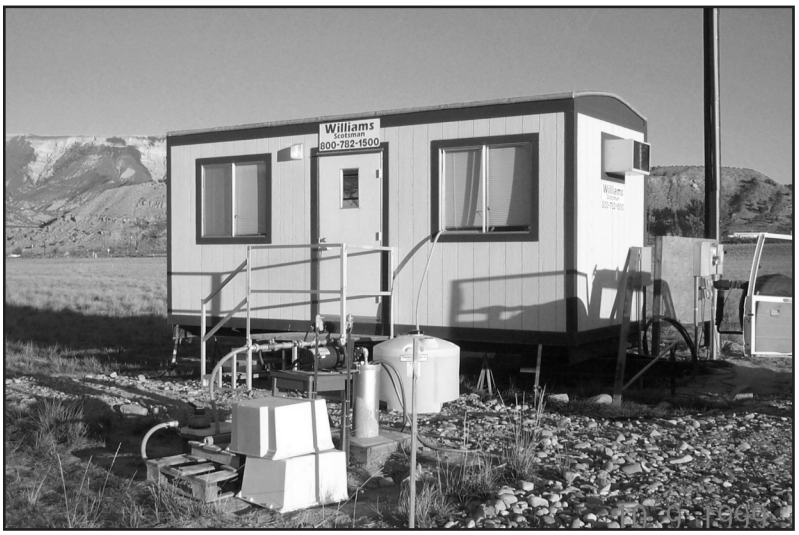
Rifle, Colorado, Pilot Study Begins for Vanadium Removal

The U.S. Department of Energy (DOE) Uranium Mill Tailings Remedial Action (UMTRA) Ground Water Project began a pilot study in October 2000 at the New Rifle site, which is located approximately 2 miles southwest of the town of Rifle, in Garfield County, Colorado.

Funding from the Accelerated Site Technology Development Project within the DOE Office of Science and Technology (EM–50) is supporting the development of the groundwater treatment technology. Personnel from the Environmental Sciences Laboratory at the DOE Grand Junction Office are conducting the technology development portion of the investigation.

Former vanadium and uranium processing activities at the New Rifle site contaminated the alluvial (shallow) groundwater system directly beneath the site and extending at least 10,000 feet hydraulically downgradient of the former mill tailings area. Groundwater modeling demonstrated that most contaminants of concern at the site would attenuate by natural flushing to applicable standards in the 100 years permitted by the Uranium Mill Tailings Radiation Control Act. Because vanadium is not regulated by a U.S. Environmental Protection Agency maximum concentration limit, DOE must determine a risk-based threshold. The vanadium concentration would probably not reach a risk-based level of 0.33 milligram per liter in the 100-year time frame because of its low mobility in the subsurface. In addition, some soils at the site contain elevated concentrations of vanadium, which may serve as a continuing source of groundwater contamination.

The selected compliance strategy at the New Rifle site is natural flushing for all contaminants of concern except vanadium, which will be treated in the pilot study to a concentration that would allow the remaining vanadium to be removed by natural flushing. An alternative evaluation of treatment methods that would effectively remove vanadium from groundwater was presented in the Site Observational Work Plan prepared for New Rifle (dated November 1999). The alternative evaluation indicated that a flow-through treatment using zero-valent iron (ZVI) would remove vanadium to nondetectable levels and was more cost effective than other methods. ZVI is granular cast iron produced by the automotive industry and has been used extensively to treat groundwater passively in permeable reactive barriers (see related article on page 12). Because this technology had not been applied in an ex situ flow-through system, a pilot study was undertaken to optimize the design.



Environmental Science Laboratory personnel conducted a pilot study in this structure at the New Rifle, Colorado, site to determine the suitability of zero-valent iron to remove vanadium contamination from groundwater.

The DOE Grand Junction Office (GJO) developed a two-phased pilot study last summer that focuses on vanadium removal and treatment at the New Rifle site. Phase I was designed to evaluate the feasibility of removing vanadium from groundwater at the site and to determine the effect of soils as a continuing source of groundwater contamination. Phase II will focus on pumping out 1 pore volume or about 20 million gallons of the highest vanadium concentrations in the dissolved contaminant plume. Results of the pilot study should set the conditions such that natural flushing will meet risk-based standards for vanadium contamination within 100 years.

Vanadium-contaminated groundwater passes through clear acrylic columns containing zero-valent iron in the pilot study conducted at the New Rifle, Colorado, site.

Phase I of the pilot study is being conducted in two parts. In Phase Ia, which began last October and was completed in January, column tests were conducted using groundwater contaminated with high concentrations of vanadium. Phase Ia tests consisted of extracting water from an existing monitor well and passing it through clear acrylic columns containing ZVI. Effluent (outflow) from the columns was treated to remove the dissolved iron and the treated effluent was reinjected into the aquifer. Technical information obtained from the pilot study is being used to design a larger scale treatment system. Variables evaluated to optimize the treatment system include type and grain size of ZVI, flow rate, oxidation state, and pH.

ZVI was identified as a viable treatment alternative based on the Phase Ia pilot study. Work has begun on scaling up the selected ZVI system (Phase Ib) and extracting larger quantities of groundwater for treatment. Groundwater modeling determined that three extraction wells are required to capture the vanadium plume and identified the best locations for these wells. The scaled-up pilot test will operate for approximately 6 months.

DOE is committed to protecting human health and the environment and to preserving current and future uses of the shallow groundwater. “We will do this in a consensus fashion using reasonable cost-to-benefit analysis techniques,” said Donald Metzler, DOE–GJO Project Manager for the UMTRA Ground Water Project. “Using the ZVI treatment approach is a simple and relatively inexpensive method to remove some of the troublesome contaminants,” he said. The shallow floodplain alluvial aquifer is not projected for extensive future use because of the limited areal extent, thin saturated thickness, and variable water quality. However, there are a few domestic and industrial users of the aquifer. DOE–GJO is working with the City of Rifle, Garfield County, and the State of Colorado to provide a clean water supply to existing and future residents. “Natural flushing, coupled with an alternative water supply and institutional controls, are a wining combination for everyone,” said Metzler.

For more information about the UMTRA Ground Water Project or the New Rifle pilot study, contact Donald Metzler, DOE–GJO Project Manager, at (970) 248–7612.❖