Brief to House of Commons Standing Committee on Environment and Sustainable Development Hearings on Oil Sands and Water Issues

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Tony Maas

Senior Policy Advisor, Fresh Water

WWF-Canada

245 Eglinton Avenue East, Suite 410

Toronto, Ontario

Canada M4P 3J1

Introduction

WWF and our work

WWF-Canada is part of one of the world's largest, most respected, and most effective conservation organizations. WWF is known for setting global conservation agendas while demonstrating meaningful and lasting conservation results on the ground, where it matters most.

Our work is grounded in sound science; our solutions are pragmatic and results driven. WWF's global to local reach allows us to tackle today's increasingly complex environmental problems at multiple scales – from local actions to national governments and economies to global markets and institutions.

WWF-Canada is addressing some of the most daunting challenges facing the country and the planet. We are actively working to protect our oceans, safeguard the Arctic, fight climate change, and to protect, manage and restore the nation's greatest asset – fresh water.

WWF-Canada is currently working with industry, federal, provincial and municipal government agencies, First Nations and Métis groups, and other NGOs as a member of the Phase 2 Framework Committee to develop a sustainable water management plan for the river. This group will provide federal (DFO) and provincial (Alberta Environment) regulators with a recommendation for Phase 2 of the Lower Athabasca River Water Management Framework in December 2009. The Phase 2 Framework is expected to be implemented in January 2011.

Focus of this brief

WWF-Canada commends the Government of Canada for undertaking hearings on the impacts of oil sands development on fresh water. Oil sands development is ground zero with respect to the increasingly tenuous connections among climate change, energy development and fresh water in Canada. Significant attention, including WWF-Canada's, has rightfully focused on the very critical local environmental and human health impacts of oil sands development. We believe it is critically important that parliamentarians also consider the very real and growing risks to Canada's economic security and national unity as relates to oil sands development and fresh water. To this end, our brief focuses on the public policy dimensions of oil sands and water; in particular those areas where the federal government has the opportunity, and more importantly, the responsibility, to act. We focus on three critical issues:

1. Protecting environmental flows in the Athabasca River;
2. Planning for water security in a changing climate; and,
3. Ensuring equity and avoiding conflict in watershed governance.

Fresh water in Canada – A shared responsibility

The legal responsibility for protecting and managing fresh water in Canada is shared between federal and provincial/territorial governments in an arrangement that has been described as "complex and confusing allocation of water management powers."[1] While indeed complex and often confusing, this jurisdictional maze is too often used as an excuse for inaction, particularly

on the part of the Government of Canada. As legal scholars note, "As Canada's waters come under more stress in the next few decades, the federal government's stance of deferring to provincial interests in areas of legitimate national concern will become increasingly untenable, and the pressure for it to act decisively on a range of water quality and water quantity concerns will only grow."[2]

This is certainly the case as relates to oil sands development. Despite clear responsibilities and policy obligations, including protection of inland fisheries and aquatic habitat, the rights of Aboriginal peoples, pollution prevention and resolution of inter-provincial/territorial disputes, ongoing erosion of federal leadership on fresh water has left a troubling void in our national capacity to meet both ongoing problems and emerging threats.

Protecting environmental flows in the Athabasca River system

Key issues:

1. **The Athabasca River supports a diverse, productive, and globally significant ecosystem. We have the rare opportunity to protect native biodiversity and sustain ecosystem integrity in one of the last remaining free-flowing rivers in North America.**
2. **The existing water management framework for the Lower Athabasca River does not provide a sufficient level of protection for the aquatic ecosystem.**

Rivers provide values and services we tend to take for granted: reliable water supplies for municipal, agricultural and industrial use, fish and waterfowl, water purification, and cultural and recreational values. It is widely agreed among ecologists that a river's flow regime – the natural rhythms of high and low flows – is the key determinant in securing the integrity of fresh water ecosystems.[3] The science of ***environmental flows*** (also referred to as instream flow needs or IFN) is used to describe these flow regimes, to assess how alteration to them impacts ecosystem integrity, and to manage development in ways that protect key ecosystem values and services.[4] The cumulative impacts of water taking and infrastructure such as dams disrupt flow regimes; disruption beyond sustainable limits can result in serious ecosystem degradation, and profound social and economic consequences – particularly for those downstream of major development activities.

Assessing and protecting environmental flow regimes essentially amounts to establishing ecologically appropriate and scientifically defined constraints on development impacts. As with other aspects of oil sands development, the cart was placed before the horse when it comes to environmental flow protection. The Alberta government awarded licenses to industry to extract volumes of water from the Athabasca River *before* sustainable limits of water withdrawals were understood and appropriate protections were put in place.

Environmental flows in the Athabasca River

The Athabasca River is North America's third longest free-flowing river. Without the control of dams, the river's flow is largely natural, reflecting prevailing climatic conditions. The natural

flow regime includes substantial intra- and inter-annual flow variability; spring and summer peak flows are commonly 10 times greater than winter low flows.[5]

This flow pattern sustains the native biodiversity, integrity and productivity of the ecosystem. The Lower Athabasca River, in the region where oil sands operations are located, provides habitat for 31 species of fish (the Alberta total is 59) including walleye, northern pike, burbot, and lake whitefish.[6] The river is also the largest direct inflow of water into the Peace-Athabasca Delta, one of the world's largest freshwater deltas, which has been recognized as a wetland of international importance by the Ramsar Convention and as a UNESCO World Heritage Site.[7] The delta provides habitat for migratory waterfowl with up to 400,000 birds using the delta in the spring and more than 1 million in autumn.[8] The ecological productivity of the Peace Athabasca Delta is dependent upon periodic flooding of its shallow perched lakes, basins, and channels.[9]

Disruption of environmental flows by water takings for oil sands development is a growing concern, and is likely to increase given the planned growth in oil sands development over the coming decades. Some confusion exists regarding the relationship between water taking and flows in the Athabasca's River. Industry advocates tend to express the amount of water allocated for oil sands operations as a percentage of annual river flow in an attempt to downplay their demand for fresh water and the related impacts on ecosystem integrity. Although it's true that oil sands mining operations are cumulatively allocated 2.2% of the Athabasca River's ***annual flow*** below Fort McMurray (~633m^3/sec) this statistic is not a useful indicator of the effect of industrial water withdrawals on the aquatic ecosystem.

A more important consideration is the impact of industrial water withdrawals on an instantaneous basis during winter months, a period of primary concern for aquatic species survivorship.[10] The Athabasca River's natural winter low flows (in the range of 177 m^3/sec) are limiting for fish habitat, which can be the primary factor regulating populations during this season.[11] Winter water withdrawals by oil sands operators may exacerbate these limiting conditions and further stress the aquatic ecosystem.[12] Inter-annual variation – the differences in flows year to year – poses additional challenges; for example, winter low flows in 2009 were below 130 m^3/sec for extended periods, and flows as low as 75 m^3/sec have been observed.

To protect the Lower Athabasca River's environmental flows, Alberta Environment and the Department of Fisheries and Oceans Canada developed Phase 1 of the Lower Athabasca River Water Management Framework in March 2007. The framework consists of three river flow conditions with differing environmental implications and corresponding management actions. While a good first step, the framework is inadequate in protecting the aquatic ecosystem for three important reasons explained below.

1. Failure to establish an ecosystem base flow (EBF).

An EBF establishes a flow threshold below which no further withdrawals are permitted. EBF is a fundamental component of environmental flow protection and is designed to ensure that there is no increase in the frequency and duration of the very low flows.[13] EBFs have been developed and promoted in a number of management regimes including in Alberta's South Saskatchewan River Basin. Under the Phase 1 Framework oil sands mining operators are always permitted to withdraw at least 5.2% of historical median flows regardless of the severity of a low flow

event.[14] Although the scientific basis for precisely defining an EBF for the Athabasca River may currently be lacking[15], the approach taken under the Phase 1 Framework provides no precautionary buffer and gives precedence to water withdrawals over ecosystem protection.[16]

2. Failure to provide for peak flows.

Peak flows from the Athabasca River periodically flood the Peace-Athabasca Delta's perched lakes, basins, and channels which provide vital habitat for fish, mammals, and migratory waterfowl. Even small changes in river levels can affect the frequency, duration, and extent of the flooding.[17] The Phase 1 Framework assumes that withdrawals during high flows will not affect fisheries, fish habitat, and the ecological productivity of the delta, so maximum withdrawals by industry are permitted during this period.[18] However, since this assumption has not been scientifically validated, the extent to which withdrawals are placing the Peace-Athabasca Delta's ecological productivity at risk is uncertain.[19]

3. Failure to consider the effects of climate change [20]

Flows in the Athabasca River below Fort McMurray have declined significantly since record-keeping began in 1957,[21] and are projected to decrease further in a changing climate.[22] The Phase 1 Framework process did not consider the effects of predicted climate change on future flows, which is expected to result in reduced water availability for both the aquatic ecosystem and the oil sands industry.[23] Climate change considerations are discussed in detail in the following section.

Finally, the scope of the Phase 1 Framework is limited to the main stem of the Athabasca River, leaving impacts on tributary streams unaddressed.[24] Entire tributaries are being removed at a rapid rate throughout the mineable oil sands area, and those tributaries that do remain are experiencing massive disturbance to large parts of their watersheds. For example, approved and planned oil sands mining projects have the potential to disturb approximately 60% of the ~1480km^2 Muskeg River Watershed, a sub-watershed of the Athabasca River Basin that provides habitat for 22 species of fish including Arctic grayling, walleye, and northern pike.[25] These tributaries provide important spawning and rearing habitat necessary to sustain fish populations of the Athabasca River.[26]

Planning for water security in a changing climate

Key issues:

1. **The Athabasca River has entered a period of declining flow as a consequence of anthropogenic climate forcing. Significant uncertainty exists regarding the rate at which river flows could decline and accurate predictions of future flows are not possible at this time. The impacts of climate forcing mean that flows could actually decline faster than previously predicted.**
2. **The oil sands industry is a significant and growing source of the greenhouse gases that are forcing global climate change and the resulting decline in Athabasca River flows. This places both the environment and industry at risk.**

The assumption that river flow data from past decades can be used to predict the availability of water in the future is the very foundation of water management planning. In this new era of climate change this assumption of stationarity is almost certainly wrong (the concept of stationarity assumes that the statistical properties of the distribution of flows do not change over time).[27] In a recent review of worldwide changes in stream flows, Milly et al. (2008) identified a global pattern in which anthropogenic climate forcing now dominates the influence of large scale atmospheric cycles on hydrology. They presented two broad conclusions:

1. The global pattern of observed annual stream flow trends is unlikely to have arisen from unforced variability and is consistent with modeled response to climate forcing.
2. In view of the magnitude and ubiquity of hydroclimatic change apparently now under way, "we assert that ***stationarity is dead*** and should no longer serve as a central default assumption in water-resource risk assessment and planning."[28]

This means that the Athabasca River will not be as it was in the past. In fact, scientists have observed a trend of declining flows in the Athabasca River that is very likely part of the global trend observed by Milly et al. In a 2006 scientific review commissioned by WWF-Canada, Dr. James P. Bruce observed that annual and winter flows had declined between 1970 and 2004 and predicted further declines based on his knowledge of the IPCC climate models.[29] Schindler et al. (2007) also observed declining flows and likewise predicted further declines.[30]

In a recent update of his original report Bruce confirmed his early observations and conclusions, and went further to consider whether the decline in flows between 1970 and 2004 could be due to regional scale atmospheric patterns, specifically the Pacific Decadal Oscillation (PDO) and the El Niño-Southern Oscillation (ENSO), rather than climate forcing. He found that these patterns could account for only a small fraction of the increase in temperature and hence the decrease in flows during that period. Bruce concluded that most of the change in the Athabasca River is due to anthropogenic climate forcing.

The Future of the Athabasca River

Future river flows can be predicted with some confidence by linking global or regional climate models to regional hydrology models. Bruce (2006) used several IPCC models to predict that the mean annual flow in the Athabasca River could decline 25% and that the minimum flow could decline 7-10% to approximately 90m^3/sec by 2050.[31]

In his recent update, Bruce warned that flows could actually decline faster than his original projections for two reasons. First, global greenhouse gas emissions and atmospheric concentrations are growing more rapidly than assumed in the latest IPCC assessment. Second, the headwater glaciers that make up a portion of the base flows of rivers such as the Athabasca have passed the tipping point, "changing from providing more water to the river and now contributing to declining flows".[32]

These warnings point to important, and seldom considered, connections among climate change policy, sustainable water management and energy development. The oil sands industry is a significant and growing source of the greenhouse gases that are forcing global climate change and the 'death of stationarity' in water management. The declining supply of water in the

Athabasca River poses clear problems for the environment, but also for industry. Just how secure are plans to expand the oil sands industry when an adequate supply of one of its primary inputs (water) is in doubt? And given the dependence of regional and national economies on oil sands development, what are the implications for the communities that depend on the industry and for Canada's economic security?

Ensuring equity and avoiding conflict in watershed governance

Key issues:

1. **Current pollution and potential risk to water quality related to oil sands tailings creates an equity issue among upstream interests and downstream communities.**
2. **Industry-proposed solutions to toxic tailings are in fact "false solutions" that will leave a toxic legacy on the land for generations.**

As water moves through watersheds it collects and it carries with it the cumulative impacts of upstream activities to downstream communities and ecosystems. This creates an equity issue. In the case of oil sands development, the issue is one of equitable distribution of the costs and benefits of development among residents of the Mackenzie River Basin, and it appears that downstream human and ecosystem health is taking a back seat to upstream economic wealth.

At the heart of the equity issue are the impacts and risks to water quality related to the mammoth tailings lakes which, until recently, were treated as an unfortunate but unavoidable consequence of oil sands development. These lakes, contaminated primarily with naphthenic acids, currently occupy 130 square kilometers of what was once Boreal wetland.[33] Ongoing maintenance is required to intercept and return tailings leachate escaping from the lakes.

Naphthenic acids are highly soluble in water and easily find their way into the tissues of aquatic organisms.[34] Within the lakes concentrations of naphthenic acids are between 60 and 120 milligrams per litre, levels that are known to be acutely toxic to aquatic organisms including fish.[35] These pollutants are also migrating into groundwater where they pose a serious ongoing threat to freshwater ecosystems.[36] Naphthenic acid levels as high as 60 milligrams per litre have been found in groundwater adjacent to tailings ponds and up to 9 milligrams per litre in sediments at a test site in the Athabasca River near the first tailings lake.[37] Current surface water quality standards do not provide guidance or limits for naphthenic acids.

The lakes also contain 750 million cubic metres (198 billion U.S. gallons)[38] of mature fine tailings behind dikes that rise up to 90 metres above the landscape. Mature fine tailings reach just 30% solids after settling for several years and then remain fluid for as long as five centuries if left undisturbed.[39] Storage of such massive amounts of toxic tailings and any leaching of pollutants into the river clearly poses a risk to communities like Fort Chipewyan immediately downstream. And while the potential for catastrophic failure of a tailings dyke might be low, a breach would have very serious implications for communities downstream. Professor David Schindler, one of Canada's most respected water scientists summed up the potential for disaster quite nicely

when he said, "If any of those tailings ponds were ever to breach and discharge into the river, the world would forever forget about the Exxon Valdez".

This risk of breach is not lost on downstream communities. Yellowknife recently followed the lead of the Dene First Nation when its city council passed a resolution calling for a moratorium on oil sands development until public contingency plans for catastrophic breach of the tailings lakes are in place, the existing tailings leaks are stopped, a ten-year plan is in place to reclaim tailings without releasing toxic effluent into the river, industry commits to producing dry tailings and an enforceable transboundary water agreement is in place.

Industry's long-term solution to the tailings issue is to pump the toxic sludge into the mine pits that remain after the bitumen has been depleted, cap the contaminated tailings with fresh water and then drain the newly-formed "end-pit lakes" into the surrounding watershed. One of the many concerns with this proposed solution is the presence of methane-producing bacteria that thrive in tailings. It's thought that methane escaping from the fine tailings will carry naphthenic acids into the capping waters and on into the watershed.[40] Approving such ill conceived “false solutions” essentially outsources the consequences of yesterday’s poor and unplanned development to future generations, leaving a toxic legacy our children and theirs.

The Government of Canada has the responsibility to address these issues of watershed equity for at least two reasons discussed below.

1. Responsibilities to Aboriginal peoples

Section 35 of the *Constitution Act* (1982) recognizes and affirms the Aboriginal and treaty rights of Aboriginal peoples in Canada. The federal government owes a special fiduciary duty to Aboriginal peoples, requiring that it act in the best interests of First Nations and to minimize impacts on Aboriginal and treaty rights. Many activities that are protected as Aboriginal rights, such as fishing, hunting, gathering, and spiritual practices, are closely tied to water. Activities such as industrial pollution that affect the quantity or quality of water in Aboriginal territory may therefore interfere with Aboriginal rights.[41]

2. Responsibilities related to transboundary waters

As signatories to the Mackenzie River Basin Transboundary Waters Master Agreement,[42] the federal government has acknowledged its role in addressing equity issues related to waters shared among provinces and territories.[43] The Master Agreement is built on the concept of “equitable utilization” of resources, which means that the use of water in one jurisdiction ought not to unreasonably harm the ecological integrity of the aquatic ecosystem in another.[44] It requires that neigbouring jurisdictions negotiate bilateral agreements to put the concept of equitable utilization into practice. Since coming into effect in 1997, little progress has been made under the Agreement[45] and legal analysts suggest that without a strong presence of the federal government, “upstream jurisdictions will either delay negotiations, or only agree to modest undertakings, so as not to constrain their own future uses of inter-provincial waters”.[46]

Alberta and the NWT recently began what will likely be the most critical and contentious bilateral negotiation under the Master Agreement. The federal government has a dual

leadership role to play in these negotiations: as a signatory to the agreement, and through the Department of Indian and Northern Affairs' designated water responsibilities in the territories.

Recommendations to the Committee

For too long, development of oil sands has progressed without the appropriate oversight and leadership by the federal government. By holding these hearings, the Government of Canada is clearly acknowledging its role and responsibility in managing the impacts of oil sands development on fresh water. WWF-Canada encourages this committee to report to parliament the urgent need for immediate and sustained action by the federal government to protect ecosystem integrity and human health from the impacts of oil sands development on fresh water.

WWF-Canada recommends that the federal government advance a precautionary approach to oil sands development. In practical terms, this will require that **no further approvals for water withdrawals or projects that require water withdrawals be granted** until the significant uncertainties and unaddressed risks related to both existing development and future expansion are addressed, and until a robust water management regime is in place for both the lower Athabasca River and the broader Mackenzie River Basin.

At a minimum, a robust water management regime would address the three critical issues discussed in this brief:

1. Protection of environmental flows and related ecosystem values and services;
2. Water security in a changing climate; and,
3. Equity and conflict management in watershed governance.

Protecting environmental flows and ensuring water security will require:

- Strong leadership by the Department of Fisheries and Oceans (DFO) to ensure that the water management recommendation put forward by the Phase 2 Framework Committee addresses the short-comings of the Phase 1 Management Framework, in particular the protection of environmental flows under both existing flow regimes and anticipated changes resulting from climate change. To exercise such leadership, DFO should be provided sufficient capacity to fulfill its core mandate of protecting fish and fish habitat in the lower Athabasca River and the Peace-Athabasca Delta.
- Political support of federal leaders, including the Minister of Fisheries and Oceans, to ensure that the recommendation put forward by the Phase 2 Framework Committee is translated, in its entirety, into a functional water management plan (assuming the recommendation results in sufficient protections for ecosystem integrity).
- Resources and capacity to ensure that the final plan is fully implemented monitored and enforced. In particular, the federal government can play a leadership role by providing funding and expertise to enhance monitoring of water quality, quantity and ecosystem integrity.

Ensuring equity and avoiding conflict in watershed governance will require:

- Federal participation in negotiations between Alberta and NWT to secure a strong bilateral agreement as per the Mackenzie River Basin Transboundary Waters Master Agreement. The resulting bilateral agreement between Alberta and NWT should fully address all of the principles in the Master Agreement, and include criteria and indicators for water quantity, water quality and ecological integrity.
- Leadership by the federal government to facilitate an open, comprehensive process to engage stakeholders from across the Mackenzie Basin to voice concerns and propose solutions to impacts and risks to water quality related to oil sands development, such as those voiced by the City of Yellowknife. These consultations could be an important input into negotiations between Alberta and NWT under the Mackenzie River Basin Transboundary Waters Master Agreement.
- Federal support, including financial resources and technical capacity, to aid the Mackenzie River Basin Board in effective implementation and monitoring of the bilateral agreement between Alberta and NWT.
- Ultimately, the federal government should heed growing calls for federal leadership on integrated river basin planning for Canada's major river basins, including the Mackenzie, to address persistent issues of jurisdictional fragmentation, gaps in responsibility and a lack of coordination that together undermine effective management and protection of our freshwater resources and ecosystems.

WWF-Canada looks forward to the Government of Canada's leadership on these issues, and we commit to participating in the development and implementation to sustainable solutions.

Endnotes

[1] Saunders, O and Wenig, M. 2007. Whose Water? Canadian Water Management and the Challenges of Jurisdictional Fragmentation. Chapter 6 in Bakker, K. (Ed.), *Eau Canada: The Future of Canada's Water* UBC Press. p.121

[2] Saunders and Wenig. 2007. p.138

[3] Poff et al., 1997; Annear, T., Chisholm, I., Beecher, H., Locke, A., and 12 other authors. 2004. Instream Flows for Riverine Resource Stewardship, Revised Edition. Cheyenne, WY: Instream Flow Council.

[4] Environmental flows describes the quantity, timing and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems. The Brisbane Declaration. 2007. 10th International Riversymposium and International Environmental Flows Conference, held in Brisbane, Australia, on 3-6 September 2007.

[5] During the open water season (April-November) flows below Fort McMurray average 859m^3/sec, whereas when the river is covered with ice (December-March) flows average 177m^3/sec. See: 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.

[6] DFO. 2008. Proceedings of the National Peer Review of the Lower Athabasca River Instream Flow Assessment and Water Management Framework. Department of Fisheries and Oceans Canada Science Advisory Secretariat, Proceedings Series 2007/032.; Nelson, J.S., and M.J. Paetz. 1992. The Fishes of Alberta (2nd Edition). Edmonton: The University of Alberta Press.

[7] Wolfe, B.B., Hall, R.I., Edwards, T.W.D., Vardy, S.R., Falcone, M.D., Sjunneskog, C., Sylvestre, F., McGowan, S., Leavitt, P.R., and P. van Driel. 2008. Hydroecological Responses of the Athabasca Delta, Canada, to Changes in River Flow and Climate During the 20th Century. *Ecohydrology*, 1: 131-148.

[8] All four North American flyways (Pacific, Central, Mississippi, and Atlantic) converge on the delta, and rare species such as the whooping crane and Ross' goose are delta migrants. See: Canadian Wildlife Service. 1985. Northern Deltas – Oases for Wildlife. Ottawa.

[9] Wolfe et al., 2008

[10] Golder Associates Ltd. 2004. Athabasca River Instream Flow Needs Scoping Study. Report Prepared for the Cumulative Environmental Management Association Surface Water Working Group.

[11] Cunjak, R.A. 1996. Winter habitat of selected stream fishes and potential impacts from land-use activity. Canadian Journal of Fisheries and Aquatic Sciences 55(Supp. 1): 267-282.; Annear et al., 2004

[12] Golder Associates Ltd., 2004; It is also important to note that very limited knowledge exits regarding winter biology and the response of the aquatic ecosystem to anthropogenic stressors in the Athabasca River See: DFO. 2008. and Golder Associates Ltd., 2004.

[13] DFO (Department of Fisheries and Oceans Canada). 2006. Lower Athabasca River In-stream Flow Needs (IFN) Ad Hoc Science Review and Advice Meeting, Freshwater Institute, Winnipeg MB, 16 February, 2006. Centre for Sceince Advice, Science Review 2006/003.

[14] 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.

[15] DFO, 2008.

[16] Woynillowicz, D. and C. Severson-Baker. 2006. Down to the Last Drop? The Athabasca River and Oil Sands. Oil Sands Issue Paper No. 1. Calgary, AB: The Pembina Institute.

[17] Schindler, D.W., Donahue, W.F., and J.P. Thompson. 2007. and DFO. 2008.

[18] AENV/DFO, 2007; DFO, 2008.

[19] DFO, 2008; Wolfe et al., 2008.

[20] Schindler, Donahue and Thompson, 2007; Woynillowicz and Severson-Baker, 2006.

[21] Shell Canada. 2007. Jackpine Mine Expansion & Pierre River Mine Project Descriptions and Environmental Impact Assessment. Prepared by Golder Associates Ltd. Submitted to Alberta Energy and Utilities Boards and Alberta Environment, December 2007.

[22] Bruce, J.P. 2006. Oil and Water – Will they Mix in a Changing Climate? The Athabasca River Story. Implications of a 2°C Global Temperature Rise on Canada's Water Resources. Sage Centre

[23] Schindler, Donahue and Thompson, 2007.

[24] DFO, 2008.

[25] Alberta Environment. 2008. Muskeg River Interim Management Framework for Water Quantity and Quality. Edmonton.

[26] DFO, 2008.

[27] Milly, P.C.D., J. Betancourt, M. Falkenmark, R. M. Hirsch, Z.W. Kindzewicz, D.P. Lettenmaier and R.J. Stouffer. 2008. Stationarity is dead: whither water management? Science (319) 573-574.

[28] Milly, et al., 2008.

[29] Dr. James P. Bruce assisted in establishing the Nobel prize-winning International Panel on Climate Change and served as co-chair of the IPCC's Working Group III. See Bruce, 2006.

[30] Schindler, Donahue and Thompson, 2007.

[31] Bruce, 2006.

[32] Other research indicates that the 20th century was an exceptionally wet one (Sauchyn et al., 2006). A return to historically more common drier conditions this century, as suggested by Edwards et al. (2008) and Wolfe et al., 2008, would compound the impact of anthropogenic climate change, further reducing flows in the Athabasca River; Edwards, T.W.D., Birks, S.J., Luckman, B.H., and G.M. MacDonald. 2008. Climatic and hydrologic variability during the past millennium in the eastern Rocky Mountains and northern Great Plains of western Canada. Quaternary Research (70) 188-197; Sauchyn, D., Pietroniro, A., and M. Demuth. 2006. Upland Watershed Management and Global Change – Canada's Rocky Mountains and Western Plains. Proceedings of Fifth Biennial Rosenberg Forum on Water Policy, September 6-11, 2006, Banff, Alberta, 100-118; Wolfe, B.B., Hall, R.I., Edwards, T.W.D., Jarvis, S.R., Sinnatamby, R.N., Yi, Y., and J.J. Johnston. 2008. Climate-driven shifts in quantity and seasonality of river discharge over the past 1000 years from the hydrographic apex of North America. Geophysical Research Letters (35) L24402.

[33] Richard Houlihan, Energy Resources Conservation Board. 2008. Personal Communication. October 2008.

[34] Clearwater Environmental Consultants Inc. 2007. Oil Sands End Pit : A Review to 2007. Report Prepared for the Cumulative Environmental Management Association End Pit Lakes Subgroup.

[35] Clearwater Environmental Consultants Inc., 2007.

[36] Barker, J., Rudolph, D., Tomkins, T., Oiffer, A., Gervais, F., and G. Ferguson. 2007. Attenuation of Contaminants in Groundwater Impacted by Surface Mining of Oil Sands, Alberta, Canada. 14th Annual International Petroleum Environmental Conference, November 5-9, 2007, Houston, TX.

[37] Barker et al., 2007.

[38] Houlihan, 2008.

[39] Houlihan, 2008; Barker et al., 2007

[40] Grant, J. Dyer, S. and D. Woynillowicz. 2008 *Fact or Fiction: Oil Sands Reclamation*. Drayton Valley, AB: The Pembina Institute.

[41] Walkem A. "The Land is Dry: Indigenous Peoples, Water, and Environmental Justice", Chapter 15 in Bakker, K. (Ed.), *Eau Canada: The Future of Canada's Water* (2007) UBC Press at pp.311-313.

[42] The Mackenzie Basin Master Agreement commits all signatories to the following principles in carrying out their responsibilities in the basin: 1) Manage the water resources in a manner consistent with the maintenance of the ecological integrity of the aquatic ecosystem; 2) Manage the use of the water resources in a sustainable manner for present and future generations; 3) Allow each Party to the Agreement to use or manage the use of water resources within its jurisdiction provided such use does not unreasonably harm the ecological integrity of the aquatic ecosystem in any other jurisdiction; 4) Provide for early and effective consultation, notification and sharing of information on developments and activities that might affect the ecological integrity of the aquatic ecosystem in another jurisdiction.; and, 5) Resolve issues in a cooperative and harmonious manner.

[43] The *Canada Water Act* (1970) provides legislative authority for the federal government to enter into agreements and partnerships with provinces to facilitate the coordination and implementation of water policies and programs. Further, the residual federal power to legislate for peace, order, and good government is a source of constitutional authority with respect to issues of national importance, such as major river basins that cross one or more provincial or territorial boundaries, and management of any conflicts that might arise related to these shared waters. See: Morris, T.J, D.R. Boyd, O.M. Brandes, J.P Bruce, M. Hudon, B. Lucas, T. Maas, L. Nowlan, R. Pentland, and M. Phare. Changing the Flow: A Blueprint for Federal Action on Freshwater. 2007. The Gordon Water Group of Concerned Scientists and Citizens.

[44] Bruce, J. P. and others. 2003. Climate change impacts on boundary and transboundary water management. Climate Change Action Fund Project A458/402. Natural Resources Canada.

[45] Only one bilateral agreement has been signed only one agreement has been signed – between the Yukon and the NWT.

[46] Saunders and Wenig, 2007.