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January 25, 2016

Amisk Hydroelectric Project
Canadian Environmental Assessment Agency
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Re: Comments on the draft Environmental Impact Statement Guidelines for the Amisk Hydroelectric Project

The Mikisew Cree First Nation ("MCFN") and the Athabasca Chipewyan First Nation ("ACFN") jointly provide this letter in response to the Canadian Environmental Assessment Agency's request for comments on the draft Environmental Impact Statement ("EIS") Guidelines on the proposed Amisk Hydroelectric Project (the "Project").

We have attached two documents to this letter which set out MCFN's and ACFN's comments on the draft EIS Guidelines being:

a) a brief written submission from MCFN and ACFN; and

b) " AHP Development Corporation Proposed Amisk Hydroelectric Project - Review of CEAA's Draft Guidelines for the Preparation of an Environmental Impact Statement", prepared by Aqua Environmental Associates dated January 25, 2016.

We ask that the Agency respond to the comments and concerns raised in these materials by amending the EIS Guidelines as suggested in these documents. To the extent that MCFN's and ACFN's comments do not result in changes to the EIS Guidelines, we ask that the Agency explain, in writing, how these comments were considered and why the requested changes have not been made.

Sincerely,

CARL BRAUN

<signature removed>

Lisa King, Director, ACFN IRC

As per.

<original signed by>

ON BEHALF OF:

Melody Lepine, Director, MCFN GIR

Encls.

Submission of the Mikisew Cree First Nation and the Athabasca Chipewyan First Nation regarding Draft Guidelines for the Preparation of an Environmental Impact Statement

We write on behalf of the Mikisew Cree Nation ("MCFN") and the Athabasca Chipewyan First Nation ("ACFN") (together, the "Nations") to provide comments on the Draft Guidelines for the Preparation of an Environmental Impact Statement (EIS Guidelines) for AHP Development Corporation's ("AHP") Amisk Hydroelectric project (the "Project"). We have attached a report prepared by Dr. Martin Carver, entitled "AHP Development Corporation Proposed Amisk Hydroelectric Project Review of CEAA's Draft Guidelines for the Preparation of an Environmental Impact Statement", dated January 25, 2016 which contain technical comments on the EIS Guidelines.

This submission and the attached report expand on the Nations' core concern: that the assessment of the potential environmental effects of the Project must be designed to thoroughly assess the potential downstream effects to areas of importance to the Nations, and in particular, to the Peace Athabasca Delta (the "Delta"). In this submission, and to add contextual background, we provide a brief introduction as to who we are as Nations and demonstrate our need to access a healthy Delta. This information serves as a backdrop by which our proposed EIS Guideline amendments should be considered. We ask that the Canadian Environmental Assessment Agency (the "Agency") consider this submission and the attached report in preparing the final version of the EIS Guidelines.

a) The Nations

MCFN is primarily a woodland Cree Nation, with a registered population of approximately 2,800 members. Approximately half of its members live in and around Fort Chipewyan and on the surrounding traditional trapping, hunting and fishing lands, and most of the remaining half live in the vicinity of Fort McKay and Fort McMurray, Alberta. MCFN has nine reserves in northeastern in Alberta in the vicinity of Fort Chipewyan, including one within Wood Buffalo National Park (Peace Point No. 222).

ACFN is a First Nation of Dene ancestry. ACFN members speak Denesuline and call themselves K'ai Taile Dene, meaning "people of the land of the willow". ACFN's traditional lands are located in the northeast corner of Alberta and the northwest corner of Saskatchewan, centered around Lake Claire, the western end of Lake Athabasca, and the lower Athabasca River. ACFN has eight reserves with a combined area of 34,767 ha. The reserves are located near the southwestern tip of Lake Athabasca, across the lake from Fort Chipewyan, and on the Athabasca River.

ACFN has a registered population of approximately 1,200 people. Approximately one third of ACFN's members live in Fort Chipewyan, which is located on the north shore of Lake Athabasca, immediately outside the eastern boundary of Wood Buffalo National Park. It is accessible by air from Edmonton and Fort McMurray, and by winter road from Fort Smith (140 km to the north) or Fort McMurray (303 km to the south).

Both Nations are signatories to Treaty 8, which guarantees the Nations the right to maintain their traditional way of life. The Treaty rights are meant to protect their ability to use the land, water and resources provided by the creator, in order to continue their way of life as their ancestors have for generations. ACFN and MCFN members continue to sustain their way of life through hunting, fishing, trapping, gathering and they regularly engage in cultural and spiritual practices within their traditional territories.

b) <u>The Peace Athabasca Delta</u>

The Nations rely on the Delta for its rich and abundant resources. The Delta is located where the Peace, Athabasca, and Birch Rivers converge at the western end of Lake Athabasca. At approximately 5000 square kilometres, the Delta is one of the world's largest freshwater deltas. Eighty percent of the Delta is located within Wood Buffalo National Park, and the delta drains nearly 600,000 square kilometres of northern British Columbia, Alberta and Saskatchewan.

The Delta is a unique ecosystem. Significant portions of the Nations' traditional lands overlap with the Delta. The Delta contains a flat topography, nutrient enriched flood plains and shallow water. Abundant sunshine throughout the growing season results in the Delta having an extremely high level of primary productivity that provides the basis for a rich food web. The Delta contains 11 different habitat types containing over 250 species of vascular plants. The Delta also provides habitat to a vast array of fauna, including 215 species of birds, 42 species of mammals, 20 species of fish and countless invertebrates. These species represent vital resources for ACFN and MCFN who hunt, trap and fish in the Delta, a place they have continuously inhabited for centuries.

The Nations participated extensively in the environmental assessment of BC Hydro's Site C Clean Energy Project, providing BC Hydro, and provincial and federal regulators with extensive information on the Delta and ACFN and MCFN's interests and use of the Delta. We ask that the Agency review those comments to understand ACFN and MCFN's interests relating to the Delta.

In particular, during the environmental assessment process for Site C, MCFN and ACFN expressed serious concerns related to changes occuring to the hydrology of the Delta, which have amplified over recent decades. The preponderance of scientific research on the Delta has indicated that there has been a decrease in the frequency and magnitude of flooding in the Delta since the construction of the W.A.C. Bennett dam in British Columbia. This research indicates that the regulation of the Peace River has contributed to a diminishment of the frequency and magnitude of flooding in the Delta, particularly large scale flooding events caused by ice-jam floods in the vicinity of the Delta.

Ice jam flooding only takes place during the ice break up period but is critical for the maintenance of water levels in many of the perched basins within the Delta, which are smaller lakes that are raised in elevation and are therefore situated beyond the reach of the open water recharge mechanisms.

The occurrence of an ice jam flood in the Delta reach depends on the interaction of many factors within a dynamic and variable system. Importantly, the occurrence of these floods depends not only on the character of ice and flows at locations proximal to the Delta, but on the interaction of flows, ice and climate in areas far upstream of the Delta.

There are many factors which influence the likelihood of an ice jam flood occurring in the Delta reach. In general, this likelihood is influenced by: (1) winter flow and weather conditions that create the ice required for an ice jam flood; and (2) spring time flow dynamics, in particular, the magnitude and timing of spring freshets that influence the break up of ice and the magnitude of overbank flooding that may occur.

One of MCFN's and ACFN's concerns is that the necessary conditions for ice jam flooding may be adversely affected by the construction and operation of the Project. This concern arises from the Project Description, which confirms that the Project contains elements which may influence the surface and ice regime in reaches of the Peace River which could affect the flooding mechanisms in the Delta. Accordingly, the Nation's overarching recommendation is that the EIS Guidelines require AHP to conduct a thorough assessment of the potential effects of the Project on the Delta, with particular emphasis on assessing the potential effects of the Project on (1) water quality, (2) open water flooding mechanisms and (3) ice jam flooding mechanisms.

c) <u>Requests for changes to the draft EIS Guidelines</u>

Given the location of the proposed Project, and the fact that the project includes the construction of a large head pond and dam, MCFN and ACFN are concerned that this project could affect ice processes and surface water processes on the Peace River which could further reduce the likelihood of ice-jam flooding and flow reversals in the vicinity of the Delta. This is a critical issue for MCFN and ACFN because their members have faced increasing difficulties in using water transportation routes to access areas of the Delta that are critical for the exercise of their Treaty rights due to decreased flooding with the Delta. This decreased incidence of flooding in the PAD has also resulted in the loss of habitat for species critical to the exercise of Treaty rights, includuing muskrat and migratory birds.

The Project Description provided by AHP confirms that the head pond and dam will impact the ice regime down stream of the Project, by preventing upstream ice from passing the dam. It is also likely (though not expressly stated in the Project Description) that the presence of the head pond will increase temperatures downstream on the Peace River during winter months. Both these factors can influence the ice regime on the Peace River. As noted in the review of the EIS Guidelines prepared by Dr. Carver,, the formation and efficacy of ice jams in the Delta reach depends on a multitude of complex factors, including functioning of ice jam release waves ("javes") that promote mechanical break ups of ice cover in a way that is critical to the formation of ice jams in the lower Delta reach. The EIS Guidelines should require AHP to undertake a detailed assessment of the potential effects of the Project on the ice regime, including effects relating to ice jam flooding in the Delta reach. Dr. Carver's comments contain detailed suggestions for improving the EIS Guidelines in this regard.

In addition to concerns about effects to the ice – regime, ACFN and MCFN have concerns about the potential effects of the project on surface water flows, both from the filling of the reservoir and from operation of the dam. The Amisk Dam, if constructed, will capture additional tributaries from downstream of the approved Site C dam. Given that both of these projects are scheduled to come on line on fairly similar timelines, the EIS Guidelines should be carefully drafted to ensure that AHP is required to collect baseline data for the environmental assessment which accounts for changes caused by BC Hydro's existing facilities and the the potential changes to the upstream environment which will be caused by Site C in the future.

As noted in the attached technical comments, the Nations request that the EIS Guidelines require AHP to conduct an assessment of the potential effects of the Project on the Delta. The spatial scoping for study areas for various disciplines, including water quality, hydrology and river ice must be set in a way that captures all potential effects of the Project on the downstream environment, including on flooding processes which influence the Delta. If the Delta is excluded from this spatial scoping, the assessment of the potential effects of the Project will lack information which is critical to understanding the potential effects of the Project on the Nations' rights and interests.

Finally, the Nations are very concerned that s.5.1 of the EIS Guidelines limits the requirement for the proponent and the Crown to engage with ACFN and MCFN in relation to the potential effects of the Project. Section 5.1 excludes the Nations from the list of First Nations that are "potentially affected Aboriginal Groups" and assumes, prior to any assessment or engagement having taken place with the Nations, that MCFN and ACFN are "expected to be less affected by the project and its related effects."

There is no justification, at this stage, for assuming that ACFN and MCFN are likely to be "less affected" by the Project. To date, no information has been shared with the Nations that allows them to understand the potential effects of the Project on the downstream surface water and ice regimes, upon which the hydrology of the Delta depends. The Agency, acting on behalf of the Crown, must not make procedural decisions which limit the participation of the Nations in this consultative process. By directing that the proponent need not meet with the Nations or share key baseline studies, the Crown risks diminishing the participation of the Nations and limiting the Crown's understanding of the potential effects of this project.

Drawing this distinction at this stage in the environmental assessment has significant consequences for the ability of MCFN and ACFN to be informed about the potential effects of the Project, which is critical for discharge of the Crown's duty to consult. The draft EIS Guidelines propose that only those First Nations who are assumed to be "potentially affected" are to be met with by AHP or to receive "baseline studies" from AHP in its engagement with First Nations.

For this environmental assessment process to properly consider the potential effects of this Project, and to assist the Crown to carry out its duty to consult, the EIS Guidelines should be amended to require AHP to work with the Nations to gather evidence relating to the Nations' exercise of Treaty 8 rights, including the necessary conditions for the continued meaningful exercise of those rights, and to share baseline studies with the Nations in a way that addresses their concerns about the potential effects of the project on the flooding mechanisms which influence the PAD. At a minimum, AHP should be directed to share early studies relating to the potential downstream effects of the Project with the Nations, and to assist the Nations in reviewing these documents with its technical advisors. The distinction proposed in s.5.1 serves instead to frustrate the Nations' desire to understand the potential effects on the Delta.

The Nations ask that these comments, and the comments included in the attached report prepared by Dr. Carver, be incorporated in the final EIS Guidelines to be issued by the Agency. The Nations also request, as part of the Crown's duty to consult, that the Nations be provided an explanation for how these comments were considered and incorporated in the final EIS Guidelines when issued. Should the Agency wish to clarify any of the comments included in this letter, the Nations would be pleased to discuss those items with you.

AHP Development Corporation
Proposed Amisk Hydroelectric Project

Review of CEAA's Draft Guidelines for the Preparation of an Environmental Impact Statement

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:

Dr. Martin Carver, PEng/PGeo, PAg, PGeo (AB)

Project #503-03

January 25, 2016

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1.0 INTRODUCTION

1.1 Terms of Reference of this Review

The Athabasca Chipewyan First Nation (ACFN) and Mikisew Cree First Nation (MCFN) retained Aqua Environmental Associates to carry out an independent review of the Draft Guidelines for the Preparation of an Environmental Impact Statement ("Draft Guidelines") for the proposed Amisk Hydroelectric Project ("Project") issued by the Canadian Environmental Assessment Agency (CEAA) December 2015. The Project would be located on the Peace River, 28 km southwest of Fairview, Alberta (AHP Development Corporation 2015). The purpose of the CEAA's Draft Guidelines is to identify all information that is needed in the Environmental Impact Statement (EIS) to evaluate the Project's projected impacts, the efficacy of proposed mitigation, and the type and significance of any residual project impacts that will not be mitigated.

The objective of this review is to identify gaps and improvements in the Draft Guidelines related to matters of importance to ACFN and MCFN and within the technical areas of 1) surface water hydrology, 2) river ice processes, and 2) fluvial morphology and sediment transport. This may include, but not be limited to:

- locations of special significance to First Nations;
- site-specific considerations requiring explicit attention in the EIS Guidelines;
- elements requiring additional detail; and
- concern about vague, unclear, and confusing requirements.

This report provides the results of this review and gap analysis, identifying revisions to the Draft Guidelines that would improve opportunities for MCFN and ACFN to evaluate the EIS in relation to matters of concern to them. Where modified and/or additional terms of reference are identified, a background/rationale is provided for the recommended changes, where relevant. In those instances in which revised wording is proposed for an existing clause, additional words are underlined. Where bulleted lists are provided, the individual bullets are given numbers, from one and up, corresponding to the order in which the bullets are presented.

1.2 The Proposed Project

AHP's proposed Project is located on the Peace River, 28 km southwest of Fairview Alberta and 15 km upstream of the Dunvegan Bridge on Highway 2. The proposed dam is situated 175 km downstream of the now approved Site C dam. Table 1 provides river distances upstream and downstream of the Project's dam. The Project has a generating capacity of 330 megawatts (MW). The dam would create an impoundment extending 50 km upstream with a surface area of 30 km^2, have a spillway of capacity 12,900 m^3/s, and include an east and a west powerhouse (i.e. headworks) and substation. It would permanently inundate 8 km^2 of land. AHP intends to prepare and submit an EIS assessing impacts due to the Project and guided by the criteria as outlined in CEAA's Guidelines for the Environmental Impact Statement, as they become finalized based on the Draft Guidelines.

1.3 Acronyms

ACFN	Athabasca Chipewyan First Nation
EIS	Environmental Impact Statement
MCFN	Mikisew Cree First Nation
PAD	Peace-Athabasca Delta
RSA	Regional Study Area
VC	Valued Component

Table 1. Tributary, town, and site locations relative to proposed Amisk dam.

Town or Site	Tributary Mouth	Downstream Position (km)[1]
Bennett Dam		-283
Peace Canyon Dam		-260
Hudson's Hope		-253
Site C Dam		-175
Fort St John		-170
	Pine River	-165
Taylor		-155
	Kiskatinaw River	-120
Alces River		-105
Amisk Dam		0
Dunvegan		15
Shaftesbury		90
	Smoky River	100
Town of Peace River		115
Sunny Valley		220
	Notikewin River	285
Carcajou		470
Fort Vermillion		550
Vermilion Chutes		605
Peace Point		855
Delta reach		~915-965
Carlson's Landing		~930

[1] Downstream location are river-length approximations and shown relative to the proposed Amisk dam.

1.4 Approach and Limitations

This report is prepared for the Environmental Impact Assessment process for AHP Development Corporation's Amisk Hydroelectric Project. The report should not be relied on for any other purpose. Any such unauthorized use of this report is at the sole risk of the user.

2.0 REVIEW OF CEAA'S DRAFT GUIDELINES FOR AMISK EIS

2.1 Hydrology

#1. Scope of Description of Baseline Surface Water Regime	
Guideline	Groundwater and Surface Water: Section 6.1.4 (hydrology) **Bullet 4**
Background & Rationale	Presentation of the surface water regime of the Peace River forms part of the Baseline Case against which the Project will be compared and its impacts evaluated. It is fundamental to the EIS that this aspect of the Baseline Case be fully described so that it can be adequately understood by all who review the EIS. The Draft Guidelines (sections 6.1.4 Bullets 1 and 4) lay out some requirements for describing the baseline hydrologic regime however these are incomplete.
Outcome	a) Revise section 6.1.4 (hydrology) Bullet 4 to read: "for each affected water body and watercourse, the total surface area, bathymetry, type of substrate (sediments), mean and extreme discharge data for watercourses at monthly, seasonal and annual timescales, mean and extreme water level data for water bodies at monthly, seasonal and annual timescales, and sediment transport characteristics.

#2. Scope of Description of Role of Existing Regulation	
Guidelines	Groundwater and Surface Water: Section 6.1.4 (hydrology) **Bullet 3**
Background & Rationale	The existing flow regime of the Peace River has been transformed by dam construction dating back to 1967. Whereas the Draft Guidelines appropriately require the description of pre-regulation ("historic") hydrologic conditions along with the effects of regulation due to the W.A.C. Bennett Dam and Peace Canyon Dam, they make no mention of the approved Site C Dam.
Outcome	a) Revise section 6.1.4 (hydrology) Bullet 3 as follows: "historic hydrologic conditions, and a discussion of how regulation of the Peace River by BC Hydro's W.A.C. Bennett Dam and Peace Canyon Dam has altered that hydrology and how the now approved Site C Dam will lead to further changes;"

#3. Description of Models Used to Describe Surface Water Hydrology	
Guidelines	Groundwater and Surface Water: Section 6.1.4 (hydrology)
Background & Rationale	Surface-water models are central tools used to identify expected impacts of the Project on the surface water regime. The description of the EIS's surface-water model(s) should include a clear description of any hydrologic and hydraulic models used in developing the EIS including identification of the limitations of the model(s) including their sources of error, simplifying assumptions and expected accuracy.
Outcome	a) Include a new clause in section 6.1.4 (hydrology) as follows: "the hydraulic and hydrologic models that will be used to predict potential changes to the hydrologic regime as a result of the Project, at all stages, including the following information: a) basis of model methodology; b) purpose for the model; c) input parameters and assumptions; d) model outputs; and e) level of confidence. Clearly identify the limitations of the model(s) including sources of error, simplifying assumptions and expected accuracy."

#4. Rationale and Description of Regional Study Area Boundary for Surface Water Hydrology	
Guideline	Groundwater and Surface Water: Section 6.1.4 (hydrology)
Background & Rationale	The boundary of the hydrology (and ice-process) Regional Study Area (RSA) is a fundamental expression of scope within an EIS. According to AENV (2013), the "Regional Study Area is the area where there is the potential for cumulative and socio-economic effects, and that will be relevant to the assessment of any wider-spread effects of the project". The Draft Guidelines (s. 2.4, p3) point out that "the proponent will demonstrate that all aspects of the project have been examined and planned in a careful and precautionary manner". Gaps in how the RSA is identified and delineated can lead to far-reaching limitations in the value and accuracy of EIS outputs. Additionally, a central consideration in defining RSA boundaries is the location of Valued Components (VCs). Following Hegmann *et al.* (1999), a VC is defined as "[a]ny part of the environment that is considered important by the proponent, public, scientists and government involved in the assessment process. Importance may be determined on the basis of cultural values or scientific concern." VCs represent the "investigative focal point of any EIA or CEA" (Hegmann *et al.* 1999). On the basis alone of the above definitions of VC and RSA, it is evident that a proponent should include the PAD within the hydrology (and ice-process) RSA. The RSA boundary should be situated to include those locations where there is the potential for effects relevant to wider-spread effects of the project. The Draft Guidelines do not indicate these information requirements concerning the RSAs. Although such content may not normally be specified within EIS Guidelines, it may also be preferable to include a clause in the final EIS Guidelines that alerts the proponent to the requirement of including the PAD in the hydrology RSA, particularly in light of the far-reaching implications of an oversight in this regard. See item #5 for further discussion. **References** Alberta Environment 2013. *Guide to Preparing Environmental Impact Assessment Reports in Alberta*. Environmental Assessment Program, Updated March 2013, 26 p. Hegmann G et al 1999. *Cumulative Effects Assessment Practitioners Guide*. Prepared for the Canadian Environmental Assessment Agency, 71 p plus four appendices.
Outcome	a) Include a new clause within section 6.1.4 (hydrology) to read: "for each local and regional study area: a) the rationale used to define the local and regional study areas considering the location and range of potential project and cumulative effects; and b) using maps, the boundaries of the local and regional study areas."

#5. Inclusion of the PAD within the Regional Study Area	
Guideline	Groundwater and Surface Water: Section 6.1.4 (hydrology)
Background & Rationale	The PAD is located within Wood Buffalo National Park which has been designated by the United Nations Educational, Scientific, and Cultural Organization as a World Heritage Site (#256) due to its "superlative natural phenomena or areas of exceptional natural beauty", its "outstanding examples… [of] …ecological and biological processes" and its "significant natural habitats for in-situ conservation of biological diversity". Ramsar notes that the PAD is "one of the most important nesting, resting and feeding areas for numerous species of waterbirds in

	North America." The PAD is also the traditional territory of the ACFN and MCFN. The PAD's ecological and cultural value is in jeopardy due to cumulative effects from hydroelectric regulation, oilsands development, and climate change. The long-term integrity of the Peace-Athabasca Delta relies on sufficient hydrologic recharge to provide water to its thousands of small lakes and wetlands. Due to the decline in its ecological integrity as a result of the cumulative effects of environmental stressors, it is now far more sensitive to small changes in hydrologic recharge. Three well-described and widely-recognized mechanisms bring hydrologic recharge to the PAD (BC Hydro 2013). *Open-Water Mechanisms* Hydraulic damming and flow reversals are open-water mechanisms that either bring water from the Peace River into the PAD or prevent water within the PAD from evacuating northward. These mechanisms have been diminished with the construction of the W.A.C. Bennett dam. BC Hydro has begun to quantify the incremental extent of lost hydrologic recharge that will be associated with its most recent approved hydroelectric project (Site C) on the Peace River (BC Hydro 2014). These mechanisms are sensitive to changes in the Peace River's open-water flow regime and as such it is important for proposed hydroelectric projects to carefully assess how changes in flow regime may further affect the efficacy of these mechanisms. The BC Hydro (2014) study calculated that Site C would cause a lost PAD recharge of 9.43 x 10^7 m^3 during one in ten of the simulated years (1965-1974). Given that flow reversals since 1972 (and not including hydraulic damming effects) have averaged 4.4 x 10^8 m^3/year (excluding 1996 and 1997 which were heavily influenced by unprecedented BC Hydro releases), the change estimate provided by BC Hydro appears to be a significant percentage (21 to 84%) of the total degree of open-water reversals available under the regulated flow regime (see Carver 2014a, for further details). Further, it appears likely that BC Hydro's initial attempt at quantifying the lost open-water recharge has underestimated the potential effect due to the following significant simplifying assumptions involved in its study. Example include: • climate change is not considered; • there are questions about the representativeness of the decade chosen for simulation (it includes pre-regulated and reservoir-filling years thus the discharge data would be reduced as a result); and • attendant ice effects are excluded. There is also confusion created in the reporting of the study's results because the same result is claimed following two different inputs for the level of Lake Athabasca ("about 1 cm" change for a 208.5 m depth versus "1 cm" change for 209 cm depth) yet the result escalates to 400% of these values for a lake level of 208 m. In light of the magnitude of this modelling determination (and given the likelihood that the actual amount will be higher, given the assumptions involved), it is evident that future proposals of this kind should be accompanied by a complete analysis of lost open-water PAD recharge. It is suggested that such future modelling work should address the gaps inherent in BC Hydro (2014) by including: • incorporation of future climates, including a range of emissions scenarios; • recognition of downward pressures on the elevation of Lake Athabasca (oil sands withdrawals, climate change, *etc.*) in light of the influential role that the level of Lake Athabasca has in shaping the magnitude of the flow reversals and hydraulic damming;

- calibration using additional and/or alternative data (*e.g.*, Peace River discharge data; Lake Athabasca stage data); and
- discussion of uncertainty and probable impacts for the family of outflow relations that may exist beyond the reach of available data sets.

With the availability of a complete assessment, appropriate mitigation can then be formulated, as necessary.

Ice-Related Mechanism

Ice-jams are the third mechanism that brings hydrologic recharge to the PAD. This mechanism relies on the occurrence of major ice jams within the “Delta reach” of the Peace River (the last 50 km of the river, starting at about 15 km above Carlson’s Landing and ending at the mouth). Of the three mechanisms, it is the ice-related one that can recharge the PAD’s high-elevation basins. This recharge of “perched” basins can come about as a result a rapid rise in stage of the Peace River due to ice jamming in the Delta reach. Without such major ice-jam events, the perched basins receive recharge through only precipitation which is far insufficient to maintain their ecological requirements. These events in the Delta reach are known to be fueled by the progressive formation and release of ice jams in what are called “javes” (Beltaos 2007). In particular, the ice-jams that bring hydrologic recharge to the PAD are fueled by ice-jam release waves that have their origin in the relatively steeper reach between the Smoky River confluence and Carcajou. (The Smoky River confluence is 100 km downstream of the proposed dam.) Beltaos (2007) suggests that break-up in the lower reach of the Peace River is typically triggered by these ice-jam release waves. Hydroelectric projects that modify ice dynamics downstream in the Peace River have the potential to also affect the strength of the linked processes that form the chain of cause-and-effect needed to support the viability of this ice-related recharge mechanism. For example, changes in winter freeze-up level and river temperature can lead to variation in ice thickness and strength and the likelihood of mechanical versus thermal break-up. These changes can contribute to changes in the strength and frequency of downstream jave occurrences. This recharge mechanism can also be sensitive to modifications in flow regimes.

It is known that the PAD is experiencing a long-term decline in hydrologic recharge due to cumulative effects from existing hydroelectric projects (Peace River), oil sands water withdrawals (Athabasca River) and climate change (and other effects). The frequency of ice-jam flood events that are large enough to recharge the perched basins has dropped from 1 in 4.4 years during the pre-regulation period (before December 1967) to 1 in 10.8 years in the post-regulation period, a reduction in frequency of more than 50%. See discussion by Carver (2014b, p 9-10) for further information on the scientific studies used to make this quantitative comparison, namely, data provided by Parks Canada (2013), Smith (2014), and Timoney (2013). Beltaos (2014) has specifically examined the comparative role of regulation and climate change on the decline of ice-jam frequency in the Delta reach and found that “[t]he results indicate that both factors have contributed significantly to the drying of the PAD, with regulation having had the more pronounced effect”. More specifically, he concludes: “the present results indicate that *regulation accounts for nearly two-thirds of the reduction in ice-jam flood frequency*” (emphasis added) (Beltaos 2014). Given that the Amisk proposal brings flow regulation closer to the PAD - and to the Smoky-Carcajou reach - it warrants detailed study as to its potential to affect hydrologic recharge due to a further decline in the ice-jam mechanism.

These known existing declines in the three mechanisms have rendered the PAD’s hydrologic integrity highly sensitive to modest incremental declines in recharge. It is important that potential impacts to the recharge mechanisms be carefully assessed in surface-water and ice-regime EIS components of related projects. To make this possible in the Amisk EIS, the PAD should be included in the hydrology (and ice-regime) Regional Study Area. This inclusion would

	also be consistent with and support the requirement of section 6.1.8 that "baseline information will describe and characterize… wetlands most likely to be affected by project activities". **<u>References</u>** Beltaos S 2014. Comparing the impacts of regulation and climate on ice-jam flooding of the Peace-Athabasca Delta. *Cold Regions Science and Technology* 108:49-58. Beltaos S 2007. The role of waves in ice-jam flooding of the Peace-Athabasca Delta. *Hydrological Processes* 21:2548-2559. Carver M 2014a. *Potential Impact of Site C on the Hydrologic Recharge of the Peace-Athabasca Delta*. Technical Memorandum prepared for the Athabasca Chipewyan First Nation and Mikisew Cree First Nation, July 17 2014, 14 p. Carver M 2014b. *Response to BC Hydro's Rebuttal Report*. Submission to the Site C Joint Review Panel, prepared for the Athabasca Chipewyan First Nation and Mikisew Cree First Nation, January 21 2014, 42 p. BC Hydro 2013. *Technical Memo Peace-Athabasca Delta May 8 2013*. Response to Working Group and Public Comments on the Site C Clean Energy Project, Environmental Impact Statement, 14 p. BC Hydro 2014. *Influence of Site C Operational Flows on the Peace-Athabasca Delta During Open Water Conditions*. Report prepared by Faizal Yusuf, BC Hydro Generation Engineering, 20 p. Parks Canada 2013. *Parks Canada's Submission to the Joint Review Panel for BC Hydro's Site C Clean Energy Project*. November 25 2013, CEAR #2618, 32 p plus one attachment. Timoney KP 2013. *The Peace-Athabasca Delta: Portrait of a Dynamic Ecosystem*. University of Alberta, 2013.
Outcome	a) Include a new clause within section 6.1.4 (hydrology) as follows: "<u>Include the Peace-Athabasca Delta within the Regional Study Area for hydrology.</u>" b) If the Regional Study Area boundary applicable to the river-ice study is different than the RSA for hydrology, then an equivalent clause should also be included within the section that addresses ice formation and break-up (see item #10).

#6. Assessment of Baseline Open-Water PAD Hydrologic Recharge	
Guideline	Groundwater and Surface Water: Section 6.1.4 (hydrology)
Background & Rationale	As explained in item #5, hydraulic damming and flow reversals are open-water mechanisms that either bring water from the Peace River into the PAD or prevent water within the PAD from evacuating northward. These mechanisms are sensitive to changes in the Peace River's open-water flow regime. To support an impact assessment, an analysis should be conducted (Baseline Case) that describes the Baseline flow regime (including Site C and excluding Dunvegan) and determines the extent of PAD recharge from open-water mechanisms. This assessment should include consideration of a range of climate change scenarios and future time periods.
Outcome	a) Include a new clause within section 6.1.4 (hydrology) as follows: "<u>how the baseline Peace River surface water regime influences the nature and quantity of open-water hydrologic recharge of the Peace-Athabasca Delta and a quantitative assessment of hydrologic recharge including the addition of Site C and in consideration of future climates.</u>"

#7. Reservoir Description	
Guideline	Groundwater and Surface Water: Section 6.2.2 (hydrology) Bullet 2
Background & Rationale	The Project will create a reservoir (or headpond) for approximately 50 km upstream of the dam. This new waterbody represents a direct and permanent impact from the Project and, as such, the dynamics of the reservoir surface should be well described in the EIS. Relevant characteristics that should be described include reservoir storage volume, bathymetry, minimum and maximum surface areas, and mean residence times.
Outcome	Include a new sub-bullet under section 6.2.2 (hydrology) Bullet 2 to read: "Describe the expected storage volume, bathymetry, and minimum and maximum surface areas of the reservoir and the mean residence times under a variety of flow conditions, including mean annual discharges and flood events. Provide the expected frequency and range of water levels for the reservoir."

#8. Assessment of Change in Open-Water PAD Hydrologic Recharge	
Guideline	Groundwater and Surface Water: Section 6.2.2 (hydrology) Bullet 2
Background & Rationale	As explained in item #5, hydraulic damming and flow reversals are open-water mechanisms that either bring water from the Peace River into the PAD or prevent water within the PAD from evacuating northward. These mechanisms are sensitive to changes in the Peace River's open-water flow regime. An analysis should be conducted (Application and Planned Development Cases) that determines the changes in PAD recharge due to changes in the surface water regime. This assessment should include consideration of a range of climate change scenarios and future time periods.
Outcome	a) Include a new sub-bullet under section 6.2.2 (hydrology) Bullet 2 as follows: "Quantify the effect of changes to the Peace River surface water regime on the amount of open-water hydrologic recharge of the Peace-Athabasca Delta. Assess recharge quantitatively including consideration of future climates."

#9. Changes to Surface Water Hydrology Downstream to Peace Point	
Guideline	Groundwater and Surface Water: Section 6.2.2 (hydrology) Bullet 2
Background & Rationale	The operating regime of the Project will modify surface water dynamics of the Peace River. The magnitude of these changes will vary downstream. Assessment and interpretation of the magnitude of related impacts to downstream Valued Components – including the PAD – requires a description and understanding of changes in the surface flow regime at downstream locations potentially as far as the Peace River mouth and including the PAD.
Outcome	a) Include a new sub-bullet under section 6.2.2 (hydrology) Bullet 2 as follows: "Identify any changes to the river regime and surface water hydrology including flood discharges and flood stages, water levels, flow velocities and flow patterns (thalweg), expected as a result of the Project in both the near- and long-term. Consider potential effects upstream and downstream of the Project, including tributaries to the Peace River and including Peace River locations between the proposed dam and the Peace River mouth, and including the Peace-Athabasca Delta."

2.2 Ice Formation and Break-Up

#10. New Grouping within Section 6.1.4 Addressing Baseline Information for Ice Formation and Break-Up	
Guideline	Groundwater and Surface Water: Section 6.1.4 (hydrology) Bullet 7
Background & Rationale	The morphology and behaviour of the Peace River are shaped by the river's annual ice dynamics. It is well known from the legacy of BC Hydro's upstream hydroelectric facilities (and on other northern rivers) that freeze-up and break-up are modified greatly by large dams and understanding these impacts can be a complex scientific pursuit. Only one bullet in the Draft Guidelines explicitly concerns ice-related baseline assessment information requirements. Ice formation and break-up require extensive modelling and assessment and as a result, warrant a dedicated section with content revised and expanded beyond that what is given in section 6.1.4 (hydrology) Bullet 7, as laid out in items 11-13 below.
Outcome	a) In addition to the hydrogeology and hydrology groupings listed in section 6.1.4, create a third grouping within that section entitled "Ice Formation and Break-Up". Include in this section the existing section 6.1.4 (hydrology) Bullet 7 and the recommended revisions and additions as indicated in items 11-13 below.

#11. Effect and Implications of Regulated (Baseline) Flow Regime on Freeze-Up Process	
Guideline	Groundwater and Surface Water: Section 6.1.4
Background & Rationale	The flow regime of the Peace River has been extensively altered by the operation of BC Hydro hydroelectric dams. In particular, filling of the reservoir behind the W.A.C. Bennett dam began in December 1967 creating the 1761-km^2 Williston Reservoir and leading to the ongoing regulation of the Peace River. Subsequently, the Peace Canyon dam was put into operation in 1980 and the Site C dam was approved in 2015 leading to expanded regulation. To support these facilities, the flow regime has been changed (and will be changed further with Site C in place) and some of these changes have implications for the downstream ice regime. One prominent aspect of these changes is the freeze-up process and its subsequent effects on break-up and ice-jam flooding. The Project may cause further changes to the surface water regime of the Peace River. To understand how these proposed changes may affect the ice regime, it is essential to first understand how the existing flow regime has affected the freeze-up process and its consequences for ice dynamics including ice jams. The discussion should include explicit description of the pre-industrial (prior to the Bennett dam) flow regime and ice dynamics so that the current situation can be fully understood. This information forms part of the Baseline Case and should be part of section 6.1.4.
Outcome	a) Include a clause within the new ice grouping of section 6.1.4 as follows: "an assessment of the effects of the current operating regime at the BC Hydro's W.A.C. Bennett Dam, the Peace Canyon Dam and proposed Site C Dam Site on the freeze-up process and its consequences for the contemporary and future ice dynamics including ice-jam occurrences. Provide a description of the pre-industrial hydrograph and ice dynamics."

#12. Models Used to Describe Ice Formation and Break-Up Processes: Limitations and Data Sets	
Guideline	Groundwater and Surface Water: Section 6.1.4 (hydrology) Bullet 7

Background & Rationale	Temperature- and ice-related models are central tools used to identify expected impacts of the Project on the ice regime, including ice formation and break-up processes. Although the Draft Guidelines ask that the modelling carried out and its assumptions be described, it does not indicate the scope of this description. (Section 3.5.1 does not indicate the need for temperature modelling, though this is implied.) Consistent with requirements for the hydraulic models, clause 6.1.4 should include a request for the following information for each temperature and ice-related model used: a) basis of model methodology, b) purpose for the model, c) input parameters and assumptions d) model outputs e) level of confidence. Ice-regime models are complex requiring careful calibration and validation to be effective. This aspect of model development within the EIS should be clearly presented and is not identified in the Draft Guidelines. Data availability and selection play an influential role in eventual model formulation. The present Bullet 7 in section 6.14 (hydrology) should be expanded to specify methods surrounding calibration and validation of these models.
Outcome	a) Replace current Bullet 7 of section 6.1.4 (hydrology) with: "ice formation and break-up processes on the Peace River and associated tributaries<u>, and the modelling that is used to simulate these processes and including the following information: a) basis of model methodology, b) purpose for the model, c) input parameters and assumptions d) model outputs e) level of confidence. Clearly identify the limitations of the model(s) including sources of error, simplifying assumptions and expected accuracy</u>." Move this bullet to be within the new ice grouping of section 6.1.4. b) Include a new clause within the new ice grouping of section 6.1.4 as follows: "<u>all suitable data sets available for calibration and validation of the ice and temperature models. Provide the rationale for the data sets selected along with the methods to be followed in calibrating and validating these models</u>."

#13. Assessment of Baseline Ice-Related PAD Hydrologic Recharge	
Guideline	Groundwater and Surface Water: Section 6.1.4
Background & Rationale	As explained in item #5, ice-jams are the third mechanism that bring water from the Peace River into the PAD. Of the three mechanisms, it is the ice-related one that can recharge the PAD's high-elevation basins. This recharge of "perched" basins can come about as a result of a rapid rise in stage of the Peace River due to ice jamming in the Delta reach. Without such major ice-jam events, the perched basins receive recharge only through precipitation which is far insufficient to maintain their ecological requirements. These events in the Delta reach are known to be fueled by the progressive formation and release of ice jams in what are called "javes" (Beltaos 2007). Thus, this mechanism is sensitive to changes in the Peace River's ice regime, particularly changes in the frequency and intensity of javes originating in the steeper Smoky to Carcajou reach, 100 to 470 km downstream of the proposed dam (Beltaos 2007). To support an impact assessment, an analysis should be conducted (Baseline Case) that describes the baseline ice regime (including Site C and excluding Dunvegan), determines the nature and frequency of associated javes able to reach the Delta reach, identifies the expected role of these javes in creating ice jams in the Delta reach, and provides an assessment of PAD recharge resulting from this mechanism. This assessment should include consideration of a range of climate change scenarios and future time periods. **<u>References</u>** Beltaos S 2007. The role of waves in ice-jam flooding of the Peace-Athabasca Delta. *Hydrological Processes* 21:2548-2559.

Outcome	a) Include a new clause within the new ice grouping of section 6.1.4 as follows: "Describe how the baseline Peace River ice regime influences the nature and quantity of ice-related hydrologic recharge of the Peace-Athabasca Delta and explicitly evaluate the role of javes. Assess recharge quantitatively including consideration of future climates."

#14. New Section within Section 6.2 Addressing Impacts to Ice Formation and Break-Up	
Guideline	Predicted Changes to the Physical Environment: Section 6.2
Background & Rationale	The morphology and behaviour of the Peace River are shaped by the river's annual ice dynamics. It is well known from the legacy of BC Hydro's upstream hydroelectric facilities that freeze-up and break-up are modified greatly by the dams and understanding these impacts can be a complex scientific pursuit. The Draft Guidelines do not include a section examining ice-related impacts assessment information requirements. Impacts on ice formation and break-up processes due to hydroelectric dams can be extensive and affect downstream flooding in various forms including potential changes far downstream toward the mouth. A dedicated section should be present in section 6.2 with new content as laid out in items 15-21 below.
Outcome	a) Create an additional section within section 6.2 entitled "Ice Formation and Break-Up". Include in this section the recommended clauses as indicated in items 15-19 below.

#15. Implications of Two Ice Fronts	
Guideline	Predicted Changes to the Physical Environment: Section 6.2
Background & Rationale	In its current state, the Peace River experiences an ice front that grows upstream, passing through the proposed site of the Project en route to a maximum extent each winter. The warmer water associated with the Project would change this annual pattern, resulting in two ice fronts developing. One front would be the current ice front however its development would end downstream of the Project. The other front would initiate at the Project's reservoir and move upstream. These changes to the ice fronts and overall development of ice cover have important implications for flooding and other consequences of ice formation and break-up. Thus, they should be described and assessed within the EIS.
Outcome	a) Include a clause within the new ice section of section 6.2 (see item #14) as follows: "Discuss and assess the effects of the proposed dam with one ice front moving from downstream and approaching the structure, and a second ice front starting at the reservoir and moving upstream toward British Columbia."

#16. Modelling of River and Reservoir Thermal Regimes	
Guideline	Predicted Changes to the Physical Environment: Section 6.2
Background & Rationale	The Project would change the thermal regime of the Peace River with environmental consequences for freeze-up, flooding and other processes. The reservoir's thermal dynamics and the changes to the existing Peace River's thermal regime need to be modelled so that their importance and potential impacts to VCs can be understood.

Outcome	a) Include a clause within the new ice section of section 6.2 (see item #14) as follows: "Assess the change in thermal regime of the Peace River as a result of the Project and include a description of the thermal regime of the proposed reservoir."

#17. Changes to Ice Thickness and Ice Strength and Their Implications	
Guideline	Predicted Changes to the Physical Environment: Section 6.2
Background & Rationale	Ice thickness and strength are important factors that influence downstream ice dynamics which include flooding, ice-jams, javes and other behaviours which directly affect downstream VCs. These factors should be assessed and the assessment include a discussion of consequent ice dynamics and the effects of the changes on downstream VCs.
Outcome	a) Include a clause within the new ice section of section 6.2 (see item #14) as follows: "Assess the change in ice cover thickness and ice strength during freeze-up as a result of the Project and discuss the implications of these changes for other ice processes and affected VCs."

#18. Changes in Flooding due to Effects on Processes of Ice Formation and Break-Up	
Guideline	Predicted Changes to the Physical Environment: Section 6.2
Background & Rationale	As introduced in items 15-17, ice formation and break-up processes will change with the Project due to changes in their formative fundamental processes. One important consequence is the resulting change in flooding dynamics resulting from (at least) changes in flooding type, magnitude, location, and timing. Changes in ice thickness can lead to changes in ice competence and thus a change in the likelihood of mechanical versus thermal break-up which exercises a strong influence on flooding dynamics. The thermal regime that the Project will bring about in the river would play a large role in re-shaping ice extent which also affects flooding dynamics. The Smoky River tributary downstream of the Project location plays an important role in shaping break-up and flooding in the Peace River and warrants careful assessment in relation to Project impacts to ice formation and break-up processes.
Outcome	a) Include a clause within the new ice section of section 6.2 (see item #14) as follows: "Discuss the potential for additional ice generation as a result of the Project and evaluate the effect of additional ice cover on the typical spring break-up processes for the Peace and Smoky Rivers." b) Include a clause within the new ice section of 6.2 (see item #14) as follows: "Assess the cumulative impacts of the Project on ice formation and break-up processes in the Peace River down to the mouth." c) Include a clause within the new ice section of section 6.2 (see item #14) as follows: "Describe changes to flood potential downstream of the Project due to ice jams and break-up down to the mouth and include consideration of javes and their role in ice-jam formation and flooding."

#19. Assessment of Change in Ice-Related PAD Hydrologic Recharge	
Guideline	Predicted Changes to the Physical Environment: Section 6.2
Background & Rationale	As introduced in item #5, ice-jams are the third mechanism that bring water from the Peace River into the PAD. As summarized in item #13, of the three mechanisms, it is the ice-related one that can recharge the PAD's high-elevation basins. This recharge of "perched" basins can come about as a result a rapid rise in stage of the Peace River due to ice jamming in the Delta

	reach. Without such major ice-jam events, the perched basins receive recharge only through precipitation which is far insufficient to maintain their ecological requirements. These events in the Delta reach are known to be fueled by the progressive formation and release of ice jams in what are called "javes" (Beltaos 2007). Thus, this mechanism is sensitive to changes in the Peace River's ice regime, particularly changes in the frequency and intensity of javes originating in the steeper Smoky to Carcajou reach, 100 to 470 km downstream of the proposed dam (Beltaos 2007). An analysis should be conducted (Application and Planned Development Cases) that determines the potential changes in PAD recharge due to potential changes in the ice regime, determines potential changes in the nature and frequency of associated javes able to reach the Delta reach, identifies the expected role of these javes in creating ice jams in the Delta reach, and provides an assessment of resulting PAD recharge from this mechanism. This assessment should include consideration of a range of climate change scenarios and future time periods. **References** Beltaos S 2007. The role of waves in ice-jam flooding of the Peace-Athabasca Delta. *Hydrological Processes* 21:2548-2559.
Outcome	a) Include a clause within the new ice section of 6.2 (see item #14) as follows: "<u>Quantify the effect of changes to the Peace River ice regime on the amount of ice-related hydrologic recharge of the Peace-Athabasca Delta and explicitly evaluate the role of javes. Assess recharge quantitatively including consideration of future climates.</u>"

2.3 Fluvial Morphology and Sediment Transport

#20. Assessment of Impacts to the Baseline Regime for Fluvial Morphology and Sediment Transport	
Guideline	Predicted Changes to the Physical Environment: Section 6.2
Background & Rationale	The Project will introduce long-term changes to sediment supply and transport within the Peace River, including the section downstream of the dam. Such changes to the sediment regime have the potential to alter the morphology of the river affecting a wide range in river attributes including flooding. The only direct requirements within the Draft Guidelines relating to fluvial morphology and sediment transport are found in the second bullet of section 6.2.2: "Changes to the hydrological and hydrometric conditions *including instream conditions*" (emphasis added). It is suggested that a section entitled "Fluvial Morphology and Sediment Transport" be created and include a range of clauses relating to a description of the baseline regime and addressing the various ways in which the Project may impact it.
Outcome	a) Create an additional section within section 6.2 entitled "Fluvial Morphology and Sediment Transport". Include in this section requirements to describe the historic pre-regulated regime, the baseline regulated regime of the Peace River and its significant tributaries, impacts to the baseline regime from the Project, consideration of climate change, and any consequences of these changes for downstream flooding to the mouth of the Peace River. Requirements should be included such that any predictive models used in the assessment will be fully described in a level of detail similar to that required for the hydrologic, hydraulic, and ice-related models.

3.0 CONCLUSION

This review has identified 20 revisions to CEAA's Draft Guidelines for the Preparation of an Environmental Impact Statement for the proposed Amisk Hydroelectric Project on the Peace River in northwest Alberta. If implemented in CEAA's final Guidelines for this project, these revisions would enable Mikisew Cree First Nation and Athabasca Chipewyan First Nation to better identify how the Project may affect their interests. Some of the revisions should also provide general improvements to the EIS structure and content.

4.0 REFERENCES

AHP Development Corporation 2015. *Amisk Hydroelectric Project Information Brochure*, 9 p.

CEAA (Canadian Environmental Assessment Agency) 2015. *Draft Guidelines for the Preparation of an Environmental Impact Statement - Amisk Hydroelectric Project*, 34 p.

Prepared by:

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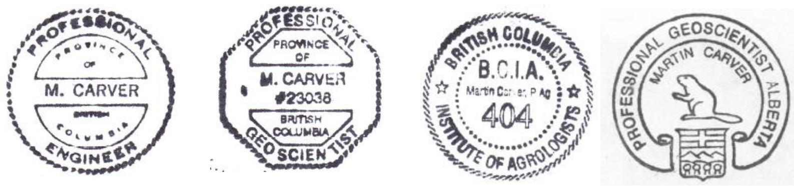

January 25, 2015
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