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Abbreviations and Acronyms

EIS	environmental impact statement
EOC	emergency outlet channel
GUDI	Groundwater Under Direct Influence
LMOC	Lake Manitoba outlet channel
LSMOC	Lake St. Martin outlet channel
PDA	project development area

QUESTION IAAC-25

EIS Guideline Reference: 3.2 Project Activities; 7.1.2 Geology and Geochemistry; 7.1.4 Groundwater and Surface Water; 7.2.2 Changes to groundwater, surface water and fluvial morphology

EIS Reference: Throughout; 6.3.2 Existing Conditions for Geology and Soils; 6.4.2 Existing Conditions with Groundwater; 6.4.3 Project Interactions with Groundwater; 6.4.5 Existing Conditions for Surface Water; 6.4.6 Project Interactions with Surface Water Environment; 6.4.7 Assessment of Residual Environmental Effects on Surface Water; 8.2.3 Project Interactions with Vegetation

Context and Rationale

The EIS Guidelines require the proponent to describe pathways of effects and present mitigation measures to support the assessment of the potential effects of the Project on groundwater and surface water.

The EIS describes surficial geology, sediment layers, and bedrock outcrops to varying degrees of specificity throughout the EIS. Bedrock outcrops are noted along the LMOC and LSMOC, though not all are quantified through field verification. Some characteristics, including the thickness of till overburden and depth to bedrock along the LSMOC and bedrock elevation along the LMOC are not yet defined, and the EIS notes additional detail will be gathered during detailed design. Conclusions are drawn from assumptions based on information available to date.

The EIS states that glacial till acts as a confining unit for the potable bedrock aquifer in the area of both the LMOC and LSMOC. In Sections 6.4.4.2 and 6.4.4.3, the EIS states that the construction of the LMOC and LSMOC will intersect with the carbonate aquifer that is under high artesian pressure in the region close to Lake Winnipeg. In the LMOC, the piezometric head can be up to 5 m above ground level. As the till is under pressure, there is a risk that the water pressure will break through the till – this is known as “blowout”. These locations in the vicinity of the water control structure are where the till could be breached during construction and can cause blowouts. Blowouts have the potential to contaminate wells under artesian pressure or wetlands with flooding surface water.

Also, it was noted that the permanent water in the channel will act as a counterweight on till to prevent blowouts. In the north section of the LMOC, passive depressurization was stated to be required by developing pressure relief wells along the channel to remove water and pressure where till and remaining water is not enough to maintain safe ground pressure.

Overall, the potential for blowouts (pressure break through till) during construction is not clearly described in the EIS. This can affect installed wells (domestic and livestock) which are only under natural artesian pressure. The EIS states that some wells may have piezometric head impacted to a large enough degree to require mitigation.

Information on geological features along the outlet channels, including the remaining thickness of the till unit following construction of the channel, is important for the assessment of the potential for blow-out of

the till. This information is necessary to understand potential changes of the project to water and wetlands, and associated environmental effects.

Information Requests

a) Provide any additional information being collected for the engineering design that will identify the areas of exposed bedrock and areas of thin till over the aquifer within the PDA that could cause blowouts during construction and operations and alter surface drainage patterns and flows.

b) Include a map of overburden thickness and potential bedrock outcrops location for both the LMOC and LSMOC.

c) If no additional information has been collected for the engineering design regarding locations of bedrock and/or thin till, provide the confidence level of understanding of presence of bedrock and thin till areas over the aquifer for successful engineering design.

d) Describe how piezometric head data for the LSMOC LAA, including areas of thin till over carbonate bedrock aquifer and bedrock outcrop areas, was used to confirm the findings of the assessment.

e) Describe potential design alterations or potential measures to mitigate the effects of groundwater/surface water interactions, if required. This can effect wetland habitat as well as water supply in wells.

Response IAAC-25

a) No further applicable information is currently available; however, Preliminary Design field studies remain ongoing and further Detailed Design field studies will be undertaken. These investigations will focus on collection of data to assess the potential of basal heave during construction and presence and operation of the outflow channels over the long term. As part of the Preliminary and Detailed Engineering Design plans, a Groundwater Management Plan will be developed that will provide guidance on minimizing potential for basal heave during construction and long-term operations. Basal heave could occur in the bottom of the channel and may reduce capacity of the channel. A blowout will not alter surface water drainage patterns. The alignment of the channel will alter surface water drainage as discussed in the environmental impact statement (EIS) Volume 2, Section 6.4.7.4 Changes in Local Drainage Areas and Local Drainage Patterns.

b) A map of overburden thickness along the Lake Manitoba Outlet Channel (LMOC) is provided within the Regional Geological Setting Report (Deliverable D5 – KGS 2017). Plate D5-9 shows a 3D perspective surface of overburden thickness, including control points and isopaches. No bedrock outcrops along the LMOC have either been observed or inferred based on the data shown on Plate D5-9.

   No hydrogeological information was available within the Lake St. Martin Outlet Channel (LSMOC) project development area (PDA) prior to the EIS filing in August 2019. In 2019, a geotechnical and

hydrogeological field investigation program was initiated within the LSMOC PDA as part of the Preliminary Design field study phase of the Project. However, the technical reporting portion of this program is not yet complete, and these data are not yet available for analysis and interpretation. However, for the purpose of design planning, hydrogeological concerns along the LSMOC are considered to be consistent with that observed along the LMOC (i.e., artesian pressures stemming from a bedrock aquifer, potential of basal heave of the excavation base). As shown in Volume 2 on Figure 6-11 of the EIS, a bedrock outcrop (approximately 2.5 km in length) has been observed along the LSMOC alignment. The bedrock outcrop is located approximately 7 km west of Lake Winnipeg, on the LSMOC.

c) 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 pressures within the bedrock and overlying overburden. The consistency of the hydrogeological findings, along the LMOC, allows for a moderate degree of confidence with respect to the hydrogeological conceptual model developed. Plate D5-8 provides a 3D Bedrock surface perspective view, which includes bedrock elevation contours and control points. This mapping provides a baseline of the bedrock surface topography, with an acceptable degree of confidence for conceptual design. Geotechnical investigations will continue in preliminary and detail design. The goal of the engineering design study will be to develop depressurization procedures to reduce the risk of basal heave or blowout of the till. Therefore, engineering design will consider the potential for breach or blowout of the till during construction. This can be mitigated by depressurization wells and/or placement of sand/gravel infill between the channel invert and the bedrock. For the LSMOC, it is expected that the findings of the Preliminary and Detailed Design field studies will allow for refinement of a Groundwater Management Plan. This strategy will provide guidance on minimizing the potential for basal heave during construction and long-term operations.

d) The EIS concluded that changes in local groundwater/surface water interactions could occur with depressurization or dewatering of shallow bedrock where limited till cover is evident. These changes may be realized near the bedrock outcrops along the LSMOC or where ground surface slope is relatively steep, namely near Lake Winnipeg.

e) The alignment of the LMOC, in an area of high artesian pressure, was chosen to prevent Groundwater Under Direct Influence (GUDI) of surface water if there is a blowout and the bedrock is exposed. If there is a blowout, groundwater flow would exit the bedrock aquifer and not contaminate the aquifer. Other potential alignments (i.e., Route C, see KGS 2017) were not chosen to prevent this contamination from occurring. This is discussed in the EIS in Volume 1, Section 2.4.2 Alternative Means of Carrying Out the Project. The selection of the route for the LMOC was the major mitigation measure to protect groundwater quality.

An assessment of water level changes in nearby surface water features is discussed within Volume 1, Section 2.3.2.2 of the Surface Water Study Report (KGS 2017). The glacial till soils underlying the proposed LMOC, which are generally greater than 15 m in thickness, function as a barrier (i.e., confining layer), limiting upward seepage from the underlying artesian bedrock aquifer. The report

concluded that the low permeability till beneath the wetland limits or precludes water level changes due to any groundwater piezometric pressure drawdown in response to channel construction or operations. It is noted that potential effects to the wetland water budgets predominantly reflect proposed catchment area changes. For example, the wetlands to the east of the LMOC will be affected by the loss of catchment area, as discussed within EIS Volume 2, Section 6.4.7.4 Changes in Local Drainage Areas and Local Drainage Patterns.

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 D6 – 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.”

Furthermore, it is noted that depressurization of the bedrock aquifer does not reflect a consumptive use. Where practical, the dewatering effluent (in whole or in part) could be diverted towards wetlands as a mitigative measure during construction or long-term operations.

The risk of blowout is a concern due to the effect on construction (e.g., increased costs) and geotechnical stability of the side slopes of the channel, not for groundwater contamination as a blowout will cause water to flow out of the aquifer as the aquifer will remain under pressure. Depressurization of the aquifer will reduce the risks of blowout and geotechnical instability during and after construction; however, this will cause a reduction in pressure in the aquifer for 3 km to 5 km from the Project as discussed in the EIS. The depressurization during construction will not pose a risk to groundwater contamination. If depressurization does allow water to seep into the aquifer during construction, this will be short term and will not travel far into the aquifer (it would remain within the right-of-way). When construction depressurization ceases, the surface water influenced groundwater will discharge out of the aquifer into the surface water.

Livestock wells that rely on artesian pressure to flow will not function without this pressure, will need to be mitigated by installing pumps or residents will be otherwise compensated. Domestic wells within the bedrock should continue to operate; however, if there are issues, the wells and pumps can be replaced by drilling deeper wells within the same aquifer. If domestic wells rely on artesian pressure, new wells and pumping will need to be supplied as mitigation. For the short-term, water could be supply by truck until the new well and pump are installed. The preliminary and detailed engineering studies will be further investigating the specifics of mitigation.

Design alterations to the depressurization system to reduce the impact on groundwater pressure reduction away from the Project will be considered in the engineering design; however, this may increase the risk of blowout and side slope instability. These tradeoffs will be reviewed during preliminary and detailed engineering.

There are no domestic or livestock wells in the vicinity of the LSMOC. Further discussion on mitigation in design is found in response to IAAC 23. An outside drain will be designed and installed to mitigate

the effect on adjacent wetlands that was observed in the construction and operation of the emergency outlet channel (EOC).

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, Appendix C – Deliverable D6 and Groundwater Study and Appendix D – Deliverable D7- Surface Water Study