SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 6

PREAMBLE: MNP breaks down its analysis into three Valuable Environmental Components (VECs), namely Lake Sturgeon, Caribou, and Other At-Risk Fauna.

QUESTION:

Please reconcile your selection of VECs to the VECs identified in the Environmental Impact Statement (EIS) for Keeyask.

RESPONSE:

MNP has selected a subset of VECs to evaluate in an effort to bound our analysis and report to a manageable level for the NFAT Panel and to provide the Panel with a summary of the most significant impacts that should be considered based on expansive studies undertaken as part of the CEC process and others. Given that water regime was a discrete area of focus and some aspects of habitat change are also considered, we selected Sturgeon, Caribou and Other At-Risk Fauna as representative and highly valued elements of the local ecosystem.

The EIS for Keeyask defines VECs as "fundamental elements of the physical, biological or socio-economic environment, including the air, water, soil, terrain, vegetation, wildlife, fish, birds and land use that may be affected by a proposed project". Overall value and importance to people and importance to regulatory agencies and regulatory requirements are high on the list of evaluation criteria for broad components such as the terrestrial and aquatic environment.

The selection process is largely qualitative in nature and VECs can be broad (wetland function) or discrete (Caribou). The Keeyask EIS studied a full range of possible categories and 18 biophysical VECs were selected:

Ecosystem diversity, intactness, wetland function, priority plant, Canada goose, Mallard, Bald eagle, Olive-sided flycatcher, Common nighthawk, Rusty blackbird, Caribou, Moose, Beaver, Water quality, Lake sturgeon, Walleye, Northern Pike, Whitefish.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 9

PREAMBLE: MNP states that:

"It is unclear if the impacts of seasonality changes attributable to alternate climate change futures have been strongly considered and incorporated into development plan evaluation.

It is unclear if climate change and the severity of increased drought risk have been adequately considered."

QUESTION:

Please explain the nature of the uncertainty and its impact on the economic/financial evaluation.

RESPONSE:

Manitoba Hydro states that its analysis of climate change impacts, namely increased precipitation, have been evaluated assuming a uniform percentage increase in annual precipitation. Given the seasonal nature of demand, exports and of operating the hydro system in general, we believe it would be more appropriate to include the expected seasonal changes attributable to climate change as part of its full water resources and economic modelling.

Manitoba Hydro states that drought risk has been modeled by implementing the 50 year historic drought ranges over key years during the projects' lifecycles. Climate change science suggests that weather occurrences will become more severe and potentially longer in duration. Therefore, longer more severe drought conditions from the historic record should have been evaluated.

Detailed system modelling would be required to determine the economic and financial ramifications of these risk factors. Directionally, in events of longer, more severe drought, less energy would be available for domestic load and therefore export, having a negative effect on overall economics of the projects.

SUBJECT: Macro-Enviornmental

REFERENCE: MNP Report, page 9

PREAMBLE: MNP states that "We believe that analytic emphasis should be placed on sensitivities of alternative scenarios that take into account the following:

- Annual precipitation expected to increase between 6% and 8.7%, but not in a uniform manner.
- Total annual water availability will increase. However, seasonal precipitation will increase mostly in the late winter and spring.
- Increased average temperatures will lead to greater evaporation.
- Severe weather is expected to increase, thereby increasing the frequency and severity of drought years.
- Temperature increases will impact Manitoba by decreasing the domestic heating load in winter, but increasing the domestic and export peak cooling load in summer.

QUESTION:

Please describe the implications, to Manitoba Hydro, of precipitation increasing primarily in late winter and spring but evaporation increasing in the summer? For example, could this change reservoir size needs? Has Manitoba Hydro considered this issue?

RESPONSE:

It is believed that these forces (should they occur in the long term) could have impacts on reservoir conditions (particularly for LWR) and water availability during specific seasonal periods. Increasing reservoir size to store more resource during the shoulder months could be a plausible solution. Detailed resource and system modelling would be required to determine the full implications. It is unclear from the NFAT filing whether this modelling has been completed.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 9

PREAMBLE: MNP states that "We believe that analytic emphasis should be placed on sensitivities of alternative scenarios that take into account the following:

- Annual precipitation expected to increase between 6% and 8.7%, but not in a uniform manner.
- Total annual water availability will increase. However, seasonal precipitation will increase mostly in the late winter and spring.
- Increased average temperatures will lead to greater evaporation.
- Severe weather is expected to increase, thereby increasing the frequency and severity of drought years.
- Temperature increases will impact Manitoba by decreasing the domestic heating load in winter, but increasing the domestic and export peak cooling load in summer.

QUESTION:

Since Manitoba is currently a winter-peaking market, would decreasing winter demand and increasing summer demand reduce peak capacity needs compared to total energy demand? Has Manitoba Hydro adequately considered this issue?

RESPONSE:

Direct climate change impacts in the long term are likely to result in a decreasing winter peak and increasing summer demand that moves closer to system peak. Therefore, system peak capacity needs could be tempered. It is unclear if Manitoba Hydro has considered this issue fully.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 9

PREAMBLE: MNP states that "We believe that analytic emphasis should be placed on sensitivities of alternative scenarios that take into account the following:

- Annual precipitation expected to increase between 6% and 8.7%, but not in a uniform manner.
- Total annual water availability will increase. However, seasonal precipitation will increase mostly in the late winter and spring.
- Increased average temperatures will lead to greater evaporation.
- Severe weather is expected to increase, thereby increasing the frequency and severity of drought years.
- Temperature increases will impact Manitoba by decreasing the domestic heating load in winter, but increasing the domestic and export peak cooling load in summer.

QUESTION:

Conversely, has Manitoba Hydro considered the impact of less summer surplus electricity being available for export? Has this factor been adequately addressed in the NPV analysis for the proposed alternatives? If not, please indicate the impact directionally.

RESPONSE:

As noted in our answer to IR PUB-MNP-003a, it is unclear if the seasonality of climate change impacts and their relation to management of the Manitoba Hydro system has been adequately considered. Therefore, the linkage between this potential impact and summer surplus electricity availability does not appear to have been addressed in the NPV analysis.

If less water resource and therefore surplus energy is available during key summer periods, there will be less potential to capture peak export revenues in US markets. NPV is likely to be reduced in this scenario.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 10

PREAMBLE: MNP states that "conservative analysis suggests only modest increases in the availability of water on the Nelson system for generation purposes with the potential for net aridity during important peak exporting periods."

QUESTION:

Please state what analysis was performed, and by whom.

RESPONSE:

In linking our findings to the analysis of the IISD (as referenced in our report), we believe it conservative to consider modest increases in annual water availability and the potential for increasing aridity during the summer peak exporting period. The Institute for Sustainable Development report titled "*Climate Change Impacts in Manitoba"* (2007), was reviewed.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 11

PREAMBLE: MNP states that there is a possibility for increased demand for water during summer for other uses (agricultural).

QUESTION:

Has MNP formed any analysis as to the impact of such increased demand on Nelson River water availability for generation?

RESPONSE:

No. This is a generalization indicating that as summers become hotter and more arid, competing uses for water resources are likely to increase in magnitude. We are identifying a possible risk that should be further considered.

SUBJECT: Macro-Enviornmental

REFERENCE: MNP Report, page 14

PREAMBLE: MNP quotes the greenhouse gas emissions projected by MH for the Preferred Development Plan and alternative plans.

QUESTION:

Does MNP agree with Manitoba Hydro's quantification of projected greenhouse gas emissions? If not, please file a comparison table.

RESPONSE:

GHG emissions related to Manitoba Hydro's operations, as part of the PDP, are quantified in a reasonable manner at the plant level using emissions intensities commensurate with what we would expect. We found no reason to recalculate these emissions.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 15

PREAMBLE: MNP states that "greater natural gas generation included in alternative plans could face carbon pricing penalties decreasing the margins they could earn in export and domestic markets."

MNP further states that "Generally, consensus exists with the six consultants that Canadian national policy will align with the US on market-based approaches in order to achieve objectives relating to emission reductions and to ensure the trading approach is economically viable and functionally harmonized."

QUESTION:

Does MNP foresee a situation in which a carbon price is implemented in the U.S. but not in Canada? What is MNP's assessment of the likelihood of this happening?

RESPONSE:

No. We believe that if carbon is monetized through market-based mechanism in the US at a federal level, Canada will be compelled to harmonize.

It is possible that Canada implement other regulatory approaches before the US implements climate policy. In this scenario, natural gas generation could be directly penalized through a performance standard or carbon tax and it may be the case that a broader cap and trade type program is not implemented. However, the effects on natural gas generation variable costs would be similar.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 15 -16

PREAMBLE: MNP states that "greater natural gas generation included in alternative plans could face carbon pricing penalties decreasing the margins they could earn in export and domestic markets."

MNP further states that "Generally, consensus exists with the six consultants that Canadian national policy will align with the US on market-based approaches in order to achieve objectives relating to emission reductions and to ensure the trading approach is economically viable and functionally harmonized."

QUESTION:

If the answer to (a) is no, then please confirm that in light of MNP's comment on page 17 of its report that "no environmental value is likely placed on non-emitting generation until the mid part of the next decade", Manitoba Hydro should not expect any domestic carbon pricing or penalties until then either. If not, please explain.

RESPONSE:

Manitoba Hydro could still expect incremental costs related to GHG emissions in a scenario where no environmental value is placed on non-emitting generation. In our Base Case, we do not assume broad-based carbon pricing until 2021 and in our low case, 2030.

However, it is possible that Canadian federal direct regulation, setting performance standards on natural gas-fired generation is implemented before 2021, placing an incremental cost on natural gas fired generation.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 16

PREAMBLE: MNP cites various U.S. renewable portfolio standards.

QUESTION:

Please advise whether under those standards, Manitoba Hydro electricity generated through the PDP would qualify for those standards if exported into the adjacent MISO region.

RESPONSE:

In North Dakota, Minnesota and Wisconsin, out of state hydropower is eligible under the respective RPS programs for LSEs to meet standards. Typically, regional renewable energy tracking systems such as M-RETs record and verify renewable energy certificates (RECs) for the purposes of trading environmental attributes. Manitoba Hydro generation would have to register on these systems.

For hydro, specific requirements must typically be met.

North Dakota - Hydro facilities must have an in service date in 2007 or later to qualify. Out of state hydro generation is eligible and must be independently verified.

Minnesota - Hydro facilities 100 MW or less are eligible to produce RECs towards the RPS.

Wisconsin - Starting in 2015, large hydro (more than 60 MW) is eligible if commercial operation began in 2010 or later. Manitoba Hydro generation is specifically identified as eligible.

For further information about specific RPS programs, see DESIRE - the DOE Database of State Incentives http://www.dsireusa.org/

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 26

PREAMBLE: MNP uses pulverized coal combustion and coal with carbon capture storage as comparison technologies.

QUESTION:

Please confirm that it is MNP's understanding that both of these technologies would be prohibited by section 16 of The Climate Change and Emissions Reductions Act of Manitoba. If not, please explain.

RESPONSE:

Our understanding is that combustion of coal is prohibited in Manitoba for electricity generation purposes by section 16 of The Climate Change and Emissions Reductions Act.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 27

PREAMBLE: MNP provides a table detailing the life cycle emission intensity for various alternatives.

QUESTION:

Please file a revised table that includes the Intergovernmental Panel on Climate Change (IPCC) 2012 hydropower estimates as well as Life Cycle Analysis (LCA) assessments for the Preferred Development Plan (PDP).

RESPONSE:

LCA assessments were prepared for the Keeyask project itself and on a technology basis only for life cycle emissions comparison purposes. The Keeyask LCA has been filed with the PUB. It is our understanding that the LCA for the Conawapa generation project is currently being completed.

See below for IPCC LCA table including hydro:

Life Cycle Emission Intensity (t CO_2e / GWh)[1]

Technology	Keeyask LCA Median	IPCC Report Minimum	IPCC Report Median	IPCC Report Maximum	MNP Assessment
Pulverized Coal Combustion (PCC)	**975**	675	**1001**	1689	IPCC median values reported for coal are aligned with the Pembina Report (IPCC +3%).
Coal with Carbon Capture and Storage (CCS)	**183**	98	**N/A**	396	Pembina reported values are within the range of minimum and maximum values and the two reports are aligned overall.
Natural Gas Combined/ Single Cycle	**509/764**	290	**469**	930	This includes both single cycle and combined cycle natural gas plants. Thus, the difference between minimum and maximum values is substantial. Overall, both single and combined cycle natural gas reported values are aligned and within the ranges outlined by IPCC.
Wind (Larger than 100 MW)	**13**	2	**12**	81	IPCC and Pembina values are strongly aligned for wind technologies. Pembina's median value is only 1 tonne higher than the IPCC's median value.
Nuclear	**15**	1	**16**	220	IPCC and Pembina values are strongly aligned for nuclear technologies. Pembina's median value is only 1 tonne lower than the IPCC's median value.
Hydropower	**2.46**	0	**4**	43	Keeyask life cycle emissions fall within the IPCC range. Keeyask life cycle emissions are aligned with the median values reported by IPCC. MNP further notes that Keeyask has been designed to reduce reservoir flooding, which is a significant contributor to life-cycle emissions of hydropower.

[1] Special Report of Intergovernmental Panel on Climate Change (IPCC). *Renewable Energy Sources and Climate Change Mitigation*. 2012. Accessed in 2013.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 27

PREAMBLE: MNP provides a table detailing the life cycle emission intensity for various alternatives.

QUESTION:

Please advise whether the IPCC assessment includes global emissions or is limited to local emissions.

RESPONSE:

By nature, life cycle analysis captures emissions resulting from a technology or project on a global scale within the defined boundaries of the analysis. Secondary emissions associated with materials manufacture for example, may occur in other countries, distant from where direct emissions associated with operation of the project occur.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 34

PREAMBLE: MNP applies a risk premium of 2.53% to its NPV calculations.

QUESTION:

Please explain how this number was arrived at.

RESPONSE:

The climate policy landscape is highly uncertain and often volatile within and across administrations. A greater risk premium is necessary to capture this policy uncertainty, specifically as it applies in our climate change policy analysis.

A 50% probability is a reasonable estimate of the likelihood of comprehensive carbon pricing. We therefore increased the discount rate used in the NFAT filing by 50% (5.05% x 1.50) to reflect policy uncertainty, relational to the market risk already embedded in Manitoba Hydro's discount rate for economic analysis.

SUBJECT: Macro-Enviornmental

REFERENCE: MNP Report, page 35

PREAMBLE: MNP states that "Preferred plan carbon value is approximately $446M higher than the MH base case, which results in an increase in the total PV of revenues for the preferred plan to $6,794M."

QUESTION:

Please prepare a column for the PDP, similar to the column in the "quilt" at Table 10.4 of the NFAT filing, comparing the NPV for the project as calculated by Manitoba Hydro for the various scenarios to the NPV as determined by MNP based on the revised base case carbon value.

RESPONSE:

We are unable to compare the NPVs of the preferred and alternative plans under MNP carbon price scenarios directly. We have not calculated the NPVs for each plan relative to Manitoba Hydro's quilt in table 10.4 of the NFAT filing as more dynamic modeling incorporating the impacts of carbon prices on demand elasticity and other factors would be required.

The values represent what MNP would consider a proxy for the inherent value embedded in MH's export price revenue forecasts. The values were isolated by estimation.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 35

PREAMBLE: MNP states that "Preferred plan carbon value is approximately $446M higher than the MH base case, which results in an increase in the total PV of revenues for the preferred plan to $6,794M."

QUESTION:

Please explain how, directionally MNP's carbon price assumption would affect the NPV of the all-gas plan and scenarios compared to the PDP.

RESPONSE:

The NPV of all plans would benefit from MNP's carbon price trajectory. Given that Manitoba Hydro exports are lower in overall emissions intensity regardless of the plan in comparison to importing markets, a higher carbon pricing trend would equate to greater value across any development plan.

Directionally, the all-gas plan would capture less increase in NPV in comparison to the PDP since the PDP drives Manitoba Hydro's emissions intensity lower by comparison. Please refer to response to PUB-MNP-041c for more details.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 41

PREAMBLE: MNP states that "Keeyask may cause higher nutrient levels in surface water."

QUESTION:

Please explain your reasoning for this statement, and clarify whether this only applies to the initial construction process or to long-term operation as well.

RESPONSE:

Manitoba's Water Strategy calls for protection and enhancement of aquatic ecosystems by ensuring surface and groundwater quality is adequate for all designated uses and ecosystem needs. It recognizes that some surface waters contain elevated nutrients currently. In the case of Keeyask, Manitoba Hydro has stated that during construction, increased levels of Total Suspended Solids (TSS) levels are expected during in-stream construction, with the largest increases occurring immediately downstream of construction. During operation, Manitoba Hydro expects short-term increases in TSS, nutrients, metals organic carbon and other materials. They also expect dissolved oxygen will decrease during ice cover.

The most significant effects to water quality (increased TSS nutrients and metals and decreases in clarity) will occur in the areas which will be flooded, lasting for the first 10-15 years and being at their highest following impoundment, when the most material would be available for decomposition and peat re-surfacing and breakdown will be greatest.

Sources:

Keeyask Generation Project Environmental Assessment Summary. Cumulative Effects Assessment Summary, pg. 34.

Ms. Schneider-Vieira. Keeyask Generation Project Public Hearing. Volume 6: Transcript of Proceedings, October 29, 2013. Manitoba Clean Environment Commission. Pg 49.

SUBJECT: Macro-Enviornmental

REFERENCE: MNP Report, page 42

PREAMBLE: MNP states that "Flooding poses a serious threat by eroding and destabilizing shorelines, eliminating wetland habitats and natural, seasonal fluctuations."

QUESTION:

Does MNP generally agree with the extent of flooding as described by Manitoba Hydro in the NFAT filing? If not, please elaborate.

RESPONSE:

Yes. We generally agree with the extent of flooding described by Manitoba Hydro in the NFAT filing.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 45

PREAMBLE: MNP states that "It has also been reported that the color and smell of the water has changed and water is no longer clean enough to drink."

QUESTION:

Does MNP have any information that the water quality in the Nelson River at the proposed site is significantly different from the water quality in Lake Winnipeg?

RESPONSE:

Anecdotal evidence suggests that water quality at times may be lower in the Lower Nelson as a result of Manitoba Hydro operations than in Lake Winnipeg. Reports of increased debris and discolouration are common in literature searches and other regulatory process documentation such as the Cree Nations Partners Environmental Evaluation Report and others such as the following document produced by the TCN:

Post Project Environmental Review Analysis of Change - http://www.tataskweyak.mb.ca/HISTORY/analysispdf/analysiscomplete.pdf

Of note, water quality testing was conducted in 2009 for Manitoba Hydro. These baseline conditions as reported are summarized in the following document:

Water Quality Data for the Lower Nelson River System - http://keeyask.com/wp/wp-content/uploads/2013/07/Water-Quality-Data-for-the-Lower-Nelson-River-System-Manitoba-20092.pdf.

In addition, multiple studies have been conducted on water quality changes in along the Nelson River system. The Environmental Impact Statement for the Keeyask Generation project states

that "the available information indicates that conditions (in Stephens Lake) have notably changed since the 1970s and the north arm is now considerably more nutrient-poor than the southern main stem of the lake or the lower Nelson River."

Source: Appendix 2E: **Assessment of Changes in Water Quality in Stephens Lake since 1972**. Environmental Impact Statement, Supporting Volume: Aquatic Environment. June 2012. http://keeyask.com/wp/wp-content/uploads/2012/07/2.-Keeyask-AE-SV-Water-and-Sediment-Quality_appendices-2E-2.pdf

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 45

PREAMBLE: MNP states that "Operation may also be constrained if monitoring shows lake sturgeon eggs are deposited downstream of the spillway, which may necessitate its continued operation until the eggs have hatched even if spilling is no longer required for operational purposes."

QUESTION:

Does MNP have any estimate as to how such a situation would affect Keeyask's production capacity, especially in light of the one-metre operating range for Keeyask? Can MNP provide an example of possible constraints and the impacts on operations and profitability of Keeyask?

RESPONSE:

MNP does not have a quantitative estimate on how continued operation of the spillway to facilitate hatching of lake sturgeon eggs would affect Keeyask's production capacity. However, if the reservoir were to be spilled in a continuous manner until it reaches the lower operating range limit, energy production opportunities may be lost as a result during the spilling.

We anticipate spillway operation will not have a significant affect since Keeyask can only operate within the one-metre range. According to the Hydropower Sustainability Assessment, possible constraints would include the prescribed operating license requirements, Keeyask's limited reservoir storage capacity and one-metre operating range.

If the operating range on the low side is exceeded, which according to Manitoba Hydro is highly unlikely, profitability of Keeyask could also be impacted because Adverse Affects Agreements include provisions for a pre-determined amount of compensation should the operating range be breached.

SUBJECT: Macro-Environmental

REFERENCE: N/A

PREAMBLE: MNP states that "Operation may also be constrained if monitoring shows lake sturgeon eggs are deposited downstream of the spillway, which may necessitate its continued operation until the eggs have hatched even if spilling is no longer required for operational purposes."

QUESTION:

Please comment on possible Conawapa impacts similar to (a).

RESPONSE:

MNP does not have an estimate of how much continued spilling as part of sturgeon impacts mitigation would affect Conawapa's production capacity.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 46

PREAMBLE: MNP discusses the management of Split Lake as an impact mitigation measure.

QUESTION:

How could this affect generation capacity of Keeyask or any other Nelson River generating station?

RESPONSE:

On page 46 of the report, MNP is discussing direct impacts to Split Lake. Specifically, the combined effects of the Keeyask reservoir and management of LWR and CRD are expected to result in no impacts to Split Lake according to Manitoba Hydro. Therefore, Manitoba Hydro expects nothing in direct relation to Split Lake to affect generating capacity at Keeyask.

However, there is evidence of flooding in and around Split Lake that has raised concerns for the Split Lake communities that further water regime alteration could result in further flooding. The need for Keeyask to open its spillway more often than planned is a reasonable scenario. To ensure no incremental flooding events at Split Lake, Manitoba Hydro may be required to use stored resources during unexpected or less desirable periods for export sales.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 46

PREAMBLE: MNP discusses the sediment management plan as a mitigation measure.

QUESTION:

In MNP's view, what is the financial or operational risk if there are issues with sediment levels?

RESPONSE:

Section 4.4.1 of MNP's report provides a summary of the anticipated impacts of sedimentaton during operations. The UNESCO report titled *"Sediment Issues & Sediment Management in Large River Basins: Interim Case Study Synthesis Report"* concludes that build of sediment upstream of a dam may result in significant costs for hydropower operations. They report dredging or other costly engineering solutions are often required to remove excess sediment or clogging and allow full flow of water. Abrasion of machinery may also occur, creating additional maintenance costs. The build up of sediment in front of power intakes also can cause issues downstream of the dam, including widening and deepening of river channels and accelerated erosion around infrastructure.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 52

PREAMBLE: MNP states that "The preferred plan could lead to conflict with the objectives of SARA in the long-term" due to impact on woodland caribou.

QUESTION:

What is the risk of operating restraints being placed on Keeyask or Conawapa due to the Species At Risk Act (SARA) once the projects have been built? How could this affect generating capacity and NPV?

RESPONSE:

SARA sets the requirement for operating permits to be approved by the competent minister for any activity with the potential to affect listed species. Once a species is listed under the SARA, it becomes illegal to kill, harass, capture or harm it in any way. Critical habitats also become protected from destruction. The Act requires that recovery strategies, action plans and management plans be developed for all listed species. Regulations governing the recommended duration of permits are still under development.

Considering the above, if the woodland caribou is listed, it is possible that a permit or renewal may not be awarded, which could restrain operation of Keeyask and/or Conawapa for a period of time and therefore reduce the expected NPV. The permit application notes that permits may be issued if all reasonable alternatives to the activity have been considered, all feasible measures to minimize impacts have been taken and if the activity will not jeopardize the survival or recovery of the species in the minister's opinion.

Given the mitigation strategies expected to be employed by MH, there is likely a low risk that operating restraints significantly impacting generating capacity will become a reality.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 56

PREAMBLE: MNP states that "Lake Sturgeon is culturally and spiritually important to the Cree Nations and they hold special status as a heritage species in Manitoba."

QUESTION:

Please describe the cultural and spiritual importance of lake sturgeon.

RESPONSE:

It is recognized in the Manitoba Lake Sturgeon Management Strategy (2012) that First Nations have traditionally harvested lake sturgeon and that a continued subsistence harvest is considered to be sustainable.

The Cree Nation Partners EER notes that sturgeon is a characteristic food of the First Nations distinctive culture and that the sturgeon, among other ecosystem elements, is integral to that culture.

The FLFN EER also notes that *"Sturgeon is a culturally important species for our people and there is a concern among Members that another population decline may be observed with further hydro development."*

According to the FLFN EER, as with all things, the protection of *"Aski"* and the holistic health of the lands and waters (including Sturgeon) is critical to the spiritual belief that *"everything is connected."*

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 56

PREAMBLE: MNP states that "Lake Sturgeon is culturally and spiritually important to the Cree Nations and they hold special status as a heritage species in Manitoba."

QUESTION:

What protections, if any, flow from lake sturgeon's status as a heritage species?

RESPONSE:

Since 1992, Manitoba has developed a Lake Sturgeon Management Strategy that includes:

- Conservation Closures on part of the Nelson River and the Winnipeg River to prevent further depletion of stocks that had become critically low.
- Fisheries Branch has remained involved in assessing lake sturgeon stocks and working with other parties.
- Sturgeon are currently protected through limited fishing. Sport fishing is strictly catch-and-release.
- There is no commercial harvest of sturgeon. Only First Nations can harvest sturgeon in Manitoba. Many First Nation communities are part of sturgeon management boards focused on protecting and conserving the remaining sturgeon populations.

These factors play a role in COSEWIC evaluation and the potential for listing on SARA.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 57

PREAMBLE: MNP believes there could be greater risk with respect to fish mortality and injury than identified in the NFAT, and discusses mitigation strategies.

QUESTION:

Has MNP reviewed any studies dealing specifically with injury to lake sturgeon? If so, please list and file the executive summaries of these studies.

RESPONSE:

Studies Listed in the EIS:

1. Anderson, Michael and Terry A. Dick. Review of reports dealing with Fish Mortality Studies and the Quantification of Fish Habitat for the Kelsey Re-runnering Project. http://www.cecmanitoba.ca/resource/hearings/39/KK-002%20Review%20of%20fish%20mortality%20studies%20for%20Kelsey,%20Terry%20Dick%20etal.pdf
2. North/South Consultants Inc. Survival and movement of fish experimentally passed through a re-runnered turbine at the Kelsey Generating Station, 2008 http://www.gov.mb.ca/waterstewardship/licensing/pdf/survival_movement_fish.pdf
3. Amaral, S.V. et al. 2008. Effects of leading edge turbine blade thickness on fish strike survival and injury. Hydro Vision, HCI publication, Number 250.
4. Amaral, S.V. et al. 2011. Designing leading edges of turbine blades to increase fish survival from blade strike. Alden Research Laboratory & EPRI, paper presented at EPRI Conference on Environmentally Enhanced Hydropower Turbines in Washington DC, May 2011.

5. Peake, S. J., Beamish, F. W. H., McKinley, R. S., Scruton, D. A., Katopodis, C. (1997). Relating swimming performance of lake sturgeon, Acipenser fulvescens, to fishway design. Canadian Journal of Fisheries and Aquatic Sciences, 54 (6), 1361 - 1366. http://dspace.hil.unb.ca:8080/handle/1882/32805

Other Studies:

1. McDougall, C. A., et al. "Movement Patterns and Size-Class Influence Entrainment Susceptibility of Lake Sturgeon in a Small Hydroelectric Reservoir." Transactions of the American Fisheries Society 142.6 (2013): 1508-1521. http://www.tandfonline.com/doi/full/10.1080/00028487.2013.815659

2. Amaral, Steve and Tim Sullivan. Downstream Passage for Lake Sturgeon. Presentation for Great Lakes Lake Sturgeon Coordination Meeting. ALDEN Research Laboratory, Inc. http://www.fws.gov/midwest/sturgeon/documents/glcoordmtg04/Amaral-TNCoordMtg04.pdf

3. Killgore, K.J., Maynord, S.T., Chan, M.D., and Morgan, R.P., II. 2001. Evaluation of Propeller-induced mortality on early life stages of selected fish species. N. Am. J. Fish. Manag. 21: 947-955.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 57

PREAMBLE: MNP believes there could be greater risk with respect to fish mortality and injury than identified in the NFAT, and discusses mitigation strategies.

QUESTION:

Please comment on the relative injury risk based on lake sturgeon size and age. Are there any disproportional risks to larger, more mature fish?

RESPONSE:

Fish small enough to enter the facility systems and come into contact with turbines, but large enough to be close to or above the 90 mm study threshold could be at significant risk of injury or mortality. Studies relied on as part of the EIS are not conclusive. Larger, slower moving fish species tend to have higher rates of injury. See Comprehensive studies investigating the probability of lake sturgeon injury and mortality relative to fish size are lacking (although the general rule is that vulnerability increases with fish size). EIS findings are based mostly on studies of other fish species. Larger fish tend to show mortality and injury rates much higher. See *Table 2 of Keeyask Generation Project EIS Aquatic Environment Supporting Volume, Appendix 1A-Part 1 Attachments*.

Source:

http://www.cecmanitoba.ca/resource/hearings/39/CAC-013%20Lake%20Sturgeon%20Mitigation%20at%20Keeyask-Concerns%20and%20Advice,%20(Presentation)%20S.%20Peake.pdf

Research has indicated that adult lake sturgeon can be expected to become entrained at Keeyask (McDougal et al. 2013) and that fish will be injured and killed.

Source:

McDougall, C. A., et al. "Movement Patterns and Size-Class Influence Entrainment Susceptibility of Lake Sturgeon in a Small Hydroelectric Reservoir." Transactions of the American Fisheries Society 142.6 (2013): 1508-1521.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 59

PREAMBLE: MNP states that "If protected under SARA, Keeyask and Conawapa could be significantly delayed or cancelled if issues cannot be addressed appropriately, depending on the requirements of the SARA listing on development projects. If the projects proceed, federal permits for the allowance of certain impacts would be required."

QUESTION:

What would be the potential outcome if lake sturgeon was added to the protected list once Keeyask and/or Conawapa are in operation?

RESPONSE:

SARA sets the requirement for operating permits to be approved by the competent minister for any activity with the potential to affect listed species. Once a species is listed under the SARA, it becomes illegal to kill, harass, capture or harm it in any way. Critical habitats also become protected from destruction. The Act requires that recovery strategies, action plans and management plans be developed for all listed species. Regulations governing the recommended duration of permits are still under development.

Fisheries and Oceans Canada (DFO) would develop a Recovery Strategy for Lake Sturgeon, followed by an Action Plan setting out the activities that would have to be undertaken to prevent harm to Lake Sturgeon and protect their habitat. If Manitoba Hydro (and, in the case of Keeyask, the partnership) wished to proceed with the Keeyask and/or Conawapa Projects, federal permits would have to be secured under the SARA in order to build and operate any new hydroelectric generating stations on the waterways where Lake Sturgeon were listed as endangered. The Keeyask and Conawapa Projects could be delayed or possibly cancelled if Lake Sturgeon is listed under SARA.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 59

PREAMBLE: MNP states that "If protected under SARA, Keeyask and Conawapa could be significantly delayed or cancelled if issues cannot be addressed appropriately, depending on the requirements of the SARA listing on development projects. If the projects proceed, federal permits for the allowance of certain impacts would be required."

QUESTION:

What would be the potential outcome if lake sturgeon was added to the protected list while the dam(s) were under construction?

RESPONSE:

According to Manitoba Hydro, SARA could impose restrictions on the potential development of the Keeyask and Conawapa Projects.

If Lake Sturgeon were to be listed under SARA, provisions would be implemented to protect individual fish and critical habitat. Fisheries and Oceans Canada (DFO) would develop a Recovery Strategy for Lake Sturgeon, followed by an Action Plan setting out the activities that would have to be undertaken to prevent harm to Lake Sturgeon and protect their habitat. If Manitoba Hydro (and, in the case of Keeyask, the partnership) wished to proceed with the Keeyask and/or Conawapa Projects, federal permits would have to be secured under the SARA in order to build and operate any new hydroelectric generating stations on the waterways where Lake Sturgeon were listed as endangered. The Keeyask and Conawapa Projects could be delayed or possibly cancelled if Lake Sturgeon is listed under SARA.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 59

PREAMBLE: MNP states that "If protected under SARA, Keeyask and Conawapa could be significantly delayed or cancelled if issues cannot be addressed appropriately, depending on the requirements of the SARA listing on development projects. If the projects proceed, federal permits for the allowance of certain impacts would be required."

QUESTION:

Please indicate the range of measures that may be required by MH under SARA, and which of those measures may delay the project or result in cancellation.

RESPONSE:

If listed, Manitoba Hydro will have to provide evidence in their operating permit application under SARA that all reasonable alternatives to the activity have been considered, all feasible measures to minimize impacts have been taken and that the activity will not jeopardize the survival or recovery.

MH already has substantial mitigation plans in place, particularly for lake sturgeon. It is at the Minister's discretion whether a permit will be approved with these considerations made.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 61

PREAMBLE: MNP discusses stocking as a mitigation measure.

QUESTION:

What is the expected capital cost, if any, to establish the necessary infrastructure for stocking, including a new hatchery, if necessary?

RESPONSE:

Manitoba Hydro did not provide the estimated capital costs for establishing the infrastructure for stocking or for a new hatchery.

Based on subsequent research, we found the following historical costs and estimates:

Hatchery	Location	Cost	Year Built
Grand Rapids Fish Hatchery - incubates walleye, whitefish and trout eggs.	Manitoba	$1.125 million[i]	Early 1970s
Wildrose Fish Hatchery - cold water hatchery - salmon and trout	Wisconsin	$33.6 million[ii]	2009
Chief Joseph Hatchery	Washington	$900K-$1.2M[iii]	2013
Lost Valley Fish Hatchery - warm/cool water culture facility	Missouri	$21 million[iv]	2000
Priest Rapids Hatchery	Washington	$15.7 million[v]	To be completed end of 2014

Proposed Facilities	Location	Estimated Cost	Completion Date
New cold water fish hatchery to address species of concern including lake sturgeon.	Wisconsin	~$20-$24 million[vi]	TBD
New cold water facility (part of French River Hatchery Updgrade Study)	Minnesota	$15-$25 million[vii] (not including land acquisition costs)	TBD

In addition to the hatchery and stocking program, KHLP will provide annual funding in support of mitigation and stewardship activities identified by the Committee formed by the Lower Nelson River Sturgeon Stewardship Agreement. The new additional base funding will commence at approximately $110,000 annually, one-third of which would come from the Project and will continue for 30 years.

[i] https://www.hydro.mb.ca/corporate/facilities/brochures/grand_rapids_1107.pdf
[ii] http://wsfr75.com/content/renovation-wisconsin%E2%80%99s-wild-rose-state-fish-hatchery
[iii] Grant County Public Utility District Hatchery Program Status. September 10, 2012
[iv] Inside Region 3, Special Edition - Division of Federal Aid Sport Fish and Wildlife Restoration Programs. "Preserving Our Hunting and Fishing Heritage". U.S. Fish & Wildlife Service. Pg 9.
[v] Grant County Public Utility District Hatchery Program Status. September 10, 2012
[vi] Executive Summary. Comprehensive Study of Wisconsin's Fish Propagation System. December 19, 2011. http://dnr.wi.gov/topic/fishing/documents/hatcheries/Volume1ExecSumm.pdf
[vii] http://files.dnr.state.mn.us/areas/fisheries/lakesuperior/HDR-Report.pdf

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 61

PREAMBLE: MNP discusses stocking as a mitigation measure.

QUESTION:

What is the expected annual operating cost related to stocking operations, including operation of the fish hatchery, that can be attributed to the PDP?

RESPONSE:

Maintenance and Operational Costs may include supplies and materials, electricity, fuel costs, and other contractual costs (such as egg take) the hatchery might incur[1].

Based on subsequent research, we found the following costs:

Hatchery	Cost	Notes
Estimate for a facility producing 5200 LBS of lake sturgeon annually.	Staffing**: $158,400 O&M: $60,000 Food*: $92,375 **Total:** $310,775 **Cost per fingerling:** $3.13	*Depends on type of diet **permanent and temporary Does not include costs associated with egg take
French River Hatchery[2]	$635,544 (2009) $627,885 (2010) $520,027 (2011)	

[1] Farrell, John M. Lake Sturgeon Population Enhancement as a Strategy for Improvement of Ecosystem Function and Controlling Invasive Species. 2009. http://www.nysturgeonfortomorrow.org/documents/Farrell09FEMRF_Final_Sturgeon_Report_2009_.pdf

[2] http://files.dnr.state.mn.us/areas/fisheries/lakesuperior/HDR-Report.pdf

15

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 61

PREAMBLE: MNP discusses stocking as a mitigation measure.

QUESTION:

Please confirm MNP'a understanding that even if a fish ladder will subsequently be constructed, Manitoba Hydro intends to continue with stocking measures. If not, please clarify.

RESPONSE:

Our understanding is that Manitoba Hydro would continue with stocking measures if and when a fishway is constructed, yes.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 64

PREAMBLE: MNP states that "MH plans to install a temporary, experimental catch and transport system and conduct studies of fish habitat and behavior for a minimum period of 3 years to determine the requirements for a more permanent fish passage system."

QUESTION:

Please provide the capital and annual operating costs for such a system, if available.

RESPONSE:

Based on subsequent research, the following cost estimates were obtained:

Passage System Locaton	Cost	Notes
Baker River Fish Passage	Capital: $4.5 Million[1] O&M: $288,267 annual	Cost for Major Modification of trap and transport system in 2008. Began operation of fish passage in 1958. Salmon and Trout.
Priest Rapids Fish Bypass	Capital $27.4 million[2] O&M: $4.2 Million annual[3]	Off-ladder Adult Fish Trap. No transportation. Will operate July to Mid-October each year. Completion expected 2014.
Mossyrock Dam Fish Passage	Capital: $4.5 million[4] O&M: $135,000 Cost of Tanker Truck will be $100,000 to $200,000	Include installation of electric barrier.

[1] Baker River Fish Passage http://www.pse.com/aboutpse/HydroLicensing/Documents/2010_Annual_Reports/100/BAK%20SA%20103%20Annual%20Report%202010.pdf

[2] http://www.grantpud.org/environment/fish-wildlife/fish-bypass

[3] Grant PUD. *Adult Fishways and Detection – Off-ladder Adult Fish Trap.* http://www.grantpud.org/environment/fish-wildlife/fish-survival/adult-fishways-and-detection

[4] Hells Canyon Complex http://www.idahopower.com/pdfs/Relicensing/hellscanyon/hellspdfs/techappendices/Aquatic/e31_02_ch09.pdf page 30-31

14

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 64

PREAMBLE: MNP states that "MH plans to install a temporary, experimental catch and transport system and conduct studies of fish habitat and behavior for a minimum period of 3 years to determine the requirements for a more permanent fish passage system."

QUESTION:

Please advise whether any of the capital costs for such a system can be salvaged if a fish ladder must subsequently be constructed.

RESPONSE:

Since during the initial period of operation, Manitoba Hydro will provide fish passage upstream by a trap and transport system. It is difficult to determine if any costs would be salvaged if they decide a fish ladder would be more appropriate for the permanent structure.

Manitoba Hydro has stated in their Response to EIS Guidelines (Section 4.5.1.5) that they will consider alternatives such as a fish ladder. However, plans for the design and location of a long term collection facility are in progress. Also, the project will be designed to accommodate another upstream and/or downstream fish passage option if required.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 64

PREAMBLE: MNP states that "MH plans to install a temporary, experimental catch and transport system and conduct studies of fish habitat and behavior for a minimum period of 3 years to determine the requirements for a more permanent fish passage system."

QUESTION:

Please elaborate on the measures that "must be taken to ensure any negative effects of this method of fish passage are mitigated as much as possible."

RESPONSE:

Catch and release of this nature can cause undue stress to individual fish. Various species respond differently. No evidence was available suggesting that this stress to lake sturgeon is well understood.

According to the *ASMFC Workshop on Fish Passage Issues Impacting Atlantic Coast States*, tagging, behavioural monitoring and population health studies will be required to determine the impacts of catch and release transport. Study of the habitat changes on successful breeding would also support the understanding of increased stress on the lake sturgeon population. However, it is unclear whether this would be possible.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 66

PREAMBLE: MNP references the operational cost of the Priest Rapids Dam of $4.2 million per year and expects the operational costs for a Keeyask fish way to be "something less."

QUESTION:

Please confirm that MNP expects the worst-case scenario for a fish way (fish ways at both Keeyask and Conawapa, maximum operating cost) to be combined annual operating cost of $8.4 million.

RESPONSE:

Based on the limited public data available, $8.4 million annually is a reasonable worst case scenario for fishways at both the Keeyask and Conawapa project.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 66

PREAMBLE: MNP references the operational cost of the Priest Rapids Dam of $4.2 million per year and expects the operational costs for a Keeyask fish way to be "something less."

QUESTION:

Please advise what components would form part of the operating cost.

RESPONSE:

Operational Costs of the fishway may include, but are not limited to, the following:

- Mitigation and Monitoring Activities
- Cultural Stewardship
- Water and Land Use Fees
- Staffing/Support (portion of HR, security, training)
- Fishway operations,
- Fishway transportation
- Fishway facility maintenance
- Fishway equipment maintenance
- Technology upgrades, as applicable
- Utilities and telephone/ telecommunication infrastructure

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 7

PREAMBLE: MNP discusses increased mercury levels in fish.

QUESTION:

Please advise whether mercury levels in fish are an inherent characteristic of waterpower development, and how one can mitigate against it.

RESPONSE:

Methylmercury levels tend to increase from new hydropower developments. Mercury biomagnifies in the food chain as a result of the anaerobic decomposition of biomass that exists where reservoir inundation occurs (newly flooded land). Mercury naturally occurs in the air, soil, sediment, vegetation and water bodies, but is mostly inorganic. Methylmercury is an organic form which poses danger to human health. Methylmercury levels in the environment are known to increase with the occurrence of hydroelectric development[1].

According to the Environmental Effects Summary Document for the Keeyask Generation Project (November 2012), concentration of mercury in fish is expected to increase after impoundment of the reservoir. Manitoba Hydro outlines a number of strategies including:

- A communication strategy and information materials providing recommended guidelines regarding the safe consumption of fish.
- Mercury levels in fish and other wildlife will be monitored and results shared with local users and health service provider

[1] Stokes P.M. and Wren, C.D. Chapter 16: Bioaccumulation of Mercury by Aquatic Biota in Hydroelectric Reservoirs: A Review and Consideration of Mechanisms. Lead, Mercury, Cadmium and Arsenic in the Environment. 1987. John Wiley & Sons Ltd. http://dge.stanford.edu/SCOPE/SCOPE_31/SCOPE_31_2.11_Chapter16_255-277.pdf

The following measures are suggested by the Institute for Environmental Studies, to mitigate mercury contamination in hydroelectric reservoirs:

- Removal of vegetation organic soil horizon from the area to be inundated prior to flooding;
- Addition of selenium to the water;
- Re-suspension of sediments to decrease mercury uptake by biota;
- Intensive fishing; and
- Control of erosion.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 74

PREAMBLE: MNP created a bubble chart to illustrate the intergenerational distribution of environmental effects.

QUESTION:

Why are water regime changes and ice regime changes listed as localized in time?

RESPONSE:

The chart is meant to indicate that water regime changes and ice regime changes are relatively equal in their impacts to present and future generations at the time of construction.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 74

PREAMBLE: MNP created a bubble chart to illustrate the intergenerational distribution of environmental effects.

QUESTION:

MNP refers to the future impact of climate change as being inequitable from an intergenerational perspective. Please confirm whether it is MNP's view that the current generation benefits from avoided or reduced GHG emissions.

RESPONSE:

To some extent; the current generation is impacted by climate change physical impacts and therefore also benefits from avoided GHG emissions to the extent both are occurring. However, on both accounts, future generations will experience greater impacts and could experience greater benefits if emissions reductions negate or reduce direct impacts. Note, if benefits draw future generations closer to the physical risk and economic baseline (as defined by the present) they may not benefit, so much as simply limit costs relative to the current generations.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 2

PREAMBLE: MNP has stated that "Based on MNP's GHG modeling and financial sensitivities analysis, there is potential upside in the present value of carbon premium derived revenues, should policies develop favorably. That said, there is tremendous uncertainty exists regarding the stringency and nature of carbon policy. There is risk that Manitoba's exports may derive little from their inherent environmental attributes."

QUESTION:

Please file MNP's modeling forecast or supporting documents related to the development of a carbon regime in the United States. Please provide a full description of the Carbon regime and costs forecast for Canada and US.

RESPONSE:

MNP has developed our carbon price forecast taking into account the expected future Canadian, US and regional carbon policies. A number of documents were reviewed to determine MNP's consensus direction on environmental policies as summarized in the following tables of our report:

- Page 15, ***Section 3.2.3: Canadian Perspective***
- Page 16, ***Section 3.2.4: Regional Perspective***
- Page 17, ***Section 3.2.5: US Perspective***

We have based our carbon price forecast on the MH consensus and independent consultants' forecasts, augmented by the Energy Information Administration's forecasting and by our view

of the probability and timing of climate change policy. No incremental direct or dynamic modeling was conducted to arrive at our conclusions.

The specific timing and stringency expectations of the source documents are protected as CSI. We have submitted pricing assumptions support through CSI protocol. Please refer to MNP responses to the following information requests: MH-MNP-009 and MH-MNP-018a.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 2

PREAMBLE: MNP has stated, related to sturgeon populations, that "There is some evidence that over the long-term, populations should recover and remain self-sustaining given the appropriate management by MH and its partners.

QUESTION:

Please file the referred to evidence in support of the assertion that Sturgeon population should recover and remain self-sustaining over the long-term.

RESPONSE:

Our review of Manitoba Hydro's mitigation plans and the NFAT filing led us to believe the increased population management activities will likely lead to a long term recovery of lake sturgeon. The mitigation measures being proposed as they stand contain gaps. However, Manitoba Hydro has stated they will monitor their efforts and adjust mitigation measures as necessary. In addition, stocking efforts initiated in the 1990's are now just beginning to show some results.

Further, if Lake Sturgeon are listed under SARA, Manitoba Hydro will be forced to implement measures to protect the sturgeon population.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 4, 37, 38 & 40

PREAMBLE: MPN has stated on page 4 of the report that "the impacts of Conawapa and its associated infrastructure are expected to be similar in nature and magnitude to those of the Keeyask project. MNP has also stated that Conawapa will flood significantly less land 5.1 KM versus 45 KM2 of new flooded land and 264KM of shoreline for Keeyask.

QUESTION:

Given the differences and nature of the affected areas related to Conawapa versus Keeyask explain how the magnitude of the impact of one project versus the other is similar.

RESPONSE:

Without detailed environmental impact review of the Conawapa project, we can only infer that differences attributable to the distinctive local water regime and each project's technical specifications, as well as nuances in the local ecosystems and wildlife populations will result in significantly different macro-environmental impacts.

Both projects include low amounts of total flooding. Their characteristics suggest that impacts to ecosystems and water regime will be similar in terms of impact to total ecosystem health and relative impacts to flora and fauna. Overall cost/benefit to emissions of the projects will be similar in magnitude.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 4, 37 to 40

PREAMBLE: MPN has stated on page 4 of the report that "the impacts of Conawapa and its associated infrastructure are expected to be similar in nature and magnitude to those of the Keeyask project. MNP has also stated that Conawapa will flood significantly less land 5.1 KM versus 45 KM2 of new flooded land and 264KM of shoreline for Keeyask.

QUESTION:

Please provide the information that supports the claim that the impacts of Conawapa will be similar to those outlined for Keeyask on pages 30 & 40

RESPONSE:

Without detailed environmental impact review of the Conawapa project, we can only infer that differences attributable to the distinctive local water regime and each project's technical specifications, as well as nuances in the local ecosystems and wildlife populations will result in significantly different macro-environmental impacts.

Both projects include low amounts of total flooding. Their characteristics suggest that impacts to ecosystems and water regime will be similar in terms of impact to total ecosystem health and relative impacts to flora and fauna. Overall cost/benefit to emissions of the projects will be similar in magnitude. Manitoba Hydro claims on their corporate website that “The environmentally conscious project would reuse water already stored and regulated through the Stephens Lake Reservoir, limiting the estimated flooding to 5 sq-km of land. The flooded land would fall almost entirely within the natural banks of the Nelson River.”

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 4, 37 to 40

PREAMBLE: MNP has stated on page 4 of the report that "the impacts of Conawapa and its associated infrastructure are expected to be similar in nature and magnitude to those of the Keeyask project. MNP has also stated that Conawapa will flood significantly less land 5.1 KM versus 45 KM2 of new flooded land and 264KM of shoreline for Keeyask.

QUESTION:

Please explain why detailed study of flow changes related to Conawapa was not made available.

RESPONSE:

Much of MNP's study of water regime impacts was drawn from the Keeyask EIS. A detailed EIS has not been completed for the Conawapa project, little information has been made publicly available regarding Conawapa and this information was not requested from Manitoba Hydro. MNP recognizes that water regimes at the two sites differ. Generally, impacts associated with flooding will be relative in scale to the smaller flooding area of Conawapa. Impacts associated with flow may be affected by topography (higher and steeper river banking) and the higher hydraulic drop.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 11

QUESTION:

Please indicate how the impact of climate change should be incorporated in MH's resource planning and economic modeling.

RESPONSE:

As described in answers to PUB-MNP-002 and PUB-MNP-003, specific risks of changes to seasonal water availability and increased severity of drought are associated with climate change scenarios.

Manitoba Hydro should therefore incorporate assumptions reflecting greater drought severity than in the historic record and seasonal water resource availability sensitivities commensurate with the expectation of dryer summers and wetter winters/early spring to best capture climate change scenarios in resource planning.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 11

PREAMBLE: MNP has stated: "Another important consideration is the expected increase in severity and frequency of drought. With longer and deeper drought periods expected, competing provincial uses for water resources could lead to little capacity for the MH system to export during extended periods of drought. This is especially important to consider as cumulative climate change impacts are anticipated to intensify in the later years of the 78 year planning horizon. This reflects the reality those future generations will be more severely impacted by the effects of climate change than present generations."

QUESTION:

To what extent is the anticipated cumulative climate change impact in the later years of the 78 year planning horizon currently reflected in the economic analysis? If not included, how should it be incorporated?

RESPONSE:

Our understanding is that cumulative climate change impacts are reflected in the economic analysis by assuming increased annual precipitation and analyzing sensitivities of historically consistent drought specifications during certain periods over the PDPs timeline.

Therefore, seasonality of precipitation and more severe drought assumptions are not captured. These details should be incorporated by Manitoba Hydro in our view.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 11

PREAMBLE: MNP has stated " MH considered climate change impacts in their economic modeling and adjusted scenarios to examine general impacts consistent with expected local futures. However, detailed analysis of the impacts of seasonally altered precipitation patterns and longer, more severe droughts were not considered explicitly."

QUESTION:

Please describe how MH considered climate change impacts in the economic modeling provided in the net present value analysis.

RESPONSE:

Please refer to response to PUB-MNP-036.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 11

PREAMBLE: MNP has stated "MH considered climate change impacts in their economic modeling and adjusted scenarios to examine general impacts consistent with expected local futures. However, detailed analysis of the impacts of seasonally altered precipitation patterns and longer, more severe droughts were not considered explicitly."

QUESTION:

How should MH adjust its current economic analysis to reflect more severe droughts?

RESPONSE:

According to the ICF report "*Independent Review of Manitoba Hydro Export Power Sales and Associated Risks",* prepared on behalf of Manitoba Hydro, drought is defined as "below average hydro conditions" for an extended period of time, typically measured as 3, 5 or 7 years (in extreme cases). At a minimum, sensitivities of +5%, +10% and +20% less water availability than the 50 year drought of record should be analyzed over longer periods than 7 years.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 13

PREAMBLE: MNP has stated that "MH's external policy view is developed based on a consensus of the forecasts provided by several expert independent consultants who specialize in policy analysis and energy markets forecasting. This consensus projection forms the basis of carbon pricing assumptions, which in turn impacts energy price projections in the electricity export market forecast, critical to the NPV analysis of the development plans."

QUESTION:

What are the implications directionally on MH's economic NPV analysis if the carbon regime envisioned does not develop in the next ten or twenty years?

RESPONSE:

If carbon pricing regimes do not develop as expected in MH's base case scenario, the NPV will be impacted. If carbon market prices are lower than expected and delayed in fruition, NPV will be impacted negatively in general direction. Electricity prices in export markets will be lower because there will be no cost penalty to low variable cost, fossil generation deflating the marginal supply cost curve. Inherently, no incremental environmental value will be placed on non-emitting hydro generation.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 13

PREAMBLE: MNP has stated that "MH's external policy view is developed based on a consensus of the forecasts provided by several expert independent consultants who specialize in policy analysis and energy markets forecasting. This consensus projection forms the basis of carbon pricing assumptions, which in turn impacts energy price projections in the electricity export market forecast, critical to the NPV analysis of the development plans."

QUESTION:

What factors would be in place to allow for the development of a carbon regime in the US and Canada as anticipated by MNP?

RESPONSE:

In the short term, the climate change policy discussion is not likely to continue meaningfully under the current US administration. Therefore, the next government cycle will have to start at a minimum. Broadly, a more stable political environment with respect to energy and environmental policy would need to exist. The economy would show strong signs of full recovery from the credit crisis and other key issues, such as the economy and health care, would not dominate resources of the legislative apparatus.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 27

QUESTION:

Please indicate what LCA value should be assigned to a modern CCGT versus SCGT rather than the median.

RESPONSE:

The IPCC report does not distinguish between CCGT and SCGT. Rather, it provides life cycle emissions data based on natural gas generation as a whole.

MNP performed research and analysis to identify specific new build plant emissions intensity values for modern CCGT and SCGT technologies:

- Combined Cycle Gas Turbine (CCGT) - 413 t CO2e / kWh
- Simple Cycle Gas Turbine (SGCT) - 557 t CO2e / kWh

New build plant emissions intensities are based on data from 34 facilities' actual emissions performance, augmented by technical specifications from EIA, NETL (DOE), EPRI and California Energy Commission data. ***MNP notes that these values reflect only direct power plant operating emissions and exclude natural gas production & distribution and construction & decommissioning emissions.***

In order determine a proxy for LCA emissions intensity values for modern CCGT and SGCT technologies, MNP augmented the new build plant emissions intensities by assuming the direct power plant operating emissions represent 75% of total life cycle emissions. The value of 75% was developed based on the National Renewable Energy Laboratory (NREL) report titled *"Life Cycle Assessment of a Natural Gas Combined-Cycle Power Generation System",* which outlined

that power plant operation emissions contribute 74.6% to the total life cycle emissions intensity values for a CCGT. The remaining 25.4% is attributable to natural gas production & distribution and construction & decommissioning life cycle phases.

Therefore, MNP outlines the following LCA values that we believe are representative proxies for modern CCGT and SCGT technologies:

- Combined Cycle Gas Turbine (CCGT) - 551 t CO2e / kWh
- Simple Cycle Gas Turbine (SGCT) - 743 t CO2e / kWh

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 34 & 35

QUESTION:

Please confirm whether the NPV of carbon included in MH's base case is based on a 5.05% discount rate, if not please indicate the NPV of carbon and the percentage of gross revenue [on a confidential basis] for the base case and MH scenarios based on that rate.

RESPONSE:

It is our understanding that all economic analysis of MH's base case in the NFAT filing is based on the discount rate of 5.05%. However, MNP's approach to isolate a representation of carbon value from the NPV of the PDP analysis base case included the application of our adjusted discount rate of 7.58%.

Scenario 1 represents MH's base case carbon price forecast and MH's net emissions displacement figures. Using a discount rate of 5.05%, the estimated carbon value of scenario 1 would be $1,055 M.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 34 & 35

QUESTION:

Please indicate to what extent the carbon values in the scenario analysis impact the all gas plan and provide a comparison of the NPV of the All Gas Plan with the MNP reference and low case.

RESPONSE:

In addition to the scenarios tested in our report, ***Section 3.5.1 Assumptions in Financial Impacts***, MNP has run four *additional* scenarios in our financial model representing All Gas Plan sensitivities as follows:

Scenario	Development Plan	Net Emissions Displacement	Carbon Price Forecast	PV 2090 Carbon Value (2014$)
Scenario A	Alternative Plan #1 All Gas	MH Market Displacement Assumptions	MNP Base Case	$121.9M
Scenario B		MH Market Displacement Assumptions	MNP Low Case	$4.7M
Scenario C		MNP Market Displacement Assumptions	MNP Base Case	$120.4M
Scenario D		MNP Market Displacement Assumptions	MNP Low Case	$3.9M

However, if MH is exporting energy to MISO and policy design allows, there may be potential to register hydro generation specifically for export and offset in REC markets (environmental attribute creation).

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 30

QUESTION:

Please file a table summarizing the views of coal retirements that support the coal generation reduction of at least 17 % in the MISO market.

RESPONSE:

MNP based the assessment of reductions in coal generation on the marginal energy forecast provided by Potomac Economics, which forecasted a 17% reduction in coal generation from 2014 to 2035.

MNP validated these coal generation expectations using other studies, including coal retirement projections of the six independent consultants who provided CSI market price forecasting to MH and from Energy Information Administration Annual Energy Outlook data.

The conclusion of a reduction of at least 17% in the MISO market is a blended analysis based on all of the above consultants' expectations which generally supports Potomac Economics' forecast.

SUBJECT: Macro-Environmental

REFERENCE: MNP Report, page 42

PREAMBLE: MNP believes the amount of flooding to be comparatively low impact for a project of this size and nature.

QUESTION:

Please provide a comparison of flooding impacts of similar size projects in Canada.

RESPONSE:

The table below is our comparison of flooding impacts of similar size projects in Canada:

Reservoir Analysis - Selected Historical Hydro Projects in Canada

Company	Generating Station	Location	Year Construction Completed	Capacity (MW)	Reservoir Area (km2)	Ratio of Reservoir Area to Capacity
Manitoba Hydro	**Keeyask**	**Nelson River**	**In Progress**	**600**	**138**	**0.23**
Manitoba Hydro	Limestone	Nelson River	1990	1,340	27	**0.02**
Manitoba Hydro	Kettle	Nelson River	1974	1,220	337	**0.28**
Hydro Quebec	Eastmain-1/Eastmain-1-A	Eastmain River	2012	768	603	**0.79**
Hydro Quebec	Laforge-1	La Grande River	1994	878	1,288	**1.47**
Hydro Quebec	Toulnustouc	Manicouagan River	2005	526	235	**0.45**
Hydro Quebec	Sainte-Marguerite-3	Sainte Marguerite River	2003	882	253	**0.29**
Hydro Quebec	Manic-5/Manic-5-A	Manicouagan River	1990	2,660	1,950	**0.73**
BC Hydro	Kootenay Canal	Kootenay River	1976	583	389	**0.67**
BC Hydro	Mica Dam	Columbia River	1976	1,805	430	**0.24**
BC Hydro	Revelstoke Dam	Columbia River	1984	1,843	115	**0.06**
BC Hydro	W.A.C. Bennet Dam	Peace River	1968	2,730	1,761	**0.65**

Average Ratio of Reservoir to Capacity	**0.51**
Average Reservoir Size (km2)	**671.65**