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Abbreviations and Acronyms

EIS	environmental impact statement
EOC	emergency outlet channel
GWMP	Groundwater Management Plan
LAA	local assessment area
LMOC	Lake Manitoba outlet channel
LSMOC	Lake St. Martin outlet channel
NDVI	normalized difference vegetation index
PDA	project development area
SWMP	Surface Water Management Plan
VCs	valued components
WMP	Wildlife Monitoring Plan

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EIS Guideline Reference: 7.2 Predicted changes to the environment; 7.2.3 Changes to riparian, wetland and terrestrial environments; 2, 7.3.2 Migratory birds; 7.3.3 Indigenous Peoples; 7.3.4 Other valued components; 7.3.5 Species at Risk

EIS Reference: 6.3.4.2 Change in Terrain Conditions; 6.4.4.3 Changes in Local Groundwater/ Surface water Interactions; 8.2.4.5 Change in Wetland Functions; 8.3.6.2 Change in Habitat; 9.2.4.3 Change in Agricultural Land Use

Context and Rationale

The EIS Guidelines require that predicted changes to the environment be described in terms of magnitude and geographic extent, duration and frequency, and whether the environmental changes are reversible or irreversible. The EIS Guidelines require that environmental effects due to changes to the environment are assessed as well as the interconnection between multiple VCs.

The EIS recognizes that the Project will result in changes to terrain conditions (soil moisture regimes) and surface water/shallow groundwater (hydrologic function) in Sections 6.3.4.2 and 6.4.4.3. This is characterized as the wetting of the up-gradient environment and the drying of the down-gradient environment and effects to wetlands, vegetation, wildlife and socioeconomic factors in Sections 8.2.4.5, 8.3.6.2, and 9.2.4.3. It is acknowledged that the experience of the Emergency Outlet Channel (EOC), where impacts have been observed 1600 m up-gradient and 600 m down-gradient, is not representative of potential impacts to either the LMOC.

The EIS infers that mitigations will be sufficient to mitigate up-gradient effects for the LMOC and partially mitigate up-gradient of the LSMOC. The EIS also notes that both channels will result in down-gradient effects to multiple VCs. The extent of the down-gradient effects is estimated to be less than 500 m perpendicular to the channels. No data or assessment is provided to justify this conclusion. Interconnections between the changes to the environment and the effects to VCs are not discussed.

Information on the magnitude and extent of interconnected changes to the environment are required because they can adversely affect areas of federal jurisdiction – wildlife including migratory birds, SAR, and species of cultural importance, etc.

Information Requests

a) Present the details of the assessment used to conclude the 500 m geographic extent of changes to the environment perpendicular to the LMOC and to the LSMOC. Include associated modelling, summarized data, and source of the data. Discuss the degree of confidence in the conclusions and any limitations of the existing data or methods.

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b) Provide an interpretation with supporting data and resource material for the magnitude, duration and seasonality, and reversibility of changes to soil moisture regimes and hydrologic function relative to baseline conditions.

c) Provide any additional data gathered since the compilation of the EIS and provide a plan to fill information gaps in the analysis of effects.

d) Discuss the interconnected nature of the predicted changes to soil moisture regimes and hydrologic function and the affected VCs. Include a mitigation strategy that considers the interconnected nature of the changes and resulting effects. Include an evaluation of the effectiveness of mitigations.

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a) The assessment of potential effects from drainage alterations due to the presence of the LMOC and the Lake St. Martin Outlet Channel (LSMOC) was completed using a multi-disciplinary approach. The assessment of potential effects to surface water hydrology are addressed in IAAC-23, and are summarized as follows:

- For the Lake Manitoba Outlet Channel (LMOC), potential effects in the Birch Creek and Watchorn Creek drainage areas due to the presence of the channel were assessed using typical approaches of measurement of drainage area and flow analysis.
- For the LSMOC, the Buffalo Creek system is hydrologically very complex; surface water does not flow uniformly through this wetland complex, and there is no obvious existing drainage network. Therefore, effects cannot be predicted using typical approaches of measurement of drainage area and flow analysis. Quantification of effects to flows in the Buffalo Creek system cannot be predicted with a high degree of confidence before construction is complete.

To support the assessment of potential effects for the LSMOC, an empirical analysis of effects associated with the Lake St. Martin emergency outlet channel (EOC) on surrounding vegetation was completed. This consisted of a comparison of vegetation conditions before and after construction of the EOC, completed using satellite imagery and a normalized difference vegetation index (NDVI) analysis. Details on the NDVI assessment techniques are found in Volume 3, Section 8.2.4.1 (pg. 8.35) of the environmental impact statement (EIS). The analysis compared changes in light reflectance as a measure of plant health to indicate effects to soil drainage/wetness and hydrological conditions.

Key to the assessment of potential effects from drainage alterations due to the presence of the channels is the consideration of mitigation incorporated into the design of LMOC and LSMOC; namely, the incorporation of drainage channels on the upgradient side of the channels (Volume 2, Section 6.4.7.4, pg. 6.197 [LMOC] and pg. 6.199 [LSMOC]). This is of particular importance to the assessment of the predicted extent of effects associated with the LSMOC, which was based largely on the empirical analysis of effects associated with the EOC, which were not mitigated with upgradient drainage channels.

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The assessment of effects is summarized for the LMOC and LSMOC, below.

LMOC Summary

The region upgradient of the LMOC is currently drained by a network of municipal and provincial drains and is largely under agricultural land use. The outside drain upgradient of the LMOC will intercept water from the west (upgradient side) and be integrated into the existing drainage system to maintain drainage parameters consistent with the past drainage on the upgradient side. The wetlands along Birch Creek will have reduced flows as discussed in Volume 2, Section 6 of the EIS.

Local land drainage in the area of the LMOC generally travels from the west to the east towards the wetlands and small lakes (Volume 2, Appendix 6B, Figure 6.4B-9). As such, an outside drain will be constructed along the length of the west side of the LMOC to capture the drainage from the Birch Creek and Watchorn Creek systems and re-direct the flow into the LMOC. The construction and operation of the LMOC will result in a decrease of 27.4% of the total drainage area of the Birch Creek drainage basin and a decrease of 4.0% of the total drainage area in the Watchorn Creek drainage basin. These changes to drainage area are expected to result in a low to moderate magnitude reduction in flows in the Birch Creek system and a negligible change in flows in the Watchorn Creek system (EIS Volume 2, Section 6.7.4, pg. 6.197).

For the LMOC, effects upgradient are expected to be localized and contained within the project development area (PDA) due to the till materials with infrequent and discontinuous sand lenses, drainage class, and moisture regimes of the predominantly mineral soils in this area. Downgradient of the LMOC, effects are expected to extend beyond the PDA (Volume 2, Section 6.3.4.2, pg. 6.112). It is challenging to accurately model or otherwise predict changes to near-surface hydrology due to the complexity in conditions in these mineral and organic soil complexes. The complexity is largely due to high spatial variability in stratigraphy (sequences and thicknesses of near-surface organic and mineral materials) and how that affects surface and near-surface hydrology. Therefore, it is unknown to what distance these effects will extend perpendicular to the channel, and hence the application of a conservative approach (Volume 2, Section 6.3.4.2, pg. 6.112; see also Volume 2, Section 6.4 Groundwater and Surface Water).

Geotechnical and hydrogeological investigations in progress will be used to refine the Project design (i.e., drainage channel design optimization) and will inform development of the Surface Water Management Plan (SWMP) and Groundwater Management Plan (GWMP). More information on this is found below and in part c) of this response.

LSMOC Summary

In the vicinity of the LSMOC, there is no existing artificial drainage network, unlike the LMOC. The assessment of the geographic extent of changes to the environment perpendicular to the LSMOC included an empirical analysis of effects associated with the EOC, as discussed above. The EOC was constructed through a similar wetlands complex in the region of the LSMOC. The satellite imagery and NDVI analysis comparison suggested that effects to soil drainage/wetness (using vegetation as a proxy) along the EOC have extended to a maximum 1,600 m upgradient and 600 m downgradient

(these were maximum extents of apparent effects noted over a portion of the channel length). However, the extent of effects were found to be variable along the length of the EOC (Volume 3, Appendix 8B, Figure 8.2B-13; presented below) and were generally detected less than 300 m perpendicular to the channel. These effects caused by the presence of the EOC are considered unmitigated as the design of the EOC does not include an outside drain on the upgradient side of the channel.

The proposed outside drainage will minimize the “backwater” effect in the wetland complex on the upgradient or east side of the LSMOC. The drain will bring the water level down to natural levels and discharge water into the LSMOC. In other words, this is anticipated to mitigate potential effects associated with "wetting-up" of soils on the upgradient side of the outlet channels. Therefore, the effects on the upgradient side of LSMOC are anticipated to occur over a reduced distance perpendicular to the channels relative to the extent of effects on the EOC, where a maximum upgradient extent of effects of 1,600 m was assessed and effects were generally less than 300 m perpendicular to the channel. For the LSMOC, an upgradient distance of potential effects of 500 m perpendicular to the channel and along the entire length of the channel is considered a conservative estimate, relative to the assessed effects on the EOC and considering the implementation of mitigation to be incorporated as part of the LSMOC design.

If monitoring of effects to wetlands west of the channel during construction and/or operational monitoring identifies a need for additional mitigation, there are several potential options to mitigate the drying-down of soils on the downgradient side of the channel. As indicated in IAAC-23 and discussed in Volume 3, Section 8.2.4.5 (pg. 8-60) of the EIS, repurposing the EOC is not being considered as an option at this time; however, if it is determined that it is necessary as a component of mitigation measures associated with the federal *Fisheries Act* Authorization, repurposing of the EOC would likely allow additional flows to the Buffalo lakes and Buffalo Creek from Lake St. Martin and would potentially replace any flows lost from interception of wetland flows to the creek. Water may also be pumped from the LSMOC to wetlands west of the channel, if needed (Volume 3, Section 8.2.4.5, pg. 8.60). Unmitigated, a 500 m perpendicular extent of effects downgradient along the length of the channel is assumed to be reasonable based on the analysis completed on the EOC and summarized above.

As confidence in the estimates of the extent of effects perpendicular to the channels on the upgradient and downgradient sides is not high, estimates considered to be conservative have been used. Further, the total estimated area of effects to LSMOC assumes the entire length of the channels will be affected to a distance of 500 m perpendicular to the channels (compared to the area assessed along the EOC), for a total area of effects of 2,400 ha. Geotechnical and hydrogeological investigations in progress will be used to refine the Project design (i.e., drainage channel design optimization) and will inform development of the SWMP and GWMP. More information on this is found below and in part c) of this response.

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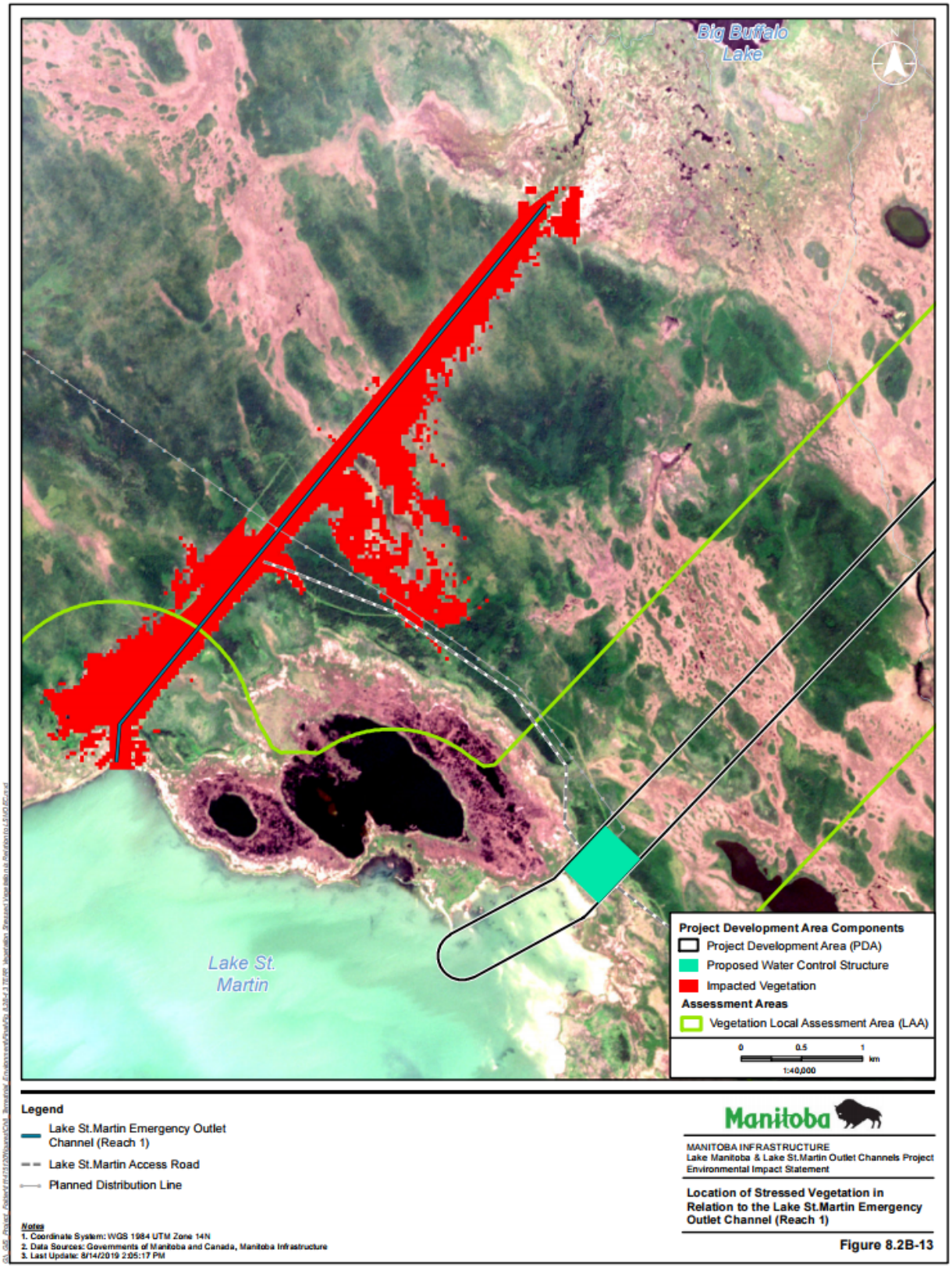

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Follow-up and Monitoring

Because of the level of confidence in the conclusions, conservatism is inherent in estimates and follow-up and monitoring is proposed, including confirmation of soil moisture changes, and effects to natural vegetation and agriculture. As indicated above, ongoing geotechnical and hydrogeological investigations will be used to refine the Project design (i.e., drainage channel design optimization) and will inform development of management plans, which will include monitoring.

In addition, Project plans will address management of drainage, monitoring and identification of additional mitigation, if necessary. These measures and plans are described in the EIS as follows:

- In order to modify the conservative assessment approach that has been applied and to better understand effects to valued components (VCs) as a result of changes to soil moisture status adjacent to the LSMOC, confirmation of the effects of drainage alterations on soils in the vicinity of LMOC and LSMOC that may result in soil moisture changes (wetter or drier) is required. It is anticipated that this need will be largely accomplished through management measures identified in the GWMP and SWMP, mentioned below, and additional monitoring. Wetland water levels are to be monitored along LMOC and LSMOC as part of the GWMP (Volume 3, Section 8.2.4.2, pg. 8.37). Alterations to hydrology that may result in soil moisture changes that may affect agricultural capability in areas of agricultural land use (Volume 3, Section 6.3.7, pg. 6.126) will be monitored through the SWMP and GWMP.

- Project planning will include the development of a GWMP and a SWMP, which will provide for management of drainage during construction and operation. Additionally, monitoring during Project construction and operation will allow for these effects to be better understood. Additional mitigation may be applied as this understanding develops (see EIS Volume 2, Section 6.3.4.2, pg. 6.112).

i. The interpretation of changes to soil moisture regimes and hydrologic function relative to baseline conditions as a result of the presence of the Project, including the potential “wetting-up” of soils on the upgradient side of the channels and “drying-down” on the downgradient side of the channels, is summarized below. This summary is based on the interpretive information presented in the EIS, from the assessment made collaboratively between geology and soils (Volume 2, Section 6.3), groundwater and surface water (Volume 2, Section 6.4) and vegetation (Volume 3, Section 8.2) using data and resource materials documented in the EIS. This consisted of estimates and assumptions developed using professional judgment based on a desktop review of effects related to the presence of the EOC and consideration of design mitigation and existing environmental conditions along the LMOC and LSMOC. Due to the level of confidence in the response of natural conditions to the Project, conservatism is inherent in these estimates. These estimates are summarized in EIS Volume 2, Section 6.3.4.4 (pg. 6.123):

   “The effects will occur over an estimated area of up to 2,400 ha within the LSMOC portion of the local assessment area (LAA), representing approximately 4% of the total LAA area and up to between approximately 40 and 50% of the LSMOC portion of the [PDA] [*note – a typo in the EIS*

text reads "LAA"]. An undetermined but limited area within the LMOC portion of the LAA is expected to be affected."

The characterizations of potential residual effects, which will occur through the operation phase, are as follows (from information presented in Volume 2, Table 6.3-2, pg. 6.75 and Table 6.3-21, pg. 6.125):

- Magnitude (degree or intensity of the change) – High (H). When considering effects to terrain conditions, a high magnitude effect would comprise a change in drainage conditions that alter agricultural capability class [or capability for natural vegetation] beyond the PDA. As described above in part a), the effects are anticipated to extend beyond the PDA on the downgradient side of the LMOC to an unknown distance, while the extent of effects along the LSMOC channel are estimated to be 500 m perpendicular to the channel upgradient and downgradient for a total estimated area of effects of 2,400 ha. As effects are anticipated to occur beyond the PDA, particularly in the case of LSMOC, the effects due to alterations to drainage conditions are considered high in magnitude.

- Duration (period of time the effect occurs) – Long-term (LT). Effects are considered long-term duration if the effect is likely to persist beyond the completion of construction and rehabilitation activities and into the operation phase of the Project (i.e., a timeframe of greater than 5 years). Alterations to drainage conditions are anticipated to occur through the operation phase.

- Timing – Not sensitive (NS). Effects are considered not sensitive to timing if timing does not affect the interaction between the Project and the effect to soils and terrain. In the case of drainage alterations, residual effects do not change with seasonal timing of construction (e.g., winter vs. summer conditions) or during periods of varying soil conditions within season (e.g., wetter or drier soils).

- Frequency (how often the effect occurs) – Regular/Continuous (RC). Effects are considered to be regular/continuous if they are anticipated to occur at regular and frequent intervals during the Project phase in which they occur or over the life of the Project. Effects related to drainage alterations as a result of the presence of the channels are expected to occur continuously through the operation of the Project.

- Reversibility (the degree of permanence) – Irreversible (I). Effects due to drainage alterations are expected to occur through Project operation and there are no plans to decommission the Project. Therefore, these effects are considered permanent and irreversible.

ii. Additional geotechnical and hydrogeological data has been gathered since the completion of the EIS and will be used to refine the Project design and inform the development of management plans. For example, as summarized in IAAC-24 for the LSMOC:

"No hydrogeological information was available within the LSMOC PDA prior to the EIS filing in August 2019. In 2019 and 2020, a geotechnical and hydrogeological field investigation program was initiated within the LSMOC PDA by KGS Group (KGS) as part of the 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 groundwater / surface water monitoring programs and management plans when fully available."

As indicated, this information is in progress and not available to support additional analysis of effects at this time.

Environmental Management Plans and other identified follow-up and monitoring commitments provided in the EIS to address uncertainty in predictions discussed above, includes:

- Environmental Management Plans – the following plans will provide for management of drainage during construction and operation. Additionally, monitoring during Project construction and operation will allow for effects to soil moisture and hydrological changes to be better understood. Additional mitigation may be applied as this understanding develops (Volume 2, Section 6.3.4.2, pg. 6.112).
  - Development of a SWMP
  - Development of a GWMP
- Follow-up for soil and terrain (Volume 2, Section 6.3.7, pg. 6.126):
  - Effects of drainage alterations on soils in the vicinity of LMOC and LSMOC that may result in soil moisture changes (wetter or drier) needs confirmation. This follow-up should be conducted jointly with vegetation in sensitive areas (e.g., wetlands or listed ecosystems) and land and resource use (agriculture) for agricultural capability in areas of agricultural land use.

iii. Where feasible, the availability of additional data to support the evaluation of alterations to drainage from the presence of the outlet channels will be used to refine estimates of the extent of effects. However, due to the complexity of the hydrology, particularly in the LSMOC LAA, this would not likely result in an increased level of confidence in the assessment conclusions or change recommendations for follow-up and monitoring to better understand and mitigate effects, as necessary. Alterations to drainage will affect soil moisture regimes and hydrologic function upgradient and downgradient of the LMOC and LSMOC. This will adversely affect soil capability for natural vegetation, while it is likely to benefit agricultural capability for crop production. The effects to natural vegetation may, in turn, affect habitat for wildlife in close proximity to the channels. The following response addresses this interconnectedness of effects, the mitigation proposed, and its effectiveness, for each of the channels.

<u>LMOC</u>

Within the LMOC LAA, approximately 43% of the land use was agricultural in 2018 (Volume 4, Table 9.2-12). Agricultural land use predominates on the west side of the channel, which is considered the upgradient side. Generally, natural land cover, which occupies approximately 31% of the LMOC LAA (Volume 4, Table 9.2.12) is more prominent on the east side of the channel, which is

considered the downgradient side. Soils within the LMOC LAA are predominantly well- to imperfectly-drained mineral and forest peat soils (approximately 64% of the soils and terrain LAA [which is a 1 km buffer around the LMOC PDA]) with inclusions of poorly-drained mineral soils and very poorly-drained, peaty mineral soils (approximately 19% of the LAA) and very poorly-drained, organic soils (approximately 9% of the LAA). Approximately 8% of the LAA is considered open water.

West side or upgradient side of the LMOC:

Mitigation is primarily comprised of constructing surface drainage structures on the upgradient side of the LMOC (Volume 2, Section 6.4.7.4, pg. 6.197). Following implementation of mitigation, it is anticipated that residual effects to surface drainage and shallow subsurface flow will be limited in extent to the PDA (Volume 2, Section 6.3.4.2, pg. 6.111-112). It is anticipated that effects to subsurface drainage in the till materials with discontinuous sand lenses are anticipated to be very localized. Further, surface drainage will be improved in close proximity to the drainage structure, which could provide beneficial effects to agricultural capability in soils with wetness limitations. Therefore, the wetting up on the upgradient side of the LMOC is anticipated to be localized and limited in area to the PDA (i.e., the western edge of the PDA in proximity to the outside drain), and the potential for residual effects to soils, agriculture, vegetation and wildlife and wildlife habitat are considered minimal. As such, additional summary of potential changes to these VCs upgradient of the LMOC is not provided.

Monitoring, to be specified in management plans (i.e., SWMP and GWMP), will be conducted to confirm effects during construction (e.g., seepage into channel, backwater effects west of the outside drain). Findings of monitoring may necessitate additional mitigation not identified in the EIS.

East side or downgradient side of the LMOC:

Residual effects downgradient (i.e., east side) of the LMOC are expected to extend beyond the LMOC PDA (Volume 2, Section 6.3.4.2, pg. 6.112). As described in part a) above, it is challenging to model or otherwise predict changes to near-surface hydrology in these mineral and organic soil complexes; therefore, it is unknown to what distance these effects will extend perpendicular to the channel (Volume 2, Section 6.3.4.2, pg. 6.112; see also Section 6.4 Groundwater and Surface Water). The change in water balance downgradient of the LMOC PDA may result in changes to water levels in wetlands (Volume 2, Section 6.3.4.2; see also Section 6.4). Should this drying-down occur it could, in turn, adversely affect soil productivity for natural vegetation but have positive effects to agricultural capability by reducing soil wetness limitations.

Monitoring, to be specified in management plans (i.e., SWMP and GWMP), will be conducted to confirm effects during construction (i.e., alterations to water levels in wetlands east of LMOC). Findings of monitoring may necessitate additional mitigation not identified in the EIS. For example, discharge from active aquifer depressurization may be directed into the Birch Creek or Watchorn Creek systems (Volume 2, Section 6.4.4.3, pg. 6.163) to mitigate altered (i.e., lower) water levels in wetlands east of the LMOC (Volume 3, Section 8.2.4.5, pg. 8.55-8.56).

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A summary of potential changes to affected VCs on the downgradient side of the LMOC is provided in Figure IAAC-7-1, below.

Geology and Soils (Soils and Terrain)	• localized effects due to limited subsurface drainage in till materials with discontinuous sand lenses • decrease in soil moisture status anticipated to extend beyond the PDA into the LAA
Land and Resource Use (Agriculture)	• no anticipated adverse effects to agriculture as land downgradient of LMOC and between the PDA and wetlands and lakes east fo the PDA is predominantly non-agricultural (currently largely natural vegetation and much agricultural land will be lost due to access limitations) • reduced soil moisture status could benefit agicultural soils due to inherent wetness limitations in soils for agriculture in the LAA
Vegetation	• potential shift in plant composition favouring species of less frequently flooded and shallower conditions • potential reduction in wetland area • potential effects are anticipated be limited to the LAA
Wildlife	• potential reduction in wetland habitat used by species at risk (e.g., horned grebe, least bittern, northern leopard frog), amphibians and reptiles, waterfowl and other migratory birds, and furbearers • potential effects will be limited to the LAA
Species of Cultural Importance	• potential reduction in wetland areas may result in reduction of some traditionally harvested plant and animal species (e.g., Labrador tea, sweetgrass, rat root, waterfowl and furbearers) • potential for increased availability of traditionally harvested plants and animals that favour drier or upland habitats (e.g., blueberry, Saskatoon berry, deer, elk) • overall, change in distribution of species of cultural importance is not expected to reduce the availability of resources in the RAA and traditional harvesting practices will be able to continue with minor alteration of behaviour by Indigenous peoples (considered a negligible to low magnitude effect; Table 10.2-3) • potential effects will be limited to the LAA

Figure IAAC-7-1 Summary of Potential Changes to Valued Components due to Drainage Alterations East (downgradient) of LMOC

Effectiveness of mitigation for drainage alterations in the vicinity of the LMOC:

The design mitigation of a drainage channel on the west side of the LMOC will effectively mitigate “wetting-up” of soils upgradient of the LMOC and effects to VCs from drainage alterations are anticipated to be limited to the PDA. Downgradient of the LMOC, “drying-down” of soils is anticipated to occur beyond the PDA, affecting surface water levels and wetlands. Monitoring will verify if predictions made in the EIS are accurate (i.e., confirm the magnitude of potential effects) and/or that mitigation is functioning as intended. Adaptive management (i.e., SWMP and GWMP) will provide for

the implementation of additional mitigation to limit effects, as appropriate. For example, and as identified above, discharge from active aquifer depressurization may be directed into the Birch Creek or Watchorn Creek systems (Volume 2, Section 6.4.4.3, pg. 6.163) to mitigate altered (i.e., lower) water levels in wetlands east of the LMOC (Volume 3, Section 8.2.4.5, pg. 8.55-8.56).

Loss of wetlands under the Project footprint or resulting from alterations to drainage, if mitigation is not functioning as intended, will be offset with wetland compensation, as or if required. Wetland compensation could help reduce effects to migratory birds, and potentially amphibians, reptiles, and affected species at risk.

The Wildlife Monitoring Plan (WMP) will outline methods to monitor the effectiveness of mitigation strategies for wildlife and their habitats (Volume 3, Section 8.3.10). Efficacy of proposed mitigation will be discussed with Indigenous groups as part of Manitoba Infrastructure's ongoing engagement (Volume 4, Section 10.2.7).

LSMOC

Within the LSMOC LAA, landcover is predominantly considered natural vegetation. The majority of the area is under wetland cover classes (i.e., approximately 76% of the vegetation LAA [which is a 1 km buffer around the LSMOC PDA]; Volume 3, Table 8.2A-3, pg. 8.A.7), with a minor portion under native upland vegetation (approximately 10% of the vegetation LAA) and a minor portion considered open water (12% of the vegetation LAA). Soils in the area are largely very poorly drained organic and peaty mineral soils to poorly drained mineral soils (approximately 46% of the soil and terrain LAA [which shares the same 1 km buffer around the LSMOC PDA as the vegetation LAA]; Volume 2, Table 6.3A-15, pg. 6A.28 [incorrectly labelled in EIS as 6A.1]) and imperfectly drained, mineral and organic (i.e., forest peat) soils to well drained mineral soils (approximately 40% of the soil and terrain LAA).

East side or upgradient side of the LSMOC:

Mitigation is primarily comprised of constructing surface drainage structures on the upgradient side of the LSMOC (Volume 2, Section 6.4.7.4, pg. 6.199). Mitigation will reduce the potential for inundation and flooding upgradient of the PDA. However, it is anticipated that residual effects to surface drainage and shallow subsurface flow will still extend beyond the PDA (Volume 2, Section 6.3.4.2, pg. 6.112). A high proportion of poorly- and very poorly-drained soils (i.e., deep organic soils and organic materials overlying mineral lacustrine and till materials) suggest that, even with mitigation, residual effects to drainage upgradient of the channel will occur beyond the PDA. As described above in part a), it is challenging to model or otherwise predict changes to near-surface hydrology in these organic soil complexes (see Volume 2, Section 6.4 groundwater and surface water). Additionally, there is the potential of artesian groundwater contributing in this area, which complicates understanding of the conditions. The LSMOC traverses a similar terrain complex as the EOC. Therefore, the EOC provides a useful example of what may occur along the LSMOC. However, the upgradient effects should be minimized and limited compared to the effects assessed on the EOC, due to the presence of the drainage structure incorporated as design mitigation.

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Natural surface and shallow subsurface drainage flow may be affected along the entire approximately 24 km length of LSMOC, with effects to drainage not expected to occur beyond 500 m upgradient of the channel (Volume 2, Section 6.3.4.2, pg. 6.112; see Volume 2, Section 6.4 Groundwater and Surface Water). This would be expected to affect drainage over an area of up to approximately 1,200 ha on the upgradient side of the channel. Therefore, on the upgradient side of the channel, there is a potential for increased soil wetness and localized inundation and flooding from backwater effects which is estimated to affect an area of up to 1,200 ha.

The wetting up on the upgradient side of the LSMOC channel will result in wetter soil conditions, which will in turn have the potential to affect other VCs, including vegetation, wildlife and wildlife habitat and species of cultural importance. A summary of potential changes to affected VCs on the east side or upgradient side of the LSMOC is provided in Figure IAAC-7-2-below:

Geology and Soils (Soils and Terrain)	• increase in soil moisture status or increased soil wetness in the predominantly very poorly, poorly and imperfectly drained soils • change in soil capability for natural vegetation will extend beyond the PDA into the LAA • extent of effects will be mitigated by the presence of surface drainage channels on the outside of the LSMOC
Vegetation	• potential shift in plant composition favouring species of more frequently flooded conditions, potentially favouring wetland sedges and grasses as non-vasccular plants could be submerged • potential tree and shrub mortality due to increased anoxic soil conditions • potential effects are anticipated be limited to the LAA
Wildlife	• local shift in the distribution of some resident and migratory birds species • potential increase in habitat for waterfowl (e.g., ducks, geese), species at risk including olive-sided flycatcher, yellow rail and short-eared owl • potential decrease in habitat for upland gamebirds (e.g., sharp-tailed grouse) • increased forage habitat for bats • potential effects will be limited to the LAA
Species of Cultural Importance	• wetter conditions may result in increased availability of some traditionally harvested plant and animal species (e.g. sweetgrass, Labrador tea, ducks, geese, beaver). • some traditionally harvested plant and animal species may be less available (e.g. jackpine, Saskatoon berry, sharp-tailed grouse) • overall, change in distribution of species of cultural importance is not expected to reduce the availability of resources in the RAA and traditional harvesting practices will be able to continue with minor alteration of behaviour by Indigenous peoples (considered a negligible to low magnitude effect; Table 10.2-3).

Figure IAAC-7-2 Summary of Potential Changes to Valued Components due to Drainage Alterations East (upgradient) of LSMOC

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West side or downgradient side of the LSMOC:

As discussed above, the LSMOC traverses a similar terrain complex as the EOC. Therefore, the EOC provides a useful example of what may occur along the LSMOC. It is reasonable to assume that the downgradient effects at the LSMOC will be similar to the unmitigated conditions assessed at the EOC (Volume 2, Section 6.3.4.2, pg. 6.112). Natural surface and shallow subsurface drainage flow may be affected along the entire approximately 24 km length of LSMOC, with effects to drainage not expected to occur beyond 500 m downgradient of the channel (Volume 2, Section 6.3.4.2, pg. 6.112; see Section 6.4 Groundwater and Surface Water). This would be expected to affect drainage over an area of up to approximately 1,200 ha on the west side of the channel. Therefore, on the downgradient side of the channel, there is potential for up to 1,200 ha to experience a drying-down, resulting in reduced surface and near-surface moisture conditions, if left un-mitigated.

As described in part a) above, while repurposing the EOC is not being considered as an option at this time (IAAC-23), this option is available, if required. Repurposing of the EOC could replenish water flows in the Buffalo bog system (Volume 3, Section 8.2.4.5, pg. 8.60). However, water may also be pumped from the LSMOC to wetlands west of the channel, if needed (Volume 3, Section 8.2.4.5, pg. 8.60).

The drying-down on the downgradient side of the LSMOC channel will result in drier soil conditions, which will in turn, have the potential to affect other VCs, including vegetation, wildlife and wildlife habitat and species of cultural importance. A summary of potential changes to affected VCs on the west side or downgradient side of the LSMOC is provided in Figure IAAC-7-3, below.

Effectiveness of mitigation for drainage alterations in the vicinity of the LSMOC:

The design mitigation of a drainage channel on the east side of the LSMOC will effectively mitigate “wetting-up” of soils upgradient of the LSMOC PDA and effects to VCs from drainage alterations are anticipated to be limited in extent as a result. However, effects are nonetheless anticipated to extend beyond the PDA. Downgradient of the LSMOC, “drying-down” of soils is anticipated to occur beyond the PDA to the west of the LSMOC, if left unmitigated, affecting surface water levels and wetlands. Monitoring will be carried out to verify if predictions made in the EIS are accurate (i.e., confirm the magnitude of potential effects) and/or that mitigation is functioning as intended. Adaptive management (i.e., SWMP and GWMP) will provide for the implementation of additional mitigation to limit effects, as appropriate. For example, and as identified above, the EOC could potentially be re-purposed to replenish water flows into the Buffalo bog system, and water may also be pumped from the LSMOC to wetlands west of the channel, if needed.

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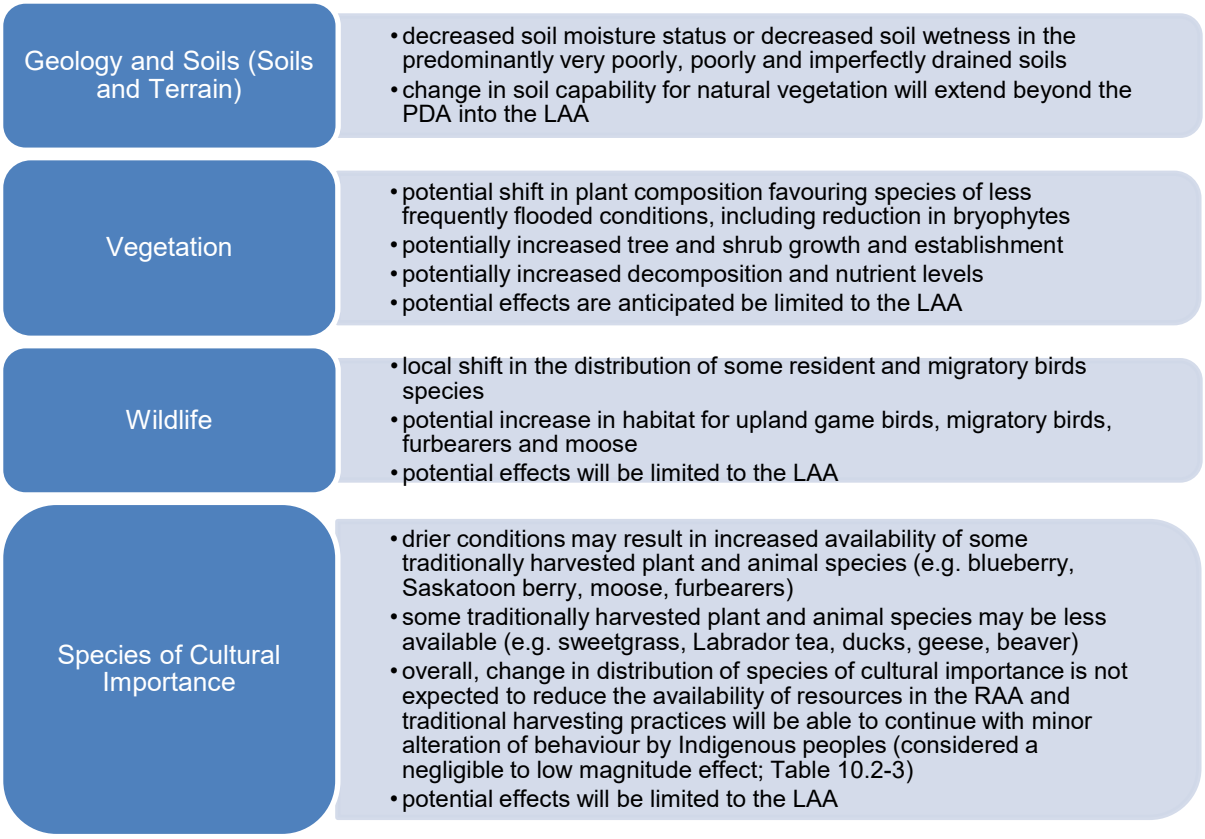

Figure IAAC-7-3 Summary of Potential Changes to Valued Components due to Drainage Alterations West (downgradient) of LSMOC

Loss of wetlands will be offset with wetland compensation, as or if required. Drainage channels are anticipated to offset some of the habitat loss (i.e., upgradient of the LSMOC) for wetland-dependent wildlife including migratory birds (e.g., ducks, songbirds) and amphibians (Volume 3, Section 8.3.6.2). Wetland compensation could help reduce effects to migratory birds, furbearers, and potentially amphibians and some species at risk.

The WMP will outline methods to monitor the effectiveness of mitigations strategies for wildlife and their habitats (Volume 3, Section 8.3.10). Mitigation measures that effectively reduce loss of wetland habitat could also serve to reduce effects on species of cultural importance that rely on wetlands. Detailed mitigation and monitoring program review discussions have been incorporated into the community-specific work plan that supports consultation (Volume 1, Appendix 5C; Volume 1, Section 2.2 'Next Steps'). Information shared throughout these discussions will be included in the subsequent development of mitigation strategies and environmental management and/or monitoring plans, in order to ensure that any potential impacts from the Project are appropriately assessed and accommodated (Volume 1, Appendix 5C; Volume 1, Section 2.2 'Next Steps'; Section 10.2.7, pg. 10.72).