McClean Lake
Site Guide

orano

Orano Canada Inc.

McClean Lake

Orano's McClean Lake operation is located in northeast Saskatchewan on Treaty 10 Territory and the Homeland of the Métis, and over 750 kilometres northeast of Saskatoon.

The site is comprised of several uranium mines and the only mill designed to process high-grade uranium ore without dilution. Orano has operated several open-pit uranium mines at the McClean Lake site, and is evaluating future mines at and near the site.

A subsidiary of the multinational Orano group, Orano Canada has been exploring for uranium, mining and producing uranium concentrate in Canada for more than 60 years. The company operates the McClean Lake uranium mill and is a major partner in the Cigar Lake, McArthur River and Key Lake operations. Orano Canada is focused on providing a reliable and responsible supply of natural uranium to nuclear electricity producers around the world to generate low-carbon electricity. We are commited to being a responsible uranium miner in terms of health, occupational safety, community involvement and dialogue, environmental protection and business ethics.

Ownership

77.5%

orano

22.5%

Denison

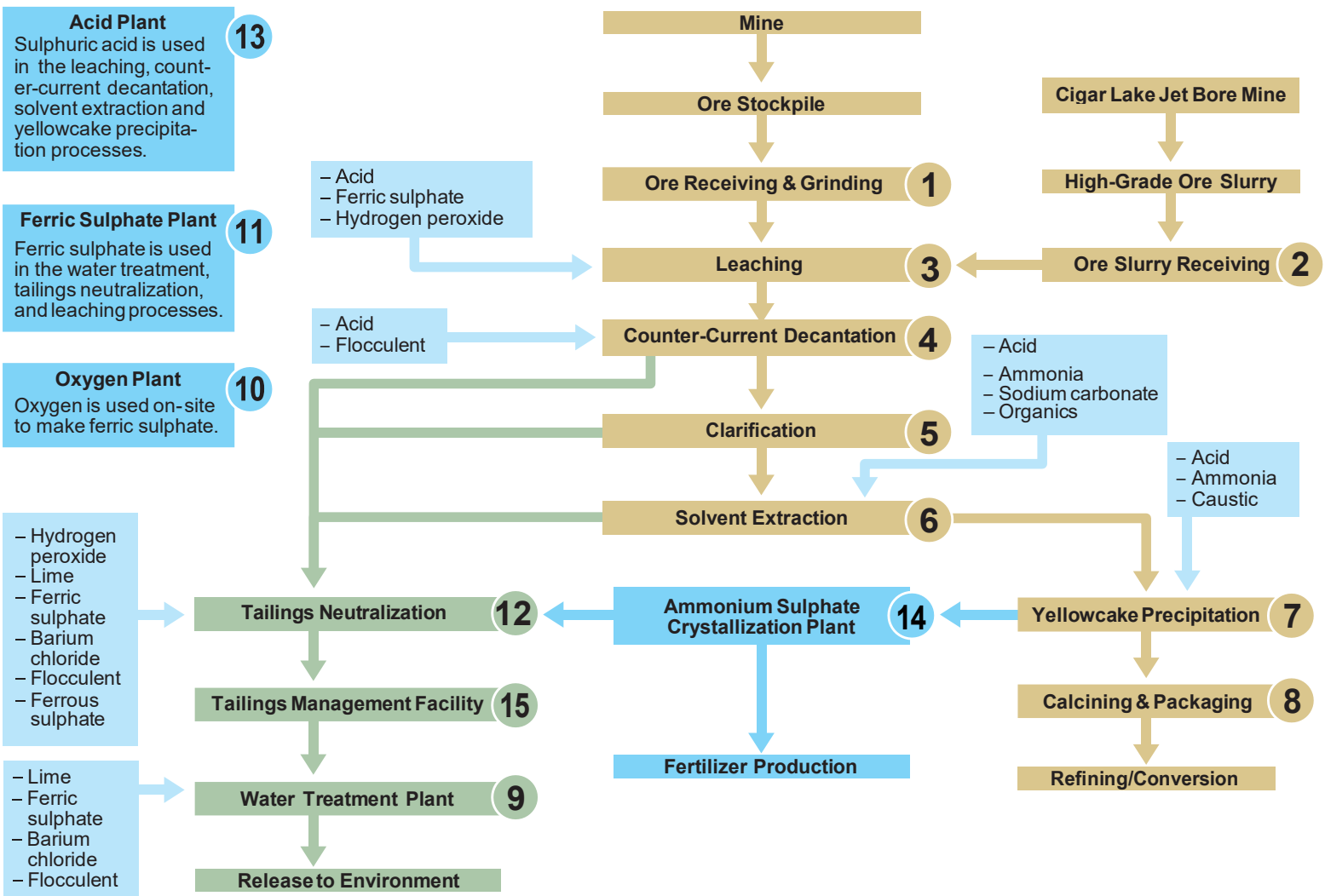
The McClean Lake Mill

The McClean Lake mill is the only facility in the world capable of processing high-grade uranium ore without dilution. It can process uranium ore grades over 100 times the world's average grade.

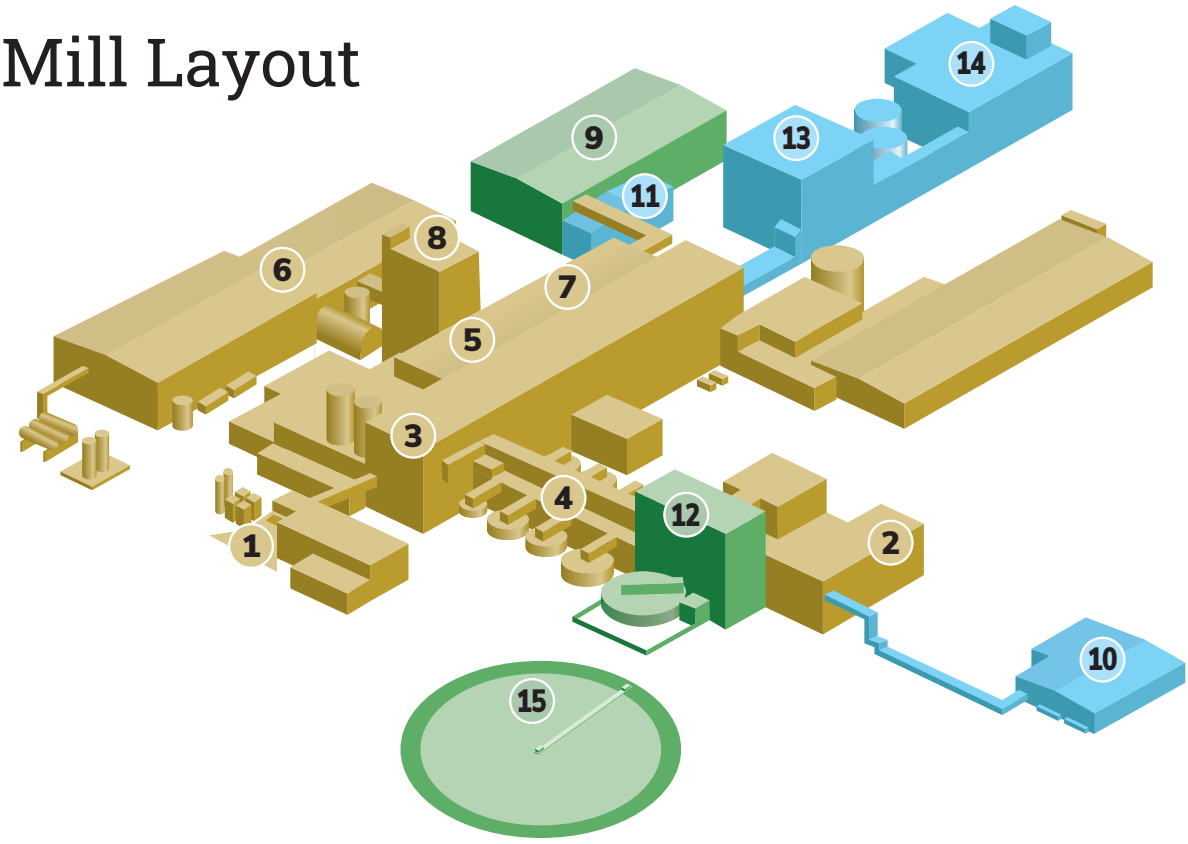
The mill has an annual production capacity of 24 million pounds of uranium concentrate, and it can receive and process uranium ore from conventional mining and high-grade ore slurry obtained through advanced remote mining techniques. The mill currently processes the high-grade ore slurry it receives from the Cigar Lake mine, the world's second-largest and highest-grade uranium mine.

The McClean Lake site operates on a two-weeks-in/two-weeks-out rotation schedule for workers, over 50% of whom reside in northern Saskatchewan communities.

Mill Schematic



Mill Layout



1. Ore Receiving & Grinding
2. Ore Slurry Receiving
3. Leaching
4. Counter-Current Decantation
5. Clarification
6. Solvent Extraction
7. Yellowcake Precipitation
8. Calcining & Packaging
9. Water Treatment
10. Oxygen Plant
11. Ferric Sulphate Plant
12. Tailings Neutralization
13. Acid Plant
14. Ammonium Sulphate Crystallization Plant
15. Tailings Management Facility

How Uranium Extraction Works

1

Grinding breaks down the ore into small particles that are mixed with water to generate an ore slurry. The ore is fed by a front-end loader to a large grate, called a grizzly. Ore that is too large to fit through the grizzly is crushed with a hydraulic rock breaker. Once through, the ore goes into two mills where water is added: an autogenous grinding mill, followed by a ball mill. The ore slurry is discharged to air-agitated storage tanks called **pachucas.**

The ore received at McClean Lake from the Cigar Lake mine arrives already ground up as a slurry.

2

Ore Slurry arrives in specially designed containers on heavy transport trucks from the Cigar Lake mine located about 80km south of McClean Lake. The slurry, containing high-grade uranium, is unloaded using a specifically designed vacuum and container wash system. The slurry and wash water are put through a thickener. The thickened slurry is then pumped into pachucas.

3

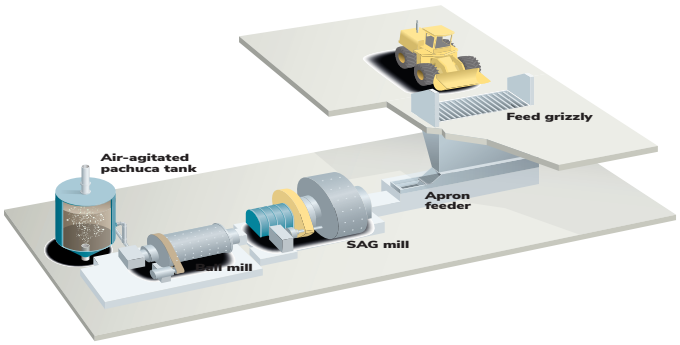
Leaching involves extracting uranium from the ore by dissolving it into a sulphuric acid solution. Ferric sulphate and hydrogen peroxide are used to oxidize the uranium into a soluble form. This is a non-selective process, meaning that other naturally occurring elements are also dissolved, such as iron, arsenic, molybdenum, nickel, cobalt, selenium, etc.

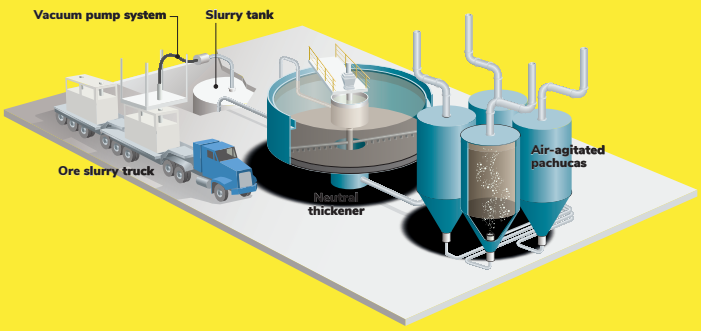
4

Counter-Current Decantation (CCD) washes the uranium solution from the waste solids in the leached residue. The CCD wash solution flows in one direction and the leached residue flows in the opposite direction. The slurry is fed through a series of thickeners where the solids are separated from the liquids. The waste solids, containing a very small amount of soluble uranium, are sent to the Tailings Neutralization circuit.

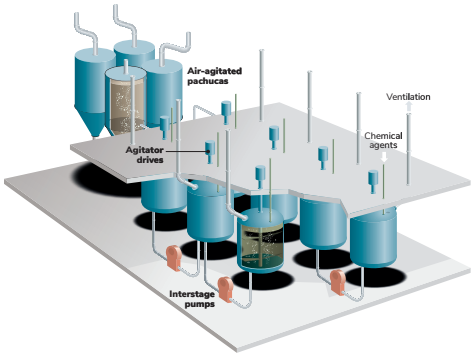
5

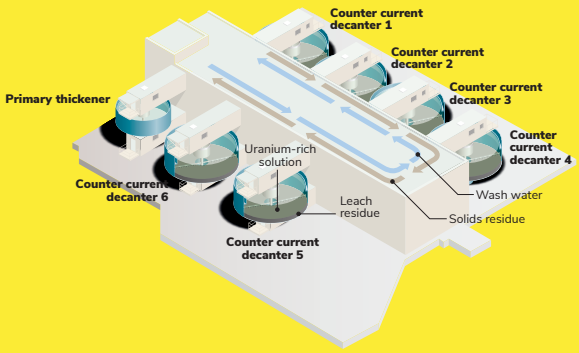
Clarification removes suspended solids from the uranium solution after CCD, using a clarifier and sand filters. This is necessary to ensure the efficiency of the Solvent Extraction (SX) circuit downstream.

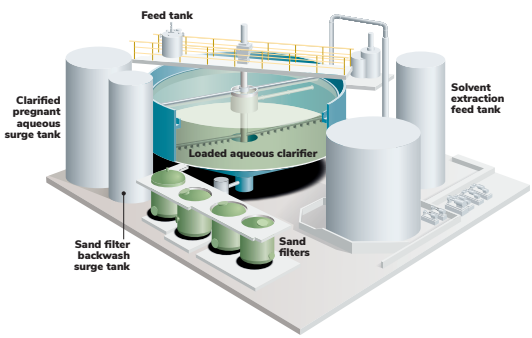

Feed grizzly
Air-agitated pachuca tank
Apron feeder
SAG mill
Ball mill


Vacuum pump system
Slurry tank
Ore slurry truck
Neutral thickener
Air-agitated pachucas


MM
255.587.22
25500806
06
ARNES


Air-agitated pachucas
Ventilation
Chemical agents
Agitator drives
Interstage pumps


Counter current decanter 1
Counter current decanter 2
Counter current decanter 3
Primary thickener
Counter current decanter 4
Uranium-rich solution
Counter current decanter 6
Leach residue
Wash water
Solids residue
Counter current decanter 5


Feed tank
Clarified pregnant aqueous surge tank
Solvent extraction feed tank
Loaded aqueous clarifier
Sand filter backwash surge tank
Sand filters

How Uranium Extraction Works

6

Solvent Extraction (SX) creates a purified and more concentrated uranium solution. By passing the uranium solution through a series of mixer and settler cells, the uranium is selectively extracted from the solution with an organic solvent. This stripping process increases the uranium's concentration by five to ten times. The remaining solution, stripped of its uranium and containing waste metals, is sent to the Tailings Neutralization circuit.

7

Precipitation converts the uranium from a solution to 60% solid after going through a centrifuge wash. The molybdenum, present as an impurity in the solution, is removed by passing the solution through a series of carbon columns before precipitating the dissolved uranium by adding ammonia. This form of uranium concentrate is yellow, giving it the term "**yellowcake**."

8

Calcining dries the yellowcake at high temperature to a black powder called uranium oxide concentrate, or more commonly, calcined yellowcake. The yellowcake from the Precipitation circuit is fed to a centrifuge, which removes 60% of the moisture. The remaining product is then completely dried in a furnace with multiple hearths, known as the calciner. This occurs at a high temperature of about 800°C. The dry calcined yellowcake is then placed in storage bins. The final product contains about 85% uranium with less than 0.5% moisture. Although it is now powder black in colour, it is still referred to as yellowcake.

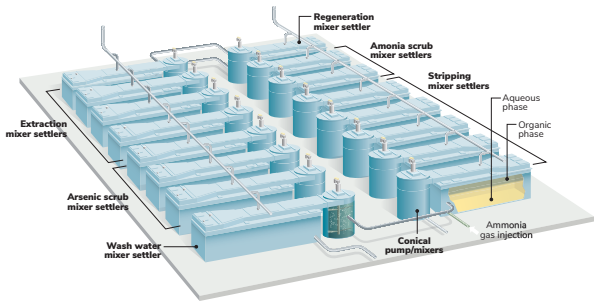
Packaging transfers the calcined yellowcake powder from the bin into steel drums. The loaded drums are trucked off site in truck-trailers and sea containers for domestic and overseas shipments. Each drum contains about 400 kilograms of yellowcake.

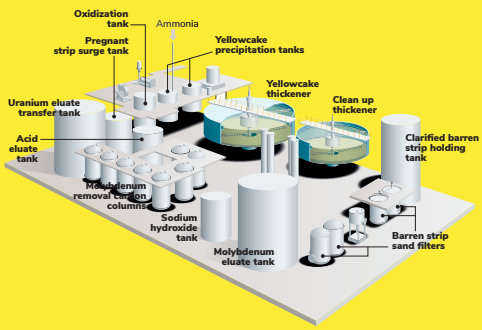
9

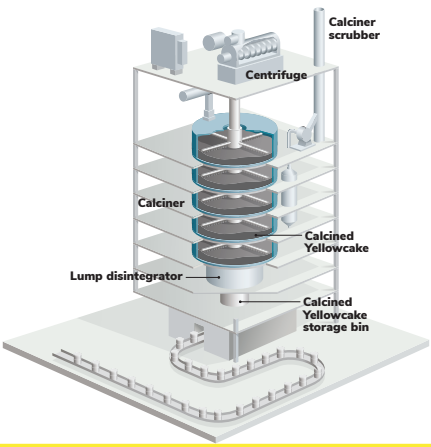
There are two **Water Treatment Plants** at McClean Lake. The JEB Water Treatment Plant treats all domestic waste water, mill process waste solution and site runoff from the mill terrace. The Sue Water Treatment Plant treats all water associated with mine dewatering at the Sue site, domestic waste water and Sue site runoff water. Both water treatment plants remove dissolved metals and suspended solids so the water can be discharged into the Sink/Vulture Treated Effluent Management System, meeting federal and provincial water quality requirements.

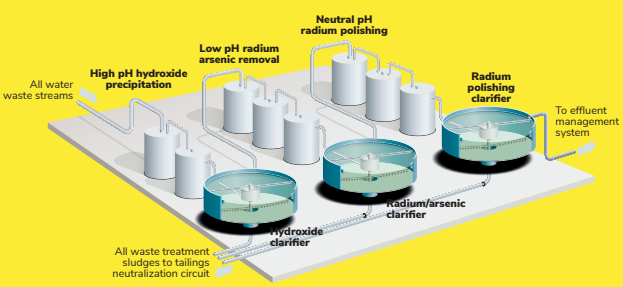
10

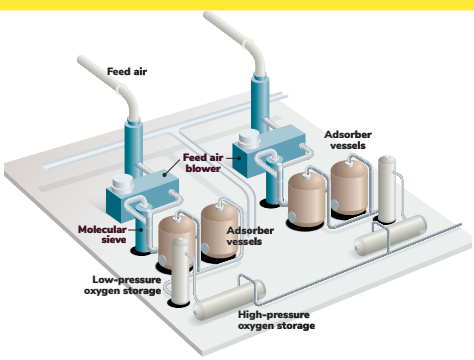
The **Oxygen Plant** concentrates oxygen from ambient air using Pressure Swing Vapor Absorption (PSVA) technology. The air is passed through a molecular sieve to produce a gas with a concentration of more than 90% oxygen. The oxygen is compressed into large storage receivers within the Oxygen Plant. Oxygen is used on-site to make ferric sulphate.


Regeneration mixer settler
Amonia scrub mixer settlers
Stripping mixer settlers
Aqueous phase
Organic phase
Extraction mixer settlers
Arsenic scrub mixer settlers
Wash water mixer settler
Conical pump/mixers
Ammonia gas injection


Oxidization tank
Ammonia
Pregnant strip surge tank
Yellowcake precipitation tanks
Yellowcake thickener
Clean up thickener
Uranium eluate transfer tank
Clarified barren strip holding tank
Acid eluate tank
Molybdenum removal ion exchange columns
Sodium hydroxide tank
Barren strip sand filters
Molybdenum eluate tank


Calciner scrubber
Centrifuge
Calciner
Calcined Yellowcake
Lump disintegrator
Calcined Yellowcake storage bin


Neutral pH radium polishing
Low pH radium arsenic removal
High pH hydroxide precipitation
All water waste streams
Radium polishing clarifier
To effluent management system
Radium/arsenic clarifier
Hydroxide clarifier
All waste treatment sludges to tailings neutralization circuit


Feed air
Adsorber vessels
Feed air blower
Molecular sieve
Adsorber vessels
Low-pressure oxygen storage
High-pressure oxygen storage

How Uranium Extraction Works

11

The **Ferric Sulphate Plant** uses magnetite ore, water, sulphuric acid and oxygen gas to produce a ferric sulphate solution. It is made in a batch process using stirred pressurized reactor vessels. Ferric sulphate is manufactured on site and used in the water treatment, tailings neutralization and leaching processes.

12

The **Tailings Neutralization (Tails Neut)** circuit processes all mill waste streams to create a solid waste (tailings) and a liquid waste, which undergoes further processing in the JEB Water Treatment Plant before being discharged to the environment as effluent. The water treatment sludges, slurry from CCD and raffinate solution from SX are collected and treated together in the Tails Neut circuit. Waste metals in the raffinate are precipitated using ferric sulphate at a carefully controlled pH. Acid residue from the slurry and raffinate are neutralized using lime. To control radium, we use barium chloride and ferric sulphate. After treatment, the solids are separated from the liquids in the tailings thickener. The solids and liquids, called **tailings**, are then pumped to the Tailings Management Facility (TMF) through different pipes to accelerate settling and consolidation of the solids.

13

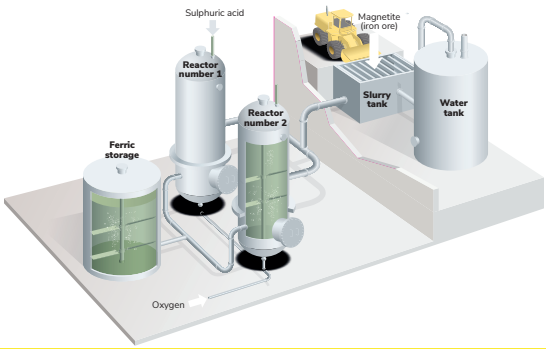
The **Acid Plant** converts sulphur to sulphuric acid. Elemental sulphur is burned to create sulphur dioxide gas and steam. A catalyst is used to convert sulphur dioxide gas into sulphur trioxide gas, which is then absorbed into water to create concentrated sulphuric acid. This essential process reagent is stored in two large tanks. Steam generated during this process is used throughout the plant.

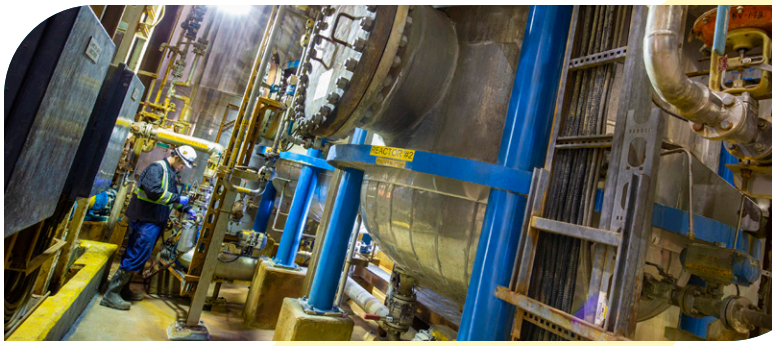
14

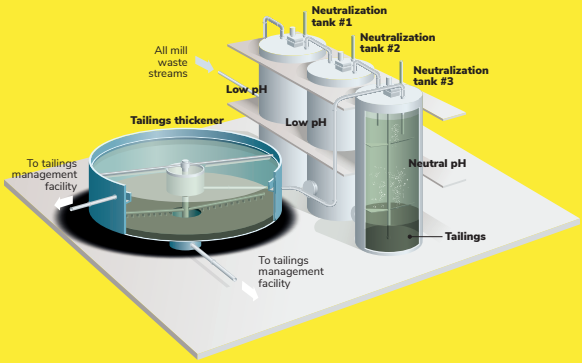
The **Ammonium Sulphate Crystallization Plant (CX)** treats excess process fluids from mill circuits that contact ammonia (SX, Yellowcake Precipitation and Calciner). The CX plant consists of two trains, each with two evaporators and one crystallizer to produce a granular ammonium sulphate fertilizer by-product.

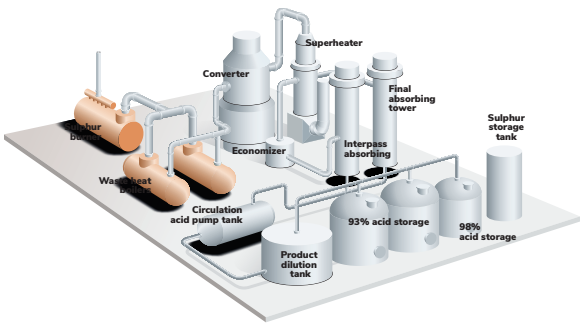
15

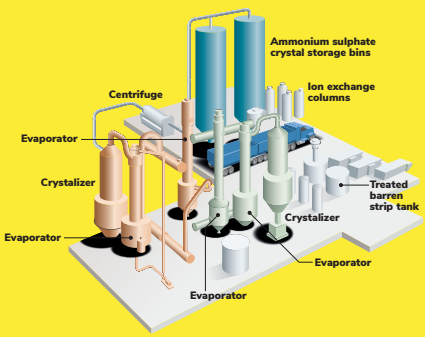
The **Tailings Management Facility** receives the process tailings. All mining and mineral processing facilities produce tailings (waste materials). At the McClean Lake operation, tailings are disposed of in the mined-out JEB pit. They are submerged under water as a method of radiation protection. In the JEB Tailings Management Facility (TMF), the tailings settle at the bottom and consolidate, or harden over time, and act as a plug that forces groundwater to travel around the pit. These hard tailings are not free-flowing, and are fully contained in the facility. The TMF was designed to minimize potential adverse environmental impacts and with final decommissioning in mind.


Sulphuric acid
Magnetite (iron ore)
Reactor number 1
Reactor number 2
Slurry tank
Water tank
Ferric storage
Oxygen

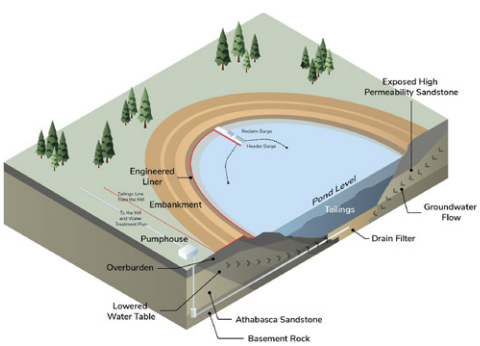



Neutralization tank #1
Neutralization tank #2
Neutralization tank #3
All mill waste streams
Low pH
Low pH
Tailings thickener
Neutral pH
To tailings management facility
Tailings
To tailings management facility


Superheater
Converter
Final absorbing tower
Sulphur storage tank
Economizer
Interpass absorbing
Circulation acid pump tank
93% acid storage
98% acid storage
Product dilution tank


Ammonium sulphate crystal storage bins
Centrifuge
Ion exchange columns
Evaporator
Crystalizer
Treated barren strip tank
Crystalizer
Evaporator
Evaporator
Evaporator


2 TONNE


Exposed High Permeability Sandstone
Reclaim Barge
Header Barge
Engineered Liner
Embankment
Pond Level
Tailings
Groundwater Flow
Pumphouse
Drain Filter
Overburden
Lowered Water Table
Athabasca Sandstone
Basement Rock

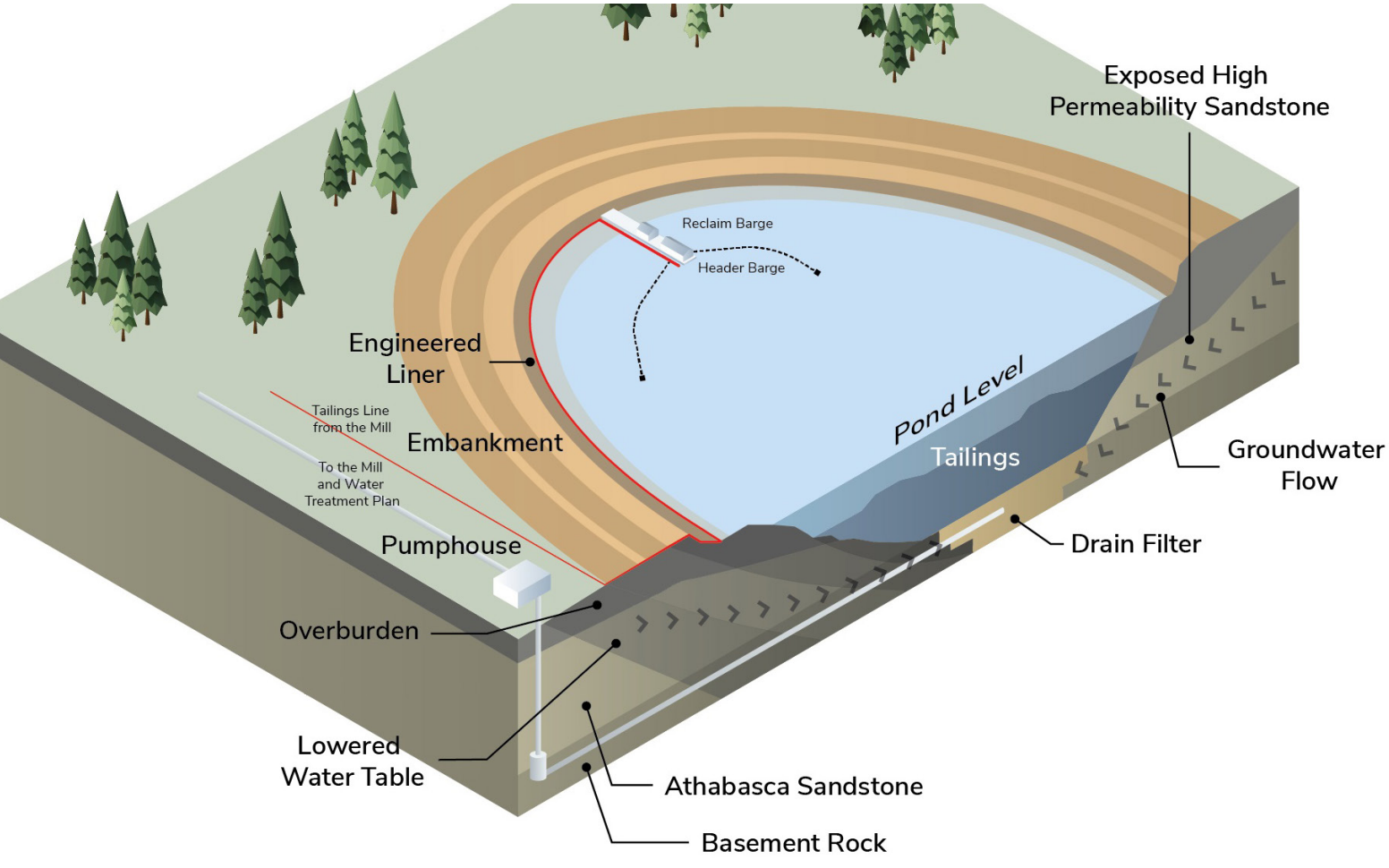
Looking to the Future

Tailings Management

Tailings are the waste material remaining after the uranium is removed from the rock or slurry in the milling process. This waste consists of leach residue solids, waste solutions and chemical precipitates that are carefully engineered for stable long-term disposal. Tailings need to be disposed of and managed properly to protect the environment. The JEB Tailings Management Facility (TMF) serves as the repository for tailings created at the McClean Lake mill. The TMF allows for proper waste management, which minimizes potential adverse environmental effects.

To ensure the longevity of the McClean Lake operation, Orano is continuously assessing options for the long-term management of tailings. In 2022, Orano received an amendment to the mill licence for the expansion of the JEB TMF. The expansion allows the operation to maintain a similar footprint while also securing McClean Lake's future as a regional milling centre. Upon closure of the McClean Lake operation, the JEB TMF will be decommissioned utilizing an engineered cover and landform system. This, in conjunction with tailings management during operations, allows for safe tailings storage, post decommissioning.

Tailings Management Facility Schematic



SABRE Mining Method

The McClean Lake Joint Venture with Denison Mines has successfully completed a five-year test mining program deploying the patented Surface Access Borehole Resouirce Extraction (SABRE) mining method on the property.

SABRE is the culmination of mining equipment invention and development initiatives that began in 2004. It is a non-entry surface-based mining method that uses a high-pressure water jet to excavate a mining cavity. The cuttings from the excavation process are then pumped to the surface as a slurry. Mining using this method is expected to begin in 2025 at the McClean Lake site.

Training

Through the support of a wide variety of innovative training programs, Orano builds opportunities for both present and prospective employees. Our operational training requirements include classroom and on-the-job training, one-on-one training with site trainers, equipment training with vendors, peer-training with senior operators and self-study courses.

In the past, Orano has partnered with Northern Career Quest, a joint federal, provincial and local northern initiative, to offer several training programs such as the Mill Operator Training Program. The company has also partnered with the Province of Saskatchewan and Ya'thi Néné to provide training programs.

Since the start of the Mill Operator program in 2012, over 100 residents of northern Saskatchewan have had the opportunity to learn new skills and experience life at McClean Lake. Approximately 85% of the trainees were offered opportunities to work at the McClean Lake operation, in the mill and in various positions around the site, while others are applying the skills they learned to other industries.

Orano's Commitments

Environment, Health & Safety

We are committed to developing and maintaining a healthy and safe work environment by following world-class best practices that safeguard people and the environment.

Protecting workers, the environment and neighbouring communities are fundamental principles guiding Orano's activities. We are committed to minimizing our environmental footprint as well as developing and maintaining a healthy and safe work environment by following world-class best practices that safeguard people and the environment. McClean Lake strives to maintain low rates of lost-time accidents through a wide range of safety-related programs, training and by fostering safety culture.

- McClean Lake maintains its certification in ISO 14001 standard for environmental management and ISO 45001 standard for occupational health and safety management.
- Extensive monitoring programs include regular sampling of air, water, land, plants and animals on site and downstream. Ongoing programs are in place to reduce water and energy consumption throughout our activities.
- Worker radiation doses are continually monitored and remain well below the regulatory limit, demonstrating the effectiveness of the radiation protection program and of the mill design to process high ore grades.

We are committed to contributing to the reduction of greenhouse gas emissions.

With our Orano group uranium mining colleagues in Kazakhstan and Niger, our McClean Lake site contributes every year to the production of low-carbon energy by fueling nuclear power plants in Canada and around the globe. The amount of uranium produced annually by the Orano group is enough to supply the electricity needs of a country such as the United Kingdom. The production of the same amount of electricity from coal would result in the release of 300 million additional tonnes of greenhouse gas emissions.

Working at McClean Lake

Orano strives to create employment opportunities for workers from northern Saskatchewan. The two-weeks-in/two-weeks-out rotation schedule enables employees and their families to remain in their home communities, which in turn benefit from an increased economic base and valuable trade and professional skills.

Charter flights collect workers from several communities and cities, making it convenient for them to travel to and from McClean Lake. Residence facilities ensure employees are comfortable; living quarters are equipped with games rooms, a fitness centre, a racquetball/squash court, musical instruments, a library and camp-wide Wifi, and all workers are treated to fantastic food. Employees also enjoy outdoor activities at McClean Lake such as swimming, fishing, canoeing, kayaking, biking, tennis, cross-country skiing and stargazing.

Orano Group is a recognized international leading operator in the field of nuclear materials, delivering solutions to address future and present global energy and health challenges. Its expertise and mastering of cutting-edge technologies enable Orano to offer its customers high-value added products and services throughout the entire nuclear fuel cycl.e.

Every day, the Group's 17,500 employees draw on their skills, unwavering dedication to safety, and constant quest for innovation, with the commitment to develop know-how in the transformation and control of nuclear materials, for the climate and for a healthy, resource-efficient world, now and tomorrow.

Orano, giving nuclear energy its full value.

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orano

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