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Abbreviations and Acronyms

BOD	biological oxygen demand
DFO	Department of Fisheries and Oceans
DO	dissolved oxygen
EIS	environmental impact statement
IAAC	Impact Assessment Agency of Canada
km	kilometre
LMOC	Lake Manitoba outlet channel
LSMOC	Lake St. Martin outlet channel
NSC	North South Consultants
WCS	water control structure

QUESTION IAAC-31

EIS Guideline Reference: 7.3.1 Fish and Fish Habitat

EIS Reference: 3.5.3.5 Ice Management; 6.4.7.4 Changes in Local Drainage Areas and Local Drainage Patterns

Context and Rationale

Section 7.3.1 of the EIS Guidelines direct the proponent to assess potential changes to water quality and effects to fish and fish habitat resulting from the Project, including from storing water in the channels.

Sections 3.5.3.5 and 3.4.3.1 of the EIS state the following, regarding water in the outlet channels:

- Solid cover of ice will form within both channels, lake type ice cover and could reduce the capacity of the LMOC.
- A limited discharge from Lake St. Martin may be conveyed through the LSMOC water control structure to maintain adequate water flow and water quality in the channel when the WCS gates are essentially closed, and to sustain water quality within parameters required for fish and other aquatic life.
- During non-flood operations, when the WCS gates are closed (70% to 87% of the time, depending on the month), there will be an approximately 1 m to 2.5 m depth of water in the channel, as a minimum, with average velocities typically less than 0.1 m/s depending on base flow. The deepest areas will be located immediately upstream of drop structures.

Survival of fish in the outlet channels during the winter when the channel is ice-covered and flow depth and velocity are limited is a concern.

Information Requests

a) Provide information regarding under-ice water quality and fish survival in the LMOC and LSMOC.

    i. Provide water quality information for the outlet channels under minimum flow and maximum ice-cover winter conditions.

b) Complete an assessment of the potential effects of the Project on fish and fish habitat from changes in water quality in the LMOC and LSMOC. Describe associated mitigation measures and assess significance of residual effects. Discuss associated monitoring and follow up.

Response IAAC-31

a) The following provides a response for the LMOC and LSMOC, respectively.

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LMOC

The Lake Manitoba Outlet Channel (LMOC) will be 24.1 kilometres (km) long, have a trapezoid cross-section with a base width of 8 m to 13 m, and 5H:1V to 6H:1V side-slopes. Water depths in the channel will range between 5 m and 8 m upstream of the control structure and 4 m to 5 m downstream of the control structure. The wetted width of the channel will vary between 30 m and 60 m. Water levels in the channel upstream of the control structure will be the same as water levels in Lake Manitoba and water levels downstream of the control structure will be the same as water levels in Lake St. Martin. Substrate composition in the LMOC will be primarily till. As identified in the EIS, when the LMOC is not operating in winter, there is risk that anoxic conditions may become established as the winter progresses, particularly in years of high snow cover. Oxygen conditions in the channel are expected to mimic conditions that occur in long narrow bays and disconnected backwater/side channels in lakes and rivers elsewhere in the province. Low amounts of organic debris in the channel and periodic flushing during channel operation may result in lower than typical biological oxygen demand (BOD) and may act to ameliorate reductions in dissolved oxygen (DO).

Oxygen depletion is known to occur in long narrow bays with no through flow of water. For example, Blind Bay, situated on the Winnipeg River immediately upstream of the Manitoba Hydro Pointe du Bois Generating Station, is known to thermally stratify during the summer and winter months such that DO concentrations at depth are below provincial objectives for the protection of aquatic life. DO concentrations near zero were recorded near the bottom of Blind Bay in the summers (July and August) of 2006, 2007, and 2015 (Hnatiuk et al. 2010; NSC unpublished data); in the winter, DO near the bottom is not as low as in the summer. Typically, when DO concentrations at depth are poor, DO concentrations within the upper five to seven meters of the water column are within those that are protective of aquatic life. Mid-channel depth of Blind Bay is approximately 10-12.5 m. Given that the depth of the LMOC is 4-8 m, it is not expected to thermally stratify and therefore marked oxygen depletion at depth is not expected during the open-water season. However, some oxygen depletion may occur during winter. It has been observed that where flow has been terminated in channels, oxygen levels at depth can decrease to concentrations that are below guidelines for the protection of aquatic life. Consequently, it can be expected that portions of the LMOC may periodically become anoxic under some winter conditions. Groundwater inputs during winter may act to reduce the severity of any oxygen depletion.

The LMOC will provide over 72 ha of habitat for fish after it is completed and fully watered. The quality of that habitat will be reduced if DO levels within the channel reach levels that are below the guideline for the protection of aquatic life. When fish are exposed to unsuitable oxygen conditions they will typically move to areas with more suitable conditions. Given that fish in the LMOC will be able to egress the channel at all times of the year, it is expected that should DO levels decrease to unsuitable levels fish will leave the channel and experience no ill effects. If fish are unable to egress from the channel and avoid unsuitable DO concentrations, they will perish. Should it be determined during monitoring that DO is falling below the guidelines suitable for the protection of aquatic life, that fish kills are occurring in the channel and that they are of unacceptable magnitude, adaptive management strategies are available for mitigation. Provision of a baseflow in the channel on a year-round basis would alleviate the oxygen depletion in the winter and avoid fish kills.

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LSMOC

The Lake St. Martin Outlet Channel (LSMOC) will be 23 km long and have a trapezoidal cross-section with a base width of 44 m and 4H:1V side slopes. The channel will have an average slope of approximately 0.12%; however, steeper gradients will occur locally. To limit water velocities at these locations, the LSMOC will have 12 drop structures constructed of rockfill with a sheet pile cut-off at the upstream crest. Pool depths upstream of the drop structures will be sufficient to maintain a wetted channel upstream to the next drop structure. Together with the channel geometry and drop structures, baseflows in the LSMOC will limit variations in water levels in the LSMOC when not in use and allow a stationary, lake-type ice cover to form on the channel without freezing to the bottom. Groundwater seepage is also expected to augment these baseflows along the channel length. Substrates in the channel will be primarily till.

The LSMOC will create approximately 100 ha of fish habitat. A year-round baseflow in the LSMOC is expected to provide conditions, including DO levels, which are suitable for fish on a year-round basis. Consequently, fish are expected to be found in the channel throughout the year. Monitoring of water quality and fish presence in the channel will provide a measure of the accuracy of environmental impact statement (EIS) predictions and a basis for implementing adaptive management such as adjusting baseflows to provide the most optimum conditions for fish in the Lake St. Martin system.

b) The fish habitat created in the LMOC will be susceptible to low DO levels during winter. It is expected that if this should occur fish will be able to exit the channel. No adverse effects to fish are expected to occur. Should fish not exit the channel and perish due to low oxygen levels, adaptive management strategies (provision of baseflow) are available to improve conditions.

The fish habitat created in the LSMOC is not expected to adversely affect fish at any time because of the commitment to provide baseflows in the channel year-round. However, should stranding or low oxygen levels occur within the channel that adversely affect fish, adaptive management and mitigative strategies are available to improve conditions.

Oxygen levels and fish presence within the channels will be monitored as part of the Aquatic Effects Monitoring Plan. Thresholds will be established for implementing adaptive management or additional mitigation. The Plan will be discussed with the Department of Fisheries and Oceans (DFO) during the *Fisheries Act* Authorization process.

References

Hnatiuk, S., Cooley, M.H. and T. Savard. 2010. Water Chemistry and Sediment Chemistry Data for the Winnipeg River in the Vicinity of the Pointe du Bois Generating Station, 2006-2008 – Final Report. A report prepared for Manitoba Hydro by North/South Consultants Inc. Pointe du Bois Aquatic Effect Monitoring Report 08-01. 344 p.