

Mark A. Gustafson

From: Robert Freedman
Sent: Tuesday, July 27, 2010 2:41 PM
To: Monique Cotton; Mark A. Gustafson
Subject: Fw: near final Mikisew.docx
Attachments: LARP funding agreement, MCFN final.docx

Pls file Mikisew land use planning

From: Linda Aidnell <linda.aidnell@shawbiz.ca>
To: 'Dave Bartesko' <Dave.Bartesko@gov.ab.ca>
Cc: 'Melody Lepine' <melody.lepine@shawbiz.ca>; Robert Freedman
Sent: Tue Jul 27 14:37:55 2010
Subject: FW: near final Mikisew.docx

Hi Dave,

Thanks for sending us an updated revised agreement for the MCFN LARP deliverable funding. We are happy with the way the deliverables read in the updated table. However, your updated agreement does not account for our suggested changes to the agreement in clause 1, 3 and 4. Please find attached our revised LARP delivery agreement including MCFN's final changes. Please review and forward us a final agreement that incorporates these changes. We are eager to sign this agreement, since we to date have not received any funds from GOA for our LARP consultation process.

Thanks,

Linda Aidnell, MNRM, BSC
Mikisew Cree First Nation
Government and Industry Relations
208-9715 Main Street
Fort McMurray, AB
T9H 1T5

Phone: 780-714 6500 ext 223
Fax: 780 715 4098

From: Dave Bartesko [mailto:Dave.Bartesko@gov.ab.ca]
Sent: June-25-10 12:16 PM
To: linda.aidnell@shawbiz.ca
Subject: near final Mikisew.docx

<<near final Mikisew.docx>> <<App C2 BCR form 80-005-eng1.pdf>> <<App C1 BCR form 80-005-eng1.pdf>>

Linda,
I have revised the agreement to include the intent of most of your comments. I have attached the 2 types of BCR's for your reference.

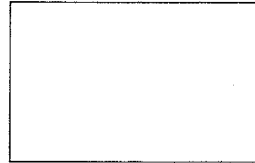
Please review and provide any comments.

Thanks and have a great weekend.

Dave

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AGREEMENT NO.



This Agreement is made this day of , .

BETWEEN:

HER MAJESTY THE QUEEN in right of the Province of Alberta,
as represented by the Minister of Sustainable Resource Development for
the Land Use Secretariat

(the "Land Use Secretariat")

- and -

MCFN

(the "Recipient")

1. A sum of up to \$100,000 will be paid to the Recipient to assist with the Recipient's preparation and compilation of written submissions and documentation, to enhance the Government of Alberta's development of the Lower Athabasca Regional Plan (LARP) under the Land Use Framework (LUF) (the "Project").

It is understood that although the Recipient's Traditional Territory overlaps more than one of the planning areas for the Land Use Framework process, given financial constraints related to deliverables, the Recipient will use the whole of the \$100,000 for the LARP. This decision by the Recipient should not be taken as demonstrating a lack of interest in planning areas outside of the LARP. Should Alberta decide to provide additional money to the Recipient, that money would be used for planning areas outside of the LARP. It should also be noted that the Recipient provided a detailed budget, work plan, and consultation approach to the Government of Alberta, which was largely not accepted. As a result, the work set out in this document and attached work plan represents a far more limited approach to LARP than would otherwise have been put forward by the Recipient.

2. The funds will be paid to the Recipient to a maximum of \$100,000 and will be paid as specified immediately below:

Deliverable	Submission date	Funding released on receipt of deliverable
1 & 2 Recipient provides written descriptions and maps of specific land uses and traditional uses of resources by members of the Mikisew Cree First Nation, in connection with off-reserve exercise of treaty and other constitutionally protected rights	No later than 60 calendar days from public release of the Visions and Objectives document for the Lower Athabasca Regional Plan (LARP)	\$75,000
3. Recipient provides written documentation of the Mikisew Cree First Nation's views in response to the content of the Visions and Objectives document for the LARP (including	No later than 60 calendar days from public release of the Visions and Objectives document for the LARP.	\$20,000

<p>questionnaires or workbooks associated with the Visions and Objectives document), including the First Nation's views on impacts of the LARP to their communities and any potential adverse impact to the First Nation's off-reserve exercise of treaty or other constitutionally protected rights.</p>		
<p>4. Recipient provides written documentation of the Mikisew Cree First Nation's views in response to the content of the draft LARP (including questionnaires or workbooks associated with the draft LARP including the First Nation's views on impacts of the LARP to their communities and any potential adverse impact to the First Nation's off-reserve exercise of treaty or other constitutionally protected rights.</p>	<p>No later than 60 calendar days from public release of the Visions and Objectives document for the LARP.</p>	<p>\$5,000</p>

3. The funds that MCFN will receive under this agreement are intended only for the purpose of covering costs of deliverables listed above in clause 2. The funding under this agreement cannot be used to cover any additional costs for consultation on other plans or frameworks under LARP, or for any other purposes including, without limitation, consultation on any government planning purposes or in respect of any project-specific consultations.
4. (1) The Land Use Secretariat will not provide any further funds if during the term of the agreement the Recipient becomes insolvent, bankrupt, ceases operations, or makes an arrangement for the benefit of creditors.
 (2) The Recipient must notify the Land Use Secretariat immediately if it becomes insolvent, bankrupt, ceases operations, or makes an arrangement for the benefit of creditors.
5. If, after entering into this Agreement, the Recipient receives any other financial contributions for the Project from Her Majesty the Queen in right of the Province of Alberta, such contributions shall be reported immediately to the Land Use Secretariat.
6. The Recipient shall keep statements, accounts, receipts and other records of the costs and expenses incurred during this Agreement and shall on request provide the Land Use Secretariat with the accounts, records and other documents that may be required by the Land Use Secretariat, and permit the Land Use Secretariat to examine, audit and take copies and extracts.
7. This Agreement is governed by the laws in force in the Province of Alberta. In carrying out this Agreement, the recipient agrees to comply with any applicable:
 - (i) Act of the Legislature of the Province of Alberta and of the Parliament of Canada;
 - (ii) Regulations in force from time to time under any of the Acts referred to in clause (i);

(iii) By-law of any municipal government; and

(iv) Permits, licences and approvals.

8. The Recipient acknowledges that the *Freedom of Information and Protection of Privacy Act* applies to all information and records provided by the Recipient to the Land Use Secretariat and to any information and records which are in the custody or under the control of the Land Use Secretariat, however the Recipient agrees that all documents or records that are provided to fulfil the requirements of section 2 above will be considered to be public documents upon their receipt by the Land Use Secretariat. For greater certainty, and based on the Recipient's assurances from Dave Bartesko, the reference to "public" herein means that the information provided by the Recipient can be shared across Alberta Government ministries, agencies, and departments. The information provided by the Recipient will not be made available to the general public unless such disclosure is required pursuant to the *Freedom of Information and Privacy Act*.

It is also understood that the Land Use Secretariat will provide information to the Recipient, where the Recipient reasonably requires such information to carry out the Deliverables pursuant to this Agreement. Such information includes, but is not limited to:

- Documentation of all of the MCFN-specific information considered in the development of the LARP, including if/how our submissions were considered;
- All information considered by RAC and the Land Use Secretariat in developing conservation areas, e.g., draft conservation area maps;
- All information considered by RAC and the Land Use Secretariat in respect to impacts to Aboriginal communities;
- All information considered by RAC and the Land Use Secretariat in respect to Aboriginal and Treaty Rights;
- The advice sheets of RAC to Cabinet on conservation areas and on impacts to Aboriginal communities

9. The Land Use Secretariat accepts no responsibility resulting from the establishment and operation of the Project and the Recipient agrees to indemnify and hold harmless the Land Use Secretariat from any and all third party claims, demands, actions or costs (including legal costs on a solicitor-client basis) for which the Recipient is legally responsible, including those arising out of negligence or wilful acts by the Recipient or the Recipient's employees or agents. This hold harmless provision shall survive this Agreement.

10. The Land Use Secretariat's representative for the purpose of administering this Agreement is:

Dave Bartesko
9th floor, 10035 – 108 street
Edmonton, Alberta T5J 3E1
(780) 422-4871
(780) 644-1034 (fax)
dave.bartesko@gov.ab.ca

11. The Recipient's representative for the purpose of administering this Agreement is:

Melody Lepine,
Director, Government & Industry Relations
Mikisew Cree First Nation
Suite 208, 9715 Main Street
Fort McMurray, AB
T9H 1T5
Office: 780-714-6500 Ext. 222
Cell: 780-792-8736

Fax: 780-715-4098

E-mail: melody.lepine@shawbiz.ca

- 12. The Land Use Secretariat's provision of funding or receipt of documents under this agreement does not constitute the Land Use Secretariat's adoption of the statements in the Recipient's submitted documents as the Land Use Secretariat's own statements. The Land Use Secretariat's provision of funding or receipt of documents under this agreement does not constitute the Land Use Secretariat's admission of any particular legal status or right of the Recipient or of the Mikisew Cree First Nation.
- 13. Any amendments to the Project including its completion date must be approved by the Land Use Secretariat in writing.
- 14. If a court of competent jurisdiction deems any provision of this Agreement to be void, illegal, or unenforceable, then such a provision is to be severed from this Agreement and the balance of the Agreement remains in full force and effect.
- 15. Time is of the essence in this Agreement.

The undersigned representatives of the Recipient hereby acknowledge the above Terms and Conditions, which constitute a binding agreement between the Recipient and the Land Use Secretariat.

Her Majesty the Queen in the right of the Province of Alberta,
as represented by the Minister of Sustainable Resource
Development

Date

Witness

For the Minister of Sustainable Resource Development

Date

Witness

For the Recipient

Date

Witness

For the Recipient

Appendix C1: Band Council Resolution authorizing FN's entering into this contract

OR

Appendix C2: authorizing Recipient to receive the FN's funding for the purposes of this contract



MIKISEW CREE FIRST NATION
Government & Industry Relations
208-9715 Main St
Fort McMurray, AB T9H 1T5
Phone: (780) 714-6500 Fax: (780) 715-4098

August 19th, 2010

Mr. Pat Marriott
Acting Regional Approval Manager
Suite 111 (Main Floor, Atrium One), Twin Atria,
4999 - 98 Avenue NW,
Edmonton, Alberta, Canada T6B 2X3

Mr. Brian Makowecki
Manager Oil Sands Projects
Department of Fisheries and Oceans (DFO)
Edmonton Office, Central and Arctic Region
4253 – 97 Street
Edmonton, Alberta Canada T6E 5Y7

Dear Mr. Marriott and Mr. Makowecki,

The Mikisew Cree First Nation (MCFN) wish to express our serious concern and disappointment with the conclusions of the Phase Two Framework Committee (P2FC) for the Lower Athabasca River (LAR). Since it has been openly admitted and confirmed by the Regional Hydrologist, Northern Region, Alberta Environment, and Environmental Management that the sections on Climate Change (under Assessment, pg. 5) and the Climate Change Sensitivity Analysis (pg. 14 – 15) are based on erroneous data and false information.

As a result of this information, we feel that the report is scientifically unsound since the premises which support the conclusion are false; this in turn invalidates the conclusion. Should this report proceed to the appropriate agencies and eventually the public unamended and unrectified, the consequences could be potentially devastating and the damages irreparable to: the MCFN, the Athabasca Watershed, Economic Investors, Regulators, Policy Makers, Scientists, and Citizens. As public citizens we are all dependent on the data, information, and facts provided to us by our Civil Servants and Governmental Agencies are: nonaligned, impartial, unbiased, and unprejudiced so that we can make educated, informed, and reasonable decisions.

Hence, we are calling on the leadership of this Province and the DFO to intervene; by rejecting the P2FC Recommendations and to institute positive changes; thereby returning some degree of accountability, credibility, professionalism, and reliability to our regulatory agencies and processes. This severe degree of uncertainty in regulatory due diligence is yet another demonstration by the Crown in failing to protect the Mikisew Cree's constitutionally protected rights to adequately use the Athabasca River.

We look forward to our upcoming meeting to discuss these and other relevant issues on the Lower Athabasca Water Management Framework.

Sincerely,

<original signed by>

Melody Lepine

Director, MCFN Government & Industry Relations

Cc: Chief Roxanne Marcel and Council, Mikisew Cree First Nation

**THE RELATIONSHIP BETWEEN THE LOWER ATHABASCA RIVER
AND THE TRADITIONAL USES AND RIGHTS OF THE ATHABASCA
CHIPEWYAN FIRST NATION AND MIKISEW CREE FIRST NATION
SUMMARY REPORT**

Submitted by:

Athabasca Chipewyan First Nation Industry Relations Corporation
110B 9816-Hardin Street
Ft. McMurray, AB T9H 4K3

Mikisew Cree First Nation Government and Industry Relations
208, 9715 Main Street
Ft. McMurray, AB T9H 1T5

Submitted to:

Brian Mackowecki
Department of Fisheries and Oceans, Canada

JANUARY 18, 2010.

AMENDED: AUGUST 20, 2010.

DISCLAIMERS

This report remains the sole property of both the Athabasca Chipewyan First Nation (ACFN) and the Mikisew Cree First Nation (MCFN). Citations, quotations, reproductions, and usage of the information contained herein is permissible only with the explicit written consent of the ACFN and the MCFN.

While the authors endeavored to state factual and relevant information (within the scope of the study), nothing in this report should be construed as a definitive list of ACFN and MCFN concerns, impacts, needs, rights, and uses; nor should it be taken as a limitation on the uses or rights of ACFN and MCFN. ACFN and MCFN reserve the right to alter, amend, revise, or update any portion of this report to reflect their fluid and emerging interests.

i. Executive Summary

In February 2007, Alberta Environment (AENV) and Fisheries and Oceans Canada (DFO) released Phase I of its Water Management Framework (Framework) for the Lower Athabasca River. The Framework was developed in order to manage industrial water withdrawals in pursuit of protecting the “ecological integrity” of the Athabasca River. In spite of the initial work completed for Phase I, AENV, DFO, and First Nations recognized that further research was required, particularly around the broader impacts of water withdrawals on First Nation traditional land use. A list of research priorities were identified for Phase II and assigned to the Phase II Framework Committee (P2FC) of the Cumulative Environmental Management Association (CEMA). Although First Nations were invited to participate in the multi-stakeholder P2FC process and assist with gathering information on respective First Nation traditional land use data, the Athabasca Chipewyan First Nation (ACFN) and the Mikisew Cree First Nation (MCFN) and other Athabasca Tribal Council (ATC) First Nations sought a separate but parallel process for direct consultation with the Crown. Because water withdrawals from the Athabasca River have the potential to infringe on the Treaty and Aboriginal rights of First Nations, the Crown has a legal and constitutional duty to consult with and accommodate First Nations for the direct, indirect, and cumulative impacts that may result from past, current, and future water withdrawals. Negotiations have been ongoing to establish a suitable consultation process that would include supplementing First Nations with adequate capacity to undertake the necessary work for Phase II. However, to address the immediate gaps in traditional use data DFO awarded contracts to both the ACFN and MCFN to gather information in two key areas:

1. Current traditional land use and activities in and along the Athabasca River
2. Potential impacts of alternative river flows on traditional land use activities

With respect to traditional land use, the research was aimed at identifying community concerns related to the impacts of lower flows on:

- Access to river areas
- Safety issues and risks
- Ecosystem relationship
- Hunting
- Fishing
- Trapping
- Boating
- Other traditional activities

Management and Solutions in Environmental Science (MSES) Inc. was contracted by ACFN Industry Relations Corporation (IRC) and MCFN Government and Industry Relations (GIR) to conduct the research, which involved a literature review and community engagement sessions. Due to budget constraints, MSES Inc. did not conduct any exploratory research, but used information provided by the ACFN IRC and MCFN GIR. The community engagement sessions were held in Fort McMurray and Fort Chipewyan with groups comprising both MCFN and ACFN members including Elders, Council members, harvesters, outfitters, trappers, and youth. Group discussions were open-ended as participants were encouraged to describe their experiences of using the Athabasca River and to express their views on environmental changes that have affected their traditional practices over time. In general, the content elicited from the engagement sessions was at a broader level, ideal for issues identification but not for detailed investigations into specific impacts or into community views on alternative flow regimes. Study limitations included the lack of primary data to confirm different study results, restrictions on confidential and licensed reports, shifting traditional land uses, sparse information on traditional food consumption, unknown numbers of River and non-River users, and difficulty in assessing transboundary impacts. In light of these limitations and the fear of misuse of the report by third parties, the ACFN and MCFN decided not to distribute the MSES Inc. report, opting instead to draft this combined summary report for use by DFO and P2FC.

The Athabasca River and associated tributaries and the Peace-Athabasca Delta (PAD) are critical waterbodies for First Nations to practice their harvesting rights – hunting, fishing, and gathering. These rights guaranteed under Treaty and enshrined in the *Constitution Act* of 1982, are important for maintaining Aboriginal culture and the well-being of local communities. Harvesting rights are at the core for sustaining other Aboriginal rights including the ability to pass on traditional knowledge and values, rights to self-determination, and rights to individual and community health. Traditional land use values associated with the Athabasca River include:

- Harvesting
- Water (drinking and domestic use)
- Muskrat
- Peace Athabasca Delta
- Travel, Access and Shipment of Supplies
- Spiritual and Sacred Values

ACFN and MCFN members have experienced many changes to these values over time. They have observed the ecological decline of their traditional lands and have expressed concerns about the impact of this decline on their health and their ability to continue their traditional activities as defined by their harvesting rights. While this report describes the importance of the Athabasca River system to the land uses and culture of both First Nations, there are still information gaps about the key ecological and socioeconomic conditions that underlie the

pattern of First Nation land use. As such, one cannot predict how different flow levels could affect use of the Athabasca River and PAD in the long-term. Nevertheless, it is clear from the available literature and experiential descriptions of ACFN and MCFN members that traditional resources harvested from the regional river system have been in decline and/or more difficult to reach because of lower flows. Fewer resources, in turn, have impacted key activities including big game hunting, waterfowl hunting, fishing, trapping, and gathering.

The Athabasca River and Lake Athabasca were used as the primary sources of drinking water for Fort Chipewyan residents and other traditional land users. Nowadays, however, drinking from the River or Lake is considered a last resort because of the decline in water quality since the 1960s. Concerns have also been expressed about the cost of accessing clean sources of drinking water and the human uptake of contaminants through food washed or grown with water from the Athabasca River. While the Framework focuses on managing the quantity of flows, it is important to examine the effects of changing flows on water quality (i.e. increased concentration at lower flows). A comprehensive study is required to understand why and how the water quality has dropped and to evaluate the impacts on drinking water sources.

Muskrat is very important to the traditional economy and is also considered an indicator of ecological integrity, but population levels have been dropping because lower water levels have reduced good quality habitat and left little shelter from winter temperatures. It is recommended that a study be undertaken to compare muskrat populations in the PAD to those in waterbodies that are not fed by the Athabasca River.

First Nations have relied on the rich ecosystem of the PAD to sustain their traditional livelihood for generations. Changes in flow have been observed over time as the occurrence of spring floods has decreased since construction of the WAC Bennett Dam. Perched basins have slowly disappeared while invasive vegetation are encroaching on wetlands. These changes, in turn, have impacted the abundance and distribution of important plant and animal species that communities are accustomed to harvesting. Other significant ecological changes that have been observed since the Bennett Dam was constructed, and that may be associated with climate change, are noted in this report.

Travel between major towns (i.e. Fort Chipewyan and Fort McMurray) and between these settlements and other reserves, traplines, cabins, and harvesting areas is still achieved via the Athabasca River and associated tributaries. Use of the River system for travel and access depends on conditions that enable safe navigation, access to the River, and access off of the River to desired locations of use. Lower flows can affect navigability in three ways: decreased depth to bottom, increased exposure to sandbars, and confinement to the main channel. Indirect impacts of poor navigability include damaged equipment, safety risks, increased cost of travel (time and expense), restrictions on travel, and limited transport of supplies.

Water is a sacred life spirit and is deeply tied to the spirituality and identity of First Nations in ways that goes beyond the specific uses of the River and the land. Traditional lands must be considered sacred because it is difficult to locate where there may be a burial. Given that the Athabasca River represents a major travel corridor, there is high possibility for unrecorded burials to be located along the River.

In light of the changes to the Athabasca River and the PAD that have been observed over time, First Nations have continually expressed concerns about the Phase II of the Framework. Despite ongoing consultation with DFO and AENV, First Nations are not convinced that the Framework is stringent enough to address the impacts of alternative flow regimes on the ACFN and MCFN communities. Further research is required to better understand:

- Impacts to the ecology and health of the Athabasca River and PAD
- Impacts to travel and access
- Impacts to harvesting
- Socioeconomic impacts
- Cultural and spiritual impacts
- Impacts to individual and community health
- Cumulative impacts
- Evaluating impacts from the perspective of the First Nations
- Meaningful consultation

Both ACFN and MCFN insist that developing a First Nation “in-stream flow need” is necessary to fully explore the potential impacts of any alternative flow regime scenario proposed in the Framework and to inform the assessment of predicted impacts. In-depth community consultation and information would be required to identify the predicted impacts and assess any proposal for mitigation. Currently, First Nations lack the necessary information and capacity to develop this “in-stream flow need”. For the ACFN and MCFN, development of this threshold would be contingent on a better understanding of specific locations used by each First Nation (e.g. trap lines, reserve lands, cabins, trails, etc.), determining the relationship between different level of flows and use, assessing access conditions for use areas, and compiling lists of species used (plant and animal).

To address these gaps and better inform the DFO and the P2FC process, it is recommended that the following studies or activities be considered as part of the ongoing research:

- Cultural needs assessment
- Traditional resource plan
- Study on muskrat health and habitat in the PAD

- Water quality
- Community based monitoring
- Community review and verification

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1. INTRODUCTION

1.1. CONTEXT: LOWER ATHABASCA PHASE II WATER MANAGEMENT FRAMEWORK

Athabasca Chipewyan First Nation (ACFN) and the Mikisew Crew First Nation (MCFN) (together, the “First Nations”) have constitutionally protected Treaty and Aboriginal rights within the Lower Athabasca Region in northeast Alberta and they wish to sustain the meaningful ability for their members to practice these rights today and into the future (ACFN IRC et al. 2009). The First Nations assert that oil sands extraction in the Lower Athabasca region is putting ecosystems, the watersheds that sustain them, and the First Nations who depend upon them, at risk for large-scale impacts that will permanently alter the biophysical and sociocultural landscape of the region.

It is the view of the First Nations that the current and future exercise of their rights depends to a great extent on the existence of adequate flows and adequate water quantity and quality of the Athabasca River, which they consider the lifeblood of their Traditional Lands. It is a source of traditionally used resources, a means of accessing other resource harvesting locations, and an important transportation corridor. It is one of the main arteries that feed the unique and complex hydrology of the Peace-Athabasca Delta (PAD), the largest boreal delta in the world and a wetland of international significance under the RAMSAR Convention. The people of ACFN and MCFN have depended upon the PAD for generations to sustain their traditional livelihoods and their well-being. The Athabasca River is the source of drinking water for the community of Ft. Chipewyan (the location of residence for many ACFN and MCFN members). The River is very important to the traditional lifeways of the First Nations and, for at least the past twenty years, they have observed changes in the ecology of the River and the PAD and have experienced impacts to their land and resource use as a result of those changes (AENV 1988, 2006; ACFN 2003; Appendices A and B; FMA 2006, 2007; ICC 1998; Calliou Group 2009). Given the importance of being sensitive to the Aboriginal perspective of their rights (R.v. Sparrow, [1990] 1 S.C.R. 1075), when taking into account socio-economic, cultural and other impacts of development on the Athabasca River, it is crucial to take into account the Aboriginal perspective of their rights and impacts thereon, in addition to western science.

Extracting bitumen from oil sands “is a water-based extraction process and the main source of water is the Lower Athabasca River. Water withdrawals from the Lower Athabasca River and their potential impacts on the aquatic ecosystems have been an issue of concern and debate for several years” (Ohlsen 2008). Companies that carry out industrial activities in the Lower Athabasca region have extracted and seek to extract additional water from the Athabasca River and affect water levels in the Athabasca River through the mining of tributaries and other disturbances to the watershed. First Nations have observed adverse impacts as a result of existing water withdrawals and predict further impacts as water withdrawals increase (FMA

2006, 2007; Appendix B and C; ACFN in prep; Calliou Group 2009; Canada 2009a and 2009b; MCFN 2006).

A planning process is underway to develop a Phase II recommendation for managing water withdrawals from the Lower Athabasca River. The recommendation will prescribe when, and how much, water can be withdrawn from the Lower Athabasca River for cumulative oil sands water use (Ohlsen, 2008). The recommendation will be informed by the results of the multiple criteria analysis of alternative water management frameworks for the Lower Athabasca River that is being undertaken by the multi-stakeholder Phase II Framework Committee (P2FC). The P2FC requires information that will help them understand the social and economic implications of alternative frameworks.

Water withdrawals from the Athabasca River have the potential to adversely affect and infringe the Treaty and Aboriginal Rights of the First Nations for a variety of reasons. For example, the River is an important travel route for many ACFN and MCFN members, which they use to access their preferred harvesting areas. Decreased flows negatively affect the navigability of the River thereby impacting travel, access, and ultimately harvesting. Lower flows in the Athabasca River could impact the habitat, health, and presence and abundance of certain species that are harvested for food and other traditional uses by the First Nations, thereby impacting their ability to do so. These are only two examples of a multitude of possible impacts from reductions in water flows. In addition to the impacts on water flows, the physical activities associated with withdrawing water may have impacts. For example, sediment barriers placed in the river during construction of water intake facilities may impede the navigability of the River while the placement of the water intake facilities along the River negatively affects aesthetic and spiritual values associated with the River. In addition to direct impacts, such as those provided above, there is a complex variety of indirect and cumulative impacts that incur as a result of the impacts of increasing industrialization throughout the First Nations traditional lands (and watershed). The permitting of water withdrawals facilitates the industrialization of the region, indirectly inducing many more impacts than those related to water flows or water withdrawals in the River. For example, tributaries of the River may be mined and diverted – thereby impeding the First Nations ability to conduct their traditional activities along those tributaries and changing the very character and qualities of that tributary (which are of importance to the value of those tributaries to the First Nations) forevermore. Federal No Net Loss policies for fish habitat allow the destruction of natural waterbodies in return for the creation of unnatural compensation lakes that hold little replacement value for First Nations traditional uses and result in the taking up of additional lands and further alteration of landscape character and watershed dynamics. Many more examples could be provided, but the point is that there are many ways in which First Nations rights stand to be impacted not only from water withdrawals, but also, possibly from the implementation of a water management framework which may, or may not, properly account for those rights.

Because withdrawals of water from the Athabasca River have the potential to adversely affect and infringe the Treaty and Aboriginal rights of the First Nations, there is a legal and constitutional duty to consult with the First Nations and to accommodate their rights and interests concerning the direct, indirect and cumulative impacts of industrial activities on their rights and interests, including the impacts of past, current and future water withdrawals from the Athabasca River, and its watershed (ACFN IRC et al. 2009). Like the P2FC process, the consultation process also requires information that will help to determine what impacts, if any, may incur as a result of water withdrawals under the eventual Phase II management framework (MCFN 2009; ACFN in prep.).

While the P2FC provided opportunity for First Nations to participate in the multi-stakeholder process, the Athabasca Chipewyan First Nation (ACFN) and the Mikisew Cree First Nation (MCFN), along with the other First Nations belonging to the Athabasca Tribal Council (ATC) to seek a separate and parallel process of direct Crown-First Nation consultations on the Phase II planning process. The Government of Alberta (Alberta Environment) and the Government of Canada (Department of Fisheries and Oceans) have been meeting with representatives of the five ATC First Nations to discuss how consultation should occur in respect to the Phase II recommendation. The First Nations have been requesting capacity to gather information that could help to inform an assessment of the effects of alternate water flow scenarios on their rights and traditional uses. At the same time, Alberta and Canada have been asking First Nations to provide specific information on potential issues of concern related to water flows, in order that such information could be used to inform the P2FC process.

1.2. PURPOSE AND OBJECTIVES

In response to these needs, DFO contracted the ACFN IRC and the MCFN GIR to gather information to determine ACFN and MCFN causes for concern related to potential impacts by decreased flows on:

- Access to the river areas
- Safety issues/risks
- Ungulate, fish and vegetation relationship
- Hunting
- Fishing
- Boating

- Trapping
- Other traditional activities (e.g., plant gathering)

DFO wishes to use this information to inform the P2FC process.

The specific objectives of the DFO contract are to provide:

- detailed information on the current traditional land use and traditional activities of the First Nations on and along the river; and,
- detailed information on how alternative flows might impact the traditional land use activities of the First Nations.

In the view of the First Nations, the objectives of the study are to provide detailed information on how alternative flows might impact:

- their land and resource use;
- their individual and community well-being; and,
- ultimately, their treaty and Aboriginal rights.

1.3. LIMITATIONS

While the study was a valuable scoping exercise for identifying the specific issues of concern of the First Nations regarding changing water flows in the Athabasca River, it was constrained in respect of being able to evaluate the impacts of alternative flow regimes on the traditional uses, rights and well-being of the First Nations.

Limitations are as follows:

- Traditional knowledge is context specific. Because many of the reports and studies reviewed for the desktop study had varying objectives and there was no access to the primary data (or the primary data are not in a format that is easily reviewed), there was a risk of decontextualizing information.
- There are restrictions on the use of the information in some of the documents reviewed (e.g, ACFN ED 2008) because of confidentiality and use stipulations. Use of any specific information (such as quotations or specific locational information or detailed traditional knowledge) from reports (or the interviews that were conducted for the study) of this type would require the informed consent of the participant(s).

- A new system of traditional land and resource use is emerging as the First Nations' members' livelihoods and places of residence are shifting, and as traditional lands are taken up and/or contaminated. This new system of land use has not yet been recorded or described to any great extent, especially in respect to the role of the Athabasca River. Detailed interviews with current harvesters would be required to provide specific information on localities of use, resources harvested, preferences, and conditions supporting use, in order to inform an assessment of possible impacts under alternative water flows.
- There is a lack of detailed information on the type, quantity and quality of traditional foods consumed within each community (ACFN and MCFN) including a break-down of the type, quantity and quality of traditional foods obtained directly from the River, as well as the type, quantity and quality of traditional foods the harvesting of which depends on access via the River.
- There is a lack of detailed information on the numbers of River users, and the number of non-River users whose consumption of traditional foods, or access to traditional resources, relies on the River users.
- The land and resource use of any particular First Nation is also interconnected with the land and resource use of other First Nations and Métis peoples, due to resource trading, pooling and sharing amongst kin and friends. Members of the same family may be members of different First Nations. ACFN members may use MCFN member traplines (and vice versa) and MCFN members may use ACFN reserves (and vice versa). This makes it difficult to evaluate or assess impacts simply on the basis of assigning use to a particular First Nation. This issue is generally not accounted for in studies and should be taken into account in any further assessments.
- While community engagement sessions highlighted issues of concern, there was little chance to gather details on localities of use (for example, specific cabins accessed via the River; specific harvesting locations) or to investigate possible impacts of alternative flow regimes (which would require more accurate data).
- Community engagement was limited as a result of availability of community participants and the list of issues from the community engagement sessions cannot be considered a comprehensive summary of the issues of concern of the First Nations. In general, it is difficult to achieve comprehensive community engagement if only using a single or discrete type of method (e.g., workshops). Availability of community members varies according to work schedules, whether they are out on the land, whether they are comfortable with sharing knowledge, etc. and is difficult to predict or accommodated, especially with limited engagement budgets.

- There is a lack of research on determining thresholds (or acceptable limits of change) for First Nations' use of the Athabasca River. Participants from both First Nations noted that this threshold has already been breached; however, people continue to use the river (although this use is declining). More research is required to determine what this threshold might be.
- The scope of this study is limited to the possible impacts of reduced water flows and does not examine the impacts of activities associated with water withdrawals, for example the construction and operation of intake facilities. This, however, is important, and should be considered in the Phase 2 Water Management Framework.
- Lack of resources to evaluate possible effects of alternate flow regimes on the ecology of the PAD, and in return, on the traditional uses, rights and well-being of the First Nation.
- Lack of resources to evaluate the cumulative effects of alternate flow regimes, water extraction from tributaries, the mining out of tributaries of the River, and the creation of compensation and end pit lakes (i.e. alteration of the watershed), on the Rights, traditional uses and well-being of the First Nations.
- It is evident that further research is required to provide the kind of detailed information that would inform evaluating and assessing impacts of alternative flow scenarios on the First Nations' rights, traditional uses and well-being. This further research should be based on answering the questions and information requirements that are appended to this report (Appendix E). Specific studies (e.g., traditional foods study; cultural needs assessment; preferences assessment; land use studies; etc.) that involve interviews, surveys and other social science and interdisciplinary methods would be required to answer some of the information requirements.

1.4. RESTRICTIONS ON THE USE OF THE INFORMATION CONTAINED HEREIN

The First Nations have had negative experiences with the decontextualization, misinterpretation and misuse of their information in other forums. This even occurs where intentions may be considered good. In addition, the participants of the community engagement sessions that were held to collect information for this study expressed that their information cannot be used unless a verification meeting is held with all participants. In light of this, as well as the information gaps and the need for additional research, the First Nations are concerned about the provision of this report to third parties, for example P2FC, by DFO (or provision to other third parties by other regulators to whom the First Nations may chose to submit this report).

Normally, a TK Sharing Agreement is required by ACFN and by MCFN to govern the collection, use and provision to third parties, of information such as that reviewed and documented for this study. We did not include the TK Sharing agreement in the contract specifications

(although the need for the agreement was raised by MCFN GIR and ACFN IRC staff in meetings with DFO on this contract). Given the lack of the TK Sharing Agreement, and the concerns about the use of the information in this report, the First Nations would like to work collaboratively with DFO to determine how best to bring the information from this report forward into the P2FC process.

2. METHODS

Information was collected via literature review and community engagement sessions. The First Nations contracted MSES Inc. to perform the information collection and compilation.

2.1. LITERATURE REVIEW

MSES conducted a review of known and accessible documents relevant to understanding the uses of the First Nations in respect to the Athabasca River, and possible impacts to those uses. The information reviewed includes project-specific environmental assessments, traditional land use and cultural or historical studies, and other reports and analyses of pertinence. A separate desktop study was completed for each First Nation and the documents reviewed for each are summarized in Table 1.

As the project budget precluded them from conducting additional research, MSES relied on the ACFN IRC and the MCFN GIR to provide information to them. It is important to note that some of the documents that were reviewed for an individual First Nation may be equally applicable to both (e.g., Alberta Executive Council 1970; Coutu and Hoffman-Mercredi 2002; Freemount 1978; Fumoleau 2004; McCormack and Ironside 1993).

Summaries of the ACFN-specific and MCFN-specific results of the desktop study completed by MSES are appended (Appendices A and B, respectively).

In addition to the information reviewed by MSES, the authors of this summary report incorporated information from some additional documents that were excluded from the MSES review due to time constraints and/or the availability of the document (AENV 1988; AENV 2006; ACFN in prep; ACFN 2009).

Table 1 Documents Reviewed by MSES

First Nation	Traditional Land Use Study and Land Use Planning	Project-specific Study or Submission	Reports Specific to the River and/or the PAD	Other
ACFN	ACFN 2003a	FMA Heritage Resources Consultants Inc. 2006	Alberta Executive Council 1970; ICC 1999; Stuart Adams & Associates 1998	CEMA 2004, 2005; Woodward & Company Barristers and Solicitors Law Corporation
MCFN	Mikisew Council and the Traditional Land Use Committee n.d.; PACTeam Canada Inc. 2007	Calliou Group n.d.; Canadian Natural Resources Limited 2003; FMA Heritage Resources Consultants Inc. 2007; Mikisew Cree	Freemount 1978	CEMA 2004, 2005; Fumoleau 2004; McCormack and Ironside 1993

		First Nation 2006		
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2.2. COMMUNITY ENGAGEMENT

In the interest of the contract budget, the ACFN IRC and MCFN GIR agreed to schedule the community engagement sessions for each First Nation (ACFN and MCFN) to be held concurrently. To support ease of participant involvement in the sessions, one session was held in Ft. McMurray (Wednesday, September 30, 2009) and one session was held in Ft. Chipewyan (Thursday, October 1, 2009).

While the IRC and GIR organized the sessions, MSES facilitated the sessions. The ACFN IRC (staff member Nicole Nicholls and consultant Ave Dersch) provided additional facilitation support at the Ft. McMurray session and documentation support at both sessions. MCFN GIR staff member Matthew Whitehead and Sherwin Shih helped to facilitate at the sessions.

Ten participants attended the Ft. McMurray session, and over 20 were present in the Fort Chipewyan session. Participants included Elders, Council members, current harvesters, outfitters, trappers, and youth. All participants were invited to attend because they are known to have experiential knowledge about the River, its uses, and how it has changed. The names of participants are being held in confidence by the ACFN IRC and MCFN GIR.

MSES prepared two sets of large scale satellite images for each of the river segments so that the difference in the River at high and low water flows could be visually depicted for participants. One set of images was from November 2001, showing one of the lowest flows on record, while another set was from July 2008 showing a higher flow. MSES also prepared and brought to the sessions an analysis of the cumulative disturbances between 1992 and 2008, along with a graph showing the declining trend in minimum flow at the north end of Segment 4 (Appendix D). During the engagement sessions the facilitators found that discussion on comparisons of low and high water flows, or discussion about specific locations of use on the river would not be appropriate for the discussion that participants were in engaging in. The sessions were more preliminary in nature, highlighting key issues that would be better explored through formal interviews.

In order to encourage discussion and reduce the possibility for bias in shaping issues, discussion was open-ended and participants were encouraged to lead the discussion about their uses of the river and their views on changes to the river and effects to their use. MSES did prepare specific questions about specific uses of the River in terms of fishing, hunting and harvesting of traditional plants, in order to guide more specific discussions where appropriate.

Overall, the community engagement session discussions were at a level of issues identification, rather than offering a means for detailed investigations of possible impacts or engagement on community views of alternative flow regimes.

A summary of the results of the Community Engagement sessions is appended (Appendix C). The information from these sessions is not distinguished according to First Nation (MCFN and ACFN) because participants of both sessions expressed that they wished to speak with a united voice, as they felt that these issues of concern are common to both First Nations, both of whose traditional livelihood and culture is closely linked to the River and the Delta. In addition, the participants stated that their information cannot be used unless a verification meeting is held with all participants.

2.3. INFORMATION SYNTHESIS AND ANALYSIS

While the DFO contract specified that a literature review and community engagement sessions were to be conducted and reported on individually, the ACFN IRC and the MCFN GIR recognized a need to synthesize the information arising from each collection method in order to develop a more comprehensive view of the relationship between the River and the rights and traditional uses of the First Nations, as well as possible impacts to those rights and uses that may be incurred as a result of flow alteration.

3. A BRIEF INTRODUCTION TO THE FIRST NATIONS

3.1. OVERVIEW

This brief overview of the lands, culture and history of the First Nations is meant only as a preliminary introduction to the First Nations. It touches briefly on the Treaty and cultural context, the reserve lands and populations of each First Nation, and a general history. An appreciation and true understanding of the Dene and Cree cultures, including their worldviews and value systems (which both enforce and are in turn enforced by their traditional land use practices and knowledge, and are ultimately at the heart of their issues of concern in respect to environmental change and degradation) can only be cultivated through on-going, respectful relationships and dialogue. The First Nations invite opportunities for DFO to engage with their members in pursuit of developing such understanding.

Both ACFN and MCFN are Aboriginal groups within the meaning of section 35 of the *Constitution Act, 1982* and are signatories to *Treaty 8*. Of ACFN's registered population of approximately 879 members approximately one third live in Ft. Chipewyan, one third live in Ft. McMurray and Ft. McKay, with other population concentrations in Ft. Smith (Northwest Territories) and Edmonton. MCFN has a registered population of 2,542 members, of which 1,767 reside off reserve in Fort Chipewyan, Fort McMurray, Edmonton and Ft. Smith (NWT). (Calliou Group 2009). The Traditional Lands of the First Nations, from which they sustain themselves and their culture, encompass Lake Athabasca, the Peace-Athabasca Delta and much of the Lower Athabasca River drainage basin. Use of the Athabasca River, Lake Athabasca and the PAD, is integral to the traditional livelihood of the First Nations.

The location of the eight reserves set aside for ACFN use and benefit pursuant to the *Indian Act*, reflect the importance of these waterbodies to ACFN. The Point Brule and Poplar Point reserves, respectively I.R. 201F and I.R. 201G, are located in Segment 3 of the Lower Athabasca River; the Delta reserves (I.R. 201 and I.R. 201B) are located in Segments 1 and 2; the Jackfish reserves (I.R. 201C, I.R. 201D, and I.R. 201E) also are within Segments 1 and 2. The Old Fort Point reserve (I.R. 201A) is located on the south shore of Lake Athabasca. ACFN has made it clear to Government and Industry that the area that is known as "Richardson Backcountry" – an area that encompasses the Reserve Lands and the eastern tributaries of the Athabasca River – is the heartland of their traditional lands that requires special protection and management in order to sustain their Treaty and Aboriginal Rights now and into the future (ACFN 2008).

ACFN is an Athapaskan-speaking people known historically as the K'ai Taile Dene, meaning "people of the land of the willow," a reference to the Peace Athabasca Delta (PAD). The K'ai Taile Dene are descendents of the Dene peoples who occupied the vast lands of what is now known as Northern Canada, and who moved in accordance with the natural migration of the

barrenland caribou herds across these lands. Lifeways began to change as the livelihood based on nomadic caribou hunting shifted towards a focus on trapping for the fur trade economy.

MCFN includes peoples of both Cree and Dene ancestry. The Cree culture, like the Dene, is widespread across northern Canada, extending from the Hudson Bay west to northern and central Alberta. The original MCFN (then known as “Cree Band”) signatories to Treaty 8 were Cree. Then, in 1944, shortly after the Wood Buffalo National Park (WBNP) was created, some of the ACFN (then known as “Chipewyan Band”) members residing in the WBNP joined the Cree Band so that they could retain their use and occupancy rights to the area.

The people of ACFN and MCFN have experienced many changes to their lifeways over the years. These changes have emerged, in most part, from the different socio-political institutions introduced and enforced by the Federal government throughout the colonial and post-colonial history and from taking part in different economic opportunities. The traditional lifeways of both ACFN and MCFN involved nomadic livelihoods based on a seasonal harvesting cycle exercised across vast extents of lands and for many years their traditional economies of both First Nations were tied to the fur trade. Over time, the people of ACFN and MCFN became increasingly centralized around “micro-villages”, or small semi-permanent settlements (for example, the ACFN reserves reflect the location of these micro-villages). Then, in the 1960s, the primary location of residence shifted to Ft. Chipewyan in response to Government and Church policies around education and social welfare. There were many social impacts associated with the shift to town life and the education of children in residential school, and the communities of ACFN and MCFN are still healing. In addition to social changes, since the advent of industrial development in the region, especially the W.A.C. Bennett Dam, ACFN and MCFN members have observed ecological changes and degradation and they are voicing concerns about the possible impacts of these changes to their ability to practice their rights, and to their individual health and community well-being.

Today, a new system of land use is emerging as people’s livelihoods and places of residence are shifting yet again. While the traditional livelihood has always been based on a seasonal harvesting cycle, the particular resources that sustain the livelihood and the particular technologies used to harvest the resources have been fluid over time. The new system of land use that is beginning to take shape has not yet been recorded or described to any great extent, but it can be considered an emergent expression of both the adaptive capacity of the First Nations cultures and of the practice of the Rights which were guaranteed by Treaty 8.

In the face of change, the First Nations value and celebrate their respective cultures, continue to practice their traditions, and wish to pass these on to their future generations. Central to this value system is a worldview that recognizes the interdependent nature of all aspects and beings of creation in a sacred circle of life, and a sense of place and identity that derives from a relationship to the land (FMA 2006a, 2007; Coutu and Hoffman-Mercredi 1999). “Although the history of the land use of the ACFN people include many changes, the core of their identify and

culture comes from their relationship with the land” (ACFN 2003a). The practice of the harvesting rights guaranteed under Treaty 8 is central to sustaining their cultures. And, as the next section discusses, the ecology of the Athabasca River, the Peace-Athabasca Delta and Lake Athabasca are linked to ACFN’s ability to practice these rights in their preferred fashion into the future.

3.2. HARVESTING RIGHTS AND THE CULTURE AND WELL-BEING OF THE FIRST NATIONS

The River, its tributaries and the PAD are important for hunting, fishing and gathering. These harvesting rights were guaranteed under Treaty 8 and are enshrined in the *Constitution Act* of Canada. They are integral to maintaining the culture of the First Nations and the well-being of their individuals and communities. The practice of the harvesting rights guaranteed under Treaty 8 is at the heart of sustaining other Aboriginal rights, such as: the ability to practice and transmit traditional knowledge, values and culture; rights to self-determination; and rights to individual and community health. The point here is not to define all of the ways in which traditional resources, their uses and the conditions that support their use are related to rights – that would be out of the scope of this study. Instead, the purpose is to remind the reader that the specific harvesting rights are linked in complex and multi-faceted ways to culture and well-being. Some examples of these relationships are explained briefly in the following paragraphs.

Traditional foods, handicrafts and spirituality have a role in sustaining cultural identity in the face of change. For example, activities around harvesting the resource (hunting, trapping, gathering), processing the materials, and creating the end products provide opportunities to reinforce cultural values and norms, and provide a learning forum for imparting traditional knowledge and values to younger members. Animals and plants play a role in traditional spiritual practice (e.g., ACFN ED 2008:18).

The traditional economy of ACFN and MCFN helps to counter the high price of store-bought foods in the community of Ft. Chipewyan and contributes to food security (Canada 1998). In addition, value-added products such as dry-meat and traditional medicines may be traded or bartered for other goods or services in the traditional economy. Handicrafts may also be sold outright and provide a source of income, especially for women. Trade and gifting plays a role in reinforcing cultural ties and networks. These networks of exchange and reciprocity are essential to culture and community resilience: they reinforce cultural identity, offer channels for exchanging cultural knowledge, and provide some security and assurance to individuals who make use of these ties in times of hardship.

Traditional foods are well known to be nutritionally superior to their storebought counterparts (MRHS & Dene Nation 1995; Wein 1991). The harvest of traditional foods encourages culturally appropriate exercise; activity and exercise are important to individual health.

Cultural keystone species are “culturally salient species that shape in a major way the cultural identity of a people, as reflected in the fundamental roles these species have in diet, materials, medicine, and/or spiritual practices” (Garibaldi and Turner 2004). While this concept likely has more of a heuristic, rather than definitive value, moose, muskrat, rat root, and certain fish species all of which are harvested along or from the River and the PAD, might be considered cultural keystone species for both ACFN and MCFN because of the role the harvest, use and distribution of such resources plays in sustaining the traditional values, spirituality, culture and economy of both First Nations (e.g., ACFN ED 2008:18). This is not to say that other species are not highly significant. From the perspective of the First Nations, all of the creatures and plants of the lands and waters have a significant role in the complex web of life, and are therefore important for sustaining the rights and culture of the First Nation. The concept of specifying or ranking the significance of certain species goes against the worldview of the First Nations. The cultural keystone species concept only implies the network of relationships amongst specific sociocultural components (e.g., diet, ritual, etc.) is more strongly coupled, and impacts would perhaps be more direct.

There are many more examples that could be examined (see for example, Turner et al. 2008; Passelac-Ross 2005), but it beyond the scope of this study to attempt to do so. Further studies are required to elucidate the network of relationships among traditional resources, harvesting activities, traditional social institutions (e.g., networks of exchange and reciprocity), and the various constituents of well-being (including cultural identity) for each First Nation. Cultural needs assessments of this type would help to develop traditional resource use and management plans, which would include developing thresholds for key species and ecological conditions (e.g., water flows in the Athabasca River) that are integral to sustaining the culture.

4. RESULTS: TRADITIONAL USE VALUES ASSOCIATED WITH THE LOWER ATHABASCA RIVER

This section presents known information about traditional use values associated with the River. These values are categorized as follows:

- Harvesting
- Muskrat
- Water (Drinking and Domestic Use)
- Peace Athabasca Delta
- Travel, Access and Shipment of Supplies
- Spiritual and Sacred Values

While ACFN and MCFN use the river itself for obtaining resources and for access and travel to other resource gathering areas, the practice of these harvesting rights is linked to sustaining other Aboriginal rights such as the ability to practice and transmit traditional knowledge, values and culture. The River itself is the subject of stories and is considered sacred. It is also important to keep in mind that the River is integrally linked to the unique and complex hydrology of the PAD, the rich ecology of which sustains the traditional uses and rights of both First Nations. Thus, understanding impacts to ACFN and MCFN rights goes beyond looking at the specific uses of the River. Where possible, impacts that have been experienced by ACFN and MCFN in regards to the above values, including concerns expressed about how changing River conditions have or may impact those values, are identified.

While this section may seem detailed in the identification of the relationship between the River and the land and resource uses and culture of the First Nations, it should be recognized that the information presented here is still at a relatively high level. Overall, there is a lack of detailed information on the key ecological, sociocultural, and economic conditions that underlie the system of river use and thus, it is difficult to make predictions or draw conclusions about what level of change would affect use or not. What we do know, is that members of both First Nations say that their use of the river has already been impacted and that this impact derives, in most part, from lower water flows.

4.1. HARVESTING

Traditional resources that are harvested from the River, from the PAD and from the tributaries (which are accessed via the river) include, but are not necessarily limited to, traditional foods, traditional medicines and raw materials for other uses, e.g., construction, heating fuel, etc. (ACFN 2003; Dersch and Bush 2008). For example, some traditional foods that ACFN and MCFN obtain from the waters of, or along the shores of, River and the PAD are moose, muskrat and fish. In addition to foods, a variety of traditional medicines are also found in the River, in the PAD and in marshy drainage outlets into the River. For example, medicines such as rat root, Labrador tea, and wild mint are widely and commonly used (Dersch and Bush 2008). Finally, animals, plants and natural materials may be used for a variety of artistic, domestic and spiritual purposes. For example, furs from aquatic furbearers provide trimmings for moccasins and mittens; eagle feathers are important for ceremonies, as are some medicinal plants.

Please note that the aforementioned materials, animals or plants are not meant to imply a limitation of use to only those species mentioned. Furthermore, while this report, for pragmatic purposes, includes information on use in respect to several of the kinds of resources, plants and animals harvested, it should not be taken as meaning that ACFN and MCFN uses or rights are limited to those aspects described in this document. The First Nations utilized all of the plants and animals that are found in their traditional lands and consider all of the plant and animals species to be important for sustaining their rights and culture. It is outside the scope of this study, however, to provide an exhaustive list of plants and animals species utilized, the specific uses, and the specific conditions pertinent to their use (e.g., seasonality considerations, etc.) – that is the kind of information that could be collected for a traditional resource use plan.

The following provides an overview of the kinds of resource procurement activities that occur along the River: big game hunting (Section 4.1.1.) waterfowl hunting (Section 4.1.2.); fishing (Section 4.1.3.); trapping (Section 4.1.4); and, gathering (Section 4.1.5.). It is possible that not all activities have been captured – it is important that review of the report results be undertaken with ACFN and MCFN harvesters and Elders to verify the results. The following overview should not be taken as a definitive list.

4.1.1. Big Game

Moose

Moose is highly valued by both First Nations, providing sustenance and a source of raw materials for traditional handicrafts and clothing. The River, the tributaries of the River, and the PAD are important moose hunting areas (ACFN 2003, 2009; ACFN ED 2008; Appendices A and B). Riparian areas along the River provide good browse. The islands in

the river are especially good habitat because the willows that dominate the islands are very good forage and the islands provide refuge from predators and from human activity. Moose often enter water bodies in the summer to escape insects. Elders and hunters say that movement of moose between the Birch Mountains and the River occurs. The side-rivers off of the Athabasca River are important for moose hunting because they are less heavily trafficked than the main river.

MCFN and ACFN hunters have developed specialized skills in hunting from canoes or boats along rivers and lakes (Appendices A and B). At any time that people travel up and down the River they are on the lookout for moose. In the fall time, hunters will drift their boats downriver, calling moose as they go. The PAD is very important for moose hunting, especially in the area of the Delta and Jackfish reserves (ACFN 2009). While this area is very productive for moose, it is also in close proximity to the community of Ft. Chipewyan, as well as the cabins and traditional camps of many members. In addition to the PAD, hunters preferentially utilize waterways such as the Athabasca River, the Firebag, the Richardson Rivers, the Ells River, and the McKay River, for moose hunting (ACFN 2003, 2009; Calliou Group 2009). The fall moose hunt is very important and people will take time off of work specifically for this purpose (ACFN 2009).

Impacts to Moose Harvesting

Harvesters have reported that their ability to harvest moose along the River (or to use the River to access the tributaries) already has been impacted by lower water flows and by declining moose populations (ACFN 2003, 2009; ACFN ED 2008; Appendices A and B). For example, while a moose may be present on the bank or on an island, a hunter may not harvest the moose because it may not be possible to land their boat in proximity to the moose kill, or because it may not be possible to get their boat back on step with a heavy load of meat when the water is low (ACFN 2009). It should be noted that there are a myriad of preferences that underlie hunter decision-making (e.g., how far one is willing to pack meat from a kill site to a boat; how far one is willing to travel to hunt moose). While understanding these preferences is necessary in order to fully evaluate impacts, research on these preferences in the context of ACFN and MCFN has not been undertaken.

The River hunting corridor provides a good example of why the First Nations would be concerned about the use and misinterpretation of their traditional use information. The geographic information system database derived from mapping interviews conducted for the ACFN Traditional Land Use and Occupancy Study (2003), for example, depicts discrete data points for hunting locations. This is likely because adhesive icons (which lend themselves to “point” interpretation, rather than polygynal interpretation) were used during the mapping interviews. Interpreting hunting as corresponding only to discrete locations is a gross misrepresentation of the relationship between the land, the

systems of hunting, and animal behavior (e.g., moose are not stationary). Therefore, it would be a gross error to attempt to evaluate possible impacts to moose hunting by attempting to measure the likelihood of effects to a specific location. Rather, it is important to maintain opportunities to harvest all along the River (including the islands), along its tributaries, and within the PAD

Bison

Bison are another big game species that is harvested by ACFN and MCFN members and that has been a part of their traditional economy and diet for generations (ACFN 2003, 2009; ACFN IRC 2009; Weatherell and Kmet 2000; Wein et al. 1991). Despite the historical and current importance of bison to MCFN and ACFN, information about bison and bison hunting is rarely documented in impact assessment studies (e.g., FMA 2005), perhaps as result of researcher bias. Recent studies (ACFN 2009), however, show that bison continues to be harvested.

We suggest that there are three main areas of harvest that relate to the River: the PAD in the WBNP; the PAD outside of WBNP; and the McIvor-Ronald Lake area to the south of WBNP. The River and the waterways of the PAD are essential for accessing these harvesting areas.

Impacts to Bison Harvesting

MCFN and ACFN harvesters have expressed concern about unregulated hunting by non-Aboriginal sports hunters (e.g., ACFN IRC 2009). In addition, proposed and approved oil sands mines (e.g., UTS/Teck Frontier and Equinox Projects, Shell Pierre River Project, CNRL Horizon, and possibly others) may stand to, or may already be impacting bison habitat and/or increasing the ability of non-Aboriginal sports hunters to access the bison herd(s). ACFN and MCFN harvesters have found partially butchered bison carcasses (where only the choice cuts were taken by the hunter) in their customary harvesting areas and have expressed profound dismay at what they consider to be a disrespectful and wasteful practice. In addition, as the River and PAD waterways are used to access harvesting areas by boat in the summer and by snowmobile in the winter, impediments to these access methods as a result of reduced flows could further impact the MCFN and ACFN harvest.

Black Bears

Black bears are traditionally hunted along the River and their populations are of concern to Elders and harvesters (ACFN 2009; FMA 2005; Appendices A and B). In the summer, black bears frequent the PAD and the riparian zone of the River, where they feed on berries. In the fall, black bears can be found close to fish spawning areas. They are hunted along rivers and shorelines. Elders say that there has been a decline in black

bears over the last 20 years, and have expressed concern about the prevalence of bear baiting activities in their traditional lands by sports hunters.

While black bears may not be harvested in large numbers, the traditional products obtained from black bears are important for a variety of food, domestic, medicinal and spiritual purposes.

Impacts to Black Bear Harvesting

Because black bears are often spotted in and near riparian areas, and taken while hunters are travelling by boat, there is a concern that impediments to navigability of the River may impact the ability to harvest black bears.

4.1.2. Waterfowl

The PAD offers outstanding habitat for waterfowl and the vast flocks of various species of ducks and geese that use the marshes and lakes of the PAD during their spring and fall migrations were, and continue to be, a staple for MCFN and ACFN (ACFN 2003, 2009; ICC 1999; Appendices A and B). The predictability of the harvest was important to food security, and, besides food, the products from the birds were used for a variety of domestic and artistic purposes. Harvesters continue to engage in the spring hunt, some people take time off of work for this purpose and it is considered an important activity for retaining the traditional culture (ACFN 2009). Birds are harvested with shotguns from boats in the River, on the PAD, and Lake Athabasca. In the PAD, especially important areas for the spring bird hunt that are known to the authors are Galoot Lake, Goose Island, and Flour Bay (there may be additional places that we are not aware of at this time).

Impacts to Waterfowl Harvesting

ACFN and MCFN members have said that waterfowl no longer stop on the PAD and Lake Athabasca in the vast numbers that they once did (Appendices A and B). The decline in waterfowl is, in part, related to reduction in habitat quality incurred as a result of decreasing water flows in the PAD, possibly as a result of the Bennett Dam (Stuart Adams & Associates et al. 1998). Members are also expressing concern about the effects tailings ponds have on migration patterns, waterfowl health and mortality.

In addition, ACFN and MCFN members have expressed concern about impediments to their ability to access waterfowl hunting areas (Appendices A and B). As explained in Sections 4.4, 4.5 and 4.6, water levels in the PAD are declining. Declining water levels restrict access and impede customary hunting techniques.

4.1.3. Fish

Fish procured from the Athabasca River, Lake Athabasca and the PAD was, and is, a staple component of the traditional diet that is fundamental to the food security and

traditional economy of both First Nations (ACFN 2003, 2009; Appendix A and B). In addition, fish is a potential commercial resource for those who choose to obtain a commercial fishing license. Commercial fishing also provides opportunities for seasonal wage employment, and members of the First Nations directly benefit from these activities (although the number of those employed in these pursuits is unknown). Members of the First Nations are very concerned about the possible impacts to fish and fishing as a result of lower water flows in the Athabasca River (Appendix C).

Net fishing is still a common method for harvesting fish, and some people also fish with line methods (e.g., rod and reel). Key fish species include, but are not limited to, jackfish, whitefish, goldeye, pike, pickerel, walleye, lake trout, ling cod among others (Appendices A and B). Specific fishing locations depend on the species and the season; the seasonal fish harvest takes place in accordance with fish spawning cycles, which differ for each species, and sometimes even amongst different populations of a particular species (for example whitefish in Brander Lake spawn at a different time than those in Lake Athabasca). Richardson Lake and Lake Claire are known to be important fish spawning grounds (ACFN 2009; Applied Aquatics 2009; Appendices A and B). The ecology of Richardson Lake is known to depend on Athabasca River flows (Applied Aquatics 2009).

It is important to make clear that detailed research on ACFN and MCFN fishing practices, locations and the conditions that support fish harvest has not been undertaken to any great extent and is largely unavailable.

Impacts to Harvesting Fish

Elders say that in past (as recently as fifty years ago) it was easy to catch substantial quantities of fish in a very short period of time and that this is no longer the case today (Appendices A and B). MCFN and ACFN members say that many of the traditional fishing locations are no longer useable because of changes to water quantity and quality (Appendix A, B and C). For example, participants in the community engagement sessions said that there used to be good fishing in the Athabasca River, but that is no longer the case. Note that “good fishing” includes more than just a consideration of the presence/absence of fish; for example, the observed quality of fish, the ability to access preferred fishing locations, etc. An explicit evaluation of what conditions are necessary for “good fishing” has yet to be undertaken and could be accomplished through research that would support a traditional resource use plan.

Members also have observed that water levels have declined dramatically in recent years, making it difficult or impossible to fish by boat along the River and its tributaries (Appendices A, B, and C). Members have also noted that declining water levels in the smaller lakes and streams could impact over-wintering habitat and have raised concerns about increased fish mortality as a result of winter fish kills. In addition, community

engagement participants expressed concern about possible impacts to fish (burbot and whitefish were mentioned) spawning habitat in the Athabasca River as a result of reduced flows.

Observations of declines in the health and quality of fish in the Athabasca River and Lake Athabasca, and the relationship of contaminants in the water to that decline is a particularly contentious issue (Applied Aquatic 2009; Timoney 2007). Many ACFN and MCFN members are passionately concerned that fish flesh contaminated by industrial pollutants is linked to what they have observed to be increased rates of cancer in Ft. Chipewyan. Observations of fish deformities and increasing concern regarding water quality motivated ACFN to fund a study to assess the presence of mercury in local fish species (Applied Aquatic 2009). This study found high levels of mercury in predatory fish like pike and pickerel and recommended limits on consumption (Applied Aquatic 2009). Many people are managing their risk of exposure to contaminants by limiting (or even eliminating) their intake of fish from areas considered to be polluted. The overall health and well-being effects on the ACFN and MCFN members residing in Ft. Chipewyan are unknown.

While there are some fishing areas considered to be still “good” or uncontaminated (e.g., certain inland lakes), access and use of these areas may be prohibitive for a variety of reasons. For example, use of the inland lakes to the north and east of the Poplar Point area, around Pearson Lake, has been impacted by non-Aboriginal recreational users (ACFN 2009). Other inland lakes (e.g, Brander Lake) are known to be good for fishing, but are a bit too far away or inaccessible to be an appropriate substitute for the River, Lake Athabasca and the PAD because use of these areas creates an additional burden in terms of costs (monetary and time). Finally, in some areas, for example Ronald Lake, the encroachment of development and associated activities discourages ACFN and MCFN harvesters from using these areas. Many ACFN and MCFN traditional land users are sensitive to having to comply with imposed access management and safety policies and can feel threatened by the presence of non-Aboriginal land users.

ACFN and MCFN assert that current IFN Guidelines for the Athabasca are putting fish species at risk, and, in turn, the rights of the First Nations to their traditional harvesting, to their health, and to their culture.

4.1.4. Trapping

Trapping is an integral component of the traditional livelihood of the ACFN and MCFN, and traplines are important for the continuation of traditional land use activities above and beyond commercial trapping (e.g. Dersch and Bush 2008, p. 25; Passelac-Ross 2005). While a variety of furbearers are trapped, muskrat trapping in the PAD was the keystone of the trapping economy in Ft. Chipewyan prior to the establishment of the

W.A.C. Bennett Dam (ICC 1998). According to Elders, low fur prices in the 1980s were further impacted the fur economy.

While trapping currently is not profitable from a monetary perspective ACFN and MCFN members continue to retain their traplines and engage in trapping activities. The ownership of a registered fur management area (RFMA) and the activities of trapping are considered very important to cultural retention and maintaining traditional opportunities for future generations (ACFN 2009). Many trappers continue to hold their traplines, many of which have been in their family for several generations and/or overlap lands used by their family for generations (e.g., traditional customary traplines and family harvesting areas), and they hope to pass their traplines along to younger family members (ACFN 2009). As of 1998, there were 200 people licensed to trap in Ft. Chipewyan, but no more than 20 active trappers (Stuart Adams & Associates et al. 1998). It is important to note that ACFN and MCFN members (who may or may not own an RFMA) also use the RFMAs of their family, friends and trapping partners (who may or may not be First Nations members, or members of the same First Nation). To our knowledge, there is no recorded information on how many ACFN and MCFN members utilize RFMA's, which RFMA's they use, why they use them and the specific uses that occur there.

It is also important to note that the trapping activities of the First Nations also have non-commercial aspects, and are not limited to RFMAs. Non-commercial trapping activities occur on-reserve and in other areas throughout the traditional lands. For example, people often snare rabbits close to their residence. There is little recorded information on current consumptive trapping activities.

Regardless of the commercial viability of trapping, the ability to trap is regarded as part of the culture, and learning trapping skills is considered important to ensure that future generations can sustain themselves from the land if need be (ACFN 2009).

Impacts to Trapping

Trapping relies on adequate water flows to sustain the necessary habitat for aquatic furbearers and other animals that are trapped and to sustain access to traplines and reserve-lands (many of which are accessed via the River by boat in the summer and by snowmobile in the winter). Additional sections in this report highlight the concerns of the First Nations in respect to muskrat (which are important for trapping) and in respect to the ability to access traplines and reserve lands.

4.1.5. Gathering

“Gathering” is a broad category that may include, but is not limited to, such activities as harvesting berries and other plant foods, collecting medicines, gathering firewood, and obtaining other natural materials and non-timber forest products (feathers, stones, clay,

roots, timber, plants for dyes, bark) that may be used for a variety of domestic and spiritual purposes. Other than berry-picking and medicinal plant collection, many aspects of gathering are poorly recorded.

For both ACFN and MCFN, berry-picking and medicinal plant gathering localities occur along the Athabasca River and throughout the PAD. However, while there is ample recorded information on the commonly used medicine plants and berries, there is an absence of information on specific harvesting locations, or conditions that make harvesting locations desirable (i.e. what are the preferences that underlie decisions on where to harvest medicines and when?).

A recent study on traditional medicinal plant use in the Regional Municipality of Wood Buffalo found that declining water levels in the Athabasca River and Lake Athabasca have had a significant effect on riparian communities (Dersch and Bush 2008). Changing moisture regimes and flooding cycles alter plant communities in traditional plant collection areas. Declining water levels also have restricted access to traditional collection areas that are accessed by boat. Recommendations of the study included that water levels in the Athabasca River and Lake Athabasca be conserved.

4.2. WATER FOR DRINKING AND DOMESTIC USE

The Athabasca River is a primary source of drinking water for residents of Ft. Chipewyan and for many traditional land users. The water intake for Ft. Chipewyan is situated on Lake Athabasca, within the flow from the Athabasca River channel as it makes its way to the Quatre Fourches River and thence to the Slave River. In the past, untreated River water was used for drinking water by traditional land users. Today, it is only used as a last resort by people out on the land when they do not have access to other water sources. Most people will no longer preferentially drink water directly from the River. In addition to drinking water, the River is used to obtain wash water and to water gardens (ACFN 2009; Appendix C). The River is also used to access other tributaries and springs that are used for drinking water out on the land.

Impacts to Water for Drinking and Domestic Use

Elders and other community members say that the quality of water in Lake Athabasca and in the Athabasca River has declined since they were young (Canada 2009a and 2009b; Mikisew 2006). They used to drink water directly from the Lake and the River and most will no longer do so (ACFN 2009; Appendix C). Some ACFN members have stated that water quality changed when the Great Canadian Oil Sands oil spill occurred in the 1960s (Canada 2009a and 2009b). It is evident that water quality in the River has passed a threshold from the perspective of the ACFN and MCFN. Within the span of two generations, water quality declined such that the First Nations could no longer drink the water directly from the Lake and the River. No study has yet been undertaken to

determine when the threshold was breached (and what the water quality, or flow, parameters were in the River and the Lake at that time).

While the Ft. Chipewyan water supply is treated, ACFN and MCFN members are expressing increasing concern about the link between contaminants in the water and rates of disease (especially cancer) in the community of Ft. Chipewyan. The community of Ft. Chipewyan is located in a depositional basin, in which metals and other contaminants tend to accumulate in fine-textured sediments and is located downstream of major developments known to release contaminants into the Athabasca River (Timoney 2007). Concentrations of arsenic, mercury and polycyclic hydrocarbons appear to be rising as a result of oil sands development and some are at concentrations which may pose ecological and human health risks (Timoney and Lee 2009). It is likely that there are a variety of impacts (psychosocial, economic and health) that will emerge as concerns increase.

Economic impacts include additional monetary and time burdens associated with obtaining water from alternative sources. For example, one of the community engagement participants said that he does not like the taste of the water that comes from the water treatment centre and so he collects drinking water from Dorey Lake. He uses a quad and a bucket to transport the water from Dorey Lake to his residence at Allison Bay.

Another of the community engagement participants, who resides in a cabin situated on the banks of the Athabasca River, explained his difficulties in obtaining drinking and washing water. He will not drink the water from the Athabasca River as he considers it contaminated. He also explained that he will no longer use the Athabasca River for wash water after developing a rash after washing with the river water. He said that visitors to his cabin, on a separate occasion, also developed a rash after washing with the river water. Water security is a constant issue for him. He says that it is not possible to transport adequate supplies of drinking water to his cabin from town. There is no all season road to his cabin, which is located on the ACFN Reserve 201G, so water would have to be shipped by all-terrain vehicle or by watercraft. Quad transport is not efficient because you cannot bring enough water per trip to make it worthwhile. A round trip to obtain town water by boat would take over four hours and is cost prohibitive for him. Instead, he obtains his drinking water from several different sources on the land. One collection location is Grayling Creek, upstream of its confluence with the Athabasca River. This location is an eight kilometer round trip for him to travel to collect drinking water. Before he had a quad, he had to walk to collect the water. There is a small creek across the River and upstream of his cabin that he used to collect water from. Collection there requires access by boat. He no longer collects there because the flow has declined in that creek and the water quality is now poor. He says that he observed that the flow

declined in the creek when Industrial activities started to increase in the uplands that form the creek catchment.

Not being able to collect drinking water from the Athabasca River while out on the land means that people using the land must transport adequate supplies of drinking water with them. For example, when hunting it is not always possible to pack adequate drinking water (needs vary according to the length of trip, temperatures, number of hunters). Depending on the methods of access, it might not be possible to accommodate the extra weight or bulk of heavy loads of water (especially if one is successful in the hunt).

It is apparent that ACFN and MCFN members that use the land must have access to safe sources of drinking water on the land in close proximity to where they choose to use the land (ACFN 2009; Appendix C). Saying that they can go elsewhere, or that they can transport water from elsewhere is not a solution as they may not have the means to do so, or there may not be other locations that are appropriate.

Concerns were also expressed that contaminants from the river water might be taken up by vegetables in gardens, and ultimately impact human health. Whether or not water (or resources obtained from the water or nourished by the water) is shown with scientific certainty to be contaminated, the perception that it is such can have negative psychosocial impacts on individual and community well-being.

The First Nations understand that the Phase II Water Management Framework is about managing water quantity, not quality, per se. However, it is important to examine what effects changing flows could have on water quality (and ultimately human health). For example, do the effects of contaminants increase at lower flows? As increasingly contaminated waters fill the PAD (as a result of air deposition of contaminants, perhaps), will decreased dilution (as a result of reduced flows leading to drying of the perched basins in the PAD) result in ecological effects (e.g., increased muskrat mortality?).

Furthermore, at times of low flow it is more difficult to transport adequate water supplies, or to access alternative water sources.

In addition, as industrialization of the region increases, it is likely that the ACFN and MCFN water sources (tributaries, springs, lakes) on the land that are considered to be “still good” (again, defining “good” would encompass a variety of conditions and preferences) are at risk of contamination.

4.3. MUSKRAT

Muskrat require special consideration as the relationship between water flows in the PAD and muskrat populations is an issue of great concern to both MCFN and ACFN (Appendix C). Muskrat are used for sustenance, and their furs have both commercial and traditional

value. Muskrat are not only a cultural keystone (given their importance to the traditional trapping livelihood), but also are considered by ACFN and MCFN Elders as an indicator of ecological integrity.

Impacts to Muskrat

ACFN and MCFN Elders say that muskrat populations in the PAD have declined since the 1980s and that Athabasca River flows are important for sustaining muskrat habitat in the PAD. When water levels are too low, muskrats can freeze to death. Declining water levels in the small perched lakes of the PAD is reducing good quality muskrat habitat. For example, Hilda Lake was once good muskrat habitat, but is now said to be too dry. There have been large kill-offs of muskrats in the past; Elders say this could be due to “stagnant” or polluted water. For example, in 1988 there was a large muskrat kill-off at Egg Lake and Frezie Lake, which are fed by the Athabasca River. The kill-off did not affect another lake close by, the water level of which is not dependent on the Athabasca River.

The community engagement participants recommended that a study be conducted to compare muskrat populations in waterbodies in PAD that are fed by the Athabasca River, compared to waterbodies in the PAD that are not dependent on the Athabasca River.

4.4. PEACE ATHABASCA DELTA

The PAD is the largest boreal delta in the world and is recognized as a wetland of international significance under the Ramsar Convention. Prior to the construction of the Bennett Dam, the PAD had a rich and diverse ecology of international significance. The hydrology, landforms and lush vegetation of the Delta supported a diversity of birds, mammals and fish. The ecology of the Delta is sensitive and highly dependent on the water levels of various rivers and tributaries that feed the Delta. The flow of water in the PAD is fundamental to its unique environmental features. Periodic overland flooding caused by spring ice jams is necessary to replenish the many perched basins in the PAD (ICC 1998; Appendix C).

The First Nations have depended upon the rich ecosystem of the PAD to sustain their traditional livelihood for generations. ACFN’s use of the PAD is largely concentrated in those areas of the PAD to the south of Lake Athabasca, including the Delta Reserve (Reserve 201) and areas around Jackfish (Richardson) Lake (this should not be taken as a definitive list of use areas). MCFN members also use these areas. ACFN’s traditional trapping economy was largely based on the rich harvest of muskrat from PAD and Reserve 201 (the Delta reserve) was well known as the area of prime muskrat habitat in the PAD. It was for that reason that Chief Jonas Laviolette requested that the lands encompassed by Reserve 201 be set aside to sustain the livelihood and culture of ACFN for future generations (ACFN 2003; ICC 1998; Wetherell and Kmet 2000).

MCFN use of the PAD, known to the authors of this report, is largely concentrated in those areas of the PAD that lie within the Wood Buffalo Nation Park, including Lake Mamawi, Lake Claire, Embarras River and areas to the north of the Lake Athabasca (this should not be considered a definitive list of use areas). Given the close relationships amongst the two First Nations, members of each First Nation may utilize areas considered to be the customary use areas of the other First Nation.

Other uses of the PAD by the First Nations include, but are not limited to, hunting migratory waterfowl, fishing, the harvest of aquatic furbearers for furs and food, moose and bison hunting. In addition to harvesting uses, access to upstream areas from Ft. Chipewyan is through the PAD usually via Fletcher Channel or Goose Island Channel. If the PAD cannot be navigated by watercraft during ice free months, then there is no access to the settlements, reserves, cabins and harvesting areas on the River and along the Richardson, Firebag and Embarrass (and other tributaries).

Impacts of Flow Alterations on the PAD and on the First Nations

There have been many flow alterations observed over time (Appendix C; ICC 1998). The number of spring floods has greatly reduced since the construction of the WAC Bennett Dam. The last major flood occurred in 1974. Since then, many perched basins are disappearing and two (Egg Lake and Pushup Lake) have disappeared. Willows and other vegetation are encroaching on wetlands. These changes have an effect on the number of species and the population of species (plant and animal) that ACFN members harvest. The changes have also an effect on the ability of ACFN members to travel through the PAD and to access harvesting locations in the PAD and to travel through the PAD to their camps, cabins and traplines, and to reach the Athabasca River.

A report on the findings of an assessment on the impacts of the Bennett Dam on ACFN identified the relationship between ecological changes and impacts to ACFN's rights and culture (ICC 1998). While these findings are specific to the impacts caused by changes to flows in the Peace River, and the subsequent effects to the hydrology of the PAD, these findings are useful in identifying key issues that might emerge should the flows of the Athabasca River be reduced. The summary of the findings presented below is taken directly from ICC 1998. In some cases editorial emphasis has been added, and in some cases, additional comments are provided in brackets.

- Reduced frequency and magnitude of flood stages on the Peace River has greatly reduced the hydraulic damming of outlets from the Peace delta and Lake Athabasca to the Slave River. In turn, the lowered water levels in the Peace delta and Lake Athabasca has greatly reduced the backflooding of the Athabasca River and tributaries to Lake Claire and Mamawi. The disruption of this backflooding regime has led to greatly reduced and infrequent recharging of perched basin

lakes and wetland on the Athabasca delta. Effects have been especially severe on the northern two thirds of the Chipewyan Reserve No. 201.

- The stabilization of Lake Athabasca by the weirs on the Riviere des Rochers and Revillon Coupe has resulted in above average minimum water levels overwinter, as well as above average year round lake levels. The summer peak levels, however, are 0.5 metres below average. The net effect of these changes has been to reduce the amplitude of flooding during the spring and early summer, and to reduce open mud flats during fall and early winter. These changes have, in turn, reduced wetland habitat availability and quality for a large number of wildlife species and fish of important to the Chipewyan people.
- Changes in vegetation as a result of the drying out of the Athabasca delta has lead to reduced availability of some medicinal and food plants for the Chipewyan people, as well as reductions in the availability of productive wetland and meadow habitats and ecosystem integrity.
- Numbers of waterfowl throughout the Athabasca and Peace deltas are believed to have declined as a result of reduced nesting and brood rearing habitat, and the loss of large areas of suitable fall staging habitat. The net effect to the Chipewyan people is a loss of subsistence hunting opportunities during the spring and fall, as well as a reduced potential for a guided sports hunting industry.
- Muskrat have declined substantially since the operation of the Bennett dam, with the exception of a short recovery associated with the exception flood in 1974 and attempts by Athabasca Chipewyan Band to manage wetlands in the No. 201 Reserve.

Muskrat numbers on the Reserve following the construction and operation of the Bennett dam (and prior to wetland management on the Reserve) are in the order of 5 to 11% of previous numbers. Fur harvests realized during the post-dam conditions (1977 to 1988) are in the order of 9% of the peak harvest in 1974, and 8 to 22% of the potential harvest under optimal managed wetland conditions. Maximum losses of trapping income for muskrat pelts alone are in the order of \$40,000 to \$123,000 annually. The reductions in muskrat numbers has also negatively affected the abundance of other furbearers such as mink and fox, and ultimately the economic potential of trapping income for these species.

- Changes in habitat quality and availability have negatively affected the distribution and numbers of moose on and adjacent to the Reserve No. 201. In turn, this has greatly affected the ability of the Chipewyan band members to obtain moose meat from the Athabasca delta, and has required travel to areas

well outside the Athabasca delta to hunt, as well as increased dependency on store-bought meat sources. The economic cost of these changes are not known. [Author comment: Nor are the health impacts]

- Lower water levels have affected the ability of hunters to travel in the Reserve No. 201, as well as transportation of people and goods to and from the Reserve and Fort Chipewyan, and access to upstream areas (e.g., Fort McMurray).
- Cumulative effects of vegetation changes, reductions in waterfowl, muskrat, moose and other wildlife, and more difficult travelling conditions has resulted in reduced interest by young people in traditional lifestyles and pursuits. In turn, the spiritual and cultural values of the Athabasca Chipewyan people have been detrimentally affected.

Elders have expressed concern that upstream oil and gas water withdrawals from the Athabasca River are compounding the effects noted above (Appendices A and B). Even if the changes to water flows in the PAD are the result of natural causes, and within the natural range of variability, the potential for water withdrawals from the Athabasca River to exacerbate changes that ultimately link to impacts on ACFN's rights, traditional uses and culture should be examined.

4.5. JACKFISH (RICHARDSON) LAKE

Jackfish Lake, also known as Richardson Lake, is located in the PAD and known to be a particularly good spawning area for walleye and an important traditional fishing lake (ACFN 2003, 2009; FMA 2006; Applied Aquatic 2009). Jackfish Lake is tightly coupled with the Athabasca River with respect to water levels and water quality during the summer. The quality of the spawning habitat may be affected by water levels in the winter and the spring.

Impacts to Jackfish Lake

When the Athabasca River was high, Jackfish Lake would be full, but now mudflats obscure access. ACFN has, in particular, expressed concern about changes to the ecology of and access to Jackfish Lake and is recommending that a permanent diversion structure be constructed to direct the Richardson River through Jackfish Lake to ensure that the lake is refreshed and spawning habitat is maintained (Applied Aquatic 2009; FMA 2006).

4.6. TRAVEL, ACCESS AND SHIPMENT OF SUPPLIES

During ice free months, given adequate flow conditions, water routes offer the easiest access through much of the First Nations Traditional Lands (Appendices A and B). After freeze-up, and given adequate snowfall, the banks of rivers offer ease of navigation for sleds (historically dog sleds, and now snowmobile). The Athabasca River has been, and

continues to be, a primary travel artery providing access between Ft. Chipewyan and Ft. McMurray, and between those settlements and various reserves, traplines, cabins and important harvesting areas (Calliou Group 2009). Some of these places are located directly on the River, while others are located off of other waterways or trails accessed via the River.

It is important to note that access between Ft. Chipewyan and upstream areas via water routes requires travelling into and through the PAD. The PAD has a unique, complex hydrology that involves interactions of the Peace, Athabasca, Fond du Lac and Slave Rivers. The effects of lower water flows in the Athabasca River on PAD hydrology are of particular concern to the First Nations.

The following summarizes the specific information documented about the use of the River for travel and access. Where possible, gaps in existing information are noted. In addition to any specific gaps identified below, the travel and trail networks of the First Nations have not been recorded to any great extent. While the Richardson River and the Firebag River are documented transportation routes into Richardson Backcountry, and the Embarras is known transportation route into Wood Buffalo National Park and between the Delta and Athabasca River mainstem, more work is required to determine what other trails and travel routes are accessed via the Athabasca River, and to identify possible impediments to use of those routes that may be incurred from reduced water flows in the Athabasca River.

4.6.1. Travel and Access between Ft. Chipewyan and Ft. McMurray

The only access between Ft. Chipewyan and Ft. McMurray during summer months is by air, or by boat. Members of both First Nations regularly travel by boat between Ft. Chipewyan and Ft. McMurray during summer months. These trips provide opportunities for purchasing supplies in Ft. McMurray at lesser costs than available in Ft. Chipewyan (where goods are air-freighted in) and to visit family and friends (thereby retaining social cohesion of the community). Many ACFN and MCFN members continue to use this travel route (ACFN 2009; Calliou Group 2009).

Some ACFN and MCFN Members will not travel by air (due to issues with personal safety, issues of affordability, etc.). These members would not be able to travel outside of Ft. Chipewyan (for provisioning and visiting trips to Ft. McMurray) during ice free conditions if not for boat travel.

Members that travel between Ft. Chipewyan and Ft. McMurray will also often stop in to the camps and cabins along the river to visit and offer assistance (for example, to pick up and drop off supplies; to transport people or equipment; etc.). As well, the presence of other people on the river (in these camps and cabins), offers security to those travelling the river.

4.6.2. Transportation of Goods and Provisions from Ft. McMurray to Ft. Chipewyan

Historically, scows, river boats and barges were used to transport food and goods between Ft. McMurray and Ft. Chipewyan. Food transported to Ft. Chipewyan via barge was less expensive than that shipped via air.

In the past, some ACFN and MCFN members were employed in the river trade, manning the boats and barges. This seasonal source of income complimented income earned through trapping during winter months. Records of income are not readily available.

4.6.3. Travel and Access to Reserve Lands

Reserves represent localities of use and can be considered an indicator of other land uses and cultural values. Reserve lands were often chosen because of their proximity to villages or camps, key resource gathering locations, and spiritual or sacred sites (e.g., cemeteries). For example, almost all of the ACFN reserves were established at the location (or close to the location) of a historic settlement, the use of which has considerable time depth and is associated with various ACFN family groups. In addition, most of the ACFN reserves have an associated cemetery. There are many currently used cabins and camps located on both the ACFN and MCFN Reserves, which are used as bases from which to conduct hunting, fishing, trapping, gathering and berry-picking.

Preferentially, access to all of the ACFN Reserves during the ice free seasons is by water. The Poplar Point (I.R. 201G) and Point Brule (I.R. 201F) reserves are accessed directly via the River. The only other access to these reserves during ice free months is via all-terrain vehicle (or by air), although access by all-terrain vehicle is not possible from Ft. Chipewyan. The Delta (I.R. 201 and I.R. 201B) and Jackfish Reserves (I.R. 201C, I.R. 201D, and I.R. 201E) are accessed via boat along the Fletcher and Goose Island Channels. There is no other access to these reserves during summer months (other than by air). Please note that MCFN members may also use, or benefit from the use of, ACFN reserve lands (and vice-versa).

Specific information on MCFN reserve lands was not available at the time of drafting this document. Further work is required.

4.6.4. Travel and Access to Trap lines

Registered trap lines are a contemporary institutional mechanism that facilitates access to traditional land use areas for not only the individual trapper, but their extended families and hunting and land use partners. Trap lines are often used for many cultural and harvesting activities beyond trapping; for example, hunting, fishing, berry-picking, and spiritual activities. While the disposition for a registered trap line is held

individually, they often have significance for the collective use and rights of the particular First Nation.

Any assessment of effects on the ability to access and use trap lines would require an assessment of not only the impacts to the individual trapper who holds the line, but to the First Nations' Section 35 rights associated with use of potentially-affected trap lines. In addition, it is not known whether specific information on access to each of these lines during summer versus winter months has been documented.

There may be additional ACFN or MCFN trap lines, or trap lines held by other individuals but used by ACFN or MCFN members, that are not part of the existing database of information that was reviewed. More work is required to identify traplines utilized by ACFN and MCFN members, and to characterize the access conditions for these lines.

Traplines that are held by ACFN members and accessed via the River and/or its primary Delta channels include RFMA #445, #2863, #1625, and #1248. RFMA #445 (around Richardson River) is accessed via the Richardson River, which itself is accessed from the Athabasca River. Specific information on MCFN traplines was not available at the time of drafting this document.

4.6.5. Travel and Access to Cabins and Camps

Cabins and seasonal camps are used as a base for land use activities, harvesting and spiritual renewal. While it is known that there are cabins and camps in use by ACFN and MCFN members along the Athabasca River, and in the PAD, the locations of these currently used cabins are not recorded. More work is required to identify the specific locations of these cabins and their access conditions in order to more accurately predict whether there could be possible impacts to access.

4.6.6. Travel and Access to Sacred and Spiritual Sites and Areas

For both First Nations, gravesites, spiritual sites and historic sites are highly valued and considered sacred. In addition to specific sacred places, the River itself is considered sacred, and the Traditional Lands as a whole are important to the spirituality, culture and way of life of the First Nations with the concept of the "Land" having an element of the sacred (ACFN 2009; Coutu and Hoffman-Mercredi 2002; FMA 2006).

In addition, access to lands that can be considered "true wilderness" (undeveloped, remote, empty of non-Aboriginal land users) is important for the sense of solitude that is sought by ACFN and MCFN members when they renew their spiritual links with the land and that offers them the freedom to practice their traditional activities without fear of interference or abuse (Appendix A and B; ACFN 2009; FMA 2006).

While the following attempts to summarize information specific to each First Nation, the separation of some of these aspects between the First Nations may not be truly

representative. In addition, given the secrecy and confidentiality that is associated with much of the spirituality and sacred places of the First Nations, it is rare to have information on these aspects documented. Therefore, it is likely that this section is highly limited and should not be taken as a definitive picture of the sacred and spiritual sites of the First Nations. More work is required.

ACFN Sacred and Spiritual Sites and Areas

There are cemeteries, considered sacred sites, located across from the Point Brule (201F) reserve, and at the Poplar Point (201G) reserve. Access to both of these locations is by River during summer months. There is a cemetery located at one of the Jackfish Reserves which are accessible only by boat during the ice free months. These cemeteries are associated with the historic micro-villages, are still in use (or were until very recently) and many ACFN members express a strong family tie to these places where their relatives are buried (ACFN 2003; ACFN 2009).

In addition to the cemeteries that are associated with the historic micro-villages, there are some gravesites located along the river. The specific location of these gravesites, and historical information about nature of the sites (e.g., exact number of burials, names of individuals there, dates of burials, etc.) has not yet been determined.

There are some historic and archaeological sites recorded along the River that are considered sacred and are important to the traditional values and spirituality of tradition-oriented ACFN members. One such location is where the Clearwater River meets the Athabasca River. “Where the Rivers Meet” is an ancient gathering place for Dene peoples and is considered sacred (ACFN 2009). Another previously recorded sacred ancestral gathering place along the Athabasca River is Cree Burn Lake, which is designated as HhOv-16 in the Provincial Historic Site designation system (Coutu and Hoffman-Mercredi 2002). Many sacred sites have not been recorded for fear of this information being misappropriated and misused.

MCFN Sacred and Spiritual Sites and Areas

A number of MCFN burial sites are found along the River and in the PAD. No information was available on whether the specific locations of sites on record have been verified. Moreover, the specific access conditions to these sites are not known. However, it is known that there was a graveyard at the Embarras Store on the Athabasca River that is accessed via the PAD and Embarras River.

In addition to the burial sites, MCFN considers their camps and cabins as places of spiritual value because of they are important to maintaining the traditional culture of MCFN.

4.6.7. Travel and Access to Other Rivers and Waterbodies

The Athabasca River is used to access other rivers and waterbodies that are particularly significant for ACFN and MCFN resource harvesting activities. For example, the Athabasca River is used to access:

- The Peace-Athabasca Delta
- Embarras River
- Lake Claire
- Mamawi Lake
- Galoot Lake
- Jackfish (Richardson Lake)
- Richardson River
- Firebag River
- Steepbank River

While some of these areas are mentioned in more detail in other sections of this report, it is evident from the information review that more work is required to determine the particular access conditions for each of these areas in order to develop an understanding of what flow levels impact access (taking into account sociocultural and economic considerations such as seasonality of use, tools that support use, etc.). As well, it is likely that additional areas may be identified through further research.

4.6.8. Impacts to the Navigability of the River for Watercraft

Based on the information reviewed and the community engagement sessions, the use of the river for travel and access depends on conditions that sustain navigability of the River, access to the river, and access off of the river to specific locations of use. Direct impacts to access result from the effects that water flows may have on the navigability of the River for watercraft and snowmobiles. This may result in increased risks (safety and economic), restriction of travel to more experienced users and those who can afford specialized equipment. All of these changes may lead to impacts on the harvesting of traditional resources, and on the ability to transfer traditional knowledge and culture. In addition, there may be socioeconomic effects. These effects are described in further detail below.

Changes to the Navigability of the River for Watercraft

Navigability of the River is affected primarily by three ecological aspects related to lower water flows:

- decreased depth to bottom

- increased exposure to sandbars
- confinement to the main channel

Decreased depth to bottom as well as the presences of sandbars increases potential for large boats to bottom out, and/or for the propellers of outboard motors to hit bottom (thereby rendering them inoperable and possibly even damaging them). In the case of jet boats, if you have a heavy load, you may not be able to get your boat back “on step” if the water is too shallow. Because of the exposure of new sandbars and the shifting of sandbars, new routes must be found annually.

Sometimes watercraft travel is confined to the main channel (which will be the deepest). The main channel does not always allow access to the river banks and to the islands in the river. It is also very sinuous and can be hard to follow for inexperienced river travelers.

ACFN and MCFN members have observed that water levels have been decreasing for some time and they have expressed concern about this change. Current water levels are said to be very low compared to historic levels (Appendix C). Instead of being “full” all summer, there is now a shorter season for water in the river. Moreover, river travelers have expressed concern that there are more sandbars now than there used to be (ACFN 2009; Appendix C; FMA 2006).

Changes to the Navigability of the River for Snowmobiles

Navigability of the River for snowmobile travel is affected primary by the quality of ice (Appendix C). Irregular ice can form where water is shallow and fast-moving, and where water draw down occurs rapidly (creating a big “space” between the water and the ice). The presence of irregular ice is increasing. In the past, ice was thicker and of a more “blue” colour. Water quality may be related to poorer ice conditions on the river.

These changes make river travel more risky, both in terms of safety and in terms of time and expense.

Personal Injury and Equipment Damage

Travelers risk injury and damage to equipment if they hit a sandbar at high speeds. A boat that is hung-up can require strenuous labour to remove. If the traveler(s) cannot free it, or if equipment is damaged, the travelers may be stranded until help arrives. Because river travel has reduced (as a result of worsening conditions that support use), there is less chance of receiving immediate help. Depending on preparedness and the weather conditions, travelers may be at risk of exposure.

Increased Costs of Travel (time and, possibly, expense)

Travel is slowed when you must take extra care to avoid sandbars. If you are restricted to the main winding channel you cannot take the “point to point” shortcuts, further slowing travel (ACFN 2009).

Equipment damage is costly, as is investing in new technology (e.g., jet boat) designed for lower water flows. Some ACFN and MCFN members may not be able to afford the extra costs (which will restrict them from using the River).

Impacts of Restrictions on River Travel

As River travel becomes more difficult, only those who are highly skilled and experienced dare to travel on the River, or do so without great risk of injury or property damage (Appendix C). In addition, those who can afford more specialized equipment (e.g., jet boats) or can afford risk of damage to their existing equipment, may more readily travel the river.

This impacts the ability to access harvesting and other use areas, and restricts opportunities to transmit knowledge and cultural training to younger ACFN and MCFN members.

4.6.9. Impacts to Barging and Shipment of Supplies

Shallow waters are problematic for barges that transport goods between Ft. Chipewyan and Ft. McMurray. While the barge industry has collapsed because the barges are no longer able to navigate the river, there is still one small barge in operation. Barging, however, is still considered by resource developers to be an option for transporting goods necessary for oil sands development from a northern route (via the Arctic Ocean to the Mackenzie River, down the Slave to Lake Athabasca and southward).

Dredging may be a possible option for mitigating conditions that contribute to poor watercraft navigability, but it is considered unacceptable by ACFN because dredging is associated with the release of contaminants that accumulate in river sediments. Release of these sediments through dredging washes them downstream to the Athabasca Lake basin, with possible impacts on drinking water and fish quality, and ultimately, human health.

An alternative to barging and shipping supplies is air or land transport. Some items can only be sent by overland routes (restricted to the winter ice road). If warming conditions prevail, this might impact the ability to ship goods via a winter road. This might make barging a more attractive option. It also may increase the potential that an all weather road to Ft. Chipewyan is considered. The construction of an all weather road would have a variety of socioeconomic and rights-related impacts that must be considered. While that is out of scope of the Phase II water management framework, we suggest that it might be necessary to look at the possible opportunity costs for alternative methods of transportation (e.g., barging) for shipment of goods.

4.7. SPIRITUAL AND SACRED VALUES ASSOCIATED WITH THE RIVER

There is a dearth of recorded information on the spiritual and sacred values of the First Nations, likely because of the confidentiality which the First Nations maintain around this aspect of their lives. As such, it is difficult to provide specific details at this time.

Water is a sacred property of life, and the River is considered sacred because it is a main source of life-giving water. The ties of the sacred nature of the Land (and the River) and the identity of the First Nations is a deep cultural connection that goes beyond the specific use of the land and is manifested in a stewardship ethic that requires traditionalists to protect the Lands (and waters) from abuse and misuse. Impacts and alterations to the River itself are considered profoundly disrespectful.

Traditionalists make an offering (usually tobacco) each and every time travel occurs on the lakes and rivers of Traditional lands (L. King, personal communication). The offering is to ask for a safe journey, a gesture of asking permission from the water spirit and a request for the safe and wellbeing of all those on the journey. At the same time, the request is also for the purpose of the journey (e.g., moose hunting, or travel to a specific location).

In addition to the River itself, ACFN Elders have explained that all of the Traditional Lands must be considered sacred because one never knows where there may be a burial. In the past, the Dene culture was highly nomadic and people lived and died on the trail (where they died, they were buried). In consideration that the Athabasca River is a travel corridor, it can be expected that there might be a high potential for unrecorded gravesites to be located along the River. There are reports of observations of a burial on the banks of the Athabasca at Embarras that was exposed (and identified) as a result of the bank eroding.

5. DETERMINING IMPACTS OF DECREASED FLOWS ON THE RIGHTS, CULTURE AND WELL-BEING OF THE FIRST NATIONS

5.1. INTRODUCTION

The First Nations have a number of concerns about the possible impacts of lower water flows on their traditional uses, their rights and their well-being. An evaluation of impacts in relation to alternative flow regimes was not possible within this study. Because detailed information on the key ecological, sociocultural, and economic conditions that underlie the system of river use is lacking, it is difficult to make predictions or draw conclusions about what level of change would affect use or not. This is because much of the information that would be required to do so has not yet been compiled and we lack sufficient resources and time to do. What we do know, is that members of both First Nations say that their use of the river has already been impacted and that this impact derives, in most part, from lower water flows. We also know that it is important to maintain the uses of the River and the PAD for travel and access and for harvesting. This section summarizes the concerns of the First Nations in respect to the Phase 2 Water Management Framework, and offers suggestions on how to evaluate the possible impacts and possible studies that might provide information for doing so.

5.2. CONCERNS OF THE FIRST NATIONS IN RESPECT TO THE PHASE II WATER MANAGEMENT FRAMEWORK

DFO is interested in understanding the causes of concern of the First Nations related to potential impacts of decreased flows in the Athabasca River. As described in the preceding section, the First Nations have already experienced impacts in relation to the River and feel that limits of acceptable change for water quality and quantity in the River have already been breached. Based on the results summarized in Section 4 and in Appendices A, B, and C, the causes of concern of the First Nations related to the Phase II water management framework are (but not necessarily limited to):

- Impacts to the ecology and health of the River and the Peace-Athabasca Delta
- Impacts to travel and access
- Impacts to harvesting
- Socioeconomic impacts
- Cultural and spiritual impacts

- Impacts to individual and community health
- Cumulative impacts
- Evaluating impacts from the perspective of the First Nations
- Meaningful consultation

The above list may not be exhaustive and the First Nations reserve the right to raise additional concerns as they arise. A concise explanation of each of these concerns is provided in the following subsections. The First Nations invite further discussion on these concerns.

5.2.1. Impacts to Ecology and Health of the River and the Peace-Athabasca Delta

The First Nations have observed changes to the ecology and health of the River and the Peace-Athabasca Delta, and have experienced impacts to their traditional use and their well-being as a result. They are concerned that lower water flows may have further impacts on the ecology and health of the River and the PAD.

Specifically, what effects will lower flows in the Athabasca River have on:

- the hydrology of the PAD, including water levels in perched basins?
- water quality in the Athabasca River? In particular, in respect to contaminants present in the water and the sediment?
- fish health and habitat?
- muskrat health and habitat?

For each of these things, the First Nations consider it important to evaluate impacts against thresholds for traditional use and culture and to integrate their traditional knowledge into the assessment. This would require understanding the ecological conditions that the First Nation considers necessary to sustain their traditional rights and their values.

5.2.2. Impacts to travel and Access

The River and the PAD are integral arteries in the traditional access network for the First Nations through their Traditional Lands. Some areas are only accessible by boat (or by air). Impacts to their ability to travel via watercraft are already being experienced by the First Nations. They are concerned that further decreasing flows will destroy completely their ability to use the River for travel and access by watercraft. In turn, impacts to the

First Nations' ability to travel the River, and to use the River as access to other culturally important places, will negatively impact harvesting.

5.2.3. Impacts to Harvesting

The First Nations have experienced a multitude of impacts to their abilities to pursue harvesting of their preferred resources in their preferred locations according to their preferred means (e.g, vehicle choice; season of use; etc.). It is becoming increasingly difficult to access harvesting areas, game presence and abundance is decreasing in some preferred harvesting areas, and in some cases, the First Nations members are limiting their harvest due to concerns about contaminants in traditional foods and medicines. The First Nations are concerned that additional impacts to their ability to travel on the River and to use the River as part of their network of access to culturally significant areas within their Traditional Lands will further impact their ability to harvest. They are also concerned that impacts to the ecology and health of the River and the PAD will impact their ability to harvest resources. If the River system(s) and the PAD do not maintain sufficient quality and quantity of water for the needs of traditional users, it is likely that traditional harvesting activities may be impossible (from the perspective of those affected) and that a collapse of these cultural activities (with consequent effects on individual and community health, cultural identity, and likely other aspects) is possible (Appendices A and B).

5.2.4. Socioeconomic impacts

Impacts to travel and access and to the harvesting of traditional foods have socioeconomic implications as well. For example:

- What additional economic (i.e. time and monetary costs) burdens may the First Nations be expected to incur as a result of having to go elsewhere to harvest traditional foods? Or to purchase alternative store-bought foods, or trade or purchase traditional foods harvested by other First Nations?
- What additional economic burdens may be incurred as a result of having to purchase bottled or purified water, or water purification systems, for use on the land?
- What additional economic burdens may be incurred for those members who prefer to travel between Ft. McMurray and Ft. Chipewyan by boat during ice free conditions (as opposed to air travel) should travel using their customary means no longer be possible? Will they have to purchase new technology, or use alternative travel means? Or by those members who would have to charter a flight to reach places (harvesting areas, camps and cabins, etc.) on their

traditional lands that are preferentially accessed by boat? From the views of the affected First Nations members, are there even acceptable substitutions for travel by boat?

- What additional economic burdens may be expected to be incurred for those members who transport supplies via boat during ice free conditions if they are no longer able to do so and either have to transport supplies via air or purchase supplies at the Northern Store in Ft. Chipewyan?
- For each of these economic changes, do the changes fall within a limit of acceptable change to the First Nation or is this a situation where no replacement (in terms of resource or place) is deemed acceptable (therefore the loss is potentially an irreversible one)?

5.2.5. Cultural and Spiritual Impacts

The First Nations are concerned that the impacts of lower water flows on their ability to harvest resources, to access culturally significant and spiritual/sacred places, and to travel on the river will further erode their ability to practice their culture, to reinforce their cultural knowledge (e.g., traditional environmental knowledge), and to provide opportunities for passing their culture and knowledge on to younger generations. This leads to the loss of cultural knowledge and values and is in opposition to the goals of the First Nations to sustain their cultures and traditional livelihoods for future generations. It is predicted that should the trend of increasing development continue, the traditional uses associated with the Athabasca River would likely change within less than one generation (Appendices A and B).

In addition, impacts to the aesthetic and sensory conditions, and the conditions by which a First Nations person might define the “health” or ecological integrity of a certain place on the land can impact the spiritual or sacred values associated with the land. This can impact the First Nations uses of the land (or waters) for spiritual purposes. There may be no alternatives or appropriate (as evaluated from the perspective of the potentially affected members) replacements for this loss. Further research is required into this issue as there is inadequate recorded information on spirituality and sacred values in order to inform an adequate assessment of this type.

5.2.6. Impacts to Individual and Community Health

The First Nations are concerned that they will suffer impacts to their individual and community health as a result of lower flows in the River. For example:

- What will be the health impacts of reduced harvesting of traditional foods? Health impacts might relate to replacement of traditional foods with store-bought foods, which have poorer nutritional value, and might relate to reduced physical activity. To answer this question, a much more comprehensive understanding of traditional foods use for each First Nation is required. In addition, a much better understanding of the preferences that underlie the harvesting and consumption of traditional foods is required (for example, how is “contamination” defined, recognized and evaluated by individual harvesters or consumers?).
- What are the direct health effects of consuming contaminants in traditional foods? Do these contaminants have synergistic effects amongst themselves, or amongst other contaminants common in every-day life (e.g., nicotine).
- What will be the health impacts (e.g., chance of increased injury and associated possible socioeconomic impacts that result from this, for example, loss of work time) of decreased safety related to navigability issues for river travel?
- What are the community and individual health impacts of concerns about contamination of water and traditional foods? How do these concerns affect individual and community feelings of security and evaluation of well-being? How do these concerns influence individual preference in respect to harvesting and consumption of traditional foods?

5.2.7. Cumulative Impacts

The First Nations have already experienced a number of impacts due to activities and facilities associated with oil sands development, other industrial land uses, and recreational land uses. More oil sands mines (e.g., UTS/Teck Frontier and Equinox, Shell Jackpine Mine Expansion and Pierre River Mine) and in-situ developments are proposed and new oil sands leases are under exploration (e.g., Imperial “Muskeg” lease, UTS/Teck Lease 421). The First Nations are concerned that the impacts of lower water flows on their ability to harvest resources, to access culturally significant and spiritual/sacred places, and to travel on the river will compound the effects of the cumulative industrialization of the Lower Athabasca Region on their culture, their rights, and their community and individual well-being. From the perspective of the First Nations, it would be erroneous to look at the impacts that would derive from lower water flows in isolation from the cumulative picture.

5.2.8. Evaluating Impacts from the Perspective of the First Nations

The First Nations assert that the evaluation of impacts that may incur from lower water flows in the Athabasca River require the application of their traditional knowledge and their values in the assessment. Furthermore, they assert that the establishment of a First Nations “in-stream flow need” is necessary to evaluating the impacts and acceptability of alternative flow regimes, which would provide information necessary to inform a meaningful consultation process. A threshold based on the perspective of the First Nations would allow comparisons of alternate flow regimes to make clear what the levels of possible impact would be.

5.2.9. Meaningful Consultation

The First Nations are concerned that a decision on the Phase II water management framework will be made without appropriate consultation occurring. Meaningful consultation requires fully understanding what the impacts of a proposed activity or plan will be on the Section 35 rights of the affected First Nation(s) and requires that appropriate actions are taken to substantively address the concerns (whether through mitigation, compensation or accommodation).

5.3. EVALUATING IMPACTS: FIRST NATIONS IN-STREAM FLOW NEED

The First Nations assert that developing an “in-stream flow need” that is particular to their First Nation is necessary to fully explore possible impacts of alternative flow regime scenarios and to inform the evaluation of predicted impacts. The particular knowledge and values of each First Nation would be required to inform the assessment process. In-depth community consultation would be required on the predicted impacts, and on the proposals to address impacts.

At this time, there is insufficient information and capacity to develop a First Nations in-stream flow need. It is likely that the development of this type of threshold would be an interdisciplinary exercise that would require a variety of experts, including the traditional scientists and current harvesters of the First Nations. It would likely involve additional research on the particular conditions that underlies the preferred exercise of the First Nations’ rights. The particular kinds of questions that might be answered in the pursuit of such research are appended to this report (Appendix E, Information Requirements). Additional questions would be necessary as a better understanding of the required research unfolds.

Determining an instream flow need for ACFN and MCFN might depend on determining thresholds for three key limiting factors:

- Navigability of the River
- Hydrology of the PAD
- Water quality

For each of those three issues, the specific thresholds at which ACFN and MCFN experience impacts to their use need to be identified. We expect that this kind of assessment would be complex and perhaps beyond the scope of any one discipline.

Determining whether or not a specific change is an impact goes beyond identifying where people use the river or the land, and requires understanding preferences in terms of the economics of use and the hardship or burdens associated with forced changes to use. For example, can ACFN and MCFN harvesters afford new technologies that would help to support use of the river at lower flows? How far are people willing to pack meat and other resources by hand in order to get from the point of harvest to their boat? This kind of preference research has not yet been completed, requires specialized expertise, and is beyond the scope of the current study.

In addition, more specific research with land users and harvesters is required to examine when they experienced impacts to their use of the River. It would be important to get the river users' evaluation of how "severe" (or significant) the impact was and to pinpoint the years and seasons in which the category of impact occurred in order to cross-reference this against ecological conditions (e.g., flow rates) at that time. Comparison of impact, severity and conditions amongst different users/harvesters would allow a more thorough understanding of what the possible thresholds may be.

For the Peace-Athabasca Delta, one would need to analyze different flow regimes on the PAD (this is very complex) and incorporate information on uses, preferences and previous impacts (as described above) that would be obtained through interviews.

For water quality, this threshold has already been breached in respect to both drinking water and fishing. Research is required to determine what could be done to bring this back into an acceptable level, if possible. A comprehensive study is required to determine the sources of contamination and to implement tangible ways of mitigating the accumulation of contaminants in the River. Current guidelines that allow proponents to release wastewater so long as monitoring shows that guidelines are being met are problematic. As well, more research is required on the actual health effects of contamination in the river, as well as the health and well-being impacts of that derive from the ACFN and MCFN community's understandings about contamination in the river.

5.4. INFORMATION GAP OVERVIEW

Overall, there is a lack of detailed information on the key ecological, sociocultural, and economic conditions that underlie the system of river use and thus, it is difficult to make predictions or draw conclusions about what level of change would affect use or not. Detailed research on many ACFN and MCFN traditional activities has not been undertaken to any great extent and is largely unavailable.

A comprehensive understanding of the specific locations utilized by ACFN and MCFN members, including specific traplines, reserve lands, cabins, trails, and resource harvesting areas is not known. The specific relationships between water flows and use (for example, at what level of water does someone have difficulty accessing their cabin?) are not known in any great detail. It is evident from the information review that more work is required to determine the particular access conditions for use areas (e.g., reserve lands, traplines) in order to develop an understanding of what flow levels impact access (taking into account sociocultural and economic considerations such as seasonality of use, tools that support use, etc.). As well, it is likely that additional areas may be identified through further research. More work is required to identify use areas and to characterize the access conditions for these lines.

It was outside the scope of this study to provide an exhaustive list of plant and animal species utilized, the specific uses, and conditions of their use (e.g., seasonality considerations, etc.). In addition, it is possible that not all activities have been captured in this report.

Further studies are required to elucidate the network of relationships among traditional resources, harvesting activities, traditional social institutions (e.g., networks of exchange and reciprocity), and the various constituents of well-being (including cultural identity) for each First Nation. This would help to develop tools that would assist in bringing First Nation's rights and values into planning and decision-making.

5.5. POSSIBLE STUDIES

5.5.1. Cultural Needs Assessment

Further studies are required to elucidate the network of relationships among traditional resources, harvesting activities, traditional social institutions (e.g., networks of exchange and reciprocity), and the various constituents of well-being (including cultural identity) for each First Nation. Cultural needs assessments of this type would help to develop traditional resource use and management plans, which would include developing

thresholds for key species and ecological conditions (e.g., water flows in the Athabasca River) that are integral to sustaining the culture.

Such a study would be an interdisciplinary effort to develop an understanding of the key components supporting the meaningful practice of rights and the relationship of these rights to the culture and well-being of the First Nations. Among other things, this kind of study would gather resource use, health, socioeconomic, and ecological information and apply health and dietary assessment methods, ethnographic methods, social survey methods, and geospatial information analysis.

A cultural needs assessment study would support the development of a traditional resource use plan.

5.5.2. Traditional Resource Plan

A traditional resource use plan is a means of providing information to decision makers which will supplement existing information and fill information gaps – ultimately, consideration of this information will lead to a more credible system of decision making which integrates FN information. This kind of Plan is different than a traditional use or traditional knowledge study, which focuses on where resources were traditionally harvested and are currently harvested.

The purpose of a traditional resource use plan is to determine what resources are needed, now and in the future, to ensure the First Nations' abilities to exercise their harvesting rights now and into the future. The specific objectives of such a plan would be to:

- To provide credible, sufficient and reliable information on the land and resource needs of the First Nations to meaningfully exercise their Treaty and Aboriginal rights within their Traditional Lands.
- To identify culturally-appropriate thresholds for key ecological, sociocultural and socioeconomic aspects (e.g., specific resources, remoteness, aesthetics, contaminants, language, etc.) that sustain the exercise of the First Nations' Treaty and Aboriginal rights.
- To assist the First Nations, industry, and the Crown in making decisions about resource development by identifying land and resource management strategies that ensure continued exercise of rights (e.g., protected or conservation areas; hunting restrictions; set-backs; timing windows; access management; etc.).

5.5.3. Further Study on Muskrat Health and Habitat in the PAD

The community engagement participants recommended that a study be conducted to compare muskrat populations in waterbodies in PAD that are fed by the Athabasca River. Further consultation is required with knowledgeable members of the First Nations to scope this type of study.

5.5.4. Water Quality

Members of the First Nations have expressed that acceptable levels of water quality have already been breached. We understand that the Phase II Water Management Framework is about managing water quantity, not quality, per se. However, it is important to examine what effects changing flows could have on water quality (and ultimately human health). For example, do the effects of contaminants increase at lower flows? As increasingly contaminated waters fill the PAD (as a result of air deposition of contaminants, perhaps), will decreased dilution (as a result of reduced flows leading to drying of the perched basins in the PAD) result in ecological effects (e.g., increased muskrat mortality?).

Regarding water quality, research is required to determine what could be done to bring this back into an acceptable level, if possible. A comprehensive study is required to determine the sources of contamination and to implement tangible ways of mitigating the accumulation of contaminants in the River. Current guidelines that allow proponents to release wastewater so long as monitoring shows that guidelines are being met are problematic. As well, more research is required on the actual health effects of contamination in the river, as well as the health and well-being impacts of the perception of contamination in the river. More research is also required on whether impacts to habitat quality or stressors to aquatic life (such as fish species) that derive from reduced flows are increased in combination with contaminants in the water.

Even if the changes to water flows in the PAD are the result of natural causes, and within the natural range of variability, the potential for water withdrawals from the Athabasca River to exacerbate changes that ultimately link to impacts on ACFN's rights, traditional uses and culture should be examined.

5.5.5. Community Based Monitoring

The First Nations either have existing, or in the process of developing, community based monitoring (CBM) programs. These programs provide a way of integrating First Nations values into the monitoring and evaluation of environmental quality and related rights-based issues in the Lower Athabasca Region. It is quite possible that the CBM programs would be a good forum within which to gather information necessary to gather and understand information about the impacts of alternative flow regimes on the rights and

traditional uses of the First Nations. This could help to evaluate whatever eventual impact hypotheses are derived in the P2FC process (with the understanding that the P2 Water Management Framework may require amendments as additional information arises). There may be other relevant applications of the CBM programs.

5.6. COMMUNITY REVIEW AND VERIFICATION

Community review and verification of this draft report is required prior to its finalization. Such a review was not possible due to resource and time constraints. Community engagement participants stated that their information cannot be used unless a verification meeting is held with all participants. In addition, it is possible that this report has missed key activities or concerns. ACFN IRC and MCFN GIR would like to discuss this further with DFO.

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Dear Mr. Marriott and Mr. Makowecki

RE: Technical Reviews of the Phase 2 Framework Committee Recommendations

We are pleased to submit the Athabasca Chipewyan First Nation (ACFN) and Mikisew Cree First Nation (MCFN) Technical Reviews for the Phase 2 Framework Committee Recommendations. These reviews are based on the results of third party research undertaken by Aqua Environmental Associates, Firelight Group, and Applied Aquatic Research Ltd., and the preliminary results of a study of traditional use of the River, including community engagement, conducted by Firelight Group on behalf of the ACFN and MCFN. The Athabasca River is central to the identity, culture, well-being and the meaningful practice of Treaty and aboriginal rights for both ACFN and MCFN. Recent traditional use work provides evidence that these rights have been already adversely affected. The work conducted by the Phase 2 Framework Committee (P2FC) does not provide certainty to our First Nations that these rights will be sustained under future water withdrawal scenarios.

The meaningful consideration of Treaty and aboriginal rights in planning and decision-making requires properly identifying and understanding the criteria, thresholds and measures that support the

meaningful exercise of these rights. In the case of the Phase 2 Framework, our synthesis report provides recommendations on developing the necessary ecological thresholds, and implementing preliminary navigation-based thresholds (ABF/AXF) to sustain the ACFN and MCFN Treaty and aboriginal rights with respect to the Lower Athabasca River. The accompanying Technical Reviews provides recommendations to Alberta and Canada on these preliminary thresholds and other steps necessary to develop a Phase 2 Framework under which the Treaty and aboriginal rights of the ACFN and MCFN would be properly considered and sustained. In addition, in the final Technical Review we have provided recommendations on next steps in a meaningful consultation process.

Meaningful consultation on the Phase 2 Framework will require a full understanding of the impacts of the plan (and water withdrawals under the plan) and that appropriate actions (mitigation or accommodation) are taken to substantively address those concerns. In addition, it will require direct consultation with the ACFN and MCFN by various agencies of the Crown that have responsibility for the concerns we have identified in the Synthesis Report and in the Final Technical Reviews. The Federal agencies include: Department of Fisheries and Oceans (DFO), Transport Canada, Indian and Northern Affairs Canada, Parks Canada, and Health Canada. The Provincial agencies include: Alberta Environment (AENV), the Land Use Secretariat under Alberta Sustainable Resources Development, and Alberta Aboriginal Relations. We expect that DFO and AENV, as the responsible authorities on developing the Phase 2 Framework, will work with the ACFN and MCFN to ensure that these Federal and Provincial agencies are at the consultation table on these matters of concern.

We invite these agencies to meet with us so that we may share the specific results of our traditional use study reports and mapping products and to discuss the results of our reviews before the Phase 2 Framework is finally implemented.

Sincerely Yours,

<original signed by>

<original signed by>

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Hon. Mel Knight, Minister Alberta Sustainable Resources Development
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TECHNICAL REVIEWS

LOWER ATHABASCA RIVER (LAR) THE PHASE 2 WATER MANAGEMENT FRAMEWORK

**A REVIEW OF LOWER ATHABASCA RIVER INSTREAM FLOW
NEEDS & THE PHASE 2 WATER MANAGEMENT
FRAMEWORK- FISHES AND THEIR HABITAT.**

**REVIEW OF THE ATHABASCA RIVER PHASE II FRAMEWORK
COMMITTEE (P2FC) REPORT, JANUARY 2010 - ABORIGINAL
KNOWLEDGE, USE, INTERESTS AND RIGHTS**

**REVIEW OF THE PHASE TWO FRAMEWORK COMMITTEE
NON-CONSENSUS RECOMMENDATION FOR THE LOWER
ATHABASCA RIVER**

*Hydrology, Geomorphology, Basin Issues, Decision
Framework*

**Athabasca Chipewyan First Nation (ACFN) and the Mikisew
Cree First Nation (MCFN)**

23 August 2010



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While the authors endeavored to state factual and relevant information (within the scope of the study), nothing in this report should be constituted as a definitive list of: concerns, impacts, needs, rights, and uses nor should it be taken as a limitation on the uses or rights of both First Nations. We reserve the right to alter, amend, revise, or update any portion of this report to reflect the fluid and emerging interests of both the ACFN and MCFN.

**A REVIEW OF LOWER ATHABASCA RIVER INSTREAM FLOW NEEDS & THE
PHASE 2 WATER MANAGEMENT FRAMEWORK- Fishes and their habitat**



Submitted to:

**Athabasca
Chipewyan and
Mikisew Cree
First Nations**
Fort MacKay and
Fort McMurray,
Alberta

Submitted by:

**Applied Aquatic
Research Ltd.**
Calgary, Alberta

July 2010
File: AAR10-20

**A REVIEW OF LOWER ATHABASCA RIVER INSTREAM FLOW NEEDS and the
PHASE 2 WATER MANAGEMENT FRAMEWORK – Fishes and their habitat.**

Submitted to:

Athabasca Chipewyan and Mikisew Cree First Nations
Fort MacKay and Fort McMurray, Alberta

Submitted by:

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July 2010
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1.0 INTRODUCTION

1.1 Project Overview

The pace of development of the oil sands region of northeastern Alberta has accelerated since 1990. Both open-pit oil sands mining and *in situ* extraction, such as steam assisted gravity drainage (SAGD), require appreciable volumes of water as part of the industrial process. The outcome of hearings into oil sands projects in the mid-2000s was an initiative on the part of provincial and federal regulators to define minimum instream flow needs (IFN) for the lower Athabasca River (LAR). This was undertaken by the Cumulative Environmental Management Association (CEMA). In 2006-2007, when CEMA could not reach a conclusion regarding an IFN for the LAR, Alberta Environment (AENV) and Fisheries and Oceans Canada (DFO) introduced the Phase 1 Water Management Framework to guide water withdrawal. This approach was relatively simple and based on water withdrawal cut off (almost) during “red”, reduced withdrawal during “yellow”, and full permitted withdrawal during “green” discharge ranges. These ranges correspond to the following thresholds: “potential sustainability”, “cautionary”, and “sufficient water availability” for maximum withdrawal, respectively. Phase 1 is in effect until September 2010 at which time the Phase 2 (long-term) Water Management Framework (P2WMF) is to be in place based on the current state of hydrological and biological science.

To establish more formal guidelines for water withdrawal, the Instream Flow Needs Technical Task Group (IFNTTG) of CEMA examined various Evaluation Criteria (EC) and supplied findings and technical details to the Phase 2 Framework Committee (P2FC) which included regulatory, industry, and First Nation stake-holders. The P2FC also received input from sub-committees that investigated water needs of industry, effects of climate change, socio-economic needs (including traditional use), and ecosystem base flow (EBF – that flow below which there may be irreversible stress to the aquatic ecosystem).

The summary report of the P2FC (Ohlson *et al.* 2010) brings together a collection of insight from Delphi-type analyses, scientific studies, and models to inform the establishment of a next generation of water management rules for the river (AENV 2007). Volume 1 of the P2FC report describes options for management of the Athabasca River with particular reference to three key interest areas: Ecosystem Health, Traditional / Public Use, and Sustainable Economic Development. A second volume of technical appendices accompanies Ohlson *et al.* (2010).

The P2WMF rules conceived of by the P2FC result from selected scientific studies and reviews looking at climate change, hydrology, geomorphology, fishes, fish habitat, and traditional uses. Of these issues, by far the most studied by P2FC are fish and fish-habitat issues, while the least studied was traditional use. Option H is the recommendation preferred by the P2FC and is the recommended option that regulators adopt in the P2WMF. Option H, which was determined without consensus, but was reached by various stakeholders attempting to balance water withdrawal, costs of onsite storage, and loss of fish habitat potential (productive capacity) has been the focus of much of the P2FC’s work. Based on the outcome of the committee’s work, a maximum low flow withdrawal for industrial use of 4.4 m³/s at a minimum instream flow (EBF) of 87 m³/s has been proposed.

The Canadian Science Advisory Secretariat (CSAS) recently hosted a National Advisory Workshop on Athabasca River In-stream Flow Needs to assist DFO Science. Its purpose was to provide DFO Habitat Management with advice (*i.e.*, a Science Advisory Report, SAR) regarding instream flow needs and their

assessment in the LAR. Instream flow needs are the quantity, timing, and variability of flow required to maintain desired levels of population biomass and biotic diversity (Poff *et al.* 1997).

1.2 Review Objectives

The Mikisew Cree and Athabasca Chipewyan First Nations retained Applied Aquatic Research Ltd. (AAR) to review and comment on the merit of the science and predictions by the P2FC. We reviewed the rationale, approach, results, and interpretation of the minimum recommended discharge necessary to support a viable ecosystem in the LAR (the IFN for the river).

Specific objectives of this review are to answer three questions within its subject areas, and with respect to the work carried out under the auspices of the P2FC:

1. Is the science behind the fish biology and habitat modeling sufficient to provide confidence in an IFN for the LAR?
2. Is the Option H IFN sufficiently precautionary to avoid challenges to the integrity of the aquatic ecosystem in the LAR and Peace-Athabasca Delta (PAD) over time?
3. What are the consequences of the Option H IFN for fishes and their habitat?

The following are the findings and implications of our technical review of the components used to determine the IFN for fishes and their habitat within the P2WWMF for the LAR. The issues identified here are compiled in a final synthesis report brought together under several general topic areas: scientific uncertainty, decision framework, traditional use, monitoring, and adaptive management (ACFN, MCFN, *et al.* 2010). Based on these integrated findings, a collection of core recommendations will be provided that, if implemented, would help assure that aquatic resources have been addressed adequately from a science perspective.

2.0 APPROACH

We reviewed the rationale, approach, results, and interpretation of the minimum recommended discharge necessary to support a viable ecosystem in the LAR (the IFN for the river). Included in the approach was a comparison of the various flow scenarios on key variables and those factors which limit fish production in the river. Ultimately, the review team focused on that period of the year when flows are lowest for the discussion of water quality, quantity, and challenges facing fishes and their habitat given increased withdrawal of water from the river for industrial purposes.

Relevant discipline components of the comprehensive report, appendices, and meeting minutes undertaken by AENV and DFO to establish the IFN were reviewed (Ohlson *et al.* 2010). We reviewed the relevant literature provided associated with developing the fish biology metrics for the IFN (walleye - *Sander vitreus* recruitment, effective spawning habitat for lake whitefish - *Coregonus clupeaformis*), and those used to model fish habitat (longnose sucker - *Catostomus catostomus* habitat, amount and diversity of mesohabitat). This included P2FC Appendices B, C, D and E relevant to the modeling of fishes and their habitat, and earlier review of the original Phase 1 Water Management Framework.

The review also included attendance and active participation at the P2FC introductory meeting held by AENV for ACFN and MCFN in Fort McMurray (February 23, 2010). In addition, the team participated in a 5-day workshop from May 31 to June 4, 2010 held at the University of Calgary as part of the panel struck by the Canadian Science Advisory Secretariat (CSAS) to review the IFN proposed (Phase 2 Water Management Framework, specifically). We provided constructive input to the P2FC IFN recommendation on behalf of the First Nations which yielded additional insight and comment on additional parameters introduced for discussion (*e.g.*, revised lake whitefish spawning criterion at the CSAS workshop). Use of in-house library materials, extensive professional experience sampling fish populations in the LAR, years of review of oil sand proponent Environmental Effect Assessments and their information all contributed to the review and ultimately, recommendations made going forward.

3.0 TECHNICAL COMPONENTS

To understand and predict the potential effects of water withdrawal on fishes and their habitat in the LAR, it was divided into five segments, each containing a study reach several kilometers long. Reaches were assigned based on their being representative of riverine habitat in each of the segments (Paul and Locke 2009a; CEMA 2009). Detailed physical information was collected for each study reach and the fine-resolution data was used in the River2D hydraulic model. This model was the basis of quantitative modeling of various ECs for IFN determination for the LAR. Essentially, River2D quantifies how depth, water velocity, and substrate composition change with flow (*i.e.*, each is affected by volume of water according to channel profile and dimensions at a particular place). It is problematic that the largest error in the model coincides with lowest flows when the greatest understanding of requirements for aquatic resources is needed.

The process of devising the P2WMF was undertaken to determine IFN in the LAR. There is a historical flow record approximately 50 years long from 1957 and this is used as the basis for all modeling projections for water availability in the LAR. It is assumed that this time series is representative when it is used to evaluate effects of withdrawal on fish habitat. Whether it is representative of the longer term was discussed at the advisory workshop, particularly with regard to potential climate change trends. Associated with this is the EBF which is currently taken to be approximately 87 m³/s which happens to be the lowest flow in the historical record (*i.e.*, the ecosystem persists currently so the historic low flow must still be in excess of an EBF, or so the reasoning goes). Such rare events may happen; however, a low flow of 87 m³/s may be an anomaly and not an appropriate basis for determining cut-off flow for water withdrawal. Of more concern is the current lack of understanding whether the frequency of such flow is changing either in response to withdrawals or climate change. In principle, an EBF is supposed to ensure continued viability of fauna (fish and benthic invertebrates) and their habitats downstream from the industrial developments withdrawing water.

Several prevailing themes emerged from the CSAS National Advisory Workshop, of which the dominant is uncertainty in projections and conclusions for all parameters considered. In general, the IFN retains the following:

- appreciable residual uncertainty,
- how uncertainty compounds as one modeling result builds on another, and
- the uncertain influence of potential climate change on all factors inherent in IFN determination.

The importance of current uncertainty in both modeling (data deficiencies) and climate change (difficulty even in determining the direction of potential change) must not be underestimated. All these can influence fishes and their habitat in the LAR.

The seven ECs considered as part of the process are fish habitat, abundance and diversity of mesohabitat, channel maintenance flows, connectivity in the Peace-Athabasca delta (PAD), walleye recruitment, effective spawning habitat for lake whitefish, and dissolved oxygen concentration in fish wintering habitat. Those ECs immediately relevant to fishes and their habitat are discussed below.

3.1 IFN and Aquatic Ecosystem Health

Research into IFN has occurred for numerous watercourses in Alberta, of which the most relevant example (because it is not regulated) is the South Saskatchewan River (Clipperton *et al.* 2000). Historically, instream flow needs have been investigated using the Instream Flow Incremental Methodology (IFIM) and an IFN assigned based on the outcome of this effort (Bovee 1978). This approach relies on habitat use information at a microhabitat (highly detailed) level and provides for a useful interpretation of how habitat use relative to availability changes with flow. However, IFIM is less reliable in large sand-bottomed rivers such as the LAR and the South Saskatchewan than the meso-habitat (reach based) analysis (Clipperton *et al.* 2000; Anderson *et al.* 2006).

To summarize this process, the River2D model correlates wetted perimeter to depth and ultimately to habitat quality for a given fish species and life-history stage (fry, juvenile, adult, and spawning) for which physical preferences are known. These models have been used to define the minimum amount of water present in a channel such that no life-history stage of an individual species is vulnerable to extinction as a function of industrial operations on the river proper.

Most boreal, north-temperate freshwater fishes grow predominantly during the open-water season. Their metabolism increases with water temperature with maximum growth occurring at some optimum specific to each species and life-history stage. By November, *most* fishes have moved from fall spawning or summer feeding areas to those sufficiently deep to spend winter. These areas are typically deep enough to assure they will not be affected adversely by frazil ice (Brown and Mackay 1995).

Burbot (*Lota lota*) are an exception to this trend in that they reverse their life-history strategy. Burbot are “cold adapted” and take advantage of winter to grow and spawn from mid-late winter under the ice (Boag 1987). In the LAR, they migrate to from the PAD and lowermost reach of the river, to spawning habitat upstream from Fort McMurray (AAR 2008) and/or in selected tributaries (*e.g.*, Tar River: M. Janowicz, DFO, *pers. comm.*). Spawning (and feeding) migration begins in late-November through January in the Athabasca River (AAR 2009). Contrary to fishes like longnose sucker, northern pike (*Esox lucius*), walleye, and lake whitefish who winter in deeper sections of channel or pools in the lower reaches of tributaries such as the Clearwater River based on radio telemetry (Golder Associates 2004; AAR 2008). Several of the burbot tagged spent the latter half of the ice-covered period under thick ice (>1.5 m) and shallow water (<20 cm) along the periphery of the channel (AAR 2008). AAR (2009) hypothesized that these individuals selected shallow water because discharge was faster through these sections and thick ice provided capacity to minimize the proliferation of frazil ice.

3.2 IFN for the LAR

Meso-habitat and fish habitat

The IFNTTG, following a detailed process, incorporated three ECs deemed integral to functional integrity of the LAR ecosystem. These were river meso-habitat, lake whitefish spawning, and walleye rearing. The use of these three criteria to be evaluated in relation to output from the River2D modelling undertaken to quantify habitat losses and gains is appropriate. The IFN process relies on a series of models to address the risk to aquatic resources in the LAR and the PAD as discharge in the river changes

by season, year, and month. Of all the modeling undertaken, the fish habitat and fish biology model ECs were the most believable and managed conservatively in their output.

The River2D model estimates the area of individual depth and habitat preference criteria across a representative study reach in each of 5 unique segments of the LAR. The use of meso-habitat as a predictor of fish is useful to address ecosystem-based questions because groups (guilds) of fishes (and other fauna) can be found in each, but not all, of the 27 types identified for the LAR (Paul and Locke 2009b). For example, small-bodied forage fishes, juvenile coarse fishes, and sport fishes all co-exist in shallow water peripheral to the main channel. By mapping the shallow (<1 m deep) meso-habitat EC, one accounts for all these fishes in a given study reach and extrapolated across each segment. Specific questions can be asked based on this and the model used to predict the extent of a response. For example, one can ask the question: If wetted perimeter in the river shrinks by some percentage, what is the net loss to fish habitat?

To determine whether fishes and their habitat would be affected adversely under the regimen of withdrawals proposed, changes in weighted usable area (sum of habitat value of each unit area based on various fish requirements) in the representative reaches in response to changes in flow. These were deemed relevant to model for the IFN because habitat suitability curves existed for both species and all life-history stages. Note that this approach requires intensive data collection efforts, but may still be prone to not capturing dynamics among interacting components of the ecosystem. Hence, uncertainty remains.

The River2D model has incorporated depth, velocity, and substrate variables which permitted “lumping” of guilds of fishes. For example, small-bodied forage fishes prefer a specific combination of depth and velocity, so modelling the amount of habitat of a given depth and velocity for longnose sucker juveniles, allows extrapolation to all small-bodied fishes for which HSCs may not exist; however, this is not included specifically in this exercise. This will require validation, but is intuitive based on experience in the river.

Overall, the mesohabitat approach to model how change in flow could affect fishes and their habitats was well conceived and reproducible in its simplicity. This approach provided duplication of prediction across individual species for which HSCs have not been validated, or do not exist. However, it is not confirmed that using only depth, water velocity, and substrate composition is not too simplistic; this could be remedied in part by further data collection and field validation.

Paul and Locke (2009) reported how habitat types (meso-habitat as defined by depth, velocity and substrate composition) in the LAR would respond to change in flow during the open water and ice-covered periods. They modeled what kinds of meso-habitat would experience the greatest net change in their attractiveness as such for fishes in the river. The approach taken is rigorous (large sample size) and scientifically defensible. That is, although much of the process is qualitative, the approach to assigning value to individual habitat is based on years of experience and research. They concluded that loss of wetted perimeter during winter posed the greatest challenge to fish habitat.

Lake whitefish spawning and walleye recruitment

To determine whether habitat would be affected adversely under the regimen of withdrawals proposed, recruitment by walleye and spawning by lake whitefish were examined in more detail. Furthermore, both lake whitefish and walleye rely on connectivity to gain access to their spawning and rearing areas in the LAR. This also is an issue for species such as burbot that migrate upstream from the PAD to the rapids upstream from Fort McMurray to spawn in winter when flows are lowest (AAR 2009).

Lake whitefish and walleye are regionally important sport fishes and historically, comprised an appreciable role in the traditional (domestic), commercial, and sport fisheries in Lake Athabasca. The LAR is used as a migration corridor for at least one population of walleye and lake whitefish. Both have discrete spawning habitat requirements that in which eggs are broadcast over unembedded coarse substrates. Both the lake whitefish spawning and walleye juvenile rearing ECs are valid in that the parameters singled out for modeling (depth and substrate) are accurate and their assignment on a segment basis in the River2D model is correct. This assumes assumptions provided in the ECs are accurate and uncertainty minimized by applying the meso-habitat criterion as another layer in the model.

The lake whitefish spawning EC and HSCs used originally to relate change in wetted area to habitat loss for this species and life-history stage were reasonable. The original model is an accurate and useful tool to help predict effects on this species and life-history stage. However, this model was revised recently to include sand as suitable substrate for lake whitefish spawning in the river. At the CSAS workshop, additional material was presented which revised habitat suitability to include sand as a component of substrate used the EC for lake whitefish spawning. This overestimates grossly the distribution of possible spawning areas for this species (and others such as walleye and longnose and white sucker). The argument put forward by Alberta Sustainable Resource Development (ASRD - P2FC) was that sand was not included in the substrate component for lake whitefish reported to spawn over sand in select lakes (A. Paul, *pers. comm.*).

This model needs to be revised to exclude sand since spawning areas are discrete in the river (and selected tributaries) and these locations do not include sand as the dominant substrate. The revised lake whitefish spawning EC is incorrect for the following reason. Lake whitefish spawn occasionally on hard pan, sandy bottoms in certain lakes. The key is that sandy shoals on windswept lake shores are firmly packed through wave and wind action. Including sand as suitable substrate for spawning of lake whitefish in the Athabasca River is not appropriate. That a small change in characterization of substrate suitability changed conclusions greatly points to the fact that uncertainty is inherent in the modeling, and that further field validation and better parameterization of models used is needed.

Juvenile walleye rear in the PAD and require access from the distributaries and perched lakes. Loss of connectivity between the PAD lakes and distributaries could be exacerbated with depressed water levels associated with a combination of factors. This puts walleye (and other species) at risk because uncertainty associated with connectivity remains high. It worth noting that in evaluation of this EC issues associated with walleye recruitment were presented in the most scientifically satisfying manner of all ECs. Consideration included sophisticated application of model selection tools, clear explanation of the stock-recruitment model used, evaluation of population viability, appropriate sensitivity analysis, and forthright statement of assumptions and uncertainties. Clear statement of sources of uncertainty points to the direction for further study, data collection, and analysis.

Connectivity in the PAD

Only a single perched basin and a single channel were investigated to quantify the relationship between discharge and connectivity (Ghamry *et al.* 2009a,b). Data for these two locations were used in subsequent modelling, but uncertainty inherent in the modeling is compounded by simple lack of sample size. Uncertainty in the River2D modeling coupled with that for climate change regionally produces unease in terms of our confidence in the model predicting the complexity of what could happen to fishes and their habitats in the LAR during winter or other periods of low flow. Stakeholders are concerned about the loss of connectivity between the PAD and Lake Athabasca.

There is great uncertainty associated with climate change that could reduce flows beyond that which has been predicted. Consequently, at low flow the potential exists for much of the channel to freeze to bottom in Segments 2 and 4. Segment 4 especially is the most braided, shallow, and widest portion of the river. Shallow areas are also present in Segment 2 with depths modeled at 0.3 m. Loss of connectivity is common in summer and undoubtedly strands fishes. Nevertheless, isolation of deeper sections of channel may affect the ability of fishes to winter successfully in either reach. Telemetry data from the winters of 2004 and 2007-2008 confirm that fishes spent the winter in deeper pockets of water in both segments.

Although fish populations remain viable following rare events experienced to date (*i.e.*, the occurrence of 87 m³/s in the historical record), how freezing and thawing processes could displace or trap fishes in segments, or impair under ice migration remains uncertain. If surface discharge “trend” is a progressive reduction in volume during winter, the flows that approach that of a theoretical EBF occur more frequently. Again, the extent and magnitude are uncertain.

The role groundwater plays in boosting flow in the LAR has always been downplayed by proponents. Water chemistry data collected last winter by Golder Associates on behalf of AENV suggests a definite link between groundwater and surface water (P. McEachern, AENV, pers. comm.). The proliferation of SAGD oil sand facilities on the uplands, and their tapping of aquifers that ultimately underlie the river have been purported to have negligible effects on surface water in the Athabasca River (RAMP reports, P. McEachern, AENV, pers. comm.). The link between surface flow in the LAR and groundwater in the upland needs to be quantified, or at least qualified as a minimum and demands further investigation.

Water Quality and Dissolved Oxygen Concentration

A single EC related to water quality was evaluated as part of the P2FC process. Dissolved oxygen (DO) concentration in wintering habitat was modelled as a function of flow and found not to be affected appreciably (McEachern 2009). DO concentration that is too low renders habitat unusable for fishes, and this may be most likely to occur during winter under ice. However, other water quality parameters were not considered at all. There was no consideration of what the effect of reduced capacity for dilution of potential pollutants might be under a regime of water withdrawal when flow is low. Given the growing understanding that oil sands development does contribute to pollution of the Athabasca River (*e.g.*, Kelly *et al.* 2009), it must be determined whether the magnitude and timing of alterations to

flow for industrial use will lead to deterioration of water quality with its concomitant effects on biota. Quantitative assurance is needed that water quality will not be affected, or that current problems will not be exacerbated by water withdrawal.

The essence of the model for DO concentration is the interaction between decay in oxygen concentration by respiratory processes and change in area susceptible to enhanced decay (or lack of re-aeration) because of lost connectivity caused by water withdrawal. DO concentration in side channels or other areas susceptible to dropping water level may be affected by water withdrawals if connectivity is lost and lack of flow results in oxygen depletion by respiratory processes (*i.e.*, biochemical oxygen demand). DO concentration itself will not be the factor most likely to become limiting during water withdrawal based on the modeling exercise undertaken; the percent of channel area sensitive to DO decline was typically less than 5%.

However, uncertainty arises from the River2D model and whether it was accurate in estimating water depths and velocities in areas susceptible to loss of connectivity.

Other water quality parameters were not considered. For example, the effect of reduced capacity for dilution of increasing pollutants given a regime of increased water withdrawal and decreased flow was not assessed. Until now, there has been a general understanding that mineable oil sands operations result in large surface disturbances (*e.g.*, tailings ponds and overburden dumps) on the land. Given that these features are all located within the LAR's watershed, the potential for these sources of pollutants to pollute the Athabasca River might seem obvious. Tailings ponds are constructed with sand dikes that are designed to leak, not seal. Overburden dumps contain high sodic materials that eventually will migrate down slope. These features will require maintenance for a long time, given the risk to the LAR and further downstream, if they fail.

Potential sources of pollutants are relevant to consideration of IFN because development and the risk for release increase while increased water withdrawal reduces the capacity for any dilution. Despite efforts to avoid releases, they will occur and the frequency will increase with further development which means that the absolute amount of pollutants released will increase. However, water withdrawal implies less volume of water to dilute pollutants and possible increased concentrations of certain substances. A common approach in environmental impact assessments is to model projected concentrations of substances of concern and compare results to guidelines for water quality. No such consideration was given in the current process for establishing an IFN.

As yet, cross-lease and regional approaches to reconstruction of surface drainage on the landscape appear to be absent. Instead, long straight trenches are being approved along lease boundaries. No consideration is evident with respect to re-establishing a normalized pattern of surface to groundwater recharge and groundwater to surface discharge.

The other major source of risk comes from the processing plants and pipelines. Spills, leaks, fires, explosions, equipment malfunctions, pipeline breaks, excessive emissions and other "upset conditions" have become part of the accepted norm.

Given the expected increases in both disturbance features and process upsets, some work has been undertaken to document the current "baseline". The initial conclusions are that oil sands development

does contribute to pollution of the Athabasca River (e.g., Kelly *et al.* 2009). The next modeling challenge will be to assess increased stressors and decreased flows against water quality and biota. It seems intuitive that the directionality of those model outputs will indicate further stress, unless the landscape features are reduced in size and number, and the plant processing controls are improved.

3.3 LAR Habitat Limiting Factors

Wintering of Fishes

Fishes in north temperate boreal watersheds are most vulnerable when discharge in the watercourses they reside in is lowest. Typically, this is experienced in late-summer, late-fall, and through winter during the ice-covered periods. For the Athabasca River, this period extends from late-October to April. Fish populations are also vulnerable to summer kill in late-summer to early-fall following prolonged elevated air temperatures and low flow. A river's ability to remain sufficiently oxygenated is compromised as water temperatures climb above 20°C. The warmer the water, the lower is the oxygen concentration in it.

In winter, reduced flow and depleted oxygen concentration results because of ice cover, lack of photosynthesis, and respiration (rotting of organic material) at the sediment water interface. With progression of winter, thickening ice cover and shrinking wetted channel area, frazil ice and lower DO concentration can lead to challenges for fishes wintering in a given area (Brown and Mackay 1995). Should DO concentration decline below 5 mg/L in most boreal water bodies under ice cover, the threat of winter kill on regionally important commercial, domestic and sport fishes - walleye, lake whitefish is heightened (Barton and Taylor 1996). Northern pike, white sucker (*Catostomus commersonii*), longnose sucker and the forage fish guild are able to endure periods of lower dissolved oxygen concentration during winter. However, should DO concentration remain significantly depressed (<3 mg/L) for extended periods, these species too, can suffer mortality (Barton and Taylor 1996). Water withdrawal may exacerbate natural tendency for decrease in DO concentration. In general, the shallower the water body, the lower the DO concentration by late-winter and the higher the risk is to resident fishes of winter kill.

Golder Associates (2004) tagged numerous sport and coarse fishes in the LAR to determine their winter habitat preference and movements. This study found that fish wintered in shallow, slow-velocity habitat with fine substrates. Most fish marked with radio transmitters wintered within the mainstem LAR, at tributary confluences, or within tributaries (e.g., Clearwater River). Most wintered in Segments 4 and 5.

Role of peripheral habitat

The most valuable habitat for fishes (and invertebrates) in the LAR is that which is associated with the periphery of the river. Cover for fishes are largely in the form of depth and turbidity. The channel shifts regularly given its predominantly sand composition. The Northern River Basins Study found that fishes used shallow peripheral habitat (backwaters) within which to rear and feed, and the edges of the thalweg along the periphery of the channel regardless of erosional or depositional nature along which to

migrate (Boag 1992; NRBS 1994a,b). Snyes (large backwaters associated with islands and peninsulas more common to Segments 2 and 4) are concentrators of fishes during summer (feeding) and as staging areas during spring and fall migrations where fishes literally “catch their breath” while ascending the river (Boag 1992; NRBS 1994a,b). Loss of wetted perimeter during spring post-freshet and late summer periods could compromise the integrity of these habitats. Again, cumulative effects of proliferating SAGD operations and expanded mining are not well understood and adaptive management remains the mechanism by which adverse effects will be mitigated (CSAS proceedings).

The Peace-Athabasca Delta

A number of researchers have investigated aspects of fish population and ecosystem structure and function in the PAD (*e.g.*, Donald 1977, Donald and Kooyeman 1974). What is evident is that the PAD is richly diverse in its species assemblages, supports important spawning and rearing habitat for several species of fishes (NRBS 1994a,b; Paul 2009a,b). What is not well understood is the relationship between discharge in the LAR and consequences to fish populations in the in the PAD. Paul (2009) demonstrated that discharge in the LAR and lake level in Lake Athabasca affect walleye recruitment. The following remain to be investigated:

- *Limiting factors for the PAD:* It is well documented that operation of the WAC Bennett Dam on the Peace River has shrunk the average wetted perimeter of the north side of the PAD (if not all of it). This represents a loss of productive capacity which remains in contention between stakeholders. How the IFN in the LAR will affect wetted perimeter (habitat, meso-habitat, and walleye recruitment) remains to be determined.
- *Role of perched basins and “guilds” of fishes:* The meso-habitat EC requires validation to ensure that small-bodied forage fish guilds are using the habitat preferences suspected. It is probable that this use of habitat in the LAR can be translated to the PAD perched basins since these are rich in production during spring and summer, when used by juveniles and the forage fish guild.

3.4 Uncertainty

Examination of ECs related to fishes and their habitat was technically challenging, data-intensive, but leaves large residual uncertainty because of lack of data and lack of incorporation of potentially important ecological interactions. Where there is uncertainty, the implications of any recommended regime of permitted water withdrawal will not be understood properly. It cannot be over-emphasized that the effects of allowing water withdrawal, particularly at times of low flow, are not understood fully. Notwithstanding the technical expertise applied to the examination of ECs, uncertainty remains and it can be resolved only by further data collection, modeling, and involvement in basic science that deals with the complexities of the ecology of such a large system. Uncertainties are examined in more detail in the paragraphs that follow.

Paul and Locke (2009a,b) discuss explicitly the assumptions and uncertainties associated with the fish habitat EC. What should be emphasized is that uncertainties at each stage of this process may be compounded (additively or multiplicatively) and it remains unclear how this affects predictions regarding water withdrawal, particularly at low flow. Evaluation depended on habitat suitability criteria (HSC) curves that are derived from relatively sparse data and expert opinion. The current HSC curves may be the best starting point available currently, but they still require considerable field validation effort. The derivation and shape of HSC curves is a source of uncertainty, and this uncertainty must be dealt with explicitly and quantitatively (*i.e.*, get more data and model sensitivity to change in shape of HSC, respectively). HSC curves are used in conjunction with habitat modeling to calculate the weighted usable area (WUA) index which is, in turn, assumed to relate linearly to fish population parameters. This ignores ecological complexities that are essentially intractable given the current state of data. Whereas the assumption is explicit, it does introduce uncertainty that may render conclusions unreliable. Various life-history stages for six fish species are recognized in the HSC curves used and the WUAs calculated. Gard (2005) assessed variability in flow-habitat relationships for rainbow trout by bootstrapping from transects used as data in IFN determination. This exercise evaluated the sensitivity of the shape of HSC curves and showed that aspects of fish biology may be differentially sensitive to the amount of data used to calculate WUA. Such an approach might be a useful starting point for determining the appropriateness of HSCs used for establishing an IFN for the LAR, but this statistical exercise also requires and large amount of data to begin with and that available may not be sufficient.

Water withdrawal regimes were examined for their predicted effect on loss of habitat during sensitive life-history stages for the species examined. Unfortunately, percentage losses in habitat were compared to somewhat arbitrary guidelines that do not recognize inherent ecological complexities. For example, for periods when habitat is likely to be limiting, only a loss of 0% would be negligible, >0-<10% may result in a reversible population decline, and $\geq 10\%$ loss would likely cause a decline that might not be reversible. Professional judgement is, in part, the basis for these cut-offs which is not satisfactory given that this is a poor surrogate for actually understanding which ecological interactions matter most and what the quantitative nature of these interactions is.

The mesohabitat EC was examined to understand how flow might affect broad habitat types defined by water depth, water velocity, and substrate type as output from the River2D hydraulic model. Preservation of mesohabitat diversity should result in maintenance of associated biotic diversity and dynamics. In essence the same criticism applies as for fish habitat evaluation: ecological complexities

may be masked over and important interactions ignored. Considerable field validation and data collection is required to allay uncertainty regarding the results of the evaluation.

With respect to examination of walleye recruitment and lake whitefish spawning ECs, validation of current HSC curves is of paramount importance recognizing that collecting such data, particularly where telemetry is involved, is a daunting exercise. It is acknowledged, for example, that mechanistic information regarding basic ecological interactions such as competition and predation and their potential effects on walleye recruitment are lacking (Paul 2009b).

Wherever uncertainties and assumptions are recognized in ECs related to fishes and their habitat (Paul 2009a,b; Paul and Locke 2009a,b) the respective analyses continue with the best data currently available. It is readily apparent that assumptions require validation through further data collection, but in the absence of such information, it is critical to have a formal analysis of the magnitude of compounding uncertainty (it is even unknown how uncertainty may increase through successive steps of modeling and examination of ECs). If the fish biology ECs and habitat metrics modeled are to provide sufficient confidence that a precautionary approach to managing IFN, then it will be necessary to understand better and quantitatively the potential effects of this uncertainty.

Each report prepared for the P2FC acknowledges the inherent uncertainty in their respective introductory paragraphs. The blanket reference to Annear *et al.* (2004) and Anderson *et al.* (2006) at start of each of the EC reports is unsatisfactory as it recognizes their call to be explicit regarding complex interactions, non-linear ties, *etc.* that generate additional uncertainty and then disregards it.

3.5 IFN and Precautionary Flow

Since no consensus exists on what is an appropriate Ecosystem Base Flow (EBF) in the LAR, it was agreed at the CSAS National Advisory Workshop that the EBF should actually be deemed a Precautionary Flow. At some point, withdrawal must cease to ensure that integrity of aquatic resources downstream is not compromised, particularly given the uncertainty associated with all aspects of evaluation. This should be deemed the EBF.

It is unlikely, for example, that peak withdrawals of 34 m³/s when there is 700-800 m³/s in the river would cause measurable ecological change in the river. However, any diversion of the base flow during the winter when flows are extremely low is cause for concern. The risk to the integrity of the aquatic ecosystem in the lower river with diversion during low flows is recognized (CEMA 2009). The Phase I Water Management Framework proposed that all diversions <11 m³/s would be permitted during extreme low water conditions, more diversion (11-13 m³/s) in somewhat higher water conditions, and allow a maximum of 15 m³/s in normal and above normal conditions (*i.e.*, red, yellow, and green ranges introduced at the outset).

Whether in open water or ice-covered, should the Athabasca River ever drop below 100 m³/s at the upstream boundary of Reach 4, then measures must be in place to provide both industry and first nations with assurance that their interests will be protected at lower flow. The current P2FC recommended precautionary flow for the Athabasca River downstream from the City of Fort McMurray is 87 m³/s. At this point, no water should be withdrawn to protect the interest of fishes and their

habitat (Solstice 2009). Consensus could not be reached by the committee with respect to cessation of withdrawal at this flow. Proponents do not want to jeopardize their operations and in all four proponent's cases currently withdrawing water from the Athabasca in Segment 4 (CNRL, Syncrude, Suncor, and Shell), require a minimum 0.2 m³/s each to prevent their plumbing infrastructure from freezing in the event of precautionary flow being realized upstream.

Some current users may reduce voluntarily by 50% of their maximum allowable withdrawal volume under license from the river as part of Option H (still allowing 4.4 m³/s withdrawal at discharge corresponding to the 50-year low flow). However, this should be reduced further to <1 m³/s to allow only for industrial infrastructure currently installed in the river from being compromised. This would put the onus on proponents to improve water chemistry of their holding ponds and use it to maintain production levels during the low-flow period in the LAR. Perhaps there should be NO withdrawal from the river when discharge drops below 100 m³/s. The argument put forward is that since there is no data which provides a clear understanding of how fish populations, water quality (e.g., dissolved oxygen concentration, turbidity), frazil ice formation, surface ice thickness and consistency respond when discharge in the Athabasca drops below 150 m³/s in year's such as 2002 when the river experienced the lowest discharge measured over some 50+ years of record. The degree of risk and confidence in ability to forecast effectively would improve if one did not have to rely on speculation.

The EBF generated through the P2FC process remains in contention which is a measure of the challenge in coming up with this parameter in light of competing interests. The IFN is simply a guide in this case that caution needs to be exercised when discharge in the LAR is reduced to the EBF. It is worth reiterating that the single lowest flow during the 50-year flow time series on which so much of this process hinges may not be adequate for establishing the EBF. It is not adequate to argue that a 1-in-50 year event (or 1-in-100 year event for that matter) will protect the aquatic ecosystem. Realistically, the discharge recommended in the IFN is simply a precautionary flow comparable to the 1/100 year low flow experienced historically.

The establishment of a "precautionary flow" would seem to be a reasonable approach to protect ecosystem structure and function, but establishing the precise value of this flow is subject to the same uncertainty associated with the various evaluation criteria and technical reports discussed herein. Note that a "precautionary flow" is a management tool and not a scientific answer to the question of instream flow needs, any decisions made while managing adaptively would still be subject to the uncertainty inherent throughout the IFN process. The challenge remains to get consensus on the no withdrawal rule, since fishes are at risk should discharge fall to 87 m³/s, especially through the low flow, under ice covered months. Note that Environment Canada reported the Athabasca River flowed at 75 m³/s downstream from Fort McMurray in December 2001 (Golder Associates 2004). Whether consensus is reached or not on cut-off for water withdrawal, there must be a suitable program in place to monitor discharge downstream from Fort MacKay (Segment 4).

3.6 Additional Investigations

As a result of these findings, the following needs are identified for monitoring and adaptive management:

Baseline data collection.

HSC curves need to be validated for each species and guild relative to the mesohabitat modeled usable area. The P2FC needs to validate assumptions that longnose sucker juveniles share the same habitat in the LAR as white sucker juveniles, Lake Chub, trout perch, and flathead chub, for example. Numerically, the small-bodied and forage fish guilds are most abundant in terms of their contribution to species richness. Consequently, as a minimum, a subset of these species is important to provide some assurance that the River2D model outputs are reproducible across the forage fish guild (including young coarse fishes).

Walleye use of the PAD.

Use of PAD distributaries during winter by walleye (and others) needs to be confirmed. Importance of perched basin lakes for fish production needs to be quantified as does the nature and extent of fish habitat present.

Assumption of winter ice thickness.

Ice thickness varies in the LAR from under 0.5 m to over 2 m in some locations. The IFN has been derived on an expectation of 0.5 m as being a typical ice thickness in the river during winter. We believe this measure over represents winter river habitat. This needs to be addressed by repeating the mesohabitat model with what habitat across the various segments is more restricted, during late winter when the ice thickness is typically 0.75 - 1.0 m. Running the model under more extreme conditions (*e.g.*, 1.5 m of ice) would be illustrative of the risk associated with less frequent weather conditions. As with all models, the results need to be validated through a monitoring program, with subsequent adjustments in the assumptions and descriptions of the model's uncertainty.

Discharge monitoring

Currently, Environment Canada monitors discharge in the Athabasca River just downstream from the City of Fort McMurray. To provide credence to the notion that water can continue to be withdrawn will require permanent gauging stations at the boundary between Segments 3 and 4 and Segments 4 and 5 of the LAR. Monitoring discharge through the winter will have to be undertaken regularly for the precautionary flow to be approved. Monitoring is recommended as the river drops below 125 m³/s.

4.0 OUTSTANDING ISSUES

Concern remains around the following:

- The P2WMF stakeholders could not agree that industrial withdrawals would cease when the precautionary flow recommended for the LAR is realized. Rather, a voluntary reduction to half the possible volume which can be withdrawn would be committed for industrial use should the precautionary flow be reached at any time. This is a concern since the point of establishing the precautionary flow was to set the point at which NO further withdrawal of water from the river is possible without compromising the integrity of the aquatic ecosystem in the LAR through, and downstream from Segment 4.
- Uncertainty with this approach, plus the role of global warming on base flow (without withdrawals) in the LAR will influence how the river physically changes during freeze-up. Although the argument was put forward at the CSAS workshop that the river has experienced a 1/100 year low flow in the past 50 years and burbot still exist in the river, the potential to disrupt their migration when flow is extremely low is a concern. How global warming affects the frequency of the realization of the IFN will affect this species in some capacity.

4.1 Decision Framework

Although the P2FC process is guided by structured decision making, there are key elements within the process that depart from rigorous scientific procedure. A lack of consensus on cut-off flow potentially compromises the process. Notwithstanding that establishing an IFN for the lower Athabasca River must be based on good science, policy makers will ultimately decide that the fate of the river must be based on what is deemed to be the public's interest (*i.e.*, likely a balance of interests). We believe the most conservative approach needs to go hand-in-hand with the IFN.

When discharge reaches the precautionary flow upstream from Segment 4, then withdrawals should cease to a point that permits solely the maintenance of infrastructure for existing water licensees.

4.2 Monitoring and Enforcement

Several proposals are being developed to address aspects of the uncertainty that have arisen as a consequence of the IFN modeling exercises. These range from addressing the fate of furbearers in the PAD, validating model inputs, investigation of the movements of walleye between the PAD, the channels that connect the LAR to Lake Athabasca and delta lakes, role of side channels in fish production, *etc.*

It will be imperative to install hydrometric gauging station(s) similar to the one at Fort McMurray at the boundary between Segments 3 and 4 and ensure that data is reported year-round and at least weekly during the ice-covered period. This will aid in enforcing the Phase 2 Water Management Framework when it comes into effect, facilitate enacting the precautionary flow given annual variability in discharge, and promote transparency on the part of proponents.

DFO has admitted that any loss of wetted perimeter that can be related to industrial water use could constitute HADD. This would require habitat compensation under the *Fisheries Act*. Following the

workshop in Calgary, consensus was that any compensation efforts would be better invested in the PAD than the LAR. Monitoring proposals will help refine details of compensation should it be necessary.

Validation of models used can be undertaken within a year. Refining model inputs once they are validated and running the models themselves will require a relatively short time. Responding to a highly variable surface water regime in the LAR will require response from proponents and immediate action by regulators. Managing for change will require input from all stakeholders. Ideally, a third party should be responsible for directing investigations to monitor and manage adaptively change in LAR.

4.3 Recommendations

- Install a hydrometric station near the a) Athabasca mouth and b) in the boundary between Segments 3 and 4. This station needs to be “transparent” so that stakeholders can ensure that proponents are compliant with commitments relative to their licence allocation for water withdrawal.
- Acquire flow data for all gauges on the Athabasca River and use these data to improve knowledge of the basin water budget.
- Investigate winter ice thickness relative to water depth in each of the representative study segments known to winter fishes (*e.g.*, segments 2 and 4). Relate ice thickness to velocity and depth across the channel to identify the potential for disrupted migration by burbot during low flow in winter.
- The lake whitefish spawning EC requires removal of sand from the substrate suitability curves to improve its validity for this species and life-history stage in the river. The original model was accurate. The revised one overestimates usable habitat area for this species and life-history stage.
- Validation of the models for smaller-bodied fishes needs to be done to confirm model function/prediction for individual species and also improve reproducibility (*i.e.*, help reduce uncertainty) from the River2D modeling exercise. Are fishes actually using habitat anticipated by the model?
- Investigate location(s) that could provide compensation should DFO deem that harmful alteration, disruption, or destruction of fish habitat (HADD) has resulted long-term from oil sands operation by understanding better the movement and distribution of fishes in the PAD.

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TECHNICAL MEMORANDUM

Review of the Athabasca River Phase II Framework Committee (P2FC)
Report, January 2010 - Aboriginal knowledge, use, interests and rights

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Date: July 30, 2010

1.0 Introduction and Executive Summary

This memorandum is a technical review, from a social science perspective, of how aboriginal knowledge, use, interests, and rights, including navigational interests, have been integrated within the Athabasca River Phase II Framework Committee (P2FC) report and recommendations, dated January 2010.

The Mikisew Cree First Nation (MCFN) and the Athabasca Chipewyan First Nation (ACFN), acting together, commissioned this review. As such, particular attention has been paid to how the P2FC report considers the knowledge, interests, and rights of the ACFN and MCFN.

The Firelight Group provides this memorandum as a reasonable third party technical review of the January 2010 P2FC report given constraints of time, budget, and available information. It reflects the professional consideration of Craig Candler (Ph.D., Anthropology), following review of the P2FC report, and related material, as well as discussion of associated issues with staff, elders, and members of the ACFN and MCFN.

In several important aspects, detailed below, the P2FC report **does not reflect good social science practice, does not meaningfully or adequately address the interests of the ACFN or MCFN**, and contains important **errors of fact**, and **misleading statements** related to ACFN and MCFN interests and efforts, including navigation for subsistence purposes, and effects on consumption of traditional foods, as well as other practices, that could easily **lead to poor decision making** related to Athabasca River management, and **resulting underestimation of adverse effects on the aboriginal and treaty rights** and interests of the ACFN and MCFN.

As such, this review concludes that, **in relation to potential effects on aboriginal knowledge, interests, and rights, including navigational interests, the January 2010 P2FC Report should not be relied upon** unless it undergoes major revisions including:

- additional community-based field work involving reliably designed and executed community and social science based studies with adequate documentation of methods and resulting in substantive evidence for decision making;
- completion of a reliable subsistence navigation analysis based on appropriate assumptions and relevant stretches of river;
- a conceptual approach that recognizes that the Treaty and aboriginal rights of the First Nations are constitutionally protected and can only be adversely impacted or infringed under strict conditions outlined by the courts;
- recognition of the limits of the P2FC process in representing or considering First Nations interests and parallel government-to-government processes which some First Nations, including the ACFN and MCFN, are involved in; and,
- Consideration of the relationship between changing the amount of water in the Athabasca, and resulting changes in water quality, including contaminant concentrations.

2.0 Summary of P2FC Report and Appendices

The introduction to the P2FC report (2010:i) notes that:

“The Phase 2 Framework Committee (P2FC) was a multi-stakeholder committee established in 2008 to develop recommendations for a Phase 2 Water Management Framework that will prescribe when, and how much, water can be withdrawn from the Lower Athabasca River for cumulative oil sands mining water use. The P2FC and its subcommittees worked through to an assigned deadline of December 2009, and its products will be the subject of consultation led by Alberta Environment and Fisheries and Oceans Canada through 2010 prior to the implementation of a Phase 2 Framework in January 2011.”

Volume one of the Phase 2 Framework Committee (P2FC) Report is a 126 page document with extensive appendices (238 pages in total) that evaluates options for management of the Athabasca River with particular reference to three key interest areas: Ecosystem Health, Traditional / Public Use, and Sustainable Economic Development. A second volume of technical appendices accompanies the P2FC report.

Issues of Public Use, Traditional Use and Navigation are dealt with in Section 5.4 of the P2FC report (5 pages in total). Significant appendices include *Appendix D: Comparing water withdrawal alternatives’ effect on traditional use. Memorandum submitted to the Socio-Economic Task Group* (4 pages in total), and the supporting Westland Resources Group report *Impact Hypothesis Analysis: Effects of Water Withdrawal on Traditional Use of the Lower Athabasca River* (58 pages total) provided as a technical appendix in volume two of the P2FC report.

The P2FC report (p. 37-38) indicates that a ‘Phase 1 TUS’ was completed by Westland Resources Group in July 2009, and that this study summarized existing and available information on traditional use activities in the Lower Athabasca river region. As noted in section 4.1 below (Information Gaps), the ‘Phase 1 TUS’ report was not provided as part of the P2FC materials, and was not made available to the ACFN or MCFN, despite repeated requests.

The P2FC report (p. 38) also indicates that a 'Phase 2 TUS' was completed by Westland Resources Group, and that this study:

"...involved collecting information from community members from eight Aboriginal groups, including Chard Métis Local 214, Conklin Métis Local 193, Fort Chipewyan Métis Local 125, Fort McKay First Nation, Fort McKay Métis Local 63, Fort McMurray Métis Local 1935, Fort McMurray Métis Local 2020, and members of CEMA's Aboriginal Round Table. Results of the study are provided in a traditional use mapping and information summary report."

However, as noted below (Information Gaps), the 'Phase 2 TUS' report was not provided as part of the P2FC materials, and only a portions was made available to the ACFN and MCFN after repeated requests.

It is significant that only those groups that chose to participate in the P2FC process and studies are mentioned. The majority of First Nations in the Lower Athabasca region, including the ACFN and MCFN, chose not to participate in the process because of the limited parameters of the process itself. However, this limitation is not noted in the P2FC documents, and there is no suggestion that important gaps exist in the process or the information relied upon. There is not a single mention of 'ACFN', 'MCFN', 'Athabasca Chipewyan', or 'Mikisew Cree' in the entire P2FC report, nor any mention of parallel government-to-government processes taking place concurrently.

The one suggestion of other First Nations existing, but not represented by the P2FC 'multi-stakeholder approach', occurs on page 1:

"Although Fort McKay First Nation's interests were actively represented, and Métis involvement also occurred, it is unfortunate that wider active representation of other First Nations and Métis did not occur during the Phase 2 process, despite the efforts of many."

Section 5.4 goes on to summarize the results of the Westland Resources Group's *Impact Hypothesis Analysis* (as noted above, this is provided in the technical appendices included in volume 2 of the P2FC report). The report suggests a set of six impact hypotheses. These are:

1. Water withdrawal, in some circumstances, contributes to limitations on river access to traditional use sites and traditional use activities during late summer, fall, and winter.
2. Water withdrawal, under some circumstances, contributes to decreased opportunities for harvesting resources important to Aboriginal people in the study area.
3. Water withdrawal may contribute to the decline of the transfer of traditional knowledge in Aboriginal communities in the Lower Athabasca River area.
4. Water withdrawal contributes to decreased ability to use rivers close to the mainstem of the Lower Athabasca River for traditional Aboriginal purposes.
5. Water withdrawal, under some circumstances, contributes to the decline of traditional diet and health of Aboriginal people in the Lower Athabasca River area.
6. Water withdrawal, under some circumstances, may physically alter spiritually important areas in the Lower Athabasca River area.

Based on an interesting, but highly unusual, hypothesis testing approach to interpreting and analyzing aboriginal knowledge, the Westland Group claims sufficient evidence to reject hypotheses 4, 5, and 6 from further consideration in the examination of flow management alternatives.

3.0 Scope of Review

As defined in the Firelight Group's April 23, 2010 work plan, and through subsequent communications between the Firelight Group, ACFN IRC, and MCFN GIR staff, the scope of this technical memorandum includes comment on the application of good social science practice and adequacy of methods and documentation, and the level of consideration given ACFN and MCFN knowledge, interests, and rights within the January 2010 P2FC report, and associated recommendations.

4.0 Documents and Information Sources

Source documents, and information relied upon in preparing this technical review include the following:

- The P2FC report and appendices, dated January 2010, accessed in PDF form from the P2FC website at <http://compassrm.com/AthabascaWPlan/logon.asp>;
- Information and documents, including email correspondence, provided by ACFN and MCFN staff members to the Firelight Group for review; and,
- A series of interviews with ACFN and MCFN elders and river users conducted by the Firelight Group in Fort McMurray and Fort Chipewyan in May 2010.

4.1 Information Gaps

In its findings regarding potential effects on First Nations rights and interests, the P2FC relied heavily on several reports produced by Westland Resources Group. While some of the Westland material is presented or summarized in the P2FC report and appendices, other important Westland reports were omitted and were not made available following repeated requests by the ACFN and the MCFN.

The following documents are cited as technical documents, in either the P2FC report itself or appendices, relating to Aboriginal rights, interests and use, and considered within P2FC process in the preparation of its 2010 report and recommendations. None of these documents were made available as part of P2FC report or appendices:

- Westland Resource Group. 2009. *Traditional use mapping of the Lower Athabasca River: Phase 1 Study*.
- Westland Resource Group. 2009. *Traditional use mapping of the Lower Athabasca River: Information Summary*. (This is cited as Westland 2009A in the P2FC report)
- Westland Resource Group. 2009. *Traditional use mapping of the Lower Athabasca River: Community Interview Summaries*.

Non-confidential information from these reports was requested in emails from the ACFN and MCFN to the P2FC coordinator (May 31, 2010), to staff of the Cumulative Effects Management Association (CEMA) (June 2, 2010), and to CEMA staff and provincial and federal representatives (July 1, 2010 and July 2, 2010). In response, a small portion of the information summary dealing with methodology was provided to ACFN and MCFN for their confidential review.

5.0 Key Issues

The importance of the Athabasca River to the practice of past, current, and planned future practice of Section 35 Treaty and aboriginal rights by ACFN and MCFN members cannot be overstated. Like salmon or cedar on the west coast, available information suggests that the water of the Athabasca River and delta plays a central role in defining the way of life, livelihood, and cultural identity of the Athabasca Chipewyan and Mikisew Cree peoples.

In a variety of venues, including public documents, ACFN and MCFN have expressed a very high level of concern regarding existing levels of disruption of the quality, quantity and timing of flow of waters in the Athabasca River and delta. The following key issues were identified through interviews with ACFN and MCFN elders and expert river users and Dr. Craig Candler (Ph.D, Anthropology), and following review of the P2FC material, and discussion of related issues with staff, elders, and members of the ACFN and MCFN. This list should not be considered complete or authoritative, and may be amended, added to, or refined, through additional work:

- Concern regarding the loss and degradation of the Athabasca River as a resource essential to the practice of rights under Treaty No. 8.
- Concern regarding declining fish and wildlife habitat and populations, including waterfowl, along the Athabasca River, and particularly in the delta area. Elders and expert river users link this to low water levels on the Athabasca River and its tributaries and the continued drying in the PAD.
- Concern that low water levels create barriers to boat travel (e.g., mud flats, sand bars, log jams), particularly into side channels and up smaller rivers near where they join the LAR. The tributaries (including the Richardson, Firebag, Embarras and others) are, in many cases, the only mode of access available to ACFN and MCFN members into important land use areas. Boat travel, especially up LAR tributaries and PAD tributaries, is necessary for subsistence hunting and other activities within ACFN and MCFN traditional lands, including travel to Fort McKay and Fort McMurray. At a minimum, there must be sufficient flow to allow the rights-holder to access a particular area (LAR, tributaries, for example) as well as to transport whatever is being hunted, fished, trapped, or gathered.
- Concern regarding effects on ecosystem function and delta maintenance, including ice formation and related spring flooding (including removal of log jams) and vegetation changes, including transition from grass and herbaceous plant species to willow shrubs along river edges and into the delta, where these affect traditional use and access to traditional lands
- Concern regarding contamination of waters and declining water quality, including frequent indications of avoidance of traditional resources (including fish, moose, and medicines) in the Athabasca River watershed due to psychosocial factors (Health Canada 2005) associated with proximity to oil sands and related contaminants. Increased number and intensity of developments will result in increased containment of wetted contaminants (within tailings ponds, dedicated disposal areas, and overburden dumps), thereby increasing risk to water quality. As each new approval further and reduces the communities' confidence in environmental quality, an overly simplistic Phase 2 Framework will likely make this issue worse.

- Adverse effects on, or in the vicinity of, cultural sites, cabins, burial sites, and other places, as well as on distributed, quality-specific interests (aesthetics, privacy, sense of place, values attributed to pristine landscapes) that are important to practice of cultural and spiritual values.

7.0 Key Findings

With regard to potential effects on Treaty and aboriginal rights, knowledge, and interests including navigational interests, this review finds that, while some aspects of Ohlson et al (2010) are adequately considered (particularly the recognition that intergenerational traditional knowledge transfer is vulnerable to river change), the report is, overall, inadequate and misleading, and should not be relied upon to inform regulatory decision making.

The report contains a series of serious deficiencies, including inappropriate assumptions, definitive yet unsupported findings, errors of fact, inadequate statement of limitations, highly problematic omissions, inadequate documentation of methods, and inconsistencies in analysis suggestive of poor and unreliable research design. At least eight major flaws in the P2FC report and its treatment of Treaty and aboriginal rights, knowledge, and interests have been identified.

- **No mention or consideration of Treaty and aboriginal rights**

While there is ample recognition of commercial rights, trade-offs, and priorities relating to commercial interests in the P2FC report (e.g.: pp. vi, ix, 84, 86, 91), and the lack of consensus in the P2FC process seems to have been defined by discussion and recognition of existing commercial rights to withdraw water, the report seems to have been written without any knowledge of, or attention to, the existence of Treaty No. 8, nor the existence of significant aboriginal or Treaty rights or interests in the Athabasca River watershed, nor the priority of Section 35 rights over other kinds of rights (including commercial rights) under the constitution. Based on a search of the language in the P2FC documents, there is not a single occurrence of the word 'Treaty', nor the words 'aboriginal rights'. The avoidance of Treaty and aboriginal rights, combined with the prominent consideration of subordinate commercial rights, effectively sets a double standard within the process, where aboriginal rights are ignored, and commercial rights are affirmed. Especially given the constitutional nature of aboriginal and Treaty rights, this is highly problematic.

- **No recognition of the main limitation of the P2FC process with regard to First Nations interests.**

Key First Nations, including ACFN and MCFN, chose not to participate in the P2FC process based on concerns, expressed to the Crown, regarding the P2FC process itself, and instead chose to participate in alternative and parallel government-to-government processes. The lack of mention of these alternative processes obscures the limits and gaps of the P2FC process. Making such gaps and limits visible to decision makers was one of the guiding principles of the P2FC process. While the perspectives of the P2FC report are importantly limited with respect to the First Nations interests they represent, this limitation was not expressed in the report.

- **The report overstates its validity, apparently without warrant**

The primary analytic documents relied upon by the P2FC to evaluate potential effects regarding First Nations and Aboriginal use over state the validity of their analysis. The Westland (2009b) Impact Hypothesis Analysis indicates that their work: "should not be considered complete, but rather a representative sample of the knowledge possessed by people in the aboriginal communities of the study area" (Westland 2009b: 41). Given that the majority of First Nations in the study area did not participate in the Westland study, there is no evidence of a systematic method for sampling or

interviewing in any of the P2FC documents reviewed. A representative sample is, by definition, carefully designed to represent a population as a whole, and so it is difficult to understand how this statement in the Westland (2009b) report could be true. The statement implies either a lack of familiarity with basic social science concepts, a misunderstanding of the aboriginal communities of the study area, a serious misrepresentation of the underlying data that supports the P2FC recommendations regarding aboriginal use, or a lack of care in presenting limited evidence.

- **Inconsistency in methods of hypothesis testing is evident.**

The P2FC material considers six impact hypotheses related to First Nations use, but supporting methodological material provided by CEMA (an excerpt from Westland 2009b) indicates only five impact hypotheses were evaluated, at least in interviews with community members. Despite little indication of evidence and documentation of a clear method for analysis, the Westland (2009b) report definitively rejects three of its six hypotheses as not being vulnerable to water level change: *“Traditional use of nearby rivers, traditional diet and health of Aboriginal people, and spiritually important areas are not considered to be sensitive to water withdrawal, and need not be considered in the examination of flow management”* (Westland 2009b:42). Nor were there any reliable measures, criteria or thresholds employed to understand what is needed to exercise Treaty and aboriginal rights (including the rights incidental to the exercise of harvesting rights). Rejection of these hypotheses is not consistent with available public information, nor with preliminary results from interviews with ACFN and MCFN elders and river users.

- **Option H (the preferred option) is not assessed based on First Nations use or interests**

Section 8 of the P2FC report provides a detailed performance assessment of Option H, the non-consensus recommended option, however there is no indication that Treaty and aboriginal rights or use were among the factors considered in evaluating the suitability of Option H.

- **Confused and misleading analysis of hypotheses**

Within the P2FC material in general, there is widespread inconsistency regarding what the various hypotheses actually mean, resulting in confused and misleading analysis. In the example likely of greatest consequence, a major disconnect is apparent between the evidence contained within the Impact Hypothesis Report (Westland 2009b), the hypotheses tested in that report, and the resulting findings of Ohlson et al (2010) that dismiss ‘Traditional use of nearby rivers’ as not vulnerable to water withdrawals. The initial form of this hypothesis in the Westland 2009b report is, “water withdrawal contributes to decreased ability to use rivers close to the mainstem of the LAR for traditional Aboriginal purposes” (Westland 2009b:22), however the resulting analysis of the hypothesis (pp. 22-26) does not address ‘decreased ability to use’, but instead evaluates whether or not aboriginal use (and non-aboriginal use) will be displaced from the Athabasca River to other nearby rivers, resulting in increased traditional use pressure on rivers such as the Clearwater. While the analysis and evidence are more appropriate to a recreational-use study, the result is a finding of ‘limited’ effect, and Westland (2009b) rejects the hypothesis of increased ‘traditional use of nearby rivers’. Ohlson et al (2010) then restate the hypothesis in its original form, and this misguided analysis removes from further consideration what is possibly the most important consequence of water withdrawals for aboriginal use: decreased ability to use rivers flowing into the main stream of the Athabasca River for traditional Aboriginal purposes.

- **No consideration of water withdrawal effects on quality or contaminant concentrations**

No hypotheses dealing with the influence of withdrawals on water quality and perceptions of water quality were tested.

This is highly surprising given:

- the level of concern regarding environmental contaminants and aboriginal health in communities in the region and nationally;
- that even perceived contaminant risk can have enormous effects on the practice of Treaty and aboriginal rights; and,
- the amount of water in a river system is at least as important as the amount of chemicals going into it in determining the dilution or concentration of those chemicals.

Considering the importance of this issue to practice of rights and uses, this is a serious omission. Based on interviews with ACFN and MCFN elders and expert river users, it is clear that perceived contaminant risk and related psycho-social factors (Health Canada 2005) are already a major factor affecting aboriginal use in the Athabasca River region. Immediate attention and resourcing of community-based monitoring is required to address this problem. Water quality issues should be considered in making the P2 decision.

- **The assessment of navigation is misleading and based on inappropriate assumptions**

Section 5.4.2 of Ohlson et al (2010) provides the results of an assessment of navigation based on an incomplete 2D model and assumptions that, while they may be appropriate to jet boats traveling the main stem of the Athabasca River, are irrelevant to the issue of navigation for subsistence purposes. AECOM's (2009) examination of navigation is based on an assumption that: "When water depth exceeds 0.6m, it is anticipated that most recreational craft will be able to navigate the river unabated" (p.7). A depth of 0.6 m equals approximately two feet. Interviews with ACFN and MCFN land users indicate that, assuming an outboard motor (the standard used by subsistence users on the river), and a fully loaded boat (as after a successful hunt, or in outfitting a cabin for the winter), the minimum safe depth needed for operations (including start-up and getting 'on step') is approximately 4 feet (1.2m). Interviews also indicate that the areas most critical for subsistence navigation are off the main channel of the river, including side channels, behind islands, and up smaller tributaries that adjoin the Athabasca River. None of these areas was addressed in the AECOM (2009) analysis as it was focused on whether or not there was an available route through the main channel, assuming a depth of 0.6m as fully navigable.

Barriers to navigation due to water level are of particular concern to ACFN and MCFN. The most significant, and most common barriers occur at places where tributaries join the Athabasca River. When these blockages occur, large expanses of traditional lands can become inaccessible by boat, and thus unavailable for the practice of rights. ACFN and MCFN have conducted preliminary research based on a systematic mapping and interview method, and with a small sample of elders and expert river users. In reference to navigation and the AECOM (2009) study, Westland (2009b) notes: "the sections of the river for which navigability modeling was completed do not include areas where tributaries enter the main stem of the Athabasca River" (p. 14).

8.0 Sources of Uncertainty

Main limitations, sources of uncertainty, and missing information include the following:

- Key First Nations, including the ACFN and MCFN, chose not to participate in the P2FC process based on concerns, expressed to the Crown, regarding the P2FC process itself. The resulting information gap is not referred to, nor acknowledged, in Ohlson *et al* (2010).
- Methods for data collection and analysis are unclear, or not present, resulting in considerable uncertainty regarding the validity of what little evidence is presented in the P2FC reports and supporting documents regarding First Nations interests.
- Major issues, including effects of water withdrawals on water quality, priority Treaty rights, effects of river change on reserve lands, and effects of water level on navigation for subsistence purposes are not addressed at all, or, as noted above in the case of First Nations use of nearby rivers, were addressed with irrelevant information and then removed from further consideration.
- Models for, and assumptions regarding, navigability are inadequate to address subsistence use.
- A regional consideration of cumulative effects on the rights, interests, and environments of the ACFN and MCFN is needed. Such a study should be based on quality environmental and social science, and completed under the direction of the communities involved. It should consider the effects of the P2 framework in combination with other projects such as the proposed construction of the 'Site C' project on the Peace River system.
- Inadequate information regarding riparian vegetation change and wildlife and fisheries change related to riparian areas and streams adjacent to the Athabasca River, particularly related to culturally important species upon which aboriginal practice of rights depends (eg. muskrat, beaver, moose, various medicine plants, and waterfowl).
- Additional work related to health, diet, practice of rights, and avoidance patterns related to contaminants, as well as identification of priority solutions, is needed. This work should be considered within a wider context of cultural and environmental effects related to the Athabasca River region.
- Additional study of how transmission of cultural knowledge can be supported in the face of avoidance areas related to water quality or water level is needed, including identification of specific obstacles to traditional knowledge transfer and prioritized ways of overcoming them, supported by, and developed in consultation with, First Nations.
- Development of a comprehensive regional planning level study of aboriginal knowledge, use, rights, and interests related to the Athabasca River and adjoining watersheds, including those lands and waters where access may be influenced by Athabasca River water change, and focussing on the underlying quality and quantity of resources needed for the meaningful practice of aboriginal rights.
- A corresponding operational level study of aboriginal knowledge, use, rights, and interests, including detailed community based documentation and annual monitoring of cultural and spiritual values along the Athabasca River itself, including habitations, trails, subsistence areas, and quality or species specific values.

9.0 **Discussion and Scientific Recommendations**

Based on the above issues, findings, and areas of uncertainty, with regard to aboriginal knowledge, interests, and rights, including navigational interests, the January 2010 report of the P2FC (Ohlson *et al*

2010) is inadequate and misleading, and should not be relied upon to inform the P2 Framework and subsequent regulatory decision-making.

Correcting this would require, at a minimum:

1. additional community-based field work involving reliably designed and executed community and social science based studies with adequate documentation of methods and resulting in substantive evidence for decision making;
2. completion of a reliable subsistence navigation analysis based on appropriate assumptions and relevant stretches of river;
3. a conceptual approach that recognizes that the Treaty and aboriginal rights of the First Nations are constitutionally protected and can only be adversely impacted or infringed under strict conditions outlined by the courts;
4. recognition of the limits of the P2FC process in representing or considering First Nations interests and consideration of the place of parallel government-to-government processes which some First Nations, including the ACFN and MCFN, are involved in; and,
5. Consideration of the relationship between changing the amount of water in the Athabasca, and resulting changes in water quality, including contaminant concentrations.

10.0 Summary and Conclusion

This memorandum is a technical review, from a social science perspective, of how aboriginal knowledge, interests, and rights, including navigational interests, have been integrated within the Athabasca River Phase II Framework Committee (P2FC) report and recommendations, dated January 2010. It reflects the professional consideration of Craig Candler (Ph.D., Anthropology), following review of the P2FC report, and related material, as well as discussion of associated issues with staff, elders, and members of the ACFN and MCFN.

Based on review of available documents, in several important aspects, the P2FC report **does not reflect good social science practice, does not meaningfully or adequately address the interests of the ACFN or MCFN**, and contains important **errors of fact**, and **misleading statements** related to ACFN and MCFN interests and efforts, including navigation for subsistence purposes, and effects on consumption of traditional foods, as well as other practices, that could easily **lead to poor decision making** related to Athabasca River management, and **resulting underestimation of adverse effects on the aboriginal and treaty rights** and interests of the ACFN and MCFN.

As such, this review concludes that, **in relation to potential effects on aboriginal knowledge, interests, and rights, including navigational interests, the January 2010 P2FC Report should not be relied upon.**

ORIGINAL SIGNED

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**Review of the Phase Two
Framework Committee
Non-Consensus Recommendation
for the Lower Athabasca River**

Hydrology, Geomorphology, Basin Issues, Decision Framework

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Executive Summary

This report provides a technical review of the Phase 2 Framework Committee's (P2FC's) non-consensus Option H recommendation with respect to the hydrology, geomorphology, basin issues, and decision framework. Whereas the P2FC was tasked with coming up with an IFN to protect the aquatic ecosystem of the Lower Athabasca River and to maintain the ability of First Nations to fulfill their Treaty and aboriginal rights, the Option H recommendations falls well short of this goal with detailed in this technical review. This review forms part of a larger review that includes fish and fish habitat (Boag and Vander Meulen 2010) and traditional use (Candler 2010.) A synthesis of the reviews is provided in ACFN-MCFN *et al.* (2010.)

A range of science shortcomings is identified in the areas of climate change analysis, geomorphology, and hydrology. The climate change analysis suffers from an inappropriate timeframe under consideration, analytical biases, and major errors of fact acknowledged and, as yet, unaddressed by Alberta Environment. The full implications of climate change have not been duly considered by the various P2FC models resulting in considerable uncertainty surrounding the consequences of proposed water withdrawals under future climates. The consequences of water withdrawals for the Peace-Athabasca Delta (PAD) are evaluated by the P2FC process using a scientific design that is simplistic and does not incorporate current knowledge of the PAD. The corresponding analysis of the Lower Athabasca River (LAR) is misleading as it focuses on effects that are the least likely to occur while neglecting more sensitive issues such as changes to off-channel connectivity, fish passage under ice, loss of tributary access for navigation, and changes in the sediment regime. Appropriate expertise in LAR and PAD behaviour needs to be assembled in an independent science panel to guide future assessment of impacts to the LAR and the PAD.

The P2FC science and policy work has been undertaken out of context in both physical and policy respects. The proposed water withdrawals should be examined within the context of the regional hydrology, groundwater/surface-water interactions, upstream changes such as glacier decline, cumulative effects from land-use pressures throughout the entire drainage, and ultimately evaluated within the context of a basin water budget and in consideration of the effects of future climates. Similarly, this policy decision needs to be integrated explicitly within the provincial policy context that includes the current development of the Lower Athabasca Regional Plan (and its own climate change analysis), the Water for Life Strategy, and in keeping with climate change adaptation protocols under development within Alberta (*e.g.* from the Prairie Adaptation Research Centre).

The decision framework guiding the P2FC process includes key deficiencies that undermine the potential for a robust outcome able to protect the interests of potentially affected parties. Indefensible risk thresholds, simplistic risk measures, a lack of confidence limits on the science outcomes, and unquantified uncertainty combine to cast doubt on the legitimacy of the Option H recommendation. And when these shortcomings in the decision process combine with the errors and gaps in the P2FC science, it is clear that the P2FC is not ready to recommend a set of Phase 2 water management rules.

It is recommended here that scientists with greater independence and more appropriate expertise be assembled to complete the science work required to support an informed decision. Individuals with expertise in hydrology, climate change analysis, and fluvial geomorphology need to be engaged to design and oversee the science required to support the P2FC decision goal. Key gaps needing attention include a credible unbiased climate change analysis, modeling impacts of water withdrawals on the

Peace-Athabasca Delta now and under climate change, and a more thoughtful analysis of vulnerabilities in river morphology vis-à-vis navigation and fish passage in response to water withdrawals and under projected climate futures. In addition, improvements are needed in the decision framework particularly in terms of how science outcomes are communicated to the P2FC (or equivalent) and the process followed by the P2FC in considering the consequences of water withdrawals on potentially affected parties with long established rights. **Until the results of this additional work becomes available, short term measures are needed to supplement the Phase 1 rules to provide low flow protection. These measures should include a cut-off (LAR) flow below which withdrawals from the LAR are completely disallowed.**

6.0 Introduction

This report describes the findings and implications of a technical review of the January-2010 Phase 2 Water Management Framework (P2WMF) for the lower Athabasca River (Ohlson *et al* 2010) with a focus on hydrology, geomorphology, basin issues, and the decision framework. Fish habitat modeling was also reviewed and is included where it is within scope of this review. Based on the findings, a collection of recommendations is provided that, if implemented, would help assure that First Nations Treaty and aboriginal rights are adequately addressed from the perspective of sound science and informed decision-making.

6.1 Instream-Flow Need for the Lower Athabasca River

With increasing oilsands demands for industrial water withdrawals from the LAR, there is a need to understand the flows the river requires throughout the year to support rights of established river users. Specific concerns are the First Nations Treaty and aboriginal rights to hunting, fishing and trapping along with the incidental rights that support these primary rights (*e.g.*, navigation and tributary access). The Phase 2 Framework Committee (P2FC) has set in place a process of modelling and other scientific analysis (Ohlson *et al* 2010) to determine what this IFN should be to maintain its obligations to First Nations Treaty and aboriginal rights.

The work required to establish the instream flow need (IFN) has two parts. The first is to determine the flow needed to maintain a healthy aquatic ecosystem (*e.g.*, Clipperton *et al.* 2000). This approach is often focused on the fishes present in the river and, in this case, includes recognition that an Ecosystem Base Flow (EBF) is required: a flow level below which all withdrawals cease (DFO 2006.) The other part involves the incidental rights of First Nations to use the river effectively to fulfill their direct Treaty and aboriginal rights. Two independent reviews have been carried out to address these parts directly (Boag and Vander Meulen 2010; Candler 2010). The present work complements these two reviews by assessing how well the P2FC work has considered the hydrology and geomorphology of the Lower Athabasca River (LAR) in its science work and how appropriately the science has been interpreted for and by decision-makers. Together, the three studies provide an assessment of the P2FC non-consensus “Option H” IFN recommendation.

The P2FC is a multi-stakeholder committee set up in 2008 to develop recommendations for a new P2WMF to prescribe when, and how much, water can be withdrawn from the LAR for cumulative oilsands mining water use. Its work concluded in January 2010 with the publication of Ohlson *et al.* (2010) which included a recommendation supported by a subset of the committee and known as “Option H” that identifies, for each calendar week of the year, how much water can be taken directly from the LAR (see Table 19 of Ohlson *et al.*, 2010.) The recommendation would allow instantaneous withdrawals of up to 29 m³/s, excludes consideration of tributary and regional groundwater withdrawals, and includes a 4.4 m³/s exemption at any time regardless the severity of low flows in the LAR. It was not reached by consensus nor is it publicly documented which members of the P2FC were in support of this option.

Determination of an appropriate IFN, particularly for a river the size of the LAR, is a highly complex scientific undertaking. Despite there being myriad approaches (see instreamflowcouncil.org), there are increasing calls to move away from habitat provisions for target species toward preserving the viability

of the broader river aquatic environment (Anderson *et al.* 2006.) The P2FC acknowledges at least 28 impact hypotheses in five riverine components (hydrology; geomorphology; water quality; connectivity; biology) and four other factors (tributary land-use; upstream land-use; climate change; fish harvest) all of which have the potential to affect the IFN (Dan Ohlson, Pers. Comm.) Due to lack of data, insufficient available science, assumed lack of significance, redundancy between ECs, and budget, only a small subset of these (~9) are evaluated with detailed quantitative modelling. In so doing, the P2FC has left out of its investigation many of the process dynamics that state-of-the-art IFN practitioners recognise as necessary. Potentially important impact mechanisms remain unstudied. Further, the EC work is focused on the needs of largely the aquatic ecosystem rather than on the complexity of river use by the First Nations. While the science focus of the present review is on examining the hydrology and geomorphology work that *has* been carried out and how this science has been made available to decision makers, key omissions are raised where they are significant.

6.2 From Phase One to Two: Setting the Water Management Rules

In 2006-2007, Alberta Environment (AENV) introduced the Phase 1 Management Framework for water withdrawal for the LAR (AENV 2007.) This P1 framework was established to provide limits to industrial LAR water withdrawals in relation to LAR discharge and up to a maximum of 34 m³/s in any season. Under “green” conditions, industry is permitted a total of 15% of instantaneous flow with no maximum. Under yellow and red conditions, this percentage is reduced and reaches a minimum withdrawal of 8 m³/s under red conditions and 11 m³/s under yellow conditions. The more restrictive values are based on averages (of weekly Q90, Q95, and HDA80 values) determined from historic flow records (1957-2004, Ernst Kerkhoven, Pers. Comm.) and do not incorporate any influence of climate change in modifying the hydrograph, nor are they kept up to date by incorporating flow data from recent years (2005-2009). And because the thresholds between conditions are based on weekly exceedances, not annual exceedances, these limits change weekly with the historic mean hydrograph. While this may be appropriate for the yellow condition, using this approach under the red condition is dangerous for the river as it assumes that the unusual low flow will always occur in the same narrow window of time as in the past. Under climate change, the red condition should be based on annual exceedances so that a minimum protection is provided year round as the timing of the hydrograph shifts away from the historic norm due to various effects including climate change. Hence, while the conceptual basis for the P1 rules may be sound, they are applied to a flow frequency distribution that no longer applies and, as a result, permit excessive withdrawals during sensitive (*i.e.*, low flow) periods. In addition, the P1 rules do not include a cut-off flow below which no withdrawals are permitted. Overall, it appears that the P1 rules have been configured to provide certainty to industry rather than protection of the riverine ecosystem.

It is also unclear how the P1 rules are being applied for spawning periods. According to Tom Boag (Pers. Comm.), the following are the relevant spawning periods for fishes known to spawn in the LAR:

- Early-to-mid May - northern pike, walleye
- Mid-May through early June - suckers, Arctic grayling
- Late May to late June - forage fishes
- Early October through third week in October - lake whitefish
- Late January through mid-February - burbot

AENV confirms that the spawning restrictions indicated for all spawning periods occurring during red and yellow conditions (see Table 1 of AENV 2007) are not being applied to fall or winter spawners. Due to the lower flows present in fall and winter, the 5% spawning restriction would imply a reduced

withdrawal limit than is currently in place (as indicated in Table 5 of ANEV 2007.) Further discussions are warranted to clarify that the appropriate limit is in place during spawning periods.

Refinement to the P1 approach for management of withdrawals led to creation of the Phase 2 Water Management Framework (P2WMF) and proposed IFN released in January 2010. This non-consensus Option H outcome provides for a reduced withdrawal limit and at a lower minimum flow. So, while the scheme is more complex, it has the same emphasis as the P1: it is minimum industry withdrawals that are guaranteed, not minimum LAR flows. In establishing this approach, AENV argues that the formula recommended (1/100 year event based on historic data and ignoring the future effects of climate change on the hydrograph) will protect the aquatic ecosystem and by inference, Treaty and aboriginal rights in the Lower Athabasca River (LAR) and Peace-Athabasca Delta (PAD.)

7.0 Review Approach

The overall technical review has three components emphasising physical (this report), biological (Boag and Vander Meulen 2010), and First Nations elements (Candler 2010). A synthesis of the three components has been provided in ACFN-MCFN *et al.* (2010). The present review reports on the physical aspects with a focus on climate change, the PAD, channel geomorphology, and various cross-cutting issues. Some themes such as monitoring and scientific uncertainty overlap and are taken up in each review, as appropriate.

This review holds two central objectives within its subject areas and with respect to the work carried out under the auspices of the P2FC:

1. *To assess the adequacy of the scientific work for supporting the interpretations and conclusions reached, and in particular for supporting the Option H non-consensus P2FC recommendation. This includes three key questions:*
 - (a) *has the best science been available and was it employed?;*
 - (b) *where gaps are identified, what further work is required to resolve them; and*
 - (c) *has the science recognized and quantified uncertainty sufficiently to support informed decision making?*
2. *To identify important gaps in process associated with putting the work into a basin context, addressing uncertainty, and enabling informed and transparent decision-making.*

Key source documents and information relied upon in preparing this technical review include:

- Ohlson *et al* (2010) - *Phase 2 Framework Committee Report January 2010*;
- Technical appendices included as part of Ohlson *et al* (2010):
 - Bothe and Franzin (2009): *Evaluation Criteria for Flow Alterations in the Lower Athabasca River – Channel Maintenance Flows*
 - Ghamray *et al* (2009a): *Evaluation Criteria for Connectivity of Tributaries in the Lower Athabasca River (Fletcher Channel) – Segment 1*
 - Ghamray *et al* (2009b): *Evaluation Criteria for Connectivity of Perched Basins in the Lower Athabasca River – Segment 1*
 - Lebel *et al* (2009): *Climate Change Sensitivity Analysis*;
- A collection of background reports that led to the establishment of the P2FC;
- Attendance and technical feedback at the Department of Fisheries and Oceans (DFO) Canadian Science Advisory Secretariat (CSAS) meeting May 31-June 4 2010 held to prepare science advice for DFO's review of the proposed Option H rules;
- Peer-reviewed literature, industry reports, and government reports; and

- Personal communications including email correspondence with Alberta Environment (AENV), DFO, Athabasca-Chipewyan First Nation (ACFN), Mikisew Cree First Nation (MCFN), science experts, and others.

The synthesis report (ACFN-MCFN *et al* 2010) brings together the findings from the three technical reviews with a focus on projected impacts to the river's aquatic ecosystem and their implications for traditional use. Substantive issues with the P2FC process and proposal are presented along with the additional science needed to address gaps. Possible mitigation measures are provided. The report concludes with a series of recommendations that, if followed, would help assure that First Nations Treaty and aboriginal rights can be maintained.

8.0 Physical Components

Physical implications of the P2FC proposals are investigated through an examination of the hydrology and geomorphology of the LAR in three major areas. Within the context of climate change, patterns of flow within the river are reviewed both in terms of the documented past and the projected future and including a summary of trends in projected water demand. A review is provided of the physical dynamics of the Peace-Athabasca Delta (PAD) and an assessment given of the P2FC attempts to model impacts to the PAD from proposed water withdrawals. Lastly, the geomorphology of the river is reviewed in relation to the modelling work that has been carried out for the P2FC. Section 3.1 has been prepared with a contribution from Gregory Utzig.

8.1 Climate Change and Its Hydrologic Implications

Under a program entitled "America's Climate Choices," the prestigious USA National Academy of Sciences (2010) has recently published "Advancing the Science of Climate Change" in which it states (page 17):

"Some scientific conclusions or theories have been so thoroughly examined and tested, and supported by so many independent observations and results, that their likelihood of subsequently being found to be wrong is vanishingly small. Such conclusions and theories are then regarded as settled facts. This is the case for the conclusions that the Earth system is warming and that much of this warming is very likely due to human activities."

As the National Academy emphasises, the debate is over as to whether accelerated climate change is happening and what its cause is. Other leading global science organisations have issued communiqués to this effect (*e.g.*, AAAS 2006; AGU 2007; AMS 2007; ACS 2007; IPCC 2007a; NA 2005) not to mention a host of major international disciplinary science organisations (*e.g.*, ACS 2010; INQUA 2007; GSA 2010; AGU 2007; APS 2007). The scientific debate has moved to defining how fast climate will change in relation to potential emissions scenarios. The fourth report of the Intergovernmental Panel on Climate Change (IPCC 2007b) presents a range of possible emissions scenarios based largely on socioeconomic factors and the take up of technology. Although it is impossible to know what will happen decades out, it is clear already that we are exceeding the worst case (A1Fi) scenario considered by the IPCC and emphasises the urgency in taking seriously adaptation needs around potential future climates.

Northern climates are expected to be one of the most affected of the world's climates. The scientific literature examining changing climates around the world has become voluminous. There is a growing body of scientific literature describing what has already happened to northern climates and providing

projections on what is expected to come about as a result of anthropogenic climate change. It is accepted that globally we are not in an equilibrium climate (*e.g.*, AGU 2007) and that the recent changes are generally detectable back several decades.

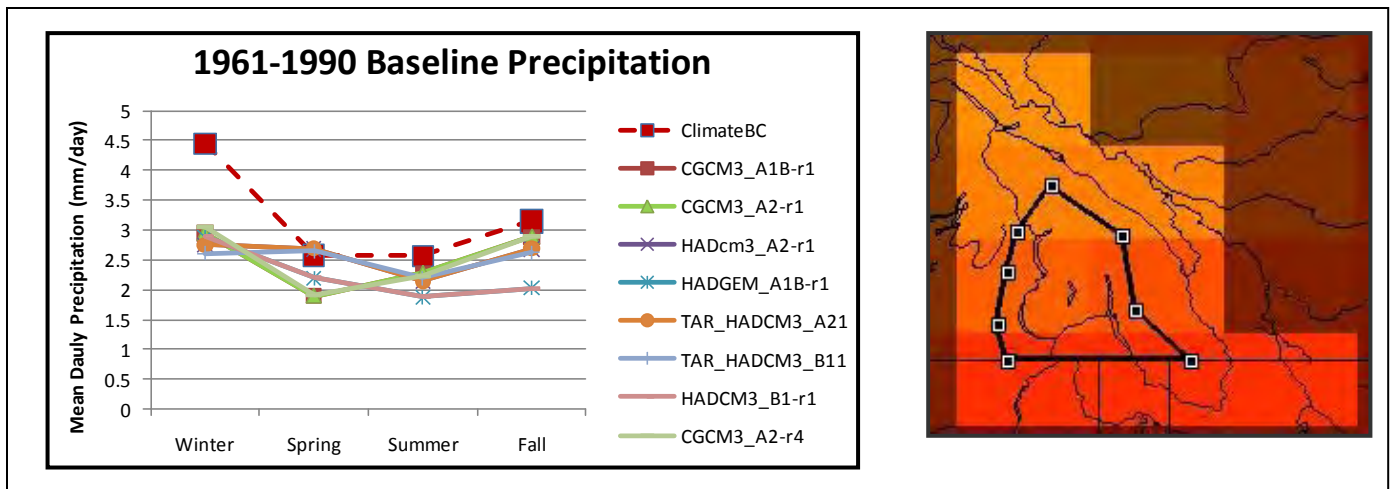
The Changing Hydrograph of the Lower Athabasca River

While total precipitation is generally increasing modestly with climate change throughout the Canadian prairies and western Cordillera, the proportion of precipitation falling as snow is declining (Akinremi 1999) and as a result mountain snowpacks are in decline (Mote 2004; Mote *et al.* 2005). With less snow, there is less storage of precipitation to provide runoff during low flow periods. Experience elsewhere has shown that although the increased precipitation counteracts some of the effect on low flows of reduced snow, increased temperatures and their effects on melt rates and on evapotranspiration overwhelm the precipitation effect so that overall, we see lower low flows from climate change (Barnett *et al.* 2005). In addition, runoff from the Athabasca drainage is significantly influenced by melt from Rocky Mountain glaciers which are known to be melting at accelerated rates (Parks Canada 2010). Furthermore, flow in the Athabasca River below Fort McMurray is dominated by runoff from these glaciated mountainous headwaters. For example, the Athabasca River basin upstream of Hinton makes up only 13% of the drainage area above the town of Athabasca but provides on average 40% of the flow volume (AENV 2004). This combination of reduced snowfall, increased glacial melt, and increased evapotranspiration, despite an increase in total precipitation, is already leading to decreased low flows throughout the prairies (Schindler and Donahue 2006).

To what extent have these effects already shown up in the hydrograph of the Athabasca at Fort McMurray? Burn *et al.* (2004) evaluate hydrometric records throughout the Athabasca drainage and find that the spring freshet is beginning earlier due to the earlier onset of higher spring temperatures. It is not always easy to see the signature of these changes in the short and medium term because initially, the enhanced glacial melt serves to *increase* the low flows and counteract the long-term impacts to low flows. However, once the enhanced glacial melt potential is exhausted, a strong decline is expected thereafter. This could be assessed through water budget analyses linked to glacier studies, however such work is beyond the scope of the present review. Such work should be carried out as part of a climate change analysis. With a better grasp on the underlying contemporary flow regime at Fort McMurray, the P2FC would be in a better position to apply appropriate climate change projections from Global Climate Models.

Choice of GCMs and Emission Scenarios in the Climate Change Analysis

The use of Global Climate Model (GCM) results for modeling future hydrologic flow regimes requires careful selection of GCMs and emission scenarios. In a recent paper on methods for assessing climate change impacts on hydrology of US pacific northwest, Salathe *et al.* (2007) emphasize the need to compare the GCM outputs for historic periods (*e.g.* 1961-1990) with empirical data for the same period



to assess the various models for their ability to accurately model local conditions. The assumption is that a model that most accurately models the past for an area, is more likely to accurately predict the future. This comparison does not appear to have been done for the GCM models used in the analysis for the Athabasca watershed. This can easily be accomplished with the Regional Analysis Tool available on the Pacific Climate Impacts Consortium website: <http://pacificclimate.org/tools/regionalanalysis/>. Figure 1 provides an example for another study area in British Columbia.

Figure 1. Comparison of mean seasonal precipitation for a southeastern British Columbian study area as summarised from historic climate data by ClimateBC and projected by various GCMs for the baseline reference period (adapted from Utzig 2010).

This is particularly important where the time period of interest is the near-future (e.g. 2010-2039), because the climate change that will occur over that period is mainly a result of past emissions, and the variation between GCM outputs over that period reflect mainly the differences between models rather than assumptions regarding emission scenarios.

Where the comparison identifies consistent bias in a set of model results (e.g. insufficient resolution to recognize local topographic effects), statistical corrections can be applied to make the GCM more applicable to local conditions (Salathe *et al.* 2007). For example the data in Figure 1 indicate that all of the GCMs consistently underestimate winter precipitation for the Kootenay area, likely due to inadequate representation of orographic effects.

Alternatively, where such analysis is not readily available, or is beyond the scope of a project, Spittlehouse and Murdoch (2010), in their recommendations for selecting emissions scenarios in BC, have suggested selecting a limited number of GCM scenario combinations that represent a range of possible outcomes (e.g., hot dry, warm wet, cool moist). This is consistent with the IPCC comments that there is insufficient certainty to say that any of the model outcomes are more likely than others (IPCC 2007a). All authors strongly recommend against utilizing a single mid-range outcome, as it would imply a level of certainty that does not exist.

For medium- and long-term climate change projections, emission scenario selection becomes more important, as the future levels of emissions begin to exert greater influence on climate change. Given that our recent past and present emissions are exceeding all scenarios previously run by previous IPCC modeling, more emphasis should be placed on the higher emission scenarios (see Figure 2.) More

emphasis should likely be placed on the A2 and A1Fi scenarios where there is an assumption of continued dependence on fossil fuels, and continuing high emissions. These scenarios are also more consistent with the assumptions about future oil sands development, where continued oil sands development implicitly implies a continued dependence on fossil fuels and high emissions. The A1 scenario, which assumes a rapid increase in low carbon energy use, could be considered a moderate probability lower limit. The B2 scenario, which assumes we make drastic cuts in emissions in the near future, should be considered as a very low probability lower limit.

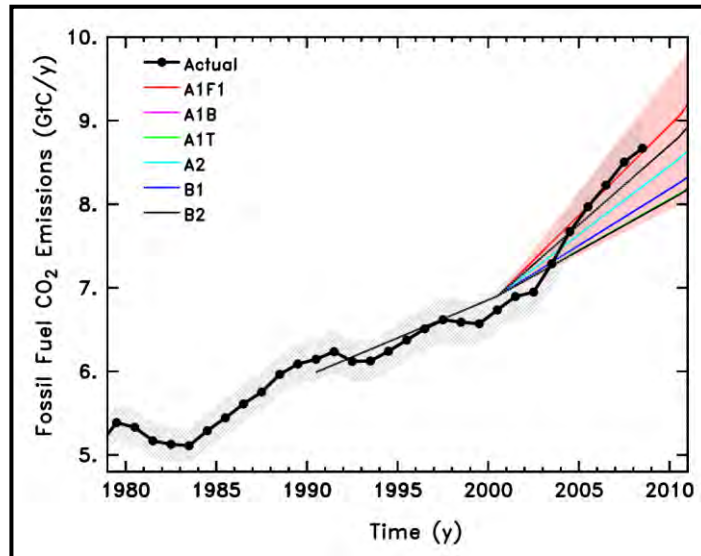


Figure 2. Actual fossil fuel emissions since 1980 compared to emission projections for various IPCC scenarios (from Allison *et al.* 2009, p.9).

Future Time Periods for the Assessment

Available information on the water demands for oil sands development indicate that demand will likely peak sometime in the 2040s (Golder 2005 - CEMA Surface Water Working Group, p28-29, Figure 12). This report indicates that some pit-lake infilling water demands will extend into the 2060s (p.22, Table 12). In addition, Golder (2009) reports on water requirements for oil sands mining operations and indicates a sustained water demand beyond the end of the period for that study (2030), and it does not take into account water demands for pond filling or pit-lake filling at the end of operations (p.9, Figure 4, note). Golder (2009, p2) also comments that there are start-up delays for some development projects, and therefore the timelines will likely be extended further.

It is clear from both of these reports, that any consideration of climate change impacts should include potential impacts into at least the 2040s and 2050s. In contrast, the Climate Change Sensitivity Analysis report (Lebel *et al.* 2009, App. 2, Table 1, p 24-25) considers only the period prior to 2040. A review of the results of the second time period (2040-2069), in Appendix 2 of Lebel *et al.* (2009, App. 2, Table 1, p 24-25) shows virtually all the models project a reduction in flow in the second time period compared to results in the first period.

In addition, with a decreasing trend in flow, utilization of the average flow values for period 1 (2010-2039) over-estimates potential impacts for the first half of the period (2010-2025), and under-estimates potential conditions for the second half of period 1 (2025-2039). If it is preferred to use just one time

period, it would be more representative to utilize 2030 to 2059, assuming a maximum demand in the 2040s. Although averages for this period were not made available in the Lebel *et al.* (2009) report, they can be easily produced from the data (see Table 1, in section 3.1.6).

Alternatively, given the data available from Lebel *et al.* (2009), it would at least be preferable to utilize the projected flow data for their period 2 (2040-2069) to err on the side of caution, rather than under-representing the potential climate change impacts for the primary period of interest.

The argument that regulations based on period 1 data could eventually be adjusted to fit period 2 in the future, as more information is available, shifts significant risk to potential oil sands developers. The lead times for development are significant, and once the investments are made, it would be very costly to downscale or delay projects because water availability has decreased.

Present and Future Trends in Oilsands Water Demand

Golder and Associates (2009) provide a report on future oilsands water requirements. They base their annual water requirements on the demands that would occur in the driest of years – defined by the 100-year drought conditions (to simulate worst case for evaporative losses and minimal availability of on-site water sources). This may or may not be reasonable under a climate change scenario. The IPCC and other climate change reports forecast an increase in the magnitude and frequency of extreme events, including drought (although the IPCC 2007b does not predict a large increase in droughts for the Athabasca region (Meehl *et al.* 2007, p 785). Climate change adaptation studies typically (Meehl *et al.* 2007) recommend against assuming that past frequencies and magnitudes of extreme events will continue to be valid under a changing climate.

Golder (2005, CEMA Surface Water Working Group, p 23-24, Table 13) assumes that all other water use on the Athabasca will be constant into the future. This seems unreasonable given the industrial growth in the area, and the possibility that climate change may affect the water needs of other users (e.g. irrigation). The analysis should include a more reasonable assessment of future water use on the Athabasca by other users. At the very least, a complete and up-to-date assembly of all licensed LAR water withdrawal volumes, existing and approved, for oilsands and other uses, should be prepared and made available. Such a compilation can then be used in forecasts gaming economic growth scenarios, climate change scenarios, proposed rules and other significant factors (see for example, Mannix *et al.* (2010), Table 2).

It is also unclear why the sensitivity report (Lebel *et al.* 2009) emphasizes summer and winter flows, to the exclusion of fall flows. Golder (2005, p 24, Table 13) indicates that fall and winter are the key seasons with respect to the percentage of the flow that is expected to be diverted (5.8% and 12.8% respectively), while summer is only 2%. Modeling of fall flows might also be warranted however this would depend on the relative importance of elevated summer-versus-fall stream temperatures and heavy ice-cover interacting with the reduced flow rates.

Sources of Uncertainty in Projecting Future Athabasca River Flow Regimes

As mentioned above, there is significant uncertainty attached to the modeling of future climate. There is significant uncertainty regarding future greenhouse gas emissions, as represented by the various IPCC scenarios. As with all models, there is also uncertainty associated with the GCMs and their application. Contributing factors include an incomplete understanding of atmospheric physics and climate

sensitivity, and the limited resolution of global models. There is also a problem calibrating the models due to an incomplete understanding of the interactions between the atmosphere and marine/terrestrial domains (e.g. changes to ocean currents, vegetation shifts). Due to insufficient data, IPCC climate modeling to date has also not fully incorporated various feedbacks such as methane releases from arctic oceans and permafrost zones, melting of the Greenland ice sheet and shifts in ocean currents. Some of these feedback mechanisms are associated with potential tipping points that could lead to amplified climate change that has not been accounted for in present modeling (Allison *et al.* 2009). In fact, there are recent signs that climate warming has been underestimated by the IPCC: accelerated sea level rise (Rohling *et al.* 2009), greater insect damage and higher incidence of forest fire (Kurz *et al.* 2008), longer periods of high atmospheric carbon dioxide (Archer *et al.* 2009), accelerated melting of permafrost (Tarnocai *et al.* 2009) and greater ocean acidification.

There is also additional uncertainty associated with the hydrologic model used to project future Athabasca River flows based on the modeled climatic changes. These are discussed in Chapters 6 and 7 of Kerkhoven (2008), and include factors such as model calibration under a warmer climate, inventory of soil properties, predictions of vegetation changes under modified climates, incomplete understanding of local interactions between the atmosphere and the land surface and statistical sampling. Other potential uncertainties are changes in flow associated with the loss of glaciers (e.g. Barnett *et al.* 2005) as discussed in section 3.1.1 and potential changes in infiltration properties. None of these is recognised nor discussed in Lebel *et al.* (2009.)

The significance of the glaciers in the headwaters of the Athabasca drainage to summer/fall low flows and to mean annual flows has not been examined by the P2FC science resulting in further uncertainty around the reliability of its projections for these important parameters. The modeling of Kerkhoven (2008), on which the projected summer/winter low flows and MAF are based, does not include glacial processes nor does it stratify the recent accelerated glacial melt from the contribution expected due to changes in snow melt and accumulation. As a result, because the model is calibrated to existing discharge records (that do not resolve glacial melt), it is possible that the model has overestimated the projected flows (including the summer low flows) due to not recognizing that there has been an embedded enhanced component within the discharge record. That component is expected to begin to sharply decline by about 2030 (Garry Clarke, Pers. Comm.) as these glaciers pass their maximum rate of disappearance. This “mixed signal” can lead to overestimates of future water availability. Demuth and Pietroniro (2001) looked at this situation in the North Saskatchewan River basin and found the minimum and mean streamflows in the North Saskatchewan River basin to already be in decline in its glaciated headwater basins.

As discussed earlier, there are also uncertainties regarding non-oilsands water diversions, and the future magnitude and timing of oil sands development and associated water requirements.

Magnitude of Athabasca Flow Changes Relevant to Planning and Regulation

The potential future changes in Athabasca River flows considered for setting future regulations should include potential changes over the full period of planned oilsands water diversions. According to data in Golder (2005), water withdrawals for operational and reclamation requirements will extend into at least the 2060s.

Kerkhoven (2008) has completed hydrologic modeling for the Athabasca River below Fort McMurray based on GCM outputs for various GCM/emission scenario combinations for three time periods 2010 to

2039, 2040-2069 and 2070-2099. His results are summarised in Lebel *et al.* (2009). In an email dated July 26, 2010, Kerkhoven indicates that the projections given in Lebel *et al.* (2009) are mistakenly presented. The minimum flow projections were portrayed as the mean annual flow projections and vice versa. Following up on his email erratum, results for the first time period (2010-2039) project changes for mean annual flow ranging from an increase of 9.3% to a decrease of 21.7% (mean -5.8%), and changes in minimum flow ranging from a 5.3% increase to a 40.2% decrease (mean -16.3%), in relation to baseline flows (1957-2007 means). Results for the second time period (2040-2069) project changes in mean annual flow ranging from an increase of 9.4% to a decrease of 28.3% (mean -12.2%), and decreases in minimum flow from 8.0% to 54.1% (mean -32.2%).

The errors in Lebel *et al.* (2009) have far reaching consequences. It is the projections of minimum flow that have been used to investigate the climate change sensitivity in other P2FC models. It is evident from the above paragraph that the estimated changes in low flow are about two to three times more severe and will deepen concerns raised in these models. This new information should also affect the outcome of DFO's CSAS process (Roger Wysocki, Pers. Comm.)

Two P2FC-commissioned reports on trends in flow based on data from the past 50 years of flow records both indicate a trend of decreasing flows over time. Gill and Rood (2009) have calculated a decreasing trend of about 0.4% per year in winter flows (~minimum flows) and a decreasing trend of 0.5% for mean annual discharge. They indicate that in the past this trend may be a result of shifting phases of PDO, but state that is unclear how the PDO will react in the future with a changing climate.

The other trend analysis (Burn 2009) shows similar trend results when the full 50-year stream flow records are taken into account. Burn (2009) also computed trends for the last 30-year period and found that when the analysis is restricted to this more recent period, the trend in decreasing flows is much steeper. The 30-year trend for annual flow is decreasing at 1.1% per year, and winter flows at 1.3% per year.

Although both authors emphasize that there is no certainty that these trends will continue into the future, if these trends are projected out to period 1 of the climate change projections, Burns (2009) indicates that they would correspond to decreases in mean annual discharge of 21.3% to 35.4% at 2022, and 29.4% to 51.1% at 2037. The decreases for winter flows, based on continuing trends, would be 15.9% to 40.3% at 2022, and 21.9% to 58.6% at 2037.

Taken in aggregate, all of the available data point to significant decreases in mean annual discharge and minimum flows over the coming decades. However, there is significant uncertainty regarding the magnitude and timing of the decreases. Given this uncertainty, it is prudent to consider a range of potential outcomes. Secondly, given that available information indicates that water demand is likely to peak sometime in the 2040s, and continue into the 2060s, it is also necessary to consider projections that are relevant into at least the 2050s or 2060s.

A logical approach might be to take the Kerkhoven (2008) flow modeling results based on climate change projections for period 2 (2050s) and use a range of one standard deviation from the mean to provide a reasonable indication of the uncertainty (see Table 1). This would mean that taking into account projections of climate change impacts would be interpreted as a 17.0% to 47.4% reduction on annual minimum flow and a 0.7% to 23.7% reduction in mean annual flow over the coming few decades. Emphasis however, should likely be placed on the larger decreases in flows to be consistent with a precautionary approach, and to be consistent with the trend analysis results.

In contrast to the above unbiased procedure, the climate change projections considered in the modelling were selected via subjective assessments and policy-biased intervention. The mean was “eyeballed” subjectively by one of the authors (Ernst Kerkhoven, Pers. Comm.) rather than calculated based on the projections available. The range of projections (variance, or standard deviation) was not provided to decision makers in a systematic manner nor was it applied appropriately to the other models in the sensitivity analyses. Instead, a subjective collection of outcomes was applied which may or may not be representative of the range as indicated by the Global Climate Models and the surface hydrology model. In addition, the Climate Change subgroup was told to not consider scenarios that were “immediately recognised as extreme hydrological changes” because they “would have significant Provincial-scale policy and management implications that would far dominate the potential implications of water withdrawals” (Ohlson *et al* 2010, p104). The P2FC essentially holds that climate change will be assessed as long as the assessment excludes extreme possibilities, no matter their likelihood. This is a policy bias inserted into what should be an objective scientific summation of climate change projections prepared to inform policy makers not modified by *a priori* policy choices.

Table 1. Projected flow changes for the 2050s as reported in Lebel *et al.* (2009) and corrected following the email by Kerkoven of July 26, 2010.

Variable	Mean	Mean+1 std devn	Mean-1 std devn	Minimum	Maximum
Minimum flow	-32.2 ¹	-17.0	-47.4	-54.1	-8.0
Mean annual flow	-12.2 ¹	-0.7	-23.7	-28.3	9.4

¹ For comparison, the (corrected) modeled change in mean annual flow for period 1 was -5.8% and for minimum flow, it was -16.3%.

Requirements for Further Analysis

The following work needs to be completed so that climate change is appropriately considered in the P2FC science:

- The climate change scenarios-GCM combinations need to be averaged in a suitable unbiased way and the mean and range of future climates and future hydrograph changes presented. An example has been provided in section 3.1.6.
- The climate change sensitivity analyses need to be re-applied to all the other models and correcting for the AENV error in Lebel *et al.* (2009.)
- Further analysis is needed to understand the significance of the Athabasca’s headwater glaciers on projected LAR streamflow. To date, 20-25% of glacial ice has been lost due to melt during 1985-2005 in the central Rocky Mountains (Bolch *et al.* 2010). Shawn Marshall has recently calculated that these glaciers will be all gone in 83 years (Bob Sandford Pers. Comm.). To improve on estimates of longevity, Parks Canada is sponsoring a major study to determine, using Light Detection Radar (LiDAR), the volume of actual ice remaining within the Columbia Icefield system, the largest glacial system in the Canadian Rockies. Led by Mike Demuth, the results of this work will be available to be coupled to GCM projections to more reliably estimate the expected lifespan of these glaciers in

relation to carbon emission scenarios. Establishing long-term water commitments to the oilsands industry in advance of receiving and applying the results of this research may result in a high level of risk to oilsands investments because additional water beyond that required for exercising Treaty and aboriginal rights may, when it is needed in the future, be unavailable.

- Lastly, ideally, the climate change projections provided would distinguish seasonal changes or justify why this aspect of climate change is not being considered.

8.2 The Peace-Athabasca Delta

The Peace-Athabasca Delta in northern Alberta is a Ramsar Wetland of international significance and a UNESCO world heritage site. It is one of the world's largest inland freshwater deltas and a wetland of international importance. It is home to some of the largest undisturbed grass and sedge meadows in North America, and provides habitat for large populations of waterfowl, muskrat, beaver and free-ranging wood bison (Beltaos *et al.* 2006a.) In recent decades, several prolonged dry periods have turned some basins in the PAD from aquatic into terrestrial ecosystems due to lack of flooding. The first came after the construction and initial filling of the W.A.C. Bennett hydroelectric dam at the headwaters of the Peace River, between 1968 and 1971, and the second after the retreat of a major spring flood in 1974. Without an abundant supply of water in areas dependent on overflow, it is difficult for wetlands to regenerate. It is flooding in the PAD that spurs the high biological productivity for which the PAD is famous and as a result, proposals to dam or divert water from the sources which create the PAD need to be carefully studied to identify their potential effects on the future of the PAD.

The PAD is a complex geomorphic feature that provides extensive habitat in response to the seasonal rhythms of the Athabasca, Peace, and Fond du Lac Rivers, as well as a collection of smaller inflows, that are collectively largely responsible for its annual recharge. Regional hydrologic regimes interact with a host of geomorphologic and anthropogenic influences to maintain the PAD's integrity. These dynamics are complex and far from fully understood. Climate change is further changing the PAD by modifying when and where key processes are available. For example, it is projected that under future climates, the ice-jam process that brings about recharge of otherwise isolated PAD lakes (perched basins), will decline (Beltaos *et al.* 2006a) thereby increasing the reliance on periods of high open water for recharging perched basins.

Ghamray *et al.* (2009a and 2009b) provide two Evaluation Criteria assessments to assess the potential impact of P2 water withdrawals on the PAD. They are essentially anecdotal case studies of one particular site, rather than an assessment of connectivity of the Athabasca River to the PAD lakes. They include an uncomfortable list of significant unquantified assumptions and simplifications perhaps the most concerning of all is the lack of an assessment as to the representativeness of this single site for connectivity and recharge to all sites. While the models are interesting, they are insufficient for understanding the potential hydrologic disconnection that is likely to result in the coming decades as industrial water withdrawals and climate change intensify, in tandem.

The first Evaluation Criterion (Ghamry *et al.* 2009a) describes a model constructed to investigate the extent to which Phase 2 water withdrawals would be expected to limit the connectivity to side channels and major tributaries thereby jeopardizing the maintenance of the quantity and quality of available habitat in the associated floodplains. They measured the relative change in connectivity at a single bifurcation of the Athabasca River in the delta, Fletcher Channel. "This bifurcation is but one of dozens of bifurcations in the delta each with its own particular flow regime. The Fletcher Channel represents

only a limited view of the potential impacts of water withdrawals on the distributaries that may or may not be connected to Lake Athabasca in the winter.” (Ghamray *et al* 2009a.) They make no attempt to assess how representative of the PAD is this one bifurcation that they analyzed in relation to many that exist elsewhere around the delta. And as mentioned above, nor was there an attempt to consider this incremental effect under the different projected climate regimes. Furthermore, the results are interpreted in terms of a low, medium and high risk levels and yet the thresholds between these classes of risk were drawn up arbitrarily and with “there being no known data for impact thresholds” (Ghamray *et al* 2009a.)

The second Evaluation Criterion (Ghamray *et al* 2009b) describes a model constructed to investigate the extent to which P2 water withdrawals would be expected to limit the connectivity of LAR perched basins to recharge, thereby affecting the quantity and quality of those available habitats. They use the connection to one perched basin, Big Egg Lake, as a surrogate for all the perched basins. However, the PAD can be stratified into zones in which different recharge processes are dominant (ice-jam flooding vs. high-open-water recharge) (Peters *et al.* 2006). These differences correspond, along with various other factors, to variations in the elevation of the perched basins and more specifically, to sills that limit the entry of water into any given lake. Ghamray *et al.* (2009b) do not gather information on lake elevations and hence are unable to link their anecdotal work to these zones of interest. While the modeling work is interesting, it is relevant to the specific spatial makeup of the site that they examined in detail; unfortunately it is not possible to generalize their [sic] results across the delta. As Ghamray *et al.* (2009b) say: “The current work focuses on a single perched basin that is in close proximity to the main channels of the Athabasca where the river’s influence is expected to be maximized. Big Egg Lake is but one of hundreds of basins spread throughout the delta each with their own particular flood regime and thus represents only a limited view of the potential impacts of water withdrawals on floodplain dynamics.”

Despite a listing of many serious uncertainties and an overall rating of “high” uncertainty, confidence limits are not provided on the model outputs. Also, there is no attempt made in these two Evaluation Criteria to consider this incremental effect under different projected climate regimes. Given the list of deficiencies and inadequacies of the modeling applied to this situation, as it stands, these models cannot be considered suitable to support informed decision-making.

While it appears from Ghamray *et al.* (2009a, 2009b) that the research literature on the PAD has been reviewed, there is little evidence of this understanding in the design of the corresponding modeling work. The research literature is rich in insights about the hydrologic dynamics of the PAD in relation to its sources, climate change, diversions, topography, and other controls. Some examples of research findings include:

- Prowse *et al.* (1996) carried out an early study under the Northern Region Basins Study. They examined the hydrometeorological conditions controlling ice jams floods associated with the Peace River. Peters *et al.* (2006) conducted a systematic followup examination of the flood hydrology of the PAD. They identify three zones of floodwater origin within the PAD and two mechanisms – ice-jam induced and open-water floods. Both types were found to recharge perched basins in the Athabasca Delta. Ice jamming is the most effective mechanism for producing extremely high backwaters capable of recharging perched basins. The lateral expansion of the central delta lake into inland areas is found to be a notable mechanism for replenishing the low-to-medium elevation contiguous wetlands.

- Beltaos *et al.* (2006a) examine the detailed requirements for ice jams to occur in the Peace River portion of the Delta. Ice jams are known to cause much higher water levels than open water floods and are particularly effective in replenishing the higher elevation, or perched, basins of the PAD.
- Wolfe *et al.* (2008) use water-isotope tracers and multi-proxy paleolimnological records to characterize connectivity controls on water balances of floodplain lakes in the Athabasca Delta within the context of its hydroecological evolution over the twentieth century. They conclude that the hydroecology of the Athabasca sector of the PAD is far more sensitive to changes in Athabasca River flow than the Peace sector which is resilient to changes in Peace River flows. They conclude that recent drying of some PAD lakes in the Athabasca sector and the surrounding landscape may represent the leading edge of rapidly evolving hydroecological conditions in the Athabasca Delta. Implications include reduction in aquatic habitats, loss of navigation access, and complete loss due to lake desiccation.
- Neill and Evans (1981) examine sediment transport through the Athabasca Delta and find that the delta front, thirty years ago, was advancing at about $0.8 \text{ km}^2/\text{yr}$. How will the progress of this delta be affected by reduced mean annual flows brought on by climate change and exacerbated by water withdrawals? How will this change navigation and biodiversity? It is not clear that the P2FC has considered the influence of a changing sediment regime on the values of concern.

These and many other research studies in hydrology and geomorphology (*e.g.*, Peters and Buttle 2009; Beltaos *et al.* 2006b; Peters and Prowse 2006; Toth *et al.* 2006; Wolfe *et al.* 2005; Prowse and Conly 1998) need to be brought together to form a state-of-the-art understanding of the PAD in relation to proposed water withdrawals. With this in hand, an appropriate scientific examination can be undertaken to address the uncertainty. It would be preferred that this work be led by a team of researchers with experience in the PAD, and with affiliations that are independent of AENV, DFO, and the oilsands industry.

In summary, Ghamray *et al.* (2009a and 2009b) provide two Evaluation Criteria assessments that are essentially anecdotal case studies of one particular site, rather than an assessment of connectivity of the Athabasca River to the delta lakes. They include an uncomfortable list of significant unquantified assumptions and simplifications perhaps the most concerning of all is the lack of any assessment as to the representativeness of this single site for connectivity and recharge to all sites. In addition, in Ghamray *et al.* (2009a), there is little reference to nor an understanding demonstrated of the peer-reviewed literature which is extensive and provides good stratification of this extensive deltaic landscape according to the processes that are hydrologically regenerative. Further industrialization of the Peace River (*e.g.*, Site C) along with water withdrawals in the Athabasca River and other anthropogenic changes create uncertainty as to whether the PAD habitats and the navigability of its river systems (and therefore First Nations' access to traditional harvesting areas in the PAD) will be sustained into the future. While the models are interesting, they cannot be considered sufficient for meeting the need for understanding the potential hydrologic disconnection that is likely to result in the coming decades as industrial water withdrawals and climate change intensify.

8.3 Channel Geomorphology

THIS SECTION IS SUBJECT TO REVISION.

The LAR is a sand-bed river that hosts populations of fishes and other organisms with life cycle needs that vary in relation to the river's seasonal rhythms. It is also the waterbody, along with the PAD, that is at the centre of life for the ACFN and MCFN, allowing these Nations access to their traditional lands to fulfill Treaty and aboriginal rights. From the high-flow freshet to the low flows of the summer and fall to the almost six months of ice cover over winter low flows, the annual cycle of the river depends on fluctuations in flow rates to maintain the structure of the river itself and the integrity of the aquatic ecosystem and to sustain the many goods and services it provides (aquatic organisms, resources, navigability, etc.). As climate change alters, most likely reduces, expected seasonal water availability, and as industrial demand for water increases, it will become more difficult to meet these industrial demands without compromising the LAR's ability to maintain its ecological goods and services, including the delivery of Treaty and aboriginal rights.

Doyle (1977) provides a summary account of the geomorphological behaviour of the LAR and Kellerhals *et al.* (1972) provide further detailed descriptive geomorphological information about various Albertan rivers including the LAR. These studies, though decades old, provide insights into the basic behaviour of the LAR. At the time of these studies, below Fort McMurray, the channel was relatively straight and supply limited in its sediment dynamics. Below these upper reaches, the channel changes to an unconfined meandering river toward Embarras with transport-limited sediment dynamics. Since these observations were made, there is likely more (not less) sediment being added to the system and with the discontinuation of dredging, there may be a tendency for the river to aggrade in general (though these interpretations need confirmation.) The interplay of sediment regime with hydrologic behaviour is how habitat and navigation opportunities evolve throughout the river. Habitat is generally best in peripheral zones and in side-channel areas. Navigation is generally the most limiting where sediment accumulates due to gradient declines, tributary interactions, and a host of other site-specific controls.

It is these kinds of dynamics that need to be identified and described so that a program of scientific study can be designed to assess how they are expected to change under water withdrawals and future climates. What particular types of local river structures are most vital to maintaining fish habitat for the various species of interest and for the seasonal needs of their individual life cycles? Which are most vulnerable to diminished flows? How do these vulnerabilities change seasonally? For example, is fish passage/access to winter rearing habitats threatened by reduced flows? Similarly, the key seasonal vulnerabilities to navigation need to be identified so that a targeted research program can be designed. For example, tributary access is a fundamental element in securing the navigation capabilities that are an essential part of the incidental rights of the ACFN and MCFN. How are these navigational opportunities affected by water withdrawals and what sorts of interactions are of concern when there are also simultaneous water withdrawals from important tributaries? These and other questions need to be answered to mount a credible analysis of the direct effects of water withdrawals on fish habitat and navigation.

What is the role of ice thickness in whether water will access side channels? According to Preston McEachern (Pers. Comm, DFO CSAS workshop), a change in ice thickness of only 5-10 cm can affect whether water will get into the side channels and highlights the significance of water depth in relation to local channel geomorphology.

In contrast, the P2FC science focuses on changes to the macrostructure of the LAR in relation to water withdrawals and does not give attention to these site-specific, more limiting possibilities. Bothe *et al.* (2009) examine the effects of water withdrawals on channel maintenance based on data from the Fort McMurray Water Survey Canada (WSC) hydrometric gauge. Rivers need periodic high flow to maintain their structure and sediment regime. These higher flows also regenerate fish habitat and mobilize and reorganize sediment deposits. Given that channel maintenance flows are generally considered the one-year or two-year flows (Wolman and Miller 1960), the approach taken in Bothe *et al.* (2009) is to use the flow frequency distribution from 1957-2007 and investigate the extent to which the river would be outside the range of such channel maintenance flows due to the proposed withdrawals. They define channel maintenance flows as 60% to 160% of bankfull. Because this range of these flows is relatively high in comparison with the proposed water withdrawals, they conclude that the P2 rules would have no significant effect on channel maintenance. There are four elements of concern specific to this methodology:

1. Using the 50-year flow record as an accurate representation of today's frequency distribution is inappropriate. As discussed earlier, the hydrologic regime is in transition to a new state and as such it is scientifically incomplete to use this historic record without applying a correction factor reflecting the pace of climate change to date on the flow regime of the LAR.
2. Allowance is not made for further changes in the hydrograph over the lifecycle of the oilsands. As discussed and summarized earlier in this section, Lebel *et al.* (2009) indicate, using a variety of analyses, that the mean annual flow (MAF) is expected to decline by 12% (range 1-24% - see Table 2) by the 2050s. While changes in spring peak flows are unavailable, these are expected to decline with the MAF. Thus, a decline in spring freshet is expected and this has not been considered in Bothe *et al.* (2009).
3. Confidence limits have not been provided on the results (for example due to the above points) nor have the assumptions been listed and the implications of these discussed for the P2FC and others to consider.
4. The risk thresholds used, though set with reference to observations of the Peace River, are grossly subjective and would benefit from an interdisciplinary examination that includes expertise in fluvial geomorphology and, in particular, experience with large sandbed rivers. According to the lead author of the EC, the risk thresholds are set high and have a very limited basis (Ron Bothe Pers. Comm., DFO CSAS Workshop, May 31- June 4 2010). In his view, the 25% limit used should be reduced to "10-15%," but that it doesn't matter because the effect is still well below the risk threshold. This level of subjectivity is unacceptable in science, particularly given the unknowns about the present and future flow regimes.

While it is clear that the macrostructure of the river is of great importance, changes to it as a result of water withdrawals are expected to be less likely, at least in the coming years, than the more sensitive vulnerabilities to fish habitat and navigation such as changes to side-channel connectivity, fish passage under ice, loss of tributary access for navigation, and changes in the sediment regime. Some of these limitations may actually already be occurring seasonally in response to *current* water withdrawals (Candler 2010.) As long as these dynamics remain unstudied, there will be additional uncertainty present in how water withdrawals are interacting with aquatic ecosystem maintenance and with the upholding of Treaty and aboriginal rights.

Another area of concern with respect to the geomorphology of the LAR is the uncertainty associated with the River 2D model because this model forms the backbone to the habitat-suitability-curve analyses. The River2D model is one of many two-dimensional depth-averaged models available. They enable study of rivers where velocities and slopes change (Chris Katopodis Pers. Comm.) The complex bedforms and ice-covered conditions of the LAR present computational challenges for simulating hydrodynamics. As a result of these challenges, there is a lengthy list of significant assumptions and uncertainties associated with the application of the River2D model. The model does not address the ice formation period and the ice-breakup period. The models were based on sites that were chosen to be representative of the segment with respect to fish not for navigation so they don't mirror navigation needs. It is a fixed-bed model without any sediment transport component. The lack of validation data is likely the greatest concern, particularly for the winter low flows where there have been insufficient observations to calibrate the model (Chris Katopodis Pers. Comm.) While assumptions are provided, they are accepted with little indication of their quantitative implications for the habitat suitability curves. And the sites with the highest River2D model error are generally where the habitat is the most desirable (the side channels). Ice freezes more at the edges so tubular cross-sections are expected rather than rectangular cross-sections that are assumed by the model. Unfortunately, it is difficult to evaluate the model results because of the lack of validation data.

Consideration is not given in the P2FC science to changes in potential riparian vegetation that may occur under projected climates (Rood *et al.* 2008.) These changes are of concern in relation to riparian habitats and implications for the practice of Treaty and aboriginal rights, however they may also have effect here by changing the competence of bank stability and thus have further effects on channel morphology.

In summary, while it is recognized and acknowledged that channel maintenance flows are less vulnerable to water withdrawals than other channel flows (e.g., low flows), the analysis provided is incomplete in several respects. At a minimum, subjectivity should be removed, attention should be given to the actual present and potential future flow regimes, and this understanding should be used in this EC and outcome confidence limits generated. In addition, the analysis needs to be redone, with guidance by a fluvial geomorphologist, recognizing a broader understanding of the controls on navigation and fish habitat in this sandbed river and incorporating field experience of the LAR. Current understanding of ice dynamics (e.g. Wojtowicz 2010) needs to be incorporated into the analysis. Extensive site-specific river surveys have been conducted and would be available to add local information—for example, Trillium Engineering and Hydrographics (2002.)

9.0 Cross-Cutting Concerns

Placing the LAR within its basin and provincial context and informing decision-makers appropriately about the scientific findings are analytical needs that cut across disciplines and can result in far-reaching problematic implications if underimplemented.

9.1 Regional and Basin-Level Considerations

Water Budget and Basin Assessment of the LAR

The P2FC discounted as negligible the complete loss of LAR tributaries due to oilsands developments and declines in LAR tributary flows due to water withdrawals (Brian Makowecki and Ernst Kerkhoven, DFO CSAS workshop, Pers. Comm.). Yet, these basin-level changes increase further the effective withdrawal above and beyond the Option H withdrawals being considered by the P2FC. Rather than disregard these non-zero increments, they should be inventoried and summed, so that interested parties can reach their own conclusions about the implications. Otherwise, it casts doubt on the validity of the assumption that they are negligible.

While significant withdrawals from tributaries need to be evaluated in light of their impact on the LAR, smaller levels of tributary withdrawals are of serious concern at the scale of the tributaries themselves. Discounting the complete loss of tributaries as “negligible” to the LAR does not take into account that even a small percentage of water taken from a tributary can have an effect on the tributary itself. Furthermore, it does not consider the impacts to the use of LAR tributaries for harvesting and access by ACFN and MCFN members and the impacts of these losses on the Treaty and aboriginal rights of the First Nations. With respect to tributary navigation, the meaningful practice of rights would be breached long before a “complete” loss came about.

Based on historic reviews of hydrometric data from the WSC stations on the LAR and on tributaries to the LAR, while winter low flows in the LAR are dominated by water originating upstream of Fort McMurray, historic spring freshet flows show strong increases in the proportion derived from the LAR tributaries and can exceed 50% (Doyle 1977). This observation highlights the need to fully inventory the pattern of withdrawals from these LAR tributaries and understand their implications.

The P2FC has not considered the potential effects of regional groundwater withdrawals on LAR flows, casting additional unrecognized and unquantified uncertainty on the P2FC outcome. Worley Parsons (2008) has described that the “Athabasca River valley exists as the dominant discharge area with flow occurring towards that low-lying feature.” In particular, based on WSC gauging data, Alberta Environment (2010) identifies that in 2008 there was an increase of 38 m³/s in the lowest ~100 km of the Athabasca River and concluded that there is a “notable contribution” from the various formations to the natural flow of the river. It is also notable that the Kearn Channel (a groundwater feature) is situated in this area, is by far the most heavily licensed aquifer (0.82 m³/s – AENV 2010, p 27), is identified as being potentially connected to the Athabasca River (Worley Parsons 2008, p 67), and is also identified as the groundwater body of “highest potential risk,” in the entire Alberta oilsands area, to contamination from surface activities (Worley Parsons 2008, p 67). These observations supported by AENV highlight the

troubling significance to the P2FC outcome of the absence of consideration of groundwater interaction with surface water.

It is clear from Worley Parsons (2008) and AENV (2010) that there is considerable uncertainty present in understanding the interactions between groundwater and surface water. As a result, the objectives of the groundwater monitoring program include gaining “further understanding of aquifer interactions and how the system is connected to surface environments” (AENV 2010.) The Interim Groundwater Management Framework (AENV 2010) goes on to point out that it will “take up to two years to properly characterize the baseline conditions in the key regional aquifers and much longer to establish the natural range of variability or seasonality.” It is unclear how the Phase 2 rules could be set at this time when a couple of years of further work appear to be needed to gain confidence in understanding how the regional groundwater withdrawals may effect the LAR discharge.

The LAR drainage system is far from pristine. With extensive development alongside the LAR and in tributary drainages upstream and downstream of Fort McMurray, this system is a partially degraded system with weakened resilience. For example, Burn *et al.* (2004) look at hydrometric records from throughout the Athabasca drainage. They report mixed signals indicating the variable effect of land-use and highlighting the need to look more closely at the flow records in light of the land-use history. The water withdrawals being considered by the P2FC need to be put in the context of a basin assessment that inventories the full range of effects present in the drainage including, but not limited to, other water withdrawals. (See also section 3.1.4.)

The above hydrologic information can be assembled into a first-order water budget for the drainage. It is within the context of such a budget, that the proposed water withdrawals would be best interpreted and linked to projected changes due to climate change and loss of glaciers.

Cumulative Effects

Existing pressures on the LAR and PAD systems include petro-chemical contamination, dams and diversions, forest removal, groundwater mining, transportation and resource corridors, and climate change, among others. The P2FC does not address these combined pressures on the LAR and PAD; new and possibly significant declines in ecosystem structure and function may be taking place which will affect First Nations’ ability to exercise Treaty and aboriginal rights. The examination of the LAR should be set in the context of the entire drainage, and include the present and future contributions of the glaciers that provide a significant percentage of the summer base flow. The common approach to cumulative effects assessment (CEA) in Alberta is a project-specific impacts approach, rather than a planning/regional approach. Further, a lack of defined thresholds and lack of shared data limit the ability to conduct CEA. Notwithstanding these challenges of conducting CEA in Alberta, the issue of cumulative effects remains unacknowledged by the modelers to the P2FC and by the P2FC for decision makers.

Decision makers have raised this issue in public forums. Former Chairman of the Energy Resources Conservation Board (ERCB), Neil McCrank, spoke to the need for regional assessments in his farewell speech at the University of Calgary (March 2007). The following month, Acting ERCB Chairman Brad McManus raised the same issue at a Canadian Energy Research Institute conference (also in Calgary). Subsequently, the Canadian Council of Ministers and Environment 2009 commissioned a report entitled “Regional Strategic Environmental Assessment in Canada: Principles and Guidance.” Given that regional effects are fully within the federal and provincial government’s mandate, they should be addressed by the P2FC. These issues are summarized by Schindler and Donahue (2006): “We predict that in the near

future climate warming, via its effects on glaciers, snowpacks, and evaporation, will combine with cyclic drought and rapidly increasing human activity in the WPP [Western Prairie Provinces] to cause a crisis in water quantity and quality with far-reaching implications.”

Provincial and Watershed Planning Initiatives

The P2FC Option H recommendation should be examined against and aligned explicitly with other provincial land-use and watershed-planning initiatives. The Lower Athabasca Regional Plan (LARP) is being developed under Alberta’s Land-Use Framework (LUF). Given the size of the water withdrawals being considered by the P2FC, information flowing from the LARP undertaking should be directed to the P2FC to improve the robustness of its recommendation. As part of this initiative, Golder and Associates is preparing a climate change analysis to inform development of the LARP (Ernst Kerkhoven Pers. Comm.). The P2 WMF should not be finalized until that relevant information is reviewed by the P2FC and affected parties and incorporated into the water withdrawal rules.

The P2FC recommendation should also be aligned explicitly with Provincial commitments under the renewed Water For Life (WFL) strategy. In its WFL renewal statement, endorsed by the Government of Alberta, the Alberta Water Council recognizes the need to be proactive and to accelerate its actions “to protect our water sources now rather than waiting until later.” In addition, a new principle has been added – WFL will be integrated into other policies and plans, such as LUF planning, to help ensure better resource management integration. The Alberta Water Council indicates that “success will depend on... a growing appreciation of the value of water as a scarce resource.” In this regard, the Council recommends renewing the strategy around safeguarding Alberta’s water sources, including “addressing aquatic ecosystem degradation.” These course corrections are being implemented to reach the goal of assuring that Alberta’s aquatic ecosystems are maintained and protected and that priorities for sustaining aquatic ecosystems are implemented through watershed plans.

Finally, the Prairie Adaptation Research Centre (PARC) provides climate change adaptation research services to the prairie provinces (Sauchyn and Kulshreshtha 2008). Despite PARC reports detailing the need for climate change adaptation throughout Alberta in response to climate change projections, it is not clear that the Province of Alberta uses these products in guiding its policy development.

It appears that the P2FC work is not unfolding in step with these very significant provincial initiatives and commitments. The P2FC’s mandate on setting water withdrawals needs to be integrated within this broader collection of provincial land, water and climate initiatives already underway. And in general, greater transparency would be useful with respect to how the Province integrates the various procedures, commitments, and initiatives that are underway, particularly with respect to climate change.

9.2 Decision Making Framework

The Phase 2 Framework Committee has followed a Structured Decision-Making process. While in general it is a strength of the P2FC work, there are some major gaps in the process and in how the science is provided to the P2FC that render the SDM approach ineffective in grappling appropriately with pivotal issues present in this decision-making challenge. While the decision-making structure possesses a defined structure, its implementation reflects a blindness to serious gaps in knowledge brought about by deficiencies in how the science has been provided to the P2FC.

P2FC Principles

The P2FC principles include some valuable items that if implemented in their full spirit could support an effective decision-making process. Unfortunately, some of the most important principles have not been implemented while others suffer from being incomplete and thus ineffective. Four specific gaps in the SDM process are highlighted below.

1) The Principle “Be Explicit About Uncertainty” is not met. Modeling results need to include a quantitative understanding of the level of confidence with the model outputs.

Uncertainty in modeling outcomes needs to be quantitatively presented to decision-makers. The principle as stated creates an expectation that the decision maker will be clear on the level of confidence that accompanies a model output yet, in reality, model outputs are provided to decision makers without a quantitative understanding of their reliability. Section 4.3 expands on concerns about scientific uncertainty in the P2FC process.

2) The principle “The best available information from all sources would be used” is not met. Significant improvements are required on some models and analyses before they can be considered the best available information (notably the climate change analysis provided in Lebel et al. 2009).

As evident in the discussions at the DFO CSAS workshop (May 31-June 4, 2010), and Chapter 3 of this report, there are significant improvements needed on some of the models before they could be considered “best information.” Note that the Regional Aquatic Monitoring Program (RAMP) possesses field data that would be very useful to the P2FC work, is not included in the P2FC work, and yet would be part of what one would consider the best information.

3) The fourth principle in the P2FC Process Guidelines states that “the process would strive for consensus but not require a consensus recommendation among participants. Areas of consensus and non-consensus (if necessary) would be clearly documented along with the perspectives of each participating party.” Striving for consensus but not requiring it will always be problematic because decision-making discretion and accommodation remain unclear.

Consensus cannot be operationalised successfully in this way. Any valid consensus process requires that a clear alternative process be in place should the consensus one fail. In practice, not only did consensus fail in the final outcome of the P2FC (non-consensus Option H), the perspectives of each participating party have not been recorded and made available. Without these components, the decision-making process is most likely driven by the most influential stakeholders. From a decision-making perspective, this offers little to indicate what a minority view can expect in terms of due process. There are no minimum timelines provided, no conflict resolution policies indicated, no clarification provided as to what would constitute consensus and what would not, no explanation of when efforts would cease in the discussions to accommodate each party’s concerns, and lastly and most importantly, the manner in which one party’s interests can be favoured over another’s when those interests cannot be mutually met. In practice, this puts certain stakeholders at an implicit disadvantage over others and means that the process does not meet the spirit of what the principles portray. And when the deliberations are established explicitly to “balance” (Ohlson et al 2010, p2) various stakeholder interests, the lack of procedure on how this will be done coupled with the ambiguity and lack of commitment to consensus means that the balancing will be reflective of the most powerful stakeholders as in conventional exploitative decision-making.

While the principles and structure of the P2FC process give the impression that science is guiding policy development, in practice, policy preferences are also, at times, infused into the science work in the P2FC process resulting in a scientific bias in favour of industrial development. Examples include the climate change analysis (section 3.1), the Option H bias toward oilsands water licenses rather than First Nations Treaty and aboriginal rights, and the modeling focus on a handful of species of management interest rather than an ecosystem focus. While it is difficult to correct this at this point in the process, it still remains possible to make clear to decision-makers this leakage of policy bias into science so that this information can be duly considered.

It is understood that AENV has acted as neutral facilitator for the P2FC process and has opted not to have representatives involved in the discussion. While it is appropriate for the provincial regulator to provide facilitation, the role of AENV does not end at this point. Neither AENV nor any other department of the Alberta Government can simply play a role akin to a “referee” or facilitator given the importance of the issue at hand. AENV must take a positive role in this process including, among other things, carrying out the legal responsibility of the Crown before making any decisions, including supporting any recommendations.

4) *The Precautionary Principle, though implied at times, is not met. The use of the term precautionary in the P2FC discussions could give the impression to those outside these processes, especially decision-makers and the public, that the Precautionary Principle is being applied. Yet there is no clear evidence of its application in the P2FC results nor in its final report.*

The essence of the Precautionary Principle is as follows:

“When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically. In this context, the proponent of an activity, rather than the public, should bear the burden of proof. If an action poses a risk of causing harm to the environment, in the absence of scientific consensus that the action is harmful, the burden of proof that it is not harmful falls on those who advocate implementing the action.” (<http://www.sehn.org/wing.html>)

While the Canadian government does not consider the Precautionary Principle to be a rule of customary international law (GoA 2003), it holds more importance in other jurisdictions. For example, the 1992 Maastricht Treaty adopted the principle as a fundamental element of environmental policy. Still, the Government of Canada does hold that “[T]he application of precaution is a legitimate and distinctive decision-making approach within risk management.” Members of the P2FC committee appear not to understand the concepts of precaution given that Ohlson *et al.* (2010, p 111) state “Option H’s 4.4m³/s EBF exemption is a precautionary approach to managing low flow events (being significantly below the assumed 16 m³/s) demand requirement.” There is nothing precautionary about taking water from the river at discharges down to zero; the willingness of water license holders to reduce their withdrawal voluntary may be a *concession*, but it is not a *precaution* and it cannot be regulated because it depends on voluntary measures. How can AENV ensure a precautionary approach if it cannot enforce so-called precautionary measures?

Regardless of the lack of take up of the Precautionary Principle, it is well recognized that a modern decision-making process must be informed by an appropriate assessment of “consequent risks” (GoC 2003). Furthermore, during the DFO CSAS workshop in Calgary, scientific discussions were at times

misdirected by policy directives. For example, rather than focus on what the fish populations require, the modelers generally fell back to considering a policy option (Option H). This muddling of policy and science contributes to a loss of effectiveness in the science work, particularly given the extreme level of uncertainty present.

Risk Assessment

Rather than follow the precautionary principle in making its tradeoffs, the P2FC has chosen to incorporate risk assessment. Whereas precaution asks how much harm can be avoided, risk assessment tries to determine how much harm will be tolerated (Raffensperger and Schettler 2000). For each Evaluation Criterion, a single metric is determined for evaluation and expressed as a “percentage change relative to natural.” Embedded in this risk assessment are the ubiquitous problems associated with the P2FC’s assumption that the historic flow regime is equivalent to the present or “natural” flow regime (section 3.1). Setting aside this significant concern, the change in each metric is compared against two thresholds that separate three zones of response: undetectable, detectable, and potentially irreversible (Ohlson *et al.* 2010, p 29-30). While this is conceptually sound, the identification of the thresholds for each EC is, at best, weakly scientific and, in some cases, subjective or essentially arbitrary (depending on the EC).

Stronger alternatives are conceivable to the rather simplistic risk assessment scheme pursued by the P2FC science. While single metrics may in some instances be reasonable proxies of key aspects of ecosystem maintenance, in other instances, blended indices or other constructions based on multiple indicators may be more effective in representing the overall result of interest. Such expert system ratings can be supported by informed viewpoints of independent science experts able to interpret, say, a suite of indicators in relation to larger measure of interest (*e.g.*, navigability). Other possibilities exist.

The P2FC approach to risk assessment is misleading to decision makers. With weakly defensible risk thresholds and with option uncertainties that are not prioritized, quantified, nor otherwise interpreted for the decision-maker, how can a decision-maker know how best to trade off proposed options? In the simplest of decision-making situations, Hammond *et al.*, (1999) stress the need to build a risk profile of the options and for each, identify the key uncertainties that might significantly influence the consequences associated with each option. Ecological/environmental risk assessment (ERA - *e.g.*, Salasan Consulting 1999) is a more comprehensive organized approach that estimates the likelihood of adverse outcomes from various hazards under consideration. It is a vibrant area of study and development and the P2FC’s present decision challenge would benefit from improving how ERA is incorporated into its Structured Decision-Making process.

While there is a broad spectrum of ERA approaches in use around the world (Power and McCarty 2002), there are fundamental principles of transparency, inclusiveness, communication of uncertainty, and clarity of separation between science and policy that underpin all approaches and relate to basic communication and group process rather than decision theory *per se*. It is in these fundamentals that the P2FC process needs important adjustments before it will be able to reach a sound science-based decision equitable to all affected parties.

The P2FC states (Ohlson *et al.*, p 2) that there will be a “balancing” of environmental, social, and economic interests and that trade-offs will be needed as part of the decision-making process. Given the interests at stake, it seems likely that it will be difficult, or at least very costly, to meet all rights simultaneously. Yet, this is at the heart of the balance that the P2FC identifies. Gregory et out the pitfalls

of overemphasizing science when there are social choices being made. In the P2FC instance, it appears that, while a significant amount of scientific effort has been expended, a social choice is preventing science from being more fully heard because recent water licenses are upheld in the Option H at the expense of upholding Treaty and aboriginal rights. The process would be more efficient if this social choice were clearly stated because then the debate could move toward the social realm rather than the scientific work being confused with the social choice (*i.e.*, Option H). Preferred would be to provide a transparent procedure for making social choices. How will one party's interests be favoured ("balanced") over another's when those interests cannot be mutually met? In practice, underneath the SDM and science that are the focus of attention, lies a social tradeoff that is not being given sufficient recognition – preferred would be to document how "losing" parties will be compensated in those situations where each party's needs cannot be simultaneously met.

Ohlson et al (2010, p4) state "SDM helps people deal clearly and consistently with uncertainty, explore risk tolerance, make judgments about acceptable levels of risk and precaution, and find creative ways to manage residual risk." Given the lack of measure of uncertainty (see next section), the almost arbitrary nature of the risk thresholds used in some of the models, the lack of a transparent consensus process, it is not clear how SDM in this case has assisted decision-makers with 'dealing with uncertainty' nor has it helped individuals "explore risk tolerance."

al (2006) point Uncertainty

Ragas *et al.* (2009) distinguish between three types of uncertainty in risk assessment. First, "problem definition uncertainty" arises when the definition of the management problem differs from that of the scientific risk assessment problem. This is not unusual as surrogates or indicators are frequently used, as they are in the P2FC process, to represent the management issue of concern – for example, the protection of an aquatic ecosystem. Second, "true uncertainty" results from a lack of knowledge. Given climate change and the unknown behavior and needs of many fishes particularly under a changing hydrograph, the scope for this type of uncertainty is very high in the P2FC situation. While it is not always possible to quantify true uncertainty, it can be broken down and described to highlight its scope. Vercelli (1995, in Ragas *et al.* 2009) use the terms hard and soft (true) uncertainty to distinguish between uncertainty that can be quantified and that which can be expressed only qualitatively. Other stratifications of uncertainty are plausible. Third, "variability" is inherent in natural systems such as the LAR and the PAD and describes the distribution of a system characteristic around a mean.

As introduced in section 4.2, the many uncertainties associated with the P2FC decision problem have been inadequately presented to the P2FC. In some of the ECs, there is a reasonable effort made at listing the sources of uncertainty (and including some of the modeling errors), however this information is rarely converted into quantitative expressions of confidence around the modeled outcomes. It is recognized that quantification of uncertainty is not always feasible and to that end, it is useful to distinguish between different types of uncertainty. Despite mandating its subcommittees to "be explicit about uncertainty," the model outputs as provided to decision-makers for consideration do not include confidence limits, nor an accounting of the combined implications of uncertainty for the outputs. There is apparently no attempt made to propagate error in data inputs through to the model outputs nor effort given to examining compounded and interacting errors. In the P2FC's analysis of the LAR, as with many northern rivers, there is a lack of basic data on fluvial geomorphology and fish biology data and along with extensive assumptions, other data gaps, and modeling simplifications, the confidence of modeling outputs is generally low yet this is not communicated. Decision makers are not able to make an informed choice when they are not informed about the unstated and unquantified implications of

data gaps and scientific simplifications/assumptions. Unless uncertainty is made clear, then the science is not ready to be considered in decision making.

According to the Government of Canada (2000), "scientists and science advisors should ensure that scientific uncertainty is explicitly identified in scientific results and is communicated directly in plain language to decision makers." The P2FC report does not do this. Instead, there is a complex suite of models each with its own limitations. Error analyses sufficient to inform decision makers of the implications of uncertainty within the models are required to remedy this. Completing these error analyses will require the participation of all the modelers to propagate the errors through the models and to devise estimates that represent interactions and non-linearities within and between the models. It will also require the modelers' professional judgments as to the implications for uncertainty of the many simplifying assumptions upon which the models have been built. This is a complex undertaking requiring the input of the entire modeling team. The Minimum Significant Increment of Change (MSIC – Ohlson *et al.* 2010, p 27) is not a replacement for an error analysis and communication of uncertainty largely because it is a subjective simplification that tends to reduce the potential for identifying uncertainty and error. No effort was given to this important step in interpreting the science that is intended to underpin this decision. Do the modelers and other applied scientists understand how projected changes translate into risk for important water values such as navigability and ecosystem maintenance? And where this is understood, have these uncertainties been effectively communicated to the P2FC and/or to decision makers?

In designing a scientific problem-solving effort like the P2FC one, resources need to be allocated carefully to assure that the information base for the decision will be complete. Extensive detail in one area at the expense of a basic level of interpretation or communication in another may result in the entire decision process being disabled. Ohlson *et al.* (2010) state: "Within the constraints of time and resources, every attempt was [be] made to: be explicit about uncertainty." If time and resources indeed prevented the appropriate presentation of uncertainty and risk to the P2FC, then the combined science and decision process of the P2FC may be interpreted as a failure in the allocation of resources. In the balance of resource allocation to this decision problem, some of the resources given to modeling studies would have been better allocated to quantifying the uncertainty (in various ways) while more resources are needed to gather basic physical and biological data to calibrate and validate the models and ultimately better describe how the system functions. Any situation is constrained by time and resources and this cannot be held as a justification for making a decision based on inadequate and poorly interpreted science.

10.1 Progress Toward an IFN

Based on this review and that of Boag and Candler (2010) and Vander Meulen (2010), it can be concluded that the P2FC science and its decision-making process are incomplete and inadequate for establishing the P2 water management rules at this time. A science program that can address the existing data and analytical deficiencies needs to be put in place along with improvements to the decision-making process including how the science is provided to decision-makers for their consideration. These adjustments will take time and resources and in the meantime, it is important that safeguards be put in place to protect the LAR while this further work is undertaken, by filling gaps in protection currently existing under the P1 rules.

As discussed in section 1.1, establishing a sound IFN for the LAR requires understanding, amid a changing hydrologic regime, the measures needed into the future both to protect the aquatic ecosystem and to honour earlier legal commitments to First Nations Treaty and aboriginal rights for using the river. The P2FC has reduced the scope of its IFN efforts to emphasizing selected fish species and giving less emphasis to both the broader aquatic ecosystem and to First Nations use of the LAR. Within this narrowed scope, the P2FC outcome excludes an EBF and instead allows withdrawals of 4.4 m³/s at any river discharge, this despite previous processes recommending the inclusion of an EBF. The intent of an EBF is to halt withdrawals below a defined cut-off flow to protect essential and sensitive ecosystem processes: this has not been achieved by the P2FC outcome. The IFN should also protect Treaty and aboriginal rights: in addition to requiring a healthy ecosystem, these rights imply incidental rights to navigate the river and access tributaries. Candler (2010) identifies preliminary Aboriginal Base Flow (ABF) and Aboriginal Extreme Flow (AXF) levels to be incorporated into the IFN to provide this protection. He defines the ABF as the open-water LAR flow level below which water withdrawals result in varying degrees of direct and cumulative impacts to Treaty and aboriginal rights. Similar to the ABF, the AXF is the open-water LAR flow below which extreme disruption of Treaty and aboriginal rights occurs along the LAR, the PAD and tributaries. Unfortunately, the P2FC work does not adequately recognize these open-water needs and instead focuses on the winter low flows to protect selected fish species. As the effects of climate change increasingly show up in a changing hydrograph, the incremental hydrologic adjustments are expected to cause new “hotspots” in declining ecosystem integrity and opportunities for navigation. For example, excessive late summer stream temperatures may also become limiting and inadequate fall flows may arise for maintaining connectivity to off-channel habitats. Given the lead times and depth of investment involved in the oilsands sector, it would present increased risk to the industry to encourage this investment when there is a deep but unquantified level of uncertainty as to whether that water will be available after the obligations to Treaty and aboriginal rights and to ecosystem maintenance have been met.

Achieving a robust science-based IFN outcome has been made difficult due to the P2FC’s scientific design and its own process. Notably, the P2FC has caused a bias in the scientific work by infusing it with inappropriate policy direction. For example, its instructions to the Climate Change subgroup to not consider certain scenarios that were “immediately recognized as extreme hydrological changes” has caused a bias in the science associated with one of the most compelling scientific questions and uncertainties in the entire P2FC science analysis (section 3.1). A lopsided outcome has resulted from its emphasis on modeling fish habitat (despite significant model-input data gaps) while other key areas

have gone understudied (First Nations river use – see Candler 2010) or just haven't been allocated the appropriate scientific expertise (climate change and the PAD). This has “shown up” in its emphasis on conducting work to set up an EBF while not carrying out equivalent work to set an ABF or AXF (or equivalent.) And while the P2FC's principles include being “explicit about uncertainty,” it has apparently not insisted that the “explicitness” include quantitative measures with confidence limits.

As reviewed in chapters 3 and 4, the science itself further obfuscates the decision-making process by not being upfront and clear about the extreme level of uncertainty that is present in the scientific outcomes. Lists of assumptions and uncertainties are generally provided in qualitative terms and rarely, if ever, translated into quantitative measures interpreted for the P2FC to understand. Instead, they are converted into coarse generic qualitative classes of risk that are defined by, at times, essentially arbitrary class boundaries and embody a vast level of simplification, error, and overall uncertainty that is not communicated sufficiently. While the P2FC modeling and analytical work varies in its quality, components related to hydrology and geomorphology are notably weak due to the absence of sufficient expertise being assembled to conduct the work in these areas.

10.2 Getting Back on Track

The various scientific gaps can be addressed with additional time and resources. In addressing scientific shortcomings, the LAR and PAD knowledge base existing in peer-reviewed publications, consulting reports, and independent experts should be assembled to address this management question. Whereas literature reviews are carried out in the P2FC science, it is unclear why the hydrology and geomorphology insights from these reviews are not well reflected in the subsequent P2FC modeling. For example, the complex behavior and changing nature of the PAD is unreflected in the P2FC modeling work. The absence of efforts to evaluate how climate change may affect river development and connectivity to side-channels and tributaries, and the absence of consideration of changing sediment transport dynamics as the hydrograph changes, all suggest a need to have appropriate independent experts examine the status of the LAR in relation to proposed water withdrawals.

The science work and the decision-making process exist within a context which has not been examined in Ohlson *et al.* (2010.) The LAR exists at the downstream end of a much larger basin and it is within the context of a state-of-the-basin analysis that the P2 rules should be developed. The Athabasca drainage, as with the LAR and PAD, is not in pristine condition. It is being subjected to various anthropogenic pressures (Schindler and Smol 2006) including extensive forest removal, wetland conversion, agricultural development, water withdrawals not considered by the P2FC, climate change, among others and these together contribute to cumulative effects. Reductions associated with water withdrawals will be superimposed upon aquatic systems already under stress from other factors. The implications of these added pressures and potential cumulative effects need to be understood as the P2 rules are developed. In addition to the physical setting, the rules development exists within an existing and emerging Provincial policy framework that includes the renewed Water for Life Strategy and the Land-Use Framework. Their implications for and interactions with the P2 rules have not been transparently communicated to the P2FC. To proceed with the P2FC decision in the absence of understanding these basin contexts would, again, pose undue risks to investors and to those holding earlier river-based rights.

The PAD is a Ramsar wetland and a UNESCO world heritage site. As such, Canada and Alberta have commitments under an international agreement that oblige them to manage these PAD areas to protect their values. The decision-making objectives should be adjusted to reflect these commitments.

Climate change has an over-riding importance in setting the P2 rules due to the potentially deep changes in hydrograph behaviour that are expected through time (Lebel *et al.* 2009.). It is essential that the methodological errors and bias be fully corrected in how climate change has been addressed. In particular, the implications of the error in Lebel *et al.* (2009) recently acknowledged by AENV (Ernst Kerkhoven Pers. Comm.) be addressed in all the Evaluation Criteria. This review has offered one plausible presentation of climate change projections. Given the demonstrated vulnerability of this work to the influence of policy makers, it should be carried out by independent experts with experience in linking climate change projections to surface hydrology and land use.

Steps need to be taken immediately to fill data gaps critical to reducing scientific uncertainty. With respect to hydrology, existing data should be assembled to better understand the regional hydrology and construct a first-order water budget. These data include RAMP and Water Survey of Canada (WSC) flow measurements, records of water withdrawals, groundwater information, among others. Use insights from an examination of these data to improve understanding of groundwater interactions with the LAR flow and the seasonal significance of tributaries and tributary water withdrawals. With improved hydrologic data, and using all of the data that currently exist, a first order water budget for the drainage can then be developed. The present work can be put in context of the water budget. Similar efforts should be made to synthesise information in various consulting reports and peer-reviewed literature looking at the geomorphology of the LAR.

How science is communicated to decision-makers can be as essential in resolving a complex management question as how well the science is designed and conducted. The P2FC decision-making system can be amended and strengthened with real consensus decision making, defensible risk thresholds, and quantified modeling error and system uncertainty otherwise its outcome will remain ineffective and misleading. With further work, non-linearities and modeling interactions and compounding effects can be examined in the P2FC models to ultimately propagate the modeling uncertainties through to the modeled outcomes. Only when the outcomes are provided to decision-makers with defensible confidence limits will they be suitable for supporting informed decisions. With improved data sets in hand, and quantified uncertainties, the P2FC can address the serious gaps in data and knowledge that currently prevent it from reaching an informed decision.

10.3 Monitoring and Adaptive Management

The above discussion casts light on data and monitoring requirements needed to inform the current deliberation for a strong P2FC decision. While Appendix E of Ohlson *et al.* (2010) describes several valuable hydrologic monitoring proposals for the future, more can first be done with existing hydrologic data to support the P2 decision as indicated above. With respect to new future-oriented data, at a minimum, there is a need for a year-round hydrometric station to be put in place immediately upstream and near where the Athabasca empties into the PAD. Both WSC and the United States Geological Survey have manuals describing winter hydrometry. It is important to retain the services of someone experienced in ice-based flow measurements to get accurate measurements and avoid the pitfalls associated with hydrometric measurements under ice. The other proposals in Appendix E should also be supported (*e.g.*, a monitoring network in the LAR and PAD and improved records of water withdrawals.) Candler (2010) and Boag and Vander Meulen (2010) suggest other important data requirements in related themes.

According to Brian Makowecki (Pers. Comm., DFO CSAS workshop), once the P2 rules are established, they won't be opened again for revision for another Option H outcome be endorsed by regulators

despite its many scientific and decision-process shortcomings, it would be unjustified scientifically to not evaluate it on an ongoing basis. The lack of an EBF, the degree of uncertainty present, and the many other weaknesses in the science and the decision process all highlight the need to move slowly forward with any decision at this time. Instead, seasonal and annual adaptive management programs, with independent expert oversight, are needed that establish and evaluate performance measures directly related to navigation and ecosystem integrity.

If the Option H is adopted without a credible, independent and corrected climate change analysis being completed and applied to the P2FC models, then an annual review of the hydrograph should be carried out to assess the direction of change of peak flows and low flows. The annual observations would be used to ascertain whether unusual and more frequent low flows are occurring. If unusual extremes are suspected, this would provide further justification for implementing a temporary precautionary (cut-off) flow to protect river and navigation values. Consideration could be given to the staged-in construction of off-channel storage to prevent excessive repeated low-flow withdrawals. In such a staged storage regime, storage would be tied to annual observations of low flows following a formula; should annual flows stay low and/or decline, increased storage would be built.

The current day-to-day river situation offers an opportunity to integrate understanding of the effects of changing river dynamics and water withdrawals on emerging challenges to First Nations in exercising their Treaty and aboriginal rights. The P1 rules have been in place for a few years. Current and recent experience of river users can be explored within the context of the dynamic of each year's hydrograph and in relation to the weekly flux in industry water withdrawals. As the new hydrograph unfolds, at times with unexpected behaviour, it offers the opportunity to identify empirical thresholds in access to navigation for fulfilling Treaty and aboriginal rights. Candler (2010) has used such information to develop preliminary indications of an ABF and AXF. More field research is needed in this regard.

ten years. Should the proposed non-consensus

11.0 Recommendations

As a result of this review, the following recommendations are provided to guide the development of the appropriate science and its interpretations to support informed decision-making.

Science

1. Create an independent scientific oversight and review body.

Establish a scientific panel of independent researchers, practitioners and river users with no connection to AENV, DFO, and the oilsands industry to oversee the scientific work carried out in support of this decision.

2. Conduct a credible climate change analysis.

Building on the guidance provided in this report, revise the climate change analysis to provide plausible projections that extend through the likely duration of the oilsands development and which provide projected means and standard errors of future climates based on plausible emissions scenarios and on unbiased methods. Integrate findings from the LARP climate change analysis. (Be sure to correct known errors in Lebel *et al.* (2009) and apply these corrections to all P2FC models.) Use these climate change projections, complete with corresponding confidence limits, to develop/confirm projections for the changes in hydrograph behavior (at least winter and summer low flows, annual peak flow, and mean annual flow) for the LAR and make these model outputs available to the other science work.

3. Apply meaningful climate change projections to all P2FC models.

As existing biophysical models are refined and new models are developed to assess the impacts of water withdrawals on ecosystem health and on Treaty and aboriginal rights, apply the future climates to the model outputs for a range of plausible water withdrawal scenarios.

4. Place the LAR scientific work in the context of its regional hydrology and of the entire Athabasca drainage.

Assemble basic information and conduct preliminary analysis of groundwater-surface interactions, the significance of LAR tributary inflows, extent of LAR tributary water diversions, regional and upstream land-use pressures, and cumulative effects. Acquire the flow data for all gauges on the LAR and use these data to improve knowledge of the basin water budget.

5. Assemble an independent expert team with direct knowledge and experience of the Lower Athabasca River to lead future modeling and interpretation of the effects of water withdrawals.

Led by an independent expert team, bring together existing data, industry reports, and peer-reviewed publications on the structure and function of the LAR, its tributaries and its riparian areas to build a complete picture of its status and behaviour. Use this state-of-the-art understanding to guide the development of future LAR modeling under a range of water withdrawal scenarios, and coupled to climate change projections.

6. Assemble an independent expert team with direct knowledge and experience of the Peace-Athabasca Delta to lead future modeling and interpretation of the effects of water withdrawals.

Led by an independent expert team, bring together existing data, industry reports, and peer-reviewed publications on the structure and function of the PAD and its tributaries to build a complete picture of its status and behavior and including consideration of the climate change projections and the flow regulation on the Peace River. Use this state-of-the-art understanding to guide the development of future PAD modeling under a range of water withdrawal scenarios. Explicitly identify how provincial and federal commitments under the Ramsar treaty are being met to protect this Unesco World Heritage site.

7. Establish confidence limits on P2FC model outputs and interpret the science outcomes for the P2FC (or successor) along with any significant accompanying assumptions.

Require that uncertainty be clearly described, explicitly quantified, and the implications of uncertainty for model outputs be provided by the relevant science group for consideration by (non-science) decision-makers.

8. Interpret findings from the PAD and LAR expert groups in light of direct field experience from First Nations and other informed LAR and PAD users.

Examine past and ongoing river-use dynamics in the context of associated water withdrawals and discharge measurements for the LAR and its tributaries. Identify vulnerabilities in navigation, emerging patterns in downstream flow changes, and possible options for optimizing the interaction between water withdrawals and navigation/access needs. Interpret findings in the context of model outputs to develop improved water withdrawal proposals reflecting the needs of all affected parties.

Decision-making

9. Put in place short term measures to protect river values.

Implement temporary measures to protect river values until the needed science can be completed and the provincial/regional policy development becomes available.

10. Address deficiencies in process and decision-making of the P2FC (or its successor).

Re-establish the P2FC (or successor) process based on consensus decision-making and a requirement that uncertainty be substantially quantified and interpreted for decision-making.

11. Require that the P2FC (or its successor) follow the Precautionary Principle in designing the scientific program and in considering the scientific outcomes. If this is not implemented, then improve the communication of risk to decision-makers.

Examine this problem-solving setting for opportunities to apply the Precautionary Principle. Where risk assessment is used in place of the Precautionary Principle, improve how risk is calculated and interpreted for decision-making. Provide the modeled outputs, complete with quantitative confidence limits and the additional qualitative assumptions that accompany each metric. Assure that there is transparency around the defensibility and reliability of risk thresholds.

12. Link the findings and policy needs of the P2FC work transparently to existing provincial policy initiatives and commitments.

Put the P2FC work explicitly in the context of existing provincial policy initiatives and commitments: the Lower Athabasca Regional Plan, the Water for Life Strategy, and guidance from the Prairie Adaptation Research Council.

13. Establish an appropriate monitoring and adaptive management program.

Develop and implement a monitoring and adaptive management program focused on 1) hydrologic changes due to climate change and regional water withdrawals and 2) adjustments in the fluvial geomorphology of the LAR and PAD. Immediately install a hydrometric station near the mouth of the Athabasca River. Use monitoring results to better quantify the uncertainty. Secure use of beneficial RAMP data.

14. Request that federal agencies such as the Department of Fisheries and Oceans, Indian and Northern Affairs Canada, Transport Canada, and Health Canada intervene on behalf of the First Nations of the Lower Athabasca River.

The Department of Fisheries and Oceans needs to intervene to protect fish habitat. Indian and Northern Affairs Canada needs to intervene to preserve access to protected lands by First Nation peoples. Transport Canada needs to intervene to ensure navigability of the Athabasca River. Health Canada needs to intervene to safeguard the health of the Fort Chipewyan community.

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