Written Submission: Federal Parliamentary Committee Hearing on Water and the Oil Sands

Overview

The Pembina Institute is a national sustainable energy think tank focused on sustainable energy solutions. We have researched environmental impacts associated with oil sands development for over a decade and are committed to promoting responsible oil sands development. Unfortunately Canada's current approach to oil sands development epitomizes irresponsible development.

The manner in which the oil sands are developed is of national interest and includes issues of federal jurisdiction such as greenhouse gas pollution, transboundary issues (acid rain, water quality and quantity), fisheries and impacts to species at risk. Environmental assessment of large projects is required under the *Canadian Environmental Assessment Act*. The federal government been very weakly involved in oil sands environmental management to date despite significant areas of jurisdiction.

Given the very limited time available, I will focus my comments on three main areas — the lack of protection of water flows of the Athabasca River during low flow periods; the inadequate practices concerning management of toxic liquid wastes, or tailings; and concerns about adequacy and transparency of monitoring as it relates to water quantity and quality and oil sands development.

1. Lack of protection for the Athabasca River

Giving priority to oil production over water and fisheries

Under the current federal-provincial water management framework for the Athabasca River, there is no provision for water withdrawals to be halted in order to protect fish habitat. The water management framework has a "traffic light" system identifying green, yellow and red zone flows[i], but unfortunately, red does not mean that water withdrawals must stop. This demonstrates that precedence is given to maintaining water for the oil sands industry rather than protecting fisheries and habitat.

Often, the amount of water allocated for oil sands operations from the Athabasca River is expressed as a percentage of annual river flow in an attempt to downplay the industry's demand for freshwater. For example, oil sands mining operations are cumulatively allocated 2.2% of the Athabasca River's annual flow[ii]. Although these figures are accurate, they are misleading by virtue of being ecologically irrelevant. Expressing allocations in terms of a percentage of annual flow is irrelevant when considering the impacts of water withdrawals on the aquatic ecosystem during the winter months. This is akin to planning for the "average annual temperature" in Fort McMurray, while ignoring the freezing temperatures in winter.

Flows in the Lower Athabasca are highly variable. For example during the open water season (April–November) flows average 859m^3/sec, whereas when the river is covered with ice (December–March) flows average 177m^3/sec.[iii] Spring and summer flows are commonly 10 times greater than winter flows in any given year. Therefore the cumulative allocation total for oil sands operators, currently over 14m^3/sec, makes up a much greater proportion of the Athabasca River's flow during winter months.

During the winter months, the Athabasca River's natural low flows are limiting for fish habitat and aquatic biota, a primary factor regulating populations during this season.[iv] Winter water withdrawals exacerbate these conditions and place further stress on the aquatic ecosystem. Impacts on tributaries of the Athabasca should also be considered. A percentage reduction in flow does not always correspond to the same percentage reduction in habitat. In other words, a greater proportion of habitat or a type of habitat may be lost when flow is reduced by a certain percentage. Withdrawals during very low flows (which most commonly occur in the winter, and when habitat is more limiting or under bottleneck conditions) are a primary concern. Very little is known regarding winter biology in the Athabasca River and in rivers affected by ice more generally.

There is currently no requirement in the Management Framework that water withdrawals be halted during periods of low flow. During yellow and red zone conditions, the ecosystem is already stressed by natural low flows, yet water withdrawals for oil sands operations are permitted to continue. No matter how low flows become in the Athabasca River, the oil sands industry is permitted to continue to withdraw water.

Previous instream flow needs (IFN) studies in Alberta have determined that a fully protective IFN prescription for the aquatic ecosystem of a river would involve the establishment of an ecosystem base flow (EBF): a flow threshold below which no withdrawals are permitted[v]. In the current Management Framework during the red zone, water withdrawals of up to 5.2% of the historical median flow are permitted. During extremely low daily flows, water withdrawals could be a much higher proportion than this median.

> **Recommendation: No new approvals or water licenses for oil sands mines should be granted until the establishment of a scientifically-based Ecosystem Base Flow for the Athabasca River, beyond which withdrawals by all oil sands operations during the red zone or low flow periods would be prohibited.**

2. Liquid tailings

This section is largely adapted from the 2008 Pembina Institute Report: *Oil Sands Reclamation: Fact or Fiction?,* which is available for download at www.oilsandswatch.org/pub/1639.

How are tailings created?

Oil sands mining extraction separates bitumen from sands. The ore is mixed with hot water (and sometimes caustic soda) to wash oil from the sand.[vi] In extraction vessels, the bitumen floats to the surface, the sand settles to the bottom and in between the two floats a murky water layer (called middlings). The sand and middlings make up the waste byproduct called tailings, which consist of water, sand, silt clay, unrecovered hydrocarbons and water with dissolved components.[vii] The bitumen froth is skimmed off the top and sent to froth treatment, the middlings are fed into a secondary separation vessel to undergo more separation, and the sand, mixed with water, is pumped into large settling basins called tailings ponds — more appropriately referred to as tailings lakes.[viii]

What do tailings lakes contain?

When mining projects first start operating it is necessary to build tailings lakes outside of the mine pits, through the construction of large dykes. Tailings are transported hydraulically and deposited into the tailings facilities. Once deposited, they separate into coarse sand, a denser fluid and water. The coarse sand fraction settles quickly to form beaches. Most of the fine silts and clays enter settling basins to form a stable suspension that requires a long time to fully consolidate. As this suspension settles, it is referred to as mature fine tailings (MFT).[ix] MFT settle to become less liquid and more dense over time, reaching approximately 30% by weight of fine sand and clays. The remaining 70% is composed of water that cannot be recycled because of the suspended sediments.[x]

The amount of MFT that will be made at any particular plant is dependent on the amount of fine materials in the ore that is mined. The more fines in the ore, the more MFT generated from the extraction process. On average, approximately 1.5 barrels of MFT accumulate for every barrel of bitumen produced.[xi]

Why are tailings lakes a serious concern?

1. Size

Tailings lakes now cover 130 km^2 [xii] — an area the size of the City of Vancouver. Tailings lakes represent a current and ongoing liability to the Athabasca and Mackenzie watersheds. In over 40 years of oil sands development no areas containing tailings have ever been certified as reclaimed[xiii], and industry has never demonstrated they are able to deal with the toxic liquid waste in tailings ponds.

It is estimated that there are a total 720 million cubic metres of impounded tailings on the landscape.[xiv] This amounts to 288,000 Olympic swimming pools of toxic waste.[xv]

2. Toxicity

Tailings lakes house not only sand, fines (silts and clays) and water but a host of toxins that include naphthenic acids, phenolic compounds, ammonia-ammonium and trace metals such as copper, zinc and iron. These trace metals can exist at concentrations that exceed the Canadian water quality guideline for freshwater aquatic life.[xvi] The migration of pollutants (such as naphthenic acids) through the groundwater system and potential leaks to the surrounding soil and surface water present serious risks to the boreal landscape.[xvii] Tailings have also been found to contain residual bitumen (e.g., Suncor's tailings pond contained 9% residual bitumen).[xviii] Naphthenic acids (NAs) are considered the most significant environmental contaminant resulting from oil sands development.[xix] NAs are naturally occurring, soluble constituents of bitumen that become concentrated in tailings as a result of the bitumen extraction process. The presence of NAs in local water bodies and their potential effects on water quality and fish reproduction and tainting has brought significant attention to their persistence in the environment and to their aquatic toxicity at the levels found in tailings ponds.[xx] Concentrations of NAs in rivers within the Athabasca Boreal region are generally below 1 mg/L, but they range between 60 and 120 mg/L in process-affected waters in active tailings containment.[xxi] NAs cause tailings to be acutely toxic to aquatic organisms[xxii] and mammals.[xxiii] Mammalian toxicological results indicate that while acute toxicity in wild mammals is unlikely under worst-case exposure conditions, repeated exposure may have adverse health effects.[xxiv]

3. Risk of failure in dyke containment

In other jurisdictions, mine tailings storage has been associated with significant incidents of containment losses, which cause major ecological disasters and result in significant financial losses for companies.[xxv] Tailings lakes may become major public liabilities in the event that a company cannot cover the cleanup itself. While the oil sands tailings lakes are actively monitored and maintained, and the potential for a catastrophic failure of a tailings dyke is considered low, the long-term viability of these dykes will remain an ongoing concern long after operations cease. Any future failure of containment dykes could allow a release of unstable materials into the Athabasca River and would be catastrophic to the affected aquatic ecosystem.[xxvi]

4. Tailings lake seepage

Pembina Institute was commissioned by Environmental Defence to conduct a review of potential seepage from tailings ponds. As part of our research, we contacted the Government of Alberta on numerous occasions over the summer and fall of 2008, asking for information recorded by industry in groundwater monitoring wells. No data was provided on any occasion. It is unclear whether cumulative summaries of the data exist or if the Government of Canada has any related data.

With limited access to actual seepage data, Pembina Institute had to base our analysis on seepage rates on published data of projected seepage in individual company Environmental Assessments. Interestingly, despite some of the testimony this committee has heard, all the assessments concluded that tailings ponds will leak, even after accounting for mitigation measures. The Pembina Institute assessment projected that tailings ponds could be leaking at a rate of 11 million litres per day, and this rate of leakage could more than double if current proposed projects proceed.[xxvii] The assessment did not attempt to determine the significance of such a leakage rate Information on tailings seepage is fragmentary at best, although occasionally information is available. For example, Suncor has reported that their Pond 1 was leaking into the Athabasca River at a rate of 1,600m^3 per day.[xxviii]

v. Long term fate of tailings: Using End Pit Lakes as toxic waste dumps

Although the short- and medium-term risks associated with tailings lakes in terms of risks to wildlife and current seepage are slowly receiving more attention, a much more significant problem is the unresolved and unproven strategy of dealing with this toxic liquid waste in the long term. Most Canadians would likely be astonished to learn that provincial and federal regulators have condoned the development of 25 permanent tailings lakes called "End Pit Lakes" as long term storage vessels for toxic tailings.

At the end of a mine's life cycle and once all economically recoverable oil sands are removed, companies propose that the final mine pit becomes an end pit lake (EPL). Pit lakes are used in other mining sectors to control water drainage before discharging the water into the environment; the use of end pit lakes as proposed by oil sands operators is unique in that the EPLs are used as permanent disposal sites for toxic tailings waste. Depending on the materials remaining after mine operations, all of the following will be disposed of in the bottom of an EPL: consolidated tailings, mature fine tailings (MFT), overburden, lean oil sands and operational release waters in varying quantities.[xxix] These EPLs will be releasing into the Athabasca River in future decades.

Work by the Cumulative Environmental Management Assocation (CEMA) frankly acknowledges the significant uncertainties around EPLs.

"The development of EPLs as a natural reclamation tool for process-affected waters raises issues of concerns for regulators and stakeholders. Much of this concern results from the fact that historical data are insufficient to determine a realistic outcome of the final features of EPLs. Modelling and relevant background studies have been the basis of research, but a fully realized EPL has yet to be constructed."[xxx]

EPLs will be a permanent feature on northern Alberta's landscape, but it is not yet known if they will support a sustainable aquatic ecosystem. Based on a summary of current approved projects, at least 25 EPLs are planned for the Athabasca boreal region within the next 60 years.[xxxi]. More EPLs will likely be approved if the current rate of oil sands development continues. These EPLs have been approved in the absence of a single demonstrated EPL by any oil sands operator.

In as-yet untested theory, EPLs that house toxic tailings waste will become viable aquatic ecosystems with active littoral zones, shallow wetlands and shoreline habitat. A viable ecosystem is supposed to support biological activity and help biodegrade organic chemicals that accumulate from runoff through the reclaimed landscape (which is projected to contain significant quantities of thickened tailings). Unlike tailings ponds, which have only approximately 5 m of water overlying the MFT, EPLs will be considerably deeper, with 65–100 m of water overlying the toxic tailings deposit.[xxxii] This primary source of this water will be drawn from the Athabasca River; thus, there may be even more significant demands on the Athabasca River in the future from cumulative withdrawal of water to fill EPLs for multiple oil sands mines.

A key area of EPL uncertainty, and an area of ongoing research, is the state of meromixis, which is the condition whereby upper water layers do not mix with the lower portions. Meromixis is proposed to be achieved by increased salinity, which increases water density.[xxxiii] The reclaimed landscape will be contoured to drain into the EPL, which in turn will discharge into the Athabasca River watershed.

During this process, organic chemicals and salts will accumulate in surface runoff that passes over and through the tailings material and be incorporated into the reclaimed landscape. These chemicals and salts will accumulate in the EPL where they are expected to be diluted and biologically degraded over time. The size and volume of an EPL depends upon the pit size and the amount of tailings material that it will contain.

An EPL study released in 2004 revealed the following: in all of the EPL scenarios modeled in the study, meromixis is at best a temporary condition, due to the declining salt input over time.[xxxiv] EPLs are complex systems in terms of hydrology, chemistry and biology, and their design requirements need to be more fully developed.

Uncertainties regarding the construction, maintenance and final success of EPLs remain. An EPL will need to be controlled, managed and monitored throughout much of its initial filling and during discharge to downstream aquatic environments. Alberta Chamber of Resources has noted that "Current practices for long-term storage of 'fluid' fine tailings pose a risk to the oil sands industry." It suggested that the industry "is likely to come under increasing scrutiny from all stakeholders, including regulators, operators, owners, local groups and the Regional Municipality of Wood Buffalo."[xxxv] Given that tailings materials are proposed to be integrated into the reclaimed landscape (in the case of consolidated tailings) or disposed of in EPLs, both surface water and groundwater will pass over and through these materials. This situation will potentially affect water quality, which in turn will affect the regional ecosystem and those species that depend on it.

In spite of both the uncertainties and the risks, large oil sands mines that rely on end pit lakes as reclamation tools continue to be approved by regulators, rather than requiring that research be conducted prior to more approvals:

"The Joint Panel notes that the EPL reclamation strategy remains an unproven and unapproved reclamation option. The Joint Panel also notes that the CEMA EPLSG (Cumulative Environmental Management Association End Pit Lake Subgroup), CONRAD (Canadian Oil Sansds Network for Research and Development) and others are conducting research that will address many of the concerns expressed by MCFN (Mikisew Cree First Nation) regarding the viability of EPLs and their ability to support higher trophic levels, including fish. The Joint Panel notes MCFN's concerns and agrees that there are many uncertainties regarding the efficacy of EPLs. …The Joint Panel agrees with MCFN and AENV that due to the complexity and uncertainty about EPLs, it is a priority that ongoing, comprehensive research occur now."[xxxvi]

In addition to the uncertainty of meromixis, end pit lakes are a great source of concern given their potential to hold and discharge acutely toxic substances, such as naphthenic acids. Most EPLs will contain mature fine tailings. Even EPLs which are not used to dispose of tailings will be exposed to oil sands along the substrate or from process-affected runoff or seepage, so they may still contain toxic substances.[xxxvii]

The Tailings Directive

In February 2009 the Alberta ERCB released *Directive 074: Tailings Performance Criteria and Requirements for Oil Sands Mining Schemes*, at the same time acknowledging that companies have not been meeting their tailings reclamation performance targets over the past 40 years[xxxviii]. Even if companies meet the requirements of the Directive in the short and medium term, tailings inventories will continue to increase. The Directive requires that companies achieve targets for development of trafficable tailings — the Directive still allows for an increase in overall tailings waste, continues to support the plan for EPL use as a reclamation tool, and fails to address the legacy volumes of tailings waste.

> **Recommendation: No more oil sands mine approvals should be granted that include extraction technologies that result in mature fine tailings or that propose unproven end pit lakes as a reclamation strategy.**

3. Availability and adequacy of data on environmental performance

One of the unfortunate defining features of oil sands development is the lack of transparency and absence of publicly available data for many elements of environmental concern, such as tailings seepage and tailings reclamation performance. A clear and cumulative picture of the potential scale of tailings lake leakage has never been presented by the Alberta or federal government. There are many stakeholder concerns about inadequate monitoring of the Athabasca River. The Regional Aquatic Monitoring Program (RAMP) has been criticized as lacking provincial and federal government leadership. Federal reviewers of RAMP raised significant concerns about the program itself. Criticisms included: scientific leadership was lacking; individual components of the plan seemed to be designed, operated and analyzed independent of other components; there was no overall regional plan; clear questions were not being addressed in the monitoring; and there were significant shortfalls in the statistical design of the individual components, calling into question the finding of no detectable impacts on the Athabasca River.[xxxix]

> **Recommendation: Independent, transparent, publicly available monitoring that has a strong peer-reviewed scientific basis is needed. Publicly available data should include comprehensive water quality, tailings reclamation and tailings seepage information.**

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[i] AENV/DFO (Alberta Environment/Department of Fisheries and Oceans Canada). 2007. *Water Management Framework: Instream Flow Needs and Water Management System for the Lower Athabasca River.* Alberta Environment and the Department of Fisheries and Oceans Canada. Available from: http://environment.alberta.ca/documents/Athabasca_RWMF_Technical.pdf

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[iii] Schindler, D.W., Donahue, W.F., and J.P. Thompson. 2007. "Future Water Flows and Human Withdrawals in the Athabasca River." In *Running out of Steam? Oil Sands Development and Water Use in the Athabasca River-Watershed: Science and Market based Solutions*. Edmonton: University of Alberta Environmental Research and Studies Centre. Available from: http://www.ualberta.ca/ERSC/water.pdf.

[iv] Cunjak, R.A. "Winter habitat of selected stream fishes and potential impacts from land-use activity." *Canadian Journal of Fisheries and Aquatic Sciences* 55 (1996): 267-282.

[v] Clipperton, G.K., Courtney, R.F., Hardin, T.S., Locke, A.G.H., and G.L. Walder. 2002. *Highwood River Instream Flow Needs Technical Working Group Final Report, 2002*. Alberta Transportation. Available from: http://www.srd.gov.ab.ca/fishwildlife/fishingalberta/pdf/The%20Final%20Highwood%20Rpt.pdf.

[vi] Rogers, "Surface Oil Sands Water Management Summary Report."

[vii] M. D. MacKinnon et al., "Water Quality Issues Associated with Composite Tailings (CT) Technology for Managing Oil Sands Tailings," *International Journal of Surface Mining, Reclamation and Environment* 15, no. 4 (2001)

[viii] Rogers, "Surface Oil Sands Water Management Summary Report."

[ix] MacKinnon et al., "Water Quality Issues Associated with Composite Tailings (CT) Technology for Managing Oil Sands Tailings."

[x] Rogers, "Surface Oil Sands Water Management Summary Report."

[xi] R. J. Mikula, V. A. Munoz and O. Omotoso, "Water Use in Bitumen Production: Tailings Management in Surface Mined Oil Sands," in *World Heavy Oil Congress* (Edmonton, AB: 2008).

[xii] ERCB Tailings Directive Backgrounder http://www.ercb.ca/portal/server.pt/gateway/PTARGS_0_0_303_263_0_43/http%3B/ercbContent/publishedcontent/publish/ercb_home/news/news_releases/2008/nr2008_14.aspx

[xiii] Gateway Hill, the 104 hectare area that is the only certified reclaimed site in the oil sands, is an area of reclaimed "overburden", is not a mined area and includes no tailings.

[xiv]http://ercb.ca/portal/server.pt/gateway/PTARGS_0_0_303_263_0_43/http;/ercbContent/publishedcontent/publish/ercb_home/public_zone/ercb_process/enerfaqs/enerfaqs12.aspx

[xv] An Olympic-size swimming pool holds roughly 2,500 m^3.

[xvi] P. G. Nix and R. W. Martin, "Detoxification and Reclamation of Suncor's Oil Sand Tailings Ponds," *Environmental Toxicology & Water Quality* 7, no. 2 (1992).

[xvii] National Energy Board, *Canada's Oil Sands: Opportunities and Challenges to 2015, an Energy Market Assessment*, Government of Canada, http://www.neb.gc.ca/energy/EnergyReports/ EMAOilSandsOpportunitiesChallenges2015_2006/EMAOilSandsOpportunities2015Canada2006_e.pdf

[xviii] P. M. Fedorak et al., "Methanogenic Potential of Tailings Samples from Oil Sands Extraction Plants,"*Canadian Journal of Microbiology* 48 (2002).

[xix] V. V. Rogers et al., "Acute and Subchronic Mammalian Toxicity of Naphthenic Acids from Oil Sands Tailings," *Toxicological Sciences* 66 (2002).

[xx] John V. Headley and Dena W. McMartin, "A Review of the Occurrence and Fate of Naphthenic Acids in Aquatic Environments," *Journal of Environmental Science and Health* 39, no. 8 (2004).

[xxi] F. M. Holowenko and P. M. Fedorak, "Evaluation of a Gas Chromatography – Electron Impact Mass Spectrometry Method for Characterizing Naphthenic Acids," Department of Biological Sciences, University of Alberta, Edmonton, Alberta, (2001).

[xxii] M. MacKinnon and H. Boerger, "Description of Two Treatment Methods for Detoxifying Oil Sands Tailings Pond Water," *Water Pollution Research Journal of Canada,* 21 (1986).

[xxiii] United States Environmental Protection Agency (USEPA) Office of Toxic Substances, "Fate and Effects of Sediment-Bound Chemicals in Aquatic Systems," (proceedings of the Sixth Pellston Workshop, Florissant, Colorado, August 12–17, 1984).

[xxiv] Rogers et al., "Acute and Subchronic Mammalian Toxicity of Naphthenic Acids from Oil Sands Tailings."

[xxv] Peachey, Strategic Needs for Energy Related Water Use Technologies: Water and the EnergyINet.

[xxvi] Ibid.

[xxvii] Pembina Institute, Appendix 1. Methodology and Sample Calculations for the Environmental Defence Report, *11 Million Litres a Day: The Tar Sands Leaking Legacy* (2008).

[xxviii] Alberta Energy and Utilities Board, Decision No. 97-1. Application by Suncor Inc Oil Sands Group for Amendment of Approval No. 7632 for Proposed Steepbank Mine Development, 5.

[xxix] Fay Westcott and Lindsay Watson, "End Pit Lakes Technical Guidance Document," (prepared for the Cumulative Environmental Management Association End Pit Lakes Subgroup Project 2005-61, 2007), 33.

[xxx] Ibid.

[xxxi] Since EPLs are a permanent feature on the landscape, the total number of EPLs (25) will be present when the last EPL is constructed (Imperial Kearl Lake in 2060), as indicated in column 5 in table 4.3

[xxxii] Mary Griffiths, Dan Woynillowicz and Amy Taylor, *Troubled Waters, Troubling Trends: Technology and Policy Options to Reduce Water Use in Oil and Oil Sands Development in Alberta* (Drayton Valley, AB: The Pembina Institute, 2006).

[xxxiii] Golder Associates Ltd., "Phase II 2005/2006 Pit Lake Work Plan," (EPL Sub-Group of the Reclamation Working Group, Cumulative Environmental Management Association, 2006).

[xxxiv] Golder Associates Ltd., "Modelling Assessment of End Pit Lakes Meromictic Potential," (EPL Sub-Group of the Reclamation Working Group, Cumulative Environmental Management Association, 2004).

[xxxv] Alberta Chamber of Resources, *Oil Sands Technology Roadmap: Unlocking the Potential*, Final Report (Edmonton, AB: 2004).

[xxxvi] Alberta Energy and Utilities Board, Report of the Joint Review Panel Established by the Alberta Energy and Utilities Board and the Government of Canada, EUB Decision 2007-013: Imperial Oil Resources Ventures Limited, Application for an Oil Sands Mine and Bitumen Processing Facility (Kearl Oil SandsProject) in the Fort McMurray Area, 64

[xxxvii] Westcott and Watson, "End Pit Lakes Technical Guidance Document," 27.

[xxxviii] ERCB Draft Tailings Directive Press Release http://www.ercb.ca/portal/server.pt/gateway/PTARGS_0_0_303_263_0_43/http%3B/ercbContent/publishedcontent/publish/ercb_home/news/news_releases/2008/nr2008_14.aspx

[xxxix] *Oil Sands Regional Aquatic Monitoring Program (RAMP) Scientific Peer Review of the Five Year Report (1997-2001)*