LAKE MANITOBA
LAKE ST. MARTIN

OUTLET CHANNELS PROJECT

MANITOBA INFRASTRUCTURE

Lake Manitoba and Lake St. Martin Outlet Channel Project Wetland Compensation Plan

December 6, 2020

Manitoba

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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 should 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 Wetland Compensation 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 confirm 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 an 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 Environmental 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.

In Manitoba, wetland compensation is administered under the Water Rights Act, the intent of the Wetland Compensation Plan is to describe the amount and type of provincial wetlands that may be directly impacted through construction and/or operation of the Project, and it will also describe how key provincial policies will be applied.

GLOSSARY OF TERMS AND ACRONYMS

Acronyms

Following is a list of acronyms likely to be used:

%	Percent
AEMP	Aquatic Effects Monitoring Plan
CCME	Canadian Council of Ministers of the Environment
CEAA	Canadian Environmental Assessment Act
CEMP	Construction Environmental Management Plan
DEM	Digital Elevation Model
DO	Dissolved Oxygen
DTW	Depth to Water Index
EIS	Environmental Impact Statement
EMP	Environmental Management Program
EOC	Emergency Outlet Channel
EOSD	Earth Observation for Sustainable Development
GWMP	Groundwater Management Plan
ha	Hectares
km	Kilometre
LCC	Land Cover Classification
LAA	Local Assessment Area
LiDAR	Light Detection and Ranging
LMOC	Lake Manitoba Outlet Channel
LSMOC	Lake St. Martin Outlet Channel
m	Metre
MCC	Manitoba Conservation and Climate
MHHC	Manitoba Habitat Heritage Corporation
MI	Manitoba Infrastructure

MSD	Manitoba Sustainable Development
MWQSOGs	Manitoba Water Quality Standards, Objectives and Guidelines
NDVI	Normalized Difference Vegetation Index
NDWI	Normalized Difference Water Index
OEMO	Operation Environmental Management Program
PDA	Project Development Area (or Footprint)
Project	Lake Manitoba and Lake St. Martin Outlet Channel Project
RAA	Regional Assessment Area
RGB	Red, Green, and Blue (bands of light)
RMP	Revegetation Management Plan
SAR	Species at Risk
SARA	Species at Risk Act
SOCC	Species of Conservation Concern
SWMP	Surface Water Management Plan
TIA	Transportation Infrastructure Act
TWI	Topographic Wetness Index
WCP	Wetland Compensation Plan (or the Plan)
WCS	Water Control Structure
WMP	Wildlife Monitoring Plan
WRA	Water Rights Act

Glossary of Terms

This list and definition of terms is to be developed as each Management Plan is written and reviewed. Following is an example of a glossary term:

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.

Aquifer: A body of rock or sediment that is sufficiently porous and permeable which contains 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.

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.

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.

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

Peatland: Refers to:

(a) a bog, fen or swamp, and

(b) has waterlogged conditions that prevent plan material from fully decomposing, resulting in the production of organic matter exceeding its decomposition causing in a net accumulation of peat.

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

Stewart and Kantrud system: A wetland classification system that identifies 5 classes of prairie wetlands (Manitoba Sustainable Development 2020). The class is determined by the length of time that the wetland holds surface water in a year of average moisture conditions and the associated vegetation and soils.

- Class I: short-lived wetlands (retains water for one week or less), mainly existing in spring after winter snow melts or big rains, typically supporting vegetation such as Kentucky bluegrass, goldenrod, forbes.
- Class II: short-lived wetlands (retains water for one week to one month), mainly existing in spring after winter snow melts or big rains, typically supporting vegetation such as fine stemmed grasses, sedges and forbs.
- Class III: semi-permanent or seasonal, meaning that it retains water for one month to three months, often dry by mid-June but may hold water for the entire year, often lasting fewer than five months; typically supporting shallow marsh vegetation such as emergent wetland grasses, sedges and rushes on gleysolic soils.
- Class IV: semi-permanent, meaning that it retains water for more than three months, holds some water year round under wetter conditions but go dry in below average years, often lasting more than five months; typically supporting marsh vegetation and submerged aquatic vegetation such as cattails, bulrushes and pond weeds in the central area of the wetland as on gleysolic soils.
- Class V: permanent, meaning that it retains water year round in average years with permanent open water in the central areas, but may go dry in years with well below average moisture conditions; typically having a central area that is open water free of vegetation surrounded be a zone of submerged aquatic vegetation such as cattails, bulrushes and pond weeds on gleysolic soils.

Surface water: Water that is on the Earth's surface, such as in a stream, river, lake, or reservoir.

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

Wetland: Refers to:

> (a) a marsh, bog, fen, swamp or ponded shallow water, and
>
> (b) low areas of wet or water-logged soils that are periodically inundated by standing water and that are able to support aquatic vegetation and biological activities adapted to the wet environment in normal conditions.

Wetland conservation: The protection of both an existing wetland and its function through the restriction of development activities in and adjacent to the natural feature

Wetland restoration: The practice of restoring water levels and/or the function of a wetland that has been altered, degraded, impaired, or lost.

1.0 INTRODUCTION (MI)

Wetlands are recognized by the Province of Manitoba as integral components of a watersheds, providing numerous flood control and ecological benefits. Manitoba's Water Strategy (Manitoba 2003) outlines how wetland enhancement and restoration are important conservation goals. The objective of Manitoba's water conservation planning is to conserve and manage the lakes, rivers, groundwater and wetlands of Manitoba so as to protect the ability of the environment to sustain life and provide environmental and economic benefits, along with other values to existing and future generations. The Made-in-Manitoba Climate and Green Plan (Manitoba Sustainable Development 2017) identifies wetlands and watersheds as a keystone to Manitoba's plan; it emphasizes the importance of protecting wetlands and watersheds to preserve habitat and wildlife and to provide natural drainage features in a time of climate change and flooding. Wetland enhancement and restoration are among the measures being adopted as a component of natural and green infrastructure and the potential carbon offset programs (Manitoba Sustainable Development 2017). The steps being taken by the Province, and more specifically by Manitoba Infrastructure (MI) with respect to the Lake Manitoba and Lake St. Martin Outlet Channel Project (the Project), are consistent with to The Water Rights Act C.C.S.M. c. W80 (WRA; or the Act) and provide formalized protection for wetlands in Manitoba.

1.1 Purpose and Objectives

The purpose and objectives of this Wetland Compensation Plan (WCP, or the Plan) was outlined in the Lake Manitoba and Lake St. Martin Outlet Channels Project Environmental Impact Statement (EIS; MI 2020a) submitted by Manitoba Infrastructure in March 2020. This Plan describes the process by which those wetlands that will be affected through construction and operation of the Project will qualify for mitigation, monitoring and/or compensation. This Plan also provides an overview with respect to the monitoring of wetlands that are planned to occur along and adjacent to the Project Development Area (PDA).

The overall objectives of the Plan are to:

- Outline MI's approach for wetland compensation as it pertains to this Project.
- Summarize the key findings of the wetland mapping and field investigations (WSP 2020a) as they pertain to the determination of wetlands that qualify for compensation.
- Describe legislated approach to wetland compensation in Manitoba
- Outline follow-up and monitoring measures to be adopted for other wetlands that do not meet the criteria as requiring wetland compensation.

1.2 Background

The Lake Manitoba and Lake St. Martin Outlet Channel Project (the Project) is a flood mitigation project located approximately 220 km northwest of the City of Winnipeg (Figure 1) and consists of two new diversion channels: the Lake Manitoba Outlet Channel (LMOC) and the Lake St. Martin Outlet Channel (LSMOC). 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. The Project is located within

and extends northeast of the Rural Municipality of Grahamdale in Manitoba's Interlake region, an area within the Boreal Plains Ecozone.

The Lake Manitoba Outlet Channel (LMOC) will extend approximately 24 km from Watchorn Bay on Lake Manitoba northeast to Birch Bay on Lake St. Martin in an area characterized by agricultural lands. The terrain is generally flat, with a distinct north to south trending drumlinoid or ridged and swale topography formed from subglacial deposition, with slopes of 1% to 3% (WSP 2020a). Ridges are generally well drained with upland forest vegetation, while the swales are poorly drained and support wetland communities (Figure 2).

The PR239 alignment follows an existing municipal road for much of its length, and is bordered by agricultural lands (primarily cropland or pasture uses).

The Lake St. Martin Outlet Channel (LSMOC) extends about 24 km between the northeastern most extent of Lake St. Martin and Sturgeon Bay on Lake Winnipeg (Figure 3). This area is currently considered semi-remote as road access is currently seasonal. The LSMOC and the proposed distribution line are on Crown lands (within Treaty 2 lands) in the southern part of the Mid-Boreal Lowland Ecoregion, an area smoothed by clay, silt and sand glacial deposits that support poorly drained flat bogs and horizontal fens (WSP 2020a).

The Project EIS indicated that no wetland class will be lost from the region and made the following key statements regarding wetlands pertinent to this Plan:

- The effects from the LMOC and PR 239 realignment will be offset by wetland compensation (as per Manitoba legislation).
- Wetlands south of Lake St. Martin will undergo further wetland mapping – this occurred in 2020 and was extended to include all project development areas (WSP 2020a).
- Monitoring of the effectiveness of wetland-related mitigation measures will occur.

Figure 1: Project Area

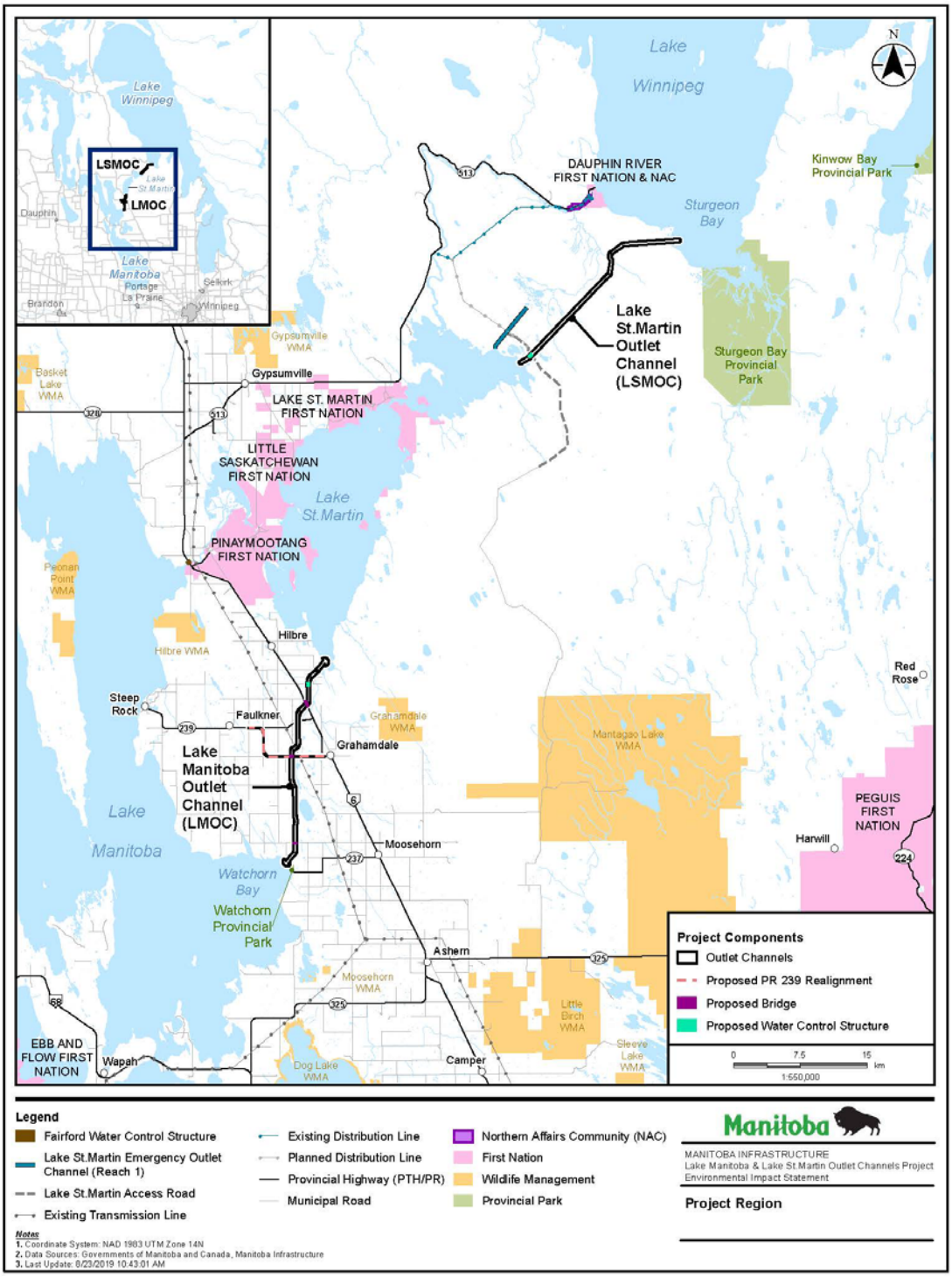


Figure 2: Wetlands in the LMOC Area

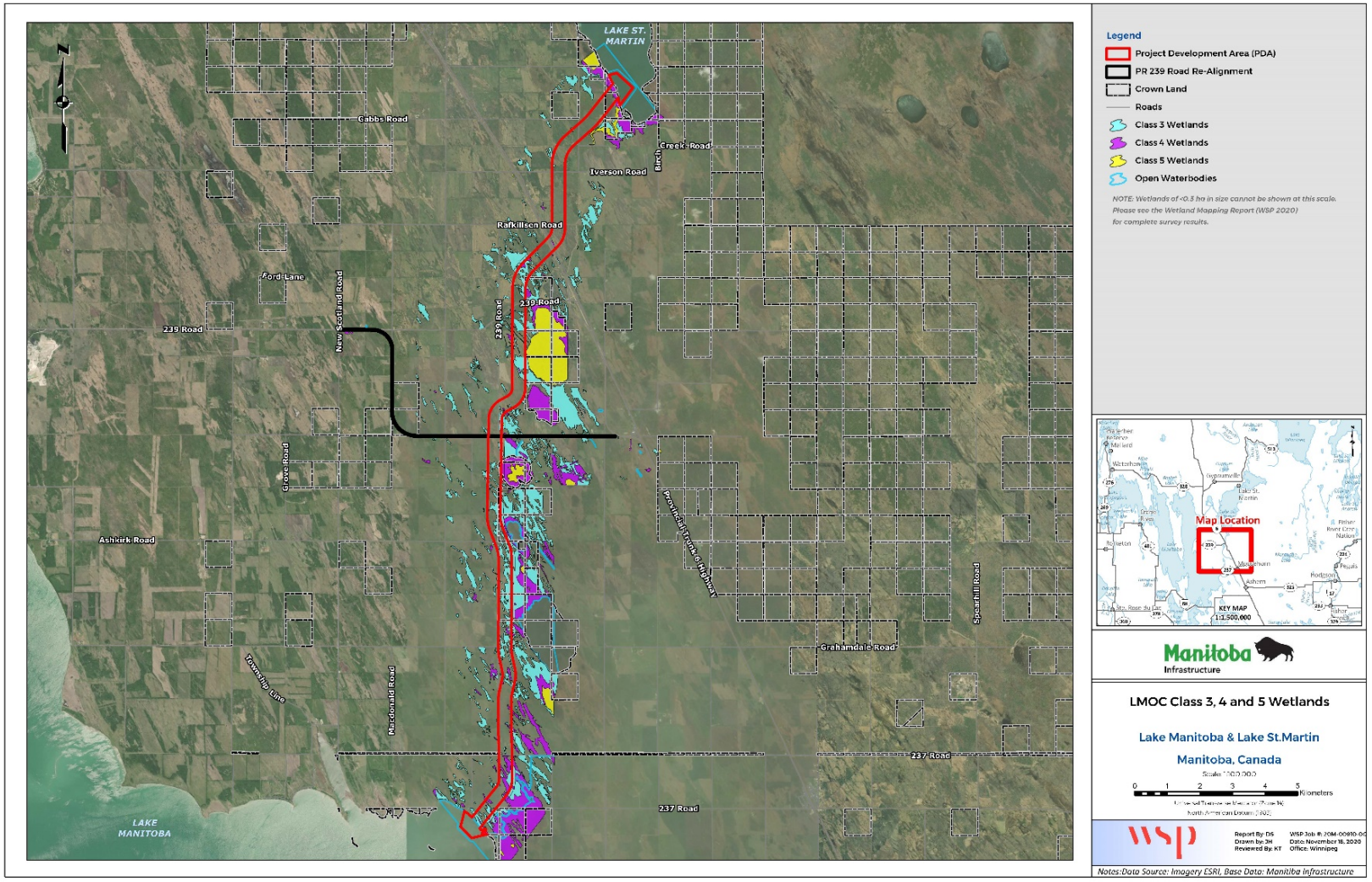
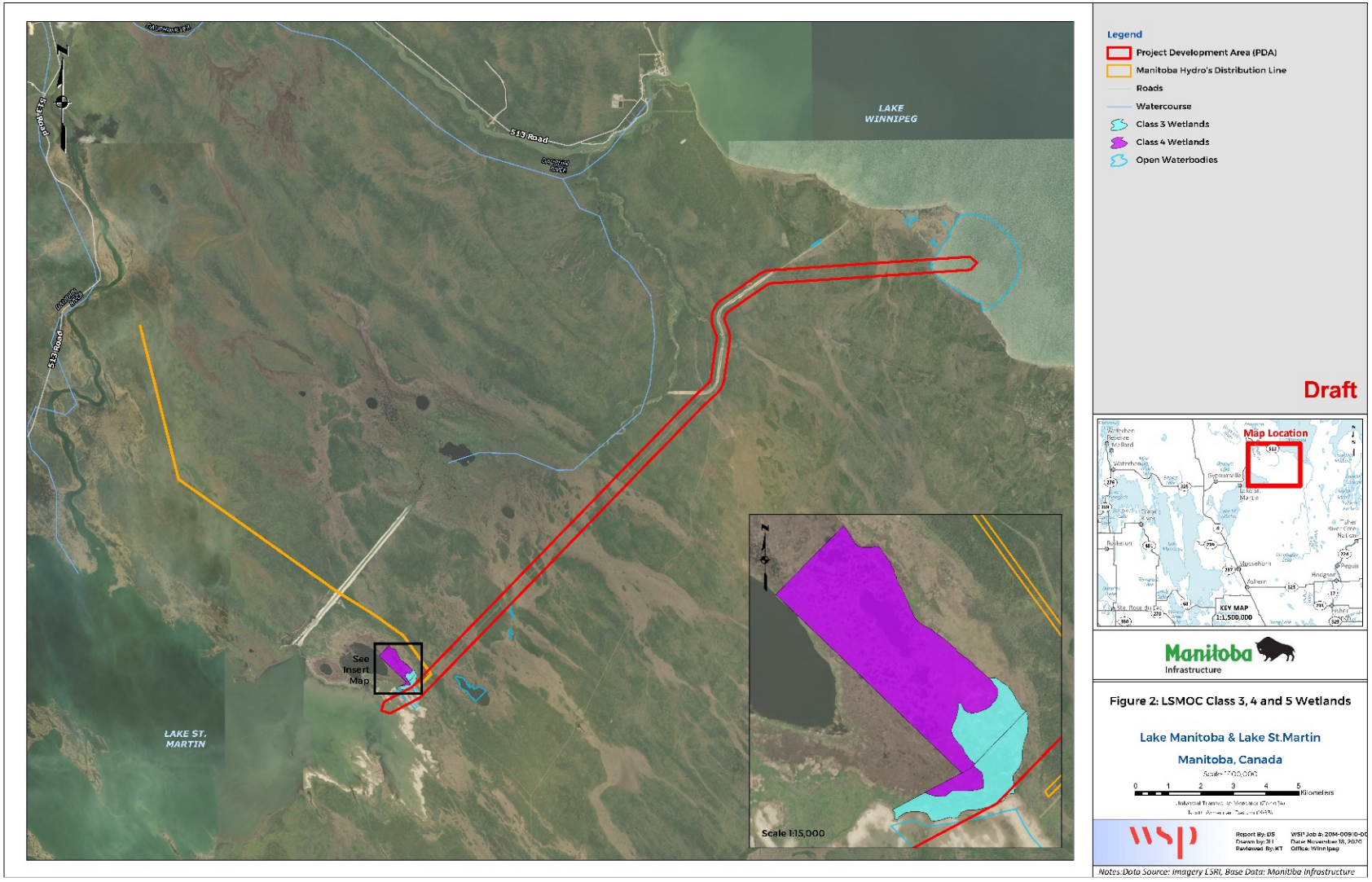


Figure 3: Wetlands in the LSMOC Area



Regulatory Requirements

The proposed Project is a designated project under the Canadian Environmental Assessment Act, 2012 (CEAA, 2012), and therefore requires an Environmental Assessment. Pursuant to Section 15(d) of the CEAA, 2012, the Impact Assessment Agency of Canada (the Agency) is the authority responsible for federal review of the proposed Project and they issued Guidelines for the Preparation of an EIS for the Project. Other key federal legislation, under which approvals may be required, includes the Fisheries Act, Canadian Navigable Waters Act (formerly the Navigation Protection Act), Migratory Birds Convention Act and Species at Risk Act (SARA).

The proposed Project is considered a 'Class III' development under the Classes of Development Regulation (164/88) of The Environment Act (Manitoba) and therefore requires an Environment Act Licence. Manitoba Conservation and Climate's (MCC, formerly Manitoba Sustainable Development) Environmental Approvals Branch is the authority responsible for provincial review of the proposed Project and they provided Environmental Impact Statement Guidelines for the Project. In addition to addressing the EIS Guidelines, provincial permits will be required under several acts to address various Project activities, such as The Crown Lands Act (camp development on provincial Crown lands), The Mines and Minerals Act (quarry development), The Wildfires Act (burning) and The Dangerous Goods Handling and Transportation Act (petroleum storage tanks). Additional information is available in the Construction Environmental Management Plan (CEMP, Appendix 1).

Under the Transportation Infrastructure Act (TIA) and the Water Resources Administration Act (WRAA), Manitoba Infrastructure (MI) is responsible for the construction and operation of water control, drainage, and transportation infrastructure. The delivery of some of these projects occur in areas where wetland habitat is present and wetland impacts are unavoidable.

In 2019, the Water Rights Act (WRA, s5) was amended to streamline drainage and water resource management, and includes a goal of no net loss of wetlands. The Act describes the measures associated with licensing system to water use and allocation primarily for agricultural, industry, and municipal users. Under the Water Rights Act, Manitoba Infrastructure is not required to seek approval for works related to water rights, diverting water or diversions. However, the wetland compensation guidance in the Act will be utilized by the Project as instruction regarding wetland compensation. The Act sets out requirements for restoration, enhancement, and/or compensation of prescribed wetlands that are lost or altered by the construction, operation and maintenance of a project. Potential wetland impacts could also include reduction in the physical size or a change that would affect the wetland classification (e.g., a change to hydrology that would alter duration of inundation). In general, provincial wetland compensation can accomplished in two ways:

- Financial compensation to an approved service provider as designated in the Water Rights Act, such as the Manitoba Habitat Heritage Corporation (MHHC) for the purposes of restoring or enhancing wetlands.
- Implementation of wetland restoration or enhancement projects in a location specified or approved by the Minister of Conservation & Climate

1.3 Roles and Responsibilities

Table 1 identifies key roles and responsibilities associated with planning, development and implementation of the wetland compensation plan. Manitoba Infrastructure hired Independent consultants to conduct an assessment of wetlands. That information was integrated into the EIS and more recently associated with follow-up wetland assessment and documentation in support of this Plan.

Currently, Manitoba Infrastructure is evaluating options to ensure that provincial no-net loss wetland objectives are satisfied, possible projects may include: protection, enhancement, restoration, and/or compensation for prescribed wetlands (Class III, IV and/or V wetlands). Roles and responsibilities for each project will be identified when projects are formalized.

Table 1: Key Roles Associated with Implementation of Wetland Compensation

Role	Organization	Responsibility
Project Owner / Proponent	Manitoba Infrastructure	Ensure provincial wetland policies and legislative objectives are met Ensure completion of identified protection, restoration, and/or enhancement projects Complete payment for identified compensation projects
Wetland Investigation and Assessment	Independent Consultant(s)	Wetland quantification and categorization
Approved Wetland Service Provider	MHHC	Approved by Minister to perform wetland restoration or enhancement projects under the Water Rights Act.
Water Rights Act Review	Manitoba Conservation and Climate	Review wetland compensation plan prior to implementation

1.4 Indigenous Engagement

Manitoba Infrastructure is committed to and in the process of ongoing engagement and consultation with Indigenous groups and other stakeholders that are potentially affected by the Project. Detailed EMP review discussions that include this Wetland Compensation Plan will, through such measures as virtual open house events and EMP-specific questionnaires, provide ongoing engagement opportunities that facilitate EMP finalization.

1.5 Related Documents

The following project documents, additional to the Project EIS, also contain wetland-related topics and details, but not necessarily included in this WCP:

- Surface Water Management Plan (SWMP) and associated monitoring;
- Groundwater Management Plan (GWMP) and associated monitoring;
- Vegetation Monitoring as outlined in the Revegetation Management Plan (RMP); and
- Wildlife Monitoring Plan (WMP).

2.0 WETLAND DELINEATION

This section outlines how wetlands were assessed and identifies key characteristics of those that move forward for compensation. The process of compensation associated with those wetlands is described in Section 3. Wetland delineation involves determining and defining the wetlands that would be directly affected by the construction and operation of the Project. MI engaged an independent consultant to delineate and quantify the loss of these wetlands that are intersected by the Project Development Area (PDA, or disturbance footprint). The wetland delineation information developed from mapping and field investigations in 2020 provides a refinement of earlier work (WSP 2020a; MI 2020a). This information was subsequently interpreted with consideration of the Water Rights Act in developing the best approach to compensate for wetlands potentially affected by the Project (Section 3).

2.1 Methodology

This section summarizes the methods used in wetland delineation described more fully in the Wetland Field Report developed on the basis of fieldwork and mapping conducted in 2020 (WSP 2020a).

2.1.1 Information Sources and Mapping

The delineation of wetland types that initially occurred in support of the EIS included vegetation mapping for the PDA, the LAA (1 km beyond the project footprint) and the Regional Assessment Area (RAA, 5 km beyond the project footprint). Mapping used two publicly-available data sources:

- The Enhanced Wetland Mapping, produced by Ducks Unlimited Canada (DUC, c. 2018)
- The Earth Observation for Sustainable Development (EOSD) Land Cover Classification (Wulder and Nelson, 2003)

Both data sets offered continuous mapping of the LMOC and LSMOC study areas, which were derived from relatively coarse scale satellite data (about 1,50,000 scale). Final mapping was at a similarly coarse scale (about 1:50,000). While satisfactory for the purposes of the EIS, more detailed delineation of wetlands at a higher resolution was obtained in 2020 on the PDA and adjacent lands to refine the wetland impact analysis and facilitate compensation planning for wetland loss.

Mapping incorporated orthoimagery and available LIDAR data within a 1.5 km area extending from the PDA centreline. The fine resolution of this data facilitated the mapping of wetland and upland areas at 1:5,000 scale, leading to improved accuracy and increased confidence in wetland and upland community delineation and characterization (WSP 2020a). Wetland mapping was initially completed using automated GIS classification techniques that combined Sentinel 2, orthoimagery, MI LIDAR (1 m resolution) and national DEM terrain data to delineate and classify wetlands and upland land cover – including drainage systems and depressions that may collect surface water. These depressions then are classified using the imagery sources (Sentinel 2 and orthoimagery) to identify wetland classes.

Wetland identification and mapping was performed using a hierarchical approach, based on analysis of satellite imagery, topographic indices generated from terrain data, and field observations. As a first step, probable wetland areas were identified from a pixel-based classification of multispectral Sentinel 2 data (10 m resolution). Spectral data was used to calculate the Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI), two key indicators of wetland vegetation and soil moisture. Classification then was performed using a Random Forest algorithm with the following input variables: Red, Green, and Blue (RGB) bands, infrared band, NDVI and NDWI. In addition to the spectral band indices, indices from the terrain LIDAR dataset were extracted. Two indices were included in the classification: Topographic Wetness Index (TWI) and the Depth to Water Index (DTW).

Wetland delineation was extracted from select areas that were then assessed during the late summer vegetation surveys conducted in August. This data allowed assessment of the accuracy of the delineations and to confirm wetland classes along the survey area. A second object-based classification was performed to evaluate wetland classes, using a series of descriptive statistics extracted from previous satellite and topographic layers. A final verification was performed using visual interpretation of the orthoimagery and field ground truthing data to ensure accuracy of wetland classification and delineation.

2.1.2 Field Verification

Field confirmations included both ground truthing surveys and visual checks (WSP 2020a). Ground truthing surveys completed during the early (July 6-12, 2020) and late summer (August 6- 12, 2020) vegetation surveys that described plant community composition. Early summer data provided initial training points for wetland classification and both early and late data were used to confirm initial and final stages of wetland and upland classifications. An aerial check of the initial mapping by helicopter survey (visual checks) along the PDA during late summer plant SOCC (species of conservation concern) surveys also helped to confirm mapped (spatial) delineations. During aerial surveys, broad zones of habitats were checked, as well as specific wetland sites. Specific wetlands were also checked in more detail during the aerial surveys (visual and ground check surveys), to confirm differentiations among forested and marsh wetland classes. In total, ground truthing checked 120 sites, representing each mapped wetland and upland type within each of the Project components (i.e., LSMOC, LMOC, Manitoba Hydro's distribution line, and PR 239 re-route).

2.1.3 Wetland Classification System

The Stewart and Kantrud (1971) system and the Canadian Wetland Classification System (National Wetlands Working Group, 1997) were both used to develop a merged classification system (Appendix 1, Table 1A-1). The combination allowed identification of the marshes in the southern Project areas (LMOC and PR239) and the organic and swamp peatland types in the northern Project areas (LSMOC and the power distribution line). As the Steward and Kantrud system is used in Manitoba's wetland compensation process, this approach facilitates analyses and discussions regarding offsets for wetland impacts. For upland habitats, forests were classified using the Manitoba Forest Ecosystem Classification system (Zoladeski, et al., 1995). Watercourses, waterbodies and anthropogenic land cover types followed the EOSD Land Cover classification for the Manitoba area (Wulder and Nelson, 2003).

2.2 Results

Appendix 1 (Tables 1A-2 to 1A-5) provides an evaluation of wetland habitat maps, as verified through field investigations. Table 2 provides a summary of the results with respect to the Class III, IV and V wetland types that are being considered for compensation under the Act. Table 2 indicate that the most common wetland habitat types intersected by the LMOC are Class III marshes (197.9 ha, or 19.2% of habitat types intersected by the LMOC PDA when considering terrestrial and wetland habitat types; WSP 2020a). A small amount (1.1 ha) of Class III wetlands are intersected by the PR 239 realignment. Peatlands and swamp predominate in the LSMOC area, where horizontal fens and stream fens represent collectively represent 63% of habitat types intersected (37% and 26%, respectively; WSP 2020a). Peatlands and swamps represent 31% of habitat types intersected by the proposed distribution power line to extend from PR 513 to the LSMOC water control structure (WCS).

Table 2: Class III, IV and V Wetlands Intersected by Project Components

Project Component	Class III	Class IV	Class V	Total Area (ha)
LMOC	197.9	38.4	0.8	237.1
PR 239	1.1	0.7	0.0	1.8
LSMOC	0.1	0.0	0.0	0.1
Distribution Power Line	0.0	0.0	0.0	0.0
Total Area (ha)	**199.1**	**39.1**	**0.8**	**239.0**

3.0 WETLAND COMPENSATION

This section outlines the process involved in in developing a wetland compensation plan, with consideration of the wetland classification described in Section 2 (Table 2). As with many jurisdictions, Manitoba's Wetland Policy framework requires avoidance, minimization, and compensation. To the extent possible, avoidance and minimization of effects to wetlands have been considered during earlier stages of Project planning (eg. location of project components). As instructed by legislation, compensation described in this section will focus on prescribed wetlands, these wetlands are defined as class III, IV, or V according to the Stewart and Kantrud (1971).

3.1 Process

The overall process that will be used to develop the specific wetland compensation projects can be generally described in 5 steps:

1. Wetland mapping, classification and assessment for appropriate project areas
2. Information sharing and discussions with Indigenous Communities, Groups and the public
3. Development of enhancement and restoration projects and the determination of compensation
4. Continued discussions and information sharing
5. Implementation of wetland compensation project plans

Step 1 – Wetland Delineation and Investigation

Wetland delineation investigation and evaluation as described further in Section 2 involves:

- Identify, map and conduct field investigations of wetlands that are intersected by or otherwise adjacent to the Project PDA
    - Occurred initially through baseline surveys and mapping for the Project to support the EIS and followed up with more detailed mapping and site investigations to characterize wetlands (MI 2020a, WSP 2020a).
- Classify wetland using both the Steward & Kantrud Wetland Classification System and the Manitoba Wetland Assessment Method
    - Conducted by WSP (2020a) for the Project.

Step 2 – Information Sharing

Initial information sharing will be accomplished by

- Posting and sharing the draft wetland compensation plan with Indigenous communities, groups and public stakeholders

- The wetland compensation plan includes MI's current understanding of current and available information.
- Providing resources and opportunity for virtual meetings to present and discuss the plan
- Ensure public access to related supporting documents including field investigation reports

Step 3 – Wetland Compensation Approach

This section outlines the steps that will be taken by Manitoba Infrastructure with respected to Class III, IV and V wetlands that may be impacted by the Project. Manitoba Infrastructure will be considering restoration, enhancement and financial compensation projects to meet its wetland compensation obligations.

- Wetland compensation ratios - Compensation ratios will be applied to Class III, IV, and V wetlands.
  - The wetland compensation ratios are identified in the Water Rights Regulation (C.C.S.M.c. W80) and are conditional on the wetland classification and the applied compensation method.

The compensation ratios for prescribed wetlands are listed in table 3.

Table 3: Wetland Compensation Ratios for Restoration and Enhancement

Action	Ratio
Restore or enlarge an existing wetland	2:1
Enhance or permanent legal protect	3:1

- Restoration and enhancement projects will be the preferred approach over financial compensation, although it should be understood that objectives of restoration and/or enhancement projects may also include:
  - Increase the size of the existing wetland
  - Improve hydric soil functions, hydrology and vegetation of a wetland and the uplands surrounding the wetland
  - Provide permanent legal protection to wetland or wetland enhancements
  - Through enhancement and/or restoration projects to reduce financial compensation

- Now that wetland field investigations have been completed, MI has begun to identify potential enhancement and restoration projects.
  - A current study will begin to look at local and regional crown land that may also include potential for enhancement, restoration and/or protection.
  - When enhancement and restoration projects have been identified, MI will determine if additional financial compensation is also required.
  - Compensation funds are to be provided to an approved service provided, currently the Project has identified MHHC has a suitable and approved service provider.

- Using the compensation ratios in Table 3, funds may be transferred to MHHC. By legislation, MHHC must use these funds to perform wetland restoration or enhancement projects.
- MI will endeavor to support MHHC and any additional identified approved service providers by ensuring wetland relevant information is submitted with the compensation transfer.

Step 4 - Information Sharing Continued

Continue to share updated and current information by:

- As a way to finalize the Plan, continue to post and share updated wetland compensation plan with Indigenous communities, groups and public stakeholders
  - Providing resources and opportunity for virtual meetings to present and discuss the new compensation plans
  - Ensure public access to related supporting documents including field investigation reports

Step 5 – Wetland Compensation Plan Implementation

Depending on the nature and need of each wetland compensation project individual implementation plans will likely be required.

- As wetland compensation projects are formalized develop implementation plans that identify appropriate project phases including: planning, construction/activities, and monitoring.
- Individual project schedules will be developed which when compiled will demonstrate the length of time it will take to complete the Projects overall wetland compensation requirements.

3.2 Wetlands Requiring Compensation

Based on recent field investigations and the current environmental assessment, this section describes the types and area of wetland that are currently included for consideration in the wetland compensation plan. MI is committed to applying the mitigations to minimize Project-related wetland impacts as identified in the EIS.

Table 2 provides a summary of the evaluation of wetland habitat maps, as verified through field investigations (Section 2.1). Table 2 illustrates that Class III wetlands represent 83.3% of all wetlands identified, followed by 16.4% Class IV and .2% Class V. Of the Class III wetlands, 99.4% are located on the LMOC, 0.5% on PR239, and 0.1% on LSMOC. This includes areas of 197.9 ha, 1.1 ha, and 0.1 ha in each of the respective project components. Of the Class IV wetlands identified, 98.2% was located on LMOC and 0.8% on PR239. This includes 38.4 ha and 0.7ha in each of the respective project components. Class V wetlands were only identified in the LMOC, including 0.8ha. Class IV and V wetlands have not been on the LSMOC. Prescribed Wetlands were not identified along the distribution power line (Figures 2 and 3).

4.0 FOLLOW-UP AND MONITORING

4.1 Project Effects and Mitigation Overview

Follow-up and monitoring is associated with the key characteristics of the potential Project effects on wetland habitats and related mitigation measures. This section provides an overview of some of the key Project effects that have led to the determination of the need for and characteristics of wetland-related follow-up and monitoring as identified in the Project Environmental Impact Statement (EIS) and various environmental management plans (e.g., Surface Water and Groundwater management plans) to verify the predictions described in the EIS (Section 4.2; MI 2020a).

The EIS identifies that some direct loss of wetland habitat will occur during construction (EIS Volume 3, Section 8.2.4.3, Table 8.2-10; MI 2020a). In addition to the loss of wetlands intersected by the Project footprint, wetlands adjacent to Lake St. Martin and Lake Manitoba may be indirectly affected by the management of flood waters during Project operation (i.e., flood conditions) and through alteration of hydrology due to changes in surface and groundwater flows during non-flood conditions. Management of flood waters during operation could have indirect effects on adjacent wetlands but are not expected to change any wetland class (i.e., shallow open water to marsh) or remove structural layers (e.g., trees, shrubs, grasses).

The Project has the potential to indirectly affect wetlands adjacent to the outlet channels due to altered drainage flows (e.g., wetlands to the east of the LMOC). Alterations to drainage flows will affect soil moisture regimes and hydrologic function upgradient and downgradient of the Lake Manitoba Outlet Channel and Lake St. Martin Outlet Channel during operation. Surface drainage structures on the upgradient side of outlet channels are expected to limit the extent of effects on surface drainage and shallow subsurface flow to the project development area (PDA) for the LMOC (EIS Volume 2, Section 6.3.4.2). Residual effects downgradient (i.e., on the east side) of the LMOC are expected to extend beyond the PDA into the local assessment area (LAA) (EIS Volume 2, Section 6.3.4.2). The change in water balance east of the LMOC PDA may result in changes to water levels in wetlands (EIS Volume 2, Section 6.3.4.2 and Section 6.4). If drying-down of wetlands occurs, it could reduce the area of open water, shift plant composition, favouring species adapted to less frequently flooded and shallower conditions, and reduce wetland extent. The degree of change will be measured through surface water and groundwater monitoring which will evaluate the magnitude of effects from the Project (Section 4.2).

The EIS predicts project changes to water levels and inflow to waterbodies within the LAA and RAA and predicts residual effects to wetlands, such as alteration of vegetation cover types. The EIS states alterations of the sub watersheds in the intersection of the LMOC and PR 239 realignment may cause changes to wetland habitat quantity and quality that result in effects on migratory birds and SAR. Migratory birds and SAR identified for the Project use various wetland types for a variety of nesting, breeding, and staging activities. Habitat loss for wetland dependent SAR such as yellow rail, least bittern, horned grebe and northern leopard frog is described in the EIS (Volume 3, Section 8.2.2.1).

During operation, overland and shallow subsurface drainage flow may be affected along the approximately 24 km length of the LSMOC. Based on examination of the effects of the Emergency Outlet Channel (EOC), located approximately 5 km west of the LSMOC, the effects would be reduced to 500 m on upgradient with mitigation, and 500 m on downgradient sides. Unmitigated, this effect would be expected to affect drainage on either side of the channel (EIS Volume 2, page 6.165). Drainage changes along the east side of the LMOC could reduce habitat for migratory birds and Species at Risk (SAR) dependent on open water habitats (e.g., waterfowl such as dabbling ducks [e.g., mallard], horned grebe, northern leopard frog) and increase it for others that prefer shallower habitats or habitats less frequently flooded (e.g., shorebirds, least bittern, yellow rail).

Wetlands bordering the LMOC are predominantly marshes and shallow open water wetlands (EIS Volume 3, Figure 8.2B-11). Possible changes in plant species composition (if any) are expected to mainly consist of changes in the dominance of different grass and sedge species. Wetland classes are expected to be unchanged (i.e., remain as marsh or shallow open water). Without mitigation, altered drainage patterns along the east side of the LMOC, for example, could reduce habitat for migratory birds and SAR dependent on open water habitats and increase it for others that prefer shallower habitats or habitats less frequently flooded. Residual effects to wetlands could alter the habitat effectiveness for wetland-dependent wildlife species, including migratory birds and SAR. Indirect change in wetland habitats from changes in surface water will be assessed by the Surface Water Management Plan with support from wetland-based SAR surveys.

It is anticipated that residual effects to surface drainage and shallow subsurface flow along the LSMOC will extend beyond the PDA into the LAA (Volume 2, Section 6.3.4.2). Following the implementation of surface drainage structures on the upgradient side of the LSMOC (i.e., the east side of the channel), the potential for increased wetness of land outside the PDA will be reduced. Natural surface and shallow subsurface drainage flow may be affected along the entire length of the LSMOC, with effects on drainage not expected to occur beyond 500 m upgradient and perpendicular to the channel (EIS Volume 2, Section 6.3.4.2 and Section 6.4). Without the proposed mitigation (e.g., outside drains), the wetting up on the east side of the LSMOC channel will result in wetter soil conditions, which will in turn, have the potential to shift plant composition favouring species adapted to wetter conditions, potentially increasing wetland sedge and grass abundance and reducing non-vascular plant abundance. Without mitigation, tree and shrubs may also be killed due to increased soil saturation and anoxic soil conditions.

The Project effects of changes in groundwater levels and flows for both construction and operation may include:

- Changes in groundwater levels and flows on wetlands (EIS Volume 2, Section 6.4.4.3)
- Changes in groundwater levels and flows on Buffalo Creek
- Changes in groundwater levels on domestic wells

For the LSMOC, an upgradient distance of 500 m is considered a conservative estimate for groundwater and surface water effects considering the implementation of mitigation. Downgradient of the LSMOC (i.e., west of the LSMOC), conditions are expected to become drier with effects potentially extending along the entire length of the channel, but not beyond 500 m perpendicular to the channel (EIS Volume 2, Sections 6.3.4.2

6.4). These drier conditions could shift plant composition to species adapted to drier conditions and increase tree and shrub growth and establishment.

Drainage changes proposed for the LSMOC could potentially effect the abundance and distribution of suitable habitats for some migratory birds including SAR. Wetter sites would provide a potential increase in suitable habitats for open-habitat species (e.g., savannah sparrow, Wilson's snipe, yellow rail) and species that use edge habitats or areas with dead standing trees (e.g., olive-sided flycatcher, tree swallow). Drier sites would provide a potential increase in suitable habitats for migratory bird species that use more complex habitats (e.g., song sparrow, vesper sparrow, American robin).

Project construction will temporarily remove terrestrial and aquatic habitat used by migratory birds, SAR, and other wildlife. Habitat loss will be reduced with mitigation and reclamation/channel revegetation. Positive effects are predicted during operation and are expected to mainly benefit the Lake St. Martin Important Bird Area (IBA) and its waterbird colonies through reduced flooding and erosion of habitat and nests. Other wildlife such as muskrats, ducks, grebes, loons, and geese that occupy marshy lake shores are also expected to benefit from reduced flooding on Lake St. Martin.

4.2 Follow-up and Monitoring

A key component of the EMP will be environmental follow-up and monitoring. Follow-up and monitoring will be designed and implemented in a manner that is consistent with Section 9 of the Impact Assessment Agency of Canada's (formerly Canadian Environmental Assessment Agency) EIS Guidelines for the Project (CEAA 2018), which states: the purpose of the program is to verify the accuracy of predictions and the effectiveness of mitigation measures, and to assure that proper measures and controls are in place in order to decrease the potential for environmental degradation during all phases of Project development.

The federal Impact Assessment Act (2019) 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."

Verification of wetland-related predictions identified in the EIS will primarily involve testing key predictions to verify that mitigation measures implemented as part of Project construction and operation are functioning as intended. Aquatic effects monitoring, for example, will include a regional water quality monitoring component to confirm that water quality is not impacted by the Project, and therefore verify that the CEMP, OEMP, or other applicable plans and the measures they contain are functioning as intended. Environmental assessment verification monitoring will also help to identify whether unanticipated adverse environmental effects are occurring as a result of the Project. Regular reporting and review of results from environmental assessment verification monitoring can be used to determine whether further review or adaptive modification to measures specified in the CEMP, OEMP, and associated environmental management plans are required.

Compliance-related monitoring (EIS Volume 1, Chapter 3, Appendix 3F; MI 2020a) will involve inspecting construction sites to assure that mitigation measures identified in the CEMP, OEMP and associated environmental plans are being implemented and are functioning as intended on a site-specific scale (e.g. surface water management and the potential influence on adjacent wetlands). Environmental compliance monitoring, and regular site inspection will also help to identify unanticipated adverse environmental effects resulting from Project activities, and will enable timely proactive or reactive response in order to avoid, minimize or mitigate these potential effects at a site-specific scale.

The results from environmental compliance monitoring and environmental assessment verification monitoring may provide information that identifies the need for and means of adaptively managing unanticipated environmental effects related to the Project. The general approach for development of the Project's EMP, and the specific management and monitoring plans that comprise it, provides a proactive means of adaptively managing unanticipated adverse environmental Project effects. Environmental management and monitoring plans are being developed in conjunction with ongoing engineering design, and will consider input received from potentially affected Indigenous groups and other stakeholders.

Overall, MI's proposed approach to environmental management, environmental monitoring, reporting, review, and ongoing engagement is meant to further assist in identifying and addressing potential information gaps, uncertainties related to potential effects, implementation of mitigation, and continual review and improvement on environmental performance. The following sections outline the key wetland-related monitoring that is occurring or planned to occur to verify the predictions described in the EIS. One of the possible outcomes of the following monitoring is that there may be adaptive management measures adopted that could be incorporated into the Project during the construction or post-construction periods.

4.2.1 Surface water

4.2.1.1 Surface Water Quantity

The Project may have indirect effects on wetlands located adjacent to the LMOC and LSMOC. The channels may alter surface water drainage flows, causing changes to soil moisture regimes and hydrologic function upgradient and downgradient of the channels. As a result, wetlands may become wetter or dryer depending on their location relative to the channels.

Planned Project monitoring will assess the changes to local drainage areas and drainage patterns in relation to Project effects on surface water and groundwater interactions and wetland hydrology. The purpose and objectives of follow-up activities will be to monitor and further understand the residual effects on surface water hydrology due to the Project and respond accordingly, if any further action is required. The surface water monitoring plan outlined in the SWMP describe the methodologies for monitoring local drainage and hydrology and methods. For the LMOC, monitoring will be developed in consultation with RM of Grahamdale and local residents. Hydrologic monitoring (water levels and flows) will be required as a key input to operation of the Project.

Existing drainage in the region around the LMOC generally flows towards the lower lying area between Watchhorn Bay on Lake Manitoba and Birch Bay on Lake St. Martin. This low-lying area includes Watchhorn Creek, draining south to Lake Manitoba, with Reed Lake, Clear Lake, Water Lake, Goodison Lake and Birch Creek draining north to Lake St. Martin. Water levels in the small lakes and wetlands along Birch Creek are among those wetland sites may also be monitored at select locations; this will be confirmed during the detailed design phase. Water levels will be monitored at selection locations in small lakes and wetlands along Birch Creek using staff gauges and/or continuous level recorders, which will be determined during the detailed design phase. Options to measure and monitor changes in local drainage and flows during construction will be incorporated in the SWMP at detailed design, as required, in consideration of the surface water monitoring described further in the Aquatic Effects Monitoring Plan (AEMP).

In the vicinity of the LSMOC, there is no existing artificial drainage network, unlike the LMOC. If monitoring of effects to wetlands west of the channel during construction and/or operational monitoring identifies a need for additional mitigation, there are several potential options to mitigate the drying-down of soils on the downgradient side of the channel that will be explored, as described in the SWMP.

On the east side of the LSMOC, the proposed outside drainage will minimize the “backwater” effect in the wetland complex on the upgradient. If monitoring of effects to wetlands west of the channel during construction and/or operational monitoring identifies a need for additional mitigation, there are several potential options to mitigate the drying-down of soils on the downgradient side of the channel (EIS Volume 3, Section 8.2.4.5, pg. 8-60). Among the considerations being evaluated are: allowing additional flows to the Buffalo lakes and Buffalo Creek from Lake St. Martin to replace any flows lost from interception of wetland flows to the creek, and; pumping water from the LSMOC to wetlands west of the channel, if needed (EIS Volume 3, Section 8.2.4.5, pg. 8.60).

Water level measurements will continue following construction of the LMOC and LSMOC, and initially this monitoring will be carried out during the first two years post-construction. The frequency and locations of the monitoring conducted during the operation phase will be based on specific environmental conditions present, success of revegetation, and in consideration of channel operations.

Monitoring results will inform an evaluation of effects to wetlands. Additional mitigation may be identified and prescribed to limit effects. Monitoring of surface waters in wetlands within and adjacent to the PDA will help determine if there are any effects not anticipated in the EIS and help determine the need for any adaptive management measures.

4.2.1.2 Water Quality

Surface water quality monitoring is currently underway to supplement existing datasets to further advance the understanding of surface water in the LMOC area. Water quality information is planned to be collected as part of the design of the Project, as outlined in monitoring identified in the SWMP. Water quality information will also be collected as part of the AEMP for the Project, which will include adaptive collection and analysis of surface water samples from regional and local waterways, some of which have a link to wetlands in the region. This will provide information on surface water quality in the Project area during Project construction, operation and relevant maintenance activities. The purpose and objective of surface water quality monitoring will be to document existing surface water quality conditions prior to the commencement of clearing or construction of the proposed outlet channels, and provide ongoing monitoring of watercourses and waterbodies in the Project area during Project construction, operation or maintenance activities.

The water quality follow-up and monitoring will include sampling for a number of parameters which will be compared to Manitoba Water Quality Standards, Objectives and Guidelines (MWQSOGs) for the protection of aquatic life (PAL), Canadian Council of Ministers of the Environment (CCME) guidelines for the protection of freshwater aquatic life, or MWQSOGs or Health Canada guidelines for drinking water. The only criteria Health Canada recognizes as being developed to be protective of human health for drinking water are the Guidelines for Canadian Drinking Water Quality (GCDWQ). The final list of parameters and locations to be included in the monitoring plans will be determined through the ongoing Indigenous consultation and engagement program, and as the detailed design for the Project advances.

4.2.1.3 Surface Water-Groundwater Interaction

The GWMP will include thresholds to aid in adaptive management, such as monitoring of groundwater levels in local wells during dewatering activities, monitoring of water temperatures, and analyses of Contaminants of Potential Concern (COPCs) such as E. coli. It is expected that the GWMP will build on the groundwater monitoring conducted to date for the LMOC PDA, and include sampling parameters and locations established to date in the area. Groundwater samples being monitored for drinking water purposes and protection of the aquifer will be referenced to the GCDWQ, and sampling of groundwater being discharged to surface water areas will be monitored and referenced to applicable Canadian Council of Ministers of the Environment (CCME) guidelines and/or Manitoba Water Quality Standards, Objectives and Guidelines (MWQSOGs) for the Protection of Aquatic Life (PAL).

Should there be the need to discharge groundwater to overland areas, these discharges will be analyzed in reference to applicable CCME guidelines and/or MWQSOGs for the Protection of Agricultural Water Uses (Irrigation and Livestock Water) (CCME 1993). Groundwater discharges, including seepages, and existing local drinking water wells will be continuously monitored to assure that groundwater quality and quantity are not adversely affected by the Project activities. The sampling frequency and groundwater discharge locations will be selected to allow for adaptive management measures, such as temporary reduction of groundwater depressurization activities, additional sampling, or redirection of groundwater discharges.

4.2.2 Groundwater

Baseline groundwater quality data in the LMOC PDA was collected by between Fall 2016 and Spring 2018 (KGS 2017a, 2017b, 2018). Groundwater quality data are currently being collected within the LMOC and LSMOC PDA as part of the Preliminary Design field investigation phase of the Project. The goal of the GWMP (MI 2020c) is to protect and maintain existing groundwater quality in the Project area for existing and future use. The objectives of the groundwater monitoring program include:

- Continued monitoring of groundwater levels near the Project.
- Groundwater monitoring locations will be located within the right of way (or at a re-established location) near the Project.
- Monitoring of groundwater levels away from the Project near local well users.
- Locations and numbers of wells will be determined based on model predictions and in discussion with landowners. These wells will monitor pressure head.
- Monitoring of groundwater levels (head) near the wetlands along Birch Creek in the bedrock and in the till.
- Locations and numbers of wells will be determined based on model predictions.
- Domestic water wells in the Lake Manitoba Outlet Channel (LMOC) project development area (PDA), because of their purpose, will be monitored for their quality, with reference to the Guidelines for Canadian Drinking Water Quality (GCDWQ).

The GWMP indicates that there is currently no evidence to suggest that groundwater associated with the LMOC will have any effect on wetlands. Regardless, the groundwater management plan will thus ensure groundwater is monitored and protected during preconstruction, construction and operation of the LSMOC. This will be expanded to include sites near wetlands adjacent to the PDA and help determine whether and the nature of any groundwater-surface water interchange within and near the PDA – and whether there is any change in water quality (Section 4.2.1.3). If monitoring reveals that there is an effect along the LMOC or LSMOC, alterations to hydrology due to the presence of the channels will be managed through mitigation measures outlined in the Surface Water Management Plan and Groundwater Water Management Plan. For example, mitigation of potential effects associated with surface and shallow subsurface drainage flow in the Lake St. Martin Outlet Channel (LSMOC) local assessment area (LAA) may include an adaptive management strategy that incorporates the results of monitoring levels in wells near wetlands, some of which may be associated with the Buffalo Creek system.

Monitoring of groundwater levels will occur to assure that changes in groundwater levels due to aquifer depressurization activities are not resulting in adverse effects on local well users or groundwater hydrology in the LAA. This will be accomplished through continuous groundwater monitoring in the Project LAA during the pre-construction, construction and post-construction phase, and throughout the operational and maintenance phases of the Project. The monitoring and analysis plan will provide information to better predict and quantify potential effects and confirm which locations of the groundwater LAA should be further monitored during aquifer depressurization. Field investigations and monitoring will provide further information on geological stratigraphy and hydrogeological parameters to further quantify potential effects due to depressurization.

Wetland water levels are to be monitored along LMOC and LSMOC as part of the GWMP (EIS Volume 3, Section 8.2.4.2, pg. 8.37). To monitor for potential effects to groundwater, monitoring of water levels will occur during construction and operation at observation wells that will be located between the Project and well users. Water quality data will include water levels and a broad suite of analytical parameters for water quality and human health. Further investigation into groundwater in the LSMOC area will be carried out prior to construction. Boreholes will be drilled at strategic locations, in relation with wetlands and springs, so the final coverage will be relatively uniform along the PDA and within the groundwater LAA. Observation water wells will be established, so groundwater samples can be taken, water levels and artesian flow can be measured, and instrumentation can be installed if required. A series of observation wells has been established in order to obtain baseline water quality readings and to allow monitoring both during and after construction. Post-construction monitoring will occur to determine if there are any long-term effects on groundwater within the LSMOC region.

For LMOC, groundwater levels will be continuously monitored during construction and results used to modify depressurization activities and adapt mitigation measures through interactions with landowners and the dewatering contractor as required. During operation, continuous level monitoring will initially be carried out during the first two years post-construction; however, the duration may be extended depending on the monitoring results, environmental conditions present, success of revegetation and the frequency of use of the LMOC.

For LSMOC, groundwater monitoring will be conducted during the construction phase and the initial operation phase, or a period of two years following construction. Monitoring during construction will focus on identifying any local or regional effects of construction activities on groundwater water levels. Initial operation phase monitoring will focus on the effect of any passive long-term aquifer depressurization, and any channel surface water/groundwater interaction, during initial channel operating and non-operating conditions. A plan for long term groundwater monitoring will be developed based on monitoring results, an assessment of any possible LSMOC effects, and public engagement.

Adaptive management strategies will be employed under the SWMP and GWMP, such that 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.

The GWMP and associated follow-up and monitoring plan currently under development by Manitoba Infrastructure will include the rationale, methods, parameters, sampling locations and sampling schedule for the groundwater quality and quantity monitoring plans. The final list of parameters and locations to be included in the monitoring plans will be determined through the ongoing Indigenous consultation and engagement program, and as the detailed design for the Project advances.

4.2.3 Vegetation

The EIS predicts project changes to water levels and inflow to waterbodies within the LAA and RAA and predicts residual effects to wetlands, such as alteration of vegetation cover types. In addition to the monitoring of wetlands that support the EIS (MI 2020a), pre-construction surveys occurred with regard to

species of conservation concern (SOCC) and wetlands in 2020 (WSP 2020a,b). The wetland mapping has been evaluated to identify all potentially affected wetlands.

Future vegetation monitoring will examine how predicted changes to vegetation species diversity and wetlands will be verified and how the effectiveness of mitigation strategies (e.g., revegetation; EIS, Section 12.6; MI 2020d). Vegetation monitoring outlined in the Revegetation Management Plan (RMP) includes details on the methods and on how predicted changes to vegetation species diversity, including wetlands to verify the effectiveness of mitigation strategies. This may, for example, involve remote sensing that may be applied for monitoring vegetation health within and outside of the ROW. The vegetation health can be identified using near-infrared energy, which is highly sensitive to vegetation stress detected through photosynthesis absorption and reflection rates. The RMP identifies reporting commitments and schedule(s).

4.2.4 Wildlife

Migratory birds and SAR observed in the Project RAA, LAA, and PDA include species that use various wetland types (e.g., open water, marsh, swamp, fen, bog) for a variety of nesting, breeding, and staging activities. The species most likely to be affected by altered wetlands include yellow rail (*Coturnicops noveboracensis*), least bittern (*Ixobrychus exilis*), and northern leopard frog (*Lithobates pipie*ns).

The Wildlife Monitoring Plan (WMP; MI 2020e) includes surveys of wetland-dependent migratory birds and species at risk (SAR) to establish an understanding of SAR presence/absence in wetland habitats located adjacent to the PDA. The occupancy and distribution of wetland-dependent SAR will be used to supplement wetland hydrology monitoring described in the SWWP and GWWP.

Surveys will occur in the LAA in wetlands adjacent to the outlet channel ROWs where potential effects are most likely to occur (i.e., within 500 m of ROW), and outside of the LAA where Project effects are not expected. Areas outside of the LAA will function as reference sites. Surveys will be stratified by wetland type for target SAR species. For example, surveys are likely to occur along the LMOC near the lakes and wetlands east of the ROW and along the LSMOC where the ROW is adjacent to wetlands or intersects large fen habitats.

Surveys will be completed following standardized survey protocols modified for the use of autonomous recording units (ARUs; see Table 2 of the Wildlife Monitoring Plan), which can be effective in detecting secretive waterbird species, particularly when attempting to optimize spatial and temporal coverage (Sidie-Slettedahl et al. 2015). ARUs will be deployed in target wetlands, spaced ≥ 250 m apart (Jobin at al. 2011), and pre-programmed to collect daily recordings during peak calling periods for the respective SAR (Table 2). Upon retrieval of the ARUs, the data files will be processed using commercial software (e.g., Kaleidoscope Pro [Wildlife Acoustics 2019]) that automatically scans data files for the species of interest using a reference library; a qualified biologist will review and validate a sample of the results for false-negative and false-positive results.

The SAR survey will be completed daily during the peak breeding period for each respective species (see Tables 2 and 3 of the Wildlife Monitoring Plan). Surveys will be undertaken during the first year of construction and will be repeated in years 2, 4, and 6 post-construction. The schedule for wetland-dependant monitoring activities is provided in Table 6 of the Wildlife Monitoring Plan.

4.3 Summary

Monitoring is planned to occur for several environmental parameters associated with surface water, ground water, vegetation and wildlife to facilitate the evaluation of how wetlands are being affected by the Project. For example, Groundwater and Surface Water Management plans identify the monitoring of water levels that contribute to wetlands and aquifers in the area. The results of that monitoring will inform whether additional mitigation is required and then identify whether the additional mitigation is effective. Additional details on the follow-up and monitoring activities associated with wetlands are located in the respective environmental management and monitoring plans.

Environmental management and monitoring plans are currently being shared with Indigenous groups and public stakeholders that may potentially be affected by the Project. The results of ongoing engagement with will inform the further development of the plans.

In addition to the current and planned wetland monitoring outlined in this section, MI anticipates that monitoring and follow-up of wetland enhancement or restoration projects would be planned as a part of the planning and development process for all individual wetland compensation programs implemented.

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APPENDIX 1

Wetland Types and Area Potentially Affected by the Project (WSP 2020a)

Table 1A-1: Project Merged Land Cover Classification System and Habitat Descriptions for Class III, IV and V Wetlands

Classification	Description
Marsh[1]	
Class II	Temporary graminoid/forb mineral wetland with wet meadow plant community; surface water is present for a short period of time after snowmelt or a heavy rainfall.
Class III	Seasonal graminoid/forb mineral wetland with shallow wetland plant community; surface water is present throughout the majority of the growing season, but is typically dry by the end of summer.
Class IV	Semi-permanent graminoid/forb mineral wetland with deep wetland community; surface water is present for most or all of the year, except in periods of drought.
Class V	Permanent graminoid/forb mineral wetland with open water community; surface water is present throughout the year.
Peatland	
Bog[2]	
Basin Bog	Topographically confined peatland with poor nutrients and level surface; water input limited to snowmelt, rain and local surface run-off.
Fen[2]	
Basin Fen	Topographically confined peatland; water inputs consisting of snowmelt, rain, surface runoff, and groundwater.
Horizontal Fen	Uniformly vegetated peatland on broad depressions or plains; water inputs consisting of snowmelt, rain, surface runoff, and groundwater.
Shore Fen	Peatland situated adjacent to lakes or ponds with firmly anchored surface peat; water inputs consisting of snowmelt, rain, surface runoff, groundwater and surface flow.
Stream Fen	Peatland located in main channel or along banks of permanent or semi-permanent streams; water inputs consisting of snowmelt, rain, surface runoff, groundwater and surface flow.
Swamp[2]	
Basin Swamp	Topographically confined shrubby or treed wetland with less than 40 cm of organic soil.
Lacustrine Swamp	Shrubby or treed wetland with less than 40 cm of organic soil occurring along the shores of permanent ponds or lakes; water level affected by lake during high water periods.

Classification	Description
Lagg Swamp	Sloping shrubby or treed wetland with less than 40 cm of organic soil occurring between upland mineral terrain and peatlands.
Riverine Swamp	Shrubby or treed wetland with less than 40 cm of organic soil occurring along banks of rivers and permanent and intermittent streams; subject to flooding when stream or river waters are high.
Unconfined Flat Swamp	Broad shrubby or treed wetland with less than 40 cm of organic soil among other kinds of wetlands with poorly defined edges.
Water Bodies[3]	
Water Bodies	Consists of all open water including lakes, rivers, streams, ponds and lagoons.

Notes:

1 Prairie Pothole Wetland Classification System, Stewart and Kantrud (1971)

2 Canadian Wetland Classification System (National Wetlands Working Group, 1997)

3 Manitoba Land Cover Classification (LCC) is based on the EOSD Land Cover Classification system (Wulder and Nelson, 2003)

Table 1A-2: Wetland Classification within the LMOC PDA

Broad Land Cover Category	Land Cover Class	Total Area In the PDA (ha)	Compensation Area (ha)
Marsh	Class II	68.0	N/A
	Class III	197.9	197.9
	Class IV	38.4	38.4
	Class V	0.8	0.8
Swamp	Basin Swamp	47.8	N/A
	Lacustrine Swamp	0.8	N/A
Total Wetlands		**353.7**	**237.1**

Table 1A-3: Wetland Classification within the PR 239 Re-route PDA

Broad Land Cover Category	Land Cover Class	Total Area In the PDA (ha)	Compensation Area (ha)
Marsh	Class II	4.1	N/A
	Class III	1.1	1.1
	Class IV	0.7	0.7
Swamp	Basin Swamp	3.2	N/A
Total Wetlands		**9.1**	**1.8**

Table 1A-4: Wetland Classification within the LSMOC PDA

Broad Land Cover Category	Land Cover Class	Total Area In the PDA (ha)	Compensation Area (ha)
Marsh	Class III	0.1	0.11
Peatland	Basin Bog	114.1	N/A
	Basin Fen	40.9	N/A
	Horizontal Fen	333.3	N/A
	Shore Fen	4.8	N/A
	Stream Fen	232.5	N/A
Swamp	Basin Swamp	3.8	N/A
	Lacustrine Swamp	10.7	N/A
	Lagg Swamp	11.5	N/A
	Unconfined Flat Swamp	18.1	N/A
Total Wetlands		**769.7**	**0.1**

Table 1A-5: Wetland Classification in the Power Distribution Line PDA

Broad Land Cover Category	Wetland Class	Total Area In the PDA (ha)	Compensation Area (ha)
Peatland	Basin Bog	0.2	N/A
	Basin Fen	2.2	N/A
	Horizontal Fen	1.8	N/A
	Stream Fen	0.2	N/A
Swamp	Lacustrine Swamp	0.1	N/A
	Lagg Swamp	4.1	N/A
	Riverine Swamp	0.9	N/A
	Unconfined Flat Swamp	4.6	N/A
Total Wetlands		**14.2**	**0**