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Alberta Energy Regulator

Syncrude Canada Ltd.

Application for Aurora North Tailings Management Plan

June 13, 2018

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Decision 20180613A: Syncrude Canada Ltd.; Application for Aurora North Tailings Management Plan

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Abbreviations

ACFN	Athabasca Chipewyan First Nation
AEPN	Aurora East Pit North
AEPS	Aurora East Pit South
AER	Alberta Energy Regulator
ASB	Aurora Settling Basin
AWPN	Aurora West Pit North
AWPW	Aurora West Pit West
BML	Base Mine Lake
CT	composite tailings
EPEA	*Environmental Protection and Enhancement Act*
ERCB	Energy Resources Conservation Board
ERP	enhanced review process
EUB	Alberta Energy and Utilities Board
FGD	flue gas desulphurization
FMFN	Fort McKay First Nation
FMMCA	Fort McKay Métis Community Association
ICAF	*Integrated Compliance Assurance Framework*
MCFN	Mikisew Cree First Nation
ML 1909	Métis Nation of Alberta Local Council 1909 Lakeland
ML 1935	Fort McMurray Métis Local 1935
MNA R1	Métis Nation of Alberta Region 1
OSCA	*Oil Sands Conservation Act*
OSEC	Oil Sands Environmental Coalition
RTR	ready to reclaim

SOC	statement of concern
TMF	*Lower Athabasca Region: Tailings Management Framework for Mineable Athabasca Oil Sands*
TMP	tailings management plan

Executive Summary

The Alberta Energy Regulator (AER) approves Syncrude Canada Ltd.'s (Syncrude's) application 1871794, subject to the approval terms and conditions in appendix 1.

Background

The AER regulates tailings arising from oil sands mining operations to ensure that the tailings are managed in an efficient, safe, orderly, and environmentally responsible manner. Tailings are a by-product of the process used to extract bitumen from mined oil sands and consist of water, silt, sand, clay, and residual bitumen.

The AER applies a risk-based approach to regulating, where higher-risk activities receive greater regulatory oversight. Given the nature and scale of fluid tailings generated by oil sands mine operations, and the ongoing research and development of tailings treatment technology, fluid tailings management is one of Alberta's higher-risk industrial activities.

The regulation of tailings has been an evolving issue in Alberta. In 2009, the Energy Resources Conservation Board (ERCB) released *Directive 074: Tailings Performance Criteria and Requirements for Oil Sands Mining Schemes*, introducing specific performance criteria for the reduction of fluid tailings and the formation of trafficable deposits. To further manage and decrease liability and environmental risk resulting from the accumulation of fluid tailings on the landscape, the Government of Alberta issued the *Lower Athabasca Region: Tailings Management Framework for Mineable Athabasca Oil Sands* (*TMF*) in 2015. The *TMF* sets out the objective that fluid tailings accumulation is minimized by ensuring that fluid tailings are treated and reclaimed progressively during the life of a project and all fluid tailings associated with a project are ready to reclaim (RTR) within 10 years of the end of mine life. In addition, the *TMF* establishes four outcomes: land use must be returned to Albertans, sustainable ecosystem, liability is minimized to Albertans, and environmental effects are managed. To support implementation of the *TMF*, the AER released *Directive 085: Fluid Tailings Management for Oil Sands Mining Projects* (*Directive 085*), which sets new requirements for fluid tailings management plans (TMPs).

Syncrude's Approval

Syncrude's Aurora North oil sands processing plant and mine (Aurora North) received approval through a joint Alberta Energy and Utilities Board (EUB) and Government of Canada panel in 1997 (*Decision 1997-013*). Syncrude commenced production at Aurora North in 2001, and tailings treatment in 2013 using composite tailings (CT) technology (site map provided in appendix 2).

On October 31, 2016, the AER registered Syncrude's application 1871794 made pursuant to section 13 of the *Oil Sands Conservation Act* (*OSCA*) for the TMP for Aurora North.

TMP Application Review Process

In its review of Syncrude's application, the AER enhanced involvement by providing opportunities for Syncrude and statement of concern (SOC) filers— including Métis Nation of Alberta Region 1 (MNA R1), Métis Nation of Alberta Local Council 1909 Lakeland (ML 1909), Fort McKay Métis Community Association (FMMCA), Mikisew Cree First Nation (MCFN), Athabasca Chipewyan First Nation (ACFN), Fort McKay First Nation (FMFN), Fort McMurray Métis Local 1935 (ML 1935), and the Oil Sands Environmental Coalition (OSEC)—to attend an AER-facilitated technical meeting. In addition, Syncrude and the SOC filers were provided an opportunity to provide feedback on circulated draft approval terms and conditions.

An overview is as follows.

Ongoing Stakeholder and Indigenous Community Engagement

Both the *TMF* and *Directive 085* highlight the importance of transparency and involvement of stakeholders and indigenous communities in tailings management. Given this overarching principle, together with the concerns expressed by SOC filers, the approval requires Syncrude to

- engage with stakeholders and indigenous communities on the activities undertaken in respect of tailings management, including research and monitoring;
- engage with stakeholders and indigenous communities on its water-capping technology demonstration, including research and monitoring;
- conduct an annual forum; and
- report to the AER on its engagement activities.

Fluid Tailings Profile

Based on Syncrude's application, its legacy fluid tailings and new fluid tailings profiles indicate that all legacy fluid tailings achieve RTR status by end of mine life (2040) and all new fluid tailings achieve RTR in 2045, five years after end of mine life, which is less than the ten years required by the *TMF*.

Although Syncrude's profiles meet the *TMF*'s objective, the AER has a number of concerns with the profiles. The ability of Syncrude's profiles to meet the *TMF* objective is dependent on the use of water-capping technology. Given that water-capped pit lakes are prohibited and water-capping technology is subject to further assessment, research, and future policy, Syncrude is required to provide, by December 31, 2023, a TMP that includes updated legacy fluid tailings and new fluid tailings profiles.

The AER is also concerned that Syncrude's new fluid tailings volume increases from 72 million cubic metres (Mm^3) to 113 Mm^3 between 2019 and 2040. This increase is not in alignment with *TMF* or *Directive 085* guidelines that require the fluid tailings treatment capacity to be equal to or greater than the

new fluid tailings production rate. SOC filers expressed concern regarding this fluid tailings volume increase. Syncrude is required to submit a plan, by December 31, 2018, and an updated TMP by December 31, 2023, both of which must describe how Syncrude will ensure treatment capacity is equal to or greater than the new fluid tailings production rate by December 31, 2027.

Tailings Treatment Technology and Performance

Syncrude is authorized to continue to use CT technology to treat fluid tailings, subject to the approval terms and conditions.

SOC filers expressed concern that CT technology treatment capacity is constrained by coarse sand availability due to competing construction and reclamation needs. The AER shares this concern. As a result, Syncrude is required to provide a summary of coarse sand production and use, including coarse sand for cell construction, beaching, and capping by location.

The AER is also concerned with the ability of the CT deposits to support future reclamation activities, achieve stable targeted ecosites, and meet the *TMF*`s outcomes. Therefore, Syncrude must monitor CT plant operations monthly, monitor CT deposits annually, and report on these monitoring results annually. In addition, in the updated 2023 TMP, Syncrude must assess the performance and limitations of the CT deposits.

Furthermore, the AER is concerned with Syncrude's proposed water-capping technology. Syncrude proposes to place 188 Mm^3 of untreated fluid tailings in two tailings deposits: Aurora West Pit North (AWPN) and Aurora West Pit West (AWPW). Syncrude intends to cover AWPN and AWPW with water to create a water-capped deposit as a closure landscape feature ("water-capped pit lake"). SOC filers raised concerns with water-capping technology and pit lakes.

Water-capping technology is subject to further assessment, research, and future policy. Therefore, the approval prohibits water-capped pit lakes and requires Syncrude to meet future policy on water-capped pit lakes.

Syncrude indicated 2023 is its decision point for using water-capping technology for Aurora North. The AER acknowledges that this is 14 years before placement of tailings in AWPW and 17 years before the end of mine life. Therefore, there should be sufficient time for Syncrude to deploy an alternative technology to water capping.

To provide the AER with assurance that the *TMF*'s objective and outcomes can be met where water-capping technology is not permitted, Syncrude is required to describe, by December 31, 2018, how it will develop alternative tailings treatment technologies and an implementation plan to treat the volume of fluid tailings that Syncrude currently proposes to treat with water-capping technology. In the event that

Syncrude continues to propose water-capping technology, Syncrude is required to provide feasible alternative tailings treatment technologies and an implementation plan in the updated 2023 TMP.

Ready-to-Reclaim Criteria

Syncrude is required to meet the following RTR criteria for CT deposits:

- 65 per cent solids content by weight, based on deposit sampling, within one year of treated fluid tailings placement;
- 75 per cent solids content by weight, based on deposit sampling, within one year after sand capping; and
- groundwater is monitored in accordance with the *Environmental Protection and Enhancement Act* (*EPEA*) approval.

The AER is not authorizing Syncrude's proposed subobjective 2 RTR criteria of monitoring elevated chloride concentrations in observation wells; treated fluid tailings and fluid levels compared to design elevations; and slope movement and pore pressure as Syncrude did not provide sufficient supporting information. As Syncrude did not propose RTR criteria for water-capped tailings deposits, the AER has not authorized any RTR criteria for this type of deposit.

Enhancements to Research

Research is key to manage risk and resolve site-specific uncertainties in Syncrude's TMP. The AER is relying on a number of research conditions in the *EPEA* approvals to manage risk and resolve uncertainties.

Syncrude is required to research and report on pit lakes as part of its *EPEA* approval, including providing information on the applicability of current research to its proposed water-capped pit lakes. This information will be important to support future regulatory decisions associated with water-capping technology. The AER expects Syncrude to ensure that its pit lake research will resolve uncertainties and provide timely, site-specific, adequate information.

Further, Syncrude is required to provide a capping research plan for its CT deposits by December 31, 2018

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Syncrude Canada Ltd.
Application for Approval of Aurora North Tailings Management Plan

Application 1871794

Decision

[1] The Alberta Energy Regulator (AER) approves Syncrude Canada Ltd.'s (Syncrude's) application 1871794, subject to the approval terms and conditions in *Oil Sands Conservation Act* (*OSCA*) Approval No. 10781K (appendix 1).

[2] In reaching its decision, the AER considered all relevant materials constituting the record of Syncrude's application. The record consists of the application, which includes supplemental information requests; supplemental material filed by Syncrude; the technical review meeting proceedings; the statements of concern (SOCs) from the Métis Nation of Alberta Region 1 (MNA R1), Métis Nation of Alberta Local Council 1909 Lakeland (MNA 1909), Fort McKay First Nation (FMFN), Mikisew Cree First Nation (MCFN), Fort McMurray Local Council 1935 (ML 1935), Athabasca Chipewyan First Nation (ACFN), Fort McKay Métis Community Association (FMMCA), and the Oil Sands Environmental Coalition (OSEC); and the feedback on draft approval conditions provided by Syncrude and the SOC filers.

[3] References in this decision to specific parts of the record are intended to assist the reader in understanding the AER's reasoning on a particular matter and do not mean that the AER did not consider all relevant portions of the record with respect to the matter.

[4] This decision report highlights the AER's consideration of the application.

Application

[5] Syncrude's Aurora North oil sands processing plant and mine (Aurora North) received approval through a joint Alberta Energy and Utilities Board (EUB) and Government of Canada panel in 1997 (*Decision 1997-013*). The Aurora North oil sands processing plant and mine are located about 70 kilometres north of Fort McMurray, Alberta, in the Regional Municipality of Wood Buffalo (site map provided in appendix 2). Syncrude commenced production at Aurora North in 2001, and tailings treatment in 2013 using composite tailings (CT) technology.

[6] On October 31, 2016, the AER registered Syncrude's application 1871794 made pursuant to section 13 of the *OSCA* for the tailings management plan (TMP) for Aurora North.[1]

[7] Under application 1871794, Syncrude sought approval for its TMP from the present until 2050.

Statements of Concern and Enhanced Involvement

[8] The AER published a public notice of application for application 1871794 and received eight SOCs:

- MNA R1 (SOC 30496)
- MNA 1909 (SOC 30497)
- FMFN (SOC 30503)
- OSEC (SOC 30504)
- MCFN (SOC 30558)
- ML 1935 (SOC 30559)
- ACFN (SOC 30562)
- FMMCA (SOC 30564)

[9] On May 31, 2017, Syncrude provided letters to each SOC filer that responded to the concerns and questions raised.

[10] On August 21, 2017, the AER notified Syncrude and SOC filers that Syncrude's application would be subject to an enhanced review process (ERP) consisting of

- written submissions,
- technical meetings, and
- final written comments on the draft approval.

[11] The technical meeting was held November 14 through 16, 2017, in Edmonton. Attendees included the AER, Syncrude, FMFN, OSEC, MCFN, ML 1935, ACFN, and FMMCA. MNA R1 and MNA 1909 did not attend the technical meeting.

[12] On December 14, 2017, the AER circulated draft approval conditions for feedback by January 18, 2018, from Syncrude and the SOC filers.

[1] This approval amendment is restricted exclusively to the TMP for Aurora North. Aurora South is not encompassed by this approval amendment. In accordance with *Directive 085*, Syncrude would need to submit an amendment application at least one year before bitumen production begins at Aurora South.

[13] The AER extended the deadline for comments to February 2, 2018. The AER received written feedback from Syncrude, MML 1935, FMFN, MCFN, ACFN, FMMCA, and OSEC.

[14] Upon receipt of the feedback, the AER reviewed the entire record, considered the SOCs and submissions by SOC filers and Syncrude, and made its decision on Syncrude's application.

Technical Meeting

[15] The AER organized an AER-facilitated technical meeting that permitted SOC filers to engage with Syncrude face-to-face on application-specific topics. The primary purpose of the technical meeting was to assist the AER in its decision making on technical matters. The technical meeting also provided an opportunity for the SOC filers to engage with Syncrude.

[16] The technical meeting included discussion on several site-specific topics, including proposed tailings treatment technology risks, uncertainties in reclamation timing, mitigations and contingencies, and tailings deposit performance criteria.

[17] The AER acknowledges the efforts of OSEC, ACFN, MCFN, FMCCA, FMFN, and MML 1935. The AER is appreciative of ACFN, MCFN, FMCCA, FMFN, and MML 1935 sharing technical consultants as part of the application review process.

[18] Collectively, the following concerns were raised at the ERP:

- improvements to stakeholder engagement;
- feasibility, performance, and selection of tailings treatment technologies, including rationale for Syncrude's proposed fluid tailings profile and constraints to increasing treatment capacity using CT or other technologies;
- the use of sand to maximize its availability for production of additional CT;
- the need for a detailed proposal for dry-land options for all tailings;
- the feasibility of alternative tailings management options including the rationale for proposed fluid tailings centrifugation treatment profiles and capping;
- ready-to-reclaim (RTR) and other performance criteria for all tailings deposits;
- the use of water-capped pit lakes as a fluid tailings management option;
- the location of the water-capped pit lake and corresponding risk mitigation;
- water quality and groundwater monitoring, triggers and risk mitigation;
- the final landscape and closure plans;

- the duration of initial treatment of fluid tailings to reclamation certification and the return to traditional use activities; and
- discharge of surface water to the Athabasca River.

[19] Additionally, the following summarizes areas of concern of the SOC filers at the technical meeting:

FMFN

- Changes in the final landscape compared to predisturbance conditions, including the elimination of wetlands, the addition of a large and deep water-capped pit lake, and the addition of a steep rise and man-made plateaus
- Lack of input from FMFN and other indigenous communities in Syncrude's planning and research
- Insufficient evaluation of alternative technologies

OSEC

- Inadequate fluid tailings treatment and progressive reclamation
- Inadequate fluid tailings treatment technology selection and performance criteria
- Deferral of reclamation activities that will increase public liability
- Unclear decision points on alternative technology selection
- Lack of fully developed alternative technology plan
- Public liability and disclosure
- Cumulative effects and regional management

MCFN and MML 1935

- Excess volume of fluid tailings over the mine life
- Lack of performance criteria for treated tailings deposits and use of criteria and indicators for reclamation certification, which were not acceptable to indigenous communities

FMMCA

- Excess volume of fluid tailings at the end of mine life compared to *Directive 085* requirements
- Lack of performance criteria for treated tailings deposits and use of criteria and indicators for reclamation certification, which were not acceptable to indigenous communities
- Lack of transparency of Syncrude with reporting on progress or research projects

- Lack of opportunities for indigenous communities to participate in review of progress reports and research results, to observe installations, and to contribute to planning

ACFN

- Inadequate inclusion of ACFN in the development of performance criteria, oversight of the TMP, and monitoring of the mine, tailings management and reclamation
- Changes in the final landscape compared to predisturbance conditions, including the elimination of wetlands coverage, the addition of a large and deep water-capped pit lake, and the addition of a steep rise and man-made plateaus
- Reliance upon tailings management technologies that are unproven, unregulated, lack performance criteria and certainty, and are poorly supported by data
- Inadequate data concerning water quality, quantity, flow, and ecology for all watercourses
- Failure to release information about water release from the CT deposits and centrifuge cake and water movement from the end-pit lake

Approval Discussion

Introduction

[20] The ability of Syncrude's TMP to meet the *TMF*'s objective is dependent on a technology that is subject to further assessment, research, and future policy. The approach in the approval granted by the AER reflects *TMF* outcomes and sets conditions that ensure appropriate information is captured in a timely manner to manage risk and make appropriate regulatory decisions at Aurora North mine.

[21] The approval terms and conditions address

- stakeholder and indigenous community engagement;
- project-specific thresholds for both new and legacy fluid tailings;
- tailings treatment technology and deposit plans and updates, including mitigation measures and research, monitoring, evaluation, and reporting; and
- environmental effects and implications.

[22] The approval terms and conditions are subject to the AER`s *Integrated Compliance Assurance Framework* (*ICAF*) and *Manual 013*. In addition, the management actions in the *TMF* and *Directive 085* are new tools available to the AER. A common theme in *ICAF*, the *TMF*, and *Directive 085* is a flexible approach; namely, to allow for the discretion to choose the appropriate tools to the specific circumstances to ensure the most effective compliance or enforcement outcome.

[23] Syncrude's TMP was submitted as an application under *OSCA* and the decision on the application was made pursuant to *OSCA*. This decision report also makes reference to other approvals, in particular the *Environmental Protection and Enhancement Act* (*EPEA*) approval issued to Syncrude in relation to this project. Further, various letters issued pursuant to *OSCA*, the *Water Act*, and *EPEA* approvals that are related to the matters discussed in this report have been attached to this decision report.

Stakeholder and Indigenous Community Engagement

[24] The *TMF* and *Directive 085* describe the importance of transparency, engagement, and enhancing stakeholder and indigenous community understanding of fluid tailings management.

Decision Summary and AER Findings

[25] All SOC filers expressed a desire for improved engagement and increased involvement in tailings management planning at Aurora North. Some SOC filers indicated there was a lack of transparency with respect to progress reporting and research. MML 1935, FMFN, AFCN, MCFN, and OSEC specifically requested that Syncrude augment its engagement to include the water-capping technology demonstration that Syncrude has been operating since 2012 at the Base Mine Lake facility at the Mildred Lake mine (BML).

[26] To increase transparency, information sharing, and involvement, Syncrude is required to engage stakeholders and indigenous communities on tailings management activities undertaken pursuant to the approval and on its water-capping technology demonstration at BML.

[27] The AER expects that

- the required engagement efforts will include SOC filers on the TMP application;
- over the life of Aurora North mine operations, the stakeholders and indigenous communities who are engaged may change to reflect the issues and concerns of the day, and, as such, the AER expects Syncrude to conduct its engagement activities accordingly; and
- Syncrude's engagement will incorporate its research and lessons learned from ongoing operations and be timely and meaningful.

[28] Syncrude is also required to hold an annual forum with stakeholders and indigenous communities regarding tailings management activities undertaken pursuant to the approval and its water-capping technology demonstration. The AER is not specifying the format of the forum (e.g., workshop, meeting) as the AER believes it is appropriate to leave the design and scope of the event to Syncrude. However, the AER expects the annual forum will be tailored to what has occurred in the past year and what is upcoming regarding tailings management and water-capping technology demonstration activities. The forum can be used to provide information, gather input, and describe plans on how engagement will occur for the upcoming year. In addition, it is expected the following annual forums will be more robust:

- in 2019, as Syncrude should explain its plan, which will have been submitted by December 31, 2018. That plan is to include details on how Syncrude will develop alternative tailings treatment technologies and an implementation plan;
- in 2022, as this is one year prior to Syncrude submitting an updated TMP; and
- in 2023, as Syncrude will have submitted an updated TMP in 2023 and this is one year prior to commencement of sand capping of the first in-pit CT deposit in Aurora East Pit North (AEPN).

[29] Syncrude is required to report to the AER on the details of its engagement efforts on an annual basis.

Fluid Tailings Profiles and Project-Specific Thresholds

[30] The *TMF* and *Directive 085* require that new and legacy fluid tailings must be treated and progressively reclaimed during the life of a project. The *TMF* and *Directive 085* also provide guidance that operators must consider in the development of their TMPs.

[31] The fluid tailings profile represents the volume of fluid tailings that are not RTR (e.g., do not meet RTR criteria). Both the new and legacy fluid tailings profiles are important tools by which the performance of an operator will be measured.

Legacy Fluid Tailings Profile

Context

[32] Legacy fluid tailings are fluid tailings that existed before January 1, 2015. All legacy fluid tailings must be RTR by end of mine life.

[33] Syncrude has 108 Mm^3 of legacy tailings located in the Aurora Settling Basin (ASB), AEPN, and Aurora East Pit South (AEPS). Syncrude's new fluid tailings are also placed in ASB, AEPN, and AEPS, resulting in combined new and legacy fluid tailings deposits. These combined tailings are then treated by CT technology. As a result, Syncrude cannot distinguish between legacy fluid tailings and new fluid tailings in these tailings deposits. For these situations the *TMF* and *Directive 085* permit the operator to allocate the volume meeting RTR criteria to either its legacy fluid tailings volume inventory or its new fluid tailings volume inventory.

Decision Summary and AER Findings

[34] Based on Syncrude's reliance on water-capping technology and proposed RTR criteria for water-capped deposits, its legacy fluid tailings profile meets the *TMF*'s objective as Syncrude's legacy fluid tailings (108 Mm^3) achieve RTR status by end of mine life (2040).

[35] Syncrude is required to achieve the legacy fluid tailings profile as shown in figure 1.

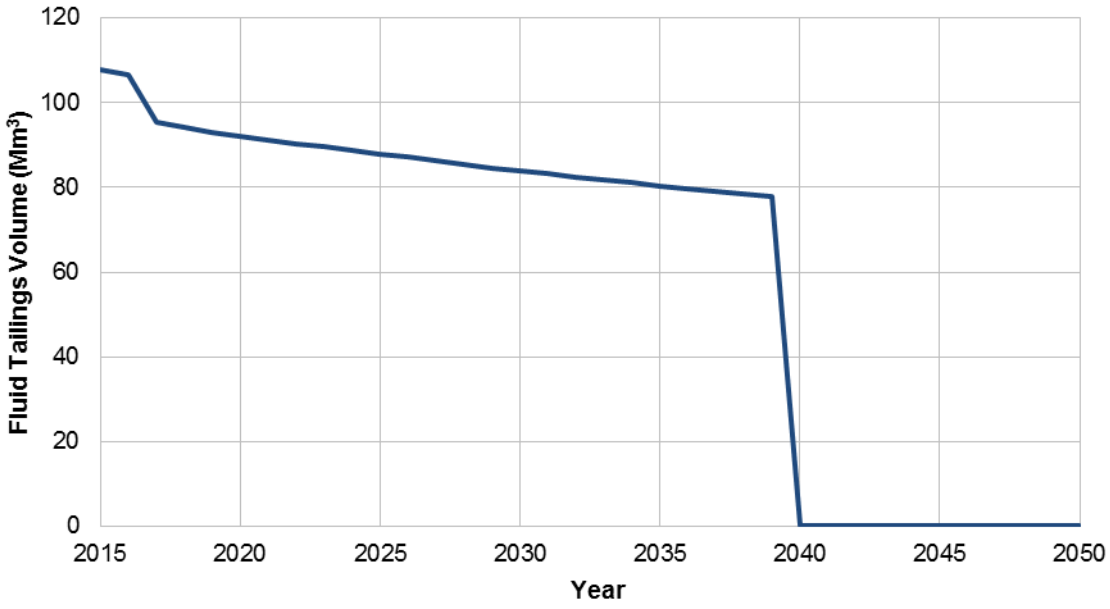


Figure 1. Legacy fluid tailings profile

[36] SOC filers raised three concerns with respect to Syncrude's legacy fluid tailings profile.

[37] First, SOC filers expressed significant concerns regarding Syncrude's reliance on water-capping technology. The AER shares these concerns, and notes that water capping is subject to further assessment, research, and future policy. The AER's findings with respect to water-capping technology can be found in the section "Water-Capping Technology" and with respect to RTR for water-capped deposits in the section "Water-Capped Deposits."

[38] The ability of Syncrude's legacy profile to meet the *TMF's* objective is dependent on Syncrude using water-capping technology, the AER authorizing RTR criteria for water-capped deposits, and RTR status being achieved as soon as the water capping has commenced. The AER is not authorizing RTR criteria for Syncrude's water-capped deposits.

[39] Syncrude is required to submit an updated TMP by December 31, 2023 (updated 2023 TMP), that includes an updated legacy fluid tailings profile. This timing requirement aligns with Syncrude's indicated decision point (2023) for the use of water-capping technology for Aurora North. The AER requires that the updated legacy fluid tailings profile will be supported by evidence to justify the technology and RTR criteria, including the timing when RTR status is achieved, and reflect all available information on water-capping technology (i.e., Base Mine Lake water-capping technology demonstration).

[40] Second, OSEC raised concerns related to the lack of progress in treating legacy fluid tailings during mine life. Given that Syncrude cannot distinguish between legacy fluid tailings and new fluid

tailings due to the combined placement, the AER recognizes that Syncrude is attributing its fluid tailings treatment to the new fluid tailings profile and not the legacy fluid tailings profile. This approach is acceptable under the *TMF*, as long as the legacy fluid tailings achieve RTR status by end of mine life.

[41] Third, some of the SOC filers raised concerns that the legacy fluid tailings profile shows a decrease in fluid tailings volume based on expected consolidation between 2016 and 2040. The decrease in legacy fluid tailings volume is not based on achievement of RTR criteria, but on annual fluid tailings volume measurement. The AER recognizes that consolidation is one of the factors resulting in the reduction in fluid tailings volume. It will be measured and reported on in accordance with *Directive 085*.

New Fluid Tailings Profile

Context

[42] The *TMF* defines new fluid tailings as fluid tailings that are produced after January 1, 2015. All new fluid tailings must be RTR within ten years of end of mine life.

Decision Summary and AER Findings

[43] Based on Syncrude's reliance on water-capping technology and proposed RTR criteria for water-capped deposits, its new fluid tailings profile meets the *TMF*'s objective as all new fluid tailings achieve RTR status in 2045, five years after the end of mine life.

[44] Syncrude's new fluid tailings profile also meets the *TMF* and *Directive 085* guidance as it includes an end of mine life target that is no greater than 5 years of accumulation of fluid tailings production at Aurora North.

[45] Syncrude is required to achieve the new fluid tailings profile as shown in figure 2.

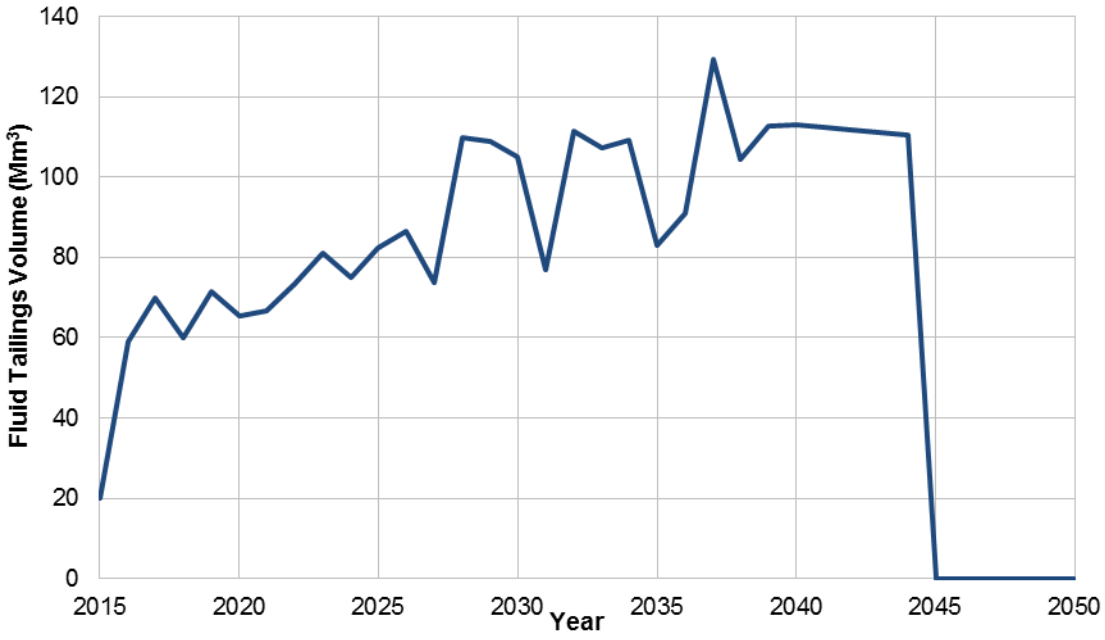


Figure 2. New fluid tailings profile

[46] SOC filers and the AER have several concerns regarding Syncrude's new fluid tailings profile:

- As with the legacy fluid tailings profile, achieving the *TMF*'s objective is dependent on using water-capping technology, and the AER authorizing RTR for water-capped deposits, which permits achieving RTR status as soon as the water capping has commenced.
- The *TMF* and *Directive 085* require profiles to be project specific. Profiles are required to track project-specific fluid tailings volume, regardless of fluid or treated tailings storage and final placement locations. It is unclear whether Syncrude's new fluid tailings profile excludes fluid tailings volumes generated from froth transferred to the Mildred Lake mine from Aurora North.
- Although the TMF acknowledges that it may take more than three to ten years to accumulate the peak volume, Syncrude is proposing growth in tailings accumulation until 2040, which is nearly forty years from the start of mining operations to accumulate the peak volume.
- Syncrude has not demonstrated that the fluid tailings treatment capacity is equal to or greater than the new fluid tailings production rate as required by the TMF and Directive 085.

[47] To further expand on the latter two concerns, between 2019 and 2040, the fluid tailings volume increases from 72 Mm^3 to 113 Mm^3, with a peak volume of 130 Mm^3. This peak volume is less than 10 years of full production, which is in accordance with the *TMF* and *Directive 085*.

[48] However, this increase between 2019 and 2040 is not in alignment with the *TMF* or *Directive 085* guidance, which states that the fluid tailings treatment capacity must be equal to or greater than the new fluid tailings production rate. This issue is addressed in the section "Technology Selection."

[49] Syncrude is required to submit an updated 2023 TMP that includes an updated new fluid tailings profile. The updated profile must demonstrate the *TMF*'s objective is achieved and ensure treatment capacity is equal to or greater than the new fluid tailings production rate by December 31, 2027. The profile must also include naphtha recovery unit tailings from Aurora North, be supported by evidence to justify its technology and RTR criteria, including the timing when RTR status is achieved, and reflect all available information on water-capping technology. The AER is requiring the updated profile by the end of 2023; this aligns with Syncrude's indicated decision point (2023) for the use of water-capping technology for Aurora North.

Thresholds

Context

[50] The volume of accumulated fluid tailings is the primary indicator in the *TMF* used to manage and decrease liability and environmental risk resulting from the accumulation of fluid tailings. Triggers and a limit (collectively referred to as "thresholds") will be set relative to the fluid tailings profiles. The thresholds will ensure that fluid tailings are not accumulating beyond a volume or at a rate that precludes operators from meeting the *TMF*'s objective. These are tools to be used to manage risks associated with TMPs. Various management actions are required when thresholds are exceeded.

[51] Three project-specific thresholds are set based on an operator's fluid tailings profiles in accordance with the *TMF* and *Directive 085*.

[52] The three thresholds are the profile deviation trigger, the total volume trigger, and the total volume limit:

- Profile deviation trigger:
  - Alerts regulators and operators when the volume of fluid tailings is growing 20 per cent faster than that approved for the profile. Additional management action is required when the profile deviation trigger is exceeded.
  - This trigger is based on when the fluid tailings volume growth is 20 per cent higher than that in the approved profile.
  - The *TMF* states that the profile deviation trigger allows a five-year rolling average to account for year-over-year variability. The profile deviation trigger applies to both legacy fluid tailings and new fluid tailings profiles.

- Total volume trigger
  - Indicates that the volume of fluid tailings has exceeded its approved maximum accumulation and requires additional management action.
  - The *TMF* states that this trigger is based on 100 per cent of the greater of the maximum approved fluid tailings volume profile or the end of mine life target.
  - The total volume trigger applies to the new fluid tailings profile.
- Total volume limit
  - Indicates that the volume of fluid tailings presents an unacceptable risk to the environment and potential long-term liability. Exceedance of this limit will compromise the ability of an operator to have all of their fluid tailings in an acceptable management state (i.e., RTR) within ten years of the end of mine life. Therefore, the most severe management responses are initiated.
  - The *TMF* states that this limit is based on 140 per cent of the greater of the maximum approved fluid tailings volume profile or the end of mine life target.
  - The total volume limit applies to the new fluid tailings profile.

Decision Summary and AER Findings

[53] The *TMF* states the profile deviation trigger would consider a five-year rolling average to account for year-over-year variability. To allow for this variability, the AER set the profile deviation trigger for Syncrude as a five-year rolling average of the annual profile deviation. The profile deviation trigger is applicable to both the legacy fluid tailings and new fluid tailings profiles.

[54] Syncrude indicated that it should only be subject to the profile deviation trigger, as fluid tailings volume measurement errors have the potential to compound over time and could affect their profile performance. OSEC recommended that the total volume limit and total volume trigger be set based on fluid tailings volumes at the time of Syncrude's decision point on the use of water-capping technology (i.e., 2023).

[55] The AER is setting the thresholds in accordance with the *TMF* and *Directive 085*, and therefore Syncrude is subject to a total volume limit and total volume trigger, in addition to the profile deviation trigger.

[56] Further, the total volume trigger and limit are based on the greater of the maximum approved fluid tailings volume profile or end of mine life target, as per the *TMF* and *Directive 085*. As Syncrude's end of mine life target is 113 Mm^3, the AER is setting the total volume trigger at 113 Mm^3 and the total volume limit at 158 Mm^3.

[57] The AER recognizes that the maximum approved fluid tailings volume is 130 Mm^3. However, this peak volume only occurs in a single year, near the end of mine life. The AER believes it is inappropriate to set a total volume trigger and limit based on this one time peak volume due to the inflated threshold it would create for the entirety of the profile. As per *Directive 085*, the AER will consider *all* the circumstances when considering appropriate management responses where a threshold is exceeded.

Fluid Tailings Treatment Technology

[58] The *TMF* stipulates that all fluid tailings must be treated with an accepted technology. The risks, benefits, and trade-offs associated with the proposed technology must be understood, have contingencies identified, and risks mitigated.

Technology Selection

Context

[59] *Directive 085* requires operators to justify that selected technologies are the best available for the project.

[60] Syncrude currently uses and proposed to continue the use of CT.

[61] Syncrude also proposed to use water-capping technology for two deposits.

Decision Summary and AER Findings

[62] SOC filers expressed concern that Syncrude did not provide a complete and detailed evaluation of technology options, including feasibility and selection of technology.

[63] Syncrude is authorized to use CT, subject to the approval terms and conditions, based on the following considerations:

- Syncrude completed a technology evaluation study in 2006 using process, deposit, and environmental performance factors, including footprint impact, closure plan changes, net environmental effects, a mass balance study, and an economic assessment. The study concluded CT was a preferred technology option.
- Syncrude has employed CT technology on a commercial scale at its Mildred Lake mine since 2000. As a result, Syncrude has operational experience with CT, including monitoring, capping, and commencing reclamation at Mildred Lake mine.
- The Aurora East Pit CT deposit performance indicates that Syncrude should be able to achieve deposit performance expectations for physical properties.

- Syncrude would be able to employ mitigation measures (e.g., re-handling, additional treatment, capping with additional material) should Aurora East Pit underperform or it is determined that Syncrude cannot achieve long-term reclamation outcomes.
- Further review and assessment of the CT deposit performance will be undertaken through the AER's review of the updated 2023 TMP. In addition, the AER expects Syncrude to update the 2006 technology evaluation study based on the additional 17 years of industry operation and research and provide this information in the updated 2023 TMP.

[64] There are a number of issues arising from Syncrude's technology selection that must be addressed. Syncrude has not demonstrated that its fluid tailings treatment capacity is equal to or greater than the new fluid tailings production rate. Further, Syncrude is proposing that a significant volume of fluid will be managed by water-capping technology.

[65] To ensure that adequate treatment capacity will be available when needed, Syncrude is required to submit, by December 31, 2018, a plan that describes how Syncrude will ensure that the treatment capacity is equal to or greater than the production rate of new fluid tailings by December 31, 2027, and that the *TMF*'s objective can be achieved. Further, Syncrude must describe how it will develop feasible alternative tailings treatment technologies and an implementation plan for the volume of fluid tailings proposed to be treated with water-capping technology. Syncrude is also required to annually provide a status update regarding the implementation priorities for the previous and next reporting period, including any limitations or constraints.

[66] Further, Syncrude is required to submit an updated 2023 TMP that ensures treatment capacity is equal to or greater than the new fluid tailings production rate by December 31, 2027, and that the *TMF*'s objective can be achieved.

[67] An additional issue arising from Syncrude's technology selection is the proposed use of water-capping technology. Syncrude's proposed water capping of 188 Mm^3 of untreated fluid tailings is not authorized, as the technology is subject to further assessment, research, and future policy. The approval prohibits the placing of water, which includes industrial wastewater, above treated or untreated tailings for the purpose of creating a water-capped deposit as a closure landscape feature ("water-capped pit lake"). The AER's decision with respect to the water-capped pit lake, including the prohibition and need for feasible alternative tailings treatment technologies to water capping, can be found in the section "Water-Capping Technology."

[68] A third issue concerns the transfer of tailings. Syncrude's Aurora North transfers froth to Mildred Lake for treatment, and naphtha recovery unit tailings are generated by the froth treatment process. The transfer of froth to Mildred Lake was previously authorized. To ensure there is ongoing transparency and up to date information with respect to naphtha recovery unit tailings, Syncrude is required to

- report annually on the volume of froth transferred to Mildred Lake and
- provide an update on naphtha recovery unit tailings in the updated 2023 TMP.

Composite Tailings Technology

Context

[69] CT technology combines a densified coarse sand tailings stream with controlled amounts of fluid tailings and gypsum to form CT. CT is expected to have limited segregation, and will release water as it consolidates.

Decision Summary and AER Findings

[70] The AER is concerned with the ability of the CT deposits to support future reclamation activities, achieve stable targeted ecosites, and meet the *TMF*'s outcomes. Syncrude is required to assess the performance and limitations for the CT deposits, and monitor CT plant operations monthly, monitor CT deposits annually, and report on these monitoring results annually.

[71] Syncrude indicated that the coarse sand volume being allocated to CT was appropriate. SOC filers expressed concern that fluid tailings treatment capacity is constrained by coarse sand availability due to competing construction and reclamation needs. The AER shares this concern, as Syncrude did not provide evidence to support its statement that the needs were appropriate.

[72] To address the concern, Syncrude is required to provide a summary of coarse sand production and use, including coarse sand for cell construction, beaching, and capping by location.

[73] Syncrude's CT technology and CT deposition plan may result in the formation of underperforming CT (i.e., off-spec CT). Off-spec CT can result in more fluid tailings than expected, an increase in capping material needs, a decrease in storage capacity, and an increase in the tailings deposit consolidation time. All of this can affect Syncrude's ability to achieve targeted ecosites in the timeframes proposed. Therefore, Syncrude is required to

- monitor on a monthly basis CT plant operation performance, including sand-to-fines ratio, and
- provide an annual CT plant operation performance report including a monthly histogram of sand-to-fines ratio variation.

[74] Syncrude disclosed using flue gas desulphurization by-product gypsum (FGD gypsum) or lime as an additive in its CT operation. The AER finds that the short-term environmental effects of FGD gypsum are likely to be similar to those previously assessed and that existing operational and regulatory mitigation measures and requirements to assess long-term effects are effective.

[75] Syncrude may propose to change additives (e.g., gypsum, lime) in the future or the manufacturer's formulas may change under the same product name. In accordance with *EPEA*, Syncrude is required to notify the AER of any proposed change to an additive, or manufacturer modifications to an approved additive formula. Depending on the significance of the proposed change, additional authorizations or amendments may be required.

Water-Capping Technology and Alternative Technologies

Context

[76] Water-capping technology involves the placement of water above untreated or treated tailings for the purpose of creating a water-capped deposit as a closure landscape feature ("water-capped pit lake"). Syncrude proposed to place 188Mm^3 of untreated fluid tailings in two tailings deposits; AWPN and AWPW. Syncrude intends to cover AWPN and AWPW with water to create a single water-capped deposit as a closure landscape feature.

[77] Placement of untreated tailings in AWPW is proposed to commence in 2037 and in AWPN in 2041. Water capping of the untreated tailings is proposed in AWPW and AWPN in 2040 and 2045, respectively.

[78] Syncrude indicated 2023 is its decision point for using water-capping technology for Aurora North. Syncrude has been operating a water-capped technology demonstration since 2012 at the BML facility. By 2023, Syncrude indicates that the demonstration project will have been monitored for ten years and it expects the performance will meet all regulatory requirements.

[79] In the event that water-capping technology or water-capped pit lakes are allowed by the Government of Alberta, Syncrude stated it would apply to the AER for an amendment to the TMP at that time.

[80] *Directive 085* requires that, where water-capped fluid tailings technology is used to generate the inventory forecast in the profiles, an alternative tailings treatment technology is provided, including timeframes for implementation.

[81] Syncrude provided a conceptual alternative tailings treatment technology option and schedule using fluid tailings centrifugation for the 188 Mm^3 of untreated fluid tailings currently proposed for treatment by water-capping technology. Syncrude has implemented fluid tailings centrifugation at a commercial scale at Mildred Lake.

Decision Summary and AER Findings

[82] All of the SOC filers raised significant concerns with water-capping technology and end-pit lakes, indicating that the technology is unproven, and that the lake Syncrude proposed to create was undesirable as a final outcome.

[83] Water-capping technology is subject to further assessment, research, and future policy. Syncrude is prohibited from placing any water, including industrial wastewater, above treated or untreated fluid tailings for the purpose of creating a water-capped pit lake. Syncrude is required to meet future policy on water-capped pit lakes.

[84] The AER recognizes that extensive research on water-capped tailings continues and the Government of Alberta will likely be developing policy for water-capping technology and water-capped pit lakes. If the feasibility of water-capped pit lakes is demonstrated and the Government of Alberta implements policies permitting their use, Syncrude must apply to the AER to amend their approval.

[85] Syncrude conducts research on water-capped tailings. The AER expects that *any* research plans, whether they are concerned with water-capping or some other matter, will focus on addressing site-specific uncertainties to ensure that the *TMF*'s objective and outcomes are met and that reclamation timelines are not extended. Syncrude has not provided sufficient information for the AER to determine if BML research will address Aurora North site-specific uncertainties, such as the AWPW and AWPN deposit design and the water chemistry of Aurora North's tailings streams. To ensure that the AER has the most current information available to inform future decisions on water-capping technology, Syncrude is required, as part of its end-pit lake research and development report required under its *EPEA* approval, to provide an explanation of

- the applicability of BML to the Aurora North pit lake and
- how Syncrude will address uncertainties and risks where BML research is not applicable.

[86] Syncrude may continue to plan on the basis that water-capped pit lakes are an option unless water-capped tailings technology proves to not be feasible and/or Government of Alberta policy does not allow it. In the meantime, Syncrude is required to plan for an alternative to water-capped pit lakes.

[87] SOC filers expressed concerns with the feasibility of alternative tailings management options, including centrifugation, and decision points associated with alternative technology selection. SOC filers also identified a need for a dry-land option for all tailings.

[88] Syncrude did not commit to fluid tailings centrifugation as its alternative tailings treatment technology in its TMP. The AER has concerns with respect to the feasibility of Syncrude’s fluid tailings centrifugation plan, including capping feasibility, settlement of the deposit, and Syncrude’s ability to achieve long-term reclamation outcomes. Syncrude also identified accelerated dewatering and CT as potential conceptual alternative treatment technologies. Syncrude did not provide adequate information on

any of centrifugation, accelerated dewatering, or CT for the AER to assess any of these technologies and implementation plans as an alternative. As such, the AER is not authorizing fluid tailings centrifugation, or any other alternative tailings treatment technologies, at this time.

[89] Syncrude is required to describe, by December 31, 2018, how it will develop feasible alternative tailings treatment technologies and an implementation plan to treat the volume of fluid tailings that is proposed to be treated with water-capping technology. In the event that Syncrude continues to propose the use of water-capping technology, Syncrude must provide feasible alternative tailings treatment technologies and an implementation plan in the updated 2023 TMP. Considering the significant volume of fluid tailings that would need to be treated both before end of mine life and within 10 years after end of mine life, Syncrude must provide the AER assurance that the *TMF*'s objective and outcomes can be met in the event that water-capping technology is not permitted.

Capping Material Availability

Context

[90] Adequate capping material, such as coarse sand, is necessary for landform contouring and stability, providing increased tailings deposit strength and trafficability, managing settlement, controlling the location of the groundwater table, controlling surface water drainage, and preventing tailings pore water from contaminating reclaimed areas. Insufficient coarse sand can result in periodic and long-term fluid tailings volume accumulation and a need for additional treatment technologies. Syncrude indicated there are competing demands for coarse sand.

[91] Syncrude requires coarse sand for the following activities:

- treating fluid tailings using CT technology,
- infill beaching,
- construction for the purposes of building dams and tailings containment structures, and
- capping tailings deposits.

[92] Syncrude proposed a CT deposit average capping thicknesses of up to 15 metres.

Decision Summary and AER Findings

[93] Syncrude's ability to meet *TMF* outcomes and future reclamation outcomes will be compromised if there is insufficient coarse sand.

[94] Some of the SOC filers expressed concern there is insufficient coarse sand to treat all Aurora North's fluid tailings and establish sustainable long-term reclamation outcomes. The AER shares this concern.

[95] Further, SOC filers expressed concern that Syncrude's average CT deposit capping thickness of up to 15 metres is greater than necessary and consequently restricts the availability of coarse sand for fluid tailings treatment. SOC filers wanted to see maximal use of coarse sand for fluid tailings treatment (i.e., additional CT). Although the proposed capping thickness increases the AER's confidence in CT deposit stability and settlement management, the capping thickness could present a risk to long-term reclamation outcomes, including the spatial extent and distribution of wetlands and water quality variability, and may constrain tailings treatment by CT.

[96] Syncrude did not provide sufficient information on CT deposit capping and suitable capping materials. Syncrude must ensure there is adequate coarse sand, or suitable capping material, available to supports its activities; otherwise, long-term reclamation and the *TMF*'s outcomes may not be achieved, and the timeliness of achieving the outcomes may be affected. In order to meet long-term reclamation outcomes, Syncrude is required to provide the following information as part of its *EPEA* life of mine closure plan and mine reclamation plan (see appendix 4):

- capping material types, objectives, and implications,
- material balances for coarse sand and any other suitable capping materials,
- contingency plans for capping material shortages, and
- an assessment of the minimum sand cap thicknesses required to manage the groundwater table, manage tailings pore water flux, provide adequate tailings deposit strength and trafficability, and drainage.

[97] Syncrude is also required to provide in its annual reclamation progress tracking report the volume of coarse sand and suitable overburden available as capping material for the CT placement locations (appendix 4).

[98] Syncrude's capping material needs remain uncertain. Syncrude's research is to provide timely and site-specific information with respect to capping material needs and availability. If there is a capping material shortage, Syncrude will need to adjust its tailings treatment technology selection to ensure its long-term reclamation outcomes can be achieved.

[99] The AER acknowledges that Syncrude has provided some capping research information as part of its *EPEA* approval. However, Syncrude did not specify what uncertainties associated with the TMP the research is planning to address, including capping objectives, capping thickness, or how capping material shortages may affect tailings treatment technology selection, future reclamation activity, or the achievement of the *TMF*'s outcomes. Syncrude is required to submit a capping research plan by December 31, 2018, for its CT deposits.

[100] Syncrude must provide details that support its research, including the objective, and the applicability of that objective in addressing the uncertainties and risks associated with Syncrude's TMP.

The AER expects Syncrude to use standard scientific methodology in the design of its research plan and that Syncrude will draw upon existing industry research on capping. Syncrude should consider the benefits of peer-reviewed research.

[101] All research plans should include the following:

- a rationale for proposed monitoring that supports research;
- a discussion of how the selection of performance measures, criteria, and validation methods relate to implementation;
- the applicability and scalability of the research to full implementation;
- a discussion on impact to long-term reclamation outcomes and timing for the mine; and
- a description of the changes that would be necessary to the mine design and materials requirements to enable long-term reclamation outcomes.

[102] Research results will be made publicly available through the *Directive 085* annual report to the AER.

[103] In the updated 2023 TMP, Syncrude is required to explain how the results of capping research have been incorporated. The AER expects that Syncrude will explain whether the results of capping research impacts its tailings treatment technology selection (i.e., inform the need for any alternative or supplemental tailings management option), targeted ecosites, future reclamation activity, or the ability to achieve the *TMF*'s outcomes.

[104] Syncrude is also required to explain how the results of capping research have been incorporated into each updated plan required one year prior to placement in the respective new deposit (the future deposit plans).

Storage

Context

[105] Site-wide storage space is needed to contain and manage fluid tailings, treated tailings, and water, including industrial wastewater. Where on-site storage capacity is exceeded, there is the potential to compromise tailings management, increase land disturbance, require the construction of additional storage facilities, sterilize resources, delay reclamation activities, and impact dam safety.

[106] Syncrude provided its planned storage capacity requirements and planned storage capacity availability at Aurora North from 2016 to 2040.

Decision Summary and AER Findings

[107] Syncrude indicated there is adequate fluid storage capacity at Aurora North. The AER is unable to verify how conservative Syncrude's planned storage capacity requirements as Aurora North's water and froth operations are integrated with the Mildred Lake mine.

[108] The AER expects Syncrude will continue to verify and update its storage planning assumptions and storage activities as Aurora North progresses. Syncrude is required to report annually on the available storage capacity of each tailings deposit or pond that contains water or tailings, and to estimate the storage volume requirements for the next five years.

Pilots, Prototypes, and Demonstrations

Context

[109] Innovation is a principle of the *TMF* and *Directive 085*. Syncrude indicated that it continues to develop a number of technologies, including accelerated dewatering of tailings and fluid tailings centrifugation.

Decision Summary and AER Findings

[110] To facilitate innovation at Aurora North and to address administrative inconsistencies between *OSCA* and *EPEA*, the AER has updated the requirements in Syncrude's *OSCA* approval to be consistent with the principles of the *TMF* and *Directive 085*, and the requirements under *EPEA*.

[111] Syncrude is required to notify the AER six months in advance of any proposed on-site pilots, on-site prototypes, or on-site demonstrations. Syncrude may not construct or implement any proposed on-site pilots, on-site prototypes, or on-site demonstrations unless a written authorization or approval amendment is granted

[112] The AER continues to support and acknowledge the importance of technological innovation, understanding, and certainty around fluid tailings treatment options.

Ready-to-Reclaim Criteria

[113] As stated in the *TMF* and *Directive 085*, fluid tailings are considered RTR when they have been processed with an accepted technology, placed in their final landscape position, and meet performance criteria (i.e., RTR criteria).

[114] RTR criteria support the objective of reclaiming oil sands mining projects to self-sustaining locally common boreal forest ecosystems that are integrated with the surrounding area and consistent with the values and objectives identified in local, subregional, and regional plans.

[115] RTR criteria are used to track the performance of a tailings deposit towards its ability to be reclaimed as predicted and in the time predicted. Consequently, RTR criteria are critical in evaluating trends and managing performance.

[116] There are two subobjectives that address different aspects of performance:

- Subobjective 1: The deposit's physical properties are on a trajectory to support future stages of activity.
- Subobjective 2: To minimize the effect the deposit has on the surrounding environment and ensure that it will not compromise the ability to reclaim to a locally common, diverse, and self-sustaining ecosystem.

[117] The *TMF* and *Directive 085* allow operators to develop RTR criteria that are suitable to their type of tailings, technology, deposit, and future reclamation activities. *Directive 085* provides guidance on RTR criteria and requires operators to include information that supports their choice of RTR criteria.

[118] RTR is a new concept and Syncrude's proposed RTR criteria may not adequately track the performance of a treated tailings deposit. Improvements to or additional RTR criteria will likely be required. The AER expects that research and monitoring results will inform and lead to modified or new RTR criteria. Syncrude's approval is conditioned to allow for improvements or additions to RTR criteria.

[119] In accordance with *Directive 085*, where treated tailings meet their RTR criteria, they can be removed from the fluid tailings inventory because they are on a trajectory to meet long-term reclamation outcomes. In circumstances where RTR criteria are no longer met or there is a deviation from the expected trajectory, Syncrude must identify the volume not meeting the RTR criteria and the degree of nonperformance.

[120] SOC filers raised concerns with the adequacy of the RTR criteria as proposed by Syncrude. The AER has similar concerns.

Measurement and Averaging

Context

[121] Each treated tailings deposit must be measured to determine if the RTR criteria has been achieved. *Directive 085* requires operators to submit a measurement system plan six months from the date of an approved TMP.

Decision Summary and AER Findings

[122] Syncrude is required to develop a measurement system plan (see appendix 5). The measurement system plan must include

- definitions of parameters for fluid tailings and RTR criteria measurements;
- reference to standards and procedures used to measure fluid tailings and treated tailings and RTR criteria;
- an explanation of and justification for measurement procedures that are unique to Syncrude and its plan;
- evidence that the plan will address the measurement outcomes as per section 5 of *Directive 085*;
- an explanation of how each of the deposit's RTR criteria will be measured using deposit sampling, calculated, and reported;
- a description of the tailings deposit sampling, measurement, and survey program; and
- a justification of how measurement, sampling, and spacing intervals will
  - show the variation of the tailings deposit properties,
  - verify that the tailings deposit is achieving RTR criteria, and
  - identify if any material in the tailings deposit is not achieving RTR criteria.

[123] RTR criteria alone do not explain how Syncrude will determine the volumes of treated tailings that do not meet RTR criteria. Syncrude proposed a conceptual measurement plan for how it would determine the volume of fluid tailings to be returned to the fluid tailings inventory where subobjective 1 or subobjective 2 RTR criteria were not met. The AER is requiring additional details in the measurement system plan as required by *Directive 085*. Syncrude's measurement system plan must describe how it will measure the volume of treated tailings that do not meet RTR criteria.

[124] Syncrude indicated that it would consider the average solids content of the entire deposit in determining if RTR status had been met. The AER does not accept averaging of the entire deposit, as averaging does not provide sufficient information to identify variations in tailings characteristics across a deposit. The use of an average limits the ability to assess risks and liabilities for underperforming treated tailings and the effect on a deposit's performance towards the targeted ecosites. A deposit may show excellent performance on average while a significant portion of the tailings deposit is actually underperforming and thereby compromising the ability to achieve long-term reclamation outcomes. The averaging process obscures a meaningful understanding of the deposit volumes that have been treated unsuccessfully or are failing to improve as expected.

[125] Therefore, Syncrude is required to measure the volume of treated tailings that meet the RTR criteria based on deposit sampling. The deposit sampling is expected to be sufficient to identify variability

within the entire deposit. Syncrude cannot use an annual average for the entire deposit to determine the volume of treated tailings meeting RTR criteria.

[126] The AER recognizes that characterization of a tailings deposit is challenging and that Syncrude may use some form of 3D modelling or spatial statistics to determine the volume not meeting the performance criteria and the degree of inadequate performance. The AER expects that the frequency and spatial extent of monitoring, and the statistical methods applied, will minimize the margin of error.

Subobjective 1: Solids Content

Context

[127] Subobjective 1 RTR criteria are related to the performance of the deposit's physical properties.

[128] Syncrude proposed to use the solids content by weight of a deposit as a subobjective 1 RTR criterion. Solids content represents the percentage of solid material by weight present in a sample.

[129] This section only discusses Syncrude's proposed use of solids content by weight. The AER findings on the associated criteria (e.g., 65 per cent solids content within 1 year of tailings placement) are discussed in "Subobjective 1: CT Deposit Trajectory."

Decision Summary and AER Findings

[130] Some SOC filers expressed concern that Syncrude's RTR criteria were unclear and the use of solids content only is inadequate.

[131] Syncrude indicated that solids content is an appropriate criterion to predict the performance of future deposits as the measured values can be compared to previously constructed CT deposits.

[132] However, solids content alone may not be sufficient to measure a deposit's performance or its ability to meet future stages of reclamation activity. Solids content can remain constant while other deposit measures, such as sands to fine ratio, effective stress, deposit consolidation, and pore water pressure, can vary. The variation of these measures may be equally critical in determining the performance of the deposit, understanding RTR criteria, and determining the deposit's ability to enable future reclamation activity and achieve the *TMF*`s outcomes.

[133] Syncrude is required, for each treated tailings deposit, to monitor and report, on an annual basis, solids and clay content, sand-to-fines ratio, effective stress, deposit consolidation, pore water pressure (including representative cross-sections), and any other parameters considered relevant by the AER or Syncrude. The results of this monitoring could result in improvements or additions to subobjective 1 RTR criteria.

[134] Given the additional monitoring and reporting required, the AER authorizes the use of solids content by weight of a deposit as a subobjective 1 RTR criterion.

Subobjective 1: CT Deposit Trajectory

Context

[135] *Directive 085* indicates that a trajectory or progression of RTR criteria over time may be necessary in order to successfully enable future reclamation activity.

Decision Summary and AER Findings

[136] The AER does not accept Syncrude's proposed RTR criterion of 60 per cent solids content. It is without a timeframe, and with a proposed target end of 65 to 80 per cent solids content and a capping milestone achieved.

[137] Syncrude's proposed RTR criteria does not provide the AER with assurance that the deposit's physical properties are on a trajectory to support future stages of activity in an appropriate timeframe.

[138] Syncrude stated that it could cap CT deposits between 65 and 85 per cent solids content. Syncrude also indicated that it could commence capping of CT deposits one year after the end of tailings placement. Therefore, based on Syncrude's CT deposit performance and capping timing information, the AER believes Syncrude can achieve a minimum of 65 per cent solids content by weight within one year of tailings placement. The AER specifies an RTR criterion of 65 per cent solids content by weight, based on deposit sampling, within 1 year of treated fluid tailings placement.

[139] Further, Syncrude stated that capping would provide additional strength to the deposit. Syncrude provided data from its CT deposits at Mildred Lake as evidence of improvements in deposit strength and solids content over time, with an entire deposit reaching over 75 per cent solids content by weight, following sand capping. Given this information, the AER is also specifying an RTR criterion of 75 per cent solids content by weight, based on deposit sampling, within one year after sand capping.

[140] In their feedback on the draft approval conditions, Syncrude considered the specified RTR criteria reasonable and some of the SOC filers found the RTR reasonable. Syncrude noted, however, that a modification to RTR criteria may change the projected fluid tailings profiles and could necessitate an amendment application. The AER recognizes that RTR criteria and the fluid tailings profiles are directly related and that a change to one may affect the other.

Subobjective 2

Context

[141] Subobjective 2 RTR criteria focus on circumstances where the operator may propose management strategies, design features, or mitigation measures for risks associated with the specific nature of the deposit or its surrounding environment that could impact reclamation—for example, design features that control specific water movement such as drainage control systems, or management of risks associated with deposit characteristics such as treated froth fluid fine tailings, acidification, specific additives, or gas formation.

[142] Syncrude proposed subobjective 2 RTR criteria related to monitoring

- treated fluid tailings and fluid levels compared to design elevations,
- slope movement and pore pressure, and
- observation wells for occurrences of elevated chloride concentrations.

Decision Summary and AER Findings

[143] The AER does *not* authorize Syncrude's proposed subobjective 2 RTR criteria.

[144] Syncrude's proposed use of treated fluid tailings and fluid levels compared to design elevations, slope movement, and pore pressure are important measurements to inform risks of geotechnical failure, overland flow of fluid tailings into adjacent water features, and seepage. However, Syncrude did not provide information that supported a clear relationship between the indicator (i.e., the measureable variable that is strongly correlated with the condition of a component that is tied to a specific objective or outcome) and subobjective 2, or provide criteria that would allow Syncrude or the AER to assess the indicator's effectiveness in minimizing the risk (e.g., evaluating contaminant mobility prevention or control success).

[145] Therefore, Syncrude's proposed subobjective 2 criteria of monitoring treated fluid tailings and fluid levels compared to design elevations, slope movement, and pore pressure are not approved at this time. The AER acknowledges that Syncrude reports on design elevation, slope movement, and pore pressure as part of its dam safety requirements.

[146] Syncrude's proposed use of observation wells for monitoring occurrences of elevated chloride concentrations is useful, in part, as chloride concentrations can provide an early indicator of contaminant mobility from tailings deposits. However, chloride concentration alone is not sufficient to address risk to groundwater. Syncrude's *EPEA* groundwater monitoring program identifies elevated concentrations of indicators *in addition* to chloride. Therefore, the AER specifies Syncrude's subobjective 2 criterion as: groundwater is monitored in accordance with the *EPEA* approval.

[147] Syncrude is required to ensure there is alignment between the groundwater monitoring program and measurement system plan (appendix 5). In their feedback on the draft approval conditions, Syncrude considered the specified RTR criteria reasonable; some of the SOC filers found the RTR reasonable.

[148] Syncrude will continue to research risks associated with tailings and the achievement of ecosystems as part of its *EPEA* approval. Research results, or other monitoring results, may also modify or identify improvements or additions to subobjective 2 RTR criteria.

Water-Capped Deposits

Context

[149] Syncrude did not propose RTR criteria for water-capped deposits.

Decision Summary and AER Findings

[150] SOC filers expressed concerns that Syncrude did not propose viable criteria for the water-capped deposit. The AER does not authorize water-capped deposits or any RTR criteria for water-capped deposits. RTR criteria for water-capped deposits are subject to further assessment, research, and future policy.

[151] Although Syncrude did not propose criteria for the water-capped deposit, it did indicate that RTR status would be achieved as soon as water-capping commenced. The AER is concerned that this approach may not be acceptable and thus may have implications to Syncrude achieving the *TMF*'s objective.

[152] To support the assessment of water-capped fluid tailings technology, the Government of Alberta will likely be developing policy and performance criteria. The AER will adjust its approach to water-capped fluid tailings in this event.

[153] As discussed in the section "Water-Capping Technology," if the feasibility of water-capped pit lakes is demonstrated and the Government of Alberta adopts applicable policy, Syncrude must apply to amend the approval.

[154] Further, if Syncrude continues to propose water-capping technology, the updated 2023 TMP must include new or modified RTR trajectory and criteria for each type of deposit.

Deposit Settlement

Context

[155] As tailings settle, tailings pore water seeps upward. This upward flux can cause a rise in the water table, contamination of soil cover, discharge to surface water drainage systems, and a change in the size,

quality, and distribution of wetlands, all of which can threaten long-term reclamation outcomes and the *TMF*'s outcomes.

Decision Summary and AER Findings

[156] To better understand the risks to *TMF* outcomes, Syncrude is required to provide, by December 31, 2018, and in future deposit plans, a consolidation model or engineering analysis, along with any supporting information, including milestones that the AER requires for each treated fluid tailings deposit. These models or analyses provide a basis to predict future settlement, flux, piezometric pressures, groundwater table levels, pore water discharge to surface drainage systems, and capping material requirements.

[157] The results of the models or analyses are expected to be used to improve or develop RTR criteria. The information also informs the assessment of CT deposit performance and capping thicknesses, and risks to long-term reclamation outcomes and the *TMF*'s outcomes.

[158] Further, it is important to understand the distribution of end land forms and the extent of planned wetlands to ensure that the RTR criteria align with the targeted final landforms and the targeted range of ecosites and that the *TMF*'s outcomes are achievable.

[159] Syncrude did not assess the spatial extent of wetlands that would be used as treatment wetlands or the potential implications to the distribution of wetland types presented in previous closure submissions. It is unclear if there are adequate management strategies, design features, or mitigation measures for risks associated with returning tailings deposits to wetlands. Syncrude is required to continue to research risks associated with tailings and the achievement of ecosystems as part of its *EPEA* approval. This research must address the uncertainties respecting suitability and thickness of capping material, the stability of reclaimed treated fluid tailings surfaces, size and type of wetlands, and seepage of water released from tailings. In addition, Syncrude must validate that developing wetlands result from surface drainage and are not surface breakthrough from the CT deposit (appendix 3). The updated TMP required by 2023 must describe the environmental risks and how these will be managed or mitigated during operation, reclamation, and closure.

Deposit Milestones

Context

[160] *Directive 085* states that approval terms and conditions will address fluid tailings deposit milestones. *Directive 085* requires applicants to identify critical milestones for each deposit, including deposit preparation, start of fluid tailings placement, capping, and start of further reclamation activities.

Decision Summary and AER Findings

[161] Syncrude is required to meet the CT deposit milestones identified in appendix 6, as these milestones enable future reclamation activity.

[162] It is recognized that Syncrude is operating its first CT deposit at Aurora North and the milestones may be modified as operations continue.

Environmental Effects and Implications

[163] The *TMF*'s objective is to minimize fluid tailings accumulation, which may reduce environment effects such as seepage, occurrences of wildlife contact with tailings ponds, and tailings footprint.

Context

[164] Efforts to minimize fluid tailings volumes may result in potential changes or trade-offs to other environmental risks and effects to air, land, and water. These changes or trade-offs must be identified and their short-term and long-term implications to environmental performance assessed. The identity, nature, location, and magnitude of environmental effects and implications need to be understood.

[165] For approved projects, the proposed TMP should be consistent with the previously predicted environmental outcomes or identify any inconsistencies. The existing and proposed monitoring plans will confirm that environmental performance is achieved.

[166] TMPs, including mitigation measures and contingency plans, will minimize the risk of environmental effects over the life of a project.

[167] Based on Syncrude's TMP, there are no *EPEA* terms and conditions, including limits, being amended. However, there are environmental effects and implications that the AER addresses below.

Air

[168] No *EPEA* approval air emission limits are being amended as a result of the TMP.

[169] The AER recognizes that there is ongoing work with respect to *Recurrent Human Health Complaints Technical Information Synthesis Fort McKay Area* (September 2016), which may result in modified or new conditions related to odours and emissions.

Surface Water and Groundwater

[170] SOC filers were particularly concerned with surface water and groundwater. Their concerns were with water quantity, quality, and flow; groundwater monitoring; groundwater flow modelling; chemistry modelling; and water release and contaminant transport. The AER recognizes the SOC filers' concerns.

[171] There are no changes arising from the TMP that require changes to previously assessed impacts to surface water and groundwater quality during the mine's operating phase. Syncrude is not proposing to alter its existing surface water and groundwater control measures as part of the TMP. Syncrude must operate these control measures in accordance with its *EPEA* approval. The AER expects that the duration of surface water and groundwater control measures will continue to be addressed in Syncrude's *EPEA* life of mine closure plan and *EPEA* renewal applications.

[172] Syncrude's water quality model assessment lacks the necessary detail to evaluate the uncertainties and risks concerning water quality and the implications for reclaimed wetlands, and the ability of water-capped pit lakes to become self-sustaining boreal forest lake ecosystems.

[173] Therefore, Syncrude is required to continue to research and evaluate the risks and uncertainties respecting water quality and long-term reclamation outcomes as part of its *EPEA* approval. This includes research concerning long-term chemistry and minerology of tailings and tailings water, and their implications to the environment, human health, and reclamation (appendix 3).

[174] SOC filers also raised significant concerns with end-pit lakes and asserted that the water-capped pit lake was an undesirable final outcome. The AER's findings with respect to water-capped pit lakes are in the section "Water-Capping Technology."

[175] SOC filers further raised concern with the location of the proposed water-capped pit lake. If Syncrude's updated 2023 TMP continues to propose a water-capped pit lake, further assessment of the lake is required. In its *EPEA* end-pit lake research and development report, Syncrude is required to assess the advantages and disadvantages of location options and justify the location based on the specified criteria (appendix 3).

[176] The AER is concerned with the sustainability of the proposed water-capped pit lake. To ensure *TMF* outcomes are achieved, water-capped pit lakes must be sustainable, including sufficient inflows to accommodate seasonal dry periods and multiyear dry periods and maintain adequate water quality, and contain any underlying tailings. To date, Syncrude has only analyzed the effects of a 20-year dry cycle, which is not fully representative. Additional evidence, including a climate change assessment, is still needed. Syncrude is required in its *EPEA* end-pit lake research and development report, to include hydrology models for the creation of sustainable water-capped pit lakes that are suitable for a range of future climate change scenarios, covering a range of 21st century climate change scenarios that collectively capture the potential range of future climate in the Lower Athabasca region (appendix 3).

Tailings Water Release

[177] Syncrude did not seek authorization to release water from Aurora North as part of application number 1871794.

[178] SOC filers raised concerns with possible future water release.

[179] Water release from Aurora North is not authorized except in accordance with Syncrude's *EPEA* approval.

[180] Syncrude is required to continue to research and evaluate the risks and uncertainties respecting tailings water release as part of its *EPEA* approval.

Other Technical Issues

TMP and OSCA Mine Plan Alignment

[181] *Directive 085* requires that TMPs include sufficient information to demonstrate alignment with existing approvals and plans, including mine plans. Where alignment does not occur, the applicant must identify the inconsistencies and describe how alignment will be achieved.

[182] Syncrude indicated alignment between the TMP and the mine plan, stating that there were no significant changes to its mining sequence compared to its approved mine plan. Syncrude also stated that while there were slight variations in the overburden volumes placed from 2017 to 2022 compared to its approved plan, the outcomes were the same. The AER notes that the TMP shows only very minor changes to the footprints of Dyke 3 and 7. Therefore, the AER finds that the TMP aligns with the existing approved mine plans.

TMP and EPEA Plan Alignment

[183] *Directive 085* requires that TMPs include sufficient information to demonstrate alignment with existing approvals and plans, including the *EPEA* life of mine closure plan. Where alignment does not occur, the applicant must identify the inconsistencies and describe how alignment will be achieved.

[184] SOC filers raised concerns with the final landscape and closure plans.

[185] Syncrude indicated alignment between the TMP and the *EPEA* life of mine closure plan. Currently, Syncrude's *EPEA* life of mine closure plan is under review as part of application 040-00000026. To ensure consistency, Syncrude is required to demonstrate alignment with approvals and plans as part of its *EPEA* life of mine closure plan and mine reclamation plan (appendix 3). The AER is not authorizing changes to Syncrude's *EPEA* life of mine closure plan in this decision.

Future Deposits

[186] Syncrude's TMP provides limited information on future tailings deposits. As placement in the various new deposits will occur over the span of many decades and the AER expects tailings management to evolve over that time, an updated plan is required one year prior to placement in the respective new deposit, to ensure the AER is provided the most current information.

[187] The plans must address the requirements of *Directive 085*, including RTR criteria, confirm the ability to achieve the fluid tailings profiles, evaluate performance of similar deposits, incorporate research results reported through Syncrude's *EPEA* approval, incorporate the long-term reclamation outcomes of the *EPEA* life of mine closure plan, and mitigate uncertainties. These plans cannot be implemented by Syncrude until written authorization or an approval amendment is granted by the AER.

Dam Decommissioning

[188] The AER is concerned that Syncrude may not be able to decommission dams when tailings ponds and deposits still contain treated fluid tailings, even if those tailings deposits have achieved RTR status.

[189] In accordance with the *Water Act*, Syncrude is required to submit a plan for decommissioning dams at least twelve months before commencing capping of any tailings pond or deposit (appendix 7).

[190] Future work with respect to dam decommissioning may result in modified or new decommissioning requirements.

Conclusion

[191] The approval of Syncrude's TMP reflects a risk-based approach tailored to project-specific considerations. The ability of Syncrude's TMP to meet the *TMF*'s objective is dependent on a technology (water-capping) that is subject to further assessment, research, and future policy. The AER recognizes there is time for Syncrude to operate, learn, and adjust, and is requiring Syncrude to submit appropriate and timely information to provide the assurance the AER requires.

[192] Syncrude proposes to employ two primary tailings treatment technologies: CT and water-capping. Syncrude is authorized to continue to use CT technology to treat fluid tailings, subject to the approval terms and conditions.

[193] Syncrude proposes to water cap the remaining inventory of fluid tailings at the end of mine life. Due to the uncertainties respecting treatment capacity and water-capping, Syncrude must describe by December 31, 2018, how it will develop alternative tailings treatment technologies and an implementation plan to treat the volume of fluid tailings proposed to be treated with water-capping technology.

[194] The AER recognizes that Syncrude has indicated that it intends to make a decision on the proposed use of water-capping in 2023. The AER acknowledges that this is 14 years before placement of tailings in AWPW and 17 years before the end of mine life. Therefore, there should be sufficient time for Syncrude to deploy an alternative tailings treatment technology to water capping if water-capped tailings and water-capped pit lakes are restricted by government policy or research and monitoring results.

[195] The approval requires Syncrude to provide an updated 2023 TMP that ensures there are feasible alternative tailings treatment technologies and an implementation plan, and that fluid treatment capacity is

equal to or greater than the production rate of fluid tailings by 2027. In addition, the updated TMP must include updated legacy and new fluid tailings profiles.

[196] A summary of the milestones, along with the various plans and updates required by the approval, is in appendix 8.

[197] In alignment with the enhanced transparency and increased role of stakeholders and indigenous communities introduced by the *TMF* and *Directive 085*, the AER expanded the involvement of stakeholders and indigenous communities in the review of Syncrude's TMP by conducting a technical meeting and circulating the draft approvals. That transparency continues through the approval terms and conditions.

[198] This approval takes a balanced approach to the continued involvement of stakeholders and indigenous communities. The approval requires Syncrude to engage with stakeholders and indigenous communities about tailings management and its water-capping technology demonstration, including holding an annual forum and annually reporting on its engagement efforts to the AER. The approval also provides Syncrude with the flexibility in who it engages with and how it undertakes its engagement activities.

[199] If the uncertainties in Syncrude's TMP (e.g., CT deposit performance, treatment capacity) are not adequately addressed there are increased risks, including risks to Syncrude (e.g., financial, reputational). If these uncertainties cannot be resolved or mitigated, or if deposits underperform, Syncrude must modify the TMP and mitigate its tailings deposits to achieve the *TMF* outcomes. Like every operator, Syncrude is required to achieve a stable landscape and a diverse, locally common, and self-sustaining ecosystem, as established in the *TMF* outcomes.

Dated in Calgary, Alberta, on June 13, 2018.

Alberta Energy Regulator

<original signed by>

Paul Ferensowicz
Senior Advisor
Alberta Energy Regulator

Appendix 1 Approval

COMMERCIAL SCHEME
Approval No. 10781K

MADE at the City of Calgary, in the Province of Alberta, on <*original dated*>	<*original signed*> ALBERTA ENERGY REGULATOR

IN THE MATTER of a Scheme Approval of Syncrude Canada Ltd., comprised of Canadian Oil Sands Partnership #1; Sinopec Oil Sands Partnership; Imperial Oil Resources; Mocal Energy Limited; Murphy Oil Company Ltd.; Nexen Oil Sands Partnership; and Suncor Energy Ventures Partnership (hereinafter called the "Operator"), for the recovery of oil sands and production of oil sands products from the **Wabiskaw-McMurray Oil Sands Deposit in the Fort Hills and Kearl Lake Sectors**, as outlined in Appendix A to this Scheme Approval No. 10781K (hereinafter called the "Scheme Approval").

WHEREAS the Operator has applied to the Alberta Energy Regulator (hereinafter called "the AER") to amend the Scheme Approval for its commercial scheme under the *Oil Sands Conservation Act* in respect of the Operator's Tailings Management Plan for Aurora North;

WHEREAS the AER is confining substantive changes in this Scheme Approval to those arising from the Operator's Tailings Management Plan for Aurora North;

WHEREAS the AER deems it administratively desirable to consolidate the Scheme Approval and all previously issued amendments to the Scheme Approval granted under the *Oil Sands Conservation Act*.

THEREFORE, pursuant to the *Oil Sands Conservation Act*, chapter O-7 of the Revised Statutes of Alberta, 2000, the AER orders as follows:

1. (a) The commercial scheme applied for by the Operator for the recovery of oil sands and production of oil sands products from the area shown on the attachment marked Appendix A to this Scheme Approval, as such commercial scheme is described in

   (i) Applications No. 960552, 1244645, 1284738, 1296639, 1317860, 1357024, 1453986, 1497852, 1625971, 1662888, 1709844, 1732595, 1754948, 1773379, 1882281, 1884500, 1871794, 1891703, 1899345, 1903548, 1904575, and 1905116

   is approved subject to the *Oil Sands Conservation Act*, the *Oil Sands Conservation Rules*, and the terms and conditions set out in this Scheme Approval.

   (b) Subclause (a) does not preclude alterations in design or equipment provided the AER is satisfied the alterations are compatible with the outline of the scheme, meet the operating criteria in the Scheme Approval, are made for the better operation of the scheme, and do not result in unacceptable adverse impacts.

2. The Operator shall not store any material nor construct any facilities to the northeast of the Aurora North tailings area, until the resource in the area has been further drilled and evaluated and the results are reviewed by the AER.

3. The Operator shall not commence development on Lease 31, the Aurora South mine, until it has assessed the following, including environmental implications, to the AER's satisfaction:

   (a) evaluation of the resource potential under all alternatives for siting surface facilities (including the plant site, disposal sites and tailings area) once additional drilling information is available;

   (b) comparison of the economic and environmental impacts of the proposed and alternative plant sites, utility corridors, tailings areas and disposal sites including off lease alternatives;

   (c) an up to date evaluation of relevant technology that justifies the final selection of the technology to be used in developing the Aurora South Mine;

   (d) an up to date economic evaluation of the project three years prior to mine start-up, including implications of the selected technology, pit limits, and ore cut-off grade; and

   (e) an up to date evaluation of potential environmental impacts from other oil sands developments and the Aurora South Mine, including the possibility of those developments interacting and compromising the mitigation strategies to be employed.

4. The Operator shall submit to the AER for approval:

   (a) a detailed assessment of resource potential and the geotechnical design for the out-of-pit disposal sites, one year prior to field preparation;

   (b) in each instance where the mineable resource extends across the lease boundary, a description of how the resource at the lease boundary will be mined, including impacts on the mining plan and tailings plan, five years prior to commencement of mining at the lease boundary;

   (c) in each instance where the mineable resource extends across the lease boundary, a detailed design including mining plan and tailings management plan showing how the proposed plan maximizes recovery of the resource at the lease boundary, two years prior to commencement of mining at the lease boundary;

   (d) an assessment of the resource potential in the areas affected by permanent relocations of utility corridors and main access roads on its leases and the method proposed to recover the ore, five years prior to commencement of mining in the affected areas;

   (e) a strategy for evaluation of the resource potential within 1,000 metres of the Athabasca River prior to opening of the Aurora North Mine west pit, and a detailed plan including the resource potential, the proposed method to recover the resource, and the impacts of mining, five years prior to mining the area;

   (f) a detailed evaluation of the resource potential adjacent to Kearl Lake, including the proposed method to recover the resource and the impacts, five years prior to mining the area, and

   (g) a detailed geotechnical design for the in-situ oil sands pillar at the north boundary of Aurora Center Pit North, prior to June 30, 2019.

5. The Operator is authorized to construct and operate an out-of-pit disposal site, known as the Fort Hills Dump Extension, as described in Application No. 1357024 and related supplemental information.

6. The Operator shall achieve the

   (a) profile specified in Appendix B, Table 1 and Figure 1; and

   (b) profile specified in Appendix B, Table 2 and Figure 2.

7. The Operator shall not exceed

   (a) any of the profile deviation trigger, total volume trigger or total volume limit specified in Appendix B, Table 3; and

   (b) the profile deviation trigger specified in Appendix B, Table 4.

8. If any limit or trigger in clause 7 is exceeded, the Operator shall comply with the management response or action directed by the AER.

9. The Operator shall provide by December 31, 2018, or other such date as the AER may stipulate in writing, a plan for Aurora North.

10. The plan in clause 9 shall:

   (a) describe how the Operator will ensure that

      (i) the treatment capacity is equal to or greater than the production rate of new fluid tailings by December 31, 2027;

      (ii) all legacy fluid tailings will be ready to reclaim by Aurora North's end of mine life; and

      (iii) all new fluid tailings are ready to reclaim within 10 years of Aurora North's end of mine life;

   (b) describe the fluid tailings treatment technology options to be assessed;

   (c) describe how the Operator will develop a feasible alternative tailings treatment technology and an implementation plan for the volume of fluid tailings that is proposed to be treated with water-capping technology where the Operator is proposing to place water, including industrial wastewater, above treated or untreated tailings for the purpose of creating a water capped deposit as a closure landscape feature ("water capped pit lake");

   (d) describe how the Operator will update the ready to reclaim trajectory and criteria for each type of deposit, including evidence that these types of deposits will reasonably achieve the targeted final landforms and the acceptable distribution of upland ecosite phases and wetland types;

   (e) explain the approach to identify and mitigate uncertainties associated with the proposed tailings treatment technologies and implementation timeframes, tailings deposit performance, ready to reclaim trajectory, and environmental effects and implications; and

   (f) provide any other information the AER may require.

11. The Operator shall provide by December 31, 2018, or such other date as the AER may stipulate in writing, a consolidation model or engineering analysis, along with any required supporting information, including milestones, as specified in writing by the AER, for the tailings deposits.

12. If the model or engineering analysis in clause 11 is found deficient by the AER, the Operator shall correct all deficiencies identified in writing by the AER by the date specified by the AER.

13. The Operator shall provide by December 31, 2023, or such other date as the AER may stipulate in writing, an updated fluid tailings management plan for Aurora North.

14. The plan in clause 13 shall comply with the application requirements in *Directive 085: Fluid Tailings Management for Oil Sands Mining Projects*, as amended or replaced (hereinafter called *Directive 085*), and shall include, but not be limited to, the following:

    (a) the results from the plan in clause 9;

    (b) updated new and legacy fluid tailings profiles;

    (c) an assessment of the proposed selected treatment technologies that ensure

        (i) the treatment capacity is equal to or greater than the production rate of new fluid tailings by December 31, 2027;

        (ii) all legacy fluid tailings will be ready to reclaim by Aurora North's end of mine life; and

        (iii) all new fluid tailings are ready to reclaim within 10 years of Aurora North's end of mine life;

    (d) an update on naphtha recovery unit tailings management;

    (e) where the Operator is proposing to place water, including industrial wastewater, above treated or untreated tailings for the purpose of creating a water capped deposit as a closure landscape feature ("water capped pit lake"), feasible alternative tailings treatment technologies and an implementation plan;

    (f) an evaluation of the performance of past and current tailings deposits where similar tailings treatment technology and targeted ecosites were proposed;

    (g) updated ready to reclaim trajectory and criteria for each type of deposit, including the evidence to support that each type of deposit will reasonably achieve the targeted final landforms and the acceptable distribution of upland ecosite phases and wetland types;

    (h) justification of the activities, materials and timelines necessary to achieve milestones;

    (i) an assessment of the performance and limitations for composite tailings deposits;

    (j) an explanation of how any consolidation model or engineering analysis results have been incorporated;

    (k) an explanation of how the research results, including the water-capping technology demonstration results from Base Mine Lake, research required in clause 22, and long-term reclamation outcomes have been incorporated;

(l) mitigation of uncertainties associated with the tailings treatment technology, tailings deposit performance and ready to reclaim trajectory; and

(m) any other information the AER may require.

15. The Operator shall not use any of the updated profiles in clause 14(b) unless the AER has updated Appendix B.

16. Subject to clause 17, the Operator shall achieve the ready to reclaim criteria as set out in Appendix C.

17.

(a) If, at any time, the AER is not satisfied with the ready to reclaim criteria in Appendix C, the Operator shall address the issues, concerns or deficiencies identified in writing by the AER by the date specified by the AER.

(b) If, at any time, the Operator proposes any new or modifications to the ready to reclaim criteria in Appendix C, the Operator shall:

(i) address the requirements in *Directive 085*;

(ii) demonstrate that the proposed new or modifications to the ready to reclaim criteria do not result in changes to any of the ready to reclaim trajectory, targeted ecosites, milestones, or fluid tailings profile;

(iii) address any required updates to the measurement system plan; and

(iv) provide any other information the AER may require.

(c) The Operator shall not use any new or modified ready to reclaim criteria unless

(i) the Operator has provided the information required by subclause 17(b) to the satisfaction of the AER; and

(ii) the AER has revised Appendix C to allow the ready to reclaim criteria.

18. The Operator shall provide one year prior to placement of fluid tailings or treated tailings, or other such date as the AER may stipulate, in each of Aurora Center Pit North, Aurora Center Pit South, Aurora West Pit South, Aurora West Pit South and Aurora West Pit North, a plan that updates the fluid tailings management for each tailings deposit.

19. Each plan in clause 18 shall comply with the application requirements in *Directive 085* and shall include, but not be limited to, the following:

(a) assess the implications to the fluid tailings profile;

(b) where the Operator is proposing to place water, including industrial wastewater, above treated or untreated tailings for the purpose of creating a water capped pit lake, provide feasible alternative tailings treatment technologies and an implementation plan;

(c) provide a consolidation model or engineering analysis, along with any required supporting information, including milestones, as specified in writing by the AER, for the tailings deposit;

(d) evaluate the performance of past and current tailings deposits where similar tailings treatment technology and targeted ecosites were proposed;

(e) explain how research results, including capping research, and long-term reclamation outcomes have been incorporated;

(f) mitigate uncertainties associated with the tailings treatment technology, tailings deposit performance and ready to reclaim trajectory; and

(g) provide any other information the AER may require.

20. The Operator shall meet the deposit milestone dates as set out in Appendix D, or such other dates as the AER may stipulate.

21. The Operator shall submit a research plan for the closure of any of the deposits upon request by the AER.

22. The Operator shall submit a capping research plan for composite tailings deposits by December 31, 2018, or such other date as the AER may stipulate in writing.

23. The plan in clause 22 shall include:

(a) an explanation and rationale for

(i) the research objectives;

(ii) hypothesis to be tested;

(iii) models to be developed;

(iv) key performance measures and criteria;

(v) experimental controls, the design and methodology for the research, model, or technique, and the research monitoring plans and methodologies;

(vi) applicability of each objective to addressing the risks and uncertainties and to achieving the targeted ecosites and long-term reclamation outcomes;

(vii) approach to incorporating research results into any plan;

(viii) incorporation of existing research results to date (both general and site-specific) into the research plan; and

(ix) summary of the research completed to date that relates to the objectives identified in (i);

(b) identification and explanation of research priorities that will ensure research results can be incorporated into site specific plans, including

(i) rationale for the sequence of the research;

(ii) timing of initiating and completing research; and

(iii) key activities;

(c) proposed schedule for research results and data submission, with a mechanism to track progress over time; and

(d) any other information the AER may require.

24. The Operator shall not implement any of the plans in clauses 13, 18, or 22 unless a written authorization or approval amendment is granted by the AER.

25. The Operator shall monitor:

(a) on a monthly basis or such other basis as the AER may stipulate in writing, the composite tailings plant operation performance including sand to fine ratio;

(b) on an annual basis or such other basis as the AER may stipulate in writing, for each treated tailings deposit, the solids and clay contents, sand to fines ratio, effective stress, and pore water pressure;

(c) on an annual basis or such other basis as the AER may stipulate in writing, for each treated tailings deposit, the degree of consolidation of the composite tailings;

(d) the volume of froth transferred to Mildred Lake mine for the reporting period;

(e) a summary of coarse sand production and use, including coarse sand for cell construction, beaching, and capping by location; and

(f) any other parameter specified in writing by the AER.

26. The Operator shall, in addition to any reporting required by *Directive 085*, provide in the annual fluid tailings management report:

(a) a status update on the plan in clause 9 including:

(i) a progress update regarding the implementation priorities for the previous reporting period;

(ii) implementation priorities for the next reporting period; and

(iii) any limitations or constraints;

(b) annual composite tailings plant operation performance including monthly histograms of sand to fine ratio variation;

(c) for each treated fluid tailings deposit, monitoring data including representative cross-sections to illustrate the variation of the following:

(i) solids and clay content;

(ii) sand to fines ratio;

(iii) effective stress;

(iv) pore water pressure;

(v) any other parameter considered relevant by the Operator; and

(vi) any other parameter specified by the AER;

(d) for each treated fluid tailings deposit, representative cross-sections illustrating deposit consolidation;

(e) the volume of froth transferred to Mildred Lake mine for the reporting period;

(f) a summary of coarse sand production and use, including coarse sand for cell construction, beaching, and capping by location;

(g) the available storage capacity of each tailings deposit or pond that contains water or tailings at the end of the reporting period; and

(h) the annual storage capacity and volume requirements for the five years following the end of each reporting period

unless otherwise specified in writing by the AER.

27. The Operator shall not create any water capped pit lakes.

28. The Operator shall not release any substance to the surrounding environment except as authorized under the EPEA Approval.

29. The Operator shall

(a) notify the AER of any proposed, on-site fluid tailings pilots, prototypes or demonstrations at least 6 months, or such other time as the AER may stipulate, prior to any proposed construction or implementation; and

(b) not construct or implement any of the proposed, on-site fluid tailings pilots, prototypes or demonstrations unless an approval amendment or written authorization is obtained from the AER.

30. The Operator shall engage with stakeholders and indigenous communities on the activities undertaken under this Scheme Approval in respect of tailings management for Aurora North, including its Base Mine Lake water-capping technology demonstration, research and monitoring.

31. The Operator shall conduct an annual forum with stakeholders and indigenous communities as part of the engagement activities required under clause 30 of this Scheme Approval.

32. The Operator shall report in the annual fluid tailings management report for Aurora North engagement efforts undertaken in the reporting period.

33. The report in clause 32 shall include the following:

(a) how the stakeholders and indigenous communities were identified for engagement;

(b) a list of stakeholders and indigenous communities identified in (a);

(c) objectives for engagement, including gathering input and feedback on tailings management, research and monitoring from stakeholders and indigenous communities identified in (a);

(d) the type of engagement activity that was undertaken, and the tailings management, research and monitoring information that was provided to each stakeholder and indigenous community identified in (a);

(e) the specific frequency and duration of the engagement with each stakeholder and indigenous community identified in (a);

(f) what specific feedback was provided by each stakeholder and indigenous community identified in (a);

(g) what specific feedback on this report was provided by each stakeholder and indigenous community identified in (a);

(h) how the Operator has included stakeholder and indigenous community feedback in their tailings management, research and monitoring;

(i) how the Operator has included stakeholder and indigenous community feedback in respect to its water-capping technology demonstration, including research and monitoring;

(j) how the Operator has shared results from research and monitoring with each stakeholder and indigenous community identified in (a);

(k) how the Operator addressed any outstanding concerns of stakeholders and indigenous communities identified in (a) arising from engagement;

(l) a discussion of any unresolved concerns identified in (k); and

(m) outcomes from the annual forum(s).

34. The Operator shall apply for an amendment to this Scheme Approval to align with any applicable government policy, including, but not limited to,

(a) tailings water release;

(b) placement of any water above treated or untreated tailings to create a water capped pit lake; and,

(c) reclamation criteria.

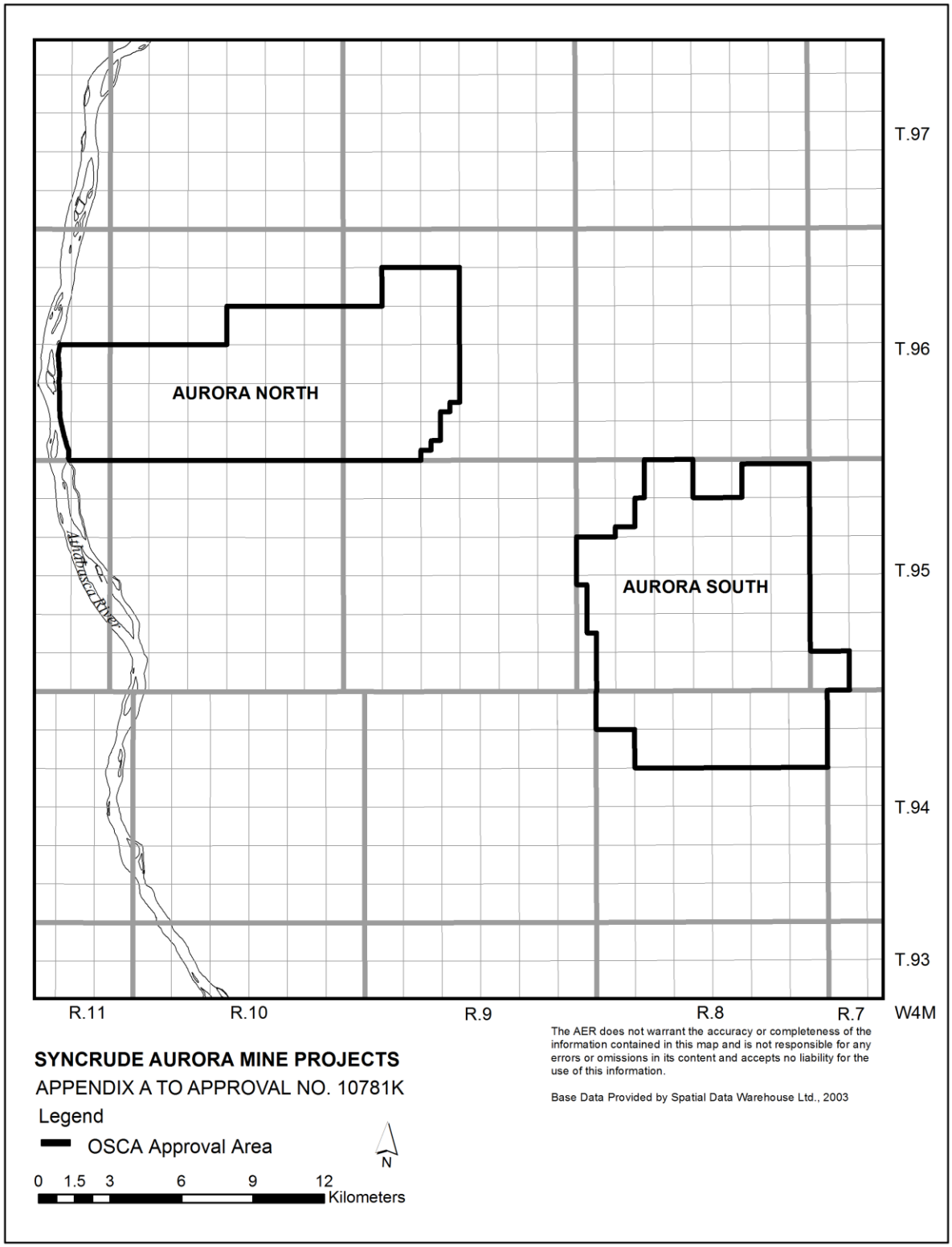
35. The AER may,

(a) upon its own motion, or

(b) upon the application of an interested person,

rescind or amend this Scheme Approval at any time.

36. The AER Approval No. 10781J is hereby repealed, rescinded, and replaced with Approval No. 10781K.


AURORA NORTH
AURORA SOUTH
Athabasca River
T.97
T.96
T.95
T.94
T.93
R.11
R.10
R.9
R.8
R.7
W4M
SYNCRUDE AURORA MINE PROJECTS
APPENDIX A TO APPROVAL NO. 10781K
Legend
OSCA Approval Area
N
0 1.5 3 6 9 12
Kilometers
The AER does not warrant the accuracy or completeness of the information contained in this map and is not responsible for any errors or omissions in its content and accepts no liability for the use of this information.
Base Data Provided by Spatial Data Warehouse Ltd., 2003

SYNCRUDE CANADA LTD. AURORA NORTH
APPENDIX B TO SCHEME APPROVAL NO.10781K

Table 1. New Fluid Tailings Profile

Year	Approved Profile New FT Inventory (million cubic metres)	Year	Approved Profile New FT Inventory (million cubic metres)
2015	20	2031	77
2016	59	2032	112
2017	70	2033	108
2018	61	2034	110
2019	72	2035	83
2020	66	2036	91
2021	67	2037	130
2022	74	2038	105
2023	81	2039	113
2024	75	2040	113
2025	83	2041	113
2026	87	2042	112
2027	74	2043	111
2028	110	2044	111
2029	109	2045	0
2030	106		

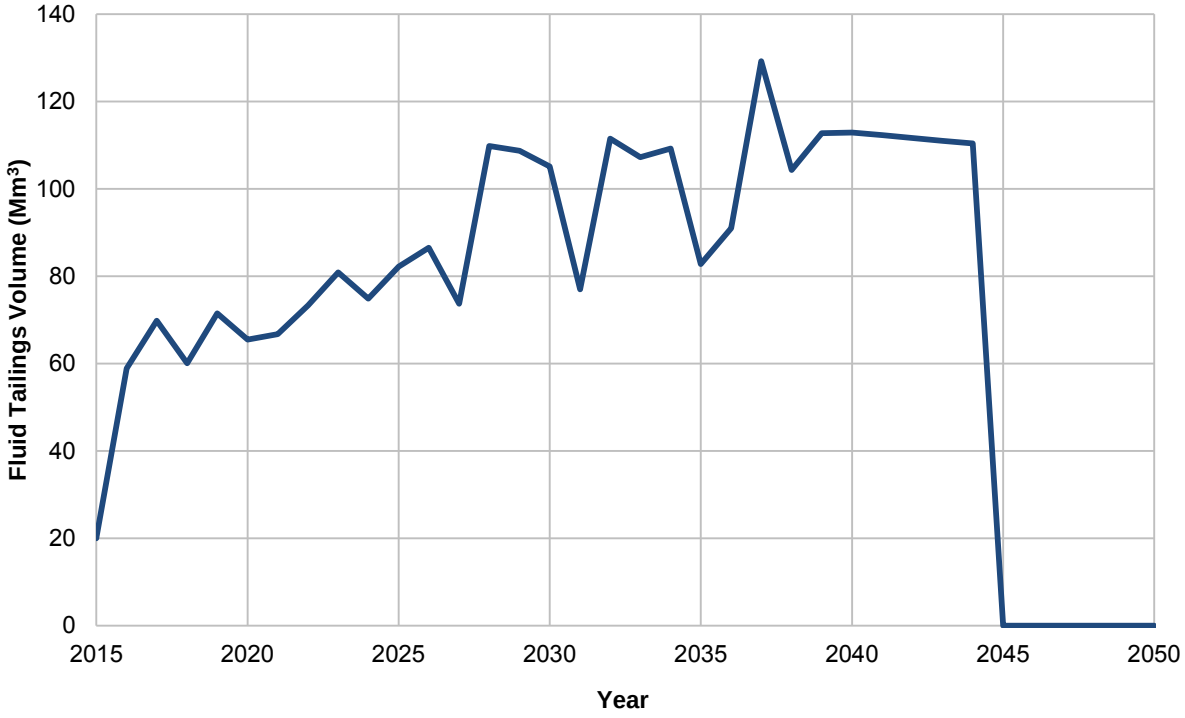


Figure 1 - New Fluid Tailings Profile

Table 2. Legacy Fluid Tailings Profile

Year	Approved Profile Legacy FT Inventory (million cubic metres)	Year	Approved Profile New FT Inventory (million cubic metres)
2015	108	2028	86
2016	107	2029	85
2017	96	2030	84
2018	95	2031	84
2019	94	2032	83
2020	93	2033	82
2021	92	2034	82
2022	91	2035	81
2023	90	2036	80
2024	89	2037	80
2025	88	2038	79
2026	88	2039	78
2027	87	2040	0

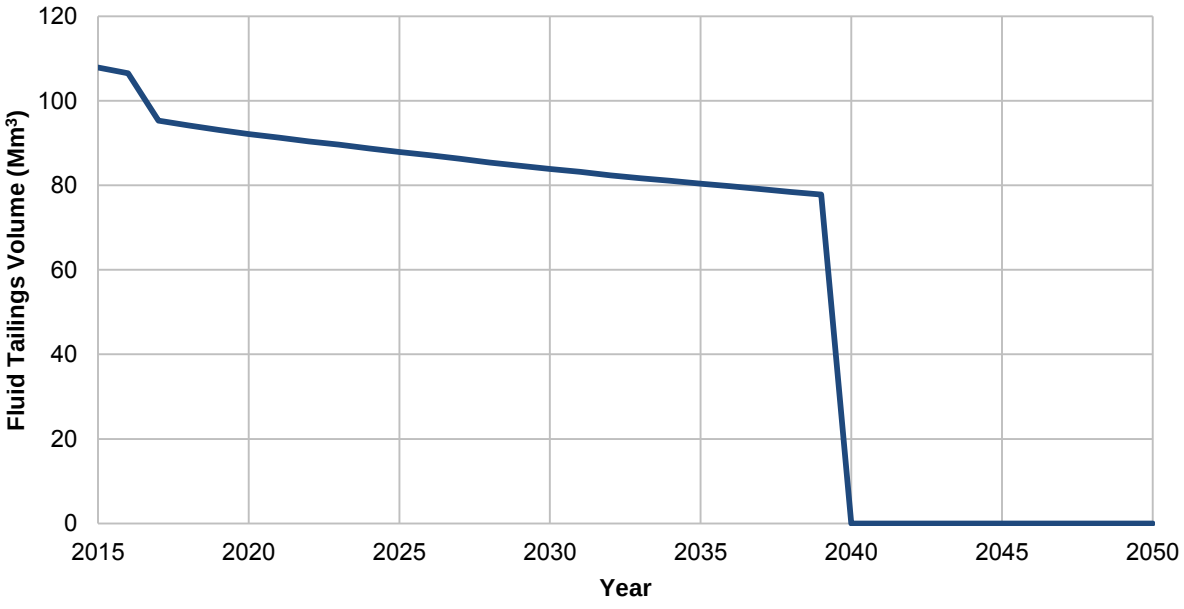


Figure 2 - Legacy Fluid Tailings Profile

Table 3. Thresholds for New Fluid Tailings Profile

Threshold Type	Trigger or Limit	Calculation Factors
Profile Deviation Trigger	20 per cent	$\text{annual deviation percent}_{year} = \frac{\text{New FT Inventory}_{\text{year}} - \text{Approved Profile New FT Inventory}_{\text{year}}}{\text{Approved Profile New FT Inventory}_{\text{year}}}$ $\text{profile deviation trigger}_{\text{year}} = \frac{\sum_{i=year}^{year-5}(\text{annual deviation percent}_i)}{\text{Count}(\text{annual deviation percent}_{\text{i}}: \text{annual deviation percent}_{\text{i}-5})}$
Total Volume Trigger	113 million cubic metres	n/a
Total Volume Limit	158 million cubic metres	n/a

Table 4. Thresholds for Legacy Fluid Tailings Profile

Threshold Type	Trigger or Limit	Calculation Factors
Profile Deviation Trigger	20 per cent	$\text{annual deviation percent}_{year} = \frac{\text{Legacy FT Inventory}_{\text{year}} - \text{Approved Profile Legacy FT Inventory}_{\text{year}}}{\text{Approved Profile Legacy FT Inventory}_{\text{year}}}$ $\text{profile deviation trigger}_{\text{year}} = \frac{\sum_{i=year}^{year-5}(\text{annual deviation percent}_i)}{\text{Count}(\text{annual deviation percent}_{\text{i}}: \text{annual deviation percent}_{\text{i}-5})}$

SYNCRUDE CANADA LTD. AURORA NORTH
APPENDIX C TO SCHEME APPROVAL NO. 10781K

Table 1. RTR Criteria for Syncrude Canada Ltd – Aurora North

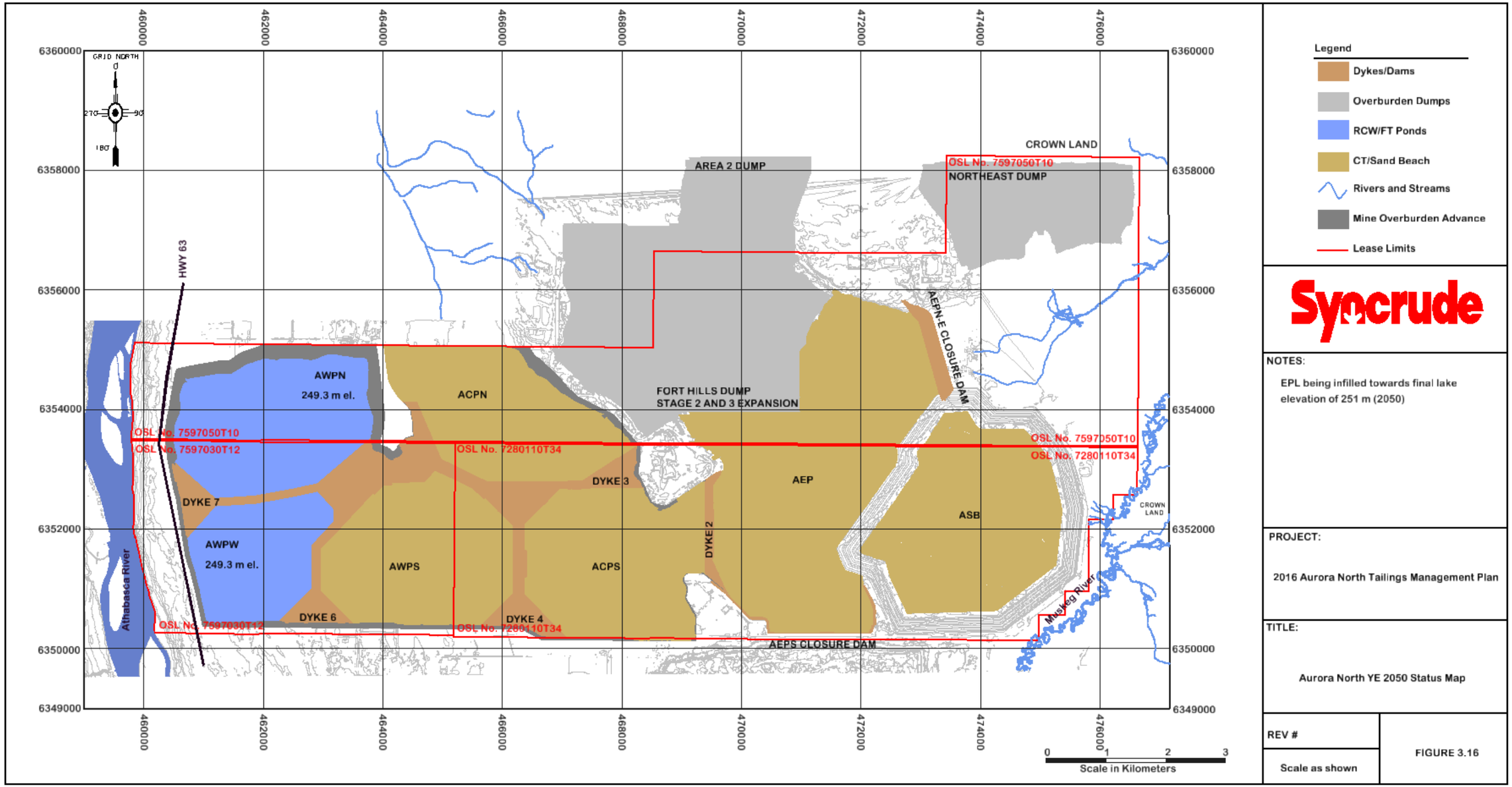
Deposit	Subobjective	RTR criteria
Composite Tailings (CT) Deposits	Subobjective 1	65 per cent solids by weight within 1 year of tailings placement, based upon deposit sampling 75 per cent solids by weight within 1 year after sand capping of deposit, based upon deposit sampling
	Subobjective 2	Groundwater is monitored as required by *Environmental Protection and Enhancement Act (EPEA)* Approval No. 26-02-00, as amended or renewed

Table 1. Deposit Milestones for Syncrude Canada Ltd – Aurora North

Deposit	Tailings Placement		Capping		Reclamation Material Placement Begins	Year at which settlement is expected to be negligible
	Start Year	Completion Year	Start Year	Completion Year		
AEP	2010	2026	2024	2027	2030	2030
ACPN	2024	2030	2031	2031	2035	2035
ACPS	2030	2036	2035	2036	2040	2040
AWPS	2036	2039	2038	2039	2043	2043

Appendix 2 Site Map

Figure 3-16 YE 2050 Status Map



Legend

- Dykes/Dams
- Overburden Dumps
- RCW/FT Ponds
- CT/Sand Beach
- Rivers and Streams
- Mine Overburden Advance
- Lease Limits

Syncrude

NOTES:

EPL being infilled towards final lake elevation of 251 m (2050)

PROJECT:

2016 Aurora North Tailings Management Plan

TITLE:

Aurora North YE 2050 Status Map

REV #

Scale as shown

FIGURE 3.16

Appendix 3 EPEA Tailings Research Report and End-Pit Lake Research and Development Report

Alberta Energy Regulator

Calgary Head Office
Suite 1000, 250 – 5 Street SW
Calgary, Alberta T2P 0R4
Canada

www.aer.ca

<original dated>

By e-mail only

Richard Pelletier, Regulatory Advisor
Syncrude Canada Ltd.
P.O. Bag 4023
Fort McMurray, AB T9H 3H5

E-mail: Pelletier.Richard@syncrude.com

Syncrude Canada Limited
Aurora North Tailings Management Plan
Tailings Research Report and End Pit Lake Research and Development Report

Dear Mr. Pelletier:

In accordance with clause 6.1.56 of *Environmental Protection and Enhancement Act* (*EPEA*) Approval No. 26-02-00, as amended, the Alberta Energy Regulator (AER) requires the following be submitted with the Tailings Research Report:

- forest ecosystem research
  - capping research that identifies capping objectives in addition to rooting-zone protection for tailings deposits and defines the capping requirements to fulfill these objectives;
- wetland ecosystem research:
  - hydrologic models to create treatment wetlands or other wetland types associated with tailings in the reclaimed landscape,
  - suitable capping materials and depth of reclamation materials required to cap tailings deposits,
  - stability of reclaimed tailings surfaces over time, the implications to the size and type of wetland ecosystems and the ability to create self-sustaining, locally common boreal forest wetlands,

  - capping objectives in addition to rooting-zone protection for wetland ecosystems on tailings deposits,
  - identification of suitable soils, site preparation and soil placement for wetlands constructed on tailings deposits or those affected by tailings water inflows,
  - identification of seepage water released from tailings, placed coversoil, subsoil, or overburden into groundwater or surface water,
  - validation that developing wetlands are from surface drainage and are not breakthrough to the surface from the consolidated tailings deposit; and

- Research assumptions, predictions, and validations concerning long term chemistry and minerology of tailings, tailings water, and additives or polymers, and their implications to the environment, human health and reclamation, based on research topics identified in current and future Syncrude's *EPEA* approvals.

In accordance with clause 6.1.59(k), of *EPEA* Approval No. 26-02-00, as amended, the AER requires the following be submitted with the End Pit Lake Research and Development Report:

- the applicability of Syncrude Canada Limited Base Mine Lake (BML) research to the Aurora North end pit lake
- how Syncrude will address uncertainties and risks where BML research is not applicable
- rationale for the siting of the proposed end pit lake adjacent to the Athabasca River escarpment, including
  - the benefits and disadvantages of relocating the proposed pit lakes farther away from the Athabasca River escarpment
- the research related to human health risk assessment and long term chemistry and minerology for end pit lakes
- research assumptions, predictions, and validations to support fisheries, aquatic resources, and aquatic habitat
  - as proposed in the closure landscape at various timeframes of end pit lake development for each the following:

        - chemical and physical behavior of untreated or treated tailings placed in an end pit lake;
        - water quality and toxicity;
        - sustainable water levels and hydrological connectivity under a range of late 21st century regional climate change scenarios developed by the *Intergovernmental Panel on Climate Change*;
        - landform design;
        - geotechnical stability; and,
        - effects of long-term shoreline retrogression.
    - for water release scenarios

- identification of research or modelling limitations and uncertainties in achieving the targeted locally common boreal forest closure outcomes
- plans and schedules to address research or modelling limitations and uncertainties in achieving the targeted locally common boreal forest closure outcomes

If you have any questions regarding this correspondence, please contact Kenneth Yap at (780) 642-9245 or Kenneth.Yap@aer.ca.

Regards,

<original signed by>

Paul Ferensowicz

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Angie.Taksas@aer.ca
Paul.Elkins@aer.ca

Appendix 4 EPEA Life of Mine Closure Plan and Mine Reclamation Plan

Alberta Energy Regulator

Calgary Head Office
Suite 1000, 250 – 5 Street SW
Calgary, Alberta T2P 0R4
Canada

www.aer.ca

<original dated>

By e-mail only

Richard Pelletier, Regulatory Advisor
Syncrude Canada Ltd.
P.O. Bag 4023
Fort McMurray, AB T9H 3H5

E-mail: Pelletier.Richard@syncrude.com

Syncrude Canada Limited
Aurora North Tailings Management Plan
Life of Mine Closure Plan, Mine Reclamation Plan, and Annual Reclamation Progress Tracking Report Requirements

Dear Mr. Pelletier:

In accordance with clauses 6.1.12(r) and 6.1.16(q) of *Environmental Protection and Enhancement Act* (*EPEA*) Approval No. 26-02-00, as amended, the Alberta Energy Regulator (AER) requires the following be submitted as part of the Life of Mine Closure Plan and Mine Reclamation Plan:

- rationale for defining capping requirements for composite tailings deposits based upon monitoring and research results, including:
  - capping objectives, such as landform development and stability, settlement management, and controlling the expression of tailings pore water, water table control, and landform contouring to facilitate the flushing of salts from the capping material;
  - capping material type; and,
  - implications to the development of self-sustaining locally common boreal forest terrestrial or wetland ecosystems.
- material balances for coarse sand and any other suitable capping materials to meet terrestrial and wetland outcomes, which shall include accounting for limited drilling data, tailings treatment technology performance demands, landform development and stability, settlement management,

expressed tailings pore water control, water table control, landform contouring, and the suitability of the capping material's chemical and physical properties;

- contingency plans for capping material shortages;
- map showing the location and spatial extent of:
  - wetlands targeted for reclamation that resemble locally common wetlands, based on the Alberta Wetland Classification System and wetlands which are proposed to be exposed to process affected water; and
  - distribution of reclaimed ecosite types targeted to be consistent with the range of pre-disturbance ecosites.
- updated and validated end pit lake model, including quantity and quality components based upon research results and a range of late 21st century regional climate change scenarios developed by the *Intergovernmental Panel on Climate Change*; and
- an assessment of the minimum sand cap thicknesses required to manage the groundwater table, manage tailings pore water flux, provide adequate tailings deposit strength and trafficability, and drainage.

In accordance with clause 6.1.89 of *EPEA* Approval No. 26-02-00, as amended, the AER requires the following be submitted with the Annual Reclamation Progress Tracking Report:

- the volume of coarse sand and suitable overburden available as capping material for the composite tailing deposits

If you have any questions regarding this correspondence, please contact Fikre Debela at (403) 297-5270 or Fikre.Debela@aer.ca.

Regards,

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Appendix 5 Measurement System Plan Requirements

Alberta Energy Regulator

Calgary Head Office
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www.aer.ca

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E-mail: Pelletier.Richard@syncrude.com

Syncrude Canada Limited
Aurora North Tailings Management Plan
***Oil Sands Conservation Act* Approval 10781K**
Measurement System Plan Requirements

Dear Mr. Pelletier:

In accordance with *Directive 085: Fluid Tailings Management for Oil Sands Mining Projects*, the Alberta Energy Regulator (AER) requires Syncrude Canada Limited (Syncrude) to submit by December 31, 2018, or on such other date stipulated by the AER, a measurement plan for fluid tailings, treated tailings volumes and ready to reclaim (RTR) criteria.

The measurement plan must include the following:

- Key definition of parameters for fluid tailings and RTR criteria measurements.
- Reference of standards and procedures used to measure fluid tailings, treated tailings, and RTR criteria.
- An explanation of and justification for measurement procedures that are unique to Syncrude Aurora North and this plan.
- Evidence that the plan will address the measurement outcomes as per section 5 of *Directive 085*, as amended.
- An explanation of how each of the tailings deposit's RTR criteria will be measured, calculated and reported.

- A description of the tailings deposit survey program.
- Justification of how measurement, sampling, and spacing intervals will show the variation of the tailings deposit properties, and verify that the tailings deposit is achieving RTR criteria.
- Identify if any material in the deposit is not achieving RTR criteria.
- Any other information the AER may require.

Where measurement plans exist for any RTR criteria subobjectives, Syncrude may incorporate references to other plans, such as the groundwater monitoring program.

Syncrude must also ensure that the measurement system plan developed aligns with the Groundwater Monitoring Program authorized under its EPEA approval.

As per clauses 25 and 26 of Approval No. 10781K, Syncrude must monitor and report on volumes of coarse sand production and use, sands to fine ratio, effective stress, deposit consolidation, pore water pressure, and solids and clay content for each treated tailings deposit. The measurement system plan must also include measurement locations and measurement methodology for this monitoring and reporting.

If you have any questions regarding this correspondence, please contact Tara Wang at (403) 297-8547 or tara.wang@aer.ca.

Regards,

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Appendix 6 Deposit Milestones

Deposit	Tailings Placement		Capping		Reclamation Material Placement Begins	Year at which settlement is expected to be negligible
	Start Year	Completion Year	Start Year	Completion Year		
AEP	2010	2026	2024	2027	2030	2030
ACPN	2024	2030	2031	2031	2035	2035
ACPS	2030	2036	2035	2036	2040	2040
AWPS	2036	2039	2038	2039	2043	2043

Appendix 7 Decommissioning Plan for Dams

Alberta Energy Regulator

Calgary Head Office
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Canada

www.aer.ca

<original dated>

By e-mail only

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E-mail: Pelletier.Richard@syncrude.com

Syncrude Canada Limited
Aurora North Tailings Management Plan
Dam Decommissioning

Dear Mr. Pelletier:

In accordance with section 32 of the *Water (Ministerial) Regulation* and subject to the terms and conditions set out in *Water Act* Approval No. 00251073-01-00, the Alberta Energy Regulator (AER) sets out the following initial requirements for decommissioning any dams associated with tailings ponds or deposits:

> Syncrude Canada Limited (Syncrude) shall, at least 12 months prior to commencing capping activities at any tailings pond or deposit, provide the AER with a plan for decommissioning of the dams.
>
> Syncrude shall not implement the plan for decommissioning of any of the dams unless written authorization or approval amendment for the plan is granted by the AER.

If you have any questions regarding this correspondence, please contact Tim Eaton at (403) 297-6855 or tim.eaton@aer.ca.

Regards,

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Appendix 8 Submission and Deposit Milestones

						Syncrude decision point on water-capped tailings technology	Deposition in ACPN commences			Treatment capacity is equal to or greater than the production rate of new fluid tailings	
Month	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
April		Additional reporting under *Directive 085* commences (annually)									
December	December 2018 plan Measurement system plan Consolidation model or engineering analysis for tailings Capping research plan					Updated fluid tailings management plan					

Not shown: Future deposit plans