

**LAKE MANITOBA AND LAKE ST. MARTIN OUTLET CHANNELS PROJECT
RESPONSE TO IAAC TECHNICAL INFORMATION REQUESTS**

Question IAAC-20

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Abbreviations and Acronyms

EIS	environmental impact statement
LAA	local assessment area
LMOC	Lake Manitoba outlet channel
LSMOC	Lake St. Martin outlet channel
PDA	project development area
RAA	regional assessment area

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EIS Guideline Reference: 7.1.4 Groundwater and Surface Water

EIS Reference: 6.4.2 Existing Conditions for Groundwater

Context and Rationale

The EIS guidelines require baseline information on groundwater elevations and seasonal variability in groundwater elevation including magnitude and direction of the hydraulic gradients between the interfaces of bedrock, till and surface water features.

In the EIS Section 6.4.2.2, the presence and thickness of the glacial till unit is the primary control on groundwater recharge and discharge and groundwater surface water interactions in the RAA. While a general description of the thickness of this unit is provided for the LMOC and LSMOC, these details are not sufficient to delineate recharge and discharge areas, or potential areas of groundwater surface water interaction. For example, Section 6.4.2.2 states that 5 m to 18 m of till is present in the area of the LMOC. While the upper end of that range likely indicates an intact aquitard, 5 m of till may not be sufficient to perform as an aquitard.

Groundwater flow patterns, groundwater recharge and discharge areas, and groundwater surface water interactions are strongly related to the thickness of the till aquitard and the location of bedrock outcrops. The spatial variations in the thickness of this unit need to be mapped to adequately assess effects of the project on groundwater quantity.

In the area of the LMOC, several meters of the till unit likely underlie all surface water features. No information on groundwater elevations or seasonal variations within this unit has been provided. Discussion is focused on a comparison between bedrock groundwater elevations and surface water elevations in the major lakes (e.g., Figure 6.4B-4). However, the thickness of the till separating the bedrock from the lakes is not discussed, nor are the groundwater elevations within the till. As this unit is the primary connection between surface water features and the bedrock aquifer, gradients through this unit and their seasonal variations need to be understood to assess the potential effects of the Project on groundwater surface water interactions.

Information Requests

- a) Provide maps of overburden thickness and bedrock topography in the LAA. Show data points used to generate the maps. Include the groundwater elevations within the till unit at both LMOC and LSMOC and in proximity to surface water features where available. Where data is not available, infer the information and provide the rationale. Where available, the locations of surface water features and groundwater springs should also be shown on this map.

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- b) Provide a cross-section showing bedrock topography, overburden stratigraphy, channel inverts, channel operation levels, and groundwater elevations required for construction and operation for both LMOC and LSMOC.
- c) Provide information on the seasonal variability in groundwater elevations within the till. Describe the hydraulic conductive and groundwater elevations with the bedrock aquifer. This assessment should include information on the magnitude and direction of the hydraulic gradients between the bedrock and the till and the till and surface water features where available.

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The response for a) b) and c) is first provided for Lake Manitoba Outlet Channel (LMOC), followed by Lake St. Martin Outlet Channel (LSMOC).

LMOC

Details of the geological and hydrogeological setting for the LMOC areas are generally provided as follows. Note that this response does not append material from cited reports due to the volume and complexity of material. These documents have been separately provided.

For the LMOC the geological and hydrogeological setting is described in KGS (2017) Appendix B – Deliverable D5. Regional Geological Setting and Appendix C – Deliverable D6. Groundwater Study. Relevant sections and pages are specifically referenced, which provide a full understanding and context of the information used to develop the geological and hydrogeological settings.

- a) Maps of overburden thickness and bedrock topography along the LMOC are provided within the Regional Geological Setting Report (Deliverable D5 – KGS 2017). Plate D5-8 provides a 3D Bedrock surface perspective, which includes bedrock elevation contours and control points. Plate D5-9 shows a 3D perspective of surface of overburden thickness, including control points and isopaches. Groundwater elevation within the till unit along the LMOC is shown on Plate D5-10, which is a longitudinal profile of the hydrogeological observations. Groundwater elevation within the till unit is also shown on two transverse profiles of the LMOC, on Plate D5-11.
- b) As discussed above, Plate D5-10 (Deliverable D5 – KGS 2017) is a longitudinal profile of the hydrogeological observations along the LMOC. This profile shows bedrock topography, overburden stratigraphy, channel inverts, channel operation levels and groundwater elevations. During construction of the channel, it is expected that groundwater pressure within the underlying bedrock will be drawn down to approximately 1 m below the base of the channel invert elevation.
- c) The seasonal variability in the bedrock was shown in Volume 2, Figure 6.4B-4 in the environmental impact statement (EIS). Each year the pressure in the bedrock rises in the spring, by 2-3 m, after snow melt occurs and then decreases over the year to a low in late winter. Plate D5-10 (Deliverable D5 – KGS 2017) provides a summary of observed groundwater levels within the bedrock aquifer, glacial till and surface water features along the LMOC. This profile illustrates the upward vertical hydraulic gradient that is observed along the entire LMOC. The vertical hydraulic gradients are

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discussed further within Section 3.1.1.3 of the KGS Groundwater Study Report (Deliverable D5 – KGS 2017). From page 27 of Deliverable D5 – “The upward vertical gradients observed reflect the presence of a groundwater discharge zone beneath the buried bedrock valley. The low permeability till and confining clay, however, restrict the outflow of water, maintaining the high piezometric conditions in the area.”

In addition, a groundwater pumping test was done and determined the reaction of pressure in the till in the vicinity of the wetlands near the LMOC. Deliverable D5 – KGS 2017 (page 39) states “Although the bedrock pumping well produced a drawdown of 10.6 m in the bedrock observation well ED-01P, drawdown in upper and lower vibrating wires installed in the till at ED-01 P (not shown on the plot) had a negligible response, indicating that a minimal amount of leakage through the till if any would be anticipated during pumping of the bedrock aquifer.”

The Groundwater Study (Deliverable D6 – KGS 2017) discusses the hydraulic conductivity of the bedrock aquifer, which was evaluated through a groundwater pumping test and lugeon tests. The interpreted hydraulic conductivity values are summarized in Table D6-17 of the Groundwater Study Report (Deliverable D5 – KGS 2017).

LSMOC

- a) For the LSMOC, no maps of overburden thickness or bedrock topography were available prior to the EIS filing in August 2019. In 2019 and 2020, a geotechnical and hydrogeological field investigation program was conducted within the LSMOC project development area (PDA) by KGS Group (KGS), as part of the ongoing Preliminary Design field study phase of the Project. Technical reporting for these investigations is in progress; as such, these data are not yet available for analysis and interpretation. However, this information will be used in developing a groundwater management plan and may assist in identifying mitigation measures when fully available. For a summary of how the assessment of the effects on groundwater was done in the LSMOC area, see responses to IAAC-21 and IAAC-23.
- b) For the LSMOC there is no cross-section showing bedrock topography, overburden stratigraphy, channel inverts, channel operation levels, and groundwater elevations available prior to the EIS filing in August 2019. In 2019 and 2020, a geotechnical and hydrogeological field investigation program was conducted within the LSMOC PDA by KGS Group (KGS), as part of the ongoing Preliminary Design field study phase of the Project. Technical reporting for these investigations is in progress; as such, these data are not yet available for analysis and interpretation. However, this information will be used in developing a groundwater management plan and may assist in identifying mitigation measures when fully available. For a summary of how the assessment of the effects on groundwater was done in the LSMOC area, see responses to IAAC-21 and IAAC-23.
- c) For the LSMOC, no information on the seasonal variability in groundwater elevations within the till and the hydraulic conductive and groundwater elevations with the bedrock aquifer were available prior to the EIS filing in August 2019. In 2019 and 2020, a geotechnical and hydrogeological field investigation program was conducted within the LSMOC PDA by KGS Group (KGS), as part of the

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ongoing Preliminary Design field study phase of the Project. Technical reporting for these investigations is in progress; as such, these data are not yet available for analysis and interpretation. However, this information will be used in developing a groundwater management plan and may assist in identifying mitigation measures when fully available. For a summary of how the assessment of the effects on groundwater was done in the LSMOC area, see responses to IAAC-21 and IAAC-23.

References

KGS Group Consulting Engineers. May 2017. Investigations and Preliminary Engineering for LMB Outlet Channels Options C and D Summary Report. Appendix B – Deliverable D5. Regional Geological Setting and Appendix C – Deliverable D6. Groundwater Study.