



Suncor Energy Inc.

Application for an External Tailings Pond
for the Millennium Mine
Fort McMurray Area

December 30, 2004

ALBERTA ENERGY AND UTILITIES BOARD

Decision 2004-113: Suncor Energy Inc., Application for an External Tailings Pond for the Millennium Mine, Fort McMurray Area

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ALBERTA ENERGY AND UTILITIES BOARD

Calgary Alberta

SUNCOR ENERGY INC. APPLICATION FOR AN EXTERNAL TAILINGS POND FOR THE MILLENNIUM MINE FORT MCMURRAY AREA

Decision 2004-113
Application No. 1325847

1 DECISION AND RECOMMENDATIONS TO ALBERTA ENVIRONMENT¹

Having carefully considered all of the evidence, the Alberta Energy and Utilities Board (EUB/Board) approves Application No. 1325847 subject to the conditions set out in this report (see [Appendix 1](#)) and subject to the approval of the Lieutenant Governor in Council.

The Board recommends that Alberta Environment (AENV)² consider the need for the following:³

- a flexible monitoring system capable of responding to sudden changes in water quality or water levels as a consequence of the South Tailings Pond (STP) project activities;
- water quality or water level triggers that will initiate corrective action;
- a detailed response plan for unexpected changes in groundwater quality or levels;
- development of monitoring contingency plans that address any unexpected changes in groundwater quality or quantity that are detected;
- an ongoing process that will evaluate remediation system performance and validate the accuracy of Suncor's seepage impact and modelling predictions;
- rapid and clear communication of monitoring results to numerous stakeholders; and
- a regional working group to examine groundwater issues.

The Board also recommends that AENV consider the need for the following additional geological or hydrogeological investigations:

- an improved characterization of groundwater-surface water interaction between the Wood Creek Sand Channel (WCSC) and McLean Creek;
- an up-to-date, three-dimensional hydrogeological model to assess the impacts of seepage, mine dewatering, and interception well operation on the local and regional groundwater and surface water flow regimes;
- an understanding of the geological and hydrogeological linkage between the WCSC and other regional buried channel aquifers in the oil sands region;
- an additional delineation exercise and hydrogeological investigation of the kame deposit,¹ and

¹ This section is provided for the convenience of readers. In the event of any difference between the directions in this section and those in the main body of the decision, the wordings in the main body of the decision prevail.

² See [Appendix 3](#): Glossary of Terms and Abbreviations.

³ See [Appendix 2](#): Summary of Recommendations to Alberta Environment.

- a buried channel mapping exercise on a regional extent under the coordination of AENV and including input from oil sands developers within the area.

2 INTRODUCTION

Suncor Energy Inc. (Suncor) applied to the EUB to construct, operate, and reclaim an external tailings pond proposed to be located southeast of Suncor's existing Millennium Mine (see Figure 1). Application No. 1325847, to amend approval No. 8535, was made by Suncor pursuant to Section 13 of the *Oil Sands Conservation Act*. In support of its proposal and as part of its application to the EUB, Suncor also submitted an environmental impact assessment (EIA) report to AENV, pursuant to the requirements of the *Environmental Protection and Enhancement Act* (EPEA). The STP project would be located primarily in the southern half of Township 91, Ranges 8 and 9, and would encroach on the northern portion of Township 90, Range 9, West of the 4th Meridian. The STP is designed with a maximum storage capacity of 350 million cubic metres (10^6 m^3). The total footprint of the STP including all infrastructure would be 2300 hectares (ha), of which 1900 ha would be the tailings pond itself. Construction of the overburden starter dike would begin in 2005, tailings deposition would begin in 2006, and filling would be complete in 2012. The STP would also include

- drainage ditches that divert surface runoff around the pond, and
- a seepage interception system that would capture seepage from the WCSC and prevent pond seepage from migrating to McLean Creek.

3 BACKGROUND

The Board issued a Notice of Hearing on August 25, 2004, published it in local and major Alberta newspapers on September 1, 2004, and sent it directly to a number of parties with which Suncor had consulted. The Board received eleven submissions, three of which were objections to the application.

The three objections are summarized as follows:

- Wood Buffalo First Nation (WBFN) - WBFN stated that its members had environmental and socioeconomic concerns with the proposed STP and that its trappers and traditional land users would be negatively impacted by the project.
- Clearwater River Paul Cree Band #175 stated that it had many environmental issues and socioeconomic issues.
- Grass Roots Organization of Fort McKay stated that proper consultation had not occurred with the community members of Fort McKay.

After reviewing the objections, the Board decided that these three parties did not demonstrate that they had rights that may be directly and adversely affected by the Board's decision on the application. The Board therefore dismissed the three objections.

The other eight submissions received by the Board are summarized as follows:

- Canadian Natural Resources Ltd. stated that it was developing a major oil sands mine in the region of the proposed STP. It did not state any objections, issues, or concerns, but did reserve the right to participate in the hearing.
- Syncrude Canada Ltd. stated that it was not requesting a hearing of the application, but it reserved the right to appear at any hearing and to make closing argument to address any industry issues that may arise.
- Oil Sands Environmental Coalition (OSEC) stated that it did not object to the proposed STP and did not believe that a hearing of the application was required. However, it remained concerned about tailings management and technology, end pit lakes (EPLs), and reclamation uncertainty. OSEC reserved the right to participate in any hearing.
- Athabasca Chipewyan First Nation (ACFN) - ACFN stated that it had reached a mitigation agreement with Suncor and did not object to the project. However, it remained concerned about the magnitude of the ongoing uncertainty regarding reclamation of tailings ponds in the oil sands region generally.
- Fort McKay Industrial Relations Corporation (Fort McKay) - Fort McKay stated that it had reached an agreement with Suncor and that it had no outstanding objection to the STP. However, it remained concerned about uncertainties regarding the reclamation of tailings ponds in the oil sands region generally.
- Mikisew Cree First Nation (MCFN) - MCFN stated that it had reached an agreement with Suncor and did not require a public hearing of the application. However, it continued to have concerns regarding the regional cumulative impacts associated with the proliferation of tailings storage facilities and reserved its right to participate in any hearing. MCFN also stated that it did not oppose approval of the STP, provided that regulatory authorities imposed conditions that address the MCFN's concerns regarding seepage, reclamation to a sustainable landscape, and Suncor meeting its commitments to the MCFN. MCFN also requested an opportunity to review and to provide input on draft regulatory approvals.
- Government of Canada (Canada) – Canada stated that the Department of Fisheries and Oceans (DFO) undertook a screening level environmental assessment of the STP which indicated that the project did not pose significant adverse effects to the environment. Canada stated that DFO was prepared to issue a Subsection 35(2) *Fisheries Act* approval (subject to the Board's decision on the application) and that Canada would not participate in an EUB hearing.
- Government of Alberta (Alberta) - AENV and Alberta Sustainable Resource Development (SRD) filed a joint submission. The submission provided Alberta's project analysis and position on the WCSC, security for mitigation, EPL discharges, and water quality modelling. Alberta stated that it had no objection in principle to approval of the STP if the Board found the project was in the public interest and provided that the matters raised in Alberta's submission were properly addressed.

After issuing its decisions to set aside the three objections, the Board cancelled the hearing scheduled to commence on October 26, 2004, and indicated that it would be making requests to Suncor and other parties for additional information relating to the STP.

Subsequently, the Board made requests for additional information from Suncor and Alberta. Suncor responded in a letter dated November 8, 2004, and Alberta responded in a letter dated

November 15, 2004. On November 22, 2004, Suncor clarified the information contained in its November 8 letter. Consequently, the Board considers that the close of evidence for this proceeding occurred on November 22, 2004.

While it does not have all the details of agreements between parties, the Board acknowledges and commends Suncor, MCFN, ACFN, and Fort McKay on their efforts to enter into agreements. While these agreements will not form part of the EUB approval, the Board expects Suncor to meet its commitments and continue its consultation and communication efforts.

With respect to the MCFN's request for an opportunity to review and provide input on draft regulatory approvals, that is not the Board's practice and the Board is not prepared to make an exception in this case.

4 ISSUES

The Board considers the issues respecting the application to be

- need, location, and preliminary design of the project
- tailings management
- environmental issues associated with the pond
- seepage mitigation and reclamation liability

5 NEED, LOCATION, AND PRELIMINARY DESIGN OF THE PROJECT

5.1 Need for the Project

5.1.1 Views of Suncor

Suncor stated that the need for additional external tailings storage space was identified in its long-range planning process and that current plans have been done in substantially more detail than its more broadly scoped 1998 Millennium application.

Suncor stated that its detailed tailings plans indicated that there would be insufficient in-pit storage space available to support the current operation once Pond 8A was full in 2006. Suncor noted that the mine plan originally developed for its Millennium application showed that in-pit tailings space in Pond 8 would be available in mid-2007. Suncor's current plan showed Pond 8 would not be available until late 2011, a difference of four to five years. Suncor stated that the following factors had affected the availability of in-pit storage space:

- changes in design and construction of dikes on the Millennium site to address geotechnical stability;
- changes in the pond/dike design for Ponds 6 and 7, which had reduced their storage capacity; and
- the fact that tailings management plan indicated that the Pond 7 area was best used for base plant tailings and mature fine tailings (MFT) management, rather than for Millennium plant tailings, as applied for in the Millennium application.

Suncor indicated that it had considered whether additional tailings storage capacity could be found within its existing operations. Suncor considered the following alternatives:

- using Pond 7 for Millennium Extraction Plant Tailings, and
- increasing the storage capacity of Pond 8A.

Suncor stated that the Pond 7 option did not present an adequate solution because it would not eliminate the long-term need for additional storage space and would not be available for three to four months after Pond 8A was full. Suncor also stated that the second option of increasing the storage capacity of Pond 8A would create additional storage capacity for only a few months and would not resolve the long-term need for additional pond space. According to Suncor, other existing tailings storage ponds were being used for recycle water or tailings thickening or were in the process of being decommissioned for final reclamation.

As a result, Suncor concluded that there was a need for additional tailings storage space to sustain the Suncor operation.

5.1.2 Views of the Board

The Board notes that in *Decision D 99-07⁴*, the Board expressed reservations that a number of Suncor's assumptions regarding tailings management appeared to be overly optimistic and that additional tailings storage space could be required.

The Board agrees that changes in dike design to ensure stability and the availability and timing of in-pit tailings storage are the primary factors that contributed to the need for the project, and the Board agrees that the pond is needed for continued operation of Suncor's oil sands mining scheme.

However, the Board believes that the size of the STP and the reclamation schedule for various ponds on Suncor's site have been impacted by Suncor's failure to achieve the tailings management performance proposed in the Millennium application. This appears to have resulted in an increase in inventory of MFT and a decrease in production of on-spec consolidated tailings (CT). The Board believes that Suncor's assumptions in the STP application related to tailings management are more likely than the assumptions in the Millennium application and that if Suncor focuses on achieving its stated goals, it should be able to achieve the proposed level of performance.

The Board will instruct EUB staff to monitor Suncor's tailings management performance to ensure that Suncor is diligent in pursuing the proposed performance. The Board believes that this should preclude the need for any additional external tailings ponds on Suncor's site beyond the proposed STP.

⁴ EUB Decision 99-7: Suncor Energy Inc., Application for Amendment of Approval No. 8101 for the Proposed Project Millennium Development, July 23, 1999.

5.2 Location of the Pond

5.2.1 Views of Suncor

Suncor stated that it had completed a screening study on three potential out-of-pit tailings disposal areas (see Figure 1):

- North Option – Adjacent to a potential mining area north of the Steepbank River,
- East Option – east of the Millennium Mine, and
- South Option - south of the Millennium Mine.

Suncor indicated that it had ruled out the East Option at the outset due to its remoteness, topography, and ground conditions. Suncor also noted that this location would not permit a pond of the required capacity.

In comparing the North and South Options, Suncor indicated that it had selected the South Option (the STP) because it presented the following advantages:

- lower capital and operating cost;
- allowed design of conservative beach slopes, ensuring ability to construct step-over dike cells;
- more favourable topography for starter dike construction, resulting in the smallest overburden dike;
- most flexible to accommodate possible changes in geotechnical design and planning assumptions; and
- least pumping distances, resulting in energy cost savings.

Suncor stated that its STP footprint optimization process considered geometry, environmental impacts, capital and operating costs, operating flexibility, lease boundaries, and geotechnical considerations. Specifically, Suncor stated that these considerations

- optimized geometry to create maximum storage capacity;
- reduced the amount and size of dike construction, resulting in lower operating and construction costs and maximizing the amount of sand available for making CT;
- accelerated the availability of tailings storage capacity;
- allowed for flexibility to accommodate potential changes to the tailings storage plan and reduced the pressure on the in-pit tailing disposal schedule; and
- reduced the environmental impacts of the STP by moving the facility farther away from the Athabasca River escarpment and reducing the impact on local watersheds.

Suncor stated that it evaluated the bitumen resources beneath the STP. Suncor's evaluation of the drillhole information showed the total-volume-to-bitumen-in-place (TV:BIP) ratios under most of the pond were greater than 12 and therefore would not be considered a mineable resource. Suncor noted there was a small area under the north limb of the pond that had a TV:BIP ratio of less than 12, but that this area was too small to be considered commercially recoverable. It would have a TV:BIP ratio higher than 12 if the pit slope angles required for recovery were included.

Suncor noted that the bitumen resources beneath the pond may be recoverable by steam-assisted gravity drainage (SAGD); however, the viability of SAGD was unknown because the presence of a suitable cap rock/geology had not been determined. Suncor completed a study to determine if a SAGD operation would affect the stability of the pond and concluded that the impacts would be low to nonexistent. Suncor stated that the existence of a pond above the bitumen resource would not affect the potential recovery of the resources using SAGD methods.

5.2.2 Views of the Board

The Board acknowledges that determination of the suitability of a tailings pond location requires careful consideration of trade-offs between evaluation criteria. Furthermore, the Board agrees with Suncor's assessment that the South Option is preferred to the North Option for reasons of cost, location, and operability. The Board is also satisfied that the East Option did not require a detailed evaluation, given its location and because it would not have provided the required capacity.

The Board notes that AENV did not indicate any concerns with respect to the STP location. The Board also notes that although seepage considerations were not part of Suncor's optimization of the pond location, the proposed seepage mitigation strategy will address this matter.

The Board agrees that the bitumen resource beneath the South Option would not be recoverable by conventional mining methods using TV:BIP=12 as a cutoff indicator. The Board believes that the STP would only delay, not prohibit, any possible bitumen recovery if the SAGD approach is viable in that location.

5.3 Preliminary Engineering Design of the Project

Informational Letter (IL) 96-7: EUB/AEP Memorandum of Understanding on the Regulation of Oil Sands Developments outlines the responsibilities of the EUB and AENV Dam Safety Branch with respect to approvals for tailings ponds. Consistent with that, the Board believes that its primary responsibility when considering applications is to address the conceptual planning and preliminary engineering design of tailings ponds.

IL 94-19: Dam Safety Accord more precisely defines the roles and responsibilities of the two organizations. As set out in the accord, the role of the EUB with respect to new tailings ponds is to ensure that

- structures are located such that resource sterilization is minimized,
- the facilities are needed and sized to adequately service the proposed project,
- the site is appropriate, considering logistics, as well as environmental acceptability, and
- the proposed design meets the requirements for worker and public safety and for the integrity of the project.

5.3.1 Views of Suncor

Suncor stated that the total capacity of the pond would be about $230 \times 10^6 \text{ m}^3$ of tailings, with the flexibility to increase the pond capacity by raising the dike elevation from 380 to 390 m. Suncor indicated that this would increase the pond capacity to a maximum of $350 \times 10^6 \text{ m}^3$.

Suncor stated that the STP design was based on guidelines established by the Canadian Dam Safety Association (CDA), which require the minimum target factor of safety for the liquefaction, end-of-construction, and steady-state seepage scenarios be 1.1, 1.3, and 1.5 respectively. Suncor stated that it would adopt the minimum target factors of safety established by CDA for all scenarios except steady-state seepage. Suncor stated that due to the short operating life of the pond, it was unlikely that steady-state seepage would be achieved. Suncor stated that the design parameters and assumptions were based on its experience with mining structures on similar foundations. Suncor confirmed that additional site-specific field and laboratory testing had been completed to confirm soil conditions and provide strength estimates for the foundation units. Suncor noted that it had completed an additional 151 drillhole and 47 kilometres (km) of surface geophysical surveys in 2004, which allowed more detailed characterization of the local geology necessary for the detailed design being presently prepared.

Suncor indicated that the presence of weak clay shales of the Clearwater Formation in the foundation controlled the stability of the dikes. Suncor indicated that the downstream dike slopes varied between 4H:1V (horizontal to vertical) to 15H:1V or flatter. It stated that the 4H:1V slopes were at locations where the STP dikes overlay the thicker WCSC (see Figure 2). Suncor stated that monitoring of the STP dikes would involve installation of slope inclinometers and piezometers around the pond perimeter at various elevations. Contingency measures being considered by Suncor as potential options to improve stability included toe berms, slope flattening, and shear keys.

Suncor stated that its preliminary design to control dike seepage involved the installation of internal filter drains at various elevations at the top of the starter dike and in the cell-constructed sand portions of the dikes. Measures to control foundation seepage would involve the installation of monitoring and interception wells within the WCSC. Suncor indicated that it would consider selectively installing low-permeability blankets to minimize foundation seepage, which if not controlled could adversely impact dike stability.

5.3.2 Views of the Board

The Board agrees that the pond is sized appropriately to contain the volume of tailings expected until in-pit storage (Pond 8) is expected to be available in late 2011. The Board also notes that the pond design has the built-in flexibility to increase storage capacity in the event that in-pit storage is not available at the predicted date.

However, the Board believes that Suncor should be able to achieve the tailings management performance described in the application so that a final STP dike elevation of 380 m provides adequate tailings storage for the project. The Board acknowledges that an increase in final pond elevation may be needed to accommodate justifiable changes to the mining scheme.

Alternatively, the need to increase the final elevation of the STP dike could arise if Suncor fails to achieve its proposed tailings management performance, a situation that may be more difficult

to justify. Therefore, the Board conditions the approval to limit the final elevation of the STP dikes to 380 m. Prior to increasing the elevation of the dikes, Suncor will need to apply for and obtain Board approval.

The Board is satisfied that Suncor's preliminary design is complete and addresses the stability and seepage issues in accordance with Suncor's experience and with accepted engineering practice.

The Board notes that Suncor is required to submit a detailed design for the STP to AENV Dam Safety Branch to obtain a licence for the structure prior to impoundment of any fluid. The Board expects that the detailed design will provide more information on selective lining of the foundation to mitigate potential seepage and stability issues.

6 TAILINGS MANAGEMENT

6.1 MFT Storage and CT Performance

The following sections discuss comparisons between the Millennium and STP applications with respect to tailings volumes. Table 1 is included to help summarize the relevant information. It shows Suncor's tailings production forecast from both the Millennium and STP applications and also includes actual production to the end of 2003. The Board notes that Suncor's predicted mine life in the STP application is four years less than in the original Millennium application. The change is due to a reduction in total ore to be mined primarily caused by Suncor's change from a cutoff TV/BIP ratio equal to 15 in the Millennium application to a ratio equal to 12 now used for mine planning.

Table 1. Actual and planned tailings volumes

	Units	Millennium application predicted to 2003	Reported production actual to 2003	Millennium application predicted 2004 to 2033	STP application predicted 2004 to 2029
Total ore mined	Mt	1701*	1667*	4137*	3711*
Total MFT produced (including beaching)	10 ⁶ m ³	n/a	310	n/a	n/a
MFT captured in beach	10 ⁶ m ³	n/a	72*	n/a	n/a
Fluid MFT (not including beaching)	10 ⁶ m ³	220*	238*	570*	603*
Total MFT consumed in beaching and CT	10 ⁶ m ³	n/a	167	n/a	n/a
Total MFT consumed in CT	10 ⁶ m ³	146*	95	613*	593*
MFT consumed in on-spec CT	10 ⁶ m ³	n/a	55	n/a	n/a
MFT consumed in off-spec CT	10 ⁶ m ³	n/a	40	n/a	n/a
MFT consumed in CT (2002 and 2003)	10 ⁶ m ³	n/a	28*	n/a	n/a
MFT consumed in effective CT (2002 and 2003)	10 ⁶ m ³	n/a	7	n/a	n/a
Inventory of MFT (at end of period)	10 ⁶ m ³	73*	143	25	154
Total CT production	10 ⁶ m ³	369*	151*	2945*	884*
On-spec CT	10 ⁶ m ³	n/a	80*	n/a	n/a
Off-spec CT	10 ⁶ m ³	n/a	71*	n/a	n/a
CT production (2002 and 2003)	10 ⁶ m ³	n/a	35*	n/a	n/a
Effective CT (2002 and 2003)	10 ⁶ m ³	n/a	12*	n/a	n/a

* Values were not directly stated by Suncor but were derived from information provided by Suncor. The following references were used to derive the information in the table:

- Actual oil sands ore production was derived from EUB *Statistical Series 2003-43*.
- The Millennium application stated that Suncor's MFT inventory was $100 \times 10^6 \text{ m}^3$.
- The STP application stated that Suncor's MFT was $143 \times 10^6 \text{ m}^3$.
- Millennium supplemental information (August 6, 1998), Table: Suncor OS Long Range Tailings Plan – Plant 3 On Lease 86/17.
- Millennium supplemental information (August 6, 1998), Table: Suncor OS Long Range Tailings Plan – Millennium Summary.
- STP application, Table 3.7-2: Tailings Mass Balance.
- STP supplemental information (June 30, 2004), Table 170-1: Tailings Volumes and Balances.
- STP supplemental information (November 8, 2004), Table 6-1: MFT Consumed in Consolidated Tailings (1995 – 2003).
- STP supplemental information (November 8, 2004), Table 7-1: CT Production 1995 – 2003.

6.1.1 Views of Suncor

Suncor noted that it adopted CT technology on a commercial scale in 1995 as the most effective technology for reducing MFT inventories and for returning tailings disposal areas to achieve dry land reclamation.

Suncor indicated that it had about $143 \times 10^6 \text{ m}^3$ of cumulative TFT/MFT in storage at the end of 2003 and now expected a cumulative of $154 \times 10^6 \text{ m}^3$ at the end of the mine life. Suncor stated that the estimated $154 \times 10^6 \text{ m}^3$ of MFT was due to the “legacy” inventory of 35 years of operation. It noted that the final MFT inventory of $25 \times 10^6 \text{ m}^3$ predicted in the Millennium application was based on its optimistic assumptions for CT creation. Having regard for current operating realities and depositional problems, Suncor revised its forecast of CT volumes. Suncor indicated that it had produced a total of $151 \times 10^6 \text{ m}^3$ of on-spec and off-spec CT to the end of 2003.

Suncor stated that the use of CT technology had reduced its MFT inventory by $167 \times 10^6 \text{ m}^3$, based on total fines capture, by the end of 2003 from a total production of $310 \times 10^6 \text{ m}^3$. However, the operations had produced MFT at a rate that exceeded MFT consumption by the CT process, resulting in the increase in total net MFT inventory to $143 \times 10^6 \text{ m}^3$. It noted that the fines in $167 \times 10^6 \text{ m}^3$ of MFT had been captured into the ponds as off-spec CT, on-spec CT, and beaching. Suncor indicated that of the $167 \times 10^6 \text{ m}^3$ of MFT, approximately $55 \times 10^6 \text{ m}^3$ had been consumed as on-spec CT, $40 \times 10^6 \text{ m}^3$ as off-spec CT, and the remainder ($72 \times 10^6 \text{ m}^3$) was consumed in beaches. Suncor stated that for the past two years (2002 and 2003) it had been monitoring effective on-spec CT, which has the minimum strength required to support a trafficable surface for final pond reclamation. It noted that $7 \times 10^6 \text{ m}^3$ of MFT had been produced into effective CT from about $28 \times 10^6 \text{ m}^3$ of MFT.

Suncor noted that on a go-forward basis, it expected management of MFT as shown in the STP application Table 170-1: Tailings Volumes and Balances. Suncor predicted that it would consume $593 \times 10^6 \text{ m}^3$ of MFT into CT from a total of $603 \times 10^6 \text{ m}^3$ and that the MFT inventory would increase $11 \times 10^6 \text{ m}^3$ (1 per cent) at the end of mine life.

Suncor stated that the construction of the STP did not impact the availability of sand for CT production. Suncor stated that the limiting factor for production of CT was in-pit pond space availability, as noted in Section 5.1. Suncor believed that the key parameters to measure CT performance were using a proper recipe necessary to produce a nonsegregating CT mixture and depositing the desired nonsegregating mixture in an appropriate manner to ensure that it did not segregate. Suncor noted that the long-range plan assumed that CT would be made with 69 per cent of the sand and that the efficiency depended on system mechanical availability, meeting product quality specifications, and proper deposition into the pond. Suncor stated that it would

focus on the following four key projects to improve CT performance over 2004-2006 at an estimated cost of \$155 million:

- implementation of the high-density pond in Pond 5 using horizontal tremie and CT beaching deposition methods;
- increased MFT supply and control capabilities;
- instrumentation and process control initiatives in CT manufacture and tailings; and
- addition of dry surge to Steepbank ore preparation to increase and stabilize residual sand available for CT.

Suncor noted that once the initiatives to increase CT performance had been implemented, almost all (about 99 per cent) of the fines generated from the mine feed would be captured.

Suncor stated that CT would be deposited into several in-pit ponds (see Figure 1) following the progression of mining. Suncor noted that Ponds 5 and 6 were scheduled to be completed with CT placement by 2009 and 2008 respectively. Following a settlement period, both ponds would be capped with sand from 2015 to 2019. Suncor indicated that this strategy was predicted to form a trafficable surface. Suncor stated that all final tailings surfaces and the EPL (see Figure 2) would be reclaimed to meet the objectives of Suncor's closure plan.

6.1.2 Views of the Board

The Board notes the increases in MFT inventories (see Table 1) as compared to the Millennium application. The Board also notes that on-spec CT production performance has been significantly less than that predicted in the relatively recent Millennium application. The Board, therefore, has some doubts about the reliability of Suncor's predictions.

The Board is concerned that MFT inventory at the end of 2003 has nearly doubled ($73 \times 10^6 \text{ m}^3$ vs. $143 \times 10^6 \text{ m}^3$) compared to that predicted in the Millennium application and that at the end of the mine life the final volume will be sixfold larger ($25 \times 10^6 \text{ m}^3$ vs. $154 \times 10^6 \text{ m}^3$). The Board also notes that since 1995, Suncor has produced less than one-half of the expected CT volume ($151 \times 10^6 \text{ m}^3$ vs. $369 \times 10^6 \text{ m}^3$), of which only one-half was considered on-spec CT ($80 \times 10^6 \text{ m}^3$). The Board observes that in comparing the actual performance to the predictions in the Millennium application, only 22 per cent ($80 \times 10^6 \text{ m}^3$ vs. $369 \times 10^6 \text{ m}^3$) of the predicted CT volume was produced as on-spec CT.

The Board believes that unless Suncor is able to conduct its tailings management operations at least as well as proposed in the STP application and improve its results to achieve the expected fines capture, MFT inventory will continue to increase.

The Board is concerned that Suncor may not be placing adequate priority on ensuring that it has systems in place to achieve its intended levels of tailings management performance, and the Board believes that additional regulatory involvement may be necessary to ensure that this is addressed. Therefore, the Board conditions the approval to require Suncor to submit an annual tailings management plan for the upcoming year as part of the Annual Mine Plan submission, commencing on September 30, 2005.

The annual tailings management plan shall show how Suncor adheres to the STP application case. The plan shall include information on volumes of MFT (production, consumption, and storage), volumes of CT (off-spec, on-spec, and effective), and other details as specified by the Board. In addition to the tailings plan, the Board conditions the approval so that Suncor shall submit quarterly tailings performance reports that indicate whether actual tailings performance complies with the most recently submitted tailings management plan. Quarterly tailings reports shall be submitted within one month of the end of each reporting period. The first reporting period shall be January 1 – March 31, 2005.

As indicated in previous decisions on oil sands mining applications, the Board accepts that CT can result in more timely reclamation of tailings in a dry landscape than some other tailings management strategies. The Board also believes that the implementation of CT as a tailings management strategy was a significant improvement over the conventional tailings management schemes employed since the startup of oil sands mining schemes in the 1960s.

However, despite considerable efforts to ensure the successful capture of the potential benefits of CT implementation, the Board is not convinced that CT performance has been improved to the point where the majority of the MFT generated from the mine feed on a go-forward basis could be consumed to create CT. The Board is further concerned that the quality of CT being produced may not result in a trafficable surface, as proposed.

The Board observes that in the current application, Suncor has predicted a significant improvement in CT performance as a result of improvements to be completed from 2004 to 2006, and the Board acknowledges Suncor's plans to expend considerable effort and cost to achieve predicted performance. On that basis, the Board accepts Suncor's continued use of CT as a tailings management strategy.

The Board expects Suncor to have installed the capacity to produce CT as consolidated deposit (i.e., effective CT) and to operate the system at the service factor stated in the application (69 per cent of the sand). The Board will require Suncor to demonstrate that deposition of CT will result in a trafficable surface, and the Board conditions the approval to require Ponds 5 and 6 to be filled with effective CT by 2009, sand capped from 2015 and 2019, and reclaimed to a trafficable surface by 2019, all as proposed by Suncor. The Board expects Suncor to develop and apply the necessary technology to satisfy this condition.

The Board notes that it has raised concerns with respect to tailings management performance in previous oil sands decisions. In the Shell Jackpine EUB *Decision 2004-009*⁵, the Joint Review Panel directed EUB staff to work with the mineable oil sands industry, AENV, and SRD to develop performance criteria for tailings management. The Board notes that it expects to receive a recommendation from EUB staff in 2005 regarding appropriate tailings management performance criteria.

The Board will continue to encourage the mineable oil sands industry to develop and implement better tailings management. The Board is aware of several industry and government initiatives that address this matter and is hopeful that these initiatives will be successful. A successful cooperative approach is desirable. If ultimately the current initiatives do not succeed in better

⁵ EUB *Decision 2004-009: Shell Canada Limited, Applications for an Oil Sands Mine, Bitumen Extraction Plant, Cogeneration Plant, and Water Pipeline in the Fort McMurray Area*, February 5, 2004.

tailings management, the Board has the option to invoke its authority to address concerns that may persist regarding the proper operation and abandonment of oils sands operations.

6.2 Alternative Tailings Technologies

6.2.1 Views of Suncor

Suncor stated that it evaluated and considered alternative tailings technologies as part of its operation. Suncor stated that it had compared its current lease-life tailings plan of conventional tailings and CT disposal strategy to

- thickener technology to create separate thickened tails and sand deposits,
- thickener technology to create a CT stream within extraction,
- thickener plus filtration technologies to produce dry, truck-hauled tails, and
- codisposal of MFT and overburden as an enhancement to the alternatives.

Suncor recognized that thickener technology to create thickened tails (TT) would have the benefits of reduced water usage, reduced overburden dike construction, enhanced trafficability for reclamation, and reduced storage volumes in the STP. However, the accumulated TT volumes would be larger than the accumulating MFT volumes in the STP, due to the delayed timing to establish a separate in-pit area, the thickened fines deposit properties on a large scale not being well understood and having a potential to behave much like MFT, the thickener technology being unproven in oil sands, and the operating and capital costs being higher than Suncor's current plan indicated.

Suncor stated that thickener underflow to create CT within extraction would reduce the excess MFT inventory by 50 per cent, but the technology required water treatment facilities.

Suncor stated that the use of thickener plus filtration to produce dry, truck-hauled tails would have the benefit of a dry, stackable tailings product that was an immediately reclaimable tailings deposit with the least volume of fluid fine tailings at the end of mining. However, this alternative involved the use of two new technologies (thickener and filtration) in oil sands, had the possibility of creating unstable, saturated dumps, increased the complexity of operation, and was the highest-cost option.

Suncor noted that codisposal of MFT and overburden would have the potential to control MFT inventory and increase the sand-to-fines ratio of CT, but had significant scheduling and operational issues when incorporated into the mine plan.

Suncor concluded that its current lease-life tailings plan of conventional tailings and CT disposal strategy would be the most effective technology for reducing MFT inventories, optimizing water usage, and returning tailings disposal areas to stable landscape. Suncor stated that of all the alternatives investigated, the current tailings plan would be the most cost effective, simplest, and least susceptible to feed fluctuations with the highest level of proven technology. Suncor noted that it would have 10 years of CT experience by 2006.

Suncor stated that its evaluation of the current TT technical and economic feasibility performance indicated that TT did not present a reasonable fit for its operations. Suncor stated

that there were technical risks associated with integrating this new technology into existing operations. In addition, Suncor stated that there would be adverse economic impacts on its operations and that thickened tailings technology did not offer an improved environmental solution to its tailings management plan.

Suncor stated that it continued to be active in research and development activities on tailings management as a participant in the Canadian Oil Sands Network for Research and Development (CONRAD) Tailings Research Group and the Canadian Water Network. Suncor stated that it was a founding industry partner in the Oil Sands Tailings Research Facility (OSTRF), operated by University of Alberta at the CANMET Western Research Centre. Suncor noted that there were projects under way at OSTRF, CANMET, and in house, including modelling of oil sands tailings slurries, carbon dioxide (CO₂) sequestration and CO₂ stabilization of CT, and coarse dewatering with fines thickening whole tailings codeposition.

Suncor stated that it had evaluated methods for MFT drying as an approach to reclaiming some of the MFT, which showed promise, and further testing was planned.

6.2.2 Views of the Board

The Board views tailings technology development as a major challenge in sustaining mineable oil sands development and believes that continued industry focus in this area is necessary to achieve significant advances. The Board notes that oil sands projects are considered to be important for future secure oil supplies and that the oil sands are considered to provide significant economic and employment benefits to the province. However, the oil sands projects disturb large areas of land during the operational phase and create extensive fluid fine tailings volumes and impoundment structures, which have many abandonment and reclamation uncertainties.

The Board considers that oil sands tailings present unique challenges that no operator has fully resolved, despite ongoing efforts at each operation and with each new project. Additionally, the Board believes that effective alternative tailings technologies can be developed and applied to reduce fluid fine tailings to solid tailings.

The Board believes that alternative tailings technologies can be developed and applied for the reduction of fluid fine tailings to solid tailings without the need for additional out-of-pit, conventional-style tailings ponds. Therefore, the Board believes that dedicated effort is required to ensure that technology is developed and demonstrated expeditiously so that new technologies can be implemented at existing sites and/or applied in new developments.

The Board will consult with the appropriate government departments about collaborative actions that may be taken to promote development of the necessary technology that would reduce fluid fine tailings impoundment and reclaim impoundments to a dry, trafficable state.

As a part of the tailings initiative that arose from Board decisions on the CNRL Horizon⁶ and Shell Jackpine applications, the Board has directed EUB staff to examine the individual and combined tailings research efforts of oil sands mining industry members and to provide an

⁶ EUB Decision 2004-005: *Canadian Natural Resources Limited, Application for an Oil Sands Mine, Bitumen Extraction Plant, and Bitumen Upgrading Plant in the Fort McMurray Area*, January 27, 2004.

assessment of these efforts to the Board in 2005. However, given Suncor's reliance on an unproven level of performance with respect to its CT operations to achieve its final reclamation goals, the Board expects greater emphasis by Suncor on research and testing of alternative tailings technologies until achievement of the proposed level of CT performance is demonstrated.

The Board considers that a number of other tailings management technologies appear to offer faster dewatering and progressive reclamation. The Board believes that technologies in use at non-oil sands mines, such as thickening, filtration, dry stacking, and water treatment, may be applied to oil sands tailings. The Board believes that collaborative industry efforts on tailings fundamentals studies, investigations of commercial tailings properties, and tailings reclamation studies are crucial to improve on tailings management. The Board recognizes that Suncor and other oil sands developers collaborated on such research in the past through such organizations as CONRAD, Cumulative Environmental Management Association (CEMA), and OSTRF. It also recognizes that significant advances have been made with respect to tailings management and reclamation. Nevertheless, the Board believes that these efforts must continue to ensure that effective tailings management strategies will be developed to ensure efficient operations and to address uncertainties regarding long-term performance of the reclaimed landscape.

The Board expects Suncor to continue testing alternative tailings management technologies and submitting annual progress reports by February 28 of each year regarding its research and development work, as conditioned in the Millennium approval.

6.3 Tailings Odour Management

6.3.1 Views of Suncor

Suncor stated that it assessed odours associated with the STP project and noted that there was a potential for an increase in odour levels at hunter/trapper locations and at Fort McKay. Suncor indicated that potential effects of the STP were discussed with trappers and that the STP was unlikely to change the frequency of odours. Suncor believed that there were no outstanding concerns about the STP and the predicted potentials for odours. Suncor noted that the one-hour increase was less than 0.3 per cent in potential occurrence and would be negligible.

Suncor stated that a significant component of the tailings management program would be storage and construction of tailings storage areas. It noted that tailings material was currently stored on both sides of the Athabasca River. Due to space limitations, materials would periodically be moved from pond to pond, including across the river. The STP would store primary extraction tailings and not froth treatment plant or secondary tailings. Assessments showed that volatile organic compounds, methane, and total reduced sulphur compounds were the main air emissions from ponds that stored primary tailings. Suncor did not expect that the operation of the STP would require any specific action to control odours.

6.3.2 Views of the Board

The Board notes Suncor's assessment of potential odours associated with the STP, discussions with the potentially affected parties, and that the STP was considered unlikely to change the frequency of odours. The Board also notes Suncor's commitment that the STP would be used to

store only primary tailings and not froth treatment tailings. The Board believes that froth treatment tailings can be a potential source of odours and off-site impacts.

The Board recognizes that tailings material is currently stored on both sides of the Athabasca River and that due to space limitations, tailings are periodically moved from pond to pond, including across the river. The Board is concerned with the movement of these tailings, which have been in contact with froth treatment tailings, to the STP and the potential for increased off-site odours. Therefore, the Board conditions the approval to prohibit transfer to the STP of MFT or other tailings streams that have been in contact with froth treatment tailings. This condition may be removed if Suncor can satisfy the Board that there will be no negative effects on stakeholders.

7 ENVIRONMENTAL ISSUES ASSOCIATED WITH THE POND

7.1 Seepage

7.1.1 Views of Suncor

Suncor indicated that a hydrogeological assessment of the STP area identified several potential pathways for foundation seepage to escape the pond area, including through the underlying WCSC, the underlying sand layers in the till, particularly on the north section of the dike, and the kame deposit (see Figure 2) that intersects the final pond elevation and the final south dike abutment.

Suncor indicated that its initial investigations of the WCSC indicated that the channel appeared to comprise the confluence of two separate drainage systems, one entering the study area from the southwest and the other from the south. Subsequent mapping by Suncor suggested that the southern portion of the system, in fact, likely entered the project area from the southeast. Suncor stated that water quality within the channel indicated that a treatment system would be required prior to WCSC aquifer water being used as drinking water.

Suncor stated that the WCSC was thought to collect seepage from the surrounding till along its length and transmit this groundwater relatively rapidly along its axis towards the northwest. Suncor indicated that the WCSC was well drained as a result of connection with one or more relatively low-elevation discharge points at the ground surface and that groundwater may discharge to McLean Creek along the lower incised reaches of McLean Creek, as well as to McLean Creek to the south and east of the STP project. Suncor calculated the WCSC groundwater discharge to McLean Creek based on creek flow measurements at two points and indicated that the measurement was considered accurate to within 15 to 20 per cent.

Suncor indicated that seepage from the STP would migrate into the WCSC and, unless intercepted, would eventually discharge into the lower portion of McLean Creek. Suncor stated that seepage from the STP had the potential to change water quality in the lower portion of McLean Creek and could therefore impact the health of aquatic life, terrestrial wildlife, and humans. Suncor indicated that during operations, the quality of the groundwater between the STP and the interception system was expected to degrade and become similar to that of the seepage water. Initially, after closure, water quality in the WCSC would be lower than that of baseline groundwater and would reflect concentrations between STP seepage water and baseline

groundwater in the WCSC. Suncor stated that initial seepage water quality from the STP would have the potential to result in acute toxicity during periods of very low flows in McLean Creek. Suncor indicated that the potential for seepage to affect water quality in McLean Creek would be highest during operations and would decrease after closure.

Suncor stated that it had evaluated a number of mitigation options for seepage from the STP and had selected a combination system of toe ditches and interception wells to accomplish mitigation tasks. Suncor indicated that it was currently evaluating the potential of using a cutoff wall to prevent seepage in the southwest portion of the WCSC and evaluating the need for seepage mitigation wells in the southeast portion of the WCSC.

Suncor stated that it conducted contaminant transport modelling that suggested that interception of seepage-impacted groundwater would need to take place for at least 60 years following STP closure, assuming no additional mitigation, before that groundwater could be allowed to flow towards McLean Creek. Suncor stated that the overall number, capacity, and spacing of wells would be sufficient to collect all seepage and that the interception system would be in place prior to filling the STP. Suncor stated that it had committed to operating the seepage interception system until the quality of seepage from the STP was acceptable for release into McLean Creek.

Suncor indicated that it committed to prepare a report reviewing methods to reduce the period of time that the interceptor well system would be required to operate. In addition, Suncor stated that should technically feasible methods to achieve this reduction in operational time be identified, it would further evaluate the utility of those systems in terms of full operational integration into the STP project.

Suncor indicated that it was committed to the implementation of a program to

- further develop understanding of the issues,
- collect additional information to reduce seepage modelling conservatism,
- identify research that could be undertaken to evaluate the rate of flushing or degradation of acute toxicity in tailings sands under closure conditions,
- detail mitigation options, and
- complete feasibility assessments on reasonable mitigation options.

Suncor stated in its initial assessment that the majority of sandy deposits within the surficial deposits in the STP area were not laterally extensive and therefore not considered to be aquifers and that sand layers in the till were covered by a variable thickness of clay till. Suncor indicated that its recent site investigations showed a substantial reduction in the presence of surficial sand deposits (outside of the main WCSC) and that an assessment of the impact of seepage on the remaining surficial sand layers was currently in progress.

Suncor suggested that mitigation options for seepage through surficial sand layers could include such measures as the placement of low-permeability blankets or of shallow cutoffs. Suncor stated that details of mitigation would be provided in the final design.

Suncor indicated that a sandy kame present to the east of the STP project footprint formed an extensive aquifer system. Suncor stated that based on initial assessments of hydraulic head

information, groundwater flow within the kame was towards the west and the kame and the WCSC were poorly connected hydraulically. Groundwater from the kame was thought to discharge to rills and gullies at the lower edge of the kame. Suncor indicated that during the operational life of the STP project and after closure, there could be an increase in hydraulic heads in the western part of the kame between a few metres and tens of metres, depending on the elevation and extent of the base of the kame relative to pond level. Suncor stated that the hydraulic gradient was expected to remain towards the west despite the increase in hydraulic heads.

Suncor indicated that seepage into the kame deposit could be mitigated by such measures as pumping wells, cutting off thin layers, or placing a low-permeability blanket.

Suncor stated that it would install a groundwater monitoring network and develop a groundwater response plan to deal with any unexpected significant impacts on groundwater levels or quality detected. Suncor stated that it would include confirmation of mitigation requirements for the seepage pathways in the detailed dike design to be submitted to regulators.

7.1.2 Views of the MCFN

In a letter to the EUB dated October 13, 2004, the MCFN stated that Suncor had addressed its concerns specific to the STP project, but that it continued to have concerns regarding regional cumulative impacts associated with the proliferation of oil sands tailings storage facilities. The MCFN also stated that its concerns related to the cumulative landscape disturbance by approved and planned oil sands development in the region and the impact on the natural flow of groundwater which feeds the Athabasca River. The MCFN indicated that it did not oppose the approval of the STP project, provided that certain approval conditions were included to address certain site-specific concerns. The MCFN asked that appropriate monitoring, reporting, and mitigation be required to ensure that any seepage from the STP was prevented from entering into the environment. In an attachment to the memorandum of understanding between the MCFN and Suncor included with the MCFN submission, Suncor stated that it was committed to using the best available commercially proven technology to minimize the environmental impacts associated with the STP project.

7.1.3 Views of ACFN and Fort McKay

In submissions to the EUB dated October 13 and October 18, 2004, the ACFN indicated that it had reached a mitigation agreement with Suncor with respect to the STP project. In submissions to the EUB dated October 13 and October 22, 2004, Fort McKay stated that it had reached an agreement with Suncor. ACFN and Fort McKay stated that they did not object to the project; however, they remained concerned about the magnitude of the ongoing uncertainty regarding the reclamation of the tailings ponds in the oil sands region generally.

7.1.4 Views of Alberta

Alberta stated that the WCSC was thought to be connected down-gradient to a larger regional aquifer system: the Clarke Channel. Alberta indicated that it considered the expected decrease in water quality within the WCSC to be an impairment of the aquifer, but that despite the changes in water quality, the water within the channel would still be considered usable according to water quality guidelines.

Alberta stated that it believed that the long-term effects on the WCSC could be minimized and restricted to the STP project area through monitoring and mitigation. Alberta indicated that any EPEA approval issued for the project might require Suncor to undertake a research and monitoring program directed at potential enhancements to its mitigation and remediation plan, including

- further delineation of the WCSC and its relationship to regional groundwater flows in the area,
- clarification of concentration values of naphthenic acids that would protect fish health,
- investigation into the feasibility of achieving concentration values of naphthenic acids that protected fish health over a shorter active mitigation period, and
- investigation into the feasibility of achieving lower concentration values of naphthenic acids at the end of the active mitigation period.

Alberta's submission discussed the details for the provision of seepage mitigation security, which are summarized in Section 8.2.

7.1.5 Views of the Board

The Board notes Suncor's numerous commitments to further study monitoring and seepage mitigation in order to better address the potential impacts that seepage from the STP could have on the water quality within McLean Creek, the WCSC, surficial deposits, and the kame deposit. The Board also notes that Suncor stated that confirmation of mitigation requirements for the seepage pathways would be included in the detailed dike design to be submitted to regulators. The Board is encouraged by these commitments and expects that Suncor will honour each of them, failing which the Board will take appropriate action to ensure that water quality concerns are properly addressed.

The Board notes that Suncor stated that groundwater within the WCSC currently flows towards and discharges to McLean Creek. Suncor identified that seepage from the STP would enter the WCSC and would migrate towards McLean Creek unless seepage mitigation was undertaken. The Board also notes that Suncor stated that initial seepage water quality from the STP would have the potential to result in acute toxicity during periods of very low flows in McLean Creek if that seepage is not intercepted first.

The Board acknowledges and shares the concerns brought forward by the MCFN and Alberta that seepage from the STP will impact water quality within the WCSC and potentially McLean Creek unless appropriate monitoring and mitigation is implemented. The Board shares the concerns raised in the initial submissions from the ACFN and Fort McKay concerning the complex, multidecade nature of the mitigation and monitoring plan Suncor proposed, especially in light of the preliminary nature of the information provided regarding Suncor's plans and the ongoing work Suncor is conducting to finalize its monitoring and mitigation strategy.

The Board notes that the final written submissions from the ACFN and Fort McKay stated that negotiations with Suncor had resulted in mitigation agreements and that those parties did not object to the project. The contents of those agreements were not shared with the Board, and so

the Board is not aware of how Suncor has addressed the specific concerns of the ACFN and Fort McKay.

The Board notes that the MCFN indicated that Suncor had addressed its concerns specific to the STP, but that the MCFN asked that an approval condition be included requiring Suncor to undertake appropriate monitoring, reporting, and mitigation to ensure that any seepage from the STP is prevented from entering into the environment. However, in the memorandum of understanding between Suncor and the MCFN, Suncor stated that it was committed to using the best available commercially proven technology to minimize the environmental impacts associated with the STP project. The MCFN appeared to have accepted that the commitment adequately addressed its concerns. There appears to be an inconsistency in the MCFN's submissions relating to this aspect of the STP project, and the Board is not able to reconcile the MCFN's final position.

The Board must conclude that the MCFN and Suncor have discussed the issues related to seepage and that the parties have a common understanding of the nature and extent of seepage and how Suncor proposes to deal with it. The Board is not prepared to include the approval condition requested by the MCFN, given that Suncor and the MCFN appear to acknowledge in the memorandum of understanding that seepage will enter the environment through the tailings pond foundation, dikes, and kame.

The Board has made and will be making a number of recommendations to Alberta in order to

- better understand tailings pond design,
- better characterize the geological and hydrogeological setting of the area,
- ensure that the monitoring well system is appropriately designed, and
- ensure that the monitoring and mitigation system will be financially sustainable into the far future.

If implemented, these recommendations will assist in minimizing the environmental impact of the STP.

The Board notes that Alberta stated that it believed that the long-term effects on the WCSC could be minimized and restricted to the STP project area through monitoring and mitigation. The Board accepts Alberta's position in this matter. The Board notes that Alberta indicated that it would consider conditions to any EPEA approval it might issue that would address concerns regarding monitoring and mitigation system design and geological and hydrogeological characterization. The Board supports Alberta's intentions and will make specific recommendations to Alberta regarding approval conditions.

The Board notes that Alberta indicated that any EPEA approval issued for the project might require Suncor to undertake a research and monitoring program directed at enhancements to its mitigation and remediation plan.

The Board recognizes the importance of monitoring to the successful operation of the mitigation system and recommends that Alberta consider the following needs in any approval process it might enter into with respect to Suncor's application:

- a flexible monitoring system capable of responding to sudden changes in water quality or water levels as a consequence of STP project activities;
- water quality or water level triggers that will initiate corrective action;
- a detailed response plan for unexpected changes in groundwater quality or levels;
- development of monitoring contingency plans that address any unexpected changes in groundwater quality or quantity that are detected;
- an ongoing process that will evaluate remediation system performance and the accuracy of Suncor's seepage impact predictions; and
- rapid and clear communication of monitoring results to numerous stakeholders.

The Board recognizes that ongoing research in the oil sands area and technological advancements in monitoring and analytical chemistry will improve understanding of the issues related to seepage.

The Board expects that Suncor will actively participate in research activities related to seepage impacts on aquatic environments, implement the findings of such research into its monitoring plans, and employ appropriate technologies in its monitoring and mitigation systems. If the Board perceives that Suncor is not meeting the Board's expectations, the Board will take appropriate action.

The Board notes that the STP project could potentially impact not only surface water quality, and therefore fish health, but also groundwater resources both within the study area and beyond the site scale.

The Board notes that a number of groups are collecting data to assess the regional impacts of development in the oil sands area on air, surface water, and wildlife, but that no group appears to be assessing the regional impact of development on groundwater. In light of the number of developments in the area, as well as the scale of those developments, the Board believes that such an initiative would be valuable in assessing all potential impacts. The Board recognizes that no single developer should be tasked with undertaking a regional groundwater monitoring study.

However, the Board also recognizes that an additional recommendation to regional working groups to undertake such an initiative may not be reasonable, given their current workloads and priorities. The Board recommends that Alberta consider establishing a regional working group to examine groundwater issues.

The Board notes that Alberta stated that it might require, as possible approval conditions, further delineation and hydrogeological investigation of the WCSC and investigation of ways to minimize mitigation timelines while reducing final chemical compound concentrations and to more fully understand the potential effects of seepage. The Board fully supports Alberta's intentions in these matters and has specific recommendations for the content of approval conditions under those headings. The Board recommends to Alberta that any additional geological or hydrogeological investigations provide the following:

- an improved characterization of groundwater-surface water interaction between the WCSC and McLean Creek;

- an up-to-date, three-dimensional hydrogeological model to assess the impacts of seepage, mine dewatering, and interception well operation on the local and regional groundwater and surface water flow regimes;
- an understanding of the geological and hydrogeological linkage between the WCSC and other regional buried channel aquifers in the oil sands region; and
- an additional delineation exercise and hydrogeological investigation of the kame deposit.

The Board notes that Suncor based methods it used to determine the WCSC component of flow to McLean Creek on two measurements, each accurate to within 15 to 20 per cent. An improved assessment of the groundwater contribution to McLean Creek will allow for a better seepage mitigation system design and may help identify any other potential discharge points.

The modelling Suncor presented was two dimensional and did not appear to take into account a number of factors, including mine dewatering; therefore it may not accurately reflect the complexities of the hydrogeologic regime under development scenarios. The Board recommends to AENV that Suncor be required to undertake ongoing model validation in order to assess model predictions, so that seepage mitigation plans can be modified in light of any new information.

The Board notes that glacial landforms, such as kame deposits, are complex stratigraphically and will possess complex hydrogeological regimes not easily explained with only limited geological and hydrogeological information. The Board is concerned that, depending on the nature of this glacial landform, other seepage pathways could exist that might circumvent the planned seepage control structures.

The Board is continuing to encounter situations in which oil sands development is impacting groundwater resources within buried channel aquifers. The impacts on the site scale are reasonably well defined, but the impacts on a regional scale are not as well understood because of the lack of detailed mapping beyond the site scale. While the Board acknowledges that at present it might not be reasonable for a single developer to be required to conduct a buried channel mapping exercise on a regional scale, the Board recognizes that such an undertaking would benefit all operations within the region, as well as water resource regulators. Therefore, the Board recommends that AENV coordinate buried channel mapping on a regional scale with assistance from oil sands developers within the area.

7.2 Water Quality

7.2.1 Views of Suncor

Suncor indicated that the STP project had the potential to affect water quality in McLean Creek through two main pathways. These included changes in water quality through EPL discharge quality and quantity and by foundation seepage from the STP conveyed to McLean Creek via the WCSC.

Suncor stated that the STP project could affect water quality in McLean Creek only once initial EPL discharge began and in the far future, since the EPL was part of the closed-circuit system until initial EPL release occurred and since seepage management systems would capture seepage and direct it into the closed-circuit system or into the EPL until the far future.

Suncor indicated that it constructed a water quality model to predict substance concentrations for the initial EPL discharge, as well as for the far future scenario, that incorporated information on flow conditions for McLean Creek, water quality profiles for sand seepage and tailings water, and EPL water quality modelling. EPL issues are more thoroughly discussed in Section 7.3. Suncor indicated that its analysis indicated that initial post-closure seepage from the STP sand dikes could result in acute and chronic toxicity in McLean Creek under low-flow conditions, but maintained that the acute and chronic toxicity would be eliminated once the toxicity of the sand seepage was reduced to 17 per cent of its initial level. Suncor indicated that these results demonstrated the need to continue operation of the interception wells for a management period after closure and that management of seepage water would take place for at least 60 years following closure.

Suncor stated that it currently carried out hydrologic and water quality monitoring of McLean Creek as a requirement under an existing *Fisheries Act* authorization. Suncor indicated that this monitoring program consisted of hydrologic monitoring, water quality monitoring, and sediment sampling. Suncor indicated that the continuation of these existing monitoring activities would provide a comprehensive monitoring program to address potential effects of the STP project on hydrology and water quality in McLean Creek. Suncor stated that it would establish a water level monitoring station within the new mitigation wetlands in addition to existing monitoring.

Suncor indicated that although the STP project would not result in any direct release of operational or reclamation water to the Athabasca River, the STP project would result in changes to the water quality of McLean Creek that could affect substance concentrations in the Athabasca River. Suncor said that potential changes in water quality in the Athabasca River could occur beginning with initial EPL release and continuing into the far future when seepage through the WCSC was no longer intercepted. Suncor developed a water quality model to predict substance concentrations in the Athabasca River under these two scenarios that considered flow conditions and substance releases. Suncor concluded that, overall, the STP project was not expected to result in changes in background concentration of most water quality parameters in the Athabasca River.

Suncor stated that it was committed to maintaining its active support and participation in the Regional Aquatics Monitoring Program (RAMP) and regional management initiatives put in place by CEMA.

7.2.2 Views of Alberta

Alberta stated that the assessment of the STP on the surface water resources was based exclusively on computer modelling and that the calibration, validation, and sensitivity analysis were based on limited available data.

Alberta suggested that any EPEA approval that may be issued for the project may require Suncor to implement a monitoring program for McLean Creek designed to validate the model predictions relative to surface water quality and allow further management actions if necessary.

7.2.3 Views of the Board

The Board accepts that Suncor has completed its modelling based on available data. The Board understands Alberta's concerns regarding the amount of data incorporated in the modelling exercise. As such, the Board supports Alberta's possible EPEA condition of requiring Suncor to implement a monitoring program for McLean Creek that would be designed to validate the model predictions relative to surface water quality and that would allow for further management actions if necessary. The Board recognizes the uniqueness of this monitoring initiative given its lengthy nature and large scale and acknowledges the importance of monitoring in the successful operation of the mitigation system.

Given these factors, the Board recommends that AENV consider the recommendations made in Section 7.1.5 with respect to monitoring and adapt them as appropriate for surface water purposes.

The Board recognizes Suncor's commitments to local and regional-scale monitoring of potential impacts of development on water quality through ongoing on-site surface water monitoring and through regional initiatives put in place by RAMP and CEMA. The Board expects that these commitments will continue and evolve as environmental issues within the region are better understood.

7.3 End Pit Lakes

7.3.1 Views of Suncor

Suncor stated that the closure drainage plan for the STP was integrated with the Millennium Mine. At closure, water and MFT would be removed from the STP and placed in the Millennium EPL. Suncor stated that it based the characteristics of the EPL upon the configuration approved for the Millennium Mine. Suncor further stated that the Millennium EPL would contain two basins (referred to as the South EPL and the North EPL), which would be separated by an overburden fill and interconnected by constructed wetlands.

Suncor stated that the South EPL would receive MFT and process water from the STP, and MFT would replace the CT deposit that was planned for transfer to the South EPL as part of the Millennium application. Suncor stated that the volume of MFT deposited in the Millennium EPL would affect the hydraulic residence time, which may indirectly affect the performance of the lake. Other impacts to EPL performance would include depth-related stratification of the lake and pore water release from MFT. However, Suncor stated that impact assessment modelling had demonstrated that the proposed volume of MFT to be transferred to the lake and its associated pore water release would not impede the development of acceptable EPL water quality.

Suncor predicted time-dependent water quality in the South and North EPLs using separate coupled flow and mass balance models. It used mean annual flows and substance loads in the EPL model. Suncor also noted that the model incorporated degradation of sulphide, ammonia, organics, whole effluent acute and chronic toxicity (a fish health index), and a tainting potential. Suncor did not apply degradation to any other substance within the EPL, nor did it model for settling. The EPL modelling predicted that concentrations of water quality parameters would increase under the application case relative to the Millennium case, mainly as a result of the additional MFT and process water added to the South EPL from the STP project.

Suncor stated that the EPLs would receive treatment by dilution and biodegradation before being released to other surface waters. Suncor expected the EPLs to provide effective settling of total suspended solids and sediment-attached substances, even though this treatment process was not simulated in the EPL water quality model. Suncor intended to manage the EPL to produce initial and ongoing outflows not acutely or chronically toxic to aquatic life.

Suncor stated that EPLs were viable, robust reclamation features that would be optimally designed to meet end land use and regulatory requirements. Suncor also stated that if the deposition of MFT in the EPL proved to not be a viable option, it was committed to treating this water to a level that would be acceptable for transfer to the EPL or through disposal by other acceptable means. Suncor stated that it remained a funder and participant in the CEMA EPL subgroup and supported continuing research initiatives.

7.3.2 Views of Alberta

Alberta stated that Suncor's surface water quality modelling exercises indicated that the STP would have an effect on water quality in its EPL. Alberta stated that any EPEA approval that may be issued for the project may require Suncor to develop

- a design and water quality standard for EPLs in cooperation with the EPL subgroup of CEMA, and
- a plan for nutrient mitigation (e.g., treatment wetlands), as part of the approved reclamation process, consistent with water quality objectives developed through the Surface Water Working Group of CEMA.

7.3.3 Views of the Board

The Board notes that MFT will be stored in the STP until about 2029, at which point Suncor would begin the transfer to the South EPL. The transfer is predicted to finish in 2035, not in 2033, as indicated in the Millennium application. The Board further notes that the material transfer to the South EPL follows the Millennium application case with the exception that the South EPL would receive $1.6 \times 10^6 \text{ m}^3$ of process-affected water and an additional $59.3 \times 10^6 \text{ m}^3$ of MFT from the STP. The Board also notes that Suncor stated that there will be no MFT or process-affected water deposited in the North EPL. The Board notes that Suncor predicts the North EPL to begin discharging to McLean Creek in 2058, as opposed to 2061, from the base case.

The Board recognizes that an oil sands mine EPL such as that proposed by Suncor is a complex and as yet unproven concept. While Suncor's closure and reclamation plans rely on the development and successful implementation of the EPL concept as part of the final closure landscape, the Board remains concerned about the lack of scientific proof of the viability of the concept.

The Board remains concerned about the increase in predicted final MFT inventory and the proposal to store this increased inventory in the EPL as part of Suncor's closure plan. The Board acknowledges Suncor's commitment to treat the fluid fine tails if the EPL concept does not prove viable. However, the Board is concerned that increasing MFT volumes throughout the life of the mine would result in increased liability. This concern is emphasized in light of the

unproven nature of Suncor's proposed closure and reclamation EPL scheme and the potential need for treatment of the MFT. Therefore the Board believes that Suncor must manage its tailings operation to result in the smallest possible final inventory of MFT. The Board will require Suncor to report on its efforts to reduce MFT volumes as described in Section 6.1.2.

The Board supports AENV's views as noted in Section 7.3.2. The Board conditions its approval to require Suncor to submit a report by February 28 of every year commencing in 2005 describing its efforts in the previous year to advance the scientific knowledge base and development of EPLs.

8 SEEPAGE MITIGATION AND RECLAMATION LIABILITY

Table 2 summarizes the estimated costs provided by Suncor to operate the seepage mitigation system after mining is complete, transfer MFT to the EPL, and reclaim the STP facility.

Table 2. Seepage mitigation and reclamation costs*

	Active mining 2006 to 2029 annual cost (\$1000s)	Post mining 2030 to 2089 annual cost (\$1000s)	Total cost 2006 - 2089 (\$1000s)
Seepage mitigation operation and maintenance		725	43,500
MFT transfer capital and operating		2,625	21,000
Reclamation	498	422	37,250
Total	498	1,496	101,750

* All costs are expressed in 2004 dollars. MFT transfer capital and operating costs are over an eight-year period. The following references were used to derive the information in the table:

- STP supplemental information (November 8, 2004), Table 1.1: South Tailings Pond Seepage Mitigation System – Annual Operating and Maintenance Costs.
- STP supplemental information (November 8, 2004), Table 3-1: MFT Transfer Costs from South Tailings Pond.
- STP supplemental information clarification (November 22, 2004), Table 4-1: South Tailings Pond Reclamation Cost Estimates.

8.1 Views of Suncor

Suncor stated that after mine closure, foundation seepage from the reclaimed sand tailings dikes would continue, but at a much lower rate than during operations. The groundwater modelling predicted that the seepage interception system could be required for over 60 years after mine closure or until the water quality was suitable for discharge to McLean Creek. Suncor noted that current EIA predictions of seepage quality were likely conservative and that groundwater monitoring would ultimately determine the requirement for and duration of seepage interception after closure. Suncor predicted that mine closure would occur in 2029 but its in situ activities would continue for about 40 years beyond this date, as would the operation of its upgrading facilities. Suncor noted that the continued operation of the upgrading facilities ensured that the infrastructure required to operate the dewatering wells would remain intact. Suncor also provided cost estimates (summarized in Table 2) for seepage mitigation and reclamation of the STP facility.

Suncor stated that at the end of mining operations in 2029, the final MFT inventory from the STP would be transferred to the bottom of the EPL. Suncor noted that the STP facility would be breached as part of the final reclamation to develop an integrated drainage system connecting the STP area to the EPL. Suncor noted that based on the projected geometry of the EPL, this MFT inventory would be covered by about 65 m of water at closure.

Suncor stated the goal of its closure and conservation reclamation plan was to achieve maintenance-free, self-sustaining ecosystems with capability equivalent to predevelopment conditions. Suncor stated that it would reclaim all final tailings surfaces and EPL to meet the objectives of its closure plan.

Suncor stated that it assessed its reclamation liability on an annual basis and submitted it to AENV in compliance with existing legislation. Suncor noted that it prepared the estimate in accordance with the guidance received from AENV, and the estimate was subject to AENV scrutiny once submitted. Suncor stated the annual determination of the reclamation liability and the security mechanisms were being defined by the Department of Energy and the Department of Environment, pursuant to a Minister's Policy approved by Cabinet in July 2004. Suncor noted that it would post letters of credit (or other acceptable forms of security) payable to the Provincial Government, when required, as specified in the new program. Suncor noted that, as indicated in the Cabinet Approval, the program would provide that the financial security would be payable at a level and within a timeframe to ensure that the financial risk to the people of Alberta was minimized. Suncor anticipated that the reclamation liability related to the STP would be subject to this process and any required security would be posted accordingly.

8.2 Views of Alberta

Alberta stated that should the STP proposal be approved, AENV anticipated that costs associated with carrying out the proposed seepage mitigation plan would be included in the security determination before tailings were placed in the pond. Alberta noted that AENV anticipated addressing this by requiring a specific re-evaluation and adjustment of security accounting for the carrying out of the proposed seepage mitigation plan.

Alberta stated that an annual re-evaluation and adjustment thereafter could reflect updated estimated costs associated with the operation, maintenance, and eventual abandonment of the mitigation facilities.

Alberta also stated that AENV's authority to include costs associated with Suncor's seepage mitigation plan in the determination of conservation and reclamation security flowed from Section 18 of the *Conservation and Reclamation Regulations*.

8.3 Views of the Board

The Board believes that the government and public are entitled to have proponents of approved projects provide security for funding to address any liability that may arise from the construction and operation of an oil sands mining project, as well as for the reclamation and decommissioning of the site at the end of the project's life. The Board acknowledges Suncor's assurances that its in situ activities and upgrading facilities will continue to operate for many years after mining is complete. However, the Board is still concerned with the estimated 60 years that the seepage mitigation system could be required for.

The Board notes that AENV anticipates that the proposed seepage mitigation plan would be included in the security determination before tailings were placed in the pond. The Board relies on AENV's representations that all costs related to the seepage mitigation, transfer of MFT, and reclamation of the STP facility will be addressed by AENV so that the citizens of Alberta are protected from liability.

Dated in Calgary, Alberta, on December 30, 2004.

ALBERTA ENERGY AND UTILITIES BOARD



J. D. Dilay, P.Eng.
Presiding Member



A. J. Berg, P.Eng.
Board Member



R. N. Houlihan, Ph.D., P.Eng.
Acting Board Member

APPENDIX 1 SUMMARY OF CONDITIONS

This section is provided for the convenience of readers. In the event of any difference between the directions in this section and those in the main body of the decision, the wording in the main body of the decision shall prevail.

- 1) Alternatively, the need to increase the final elevation of the STP dike could arise if Suncor fails to achieve its proposed tailings management performance, a situation that may be more difficult to justify. Therefore, the Board conditions the approval to limit the final elevation of the STP dikes to 380 m. Prior to increasing the elevation of the dikes, Suncor will need to apply for and obtain Board approval.
- 2) The Board is concerned that Suncor may not be placing adequate priority on ensuring that it has systems in place to achieve its intended levels of tailings management performance, and the Board believes that additional regulatory involvement may be necessary to ensure that this is addressed. Therefore, the Board conditions the approval to require Suncor to submit an annual tailings management plan for the upcoming year as part of the Annual Mine Plan submission, commencing on September 30, 2005.
- 3) The annual tailings management plan shall show how Suncor adheres to the STP application case. The plan shall include information on volumes of MFT (production, consumption, and storage), volumes of CT (off-spec, on-spec, and effective), and other details as specified by the Board. In addition to the tailings plan, the Board conditions the approval so that Suncor shall submit quarterly tailings performance reports that indicate whether actual tailings performance complies with the most recently submitted tailings management plan. Quarterly tailings reports shall be submitted within one month of the end of each reporting period. The first reporting period shall be January 1 – March 31, 2005.
- 4) The Board expects Suncor to have installed the capacity to produce CT as consolidated deposit (i.e., effective CT) and to operate the system at the service factor stated in the application (69 per cent of the sand). The Board will require Suncor to demonstrate that deposition of CT will result in a trafficable surface, and the Board conditions the approval to require Ponds 5 and 6 to be filled with effective CT by 2009, sand capped from 2015 and 2019, and reclaimed to a trafficable surface by 2019, all as proposed by Suncor. The Board expects Suncor to develop and apply the necessary technology to satisfy this condition.
- 5) The Board recognizes that tailings material is currently stored on both sides of the Athabasca River and that due to space limitations, tailings are periodically moved from pond to pond, including across the river. The Board is concerned with the movement of these tailings, which have been in contact with froth treatment tailings, to the STP and the potential for increased off-site odours. Therefore, the Board conditions the approval to prohibit transfer to the STP of MFT or other tailings streams that have been in contact with froth treatment tailings. This condition may be removed if Suncor can satisfy the Board that there will be no negative effects on stakeholders.
- 6) The Board supports AENV's views as noted in Section 7.3.2. The Board conditions its approval to require Suncor to submit a report by February 28 of every year commencing in 2005 describing its efforts in the previous year to advance the scientific knowledge base and development of EPLs.

APPENDIX 2 SUMMARY OF RECOMMENDATIONS TO ALBERTA ENVIRONMENT

This section is provided for the convenience of readers. In the event of any difference between the directions in this section and those in the main body of the decision, the wording in the main body of the decision shall prevail.

- 1) The Board notes that Alberta stated that it believed that the long-term effects on the WCSC could be minimized and restricted to the STP project area through monitoring and mitigation. The Board accepts Alberta's position in this matter. The Board notes that Alberta indicated that it would consider conditions to any EPEA approval it might issue that would address concerns regarding monitoring and mitigation system design and geological and hydrogeological characterization. The Board supports Alberta's intentions and will make specific recommendations to Alberta regarding approval conditions.
- 2) The Board recognizes the importance of monitoring to the successful operation of the mitigation system and recommends that Alberta consider the following needs in any approval process it might enter into with respect to Suncor's application:
 - a flexible monitoring system capable of responding to sudden changes in water quality or water levels as a consequence of STP project activities;
 - water quality or water level triggers that will initiate corrective action;
 - a detailed response plan for unexpected changes in groundwater quality or levels;
 - development of monitoring contingency plans that address any unexpected changes in groundwater quality or quantity that are detected;
 - an ongoing process that will evaluate remediation system performance and the accuracy of Suncor's seepage impact predictions; and
 - rapid and clear communication of monitoring results to numerous stakeholders.
- 3) The Board also recognizes that an additional recommendation to regional working groups to undertake such an initiative may not be reasonable, given their current workloads and priorities. The Board recommends that Alberta consider establishing a regional working group to examine groundwater issues.
- 4) The Board notes that Alberta stated that it might require, as possible approval conditions, further delineation and hydrogeological investigation of the WCSC and investigation of ways to minimize mitigation timelines while reducing final chemical compound concentrations and to more fully understand the potential effects of seepage. The Board fully supports Alberta's intentions in these matters and has specific recommendations for the content of approval conditions under those headings. The Board recommends to Alberta that any additional geological or hydrogeological investigations provide the following:
 - an improved characterization of groundwater-surface water interaction between the WCSC and McLean Creek;
 - an up-to-date, three-dimensional hydrogeological model to assess the impacts of seepage, mine dewatering, and interception well operation on the local and regional groundwater and surface water flow regimes;
 - an understanding of the geological and hydrogeological linkage between the WCSC and other regional buried channel aquifers in the oil sands region; and
 - an additional delineation exercise and hydrogeological investigation of the same deposit.

- 5) The modelling Suncor presented was two dimensional and did not appear to take into account a number of factors, including mine dewatering; therefore it may not accurately reflect the complexities of the hydrogeologic regime under development scenarios. The Board recommends to AENV that Suncor be required to undertake ongoing model validation in order to assess model predictions, so that seepage mitigation plans can be modified in light of any new information.
- 6) The Board is continuing to encounter situations in which oil sands development is impacting groundwater resources within buried channel aquifers. The impacts on the site scale are reasonably well defined, but the impacts on a regional scale are not as well understood because of the lack of detailed mapping beyond the site scale. While the Board acknowledges that at present it might not be reasonable for a single developer to be required to conduct a buried channel mapping exercise on a regional scale, the Board recognizes that such an undertaking would benefit all operations within the region, as well as water resource regulators. Therefore, the Board recommends that AENV coordinate buried channel mapping on a regional scale with assistance from oil sands developers within the area.
- 7) Given these factors, the Board recommends that AENV consider the recommendations made in Section 7.1.5 with respect to monitoring and adapt them as appropriate for surface water purposes.

APPENDIX 3 GLOSSARY OF TERMS AND ABBREVIATIONS

Acute toxicity – Describes the adverse effects resulting from chemical exposures of very short duration.

Aquifer – A body of rock or soil that contains sufficient amounts of saturated permeable material to yield economic quantities of water to wells or springs.

Consolidated tailings (CT) – A mixture prepared by combining mature fine tailings with cycloned fresh sand tailings to form a deposit that consolidates relatively quickly in tailings deposits. This mixture is chemically stabilized using gypsum to prevent segregation.

Dewatering – Removal of groundwater from a geological formation using wells or a drainage ditch system.

Effective CT – Any deposited nonsegregating mixture (on-spec CT) that meets the minimum sand-to-fines ratio requirement to create a reclaimable surface.

Factor of safety - The ratio of the soil strength to the driving forces.

Fluid fine tailings – Fine particles of silts and clays suspended in water and impounded behind dikes in tailings pond structures.

Hydrogeology- The branch of geology that deals with the occurrence, distribution, and effect of groundwater.

Kame deposit - An ice-contact deposit associated with the concurrent processes of melting ice and flowing meltwater.

Liquefaction - Loss of strength, and subsequent flow, of a saturated soil (usually sand) due to rapid loading and generation of hydraulic forces.

Mature fine tailings – Fine tailings that have dewatered over a period of time after deposition to a level of about 30 per cent solids.

Off-spec CT – A mixture of CT not meeting the required specifications of on-spec CT.

On-spec CT – Nonsegregating slurry that has the correct mixture components of sand, mature fine tailings, and gypsum deposited into the pond.

Rill – A small brook.

Steady state - A state in which a parameter or a process is constant and does not change with time.

Surficial deposits - Geological materials at or near the earth's surface; pertaining to or lying in or on a surface, specifically the surface of the earth.

Tailings – A by-product of oil sands extraction comprising water, sands, and clays, with minor amounts of residual bitumen.

Tremie - An apparatus for depositing consolidated tailings under water.

ACFN - Athabasca Chipewyan First Nation

AENV - Alberta Environment

Alberta – Alberta Government

Canada - Government of Canada

CDA - Canadian Dam Safety Association

CEMA - Cumulative Environmental Management Association

CONRAD – Canadian Oil Sands Network for Research and Development

CT – consolidated tailings

DFO - Department of Fisheries and Oceans

EIA - environmental impact assessment

EPEA - *Environmental Protection and Enhancement Act*

EPL - end pit lake

EUB/Board - Alberta Energy and Utilities Board

Fort McKay - Fort MacKay Industrial Relations Corporation

ha - hectares

MCFN - Mikisew Cree First Nation

MFT - mature fine tailings

10^6 m^3 - million cubic metres

OSEC - Oil Sands Environmental Coalition

OSTRF - Oil Sands Tailings Research Facility

RAMP - Regional Aquatics Monitoring Program

SAGD - steam -assisted gravity drainage

SRD - Alberta Sustainable Resource Development

STP - South Tailings Pond project

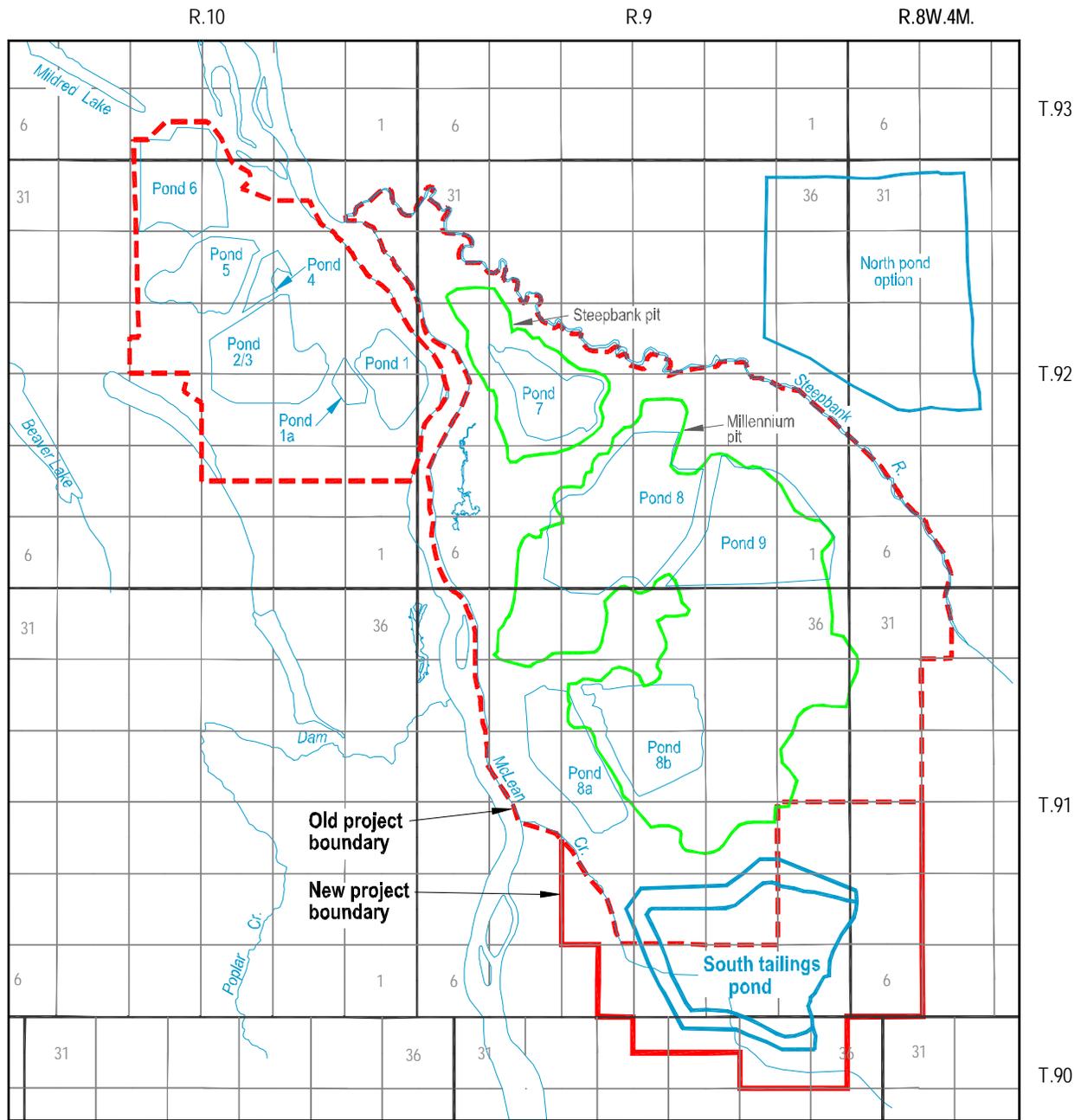
Suncor - Suncor Energy Inc.

TT - thickened tailings

TV:BIP - total-volume-to-bitumen-in-place ratio

WBFN - Wood Buffalo First Nation

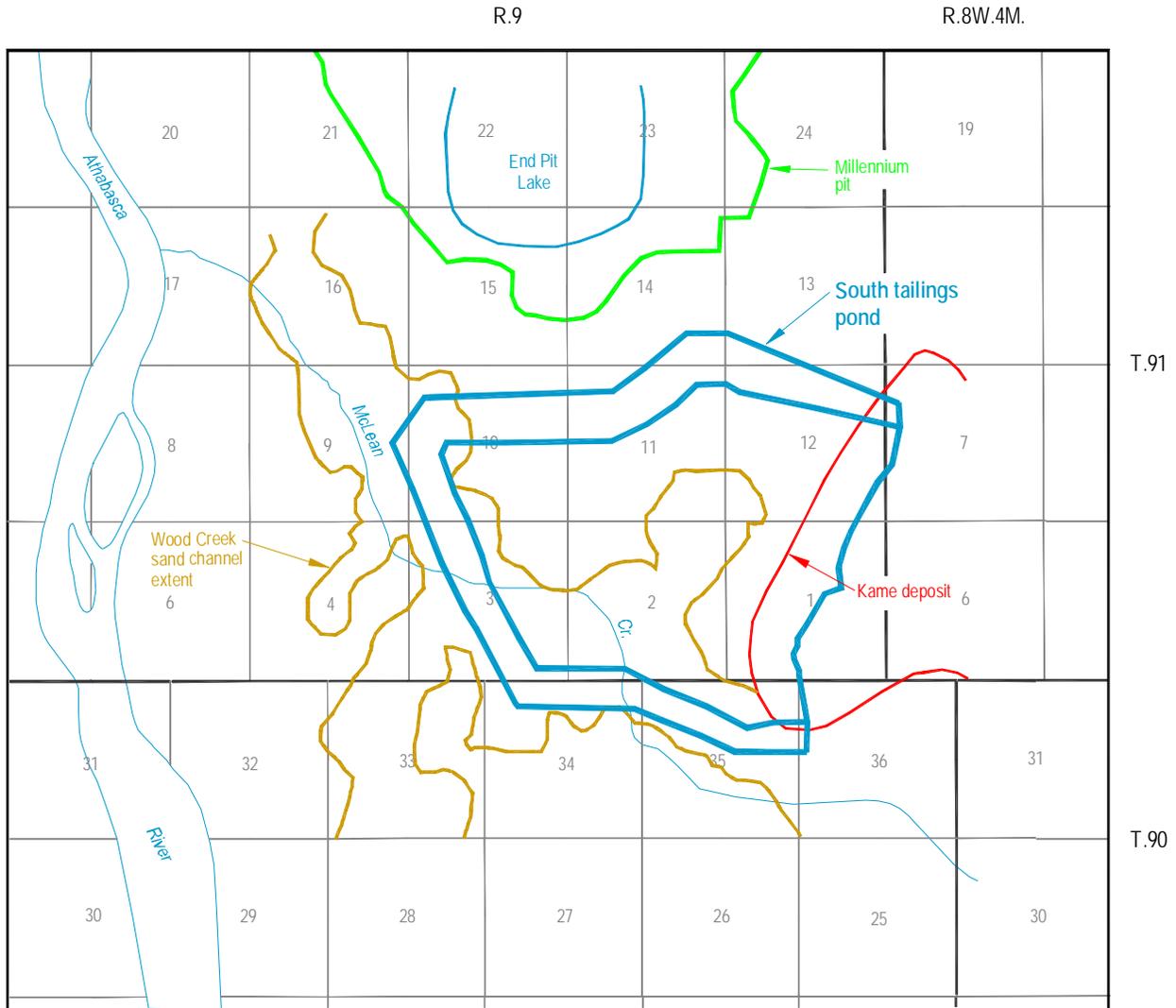
WCSC - Wood Creek Sand Channel



Legend

- Proposed project boundary
- - - Existing project boundary
- Pit boundary

Figure 1. Suncor oil sands mine project map



- Legend**
- Wood Creek sand channel
 - Pit boundary
 - Kame deposit boundary

Figure 2. South tailings pond detail