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November 14, 2014

Stacey Smythe
Senior Manager, Engagement and Relationships
Aboriginal Engagement and Planning
Stewardship Branch
Environment and Sustainable Resource Development
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Edmonton, AB
T5K 2M4

Sent by email: [Stacey.smythe@gov.ab.ca]

Re: Consultation on the Surface Water Quantity Management Framework

Dear Ms. Smythe:

We are writing in response to your October 15, 2014 email regarding the Surface Water Quantity Management Framework (SWQMF) draft and Dr. Carver's submission on the SWQMF which we provided to you on August 8th, 2014.

As you are aware, the MCFN have been diligently participating in this consultation process for quite some time now due to the implications at stake. Getting the SWQMF right from both a technical and Indigenous Knowledge perspective is of critical importance to MCFN and the exercise of our Treaty rights. Navigation, as you are aware, is an ancillary right which if disrupted has the potential to limit our ability to practice our Treaty and Aboriginal Rights within our traditional territory. MCFN has already experienced serious problems with navigation in our traditional territory and our indigenous knowledge clearly shows that water levels have declined from levels that supported safe navigation. It is for this reason that the MCFN have been advocating for quite some time now that a conservative Aboriginal Base Flow (ABF) or that an Ecological Base Flow be incorporated in the final SWQMF.

It is troubling that, in the absence of your government undertaking comprehensive research on our resource needs as a they pertain to our practice of Treaty Rights, you have declined to take a precautionary approach to the SWQMF let alone incorporate the information and concerns we have provided to you. So we are disappointed that Alberta should in fact suggest a more lax ABF would be sufficient to address our concerns, without having the scientific justification to support this claim and without engaging with the indigenous knowledge information we have shared. It is disappointing from our standpoint, that after so much time and effort, you have not incorporated our suggestions in a

meaningful way. To this end, we wish to state that based on our assessment, the final draft of the SWQMF does not address what is required for the exercise of our Treaty Rights.

In the next few weeks, you shall be receiving a response from Dr. Carver, which addresses the points you raise in your October 15th email. We hope that these efforts are not in vain. Finally, it would be helpful from our end to know when the SWQMF will be finalized. This is something that the Mikisew Cree First Nation has been requesting to know for some time now, though no clear guidance has been received from your Department on this. We thank you, and look forward to hearing your responses to our outstanding questions and concerns.

Kind Regards,

Sebastien Fekete, Consultation Coordinator, MCFN GIR

Cc: Chief and Council
Melody Lepine, Director, MCFN GIR
Chris Hopkins, Operations Manager, MCFN GIR
Mark Gustafson, Legal Counsel, JFK Law
Scott Duguid, Director, ESRD Stewardship Branch
Karin Smith Fargey, Aboriginal Engagement and Planning, ESRD
Thorsten C. Hebben, Section Head, ESRD

Surface Water Quantity Management Framework for the Lower Athabasca River (Government of Alberta & Dept. of Fisheries and Oceans)

Technical Review

Prepared for:

Athabasca Chipewyan First Nation
Industry Relations Corporation
Fort McMurray, Alberta

Mikisew Cree First Nation
Government and Industry Relations
Fort McMurray, Alberta

Prepared by:

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Project #404-06

May 28, 2014

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EXECUTIVE SUMMARY

In 2007, the Government of Alberta (GoA) and the Department of Fisheries and Oceans (DFO) put in place the Phase 1 Water Management Framework (P1 WMF) to establish interim limits to total oilsands-related water withdrawals taken directly from the lower Athabasca River (LAR). Starting in 2008, DFO and GoA initiated a process to develop a reconfigured Phase 2 framework (P2 WMF). Integral to this process was the development of recommendations by a multi-stakeholder committee called the Phase 2 Framework Committee (P2FC) undertook almost two years of process and science to develop models and input into a reconfigured Phase 2 framework released in 2010. Late in 2013, Alberta Environment and Sustainable Resource Development (AESRD) and DFO released their Surface Water Quantity Management Framework (SWQMF) to replace P1. As part of the SWQMF process, GoA is consulting with the Athabasca Chipewyan First Nation (ACFN) and Mikisew Cree First Nation (MCFN). This report provides the findings of a technical review of the proposed SWQMF and with respect to its ability to protect ACFN and MCFN Treaty and Aboriginal rights, with reference to the thresholds and indicators developed by the Nations. The review focuses on potential effects of the SWQMF related to the LAR; effects on the Peace-Athabasca Delta are out of scope.

To inform consultation, ACFN and MCFN commissioned Aqua Environmental Associates to undertake a technical review of the draft SWQMF. The technical review has four objectives: (1) Examine the scientific rationale for the withdrawal limits under the proposed SWQMF; (2) Provide a comparison of the permitted withdrawals under the existing P1 WMF and the proposed SWQMF; (3) Identify specific requirements of the SWQMF associated with the maintenance of ACFN and MCFN aboriginal use and in reference to leading science in determining in-stream flow needs (IFNs, also equivalently referred to as "environmental flow needs", EFNs); and, (4) Provide recommendations for modifying the proposed SWQMF, as suggested by the review. This report provides the findings of this technical review of the proposed SWQMF and with respect to its ability to protect key river values upon which ACFN and MCFN have said that their Treaty and Aboriginal rights depend.

The proposed SWQMF identifies maximum total direct oilsands water withdrawals permitted in terms of tiered seasonal flow-dependent limits. The seasonal withdrawal limits are bounded by flow thresholds called "short-term triggers". Five seasons are recognized: early winter (weeks 44-52), late winter (weeks 1-15), early spring (weeks 16-18), late spring (weeks 19-23), and a combined summer/fall (weeks 24-43). These withdrawal limits have no influence on the amount of water permitted to be extracted from tributaries or from groundwater. The limits are taken directly from the non-consensus "Option H" outcome of the P2FC process. The ACFN and MCFN were not involved in the P2FC process and instead engaged with DFO and AENV in a parallel process which is outlined in a report appendix.

Despite its use as the basis for the draft SWQMF, the P2FC outcome is flawed and unreliable due to a range of process and scientific deficiencies. These include the following concerns: (1) the process was not inclusive and did not achieve consensus; (2) a fundamental error was discovered after the process was over that affected most of the model outputs and with an unclear outcome; (3) the models lacked validation and involved a high degree of unverified assumptions and simplifications; (4) the outcome did not include an Ecosystem Base Flow (a withdrawal cut-off point) in any season; and, (5) the navigation assessments were in error. As a result, the outcome was also scientifically not supported by DFO's Canadian Science Advisory Secretariat. Despite these wide-ranging deficiencies, GoA has adopted the water withdrawal limits and short-term triggers directly from the P2FC outcome even though the P2FC outcome lacks a basis in science (especially due to the absence of any EBF), fails to protect both the Aboriginal Fishery and Aboriginal Navigation, and its approach using long-term triggers is slow to prevent decline in river values in situations where the core assumptions have become no longer valid (*e.g.*, changes in the river hydrograph due to advancing climate change). It falls well short of best available science thus compromising the potential validity of the new SWQMF water withdrawal rules.

The main differences from P1 WMF to SWQMF are (1) the use of long-term triggers; and (2) reduction in total permitted withdrawals during the winter season. They both allow similarly high levels of water withdrawals during the entire open-water (navigation) season including the fall and spring which are key "shoulder periods" of river use essential for sustaining traditional-use activities.

The proposed SWQMF would track selected indicators to examine the validity of the assumptions on which the withdrawal limits were originally developed. These indicators are: (1) seasonal low-flow extremes in the LAR; (2) river discharge (Fort McMurray Water Survey of Canada station); (3) total "gross" oilsands water use; and, (4) "net" water use upstream of Fort McMurray. The crossing of thresholds of these indicators (called "long-term triggers") is used in the SWQMF to identify circumstances in which the assumptions on which the SWQMF is based may have been violated, thus suggesting the need to determine new withdrawal limits. Although the SWQMF recognizes the need to track the navigability of the Athabasca River, the SWQMF provides no method of assessment to do this, opting to describe this instead as a "knowledge gap" while, throughout the report, not acknowledging the reliable evidence-based information they have regarding navigation from ACFN and MCFN. Application of the long-term triggers are the proposal's response to hydrologic non-stationarity due to climate change.

The SWQMF fails to properly consider and protect the Aboriginal Fishery. The full 16 fish species commonly found in the LAR are part of the Aboriginal Fishery (following DFO's new definition in the Fisheries Act). Of these, four key species (Burbot, Lake Whitefish, Northern Pike, and Walleye) can be examined to provide a basis for understanding the broad in-stream flow needs associated with the entire Aboriginal Fishery. Three different life-history strategies are summarized for the four key species: (1) key habitat in the mainstem river; (2) habitat between the mainstem and tributaries, and (3) strategies that cycle between the PAD lakes and the LAR. The LAR's dominant function for fishes important to the Aboriginal Fishery is as a year-round movement corridor. The critical point in the river that limits fish passage is at Fort McKay. In this region, the river is wide (~1 km), braided and susceptible to freezing to the bottom in places. Flow should be maintained at a minimum of 100 m^3/s to ensure that water depths are $\geq$1 m through the stretch of the river around Fort McKay. A flow of 100 m^3/s is also expected to provide approximately this depth elsewhere in the LAR and in other limiting situations. As a result, to ensure unimpeded migration of all fishes in the LAR migration corridor, water depth should be maintained at a minimum of 1 m, and water withdrawals should cease once flows drop to 100 m^3/s.

The in-stream flow need for Aboriginal Navigation has not been considered and incorporated. LAR flow requirements for Aboriginal Navigation have been studied by ACFN and MCFN in terms of the discharge required for access around their territories and pertinent information provided to GoA and DFO in 2010 in a comprehensive study entitled *As Long as The Rivers Flow*. "Aboriginal Navigation" includes not only the ability to navigate the river, but also the ability to access areas along the river, including banks and tributaries, which are important for traditional-use purposes. Aboriginal Base Flow (ABF) is the river discharge above which ACFN and MCFN are able to practice rights and access territories fully and has been determined to be 1600 m^3/s (as measured near Fort McMurray). The Aboriginal Extreme Flow (AXF) is the river discharge below which widespread and extreme disruption of rights occurs due to loss of access related to low waters and is determined to be 400 m^3/s. Additionally, according to ACFN and MCFN river users, open-water navigability of the LAR by small craft is generally possible with at least four feet of water. Access and navigability concerns associated with the high-flow time of the year are generally more related to the PAD and involve complex cumulative effects with the Peace River and climate change, rather than just the LAR proper which is the focus of this review. It is the shoulders of the open-water season (fall and spring) that present frequent challenges to navigation in the LAR and which are also of central importance in the annual hunting cycle. Additional qualitative information regarding sites of special navigation concern have been documented and earlier made available to GoA in *As Long as the Rivers Flow*. Examples include: rock hazards downstream of Fort McMurray, sand bars south of Poplar Point, loss of access up tributaries, especially the Firebag, and blockage in the mainstem at tributary mouths.

The ACFN and MCFN depend on the integrity of the LAR for the exercise of their Treaty and Aboriginal rights. The river and the PAD exist at the centre of their culture, enabling them to carry out hunting, fishing, harvesting, and ceremonial and spiritual activities upon which their cultures are based. Any withdrawal scheme that aspires to protect the instream-flow needs (IFNs) associated with ACFN and MCFN Treaty and Aboriginal rights, must at a minimum, directly sustain Aboriginal Navigation (*i.e.,* open-water navigation river values during the two seasons of spring and fall) and maintain habitat for the Aboriginal Fishery. It must also sustain access in the PAD, however that requires a broader cumulative effects analysis which is beyond the scope of this review. Direct gaps in protection are present in the SWQMF in terms of short-term and long-term triggers and corresponding limits to withdrawals. The SWQMF's Late Spring and Summer/Fall seasons require short-term triggers at 400 m^3/s which is the point below which withdrawals jeopardize Aboriginal Navigation and all seasons require a short-term trigger at approximately 100 m^3/s, a point below which withdrawals threaten the Aboriginal Fishery (and notably in the Early Winter and Late Winter seasons). An additional long-term trigger is also needed in terms of an Index of Aboriginal Navigation to track the overall condition of LAR (and PAD) navigability.

A collection of management-related concerns accompanies the deficiencies in the triggers. These include: (1) identified management responses to long-term triggers are sparse and lack any detail; (2) the monitoring and adaptive management (and research) plan to address "knowledge gaps" is unclear and its performance is not tied to the SWQMF; and, (3) the SWQMF has a stressor focus rather than an effects focus that would be part of a cumulative effects assessment. Gaps and ambiguities thus remain in the GoA's approach to oilsands water-use licensing, reporting, verification, and communication to affected parties.

Under the SWQMF, the withdrawal rules remain nonscientific. Without improvements, the SWQMF perpetuates many of the same problems that are in place currently. Nine recommendations are provided to address gaps in the SWQMF with respect to its ability to address uncertainty and sustain Aboriginal Navigation and the Aboriginal Fishery. If adopted, they may enable the SWQMF to become a suitable successor to the P1 WMF. Particular note is made of the recommendation that the GoA conduct additional modelling of storage requirements in relation to a) escalating oilsands demands and b) heightened potential for episodes of water scarcity (due to climate change and other factors) and use this information to direct oilsands license holders to put in place pre-emptive mitigation to assure capacity is in place during periods of water scarcity. Ultimately, the SWQMF must contain sufficient provisions to assure that GoA is able to protect Treaty and Aboriginal rights under all conditions and scenarios.

In conclusion, the review identifies widespread scientific deficiencies that yield significant gaps in the SWQMF's protection of key river values, including the Aboriginal Fishery and Aboriginal Navigation. The SWQMF is a modest improvement, at best, upon the existing P1 WMF and it generally maintains the current gaps in protection, even potentially exacerbating those during specific weeks of the "shoulder periods" of the open-water year. Guidance from leading science is clear that there should be seasonal cut-off flows, below which withdrawals are not permitted. Allowing industrial withdrawals at any low flows is both nonscientific and also contradicts priority use, given that the ACFN's and MCFN's rights have earlier priority.

- **Recommendation #1: Water-Scarcity Preparedness.** Conduct additional modelling with a focus on Aboriginal Navigation and with the goal of determining the off-channel water storage required to protect contemporary needs for Aboriginal Navigation. Require industry to increase its off-channel storage capacity to meet this standard of preparedness. If this level of storage is impracticable, then reduce the scope of water that is licensed to be withdrawn.
- **Recommendation #2: Verification Using RAMP Eymundson Station.** Use the RAMP Eymundson Station to improve understanding of 1) water available for navigation and fish, and 2) actual flow withdrawals. Resolve any questions that arise concerning differences in measurement standards (open water and ice covered) between the Fort McMurray and Eymundson hydrometric stations.

- **Recommendation #3: Explicit Management Responses.** Include realistic scenarios in the proposed SWQMF to indicate clearly the management steps that can be expected when long-term triggers are crossed, and the associated objectives that will be met.
- **Recommendation #4: Accurate Water Licences.** If the SWQMF remains tied to gross water oilsands use (rather than licensed use), amend the oilsands water licenses to reflect this reduction.
- **Recommendation #5: Aboriginal Navigation – Summer/Fall Short-Term Trigger.** Using information contained in *As Long as the Rivers Flow* (Candler *et al*. 2010), establish a new short-term trigger for the Late Spring and the Summer/Fall seasons such that below 400 m^3/s, water withdrawals are not permitted.
- **Recommendation #6: Aboriginal Fishery – Winter Short-Term Trigger.** Remove the water withdrawal exemption of 4.4 m^3/s permitted below 87 m^3/s during the winter seasons.
- **Recommendation #7: Aboriginal Navigation – Long-Term Trigger.** Include an additional long-term trigger based on the Index of Aboriginal Navigation to address concern for ongoing declines in fall flows and to protect spring navigation. Work with ACFN and MCFN on the best means for identifying and verifying issues that require management action. Include aboriginal communities in an associated weekly reporting and evaluation system.
- **Recommendation #8: Risk and Precaution.** Identify and quantify explicitly the uncertainties and residual risks implicit within the proposed SWQMF.
- **Recommendation #9: Monitoring and Adaptive Management Program.** Provide the details of the monitoring and adaptive-management program elements (including component research projects) that are tied to the SWQMF.

1.0 INTRODUCTION

In 2007, the Government of Alberta (GoA) and the Department of Fisheries and Oceans (DFO) put in place the Phase One Water Management Framework (P1 WMF) to establish limits to total oilsands-related water withdrawals taken directly from the lower Athabasca River (LAR) (AENV & DFO 2007). Integral to the P1 development, was a commitment to subject this Framework to "review and modification in Phase 2 as ecosystem knowledge improves and socio-economic considerations are taken into account" (AENV & DFO 2007, p.12) and to "make the required decisions by the regulatory backstop dates" which culminated in implementation beginning by September 30, 2010. This date was to be final, regardless of stakeholder agreement. In November 2013, Alberta Environment and Sustainable Resource Development (AESRD) and DFO released the Surface Water Quantity Management Framework (SWQMF), which represents the outcome of their two-phased approach and will replace P1. As part of the SWQMF process, GoA is engaging with the Athabasca Chipewyan First Nation (ACFN) and Mikisew Cree First Nation (MCFN). The ACFN and MCFN have retained Aqua Environmental Associates to undertake a technical review of the proposed SWQMF with respect to its ability to protect their Treaty and Aboriginal rights of the ACFN and MCFN. This report provides the outcome of this review.

1.1 Objectives

This technical review has four objectives:

1. Examine the scientific rationale for the withdrawal limits under the proposed SWQMF.

2. Provide a comparison of the permitted withdrawals under the existing P1 WMF and the proposed SWQMF.

3. Identify specific requirements of the SWQMF associated with the maintenance of ACFN and MCFN aboriginal use and in reference to leading science in determining in-stream flow needs (IFNs, also equivalently referred to as "environmental flow needs", EFNs).

4. Provide recommendations for modifying the proposed SWQMF, as suggested by the review.

Section 2 provides the context to the SWQMF. Section 3 describes the proposed SWQMF and compares its withdrawal limits to that of the existing P1 WMF, addressing objectives 1 and 2. The section 4 gap analysis addresses objective 3. Section 5 addresses objective 4.

1.2 Limitations

Aqua Environmental Associates has prepared this report for ACFN and MCFN to inform the SWQMF consultation process and is not responsible for any use, interpretations or conclusions that may be made on the basis of the information contained herein if used by other parties and/or outside of this process. Any such unauthorized use of this report is at the sole risk of the user.

The review is focused on the in-stream flow needs of the mainstem Athabasca River between Fort McMurray and Embarras. Due to significant budget limitations, it does not consider the consequences of the proposed SWQMF on the hydrology of the Peace-Athabasca Delta (PAD).

1.3 Acknowledgments

I would like to recognize the contributions to this report provided by Mr. Tom Boag and Ms. Nicole Nicholls.

Mr. Tom Boag, M.sc P.Bio is the lead author for section 5.2 and Appendix A2. Tom has worked with fishes and their habitats in Alberta for 30 years. He received his B.Sc. from the University of Victoria 1986 and his M.Sc. in 1989 from the University of Alberta where he studied how the lake environment influences growth and reproduction of Burbot. He has been a consultant for 25 years and, over the past 15 years, has reviewed the "aquatic resource" sections of virtually every oilsands EIA currently in operation or under construction. He has investigated the consequence of linear developments on riverine habitat and fishes in the LAR since 2000 on behalf of energy proponents, municipalities and the Alberta provincial government. He has overseen fish salvages from entire watersheds in the region and has fished (boat, float and backpack electrofisher), trapped and seined many of the tributaries and the mainstem Athabasca River. He oversaw and participated in inventories of the Peace River, the PAD and the Slave River fish communities on behalf of the Northern River Basins Study. He has captured fishes for inventory and contaminant body burden investigations (ecosystem heath) on the Athabasca River from Jasper National Park to the PAD. He has overseen several important efforts into the fate and status of fishes and their health in the PAD and LAR on behalf of the ACFN and MCFN and the Cumulative Environmental Management Association (CEMA).

Ms. Nicole Nicholls provided valuable historic information about the consultation history between the ACFN and GoA and between the MCFN and GoA. She was the lead author of Appendix A1.

2.0 CONTEXT FOR THE SWQMF AND FOR THIS REVIEW

The proposed SWQMF is the outcome of a process, including scientific study and policy development, initiated over a decade ago in relation to expressed concern about potential implications of oilsands water withdrawals on LAR ecology and its continued ability to support aboriginal use. Considering this earlier process gives context and scope to the present review.

2.1 Background to the SWQMF

The recent SWQMF proposal for managing water withdrawals from the lower Athabasca River comes after a succession of interim and partial responses to initial expressions of concern regarding a trend of decreasing LAR flows and the increased likelihood that oilsands withdrawals would cause detrimental effects to the goods and services provided by the Athabasca River.

For example, in the 2003 hearing for the Horizon mine, MCFN expressed concern about declining water levels in the LAR, decreased difficulties in use of the river to access harvesting areas, and the potential for oil sands withdrawals to exacerbate these issues:

> "MCFN identified water as its primary concern about the project [Horizon]. MCFN was concerned that the influence of climate change on flows in the Athabasca River and the Peace-Athabasca Delta were not addressed by the EIA, as it believed that the effects of climate change would result in decreased flows in the Athabasca River.
>
> …
>
> MCFN believed that a significant decreasing trend was apparent in both mean stream flow and Q10 low flow in the Athabasca and that these trends were related to climate change… MCFN stated that it was concerned about the impact of this project and other planned oil sands projects on the Athabasca River basin in light of the increasing trend in licenses to withdraw water from the Athabasca. MCFN noted that continuation of its traditional way of life hinged on adequate water flow in the Athabasca River. MCFN stated that the residents of Fort Chipewyan relied on the Athabasca River for many things, including food and transportation. Low flows could limit access to medicinal plants and herbs, spiritual and cultural sites, and trapping and hunting areas. MCFN stated that it believed that this was happening now [as of 2003] and that impacts would be magnified as water use by oil sands development increased." (AEUB & CEAA 2004a, p.37).

While the Cumulative Effects Management Association (CEMA) had a subgroup already working on developing an IFN for the LAR, work that was to be completed by 2005, it is apparent that oil sands proponents did not support development of an IFN (see, for instance, AEUB & CEAA 2004a and 2004b).

As AENV & DFO (2007, p.4) summarize:

> "In 2003, the Federal/Provincial Panel reviewing the Shell Jackpine Phase 1 and Canadian Natural Resources Limited Horizon oil sands mine applications stressed the importance of CEMA completing an in-stream flow needs recommendation for the Athabasca River. The panel further directed that Fisheries and Oceans Canada and Alberta Environment complete the in-stream flow needs framework if CEMA could not provide a recommendation by December 31, 2005. In January 2006, Alberta Environment issued an interim framework for public review and comment. Fisheries and Oceans Canada and Alberta Environment subsequently began a joint process to improve the initial draft and presented a two-phase framework to CEMA in April 2006. This current framework document is a synthesis of the Alberta Environment interim framework, the Fisheries and Oceans work on in-stream flow needs and stakeholder concerns brought forward during the framework review period."

This passage explains that the obligation for a scientific assessment of IFNs of the Athabasca River came over a decade ago as new oilsands mines were being considered in a context of already-decreasing LAR flows. AENV and DFO implemented a two-phased Water Management Framework (WMF): *Instream Flow Needs and Water Management System for the Lower Athabasca River* (hereafter "the P1 WMF") in 2007 as an interim measure to allow time for a comprehensive WMF approach to be developed during Phase 2 (P2) that "will meet environmental and socio-economic goals over the long-term" (AENV & DFO 2007, p.4).

In 2008, three years after the failure of the CEMA IFN process to develop an IFN by 2005, GoA and DFO created the Phase 2 Framework Committee (P2FC). The mandate of this multi-stakeholder committee was to develop recommendations for a Phase 2 framework that "prescribe when, and how much, water can be withdrawn from the Lower Athabasca River for cumulative oil sands mining water use" (Ohlson *et al.* 2010, p.*i*). The P2FC process and science contained significant gaps and flaws. These are presented in section 3.1.2 along with a discussion of how the P2FC outcome has been incorporated into the proposed SWQMF. In June 2010, DFO's Canadian Science Advisory Secretariat examined the P2FC science. Key CSAS findings are provided in section 3.1.3. The P2FC completed its work in January 2010, but GoA delayed using the outcome to complete the P2 WMF until after the Lower Athabasca Regional Plan was finalized and set into force. AESRD eventually released the draft SWQMF in November 2013, which has replaced P2, and, once finalized, will replace the P1 WMF.

The delay in finalizing the Phase 2 WMF (which is now GoA's SWQMF) and the development of the final SWQMF occurred in the context of a province-wide land-use planning process initiated in 2008 with Alberta's Land-Use Framework (LUF). The LUF established seven new land-use regions and called for the creation of a regional land-use plan in each, and development of the Lower Athabasca Regional Plan (LARP) began in 2009 and concluded in 2011. The GoA's 2012-2022 LARP (GoA 2012) came into force on September 1, 2012 and put forth seven outcome statements. Outcome 4 states: "Air and water are managed to support human and ecosystem needs." Achieving this outcome is supported with five frameworks themed by air, surface water quality, surface water quantity, groundwater quality and quantity, and biodiversity. Three of these have been developed and were put in place with the creation of the LARP (one exception: as of 2012, triggers and limits were yet to be developed for the groundwater theme), leaving the surface water quantity and biodiversity frameworks to be developed. The LARP identifies that the Phase Two Water Management Framework will become its Surface Water Quantity Management Framework (SWQMF) (i.e., a formal framework under LARP).

It is not apparent what advantages this delay has resulted in for the soundness of the SWQMF, both in terms of science and policy. While the LARP document states that it arises from a context of increased recognition on the part of GoA to take a cumulative-effects based approach to environmental management (GoA 2012, p.27, see also p.3), and also in GoA's statements of provincial policy and associated regulations, LARP theoretically could inform the development of the SWQMF, the actual value of the LARP in doing so seems questionable.

It appears that the LARP does not provide for science-based assessments nor does it provide guidance on how to consider and incorporate aboriginal use and Treaty rights-based information in planning and decision-making. In addition, it remains unclear in the various initiatives (strategies, frameworks, etc.) how GoA intends to actually analyze, understand and manage for cumulative effects (CE) on ecological aspects of the environment and on Treaty rights and aboriginal use in relation to the many stressors that are in place on the landscape and generally growing in intensity – that is to say, its CE frameworks don't actually manage for CE on ecological aspects, instead focus on attempting to ensure continued production despite those ecological aspects. At this point, the frameworks appear to be focused on a compilation of target stressors within a theme, rather than examining overall effects of all stressors, which would be needed in a cumulative effects assessment (CEA) (MacDonald 2000). Although the SWQMF is presented in a manner that reflects the consistent structure of LARP's approach to constructing management frameworks, it is not apparent that the functional aspects of SWQMF (i.e., its improvement in P1) have been augmented in any way by being part of the LARP process: the short term triggers are taken directly from the flawed outcome of the 2010 P2FC process (see section 3.1.2), the concern that the long-term triggers attempt to address have been on the record since 2010 (Carver 2010), the SWQMF disregards new and valuable post-2010 technical information on navigation provided through the First Nations consultation

process (sections 4.1 and 4.4), and information on management responses and addressing "knowledge gaps" (see section 4.6) remain noncommittal, vague and/or postponed until an unspecified future date (see section 4.7and 4.9).

Other frameworks and strategies have been developed that are intended to be translated into the regional context via the LARP. The most relevant for the SWQMF is *Water for Life: Alberta's Strategy for Sustainability* which is Alberta's broad policy vehicle guiding its management of Alberta water resources. Initially put forth in 2003, then later updated in 2008, Water for Life lays out its three broad objectives of safe drinking water, healthy ecosystems, and water for economic development. As part of the Action Plan created to meet the objectives set out in the Water for Life Strategy, AESRD has completed development of the "Desk-Top Method for Establishing Environmental Flows in Alberta Rivers and Streams" (Locke and Paul 2011). This method "provides a technique to estimate flows to meet the objective of full protection of the riverine environment, in the absence of site-specific studies" (p.*iv*). The work that has been undertaken by GoA and DFO goes beyond the scope of this new Desk-Top Method and, as a result, is not reviewed further here.

To summarize, the SWQMF is the most recent outcome of a series of attempts to address concerns about water quantity in the LAR over the last 10 years, at least. The concerns expressed by MCFN in the statement quoted above continue to be expressed today by ACFN and MCFN, however a science-based IFN is still not in place, despite JRP recommendations and the establishment of a land-use plan for the LAR area.

Mackenzie River Basin Transboundary Waters Master Agreement

The Mackenzie River Basin Transboundary Waters Master Agreement was signed in 1997 and provides additional context and obligation for the management of water quantity in the Athabasca River. This agreement contains high-level principles for the cooperative management of the aquatic ecosystem of the Mackenzie River Basin. As explained on AESRD's website, it also commits Alberta to developing individual bilateral water management agreements with each neighbouring jurisdiction in the Mackenzie River Basin. According to Mackenzie River Basin Board (2009), the objectives of the bilateral agreements are:

- to effect cooperative watershed management among the jurisdictions which share the water resources of the Mackenzie River Basin;
- to sustain the ecological integrity of the aquatic ecosystems of the Mackenzie River Basin; and
- to facilitate equitable and sustainable use of shared water resources by establishing criteria and desired outcomes that address water consumption, flows, quality, ground water management and aquatic ecosystem health commitments.

It is intended that the bilateral agreements commit jurisdictions to work cooperatively to achieve the objectives identified in the terms set out in the Master Agreement.

This transboundary agreement and its subsequent bilateral agreements, oblige GoA to create a SWQMF that protects the aquatic ecosystem and facilitates shared use of the water resource.

2.2 Peace-Athabasca Delta

The lower Athabasca River contributes to the structure and function of a complex landform known as the Peace-Athabasca Delta (PAD). The PAD is subject to long-term cumulative effects from oilsands mining, hydroelectric development on the Peace River, climate change, and other factors. From a hydrologic perspective, these stressors continue to escalate changes in the quantity and timing of water flows in the PAD with direct consequences for the seasonal navigability of the PAD's myriad streams, wetlands, and lakes. For the most part, those impacts from oilsands water withdrawals are not the focus of this review. However, these are discussed within the overall context of cumulative effects assessment (see section 4.9.4).

3.0 THE PROPOSED SWQMF FOR THE LAR

This section provides an overview of the key elements of the proposed SWQMF (AESRD 2013) and a comparison of this proposal with the existing P1 rules.

3.1 Approach to Developing the Proposed SWQMF

3.1.1 Description and Scope

The proposed SWQMF identifies maximum total direct oilsands water withdrawals permitted in terms of tiered seasonal flow-dependent limits from "the lower section of the Athabasca River, from just downstream of the Grand Rapids (approximately 135 kilometres upstream of Fort McMurray) to the Athabasca River Delta" (AESRD 2013, p.3). The seasonal withdrawal limits are bounded by flow thresholds called "short-term triggers". Five seasons are recognized: early winter (weeks 44-52), late winter (weeks 1-15), early spring (weeks 16-18), late spring (weeks 19-23), and a combined summer/fall (weeks 24-43) as shown in Table 3 (AESRD 2013) and summarized here in Table 1. (All discharges are calculated as weekly averages at the WSC station "Athabasca below Fort McMurray", hereafter called the "Fort McMurray WSC station".) These withdrawal limits have no influence on the amount of water permitted to be extracted from tributaries or from groundwater, regardless of direct or indirect consequences of such additional withdrawals to flow in the Athabasca River. The limits are taken directly from the non-consensus "Option H" outcome of the P2FC process (see next section for more information on the P2FC).

Selected indicators will be tracked to examine the integrity of the assumptions on which the withdrawal limits were originally developed (AESRD 2013). The apparent premise of this approach is that if these indicators lie within certain limits, the assumptions underpinning the development of the rules remain valid and thus the withdrawal limits also remain appropriate. These indicators are:

- seasonal low-flow extremes in river discharge (as recorded at the Fort McMurray WSC station)
- total "gross" oilsands water use; and
- "net" water use upstream of Fort McMurray.

Thresholds for these indicators - called "long-term triggers" - are used in the SWQMF to identify circumstances in which the assumptions on which the SWQMF is based may have been violated, thus suggesting the need to determine new withdrawal limits. These indicators and their thresholds are as listed in Table 2. In addition, two ecological indicators have been flagged for potential use, though the proposal indicates that they would need further development to confirm their validity in this application. These are also included in Table 2. Although AESRD (2013) recognizes the need to track the navigability of the Athabasca River, the SWQMF provides no method of assessment to do this, opting to describe this instead as a "knowledge gap". Application of the long-term triggers is the proposal's response to hydrologic non-stationarity due to climate change (Milly *et al.* 2008).

The SWQMF triggers have been developed with a focus on providing some protection to the aquatic ecosystem only (p.8): "The risk to the aquatic ecosystem from a constant year-round water demand will generally be highest when flows are lowest. Therefore, weekly water withdrawal limits reflect a hierarchy of protection across seasonal time periods; withdrawal restrictions are most stringent during periods of lowest flow." Risks to other river values such as navigation and access are not addressed in the short-term or long-term triggers (AESRD 2013, p.8).

Table 1. Withdrawal limits & short-term triggers (thresholds) of proposed SWQMF (numbers taken from AESRD 2013, p.24, Table 3).

Season	Range in Discharge[1] (m^3/s)	Corresponding Withdrawal Limits (m^3/s)	Comment
Early Winter Weeks 44-52 Short-Term Triggers: 87, 150, 200	< **87**	4.4	
	87 to 94.6	Weekly flow minus 82.6	Due to transition rule[2]
	94.6 to 150	12	
	150 to 200	8% of weekly flow	
	> **200**	16	
Mid-Winter Weeks 1-15 Short-Term Triggers: 87, 150, 270	< **87**	4.4	
	87 to 91.6	Weekly flow minus 82.6	Due to transition rule[2]
	91.6 to 150	9	
	150 to 270	6% of weekly flow	
	> **270**	16	
Early Spring Weeks 16-18 Short-Term Triggers: 87, 98.6	< **87**	4.4	
	87 to 98.6	Weekly flow minus 82.6	Due to transition rule[2]
	> **98.6**	16	
Late Spring Weeks 19-23 Short-Term Triggers: 87, 102.6	< **87**	4.4	
	87 to 102.6	Weekly flow minus 82.6	Due to transition rule[2]
	> **102.6**	20	
Summer/Fall Weeks 24-43 Short-Term Triggers: 87, 111.6	< **87**	4.4	
	87 to 111.6	Weekly flow minus 82.6	Due to transition rule[2]
	> **111.6**	29	

[1] The bolded numbers are the specified short-term triggers.

[2] The transition rule is a procedural correction to avoid inappropriate changes in limits across a threshold boundary.

Whereas the short- and long-term triggers define the rules and the limits of their assumed applicability, "management responses" and research to address "knowledge gaps" are introduced to address deficiencies in the rules (e.g., in not protecting navigation) and changes in the system (e.g., due to climate change). Figure 6 identifies procedural considerations that would take place if a long-term trigger were crossed (AESRD 2013, p.33). The management response focuses on verifying whether the change is real and of concern. Although vague and unspecified in how these may be invoked, possible actions identified are "support for additional evaluative criteria, revision of water withdrawal limits, additional long-term monitoring requirements, or improving water-use reporting."

Table 2. Proposed SWQMF indicators to be tracked for use in applying long-term triggers (AESRD 2013).

Indicator	Long-Term Trigger
Seasonal discharge as measured at WSC Athabasca River below Fort McMurray. The frequency of three or more low-flow events in a 10-year period (in one season) is chosen to indicate that a change in prevailing climate and/or hydrology has come about (e.g., due to climate change, rather than weather variability).	Early Winter: 131 m^3/s Mid Winter: 94.7 m^3/s Early Spring: 199 m^3/s Late Spring: 459 m^3/s Summer/Fall: 520 m^3/s
Total annual gross water withdrawals by all oilsands licensees	$\geq 441x10^6$ m^3/yr (~14 m^3/s)
Total net water allocation (all licensees) upstream of Fort McMurray	$\geq 160x10^6$ m^3/yr (~5 m^3/s)
Total net upstream water withdrawals (reported) by all water licensees upstream of Fort McMurray	$\geq 60x10^6$ m^3/yr (~2 m^3/s)
Fish Sustainability Index providing a population-level metric of fish status	Nothing available: it is under consideration here and would need to be developed. It is currently being developed for watersheds throughout Alberta
Index of Native Fish Integrity providing a community-level metric of fish status	Nothing available: it is under consideration and would need to be developed.

The proposal identifies the need for "ecological and navigation" indicators and triggers but says that "further research is required" before they can be established (AESRD 2013, p.20 and p.27): "further research is required before ecological and navigational indicators and triggers can be established." The proposal suggests that any interim risks associated with these environmental values will be addressed through the use of a "qualitative trigger" set with regard to identified ecological and navigational knowledge gaps: "If the analysis of study results identifies significant risk, the appropriate management response, identified in Section 6.0, will be undertaken." (AESRD 2013, p.27). However, there is no methodology provided or definitions given for what would constitute "significant risk", nor is a transparent and structured decision-making process provided in Section 6.0 of the proposal.

The SWQMF indicates that it is meant to support the GoA's commitment to managing cumulative effects:

> "The Government of Alberta is committed to managing cumulative effects at the regional level, using management frameworks in a new approach to integrated management. Management frameworks outline monitoring, evaluation, and reporting requirements for resource users, set early warning triggers for government to determine the need for action, and identify what actions may be taken. Three environmental management frameworks have been developed for the Lower Athabasca Regional Plan…" (AESRD 2013, p.1)

In its subsequent discussion of its purpose, the proposal states it is "part of a shift to cumulative effects management" and its objective "is to manage cumulative water withdrawals, to support both human and ecosystem needs, while balancing social, environmental, and economic interests" (AESRD 2013, p.2). However, the SWQMF provides no indication of how it will be, or can be, used to support a cumulative effects assessment which would be required to support a shift to managing cumulative effects. It focuses on total water withdrawal, not cumulative effects. Whereas it indicates that this framework is part of a shift to managing cumulative effects,

calculating "cumulative water withdrawals" is not an analysis of cumulative effects, but rather a simple tallying of *total* regional withdrawals and only those taken directly from the LAR. (In fact, the word "cumulative" appears 71 instances in the SWQMF, as opposed to the word "total", which could be misleading to readers who may assume that cumulative effects are being analyzed.) Hence, although discussion of this "shift" is prominent in the opening sections of the proposal, there is little in the proposal to indicate that cumulative effects on the aquatic ecosystem and other river values (i.e., navigability) are being managed in consideration of their science-based thresholds for impact. Furthermore, while cumulative effects frameworks should provide guidance for project-specific CEA, the SWQMF falls short of this (Duinker and Greig 2006).

3.1.2 Phase 2 Framework Committee

The Phase 2 Framework Committee (P2FC) was a two-year multi-stakeholder process set up by the Government of Alberta and the federal Department of Fisheries and Oceans (DFO) to "find a set of rules that could effectively and efficiently manage long term, cumulative oil sands mining industry water withdrawals from the Athabasca River." (Ohlson *et al.* 2010, p.i) It was a structured, iterative process that developed objectives and evaluation criteria, by "progressing from exploration of interest areas and objectives at the broadest level by the P2FC to detailed development of impact hypotheses and assessment of potential impacts by the task groups." It considered economic (costs to oilsands industry), environmental (fish habitat; aquatic ecosystem) and social (navigation) concerns in a "tradeoff" process. According to Ohlson *et al.* (2010):

> "An interactive spreadsheet tool was developed to enable committee members to create flow management alternatives based on their interests, and to assess the performance of these alternatives using a number of representative evaluation criteria or proxy criteria. All alternatives were designed assuming an ultimate oil sands mining industry build out scenario that would require a combined 16 m^3/s average industry water withdrawal rate and a combined 29 m^3/s industry peak water withdrawal rate."

This approach was considered to be a "high-growth" oilsands mining future development scenario.

To generate an outcome, the P2FC evaluated water-management alternatives, applying evaluation-criteria models and supporting assessments (e.g., climate change analysis). Extreme scenarios and "interest-based" alternatives were used to bracket the exercise and inform the participants about the consequences of contrasting priorities. Participants agreed to explore a subset of four alternatives using selected in-stream flow protection principles and translating the outcome into industry storage-cost estimates "so that the implications for industry could be better assessed." It was decided to examine variations on Option A because this option "demonstrated marked improvements in wetted area over the current Phase 1 Framework while preserving performance with respect to industry interests" (Ohlson *et al.* 2010, p iv). According to Ohlson at al. (2010, p.iv), these variations generally "represented a trade-off of environmental gains in average years (as achieved with Option A) for increased protection in rare low flow years (Options B through H)." Although consensus could not be reached within the timeframe GoA and DFO made available for the process, Ohlson at al (2010) put forth Option H as the best option under consideration, despite there being areas of disagreement and especially around the needs for an Ecosystem Base Flow (EBF, or "cut-off flow").

3.2 Changes from WMF Phase 1 to SWQMF

3.2.1 P1 WMF Description

The P1 WMF rules provide oilsands total withdrawal limits in terms of a mixture of fixed withdrawals below specified thresholds and variable withdrawals above them that rise as 15% of Athabasca flow. *Significant withdrawals are allowed at all extreme seasonal and annual low-flow events*. Specific seasons are not explicitly delineated and named; instead, a weekly flow expectation is determined based on 1957-2007 data (WSC Fort McMurray station) and the withdrawal limits are tied to this fixed historic hydrograph, no matter how different the hydrograph may become due to climate change, future upstream withdrawals, or other factors.

During the ice-covered period, withdrawals above 8 m^3/s remain available no matter how diminished the river discharge may become and go up as 15% of the river discharge above ~162-245 m^3/s, depending on the particular week within the ice season. The minimum permitted withdrawals are higher in the Early Winter (10 m^3/s) and the Early Spring (15 m^3/s). Once the open-water season arrives (implied in SWQMF to begin at the start of the Late Spring, i.e., May 7), permitted withdrawals rise to a minimum of 27 m^3/s and above the limits specified in AENV&DFO (2007), they rise as 15% of the Athabasca River discharge, depending on the particular week of the open-water season (see next section for graphical representation of this).

3.2.2 Comparison of P1 WMF and the proposed SWQMF

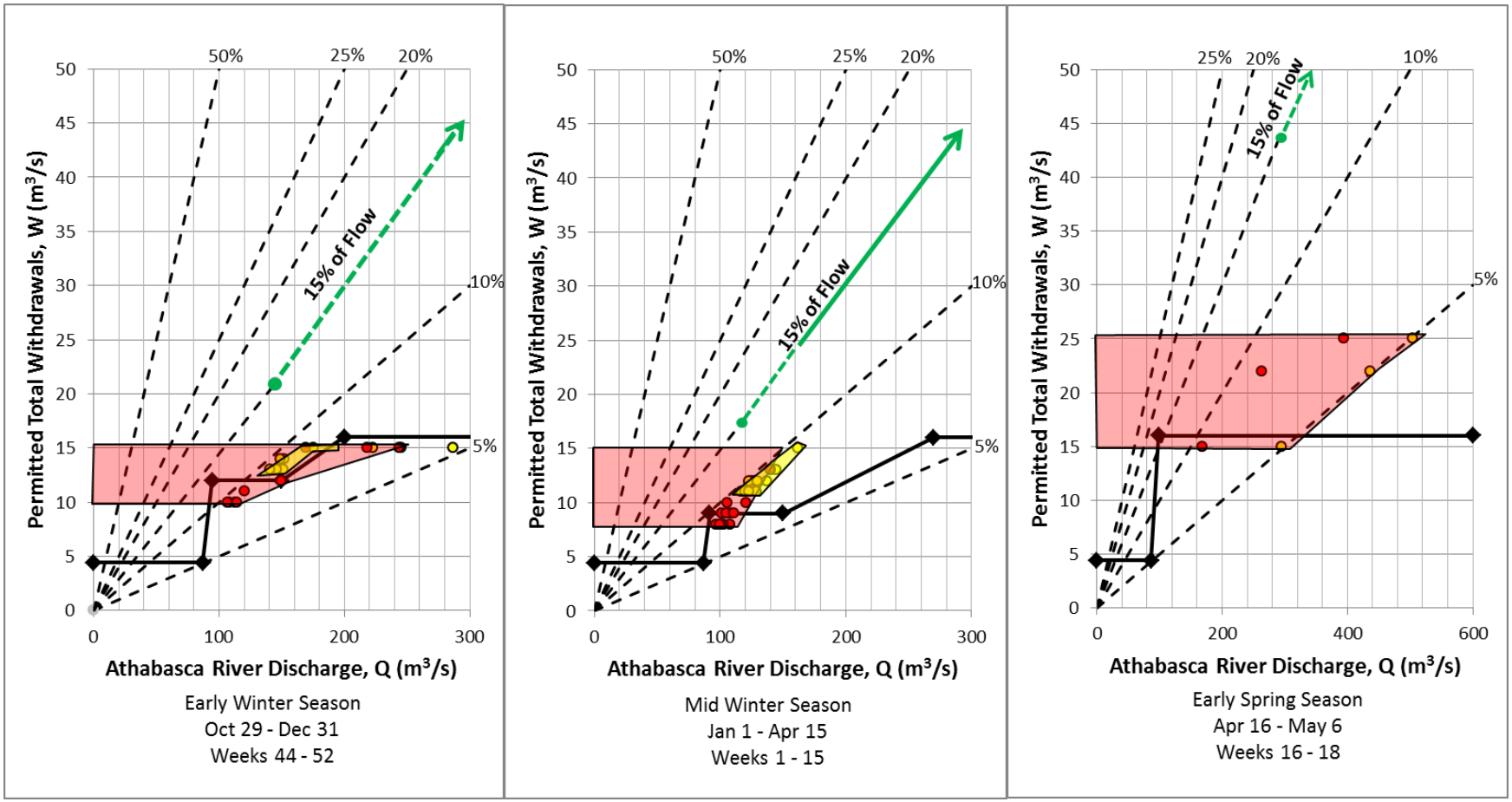
Differences between the existing P1 WMF and proposed SWQMF can be characterized in terms of their respective structures, ease of operability, and withdrawal limits. Each aspect is discussed briefly in this section.

The two schemes have different structures, making a direct comparison somewhat difficult. The P1 limits are tied to a simulated weekly hydrograph (based on historic data) that change with each week of the year. The rules under the proposed SWQMF provide limits seasonally and do not change therein. In the SWQMF, the winter and spring seasons are each subdivided into two parts whereas the summer and fall are lumped into one combined lengthy season. (See SWQMF Table 3 for further week numbers contained in the SWQMF seasons.) The P1 makes reference to a variety of hydrologic and habitat metrics that may be difficult for some to interpret and applies these at different reaches along the river. In contrast, the SWQMF is based solely on flow at the WSC Fort McMurray WSC station and as such is simpler to understand and implement than its P1 counterpart.

Figures 1 (ice-covered season) and 2 (open-water season) provide a direct graphical comparison of the withdrawal limits of the two approaches to illustrate their differences in thresholds and withdrawals. The new SWQMF rules remove the proportional limit (15%) at the upper discharge end whereby withdrawal limits increase with river discharge above a specified upper discharge limit. These are replaced with fixed caps at the upper end, no matter how high river discharge becomes. At the lower end, the winter season flows remain unprotected because the SWQMF rules permit 4.4 m^3/s at any flow rate, no matter how low the flow may become. As a result, the fall period remains unprotected with extreme withdrawals permitted down to all (conceivable) low fall flows, and resulting in up to 25% of the river flow potentially being removed, similar in scale to the allowable fall-period withdrawals under the present P1 rules. Under intermediate LAR flows, the new proposal generally tightens up permitted withdrawals, especially in the Early Spring, though there are individual weeks in which the permitted withdrawal may be higher than under P1. The two winter seasons provide for a stepped reduction in permitted withdrawal for LAR flows in the vicinity of 100-150 m^3/s. In practice, the other three seasons provide for one flat total permitted withdrawal rate.

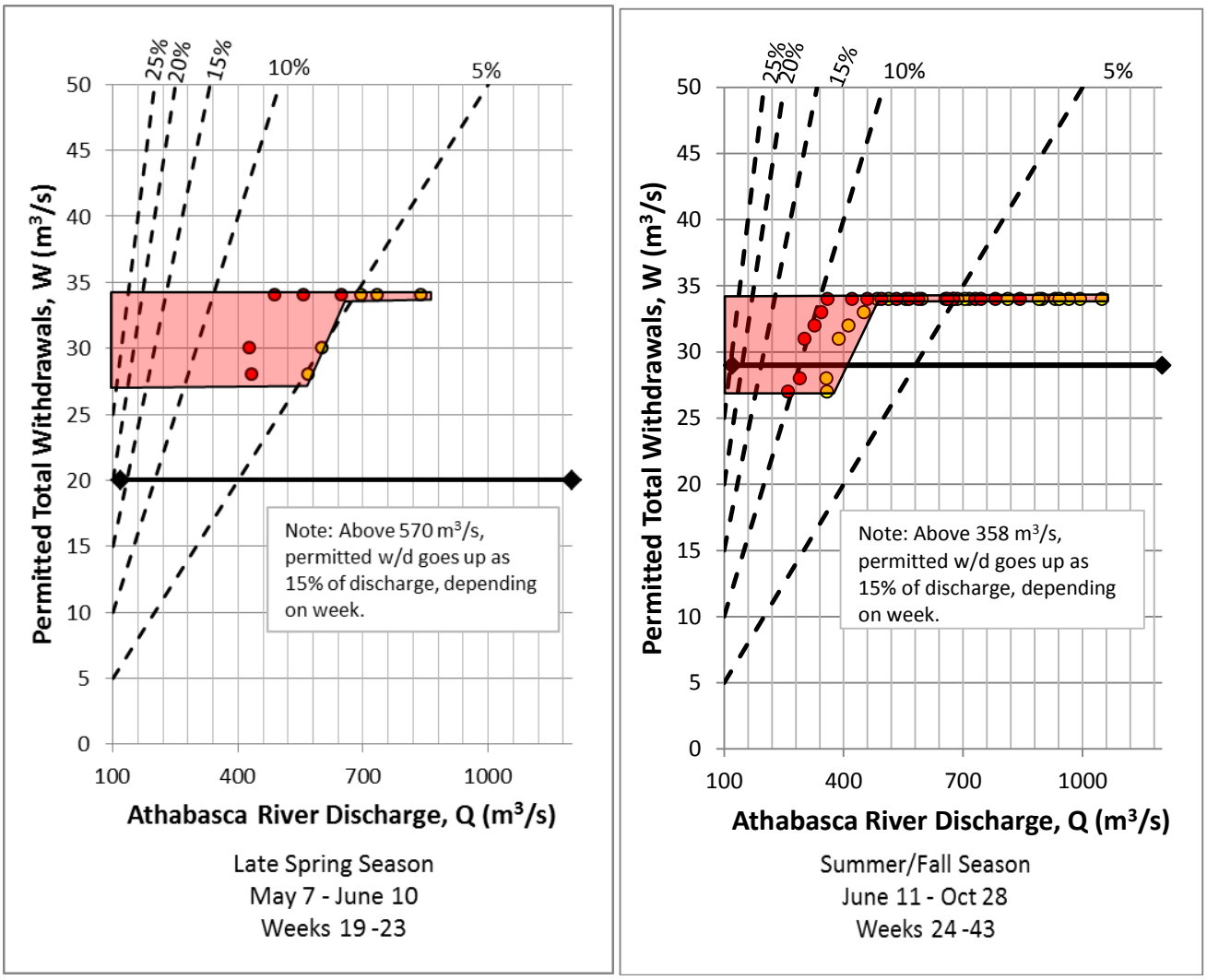
In summary, the proposed SWQMF rules group the weeks of the year into seasons and present a scheme that is easier to understand than the present P1 rules. The SWQMF reduces some limits while keeping others similar to P1. For three notable sensitive periods of the annual hydrograph (winter low flow for fish survival and spring and fall flow for navigation), the proposed SWQMF continues to provide a lack of protection, as did the P1. During winter extreme low flows, P2 permits 4.4 m^3/s total withdrawal down to any low flow consistent with the P1 which also allows withdrawals to any low flow (though down from a higher rate of at least 8 m^3/s, depending on the week). During the summer/fall season, the proposed SWQMF rules allow a similar rate of withdrawals as currently permitted under P1, and in fact, allow higher withdrawals during the tail end of the navigation season when extreme fall low flows would be the most likely to occur: during weeks 42 and 43, permitted withdrawals *increase* from 27 m^3/s and 28 m^3/s (respectively) to 29 m^3/s (available for abstraction down to extreme low flows of 111.6 m^3/s).

Figure 1. Comparison of P1 & proposed SWQMF withdrawal limits during ice-covered periods.



See Figure 2 for explanatory notes.

Figure 2. Comparison of P1 & proposed SWQMF withdrawal limits during open-water periods.



Explanatory notes for Figures 1 and 2.

Thick solid black line and diamonds represent the proposed SWQMF limits.

- Red circles/polygons, yellow circles/polygons, and green dashed lines represent the existing Phase 1 limits:
- Yellow limits differ from red limits only in the winter season.
- Red and yellow limits are provided as polygons because the P1 limits vary through each season. (In contrast, the P2 limits are the same throughout all weeks of a given season.)

The start of the green zone depends on week number within each season.

For P1, the figures use Reach 5 information. Dashed black lines show percentages of Athabasca River flow, for reference.

4.0 ESTABLISHING IN-STREAM FLOW NEEDS – A SCIENCE REVIEW

"Streamflow has been called the master variable (Power *et al.* 1995) or the maestro that orchestrates pattern and process in rivers (Walker *et al.* 1995)" (from Poff *et al.* 2010). It is this growing awareness of the central importance of streamflow that has brought to worldwide prominence (*e.g.*, Acreman and Ferguson 2010) the discussion of the in-stream flow needs (IFNs; also called environmental flows and ecological flows) of rivers of all sizes and types. There are now thousands of scientific publications discussing various aspects of this topic in an attempt to create suitable methods to define IFNs for contrasting rivers as well as diverse data and river-management situations. Although generalizations can be difficult, some themes have emerged and are introduced here. The intention is not to provide a comprehensive review of methods but to provide a targeted science background relevant to the LAR that can give context and a stronger understanding of the findings discussed in section 5. The reader is referred elsewhere for more detailed reviews of IFN methodologies (*e.g.*, Linnansaari *et al.* 2013; Caissie and El-Jabi 2003).

Poff *et al.* (2010) reviewed 165 papers published since 1970 in search of a relation between various kinds of flow alteration and ecological responses, with a focus on more recent papers. For all of the papers, they characterized flow alteration in terms of the magnitude, frequency, duration, timing, and rate of change as reported by the individual studies. Ecological responses were characterized according to taxonomic identity and type of response. The results strongly corroborated previous (less comprehensive) reviews in finding strong ecological responses to all types of flow alteration. Their analyses "support the inference that flow alteration is associated with ecological change and that the risk of ecological change increases with increasing magnitude of flow alteration." They were unable to find simple linear or threshold relations. An important conclusion of their work is the need for the establishment of a *prescribed* monitoring program in which data is collected in a before-after-control-impact design to support statistical inference of ecological response. The explicit identification of a statistically-robust monitoring program would help to address the common problems they observed related to study design, species responses and stressor characterization - in addition to effects attribution in a cumulative effects situation.

An IFN is defined as the quantity, timing, and quality of water flows required to sustain freshwater and estuarine ecosystems as well as the human livelihoods and well-being that depend on these ecosystems (Brisbane Declaration 2007 in Richter 2012). Specifically, in the present review, the IFN includes consideration of fish, the aquatic ecosystem, and the navigability of the LAR as required to sustain the Treaty and Aboriginal rights of ACFN and MCFN. Water is needed in a river channel for various purposes throughout the year. Determining how much is required at what time of year has created decades of scientific discourse due to the immense variability in natural and social systems worldwide. Generally, there are three groupings of IFN methodologies - hydrologic, hydraulic, and habitat approaches - involving contrasting levels of complexity and site-specific information. Jowett (1997) and Caissie and El-Jabi (2003) provide descriptions of the various IFN modelling approaches. Hydrologic methods focus on aspects of basin hydrology and develop rules for maintaining river flows as a function of the hydrograph (*e.g.*, percentage of mean annual flow; limits related to seven-day low flows). These approaches can be developed based strictly on long-term hydrometric monitoring. The early Tennant Method (Tennant 1976) is arguably the most popular hydrologic method and provides rules based on mean annual flow. Hydraulic methods are based on a relation between a hydraulic river metric (usually wetted perimeter or depth) and river discharge. These approaches require additional field data and thus involve added complexity. Habitat methods are based on the belief that there is an underlying relation between discharge and the optimum physical habitat conditions for each key species. Habitat approaches have gained considerable popularity in recent years.

A vibrant discussion is ongoing in the scientific literature around new and existing methods for IFN assessment. A new approach called Ecological Limits of Hydrologic Alteration (ELOHA) is provided as a consensus view from a team of international scientists "for assessing environmental flow needs for many streams and rivers simultaneously to foster development and implementation of environmental flow standards at the regional scale"

(Poff *et al.* 2010). Their recent "logical approach" is intended to flexibly allow "scientists, water-resource managers and other stakeholders to analyse and synthesise available information into coherent and ecologically based and socially acceptable goals and standards for management of environmental flows" (Jowett 1997). Various publications propose improvements to how IFN assessment is conducted. For example, Bradford (2008) proposes an integrated framework to support IFN assessment in Canada that includes establishing a design-flow objective and a three-tiered hierarchy of analyses "such that more sophisticated tools are applied as more focused and quantitative assessments are necessary." In an excellent review paper, Acreman and Dunbar (2004) discuss a variety of strengths and weaknesses of IFN approaches. They note that "[q]uantification of uncertainty is an element that is frequently overlooked." For example, studies using the Instream Flow Incremental Methodology (Bovee 1982) (which may share technical similarities with the P2FC process) are often criticized for an over-emphasis on modelling at the expense of other critical stages. Acreman and Dunbar (2004) also state:

> "The challenge for river scientists is to support decision-makers in defining the flow regime that best meets the objectives set….A range of methods now exists to achieve this together with broader decision making frameworks. No single method is universally the best; each method has its advantages and disadvantages depending on climatic regimes and different scales, and each works at various levels of detail."

The complexity of determining an appropriate IFN for a given river of interest can, at times, result in "doing nothing" due to "real and perceived hurdles" (Richter et al. 2012). As a result, Richter et al. (2012) have put forth a "presumptive standard for environmental flow protection" following a sustainability boundary approach. The premise with this approach is that the basic shape of the hydrograph should be protected through a "percent of flow" (PoF) approach to permitting withdrawals. The proposal holds that, until more detailed information is made available, the initial limits on water withdrawals are: low risk (<10%), moderate risk (10-20%), high risk (>20%) where risk is defined qualitatively as "level of ecological protection". In addition to this standard under normal flows, they propose an additional consideration being "hands-off" flow thresholds (also known as cut-off flows and ecosystem base flows) to limit impacts to the frequency and duration of low-flow events in situations where fish passage, water quality or other considerations (such as navigability) may be impaired by low flows. In summary, their proposal includes tiered percentage allowable withdrawals (to 10% for low risk and up to 20% for moderate risk) coupled with seasonal EBFs, as needed to protect environmental and social values. These generic standards appear to be broadly supported by DFO. In its *Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada* (CSAS 2013), it is stated:

> p.3: "A floor value, or 'cut-off limit' should be part of the overall prescription to conserve and protect fisheries."
>
> p.2: "Cumulative flow alterations <10% in amplitude of the actual (instantaneous) flow in the river relative to a "natural flow regime" have a low probability of detectable impacts to ecosystems that support commercial, recreational or Aboriginal fisheries."

There is also a tension at play between retention of the normal flow in the river channel and the need for storage, given a specific level of water demand. As IFN protection increases, the storage requirement also increases (to accomplish the protection) and this can have consequent ecological impacts particularly if the storage is created by in-stream methods (Richter et al 2012). As ecological and social impacts rise (be it due to direct withdrawals or due to in-stream or other storage), reducing the withdrawal demand may be the only option remaining to maintain all social and environmental values at, say, a low (or moderate) risk.

The growing awareness internationally about the core societal value of river systems and the goods and services they provide is "raising the bar" on expectations for strong stewardship (Richter et al 2003). It is no longer acceptable to over-allocate water withdrawals with consequent declines in river function. In reference to the task of setting the appropriate IFN for a river of concern, Arthington et al (2006) emphasize "that just because this cannot be done easily, there is no justification to revert to an overly simplistic approach". In the next section, some of the principles discussed above are examined as the SWQMF, described in section 3 is evaluated with respect to its scientific characteristics and its ability to sustain the key river values on which ACFN and MCFN depend to exercise their Treaty and Aboriginal rights associated with the LAR.

5.0 SWQMF DISCUSSION AND GAP ANALYSIS

AESRD (2013, p.1) states that the consultation input from First Nations has been central to the development of the SWQMF:

> "Collaboration with the Cumulative Environmental Management Association, the Phase 2 Framework Committee, *and First Nations* has been instrumental in developing Phase 2 of the water management framework" (emphasis added).

However, there is little or no sign of ACFN and MCFN input in the proposal with respect to Aboriginal Navigation and there is no mention of the Aboriginal Fishery (as per changes to the Fisheries Act). "Aboriginal Navigation" includes not only the ability to navigate the river, but also the ability to access areas along the river, including banks and tributaries that are important for traditional-use purposes. Appendix A1 highlights relevant input given to GoA and DFO concerning the importance of the LAR to ACFN and MCFN exercise of their Treaty and Aboriginal rights. Although the SWQMF (AESRD 2013 p.9) indicates that it "explicitly considered stakeholder interests in its analyses", it is unclear how this could be true given the lack of inclusion of ACFN and MCFN information provided about navigation, the mischaracterization of navigation concerns as a "knowledge gap," and the lack of definition provided of the Aboriginal Fishery.

Section 5.1 introduces the LAR river values that must be protected in order to maintain ACFN and MCFN Treaty and Aboriginal rights. This information is presented as a foundation for the subsequent sections 5.2 and 5.3 that explore in more detail what is required of the SWQMF from this First Nations' perspective with respect to fish and navigation, respectively. Sections 5.4 and 5.5 provide a discussion of the SWQMF withdrawal limits in relation to what is needed to protect Treaty and Aboriginal rights. The remaining sections discuss other broad concerns associated with the SWQMF proposal.

5.1 Weak Linkage of SWQMF to River Values Supporting ACFN & MCFN Treaty and Aboriginal Rights

The GoA explains (AESRD 2013, p17) that "fish habitat and fish populations have been chosen as key indicators of ecosystem health" because "[f]ish are integrators of impacts on the entire aquatic ecosystem and are also of concern for the local residents." The SWQMF goes on to explicitly discuss the fish and fish habitat present in the river (AESRD 2013, p. 18-19) then uses the outcome of the P2FC process as its withdrawal rules thus emphasizing the maintenance of fish-related water needs in its approach (see section 3.1.2). Furthermore, despite having considerable authoritative information about Aboriginal Navigation made available to it subsequent to the P2FC process (i.e., Candler *et al.* 2010; see Appendix A), GoA has not included this information as part of the P2 proposal. Instead, it refers to the navigation aspect strictly as a "knowledge gap" requiring further research (see section 4.6.1). In fact, Candler *et al.* (2010) have quantitatively identified specific aspects of the LAR hydrograph (WSC Fort McMurray station) required to support Aboriginal Navigation (see Section 5.3 for specifics). Additionally, Candler (2010) has explained in detail why the P2FC outcome is in error with respect to Aboriginal Navigation yet it has been endorsed by the SWQMF.

Because weekly water limits are based on a "balance" of preserving performance with respect to industry interests in relation to the aquatic ecosystem, without bringing navigation into the balance, water withdrawals are reduced only during winter low flow seasons, without protections for critical open-water seasons for Aboriginal use, access and river navigation. For example (AESRD 2013, p.23):

> "Implementation of the weekly water withdrawal limits will include reducing water withdrawals during low flow seasons (winter), in order to protect the aquatic ecosystem."

Only the winter is identified as a period of low-flow concern; the fall and spring are not mentioned in this respect. This is reinforced in the SWQMF's discussion of possible operational measures to protect river values of concern: "Storage would enable the withdrawal of water during high flow periods (summer) so that it can be stored and used during low flow periods (winter)" (AESRD 2013, p.23). No mention is made of the need to store

water in the summer to use during the fall when Aboriginal Navigation is of particular significance and may be vulnerable, nor of having sufficient water in storage to sustain operations through the early spring period when navigation can be limited by LAR discharge. The proposed SWQMF states (AESRD 2013, p.8): "…weekly water withdrawal limits reflect a hierarchy of protection across seasonal time periods; withdrawal restrictions are most stringent during periods of lowest flow." While it is appropriate that the framework provide protection for the aquatic ecosystem during the periods of annual low flow, it is also important that it provide protection of *seasonal* low flow related to Aboriginal Navigation, notably in the fall and spring periods. River values generally require water seasonally, not annually, and this is evident for both the Aboriginal Fishery and Aboriginal Navigation.

This SWQMF gap in adequately characterizing and protecting the river values that support ACFN & MCFN Treaty and Aboriginal rights is detailed in the next sections. For example, the proposed framework has not incorporated the extensive input provided to it by ACFN and MCFN on the critical use and value of the river for Aboriginal navigation and access to harvesting areas. Instead, the proposed SWQMF focuses on balancing aquatic ecosystem needs with ensuring oilsands production in a full build-out scenario. It becomes evident that the SWQMF is based on accommodating current and proposed levels of oilsands withdrawals without a rigorous and scientific consideration and protection of Treaty and Aboriginal rights.

5.2 LAR In-Stream Flow Need for the Aboriginal Fishery

In 2013, the Fisheries Act was amended, introducing the concept of an Aboriginal Fishery. However, the SWQMF does not consider the existence and definition of an Aboriginal Fishery, as defined by DFO, or provide an explanation of how populations upon which the SWQMF limits are based will protect the Aboriginal Fishery. Instead, the GoA indicates (AESRD 2013, p.17) that "fish habitat and fish populations have been chosen as key indicators of ecosystem health" because "[f]ish are integrators of impacts on the entire aquatic ecosystem and are also of concern for the local residents" and then places seasonal limits on water withdrawals that are taken directly from the non-consensus "Option H" outcome of the P2FC process. However, as detailed in section 5.4, the P2FC outcome has many deficiencies and hence does not provide protection of the aquatic ecosystem. The necessity of an adequate IFN for the LAR is intuitive given that additional abstraction of water from the LAR will have a quantifiable adverse cumulative effect on the biological integrity of the river (see Stevens *et al.*, 2010).

As discussed in section 4, the development of a science-based IFN for the LAR is a complex undertaking that requires a significant budget. Given that this is unavailable to the ACFN and MCFN, this section provides a targeted perspective and alternative analysis on whether these limits will protect the Aboriginal Fishery. To that end, the following discussion presents a data-supported scientific rationale relating to the minimum contiguous water level required to protect all fishes in the LAR.

5.2.1 Context: DFO's "Aboriginal Fishery"

In 2013, DFO revised the federal Fisheries Act to regulate and protect habitat for fishes that contribute to commercial, recreational and aboriginal (CRA) fisheries important to individuals and communities. In its *Fisheries Protection Policy Statement*, DFO (2013) states "[f]ish that are part of commercial, recreational or Aboriginal fisheries are interpreted to be those fish that fall within the scope of applicable federal or provincial fisheries regulations as well as those that can be fished by Aboriginal organizations or their members for food, social or ceremonial purposes or for purposes set out in a land claims agreement." Further, "fish that support these fisheries are those fish that contribute to the productivity of a fishery." In 2013, DFO revised the legislation to protect ecosystem components that support fishes in each of the three fisheries (commercial, recreational or Aboriginal). Of particular interest in the present context is the scope of the Aboriginal Fishery in the LAR.

Although "31 species of cool- and cold-water fish have been documented in the lower Athabasca River between Fort McMurray and Lake Athabasca," a subset of 16 species is of significance to the ACFN and MCFN in the

river proper between Fort McMurray and the PAD[1]. It is these 16 species, in particular, that require protection in the P2 proposal to maintain fish-related Treaty and Aboriginal rights.

Of the 16 species of fishes (NRBS 1994a, FWMIS 2014; see Table 3) encountered commonly in LAR, various species are used by ACFN and MCFN members for "food, social or ceremonial purposes" and all form part of the Aboriginal Fishery. The specific uses and frequencies of use for different species may vary given that their abundance, location and ease of harvesting varies seasonally (e.g., preferred /accessible harvesting locations, spawning times and locations, and the variance of these by season and open-water/ice-free conditions), alongside differing preferences for use and consumption (e.g., staple traditional food; special food or delicacy; use in feasts/ceremonies; etc.) (Bruce MacLean 2014 and Craig Candler 2014, personal communications).

Some of the 16 species are known to be particularly important to the ecology of the LAR and are generally most abundant in tributaries, ponds and small lakes which flow into the LAR. Even if not directly used for traditional consumptive purposes, ACFN and MCFN consider that these species form part of the Aboriginal Fishery due to their contribution (as prey) to the productivity of consumptive species. Providing a comprehensive legal definition of the LAR Aboriginal Fishery is beyond the scope of the present review. However, for the present purposes, it can be assumed that all 16 species in the LAR form part of the Aboriginal Fishery with seven of these contributing directly to it. In addition, six species are sought after by recreational fishermen, and two are sought after by the commercial fishery - Table 1.

Table 3. Guild, species composition and place in respective fisheries for fishes encountered commonly in the LAR (NRBS 1994; FWMIS 2014).

Guild	Species[1]	Scientific Name	Aboriginal[2]	Commercial	Recreational
Sport Fish	Burbot	*Lota lota*	direct		x
	Goldeye	*Hiodon alosoides*	direct		x
	Lake Whitefish	*Coregonus clupeaformis*	direct	x	x
	Northern Pike	*Esox lucius*	direct		x
	Walleye	*Sander vitreus*	direct	x	x
Coarse Fish	Longnose Sucker	*Catostomus catostomus*	direct		
	White Sucker	*Catostomus commersoni*	direct		
Forage Fish	Trout-perch	*Percopsis omiscomaycus*	support		
	Brook Stickleback	*Culaea inconstans*	support		
	Emerald Shiner	*Notropis atherinoides*	support		
	Flathead Chub	*Platygobio gracilis*	support		
	Fathead Minnow	*Pimephales promelas*	support		
	Lake Chub	*Coesius plumbius*	support		
	Longnose dace	*Rhinichthys cataractae*	support		
	Spoonhead Sculpin	*Cottus ricei*	support		
	Spottail Shiner	*Notropis hudsonius*	support		

[1] Fishes listed in the table have been caught during inventories of the river and peripheral habitats. There are 15 other species that are found predominantly in tributaries and NOT in the mainstem Athabasca River (Bull Trout and Rainbow Trout are represented by single individuals sampled historically and their presence is incidental at best – see Appendix C of AESRD 2013).

[2] Distinction is made here between those species that are known to be sought by ACFN and MCFN members (direct) and those that are assumed, in some way, to support the other species. It is understood that this information is preliminary and requires verification.

[1] Of the 31 species, minnows (Cyprinidae – 7 species), Brook Stickleback and Slimy Sculpin are appreciably more common in tributaries to the mainstem river (first through 4th order) or in ponds and lakes on the benches above the river and/or PAD. Exceptions are Flathead Chub, River Shiner and Longnose Dace which are sampled from peripheral habitat in the LAR. Yellow Perch, Lake Trout and Cisco complete their life-cycles in Lake Athabasca and occasionally stray into the PAD. Any Yellow Perch captured in the mainstem Athabasca River are likely juveniles which have been swept inadvertently downstream ("escapees") from Lac La Biche via the La Biche River.

5.2.2 Discussion of In-Stream Flow Needs for the Aboriginal Fishery

Of the subset described above, four key species– Burbot, Lake Whitefish, Northern Pike, and Walleye - are examined in detail as a basis for discussing and understanding the broad in-stream flow needs associated with the Aboriginal Fishery[2]. It is suggested here that if the IFNs of these contrasting/valued species are protected, then the IFNs of the remainder will also be assured. This approach provides a collective perspective of the general requirements of an Aboriginal Fishery IFN so that the SWQMF can be evaluated. The life-history characteristics and habitat requirements of these species are described in Appendix A2 and include time of migration, preferred habitat characteristics, and distribution of each with respect to season. An overview of this detailed information is given in Table 4.

In Table 4, three different life-history strategies are summarized for the four key species: i) key habitat in the mainstem river, ii) habitat between the mainstem and tributaries, and iii) strategies that cycle between the PAD lakes and the LAR[3]. Despite these broad life-history characteristics, none of the species in the Aboriginal Fishery has evolved to stack all its "eggs in one basket". This is a logical evolutionary approach to avoid catastrophic population loss during years when weather extremes occur or part of drainage is cutoff from the mainstem because of a natural or man-made disruption. For example, different populations of Lake Whitefish have evolved in different locations to assure successful reproduction of the species in the LAR. They migrate from the PAD upstream to spawn in the LAR in October, and actively-spawning Lake Whitefish have been captured in the LAR over submerged gravel bars under Highway 63 (AAR 2004). Pre-spawning adults have been also captured in the Clearwater River, likely en route to the Christina River, a tributary known to support spawning. Similarly, Northern Pike, Walleye, Burbot and Goldeye use different portions of the LAR watershed to complete their life-cycles to avoid catastrophic loss.

Table 4. Summary of habitat requirements and periodicity of life-history stages for four key LAR fishes.

Species	**Timing**		**LAR Habitats**	
	Spawning	**Emergence of Fry**	**Spawning**	**Rearing**
Burbot	January to February	May	Water up to 1 m deep	Peripheral habitat near or at air water interface
Lake Whitefish	Mid-late October	May	Water up to 2 m deep over course, unembedded substrate	Pelagic habitats in delta channels and Lake Athabasca (hypothesized)
Northern Pike and Walleye	Early to mid-May	late May to June	Water up to 2 m deep over course, unembedded substrate	Pelagic habitats in delta channels and Lake Athabasca; peripheral of snye and backwater habitat (hypothesized)

The LAR's dominant function for fishes important to the Aboriginal Fishery (and others) is as a year-round movement corridor. Peripheral habitat is also important for juvenile fishes, since fry and young-of-the-year individuals rear and rest there as they are transported passively downstream from spawning areas to habitat sufficiently deep to support them over winter. In order to assure continuance of all species in the LAR, an IFN must both: (1) ensure that erosional bankside habitat remains submerged consistently from mid-June through November; and (2) ensure fish passage during periods of low flow (late summer, fall and winter).

[2] Goldeye, Lake Trout and Yellow Perch also have importance in the Aboriginal Fishery; however, they are not included in this discussion because their lifecycle is completed largely between habitats in the PAD and/or Lake Athabasca itself (as discussed in section 2.2).

[3] Key habitat is that which without a species cannot complete its life-cycle; however, will not lead to a catastrophic loss if affected.

Fishes that spawn in spring are not at risk since their habitat is abundant in the LAR (Mountain Rapids and LAR tributaries) when they reproduce. Winter is the time at which all fishes are most vulnerable in the river. Recent investigation into habitat availability in the LAR found that water velocity dictates the location where most fishes select habitat during winter (LGL 2013). This is similar to findings of Mushens *et al.* (2009), who found that Burbot select locations in the LAR that are shallow and have faster water velocity immediately under ice cover, likely as a tactic to avoid frazil ice elsewhere in deeper habitats. Burbot is the only fish species that does not feed in winter simply to maintain its daily metabolic ration. Instead, it feeds extensively as it migrates upstream to spawn in mid-winter. For this reason, Burbot is a key index species, and preserving a winter migration corridor for that species and providing an equivalent IFN to the other species would thereby guarantee a corridor for fishes that spawn in different seasons.

Burbot, and by inference all sport fish and the coarse fish guild (including both pre-and post-spawning types), require a 1-m depth in the LAR to encourage migration (Golder 2009). For this reason, minimum contiguous depths of 1 m need to be maintained in the LAR during fall through early winter downstream from Fort McMurray to ensure adequate Burbot passage along the migration corridor between the delta and Mountain Rapids. Ensuring this depth contour is present year-round contiguously between the PAD and Fort MacKay will serve to provide sufficient flow for all fishes in the LAR. Ensuring this depth contour is present year-round contiguously between the PAD and Fort MacKay will serve to provide sufficient flow for all fishes in the LAR.

The critical 'pinch point' in the river, is at Fort McKay. In this region, the river is wide (~1 km), braided and susceptible to freezing to the bottom in places. This localized freezing causes ice jams, which obstruct fish migration. Freezing to bottom also diverts the thalweg in winter, in turn causing velocity to increase past ice obstructions. For this reason, flow should be maintained at baseflow levels over winter to ensure that water depths are sufficient to allow fish passage. Based on the Water Survey of Canada (WSC) gauge near Fort McMurray (07DA001), minimum flows for the Late Winter (see Table 1 for definition) generally have been approximately 119 m^3/s. Although no discharge and depth data are available directly from the LAR at Fort McKay, it is understood from experience that a flow of 100 m^3/s should provide approximately 1 m depth at this critical point in the migration corridor. Given this information on flows and experience of the river, it is recommended that water withdrawals should cease once flows drop to 100 m^3/s. As a result, to ensure the unimpeded migration of all fishes in the LAR migration corridor, the key recommendation from this analysis is that water depth should be maintained at a minimum of 1 m, and water abstraction should cease once flows drop to 100 m^3/s. Further, updated modelling using River 2D along the LAR migration corridor should be carried out with a focus on other limiting fish-passage constrictions so that an overall recommendation can be made that addresses specific reaches of the river at higher spatial resolution.

5.3 LAR In-Stream Flow Need for Aboriginal Navigation

The open-water navigability of the LAR by small craft (see Appendix A1; Candler et al, 2010a; Candler 2010) is a second critical river value that must be protected if Treaty and Aboriginal rights of the ACFN and MCFN are to be sustained during oilsand water withdrawals. As has been introduced earlier in this review, continuation of ACFN's and MCFN's traditional ways of life hinge on adequate water flow in the Athabasca River. The open-water season is dominated by the annual freshet which increases flows in the LAR and in the PAD. As has been indicated earlier (Appendix A1), access and navigability concerns associated with the high-flow time of the year are generally more related to the PAD, rather than the LAR proper. It is the shoulders of the open-water season that present frequent challenges to navigation and which are also of central importance in the annual hunting cycle. These concerns are discussed in this section, gaps in the SWQMF identified, and proposals introduced to address those gaps.

5.3.1 Context: Defined Navigation Thresholds

As discussed elsewhere in this review, ACFN and MCFN have provided considerable input to GoA and DFO on the need to sustain the navigability of the river at different periods during the open-water season so that ACFN

and MCFN land-users can carry out their river-based traditional practices. Both the spring season from after break-up to about mid-May (beaver, muskrat, and waterfowl) and the fall season from late August to the end of October (moose and waterfowl) are important to the First Nations. These are also the times when available LAR flow may be limiting to navigation. Oilsands withdrawals exacerbate these existing concerns because the P1 rules focus industry withdrawals on either side of the winter season in order to give some protection to the annual low-flow period. The net result is an increase in the likelihood of inadequate in-stream water availability for navigation purposes during the spring and fall periods.

Any withdrawal scheme, that aspires to protect the instream-flow needs associated with ACFN and MCFN Treaty and aboriginal values, must at a minimum directly sustain open-water navigation river values during these two seasons. To assist in defining these in-stream flow need for Aboriginal Navigation, ACFN and MCFN have provided GoA with evidence-based navigation thresholds for flows in the river (Candler *et al.*, 2010):

> **Aboriginal Base Flow** (ABF): the river discharge above which ACFN and MCFN are able to practice rights and access territories fully.
>
> **Aboriginal Extreme Flow** (AXF): the river discharge below which widespread and extreme disruption of rights occurs due to loss of access related to low waters.

Based on their initial study, Candler *et al.* (2010) provided estimates of these thresholds:

ABF=1600 m^3/s
AXF=400 m^3/s

ACFN and MCFN have subsequently undertaken community-based monitoring to determine the water-level requirements of specific locations that are limiting to navigation, with a focus on the PAD. In general terms, they have found that "pinch points" and other related access locations require a water depth of 4 feet for ACFN and MCFN members to pass through successfully. Many instances have been documented of navigation declines below this critical point, and these occurrences occur in the fall and spring. The GoA is aware of this work (the Community-Based Water Monitoring Program) through ACFN's participation in the Joint Panel Review Process for the Jackpine Mine Expansion, as well as through ACFN's past attempts to participate in the Joint Oil Sands Monitoring Program. Despite this information and additional qualitative information regarding sites of special navigation concern (examples include: rock hazards downstream of Fort McMurray, sand bars south of Poplar Point, loss of access up tributaries, especially the Firebag, and blockage in the mainstem at tributary mouths – Craig Candler personal communication), the GoA has not incorporated the navigation value of the river in the SWQMF. Instead, AESRD (2013) describes Aboriginal Navigation as a "knowledge gap" that will be addressed in future revisions of the framework. (See section 5.6.1 below for further discussion of this AESRD perspective.)

GoA recognizes the limitations present to Aboriginal Navigation in the LAR and the interactions of industry water withdrawals with these constraints. As a result, CEMA has initiated a collection of studies attempting to bring greater scientific understanding to the dynamics of declining Aboriginal Navigation associated with the LAR and to begin to address some of the P2FC deficiencies. CEMA (undated) describes the focus of its recently initiated study entitled *Navigation on the Athabasca River*:

> "The study proposed here will focus on areas of known navigation concern in the open water season. It will assess the extent to which navigation concerns are related to water withdrawal, cessation of dredging, and climate and flows in the Athabasca River basin. The study will further assess whether navigation concerns are a legacy of dredging which may dissipate over time or are systemic to the lower Athabasca River. And finally the study will assess the velocity and/or water depths required at places of known navigation concerns which is required to maintain an open channel. *These velocities may enable a flow range to be established for the lower Athabasca River where water withdrawals could be curtailed when flow is within this range*. This would enable a navigable channel to be maintained for as long as possible. Such actions would primarily occur in the fall prior to freeze-up as flow in the river is receding" (emphasis added).

While it is encouraging to see this recognition of a declining river value critical to the Treaty and Aboriginal rights of the ACFN and MCFN, it is unclear why the SWQMF does not include any preliminary protection in the spring or fall for Aboriginal Navigation given the information that is already available with the GoA in this respect. The remainder of this section proposes additions to the SWQMF short- and long-term triggers to include initial protection of Aboriginal Navigation, while the additional science is completed.

5.3.2 An Aboriginal Navigation IFN: SWQMF Needs an Additional Short-Term Trigger

As introduced above, ACFN and MCFN river users travel the length of the Athabasca in the spring and fall for traditional purposes. Though the actual dates vary from year to year, these periods of intense river use correspond with weeks 19 to 23 (Late Spring) and weeks 33-43 (Summer/Fall, latter half) of the SWQMF's withdrawal rules reviewed earlier in section 3.1.1. The SWQMF is structured to allow oilsands water withdrawals to be substantial during these periods so that the amount of storage required to get through the winter can be minimized. Also, as introduced above, Candler *et al.* (2010) and Candler (2010) have identified thresholds of LAR discharge that define limits to navigability but which are absent from the SWQMF just when they can be most limiting: Late Spring and Fall. (See Table 1 for definitions; Fall begins with week #43). To resolve this situation, it is here proposed that an additional short-term trigger be included in the SWQMF Table 3 at 400 m^3/s, below which all oilsands water withdrawals would cease. The 4.4 m3/s exemption granted to oilsands companies during any extreme low flow would not apply because there is no chance of freezing during these two warm-season periods.

It is noted that this measure should not limit the present oilsands operators from meeting their current water demands. The P2FC developed a "storage calculator" that was used to estimate the storage needs associated with various withdrawal rules. This tool indicated that winter water storage was generally met in August, thus suggesting a lack of conflict between the needs of pre-existing Aboriginal Navigation and those of the more recent demands put in place by the emerging oilsands industry.

This proposal would bring immediate protection for the maintenance of many opportunities for the exercise of ACFN and MCFN Treaty and Aboriginal rights. Its specifics could be refined later as more science becomes available relating hydro-geomorphic dynamics to river use and fish life stages. As indicated earlier, considerations of PAD navigability are beyond the scope of the present review and, as a result, the proposed short term trigger focuses on LAR navigability. With an appropriate analysis of the hydrology of the PAD, it could be determined under what conditions it would be appropriate to also limit summer withdrawals to protect the more complex dynamic of PAD access and navigability. In the meantime, this measure would help prevent further erosion of ACFN and MCFN ability to carry out traditional practices in the LAR itself.

5.3.3 SWQMF Needs a Long-Term Trigger Reflecting an Index of Aboriginal Navigation

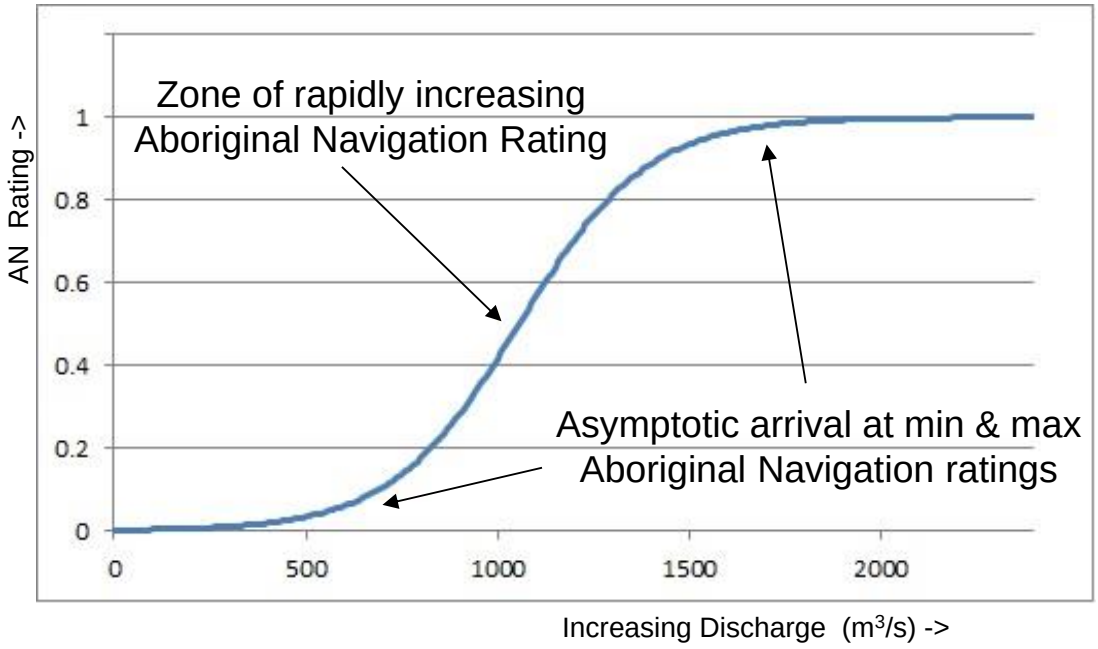
Given the present makeup of the SWQMF' short-term triggers and corresponding withdrawal limits, there is currently no recognition of a long-term deterioration in the LAR navigability (for traditional purposes) due to hydrologic non-stationarity and other influential incremental changes. Given the generally permissive nature of the withdrawal rules and the long-term triggers, it is critical that changes in Aboriginal Navigation be evaluated and tracked and thresholds be defined for action. This section introduces a new concept called the Aboriginal Navigation Index that is proposed to be used as a long-term trigger in a revised version of the SWQMF.

The AXF and ABF (see section 5.3.1) provide initial brackets defining the upper and lower limits of adequate LAR and PAD navigability. Below the AXF, navigability is essentially zero. Above the ABF, navigability is essentially at 100% (unlimited). These brackets can be used to develop a rating of the quality of LAR navigability, expressed as a percentage (0 to 100) of its potential (AXF=0%; ABF=100%). How the rating varies in between these two limits is currently unknown, but could reasonably be assumed to be linear until further data are available. With further study, an Aboriginal Navigation Rating (ANR) could easily be developed to provide a quantitative ANR for any given discharge (referenced to the WSC gauge near Fort McMurray). Figure 1

illustrates the concept with a hypothetical curve. The actual curve could vary in any number of patterns, depending on the local river elevation and configuration of each of the significant passage constraints. The rating would also be subject to some amount of change as new constraints develop and dissolve with bed reconfiguration occurring locally due to periodic flooding. It may be necessary to develop separate ratings for the Late Spring and the Fall seasons, depending on the residual role of ice in the Late Spring. (See Table 1 for definitions of the SWQMF seasons.)

It is proposed that a preliminary long-term trigger be included as part of the SWQMF based on available data and reasonable assumptions and a plan created to readily improve its specific limits. Specifically, it is proposed that an Aboriginal Navigation Rating be determined and recorded on a daily basis in relation to the discharge at Fort McMurray, and based on the AN curve (initially taken as linear between the AXF and ABF). It is also proposed that the following metrics be summarized each week: maximum daily ANR, minimum daily ANR, weekly average IAN. For the Fall and Late Spring, overall descriptive statistics of the IAN_{weekly} and ANR_{daily} would be compiled for review. In consultation with the ACFN and MCFN, thresholds (or composites of them) in these statistics would be established to serve as a long-term trigger to indicate when there has been a significant deterioration in the LAR's aboriginal navigability. Daily flow at the RAMP LAR discharge station (at Eymundson) should be used to confirm the interpretations made based on the Fort McMurray WSC station.

Figure 3. Conceptual example of a curve indicating the change in Aboriginal Navigation Rating as a function of LAR discharge.



5.4 Non-Consensus "Option H" P2FC Outcome

Although the P2FC was a structured decision-making process, informed by science, a range of serious deficiencies render its non-consensus Option H outcome both unreliable and faulty. Four areas are discussed below. Implications of the deficiencies discussed in this section are discussed in section 5.5 once the Aboriginal Fishery and Aboriginal Navigation have been discussed.

5.4.1 The P2FC Outcome Was Not Inclusive and Did Not Achieve Consensus

As introduced above in section 3.1.2, the outcome of the structured decision-making process was not in consensus. It does not appear that Ohlson *et al.* (2010) identifies which P2FC members were in support of the

Option H recommendation and those which opposed it. This is unfortunate because this information may assist in clarifying the objectives that are met by that outcome and those that remain unmet. Instead, Ohlson *et al.* (2010) provide generic statements to illustrate the range of viewpoints held with respect to "water withdrawal rules", "science and uncertainty" and "means". This way of presenting a failed process highlights a central weakness in this overall approach: values are traded off by those at the table, without clarity on how an "acceptable balance between environmental, social and economic considerations" (Ohlson et al, p.110) is arrived at. According to the ACFN IRC and the MCFN GIR, ACFN and MCFN have expressed that First Nations Treaty and Aboriginal rights should not be subject to an ambiguous stakeholder tradeoff discussion, particularly one that has not been inclusive and the outcome of which does not achieve consensus.

5.4.2 P2FC Navigation Assessments Are in Error and Are Unreliable

Upon completion of the P2FC process, ACFN and MCFN undertook a detailed technical review of the outcome and its component assessments (Boag and Vander Muellen 2010; Candler 2010a; Carver 2010). Two of these technical reviews examined the navigation assessments undertaken to support the P2FC outcome (Candler 2010; Carver 2010). These reviews found extensive flaws in the primary P2FC assessments looking at LAR navigability in relation traditional use. Most of their criticisms remain valid in the SWQMF (though the long-term triggers may have addressed some aspects of non-stationarity). Three excerpts are provided below; however the reader is referred to those sources for a more complete discussion of the many inadequacies and errors in those navigation assessments:

> ***Candler (2010, pxiii)***
>
> "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 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)."

> ***Candler (2010, p. xi)***
>
> P. ii: The report [Ohlson *et al.* 2010] 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.

Carver (2010, p.26)

"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.)"

In addition to these primary technical reviews, the individual reviews were assembled into one synthesis review (ACFN&MCFN 2010) to make it easier for GoA and DFO to receive and integrate the detailed findings. For example, ACFN & MCFN (2010, p31) states:

"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. This work is summarized in 2.3.5.1 below. In reference to navigation and the AECOM (2009) study, Westland (2009c) 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)."

The specific concerns about the P2FC assessment of traditional navigation are presented in section 5.3.

5.4.3 P2FC Outcome Is Unsupported by DFO's Canadian Science Advisory Secretariat

The Canadian Science Advisory Secretariat (CSAS) of DFO was requested by the DFO Habitat Management staff to conduct a peer review of the scientific information used to develop the Evaluation Criteria reports and technical appendices of the P2FC Report. As a result, DFO hosted a DFO Science advisory workshop, bringing together approximately 35 experts from DFO, the Province of Alberta (Sustainable Resource Development and Environment), private industry, international experts, First Nations, environmental non-government organizations and academia. "These experts peer reviewed the various P2FC evaluation criteria (EC) and technical reports, and examined the soundness and completeness of the scientific information and rationale that formed the basis for the P2FC recommendations. In addition, the workshop participants provided recommendations for a monitoring program for the Lower Athabasca River" (CSAS 2010).

In 2010, CSAS (2010) provided an outcome report to reflect the findings of its scientific review of the various P2FC technical documents and from the perspective of the mandate of DFO.

"The recommendations of the Phase 2 Framework Committee were reviewed through the Canadian Science Advisory Secretariat process (Fisheries and Oceans Canada 2010), a peer review process that is designed to be objective, open, and transparent. The review process included the National Science Advisory Workshop on Lower Athabasca River In stream Flow Needs, held in Calgary from May 31 to June 4, 2010. … Workshop participants examined what would constitute 'serious and irreversible harm' to the lower Athabasca River ecosystem and whether the recommendations would effectively protect the aquatic ecosystem. Feedback from the workshop was incorporated into the Science Advisory Report presented to Fisheries and Oceans Canada and the Government of Alberta. This report is posted on the Canadian Science Advisory Secretariat website (http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2010/2010_055-eng.html)."

A key finding of the CSAS report, consistent with all leading IFN science (see section 4.2) is the need for an annual "cut-off" flow, generally known as an Ecosystem Base Flow. There was a range in opinion as to the LAR discharge at which it should take effect, however the range in the group was 87-100 m^3/s. The P2FC outcome uses the lowest number in this range (87) but also does not include a reduction to zero withdrawals at that point, or at any point. Thus, the P2FC outcome is in conflict with the outcome by GoA and DFO (from P2FC) and used in GoA and DFO's SWQMF is in conflict with DFO's own CSAS outcome and other IFN science (speaking on EBF requirements), as attended by leading scientists from around North America including GoA's own science staff. It is notable that AESRD (2013, p.5) explains that the CSAS process and workshop were part of a peer review of the P2FC outcome, supposedly to indicate the "robustness" of the P2FC work, yet the passage in AESRD (2010) fails to acknowledge that the peer review found fault with the P2FC outcome and this fault is being locked into the SWQMF in terms of a lack of any EBF in any season.

Additional concerns identified in the CSAS review are raised in the next section.

5.4.4 P2FC Model Outcomes Are Known To Be Unreliable

Due to its scientific unreliability, it is scientifically unjustified that the P2FC "Option H" outcome would be used to provide the short-term triggers and associated withdrawal limits of the SWQMF. Three areas of concern, ranging from explicit substantive errors to lack of model validation, point to the importance of avoiding direct application of the "as is" P2FC outcome. Further science is required and until the uncertainties created by these scientific shortcomings have been understood, and addressed in the outcome, this situation suggests the need to adjust the outcomes to be more precautionary in protecting river values, as discussed in section 5.6.

5.4.4.1 P2FC outcomes contain a significant recognized error affecting many of its models

Carver (2010, p.17) has already reported on the concern associated with a substantial GoA modelling error:

> "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.)"

On May 5, 2014, by email, Dr. Andrew Paul provided in-progress information toward addressing this scientific gap in the P2FC. (This came after numerous requests by Martin Carver in 2010 and 2011 for this information were declined by GoA.) However, this rough work (dated Oct 6, 2010) has not been completed nor has a publicly-released revised interpretation been provided of the implications for the model outputs and, most importantly, for the short-term triggers. At the May 12, 2014 consultation meeting, AESRD (Dr. Caroline Bampfylde, personal communication) indicated that the errors in the modelling would not change any of the findings, however no evidence was provided in support of this assertion.

CSAS (2010, p.2) has also identified this concern of "a recurrent error within the climate change analysis". As a result, it states that "[i]t is recommended that the climate change analysis *and any other technical analyses using these climate change projections*, be re-conducted to address this error" (emphasis added).

5.4.4.2 P2FC fish models have not been validated

P2FC relied on extensive modelling of fish biology and fish habitat. However, models are only as good as the data available to calibrate their content and then validate their outcomes. As discussed extensively during the 2010 CSAS expert advisory workshop held at the University of Calgary (see section 5.4.4), it is well known that such life-stage and impact modelling of LAR fish populations is unreliable due to a lack of field data. As CSAS (2010, p.2) states:

> "While the models used within the various P2FC technical reports are generally acceptable, they are based on a large number of assumptions that cannot be validated with the presently available data on fish biology and habitat for the Lower Athabasca River. Thus, one of the principal recommendations of this scientific review is that the predictions of the various models should be field tested."

As explained above in section 5.2, these field data continue to be unavailable and thus this principal recommendation from DFO's expert peer review of the "Option H" outcome remains unaddressed.

5.4.4.3 P2FC non-fish models are built on extensive untested assumptions and P2FC does not provide analysis demonstrating how representative its modeled examples are

The P2FC modeled hydro-geomorphic aspects of the LAR system including navigability and connectivity. As earlier reported to GoA (Carver 2010, p.20), these models incorporate extensive untested assumptions and simplifications and do not include an assessment of whether they are representative of all sites:

> "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."

In addition, it is reported elsewhere in this review that the navigability assessments used to generate the P2FC outcome are flawed (see section 5.4.3).

5.4.5 P2FC Implications for the SWQMF IFN

The proposed SWQMF has incorporated the full "Option H" outcome of the P2FC and in so doing, it has approved of the extensive shortcomings of an incomplete, even "failed", scientific process. This section 5.4 has reviewed and summarized the many scientific deficiencies integral to this P2FC outcome. This section interprets those failings in terms of their implications for specific elements of the SWQMF IFN.

5.4.5.1 SWQMF IFN lacks basis in science

The P2FC was a structured decision-making process involving extensive science and modeling, however, the value of its science is severely diminished by a lack of field data and many unsupported simplifications and assumptions. In addition, the scientific value of the outcome is further diminished by the process "balancing" industry demands at the expense of ecological and navigation values that ACFN and MCFN have said are linked to Treaty and Aboriginal rights. This was confirmed in a conference call with GoA (April 24, 2014) in which staff confirmed that high fall withdrawal limits are in place in the SWQMF because of industry positions to ensure their ability to withdraw water during the fall remained in place even though modelling indicated that industry was able to fill up its winter storage needs by August (before the onset of the navigation season). Despite this non-scientific outcome, the result has been endorsed in the SWQMF thereby incorporating these scientific deficiencies into the new framework. As a result, the SWQMF IFN now also lacks a basis in appropriate science and cannot be considered to reflect "best available science".

5.4.5.2 SWQMF IFN lacks both seasonal and annual EBFs

Extreme low flows can happen in any season. Each season requires that its low flows be protected if the corresponding river values that depend on those seasonal low flows, are to be sustained. The Aboriginal Fishery and Aboriginal Navigation are key LAR values both of which require seasonal protection, particularly during each season's period of lowest flow. This science was recognized throughout the P2FC process. Ohlson *et al.* (2010) states:

> "The Government of Alberta recently conducted an extensive review of the EBF concept and how it has been implemented in various jurisdictions in North America and overseas. The review included examples from South Africa, Australia, New Zealand, United Kingdom, France, Norway and numerous states and provinces in the USA and Canada. The review demonstrated that the concept of a cut-off flow to protect ecosystem values during low flows is widely held throughout the world."

In the LAR system, the focus of the winter low-flow is for fish survival while the periods of the fall (and spring) seasons must include consideration of flows necessary to ensure navigation and access. The SWQMF does not do this.

In its purpose statement, the SWQMF states (AESRD 2013, p.2):

> "Weekly water withdrawal limits reflect seasonal variability and become more restrictive as flows in the river decrease."

However, this is true only at higher flows. At the lowest flows in the river, which are widely known to be the flows of greatest concern to the viability of the aquatic ecosystem, the percentage of flow that is permitted to be removed actually increases as the flow rate declines (as it does under the current Phase 1 rules). AESRD (2013, p.5) also states:

> "When Alberta Environment and Sustainable Resource Development, and Fisheries and Oceans Canada jointly released the original Water Management Framework: Instream Flow Needs and Water Management System for the Lower Athabasca River (2007), the federal and provincial governments made a commitment to further engagement with stakeholders and Aboriginal communities. The intent of this engagement would be to address issues identified for additional consideration. These issues included socio-economic factors, future oil sands sector growth, climate change science, and *consideration of an ecosystem base flow*" (emphasis added).

The EBF aspect of the original commitment remains unaddressed in the latest proposal SWQMF.

5.4.5.3 Protection for the aquatic ecosystem decreases at critical low flow conditions

The opening "Purpose" section of the SWQMF (AESRD p.2) states "Weekly water withdrawal limits reflect seasonal variability and become more restrictive as flows in the river decrease." In practice, however, this lead statement is not true. There are stepped down limits in the two winter seasons, but below 87 m3/s, the percentage of the river that can be abstracted actually increases as flow declines in the critical lowest flows. Also, in the open-water season, there is essentially one withdrawal rate permitted in each season, regardless of LAR discharge. (The LAR discharge required to invoke the reduced withdrawal rate has never occurred in those seasons.) This claim is reiterated on page 8 of the SWQMF: "weekly water withdrawal limits reflect a hierarchy of protection across seasonal time periods: withdrawal restrictions are most stringent during periods of lowest flow." However, this is not true in practice during the open-water period as explained above: instead, significant constant industrial withdrawals are permitted including at the seasonally extreme low flows.

5.4.5.4 SWQMF IFN fails to protect Aboriginal Navigation

Principle #1 of the SWQMF (AESRD, p.8) is that the SWQMF "Identifies and Manages Risk and Adverse Trends". However, the SWQMF does not do this for navigation. Despite having science information that

describes the navigation value and relates it to LAR discharge, it instead identifies navigation as a "knowledge gap" and allows high levels of industrial water withdrawals through both the fall and spring navigation seasons with no consideration for the impacts to Aboriginal Navigation, thus failing to follow its own first principle. Further, the commitments made in the SWQMF (AESRD, p.29) are weak and do not bind the GoA to a timeline of addressing these gaps toward protecting Aboriginal Navigation: "additional research is *planned*" and "[t]his work, which must be completed before navigational indicators and triggers can be explored, *will attempt to establish* how changes in water withdrawals may impact river navigation" (emphasis added).

5.4.5.5 SWQMF IFN fails to protect the Aboriginal Fishery

The P2FC outcome, now the SWQMF withdrawal limits, are unreliable in protecting the Aboriginal Fishery for the many reasons already described. Two long-term ecosystem status indices that reflect fish population-level and community-level status "are being considered" for use in the SWQMF. "Triggers and limits for these indicators have not yet been established" (AESRD 2013, p.28). Again, the lack of protection of the Aboriginal Fishery provided for in the short term triggers and withdrawal limits is not being "backstopped" by implemented reliable long-term triggers examining fish status. This gap in protection of river values remains open.

It is noted here that AESRD (2013, p.21) states:

> "The weekly management triggers and cumulative water withdrawal limits have been adopted from the recommendations of the 'Phase 2' process. Input from other processes was also taken into consideration (see Section 2.2)."

Examination of the SWQMF section 2.2 suggests that one of the "other processes" referred to in this passage is the CSAS peer review, which actually reinforces the concerns expressed above. Based on the draft SWQMF, these concerns appear not to have been addressed yet by GoA. If there is other input that the GoA has used to modify the SWQMF management short-term triggers and withdrawal limits (beyond the P2FC "Option H"), it is not evident in AESRD (2013).

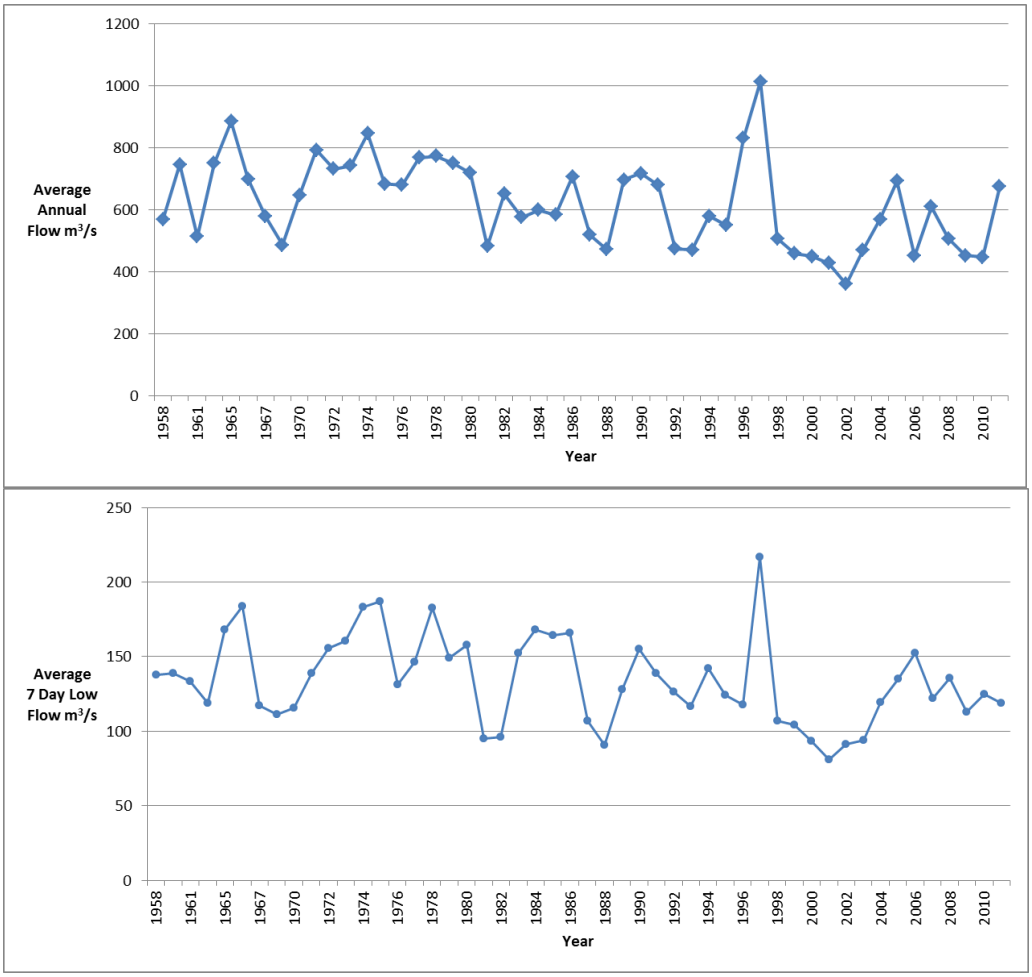
5.4.5.6 Approach using long-term triggers is slow to prevent damage due to violated assumptions

Notwithstanding its other shortcomings, the applicability of the P2FC outcome depends on a stationary hydrologic environment. The SWQMF emphasizes a hydrologic likelihood based on an average of the past. In discussing the trigger value of 87 m^3/s, the SWQMF states: "This flow condition is estimated, statistically, to occur rarely, having about a 1 in 100 chance of persisting from January to March in any given year." This approach to communicating the likelihood of a low flow extreme is based on an assumption that an average of the past will occur in the future. However, it is known that this is no longer in place due to (at least) climate change. Figure 4 shows how the mean annual flow and annual 7-day low flow are in decline in the LAR downstream of Fort McMurray. The approach that has been developed for the SWQMF to "protect" the relevance of the P2FC's withdrawal limits allows for a loss in integrity of the assumptions prior to any action being initiated. As is discussed in section 5.6.1, the triggered action is vague and non-specific and only points to the need to review the withdrawal limits. The P2FC spent almost two years developing these limits through a structured decision-making process: it is unclear how long a review would take if it were prompted by a long-term trigger.

5.5 Water-Use Licensing, Reporting, Verification, and Communication

A system of conflicting resource use and escalating demands with periods of relative water scarcity cannot rely on weak licensing terms, voluntary use reporting, inadequate enforcement, or vague communication. Affected parties must be able to assess where they stand with respect to their needs and rights for the goods and services provided by the water resource. Sections 4.4, 4.4.1, and 6.3.1 in the SWQMF provide information on aspects of the licensing, reporting, and communication of LAR water use by oilsands operators. The first three sub-sections below provide a review of the information provided. The final subsection discusses the findings.

Figure 4. Trends in historic LAR discharge at WSC Fort McMurray: a) mean annual flow, and b) annual 7-day low flow.



5.5.1 Water Licensing

A feature of the P1 WMF, and now the SWQMF, is that the amount of water licensed for withdrawal for oilsands use is often considerably higher than the gross withdrawal (*i.e.*, the water amount that is actually withdrawn). It is the gross withdrawal that the SWQMF uses in its framework rules, however without any explicit constraint on the license holder withdrawing to the licensed volume. The rules rely solely on probability and operational issues as to whether the license holder will self-limit to levels of gross withdrawals that follow past trends. Given the consequences of water use on existing rights holders, this inconsistency leaves open the potential for a loss of effectiveness in the SWQMF rules. The SWQMF should either (1) choose to use the volumes that are licensed to be withdrawn; or (2) use the gross water withdrawals, and be consistent in its rules. The inconsistency that is integrated into the SWQMF rules creates a gap in protection of LAR water values.

AESRD (2013, p.30) states:

> "While existing Water Act licences (sic) specify annual allocation volume and maximum withdrawal rates, this Framework adds conditions that apply during seasonal low flow periods. All new, renewed and amended water licences (sic) for the oil sands sector that either withdraw from the Athabasca River, or will have a significant effect on the Athabasca River downstream of Fort McMurray, will include conditions that require adherence to the weekly management triggers and withdrawal limits specified in this Framework."

Again, this passage leaves it unclear the extent to which existing license holders (with licenses that are not renewed or amended) can avoid these additional constraints. It is also unclear which existing licenses are subject to amendment and why? It appears that some are not subject to amendment. The SWQMF would be improved if it were clearer on the nature of these vague statements.

5.5.2 Water-Use Measurement and Reporting

The information provided in AESRD (2013) and later upon request (Thorsten Hebben personal email communication) about water-use monitoring and reporting is unclear. AESRD recognizes the inconsistent nature of its historic water-use data. Only for recent years (2011 and 2012) have daily data of oilsands water withdrawals been compiled and made available. Prior to that, there are gaps and differences in available data monitoring and recording. However, the SWQMF is not forthcoming about these inconsistencies, instead using terms like "in the past", "currently", and "usually". Use of these vague terms creates doubt about the rigour of AESRD's monitoring and reporting of oilsands water use and should be avoided in the SWQMF.

One licensee – Syncrude – is free to measure and report following a protocol that differs from the other license holders, thus creating added uncertainty about the actual gross withdrawals being taken. Syncrude does not have to use flow meters in determining its withdrawal volumes and instead bases its estimates on pumping hours. AESRD has accepted this as equivalent method of monitoring, but apparently without verification. "[A]ESRD cannot say at this point when meters may be required to be installed" (Thorsten Hebben personal email communication).

Additionally, AESRD (2013, p.16) states that "[t]o date, this water has been used at a consistent rate throughout the year." This statement appears to be at odds with the objective of the P1 WMF which is intended to limit withdrawals during periods of relative water scarcity. Does this SWQMF statement imply that seasonal restrictions are not of any significance under the P1 WMF? If so, are there related implications for the SWQMF?

5.5.3 Water-Use Verification and Enforcement

The SWQMF does not provide any indication that there is an enforcement aspect to the proposed rules. Consider AESRD (2013, p32):

> "If an oil sands operator is in non-compliance with their (sic) water licence (sic), the water management Framework, or the industry sharing agreement, they will be required to report it to Alberta Environment and Sustainable Resource Development."

It seems remarkable that in its enforcement capacity, the AER will have to rely on a non-compliant license holder to *voluntarily report* its non-compliance to AESRD. Such an approach to compliance and enforcement of industrial water use would be unacceptable in most jurisdictions, and in the LAR, threatens to jeopardise the ability of ACFN and MCFN river users to exercise their traditional practices should a license holder go out of compliance with the rules and choose not to disclose this.

It has been previously recognized that a flow monitoring station downstream of the oilsands water intakes is a recommended and/or necessary element in an effective monitoring and enforcement regime (Ohlson *et al.* 2010, ACFN & MCFN *et al.* 2010). Currently, there is one discharge station located on the Athabasca River, downstream of the Fort McMurray station. It is located near the mouth of Eymundson Creek and is operated by RAMP (since 2001). However, the SWQMF makes no use whatsoever of data from this station. Two measures are recommended here. The first (interim) measure is to make use of the Eymundson data, in conjunction with other monitoring (and modelling if necessary) in verifying total oilsands withdrawals and actual flow conditions on the LAR, well downstream of Fort McMurray. Such a step could assist greatly in enforcement and in resolving conflicts in understanding river conditions. The second (long-term) measure is to install a year round station downstream of all of the oilsands water intakes and to the same degree of reliability (error) as the WSC station near Fort McMurray, in all seasons.

Rather than provide assurance that downstream LAR flows will be sufficiently monitored, the SWQMF (AESRD, p.34) states that LAR water monitoring will continue "as needed". This is unclear and should be clarified. Use of vague expressions like this does not create confidence that AESRD has a clear monitoring plan that has been thought through adequately. To what kind of supplemental monitoring is the SWQMF referring?

5.5.4 Discussion of Gaps and Communication

The SWQMF should involve thorough and transparent water-use reporting, accurate and robust water license requirements, evaluation and verification by an objective party and using objective data, and clear and comprehensive communication to all affected and interested parties. According to the information provided in the SWQMF and in supplemental information provided to the author by AESRD, it is evident that AESRD does not plan to achieve these performance standards as part of the SWQMF. In fact, the language of AESRD (2013) suggests an optional future associated with the proposed rules. AESRD (2013, p.34) "***intends*** to enhance the current web-pages that report flow estimates and corresponding withdrawals limits, to also report information on withdrawals" (emphasis added). Further, AESRD's (2013, p.34) "***intention*** is to advance the data collection systems so that it will be possible to provide daily withdrawal information on a more frequent basis (e.g., weekly or daily)". The reader is left questioning whether the AESRD is committed to appropriate monitoring evaluation and reporting.

Other instances of misleading communication are evident in the SWQMF. The SWQMF describes (AESRD 2013, p.15) "relatively small" water use in comparison to "historically occurring flows" without making mention of the known declining hydrograph of the Athabasca River (just downstream of Fort McMurray). This lack of transparency creates doubt about the credibility of the reporting and assessment information provided by AESRD in relation to water withdrawal volumes and implies the potential for a lack of transparency in future reporting. Instead, it would be preferred if these statements were provided quantitatively and in terms of seasonal low flows, including projections of changes in seasonal extremes due to climate change.

Proposed SWQMF communication protocols are not described in AESRD (2013). Upon request, clarification was received from AESRD that water-use information will be provided, in the future, on a public website, and apparently without analysis. It is important that any affected parties, especially pre-existing rights-holders, including First Nations who hold Treaty and Aboriginal rights, have a clear and reliable understanding of the extent of industrial water withdrawals and their consequences to the LAR. Transparency in issues of monitoring and management action (including enforcement) is essential for rivers users so that their experiences can be understood in relation to the context of the regulatory system of industrial management.

5.6 SWQMF Preparedness for Water Scarcity and Water-Use Conflict

5.6.1 Vague Management Responses Inconsistent with Protection of River Values

The opening section of the SWQMF states (AESRD 2013, p.1):

> "Management frameworks outline monitoring, evaluation, and reporting requirements for resource users, set early warning triggers for government to determine the need for action, and *identify what actions may be taken*" (emphasis added).

Examination of Figure 6 in the SWQMF indicates that most of the identified effort associated with defining the management responses is involved with verifying whether any action is required, not with actually carrying out a needed action. As a result, it reads as an approach to avoid action, rather than one that initiates action. The only identification provided of the management actions that may be taken in response to "early warning triggers" is given in the fourth panel of Figure 6 in section 6.2 (AESRD, p.33):

> "Actions may include support for additional evaluation criteria, revision of water withdrawal limits, additional long-term monitoring requirements, or improving water-use reporting."

It is suggested that this flowchart should also detail the management response(s) *for each of the long-term triggers.* Otherwise, and given the ambiguity of the long-term triggers themselves, it provides little guidance on how to respond to conflicts and potential resource crisis. Additionally, this list of actual possible management responses is self-evident; what is, in fact, needed is more information on how a particular set of conditions would lead to a specific response.

In defense of its non-committal position around defining how it will respond to emerging situations – for example, the loss of adequate Aboriginal Navigation during high oilsands withdrawals – AESRD has indicated (conference call meeting on April 25, 2014) that there are too many unknown variables for it to specify, in advance, what it will do in any given situation. The concern with this perspective is that it does not indicate that there is preparedness in place or perhaps even willingness to make uncomfortable decisions to protect pre-existing rights of water users such as the ACFN and MCFN. While it is obvious that a future situation cannot be "nailed down" in advance because the details cannot be known before they happen, there are principles and responses that can be described to demonstrate (a) an understanding of the system and system response to function outside of acceptable limits, and (b) a commitment to protecting the interests of pre-existing (First Nations) rights holders even when those interests may conflict with those of the oilsands operators who have recently been granted water rights (i.e., over only the past few decades). One approach that AESRD can consider for communicating this information is through the use of scenarios. Scenarios are a useful tool for communicating strategies and priorities associated with uncertain management responses to a wide audience (Duinker and Greig 2007).

Another reason that AESRD should be clear about possible management responses is to support the development of preparedness. If AESRD waits until a crisis is on its hands before it effectively considers its options for protecting pre-existing rights holders, it is less likely that it will be possible to meet those needs. For example, detailed exploration of potential management responses could reveal that there are limits to oilsands water withdrawals that can be serviced by the LAR under expected climate and river conditions; perhaps the potential for off-channel storage is a limiting variable under certain circumstances. It is only through a rigorous assessment of plausible future scenarios that GoA may be able to uncover inherent management limitations, particularly amid an escalating degree of water licensing for LAR-dependent industrial activity, and during a time of global climate change (and increased frequency of relative water scarcity). There is no indication in the SWQMF that this gap is of concern to AESRD.

Instead of a culture of mandated preparedness, the SWQMF reinforces a culture of operational industrial flexibility with unclear potential of achieving its other implied obligations: "[t]he oil sands sector will have the flexibility to adopt appropriate operational measures to enable compliance with the weekly water withdrawal limits" (AESRD 2013, p.23). Given that water scarcity is the central issue of concern in creating the SWQMF, the conflict in water use that it can induce means that the preferred measure is to require that industry adopt operational measures that enable it to *avoid requiring direct withdrawals for certain specified periods*. The AESRD approach instills a lack of confidence that the GoA is ready to protect pre-existing rights holders during inevitable periods of water scarcity.

Elaboration of management responses to occurrences of water scarcity and other concerns associated with a decline in water values (e.g., of Aboriginal Navigation), requires meaningful and relevant field data and actual system understanding. These may be in short supply and hence this need implies that monitoring and adaptive management should be developed and clearly laid out at an early stage. For example, if the protection of pre-existing LAR water rights is dependent on adequate water storage capacity, then the appropriate quantitative information has to be gathered through scientific exercises that include monitoring and adaptive management. Such field exercises take time and resources; their findings cannot be created at the last minute when they are needed, and instead initiatives need to be put in place years in advance.

5.6.2 Unclear Plan to Address Knowledge Gaps; Navigation "Gap" Inconsistent with Data

There are numerous instances in which the SWQMF emphasizes the need for further research and monitoring associated with a range of system attributes (AESRD 2013), for example on p.34:

> "further research and monitoring will be required to improve our understanding of the aquatic ecosystem"
>
> "additional monitoring and research are required to understand ecological response relationships"
>
> "…further study is necessary to understand the link between flow and ecological responses…"

The SWQMF provides a list of "ecological knowledge gaps" that is states have been previously identified by CEMA (2011):

- winter ecology in the delta;
- riparian vegetation and aquatic mammals in the delta;
- access to tributaries;
- walleye recruitment;
- Richardson Lake connectivity;
- Big Egg Lake connectivity (perched basins); and
- dissolved oxygen in river segments 2-5.

It explains that these are being addressed collaboratively by AESRD and CEMA and "are expected to be complete within five years of this Framework being finalized" (AESRD 2013, p.28). AESRD (2013, p.29) indicates that additional research is planned to address outstanding uncertainties related to two P2FC navigation studies (see section 5.4.2 for comments) and that "[t]his work must be completed before navigational indicators and triggers can be explored further" (AESRD 2013, p.29). Further, "this work….will attempt to establish how changes in water withdrawals may impact river navigation" (AESRD 2013, p.29). The SWQMF (p.38) also lists a collection of regional organizations that provide support to the Framework and states: "These partnerships will be instrumental in addressing ecological and navigational knowledge gaps." However, details are not provided.

In summary, the SWQMF expresses at length the uncertainties associated with the knowledge base needed to protect river values in the face of escalating water withdrawals and climate change. It refers to a range of mostly implied research work to be undertaken by AESRD, CEMA, or any of a host of oilsands monitoring-related organizations (CEMA, RAMP, ADMI, AEMERA, JCAIPOSM). An explicit coherent plan is absent in the SWQMF and instead studies are referred to with no specifics and accountabilities. Notably, the discussion of navigation knowledge gaps completely disregards Candler *et al.* (2010) that provides credible information directly from the ACFN and MCFN on Aboriginal Navigation requirements and that addresses the SWQMF's stated need "to establish how changes in water withdrawals may impact river navigation" (AESRD 2013, p.29). Further, at the May 12, 2014 consultation meeting in Edmonton, it was recognized by the previous AENV lead on the P2 WMF and SWQMF work, Pat Marriot, that it would be a straightforward exercise to determine the navigability details along the LAR in relation to discharge (Record of Edmonton meeting from May 12, 2014). Thus, with respect to navigability being a "knowledge gap", it appears that it could have been filled long ago.

5.6.3 Ambiguous/Fragmented Planning Associated with Monitoring & Adaptive Management

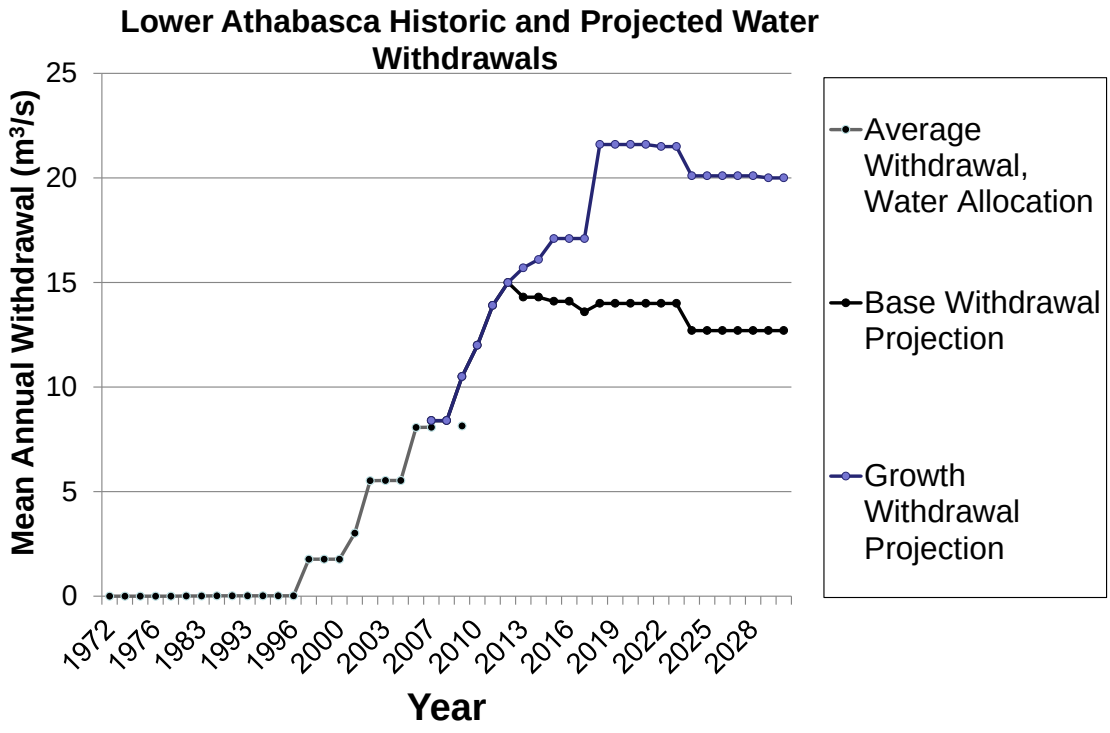
CEMA (2011) is the outcome of the P2FC's monitoring and adaptive management planning exercise. The SWQMF cites CEMA (2011) in several locations, however it does not indicate that this program of monitoring and adaptive management is a tied requirement of the SWQMF. This program formed an essential output of the P2FC and helped support the selection of "Option H". If the implementation of its monitoring and adaptive

management program is in question, then the deficiencies inherent in its rules must be re-interpreted in the new context.

A further concern is highlighted in the *Report on the Lower Athabasca River Instream Flow Needs Monitoring Workshop* (Korman and Walters, 2007). From this workshop, Korman and Walters (2007) summarize six impact hypotheses provided by the workshop participants, that identify how the stressors lead to an effect on physical and biological resources: 1) loss of connectivity between tributary and mainstem for spawning, rearing or overwintering of fishes; 2) loss of connectivity within the mainstem during winter; 3) loss of connectivity among delta features and between side channels and the mainstem; 4) reduced habitat availability in the mainstem; 5) reduced water quality; and 6) changes in water temperature. This expert group assembled by the CEMA's Instream Flow Needs Technical Task Group (IFNTTG) pointed out that the oilsands industry is expected to grow for some time (see Figure 4) and thus "will generate progressively larger potential impacts over at least the next decade, and that some of these impacts (e.g. on fish recruitment) may take at least an additional decade to be fully expressed". The SWQMF does not explain how it will interpret monitoring data of fish in light of multiple stressors and how it will then conclude as to the impacts from oilsands water withdrawals. It behooves GoA to have a theoretical scientific framework indicating how it will interpret potentially ambiguous monitoring data in light of multiple stressors (see section 5.6.4 for additional discussion).

Notwithstanding their ambiguities in the SWQMF's presentation, the studies and monitoring alluded to may provide useful information to resolving the knowledge gaps - however it is impossible to know given the lack of information provided. The water withdrawals have already been underway for years and are expected to rise in the coming years regardless of any knowledge gaps, and as climate change deepens. As a result, it is important that a coherent and effective research plan be created immediately and strongly coupled to any required monitoring, particularly given that GoA plans to distribute these efforts across myriad unconnected (or weakly connected) monitoring organizations with diverse mandates. In tandem, given the many uncertainties associated with the LAR system (notably the lack of field data), the SWQMF should be setting course for a precautionary management regime until the appropriate science becomes available.

Figure 5. Past and projected growth in water demands due to oilsands activities.



5.6.4 The SWQMF Is Not a Cumulative Effects Assessment

As introduced earlier in section 3.1.1, although the SWQMF describes itself within the context of cumulative effects (CE) management, and frequently uses the term "cumulative", it is in no way providing a cumulative effects assessment (CEA). Creating a meaningful CEA context would be beneficial in this situation because multiple stressors can impact river values in myriad ways and evidence shows that the magnitude of the stressors is going to only increase in the coming years. A genuine effort at examining the CEs on Aboriginal water values (and including the PAD) would involve identifying impact hypotheses and pathways of effect for each water value. Given the many species of fish and their contrasting life-stage behaviours, it is explaining the CEs on fish may be particularly difficult until field data become more readily available.

Any CEA should be built upon an accurate characterization of the hydro-geomorphic conditions of the area of interest. AESRD (2013, p.12-15) provides a description of the "surface water flow within the region". The introduction to this section describes the historic hydrograph without mention of clear trends evident in the pattern of flows, and does not make mention of climate change. The description presents a static hydrologic description that implies a stationary hydrologic environment, which is known to be untrue and discussed at length in GoA-sponsored and GoA-endorsed science publications. It is suggested that if the SWQMF wants to move toward a CEA framework that it present a clearer account of the system complexity that must be understood in relation to multiple stressors combining to create multiple effects across diverse spatial and temporal scales and include monitoring of effects-based indicators.

5.6.5 Requirement for Storage and Operational Preparedness for Times of Water Scarcity

The existing P1 WMF was structured to provide reliable source of water to industry while providing minimal protection to river values. Periods of water scarcity have already come about and have been associated with navigation difficulties and unspecified disruptions to fish populations. Looking ahead, it is expected that periods of relative water scarcity will become more frequent (with further climate change) as the rate of withdrawals also rise, along with a general increase in other stressors. As the SWQMF is developed, it is reasonable to ask GoA what steps are being required of industry to prepare for periods of water scarcity so that when water conflict arises, oilsands operators will be able to respond and protect river values without shutting down their operations. Does industry have enough storage capacity to fully protect navigation during water scarcity?

It is evident that additional modelling is required to address this key question. Realistic future scenarios need to be established in terms of climate and hydrology and then modelling undertaken that protects the full needs of Aboriginal Navigation and the Aboriginal Fishery (as both have been described in this report). The fall was not modelled in the P2FC work. This incomplete science needs to be updated and finished so that the capacity of the river to provide water to oilsands production *while still maintaining aboriginal values during periods of water scarcity would be properly quantified*.

5.6.6 High Risk due to Uncertainty and Escalating Stressors: Need Precautionary Approach

AESRD (2013, p.5) states: "The Surface Water Quantity Management Framework for the Lower Athabasca River was prepared by Alberta Environment and Sustainable Resource Development, with the support of Fisheries and Oceans Canada. It is the culmination of over 10 years of planning, research, and consultation." Despite this lengthy period of preparation, a SWQMF is being proposed that has not addressed uncertainties in identifying the requirements of pre-existing river values. The GoA is proposing to put in place a system of withdrawals that allows for the Aboriginal Fishery and Aboriginal Navigation to be severely compromised, particularly during periods of water scarcity. This potential exists because, even though there remain significant sources of unaddressed uncertainty, permissive rules would be in place with industrial pressures expected to continue to rise.

In contrast with what GoA is proposing, the SWQMF should incorporate precautionary steps that lessen the likelihood that pre-existing values will be affected negatively. The steps would focus on the implementation of seasonal EBFs initiated at high discharges, more consistent with the physical reality of the LAR system. The steps may also include reduced rates of water withdrawal at other discharges. These steps would remain in place as the system is analyzed more carefully and adequate mitigation preparedness is put in place. Without these steps, significant ecological and socio-cultural risk will remain "at large" and thus threatening, especially during periods of relative water scarcity, at least two key river values – Aboriginal Fisheries and Aboriginal Navigation – that are linked to the exercise of Treaty and Aboriginal rights.

The SWQMF does not make reference to significant socio-cultural risk which is of concern to First Nations. Andrew Paul (2014 personal communication) indicates that there are differences of opinion on what this might mean in practice and that a definition would need to be developed by CEMA. He suggests that a temporary definition may be incorporated in the SWQMF that states: "Until updated knowledge suggests otherwise, significant ecological and navigational risk would be identified as the level 2 threshold values from the P2FC process." In reference to the SWQMF, Dr. Andrew Paul states (personal communication by email May 28, 2014):

> "The draft Framework (section 6.3.2 page 34) indicates under maximum withdrawals measurable but reversible declines in some fish populations are predicted to occur (i.e., the undetectable/detectable reference scale of the P2FC would be crossed). This first reference scale should be a trigger/threshold that would be monitored and evaluated. If crossed, work should be completed to assess whether changes are continuing to trend toward the second reference scale (detectable/irreversible) or are stablizing (sic). The second reference scale should be avoided and not managed as a target."

Although this appears theoretically sound, the complex life stages of fish populations and the difficulties in monitoring their year-to-year status suggest that this approach may be more "theoretical" than practical or realistic, particularly in light of the comments provided in section 5.6.3 (Korman and Walters 2007) which points to some impacts to fish populations taking "at least an additional decade to be fully expressed".

While the SWMF states that it is adaptive: "[a]s more knowledge becomes available, the Framework's withdrawal limits can be adapted." (AESRD, p.8) - elaboration is not provided of how new information will be used to create an adaptation. Furthermore, there is no explanation on how risk-averse of risk-friendly the current triggers and limits are, and in particular, the long-term triggers that are new with the SWQMF. It does mention that "Performance measurement is an essential element that provides information about environmental conditions and identifies the need for adjustment on an ongoing basis." but how is this achieved?

6.0 CONCLUSION AND RECOMMENDATIONS

This review has looked in detail at what the proposed SWQMF provides to protect river values of importance to the ACFN and MCFN and the exercise of their Treaty and Aboriginal rights, with reference to the thresholds and indicators developed by the Nations. To do this, it has returned to earlier science and process that the SWQMF has adopted. The review has found widespread scientific deficiencies in the SWQMF that yield significant gaps in the protection of key river values, including the Aboriginal Fishery and Aboriginal Navigation. A comparison with the existing P1 WMF suggests that the SWQMF is a modest improvement, at best, and that it generally maintains the gaps in protection that are currently in place, even exacerbating those during some open-water weeks of the year. Guidance from leading science is clear that there should be seasonal cutoff flows, below which there are no withdrawals permitted. Allowing industrial withdrawals at any low flows is both nonscientific and also contradicts priority use, given that the ACFN's and MCFN's rights have earlier priority.

The proposed SWQMF appears to be based on a philosophy of abundance with respect to the availability of water for oilsands purposes. While withdrawals are reduced during the winter season, they are not cut off entirely during critical low flow periods, and during the remaining open-water seasons, priority is clearly given to industrial use of the LAR's water supply. Setting aside concerns for the gaps in protection of winter aboriginal values (Aboriginal Fishery), this review has shown that there are significant open-water values (Aboriginal Navigation) that are also in need of protection in the SWQMF. In the SWQMF, Aboriginal Navigation is mentioned but no tangible steps are taken to give them protection. Further, industrial withdrawals are permitted at rates comparable to current allowance under the P1 WMF. It appears from the P2FC's application of the storage calculator, in addition to more recent comments directly from GoA staff, that the absence of protection for Aboriginal Navigation derives from the wish to avoid the need for further water storage, given the extent of water licenses that are in place and planned for oilsands purposes. This "tradeoff" indicates that the increase in capacity of water supply for the oilsands industry appears to be put in place directly at the expense of the Aboriginal Fishery and Aboriginal Navigation values, both of which ACFN and MCFN have identified as critical to their Treaty and Aboriginal rights.

Additional information not considered by the SWQMF suggests that the Aboriginal Fishery and Aboriginal Navigation would be served by year-round maintenance of a contiguous flow depth of about 1.3 m with special attention paid to "pinch points" and other notable constrictions. As things stand, it may be that the winter is the most limiting, followed soon behind by the fall and the late spring. Summer appears to offer a sustained period of greater opportunity for oilsands water withdrawals, at least during significant freshets. However, if the PAD is included in the analysis, there is a need for the summer water, too, to enable adequate passage around the PAD to continue to be able to carry out traditional practices. This complexity calls for a CEA of the combined effects of all stressors on the navigability of the PAD so that minimum performance characteristics can be achieved in every season ,and in doing that planning, it can be determined which weeks of the year have water to spare for other uses, such as oilsands production.

Under the SWQMF, the withdrawal rules remain nonscientific. Nine recommendations are provided below that may enable the SWQMF to become a suitable successor to the P1 WMF. Without improvements, however, the SWQMF perpetuates many of the same problems that are in place currently.

6.1 Management Issues

Recommendation #1: Water-Scarcity Preparedness

Conduct additional modelling with a focus on Aboriginal Navigation and with the goal of determining the off-channel water storage required to protect contemporary needs for Aboriginal Navigation. Require industry to increase its off-channel storage capacity to meet this standard of preparedness. If this level of storage is impracticable, then reduce the scope of water that is licensed to be withdrawn.

Recommendation #2: Verification Using RAMP Eymundson Station

Use the RAMP Eymundson Station to improve understanding of 1) water available for navigation and fish, and 2) actual flow withdrawals. Resolve any questions that arise concerning differences in measurement standards (open water and ice covered) between the Fort McMurray and Eymundson hydrometric stations.

Recommendation #3: Explicit Management Responses

Include realistic scenarios in the proposed SWQMF to indicate clearly the management steps that can be expected when long-term triggers are crossed, and the associated objectives that will be met.

Recommendation #4: Accurate Water Licences

If the SWQMF remains tied to gross water oilsands use (rather than licensed use), amend the oilsands water licenses to reflect this reduction.

6.2 The Structure and Limits of the SWQMF

Recommendation #5: Aboriginal Navigation – Summer/Fall Short-Term Trigger

Using information contained in *As Long as the Rivers Flow* (Candler et al. 2010), establish a new short-term trigger for the Late Spring and the Summer/Fall seasons such that below 400 m^3/s, water withdrawals are not permitted.

Recommendation #6: Aboriginal Fishery – Winter Short-Term Trigger

Remove the water withdrawal exemption of 4.4 m^3/s permitted below 87 m^3/s during the winter seasons.

Recommendation #7: Aboriginal Navigation – Long-Term Trigger

Include an additional long-term trigger based on the Index of Aboriginal Navigation to address concern for ongoing declines in fall flows and to protect spring navigation. Work with ACFN and MCFN on the best means for identifying and verifying issues that require management action. Include aboriginal communities in an associated weekly reporting and evaluation system.

6.3 Scientific Foundation of the Phase Two WMF

Recommendation #8: Risk and Precaution

Identify and quantify explicitly the uncertainties and residual risks implicit within the proposed SWQMF.

Recommendation #9: Monitoring and Adaptive Management Program

Provide the details of the monitoring and adaptive-management program elements (including component research projects) that are tied to the SWQMF.

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8.0 APPENDIX A1. ACFN & MCFN ENGAGEMENT ON THE P2 WMF

This appendix is written by Ms. Nicole Nicholls - see Acknowledgements for further details.

History of Engagement: 2007 to 2010

Alberta's engagement with ACFN and MCFN on the P2 WMF process began in June 2007[4]. At the time, ACFN and MCFN, along with the three other First Nations party to the Athabasca Tribal Council (ATC) expressed concerns about the P1 WMF process, and the need to address those concerns including implementation of an "Ecological Base Flow" (EBF). The First Nations' participation in CEMA for the Phase 1 In-stream Flow Needs did not meet their expectations and they considered that their input was not reflected in the final Phase I rules. The First Nations were concerned with ensuring that Phase 2 development would be transparent, that their input would be considered explicitly, and that a precautionary EBF would be set[5]. Alberta Environment (AENV) requested input on the P2 consultation process and "confirmed that an EBF is part of the Phase II work."[6]

Alberta Environment (AENV) and DFO proposed that the planning process approach (the "Ohlson process") being used by the Cumulative Effects Management Association's (CEMA) Surface Water Working Group (SWWG) could address issues about transparency and First Nations participation. The First Nations were invited to participate in the Ohlson process, which was characterized as a cooperative stakeholder process that could recognize Treaty rights.[7] Despite recognition that the Ohlson process appeared better than the P1 process, the ATC First Nations were concerned that in the "trade-offs" entailed by the multi-stakeholder planning process, which included industry as participants, their Treaty rights would be compromised. The Advice Chart entry for June 25, 2008 summarizes two related ACFN concerns, among others, as follows: "The word 'trade-offs' concerns FNs if it means trading off Treaty Rights…First Nations do not want their participation to threaten Treaty Rights and feel there is a certain level environmental protection that is required to protect Treaty Rights." At the same meeting, AENV/DFO responded verbally to this concern:

> "Trade offs aren't referencing Treaty Rights, they are in reference to economic, social and environmental trade offs… Treaty Rights need to be presented to the process to have them incorporated into recommendations. If there is a level of environmental protection to which Treaty Rights need to be protected then this would have to be respected."

In response, MCFN reminded AENV/DFO that "Treaty Rights are directly related and connected to the environment" and expressed the need for a government t. Overall, the Nations desired greater assurance that Treaty rights would be considered and protected.

In August, 2008, the Directors of the Athabasca Tribal Council First Nations provided to AENV/DFO a proposed *Framework Agreement to establish a Consultation Process Concerning Interim Flow Needs, Phase II, for the Lower Athabasca River* ("Framework Agreement"). In the view of the First Nations, the Framework Agreement would allow them to "participate freely in a multi-stakeholder process, knowing that [their] constitutionally protected Treaty rights were being respected and addressed in a well-defined and agreed-upon

[4] GoA kept a record called an "Advice Chart" (also called a "SPAR" table or chart) of all DFO/AENV meetings with Athabasca Tribal Council First Nations, including ACFN and MCFN, regarding the P2 WMF from 2007 to January 14, 2010. The first entry of the chart is dated June 25, 2007. The chart is divided into two separate documents, one documenting engagement from 2007 through 2008, and the other documenting engagement from 2009 to January 14 2010. Copies of all documents referred to in this summary are on file with the Athabasca Chipewyan First Nation Industry Relations Corporation and with Mikisew Cree Government and Industry Relations, Fort McMurray, Alberta.

[5] June 25, 2007, August 31, 2007 and October 22, IFN Phase 2 2007-2008 SPAR Chart entries.

[6] August 31, 2007 entry, Phase 2 2007-2008 SPAR Chart.

[7] March 5, 2008 and June 25, 2008 entries, Phase 2 2007-2008 SPAR Chart.

parallel process."[8] In a letter dated December 18, 2008 to the Deputy Minister of AENV, ACFN advised Alberta Environment that it would not participate in the Ohlson Process without the "certainty and structure" offered by the Consultation Framework Agreement. [9]

Neither DFO nor Alberta would consider entering into the Consultation Framework Agreement.[10] After a series of meetings and written correspondence, Alberta promised to draft a formal consultation plan for the Phase 2 process. Nothing was received other than a proposed meeting plan and a promise for an additional document addressing capacity assistance from Alberta Environment on January 30, 2009[11].

On April 1, 2009, ACFN, MCFN and Fort McMurray First Nation submitted a Consultation Proposal stating:

> *"We remain concerned that the Ohlsen Process, which is essentially a public stakeholder "trade off" process, will not achieve our goals. We have previously expressed in writing our concerns in this respect. Having said that, we are prepared to enter into the Ohlsen process if our concerns can be addressed; and, we continue to seek information from AENV and DFO how these concerns can be addressed.*
>
> *What we are proposing is that prior to any recommendations from the Ohlsen process being accepted by the Crown, that a parallel process of consultations takes place to ensure that we have input into the planning process and which ensures, outside of the public stakeholder process, that we have input into decision making. That consultation may well be informed by the information coming out of the Ohlsen process, but would be separate and apart from that process."*[12]

The Consultation Proposal also requested that adequate financial and technical resources be provided for the First Nations to develop their own recommendation (in parallel to CEMA's P2 Framework Committee) to be considered by AENV/DFO.

AENV's May 8, 2009 response indicated that since the Ohlson process was already well advanced and that past decisions taken during that process would not be revisited:

> "[I]t may be more effective for AENV and DFO to arrange for the P2FC to update First Nations after the P2FC has gathered all the data for developing their recommendations and then again once the recommendations have been completed. AENV and DFO could then focus its energy on Crown consultation on the recommendations of the Ohlson Process and the draft Water Management Framework for the Lower Athabasca River."[13]

After subsequent related discussions and other correspondence Alberta Environment eventually proposed a Consultation Plan (and related capacity funding through AENV and DFO grants) on November 4, 2009, which was later revised on January 14, 2010 with input from ACFN and MCFN[14]. From June 2010 (once capacity funding was in place) to October 2010, ACFN and MCFN used their staff time and resources to collect ACFN- and MCFN-specific information and to review the P2FC in order to develop their own ("parallel") recommendations to provide Canada and Alberta in their drafting of the P2 WMF.

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[8] December 18, 2008 Letter from Chief Allan Adam and ACFN IRC Director Rick Bennett to Deputy Minister of AENV Jim Ellis.
[9] Ibid
[10] June 25, 2008 entry in the 2007-2008 SPAR Chart; November 28, 2008 letter from AENV Northern Region Director, Rick Brown, to the IRC Directors of ATC First Nations; January 6, 2009, Phase II of the Water Management Framework for the Lower Athabasca River, DRAFT Meeting Notes.
[11] January 30, 2009 Letter to ACFN IRC Director Rick Bennet from Rick Brown, Director, Northern Region, Alberta Environment
[12] April 1, 2009 Letter to Rick Brown, Director, Northern Region, Alberta Environment, from Lisa King, ACFN IRC Director.
[13] May 8, 2009 letter from Rick Brown, Director, Northern Region, Alberta Environment, to Ms. Melody Lepine (GIR Director, Mikisew Cree First Nation), Ms. Lisa King (IRC Director, Athabasca Chipewyan First Nation), Ms. Doreen Somers (IRC Director, Fort McMurray First Nation), et al.
[14] See November 4, 2009 and January 14, 2010 entries in the 2009-2010 SPAR chart.

A1.1.1 Summary of Key ACFN/MCFN Input

Between August and October of 2010, ACFN and MCFN submitted to both AENV and DFO, a number of submissions meant to inform and foster consultation on, and development of, the P2 WMF (now the SWQMF). These submissions are:

- January, 2010 - *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* (Draft).[15] Note that the final report provided August 25, 2010 to DFO.
    - This submission to DFO provided a summary of the known uses of the LAR for ACFN and MCFN, based on previously documented information, and included suggestions on research areas important for the planning process.
- July 19, 2010 – *Athabasca Chipewyan First Nation and Mikisew Cree First Nation Review of the Phase 2 Framework Committee Recommendations: Synthesis Report*[16]
    - This submission provided a critique and recommendations concerning the P2FC Recommendations, and was based on a synthesis of information from scientific technical reviews and traditional ecological knowledge studies.
- August 23, 2010 - Technical Reviews Lower Athabasca River (LAR) The Phase 2 Water Management Framework including:
    - *A Review of the Lower Athabasca River Instream Flow Needs and the Phase 2 Water Management Framework – Fishes and their Habitat*[17]
    - *Review of the Athabasca River Phase II Framework Committee (P2FC) Report, January 2010 – Aboriginal knowledge, use, interests and rights*[18]
    - *Review of the Phase Two Framework Committee Non-Consensus Recommendation for the Lower Athabasca River: Hydrology, Geomorphology, Basin Issues, Decision Framework*[19]
- October 13, 2010 *As Long as the Rivers Flow: Athabasca River Use, Knowledge and Change, ACFN Community Report, August 16, 2010.*[20] By a letter dated February 8, 2010, AENV and DFO were also informed that a publication pertaining to the river use and knowledge of both ACFN and MCFN's was

[15] ACFN IRC and MCFN GIR. 2010. *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 to: Brian Mackowecki, Department of Fisheries and Oceans. January 18, 2010. Amended: August 20, 2010.
[16] ACFN IRC, MCFN GIR, Carver, M., Candler, C. and Boag, T. 2010. *Athabasca Chipewyan First Nation and Mikisew Cree First Nation Review of the Phase 2 Framework Committee Recommendations: Synthesis Report*. Submitted to Patt Marriot, Alberta Environment and Brian Mackowecki, Department of Fisheries and Oceans, July 2010.
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[19] Carver, M. 2010. *Review of the Phase Two Framework Committee Non-Consensus Recommendation for the Lower Athabasca River: Hydrology, Geomorphology, Basin Issues, Decision Framework: Final Report.* Prepared for ACFN IRC and MCFN GIR, prepared by Aqua Environmental Associates, July 2010.
[20] Candler, C., Olsen, R. Deroy, S. 2010. *As Long as the Rivers Flow: Athabasca River Use, Knowledge and Change: ACFN Community Report, August 16, 2010.* Prepared by the Firelight Research Group Cooperative, prepared for Athabasca Chipewyan First Nation, August 16, 2010.

available from the Parkland Institute on-line at http://parklandinstitute.ca/research/summary/as_long_as_the_rivers_flow/]

- This report documents, in detail, traditional knowledge and aboriginal use of the LAR and how it has changed over recent decades. In particular, the report describes the past and continued importance of the LAR to the practice of aboriginal and treaty rights and how use of the LAR for the exercise of rights is made more difficult at low water levels because of navigation hazards and incidents. The report proposes, based on TK, a threshold for the minimum water flows required for aboriginal use of the LAR, and includes a series of recommendations for how to consider and incorporate the information provided into planning and consultation.

These submissions, in particular those that brought forward traditional knowledge and land use information, consistently emphasize that the Athabasca River lies at the heart of the ACFN's and MCFN's traditional livelihoods and associated Treaty and Aboriginal rights. Fishing and hunting are central traditional practices for both ACFN and MCFN that continue to contribute to the well-being and cultural sustainability of both First Nations, and their members. The LAR is used both as a fishing and hunting corridor, as well as to access other preferred harvesting (hunting, fishing, trapping and gathering) locales and areas, to access Indian Reserve lands and other occupancy areas such as cabins and traplines and to transport meat, other traditional resources and supplies between the main communities (Fort Chipewyan, Fort McMurray, Fort McKay) and cabins, traplines and reserves.[21] These submissions emphasized that the P2 WMF should focus on maintaining: a) the integrity of the aquatic ecosystem to sustain all aboriginal fish populations; and b) the navigability of the river to pass loaded boats with an outboard motor.

Based on the technical reviews of the P2FC Recommendation, ACFN and MCFN made a number of detailed recommendations to AENV and DFO that would allow for corrections where the P2FC Recommendation fell short of protecting Treaty rights.

The overarching recommendation of the *Synthesis Report* was that recommendations from the technical reviews could not be demonstrably integrated by DFO/AENV in the final P2 WMF (SWQMF) that:

- "The Crown will provide explicit details, in writing, on how it has considered these recommendations and rational for why the Crown believes they cannot be accommodated."

- "The Crown will enter into discussions immediately with ACFN and MCFN on appropriate mitigation and accommodation options related directly to the ability of ACFN and MCFN on appropriate mitigation and accommodation options related directly to the ability of ACFN and MCFN to meaningfully exercise their Treaty and Aboriginal rights. This discussion/consultation/model needs to be directly integrated into the P2 Water Management Framework and be concluded before the P2 implementation."

Finally, "[i]n the absence of pursuing the above measures, the Crown would be implicitly creating further uncertainty for subsequent AENV water-licensing decisions."[22]

A1.1.2 Engagement on ACFN and MCFN Submissions

In a meeting with ACFN IRC and MCFN GIR on September 9, 2010, AENV and DFO representatives committed to participating in a technical review meeting regarding the ACFN and MCFN joint submissions on the P2FC

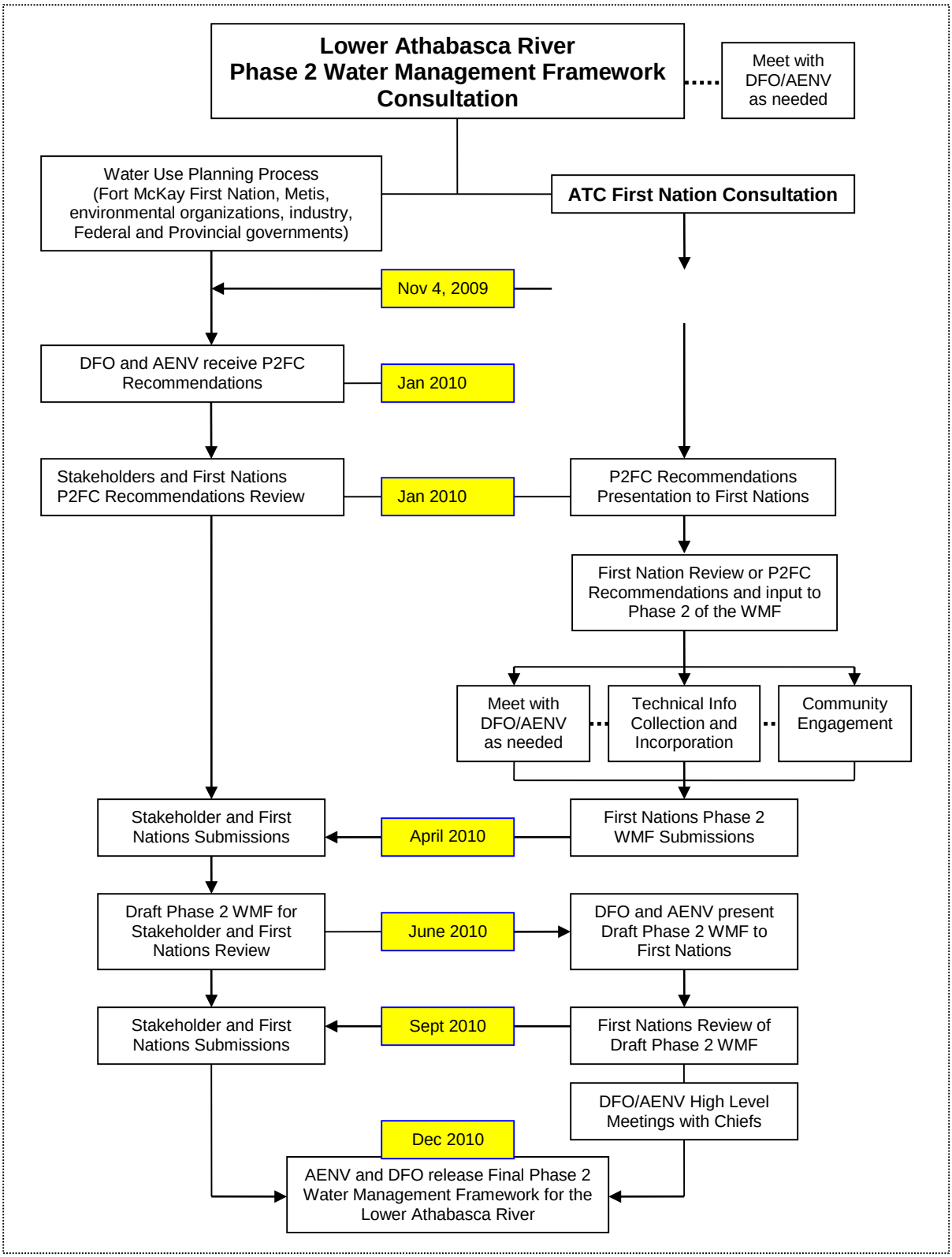
[21] See ACFN and MCFN 2010 and Candler *et al.* 2010 for further details.
[22] ACFN, et. al. 2010., p. 50/73.

recommendations prior to proceeding with drafting the P2 WMF (now the SWQMF)[23]. At that September 9th meeting, there had been discussion about the value in DFO and AENV providing comments and questions on the technical review and DFO/AENV representatives had requested a Word version of the technical review so that they could insert comments directly into the document.

No response was received from DFO or AENV was received. ACFN IRC and MCFN GIR followed up in February 2011 to reiterate that they wished to meet regarding the information presented in the various submissions "to clarify how this data should be incorporated into the Phase 2 Framework." Because the information provided by ACFN and MCFN submissions was intricate and complex, especially the proposed Aboriginal Base Flow (ABF) and Aboriginal Extreme Flow (ABX), the Nations saw value in meeting face to face to answer questions, clarify information and discuss how best to consider and incorporate the information. At that time, ACFN IRC and MCFN GIR note that: to date [February 8, 2011], neither of your governments have contacted either of our First Nations to arrange to meet and discuss our concerns and recommendations vis-à-vis the Phase 2 Framework." [24]

On August 4, 2011, DFO and AENV wrote to ACFN IRC and GIR in reply to the February 8, 2011 letter. In the August 4th letter, DFO and AENV introduced the new terminology of the "renewed surface water quantity framework", placing it in the context of Lower Athabasca Regional Plan (LARP) commitments. DFO advised that they were "continuing to work closely with Alberta Environment (AENV)" and that "once a draft updated framework has been prepared, DFO and AENV will share the draft with ACFN and MCFN, and meet with you to get your advice on finalizing the renewed surface water quantity management framework." [25]

[23] Email dated September 10, 2010 from Nicole Nicholls, Project Manager, ACFN IRC, to Brian Mackowecki (DFO), Pat Marriott (AENV) and Karina Andrus (AENV), Subject: ACFN-MCFN Phase II Review – follow up to yesterday's meeting
[24] Letter dated February 8, 2010 from ACFN IRC Director, Lisa King and MCFN GIR Director, Melody Lepine, to Acting District Approvals Manager, Alberta Environment, Pat Marriot, and Manager of Oil Sand Projects, Department of Fisheries and Oceans, Mr. Brian Makowecki, Re: Consultation on the Phase 2 Framework.
[25] Letter dated August 4, 2011 from Brian Mackowecki, Manager, Oil Sands Major Projects, Fisheries and Oceans Canada and from Patrick Marriot, Regional Approvals Manager, Northern Region, Alberta Environment, to Melody Lepine, MCFN, and Lisa King, ACFN, Subject: Consultation on the Phase 2 Framework.


Lower Athabasca River
Phase 2 Water Management Framework
Consultation
Meet with DFO/AENV as needed
Water Use Planning Process (Fort McKay First Nation, Metis, environmental organizations, industry, Federal and Provincial governments)
ATC First Nation Consultation
Nov 4, 2009
DFO and AENV receive P2FC Recommendations
Jan 2010
Stakeholders and First Nations P2FC Recommendations Review
Jan 2010
P2FC Recommendations Presentation to First Nations
First Nation Review or P2FC Recommendations and input to Phase 2 of the WMF
Meet with DFO/AENV as needed
Technical Info Collection and Incorporation
Community Engagement
Stakeholder and First Nations Submissions
April 2010
First Nations Phase 2 WMF Submissions
Draft Phase 2 WMF for Stakeholder and First Nations Review
June 2010
DFO and AENV present Draft Phase 2 WMF to First Nations
Stakeholder and First Nations Submissions
Sept 2010
First Nations Review of Draft Phase 2 WMF
DFO/AENV High Level Meetings with Chiefs
Dec 2010
AENV and DFO release Final Phase 2 Water Management Framework for the Lower Athabasca River

APPENDIX A2. LAR FISH LIFE-CYCLE INFORMATION

A2.1 Burbot

Burbot are common in the LAR and its tributaries and the species exhibits a unique life-history strategy across its range. They are most active in cold water (<10°C) and, according to research into their habitat requirements in the LAR, they select velocities between 0.05 and 0.45 m/s (Golder 2009; Mushens *et al.* 2009). In north-central Alberta, they emerge by late May (Tom Boag, personal observation). Rearing habitat is typically pelagic as larvae (Richardson Lake, Lake Athabasca populations), then peripheral along river banks or lake margins associated with cover (Boag 1989; Golder 2009). Juveniles rear for up to one year among rocks and debris at bankside at and near the land-water interface, which is a characteristic unique to this species. Adults seek out deeper habitat by day and move into shallower water to feed at night. They are present in the river year-round and move upstream from the PAD beginning in mid-November. They spawn upstream from Fort McMurray below Mountain Rapids, and it is likely that some proportion of the population also spawns in tributaries, including the Tar and Clearwater rivers, between the Mackay and Muskeg river confluences and further downstream (FWMIS 2014; Mushens et. al 2009). Burbot broadcast their eggs in early January over substrates from sand to cobble, and in depths from 0.5 to 2.0 m (McCart *et al.* 1982; Mushens *et al.* 2009; Golder 2009). Given the diversity of substrates over which eggs are encountered (Mushens *et al.* 2009), Burbot spawning site-selection appears to be defined by velocity and depth in the LAR, and not substrate composition.

A2.2 Northern Pike

Northern Pike are present in the mainstem LAR, its tributaries and PAD lakes and channels (Mushens and Barton 2009; Mushens *et al.* 2009). In the LAR, they are found in peripheral backwater and snye habitat >0.3 m depth during the open-water season (NRBS 1994a; NRBS 1994b; Mushens and Barton 2009). Backwater habitat forms downstream from point bars and at channel confluences (snye units are located in the calm water created on the downstream side of peninsulas that jut into the mainstem.) Northern Pike prefer reduced water velocity (<0.2 m/s) but can tolerate stronger current when they migrate from deeper winter habitat to spawn upstream in the mainstem or tributaries in the spring (Nelson and Paetz 1992; Joynt and Sullivan 2000; Golder 2009). Spawning takes place from early- to mid-May over emergent vegetation along flooded shore margins in snye and tributary habitats. Larvae attach themselves to vegetation by cranial papilla once hatched and until yolk sacs are resorbed (Nelson and Paetz 1992). With post-freshet water-level recession, larvae swim free and are dispersed passively by the receding current. Movements of top predators including Burbot, Northern Pike, and Walleye have been documented from summer feeding to winter habitat, but too few individuals of the latter two groups have been marked to warrant definitive conclusions. Sub-populations are suspected in tributaries and in the LAR proper.

A2.3 Lake Whitefish

Lake Whitefish in the LAR migrate from Lake Athabasca and the PAD upstream to Mountain Rapids, 75 km upstream from the City of Fort McMurray. They spawn in this region by late October over course substrate in water up to 1.5 m deep (McCart *et al.* 1982). Based on capture results, it appears that migration takes place over summer (Mushens *et al.* 2009). Like Northern Pike, Lake Whitefish prefer deeper (>0.6 m) lower-velocity habitat in the LAR. They migrate between the PAD, moving from late-spring through summer, arriving at Mountain Rapids by October where they spawn (Wallace and McCart 1984). In addition, sub-populations are present in select tributaries (e.g., Clearwater River in summer–fall) during the open-water season and likely move upstream to spawn in the Christina River where they concentrate at the mouth in late-August (AAR 2005). They prefer reduced water velocity but can tolerate stronger current, up to 1 m/s velocity, when they migrate upstream to spawn in the fall (Nelson and Paetz 1992; Joynt and Sullivan 2000; Golder 2009). They are present in the river and PAD lakes and channels year-round (Mushens and Barton 2009; Mushens *et al.* 2009). Once hatched, larvae swim free and are dispersed passively downstream by the current from mid-May through June. It is thought that rearing occurs in PAD lakes, Lake Athabasca and channels over summer for up to four years.

A2.4 Walleye

Like the other species discussed above, Walleye are distributed throughout the LAR and its tributaries. They complete their lifecycle between Lake Athabasca and the PAD (Paul 2008) where they are sought after by the commercial and aboriginal fishery. In the LAR, Walleye migrate from deep winter habitat in the mainstem Athabasca River, tributary confluences, and Lake Athabasca and PAD channels. They move upstream from mid-April through mid-May based on water temperature to spawn below mountain rapids or tributaries, including the Clearwater River (Wallace and McCart 1984). Walleye are common in the Clearwater River 5–8 km upstream from the City of Fort McMurray in July (Tom Boag, personal observation). Like Lake Whitefish, it is probable that sub-populations of Walleye spawn in the LAR and tributaries. This hypothesis is based on incidental catches of Walleye during inventories of fishes and their habitats in tributaries (FWMIS 2014). However, this remains a data gap for Walleye (and Lake Whitefish.)

Surface Water Quantity Management Framework for the Athabasca River (GoA & DFO 2014)
Review of Draft 2 - Martin Carver (August 5, 2014)

1.0 Introduction

The GoA released the Surface Water Quantity Management Framework (SWQMF) late in 2013 to replace the Phase One Water Management Framework which is currently in place to guide direct oilsands water withdrawals from the Athabasca River (AENV & DFO 2007). The Mikisew Cree First Nation (MCFN) and the Athabasca Chipewyan First Nation (ACFN) provided detailed feedback on May 28, 2014 (Carver 2014) including recommendations related to the following key issues:

- Lack of consideration of navigation
- Over-reliance on flawed outcome of the Phase Two Framework Committee (P2FC) process
- No ecosystem base flow (EBF) in any season
- Need to reconcile storage requirements and licensed water use with pre-existing rights for Aboriginal navigation
- Missing and/or inappropriate short- and long-term triggers
- Incomplete/inappropriate elements in the management regime

The Government of Alberta (GoA) provided a subsequent Draft 2 (July 2014) in response to concerns expressed by MCFN and ACFN. MCFN has retained the services of Aqua Environmental Associates (AEA) to conduct a brief and targeted review of Draft 2 in relation to the comments submitted in late May and with familiar objectives of the earlier review (Carver 2014). This memorandum provides an overview of the findings.

Findings are presented in six sections:

- Presentation and Communication of Revisions
- Lack of an Ecosystem Base Flow in Any Season
- New Fall Season and Associated Long-Term Trigger
- Consideration of Aboriginal Navigation
- Use of Outcome of the Phase Two Framework Committee
- Other Monitoring and Management Issues

Limitations

This review was conducted with a restricted budget and with limited notice (comments due in to regulator within ten days of project initiation). As a result, the findings are provided in overview form. Additional detail can be provided, upon request, after the August 8 submission deadline. Due to weaknesses in how the changes from Draft 1 to Draft 2 have been communicated and an unworkably tight deadline for submitting comments, these findings should be considered preliminary and subject to change.

Aqua Environmental Associates has prepared this report for MCFN to inform the SWQMF consultation process and is not responsible for any use, interpretations or conclusions that may be made on the basis of the information contained herein if used by other parties and/or outside of this process. Any such unauthorized use of this report is at the sole risk of the user.

The review is focused on the in-stream flow needs of the mainstem Athabasca River between Fort McMurray and Embarras. It does not consider the consequences of the proposed SWQMF on the hydrology of the Peace-Athabasca Delta (PAD).

2.0 Findings

2.1 Presentation and Communication of Revisions

Draft 2 shows selected text in yellow highlight implying that these are the sections that have been changed from Draft 1 to Draft 2. However, it is evident that many of the new parts are not highlighted in Draft 2 suggesting that an absence of yellow highlight is unreliable in suggesting no change. Further, other changes in the text are noticed that were not highlighted but which are different in Draft 2 in comparison with Draft 1. Further, Draft 2 does not indicate which sections in Draft 1 have been deleted. These areas of unreliability have burdened the present review. It is suggested that the GoA provide a subsequent communication of Draft 2 that clearly identifies all the modified, added and deleted text, and to solicit further review input.

Note also that two appendices in Draft 2 are called Appendix E. The second one is referred to as Appendix G in this review. Also, the new Figures 6 and 7 are not included in the Draft 2's list of Figures.

2.2 Lack of an Ecosystem Base Flow in Any Season

Draft 2 continues the deficiency that is evident in Draft 1, namely the absence of an ecosystem base flow in any of the now six seasons. This element was integral to Recommendations #5 and #6 provided in Carver (2014). The reader is referred to Carver (2014) for the detailed rationale behind this provision.

2.3 New Fall Season and Associated Long-Term Trigger

Draft 2's section 5.2.2.2 (Table 4) introduces a new fall season into the regime of long-term triggers. A fall season is not included as part of the short-term triggers (which remain unchanged from Draft 1 to Draft 2). Setting aside this inconsistency, the long-term low-flow triggers that are in Draft 1 have been revised downward (i.e., are less protective) in all seasons except the summer which has been raised. A scientific rationale is not provided for this reduction in protection during all but the least sensitive season. In Draft 1, and now in Draft 2, these seasonal low-flow long-term triggers are based on the same interpretation of modelled results. It is unclear how the same approach can "downgrade" the early warning threshold associated with most of the other seasons to include one for the new fall season. It appears that the protection in the five seasons in Draft 1 has been reduced to allow for added protection for the new fall season. No explanation is given, but the protection is reduced in Draft 2 meaning that seasonal flows must now depart (decline in magnitude) further from their past behaviour for a management response to be triggered.

2.4 Consideration of Aboriginal Navigation

It is positive that Draft 2 now recognizes Aboriginal Navigation and the importance of the content of Candler *et al* (2010) in the development of the SWQMF. Whereas Draft 1 made no mention of this source of relevant information, Appendix D of Draft 2 presents a new Aboriginal Navigation Index (ANI), pursuant to Recommendation 7 of Carver (2014). Draft 2 confirms what MCFN has been saying for years: that the ANI is in decline (for decades) and that oilsands withdrawals are exacerbating this decline. Draft 2 also recognises the importance of "pinch points" (limiting sections

of the river) in navigation. Specifically, with respect to the statement in Candler *et al* (2010) that a flow rate of 400 m^3/s corresponds to about 1.2 m depth which is the depth required by a fully loaded boat to navigate, page 55 (Draft 2, Appendix D) states: "This relationship matches very well with Candler *et al* (2010), particularly the 1.2 metres safe navigation depth occurring at the AXF."

Despite these positive changes and acknowledgements, there are two significant concerns associated with this new material:

a) Draft 2 uses 300 m^3/s as the Aboriginal Extreme Flow Without Justification
Whereas Candler *et al* (2010) documented 400 m^3/s as the flow rate below which navigation with a fully loaded boat is restricted, Draft 2 disregards this basement in favour of 300 m^3/s as the point at which ANI reaches "zero". The justification is provided as follows (Draft 2, page 55): "However, while navigation [between a river flow of 300 and 400 m^3/s] is probably limited, it is likely not impossible." This is provided entirely without justification; it is neither scientific nor based on any credible Indigenous Knowledge parameters. Given the detailed work provided in Candler *et al* (2010) and the support for that work recognised in Draft 2, this new ANI scheme should consider Aboriginal Navigation opportunities to cease at 400 m^3/s, until sufficient scientific rationale is provided otherwise.

b) A change in average fall ANI of 10% is required to suggest management concern
A change of 10% is required in Draft 2 to suggest concern for a decline in Aboriginal Navigation yet this amount of change is provided without scientific rationale. Elsewhere in Draft 2, it is shown that ANI has demonstrated a persistent decline over recent decades and is known to be vulnerable in any given year. It is plausible that a much smaller change in ANI should precipitate a management response to address any emerging issues. Instead, the Draft 2 allows for a 10% change and makes this determination through calculation of an *average* ANI for the entire fall season. It is hard to understand how Draft 2 can assert that this is a "highly conservative indicator" without defense of this statement and without reference to the current condition of Aboriginal Navigation.

2.5 Use of Outcome of the Phase Two Framework Committee

As in Draft 1, Draft 2 continues to use the outcome of the P2FC despite its extensive deficiencies as outlined in detail in Carver (2014). Notably, Draft 2 provides a partial response to some of those deficiencies through the inclusion of "Appendix G" (shown as second Appendix E in Draft 2). For example, in this new material, it is noted that the modelled results, from a particular application rise to 21% and 31% (Draft 2, page 61) which resulted in "evaluation criteria just crossing the irreversible/biodiversity threshold. Whether this corrected result would have altered the P2FC's decision is unknown." And this concern for the quantitative errors in P2FC results is but one of many associated with the P2FC's non-consensus outcome. The reader is referred to the extensive discussion provided in Carver (2014) describing the shortcomings and deficiencies associated with Draft 1's, and now Draft 2's excessive reliance on the outcome of the P2FC process.

2.5 Other Monitoring and Management Issues

Additional issues remain outstanding in relation to monitoring and other management issues.

Downstream Hydrometric Station on the Lower Athabasca River
Draft 2 continues Draft 1's reliance on reported records of oilsands water use, rather than measured water flowing in the Athabasca River, downstream of the oilsands withdrawals. This places an

inappropriate reliance on the accuracy of disparate monitoring results provided by industry rather than independent results-based monitoring from the river itself. Rather than dismissing the utility of the Eymundson RAMP station (as put forth in Carver (2014) Recommendation 2), GoA and DFO should instead be taking steps to assure that there is a hydrometric station that is providing results of the same reliability as found with the Water Survey of Canada station located just downstream of Fort McMurray.

Need for Amended Water Licenses

Although GoA has indicated that the terms of water licenses are "out of scope" with respect to Draft 2, it remains inappropriate that the licenses allow for much greater withdrawals than the withdrawals that are used in the modelling. Further, and as emphasised in Recommendation 1 of Carver (2014), the amount of licensed withdrawals must be reconciled with the requirements for Aboriginal navigation through consideration of the storage needs required to bridge seasons. If the pre-existing rights associated with Aboriginal navigation cannot be met and industry is not required to build required additional storage, then the withdrawals permitted by the oilsands water licenses should be revised downward to be adequately prepared for times of water scarcity.

*Uncertainty and Management Response*s

Draft 2 continues Draft 1's disregard for determining uncertainty. Instead, Draft 2 states that "the evaluation criteria are too uncertain for such an evaluation" (in reference to the P2FC outcomes). This is an explicit recognition of the degree of uncertainty associated with the science involved and thus demands an explicit response that recognises rationally the degree of confidence associated with these stated outcomes. This concern is partially reflected in Recommendations 3, 8 and 9 of Carver (2014) and these recommendations remain outstanding.

3.0 Conclusion

The new Draft 2 of the Surface Water Quantity Management Framework provides some positive structural additions however these additions are largely undermined by reductions in protection provided by thresholds that are set unscientifically in the new draft. In addition, deficiencies in the P2FC science and its non-consensus outcome remain outstanding, and now to some extent explicitly acknowledged by GOA, yet GOA continues to maintain incorrectly that this earlier body of work provide a sound rationale for the short-term triggers in Draft 1 and 2. Until the scientifically unjustified short-term triggers have been addressed and until the new thresholds provided as long-term triggers are revised to reflect conditions on the ground and available data sources, it is unlikely that the Draft 2 SWQMF will be able to protect the Aboriginal Fishery and Aboriginal Navigation.

4.0 References

Alberta Environment (AENV) and Department of Fisheries and Oceans (DFO) 2007. *Water Management Framework: Instream Flow Needs and Water Management System for the Lower Athabasca River*, 37 p.

Candler et al 2010. *As Long As the Rivers Flow*. Prepared for ACFN and MCFN. November 26, 2010, Parkland Institute and University of Alberta.

Carver M 2014.*Surface Water Quantity Management Framework for the Lower Athabasca River (GoA and DFO) - Technical Review*. Aqua Environmental Associates, Nelson BC, 57 p.

Government of Alberta (GoA) and Department of Fisheries and Oceans (DFO) 2013. *Surface Water Quality Management Framework*, Draft 1, November 2013.

Government of Alberta (GoA) and Department of Fisheries and Oceans (DFO) 2014. *Surface Water Quality Management Framework* Draft 2, July 2013.