

# Exxon–Highland Uranium Recovery Facility

## Site Location and Facility Description

Exxon’s Highland uranium mill site is located in Converse County, Wyoming, about 35 miles north of Douglas, Wyoming (Figure 1). The mill operated from 1972 until shutdown in 1984 and currently is in decommissioning status. A plume of contamination has been detected flowing to the east of the site onto private property. New wells have been installed, and samples are being collected to determine the extent of the plume. The Pit Lake (Figure 2) has also been contaminated and has elevated levels of uranium and selenium. These areas of contamination will delay site closure. No new closure date has been estimated.

The Highland mill used a conventional acid leach-solvent extraction process to extract uranium from the ore. Approximately 2,190 acres of land was disturbed by mining activities. The minable uranium occurred as a roll-front deposit that trended roughly northwest in the area of the milling site. The mill tailings were deposited in an above-grade impoundment formed by damming an

unnamed ephemeral tributary to the North Fork of Box Creek. Overburden removal for surface mining began in September 1970, and underground mining began in 1973, with the sinking of the Buffalo Shaft. *In-situ* recovery mining occurred in a pilot mine that was initiated in 1972 and terminated in 1981. The overburden from new mining operations was placed in old mined out pits. The final two pits (Pits 3 and 4) were not filled. Beginning in March 1984, groundwater from the surrounding aquifer was allowed to discharge into the two pits, forming the Pit Lake. The Pit Lake is oriented roughly southeast-northwest, covers about 110 acres, and is more than 130 feet deep. Reclamation work and groundwater corrective action have taken place since 1984.

## Facility Licensing and Operating History

A Source Materials License No. SUA-1139 was originally issued to Standard Oil Company of New Jersey, operating as Humble Oil and Refining Company, by the Atomic Energy Commission (AEC). Exxon (then Standard) began conventional

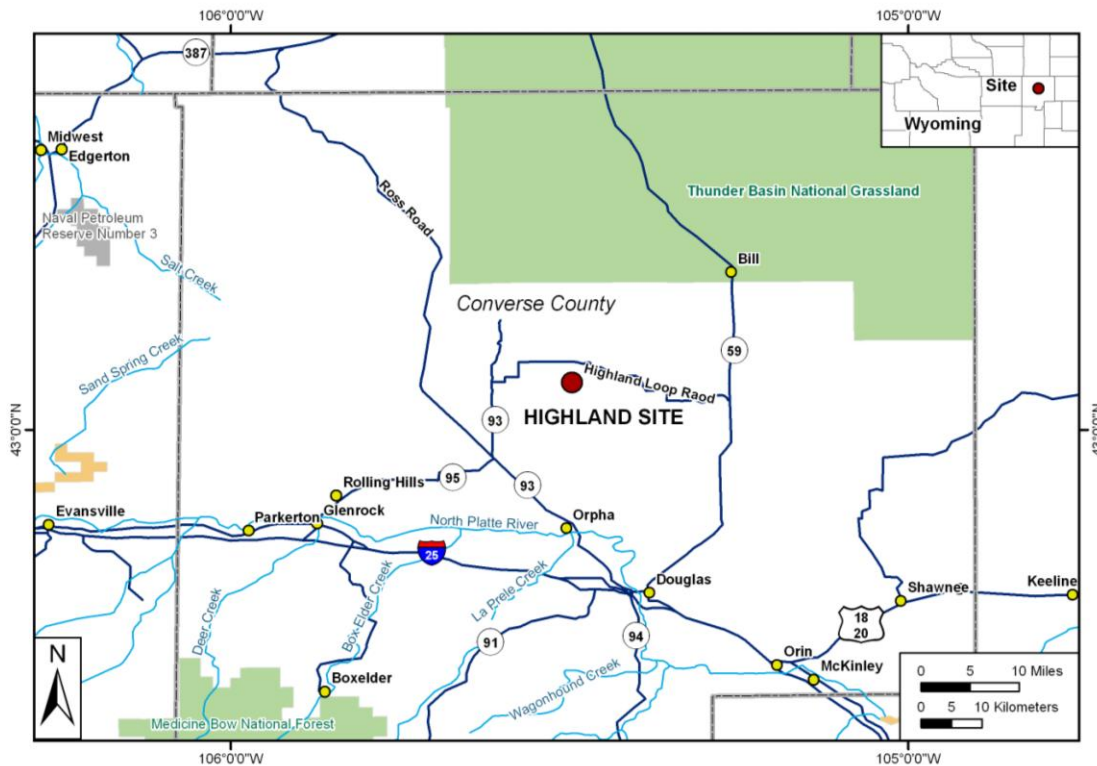
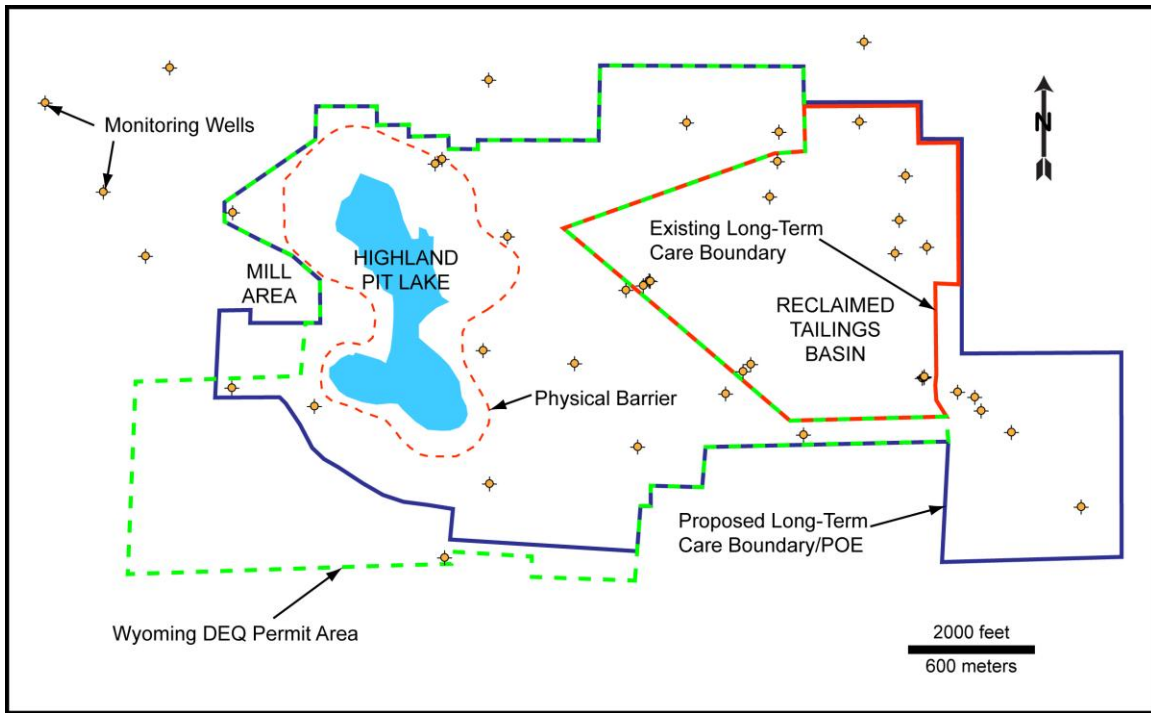


Figure 1. Highland Uranium Mill Site Location Map



**Figure 2. Highland Site Layout**

uranium milling at the Highland site in October 1972. Exxon owned and operated the uranium mines that provided the ore for the mill. A limited amount of toll milling also took place at the Highland facility.

The mill processed about 10.5 million tons of uranium ore, which did not have significant concentration of vanadium or molybdenum typical of some uranium ores. The mill contained a conventional dry crusher and wet rod mill to separate the individual grains in the ore. The resulting slurry was leached with sulfuric acid and sodium chlorate at a pH of between 1 and 1.5. The uranium was separated from the tailings through countercurrent decantation using a series of thickeners. Barren tailings were pumped into the basin at about 35 percent solids by weight. The uranium liquor was processed by solvent extraction to yield a rich eluate for uranium precipitation and drying. All aspects of mining and milling ceased in 1984 when reclamation activities began.

The uranium mill area, including the ore storage pads and the laboratory, has been cleaned up and

the tailings buried under a radon barrier, eliminating nearly all potential for radiation exposures to workers or members of the general public from these sources. However, the reclamation operations may result in minimal exposure of workers to radioactive materials. All windblown material has been reclaimed to unrestricted release standards. The byproduct material exposure is limited to the groundwater pathway. There is no current use of groundwater.

### **Tailings Management and Disposal**

Tailings deposition took place from the mill startup in October 1972 until June of 1984. The resultant tailings consisted of sand and slimes fractions, which were discharged to an approximate 20-acre tailings basin around the perimeter of the tailings basin, and causeways were built out into the tailings basin. The rock formations mined at the site are primarily in the Paleocene Fort Union Formation, which underlies the Eocene Wasatch Formation and are composed of a stacked sequence of sedimentary rocks that generally consist of interbedded sandstones and shales.

<sup>1</sup>Source: ARCADIS. "Groundwater Well Locations and WDEQ and NRC Boundaries Map." Lakewood, Colorado: ARCADIS. 2008.

During operation, seepage from the tailings basin resulted in the development of a groundwater mound under and around the tailings basin. As the mound grew, it eventually reached an elevation that caused tailings fluid seepage to enter the alluvial deposits downstream of the dam. The center of the dam was keyed into the underlying Tailings Dam Shale (TDSH), which prevented any seepage moving under the dam. However, the wings of the dam were not keyed into the TDSH and allowed seepage to move through the wings and outside of the tailings impoundment. In 1975, a sump system was constructed to capture this seepage and pump it back to the tailings basin.

The underground and open pit mining that took place at the Highland site necessitated lowering the local water table below the working level in the mines. Groundwater at the site generally flows in an easterly direction. Studies done in 2007 by Exxon also suggest contaminants have seeped to the west into Pit Lake.

Several amendments have been made to the license to allow alternate concentration limits (ACLs) for groundwater at three of the point of compliance (POC) wells, on a well-by-well, constituent-by-constituent basis. In 2009, Exxon

submitted a notice of intent to redefine the proposed long-term surveillance and monitoring boundary, including the establishment of new and revised ACLs with associated POCs and points of exposure (POEs). This proposal was not implemented because a plume of contamination was discovered. The following groundwater protection standards were implemented in 2006 for four POC wells (Nos. 125, 175, 176 and 177) and on background well No. 182: arsenic = 0.05 mg/L, cadmium = 0.01 mg/L, chromium = 0.1 mg/L, gross alpha = 15.0 pCi/L, lead = 0.05 mg/L, nickel = 0.1 mg/L, radium-226 and 228 = 5.0 pCi/L, selenium = 0.05 mg/L, thorium-230 = 0.55 pCi/L, and uranium = 0.03 mg/L. Exceptions were well 125 uranium = 0.089 mg/L, well 175 nickel = 1.8 mg/L, and radium-226 and -228 = 25 pCi/L, and well 177 uranium = 0.11 mg/L.

### **Additional Information**

For more information about the Highland uranium recovery facility, visit the U.S. Nuclear Regulatory Commission (NRC) uranium recovery website at <http://www.nrc.gov/info-finder/materials/uranium/> or contact the NRC facility project manager, Thomas McLaughlin, at (301) 415-5869 or [tgm@nrc.gov](mailto:tgm@nrc.gov).