LAKE MANITOBA
LAKE ST. MARTIN

OUTLET CHANNELS PROJECT

MANITOBA INFRASTRUCTURE

Sediment Management Plan

November 16, 2020

Manitoba

TABLE OF CONTENTS

List of Figures

DISCLAIMER

This document was developed to support the Lake Manitoba and Lake St. Martin Outlet Channel Environmental Management and Monitoring Program. This document has been prepared by Manitoba Infrastructure as a way to share information and have discussion with Indigenous Communities and Groups and the public. This document has been prepared using existing environmental and preliminary engineering information, professional judgement as well as information from previous and ongoing public and Indigenous engagement and consultation. The contents of this document are based on conditions and information existing at the time the document was prepared and do not take into account any subsequent changes. The information, data, recommendations, and conclusions in this report are subject to change as the information has been presented as draft and will not be considered complete until further engagement and consultation is complete. The plans may be further revised based on information and direction received from provincial and federal environmental regulators. This draft report be read as a whole, and sections or parts should not be read out of context.

PREFACE

The Lake Manitoba and Lake St. Martin Permanent Outlet Channels Project (the "Project") is proposed as a permanent flood control mitigation for Lake Manitoba and Lake St. Martin to alleviate flooding in the Lake St. Martin region of Manitoba. It will involve the construction and operation of two new diversion channels: the Lake Manitoba Outlet Channel (LMOC) will connect Lake Manitoba to Lake St. Martin and the Lake St. Martin Outlet Channel (LSMOC) will connect Lake St. Martin to Lake Winnipeg. Associated with these outlet channels are the development of bridges, control structures with power connections, a new realignment of PR 239, and other ancillary infrastructure.

Manitoba Infrastructure (MI) is the proponent for the proposed Project. After receipt of the required regulatory approvals, MI will develop, manage and operate the Project. This Sediment Management Plan is one component of the overall Environmental Management Program (EMP) framework which describes the environmental management processes that will be followed during the construction and operation phases of the Project. The goal of the EMP is to ensure that the environmental protection measures committed to in the Environmental Impact Statement (EIS) and the conditions of *The Environment Act* Licence and Federal Decision Statement Conditions are undertaken in a timely and effective manner. This includes the verification that environmental commitments are executed, monitored, evaluated for effectiveness, and that information is reported back in a timely manner to the Project management team for adjustment if required.

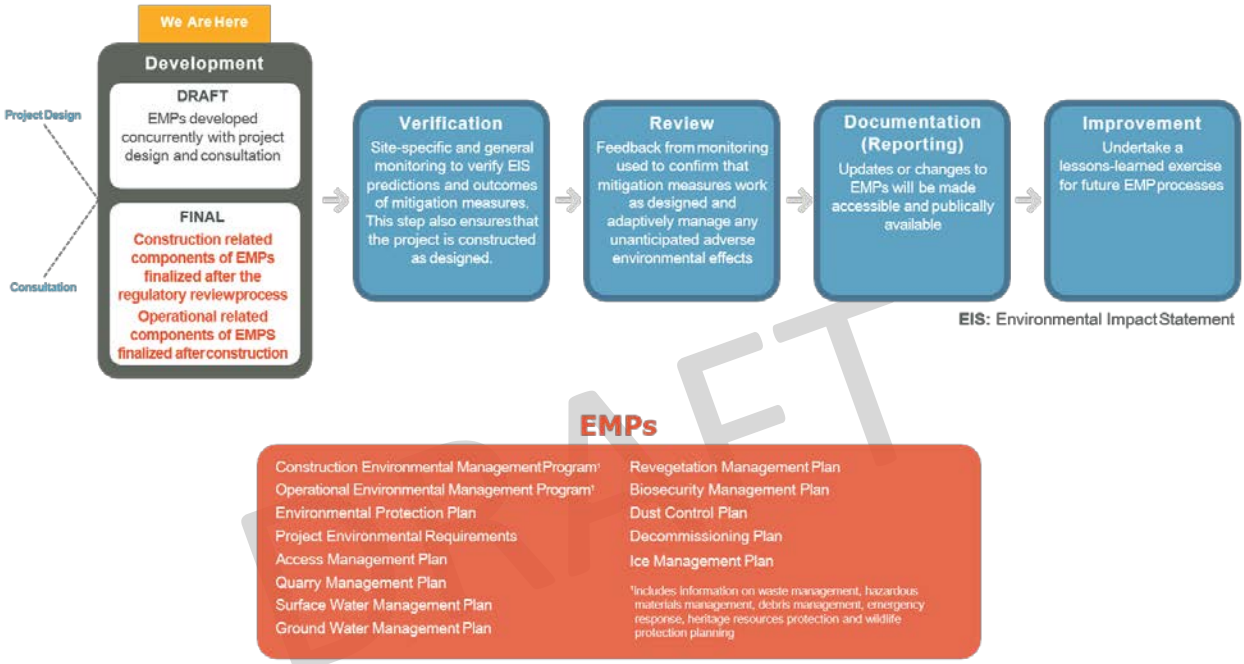
Manitoba Infrastructure remains committed to ongoing engagement and consultation with Indigenous groups and other stakeholders that are potentially impacted by the Project. Detailed EMP review discussions have been incorporated into community-specific consultation work plans and additional engagement opportunities will be provided prior to EMP finalization. Engagement opportunities include virtual open house events and EMP-specific questionnaires. EMP-specific questionnaires will be provided to Indigenous groups and stakeholders to obtain feedback and views on the draft plans, in addition to exploring opportunities for Indigenous participation in follow-up monitoring. Feedback and recommendations will be used to inform the completion of the plans.

The EMP provides the overarching framework for the Construction Environmental Management Program (CEMP) and the Operation Environmental Management Program (OEMP), which will be finalized as separate documents prior to Project construction and ideally operation, respectively. Their finalization will consider applicable conditions of *The Environment Act* Licence and associated approvals, any other pertinent findings through the design and regulatory review processes and key relevant outcomes of the ongoing Indigenous and public engagement and Consultation processes.

The purpose of the CEMP and OEMP is to guide how environmental issues will be addressed during construction and operation, respectively and how adverse effects of activities will be mitigated. The CEMP is supported by several specific or targeted management plans (e.g. surface water, groundwater, sediment, etc.), as shown in the Figure below, that will guide MI's development of the Project's contract documents and subsequently, the Contractor(s) activities, in constructing the Project in an environmentally responsible manner. The OEMP will likely include the same targeted plans developed to manage issues during construction, but prior to construction completion they would be revised and adapted to suit the specific needs during the operation phase.

ENVIRONMENTAL MANAGEMENT PROGRAM PROCESS AND ASSOCIATED ENVIRONMENTAL MANAGEMENT PLANS

Environmental Management Program (EMP) Process



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OUTLET CHANNELS PROJECT

GLOSSARY OF TERMS AND ACRONYMS

Acronyms

AEMP	Aquatic Effects Monitoring Plan
CCME	Canadian Council of Ministers of the Environment
CEMP	Construction Environmental Management Program
DFO	Department of Fisheries and Oceans Canada
EIS	Environmental Impact Statement
EMP	Environmental Management Program
GWMP	Groundwater Management Program
km	Kilometre
LMOC	Lake Manitoba Outlet Channel
LSMOC	Lake St. Martin Outlet Channel
m	Metre
m/s	Metres per second
m^3/s	Cubic metres per second
mg/L	milligrams per litre
MI	Manitoba Infrastructure
mm	Millimetre
MWQSOG	Manitoba Water Quality Standards, Objectives and Guidelines
OEMP	Operation Environmental Management Program
PER	Project Environmental Requirements
PR	Provincial Road
PTH	Provincial Trunk Highway
Project	The Lake Manitoba and Lake St. Martin Permanent Outlet Channels Project
Reg.	Regulation
ROW	Right of Way
SMP	Sediment Management Plan
SWMP	Surface Water Management Plan

TSS	Total Suspended Solids
WCS	Water Control Structure

Glossary of Terms

Aquatic habitat: The living and non-living components of a lake, river, wetland or other waters upon which aquatic life depends

Aquatic life: Organisms temporarily or permanently living or found in water.

Aquatic vegetation: Submerged, floating-leaved and floating plants that only grow on or beneath the water surface. Submerged plants may be rooted in soils or free-floating.

Aquifer: A body of rock or sediment that is sufficiently porous and permeable to store, transmit, and yield significant or economic quantities of groundwater to wells and springs.

Aquitard: A confining bed and/or formation composed of rock or sediment that retards but does not prevent the flow of water to or from an adjacent aquifer. It does not readily yield water to wells or springs, but stores groundwater.

Artesian: A body of rock or sediment containing groundwater that is under greater than hydrostatic pressure: that is a confined aquifer. When an artesian aquifer is penetrated by a well, the water level will rise above the top of the aquifer; a flowing artesian well is when the water level will rise above ground surface.

Baseline: Initial environmental conditions, prior to construction or anthropogenic actions.

Bedrock: The solid rock that lies beneath the soil and other loose material on the Earth's surface.

Cofferdam: An enclosure, usually only partially obstructing a river, from which water is pumped to expose the bottom to permit construction.

Confined aquifer: An aquifer that is bounded above and below by formations of distinctly lower permeability than that of the aquifer itself. An aquifer containing confined ground water. See artesian.

Depressurization: Action of decreasing hydrostatic pressure. Active depressurization involves the use of pumps. Passive depressurization does not involve the use of pump, but rather uses a relation between hydrostatic pressure elevation and topographic elevation.

Dewatering: Removal or draining groundwater or surface water from a riverbed, construction site, caisson, or mine shaft, by pumping or evaporation.

Discharge: Rate of outflow; volume of water flowing down a river, from a lake outlet, or man-made structure.

Groundwater: Water that occurs beneath the land surface and fills the pore spaces of soil or rock below saturated zone.

Hydraulic profile: The graphical representation of the water level through the channel based on the water level of the receiving water, control points, and the head loss.

Invert (channel): The stream bed or floor within a structure or channel.

Piezometric pressure: A measurement at a discrete location expressing the potentiometric surface which is an imaginary surface representing the pressure of groundwater in an aquifer that is defined by the level to which water will rise in a well.

Riprap: A lightweight stone covering used to protect soil or surface bedrock from erosion by water or the elements.

Runoff: The flow of flood waters out of a drainage basin.

Suspended sediment: Particulate matter that is held in the water column due to movement of the water.

Till: An unstratified, unconsolidated mass of boulders, pebbles, sand and mud deposited by the movement or melting of a glacier.

Turbidity: A measure of the relative clarity of water.

Part 1: Introduction

1.0 PURPOSE AND SCOPE

The Sediment Management Plan (SMP) is a component of the overall Environmental Management Program (EMP) for the Lake Manitoba and Lake St. Martin Permanent Outlet Channel Project (the Project).

The purpose of the SMP is to describe measures to minimize or mitigate impacts of erosion and sedimentation in or near water from construction and operation activities of the Lake Manitoba Outlet Channel (LMOC) and the Lake St. Martin Outlet Channel (LSMOC). These include temporary construction management practices, as well as permanent mitigation measures built into the channel design, to minimize the potential for erosion and to minimize and mitigate the transport and deposition of sediment beyond construction areas or into off-site receiving water bodies.

The SMP is intended to be a living document that will be refined over the life of the Project and will be updated as preliminary and detailed design advances, incorporating applicable engagement feedback provided via regulatory review of the Environmental Impact Statement (EIS), landowners and/or Indigenous Groups. In particular, additional information will be added to the SMP during detailed design that will include general arrangement layout drawings for the project footprint and the locations where the sediment management measures will be implemented.

At present, this document has been prepared to facilitate Manitoba Infrastructure's consultations with stakeholders. The plan laid out is preliminary and will be updated once input from stakeholders is obtained.

Different sediment management strategies are required for the LMOC and the LSMOC as these distinct components of the Project are located in significantly different settings with different hydraulic profiles. The LMOC, for example, is located in a well-developed agricultural area with less available area for vegetated buffers and other more naturalized mitigation measures, whereas the LSMOC is located in an undeveloped wetland and forested area. Furthermore, the strategies for handling local surface water drainage during construction differ between the two channels, as their specific designs impact on how surface water can be managed, which in turn impact the sediment management practices planned. Given these overarching site-specific differences, the SWMP is organized into three parts:

- Part 1 contains general information that is common to both the LMOC and LSMOC.
- Part 2 contains information that is specific to the LMOC.
- Part 3 contains information that is specific to the LSMOC.

It should be noted that a number of other environmental management and monitoring plans are being developed for the project that interrelate with sediment management, including an Aquatic Effects Monitoring Plan (AEMP), a Surface Water Management Plan (SWMP) and a Revegetation Management Plan (RVMP).

Monitoring to confirm effectiveness of sediment management measures and the identification of when adaptive management may be required is summarized in this document, with the details presented in the AEMP and SWMP.

2.0 OBJECTIVES

The SMP has been developed to address the following objectives:

- Define guidelines and procedures for construction to minimize the potential for erosion and sedimentation.
- Develop site-specific control measures to manage potential drainage issues (e.g., run-off).
- Develop site-specific erosion and sediment control measures to minimize adverse, sediment related, effects to the receiving waterbody.
- Develop emergency response practices to mitigate extreme design conditions, respond to unforeseen events and accidents, and minimize potential environmental impacts.
- Ensure that Contractors maintain the expectations of the SMP.

3.0 DESIGN REQUIREMENTS

3.1 General Considerations

A number of physical and hydrologic (weather) related items are considered in the development of erosion and sediment control measures, including:

- The range of potential rainstorm events that could occur during construction of the LMOC and LSMOC.
- The background sediment concentrations in downstream receiving bodies.
- The rate at which revegetation will occur due to various weather influences occurring during construction.
- The potential for erosion relative to the time of year in which construction will take place.
- The potential for runoff into the construction sites and the control of water during construction.
- The integration of the temporary and permanent vegetation.
- Issues related to site dewatering and acceptable dewatering practices.
- The use of temporary diversion ditches and treatments.
- The responsibility expectations for construction site management.
- The regular inspection criteria and frequency of these inspections.

3.2 Water Quality Criteria

It is important to note that erosion and sedimentation are natural processes that occur during precipitation events and in watercourses, particularly during spring or flood events. However, Project-related erosion and sedimentation that increases conditions beyond these natural events must be managed. The erosion and sediment control measures are designed to mitigate the potential environmental effects during construction and operation activities for the proposed LMOC and LSMOC. Sediment transport to downstream receiving bodies is viewed as detrimental to the potential habitats in the receiving stream. Suspended sediment can cover spawning, feeding and rearing areas, as well as transport other pollutants into the receiving environment.

It is generally accepted that the Manitoba Water Quality Standards, Objectives and Guidelines (MWQSOG) Regulation (Reg. 196/2011) and Canadian Council of Ministers of the Environment (CCME), Canadian Water Quality Guidelines for Protection of Aquatic Life – Total Particulate Matter should be adhered to for all anthropogenic activities including construction work. These guidelines have been adopted in principal by the governments of Manitoba and Canada. Erosion and sediment control measures will be developed in consideration of these guidelines, environmental needs and project cost. The range of baseline TSS concentrations in potential receiving waters will also be considered.

It is possible that short-term increases in TSS over background levels may occur during commissioning and initial operation of the LMOC and LSMOC. Further work will be undertaken prior to construction to estimate

the potential increase in short-term TSS and develop a response protocol that links to the adaptive management strategies for each channel (described in Section 8 and 15).

3.3 Design Criteria

The storm event to be used for the design of sediment control measures during construction will be selected with consideration of the final design of temporary surface water management features, as discussed in the SWMP. This will be completed at detailed design once the duration and size of contracts are finalized. A storm event will be selected to manage and mitigate environmental risks that is commensurate with overall project costs.

For the operation phase, the LMOC and LSMOC channels and outside drains are being designed according to criteria adopted for the Project to minimize the potential for bed erosion.

Part 2: Lake Manitoba Outlet Channel

4.0 PROJECT INFORMATION

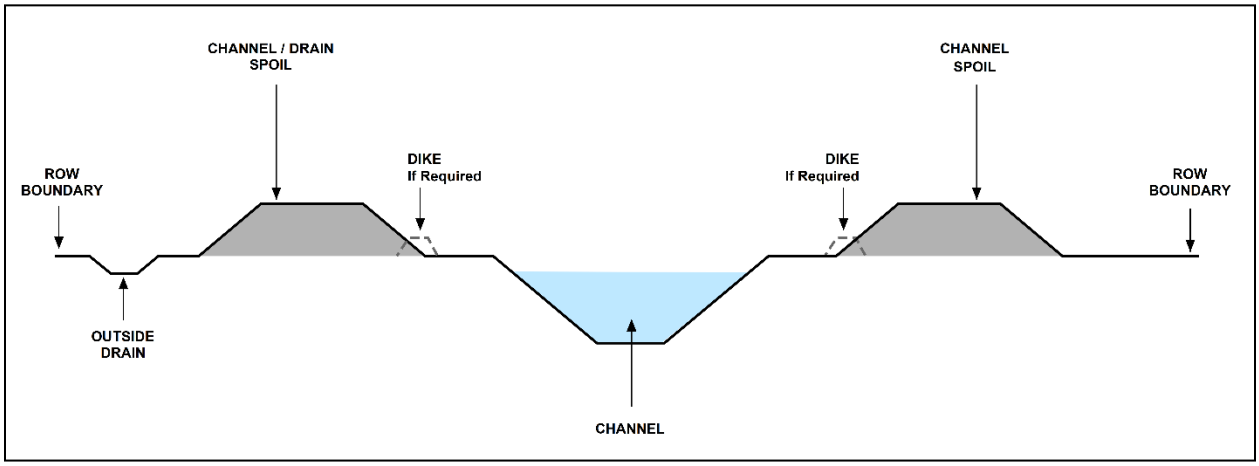
4.1 Project Description

The LMOC Project consists of an approximately 24 km long outlet channel, with the inlet positioned at Watchorn Bay on Lake Manitoba and the outlet on the west side of Birch Bay on Lake St. Martin, as shown in Figure 1. The LMOC is designed to convey a flow of 212 m^3/s (7,500 cfs) at a Lake Manitoba water level of 248.11 m (812.5 ft) and a Lake St. Martin water level of 244.14 m (801 ft).

Figure 1: LMOC Project Area

The proposed channel will have an invert elevation of about 242.1 m at Watchorn Bay and about 239.3 m at Birch Bay. The channel will have a trapezoidal shape with a flat base varying in width from 12 m to 22 m and side slopes varying between 4H:1V to 5H:1V. Embankment dikes will be constructed on both sides of the channel in areas where existing ground levels are low. Spoil berms will be located behind the dikes on either side of the channel which will also be used to gain access to the channel for maintenance. An outside drain will be constructed and located on the west side of the channel to collect surface water runoff originating from the west and convey it into Lake Manitoba and Lake St. Martin. Drainage overflow structures may also be incorporated to allow flows in the outside drain during high local runoff periods to discharge into the LMOC. A typical cross-section of the channel is provided in Figure 2.

Figure 2: Typical Cross-Section of the Lake Manitoba Outlet Channel



Inlet and outlet works will be required to allow for a smooth transition of flow from Watchorn Bay into the channel and from the channel into Birch Bay. The hydraulic profile of the channel will require the lake bottom to be excavated at the channel inlet and outlet to match the proposed channel invert elevations. The excavations will be tapered over a short distance out from the shoreline to meet natural lakebed elevations.

A water control structure (WCS) will be constructed at Iverson Road (approximately 21 km downstream of the inlet) to control flows through the LMOC while ensuring that Lake Manitoba water levels remain within their normal operating range when use of the channel is not required. A bridge will be integrated into the WCS to provide access across the channel. The preliminary design of the WCS consists of three 5.4 m wide sluice bays with vertical lift gates, upstream and downstream stoplogs, and a stilling basin with chute blocks, baffle blocks and an end sill.

The LMOC will intersect provincial highways and municipal roads. Realignment of PR 239 is required in order to accommodate the LMOC while still allowing for safe, economically feasible, and hydraulically efficient structures across the channel. Various sections of municipal road will also be realigned or extended for the purposes of maintaining residential access and agricultural activities.

A total of four new bridges are planned to span the LMOC, of which one will be combined with the WCS as described above. The other three will be dedicated multi-span bridges, constructed to maintain connectivity along the Township Line Road, realigned PR 239 (currently Carne Ridge Road) and PTH 6.

4.2 LMOC Operation

The LMOC will work in conjunction with the existing Fairford River WCS to regulate water levels on Lake Manitoba as established by the Operating Guidelines prepared for the Project. The LMOC will carry water directly into Lake St. Martin during periods when the water level on Lake Manitoba exceeds el. 247.65 m (812.5 ft), which is the top of its normal operating range.

The hydraulic profile for the LMOC is shown on Figure 3 for the normal operating range of the lakes (when the WCS gates are closed), as well as for the design conveyance condition of 212 m^3/s (7,500 cfs) in the channel with Lake Manitoba at el. 248.11 m (814 ft) and Lake St. Martin at el. 244.14 m (801 ft). Average velocities in the LMOC are expected to range between approximately 0.8 m/s and 1.0 m/s, with locally higher velocities occurring in the vicinity of the bridges and the WCS, during passage of the design conveyance condition.

Figure 3: LMOC Water Surface Profile

The LMOC is designed to be operated under both open water and ice covered conditions. The operation of the LMOC has been simulated by MI for a 103 year period from 1915-2017, based on historic lake levels and

inflows. The simulation results indicate that the LMOC would have been used in 36 years over this period and been in operation for approximately 21% of the time on a daily basis.

4.3 Sequence of Construction

A preliminary construction sequencing plan is presently under development for the LMOC and will be provided in the preliminary engineering channel design report once it is complete. A brief high level overview of the general construction methodology is provided below.

4.3.1 Site Preparation

Site preparation will be the first activity to be undertaken, as it must be completed before construction can commence in all other work areas. This will include tree clearing, construction of drainage works, and establishment of bridge detours to facilitate bridge construction. Grubbing will not take place at the same time as tree clearing in order to minimize the risk of promoting the proliferation of invasive weed species, and thus will be part of individual construction contracts. This will also reduce the potential for erosion and sediment transport prior to the start of individual construction contracts.

Tree clearing will be done in the winter months to avoid interference with the nesting window for migratory birds.

Permanent drainage to the west of the channel is needed in order to manage surface water runoff in the area and prevent it from flowing into the construction zones. Overland drainage from the west will be collected in a permanent outside drain located just to the west of the LMOC and routed to Lake Manitoba and Lake St. Martin. This drain will also be used to convey water from local construction dewatering and groundwater depressurization works along the LMOC.

Bridge detours would ideally be put in place during the construction season preceding bridge construction to avoid risk of delays.

4.3.2 Channel

The main consideration in the construction methodology and sequencing for the LMOC is managing the risks associated with basal heave and fracturing of the till aquitard, and/or slope instability, due to the high bedrock piezometric pressures that exist over the entire channel alignment. At present, it is anticipated that an active depressurization system will be used to lower the piezometric level in the vicinity of the LMOC to limit the risk of excavation basal heave during construction.

In order to reduce the required duration of active depressurization pumping, the construction methodology involves completing the channel excavation in several discrete segments that are separated from each other by a narrow natural land barrier (plug). Targeted depressurization pumping would then take place to lower the piezometric level within a particular segment and, once excavation of that segment is complete, that segment would be allowed to fill with water to restore weight to the till aquitard and thus no longer require active pumping to address basal heave risks.

Once excavation of each successive segment is complete, the plug that separates them would be removed. This will require flooding of the dry segment so as to equalize the water level on both sides of the plug, and thus prevent excessive erosive forces associated with the inrush of water that would otherwise occur into the dry segment when plug removal commences. Appropriate erosion and sedimentation controls, such as turbidity curtains, would be in place during the plug removal activities. A fish salvage will be required within the isolated area should fish be present.

Channel construction is envisioned to commence from each of the lakes and progress inland. This will allow each successively completed segment to then be opened to the lake, and thus use the lake water to restore weight to the till aquitard. At the upstream end, the work would be sequenced to allow construction activities for the inlet, Township Line Road bridge and the channel segment connecting them to be completed around the same time to allow this area to be opened to Lake Manitoba. Channel excavation segments would then be progressively advanced downstream towards the WCS, with the construction activities for the PR 239 bridge and PTH 6 bridge sequenced such that they are completed around the same time as the channel excavation segments at those locations. A similar strategy would be used at the downstream end of the LMOC where the channel excavation would be advanced from Lake St. Martin upstream towards the WCS. The channel segments around the WCS are likely to be the last sections to be excavated and these cannot be completed until construction of the WCS is complete.

Excavation activities within each segment are expected to advance in stages to further limit the duration of active depressurization pumping required, while managing the risks associated with basal heave and fracturing of the till aquitard. In general, initial excavation of a segment would be advanced to full width down to a level where the risk of basal heave is considered acceptable. This initial excavation would not require any depressurization pumping and thus could take place in either the winter or summer months. The remainder of the excavation within a segment would then be completed to the final geometry with active depressurization pumping in place, and ideally would be completed in the summer months so as to avoid the complications of having to pump and manage water in sub-freezing temperatures.

An alternate construction methodology is also under consideration that would involve limiting active depressurization to the bridges, water control structure, and potentially other discrete areas and accepting some risk of fracturing of the till aquitard. This would require a trench to be sub-cut into the base of the channel (below final grade) that would be backfilled with graded material to act as a filter. The trench would create a controlled path for groundwater seepage, as well as a location to divert and collect water that comes into excavation. This would greatly reduce the amount of depressurization pumping required and in turn, reduce the impacts to the regional groundwater system during construction.

4.3.3 Inlet and Outlet

It is presently assumed that construction of the inlet and outlet works will take place in the wet with the construction area isolated by a double turbidity curtain to prevent or minimize the migration of disturbed sediments into the lake. This work would take place in the summer, between July 1 and September 15, so as to be outside of the restricted spring (April 1 to June 15), summer (May 1 to June 30) and fall (September 15 to April 30) fish spawning windows. A fish salvage program will be required within the isolated area.

Alternate construction methods may also be considered, such as isolating the area with a cofferdam that would be constructed behind a turbidity curtain. In this case, only the construction and removal of the cofferdam would need to take place outside of the restricted spawning windows, however the overall construction time frame and impacted in-water area would be expected to be greater.

4.3.4 Bridges and Water Control Structure

Localized excavation and foundation preparation is required for the construction of the bridges and the WCS. It is expected that these work areas will be isolated from the rest of the channel with natural land plugs. These work areas would be kept small so as to limit the amount of pumping required to facilitate groundwater depressurization requirements and manage surface water runoff within the excavation. For the WCS, it is anticipated that pumping will need to continue for the full duration of its construction.

Detour roads will be established at each of the bridge locations and at the WCS to maintain traffic while those structures are being constructed.

5.0 CONSTRUCTION PHASE (TEMPORARY MEASURES)

The following general construction management practices are key components of the temporary erosion and sediment control measures for the LMOC.

- Coordinating construction staging and sequencing to maximize excavation in each work area while minimizing the time of exposure for newly excavated slopes. This will be accomplished by restricting excavation to within manageable units.
- Implementation of erosion and sediment control measures such as silt fences, slope roughening techniques, slope terracing, runoff management, and straw mulching. These will be specified on construction drawings and will be implemented in accordance with Project Environmental Requirements (PERs) for Erosion and Sediment Control and Working Within or Near Water.
- Maintaining a natural vegetated buffer zone on the east side of the right of way (ROW), where possible, to reduce erosion and sediment transport between the construction site and existing receiving water bodies and streams.
- Revegetating exposed areas directly after finished grade is established. Planting will, if practicable, commence immediately upon completion of a section of LMOC to maximize the potential for growth and establishment of a vegetative cover. The revegetation is considered to be part of the permanent erosion and sediment control measures discussed in Section 6.0.
- Minimizing disturbance to adjacent vegetated areas to accommodate buffering of suspended sediment.

It should be noted that channel design features such as shallow side slopes will help minimize the erosion and sediment generated during construction. The sections which follow provide further detail on erosion and sediment control measures that will be applied during the construction of the various components of the LMOC.

5.1 Main Channel Excavation

The temporary erosion and sediment control measures for excavation of the main channel are based on accepted construction industry practice to minimize erosion and sediment transport to receiving water bodies. These measures are broken down into perimeter measures, intermediate measures, and potential adaptive management and contingency measures. A definition of each of these terms is given below.

- Perimeter erosion and sediment control measures are implemented at the onset of each construction contract to enclose the designated construction area.
- Intermediate erosion and sediment control measures are the measures implemented within each construction area.
- Adaptive management measures are the erosion and sediment control measures that would be implemented in the event that one or more of the intermediate measures fails to perform as expected. These are described in Section 8.0.

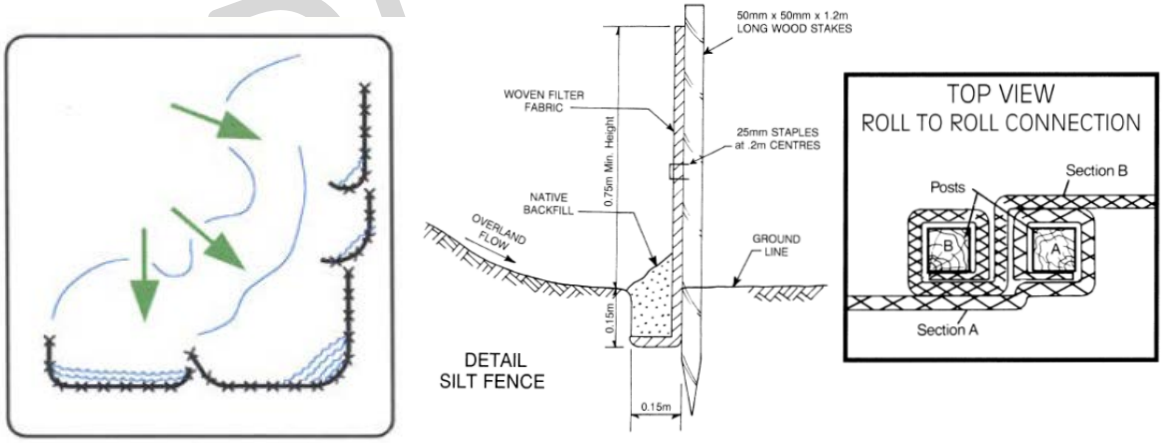
- Contingency measures would be implemented in the event of an emergency condition that would overwhelm the "base" erosion and sediment control measures, for example, due to a storm event that exceeds the selected design event. These are described in Section 9.0.

Specifications and drawings for LMOC construction will be prepared during detailed design and customized for each individual contract as required. Sections 5.1.1 and 5.1.2 describe the base measures that will be implemented as a minimum for the LMOC.

5.1.1 Perimeter Controls

The best method for establishing and maintaining a perimeter around exposed areas, such as staging areas and material stockpiles, is with a vegetated buffer zone. However, as vegetated buffer zones will be limited for the LMOC, especially on the west side of the channel, it is envisioned that silt fencing will also be installed along the full length of the LMOC. Location and placement of the silt fences will be carefully selected to prevent additional erosion due to undercutting or end-cutting of the fence. Installation of the silt fences would adhere to typical industry specifications, with a typical detail as shown on Figure 4.

Figure 4: Typical Silt Fencing Detail



Note: Details may vary.

Silt fences will be of particular importance to control sediment movement in areas where staged excavation and spoil placement takes place prior to final grades being established, which are required to allow revegetation to proceed. For example, as discussed in Section 4.3.2, excavation of the upper portion of the channel within a channel segment could be performed in the winter months (when no depressurization pumping is required to address the risk of basal heave), with the remaining lower portion excavation then completed in the summer months so as to limit the duration of depressurization pumping required and avoid the complications of having to pump and manage water in sub-freezing temperatures.

In addition to silt fences, surface water quality from within the construction area that must be discharged offsite will be monitored and controlled, as required, to comply with the water quality criteria outlined in

Section 3.2. Surface runoff within excavation areas will be directed to low areas of the excavation to allow any sediment to settle prior to being pumped to offsite receiving areas. Pump discharge points will be lined with clean rock or other acceptable flow dissipating applications, as required, to prevent erosion and the release of suspended sediments. Settling ponds will be constructed adjacent to work areas, as deemed necessary, prior to discharge into the outside drain and/or the waterbodies east of the LMOC, or at alternate locations that may be approved by MI during construction.

Turbidity curtains will be used to prevent or minimize the migration of disturbed sediments during removal of earth plugs that separate one channel excavation segment from another, if flooding of those segments is required.

5.1.2 Intermediate Controls

Intermediate controls will be developed as the channel excavation proceeds with a full set of controls in-place upon completion of excavation and before revegetation begins. As the excavation progresses downward to the final grade, slope roughening techniques on exposed side slopes will be implemented.

Re-establishing the vegetation cover in the LMOC is fundamental to minimizing the erosion potential during both the construction and operation phases of the LMOC. Within the planting season, and after final grade is established within a reasonably sized work area of a channel segment, the grade will be prepared and revegetated according to the appropriate revegetation prescription(s) as outlined in the RVMP. A component of the main revegetation prescription includes a cover species that will establish quickly to protect the base soil from erosion as the remainder of the species germinates.

Temporary topsoil stockpiles will be contoured and seeded during construction to reduce erosion and control weed establishment, if stockpiles are to be left in place for more than one growing season.

Additional intermediate controls will also be considered in the completed excavation area and will be developed during detailed design based on an assessment of potential sediment that could be generated and the final construction contracting strategy. This may involve the use of the Modified Universal Soil Loss Equation, which is an event-based methodology for estimating the quantity of erosion from a given land use including construction sites. These intermediate controls may include:

- Slope interrupters may be constructed at regular intervals (10 m) cross-slope on the channel and spoil embankment slopes. These can be effectively constructed with a grader or dozer with an adjustable blade to create a deep furrow into the side slope. Slope interrupters are not intended to trap or filter sediment, but they will serve to minimize further slope erosion protecting against deep rills or gullies by interrupting flow of runoff down the slope.
- Straw mulch treatment may be considered outside of the channel after the surface has been seeded with vegetation. The straw mulch would be anchored/crimped into the surface of the soil. The straw mulch helps protect the slope against erosion, but also provides an enhanced environment to promote quick growth of the grass seed. Other environmentally friendly types of topical spray on mulches may also be considered, where appropriate.

The temporary erosion and sediment control measures discussed above will be left in place while the permanent vegetation is re-established. Other erosion and sediment control methods will be considered as alternatives for use as adaptive management and/or contingency measures if the base approach measures do not perform as expected. Further discussion of these adaptive management and contingency measures is provided in Sections 8.0 and 9.0.

5.2 Other Project Components

Temporary erosion and sediment control measures will be required for the other project components that are part of the LMOC, which include:

- Outside Drain
- Water Control Structure and Bridges
- Inlet and Outlet works

An overview description of the temporary erosion and sediment control measures for each component listed above is provided in the following subsections. Adaptive management and/or contingency and emergency response measures for these components will include similar measures described in Sections 8.0 and 9.0.

5.2.1 Outside Drain

As part of the site preparation project works, an outside drain will be constructed on the west side of the LMOC to collect surface water runoff. The design discharge for the outside drain will be based on the 1 in 10 year runoff event from the contributing area west of the channel alignment. To prevent erosion in this drain, maximum average velocities will be kept below 1.0 m/s during the design event. Rockfill gradient control structures may be constructed within the outside drain to reduce the velocities to meet this erosion criteria. After the outside drain has been excavated it will be revegetated in accordance with the RVMP. Once the outside drain is excavated and revegetated, permeable in-stream geosynthetic sediment barriers (check dams) may be placed, as required, to control the flow velocity and help to intercept and settle out any sediment that is mobilized.

A vegetated buffer will be maintained between the outside drain and the channel excavation spoil pile, where practicable. Silt fences will be used where vegetated buffer zones cannot be maintained effectively. Combined, these measures are expected to substantially reduce the potential for sediment transport along the drain.

Flows intercepted by the outside drain will be discharged into Lake Manitoba and Lake St. Martin. Temporary settling ponds may be considered, if practical, upstream of the discharge points to remove excess sediment or to reduce the TSS concentration of the discharge to the receiving water bodies.

5.2.2 Water Control Structure and Bridges

Construction work areas for the bridges and WCS will be isolated from channel construction activities to prevent surface water runoff from entering and to reduce the amount of groundwater depressurization pumping required.

Water quality within these work areas will be monitored and controlled, as required, to comply with the water quality criteria outlined in Section 3.2. Surface runoff within excavation areas will be directed to low areas of the excavation to allow any sediment to settle prior to being pumped to offsite receiving areas. Pump discharge points will be lined with clean rock or other acceptable flow dissipating applications, as required, to prevent erosion and the release of suspended sediments. Settling ponds will be constructed adjacent to the work areas, as deemed necessary, prior to discharge into the outside drain and/or the waterbodies east of the LMOC, or at alternate locations that may be approved by MI during construction.

5.2.3 Inlet and Outlet Works

The inlet works will consist of excavating the lake bottom within an approximately 100 m long by 200 m wide area of Lake Manitoba. The preliminary design assumes that this excavation will take place in the wet with the construction area isolated by a double turbidity curtain (i.e., two separate turbidity curtains) to prevent or minimize the migration of disturbed sediments into the lake during construction. Turbidity monitoring will be used to confirm the effectiveness of the measures and allow for adaptive management to be implemented if required. A fish salvage program will be required within the isolated area.

Installation and removal of the double turbidity curtain, as well as the excavation work itself, will comply with the Department of Fisheries and Oceans Canada (DFO) Restricted Activity Timing Windows (DFO, 2013), and will be completed in accordance with the conditions outlined in the DFO Authorization. Removal of the curtain would occur once monitored water quality parameters on both sides of the curtain are similar and meet the criteria outlined in Section 3.2.

Methods of construction within the area will be left to the contractor. Alternate construction methods may be proposed, such as isolating the area with a cofferdam that would be constructed behind a turbidity curtain. In this case, any water that must be pumped outside of the work area would be discharged into settling ponds, if necessary, prior to release into Lake Manitoba.

The outlet works will consist of excavating the lake bottom within an approximately 130 m long by 115 m wide area of Lake St. Martin. Construction activities and measures to manage surface water during construction will be similar to the inlet works and will comply with regulatory conditions.

6.0 OPERATION PHASE (PERMANENT MEASURES)

The permanent erosion and sediment control measures are those that are implemented for long-term, post construction erosion control. Permanent erosion and sediment control will consist primarily of the establishment of a permanent vegetative cover, as described in the RVMP. Critical areas such as the channel inlet and outlet, WCS and bridges will have additional methods of permanent erosion protection as described in Section 6.2.

The temporary erosion and sediment control measures described in Section 5.0 will be maintained post construction until vegetation has fully established. Additionally, the temporary measures may need to be re-implemented post construction following an extended operation period with WCS gates open, or other conditions that may result in the permanent vegetation not providing effective permanent erosion and sediment protection.

6.1 Constructed Channel

The LMOC is being designed to minimize the potential for bed erosion during operation at the design discharge by limiting the average channel velocities and shear stresses to the criteria adopted for the Project.

Disturbed areas throughout the entire length of the LMOC will be revegetated, except for the areas under permanent water cover, riprap, permanent roads, and concrete structures. Establishing and maintaining the vegetation cover on the side slopes of the channel and spoil piles is a key component to minimizing the long-term erosion potential. The revegetation plan is designed to provide a competent initial cover that will establish quickly to protect the base soil from erosion as the remainder of the permanent non-invasive perennial vegetation cover establishes, as described in the RVMP. It is based on the following:

- A seed mix consisting of permanent perennial native species and a quicker growing cover crop species (cereal crop) suited for the growing conditions.
- Seeding would occur in the spring months for optimal growth. Seeding would continue in the summer months with an adjusted seed mix to improve seed propagation. Seeding would not occur in the late summer/early fall as it would not likely yield enough growth to provide soil protection during fall, winter and early spring.
- Seeding with a fall prescription mix would take place after frost conditions are established and before snow hinders placement to allow early germination in the spring.
- Re-seeding would be required to compensate for the lack of vegetation cover success, if necessary.

Where possible, the Contractor's construction activities will be staged to keep the amount of un-vegetated surfaces during the excavation process to a manageable size.

The mode of operation of the LMOC is such that portions of the channel side slopes will experience alternating periods of submergence (wet) and exposure (dry). This may lead to a zone where vegetation may not survive or grow well, thus making these portions of the slopes potentially susceptible to erosion. Where flooding due to opening of the WCS gates causes substantial die off of planted vegetation, it is reasonable to expect that residual root systems that have been established will offer an interim temporary mode of erosion control while volunteer seedlings (or surviving plants) establish or recover and provide ground cover.

Plant species used in areas that will be seasonally inundated will be selected based on their inherent capability to withstand flooding as well as seasonal drought. The channel and outside drain need erosion control in both dry and wet conditions using dry and wet condition tolerant plants and seed mixes with appropriate successional rates and processes. Mitigation measures such as monitoring and adjustment of seed mixes, may be required to address the risk of poor vegetation growth on the portions of the channel side slopes that will experience alternating periods of submergence and exposure as a result of long-term operation of the LMOC.

Over time, areas along the channel that are continually flooded may favour the growth of annual weedy species and potentially the establishment of taller woody species including willow that may be able to access oxygen during periods of prolonged flooding. Routine inspection and maintenance of vegetation (mowing/cutting) will be undertaken to ensure the channel maintains hydraulic capacity in the long-term as discussed in the RVMP.

6.2 Other Project Components

The permanent erosion and sediment control measures required for the other project components that are part of the LMOC will also generally consist of revegetation consistent with that identified in Section 6.1. If there are specific areas in which vegetation is not appropriate or adequate for permanent erosion and sediment protection, other measures such as the placement of riprap, turf reinforcement mats, etc. may be utilized. Some specific areas in which vegetation will not provide the required level of protection and other methods for permanent erosion and sediment control will be required include:

- Gradient Control Structures – Gradient control structures may be necessary with the outside drain in areas where high erosive forces may be present to prevent erosion in the drain. The gradient control structures will be constructed of rockfill.
- Channel Inlet – Riprap protection will be provided along channel banks and shoreline near the channel inlet where the project is vulnerable to wave action.
- Channel Outlet – Riprap protection will be provided along the channel banks and shoreline near the channel outlet where the project is vulnerable to wave action.
- Drainage Overflow Structures – The capacity of the outside drain may be augmented by incorporating overflow structures at a few locations along the LMOC to allow for excess water to overflow into the channel during large runoff events. These overflow structures would be constructed of riprap in order to address erosion concerns.

- Water Control Structure – The channel bottom and side slopes upstream and downstream of the WCS will have permanent riprap erosion protection installed to address the higher velocities that will be present. The WCS also includes a concrete stilling basin to dissipate energy downstream of the structure.
- Bridges – The channel bottom and side slopes in the vicinity of each bridge will have permanent riprap erosion protection installed to address the higher velocities that will be present.

7.0 MONITORING

7.1 Construction Phase Monitoring

Surface water quality monitoring during construction of the LMOC is discussed in the SWMP, which will be undertaken to identify any changes that may result from construction activities and to assess the effectiveness of proposed erosion and sedimentation control measures. If the water quality criteria identified in Section 3.2 are exceeded and attributed to the project, then additional mitigation measures would be considered as described in Sections 8.0 and 9.0.

During the initial channel commissioning, a short-term temporary increase in suspended sediment concentration in the outlet area may occur due to the mobilization of several sources of material (i.e., loose material within the channel after construction, erosion of fine sands in Lake St. Martin downstream of the outlet, re-suspended sediment near the inlet, etc.). Accordingly, water quality monitoring in the LMOC and Lake St. Martin will be conducted during this period as discussed in the AEMP.

7.2 Operation Phase Monitoring

Surface water quality monitoring during the operation phase of the LMOC is discussed in the AEMP.

A short-term temporary increase in suspended sediment concentration in the outlet area may occur each time the WCS gates are first opened. The potential for this will be evaluated further prior to construction and, if need be, will be incorporated into the monitoring program provided in the AEMP.

8.0 ADAPTIVE MANAGEMENT AND FOLLOW-UP

8.1 General

A follow up process is a form of adaptive management to improve practices by learning about their effects and then making changes in those practices as new information is available. The federal Impact Assessment Act defines a follow up program as "a program for verifying the accuracy of the impact assessment of a designated project and determining the effectiveness of any mitigation measures." An associated Operational Policy Statement (https://www.canada.ca/content/dam/iaac-acei/documents/ops/ops-follow-up-programs-2011.pdf) indicated that "a follow-up program is used to:

- verify predictions of environmental effects identified in the environmental assessment
- determine the effectiveness of mitigation measures in order to modify or implement new measures where required
- support the implementation of adaptive management measures to address previously unanticipated adverse environmental effects
- provide information on environmental effects and mitigation that can be used to improve and/or support future environmental assessments including cumulative environmental effects assessments, and
- support environmental management systems used to manage the environmental effects of projects."

As discussed in Section 12.4.1.2 of the EIS, construction activities and the changes in flows and water levels caused by the Project may have minor effects on fluvial geomorphology, sediment and debris transport, in the surface water LAA, but primarily during and immediately after construction. Suspended sediment levels may temporarily increase at work sites during construction activities, and at outlet areas during initial operation (gates open) of the outlet channels after a period of non-operation (gates closed). As such, the purpose and objectives of follow-up activities will be to monitor and further understand the residual effects due to the Project.

Although the methods and recommendations outlined in the SMP were developed based on site specific expectations and conditions, it is accepted that these conditions are subject to change. For example, weather conditions and climate change will inevitably drive some of the design decisions during implementation and long-term operation. By employing adaptive management strategies, assumptions used in the initial design will be evaluated and management practices modified in response to the outcomes during the project construction period and subsequent operation phase based on baseline investigations, follow-up monitoring and reporting.

Adaptive management uses the Project designs while learning from field performance to manage risk and allow the incorporation of new knowledge into subsequent steps. The foundation of this process relies on data input and implementation of sound monitoring programs. Based on the monitoring results and feedback

during construction, temporary mitigation measures described in this SMP, as well as those included in the SWMP and RVMP, should be revisited and updated, as required. For example, if the establishment of vegetation following excavation work is more difficult than expected, alternate vegetating methods may be considered, or additional temporary erosion control measures may be warranted. Adaptive management will play an important role in acknowledging and working through management challenges in the presence of uncertainty.

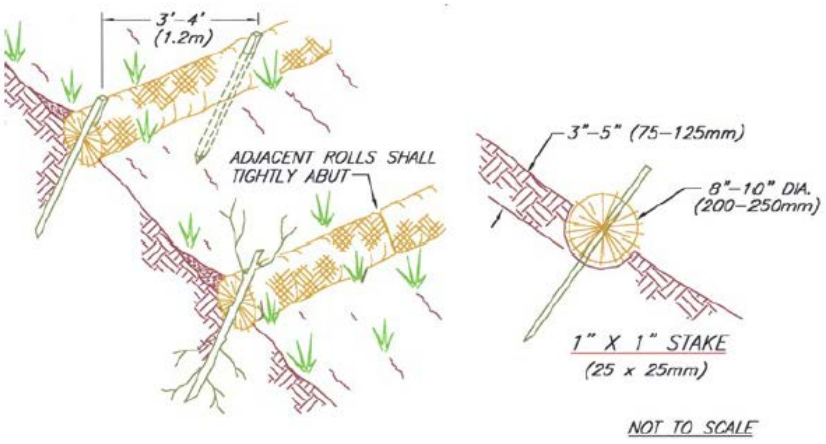
8.2 Follow Up Response

As described in Section 7, monitoring will include visual inspections, and water quality monitoring as part of the SWMP and AEMP. The data and analyses generated by monitoring will be used to provide information on the effectiveness of mitigation measures, aid in the validation of predicted residual effects, and provide data and results required for environmental licensing requirements. These plans will include management thresholds developed as part of the monitoring plan and may utilize regulated criteria, input from stakeholders, and consideration of findings from applicable management plans.

Based on the management thresholds, there are various follow up activities that could be implemented for any of the construction activities, in the context of erosion control and sediment management. They are listed below. Several of these measures could also be implemented during the operation phase, depending on the specific situation that must be addressed.

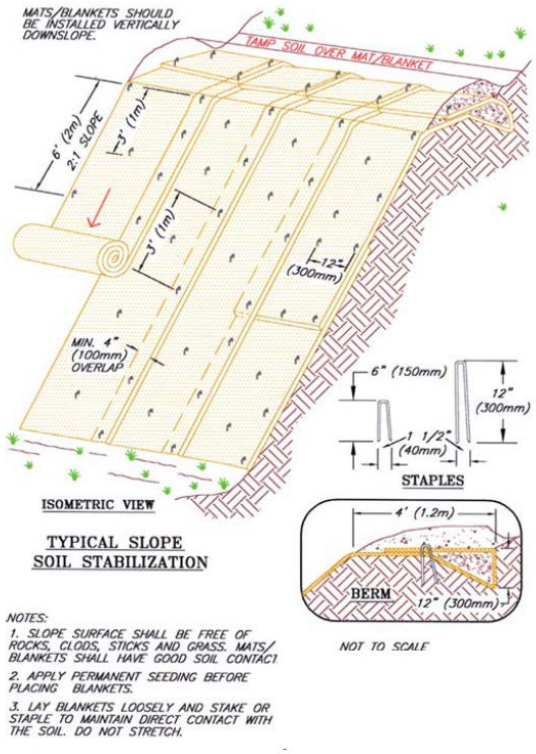
- Straw rolls/wattles could be considered as alternate measure or in addition to the slope interrupters. Typical details are shown in Figure 5.
- Erosion control blankets could be used in critical areas where erosion potential is concentrated. Lining exposed areas with erosion control blankets was not considered for widespread application, as it would be very costly given the amount of area to cover. Typical details are shown in Figure 6.
- Spray mulches and bonded matrix could be substituted for straw mulch areas that require special treatment or access for straw mulch is limited. Concerns associated with the high cost and poor success rates when the products are applied during periods of the year when temperatures are near or below freezing would need to be overcome.
- Turbidity curtains or filter systems could be installed in locations where there is water with flow velocities slow enough to ensure effective filtration of suspended sediment.
- Rapid stabilization techniques that could include the placement of riprap and tackifiers (i.e., soil bonding agents).
- Dewatering techniques and/or pumping to decanting areas.

Figure 5: Typical Straw Roll Detail



Note: Details may vary.

Figure 6: Typical Erosion Control Blanket Details



Note: Details may vary.

- Additional slope interrupters if the specified number does not meet requirements to control runoff.
- Additional sediment controls such as silt fencing or filter/check dams.
- Supplementary seeding or additional agronomic measures, such as irrigation, to promote the temporary and permanent re-vegetation on finished sections of the completed channel.
- Modification of the excavation schedule to adapt to weather conditions or limit overall exposed excavation areas.

9.0 CONTINGENCY MEASURES AND EMERGENCY RESPONSE

Adaptive management and follow up plans discussed in the previous section are implemented based on initial monitoring of the effectiveness of the "base" erosion and sediment control measures with adjustments made as needed. The "base" erosion and sediment control measures will be designed and maintained in good working order to manage conditions arising from the design event, as described in Section 3.3.

Contingency measures and emergency response plans will be developed in the event that the "base" erosion and sediment control measures are overwhelmed during a severe runoff event greater than the design. Contingency planning will also be incorporated for unexpected events such as, but not limited to, an uncontrolled breach of a settling pond or failure of a turbidity curtain. Many of the contingency measures will be similar to those identified as part of adaptive management in Section 8.0.

In the event of an emergency during construction, the Contractor and design team will determine which contingency and emergency control measures will be implemented. These measures would be carried out within a predetermined time period depending on the site conditions and nature of the emergency. It should be noted that in the event of an excessive precipitation event during construction, runoff would generally be contained to the area within the excavation.

During the operation phase, the channel will be resistant to large precipitation events through vegetation and armoring. Nevertheless, contingency and emergency control measures will be implemented by MI, depending on the site conditions and nature of the emergency, with due consideration given to the Operations & Maintenance (O&M) manual that will be developed for the Project prior to the operation phase.

10.0 REFERENCES

Department of Fisheries and Oceans (DFO). December 27, 2013. Manitoba Activity Timing Windows for the Protection of Fish and Fish Habitat [online]. Available from https://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/mb-eng.html [accessed October 29, 2020].

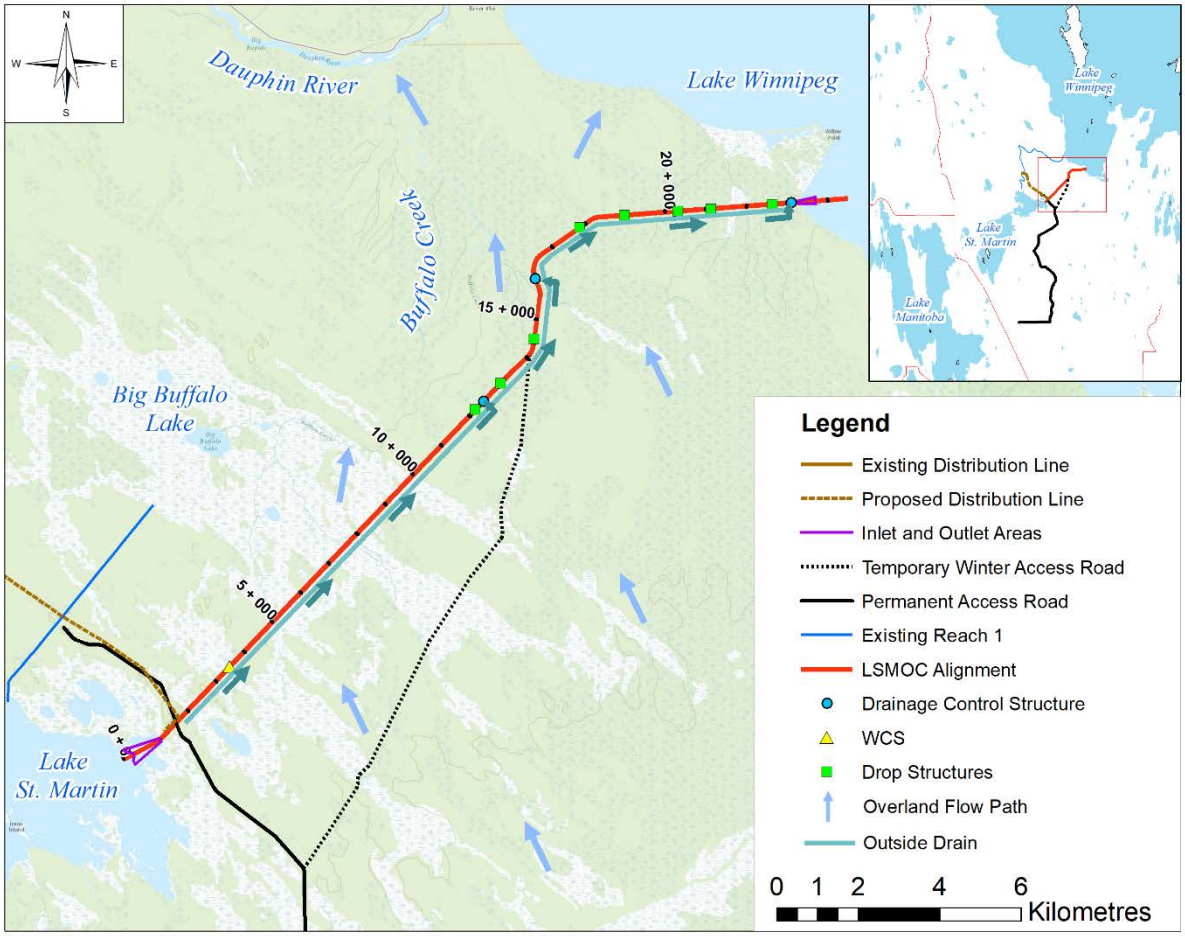
Part 3: Lake St. Martin Outlet Channel

11.0 PROJECT INFORMATION

11.1 Project Description

The LSMOC Project consists of an approximately 23 km long outlet channel, with the inlet positioned at the east end of Lake St. Martin and the outlet south of Willow Point on Sturgeon Bay of Lake Winnipeg. A plan showing the LSMOC and key project infrastructure is provided in Figure 7.

Figure 7: Overview Plan of the LSMOC



The LSMOC will have a capacity of 326 m^3/s at a Lake St. Martin south basin water level of 244.14 m and is designed to convey flows up to the Inflow Design Flood (IDF), considering the intent of the Canadian Dam Association Dam Safety Guidelines. A 1:1000-year flood event has been assumed for the IDF and will be updated at detailed design based on the results of a detailed dam safety classification and dam breach assessment.

The proposed channel will have an invert elevation of about 241 m at Lake St. Martin and about 213 m at Lake Winnipeg and designed to limit erosion. The design is based on a trapezoid shaped channel with a flat base approximately 42 m wide, 6 to 8 m depth and 4H:1V to 4.5H:1V side slopes. The hydraulic profile of the channel will require the lake bottoms to be excavated at the channel inlet and outlets to match proposed channel invert elevations. The excavations will be tapered over a short distance out from shoreline to meet natural lake bed elevations.

At the outlet, rock jetties will be situated over the first 100 m distance to reduce the potential for debris accumulation and sediment deposition within the excavation limits from littoral drift during non-operation of the channel. The length of the jetties was selected to limit sedimentation within the deepest portion of the outlet when the water control structure is closed, while also limiting the length of the structures to minimize its footprint and cost. Sand from the lake that may be moving in the area is expected to freely deposit beyond the extent of the jetties when the channel is not in operation, which would then likely be transported further into the lake when the channel is operated again. The process of sand deposition and transport is not expected to be significant but would repeat itself each time the LSMOC is operated. Since the movement of sand along the shoreline is a naturally occurring process, a long-term plan for maintenance (e.g., dredging) was not included at the preliminary design phase. This will be reviewed during detailed design with input from the environmental approval and engagement process. The exact length and configuration of the jetties will also be refined at detailed design based on updated results from the shoreline morphology assessment.

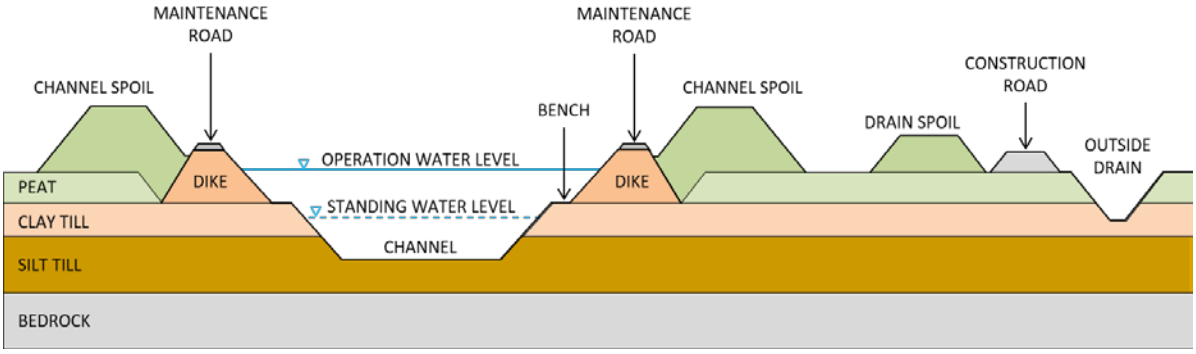
At the inlet, results from a baseline shoreline morphology indicated a low wave energy environment in the area. It was therefore concluded that rock fill jetties are not likely required and were therefore omitted from the preliminary design of the inlet works. Since there is a minimal potential for sand to migrate into the area, a long-term plan for maintenance is not anticipated.

Permanent water retaining dikes will be located on both sides of the excavated channel to contain design flows within the LSMOC and also to isolate the surface water and the upper saturated peat system from the excavated channel. Spoil piles for the excavated material will be located outside of the channel dikes.

An outside drain will be constructed on the east side of the project to intercept the surface water runoff flowing towards the LSMOC.

Access for long term maintenance and inspection will be available on top of the dikes on both sides of the LSMOC for the entire 23 km with a maintenance road. A typical cross section for the LSMOC is provided in Figure 8.

Figure 8: Typical Cross Section of the LSMOC



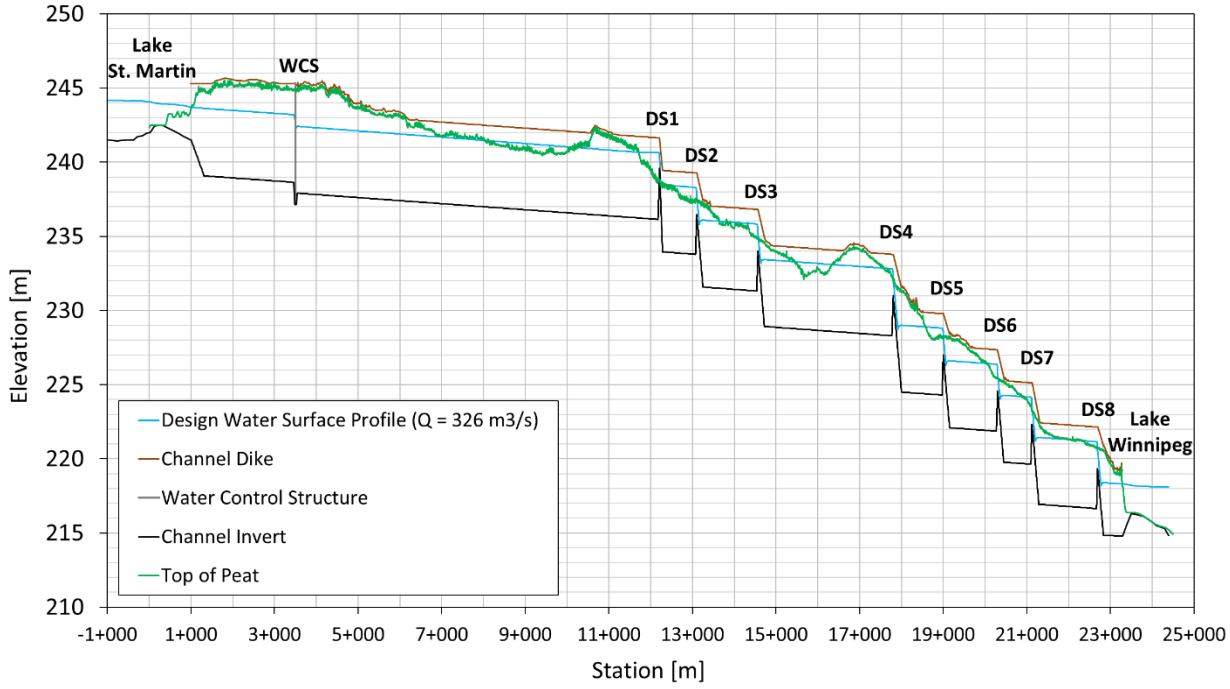
A water control structure is required to control flows through the LSMOC while ensuring that Lake St. Martin water levels remain within their planned range. The structure will be constructed near the inlet, although the exact location of the structure will be confirmed at detailed design. It will also act as a bridge to provide access to both sides of the channel. The water control structure will be a concrete structure with two 9 m wide sluice bays, guides and sill beams for upstream stoplogs, vertical lift gates and downstream stoplogs.

The LSMOC will require approximately eight drop structures to minimize channel flow velocity and erosion in areas of steep sloping terrain. The drop structures will be constructed of rockfill, with a sheet pile cutoff at the upstream crest. When the water control structure gates are closed, a minimum one-meter depth of water will be maintained in the channel to minimize the growth of aquatic vegetation. Near the drop structures, the minimum water depth during non-operation will be at least 2.0 m to maintain a pool of water below the surface ice cover during the winter, to minimize potential impacts to aquatic habitat (fish).

A base flow will be provided through the water control structure with gated conduits to maintain appropriate water quality conditions (oxygen levels) in the channel.

The hydraulic profile for the LSMOC is provided in Figure 9. Additional project details, including design information and drawings, are available with the preliminary design.

Figure 9: Hydraulic Profile of the LSMOC



11.2 LSMOC Operation

When the LSMOC is in operation, the water level in the channel increases. This can affect surface water drainage and erosion and sediment control measures. The range in water levels expected within the LSMOC and frequency of operation were therefore considered for developing the permanent erosion and sediment control measures described in this SMP.

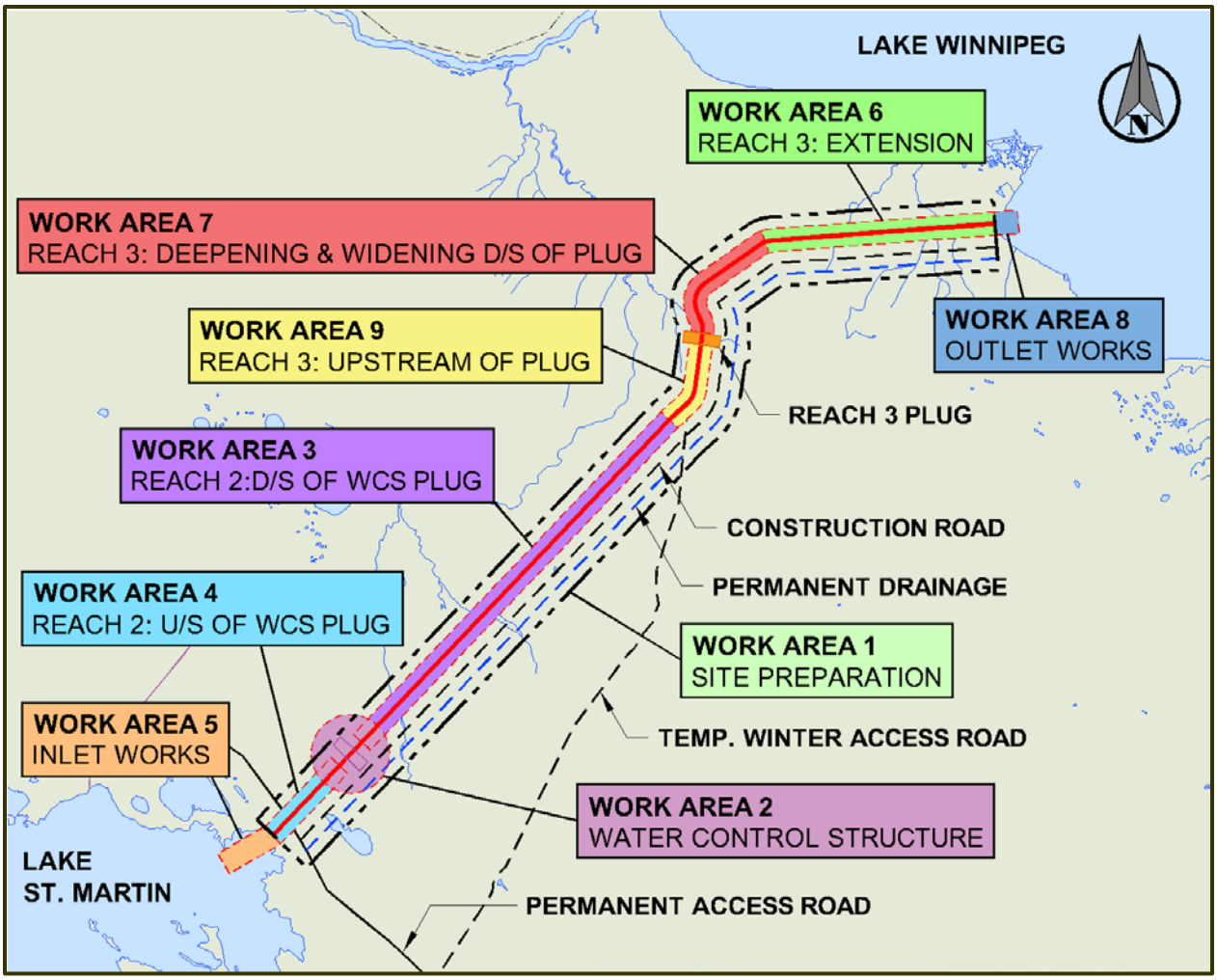
The LSMOC is designed to be operated in both open water and ice-covered conditions. Based on historic lake levels and inflows, MI has simulated the operation of the LSMOC for the 103-year period from 1915 to 2017. Results indicate that the LSMOC would have been operated approximately 22% of the time (days), and in 38 years of the 103-year period. The average duration of operation was approximately one year and the average discharge in the channel during periods of operation was 130 m^3/s.

11.3 Sequence of Construction

A preliminary construction sequencing plan has been developed for the project as part of preliminary design. A brief summary has been included below as it provides a basis for developing the SMP for the construction phase of the project.

The project has been subdivided into the nine work areas shown on Figure 10. The work areas were numbered considering the preliminary sequencing plan.

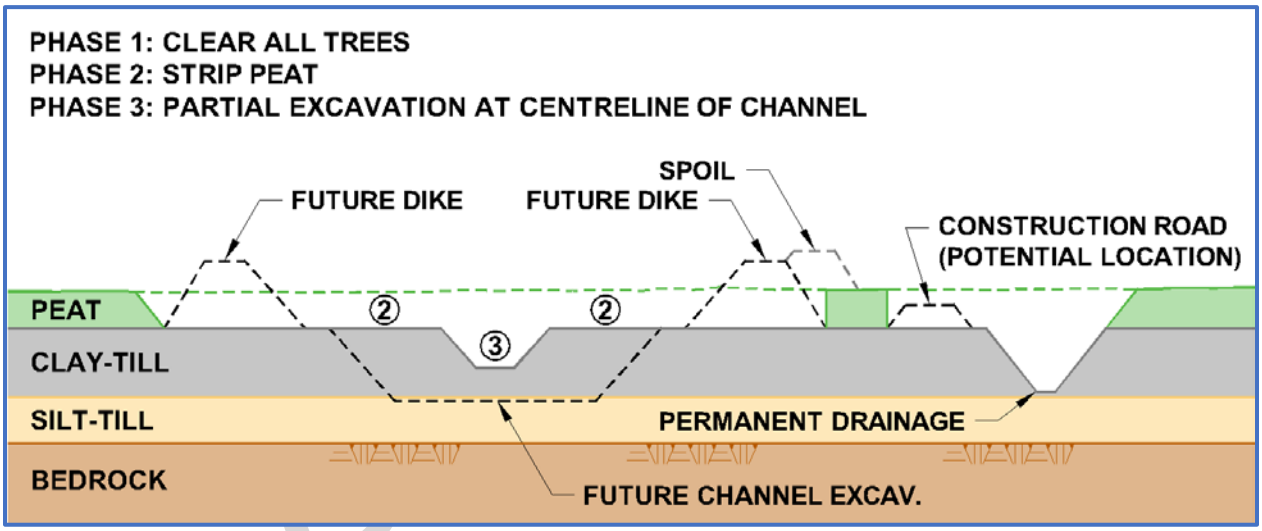
Figure 10: Overview of Work Areas for Construction and Preliminary Sequencing of Work



Work Area 1 – Site Preparation and Peat Excavation must be tendered first. It is a critical path activity to be undertaken before construction can begin in the other work areas. Tree clearing, peat excavation, and construction access road development is best done in the winter months allowing for access over the peatland, simplifying water and sediment management requirements, and avoiding interference with the nesting window for migratory birds. It is important to construct permanent drainage to the east of the channel and excavate the peat within the channel/dike footprint early in construction to reduce (but not eliminate) surface water runoff and groundwater seepage into the work area, as well as to promote drainage within the channel construction limits thus improving access to the underlying mineral soils. Overland drainage from the east side will be collected in the permanent outside drainage ditch and routed towards Buffalo Creek during construction.

A partial pilot ditch along the centerline of the channel (within the mineral soil) is proposed to collect and drain seepage/surface runoff entering the excavation area during construction, particularly in Reach 2 and the Reach 3 Extension where there is currently no existing excavation. This will improve drainage of the materials underlying peat and promote better access conditions for the subsequent earthworks contracts. Figure 11 shows the assumed construction sequencing for Work Area 1.

Figure 11: Construction Sequencing for Work Area 1



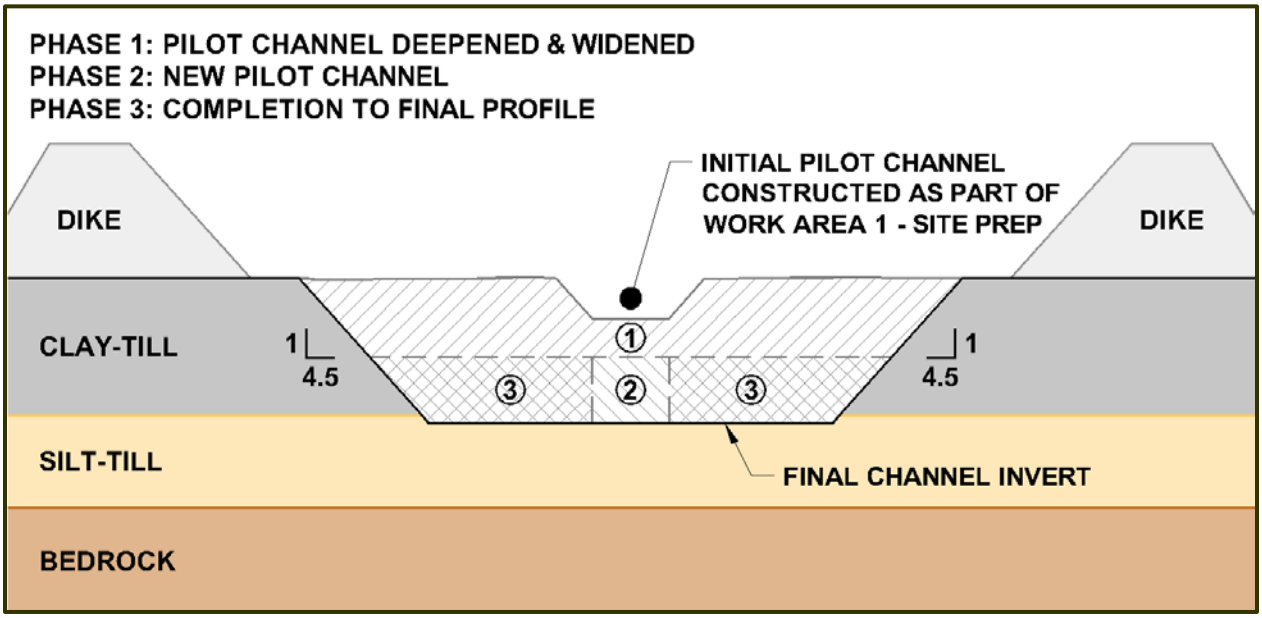
Work Area 2 - The Water Control Structure, will likely be tendered as a stand-alone contract due to the unique scope of work included. Localized excavation and foundation preparation are required for construction of the WCS. Due to high bedrock piezometric pressures (at times artesian) within the bedrock aquifer in this area, an active depressurization system will be required to limit the risk of excavation basal heave and to control, monitor and dewater the work area.

Work Areas 3 to 9 - The remaining work areas (3 to 9) could be tendered separately, or in different combinations based on contractor capabilities and consideration of the increased complexity of managing multiple contracts.

Earthwork activities are planned to start at the downstream end of the construction reach, gradually progressing up the channel, to promote gravity drainage of the work areas. The existing plug in Reach 3 will facilitate the isolation of Work Areas 6, 7 and 8 from Work Areas 3 and 9 to help manage drainage during construction. The existing plug in Reach 3 maintains natural flow patterns towards Buffalo Creek and provides an opportunity to start channel excavation in Work Area 7 and Work Area 3 independently and simultaneously. Once Work Area 7 is completed, the plug in Reach 3 can be removed, allowing Work Area 9 to be dewatered (by gravity drainage) for construction. Alternate construction sequencing plans will also be considered during detailed design, including the option of discharging flows towards Buffalo Creek by utilizing the existing Reach 3 emergency channel.

Due to high bedrock piezometric pressures along the channel alignment, excavation activities are expected to advance in stages to manage risks associated with basal heave and fracturing of the till aquitard. The anticipated excavation sequence within the mineral soil (following peat excavation) is shown in the schematic on Figure 12. Stage 1 involves advancing channel excavation at full width to a level where the risk of basal heave is considered acceptable. Stage 2 involves advancing a new pilot channel to full depth along the channel centerline. The intent is to promote concentration of potential interconnections between the bedrock aquifer and channel invert (i.e., fracturing of the till) along the centreline while improving drainage to the remaining excavation areas moving toward the excavation slopes (Stage 3). Stage 3 involves expanding the new pilot ditch to full width, completing the excavation to the final geometry.

Figure 12: Channel Excavation Phases



Construction of the channel dikes and associated channel excavation used as fill source, will need to occur above freezing temperatures to facilitate subgrade preparation and material compaction. The remaining channel excavation activities could occur at any time. Construction of the drop structures can occur at the contractor's discretion during or after completion of channel excavation. Drainage control structures will be constructed at the same time as dike construction.

Upstream of the WCS, construction of Work Area 4 is expected to occur towards the end of the project to maintain access towards Reach 1 until the WCS is completed and also to maintain a natural barrier between Lake St. Martin and the WCS.

The inlet and outlet works (Work Areas 5 and 8) were assumed to start construction in the summer, outside of the restricted spring (April 1 to June 15), summer (May 1 to June 30) and fall (September 15 to April 30) fish spawning windows. The in-water works to be conducted outside of these restricted windows includes the installation and removal of the cofferdams. Construction activities in the area isolated from the lakes will

then proceed at the discretion of the contractor for approximately a one-year period. Alternate construction methods will also be considered at detailed design, including construction behind a double turbidity curtain or winter excavation in locations where the lake ice freezes to the lake bottom.

Each work area will have associated roadworks and revegetation which can occur as soon as possible as channel excavation and dike construction advances.

12.0 CONSTRUCTION PHASE (TEMPORARY MEASURES)

The following general construction management practices are key components of the temporary erosion and sediment control measures.

- Construction staging and sequencing will be coordinated to maximize excavation in each work area while minimizing the time of exposure for newly excavated slopes. This will be accomplished by restricting excavation to within manageable units.
- Implementation of erosion and sediment control measures such as silt fences, slope roughening techniques, slope terracing, runoff management, and straw mulching. These will be specified on construction drawings and will be implemented in accordance with Project Environmental Requirements (PERs) for Erosion and Sediment Control and Working Within or Near Water.
- A vegetated buffer zone will be maintained where possible as it can reduce erosion and sediment transport by more than 90% (USDA-NRCS, Connecticut Technical Guide). Along the LSMOC, existing vegetation on either side of the right of way (ROW) will act as a natural vegetated buffer zone between the construction site and existing receiving water bodies and streams such as Lake St. Martin and Lake Winnipeg, or any tributary of Buffalo Creek. A vegetated buffer will also be maintained between the outside drain and the channel excavation spoil pile, where practicable.
- Exposed areas will be revegetated directly after finished grade is established and minimize the amount of over-winter exposed surfaces. Planting will commence immediately upon completion of a section of LSMOC to maximize the potential for growth and establishment of a vegetative cover. The revegetation is considered to be part of the permanent erosion and sediment control measures, discussed in Section 13.0.
- Disturbance to adjacent vegetated areas for buffering suspended sediment will be minimized.

It should be noted that the channel design features such as shallow side slopes will help minimize the erosion and sediment generated during construction. The sections which follow provide further detail on erosion and sediment control measures that will be applied during the construction of the various components of the LSMOC.

12.1 Main Channel Excavation and Dike Construction

The temporary erosion and sediment control measures are based on accepted construction industry practice to minimize erosion and sediment transport to receiving water bodies. Specifications and drawings for LSMOC construction will be prepared during detailed design and customized for each individual contract as required.

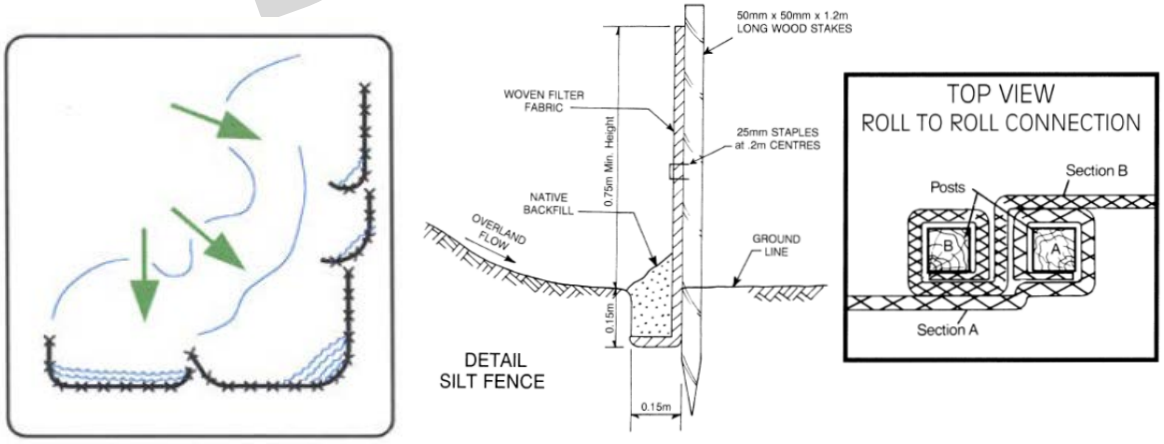
The temporary erosion and sediment control measures design was defined by establishing perimeter and intermediate measures and defining potential contingency measures. A definition of each of these terms is given below.

- Perimeter erosion and sediment control measures are implemented at the onset to enclose the designated construction area.
- Intermediate erosion and sediment control measures are implemented during construction and are the focus of this section.
- Adaptive management measures are the erosion and sediment control measures that would be implemented in the event that one or more of the intermediate measures fails to perform as expected. These are described in Section 15.0.
- Contingency measures would be implemented in the event of an emergency condition that would overwhelm the "base" erosion and sediment control measures, for example, due to a storm event that exceeds the selected design event. These are described in Section 16.0.

12.1.1 Perimeter Controls

The best method for establishing and maintaining a perimeter around exposed areas, such as staging areas and material stockpiles, is with a vegetated buffer zone. For the LSMOC, where vegetated buffer zones or intermediate controls described in Section 12.1.2 cannot be maintained effectively, installation of silt fencing will be considered. Location and placement of the silt fences will be carefully selected to prevent additional erosion due to undercutting or end-cutting of the fence. Installation of the silt fences would adhere to typical industry specifications, with a typical detail as shown on Figure 13.

Figure 13: Typical Silt Fencing Detail

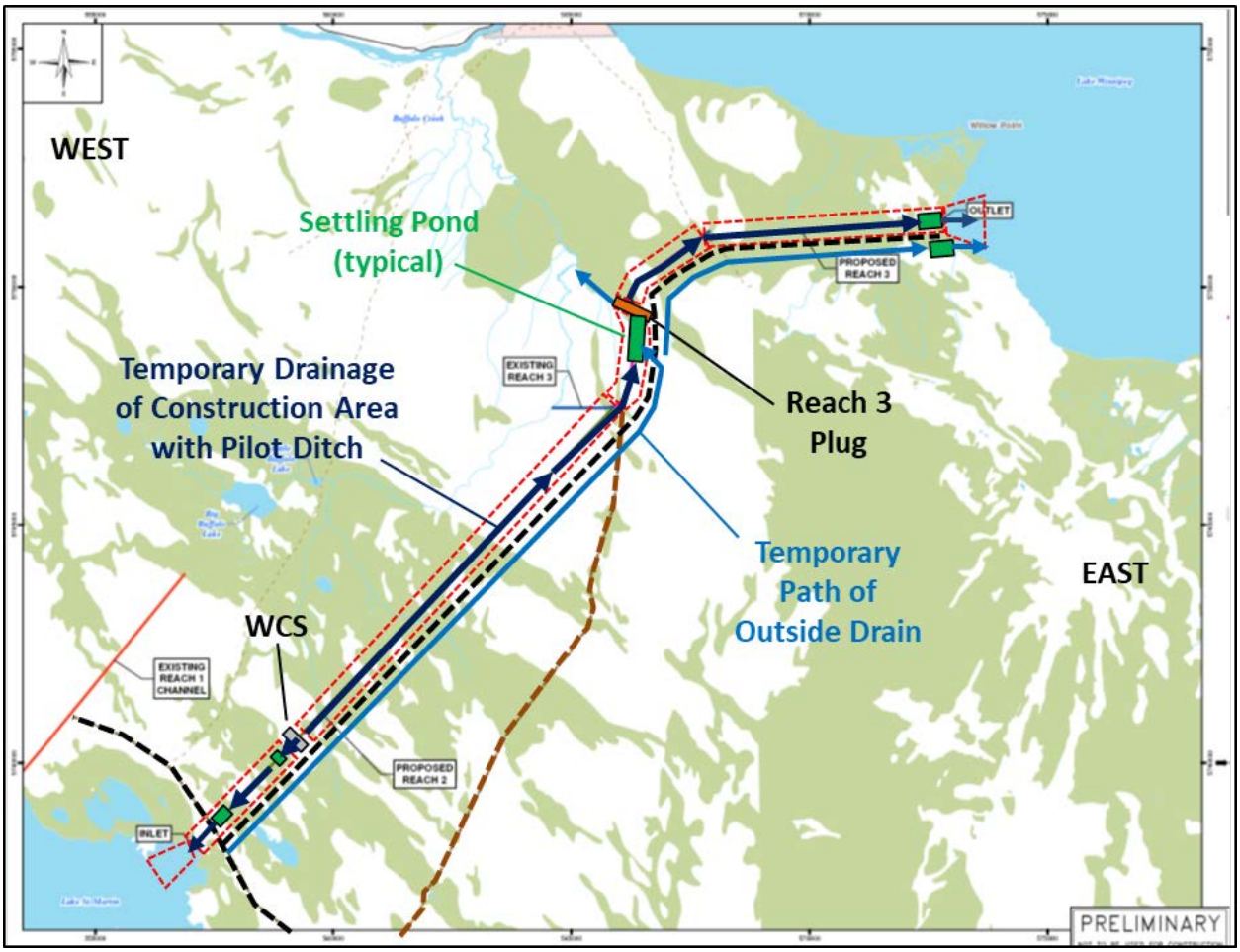


Note: Details may vary.

In addition to silt fences, surface water runoff from the construction area that must be discharged offsite will be released to settling ponds, filtering systems or through dense terrestrial vegetation of sufficient distance from waterbodies or streams to reduce the potential of sediment release downstream of the construction area, or as directed by the Engineer to minimize effect based on current and evolving site conditions. Potential locations where settling ponds will be considered are shown in Figure 14. The storage capacity of each sediment pond will be defined according to the total run-off volume from the design storm event, as

described in Section 3.3. Pump discharge points will be lined with clean rock or other acceptable flow dissipating applications, as required, to prevent erosion and the release of suspended sediments.

Figure 14: Temporary Drainage Plan with Preliminary Settling Pond Locations



12.1.2 Intermediate Controls

Intermediate controls will be developed as the channel excavation proceeds with a full set of controls in-place upon completion of excavation and before revegetation begins. As the excavation progresses downward to the final grade, slope roughening techniques on exposed side slopes will be implemented. Slope roughening will be accomplished by harrowing the final graded surface, which is part of the revegetation plan.

Re-establishing the vegetation cover in the LSMOC is fundamental to minimizing the erosion potential during both the construction and operation phases of the LSMOC. After each month of excavation within the planting season the final grade will be prepared and revegetated according to the appropriate revegetation prescription as outlined in the RVMP. A component of the RVMP includes a temporary cover species that will

provide a quick temporary cover that will protect the bare soil from erosion. It is assumed that the newly seeded vegetation will yield a sufficient root mass within 30 to 60 days, which will result in reducing the erosion potential by 50%. Even with a 10% grass cover, erosion potential can be reduced by up to 65% (MTO, 1997). It is considered that the newly seeded vegetation will be fully effective with one full season of growth, that is, if approximately 95% ground cover is achieved after one year, the vegetation will reduce the erosion potential by up to 99%. However, even if only a 50% ground cover is achieved after one year, the erosion potential could be reduced by approximately 85%. On a contingency basis, alternative seed mixtures and/or planting practices (use of irrigation) will minimize the amount of open excavation exposed to erosion and sediment transport risk. These contingency measures are discussed in the RVMP.

Additional intermediate controls will also be considered in the completed excavation area and will be developed during detailed design based on an assessment of sediment that could be generated and the final construction contracting strategy. This may involve the use of the Modified Universal Soil Loss Equation, which is an event-based methodology for estimating the quantity of erosion from a given land use including construction sites. Additional intermediate controls may include:

- Slope interrupters may be constructed at regular intervals (10 m) cross-slope on the channel and spoil embankment slopes. These can be effectively constructed with a grader or dozer with an adjustable blade to create a deep furrow into the side slope. Slope interrupters are not intended to trap or filter sediment, but they will serve to minimize further slope erosion protecting against deep rills or gullies by interrupting flow of runoff down the slope.
- Straw mulch treatment may be considered outside of the channel after the surface has been seeded with vegetation. The straw mulch would be anchored/crimped into the surface of the soil. The straw mulch helps protect the slope against erosion, but also provides an enhanced environment to promote quick growth of the grass seed. Other environmentally friendly types of topical spray on mulches may also be considered, where appropriate.

The temporary erosion and sediment control measures discussed above will be left in place while the temporary cover species vegetation and the permanent vegetation are re-established. A number of other erosion and sediment control methods will be considered as alternatives for use as adaptive management or contingency measures if the base approach measures do not perform as expected. Further discussion of these adaptive management and contingency measures is provided in Sections 15.0 and 16.0.

12.2 Other Project Components

Temporary erosion and sediment control measures will be required for the other project components that are part of the LSMOC, which include:

- Outside Drain
- Various types of structures
- Inlet and Outlet works

An overview description of the temporary erosion and sediment control measures for each component listed above is provided in the following subsections. Adaptive management and/or contingency and emergency response measures for these components are described in Sections 15.0 and 16.0.

12.2.1 Outside Drain

As part of the site preparation project works, an outside drain will be constructed on the east side of the LSMOC to collect surface water runoff. The design discharge for the outside drain will be based on the 1 in 10 year runoff event from the contributing area east of the channel alignment. To reduce the potential for erosion in this drain, allowable velocities and shear stress will not exceed the design criteria, as defined in Section 3.3. Five gradient control structures will be constructed along the outside drain to meet this erosion criteria. After the outside drain has been excavated it will be revegetated in accordance with the RVMP. Once the outside drain is excavated and revegetated, permeable in-stream geosynthetic sediment barriers (check dams) may be placed, as required, to control the flow velocity and help to intercept and settle out any sediment that is transported into the drain.

A vegetated buffer will be maintained between the outside drain and the channel excavation spoil pile, where practicable. In addition, silt fences will be considered where vegetated buffer zones cannot be maintained effectively. Combined, these measures will substantially reduce the potential for sediment transport along the drain.

During construction, intercepted flows will be discharged towards Buffalo Creek and Lake Winnipeg with a temporary outlet protected with riprap, as deemed necessary. Temporary settling ponds may be considered upstream of the discharge points, as previously shown in Figure 14, to remove excess sediment or to reduce TSS concentration of the discharge to the receiving water bodies.

12.2.2 Structures

Various types of structures will be constructed as part of the project, including a WCS, multiple drop structures, and drainage control structures. Construction of structures will be isolated from channel construction activities to prevent surface water runoff from entering the work area and therefore reduce the potential for erosion and sedimentation. For all structures, dewatering activities will be required during construction to collect surface water runoff within the work area. At the WCS, dewatering is also required to address groundwater depressurization requirements, as described in the GWMP. Water quality within the work areas will be monitored and controlled, as required, to comply with the criteria outlined in Section 3.2. Settling ponds will be constructed adjacent to the work area, as deemed necessary, prior to discharge towards Buffalo Creek, into the temporary outside drain or at alternate locations to be approved by MI during construction. Pump discharge points will be lined with clean rock or other acceptable flow dissipating applications, as required, to prevent erosion and the release of suspended sediments.

12.2.3 Inlet and Outlet Works

Inlet works will consist of excavating the lake bottom within an approximately 800 m long by 400 m wide area of Lake St. Martin. The construction area will be surrounded with a temporary rock plug or cofferdam to allow work activities to be isolated from the lake preventing release of any deleterious substances. Riprap protection will be incorporated into the design to protect the plug/cofferdam against wave action. A turbidity curtain will be temporarily installed in Lake St. Martin outside of the rock plug/cofferdam, as required, to prevent or minimize the migration of sediments into the lake during their installation/removal. A fish salvage program will be required within the isolated area. Once construction of the LSMOC is complete, the rock plug/cofferdam will be removed in part or in whole, as required and in accordance with environmental requirements.

Installation and removal of the turbidity curtain, as well as the construction and removal of the cofferdam, will comply with the Department of Fisheries and Oceans Canada (DFO) Restricted Activity Timing Windows (DFO, 2013), and will be completed in accordance with the conditions outlined in the DFO Authorization.

Installation of a double turbidity curtain, in lieu of a rock plug/cofferdam, will also be considered depending on the preferred construction methods to be determined during detailed design. Winter construction may also be considered where the lake typically freezes to bottom to help improve constructability. With winter construction, the potential for erosion and sedimentation is significantly reduced.

Outlet works will consist of excavating the lake bottom within an approximately 200 m long by 200 m wide area of Lake Winnipeg. Construction activities and measures to manage surface water, erosion and sedimentation during construction will be similar to the inlet works. In addition to the excavation, groins extending into Lake Winnipeg will be constructed to control the longer-term migration of sediment. Similar erosion control methods will be used to manage sediment during the construction of these structures.

Turbidity monitoring will be used at both the inlet and outlet locations to confirm the effectiveness of the measures and allow for adaptive management to be implemented if required.

13.0 OPERATION PHASE (PERMANENT MEASURES)

The permanent erosion and sediment control measures are those that are implemented for long-term post construction erosion control. Permanent erosion and sediment control will consist primarily of the establishment of a permanent vegetative cover, as described in the RVMP. Critical areas such as the channel inlet and outlet, WCS and drainage control structure inlets and outlets will have additional methods of permanent erosion protection as described in Section 13.2.

The temporary erosion and sediment control measures, described in Section 12.0, will be maintained post construction until vegetation has fully established. Additionally, the temporary measures may need to be implemented post construction following an extended operation period with WCS gates open, or other conditions that may result in the permanent vegetation not providing effective permanent erosion and sediment protection.

13.1 Constructed Channel and Dikes

The LSMOC is being designed to minimize the potential for bed erosion during operation at the design discharge by limiting the average channel velocities and shear stresses to the criteria adopted for the Project.

Establishing and maintaining the vegetation cover on the side slopes of the channel and spoil piles is a key component to minimizing the long-term erosion potential. The revegetation plan is designed to provide a competent temporary coverage within 60 days of planting, given reasonable growing conditions, with a permanent non-invasive perennial vegetation coverage established for the previous year's excavation, as described in the RVMP. It is based on the following:

- A seed mix consisting of permanent perennial native species and a temporary cover crop species (cereal crop) suited for the growing conditions.
- The planting season would be from mid-May to mid-June for the native species and to late August for the cover crop. Planting after September will not likely yield enough growth to provide soil protection during fall, winter, and early spring.
- Areas that are excavated following the end of the typical growing season in a year will be seeded after October 15th of that year during the dormant seeding window until frost or snow inhibits seed placement. This will ensure that there is vegetation growth in the spring even in the event that conditions are not suitable to allow for seeding during the spring period.
- Re-seeding would be required to compensate for the lack of vegetation cover success, if necessary.

Where possible, the Contractor's construction activities will be staged to ensure that manageable areas of un-vegetated surface will be specified and maintained during the excavation process.

The revegetation plan for the LSMOC consists of two zones, an upper berm and lower berm zones, to reflect the different environmental conditions that will be present during the operation phase. The zones are defined largely by an anticipated gradient in moisture availability from the uplands to the side slopes, as follows:

- The upper berm zone includes sites that will regularly be subjected to drought conditions during dry summer months, however, in extreme wet conditions these sites may also experience flooding for short periods (three to four days). Species planted in this zone will include drought tolerant native grasses well-suited to upland sites and local climatic conditions. Several species in this mix will also have a degree of flood tolerance to account for flooding potential.
- The lower berm zone includes channel and drain side-slopes that will be periodically flooded during heavy rainfall periods and channel operation. In times of water deficit, this zone may also be subjected to extended periods of drought. To account for these moisture variations, the seed mix will be designed using species capable of tolerating inundation as well as those adapted to drought conditions.

The final RVMP will include plant species suited to the anticipated site conditions with some overlap in species selected for each zone to accommodate seasonal moisture variations.

Disturbed areas including those areas along the side slopes, ditch bottoms, and back slopes throughout the entire length of the project will be revegetated. To make the most efficient use of seeding opportunities and to minimize exposure of prepared sites to further erosion, seeding will commence immediately upon completion of final grading operations. Areas to be seeded will be prepared by decompacting the subsoil, placement of stockpiled organics and integration of the organics into the subsoil by harrowing. Following preparation the permanent native grasses and/or cover crop will be seeded in accordance with the planting windows. Seed bed preparation and seeding operations will be carried out parallel to the centreline of the channel to discourage erosion. Further details are provided in the RVMP.

The mode of operation of the LSMOC is such that portions of the channel side slopes will experience alternating periods of submergence (wet) and exposure (dry). This may lead to a zone where vegetation may not survive or grow well, thus making these portions of the slopes potentially susceptible to erosion. Where flooding due to opening of the WCS gates causes substantial die off of planted vegetation, it is reasonable to expect that residual root systems that have been established will offer an interim temporary mode of erosion control while volunteer seedlings (or surviving plants) establish or recover and provide ground cover.

Plant species used in areas that will be seasonally inundated have been selected based on their inherent capability to withstand flooding as well as seasonal drought. The channel and outside drain need erosion control in both dry and wet conditions using dry and wet condition tolerant plants. Mitigation measures such as monitoring and adjustment of seed mixes, as discussed in the RVMP, may be required to address the risk of poor vegetation growth on the portions of the channel side slopes that will experience alternating periods of submergence and exposure as a result of long-term operation of the Project.

Over time areas along the channel that are continually flooded may favour the growth of annual weedy species and potentially the establishment of taller woody species including willow that may be able to access

oxygen during prolonged flooding. Routine inspection and maintenance of vegetation (mowing/cutting) will be undertaken to ensure the channel maintains hydraulic capacity in the long-term as discussed in the RVMP.

13.2 Other Project Components

The permanent erosion and sediment control measures required for the other project components that are part of the LSMOC will also generally consist of revegetation consistent with that discussed in Section 13.1. If there are specific areas in which vegetation is not appropriate or adequate for permanent erosion and sediment protection, other measures such as the placement of riprap, turf reinforcement mats, etc. may be utilized. Some specific areas in which vegetation will not provide the required level of protection and the other methods for permanent erosion and sediment control will be required include:

- Rock Fill Drop Structures – The LSMOC will require eight drop structures to minimize channel flow velocity and erosion in areas of steep sloping terrain. The drop structures will be constructed of rockfill, with a sheet pile cutoff at the upstream crest.
- Gradient Control Structures – Five gradient control structures will be constructed along the outside drain to minimize flow velocities and erosion in areas of steep sloping terrain. The gradient control structures will be constructed of rockfill.
- Channel Inlet – Riprap protection will be constructed along channel banks and shoreline near the channel inlet where the project is vulnerable to wave action.
- Channel Outlet – Rock jetties and riprap protection will be constructed along the channel banks and shoreline near the channel outlet where the project is vulnerable to wave action. The jetties will also limit sedimentation from natural shoreline morphology processes within the deepest portion of the outlet.
- Drainage Control Structures – Specific areas near the inlet and outlet of these structures will require the placement of riprap protection.
- Water Control Structure – The channel bottom and side slopes upstream and downstream of the WCS will include riprap to provide permanent erosion protection. The WCS also includes a concrete stilling basin to dissipate energy downstream of the structure.

14.0 MONITORING

14.1 Construction Phase Monitoring

Surface water quality monitoring during construction of the LSMOC is discussed in the SWMP, which will be undertaken to identify any changes that may result from construction activities and to assess the effectiveness of proposed erosion and sedimentation control measures. If the water quality criteria identified in Section 3.2 are exceeded and attributed to the project, then additional mitigation measures would be considered as described in Sections 15.0 and 16.0.

During the initial channel commissioning, a short-term temporary increase in suspended sediment concentration in the outlet area may occur due to the mobilization of several sources of material (e.g., loose material within the channel after construction, erosion of fine sands in Lake Winnipeg downstream of the outlet, etc.). Accordingly, water quality monitoring in the LSMOC and Lake Winnipeg will be conducted during this period as discussed in the AEMP.

14.2 Operation Phase Monitoring

Surface water quality monitoring during the operation phase of the LSMOC is discussed in the AEMP.

A short-term temporary increase in suspended sediment concentration in the channel may occur each time the WCS gates are first opened. The potential for this will be evaluated further prior to construction and, if need be, incorporated into the monitoring program provided in the AEMP.

15.0 ADAPTIVE MANAGEMENT AND FOLLOW-UP

15.1 General

A follow up process is a form of adaptive management to improve practices by learning about their effects and then making changes in those practices as new information is available. The federal Impact Assessment Act defines a follow up program as "a program for verifying the accuracy of the impact assessment of a designated project and determining the effectiveness of any mitigation measures." An associated Operational Policy Statement (https://www.canada.ca/content/dam/iaac-acei/documents/ops/ops-follow-up-programs-2011.pdf) indicated that "a follow-up program is used to:

- verify predictions of environmental effects identified in the environmental assessment
- determine the effectiveness of mitigation measures in order to modify or implement new measures where required
- support the implementation of adaptive management measures to address previously unanticipated adverse environmental effects
- provide information on environmental effects and mitigation that can be used to improve and/or support future environmental assessments including cumulative environmental effects assessments, and
- support environmental management systems used to manage the environmental effects of projects.

As discussed in Section 12.4.1.2 of the EIS, construction activities and the changes in flows and water levels caused by the Project may have minor effects on fluvial geomorphology, sediment and debris transport, in the surface water LAA, but primarily during and immediately after construction. Suspended sediment levels may temporarily increase at work sites during construction activities, and at outlet areas during initial operation (gates open) of the outlet channels after a period of non-operation (gates closed). As such, the purpose and objectives of follow-up activities will be to monitor and further understand the residual effects due to the Project.

Although the methods and recommendations outlined in the SMP were developed based on site specific expectations and conditions, it is accepted that these conditions are subject to change. For example, weather conditions and climate change will inevitably drive some of the design decisions during implementation and long-term operation. By employing adaptive management strategies, assumptions used in the initial design will be evaluated and management practices modified in response to the outcomes during the project construction period and subsequent operation phase based on baseline investigations, follow-up monitoring and reporting.

Adaptive management uses the initial designs while learning from field performance to manage risk and allow the incorporation of new knowledge into subsequent steps. The foundation of this process relies on data input and implementation of sound monitoring programs. Based on the monitoring results and feedback

during construction, temporary mitigation measures described in this SMP, as well as those included in the SWMP and RVMP, should be revisited and updated, as required. For example, if the establishment of vegetation following excavation work is more difficult than expected, alternate vegetating methods may be considered, or additional temporary erosion control measures may be warranted. Adaptive management will play an important role in acknowledging and working through management challenges in the presence of uncertainty.

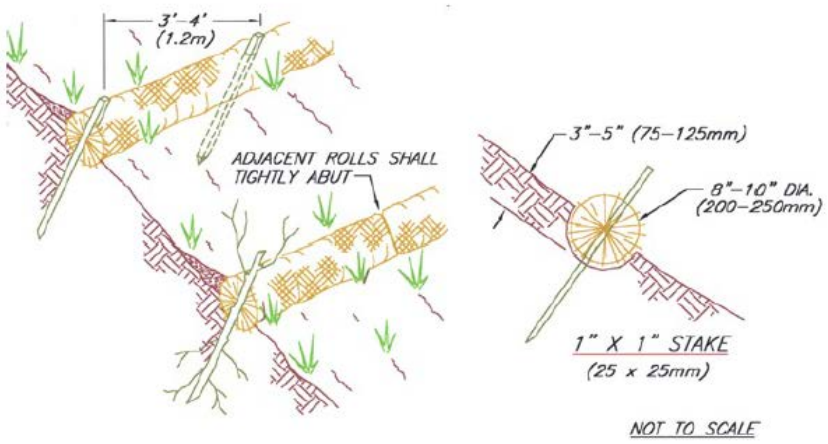
15.2 Follow Up Response

As described in Section 14, monitoring will include visual inspections, and water quality monitoring as part of the SWMP and AEMP. The data and analyses generated by monitoring will be used to provide information on the effectiveness of mitigation measures, aid in the validation of predicted residual effects, and provide data and results required for environmental licensing requirements. These plans will include management thresholds developed as part of the monitoring plan and may utilize regulated criteria, input from stakeholders, and consideration of findings from applicable management plans.

Based on the management thresholds, there are various follow up activitiesthat could be implemented for any of the construction activities, in the context of erosion control and sediment management. They are listed below. Several of these measures could also be implemented during the operation phase, depending on the specific situation that must be addressed.

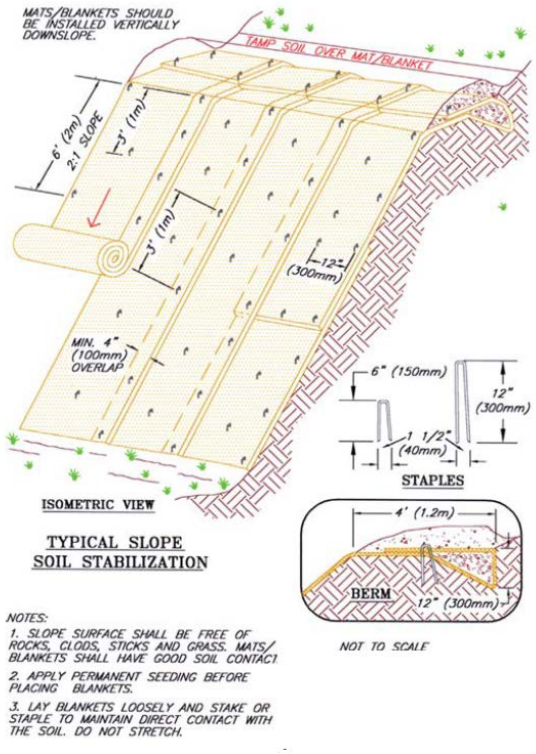
- Straw rolls/wattles could be considered as alternate measure or in addition to the slope interrupters. Typical details are shown in Figure 15.
- Erosion control blankets could be used in critical areas where erosion potential is concentrated. Lining exposed areas with erosion control blankets was not considered for widespread application, as it would be very costly given the amount of area to cover. Typical details are shown in Figure 16.
- Spray mulches and bonded matrix could be substituted for straw mulch areas that require special treatment or access for straw mulch is limited. Concerns associated with the high cost and poor success rates when the products are applied during periods of the year when temperatures are near or below freezing would need to be overcome.
- Turbidity curtains or in channel filter systems could be installed in locations where there is water with flow velocities slow enough to ensure effective filtration of suspended sediment.
- Rapid stabilization techniques that could include the placement of rip rap and tackifiers (i.e., soil bonding agents).
- Dewatering techniques and/or pumping to decanting areas.

Figure 15: Typical Straw Roll Detail



Note: Details may vary.

Figure 16: Typical Erosion Control Blanket Details



Note: Details may vary.

- Additional slope interrupters if the specified number does not meet requirements to control runoff.
- Additional sediment controls such as silt fencing or filter/check dams.
- Supplementary seeding or additional agronomic measures, such as irrigation, to promote the temporary and permanent revegetation on finished sections of the completed channel.
- Modification of the excavation schedule to adapt to weather conditions or limit overall exposed excavation areas.

16.0 CONTINGENCY AND EMERGENCY RESPONSE PLANNING AND CONTROLS

Adaptive management plans discussed in the previous section are implemented based on initial monitoring of the effectiveness of the "base" erosion and sediment control measures with adjustments made as needed. The "base" erosion and sediment control measures will be designed and maintained in good working order to manage conditions arising from the design event, as described in Section 3.3.

Contingency measures and emergency response plans have been developed in the event that the "base" erosion and sediment control measures are overwhelmed during a severe runoff event greater than the design. Contingency planning will also be incorporated for unexpected events such as, but not limited to, an uncontrolled breach of a settling pond or failure of a turbidity curtain. Many of the contingency measures will be similar to those identified as part of adaptive management in Section 15.0.

In the event of an emergency during construction, the Contractor and design team will determine which of the contingency and emergency control measures will be implemented. These measures would be carried out within predetermined time period depending on the site conditions and nature of the emergency.

During the operation phase, the channel will be resistant to large precipitation events through vegetation and armoring. Nevertheless, contingency and emergency control measures will be implemented by MI, depending on the site conditions and nature of the emergency, with due consideration given to the Operations & Maintenance (O&M) manual that will be developed for the Project prior to the operation phase.

17.0 REFERENCES

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