditions. Slug testing and microbial analysis was performed prior to and following injections to evaluate the extent of bioaccumulation.

**Results/Lessons Learned.** The presentation will briefly present the results of the bench-scale studies and how they guided the implementation of the field study. The primary focus of the presentation will be on the results of the field study, including the effectiveness of in situ bioremediation on reducing the contaminants of concern in both coarse-grained and fine-grained aquifers as well as lessons learned for future applications of the technology. The results of metal mobilization and creation of by products will also be discussed.