UMTRCA Title I

Monument Valley, Arizona, Processing Site

This fact sheet provides information about the Uranium Mill Tailings Radiation Control Act of 1978 Title I processing site at Monument Valley, Arizona. This site is managed by the U.S. Department of Energy Office of Legacy Management.

Site Description and History

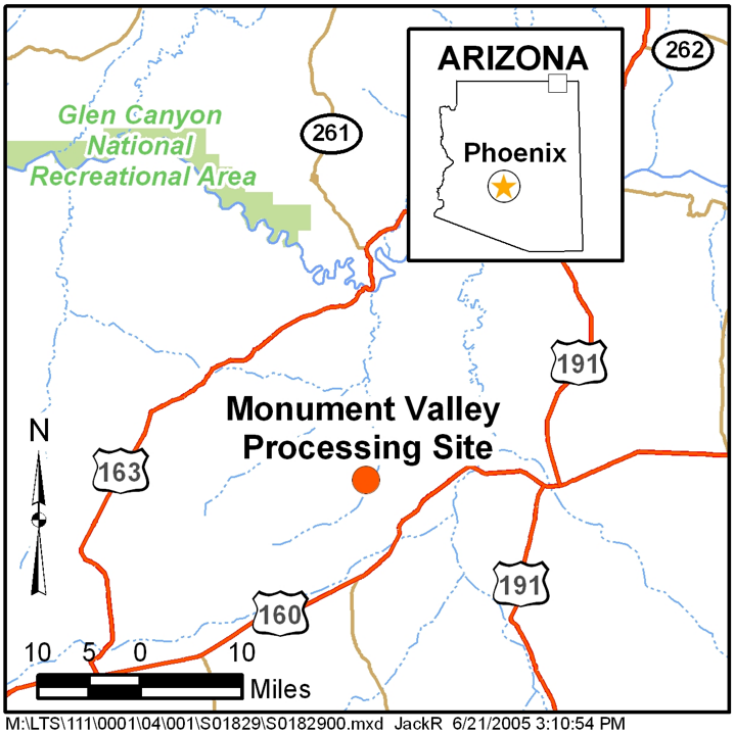
The Monument Valley processing site is located on the Navajo Nation in northeastern Arizona, approximately 15 miles south of Mexican Hat, Utah, on the west side of Cane Valley. A uranium-ore processing mill operated at the site from 1955 to 1968 on property leased from the Navajo Nation. The mill closed in 1968, and control of the site reverted to the Navajo Nation. Most of the mill buildings were removed shortly thereafter.

Uranium was first discovered in 1942 approximately 0.5 mile west of the site. From 1955 until 1964, ore at the site was processed by mechanical milling using an upgrader, which crushed the ore and separated it by grain size. The finer-grained material, which was higher in uranium content, was shipped to other mills for chemical processing. Coarser-grained material was stored onsite. The milling process also produced radioactive mill tailings, a predominantly sandy material.

Source materials and other site-related contamination were removed during surface remediation at the site from 1992 through 1994. All contaminated materials from the Monument Valley processing site were transported north (approximately 15 miles) and encapsulated in the Mexican Hat disposal cell. However, analyses of subpile soil samples (samples collected beneath the "footprint" of the former tailings piles) at the site indicate contaminants in these soils may be a continuing source of groundwater contamination. Ammonium in the subpile soil appears to be contributing to nitrate contamination in groundwater.

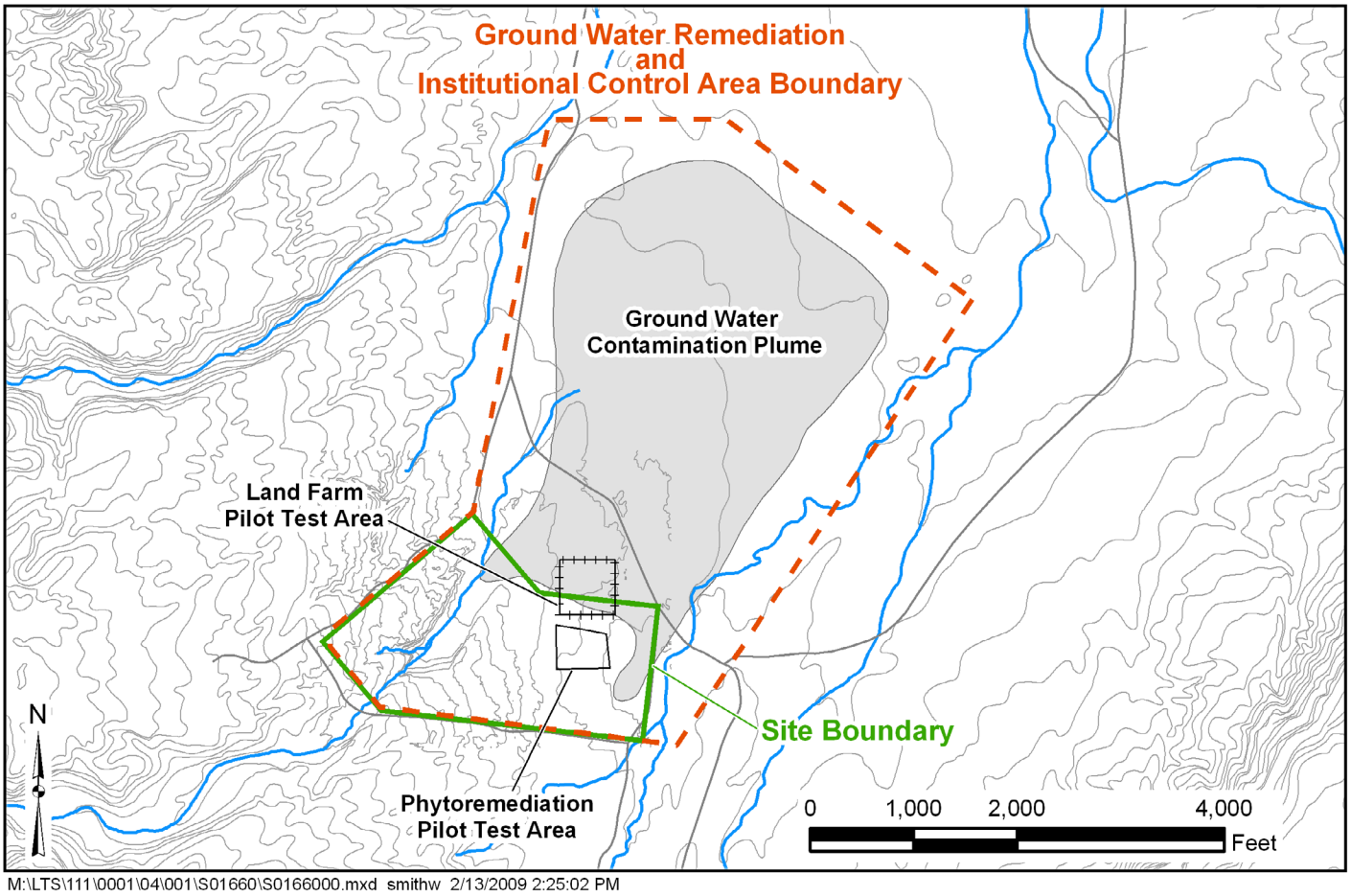
Regulatory Setting

U.S. Congress passed the Uranium Mill Tailings Radiation Control Act (UMTRCA) in 1978 (Public Law 95-604), and the



Location of the Monument Valley, Arizona, Processing Site

U.S. Department of Energy (DOE) remediated 22 inactive uranium-ore processing sites under the Uranium Mill Tailings Remedial Action Project in accordance with standards set by the U.S. Environmental Protection Agency in Title 40 *Code of Federal Regulations* (CFR) Part 192. Subpart B of 40 CFR 192 regulated cleanup of contaminated groundwater at the processing sites. The radioactive materials were encapsulated in U.S. Nuclear Regulatory Commission (NRC)-approved disposal cells. NRC general license for UMTRCA Title I sites is established in 10 CFR 40.27.



Institutional Control Boundary, Groundwater Contaminant Plume, and Phytoremediation Areas at the Monument Valley, Arizona, Processing Site

The Mexican Hat disposal site was included under the general license in 1997 and transferred to DOE at that time.

Processing Site

Groundwater at the former processing site is present in three aquifers: the alluvial (uppermost), the underlying Shinarump, and the De Chelly, the deepest of the three. Only the alluvial and De Chelly aquifers show evidence of milling-related contamination. Contamination in the De Chelly is limited to a small, isolated area where uranium concentrations in samples collected from one well slightly exceed the standard in 40 CFR 192. Historically, the De Chelly aquifer was used to supply water for the milling operation. Pumping from this source drew uranium contamination from the overlying alluvium into the De Chelly aquifer. Uranium in the alluvial aquifer is also limited to this same isolated area.

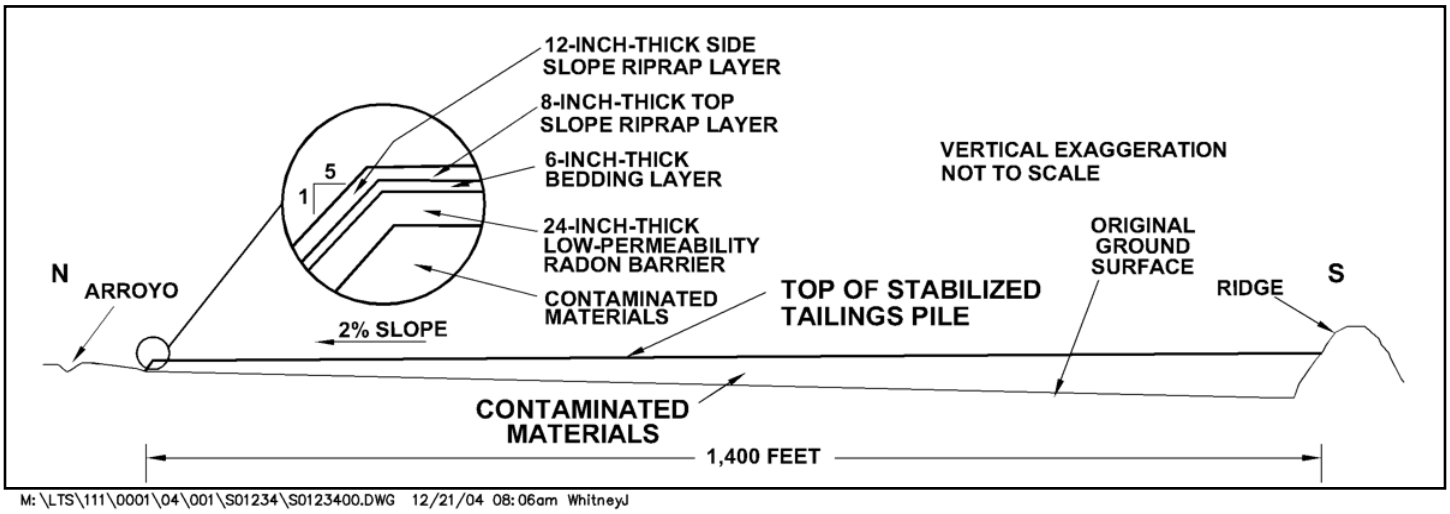
Approximately 540 million gallons of water are contaminated in the alluvial aquifer. Ammonium, nitrate, and sulfate are the contaminants of concern in the groundwater. Nitrate contamination in alluvial groundwater has migrated more than 4,500 feet north of the former mill site.

Compliance Strategy

Compliance strategies for both the De Chelly and alluvial aquifers include natural flushing, monitoring, and institutional controls. Natural flushing includes a variety of natural physical, chemical, and biological processes that reduce the concentration of contaminants in soil or groundwater. Provisions in 40 CFR 192 allow for natural flushing as a compliance strategy if contaminant concentrations will decrease to acceptable levels within 100 years. Monitoring will consist of collecting and analyzing groundwater samples from monitoring wells screened in the De Chelly and alluvial aquifers.

The compliance strategy for the alluvial aquifer addresses three areas of concern: subpile soils, shallow alluvial groundwater, and deep alluvial groundwater. Natural flushing is proposed for the deeper portions of the aquifer. The compliance strategies for subpile soils and shallow portions of the aquifer are a combination of natural flushing and phytoremediation. Phytoremediation relies on the deep roots of plants to uptake water and convert nutrients to plant growth. Ammonium and nitrate, constituents of concern in the alluvial aquifer, are nutrients that enhance plant growth. Preliminary estimates indicate that phytoremediation could potentially reduce the time required to clean up the alluvial nitrate plume.

DOE is currently conducting a series of pilot studies of the alluvial aquifer to evaluate how well phytoremediation and other natural flushing processes, such as enhanced



North-South Cross Section of the Mexican Hat Disposal Cell

attenuation and bioremediation, will work. Enhanced attenuation involves starting or boosting natural and sustainable attenuation processes. The goal is to increase the level of attenuation beyond the process that happens naturally. Bioremediation relies on bacteria to change or break down contaminants into less harmful substances (e.g., microbial denitrification) to reduce concentrations of nitrate in the source area and plume. To date, results of these studies confirm that the natural attenuation of nitrate is occurring at the site and that natural and enhanced phytoremediation and bioremediation may be workable options for lowering nitrate and sulfate levels in the alluvial aquifer and at the plume source. Planting and irrigating the source area has worked to remove nitrate from the soil by microbial denitrification, and the pilot studies have shown that natural attenuation is happening in the plume. Also, modeling suggests that injecting ethanol as a base for denitrification bacteria to live, could greatly increase the rate of denitrification and shorten the cleanup time.

The pilot studies were completed late in 2011 and in April 2013, DOE issued the *Monitored Natural and Enhanced Attenuation of the Alluvial Aquifer and Subpile Soils at the Monument Valley, Arizona, Site: Final Pilot Study Report,* which answers the questions—why did LM conduct the pilot studies, what was done, and what was found? DOE intends to release a final Groundwater Compliance Action Plan and National Environmental Policy Act documentation to begin implementing long-term compliance strategies in 2016.

An additional pilot study evaluated land farming, a form of active phytoremediation that uses groundwater pumped from deeper portions of the contaminated alluvial aquifer to fertilize plants to provide fodder for livestock or native plant seed that could be marketed (e.g., for mine land reclamation).

Institutional Controls

Institutional controls at the site include fencing around the phytoremediation areas to prevent grazing by livestock and wildlife and to maximize plant growth. DOE will work with the Navajo Nation to restrict access to contaminated groundwater during the remediation period and has provided a treated water supply to local residents for domestic use.

Mexican Hat, Utah, Disposal Site

Approximately 1.3 million dry tons of tailings and associated waste were hauled from the Monument Valley processing site and placed with tailings from the Mexican Hat processing site in the Mexican Hat disposal cell.

The cell contains 4.4 million dry tons (approximately 3.6 million cubic yards) of contaminated material with a total activity of 1,800 curies of radium-226. Information about the Mexican Hat disposal site is available at http://www.lm.doe.gov/Mexican_Hat/mexhat-factsheet.pdf.

Disposal Cell Design

The cell occupies an area of 68 acres on the 119-acre site. It lies along a rock outcrop on the south and rises 50 feet above the surrounding land on the other sides. A posted, wire fence surrounds the cell. The cover of the disposal cell system is designed with multiple parts to encapsulate and protect the contaminated materials. The cover is formed of (1) a radon barrier (first layer placed over compacted tailings) that does not allow substances to flow through easily, (2) a bedding layer of sand and gravel to control moisture, and (3) a rock (riprap) layer to prevent erosion. The cell design promotes rapid runoff of moisture so that it has less of a chance to seep through the protective layers. Runoff water flows down the 20-percent side slopes into the surrounding rock apron.

The site location and disposal cell design were selected to minimize the potential for erosion from onsite runoff or storm water flow. All surrounding remediated areas were regraded and reseeded with native plantings. Existing gullies around the cell were protected with riprap that was keyed into competent rock to prevent erosion. Riprap-protected diversion ditches were installed to direct runoff water away from the cell.

Legacy Management Activities

The DOE Office of Legacy Management (LM) will conduct pilot studies at the Monument Valley processing site and will continue with the strategy of phytoremediation, groundwater monitoring, and enforcement of institutional controls until contaminant concentrations have decreased to acceptable levels. LM manages the Mexican Hat disposal site according to a site-specific Long-Term Surveillance Plan to ensure that the disposal cell systems continue to prevent release of contaminants to the environment. Under provisions of this plan, LM conducts annual site inspections to evaluate the condition of surface features, and performs site maintenance, as necessary, to ensure the continued integrity of the disposal cell.

In accordance with 40 CFR 192.32, the disposal cell is designed to be effective for 1,000 years to the extent reasonably achievable, and, in any case, for at least 200 years. However, the general license has no expiration date, and LM's responsibility for the safety and integrity of the Mexican Hat disposal cell will last indefinitely.

Contacts

Documents related to the Monument Valley processing site and the Mexican Hat disposal site are available on the LM website at http://www.lm.doe.gov/monvalley/Sites.aspx and http://www.lm.doe.gov/mexican_hat/Sites.aspx.

For more information about LM activities at the Monument Valley and Mexican Hat sites, contact:

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