Tailings ponds are an integral part of our water management system which help to reduce withdrawals from the Athabasca River. These facilities store the tailings from the bitumen extraction process. As the tailings settle, water is released and then recycled back into plant operations. Over 85 per cent of our water needs are met through these facilities.

Tailings structures are highly engineered and managed for long-term integrity and safety. At the same time, significant resources and expertise are focused toward reducing the volume of tailings and treating them to be used in constructing our reclamation landscape. Based on our current suite of technologies, and in line with regulatory requirements, all Syncrude tailings areas will either have been reclaimed or will be undergoing reclamation within 10 years of the end of mining operations. No untreated fluid tailings will remain in our post-closure landscape.

**WHAT ARE TAILINGS?**

Tailings is the material that remains after bitumen is extracted from the oil sand. It is a mixture of sand, silt, clay, water and residual hydrocarbon. Tailings are stored in in-pit or out-of-pit tailings placement areas. As it is deposited, the coarser components settle rapidly and are used in the construction of sand beaches or other landforms. The remaining components form fluid fine tailings (FFT), also referred to as fluid tailings. Currently, the surface area of our fluid tailings is approximately 55 square kilometres.

Fluid tailings material consolidates to 30 per cent solids by weight within a few years of deposition. However, further consolidation is slow. Therefore we use both mechanical and passive technologies to accelerate this process in order to obtain a soil substrate capable of supporting reclamation activities. In total, seven million cubic metres of fluid tailings were removed from settling basins and processed in 2020.
SAFETY AND MONITORING

Syncrude’s tailings facilities are built according to strict government regulations and are monitored for structural integrity and seepage. The Alberta Energy Regulator (AER) further oversees the safety of our tailings ponds under the Water Act, Water (Ministerial) Regulation - Part 6 Dam and Canal Safety and Alberta Dam and Canal Safety Directive, and performs annual inspections and audits. We are also guided by the Lower Athabasca Region Tailings Management Framework (TMF) and Directive 085: Fluid Tailings Management for Oil Sands Mining Projects which require operators like Syncrude to progressively treat and reclaim tailings.

As required under the Alberta Dam & Canal Safety Directive, the AER conducts a Leading Practices Assessment every three years to assess our tailings management system. For the 2019 review, Syncrude achieved a rating of “Excellent”.

A network of 276 groundwater monitoring wells are located across our operation, of which approximately 80 per cent monitor for tailings seepage. A series of interceptor ditches and sumps ensure any seepage or run-off water from rain or snow falling on the pond embankments is collected and pumped back into the pond. Monitoring results are reported to the AER annually, as required by our operating approval.

Responsible management of our tailings facilities is also a key component of the Mining Association of Canada (MAC) Towards Sustainable Mining (TSM) initiative. As a member, Syncrude follows industry best practices in tailings dam safety and operation. Internal assessments are required annually, with an independent, external verification every three years. An external audit for the 2019 reporting year confirmed Syncrude to have a an excellent, well-developed tailings management system, with comprehensive monitoring and external technical review practices. Further information on Syncrude’s TSM performance can be found at https://mining.ca/companies/syncrude-canada-ltd.

REDUCING AND RECLAIMING TAILINGS

To reclaim tailings, we’ve invested over $3 billion over the last decade in three main technologies: centrifuged tails, composite tailings (CT) and water-capped tailings in pit lakes. These technologies are incorporated into our tailings management plans for Mildred Lake and Aurora North. We have consistently met our regulatory commitments and continue to work with Canada’s Oil Sands Innovation Alliance, industry partners, academia and the scientific community to develop further solutions.
COMPOSITE TAILINGS

Composite Tailings (CT) technology combines fluid tailings with gypsum and sand. Upon deposit in mined-out areas, the tailings release water and quickly settle. The area is then capped with sand and soil, enabling the development of landscapes that support forests and wetlands. CT is being used at both the Mildred Lake and Aurora North sites. In 2020, 2.9 million cubic metres of fluid tailings was processed using this process.

At Mildred Lake, CT placement is being used to reclaim our former East Mine. We expect sand placement to be complete in 2021 and the area fully reclaimed by the mid-2020s. The 57-hectare Sandhill Fen wetland research watershed was constructed at the northwest end of this area. More information on reclamation of this former mine can be found in the Land fact sheet.

CENTRIFUGING

Centrifuge technology combines fluid tailings with a coagulant and flocculent, acting as process aids, in vessels (centrifuges) to separate out the water from the fluid tailings. The released water is recycled into plant operations and the dewatered clay material (referred to as centrifuge cake) is used in reclamation and landform construction.

In our initial placement activities, where material was deposited in thin layers, the clay product was dense and strong after about one year, following a freeze-thaw cycle, and is now undergoing reclamation. Placement of centrifuge cake currently occurs in a former mined out area, or in-pit deep deposit at our Mildred Lake site. There are currently 18 centrifuges – each nine metres long and two metres high – in operation. In 2019, 4.7 million m$^3$ of FFT was treated using this technology. Monitoring and evaluation of deposit performance continues.
We are currently researching additional technologies that could be used to supplement existing tailings remediation methods. These include:

**PIT LAKES**

Pit lakes are a common and successful closure practice in the global mining industry. At Syncrude, one example involves adding a layer of water over fluid tailings to physically isolate the tailings and create a lake. Syncrude has invested over 40 years of research to study this technology, with the industry’s first commercial-scale end-pit lake demonstration now underway in our former West Mine.

Focus areas for research and monitoring include water quality, impacts of the underlying fluid tailings layer, consolidation of the tailings, development of the shoreline, and the establishment of plants and insects. A number of universities have assisted in the research, including the University of Toronto, McMaster University, University of Alberta, University of Calgary, University of British Columbia and the University of Saskatchewan.

An adaptive management approach is being used to actively steward the lake towards achieving our closure objectives. To date, monitoring and research indicates that the fines are physically isolated beneath the water cap, and the water quality is improving. Fluid tailings consolidation has been progressing as expected, with approximately one metre of settlement per year since 2013 and a water cap of up to 12 metres deep as of 2019. In addition, there is oxygen in the water, water quality is improving, and naphthenic acids have declined in concentration. A variety of biological communities are also developing, including algae, aquatic plants, zooplankton and macroinvertebrates. Skimming, dredging and shoreline cleaning are underway to address the presence of residual bitumen. In addition, waterfowl deterrents continue to be in place throughout this demonstration period.

**TAILINGS TECHNOLOGY DEVELOPMENT**

We are currently researching additional technologies that could be used to supplement existing tailings remediation methods. These include:
**ACCELERATED IN-LINE DEWATERING**

Accelerated in-line dewatering is a low energy fluid tailings management technology that Syncrude began developing in 2007. The technology involves mixing fluid tailings with a coagulant, followed by in-line flocculation with a polymer to produce a material called flocculated tailings (similar to centrifuge cake), which is then hydraulically placed in deep deposits. We expect to implement this technology in 2022.

**OVERBURDEN CO-MIXING**

This method, studied since the late 1980s, mixes fluid tailings with overburden (from mining operations) to create a fully functional surface that can be walked or driven upon, and used for terrestrial reclamation. The technology is most suitable for small-scale applications and can be implemented in the field as needed.

**TAILINGS CO-DEPOSITION**

Tailings co-deposition places two or more tailings products in a mined-out pit with limited to no intentional mixing. We have performed laboratory scale tests to study several different combinations and, based on the positive results so far, we are evaluating opportunities to implement co-deposition at a larger scale. While co-deposition in itself is not a treatment technology, its use has the potential to improve deposit performance through enhanced dewatering and consolidation.

**COLLABORATIVE RESEARCH EFFORTS**

We operate one of the largest private sector research facilities in Western Canada and participate in Canada’s Oil Sands Innovation Alliance (COSIA). COSIA coordinates collaborative industry research and knowledge exchange among its members. Research work includes literature reviews, laboratory projects, pilot trials and large, field scale demonstration and commercialization programs.
## Tailings Management Performance Data

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<tr>
<th>Location</th>
<th>2016</th>
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<th>2018</th>
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<td>Mildred Lake</td>
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<tr>
<td>Fluid Tailings volumes(^1) (million m(^3))</td>
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<td>Centrifuge Cake volume(^2) (million m(^3))</td>
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<td>CT Beach deposit(^3) (million m(^3))</td>
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<td>Aurora North</td>
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<td>Fluid Tailings volumes(^1) (million m(^3))</td>
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<td>CT Beach deposit(^2) (million m(^3))</td>
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<td>5.9</td>
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</table>

1. Treated and untreated volumes as measured (mid-year). As accepted by the Alberta Energy Regulator, due to the COVID-19 pandemic and subsequent state of public health emergency, tailings pond sampling and testing were cancelled in 2020; volumes reported are based on a combination of measurement and modelling.
2. Volume of reclaimable treated fluid fine tailings (cake) material produced from centrifuge process, calculated using a combination of instrumentation and sampling data.
3. Volume of reclaimable treated fluid tailings (beach deposit) material produced from composite tails (CT) process, calculated assuming a dry density of 1.45 tonnes/m\(^3\).