CLUFF LAKE DECOMMISSIONING: SAFE AND STABLE FOR THE FUTURE

Project Overview:

The Cluff Lake Project is a decommissioned mine site located in northwestern Saskatchewan on Treaty 8 territory and within the homeland of the Metis. The closest community is Fort Chipewyan, Alberta about 100 km to the northwest although there is no direct road link. The closest communities by road are Clearwater River Dene First Nation and La Loche, Saskatchewan about 250 km to the south.

The Cluff Lake Project was owned, operated, and decommissioned by Orano Canada Inc. (Orano) which has undergone several name changes over the years from AMOK to COGEMA to AREVA to Orano. The project is named after Cluff Lake, the largest lake found on the surface lease. The site has been managed by Orano throughout its history. During operations, which began in 1980 and ended in 2002, the Cluff Lake Project produced uranium and gold.

The Cluff Lake Project followed a responsible approach to uranium mining. Unlike earlier Uranium mining projects, decommissioning was considered in detail during the mine's development and production phases, and Orano maintained responsibility for the entire life of the project. Decommissioning of the mine was subject to an environmental assessment that lasted several years with review from federal and provincial regulatory agencies and the public.

The goal of decommissioning is to make the area safe and stable for land use now and in the very long-term, with only a small fingerprint remaining from mining activity. Decommissioning works were largely completed by 2006. All buildings were demolished, contaminated water was treated, mined out pits were flooded to create lakes, and hundreds of thousands of trees were planted.

Northern residents were engaged throughout the decommissioning of the Cluff Lake Project through site tours, workshops and meetings. Here members of the Athabasca Chipewyan First Nation tour the site in August 2018.

Decommissioning Planning and Design:

Many studies were conducted throughout decommissioning to understand the post-decommissioning environment. The most detailed studies were related to waste rock and tailings, the two primary mine wastes. Both waste rock and tailings contain contaminants such as metals and radioactive elements that can move in groundwater and surface water. These metals and radioactive elements are naturally present in the environment but can cause environmental effects in high concentrations. Effective decommissioning of the waste rock and tailings facilities limits the movement of these contaminants in the environment to keep them at low and acceptable concentrations.

Waste rock is rock that must be moved to access ore. During operations at Cluff Lake, waste rock was blasted and moved to storage areas without any processing. Care was taken in the storage of waste rock to avoid potential issues.

During decommissioning, some waste rock was hauled back to mined out pits and some was left on surface. The waste rock was shaped, compacted, and then covered with a minimum of one metre of loose soil to allow vegetation to grow.

The waste rock areas are designed to minimize the amount of water that moves through the waste rock to avoid potential effects of metals or acidity that may be washed out of the pile.

After ore is milled, the left over processed rock and milling chemicals leave the mill as tailings. Tailings were placed in a tailings management area during operations and efforts were made to remove as much water as possible to make them more solid. Water from the tailings was treated in a water treatment plant to remove contaminants before it was released to the environment. During decommissioning, layers of soil were placed over the tailings to a minimum depth of one metre to isolate them from the environment and provide a base of soil deep enough to protect root growth of vegetation. This cover was then graded and drainage ditches were installed so that rain and melt water would run around the tailings area or over top of the soil cover. The tailings under the cover were prepared and deposited so that it is difficult for water to flow through them. This decommissioning design effectively limits the amount of water moving through the tailings which, as with the waste rock, limits effects to the environment near the tailings from contaminants being washed out.

Decommissioning Approval and Risk Updates:

Before any decommissioning took place the decommissioning designs, including those for waste rock and tailings covers, were evaluated with computer programs that predict the movement of metals and radioactive elements in the environment. Groundwater and surface water computer modelling and a risk assessment predicted that the decommissioned site would remain safe and stable over the very long-term. Provincial and federal regulatory authorities reviewed and approved the plans, and decommissioning work began in 2004.

A number of research projects and targeted monitoring were conducted during and after decommissioning to evaluate the effectiveness of decommissioning works and enhance the certainty of long-term predictions. This site-specific information was used to refine risk assessments over the course of decommissioning and the post-decommissioning period. A key update done in 2015 confirmed the long-term stability and safety of the site. In 2019, a comprehensive review by the Canadian Nuclear Safety Commission and Province of Saskatchewan concluded that the decommissioning objectives for Cluff Lake were achieved. The 2019 revised risk assessment is a revision of the 2015 submission with revisions to address comments from the public and regulatory experts.

Groundwater Model Overview:

The foundation of the decommissioning plan at Cluff Lake is the groundwater model. The model is based on a detailed understanding of how water enters the ground water system on the site, and where it moves before surfacing in lakes, streams and low-lying areas. The model uses the landscape (topography) of the region and groundwater levels measured in many observation wells to map the movement of groundwater, or flow paths, on the site. Once the movement of groundwater is understood, the covered waste rock and tailings are considered as sources for potential release of metals and radioactive elements to the groundwater. The characteristics of the sources and the flows are described within a computer program that calculates movement of contaminants along the flow paths. Together, the program, the characteristics, and the calculations are referred to as the groundwater model. Not all metals and radioactive elements travel in groundwater at the same pace. Some appear in surface water in decades and others over centuries or millennia. The slow movement of metals and radioactive elements demonstrates a success of decommissioning, which is to minimize and manage transport of contaminants from waste rock and tailings to the surrounding environment. The 2019 groundwater modelling document describes in detail the nature of the tailings, waste rock, and groundwater flows, and how the groundwater model is used to predict the movement of metals and radioactive elements in the environment under different scenarios.

Extensive monitoring of water, plants and animals on the site was conducted as part of decommissioning and continues today.

Environment:

Volume 1 of the Environmental Performance Technical Information Document (EP TID) describes the ecosystem and summarizes environmental data from the site (Pre-1979 Baseline to 2014). This information is used to evaluate the current environmental conditions of the decommissioned site and provide valuable input for the surface water quality modelling that is used to predict the future conditions at the site.

Ecological and Human Health Risk Assessment:

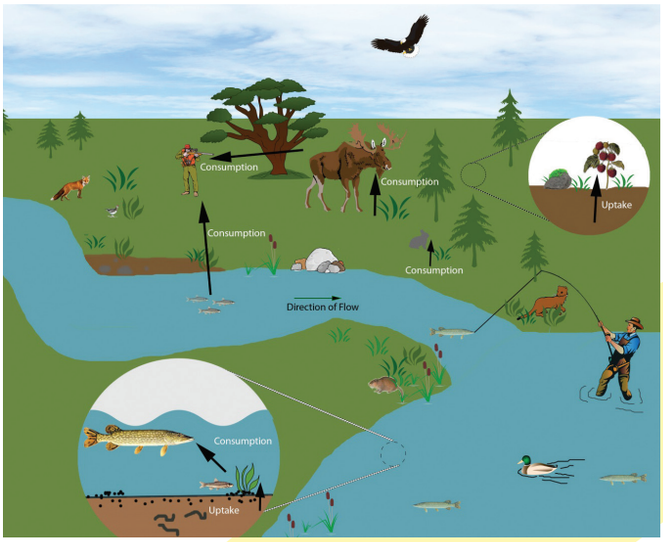
Metals and radioactive elements are naturally present in the environment. Mining activities can add to these levels through disturbance of natural landforms and storage of waste rock and tailings. Orano evaluates how these metals and elements move within the environment, including in surface water and groundwater and then applies the data to predict their future concentrations and determine any risk to the health of plants and animals living in the lakes and streams (aquatic) and the plants and animals (terrestrial) growing and living at the site.

Currently, the concentrations of some metals in Island Lake and immediately downstream are higher than background with some concentrations greater than water quality guidelines. The effects of 22 years of mining operations on water quality at the site are measurable, but are limited to an area of about 2.5 square kilometres, with dramatic improvement since operations ceased and ongoing recovery is expected.

In the future there is the potential for limited areas (Snake Lake, Claude Lake and Claude Creek) at site to have concentrations of metals or radionuclides that are higher than guidelines. It is important to understand the potential environmental risks that could occur from elevated metals and radioactive elements and determine if those risks are reasonable. In the aquatic environment, there is a potential for effects to some of the insects that live in the sediment at the bottom of Island Lake and the fen while the area recovers. In the future, there is potential for effects to some insects in Snake Lake and the organisms in Claude Creek. With the exception of these locations, where concentrations will decrease after peak concentrations are reached in the future, there is little indication of a potential for adverse effects on the aquatic environment.

Currently, there is some potential for effects to individual animals (mammals, waterfowl and other birds) that may use Island Lake and the fen exclusively during a period of elevated concentrations. Potential for effects decrease as concentrations of metals and radionuclides continue to decrease over time. There is a very low likelihood, but some possibility, for effects to individual mink, muskrat, yellowlegs, and nighthawk that may use Snake Lake or Claude Lake area during a period of elevated concentrations in the future. Due to their diets, these animals are expected to be exposed to more metals than other animals in the area. Once concentrations of metals and radionuclides peak in the future, they will then generally decrease (or improve) and the possibility of effects to individual animals will also decrease.

The objective of Cluff Lake decommissioning is to ensure the site is stable and safe for traditional land use both in the short term and over the long term. The human health risk assessment evaluated the potential effects on people using the decommissioned site. The assessment concludes that the site is safe for people who may hunt, fish, drink water, and gather (e.g. tea, berries, rat root) from the site and that food from and near the decommissioned mine site is safe to share with extended families, including children.



Ecological life cycle model.

Provincial Institutional Control:

Institutional control is a legislated program in Saskatchewan that protects the government and tax payers from the burden of managing old mine sites. The program ensures that companies decommission mine sites well with low remaining risks and ensures that any ongoing costs for monitoring and maintenance are covered by the company, not the taxpayer. The program also protects areas of land to make sure they are used appropriately in the future so that the decommissioned sites are not disturbed by other developments. With the Cluff Lake site fully decommissioned, stable, and safe, Orano has applied to transfer the site into institutional control.

Federal Regulator contact:
CNSC Uranium Mines and Mills Division
Tel: (306) 975-6372 email: cnsc.info.ccsn@canada.ca

Provincial Regulator contact:
Saskatchewan Ministry of Environment – Environmental Protection Branch
Tel: (306) 933-6240 email: centre.inquiry@gov.sk.ca

For more information, questions or comments:
Orano Canada Inc.
833 – 45th Street West
Saskatoon, SK S7L 5X2
Tel: (306) 343-4500
email: OC-publicrelations@orano.group
www.oranocanada.com

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