

# Willow Creek Uranium Recovery Project

## Site Location and Facility Description

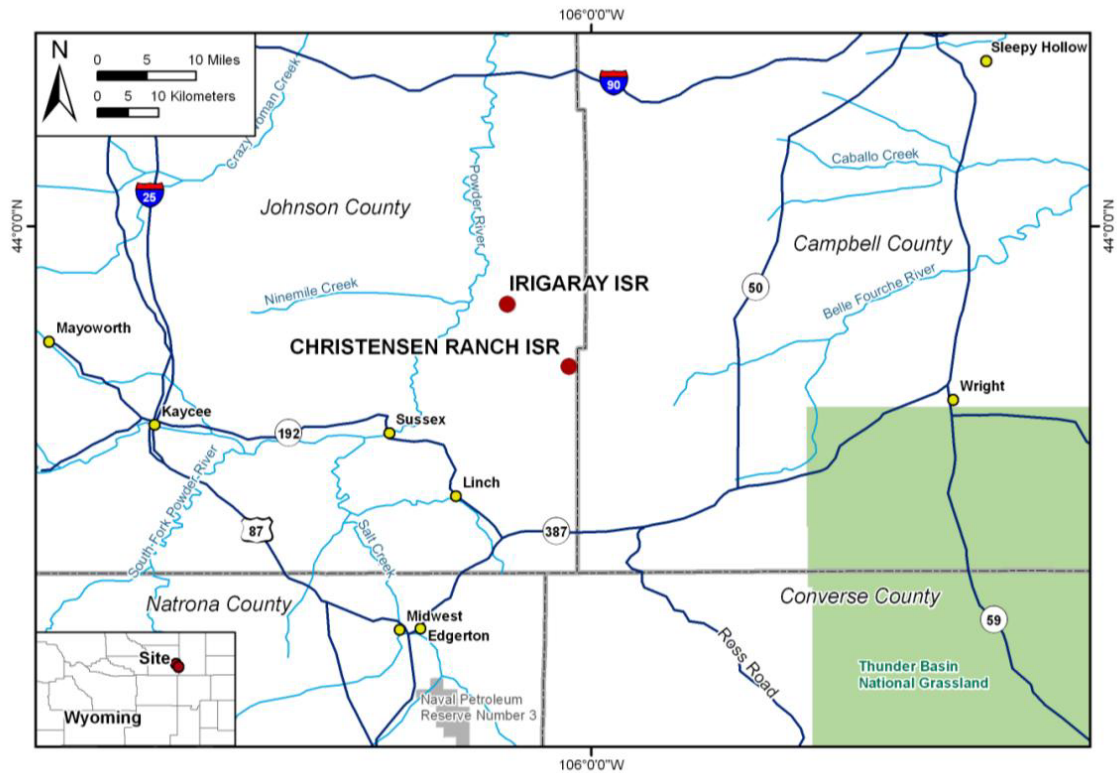
The Willow Creek Project, formally known as Irigaray and Christensen Ranch, is composed of two distinct sites (Figure 1). The Irigaray site (Figure 2) contains the Irigaray central processing plant (CPP) and wellfields and is located in southeast Johnson County, approximately 10 miles northeast of Sussex, Wyoming; 43 miles southeast of Buffalo, Wyoming; and 90 miles north-northeast of Casper, Wyoming. The Christensen Ranch site satellite operation (Figure 3) contains an ion exchange plant and wellfields and is located along the Campbell Johnson County boundary, about 30 miles north-northeast of the town of Midwest, Wyoming, and 50 miles southwest of Gillette, Wyoming. The Willow Creek Project contains approximately 15,000 acres of land—half is privately owned and half is owned by Bureau of Land Management and the State of Wyoming. Active uranium recovery operations restarted at the Willow Creek Project in December 2010.

Processing facilities include the Irigaray CPP, which contains an average 2,400 gallons per minute ion exchange plant and the resin elution, precipitation, and drying/packing circuits. Drying capability at the Irigaray CPP is equivalent to approximately 2.5 million pounds throughput per year. The Christensen Ranch satellite extraction plant consists of an ion exchange circuit, which will be operated at a maximum flow rate of 9,000 gallons per minute on an annual average, and a lixiviant makeup circuit. Resins are shipped to the Irigaray CPP for elution, precipitation, and drying.

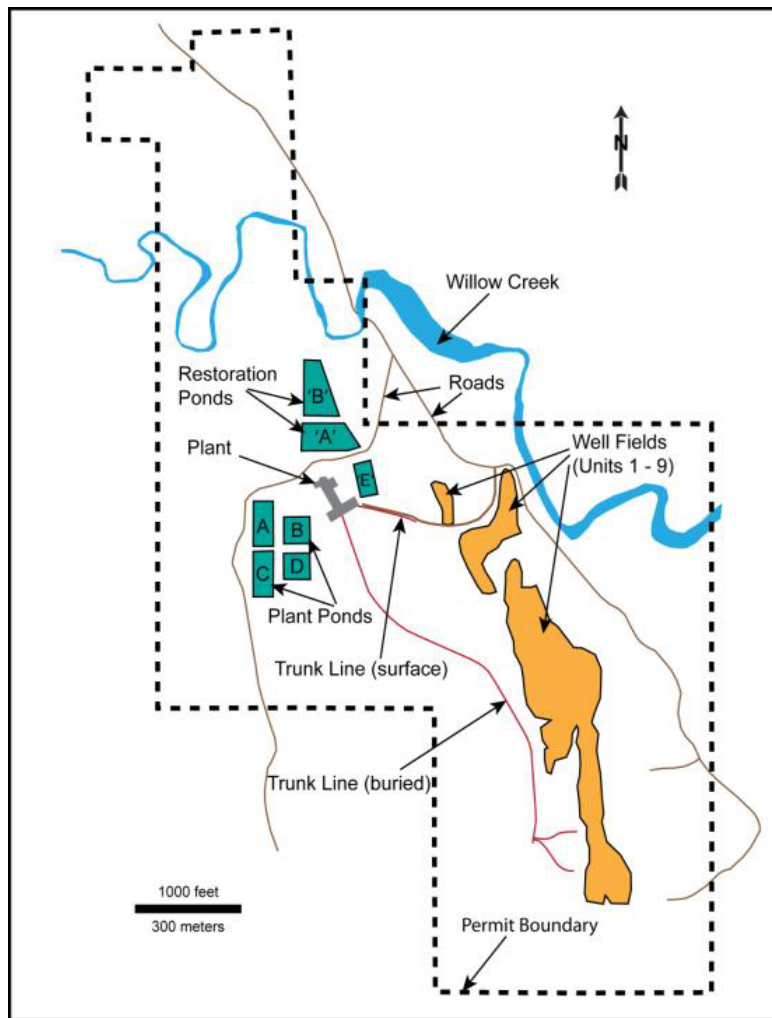
At the Irigaray site, restoration of wellfield mine units 1 through 9 has been completed and the U.S. Nuclear Regulatory Commission (NRC) approved the groundwater restoration in September 2006. All wells in mine units 1 through 6 have been sealed and abandoned, the wellheads and surface piping have been removed, and the restoration building is currently being used for storage. In mine units 7, 8, and 9, the wellfield buildings, buried trunklines, and manholes have been removed. Also, the buried pipelines leading to each well in Unit 7 have been removed, but a few wellheads remain to mark the locations of existing buried piping in Units 8 and 9.

At the Christensen Ranch site, production activities were completed in mine units 2 through 6 in June 2000. Groundwater restoration and stabilization in mine units 2 through 6 was completed in May 2005. A report on groundwater restoration was submitted to NRC in April 2008. The NRC completed its review of the groundwater restoration efforts in mine units 2 through 6 in October 2012, but did not approve groundwater restoration at the Christensen Ranch site. Prior to the resumption of operations, the floor of the plant building was repaired, the plant equipment was refurbished, and the control room was remodeled. Four lined evaporation ponds remain at the site (Figure 3).

Two deep disposal wells are used for liquid waste disposal at the Christensen Ranch site. In addition, two additional deep disposal wells are licensed for the Christensen site under license SUA-1341, but have not been drilled.

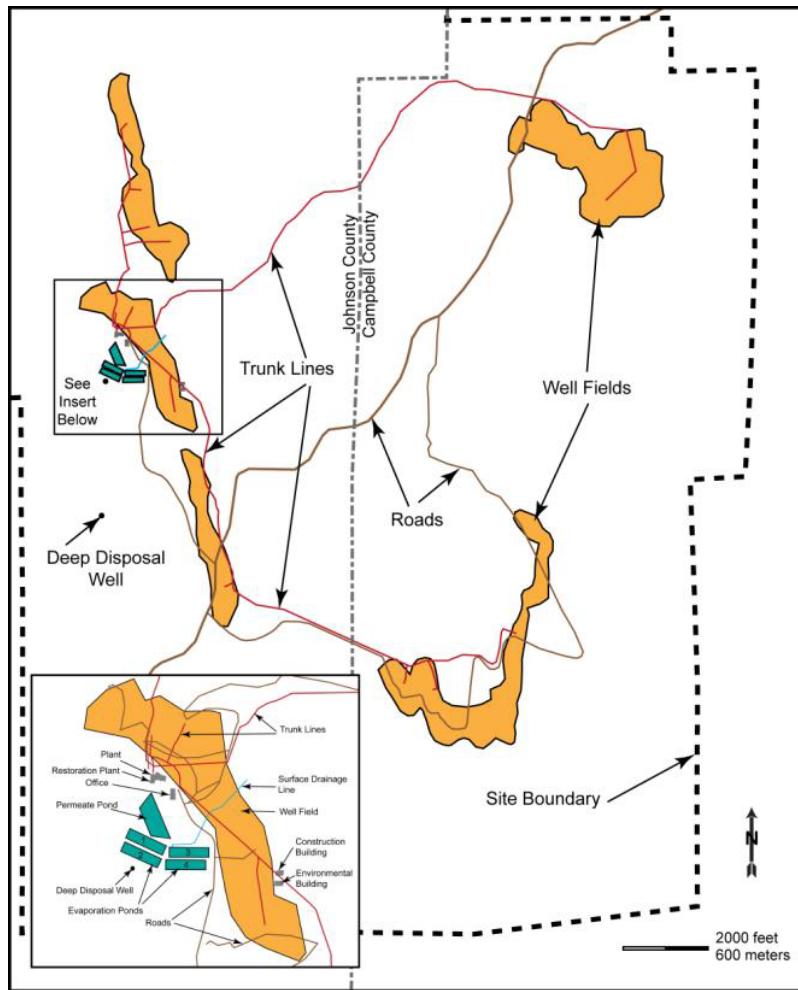


**Figure 1. Willow Creek Project, Irigaray and Christensen Ranch Uranium Recovery Site Location Map**



**Figure 2. Irigaray Site Layout<sup>1</sup>**

<sup>1</sup> COGEMA Mining, Inc. — Irigaray and Christensen Ranch Projects: Annual Report. Mills, Wyoming: COGEMA Mining, Inc. 2009.



**Figure 3. Christensen Ranch Site Layout<sup>2</sup>**

<sup>2</sup> Ibid.

## **Facility Licensing and Operating History**

The Irigaray site was originally acquired and operated by Wyoming Mineral Corporation, a subsidiary of Westinghouse Electric Corporation, in August 1978. Malapai Resources Company, a subsidiary of Arizona Public Service, purchased the Irigaray site from Westinghouse in June 1987 and incorporated the Christensen Ranch site under the same license in 1988. The source material license SUA-1341 was originally issued to Wyoming Mineral Corporation in November 1978. Prior to issuance of the commercial license, Wyoming Mineral Corporation was granted source material license SUA-1204 in July 1974, authorizing a research and development uranium recovery operation at the Irigaray site. The Irigaray project was licensed to operate at an 800 gallon per minute flow rate, using an ammonium bicarbonate lixiviant. Additionally, the use of sodium bicarbonate was discontinued in the uranium precipitation cycle in the processing plant in favor of precipitation with hydrogen peroxide. In 1982, operations ceased at the Irigaray plant and wellfields, and the facility was placed on standby status pending improvements in the uranium market.

In 1987, Malapai Resources Company purchased the Irigaray site and resumed operations. In 1988, NRC approved an amendment request from Malapai Resource Company to include the Christensen Ranch satellite ion exchange plant and the associated wellfields. The Irigaray process was then upgraded to include facilities for processing ion exchange resin from Christensen Ranch, and the flow rate of the Irigaray recovery plant was increased to 2,400 gallons per minute capacity. Operations under Malapai Resource

Company continued through February 1990. In September 1990, Malapai was sold to Electricité de France (EdF), a French nuclear utility. EdF chose Total Minerals Corporation (TOMIN) to be the operator of the Irigaray and Christensen Ranch projects. Effective September 20, 1990, all state and federal permits and licenses Malapai formerly held were transferred to TOMIN. TOMIN resumed operations of the Malapai properties in 1991. In 1993, another French company, COGEMA Mining Inc. (COGEMA), acquired the ownership of the EdF Malapai properties in Wyoming and Texas and continued the *in-situ* recovery operation until June 2000. At this time, the licensee stopped uranium production and transitioned to wellfield restoration and site decommissioning.

In April 2007, COGEMA requested a return to operational status with essentially the same license conditions that existed in its last operational license before it obtained a possession-only license for restoration and decommissioning. NRC approved the request to return to operating status on September 30, 2008. On January 25, 2010, Uranium One USA, Inc. (Uranium One) completed the purchase of COGEMA, which included the change of control for SUA-1341. The NRC approved the return to active uranium recovery operations at the Willow Creek Project in December 2010. On December 27, 2010, Russian State Atomic Energy Corporation (Rosatom) completed the purchase of Uranium One, Inc., which resulted in a change of control from Uranium One, Inc., the Canadian parent company of Uranium One, to Rosatom.

## **Groundwater Protection and Airborne Effluent and Environmental Monitoring Program**

Four distinct stratigraphic units are recognized in the Powder River Basin as a result of surrounding tectonic activities. These are the Cretaceous Lance Formation, Paleocene Fort Union Formation, Eocene Wasatch Formation,

and Oligocene White River Formation. Surficial geology of the area is made up of Quaternary alluvial and Tertiary Wasatch outcrops. The White River Formation does not exist within the Powder River Basin in the vicinity of the Irigaray and Christensen Ranch sites, except for a thin cap on top of the Pumpkin Buttes. Subsurface geology consists of fluvial deposits of the Wasatch Formation, Fort Union, and Lance Formation. The subsurface Wasatch sediments, which contain the uranium deposits being mined, are a complex, interrelated sequence of shales, mudstones, siltstones, sandstones, and thin lignite coal seams.

Movement of lixiviant, source, and byproduct material is monitored through wells within and surrounding the wellfields. These wells are monitored every 2 weeks during operations. Additionally, all injection wells are required to be tested for mechanical integrity every 5 years to ensure they will not leak lixiviant, source, and byproduct material. Those that fail are taken out of service or repaired.

Willow Creek, which intermittently flows through the Irigaray and Christensen Ranch sites, is sampled quarterly. The water is sampled for eight chemical parameters and five radionuclides. NRC staff reviewed the available surface water samples collected during 2012 and determined that all sample results were less than the 10 CFR Part 20, Appendix B, Table 2, effluent concentration limits for all radionuclides.

The process plants are equipped with a spillage containment system. The curbed plant foundation and sumps

ensure that leaks and spills within the plant should not leave the plant area. Monitoring and inspections ensure that evaporation ponds are not overfilled and that leaks, eroded areas, liner damage, or other potential problems are detected. No transport pathways exist that are likely to bring process solutions into contact with surface water.

Radon concentrations and gamma radiation levels are measured quarterly at several environmental stations on the Irigaray and Christensen Ranch sites. Uranium fines released during drying and packaging of yellowcake are limited by a stack scrubber and filtration system, and routine monitoring is conducted for airborne uranium particulates. These particulates were controlled within required limits during past production. Radioactive particulates within the buildings, the dryer facility, and the perimeter of the site are monitored and controlled within the required radiological limits. During dryer operations, the licensee is required to perform dryer stack emissions tests and continuous airborne radionuclide sampling.

For 2012, gamma radiation measured at various locations around both the Irigaray and Christensen Ranch sites were found to be below the annual dose limit to members of the public of 100 millirems.

#### **Additional Information**

For more information about the Willow Creek Project, visit the NRC uranium recovery website at <http://www.nrc.gov/info-finder/materials/uranium/> or contact the NRC facility project manager, Ron Linton, at (301) 415-7777 or [ron.linton@nrc.gov](mailto:ron.linton@nrc.gov).