Technical Reports

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Appendix A:

Greenhouse Gas Follow –Up Assessment

by Dillon Consulting

DILLON CONSULTING

MANITOBA INFRASTRUCTURE REMOTE ROAD OPERATIONS

Greenhouse Gas Follow-Up Assessment

East Side Lake Winnipeg

August 2017 – 16-3689

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East Side Lake Winnipeg Greenhouse Gas Follow-Up Assessment – Final Report

Dillon Consulting Limited (Dillon) is pleased to present the methodology and results for the East Side Lake Winnipeg Greenhouse Gas (GHG) Follow-Up Assessment. Desktop GHG calculations for the proposed RRO all-season road construction projects (P1 P2, P3a, P3b, P3c, P4, P5, P6, P7, and P7a) are summarised in this report. The results of the assessment are based on available data and a winter road traffic count conducted in February 2017.

Sincerely,

DILLON CONSULTING LIMITED
<Original Signed By>

Ravi Mahabir, P.Eng., CRM
Project Manager

Our file: 16-3689

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1.0 Introduction

1.1 Background

Manitoba Infrastructure Remote Road Operations (RRO), formerly the East Side Road Authority (ESRA), is responsible for the design and construction of new all-season road (ASR) projects on the east side of Lake Winnipeg. Currently, communities in the area are serviced only by airplane, ferry, and seasonal winter/ice roads. The design and construction of ASRs will improve accessibility to the remote communities in this area.

Projects under RRO's mandate are under different phases of development; such as planning, Environmental Assessment process, functional design, detailed design, and construction.

Climate change and greenhouse gas (GHG) considerations must be incorporated into the Environmental Assessment (EA) process as per federal guidelines and as part of the provincial Environment Act licensing. A GHG Assessment for the Project 1 (P1) ASR was conducted by Dillon Consulting Limited (Dillon) in 2010 and was incorporated into the Environmental Assessment (EA) for P1. In that assessment, future values such as fuel consumption, equipment use, and traffic volumes were estimated based on the best available information. Now that construction activities have begun on P1, data related to fuel consumption, construction equipment, air travel, vehicle travel, and ferry travel has been collected over the past five years, and may be more accurate than the estimated values used in the 2010 P1 GHG Assessment. In addition, a winter road traffic count was conducted in February of 2017 throughout the East Side Lake project area. The recently collected data is relevant to all of the proposed ASR projects, and therefore this report provides an update of the 2010 P1 estimates based on current data methodologies, available data on the new projects, and data collected from P1 which would be representative of other projects.

The Canadian Environmental Assessment Agency (CEAA) provided a letter to the RRO/ESRA highlighting specific requirements for the GHG considerations within the Project 4 (P4) ASR EA on February 11, 2016. The requirements include:

- An estimate of the direct GHG emissions associated with all phases of the project. This information is to be presented by individual pollutant and should also be summarized in carbon dioxide equivalents (CO_2e) per year. Individual GHGs include CO_2, methane (CH_4) nitrous oxide (N_2O), perflurocarbons (PFCs), hydroflurorcarbons (HFCs), sulphur hexafluoride (SF_6) and nitrogen trifluroide (NF_3).
- An analysis of cumulative GHG emissions of current (e.g. facilities in operation) and reasonably foreseeable (e.g. proposed) projects should also be included in the cumulative effects assessment.

These comments have been taken into consideration in the development of this study, to the extent possible. CEAA comments related to identification of GHG mitigation measures applicable to each individual project are outside of the scope of this report.

1.2 Greenhouse Gas Considerations

The ASR projects involve the construction and operation of the ASR in the region east of Lake Winnipeg. Ongoing and proposed ASR projects will have GHG emissions associated with both the construction and operational phases.

The projects vary in scale and anticipated construction timelines, as described in further detail in Section 2.2. The existing and planned RRO ASR projects total approximately 1,100 km, and will replace approximately 1,250 km of winter roads. Manitoba Infrastructure maintains approximately 19,000km of all-season roads and constructs 2,200 km of winter roads yearly (MI, 2016). The projects will contribute to a minor increase in the total length of roadway in Manitoba, and primarily replaces winter roads with all-season roads.

Environment and Climate Change Canada (ECCC, 2016) provides annual national and provincial GHG emissions per sector, from 1990 to 2014. The most recent GHG inventory year of 2014 indicated that for construction activities in Manitoba, approximately 0.111 megatonnes CO_2e were emitted in 2014, the total emissions for road transportation in the province was approximately 6.29 megatonnes CO_2e. Since 1990, the annual GHG emissions from construction in Manitoba have increased by approximately 75% and GHG emissions due to road transportation in Manitoba have increased by approximately 62%.

Nationally, GHG emissions from the construction sector in 2014 was estimated to be approximately 1.29 megatonnes CO_2e, and for the road transportation sector it was estimated to be approximately 140 megatonnes CO_2e (ECCC, 2016). The emissions due to construction decreased in 2014 by 31% from 1990 levels and for the road transportation sector there was an increase of approximately 41%. Manitoba contributed less than 9% to the national GHG emissions due to construction and less than 5% to the national road transportation GHG emissions in 2014.

In order to determine the magnitude of the GHG emissions associated with the ASR projects, this GHG assessment is being conducted.

1.3 Assessment Outline

An overview of the RRO ASR projects can be found in Section 2. A description of the assessment methodology is detailed in Section 3, and a summary of the estimated GHG emissions associated with each ASR project can be found in Section 4.

2.0 The Projects

The RRO ASR projects located along the eastern shoreline of Lake Winnipeg area shown in Figure 1. The study area encompasses First Nations traditional lands and the limits extend from the:

- South - Hollow Water First Nation traditional land;
- North - Bunibonibee Cree Nation;
- East - Pauingassi First Nation, Little Grand Rapids First Nation, and Red Sucker Lake First Nation; and
- West - Poplar River First Nation and Norway House Cree Nation.

2.1 Existing Conditions

The area to the north and east of Lake Winnipeg is not currently served by ASRs, with the exception of some sections of the P1 ASR where construction is complete. The remoteness of communities in the area, their size and lack of economic development has resulted in a costly and limited transportation system. These communities included the Southeast Resource Development Council (SRDC) communities of Poplar River, Berens River, Bloodvein, Little Grand Rapids, and Pauingassi; the Island Lake Tribal Council (ILTC) communities of St. Theresa Point, Wasagamack, Garden Hill, and Red Sucker Lake; and the Keewatin Tribal Council (KTC) communities of Oxford House (Bunibonibee), Gods Lake Narrows, and Gods River (Manto Sipi).

The transportation system for the East Side Lake Winnipeg project area relies on air service, seasonal ferry service during the non-winter months, and seasonal winter/ice roads. The northern portion of the seasonal road network is connected to Provincial Trunk Highway (PTH) 6 and Provincial Road (PR) 373. The southern portion of the seasonal road network is connected to PR 304, which is a paved provincial trunk road and connects to Winnipeg via Highway 59. In addition, a ferry, M.V. Edgar Wood, serviced Bloodvein via Islandview prior to the recent development of the P1 ASR project. Lastly, scheduled and charter flights provide service to the East Side Lake Winnipeg project area.

The study area is covered by boreal forest, wetlands, small rivers and lakes. The predominant forest cover is Black Spruce and Jack Pine within the Boreal Shield ecozone.

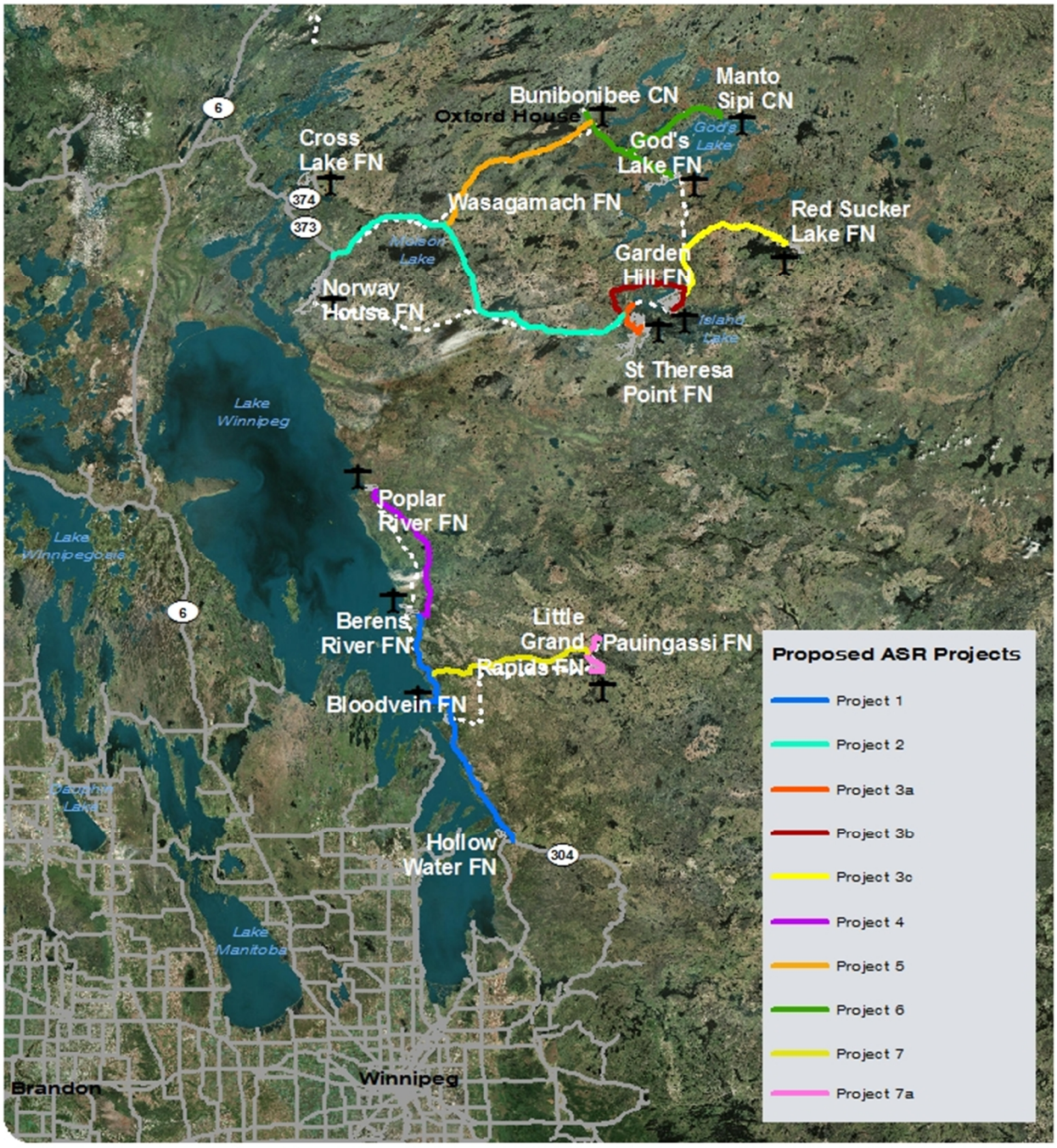


FIGURE 1

All Season Road Project Area

AIRFIELDS

HIGHWAYS

WINTER ROAD

Manitoba

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MAP DRAWING INFORMATION:
DATA PROVIDED BY MANITOBA EAST SIDE ROAD AUTHORITY
MAP CREATED BY: PMH
MAP CHECKED BY: KP
MAP PROJECTION: NAD 1983 UTM Zone 14N
FILE LOCATION: I:\DILLON.CA\DILLON_OFFICES\SASKATOON\CAD\GIS\163659 ESMA GHG ASSESSMENT

SCALE 1:5,000,000

PROJECT: 163659 STATUS: FINAL DATE: 2017-08-08

Figure 1– Study Area

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2.2 Project Description

The RRO ASR projects are detailed in Table 2.1.

The proposed ASRs will be gravel, 10 m in width, with two 3.7 m wide lanes, 1.0 m shoulders and a 0.3 m shoulder rounding allowance. The roadway will be centred within a 100 m right of way (ROW) and the cleared limit of the roadway will be 60 m within this ROW. Further clearing will be on as required basis to maintain line of sight. In an effort to minimise clearing, where applicable, the alignment will follow the existing seasonal winter/ice road and Manitoba Hydro distribution line ROW. The proposed ASRs will also entail the construction of a number of bridges (both permanent and modular) in order to cross water courses.

The construction of each proposed ASR is anticipated to be completed within 4-8 years, depending on the project. Borrow and quarry areas near the proposed ASRs will be required to support construction, operations, and maintenance needs.

Table 2.1 – RRO ASR Projects and Phases

Project	Length[1] (km)	Alternative Modes of Transportation	Number of Proposed Bridges[2/6]	Phase/ Status	Assumed Construction Dates[3]	Assumed Years of Construction[4]
Project 1 (P1)	167.8	· Air Travel · Ferry · PR 304/Highway 59 to Seasonal Road	Modular - 0 Permanent - 9	Construction	2012-2019	8
Project 2 (P2)	225.9	· Air Travel · PTH 6/ PR 373 to Seasonal Road	Modular - 0 Permanent - 2	Planning	2030-2037	8
Project 3a (P3a)	28.2	· Air Travel · PTH 6/ PR 373 to Seasonal Road	Modular - 0 Permanent - 3	Construction	2016-2021	5
Project 3b (P3b)	79.6	· Air Travel · PTH 6/ PR 373 to Seasonal Road	Modular - 0 Permanent - 7	Planning	2030-2036	7
Project 3c (P3c)[5]	114.6	· Air Travel · PTH 6/ PR 373 to Seasonal Road	Modular - 1 Permanent - 2	Planning	2030-2036	7
Project 4 (P4)	94.4	· Air Travel · PR 304/Highway 59 to Seasonal Road	Modular - 0 Permanent - 4	Environmental Assessment	2018-2025	8
Project 5 (P5)	113.6	· Air Travel · PTH 6/ PR 373 to Seasonal Road	Modular - 3 Permanent - 0	Planning	2030-2037	8
Project 6 (P6)	137.3	· Air Travel · PTH 6/ PR 373 to Seasonal Road	Modular - 0 Permanent - 2	Environmental Assessment	2030-2037	8

Project	Length[1] (km)	Alternative Modes of Transportation	Number of Proposed Bridges[2/6]	Phase/ Status	Assumed Construction Dates[3]	Assumed Years of Construction[4]
Project 7 (P7)	102.4	· Air Travel · PR 304/Highway 59 to Seasonal Road	Modular - 0 Permanent - 6	Planning	2020-2027	8
Project 7a (P7a)	41.2	· Air Travel · PR 304/Highway 59 to Seasonal Road	Modular - 0 Permanent - 2	Environmental Assessment	2016-2020	5

1 – Proposed ASR lengths based on geographic information systems (GIS) shapefiles provided by RRO staff on June 10, 2016.

2 – Proposed number of bridges per project based on GIS shapefiles provided by RRO staff.

3/4 – Anticipated construction dates estimated for P2, P3a, P3b, P3c, P5, and P6 were assumed based on limited data and confirmed with RRO staff. These dates are subject to change.

5 – The proposed P3c road alignment and associated bridge requirements have not been determined. The stated information, therefore, follows existing winter road alignment and estimates the number of bridges based on similar proposed ASR projects in the area.

6 – A detailed examination of the topography needs to be completed before routing and crossings can be finalized.

3.0 GHG Emissions Assessment Methodology

The GHG Assessment is based on comparing the estimated annual GHG emissions for the Baseline Scenario (without the project) to the Project Scenario (with the project). In both scenarios, the timeframe of the annual GHG emissions is projected for the anticipated length of Project Scenario construction of the ASR followed by up to 30 years of operation. The natural ecosystem sources and sinks are also included to demonstrate their contribution to the overall GHG implications of the Baseline and Project Scenarios. Section 3.1 describes the Baseline Scenario calculation methodology, and Section 3.2 describes the Project Scenario calculation methodology.

Calculations associated with both the Baseline Scenario and Project Scenario are included in Appendix A.

3.1 Baseline Scenario

The Baseline Scenario assumes that existing conditions are to continue into the future. The timeline begins at the proposed start date for each ASR project, and is projected for the length of time equal to the total construction period of the proposed ASR plus up to 30 years of operation. The scenario further assumes that the existing climatic conditions will be maintained, as the impacts of climate change to the study region cannot be exactly predicted and is beyond the scope of this GHG assessment. The changes in climate are expected to impact the transportation patterns of the study region due to a shortened winter road season, and increased frequency of extreme weather events.

The Baseline Scenario GHG emissions and sinks / removals and the resulting cumulative GHG emissions are estimated by the following equation:

Annual Baseline GHG Emissions (tonnes CO_2e/yr)
= *- Carbon sequestration due to forest carbon sequestration along the proposed ASR (tonnes CO_2e/yr)*
+ Net GHG emissions due to wetlands and soil along the proposed ASR (tonnes CO_2e/yr)
+ GHG emissions due to air travel to/from relevant communities (tonnes CO_2e/yr)
+ GHG emissions due to ferry crossings to/from relevant communities (tonnes CO_2e/yr)
+ GHG emissions due to vehicular travel on seasonal winter/ice roads (tonnes CO_2e/yr)
+ GHG emissions due to the construction and maintenance of seasonal roads (tonnes CO_2e/yr).

Estimated emissions for specific GHGs were also calculated, based on the above equation (including CO_2, CH_4, and N_2O). Detailed results can be found in Appendix B.

Details on the above sources and sinks / removals are given in the following sections.

3.1.1 Carbon Sequestration of Forest

Canada's National Forest Inventory (NFI, 2016a) has classified the ecozone, within which the study area is located, as Boreal Shield. For the study area, the NFI plot statistics indicated that the predominant tree species in the study area is Black Spruce followed by Jack Pine based on the most recent forest inventory maps.

Trees serve as a carbon sink by sequestering carbon emissions (in the form of CO_2) from the air. In order to estimate the carbon sequestration rate of the forest cover, the total carbon stock of the forest cover along the proposed ASR was calculated, and was attributed to the estimated average age of the forest cover in each project area. The methodology used in estimating the total carbon stock was based on the Tree Canada (2015) protocol for calculating the above and below ground carbon stock of the forest cover.

The aboveground carbon (C) stock is estimated using the following relationship:

Above Ground C-stock (tonnes CO_2)
= above ground tree density (tonnes tree/ha)
× project area (ha)
× specific gravity of tree dry weight to green tree weight (unitless)
× conversion to aboveground dry tree biomass to tree biomass C (tonne C/ tonnes dry tree biomass)
× C-CO_2 conversion (tonne CO_2/tonne C).

The below ground C-stock is estimated by:

Below Ground C-stock (tonnes CO_2)
= root-shoot ratio
× Aboveground C-stock (tonnes CO_2).

The rate of carbon sequestration is estimated by:

Forest Sequestration Rate (tonnes CO_2/year)
= Aboveground C-stock (tonnes CO_2) + Belowground C-stock (tonnes CO_2)
x Average age of forest (years).

Parameters pertaining to the above equation (C-CO_2 conversion, and root shoot ratio) are retrieved from the Tree Canada (2015) methodology for broadleaf, coniferous, and mixed wood forests in Manitoba's boreal shield. NFI (2016b) statistics for the Manitoba boreal shield west forest provide the tree density of the forest cover.

The age of the forest stand in the area is estimated based on an analysis of Natural Resource Canada's Wildland Fire Information System GIS maps (NRCan, 2016a). The GIS maps provide forest fire perimeters in the province of Manitoba from the year 1928 to 2014. Historic forest fire activity influences the overall age of the forest stand which in turn informs the biomass density and volume parameters described above. The weighted average age of forest within each project area was determined based on historical fire areas and dates. Where no fires occurred within the GIS data, it was assumed that the maximum tree age was 100 years.

The aboveground tree biomass and density represents green biomass, where water content is included in the tree weight. The average moisture content of wood as a percentage of green wood by weight is 36% for North American spruce tree species and 43% for pine tree species (Miles and Smith, 2009). As such, an average dry weight biomass to green tree biomass of 40% is applied to the aboveground green tree biomass.

Spatial coverage of hardwood, softwood, and other land uses along the ROW of the proposed ASR was determined for the proposed RRO ASR project in question. A 60 m width along the length of the proposed ASR was considered as the project area. The land cover statistics along the ROW for the length of the ASR were determined through publically available land use GIS data (NRCan, 2000).

3.1.2 Net GHG Emissions from the Land Cover

The route of the proposed ASR traverses both wetlands and forested areas. Boreal wetlands and uplands (forested areas) are known natural sources and sinks of CH_4 (e.g., Bubier et al., 2005, and Potter et al., 2001) and CO_2 (Potter et al., 2001, and Trumbore et al., 1999).

The following methodology was used in estimating the net GHG emissions from the wetlands impacted by the ASR:

Net GHG emissions due to land cover along the proposed ASR (tonnes CO_2e/yr)
= Methane flux from forest soils (tonnes CO_2e/ha) × forest area (ha)
+ Methane flux from wetlands (tonnes CO_2e/ha) × wetland area (ha)
+ Carbon dioxide flux from forest soils (tonnes C/ha) × forest area (ha)
+ Carbon dioxide flux from wetlands (tonnes C/ha) × wetland area (ha)
× C-CO_2 conversion (tonne CO_2/tonne C).

Several academic studies pertaining to methane and carbon flux (net ecosystem production) have been conducted in the boreal wetland and old black spruce upland near Thompson, Manitoba. These studies include: Potter et al. (2001a), Potter et al. (2001b), Bubier et al. (2005), Yuan et al. (2008), and Trumbore et al. (1999). The studies provided ranges of measured or modelled emission flux values. An average of the ranges provided in all five studies was taken to estimate both the methane and carbon flux from

forest soils and wetlands, respectively. Each study is described below, and the overall flux value used for the purposes of this study is presented in Table 3.1.

Using a process model, Potter et al. (2001a) estimated the carbon sink ranging from -10.7 to -11.8 g C/m^2/yr for wetland (fen) area and -49.1 to -25.8 g C/m^2/yr for an old black spruce upland area. Methane (CH_4) emissions were estimated to range from 4.0 to 5.3 mg CH_4/m^2/day in wetland areas, and -0.79 to -0.86 mg CH_4/m^2/day in old black spruce uplands.

A study by Potter et al. (2001b) compared the results of net ecosystem production from nine models considering the same study area near Thompson, Manitoba. Results of the comparison demonstrated a range of -11 to 61 g C/m^2/yr with an average carbon source of 24 g C/m^2/yr for the forest stand.

Bubier et al. (2005) measured that methane (CH_4) emissions over the growing season from wetlands ranged from 12 to 250 mg CH_4/m^2/day and sinks (removals) from black spruce upland soils that ranged from -0.1 to 0.1 mg CH_4/m^2/day. The wetland consisted of fens, bogs, and small ponds. The forested areas were mature forests 60 years or more in age (since the last burn). These emissions and removals would occur over the growing season of the study area which was estimated to be from April to October.

Another study by Yuan et al. (2008) observed net ecosystem production of 81 g C/m^2/yr in the Thompson, Manitoba black spruce study area.

Trumbore et al. (1999) measured and estimated the annual carbon sink from four differing wetlands and using three different estimation methods that ranged from - 180 to 2.65 g C/m^2/yr. The negative value indicates that the wetland was a carbon source during the study period.

Table 3.1 – Average Carbon and Methane Fluxes in Forest Uplands and Wetlands

Land Cover	CH_4 Emission Average* (g CH_4/m^2/year)	C Emission Average (g C/m^2/year)	Net GHG Emission Average (g CO_2e/m^2/year)
Forest (Uplands)	-0.145	7.53	24.0
Wetland	16.9	-59.3	206

* CH_4 emissions are assumed to occur over the growing season only, estimated to be from April to October.

The land cover statistics along the ROW for the length of the ASR were determined through publically available land use GIS data (NRCan, 2000). The data provides the land areas considered forest and wetland within the project ROW. Net GHG emissions (emissions minus removals) are estimated from the wetland and forested area data. The methane emissions and removals occur over the growing season of the study area which was estimated to be from April to October. The carbon emissions and removals occur over the course of the entire year. As presented in Table 3.1 above, both forest (uplands) and wetlands areas serve as a net GHG source.

It should be noted that CO_2 and CH_4 emissions and removals (i.e., flux) are highly variable, intermittent and are dependent on environmental temperature (growing season), moisture and precipitation. Thompson, Manitoba, where the studies above were conducted, is approximately 150-400 km north of the study area and, therefore, has lower annual environmental temperatures and rainfall than the study area. It is, therefore, expected that the net CO_2 and CH_4 flux may be slightly higher for the study area than the calculated approximations from these research studies. The above process for the estimation of net CO_2 and CH_4 emissions from wetlands and forest soil for the study area should, therefore, be considered as an approximation.

3.1.3 GHG Emissions of Air Travel

Air travel by airplane and helicopter is the primary mode of transit in and out of the communities in the project areas in the Baseline Scenario. The GHG emissions based on air travel was estimated from the routes of flights (based on schedules), flight distances, and the total average annual passenger kilometers projected up to 30 years after the proposed project is constructed. Helicopter flights to connect isolated communities to airports were also considered. Fuel burned in air travel emits CO_2, CH_4, and N_2O.

The annual GHG emissions due to the air traffic can be calculated from:

Annual Air Travel GHG Emissions (tonnes CO_2e/yr)

$= \Sigma_{Airport}$ *{Passenger-kilometers (km) x* EF_{air} *(kg* CO_2e*/passenger kilometer) x* 10^{-3} *tonnes/kg}*

$= \Sigma_{Airport}$ *{Annual use (hours) x Fuel* $Efficiency_{helicopter}$ *(L/hr) x* $EF_{helicopter}$ *(kg* CO_2e*/L fuel)}.*

Where:

Airport refers to the airport in the relevant communities;
Passenger-kilometers is the annual summation of kilometers travelled by all passengers;
EF_{air} = the emission factor short-haul flights; and
$EF_{helicopter}$ = the emission factor for helicopters.

Airplane Travel

Nearly every community in the study area is supported by a remote airstrip; however, the following communities are serviced by airports with commercial/scheduled airline service:

- Berens River
- Bloodvein;
- Cross Lake;
- Garden Hill (Island Lake);
- Gods Lake;
- Gods River (Manto Sipi);
- Little Grand Rapids;
- Norway House;

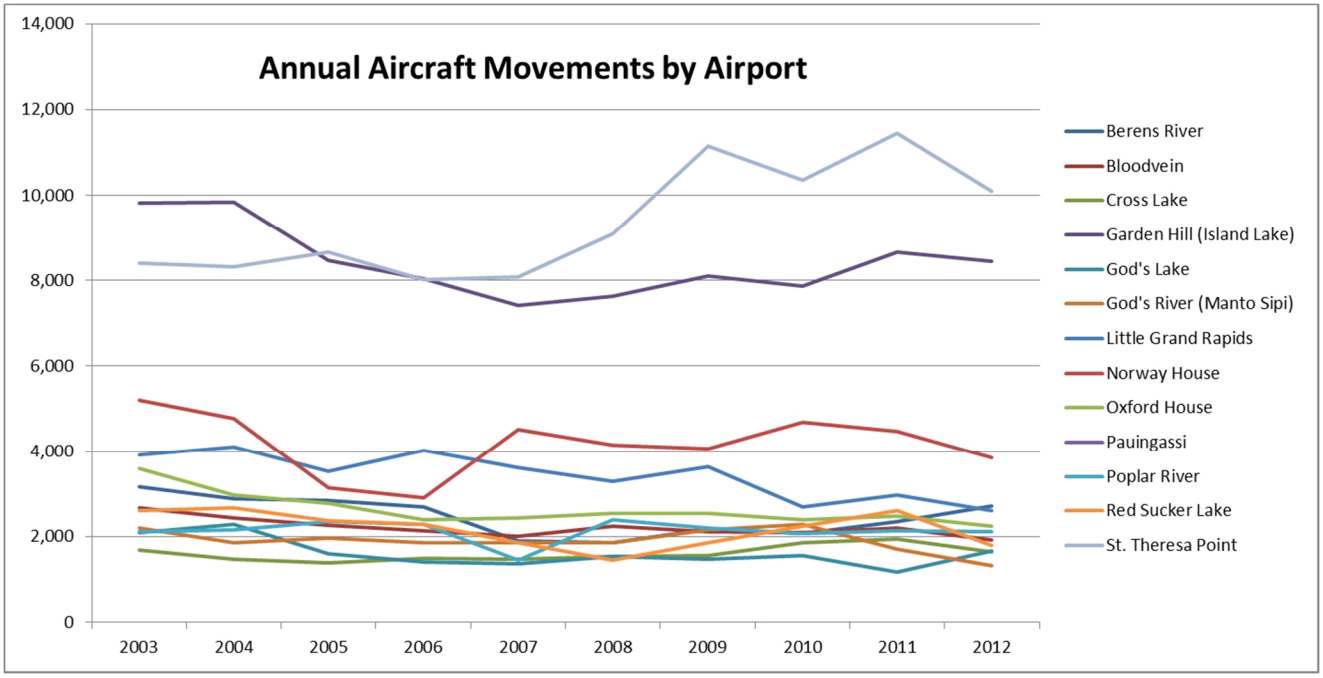
- Oxford House;
- Poplar River;
- Red Sucker Lake; and
- St. Theresa Point.

Data on the number of air movements at the relevant airports was sourced from Manitoba Infrastructure (MI, 2016b) and is presented in Table 3.2. The average air traffic movements from 2003 – 2012 was used to estimate air travel from each relevant airport, as this time period represents the most recent available 10 year data set (MI, 2016b). As demonstrated in the graph in Figure 2 below, no distinguishable trends in air traffic increases or decreases can be reasonably confirmed, and as such it was assumed that aircraft movements will remain consistent (with the 10 year average) in future years for the purposes of this assessment.

Table 3.2 – Total Air Movements in the Study Area from 2003 to 2012

Airport	Number of Air Craft Movements										
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average
Berens River	3,175	2,881	2,838	2,686	1,902	1,860	2,176	2,070	2,347	2,706	2,464
Bloodvein	2,668	2,429	2,272	2,144	1,997	2,233	2,112	2,092	2,207	1,928	2,208
Cross Lake	1,677	1,463	1,382	1,484	1,480	1,537	1,554	1,853	1,946	1,645	1,602
Garden Hill (Island Lake)	9,812	9,835	8,465	8,027	7,417	7,621	8,102	7,873	8,653	8,453	8,426
God's Lake	2,091	2,275	1,598	1,400	1,354	1,526	1,467	1,553	1,159	1,655	1,608
God's River (Manto Sipi)	2,196	1,861	1,966	1,851	1,863	1,866	2,150	2,290	1,714	1,321	1,908
Little Grand Rapids	3,910	4,115	3,531	4,025	3,626	3,290	3,637	2,695	2,982	2,606	3,442
Norway House	5,213	4,777	3,134	2,901	4,510	4,147	4,072	4,697	4,473	3,841	4,177
Oxford House	3,593	2,970	2,770	2,402	2,434	2,538	2,534	2,398	2,482	2,234	2,636
Poplar River	2,108	2,151	2,356	2,296	1,458	2,400	2,205	2,066	2,144	2,118	2,130
Red Sucker Lake	2,603	2,682	2,380	2,285	1,860	1,440	1,861	2,246	2,612	1,782	2,175
St. Theresa Point	8,390	8,323	8,668	8,020	8,078	9,092	11,142	10,348	11,458	10,104	9,362

Figure 2 – Annual Aircraft Movements by Airport (2003-2013)



Based on an analysis of scheduled flights from commercial airlines, the airport to airport air movement fraction was determined. Airline schedule data was obtained through airline websites (Northway Aviation, 2016a; Perimeter Aviation, 2016a). The airport movement fraction ratios were applied to the passenger traffic values presented in Table 3.3 (which encompasses both scheduled and chartered flights) to estimate the annual passenger traffic for each airport by destination. These values were multiplied by the airport to airport distance (in kilometers) to determine the overall passenger kilometers travelled by airport and year.

It should be noted, however, that actual air movements are suspected to be higher than those officially recorded as aircraft arrive and depart from the airports outside of official hours. Therefore, when estimating the GHG emissions associated with air traffic movement, the reported air movements given in Table 3.2 and reported passenger traffic given in Table 3.3 were increased by 25% to account for the unrecorded air movements, based on feedback from RRO. This assumption was also made in the 2010 P1 GHG assessment, as was deemed reasonable. A sensitivity analysis has demonstrated that the assumed 25% assumed increase in recorded passenger traffic values does not affect the results of the assessment. The air movement and passenger traffic analysis is presented in full in Appendix C.

Table 3.3 – Total Passenger Airplane Traffic in the Study Area from 2000 to 2012

Airport	Passenger Traffic										
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average
Berens River	7,853	7,697	6,553	6,456	4,418	4,892	5,581	5,644	6,790	8,648	6,453
Bloodvein	3,851	3,434	3,153	3,353	2,377	1,264	1,264	3,928	1,264	4,715	2,860
Cross Lake	5,205	4,615	3,392	4,055	3,523	3,993	4,076	5,548	5,770	5,019	4,520
Garden Hill (Island Lake)	34,238	35,302	37,175	39,030	34,577	38,221	40,716	36,341	50,567	54,615	40,078
God's Lake	7,825	6,880	10,786	14,391	11,231	14,755	13,852	13,682	11,890	14,820	12,011
God's River (Manto Sipi)	4,717	4,087	4,710	4,936	4,452	5,386	5,300	5,458	4,933	4,283	4,826
Little Grand Rapids	7,688	8,630	7,917	9,505	7,376	7,702	8,788	6,712	6,313	5,124	7,576
Norway House	13,652	12,985	8,339	4,415	3,999	7,201	8,515	8,657	6,690	6,226	8,068
Oxford House	13,335	10,743	10,598	10,261	9,665	10,282	10,956	10,385	14,590	11,866	11,268
Poplar River	5,473	6,072	6,733	6,209	4,327	7,486	8,426	8218	7728	7676	6,835
Red Sucker Lake	4,867	5,538	6,010	4,933	5,135	4,770	5,710	5,612	4,845	4,010	5,143
St. Theresa Point	25,951	26,028	31,000	31,398	31,699	39,273	35,126	32,544	39,759	45,962	33,874

The air service providers and types of aircraft operating within the study area are presented in Table 3.4. Aircraft fleet data is obtained through Transport Canada's Civil Aircraft Registry (Transport Canada, 2016). In general, turbo prop short-haul aircraft are used in the project area.

Table 3.4 – Air Service Providers and Aircraft Types

Service Provider	Airports Serviced	Aircraft Make and Model	Quantity
Perimeter Aviation	Berens River St. Theresa Point Wasagamack Island Lake / Garden Hill God's Lake Red Sucker Lake Manto Sipi/ God's River Oxford Lake/ Bunibonibee Cross Lake	Fairchild SA227-AC	8
		Swearingen SA226-TC	15
		Beech E95	1
		Beech 95-B55	2
		Dehavilland DHC-8-106	2
		Dehavilland DHC-8-314	2
		Dehavilland DHC-8-102	1
Northway Aviation	Berens River Bloodvein Pauingassi Poplar Hill Little Grand Rapids	Pilatus PC-12	1
		Cessna 208	2
		Cessna 208B	4
Amik Airlines	Pauingassi Little Grand Rapids Bloodvein	Cessna 208	2
		Cessna 208B	1
		Cessna A185F	1

An emission factor, EF_{air}, for domestic flights from the United Kingdom (UK) Department for Business, Energy, and Industrial Strategy (2016) was used based on passenger kilometers travelled (0.2787 kg

CO_2e/passenger-km). This emission factor includes an 8% uplift factor, an adjustment recommended by the Intergovernmental Panel on Climate Change (IPCC) to account for discrepancies in geographical distance and actual flight distance, circling, and routing of take-off/landing. A multiplier (of 1.9) was applied to the CO_2 emission factor to account for uncertainty surrounding non-CO_2 climate change effects of aviation, as recommended by the methodology (UK Department for Business, Energy, and Industrial Strategy, 2016). Speciated emission factors, EF_{air} in units of kg/passenger kilometer were applied for CO_2, CH_4, and N_2O emissions from the same source.

Helicopter Travel

Helicopter travel is required in the Little Grand Rapids, Pauingassi and Island Lake communities to shuttle persons to the nearest airport for approximately three months per year during spring break up and winter freeze up, when both winter roads and ferry travel are not available. This situation is not the case for all communities. Annual helicopter usage was provided by RRO staff and obtained from helicopter service providers. The fuel efficiency is assumed to be 114L/hr, as per the Bell Jet Ranger helicopter statistics (Delta Helicopters, 2016), which are the most commonly used helicopters in the area.

Emission factors, $EF_{helicopter}$, were sourced from the ECCC speciated emission factors (NIR, 2016) in units of kg/L fuel for CO_2, CH_4, and N_2O emissions.

3.1.4 GHG Emissions of Ferry Crossing

Manitoba Infrastructure operated the one ferry in the study area, M.C. Edgar Wood. The ferry service provided a vital link for the connected communities in the Baseline Scenario. According to RRO staff, a private ferry operation also historically operated in the same region as the M.C. Edgar Wood.

Ferry operations emit CO_2, CH_4, and N_2O emissions associated with burning fossil fuels. The GHG emission estimates are based on the total number of round trip ferry crossings per year, the total distance of each trip, and the projected number of such trips forecasted up to 30 years past construction completion.

The annual GHG emissions due to the ferry crossings can be calculated as follows:

Annual Ferry Crossing GHG Emissions (tonnes CO_2e/yr)
= *Average annual passenger traffic (unitless)*
× *Distance per trip (km)*
× *Fuel consumption$_{ferry}$ (L/passenger-100 km)*
× *EF_{ferry} (kg CO_2e/L) x 10^{-3} (tonnes/kg).*

Historically, ferry and barge service to Bloodvein occurred from April / May to October, inclusive, from Islandview and Pine Dock harbours. Ferry services in the existing scenario are presented in Table 3.5

below. The M.C. Edgar Wood ferry closed in late 2015, but it will be considered in the Baseline Scenario since its closure was due largely to the availability of the partially completed P1 ASR. Manitoba Infrastructure (MI, 2016c) provided data on the ferry service which is used to estimate the existing and the potential future annual number of trips conducted by the ferry service, details of which are highlighted in the table below.

Table 3.5 – Ferry Information – Baseline Scenario

Ferry Name	Connecting Communities	Projects Impacted	Operating Schedule	Trip Distance (km)	Average Annual Passenger Traffic (2000-2010)
M.V. Edgar Wood	Bloodvein Princess Harbour Islandview	P1	May 25- October 26	45	2,393

For the purposes of this study, it is assumed that the ferry season is from the beginning of May to the end of October. An emission factor (EF_{ferry} =5.1 L diesel/ passenger-100km) and fuel consumption rate (EF_{ferry} = 2.914 kg CO_2e/L diesel) for ferries from the B.C. Ministry of Environment (2016) is used based on passenger kilometers travelled. A speciated emission factor for CO_2, CH_4, and N_2O was also used, as provided in B.C. Ministry of Environment (2016) guidelines.

No data is available for the privately operated ferry/barge. Therefore it is assumed that the annual GHG emissions associated with this private operation was approximately 50% of the emissions due to the M.V. Edgar Wood ferry.

It should also be noted that in addition to ferry services in Bloodvein, there is also water taxi services on Island Lake in the open water season. Water taxi services were not included in calculations as it is assumed that this type of travel will remain relatively consistent between both the Baseline Scenario and Project Scenario, and there is limited data availability.

3.1.5 GHG Emissions of Vehicular Travel

For the Baseline Scenario, vehicular travel results from transporting community supplies during the winter/ice road season, and travel to ferry access. As such, the annual GHG emission due to vehicles travelling both on existing highways and seasonal roads was estimated using the following formulae:

Annual GHG due to Vehicular Travel (tonnes CO_2e/yr)
= Travel on Existing Seasonal (Winter and Ice) Roads (tonnes CO_2e/yr)
+Travel on Existing Highways to Ferry Terminal (tonnes CO_2e/yr).

Where:

Annual GHG Emissions of Travel on Existing Seasonal Roads (tonnes CO_2e/yr)

= $\Sigma_{seasonal\ road\ segment}\ \Sigma_{vehicle\ category}$ {Vehicle Category Number of Trips (trips/yr) X Trip Distance (km/trip) X Fuel Use (L/100km) X $EF_{vehicle\ category}$ (g CO_2e/L) × 10^{-6} (tonnes/g)}.

And:

Annual GHG Emission Travel on Existing Highways to Ferry Terminals (tonnes CO_2e/yr)

= $\Sigma_{vehicle\ category\{}\ \Sigma_{vehicle\ category}$ {Vehicle Category Number of Trips (trips/yr) X Trip Distance (km/trip) X Fuel Use (L/100km) X $EF_{vehicle\ category}$ (g CO_2e/L) × 10^{-6} (tonnes/g)}.

Emission factors were retrieved from ECCC (NIR, 2016). Specifically, the emission factor is 2,462 g CO_2e/L for cars (light duty vehicles or LDV), 2,495 g CO_2e/L fuel for pickup trucks (light duty truck or LDT), 2,718 g CO_2e/L fuel for heavy trucks (heavy duty or HD), and 2,992 for off-road vehicles. Light duty vehicle cars, light duty trucks, and off-road vehicles were assumed to be gasoline-fueled with moderate controls, as gasoline was observed to be the most widely available fuel in the area. Heavy duty (transport) trucks were assumed to be diesel. Speciated emission factors in units of kg/L fuel for CO_2, CH_4, and N_2O emissions (NIR, 2016) were also used in the calculations.

The fuel consumption rate of 9.2 L/100 km for a typical car (LDV), 12.3 L/100 km for a typical pickup truck (LDT) or off-road vehicle travelling on asphalt road surface was conservatively assumed to represent the fuel economy (B.C. Ministry of Environment, 2016). For the heavy truck category, a fuel consumption rate of 39.5 L/100 km for a typical heavy truck (HD) travelling on asphalt road surface was assumed (NRCan, 2016b).

However, gravel road and winter road surfaces lower fuel efficiency as compared to asphalt road surfaces. Due to the poorer road surface conditions that a gravel road present in comparison to a paved road surface, the US EPA (2006) has estimated that fuel efficiency on gravel roads are 83.9% of paved roadways. This deterioration in fuel economy is applied to travel on gravel roadways such as PR 234 which connects Winnipeg to ferry services in Pine Dock. Winter and ice road surfaces also lower fuel efficiency as compared to asphalt roads. NRCan (2016c) estimates that the fuel economy degrades by 1.5-3.0% due to temperature, and 7%-35% due to poor road conditions, both of which are present during winter road travel. As such, it is assumed that fuel economy is decreased for travel on snowy gravel roads in comparison to dry paved (asphalt) roads by an average of the two above ranges (approximately 23%).

Travel on Seasonal (Winter/Ice) Roads

Vehicular traffic volumes on the winter and ice roads were estimated for the projects based on a winter road traffic count that was conducted over several days at a variety of locations in the East Side Lake Winnipeg project area in February 2017. Results of the winter road traffic assessment are found in Appendix D.

The traffic count was conducted at eight locations in the project area over the course of a two-week period during the winter road season for a total of 24 - 74 hours per location. Traffic counting shifts occurred between 4am and 10pm. The winter and ice roads are estimated to be operational for two months from approximately January 1st to March 1st (i.e., approximately 60 days), and as such results of the traffic count were extrapolated to a 60 day seasonal (ice/winter) road season. This assumption provides an estimate on the total number of trips per vehicle category for the season (i.e., year) on a given road segment (ice road or winter road). It was assumed that each vehicle counted was headed to the next community in order to estimate approximate kilometerage for each project area.

Table 3.6 summarises the traffic volumes on winter roads associated with each ASR project. It should be noted that these volumes are an approximation and that traffic volumes are dependent on a variety of factors such as weather, road conditions, bulk shipment schedules, special community events, development activities, and other factors.

Table 3.6 – Estimated Winter and Ice Road Travel Distances

Project	Winter Road Vehicle Travel Distance per 60 Days (km)			
	ATV/ Snowmobile (Off-Road)	Car (LDV)	Truck /Van / SUV (LDT)	Transport Truck (HD)
P1	0	27,691	1,542,412	274,145
P2	13,072	0	309,377	392,168
P3a	0	0	20,507	34,862
P3b	2,164	0	62,742	29,568
P3c	9,720	0	345,053	35,794
P4	1,962	3,924	280,536	19,618
P5	43,872	0	1,144,664	414,791
P6	23,999	0	581,768	183,710
P7	0	4,517	309,421	60,981
P7a	0	547	37,503	7,391

Estimated Annual Volume of Vehicles based on Ferry Travel

Multi-modal travel to the study area may involve vehicular travel in conjunction with ferry. As such, travel from Winnipeg to Pine Dock/Islandview Harbour to access the ferry terminal is included in the Baseline Scenario. For the purpose of this study, it was conservatively assumed that all travel originated or terminated from or in Winnipeg. Estimating the travel distances and patterns from other communities along the highways, and other travel patterns that would flow into these roadways was considered beyond the scope of this study. Access to the ferry from Winnipeg is via PR 234 (80 km) and PTH 8 (140 km). PTH 8 is asphalt and PR 234 from PHT 8 to Islandview / Pine Dock is a gravel road.

The annual total number of cars and pickup trucks, and heavy trucks travelling between Winnipeg and Pine Dock/Islandview Harbour was estimated from the ferry passenger and freight data, received from

Manitoba Infrastructure staff (MI, 2010). Publically available data (MI, 2016d) on the number of passengers, volumes of vehicles and the vehicle classes that used the ferry to cross to and from Pine Dock/ Islandview Harbour and Bloodvein were also used in the calculation. Note that the cars and pickup truck category include vehicles up to ¾ -ton trucks and miscellaneous vehicles (motorcycles and all terrain personal vehicles). The heavy truck category included trucks with single and dual axle over ¾-ton, semi-trailers, buses, graders and loaders.

No data on vehicular volumes and types were available for the privately operated ferry/barge. Therefore it was assumed that the additional traffic going to this ferry/barge was 50% of the traffic reported for the M.V. Edgar Wood.

3.1.6 GHG Emissions of Seasonal Road Construction and Maintenance

Seasonal roads (i.e., winter roads and ice roads) currently serve communities throughout the project area. It was assumed that the seasonal roads are constructed and operated annually for a two month period between January and March. The GHG emissions are due to the mobile equipment used to construct the winter roads and ice roads, and the emissions associated with the equipment used in the general maintenance of the seasonal roads as demonstrated in the equation below.

$$\textit{Annual GHG Emissions Construction and Maintenance of Seasonal Roads (tonnes } CO_2e/yr) = \Sigma_{\textit{equipment type}} \{\textit{Equipment Use (hr/km) X Length (km) X } EF_{\textit{equipment type}} \textit{ (g } CO_2e/hr) \times 10^{-6} \textit{ (tonnes/g)}\}.$$

The type and quantity of road construction equipment assumed to be used in the construction of the seasonal roads is given in Table 3.7. It was assumed that the construction and maintenance of seasonal roads would employ all of the equipment listed in the table. Average annual equipment use per kilometer was based on average contractor equipment usage for the construction and maintenance of the 2014/2015 and 2015/2016 winter roads.

The aggregated GHG emission factors for each type of equipment ($EF_{equipment}$) are also listed in Table 3.7. The CO_2 emission factors are based on US EPA NONROAD 2008 emission factors for non-highway mobile equipment (US EPA, 2006). Net power for each piece of equipment is required in calculating $EF_{equipment}$ and was retrieved from manufacturers' specifications. Speciated GHG emissions are not currently available from ECCC for specific types of construction equipment based on hourly use. As such, the ratios between speciated emission factors from ECCC's speciated emission factor (NIR, 2016) in units of kg/L fuel for heavy duty, moderate control vehicles were used as the basis for determining emission factors for CH_4 and N_20 in kg/hr.

Table 3.7 – Equipment Type and Utilization for the Construction of Winter/Ice Roads

Equipment Type	Average Use (hrs/km)	Emission Factor (kg CO_2e/hr)
Bobcat (50-75 HP)	0.54	36
Bulldozer (75-100 HP)	3.43	53
Equipment (25-50 HP)	0.14	15
Front-End Loader (100-175 HP)	2.77	95
Grader (100-175 HP)	1.68	68
Grader (175-300 HP)	1.40	109
Snowmobile (50-75 HP)	3.00	45
Truck (300-600 HP)	4.18	181

3.2 Project Scenario

The Project Scenario estimated the GHG emissions associated with years of construction of the ASR in addition to projecting up to 30 years of emissions associated with the operation of the ASR. As with the Baseline Scenario, the Project Scenario assumes that the existing climatic conditions will be maintained into the future and the impact of climate change is not incorporated into the assessment. The Project Scenario also does not assume any growth in the communities. Such growth may potentially impact the traffic volumes on the ASR predicted for the purposes of this GHG assessment and is beyond the scope of this study.

It should be noted that Baseline Scenario conditions would persist during the initial construction period and gradually change, as defined in each of the following sections. The Project Scenario estimated the GHG emissions and sinks / removals and the resulting cumulative GHG emissions by:

Annual Project GHG Emissions (tonnes CO_2e/yr)
= - Carbon sequestration due to forest carbon sequestration along the proposed ASR (tonnes CO_2e/yr)
+ Net GHG emissions due to wetlands and soil along the proposed ASR (tonnes CO_2e/yr)
+ GHG emissions due to air travel to/from relevant communities (tonnes CO_2e/yr)
+ GHG emissions due to ferry crossings to/from relevant communities (tonnes CO_2e/yr)
+ GHG emissions due to vehicular travel on existing highways and ASR (tonnes CO_2e/yr)
+ GHG emissions due to the construction and maintenance of seasonal roads (tonnes CO_2e/yr)
+ GHG emissions due to land clearing along the proposed ASR (tonnes CO_2e/yr)
+ GHG emissions due to construction of the proposed ASR (tonnes CO_2e/yr).

Estimated GHG emissions for specific GHGs were also calculated, based on the above equation (including CO_2, CH_4, and N_2O). Details on the above sources and sinks / removals are given in the following sections. Detailed results can be found in Appendix B.

3.2.1 Carbon Sequestration of Disturbed Land and Reforested Area

In order to mitigate the environmental impacts and GHG emissions associated with the ASR, it is estimated that approximately 15% of the land cleared along the ASR route will be allowed to reforest naturally. The carbon sequestered by the reforestation will occur over a multi-decadal time period. However, for the purposes of this assessment, it was assumed that the carbon sequestered over the time period to establish a mature forest can be distributed linearly over time.

The annual carbon sequestration rate (tonnes CO_2e/year-ha forest) of the project-specific study area was used, as determined in Section 3.1.1. It is assumed that the land clearing and reforestation associated with construction occurs gradually over the course of the construction phase.

3.2.2 Net GHG Emissions from Land Cover

The proposed ASR is anticipated to cover approximately 27% of the land cleared for each project. This estimate was based on the width of the road of 10 m and the assumption that there is an additional 3 m on each side of the road that will be disturbed and cover the existing land surface. Therefore, it is estimated that the net annual GHG emissions under the Baseline Scenario would be reduced by 27% due to the coverage of the ASR.

The methodology for calculating net GHG emissions from land cover was described in Section 3.1.2. It is assumed that the changes in GHG emissions related to land cover associated with road construction occurs gradually over the course of the construction phase.

3.2.3 GHG Emissions of Air Travel

It is assumed that air travel to and from relevant communities would remain the same as the Baseline Scenario during the construction phase. In the first year of ASR operation, it was assumed that air traffic would decline to 80% of the Baseline Scenario for roads in the south (P1, P4, P7, and P7a), and to 90% for roads in the north (P2, P3a, P3b, P5, and P6). The decline in air travel is expected since the lower priced mode of transportation (road based) would be favoured. The lower reduction in the north is due to the fact that community members in the north will still have to drive around Lake Winnipeg (west side) to access roads in to Winnipeg. Therefore, it was assumed that there would be a lower modal shift (air to passenger vehicle) for communities in the North.

It is important to note that some of the air traffic serviced routes between communities, and for the northern communities it was found that variations in the percentage of modal shift did not affect the results of the assessment. The relatively short distances between communities in the north (compared to the distance to driving to Winnipeg) led to insignificant impacts on the GHG profile of the project scenario when changes in model shift for inter-community air travel was assumed.

Helicopter travel would cease after the construction period, as the primary purpose of helicopter travel was to shuttle persons to the nearest airport for approximately three months per year during spring

break up and winter freeze up, when both winter roads and ferry travel are not available. In the Project Scenario, the ASR would replace the need for the helicopter travel.

The methodology used in estimating the annual GHG emissions due to air travel described in Section 3.1.3 was applied with the above assumptions.

3.2.4 GHG Emissions of Ferry Crossing

As with air travel, it was assumed that ferry traffic to and from relevant communities would remain the same as the Baseline Scenario during the construction phase. In the first year of ASR operation, it is assumed that ferry/barge services would cease to operate.

The methodology used in estimating the annual GHG emissions due to ferry crossing described in Section 3.1.4 was applied with the above assumptions.

3.2.5 GHG Emissions of Vehicular Travel

In the Project Scenario, there are three components which would define vehicular traffic as described in the formula below:

Annual Vehicular Travel GHG Emissions (tonnes CO_2e/yr)
= GHG Emissions from Shift from Winter/Ice Road to ASR (tonnes CO_2e/yr)
+ GHG Emissions from Modal Shift from Air Travel to ASR (tonnes CO_2e/yr)
+ GHG Emissions from Modal Shift from Ferry Travel to ASR (tonnes CO_2e/yr).

The emission factors used in estimating the annual Project Scenario GHG emissions due to vehicular travel described in Section 3.1.5 were used, along with the methodology described below.

Seasonal (Winter/Ice) Road to ASR Shift

As the ASRs become operational, travel on seasonal roads will shift to travel on ASRs. Traffic levels estimated based on the 2017 winter road traffic assessment (Appendix D) have been assumed to remain consistent; however, fuel efficiency will improve from driving on winter roads to ASR travel as discussed in Section 3.1.5. In addition, road lengths vary slightly when between seasonal (winter/ice) roads and ASRs. For the purpose of this study, it was conservatively assumed that all travel is to the nearest community.

Air Travel Modal Shift

Air travel is expected to decline upon completion of the ASR, as the passengers shift to vehicular travel. As described in Section 3.2.3, it is estimated that 20% of the Baseline Scenario passenger air traffic estimates, are shifted from air travel to ASR travel for communities in the south. For those in the north, 10% shift was assumed as described in Section 3.2.3.

It is assumed that air travel to and from relevant communities would remain the same as the Baseline Scenario during the construction phase. In the first year of ASR operation, it was assumed that air traffic would decline. The decline in air travel is expected as the potentially cheaper mode of road transportation would be favoured. For the purpose of this study, it was assumed that all travel originated or terminated from or in Winnipeg. In addition, it was assumed that the modal shift from air travel to vehicular travel on the ASRs occurred in vehicles with two occupants (i.e. two persons per vehicle when driving on an ASR rather than flying).

Air passenger traffic volumes were retrieved from Manitoba Infrastructure (2016). The breakdown of air passenger traffic volumes by departure and destination community were analyzed based on commercial airline schedules, and airport movement fraction ratios applied to the passenger traffic. This methodology and associated emission factors are described in Section 3.1.3 and Section 3.1.5.

Ferry Travel Modal Shift

Ferry travel is expected to cease upon completion of the ASR, as the passengers shift to ASR travel. The Baseline Scenario ferry passenger traffic estimates, described in Section 3.1.4, were shifted from ferry/ seasonal road travel to ASR travel. The percentage of cars and pickup trucks (LDT) versus heavy trucks (HD) using the ferry in the Baseline Scenario was also applied to the Project Scenario.

It is assumed that travel using the ferry/barge service would continue during the years of construction to allow for commuting between communities along existing highways between Winnipeg and ferry service communities. It is assumed that ferries in the project area will cease in the first year of ASR operation due to their redundancy. For the purpose of this study, it was conservatively assumed that all travel originated or terminated from or in Winnipeg.

3.2.6 GHG Emissions of Seasonal Road Construction and Maintenance

The operation of winter roads will continue throughout the ASR construction phase. Emissions associated with the construction and maintenance of seasonal roads will remain consistent with the Baseline Scenario as described in Section 3.1.6.

Upon completion of the ASR construction phase, the winter road construction and maintenance (and associated emissions will cease.

3.2.7 GHG Emissions Due to Land Clearing

GHG emissions associated with land clearing in preparation of the construction of the proposed ASR include the assumed burning of slash and shrubs and the use of land clearing and construction equipment in the harvesting of the wood and clearing of the land.
Total annual GHG emissions are calculated by:

Annual GHG Emissions due to Land Clearing (tonnes CO_2e/yr)

= GHG Emissions from Tree and Shrub Slash and Burn (tonnes CO_2e/yr)
+ GHG Emissions Land Clearing Equipment (tonnes CO_2e/yr).

Tree and Shrub Slash and Burn

The proposed ASR projects have a 100 m ROW with approximately 60 m of cleared land. The land cover statistics along the ROW for the length of the ASR were determined through publically available land use GIS data (NRCan, 2000). The data provides the land areas considered forest and shrub covered land in the right-of-way of the proposed ASR. Total net GHG emissions were then estimated from the wetland and forested area data. The emission factors and methodology from the IPCC 2006 Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) were used to calculate GHG emissions from the treed biomass and shrub biomass cleared for the ASR construction.

While there may be efforts to have some of the harvested tree biomass converted into durable products, it was conservatively assumed that 100% of the biomass was to be burnt.

The IPCC (2006) methodology was used in estimating the GHG emissions due to slash burning:

GHG Emissions from Slash Burning (tonnes CO_2e/yr)
= Area of Burn (ha)
× Density of Available Fuel (tonnes/ha)
× C_f
× Specific gravity of tree dry weight to green tree weight (unitless)
× EF_{slash} (g/kg dry biomass burnt).

Where C_f is the combustion factor and is considered to be 0.33 for boreal forest post logging slash burn, and EF_{slash} = 1748 g CO_2e/kg fuel for extra tropical forests (i.e., temperate, boreal).
The Mass of Available Fuel is the sum of the tree biomass available for slash burning and the total shrub biomass cleared for the ASR. The GHG emission due to slash burning was assumed to occur linearly over the years of construction of the proposed ASR project.

Land Clearing

The GHG emissions associated with the clearing of the land in preparation of the proposed ASR was estimated by:

Annual GHG Emissions Land Clearing (tonnes CO_2e/yr)
= Σequipment types {Number of Equipment Type × Rate of Use (hr/km) × Distance (km) x $EF_{equipment}$ (kg CO_2e/hr) × 10^{-4} (tonnes/kg)}.

The hourly use, type, and quantity of earth moving, land clearing, and general mobile equipment used in the clearing and mulching operation was provided by Dillon (2016) in daily and weekly inspection

reports associated with P1 land clearing. This data was analyzed to determine the rate of use (hr/km) of each piece of equipment.

The emission factors are based on equipment make/model from actual construction activities data, and the cumulative GHG emission factors, $EF_{equipment}$, for each type of equipment are listed in Table 3.8. The CO_2 emission factors are based on US EPA NONROAD 2008 emission factors for non-highway mobile equipment (US EPA, 2006). Net power for each piece of equipment is required in calculating $EF_{equipment}$ and was retrieved from manufacturer specification documentation. Speciated GHG emissions are not currently available from ECCC for specific types of construction equipment in hourly units. As such, the ratios between speciated emission factors from ECCC's speciated emission factor (NIR, 2016) in units of kg/L fuel for heavy duty, moderate control vehicles were used as the basis for determining emission factors for CH_4 and N_20 in kg/hr.

Table 3.8 – Equipment Used in Land Clearing – Rate of Use and GHG Emission Factors

Equipment	Net Power (HP)	Rate of Use (hrs/km)	$EF_{equipment}$ ($kgCO_2e/hr$)
Backhoe	215	221.5	136
Backhoe with Mulcher	182	48.9	115
Bulldozer	191	149.7	103
Front-End Loader	305	0.1	193
Rock Truck	359	75.8	227
Tandem Truck	500	20.1	271
Timberjack Skidder	200	0.8	126

3.2.8 GHG Emissions Due to Construction of the ASR

Construction of the ASR involves the construction of the roadway and bridges (both permanent and modular bridges). The following was used to estimate the GHG emissions associated with the construction:

Annual GHG Emissions Due to Construction (tonnes CO_2e/yr)

$$= \Sigma ASR_{equipment} \{Number\ of\ Equipment \times Rate\ of\ Use\ (hr/km) \times Distance\ (km)\ x\ EF_{equipment}\ (kg\ CO_2e/hr) \times 10^{-4}\ (tonnes/kg)\}$$

$$+ \Sigma Bridge_{equipment} \{Number\ of\ Equipment \times Rate\ of\ Use\ (hr/km) \times Distance\ (km)\ x\ EF_{equipment}\ (kg\ CO_2e/hr) \times 10^{-4}\ (tonnes/kg)\}$$

Dillon (2016) provided data on the list of equipment used in the construction of the ASR and bridges, and the total number of hours of operation for each type of equipment based on P1 construction administration reporting. This data was analysed to determine the rate of use (hr/km) of each piece of equipment for ASRs and the use (hr) for bridges.

The emission factors are based on equipment make/model from actual construction activities data, and the cumulative GHG emission factors, $EF_{equipment}$ and usage for each type of equipment are listed in Table 3.9 (ASR), Table 3.10 (Permanent Bridges), and Table 3.11 (Modular Bridges). The $EF_{equipment}$ may vary since the actual equipment net horsepower and rate of use for P1 projects was used to calculate the emission factor. The CO_2 emission factors are based on US EPA NONROAD 2008 emission factors for non-highway mobile equipment (US EPA, 2006). Net power for each piece of equipment is required in calculating $EF_{equipment}$ and was retrieved from manufacturers' specifications. Speciated GHG emissions are not currently available from ECCC for specific types of construction equipment in hourly units. As such, the ratios between speciated emission factors from ECCC's speciated emission factor (NIR, 2016) in units of kg/L fuel for heavy duty, moderate control vehicles were used as the basis for determining emission factors for CH_4 and N_20 in kg/hr.

Table 3.9 – Equipment Used in Construction of ASR – Rate of Use and GHG Emission Factors

Equipment	Net Power (hp)	Rate of Use (hrs/km)	$EF_{equipment}$ (kg CO_2e/hr)
Backhoe	228	497.5	144
Bulldozer	211	299.7	114
Crusher	240	196.0	130
Front-End Loader	380	416.3	240
Grader	240	20.4	130
Rock Drill	225	421.8	120
Rock Truck	362	1188.7	229
Semi and Trailer	503	338.2	272
Smooth Drum Roller	104	64.7	56
Tandem Truck	500	88.3	271
Truck	334	46.7	181
Water Truck	275	10.4	149

Table 3.10 – Equipment Used in Construction of Permanent Bridges – Use and GHG Emission Factors

Equipment	Net Power (hp)	Use per Bridge (hrs)	$EF_{equipment}$ (kg CO_2e/hr)
Backhoe	228	102	144
Bobcat	53	310	37
Bulldozer	211	480	114
Compactor	208	110	111
Concrete Truck	363	72	229
Crane	329	82	176
Crusher	240	110	130
Equipment General	100	100	60

Equipment	Net Power (hp)	Use per Bridge (hrs)	$EF_{equipment}$ (kg CO_2e/hr)
Forklift	70	30	42
Front-End Loader	380	1290	240
Excavator	100	1195	54
Grader	240	50	130
Packer	39	30	23
Pump Truck	2050	71	1,110
Rock Drill	225	160	120
Rock Truck	362	321	229
Semi and Trailer	503	60	272
Smooth Drum Roller	104	50	56
Tandem Truck	500	197	271
Truck	334	384	181
Zoom Boom	112	930	61

Table 3.11 – Equipment Used in Construction of Modular Bridges – Use and GHG Emission Factors

Equipment	Net Power (hp)	Use per Bridge (hrs)	$EF_{equipment}$ (kg CO_2e/hr)
Bobcat	69	556	48
Bulldozer	103	580	56
Concrete Truck	106	40	57
Conveyor	35	35	21
Crane	130	167	70
Excavator	189	1055	161
Generator	25	3168	102
Grader	185	177	15
Front-End Loader	198	603	100
Mechanic Truck	255	320	125
Ranger All-Terrain	44	303	138
Rock Drill	300	190	26
Rock Truck	285	961	153
Semi and Trailer	500	518	271
Tandem Truck	303	553	164
Tractor	500	20	271
Truck	385	2268	208

4.0 Project Specific Calculations

Table 4.1 presents a summary of the Baseline Scenario and Project Scenario GHG emissions for each project, speciated into GHG emission estimates such as CO_2, CH_4, and N_2O, as well as in CO_2e during a 10 year operation time period. Table 4.2 presents the same data for a 30 year operation time period. Table 4.3 presents a summary of the Baseline Scenario and Project Scenario GHG emissions for each project and by GHG source/sink category for a 10 year time period. Table 4.4 presents the same data for a 30 year operation time period. Detailed calculations are presented in Appendix A and a summary of annual results are in Appendix B.

Note that the results below represent an estimate of GHG emissions based on the assumptions described in Section 3. Table 4.5 presents the key input parameters associated with the GHG calculations for each project.

Perflurocarbons (PFCs), hydroflurorcarbons (HFCs), sulphur hexafluoride (SF_6) and nitrogen trifluroide (NF_3) are not expected to be a significant source of emissions from this project.

4.1 Discussion

Results of the analysis estimate that *construction* of the ASR and land clearing drive an increase in GHG emissions over the course of the ASR construction phase and are above Baseline Scenario emissions. These are temporary increases related to the construction phase.

However, in general, estimated GHG emissions associated with the *operational* phase of the ASR in the Project Scenario are comparable to or lower than the estimated GHG emissions in the operational phase of the Baseline Scenario.

Cases where Project Scenario operational emission estimates are higher than the Baseline Scenario operational emissions include communities with high traffic airports associated with an individual project (ASR) such as Island Lake and Saint Theresa Point. The assumed displacement of some air traffic by passenger vehicle traffic (10% shift of air traffic) leads to a significant increase in vehicular emissions because of the significant distance associated with this vehicular travel. If a reduced level of modal shift is assumed (e.g., 5%) the overall results show that the Baseline Scenario would potentially have higher emissions than the Project Scenario. For the purposes of this study, the more conservative assumption (10%) has been used.

Table 4.1 – GHG Emission Estimate by Project – 10 Years of Operation – Speciated (tonnes CO_2, tonnes CH_4, tonnes N_2O)

Project	Scenario	Year Range	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	CO_2e (tonnes)
P1	Baseline – During ASR Construction Period	Year 1 – Year 8	6,649	548	1	20,789
	Baseline – During ASR Operational Period	Year 9 – Year 18	8,311	685	2	25,986
	Baseline – Total	Year 1 – Year 18	14,960	1,233	3	46,775
	Project – During ASR Construction Period	Year 1 – Year 8	154,710	506	7	169,589
	Project – During ASR Operational Period	Year 9 – Year 18	11,808	502	2	24,915
	Project – Total	Year 1 – Year 18	166,518	1,009	9	194,504
P2	Baseline – During ASR Construction Period	Year 1 – Year 8	37,069	442	1	48,433
	Baseline – During ASR Operational Period	Year 9 – Year 18	46,336	552	1	60,542
	Baseline – Total	Year 1 – Year 18	83,405	993	2	108,975
	Project – During ASR Construction Period	Year 1 – Year 8	224,632	424	9	237,790
	Project – During ASR Operational Period	Year 9 – Year 18	51,553	405	2	62,212
	Project – Total	Year 1 – Year 18	276,185	830	10	300,003
P3a	Baseline – During ASR Construction Period	Year 1 – Year 5	27,416	5	0	27,682
	Baseline – During ASR Operational Period	Year 6 – Year 15	45,693	8	1	46,136
	Baseline – Total	Year 1 – Year 15	73,109	13	1	73,818
	Project – During ASR Construction Period	Year 1 – Year 5	53,292	11	2	54,005
	Project – During ASR Operational Period	Year 6 – Year 15	53,231	7	1	53,826
	Project – Total	Year 1 – Year 15	106,523	17	3	107,830
P3b	Baseline – During ASR Construction Period	Year 1 – Year 7	34,161	35	1	35,243
	Baseline – During ASR Operational Period	Year 8 – Year 17	48,802	50	1	50,347
	Baseline – Total	Year 1 – Year 17	82,963	86	2	85,590
	Project – During ASR Construction Period	Year 1 – Year 7	106,961	50	4	109,305

Project	Scenario	Year Range	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	CO_2e (tonnes)
	Project – During ASR Operational Period	Year 8 – Year 17	53,585	38	2	55,076
	Project – Total	Year 1 – Year 17	160,546	88	5	164,381
P3c	Baseline – During ASR Construction Period	Year 1 – Year 7	3,828	279	0	10,905
	Baseline – During ASR Operational Period	Year 8 – Year 17	5,469	398	1	15,579
	Baseline – Total	Year 1 – Year 17	9,297	677	1	26,485
	Project – During ASR Construction Period	Year 1 – Year 7	100,871	260	4	108,628
	Project – During ASR Operational Period	Year 8 – Year 17	6,430	292	1	13,904
	Project – Total	Year 1 – Year 17	107,301	552	5	122,532
P4	Baseline – During ASR Construction Period	Year 1 – Year 8	3,861	260	0	10,479
	Baseline – During ASR Operational Period	Year 9 – Year 18	4,827	326	0	13,099
	Baseline – Total	Year 1 – Year 18	8,688	586	1	23,579
	Project – During ASR Construction Period	Year 1 – Year 8	86,523	245	4	93,762
	Project – During ASR Operational Period	Year 9 – Year 18	6,167	239	1	12,318
	Project – Total	Year 1 – Year 18	92,690	484	4	106,079
P5	Baseline – During ASR Construction Period	Year 1 – Year 8	17,277	189	1	22,384
	Baseline – During ASR Operational Period	Year 9 – Year 18	21,596	237	2	27,980
	Baseline – Total	Year 1 – Year 18	38,873	426	3	50,364
	Project – During ASR Construction Period	Year 1 – Year 8	114,956	187	5	121,174
	Project – During ASR Operational Period	Year 9 – Year 18	21,993	174	2	26,810
	Project – Total	Year 1 – Year 18	136,950	361	7	147,983
P6	Baseline – During ASR Construction Period	Year 1 – Year 8	15,625	159	1	19,851
	Baseline – During ASR Operational Period	Year 9 – Year 18	19,532	199	1	24,814
	Baseline – Total	Year 1 – Year 18	35,157	358	2	44,665

Project	Scenario	Year Range	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	CO_2e (tonnes)
	Project – During ASR Construction Period	Year 1 – Year 8	132,381	170	6	138,300
	Project – During ASR Operational Period	Year 9 – Year 18	19,750	146	1	23,690
	Project – Total	Year 1 – Year 18	152,130	316	7	161,990
P7	Baseline – During ASR Construction Period	Year 1 – Year 8	7,113	238	0	13,203
	Baseline – During ASR Operational Period	Year 9 – Year 18	8,891	298	1	16,504
	Baseline – Total	Year 1 – Year 18	16,005	536	1	29,707
	Project – During ASR Construction Period	Year 1 – Year 8	97,556	227	4	104,438
	Project – During ASR Operational Period	Year 9 – Year 18	6,061	218	1	11,688
	Project – Total	Year 1 – Year 18	103,616	445	5	116,126
P7a	Baseline – During ASR Construction Period	Year 1 – Year 5	4,661	40	0	5,692
	Baseline – During ASR Operational Period	Year 6 – Year 15	9,323	79	0	11,385
	Baseline – Total	Year 1 – Year 15	13,984	119	0	17,077
	Project – During ASR Construction Period	Year 1 – Year 5	40,383	43	2	41,921
	Project – During ASR Operational Period	Year 6 – Year 15	7,102	58	0	8,692
	Project – Total	Year 1 – Year 15	47,485	101	2	50,613

Table 4.2 – GHG Emission Estimate by Project – 30 Years of Operation – Speciated (tonnes CO_2, tonnes CH_4, tonnes N_2O)

Project	Scenario	Year Range	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	CO_2e (tonnes)
P1	Baseline – During ASR Construction Period	Year 1 – Year 8	6,649	548	1	20,789
	Baseline – During ASR Operational Period	Year 9 – Year 38	24,934	2,054	6	77,959
	Baseline – Total	Year 1 – Year 38	31,583	2,602	7	98,748
	Project – During ASR Construction Period	Year 1 – Year 8	154,710	506	7	169,589
	Project – During ASR Operational Period	Year 9 – Year 38	35,424	1,507	6	74,746
	Project – Total	Year 1 – Year 38	190,134	2,013	13	244,335
P2	Baseline – During ASR Construction Period	Year 1 – Year 8	37,069	442	1	48,433
	Baseline – During ASR Operational Period	Year 9 – Year 38	139,008	1,656	4	181,625
	Baseline – Total	Year 1 – Year 38	176,076	2,097	5	230,058
	Project – During ASR Construction Period	Year 1 – Year 8	224,632	424	9	237,790
	Project – During ASR Operational Period	Year 9 – Year 38	154,660	1,216	5	186,637
	Project – Total	Year 1 – Year 38	379,292	1,640	14	424,427
P3a	Baseline – During ASR Construction Period	Year 1 – Year 5	27,416	5	0	27,682
	Baseline – During ASR Operational Period	Year 6 – Year 35	137,079	24	2	138,409
	Baseline – Total	Year 1 – Year 35	164,495	29	3	166,090
	Project – During ASR Construction Period	Year 1 – Year 5	53,292	11	2	54,005
	Project – During ASR Operational Period	Year 6 – Year 35	159,692	20	4	161,477
	Project – Total	Year 1 – Year 35	212,984	30	6	215,481
P3b	Baseline – During ASR Construction Period	Year 1 – Year 7	34,161	35	1	35,243
	Baseline – During ASR Operational Period	Year 8 – Year 37	146,406	151	3	151,041
	Baseline – Total	Year 1 – Year 37	180,567	186	4	186,283
	Project – During ASR Construction Period	Year 1 – Year 7	106,961	50	4	109,305

Project	Scenario	Year Range	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	CO_2e (tonnes)
	Project – During ASR Operational Period	Year 8 – Year 37	160,756	113	6	165,227
	Project – Total	Year 1 – Year 37	267,717	163	9	274,532
P3c	Baseline – During ASR Construction Period	Year 1 – Year 7	3,828	279	0	10,905
	Baseline – During ASR Operational Period	Year 8 – Year 37	16,407	1,194	2	46,737
	Baseline – Total	Year 1 – Year 37	20,235	1,473	2	57,643
	Project – During ASR Construction Period	Year 1 – Year 7	100,871	260	4	108,628
	Project – During ASR Operational Period	Year 8 – Year 37	19,289	876	2	41,713
	Project – Total	Year 1 – Year 37	120,160	1,136	6	150,340
P4	Baseline – During ASR Construction Period	Year 1 – Year 8	3,861	260	0	10,479
	Baseline – During ASR Operational Period	Year 9 – Year 38	14,480	977	1	39,298
	Baseline – Total	Year 1 – Year 38	18,341	1,237	2	49,777
	Project – During ASR Construction Period	Year 1 – Year 8	86,523	245	4	93,762
	Project – During ASR Operational Period	Year 9 – Year 38	18,501	717	2	36,953
	Project – Total	Year 1 – Year 38	105,024	962	6	130,715
P5	Baseline – During ASR Construction Period	Year 1 – Year 8	17,277	189	1	22,384
	Baseline – During ASR Operational Period	Year 9 – Year 38	64,789	711	5	83,939
	Baseline – Total	Year 1 – Year 38	82,066	900	6	106,323
	Project – During ASR Construction Period	Year 1 – Year 8	114,956	187	5	121,174
	Project – During ASR Operational Period	Year 9 – Year 38	65,980	522	5	80,429
	Project – Total	Year 1 – Year 38	180,936	709	10	201,602
P6	Baseline – During ASR Construction Period	Year 1 – Year 8	15,625	159	1	19,851
	Baseline – During ASR Operational Period	Year 9 – Year 38	58,596	597	3	74,442
	Baseline – Total	Year 1 – Year 38	74,221	757	4	94,294

Project	Scenario	Year Range	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	CO_2e (tonnes)
	Project – During ASR Construction Period	Year 1 – Year 8	132,381	170	6	138,300
	Project – During ASR Operational Period	Year 9 – Year 38	59,249	438	3	71,069
	Project – Total	Year 1 – Year 38	191,630	608	9	209,369
P7	Baseline – During ASR Construction Period	Year 1 – Year 8	7,113	238	0	13,203
	Baseline – During ASR Operational Period	Year 9 – Year 38	26,674	893	2	49,512
	Baseline – Total	Year 1 – Year 38	33,788	1,131	2	62,716
	Project – During ASR Construction Period	Year 1 – Year 8	97,556	227	4	104,438
	Project – During ASR Operational Period	Year 9 – Year 38	18,182	655	2	35,064
	Project – Total	Year 1 – Year 38	115,737	881	6	139,502
P7a	Baseline – During ASR Construction Period	Year 1 – Year 5	4,661	40	0	5,692
	Baseline – During ASR Operational Period	Year 6 – Year 35	27,968	238	1	34,155
	Baseline – Total	Year 1 – Year 35	32,630	278	1	39,847
	Project – During ASR Construction Period	Year 1 – Year 5	40,383	43	2	41,921
	Project – During ASR Operational Period	Year 6 – Year 35	21,306	175	1	26,076
	Project – Total	Year 1 – Year 35	61,689	218	3	67,997

Table 4.3 –GHG Emission Estimate by Project and by Activity – 10 Years of Operation (tonnes CO_2e)

Project	Scenario	Year Range	GHG Estimate (tonnes CO_2e)								
			Forest Sequest-ration	Land Cover	Air Travel	Ferry Travel	Vehicular Travel	Winter Road Construction	Land Clearing	ASR Construc-tion	Total
P1	Baseline – During ASR Construction Period	Year 1 – Year 8	-3,649	7,839	5,078	192	9,149	2,179	-	-	20,789
	Baseline – During ASR Operational Period	Year 9 – Year 18	-4,561	9,799	6,348	240	11,437	2,724	-	-	25,986
	Baseline – Total	Year 1 – Year 18	-8,210	17,639	11,426	432	20,586	4,902	-	-	46,775
	Project – During ASR Construction Period	Year 1 – Year 8	-1,904	6,664	5,078	192	9,149	2,179	25,026	123,205	169,589
	Project – During ASR Operational Period	Year 9 – Year 18	-684	7,186	5,078	0	13,335	0	0	0	24,915
	Project – Total	Year 1 – Year 18	-2,588	13,850	10,156	192	22,484	2,179	25,026	123,205	194,504
P2	Baseline – During ASR Construction Period	Year 1 – Year 8	-3,847	6,650	36,563	0	5,135	3,932	-	-	48,433
	Baseline – During ASR Operational Period	Year 9 – Year 18	-4,809	8,313	45,704	0	6,419	4,915	-	-	60,542
	Baseline – Total	Year 1 – Year 18	-8,655	14,963	82,267	0	11,553	8,847	-	-	108,975
	Project – During ASR Construction Period	Year 1 – Year 8	-2,008	5,653	36,563	0	5,135	3,932	31,727	156,789	237,790
	Project – During ASR Operational Period	Year 9 – Year 18	-721	6,096	41,134	0	15,704	0	0	0	62,212
	Project – Total	Year 1 – Year 18	-2,729	11,749	77,697	0	20,839	3,932	31,727	156,789	300,003
P3a	Baseline – During ASR Construction Period	Year 1 – Year 5	-588	251	27,422	0	323	273	-	-	27,682
	Baseline – During ASR Operational Period	Year 6 – Year 15	-979	419	45,704	0	539	454	-	-	46,136
	Baseline – Total	Year 1 – Year 15	-1,567	670	73,126	0	862	727	-	-	73,818
	Project – During ASR Construction Period	Year 1 – Year 5	-296	212	27,422	0	323	273	4,031	22,040	54,005
	Project – During ASR Operational Period	Year 6 – Year 15	-147	307	41,134	0	12,532	0	0	0	53,826
	Project – Total	Year 1 – Year 15	-443	519	68,556	0	12,855	273	4,031	22,040	107,830
P3b	Baseline – During ASR Construction Period	Year 1 – Year 7	-2,176	1,158	35,202	0	447	613	-	-	35,243
	Baseline – During ASR Operational Period	Year 8 – Year 17	-3,109	1,654	50,288	0	638	876	-	-	50,347

Project	Scenario	Year Range	GHG Estimate (tonnes CO_2e)								
	Baseline – Total	Year 1 – Year 17	-5,286	2,812	85,489	0	1,085	1,489	-	-	85,590
	Project – During ASR Construction Period	Year 1 – Year 7	-1,119	981	35,202	0	447	613	12,287	60,895	109,305
	Project – During ASR Operational Period	Year 8 – Year 17	-466	1,213	44,067	0	10,262	0	0	0	55,076
	Project – Total	Year 1 – Year 17	-1,586	2,194	79,269	0	10,709	613	12,287	60,895	164,381
	Baseline – During ASR Construction Period	Year 1 – Year 7	-1,681	3,946	5,874	0	1,276	1,490	-	-	10,905
	Baseline – During ASR Operational Period	Year 8 – Year 17	-2,401	5,638	8,392	0	1,823	2,128	-	-	15,579
P3c	Baseline – Total	Year 1 – Year 17	-4,082	9,584	14,266	0	3,099	3,618	-	-	26,485
	Project – During ASR Construction Period	Year 1 – Year 7	-864	3,345	5,874	0	1,276	1,490	15,823	81,684	108,628
	Project – During ASR Operational Period	Year 8 – Year 17	-360	4,134	7,552	0	2,578	0	0	0	13,904
	Project – Total	Year 1 – Year 17	-1,225	7,479	13,427	0	3,854	1,490	15,823	81,684	122,532
	Baseline – During ASR Construction Period	Year 1 – Year 8	-2,315	3,938	6,611	0	1,072	1,173	-	-	10,479
	Baseline – During ASR Operational Period	Year 9 – Year 18	-2,893	4,922	8,263	0	1,340	1,466	-	-	13,099
P4	Baseline – Total	Year 1 – Year 18	-5,208	8,860	14,874	0	2,413	2,640	-	-	23,579
	Project – During ASR Construction Period	Year 1 – Year 8	-1,208	3,347	6,611	0	1,072	1,173	14,408	68,358	93,762
	Project – During ASR Operational Period	Year 9 – Year 18	-434	3,610	6,611	0	2,531	0	0	0	12,318
	Project – Total	Year 1 – Year 18	-1,642	6,957	13,221	0	3,604	1,173	14,408	68,358	106,079
	Baseline – During ASR Construction Period	Year 1 – Year 8	-2,218	3,041	12,015	0	8,013	1,533	-	-	22,384
	Baseline – During ASR Operational Period	Year 9 – Year 18	-2,772	3,801	15,019	0	10,017	1,916	-	-	27,980
P5	Baseline – Total	Year 1 – Year 18	-4,990	6,841	27,034	0	18,030	3,448	-	-	50,364
	Project – During ASR Construction Period	Year 1 – Year 8	-1,157	2,585	12,015	0	8,013	1,533	16,461	81,725	121,174
	Project – During ASR Operational Period	Year 9 – Year 18	-416	2,787	13,517	0	10,921	0	0	0	26,810
	Project – Total	Year 1 – Year 18	-1,573	5,372	25,532	0	18,935	1,533	16,461	81,725	147,983
P6	Baseline – During ASR Construction Period	Year 1 – Year 8	-4,122	3,327	14,242	0	3,792	2,612	-	-	19,851
	Baseline – During ASR Operational Period	Year 9 – Year 18	-5,153	4,159	17,802	0	4,740	3,265	-	-	24,814

Project	Scenario	Year Range	GHG Estimate (tonnes CO_2e)								
	Baseline – Total	Year 1 – Year 18	-9,275	7,487	32,044	0	8,532	5,878	-	-	44,665
	Project – During ASR Construction Period	Year 1 – Year 8	-2,151	2,828	14,242	0	3,792	2,612	20,979	95,998	138,300
	Project – During ASR Operational Period	Year 9 – Year 18	-773	3,050	16,022	0	5,390	0	0	0	23,690
	Project – Total	Year 1 – Year 18	-2,924	5,878	30,264	0	9,182	2,612	20,979	95,998	161,990
P7	Baseline – During ASR Construction Period	Year 1 – Year 8	-2,278	3,664	8,544	0	1,592	1,682	-	-	13,203
	Baseline – During ASR Operational Period	Year 9 – Year 18	-2,848	4,580	10,680	0	1,990	2,102	-	-	16,504
	Baseline – Total	Year 1 – Year 18	-5,126	8,244	19,224	0	3,582	3,784	-	-	29,707
	Project – During ASR Construction Period	Year 1 – Year 8	-1,189	3,115	8,544	0	1,592	1,682	15,053	75,641	104,438
	Project – During ASR Operational Period	Year 9 – Year 18	-427	3,359	5,553	0	3,203	0	0	0	11,688
	Project – Total	Year 1 – Year 18	-1,616	6,473	14,097	0	4,795	1,682	15,053	75,641	116,126
P7a	Baseline – During ASR Construction Period	Year 1 – Year 5	-567	673	5,340	0	121	127	-	-	5,692
	Baseline – During ASR Operational Period	Year 6 – Year 15	-1,135	1,346	10,680	0	241	253	-	-	11,385
	Baseline – Total	Year 1 – Year 15	-1,702	2,018	16,020	0	362	380	-	-	17,077
	Project – During ASR Construction Period	Year 1 – Year 5	-278	565	5,340	0	121	127	5,985	30,062	41,921
	Project – During ASR Operational Period	Year 6 – Year 15	-170	987	5,553	0	2,322	0	0	0	8,692
	Project – Total	Year 1 – Year 15	-448	1,552	10,893	0	2,443	127	5,985	30,062	50,613

Table 4.4 – GHG Emission Estimate by Project and by Activity – 30 Years of Operation (tonnes CO_2e)

Project	Scenario	Year Range	GHG Estimate (tonnes CO_2e)								
			Forest Sequest-ration	Land Cover	Air Travel	Ferry Travel	Vehicular Travel	Winter Road Construction	Land Clearing	ASR Construc-tion	Total
P1	Baseline – During ASR Construction Period	Year 1 – Year 8	-3,649	7,839	5,078	192	9,149	2,179	-	-	20,789
	Baseline – During ASR Operational Period	Year 9 – Year 38	-13,683	29,398	19,043	720	34,310	8,171	-	-	77,959
	Baseline – Total	Year 1 – Year 38	-17,331	37,237	24,121	912	43,459	10,350	-	-	98,748
	Project – During ASR Construction Period	Year 1 – Year 8	-1,904	6,664	5,078	192	9,149	2,179	25,026	123,205	169,589
	Project – During ASR Operational Period	Year 9 – Year 38	-2,052	21,559	15,234	0	40,005	0	0	0	74,746
	Project – Total	Year 1 – Year 38	-3,957	28,222	20,313	192	49,154	2,179	25,026	123,205	244,335
P2	Baseline – During ASR Construction Period	Year 1 – Year 8	-3,847	6,650	36,563	0	5,135	3,932	-	-	48,433
	Baseline – During ASR Operational Period	Year 9 – Year 38	-14,426	24,938	137,112	0	19,256	14,745	-	-	181,625
	Baseline – Total	Year 1 – Year 38	-18,273	31,588	173,675	0	24,390	18,677	-	-	230,058
	Project – During ASR Construction Period	Year 1 – Year 8	-2,008	5,653	36,563	0	5,135	3,932	31,727	156,789	237,790
	Project – During ASR Operational Period	Year 9 – Year 38	-2,164	18,288	123,401	0	47,112	0	0	0	186,637
	Project – Total	Year 1 – Year 38	-4,171	23,941	159,964	0	52,247	3,932	31,727	156,789	424,427
P3a	Baseline – During ASR Construction Period	Year 1 – Year 5	-588	251	27,422	0	323	273	-	-	27,682
	Baseline – During ASR Operational Period	Year 6 – Year 35	-2,938	1,256	137,112	0	1,617	1,363	-	-	138,409
	Baseline – Total	Year 1 – Year 35	-3,526	1,507	164,534	0	1,940	1,635	-	-	166,090
	Project – During ASR Construction Period	Year 1 – Year 5	-296	212	27,422	0	323	273	4,031	22,040	54,005
	Project – During ASR Operational Period	Year 6 – Year 35	-441	921	123,401	0	37,596	0	0	0	161,477
	Project – Total	Year 1 – Year 35	-737	1,133	150,823	0	37,919	273	4,031	22,040	215,481
P3b	Baseline – During ASR Construction Period	Year 1 – Year 7	-2,176	1,158	35,202	0	447	613	-	-	35,243
	Baseline – During ASR Operational Period	Year 8 – Year 37	-9,328	4,962	150,864	0	1,915	2,628	-	-	151,041

Project	Scenario	Year Range	GHG Estimate (tonnes CO_2e)								
	Baseline – Total	Year 1 – Year 37	-11,504	6,120	186,065	0	2,362	3,241	-	-	186,283
	Project – During ASR Construction Period	Year 1 – Year 7	-1,119	981	35,202	0	447	613	12,287	60,895	109,305
	Project – During ASR Operational Period	Year 8 – Year 37	-1,399	3,639	132,201	0	30,787	0	0	0	165,227
	Project – Total	Year 1 – Year 37	-2,519	4,620	167,403	0	31,233	613	12,287	60,895	274,532
	Baseline – During ASR Construction Period	Year 1 – Year 7	-1,681	3,946	5,874	0	1,276	1,490	-	-	10,905
	Baseline – During ASR Operational Period	Year 8 – Year 37	-7,203	16,913	25,175	0	5,468	6,385	-	-	46,737
P3c	Baseline – Total	Year 1 – Year 37	-8,884	20,859	31,049	0	6,744	7,874	-	-	57,643
	Project – During ASR Construction Period	Year 1 – Year 7	-864	3,345	5,874	0	1,276	1,490	15,823	81,684	108,628
	Project – During ASR Operational Period	Year 8 – Year 37	-1,080	12,403	22,657	0	7,733	0	0	0	41,713
	Project – Total	Year 1 – Year 37	-1,945	15,748	28,531	0	9,009	1,490	15,823	81,684	150,340
	Baseline – During ASR Construction Period	Year 1 – Year 8	-2,315	3,938	6,611	0	1,072	1,173	-	-	10,479
	Baseline – During ASR Operational Period	Year 9 – Year 38	-8,680	14,767	24,790	0	4,021	4,399	-	-	39,298
P4	Baseline – Total	Year 1 – Year 38	-10,994	18,705	31,401	0	5,094	5,572	-	-	49,777
	Project – During ASR Construction Period	Year 1 – Year 8	-1,208	3,347	6,611	0	1,072	1,173	14,408	68,358	93,762
	Project – During ASR Operational Period	Year 9 – Year 38	-1,302	10,829	19,832	0	7,594	0	0	0	36,953
	Project – Total	Year 1 – Year 38	-2,510	14,176	26,443	0	8,666	1,173	14,408	68,358	130,715
	Baseline – During ASR Construction Period	Year 1 – Year 8	-2,218	3,041	12,015	0	8,013	1,533	-	-	22,384
	Baseline – During ASR Operational Period	Year 9 – Year 38	-8,317	11,402	45,057	0	30,050	5,747	-	-	83,939
P5	Baseline – Total	Year 1 – Year 38	-10,535	14,443	57,072	0	38,064	7,280	-	-	106,323
	Project – During ASR Construction Period	Year 1 – Year 8	-1,157	2,585	12,015	0	8,013	1,533	16,461	81,725	121,174
	Project – During ASR Operational Period	Year 9 – Year 38	-1,248	8,362	40,551	0	32,763	0	0	0	80,429
	Project – Total	Year 1 – Year 38	-2,405	10,946	52,566	0	40,777	1,533	16,461	81,725	201,602
P6	Baseline – During ASR Construction Period	Year 1 – Year 8	-4,122	3,327	14,242	0	3,792	2,612	-	-	19,851
	Baseline – During ASR Operational Period	Year 9 – Year 38	-15,458	12,478	53,407	0	14,220	9,796	-	-	74,442

Project	Scenario	Year Range	GHG Estimate (tonnes CO_2e)								
	Baseline – Total	Year 1 – Year 38	-19,580	15,805	67,648	0	18,012	12,408	-	-	94,294
	Project – During ASR Construction Period	Year 1 – Year 8	-2,151	2,828	14,242	0	3,792	2,612	20,979	95,998	138,300
	Project – During ASR Operational Period	Year 9 – Year 38	-2,319	9,150	48,066	0	16,171	0	0	0	71,069
	Project – Total	Year 1 – Year 38	-4,470	11,979	62,308	0	19,963	2,612	20,979	95,998	209,369
P7	Baseline – During ASR Construction Period	Year 1 – Year 8	-2,278	3,664	8,544	0	1,592	1,682	-	-	13,203
	Baseline – During ASR Operational Period	Year 9 – Year 38	-8,544	13,741	32,040	0	5,969	6,307	-	-	49,512
	Baseline – Total	Year 1 – Year 38	-10,822	17,405	40,583	0	7,561	7,989	-	-	62,716
	Project – During ASR Construction Period	Year 1 – Year 8	-1,189	3,115	8,544	0	1,592	1,682	15,053	75,641	104,438
	Project – During ASR Operational Period	Year 9 – Year 38	-1,282	10,076	16,660	0	9,609	0	0	0	35,064
	Project – Total	Year 1 – Year 38	-2,471	13,191	25,204	0	11,201	1,682	15,053	75,641	139,502
P7a	Baseline – During ASR Construction Period	Year 1 – Year 5	-567	673	5,340	0	121	127	-	-	5,692
	Baseline – During ASR Operational Period	Year 6 – Year 35	-3,404	4,037	32,040	0	723	759	-	-	34,155
	Baseline – Total	Year 1 – Year 35	-3,971	4,709	37,379	0	844	886	-	-	39,847
	Project – During ASR Construction Period	Year 1 – Year 5	-278	565	5,340	0	121	127	5,985	30,062	41,921
	Project – During ASR Operational Period	Year 6 – Year 35	-511	2,960	16,660	0	6,966	0	0	0	26,076
	Project – Total	Year 1 – Year 35	-789	3,525	22,000	0	7,087	127	5,985	30,062	67,997

Table 4.5 – Key Input Parameters by Project

Project	Assumed Construction Start Year	Assumed Operation Start Year	ASR Length (km)	Number of Permanent Bridges	Number of Modular Bridges	Existing Winter Road Length (km)	Total Project Area (ha)
P1	2012	2020	167.8	9	0	167.9	1,007.4
P2	2030	2038	225.9	2	0	303.0	1,355.8
P3a	2016	2022	28.2	3	0	28.0	170.0
P3b	2030	2037	79.6	7	0	54.0	478.0
P3c	2030	2037	114.6	2	1	131.2	687.8
P4	2018	2026	94.4	4	0	90.4	566.6
P5	2030	2038	113.6	0	3	118.1	682.0
P6	2030	2038	137.3	2	0	201.3	824.1
P7	2020	2028	102.4	6	0	129.6	614.7
P7a	2016	2021	41.2	2	0	15.6	248.2

Appendix A

Calculations for Baseline Scenario and Project Scenario GHG Emission Estimations

East Side Road GHG Assessment

Emission Factors

Emission Intensities (100 Year GWPs)

GHG	100 Year GWP
Carbon Dioxide (CO_2)	1
Methane (CH_4)	25
Nitrous Oxide (N_2O)	298

Source - 2016 National Inventory Report (1990-2014), Environment Canada, Table 1-1

C-CO_2 Conversion	3.666666667 tonne CO_2/tonne C

Source - Table 11 of Tree Canada Forest and Urban Tree Carbon Project Protocol (2009)

Clearing/ Burning

EF_{slash} (g CO_2/kg dry biomass fuel burnt)	1569
EF_{slash} (g CH_4/kg dry biomass fuel burnt)	4.7
EF_{slash} (g N_2O/kg dry biomass fuel burnt)	0.26
EF_{slash} (g CO_2e/kg dry biomass fuel burnt)	1764

Source - Extra Tropical Forest/ Other Forest in Table 2.5 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 2

Air Travel - Airplane

EF_{air} (kg CO_2/passenger-km)	0.2772
EF_{air} (kg CH_4/passenger-km)	0.000004
EF_{air} (kg N_2O/passenger-km)	0.000005
EF_{air} (kg CO_2e/passenger-km)	0.2787

Source - Table 34 (Domestic Flights) of the UK Department for Business, Energy and Industrial Strategy 2016 GHG Conversion Factors for Company Reporting:Methodology Paper for Emission Factors

Includes an 8% uplift factor (for CO_2, CH_4, N_2O) and a 1.9 multiplier for non-CO_2 radiative forcing impacts (for CO_2 only) as prescribed in the methodology.

Air Travel - Helicopter

Fuel Efficiency $_{helicopter}$ (L/hr)	114

Source - Delta Helicopter Specifications For Bell Jet Ranger Helicopter <http://www.deltahelicopters.com/bell206b.html>

$EF_{helicopter}$ (kg CO_2/L fuel)	2.560
$EF_{helicopter}$ (kg CH4/L fuel)	0.000029
$EF_{helicopter}$ (kg N2O/L fuel)	0.000071

Source - 2016 National Inventory Report (1990-2014), Environment Canada, Table A6-12 for aviation turbo fuel

$EF_{helicopter}$ (kg CO_2e/L fuel)	2.582

Calculated based on GWPs

Ferry Travel

Fuel Efficiency $_{ferry}$ (L diesel/ passenger-100km)	5.1
EF_{ferry} (kg CO_2e/L diesel)	2.914
EF_{ferry} (kg CO_2/L diesel)	2.582
EF_{ferry} (kg CH_4/L diesel)	0.00015
EF_{ferry} (kg N_2O/L diesel)	0.0011

Source- "2016/2017 B.C. Best Practices Methodology for Quantifying Greenhouse Gas Emissions", Table 10

Road Vehicle Transportation

Vehicle Class	Emission Factor (g CO_2e/L fuel)			
	CO_2	CH_4	N_2O	CO_2e
Light Duty Gasoline Vehicle (2004-2013)	2316	0.14	0.022	2326.1
Light Duty Gasoline Vehicle (1994-2003)	2316	0.23	0.47	2461.8
Light Duty Gasoline Vehicle (1980-1995)	2316	0.32	0.66	2520.7
Light Duty Gasoline Truck (2004-2013)	2316	0.14	0.022	2326.1
Light Duty Gasoline Truck (1994-2003)	2316	0.24	0.58	2494.8
Light Duty Gasoline Truck (1980-1995)	2316	0.21	0.66	2517.9
Heavy Duty Gasoline Vehicle Controlled	2316	0.29	0.047	2337.3
Heavy Duty Gasoline Vehicle Uncontrolled	2316	0.49	0.084	2353.3
Light Duty Diesel Vehicle Moderate Control	2690	0.068	0.21	2754.3
Light Duty Diesel Truck Moderate Control	2690	0.068	0.21	2754.3
Heavy Duty Diesel Vehicle Moderate Control	2690	0.14	0.082	2717.9
Off-Road Diesel	2316	2.7	0.05	2398.4
Off-Road Gasoline	2690	0.15	1.0	2991.8

Source - 2016 National Inventory Report (1990-2014), Environment Canada, Table A6-12

Vehicle Class	Average Fuel Efficiency (L fuel/100km)	Emission Factor (kg CO_2e/L)
Light Duty Gasoline Vehicle	9.2	
Light Duty Diesel Vehicle	7.2	
Light Duty Gasoline Truck	12.3	
Light Duty Diesel Truck	10.8	
Heavy Duty Gasoline		2.262
Heavy Duty Diesel		2.63
Off Road Vehicle Equipment Gasoline		2.283
Off Road Vehicle Equipment Gasoline		2.914

Source - 2016/2017 B.C. Best Practices Methodology for Quantifying Greenhouse Gas Emissions, Table 7 and Table 10

1- In units of L/passenger-100km

Vehicle Class	Average Fuel Efficiency (L fuel/100km)
Heavy Duty Trailer Truck	39.5

Source- Natural Resources Canada, 2016, "Fuel Efficiency Benchmarking in Canada's Trucking Industry. From <http://www.nrcan.gc.ca/energy/efficiency/transportation/commercial-vehicles/reports/7607>

Construction & Maintenance Equipment

Source- Calculations and EFs based on US EPA NONROAD 2008 Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling Compression-Ignition (2010)

**CH_4 and N_2O emission rates are based on the ratio of CO_2 : CH_4 and CO_2 :N_2O from 2016 National Inventory Report (1990-2014), Environment Canada, Table A6-12 for Heavy Duty diesel vehicles with moderate control*

Equipment Type	HP	EF_{ss}		TAF		DF		Ef_{adj}		CO_2 (g/hp-hr)	CO_2 (kg CO_2/hr)	CH_4 * (kg CH_4/hr)	N_2O* (kg N_2O/hr)	CO_2e (kg CO_2/hr)
		BSFC	HC	BSFC	HC	BSFC	HC	BSFC	HC					
ASR Construction Equipment														
Backhoe (175-300 HP)	228	0.367	0.3384	1.18	2.29	-	1.017	0.4331	0.78811	624.1	142.3	0.007	0.004	144
Bulldozer (175-300 HP)	211	0.367	0.3384	1.01	1.05	-	1.017	0.3707	0.36136	535.2	112.9	0.006	0.003	114
Crusher (175-300 HP)	240	0.367	0.3384	1.01	1.05	-	1.017	0.3707	0.36136	535.2	128.4	0.007	0.004	130
Front-End Loader (300-600 HP)	380	0.367	0.1669	1.18	2.29	-	1.017	0.4331	0.388698	625.4	237.6	0.012	0.007	240
Grader (175-300 HP)	240	0.367	0.3384	1.01	1.05	-	1.017	0.3707	0.36136	535.2	128.4	0.007	0.004	130
Rock Drill (175-300 HP)	225	0.367	0.3384	1.00	1.00	-	1.017	0.3670	0.344153	529.9	119.2	0.006	0.004	120
Rock Truck (300-600 HP)	362	0.367	0.1669	1.18	2.29	-	1.017	0.4331	0.388698	625.4	226.4	0.012	0.007	229
Semi & Trailer (300-600 HP)	503	0.367	0.1669	1.01	1.05	-	1.017	0.3707	0.178224	535.8	269.5	0.014	0.008	272
Smooth Drum Roller (100- 175 HP)	104	0.367	0.3384	1.01	1.05	-	1.017	0.3707	0.36136	535.2	55.7	0.003	0.002	56
Tandem Truck (300-600 HP)	500	0.367	0.1669	1.01	1.05	-	1.017	0.3707	0.178224	535.8	267.9	0.014	0.008	271
Truck (300-600 HP)	334	0.367	0.1669	1.01	1.05	-	1.017	0.3707	0.178224	535.8	179.0	0.009	0.005	181
Water Truck (175-300 HP)	275	0.367	0.3384	1.01	1.05	-	1.017	0.3707	0.36136	535.2	147.2	0.008	0.004	149
Bridge (Permanent) Construction Equipment														
Backhoe (175-300 HP)	228	0.367	0.3384	1.18	2.29	-	1.017	0.4331	0.78811	624.1	142.3	0.007	0.004	144
Bobcat (50-75 HP)	53	0.408	0.3672	1.18	2.29	-	1.017	0.4814	0.855183	693.9	36.8	0.002	0.001	37
Bulldozer (175-300 HP)	211	0.367	0.3384	1.01	1.05	-	1.017	0.3707	0.36136	535.2	112.9	0.006	0.003	114
Compactor (175-300 HP)	208	0.367	0.3384	1.00	1.00	-	1.017	0.3670	0.344153	529.9	110.2	0.006	0.003	111
Concrete Truck (300-600 HP)	363	0.367	0.1669	1.18	2.29	-	1.017	0.4331	0.388698	625.4	227.0	0.012	0.007	229
Crane (300-600 HP)	329	0.367	0.1669	1.00	1.00	-	1.017	0.3670	0.169737	530.5	174.5	0.009	0.005	176
Crusher (175-300 HP)	240	0.367	0.3384	1.01	1.05	-	1.017	0.3707	0.36136	535.2	128.4	0.007	0.004	130
Equipment (75-100 HP)	100	0.408	0.3672	1.01	1.05	-	1.017	0.4121	0.392115	595.0	59.5	0.003	0.002	60
Forklift (50-75 HP)	70	0.408	0.3672	1.01	1.05	-	1.017	0.4121	0.392115	595.0	41.7	0.002	0.001	42
Front-End Loader (300-600 HP)	380	0.367	0.1669	1.18	2.29	-	1.017	0.4331	0.388698	625.4	237.6	0.012	0.007	240
Excavator (100-175 HP)	100	0.367	0.1836	1.01	1.05	-	1.017	0.3707	0.196057	535.7	53.6	0.003	0.002	54
Grader (175-300 HP)	240	0.367	0.3384	1.01	1.05	-	1.017	0.3707	0.36136	535.2	128.4	0.007	0.004	130
Packer (25-50 HP)	39	0.408	0.2789	1.00	1.00	-	1.017	0.4080	0.283641	589.5	23.0	0.001	0.001	23
Pump Truck (>1200 HP)	2050	0.367	0.1669	1.01	1.05	-	1.017	0.3707	0.178224	535.8	1098.4	0.057	0.033	1110
Rock Drill (175-300 HP)	225	0.367	0.3384	1.00	1.00	-	1.017	0.3670	0.344153	529.9	119.2	0.006	0.004	120
Rock Truck (300-600 HP)	362	0.367	0.1669	1.18	2.29	-	1.017	0.4331	0.388698	625.4	226.4	0.012	0.007	229
Semi & Trailer (300-600 HP)	503	0.367	0.1669	1.01	1.05	-	1.017	0.3707	0.178224	535.8	269.5	0.014	0.008	272
Smooth Drum Roller (100- 175 HP)	104	0.367	0.3384	1.01	1.05	-	1.017	0.3707	0.36136	535.2	55.7	0.003	0.002	56
Tandem Truck (300-600 HP)	500	0.367	0.1669	1.01	1.05	-	1.017	0.3707	0.178224	535.8	267.9	0.014	0.008	271
Truck (300-600 HP)	334	0.367	0.1669	1.01	1.05	-	1.017	0.3707	0.178224	535.8	179.0	0.009	0.005	181
Zoom Boom (100-175 HP)	112	0.367	0.1836	1.01	1.05	-	1.017	0.3707	0.196057	535.7	60.0	0.003	0.002	61

Bridge (ACROW) Construction Equipment														
Bobcat (50-75 HP)	69	0.408	0.3672	1.18	2.29	-	1.017	0.4814	0.855183	693.9	47.9	0.002	0.001	48
Bulldozer (100-175 HP)	103	0.367	0.3384	1.01	1.05	-	1.017	0.3707	0.36136	535.2	55.1	0.003	0.002	56
Concrete Truck (100-175 HP)	106	0.367	0.3384	1.00	1.00	-	1.017	0.3670	0.344153	529.9	56.2	0.003	0.002	57
Conveyor (25- 50 HP)	35	0.408	0.3389	1.01	1.05	-	1.017	0.4121	0.361894	595.1	20.8	0.001	0.001	21
Crane (100-175 HP)	130	0.367	0.3384	1.00	1.00	-	1.017	0.3670	0.344153	529.9	68.9	0.004	0.002	70
Rock Drill (175-300 HP)	300	0.367	0.3085	1.00	1.00	-	1.017	0.3670	0.313745	530.0	159.0	0.008	0.005	161
Excavator (175-300 HP)	189	0.367	0.3085	1.01	1.05	-	1.017	0.3707	0.329432	535.3	101.2	0.005	0.003	102
Generator (16-25 HP)	25	0.408	0.4380	1.01	1.05	-	1.017	0.4121	0.467718	594.8	14.9	0.001	0.000	15
Grader (175-300 HP)	185	0.367	0.3085	1.01	1.05	-	1.017	0.3707	0.329432	535.3	99.0	0.005	0.003	100
Front-End Loader (175-300 HP)	198	0.367	0.3085	1.18	2.29	-	1.017	0.4331	0.718475	624.3	123.6	0.006	0.004	125
Mechanic Truck (175-300 HP)	255	0.367	0.3085	1.01	1.05	-	1.017	0.3707	0.329432	535.3	136.5	0.007	0.004	138
Ranger All- Terrain (25- 50 HP)	44	0.408	0.3389	1.00	1.00	-	1.017	0.4080	0.344661	589.3	25.9	0.001	0.001	26
Rock Truck (175-300 HP)	285	0.367	0.3384	1.00	1.00	-	1.017	0.3670	0.344153	529.9	151.0	0.008	0.005	153
Semi & Trailer (300-600 HP)	500	0.367	0.1669	1.01	1.05	-	1.017	0.3707	0.178224	535.8	267.9	0.014	0.008	271
Tandem Truck (300-600 HP)	303	0.367	0.1669	1.01	1.05	-	1.017	0.3707	0.178224	535.8	162.3	0.008	0.005	164
Tractor (300-600 HP)	500	0.367	0.1669	1.01	1.05	-	1.017	0.3707	0.178224	535.8	267.9	0.014	0.008	271
Truck (300-600 HP)	385	0.367	0.1669	1.01	1.05	-	1.017	0.3707	0.178224	535.8	206.3	0.011	0.006	208
Land Clearing Equipment														
Backhoe (175-300 HP)	215	0.367	0.3384	1.18	2.29	-	1.017	0.4331	0.78811	624.1	134.2	0.007	0.004	136
Backhoe with Mulcher (175-300 HP)	182	0.367	0.3384	1.18	2.29	-	1.017	0.4331	0.78811	624.1	113.6	0.006	0.003	115
Bulldozer (175-300 HP)	191	0.367	0.3384	1.01	1.05	-	1.017	0.3707	0.36136	535.2	102.2	0.005	0.003	103
Front-End Loader (300-600 HP)	305	0.367	0.1669	1.18	2.29	-	1.017	0.4331	0.388698	625.4	190.7	0.010	0.006	193
Rock Truck (300-600 HP)	359	0.367	0.1669	1.18	2.29	-	1.017	0.4331	0.388698	625.4	224.5	0.012	0.007	227
Tandem Truck (300-600 HP)	500	0.367	0.1669	1.01	1.05	-	1.017	0.3707	0.178224	535.8	267.9	0.014	0.008	271
Timberjack Skidder (175-300 HP)	200	0.367	0.1669	1.18	2.29	-	1.017	0.4331	0.388698	625.4	125.1	0.007	0.004	126
Winter Road Construction Equipment														
Bobcat (50-75 HP)	51	0.408	0.3672	1.18	2.29	-	1.017	0.4814	0.855183	693.9	35.4	0.002	0.001	36
Bulldozer (75-100 HP)	88	0.408	0.3672	1.01	1.05	-	1.017	0.4121	0.392115	595.0	52.4	0.003	0.002	53
Equipment (25-50 HP)	25	0.408	0.2789	1.01	1.05	-	1.017	0.4121	0.297823	595.3	14.9	0.001	0.000	15
Front-End Loader (100-175 HP)	151	0.367	0.3384	1.18	2.29	-	1.017	0.4331	0.78811	624.1	94.2	0.005	0.003	95
Grader (100-175 HP)	125	0.367	0.3384	1.01	1.05	-	1.017	0.3707	0.36136	535.2	66.9	0.003	0.002	68
Grader (175-300 HP)	201	0.367	0.3085	1.01	1.05	-	1.017	0.3707	0.329432	535.3	107.6	0.006	0.003	109
Snowmobile (50-75 HP)	75	0.408	0.3672	1.00	1.00	-	1.017	0.4080	0.373442	589.2	44.2	0.002	0.001	45
Truck (300-600 HP)	334	0.367	0.1669	1.01	1.05	-	1.017	0.3707	0.178224	535.8	179.0	0.009	0.005	181
		From Table A4		From Table A5		From Table A6								
		For Tier 2				Assumes half of useful life is expended								

$$CO_2 = (BSFC * 453.6 - HC) * 0.87 * (44/12)$$ [Equation 6]

where

CO_2 is in g/hp-hr
BSFC is the in-use adjusted fuel consumption in lb/hp-hr
453.6 is the conversion factor from pounds to grams
HC is the in-use adjusted hydrocarbon emissions in g/hp-hr
0.87 is the carbon mass fraction of diesel
44/12 is the ratio of CO_2 mass to carbon mass

$$EF_{adj\ (HC\ ,CO\ ,NOx\ )} = EF_{ss} \times TAF \times DF$$ [Equation 1]

where:
EF_{adj} = final emission factor used in model, after adjustments to account for transient operation and deterioration (g/hp-hr)
EF_{ss} = zero-hour, steady-state emission factor (g/hp-hr)
TAF = transient adjustment factor (unitless)
DF = deterioration factor (unitless)

East Side Road GHG Assessment
Project P6
Project Information

Project Name

P6

Proposed ASR Length

137.3 km

Retrieved from ESRA GIS shapefiles

Project Area within 60m of ROW

8,240,940 m^2

824.094 ha

Retrieved from ESRA GIS shapefiles

Project Timeline

Construction Start Year=	2030	Years of Construction=	8
Construction End Year =	2037		
Operation Start Year=	2038		

Number of Bridges to be Constructed in Project Area

2 Permanent Bridges

0 ACROW Modular Bridges

Existing Winter/ Ice Road Length

201.3 km

Retrieved from ESRA GIS shapefiles

Approximate Age of Tree Stand in Project Area

100 years

Based on an analysis of Natural Resource Canada's Wildland Fire Information System GIS maps within 60m ROW of project

Landcover Classification Within 60m of ROW

Land Use Type	GIS Code (COVTYPE)	Area (m^2)	Area (ha)	Percent
Water	20	19,467	1.9466886	0%
Barren	30	0	0	0%
Exposed Land	33	280,028	28.00282	3%
Developed	34	0	0	0%
Shrubland	50	0	0	0%
Shrub Tall	51	0	0	0%
Shrub Low	52	0	0	0%
Wetland	80	0	0	0%
Wetland Treed	81	94,940	9.4940163	1%
Wetland Shrub	82	1,082,854	108.28543	13%
Wetland Herb	83	51,420	5.1419998	1%
Grassland	110	0	0	0%
Cultivated Agricultural	120	0	0	0%
Annual Crops	121	0	0	0%
Perennial Crops Pasture	122	0	0	0%
Forest Treed	200	0	0	0%
Coniferous	210	0	0	0%
Coniferous Dense	211	3,058,130	305.81299	37%
Coniferous Open	212	2,529,154	252.91535	31%
Coniferous Sparse	213	1,030,428	103.04283	12%
Broadleaf	220	0	0	0%
Broadleaf Dense	221	64,058	6.405762	1%
Broadleaf Open	222	0	0	0%
Broadleaf Sparse	223	0	0	0%
Mixedwood	230	0	0	0%
Mixedwood Dense	231	16,346	1.634619	0%
Mixedwood Open	232	0	0	0%
Mixedwood Sparse	233	0	0	0%
Other (Cloud, Shadow)	0,10,11,12	24,191	2.41914	0%
TOTAL		8251016.54	825.10165	

Retrieved from GIS analysis within 60m of the ROW
Landcover data from GeoBase shapefiles - Land Cover, circa 2000-Vector (LCC2000-V)
<http://ftp2.cits.rncan.gc.ca/pub/geobase/official/lcc2000v_csc2000v/shp_en/>

Total Tree Cover =	679	ha	82%

Total Broadleaf Tree Cover =	6	ha	1%
Total Coniferous Tree Cover =	662	ha	80%
Total Mixed Tree Cover =	11	ha	1%

Total Soft Wood Tree Cover =	671	ha	81%
Total Hard Wood Tree Cover =	8	ha	1%

Total Wetland Cover=	123	ha	15%

Total Shrub Cover=	113	ha	14%

East Side Road GHG Assessment
Project P6
Baseline Scenario: Forest Land Cover

Above Ground C-stock (tonnes CO_2) [1]
= *above ground tree density (tonnes/ha)*
× *project area (ha)*
× *specific gravity of tree dry weight to green tree weight (unitless)*
× *conversion to aboveground dry tree biomass to tree biomass C (tonne C/ tonnes dry tree biomass)*
× *C-CO_2 conversion (tonne CO_2/tonne C)*

Below Ground C-stock (tonnes CO_2) [1]
= *root-shoot ratio*
× *Aboveground C-stock*

Methodology and parameters based on Tree Canada's Tree Canada Afforestation and Reforestation Protocol, Version 2.0 (April 2015)

Approximate age of tree stand in project area= 100 years
(based on an analysis of Natural Resource Canada's Wildland Fire Information System GIS maps within 60m ROW of project)

Aboveground tree density=
106.5 tonnes tree/ha broadleaf
77.3 tonnes tree/ha coniferous
81.3 tonnes tree/ha mixed wood
(based on Canada's National Forest Inventory tables for boreal shield - see table to right)
77.7 tonnes tree/ha weighted average

Area,Gross Total Volume,Total Above-Ground Biomass by Forest/Non-forest,Forest Type

Terrestrial Ecozone	Forest/Non-forest	Forest Type	Area (1000 ha)	Tree Volume (million m3)	Tree Biomass (million t)
Boreal Shield	Non-forest land	Unreported	32751.08	153.11	390.87
Boreal Shield	Forest land	Broadleaf	12903	2076.43	1374.1
Boreal Shield	Forest land	Coniferous	78878.98	9378.45	6099.2
Boreal Shield	Forest land	Mixedwood	30789.26	4014.03	2503.02
Boreal Shield	Forest land	Non-treed	8703.49	1.34	64.9
Boreal Shield	Water	Unreported	28081.47	0	0
			192107.28	15623.36	10432.09

Generated: 11/21/2016
Source: Canada's National Forest Inventory, ***revised 2006 baseline***

Area=
6 ha broadleaf
662 ha coniferous
11 ha mixed wood

Average Dry Weight to Green Tree Specific Gravity = 40 %
(based on Table 5 of P. Miles/ W.Smit/ US Department of Agriculture Forest Service - Specific Gravity and Other Properties of Wood and Bark for 156 Tree Species Found in North America)

Conversion to tree biomass C= 0.5 tonne C/ tonnes dry tree biomass
(based on Table 4 of Tree Canada (2015) protocol)

C-CO_2 conversion = 3.67 tonne CO_2/tonne C
(based on Table 4 of Tree Canada (2015) protocol)

Root shoot ratio=
0.10 hardwood (broadleaf, mixed wood)
0.20 softwood (coniferous- pine and spruce)
0.20 weighted average
(based on Table D2 of Tree Canada (2015) protocol)

Aboveground dry biomass =	273	tonnes	broadleaf
	20,468	tonnes	coniferous
	362	tonnes	mixed wood
Belowground biomass =	27	tonnes	broadleaf
	4,094	tonnes	coniferous
	71	tonnes	mixed wood
Aboveground C-Stock =	500	tonnes CO_2	broadleaf
	37,525	tonnes CO_2	coniferous
	663	tonnes CO_2	mixed wood
	38,689	tonnes CO_2	
	-387	tonnes CO_2/year	
Belowground C-Stock =	50	tonnes CO_2	broadleaf
	7,505	tonnes CO_2	coniferous
	131	tonnes CO_2	mixed wood
	7,686	tonnes CO_2	
	-77	tonnes CO_2/year	
Total C-Stock=	46,375	tonnes CO_2	Total

Forest Sequestration Rate =	-515.3	tonnes CO_2/year
	0.00	tonnes CH_4/year
	0.00	tonnes N_2O/year
	-515.3	tonnes CO_2e/year

East Side Road GHG Assessment
Project P6
Baseline Scenario: Land Cover

Net GHG emissions due to land cover along the proposed ASR (tonnes CO_2e/yr)
= Methane flux from forest soils (tonnes CO_2e/ha) × forest area (ha)
+ Methane flux from wetlands (tonnes CO_2e/ha) × wetland area (ha)
+ Carbon dioxide flux from forest soils (tonnes C/ha) × wetland area (ha)
+ Carbon dioxide flux from wetlands (tonnes C/ha) × wetland area (ha)
× C-CO_2 conversion (tonne CO_2/tonne C).

C-CO_2 conversion = 3.67 tonne CO_2/tonne C

Land Cover		Study				
		Potter et al. (2001a)	Potter et al. (2001b)	Bubier et al. (2005)	Yuan et al. (2008)	Trumbore et al. (1999)
Forest (Upland)	Methane Emissions (mg CH_4/m^2/day)	-0.79 -0.86		-0.1 -1.0 -0.1 -1.3		
	Carbon Emissions (g C/m^2/year)	-49.1 -25.8	24		81	
Forest (Wetland)	Methane Emissions (mg CH_4/m^2/day)	4.0 5.2		12 44 133 70 45 148 12 70 250 120 45 171		

Forest (Wetland)		-10.7	2.65
		-11.8	-111.19
			-164.15
			-15.24
			-23
	Carbon Emissions (g C/m^2/year)		-180
			-180
			-25
			-3
			-65
			-31
			-13

Land Cover	CH_4 Emission Average (mg CH_4/m^2/day)	CH_4 Emission Average (g CH_4/m^2/year)	C Emission Average (g C/m^2/year)	Net GHG Emission Average (g CO_2e/m^2/year)	Land Cover area (ha)
Forest (Uplands)	-0.69	-0.145	7.53	23.96	679
Wetland	80.66	16.94	-59.32	205.96	123

Methane flux from forest upland areas- growing season (Apr-Oct)=	-0.99	tonnes CH_4/year	-25	tonnes CO_2e/year
Methane flux from wetland areas- growing season (Apr-Oct)=	20.8	tonnes CH_4/year	521	tonnes CO_2e/year
Carbon dioxide flux from forest upland areas =	187	tonnes CO_2/year	187	tonnes CO_2e/year
Carbon dioxide flux from wetlands areas=	-267	tonnes CO_2/year	-267	tonnes CO_2e/year

Net GHG Emissions from Wetlands =	-79.9	tonnes CO_2/year
	19.8	tonnes CH_4/year
	0	tonnes N_2O/year
	415.9	tonnes CO_2e/year

East Side Road GHG Assessment
Project P6
Baseline Scenario: AirTravel

Annual Air Travel GHG Emissions (tonnes CO_2e/yr)

= Plane travel (kg CO_2e) + helicopter travel(kg CO_2e)

= $\Sigma_{Airport}$ {Passenger-kilometers x EF_{air} (kg CO_2e/passenger-km)}

+ $\Sigma_{Airport}$ {Annual use (hours) x Fuel Efficiency $_{helicopter}$ (L/hr) x $EF_{helicopter}$ (kg CO2e/L fuel)}

Airplane Travel

% Unrecorded air movements = 25% 0.25

Applicable to Project (0=no, 1=yes)	From Airport	Passenger Kilometers[1] (passenger-km)	Increased Passenger Kilometers[2] (passenger-km)	EF_{air} (kg CO_2/ passenger-km)	EF_{air} (kg CH_4/ passenger-km)	EF_{air} (kg N_2O/ passenger-km)	EF_{air} (kg CO_2e/ passenger-km)	GHG Emissions (tonnes CO_2)	GHG Emissions (tonnes CH_4)	GHG Emissions (tonnes N_2O)	GHG Emissions (tonnes CO_2e)
0	Berens River	1,347,981	1,684,977	0.2772	0.0000043	0.0000047	0.2787	0.00	0.0000	0.0000	0.00
0	Bloodvein	473,856	592,320	0.2772	0.0000043	0.0000047	0.2787	0.00	0.0000	0.0000	0.00
0	Cross Lake	1,264,666	1,580,833	0.2772	0.0000043	0.0000047	0.2787	0.00	0.0000	0.0000	0.00
0	Garden Hill (Island Lake)	14,052,914	17,566,143	0.2772	0.0000043	0.0000047	0.2787	0.00	0.0000	0.0000	0.00
1	God's Lake	2,971,824	3,714,780	0.2772	0.0000043	0.0000047	0.2787	1029.83	0.0160	0.0175	1,035.45
1	God's River (Manto Sipi)	2,137,568	2,671,960	0.2772	0.0000043	0.0000047	0.2787	740.73	0.0115	0.0126	744.77
0	Little Grand Rapids	1,992,357	2,490,446	0.2772	0.0000043	0.0000047	0.2787	0.00	0.0000	0.0000	0.00
0	Norway House	2,643,582	3,304,477	0.2772	0.0000043	0.0000047	0.2787	0.00	0.0000	0.0000	0.00
0	Oxford House	4,310,560	5,388,201	0.2772	0.0000043	0.0000047	0.2787	0.00	0.0000	0.0000	0.00
0	Poplar River	2,371,676	2,964,595	0.2772	0.0000043	0.0000047	0.2787	0.00	0.0000	0.0000	0.00
0	Red Sucker Lake	2,408,456	3,010,570	0.2772	0.0000043	0.0000047	0.2787	0.00	0.0000	0.0000	0.00
0	St. Theresa Point	13,117,414	16,396,768	0.2772	0.0000043	0.0000047	0.2787	0.00	0.0000	0.0000	0.00

1- Analysis conducted in a separate spreadsheet, based on publically-available MIT Data and commercial airline flight schedules.

2- Assume a 25% increase in air traffic to account for periods when flights are not recorded.

1770.57 tonnes CO_2/year
0.0276 tonnes CH_4/year
0.0301 tonnes N_2O/year

GHG Emissions from Airplane Travel = 1,780.2 tonnes CO_2e/year

Helicopter Travel

Required to shuttle persons to airports for approximately 3 months per year (during spring breakup and winter freezeup) when both winter roads and ferry travel is not available.

Annual Helicopter Usage estimates provided by ESRA staff

Applicable to Project? (0=no, 1=yes)	To Airport	Annual Use (hrs)	Fuel Efficiency (L/hr)	EF_{air} (kg CO_2/L fuel)	EF_{air} (kg CH_4/L fuel)	EF_{air} (kg N_2O/L fuel)	EF_{air}[1] (kg CO_2e/L fuel)	GHG Emissions (tonnes CO_2)	GHG Emissions (tonnes CH_4)	GHG Emissions (tonnes N_2O)	GHG Emissions (tonnes CO_2e)
0	Island Lake	450	114	2.560	0.000029	0.000071	2.582	0	0.00000	0	0.0
0	Little Grand Rapids	1,270	114	2.560	0.000029	0.000071	2.582	0.00	0	0	0.0

1- From 2016 National Inventory Report (1990-2014), Environment Canada, Table A6-12 for aviation turbo fuel

	0	tonnes CO_2/year
	0.00000	tonnes CH_4/year
	0	tonnes N_2O/year
GHG Emissions from Helicopter Travel =	0.0	tonnes CO_2e/year

GHG Emissions from Air Travel =	1,770.57	tonnes CO_2/year
	0.03	tonnes CH_4/year
	0.03	tonnes N_2O/year
	1,780.2	tonnes CO_2e/year

East Side Road GHG Assessment
Project P6
Baseline Scenario: Ferry Travel

Annual Ferry Crossing GHG Emissions (tonnes CO_2 e/yr)
= *Average annual passenger traffic (unitless)*
× *Distance per Trip (km)*
× *Fuel consumption $_{ferry}$ (L/passenger-km)*
× *EF_{ferry} (kg CO_2 e/L) x 10-3 (tonnes/kg)*

Applicable to Project (0=no, 1=yes)	Ferry Name	Locations	Average Annual Passenger Traffic (2000-2010)	Average Annual Vehicular Traffic (2000-2010)	Distance per Trip (km)	Fuel Consumption[2] (L diesel/ passenger-100km)	EF_{ferry} (kg CO_2/L diesel)	EF_{ferry} (kg CH_4/L diesel)	EF_{ferry} (kg N_2O/L diesel)	EF_{ferry} (kg CO_2e/L diesel)	GHG Emissions (tonnes CO_2e)
0	M.V. Edgar Wood	Island View - Bloodvein -	2,393	1,129	45	5.1	2.582	0.00015	0.0011	2.914	0.00
0	Private[1]	Princess Harbour	-	-	-	-	-	-			0.00

1 - Assumed that the private ferry services 50% of the M.V. Edgar Wood ferry traffic/emissions

GHG Emissions from Ferry Travel =	0.00	tonnes CO_2/year
	0.0000	tonnes CH_4/year
	0.0000	tonnes N_2O/year
	0.0	tonnes CO_2e/year

East Side Road GHG Assessment
Project P6
Baseline Scenario: Vehicular Travel

Annual GHG due to Vehicular Travel (tonnes CO_2e/yr)
= Travel on Seasonal (Winter and Ice) Roads
+ Travel on Existing Highways to Ferry Terminals

Travel on Seasonal (Winter and Ice) Roads (tonnes CO_2e/yr)
= Σ seasonal road segment Σ vehicle category {Vehicle Category Number of Trips (Trips/yr) X Trip Duration (hr/Trip) X Fuel Use (L/hr) X $EF_{vehicle\ category}$ (g CO_2e/L) × 10-6 (tonnes/g)}

Travel on Existing Highways to Ferry Terminals (tonnes CO_2e/yr)
= Σ vehicle category {Vehicle Category Number of Trips (Trips/yr) X Trip Duration (hr/Trip) X Fuel Use (L/hr) X $EF_{vehicle}$ category (g CO_2e/L) × 10^{-6} (tonnes/g)}

Travel on Winter Roads (based on winter road traffic count)

Vehicle Distance Travel Per 60 Days on Winter Road (km)

	ATV/ Snowmobile	Car	Truck/ Van/ SUV	Transport Truck
Distance Travelled[1] (km)=	23,999	0	581,768	183,710

1- Analysis conducted in a separate spreadsheet, based on a winter road traffic count conducted in February 2017

Class=	Off-Road	LDV	LDT	HD	
Fuel Consumption[2] (L/100km) =	15.2	11.3	15.2	48.7	
EF (gCO_2/L fuel)=	2,690.0	2,316.0	2,316.0	2,690.0	
EF (gCH_4/L fuel)=	0.15	0.23	0.24	0.14	
EF (gN_2O/L fuel)=	1.00	0.47	0.58	0.08	
EF (gCO_2e/L fuel)=	2,991.8	2,461.8	2,494.8	2,717.9	
	9.8	0.0	204.3	240.6	tonnes CO_2/year
	0.0	0.0	0.0	0.0	tonnes CH_4/year
	0.0	0.0	0.1	0.0	tonnes N_2O/year
	10.9	0.0	220.0	243.1	tonnes CO_2e/year

2- Fuel is seasonally adjusted at the pump. A liter of winter gas has 1.5% -3.0% less energy than a liter of summer gas due to temperature adjustments. Fuel consumption can increase 7-35% due to poor road conditions (such as heavy snow, slush, etc).
Source- NRCan Cold Weather Effects on Fuel Efficiency <http://www.nrcan.gc.ca/energy/efficiency/transportation/cars-light-trucks/buying/16748>

	454.6	tonnes CO_2/year
	0.034	tonnes CH_4/year
	0.062	tonnes N_2O/year
GHG Emissions due to Vehicular Traffic =	474.0	tonnes CO_2e/year

Travel on Existing Highways (Based on Ferry Travel)

Applicable only to P1

Average Annual Traffic (2000-2010)[1]

Applicable to Project (0=no, 1=yes)	Ferry	Passengers	Car/ Truck	Heavy Duty Truck	Semi-Trailer	Bus	Loader	Grader	Miscellaneous	Total Vehicles
0	M.V. Edgar Wood	2395	710	144	56	8	7	4	200	1129
0	Private[3]	1198	355	72	28	4	4	2	100	565

1- Data provided by Lauri Blair, Government of Manitoba in 2010 P1 GHG Assessment. Older data used to account for changes in traffic due to the construction of P1.

2- Assume 2 passengers per vehicle on average

3- Assume the number of vehicles in increased by 50% to account for private barge/ferry

Travel to Ferry on Paved Road (PTH 8)

Paved Road Speed Limit =	100	km/hr
Estimated Vehicle Speed=	80	km/hr
Paved Road Trip Distance=	140	km
Total Annual Distance (HD)=	0	km
Total Annual Distance (LDT)=	0	km
Paved Road Trip Duration=	1.75	hr
Total Annual Duration (HD)=	0	hr
Total Annual Duration (LDT)=	0	hr
Fuel Consumption HD =	39.5	L/100 km
Fuel Consumption LDT =	12.3	L/100 km
EF_{HD} =	2718	g CO_2e/L fuel
EF_{LDT} =	2754	g CO_2e/L fuel

Travel to Ferry on Gravel Road (PR 234)

Gravel Road Speed Limit =	90	km/hr
Estimated Vehicle Speed=	75	km/hr
Paved Road Trip Distance=	80	km
Total Annual Distance (HD)=	0	km
Total Annual Distance (LDT)=	0	km
Paved Road Trip Duration=	1.07	hr
Total Annual Duration (HD)=	0	hr
Total Annual Duration (LDT)=	0	hr
Fuel Consumption HD[1] =	45.9	L/100 km
Fuel Consumption LDT[1] =	14.3	L/100 km
EF_{HD} =	2718	g CO_2e/L fuel
EF_{LDT} =	2754	g CO_2e/L fuel

1- Fuel efficiency on gravel roads is reduced to 83.9% on average as per US EPA, 2006, "Final Technical Support Document:Fuel Economy Labeling of Motor Vehicle Revisions to Improve Calculation of Fuel Economy Estimates"

	0.0	tonnes CO_2/year
	0.000	tonnes CH_4/year
	0.000	tonnes N_2O/year
GHG Emissions due to Vehicular Traffic (based on ferry travel data) =	0.0	tonnes CO_2e/year

GHG Emissions due to Vehicular Traffic =	454.6	tonnes CO_2/year
	0.034	tonnes CH_4/year
	0.062	tonnes N_2O/year
	474.0	tonnes CO_2e/year

East Side Road GHG Assessment
Project P6
Baseline Scenario: Construction and Maintenance of Winter and Ice Roads

Annual GHG Emissions Construction and Maintenance of Seasonal Roads (tonnes CO_2 e/yr)
= Σ equipment type {Equipment Use (hr/km) X Length (km)
X $EF_{equipment\ type}$ (g CO_2 e/hr) × 10-6 (tonnes/g)}

Construction

Equipment Type	Average Annual Use[1] (hrs/km)	EF_{equip} (kg CO_2/hr)	EF_{equip} (kg CH_4/hr)	EF_{equip} (kg N_2O/hr)	EF_{equip} (kg CO_2e/hr)	Winter/Ice Road Length in Project Area[2]	Hours Required	GHG Emissions (tonnes CO_2)	GHG Emissions (tonnes CH_4)	GHG Emissions (tonnes N_2O)	GHG Emissions (tonnes CO_2e)
Bobcat (50-75 HP)	0.54	35.39	0.0018	0.0011	35.76	201.3	109	3.85	0.0002	0.0001	3.89
Bulldozer (75-100 HP)	3.43	52.36	0.0027	0.0016	52.91		690	36.15	0.0019	0.0011	36.53
Equipment (25-50 HP)	0.14	14.88	0.0008	0.0005	15.04		28	0.42	0.0000	0.0000	0.42
Front-End Loader (100-175 HP)	2.77	94.24	0.0049	0.0029	95.22		558	52.55	0.0027	0.0016	53.09
Grader (100-175 HP)	1.68	66.90	0.0035	0.0020	67.59		338	22.62	0.0012	0.0007	22.86
Grader (175-300 HP)	1.40	107.60	0.0056	0.0033	108.71		282	30.32	0.0016	0.0009	30.64
Snowmobile (50-75 HP)	3.00	44.19	0.0023	0.0013	44.65		604	26.69	0.0014	0.0008	26.96
Truck (300-600 HP)	4.18	178.95	0.0093	0.0055	180.81		841	150.58	0.0078	0.0046	152.14

1-Average annual equipment use per kilometer based on 2014/2015 and 2015/2016 contractor equipment use data received by ESRA. Analysis conducted in a separate spreadsheet.
2-Ice/Winter Road Length in Project Area determined through ESRA GIS files

	323.18	tonnes CO_2/year
	0.0168	tonnes CH_4/year
	0.0099	tonnes N_2O/year
GHG Emissions from Winter and Ice Road Construction & Maintenance =	326.5	tonnes CO_2e/year

East Side Road GHG Assessment
Project P6
Project Scenario: Forest Land Cover

GHG Emissions from Forest Sequestration (tonnes CO_2e/yr)

= ∑ year (GHG Emissions from Tree Sequestration in Baseline Scenario (tonnes CO_2e/ha) X Proportion of Tree Cover Remaining (ha))

+ ∑year(GHG Emissions from Tree Sequestration in Baseline Scenario (tonnes CO_2e/ha) X Reforested Area (ha))

Forest sequestration rate = -515.3 tonnes CO_2e/year
Total tree cover area in project area = 679 ha
Estimated carbon sequestration rate of reforested land = -0.76 tonnes CO_2e/year-ha forest
Reforested land= 101.9 ha
Assumed that 15% of total forested cleared area is reforested.
Years of Construction = 8

	Year								
	1	2	3	4	5	6	7	8	
Forested Area Land Cover Sequestration - During Construction =	-461	-406	-351	-296	-242	-186.8	-132	-77.29	tonnes CO_2/year
Land clearing assumed to be distributed linearly over years of construction (ie. forest removed gradually over the course of construction period). Reforestation is also assumed to occur linearly.	0	0	0	0	0	0	0	0	tonnes CH_4/year
	0	0	0	0	0	0	0	0	tonnes N_2O/year
	-461	-406	-351	-296	-242	-186.8	-132	-77.29	tonnes CO_2e/year

Reforested Area Land Cover Sequestration - During Operation =	-77	tonnes CO_2/year
Assumed to be distributed linearly over 90 years	0	tonnes CH_4/year
	0	tonnes N_2O/year
	-77	tonnes CO_2e/year

East Side Road GHG Assessment
Project P6
Project Scenario: Land Cover

Net GHG emissions due to land cover along the proposed ASR (tonnes CO_2e/yr)
= ∑year(GHG Emissions from Wetlands in Baseline Scenario (tonnes CO_2e/yr)
X Proportion of Landcover Remaining)

Width of road =	10	m
Road Shoulder =	3	m
Total ROW =	60	m

Proportion of area covered by road and road shoulder = 27%

Years of Construction = 8

	Year								
	1	2	3	4	5	6	7	8	
Wetland GHG Emissions - During Construction =	-77	-75	-72	-69	-67	-64	-61	-59	tonnes CO_2/year
Construction (road coverage) assumed to be distributed linearly over years of construction (ie. Wetlands covered gradually over the course of construction period).	19	19	18	17	17	16	15	15	tonnes CH_4/year
	0	0	0	0	0	0	0	0	tonnes N_2O/year
	402	388	374	360	347	333	319	305	tonnes CO_2e/year

Wetland GHG Emissions - During Operation =	-59	tonnes CO_2/year
Assumed to be distributed linearly over 90 years	15	tonnes CH_4/year
	0	tonnes N_2O/year
	305	tonnes CO_2e/year

East Side Road GHG Assessment
Project P6
Project Scenario: AirTravel

Annual Air Travel GHG Emissions (tonnes CO_2e/yr)
= GHG Emissions from Air Travel in Baseline Scenario (tonnes CO_2e/yr)
X Proportion of Air Travel Remaining

GHG Emissions from Air Travel During Construction=	1,770.57	tonnes CO_2/year
Assumed that air travel will remains consistent during construction.	0.028	tonnes CH_4/year
	0.030	tonnes N_2O/year
	1,780.2	tonnes CO_2e/year
GHG Emissions from Air Travel During Operation=	1,593.51	tonnes CO_2/year
Assumed that air travel will reduce to 80% in first two years of operation and helicopter travel to airport will cease.	0.02	tonnes CH_4/year
	0.03	tonnes N_2O/year
	1,602.2	tonnes CO_2e/year

East Side Road GHG Assessment
Project P6
Project Scenario: Ferry Travel

Annual Ferry Travel GHG Emissions (tonnes CO_2e/yr)
= GHG Emissions from Ferry Travel in Baseline Scenario (tonnes CO_2e/yr)
X Proportion of Ferry Travel Remaining

GHG Emissions from Ferry Travel During Construction=	0.00	tonnes CO_2/year
Assumed that ferry travel will remain consistent during construction	0.00	tonnes CH_4/year
	0.00	tonnes N_2O/year
	0.0	tonnes CO_2e/year
GHG Emissions from FerryTravel During Operation=	0.00	tonnes CO_2/year
Assumed that ferry travel will cease after operation begins	0.00	tonnes CH_4/year
	0.00	tonnes N_2O/year
	0.0	tonnes CO_2e/year

East Side Road GHG Assessment
Project P6
Project Scenario: Vehicular Travel

Annual Vehicular Travel GHG Emissions (tonnes CO_2e/yr)

= GHG Emissions from Vehicular Travel in Baseline Scenario based on Modal Shift from Winter Road to ASR Travel (tonnes CO_2e/yr)

+ GHG Emissions from Vehicular Travel in Baseline Scenario X Proportional Increase from Modal Shift from Air Travel (tonnes CO_2e/yr)

+ GHG Emissions from Vehicular Travel in Baseline Scenario X Proportional Increase from Modal Shift from Ferry Travel (tonnes CO_2e/yr)

Modal Shift from Winter Road to ASR (Based on tonnage requirements per community)

Assume remains consistent; baseline scenario winter road traffic moves to gravel ASR once constructed

Vehicle Distance Travel Per 60 Days on Winter Road (km)

	ATV/ Snowmobile	Car	Truck/ Van/ SUV	Transport Truck
Distance Travelled[1] (km)=	16,369	0	396,804	125,302

1- Analysis conducted in a separate spreadsheet, based on a winter road traffic count conducted in February 2017, prorated to convert winter road length to ASR length

Class=	Off-Road	LDV	LDT	HD	
Fuel Consumption[2] (L/100km) =	14.3	10.7	14.3	45.9	
EF (gCO_2/L fuel)=	2,690.0	2,316.0	2,316.0	2,690.0	
EF (gCH_4/L fuel)=	0.2	0.2	0.2	0.1	
EF (gN_2O/L fuel)=	1.0	0.5	0.6	0.1	
EF (gCO_2e/L fuel)=	2,991.8	2,461.8	2,494.8	2,717.9	
	6.3	0.0	131.2	154.6	tonnes CO_2/year
	0.0	0.0	0.0	0.0	tonnes CH_4/year
	0.0	0.0	0.0	0.0	tonnes N_2O/year
	7.0	0.0	141.4	156.2	tonnes CO_2e/year

2 - Fuel efficiency on gravel roads is reduced to 83.9% on average as per US EPA, 2006, "Final Technical Support Deocument:Fuel Economy Labeling of Motor Vehicle Revisions to Improve Calculation of Fuel Economy Estimates"

	292.1	tonnes CO_2/year
	0.022	tonnes CH_4/year
	0.040	tonnes N_2O/year
GHG Emissions due to Vehicular Traffic shifting from winter road to ASR =	304.5	tonnes CO_2e/year

Increase due to Travel Modal Switch (Air Travel)

Assume 20% of air travel moves to vehicular travel

Baseline Scenario Air Passenger Traffic

Estimated Annual Passenger Traffic - Return

Applicable to Project (0=no, 1=yes)	From Airport	To Airport: Winnipeg	Berens River	Bloodvein	Cross Lake	Garden Hill	God's Lake	God's River	Oxford House	Norway House	Red Sucker Lake	St. Theresa Point	TOTAL
0	Berens River	4,425	-	2,028	-	-	-	-	-	-	-	-	6,453
0	Bloodvein	1,907	953	-	-	-	-	-	-	-	-	-	2,860
0	Cross Lake	2,054	-	-	-	-	-	-	-	2,465	-	-	4,519
0	Garden Hill (Island Lake)	29,068	-	-	-	-	-	-	-	-	2,202	8,808	40,078
1	God's Lake	4,425	-	-	-	-	-	1,580	6,006	-	-	-	12,011
1	God's River (Manto Sipi)	3,510	-	-	-	-	731	-	292	-	292	-	4,825
0	Little Grand Rapids	7,576	-	-	-	-	-	-	-	-	-	-	7,576
0	Norway House	5,379	-	-	2,689	-	-	-	-	-	-	-	8,068
0	Oxford House	6,966	-	-	-	-	3,893	410	-	-	-	-	11,269
0	Poplar River	6,835	-	-	-	-	-	-	-	-	-	-	6,835
0	Red Sucker Lake	4,377	-	-	-	547	-	219	-	-	-	-	5,143
0	St. Theresa Point	28,034	-	-	-	5,840	-	-	-	-	-	-	33,874

Project Scenario Vehicle Trips (20% of air traffic, 2 persons per car)

Estimated Annual Traffic Diverted from Air Travel to Vehicular Travel

Applicable to Project (0=no, 1=yes)	From Airport	To Airport: Winnipeg	Berens River	Bloodvein	Cross Lake	Garden Hill	God's Lake	God's River	Oxford House	Norway House	Red Sucker Lake	St. Theresa Point	TOTAL
0	Berens River	221	0	101	0	0	0	0	0	0	0	0	323
0	Bloodvein	95	48	0	0	0	0	0	0	0	0	0	143
0	Cross Lake	103	0	0	0	0	0	0	0	123	0	0	226
0	Garden Hill (Island Lake)	1,453	0	0	0	0	0	0	0	0	110	440	2,004
1	God's Lake	221	0	0	0	0	0	79	300	0	0	0	601
1	God's River (Manto Sipi)	176	0	0	0	0	37	0	15	0	15	0	241
0	Little Grand Rapids	379	0	0	0	0	0	0	0	0	0	0	379
0	Norway House	269	0	0	134	0	0	0	0	0	0	0	403
0	Oxford House	348	0	0	0	0	195	21	0	0	0	0	563
0	Poplar River	342	0	0	0	0	0	0	0	0	0	0	342
0	Red Sucker Lake	219	0	0	0	27	0	11	0	0	0	0	257
0	St. Theresa Point	1,402	0	0	0	292	0	0	0	0	0	0	1,694

Distance by Vehicle (km) - Paved Roads (Highways)

Applicable to Project (0=no, 1=yes)	From Location	To Location: Winnipeg	Berens River	Bloodvein	Cross Lake	Garden Hill	God's Lake	God's River	Oxford House	Norway House	Red Sucker Lake	St. Theresa Point
0	Berens River	195										
0	Bloodvein	195										
0	Cross Lake	765								115		
0	Garden Hill (Island Lake)	765										
1	God's Lake	765										
1	God's River (Manto Sipi)	765										
0	Little Grand Rapids	195										
0	Norway House	805			115							
0	Oxford House	765										
0	Poplar River	195										
0	Red Sucker Lake	765										
0	St. Theresa Point	765										

Distance by Vehicle (km) - Gravel Roads (ASR)

Applicable to Project (0=no, 1=yes)	From Location	To Location: Winnipeg	Berens River	Bloodvein	Cross Lake	Garden Hill	God's Lake	God's River	Oxford House	Norway House	Red Sucker Lake	St. Theresa Point
0	Berens River	167.8		73								
0	Bloodvein	88.8	73									
0	Cross Lake	0										
0	Garden Hill (Island Lake)	305.5									115	108
1	God's Lake	257.3						101	66			
1	God's River (Manto Sipi)	298.2					101		107		524	
0	Little Grand Rapids	286.7										
0	Norway House	0										
0	Oxford House	190.9					66	107				
0	Poplar River	262.2										
0	Red Sucker Lake	420.1				115		524				
0	St. Theresa Point	254.1				108						

Paved Road (Highway) Segment

Percent HD Vehicles=	24%
Percent LDT Vehicles=	76%
Percent LDV Vehicles=	0%

Total Distance (Paved/Highway Road)=	303,514	km
Total Annual Distance (HD)=	72,841	km
Total Annual Distance (LDT)=	230,672	km
Total Annual Distance (LDV)=	0	km

Fuel Consumption $_{HD}$ =	39.5	L/100km
Fuel Consumption $_{LDT}$ =	12.3	L/100km
Fuel Consumption $_{LDV}$ =	9.2	L/100km

ASR Road (Gravel) Segment

Percent HD Vehicles=	24%
Percent LDT Vehicles=	76%
Percent LDV Vehicles=	0%

Total Distance (Gravel/ASR Road)=	150,057.43	km
Total Annual Distance (HD)=	36,013	km
Total Annual Distance (LDT)=	114,045	km
Total Annual Distance (LDV)=	0	km

Fuel Consumption $_{HD}$ =	45.9	L/100km
Fuel Consumption $_{LDT}$ =	14.3	L/100km
Fuel Consumption $_{LDV}$ =	10.7	L/100km

Fuel efficiency on gravel roads is reduced to 83.9% on average as per US EPA, 2006, "Final Technical Support Deocument:Fuel Economy Labeling of Motor Vehicle Revisions to Improve Calculation of Fuel Economy Estimates"

	HD	LDT	LDV
EF (gCO_2/L fuel)=	2,690.0	2,316.0	2316.0
EF (gCH_4/L fuel)=	0.1	0.2	0.2
EF (gN_2O/L fuel)=	0.1	0.6	0.5
EF (gCO_2e/L fuel)=	2,717.9	2,494.8	2461.8

143.1	tonnes CO_2/year	
0.0	tonnes CH_4/year	
0.0	tonnes N_2O/year	
149.0	tonnes CO_2e/year	
		82.1 tonnes CO_2/year
		0.0 tonnes CH_4/year
		0.0 tonnes N_2O/year
		85.5 tonnes CO_2e/year

225.3	tonnes CO_2/year
0.017	tonnes CH_4/year
0.030	tonnes N_2O/year
234.5	tonnes CO_2e/year

GHG Emissions due to Modal Switch (Air to Vehicular Traffic) =

Increase due to Travel Modal Switch (Ferry Travel)
Applicable only to P1 -M.V. Edgar Wood
Assume all ferry traffic is diverted to ASR after in the first year of operation
Assume two passengers per vehicle

Applicable to project (0=no, 1=yes)	0
Average passenger traffic (2000-2010)=	3,590
Assumes private ferry services 50% of the M.V. Edgar Wood ferry	
Percent HD Vehicles=	24%
Percent LDT Vehicles=	76%

Paved Road (Highway) Segment

Paved Road Speed Limit =	90	km/hr
Estimated Vehicle Speed=	80	km/hr
Fuel Consumption HD =	39.5	L/100 km
Fuel Consumption LDT =	12.3	L/100 km
EF_{HD} =	2718	g CO_2e/L fuel
EF_{LDT} =	2754	g CO_2e/L fuel

ASR Road (Gravel) Segment

Gravel Road Speed Limit =	60	km/hr
Estimated Vehicle Speed=	50	km/hr
Fuel Consumption HD[1] =	45.9	L/100 km
Fuel Consumption LDT[1] =	14.3	L/100 km
EF_{HD} =	2718	g CO_2e/L fuel
EF_{LDT} =	2754	g CO_2e/L fuel

1- Fuel efficiency on gravel roads is reduced to 83.9% on average as per US EPA, 2006, "Final Technical Support Deocument:Fuel Economy Labeling of Motor Vehicle Revisions to Improve Calculation of Fuel Economy Estimates"

	Distance (km)				Trip Duration from Winnipeg (hr)		Total Annual Duration from Winnipeg (hr)		Total Annual Distance from Winnipeg (km)	
Destination	Paved Roads	ASR Gravel Road	% Breakdown[1]	Number of Vehicle Trips	Paved Roads	ASR Gravel Road	Paved Roads	ASR Gravel Road	Paved Roads	ASR Gravel Road
Bloodvein	195	88.8	17%	299	2.44	1.78	727.9	530.3	58,229	26,517
Berens River	195	168	33%	600	2.44	3.36	1463.2	2017.0	117,059	100,851
Poplar River	195	258.7	20%	365	2.44	5.17	890.7	1890.7	71,256	94,533
Little Grand Rapids	195	218.4	20%	362	2.44	4.37	882.4	1581.3	70,596	79,067
Pauingassi	195	218.4	9%	168	2.4375	4.37	410.5	735.5	32,837	36,777

1- Proportion based on population size

	0	tonnes CO_2/year
	0.0000	tonnes CH_4/year
	0.0000	tonnes N_2O/year
GHG Emissions due to Modal Switch (Ferry to Vehicular Traffic) - operation=	0.0	tonnes CO_2e/year

GHG Emissions from VehicularTravel During Construction=	454.6	tonnes CO_2/year
Assumed that vehicular travel will remain consistent during construction.	0.03	tonnes CH_4/year
	0.06	tonnes N_2O/year
	474.0	tonnes CO_2e/year
GHG Emissions from Vehicular Travel During Operation=	517.4	tonnes CO_2/year
Assumed modal shift from winter road/ ferry/ air travel to ASR. Assumed that ferry travel will cease once operating and will be diverted to ASR traffic.	0.0	tonnes CH_4/year
	0.1	tonnes N_2O/year
	539.0	tonnes CO_2e/year

East Side Road GHG Assessment
Project P6
Project Scenario: Construction and Maintenance of Winter and Ice Roads

Annual GHG Emissions Construction and Maintenance of Seasonal Roads (tonnes CO_2 e/yr)
= Σ equipment type {Equipment Use (hr/km) X Length (km)
X $EF_{equipment\ type}$ (g CO_2 e/hr) × 10-6 (tonnes/g)}

Construction

Equipment Type	Average Annual Use[1] (hrs/km)	EF_{equip} (kg CO_2/hr)	EF_{equip} (kg CH_4/hr)	EF_{equip} (kg N_2O/hr)	EF_{equip} (kg CO_2e/hr)	Winter/Ice Road Length in Project Area[2]	Hours Required	GHG Emissions (tonnes CO_2)	GHG Emissions (tonnes CH_4)	GHG Emissions (tonnes N_2O)	GHG Emissions (tonnes CO_2e)
Bobcat (50-75 HP)	0.54	35.39	0.0018	0.0011	35.76	201.3	109	3.85	0.0002	0.0001	3.89
Bulldozer (75-100 HP)	3.43	52.36	0.0027	0.0016	52.91		690	36.15	0.0019	0.0011	36.53
Equipment (25-50 HP)	0.14	14.88	0.0008	0.0005	15.04		28	0.42	0.0000	0.0000	0.42
Front-End Loader (100-175 HP)	2.77	94.24	0.0049	0.0029	95.22		558	52.55	0.0027	0.0016	53.09
Grader (100-175 HP)	1.68	66.90	0.0035	0.0020	67.59		338	22.62	0.0012	0.0007	22.86
Grader (175-300 HP)	1.40	107.60	0.0056	0.0033	108.71		282	30.32	0.0016	0.0009	30.64
Snowmobile (50-75 HP)	3.00	44.19	0.0023	0.0013	44.65		604	26.69	0.0014	0.0008	26.96
Truck (300-600 HP)	4.18	178.95	0.0093	0.0055	180.81		841	150.58	0.0078	0.0046	152.14

1-Average annual equipment use per kilometer based on 2014/2015 and 2015/2016 contractor equipment use data received by ESRA. Analysis conducted in a separate spreadsheet.

2-Ice/Winter Road Length in Project Area determined through ESRA GIS files

	323.18	tonnes CO_2/year
	0.0168	tonnes CH_4/year
	0.0099	tonnes N_2O/year
GHG Emissions from Winter and Ice Road Construction & Maintenance =	326.5	tonnes CO_2e/year

East Side Road GHG Assessment
Project P6
Project Scenario: Land Clearing

Annual GHG Emissions due to Land Clearing (tonnes CO_2e/yr)
= GHG Emissions from Slash and Shrub Burning (tonnes CO_2e/yr)
+ GHG Emissions Land Clearing Equipment (tonnes CO_2e/yr)

GHG Emissions from Slash Burning (tonnes CO_2e/yr) [1]
= Area of Burn (ha)
× Density of Available Fuel (Wood Biomass) (tonnes/ha)
× C_f
× specific gravity of tree dry weight to green tree weight (unitless)
× EF_{slash} (g/kg dry biomass burnt)

GHG Emissions Land Clearing Equipment (tonnes CO_2e/yr)
= Σ equipment types {Number of Equipment Type × Distance (km) x Rate of Use (hr/year) × $EF_{equipment\ type}$ (kg CO_2e/L) × 10-4 (tonnes/kg)}

1 - Methodology and parameters based on IPCC 2006 Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 2, Equation 2.27

2 - Methodology and parameters retrieved from Tree Canada Forest and Urban Tree Carbon Project Protocol, V.1.1 (2009)

Slash Burning

Trees

Total tree covered area cleared =	679	ha	
Percent slash burned =		80%	
Percent remaining in ground=		20%	
Percent recovered (firewood, construction materials)=		0%	
		100%	*(must sum to 100%)*
Density of fuel (wood biomass) =	77.7	tonnes fuel/ha	
Combustion Factor (C_f) =	0.33		

(based on post-logging slash burn in boreal forest in Table 2.6 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 2)

EF_{slash} =	1569	g CO_2/kg dry biomass fuel burnt
EF_{slash} =	4.7	g CH_4/kg dry biomass fuel burnt
EF_{slash} =	0.26	g N_2O/kg dry biomass fuel burnt
EF_{slash} =	1764.0	g CO_2e/kg dry biomass fuel burnt

(based on Extra Tropical Forest/ Other Forest in Table 2.5 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 2)

Average Dry Weight to Green Tree Specific Gravity = 40%

(based on Table 5 of P. Miles/ W.Smit/ US Department of Agriculture Forest Service - Specific Gravity and Other Properties of Wood and Bark for 156 Tree Species Found in North America)

		8,769.380	tonnes CO_2	1,096.2 tonnes CO_2/year
		26.269	tonnes CH_4	3.28 tonnes CH_4/year
		1.453	tonnes N_2O	0.18 tonnes N_2O/year
GHG Emissions from slash burning (trees) =		9,859.153	tonnes CO_2e	1,232.4 tonnes CO_2e/year

Shrubs

Total shrub covered area cleared = 113.4274339 ha

Density of fuel (wood biomass) = 37 tonnes fuel/ha

(based on willow/alder/shrub average biomass for Manitoba Boreal Shield in Landscape Management Network, 2007, Canada's Forest Biomass Resources)

Combustion Factor (C_f) = 0.33

(based on post-logging slash burn in boreal forest in Table 2.6 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 2)

EF_{slash} = 1569 g CO_2/kg dry biomass fuel burnt

EF_{slash} = 4.7 g CH_4/kg dry biomass fuel burnt

EF_{slash} = 0.26 g N_2O/kg dry biomass fuel burnt

EF_{slash} = 1764 g CO_2e/kg dry biomass fuel burnt

(based on Extra Tropical Forest/ Other Forest in Table 2.5 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 2)

Average Dry Weight to Green Tree Specific Gravity = 40%

(based on Table 5 of P. Miles/ W.Smit/ US Department of Agriculture Forest Service - Specific Gravity and Other Properties of Wood and Bark for 156 Tree Species Found in North America)

	869.19 tonnes CO_2	108.6 tonnes CO_2/year
	2.60 tonnes CH_4	0.3 tonnes CH_4/year
	0.14 tonnes N_2O	0.0 tonnes N_2O/year
GHG Emissions from slash burning (shrubs) =	977.2 tonnes CO_2e	122.2 tonnes CO_2e/year

Equipment

Equipment	Rate of Use (hrs/km)	Total Use (hrs)	EF_{equip} (kg CO_2/hr)	EF_{equip} (kg CH_4/hr)	EF_{equip} (kg N_2O/hr)	EF_{equip} (kg CO_2e/hr)	GHG Emissions (tonnes CO_2)	GHG Emissions (tonnes CH_4)	GHG Emissions (tonnes N_2O)	GHG Emissions (tonnes CO_2e)
Backhoe	221.5	30,417	134.19	0.0070	0.0041	135.5786	4081.54	0.2124	0.1244	4124
Backhoe with Mulcher	48.9	6,710	113.59	0.0059	0.0035	114.7689	762.20	0.0397	0.0232	770
Bulldozer	149.7	20,553	102.22	0.0053	0.0031	103.2850	2100.97	0.1093	0.0640	2123
Front-End Loader	0.1	14	190.74	0.0099	0.0058	192.7251	2.69	0.0001	0.0001	3
Rock Truck	75.8	10,414	224.52	0.0117	0.0068	226.8470	2338.03	0.1217	0.0713	2362
Tandem Truck	20.1	2,760	267.89	0.0139	0.0082	270.6746	739.41	0.0385	0.0225	747
Timber Jack Skidder	0.8	106	125.08	0.0065	0.0038	126.3771	13.21	0.0007	0.0004	13

	10038.04 tonnes CO_2	1,254.75 tonnes CO_2/year
	0.5224 tonnes CH_4	0.065 tonnes CH_4/year
	0.3060 tonnes N_2O	0.038 tonnes N_2O/year
Total GHG Emissions from land clearing equipment =	10,142.3 tonnes CO_2e	1,267.8 tonnes CO_2e/year

GHG Emissions from land clearing -construction=	2,459.6 tonnes CO_2/year
	3.7 tonnes CH_4/year
	0.2 tonnes N_2O/year
	2,622.3 tonnes CO_2e/year

East Side Road GHG Assessment
Project P6
Project Scenario: Construction of All Season Road (ASR)

Annual GHG Emissions Due to Construction (tonnes CO_2 e/yr)

= Σ *ASR equipment {ASR Length (km) x Rate of Use (hr/km) × $EF_{equipment}$ (kg CO_2 e/hr) × 10-4 (tonnes/kg)}*

+ Σ *bridge equipment {Number of bridges x Rate of Use (hr/bridge) × $EF_{equipment}$ (kg CO_2 e/hr) × 10-4 (tonnes/kg)}*

ASR Construction

Distance of Project ASR to be Constructed = 137.3 km

Equipment	Use (hrs/km)	Total Use (hrs)	EF_{equip} (kg CO_2/hr)	EF_{equip} (kg CH_4/hr)	EF_{equip} (kg N_2O/hr)	EF_{equip} (kg CO_2e/hr)	GHG Emissions (tonnes CO_2)	GHG Emissions (tonnes CH_4)	GHG Emissions (tonnes N_2O)	GHG Emissions (tonnes CO_2e)
Backhoe (175-300 HP)	497.5	68,312	142.30	0.0074	0.0043	143.78	9721	0.506	0.296	9822
Bulldozer (175-300 HP)	299.7	41,155	112.93	0.0059	0.0034	114.10	4648	0.242	0.142	4696
Crusher (175-300 HP)	196.0	26,911	128.45	0.0067	0.0039	129.78	3457	0.180	0.105	3493
Front-End Loader (300-600 HP)	416.3	57,159	237.65	0.0124	0.0072	240.12	13584	0.707	0.414	13725
Grader (175-300 HP)	20.4	2,802	128.45	0.0067	0.0039	129.78	360	0.019	0.011	364
Rock Drill (175-300 HP)	421.8	57,912	119.24	0.0062	0.0036	120.48	6905	0.359	0.210	6977
Rock Truck (300-600 HP)	1188.7	163,211	226.39	0.0118	0.0069	228.74	36950	1.923	1.126	37333
Semi & Trailer (300-600 HP)	338.2	46,436	269.50	0.0140	0.0082	272.30	12514	0.651	0.381	12644
Smooth Drum Roller (100- 175 HP)	64.7	8,886	55.66	0.0029	0.0017	56.24	495	0.026	0.015	500
Tandem Truck (300-600 HP)	88.3	12,118	267.89	0.0139	0.0082	270.67	3246	0.169	0.099	3280
Truck (300-600 HP)	46.7	6,414	178.95	0.0093	0.0055	180.81	1148	0.060	0.035	1160
Water Truck (175-300 HP)	10.4	1,422	147.18	0.0077	0.0045	148.71	209	0.011	0.006	212

	93,236	tonnes CO_2	11,654	tonnes CO_2/year
	4.85	tonnes CH_4	0.61	tonnes CH_4/year
	2.84	tonnes N_2O	0.36	tonnes N_2O/year
Total GHG Emissions from ASR construction equipment =	94,204.1	tonnes CO_2e	11,775.5	tonnes CO_2e/year

Bridge Construction

Permanent Bridges

Number of Permanent Bridges to be Constructed along ASR= 2

Equipment	Total Use (hrs/bridge)	EF_{equip} (kg CO_2/hr)	EF_{equip} (kg CH_4/hr)	EF_{equip} (kg N_2O/hr)	EF_{equip} (kg CO_2e/hr)	GHG Emissions (tonnes CO_2)	GHG Emissions (tonnes CH_4)	GHG Emissions (tonnes N_2O)	GHG Emissions (tonnes CO_2e)
Backhoe (175-300 HP)	102	142.30	0.0074	0.0043	143.78	29.0	0.0015	0.0009	29.3
Bobcat	310	36.78	0.0019	0.0011	37.16	22.8	0.0012	0.0007	23.0
Bulldozer (175-300 HP)	480	112.93	0.0059	0.0034	114.10	108.4	0.0056	0.0033	109.5
Compactor	110	110.23	0.0057	0.0034	111.37	24.3	0.0013	0.0007	24.5
Concrete Truck	72	227.02	0.0118	0.0069	229.37	32.7	0.0017	0.0010	33.0
Crane	82	174.54	0.0091	0.0053	176.35	28.6	0.0015	0.0009	28.9
Crusher (175-300 HP)	110	128.45	0.0067	0.0039	129.78	28.3	0.0015	0.0009	28.6
Equipment	100	59.50	0.0031	0.0018	60.12	11.9	0.0006	0.0004	12.0

Forklift	30	41.65	0.0022	0.0013	42.08	2.5	0.0001	0.0001	2.5
Front-End Loader (300-600 HP)	1290	237.65	0.0124	0.0072	240.12	613.1	0.0319	0.0187	619.5
Excavator	1195	53.57	0.0028	0.0016	54.13	128.0	0.0067	0.0039	129.4
Grader (175-300 HP)	50	128.45	0.0067	0.0039	129.78	12.8	0.0007	0.0004	13.0
Packer	30	22.99	0.0012	0.0007	23.23	1.4	0.0001	0.0000	1.4
Pump Truck	71	1098.36	0.0572	0.0335	1109.77	156.0	0.0081	0.0048	157.6
Rock Drill (175-300 HP)	160	119.24	0.0062	0.0036	120.48	38.2	0.0020	0.0012	38.6
Rock Truck (300-600 HP)	321	226.39	0.0118	0.0069	228.74	145.3	0.0076	0.0044	146.9
Semi & Trailer (300-600 HP)	60	269.50	0.0140	0.0082	272.30	32.3	0.0017	0.0010	32.7
Smooth Drum Roller (100- 175 HP)	50	55.66	0.0029	0.0017	56.24	5.6	0.0003	0.0002	5.6
Tandem Truck (300-600 HP)	197	267.89	0.0139	0.0082	270.67	105.5	0.0055	0.0032	106.6
Truck (300-600 HP)	384	178.95	0.0093	0.0055	180.81	137.4	0.0072	0.0042	138.9
Zoom Boom	930	60.00	0.0031	0.0018	60.62	111.6	0.0058	0.0034	112.8

ACROW Modular Bridges

Number of ACROW Bridges to be Constructed along ASR= 0

Equipment	Total Use (hrs/bridge)	EF_{equip} (kg CO_2/hr)	EF_{equip} (kg CH_4/hr)	EF_{equip} (kg N_2O/hr)	EF_{equip} (kg CO_2e/hr)	GHG Emissions (tonnes CO_2)	GHG Emissions (tonnes CH_4)	GHG Emissions (tonnes N_2O)	GHG Emissions (tonnes CO_2e)
Bobcat	556	47.88	0.00249	0.00146	48.38	0.0	0.0000	0.0000	0.0
Bulldozer (100-175 HP)	580	55.13	0.00287	0.00168	55.70	0.0	0.0000	0.0000	0.0
Concrete Truck (100-175 HP)	40	56.17	0.00292	0.00171	56.76	0.0	0.0000	0.0000	0.0
Conveyor	35	20.83	0.00108	0.00063	21.05	0.0	0.0000	0.0000	0.0
Crane (100-175 HP)	167	68.89	0.00359	0.00210	69.61	0.0	0.0000	0.0000	0.0
Rock Drill	190	159.01	0.00828	0.00485	160.66	0.0	0.0000	0.0000	0.0
Excavator	1055	101.17	0.00527	0.00308	102.22	0.0	0.0000	0.0000	0.0
Generator	3168	14.87	0.00077	0.00045	15.02	0.0	0.0000	0.0000	0.0
Grader	177	99.03	0.00515	0.00302	100.06	0.0	0.0000	0.0000	0.0
Front-End Loader	603	123.62	0.00643	0.00377	124.90	0.0	0.0000	0.0000	0.0
Mechanic Truck	320	136.50	0.00710	0.00416	137.92	0.0	0.0000	0.0000	0.0
Ranger	303	25.93	0.00135	0.00079	26.20	0.0	0.0000	0.0000	0.0
Rock Truck	961	151.03	0.00786	0.00460	152.60	0.0	0.0000	0.0000	0.0
Semi Trailer	518	267.89	0.01394	0.00817	270.67	0.0	0.0000	0.0000	0.0
Tandem Truck	553	162.34	0.00845	0.00495	164.03	0.0	0.0000	0.0000	0.0
Tractor	20	267.89	0.01394	0.00817	270.67	0.0	0.0000	0.0000	0.0
Truck	2268	206.28	0.01074	0.00629	208.42	0.0	0.0000	0.0000	0.0

1,775.82 tonnes CO_2	222 tonnes CO_2/year
0.092 tonnes CH_4	0.01 tonnes CH_4/year
0.054 tonnes N_2O	0.01 tonnes N_2O/year
Total GHG Emissions from bridge construction equipment = 1,794 tonnes CO_2e	224.3 tonnes CO_2e/year

GHG Emissions from ASR and bridge construction=	11,876 tonnes CO_2/year
	0.618 tonnes CH_4/year

0.362	tonnes N_2O/year
11,999.8	tonnes CO_2e/year

Appendix B

Detailed GHG Emission Estimates

East Side Road GHG Assessment
Project P6
GHG Summary

Total GHGs

CO_2e

Phase		Baseline Scenario GHG Estimate (tonnes CO_2e) Forest Sequestration	Land Cover	Air Travel	Ferry Travel	Vehicular Travel	Winter Road Construction & Maintenance	TOTAL	
Construction									
	2030	-515	416	1,780	0	474	327	2,481	
	2031	-515	416	1,780	0	474	327	2,481	
	2032	-515	416	1,780	0	474	327	2,481	
	2033	-515	416	1,780	0	474	327	2,481	
	2034	-515	416	1,780	0	474	327	2,481	
	2035	-515	416	1,780	0	474	327	2,481	
	2036	-515	416	1,780	0	474	327	2,481	
	2037	-515	416	1,780	0	474	327	2,481	
Operation									
	2038	-515	416	1,780	0	474	327	2,481	
	2039	-515	416	1,780	0	474	327	2,481	
	2040	-515	416	1,780	0	474	327	2,481	
	2041	-515	416	1,780	0	474	327	2,481	
	2042	-515	416	1,780	0	474	327	2,481	
	2043	-515	416	1,780	0	474	327	2,481	
	2044	-515	416	1,780	0	474	327	2,481	
	2045	-515	416	1,780	0	474	327	2,481	
	2046	-515	416	1,780	0	474	327	2,481	
	2047	-515	416	1,780	0	474	327	2,481	
	2048	-515	416	1,780	0	474	327	2,481	
	2049	-515	416	1,780	0	474	327	2,481	
	2050	-515	416	1,780	0	474	327	2,481	
	2051	-515	416	1,780	0	474	327	2,481	
	2052	-515	416	1,780	0	474	327	2,481	
	2053	-515	416	1,780	0	474	327	2,481	
	2054	-515	416	1,780	0	474	327	2,481	
	2055	-515	416	1,780	0	474	327	2,481	
	2056	-515	416	1,780	0	474	327	2,481	
	2057	-515	416	1,780	0	474	327	2,481	
	2058	-515	416	1,780	0	474	327	2,481	
	2059	-515	416	1,780	0	474	327	2,481	
	2060	-515	416	1,780	0	474	327	2,481	
	2061	-515	416	1,780	0	474	327	2,481	
	2062	-515	416	1,780	0	474	327	2,481	
	2063	-515	416	1,780	0	474	327	2,481	
	2064	-515	416	1,780	0	474	327	2,481	
	2065	-515	416	1,780	0	474	327	2,481	
	2066	-515	416	1,780	0	474	327	2,481	
	2067	-515	416	1,780	0	474	327	2,481	
Total Construction		-4,122	3,327	14,242	0	3,792	2,612	19,851	CO_2e
Total Operation (10 Years)		-5,153	4,159	17,802	0	4,740	3,265	24,814	CO_2e
Total Operation (30 Years)		-15,458	12,478	53,407	0	14,220	9,796	74,442	CO_2e
TOTAL 10 Year		-9,275	7,487	32,044	0	8,532	5,878	44,665	CO_2e
TOTAL 30 Year		-19,580	15,805	67,648	0	18,012	12,408	94,294	CO_2e

East Side Road GHG Assessment
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GHG Summary

Total GHGs

CO_2e

Phase		Project Scenario GHG Estimate (tonnes CO_2e) Forest Sequestration	Land Cover	Air Travel	Ferry Travel	Vehicular Travel	Winter Road Construction & Maintenance	Land Clearing	ASR Construction	TOTAL	
Construction											
	2030	-461	402	1,780	0	474	327	2,622	12,000	17,144	
	2031	-406	388	1,780	0	474	327	2,622	12,000	17,185	
	2032	-351	374	1,780	0	474	327	2,622	12,000	17,226	
	2033	-296	360	1,780	0	474	327	2,622	12,000	17,267	
	2034	-242	347	1,780	0	474	327	2,622	12,000	17,308	
	2035	-187	333	1,780	0	474	327	2,622	12,000	17,349	
	2036	-132	319	1,780	0	474	327	2,622	12,000	17,390	
	2037	-77	305	1,780	0	474	327	2,622	12,000	17,431	
Operation											
	2038	-77	305	1,602	0	539	0	0	0	2,369	
	2039	-77	305	1,602	0	539	0	0	0	2,369	
	2040	-77	305	1,602	0	539	0	0	0	2,369	
	2041	-77	305	1,602	0	539	0	0	0	2,369	
	2042	-77	305	1,602	0	539	0	0	0	2,369	
	2043	-77	305	1,602	0	539	0	0	0	2,369	
	2044	-77	305	1,602	0	539	0	0	0	2,369	
	2045	-77	305	1,602	0	539	0	0	0	2,369	
	2046	-77	305	1,602	0	539	0	0	0	2,369	
	2047	-77	305	1,602	0	539	0	0	0	2,369	
	2048	-77	305	1,602	0	539	0	0	0	2,369	
	2049	-77	305	1,602	0	539	0	0	0	2,369	
	2050	-77	305	1,602	0	539	0	0	0	2,369	
	2051	-77	305	1,602	0	539	0	0	0	2,369	
	2052	-77	305	1,602	0	539	0	0	0	2,369	
	2053	-77	305	1,602	0	539	0	0	0	2,369	
	2054	-77	305	1,602	0	539	0	0	0	2,369	
	2055	-77	305	1,602	0	539	0	0	0	2,369	
	2056	-77	305	1,602	0	539	0	0	0	2,369	
	2057	-77	305	1,602	0	539	0	0	0	2,369	
	2058	-77	305	1,602	0	539	0	0	0	2,369	
	2059	-77	305	1,602	0	539	0	0	0	2,369	
	2060	-77	305	1,602	0	539	0	0	0	2,369	
	2061	-77	305	1,602	0	539	0	0	0	2,369	
	2062	-77	305	1,602	0	539	0	0	0	2,369	
	2063	-77	305	1,602	0	539	0	0	0	2,369	
	2064	-77	305	1,602	0	539	0	0	0	2,369	
	2065	-77	305	1,602	0	539	0	0	0	2,369	
	2066	-77	305	1,602	0	539	0	0	0	2,369	
	2067	-77	305	1,602	0	539	0	0	0	2,369	
Total Construction		-2,151	2,828	14,242	0	3,792	2,612	20,979	95,998	138,300	CO_2e
Total Operation (10 Years)		-773	3,050	16,022	0	5,390	0	0	0	23,690	CO_2e
Total Operation (30 Years)		-2,319	9,150	48,066	0	16,171	0	0	0	71,069	CO_2e
TOTAL 10 Year		-2,924	5,878	30,264	0	9,182	2,612	20,979	95,998	161,990	CO_2e
TOTAL 30 Year		-4,470	11,979	62,308	0	19,963	2,612	20,979	95,998	209,369	CO_2e

East Side Road GHG Assessment
Project P6
GHG Summary - Speciated

Speciated GHGs

CO_2

Baseline Scenario
GHG Estimate (tonnes CO_2)

Phase		Forest Sequestration	Land Cover	Air Travel	Ferry Travel	Vehicular Travel	Winter Road Construction & Maintenance	TOTAL	
Construction									
	2030	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2031	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2032	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2033	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2034	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2035	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2036	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2037	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
Operation									
	2038	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2039	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2040	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2041	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2042	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2043	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2044	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2045	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2046	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2047	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2048	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2049	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2050	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2051	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2052	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2053	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2054	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2055	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2056	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2057	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2058	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2059	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2060	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2061	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2062	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2063	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2064	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2065	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2066	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
	2067	-515.3	-79.9	1,770.6	0.0	454.6	323.2	1,953	
Total Construction		-4,122	-639	14,165	0	3,637	2,585	15,625	CO_2
Total Operation (10 Years)		-5,153	-799	17,706	0	4,546	3,232	19,532	CO_2
Total Operation (30 Years)		-15,458	-2,397	53,117	0	13,639	9,695	58,596	CO_2
TOTAL 10 Year		-9,275	-1,438	31,870	0	8,183	5,817	35,157	CO_2
TOTAL 30 Year		-19,580	-3,037	67,281	0	17,276	12,281	74,221	CO_2

East Side Road GHG Assessment
Project P6
GHG Summary - Speciated

Speciated GHGs

CO_2

Project Scenario
GHG Estimate (tonnes CO_2)

Phase		Forest Sequestration	Land Cover	Air Travel	Ferry Travel	Vehicular Travel	Winter Road Construction & Maintenance	Land Clearing	ASR Construction	TOTAL	
Construction											
	2030	-461	-77.3	1,770.6	0.0	454.6	323.2	2,459.6	11,876.5	16,347	
	2031	-406	-74.6	1,770.6	0.0	454.6	323.2	2,459.6	11,876.5	16,404	
	2032	-351	-71.9	1,770.6	0.0	454.6	323.2	2,459.6	11,876.5	16,461	
	2033	-296	-69.3	1,770.6	0.0	454.6	323.2	2,459.6	11,876.5	16,519	
	2034	-242	-66.6	1,770.6	0.0	454.6	323.2	2,459.6	11,876.5	16,576	
	2035	-187	-63.9	1,770.6	0.0	454.6	323.2	2,459.6	11,876.5	16,634	
	2036	-132	-61.3	1,770.6	0.0	454.6	323.2	2,459.6	11,876.5	16,691	
	2037	-77	-58.6	1,770.6	0.0	454.6	323.2	2,459.6	11,876.5	16,749	
Operation											
	2038	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2039	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2040	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2041	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2042	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2043	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2044	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2045	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2046	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2047	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2048	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2049	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2050	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2051	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2052	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2053	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2054	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2055	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2056	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2057	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2058	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2059	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2060	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2061	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2062	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2063	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2064	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2065	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2066	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
	2067	-77.3	-58.6	1593.5	0.0	517.4	0.0	0.0	0.0	1,975	
Total Construction		-2151	-543	14165	0	3637	2585	19677	95012	132,381	CO_2
Total Operation (10 Years)		-773	-586	15935	0	5174	0	0	0	19,750	CO_2
Total Operation (30 Years)		-2319	-1758	47805	0	15521	0	0	0	59,249	CO_2
TOTAL 10 Year		-2,924	-1,129	30,100	0	8,811	2,585	19,677	95,012	152,130	CO_2
TOTAL 30 Year		-4,470	-2,302	61,970	0	19,158	2,585	19,677	95,012	191,630	CO_2

Speciated GHGs

CH_4

Baseline Scenario

GHG Estimate (tonnes CH_4)

Phase		Forest Sequestration	Land Cover	Air Travel	Ferry Travel	Vehicular Travel	Winter Road Construction & Maintenance	TOTAL	
Construction									
	2030	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2031	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2032	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2033	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2034	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2035	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2036	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2037	0.000	19.834	0.028	0.000	0.034	0.017	20	
Operation									
	2038	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2039	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2040	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2041	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2042	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2043	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2044	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2045	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2046	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2047	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2048	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2049	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2050	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2051	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2052	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2053	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2054	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2055	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2056	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2057	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2058	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2059	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2060	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2061	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2062	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2063	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2064	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2065	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2066	0.000	19.834	0.028	0.000	0.034	0.017	20	
	2067	0.000	19.834	0.028	0.000	0.034	0.017	20	
Total Construction		0.000	158.670	0.221	0.000	0.274	0.135	159	CH_4
Total Operation (10 Years)		0.000	198.337	0.276	0.000	0.342	0.168	199	CH_4
Total Operation (30 Years)		0.000	595.012	0.828	0.000	1.027	0.505	597	CH_4
TOTAL 10 Year		0.00	357.01	0.50	0.00	0.62	0.30	358	CH_4
30 Year		0.00	753.68	1.05	0.00	1.30	0.64	757	CH_4

Speciated GHGs

CH_4

Project Scenario

GHG Estimate (tonnes CH_4)

Phase		Forest Sequestration	Land Cover	Air Travel	Ferry Travel	Vehicular Travel	Winter Road Construction & Maintenance	Land Clearing	ASR Construction	TOTAL	
Construction											
	2030	0	19.173	0.028	0.000	0.034	0.017	3.674	0.618	24	
	2031	0	18.511	0.028	0.000	0.034	0.017	3.674	0.618	23	
	2032	0	17.850	0.028	0.000	0.034	0.017	3.674	0.618	22	
	2033	0	17.189	0.028	0.000	0.034	0.017	3.674	0.618	22	
	2034	0	16.528	0.028	0.000	0.034	0.017	3.674	0.618	21	
	2035	0	15.867	0.028	0.000	0.034	0.017	3.674	0.618	20	
	2036	0	15.206	0.028	0.000	0.034	0.017	3.674	0.618	20	
	2037	0	14.545	0.028	0.000	0.034	0.017	3.674	0.618	19	
Operation											
	2038	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2039	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2040	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2041	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2042	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2043	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2044	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2045	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2046	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2047	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2048	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2049	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2050	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2051	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2052	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2053	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2054	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2055	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2056	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2057	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2058	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2059	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2060	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2061	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2062	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2063	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2064	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2065	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2066	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	
	2067	0.0	14.545	0.025	0.000	0.039	0.00	0.000	0.000	15	CH_4
Total Construction		0.000	134.869	0.221	0.000	0.274	0.135	29.395	4.945	170	CH_4
Total Operation (10 Years)		0.000	145.447	0.248	0.000	0.391	0.000	0.000	0.000	146	CH_4
Total Operation (30 Years)		0.000	436.342	0.745	0.000	1.172	0.000	0.000	0.000	438	CH_4
TOTAL 10 Year		0.000	280.317	0.469	0.000	0.664	0.135	29.395	4.945	316	CH_4
30 Year		0.000	571.212	0.966	0.000	1.445	0.135	29.395	4.945	608	

Speciated GHGs

N_2O

Baseline Scenario
GHG Estimate (tonnes N_2O)

Phase		Forest Sequestration	Land Cover	Air Travel	Ferry Travel	Vehicular Travel	Winter Road Construction & Maintenance	TOTAL	
Construction									
	2030	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2031	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2032	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2033	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2034	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2035	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2036	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2037	0.000	0.000	0.030	0.000	0.062	0.010	0	
Operation									
	2038	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2039	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2040	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2041	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2042	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2043	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2044	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2045	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2046	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2047	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2048	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2049	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2050	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2051	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2052	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2053	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2054	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2055	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2056	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2057	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2058	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2059	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2060	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2061	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2062	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2063	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2064	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2065	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2066	0.000	0.000	0.030	0.000	0.062	0.010	0	
	2067	0.000	0.000	0.030	0.000	0.062	0.010	0	
Total Construction		0.000	0.000	0.241	0.000	0.497	0.079	1	N_2O
Total Operation (10 Years)		0.000	0.000	0.301	0.000	0.621	0.099	1	N_2O
Total Operation (30 Years)		0.000	0.000	0.903	0.000	1.864	0.296	3	N_2O
TOTAL 10 Year		0.00	0.00	0.54	0.00	1.12	0.18	2	N_2O
TOTAL 30 Year		0.00	0.00	1.14	0.00	2.36	0.37	4	N_2O

Speciated GHGs

N_2O

Project Scenario
GHG Estimate (tonnes N_2O)

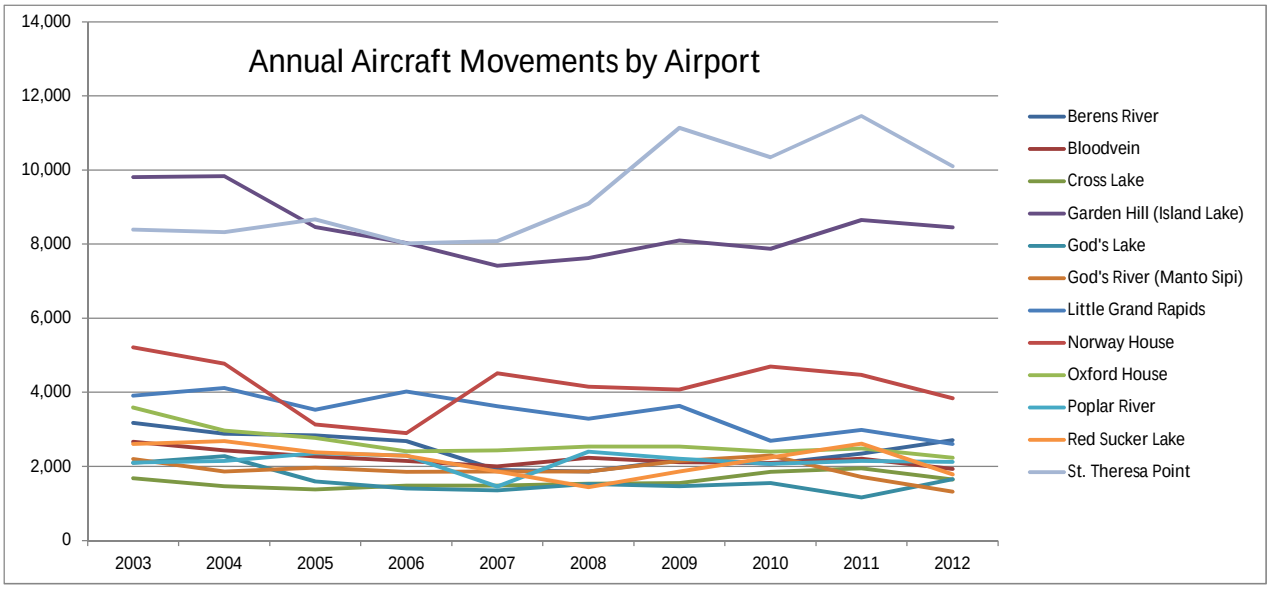
Phase		Forest Sequestration	Land Cover	Air Travel	Ferry Travel	Vehicular Travel	Winter Road Construction & Maintenance	Land Clearing	ASR Construction	TOTAL	
Construction											
	2030	0.000	0.000	0.030	0.000	0.062	0.010	0.238	0.362	1	
	2031	0.000	0.000	0.030	0.000	0.062	0.010	0.238	0.362	1	
	2032	0.000	0.000	0.030	0.000	0.062	0.010	0.238	0.362	1	
	2033	0.000	0.000	0.030	0.000	0.062	0.010	0.238	0.362	1	
	2034	0.000	0.000	0.030	0.000	0.062	0.010	0.238	0.362	1	
	2035	0.000	0.000	0.030	0.000	0.062	0.010	0.238	0.362	1	
	2036	0.000	0.000	0.030	0.000	0.062	0.010	0.238	0.362	1	
	2037	0.000	0.000	0.030	0.000	0.062	0.010	0.238	0.362	1	
Operation											
	2038	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2039	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2040	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2041	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2042	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2043	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2044	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2045	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2046	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2047	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2048	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2049	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2050	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2051	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2052	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2053	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2054	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2055	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2056	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2057	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2058	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2059	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2060	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2061	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2062	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2063	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2064	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2065	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2066	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
	2067	0.000	0.000	0.027	0.000	0.070	0.0	0.000	0.000	0	
Total Construction		0.000	0.000	0.241	0.000	0.497	0.079	1.903	2.896	6	N_2O
Total Operation (10 Years)		0.000	0.000	0.271	0.000	0.695	0.000	0.000	0.000	1	N_2O
Total Operation (30 Years)		0.000	0.000	0.812	0.000	2.086	0.000	0.000	0.000	3	N_2O
TOTAL 10 Year		0.000	0.000	0.512	0.000	1.192	0.079	1.903	2.896	7	N_2O
TOTAL 30 Year		0.000	0.000	1.053	0.000	2.583	0.079	1.903	2.896	9	N_2O

Appendix C

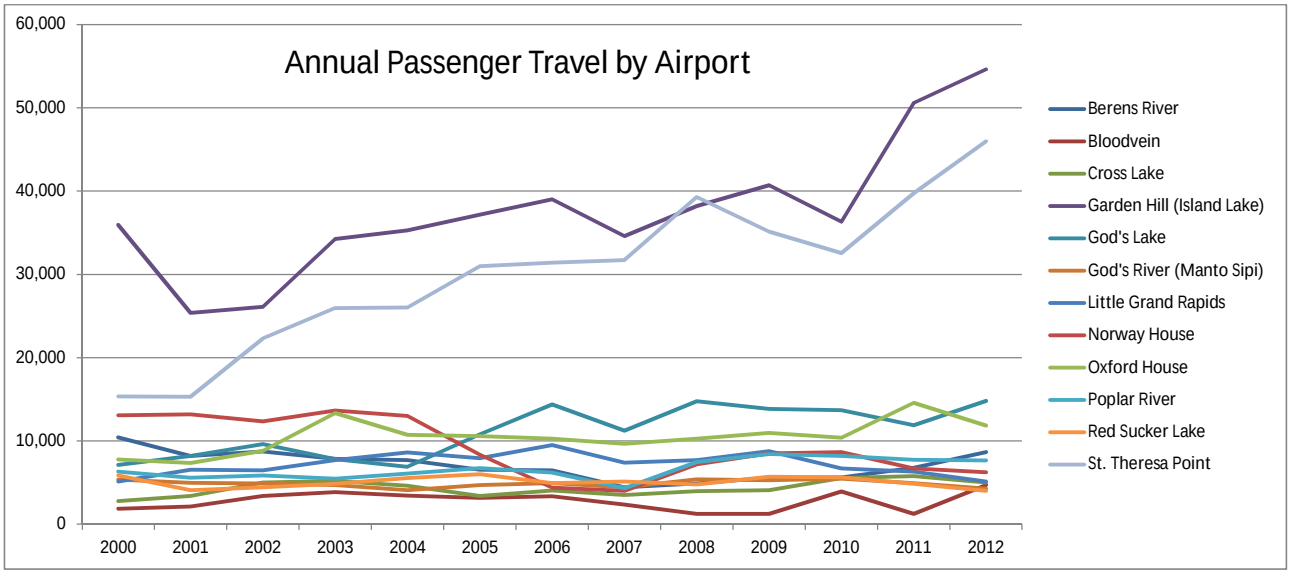
Aircraft Movement and Passenger Traffic Analysis

Air Traffic Analysis
Raw Air Movement Data

Aircraft Movements														
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Average (2003-2012)
Berens River	4,392	3,394	3,153	3,175	2,881	2,838	2,686	1,902	1,860	2,176	2,070	2,347	2,706	**2,464**
Bloodvein	1,319	1,491	2,361	2,668	2,429	2,272	2,144	1,997	2,233	2,112	2,092	2,207	1,928	**2,208**
Cross Lake	1,564	1,537	1,686	1,677	1,463	1,382	1,484	1,480	1,537	1,554	1,853	1,946	1,645	**1,602**
Garden Hill (Island Lake)	9,971	9,113	8,059	9,812	9,835	8,465	8,027	7,417	7,621	8,102	7,873	8,653	8,453	**8,426**
God's Lake	2,497	2,795	2,687	2,091	2,275	1,598	1,400	1,354	1,526	1,467	1,553	1,159	1,655	**1,608**
God's River (Manto Sipi)	2,346	2,231	2,423	2,196	1,861	1,966	1,851	1,863	1,866	2,150	2,290	1,714	1,321	**1,908**
Little Grand Rapids	3,086	3,591	3,619	3,910	4,115	3,531	4,025	3,626	3,290	3,637	2,695	2,982	2,606	**3,442**
Norway House	5,589	5,263	5,141	5,213	4,777	3,134	2,901	4,510	4,147	4,072	4,697	4,473	3,841	**4,177**
Oxford House	2,236	2,071	2,558	3,593	2,970	2,770	2,402	2,434	2,538	2,534	2,398	2,482	2,234	**2,636**
Poplar River	2,204	2,191	2,528	2,108	2,151	2,356	2,296	1,458	2,400	2,205	2,066	2,144	2,118	**2,130**
Red Sucker Lake	1,817	1,710	1,891	2,603	2,682	2,380	2,285	1,860	1,440	1,861	2,246	2,612	1,782	**2,175**
St. Theresa Point	7,652	6,916	7,720	8,390	8,323	8,668	8,020	8,078	9,092	11,142	10,348	11,458	10,104	**9,362**



Passenger Traffic														
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Average (2003-2012)**
Berens River	10,440	8,214	8,752	7,853	7,697	6,553	6,456	4,418	4,892	5,581	5,644	6,790	8,648	**6,453**
Bloodvein	1,880	2,140	3,395	3,851	3,434	3,153	3,353	2,377	1,264	1,264	3,928	1,264	4,715	**2,860**
Cross Lake	2,795	3,398	5,007	5,205	4,615	3,392	4,055	3,523	3,993	4,076	5,548	5,770	5,019	**4,520**
Garden Hill (Island Lake)	35,945	25,386	26,118	34,238	35,302	37,175	39,030	34,577	38,221	40,716	36,341	50,567	54,615	**40,078**
God's Lake	7,111	8,214	9,617	7,825	6,880	10,786	14,391	11,231	14,755	13,852	13,682	11,890	14,820	**12,011**
God's River (Manto Sipi)	5,347	4,980	4,913	4,717	4,087	4,710	4,936	4,452	5,386	5,300	5,458	4,933	4,283	**4,826**
Little Grand Rapids	5,143	6,537	6,488	7,688	8,630	7,917	9,505	7,376	7,702	8,788	6,712	6,313	5,124	**7,576**
Norway House	13,063	13,203	12,349	13,652	12,985	8,339	4,415	3,999	7,201	8,515	8,657	6,690	6,226	**8,068**
Oxford House	7,780	7,366	8,823	13,335	10,743	10,598	10,261	9,665	10,282	10,956	10,385	14,590	11,866	**11,268**
Poplar River	6,336	5,584	5871	5,473	6,072	6,733	6,209	4,327	7,486	8,426	8218	7728	7676	**6,835**
Red Sucker Lake	5,862	4,093	4,436	4,867	5,538	6,010	4,933	5,135	4,770	5,710	5,612	4,845	4,010	**5,143**
St. Theresa Point	15,332	15,293	22,288	25,951	26,028	31,000	31,398	31,699	39,273	35,126	32,544	39,759	45,962	**33,874**



Based on the data above, assume that air traffic levels will remain consistent. The 10 year average will be taken to estimate future travel.

Data Sources (June 2016):

Manitoba Infrastructure, Northern Airports and Marine Operations, Aircraft Movements: http://www.gov.mb.ca/mit/namo/air/movement.html

Manitoba Infrastructure, Northern Airports and Marine Operations, Passenger Traffic: http://www.gov.mb.ca/mit/namo/air/passenger.html

Air Traffic Analysis
Scheduled Flight Data

Weekly Commercial Flights (Two-Way)

Flight #	To	From	Quantity per Week	Airline	Distance (km)	Total Distance (km)
113/114	Berens River	Winnipeg	12	Perimeter	273	3276
117/118	Cross Lake	Winnipeg	10	Perimeter	528	5280
106/105,115/116	Cross Lake via Norway House	Winnipeg	24	Perimeter	567	13608
107/108, 109/110, 612	Garden Hill (Island Lake)	Winnipeg	33	Perimeter	473	15609
107/108	Garden Hill via Red Sucker Lake	Winnipeg	5	Perimeter	603	3015
639,611	Garden Hill via St. Theresa Point	Winnipeg	10	Perimeter	479	4790
203/204	God's Lake	Winnipeg	7	Perimeter	567	3969
203/204, 209/210	God's Lake via Oxford House	Winnipeg	17	Perimeter	639	10863
203	God's Lake	Oxford House	2	Perimeter	66	132
407/408	God's Lake	God's River (Manto Sipi)	5	Perimeter	25	125
207,218,219	God's River (Manto Sipi) via Red Sucker Lake	Winnipeg	2	Perimeter	615	1230
219,201/202,207,214/213	God's River (Manto Sipi)	Winnipeg	12	Perimeter	588	7056
403/404	God's River (Manto Sipi)	Oxford House	2	Perimeter	78	156
205/206, 211/212, 207/208	Red Sucker Lake	Winnipeg	13	Perimeter	533	6929
639,621/622,610/609	St. Theresa Point	Winnipeg	33	Perimeter	465	15345
612	St. Theresa Point via Garden Hill	Winnipeg	5	Perimeter	488	2440
639	Garden Hill	St. Theresa Point	5	Perimeter	14	70
	Berens River via Bloodvein	Winnipeg	11	Northway Aviation	273	3003
	Little Grand Rapids / Pauingassi	Winnipeg	27	Northway Aviation	263	7101
	Poplar Hill via Deer Lake	Winnipeg	6	Northway Aviation	347	2082

Data Sources (June 2016):

Total Number of Flights 315

Perimeter Airlines: https://www.perimeter.ca/passengers/destinations-map — 106,079 km weekly

Northway Aviation :http://www.northwayav.com/index.php/flight-schedule — 5,516,108 km annually

Air Traffic Analysis
Analysis of Air Movements

Number of Air Movements per Week for Scheduled Flights

	From Airport											
To Airport	Winnipeg	Berens River	Bloodvein	Cross Lake	Garden Hill	God's Lake	God's River	Oxford House	Norway House	Red Sucker Lake	St. Theresa Point	TOTAL
Berens River	12	-	6	-	-	-	-	-	-	-	-	18
Bloodvein	11	6	-	-	-	-	-	-	-	-	-	17
Cross Lake	10	-	-	-	-	-	-	-	12	-	-	22
Garden Hill (Island Lake)	33	-	-	-	-	-	-	-	-	3	10	46
God's Lake	7	-	-	-	-	-	3	10	-	-	-	19
God's River (Manto Sipi)	12	-	-	-	-	3	-	1	-	1	-	17
Little Grand Rapids	27	-	-	-	-	-	-	-	-	-	-	27
Norway House	24	-	-	12	-	-	-	-	-	-	-	36
Oxford House	17	-	-	-	-	10	1	-	-	-	-	28
Poplar River	6	-	-	-	-	-	-	-	-	-	-	6
Red Sucker Lake	20	-	-	-	3	-	1	-	-	-	-	24
St. Theresa Point	48	-	-	-	10	-	-	-	-	-	-	58
												315

Air Movements Fractions

	From Airport											
To Airport	Winnipeg	Berens River	Bloodvein	Cross Lake	Garden Hill	God's Lake	God's River	Oxford House	Norway House	Red Sucker Lake	St. Theresa Point	TOTAL
Berens River	69%	-	31%	-	-	-	-	-	-	-	-	100%
Bloodvein	67%	33%	-	-	-	-	-	-	-	-	-	100%
Cross Lake	45%	-	-	-	-	-	-	-	55%	-	-	100%
Garden Hill (Island Lake)	73%	-	-	-	-	-	-	-	-	5%	22%	100%
God's Lake	37%	-	-	-	-	-	13%	50%	-	-	-	100%
God's River (Manto Sipi)	73%	-	-	-	-	15%	-	6%	-	6%	-	100%
Little Grand Rapids	100%	-	-	-	-	-	-	-	-	-	-	100%
Norway House	67%	-	-	33%	-	-	-	-	-	-	-	100%
Oxford House	62%	-	-	-	-	35%	4%	-	-	-	-	100%
Poplar River	100%	-	-	-	-	-	-	-	-	-	-	100%
Red Sucker Lake	85%	-	-	-	11%	-	4%	-	-	-	-	100%
St. Theresa Point	83%	-	-	-	17%	-	-	-	-	-	-	100%

Estimated Annual Air Movements

	From Airport											
To Airport	Winnipeg	Berens River	Bloodvein	Cross Lake	Garden Hill	God's Lake	God's River	Oxford House	Norway House	Red Sucker Lake	St. Theresa Point	TOTAL
Berens River	1,690	-	774	-	-	-	-	-	-	-	-	2,464
Bloodvein	1,472	736	-	-	-	-	-	-	-	-	-	2,208
Cross Lake	728	-	-	-	-	-	-	-	874	-	-	1,602
Garden Hill (Island Lake)	6,111	-	-	-	-	-	-	-	-	463	1,852	8,426
God's Lake	592	-	-	-	-	-	212	804	-	-	-	1,608
God's River (Manto Sipi)	1,387	-	-	-	-	289	-	116	-	116	-	1,908
Little Grand Rapids	3,442	-	-	-	-	-	-	-	-	-	-	3,442
Norway House	2,784	-	-	1,392	-	-	-	-	-	-	-	4,177
Oxford House	1,629	-	-	-	-	910	96	-	-	-	-	2,636
Poplar River	2,130	-	-	-	-	-	-	-	-	-	-	2,130
Red Sucker Lake	1,851	-	-	-	231	-	93	-	-	-	-	2,175
St. Theresa Point	7,748	-	-	-	1,614	-	-	-	-	-	-	9,362

Estimated Annual Passenger Traffic

	From Airport											
To Airport	Winnipeg	Berens River	Bloodvein	Cross Lake	Garden Hill	God's Lake	God's River	Oxford House	Norway House	Red Sucker Lake	St. Theresa Point	TOTAL
Berens River	4,425	-	2,028	-	-	-	-	-	-	-	-	6,453
Bloodvein	1,907	953	-	-	-	-	-	-	-	-	-	2,860
Cross Lake	2,054	-	-	-	-	-	-	-	2,465	-	-	4,520
Garden Hill (Island Lake)	29,068	-	-	-	-	-	-	-	-	2,202	8,808	40,078
God's Lake	4,425	-	-	-	-	-	1,580	6,006	-	-	-	12,011
God's River (Manto Sipi)	3,510	-	-	-	-	731	-	292	-	292	-	4,826
Little Grand Rapids	7,576	-	-	-	-	-	-	-	-	-	-	7,576
Norway House	5,379	-	-	2,689	-	-	-	-	-	-	-	8,068
Oxford House	6,966	-	-	-	-	3,893	410	-	-	-	-	11,268
Poplar River	6,835	-	-	-	-	-	-	-	-	-	-	6,835
Red Sucker Lake	4,377	-	-	-	547	-	219	-	-	-	-	5,143
St. Theresa Point	28,034	-	-	-	5,840	-	-	-	-	-	-	33,874

Flight Distance (km)

	From Airport											
To Airport	Winnipeg	Berens River	Bloodvein	Cross Lake	Garden Hill	God's Lake	God's River	Oxford House	Norway House	Red Sucker Lake	St. Theresa Point	TOTAL
Berens River	273	-	69	-	-	-	-	-	-	-	-	342
Bloodvein	214	69	-	-	-	-	-	-	-	-	-	283
Cross Lake	528	-	-	-	-	-	-	-	73	-	-	601
Garden Hill (Island Lake)	473	-	-	-	-	-	-	-	-	82	14	569
God's Lake	567	-	-	-	-	-	42	66	-	-	-	675
God's River (Manto Sipi)	588	-	-	-	-	42	-	67	-	80	-	777
Little Grand Rapids	263	-	-	-	-	-	-	-	-	-	-	263
Norway House	455	-	-	73	-	-	-	-	-	-	-	528
Oxford House	578	-	-	-	-	66	67	-	69	-	-	780
Poplar River	347	-	-	-	-	-	-	-	-	-	-	347
Red Sucker Lake	536	-	-	-	82	-	80	-	-	-	-	698
St. Theresa Point	465	-	-	-	14	-	-	-	-	-	-	479

Total Passenger Kilometers (passenger km)

	From Airport											
To Airport	Winnipeg	Berens River	Bloodvein	Cross Lake	Garden Hill	God's Lake	God's River	Oxford House	Norway House	Red Sucker Lake	St. Theresa Point	TOTAL
Berens River	1,208,039	-	139,942	-	-	-	-	-	-	-	-	1,347,981
Bloodvein	408,069	65,787	-	-	-	-	-	-	-	-	-	473,856
Cross Lake	1,084,704	-	-	-	-	-	-	-	179,962	-	-	1,264,666
Garden Hill (Island Lake)	13,749,025	-	-	-	-	-	-	-	-	180,572	123,318	14,052,914
God's Lake	2,509,076	-	-	-	-	-	66,378	396,370	-	-	-	2,971,824
God's River (Manto Sipi)	2,063,859	-	-	-	-	30,712	-	19,597	-	23,400	-	2,137,568
Little Grand Rapids	1,992,357	-	-	-	-	-	-	-	-	-	-	1,992,357
Norway House	2,447,263	-	-	196,319	-	-	-	-	-	-	-	2,643,582
Oxford House	4,026,195	-	-	-	-	256,913	27,453	-	-	-	-	4,310,560
Poplar River	2,371,676	-	-	-	-	-	-	-	-	-	-	2,371,676
Red Sucker Lake	2,346,083	-	-	-	44,864	-	17,508	-	-	-	-	2,408,456
St. Theresa Point	13,035,650	-	-	-	81,765	-	-	-	-	-	-	13,117,414

Total Passenger Kilometers by Airport		
Berens River	1,347,981	passenger km
Bloodvein	473,856	passenger km
Cross Lake	1,264,666	passenger km
Garden Hill (Island Lake)	14,052,914	passenger km
God's Lake	2,971,824	passenger km
God's River (Manto Sipi)	2,137,568	passenger km
Little Grand Rapids	1,992,357	passenger km
Norway House	2,643,582	passenger km
Oxford House	4,310,560	passenger km
Poplar River	2,371,676	passenger km
Red Sucker Lake	2,408,456	passenger km
St. Theresa Point	13,117,414	passenger km

Air Traffic Analysis
Overview of Methodology

METHODOLOGY

1. Analyse 'Air Movements' data from publically available MIT website to consider trends at each airport (ie. Are aircraft movements increasing, decreasing, consistent?)
2. Analyse 'Scheduled Flights' to determine the ratio (fractions) of flight passenger traffic to/from each airport based on publically available commercial flight data.
3. Apply Ratio/Fraction to Flight Passenger Traffic (by airport) to determine passenger kilometers (by airport)
4. Consider typical commercial aircraft operating in the project area to determine appropriate emission factors.

Appendix D

Winter Road Traffic Assessment

163689 Greenhouse Gas Followup
P6 Area Traffic Count Analysis

Total Time Traffic Counter on Shift

Intersection	Hours	Days
Oxford	71.1	3.0
GodsRiver	49.7	2.1

Total Traffic Count

		ATV/Snowmobile			Car			Truck/Van/SUV			Transport Truck			Construction Equipment		
Intersection	Direction	Count	Count Per 60 Days	Total Km	Count	Count Per 60 Days	Total Km	Count	Count Per 60 Days	Total Km	Count	Count Per 60 Days	Total Km	Count	Count Per 60 Days	Total Km
GodsRiver	Oxford House/Gods Lake	0	0	0	0	0	0	66	1,337	128,100	61	1,236	118,396	0	0	0
GodsRiver	Gods Lake/Gods River	0	0	0	0	0	0	5	101	10,774	0	0	0	0	0	0
GodsRiver	Gods River/Oxford House	1	20	2,649	0	0	0	2	41	5,299	0	0	0	0	0	0
Oxford	Oxford House/Gods Lake	11	223	21,350	0	0	0	229	4,639	444,469	10	203	19,409	2	41	3,882
Oxford	Gods Lake/Norway House	0	0	0	0	0	0	58	1,175	96,382	94	1,904	156,205	1	20	1,662
Oxford	Norway House/Oxford House	0	0	0	0	0	0	89	1,803	24,845	29	587	8,095	2	41	558

Vehicle Distance Travel Per 60 Days on Winter Road (km)

ATV/ Snowmobile	Car	Truck/ Van/ SUV	Transport Truck	Construction Equipment
23,999	0	581,768	183,710	6,102

Note: Transport Trucks and Pickup Trucks were not inlcuded using the Gods River data to avoid double counting data, Oxford Data was used due to it having the higher 60day traffic volume.

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Appendix B:
Vegetation Reports

Appendix B-1:

Botanical and Vegetation Resource Survey of the Proposed All-Season Road Project 6: Field Report

By Szwaluk Environmental Consulting, Karin Newman and Calyx Consulting

BOTANICAL AND VEGETATION RESOURCE SURVEY OF THE PROPOSED ALL-SEASON ROAD PROJECT 6 FIELD REPORT

Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation

Prepared for:

Manitoba Infrastructure

Prepared by:

Szwaluk Environmental Consulting Ltd.

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and

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January 2017

SUMMARY

Thirty-eight forested and wetland sites were sampled between Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation along the proposed P6 alignment and quarry areas. Forested sites were classed into 11 vegetation community types, and wetland sites were classed into five community types.

A total of 143 plant taxa were observed in the local assessment area. Eight documented uncommon species (S3 to S3S4) were recorded at or near survey sites. Species included oblong-leaved sundew (*Drosera anglica*), round-leaved bog orchid (*Platanthera orbiculata*), parsley fern (*Cryptogramma acrostichoides*), trailing club-moss (*Diphasiastrum complanatum*), black twinberry (*Lonicera involucrata*), alpine bearberry (*Arctous alpina*), Greenland primrose (*Primula egaliksesis*) and satin willow (*Salix pellita*). No species listed by the federal Species at Risk Act, the Manitoba Endangered Species and Ecosystems Act or the Committee on the Status of Endangered Wildlife in Canada were observed during fieldwork.

During the vegetation surveys, 12 cultural plant species were observed in the local assessment area. Of these, eight species were food plants, three were medicinal plants and three were other uses. Food plants observed included Saskatoon (*Amelanchier alnifolia*), strawberries (*Fragaria virginiana*), cherry (*Prunus* spp.), swamp gooseberries (*Ribes* spp.), cloudberries and head berries (*Rubus chamaemorus*), mossberries (*Vaccinium oxycoccus*), blueberries (*Vaccinium* spp.) and cranberries (*Vaccinium vitis-idaea*). Medicinal plants observed included juniper (*Juniperus* spp.), black spruce (*Picea mariana*) and Labrador tea (*Rhododendron groenlandicum*), while willow sticks (*Salix* spp.) were also valued. The most frequent species observed in sampled plots was black spruce. Other common species included blueberries, willows, Labrador tea, cranberries and mossberries.

Three environmentally sensitive sites were identified from field assessments along the proposed P6 All-Season Road. These sites supported older growth black spruce forest greater than 120 years age (121, 156 and 165 years).

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1.0 INTRODUCTION

1.1 Background

To the northeast of Lake Winnipeg, Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation have relied primarily on winter road and air travel to transport people and goods. In 2008, the Government of Manitoba announced a strategic initiative to provide improved, safer and more reliable transportation services to connect the remote communities on the east side of Lake Winnipeg with the rest of Manitoba. Manitoba East Side Road Authority (MESRA), formerly Manitoba Floodway and East Side Road Authority (MFESRA), was established as a provincial Crown Agency to manage the East Side Transportation Initiative with the intent of increasing transportation opportunities for communities on the east side of Lake Winnipeg. This task has since been transferred to Manitoba Infrastructure (MI).

As part of the East Side Transportation Initiative, MI is proposing the construction of an all-season road northeast of Lake Winnipeg between Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation, Project 6 (P6). The proposed P6 All-Season Road will occur at the northeastern extent of the Transportation Initiative network.

1.2 Project Overview

The proposed All-Season Road will consist of approximately 137 km of two-lane gravel highway on new right-of-way (ROW) on provincial Crown land, connecting Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation (Map 1).

The All-Season Road will be a gravel-surface public highway, with a design width of 10 m. The All-Season Road will intersect two major water crossings over God's River and Magill Creek. The components of the Project include the following:

- All-Season Road on new ROW;
- Up to two bridges at water crossings (bridge replacement at God's River, possible bridge construction at Magill Creek);
- Culverts for stream crossings and drainage equalization;
- Rock quarries and granular borrow areas; and
- Temporary access trails, bridges, staging areas and camps.

The portion of the Project located on Provincial Crown Land requires an Environmental Impact Assessment under the Manitoba Environment Act as a Class II development and under the Canadian Environmental Assessment Act.

The specific objectives established for this study were as follows: i) describe vegetation types and composition, all overstory and understory species, and forest resource information; ii) verify the presence/absence of plant species of conservation concern and plant species of interest such as those traditionally used for medicine, subsistence and cultural purposes; and iii) conduct soil surveys associated with vegetation sampling.

2.0 STUDY AREA

The proposed All-Season Road Project is located northeast of Lake Winnipeg, near Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation, approximately 950 km northeast of Winnipeg (by air). The P6 All-Season Road extends from Bunibonibee Cree Nation southeast to God's Lake First Nation, and approximately midway is intersected to extend northeast to Manto Sipi Cree Nation. The total distance is approximately 137 km of proposed All-Season Road. For this study, the P6 segment from Bunibonibee Cree Nation to God's Lake First Nation is referred to as P6a and the segment from the junction to Manto Sipi Cree Nation as P6b.

The proposed All-Season Road Project occurs in the God's Lake, Knee Lake and Island Lake Ecodistricts, which are located in the Hayes River Upland Ecoregion and the Boreal Shield Ecozone.

2.1 Spatial Boundaries

The spatial boundaries for the assessment consist of project, local and regional assessment areas and are described below, and illustrated in Appendix II, Map 1.

Project Assessment Area (PAA) – Footprint of the proposed P6 All-Season Road Project, including rock quarries, borrow areas and access roads. The proposed P6 All-Season Road will be centered on a 100 m ROW with a typical clearing width of 60 m and additional clearing as required at horizontal curves to maintain sight distances.

Local Assessment Area (LAA) – One km on either side of the proposed P6 All-Season Road Project, including rock quarries, borrow areas and access roads.

Regional Assessment Area (RAA) – Five km on either side of the proposed P6 All-Season Road Project.

2.2 Existing Environment

2.2.1 Ecological Land Classification

The proposed All-Season Road Project connecting the communities of Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation, occurs almost entirely within the God's Lake Ecodistrict and the Knee Lake Ecodistrict (Appendix II, Map 2). The Island Lake Ecodistrict occurs at the northeastern portion of the study area. These ecodistricts occur within the Hayes River Upland Ecoregion which extends from the Grass River Basin in east-central Manitoba to northwestern Ontario, and the Boreal Shield Ecozone, which stretches from northern Saskatchewan to Newfoundland (Smith et al. 1998).

2.2.2 Geology and Surficial Geology

The geology of the area consists of Precambrian rock from the Archean era (Geology of Manitoba 2016). In the Oxford Lake area, the lithotec consists of late metasedimentary and metavolcanic rocks (Oxford Lake Group, Island Lake Series, San Antonio formation). The unit consists of greywacke, conglomerate, arkose and arenite, as well as mafic and felsic fragmental volcanic rocks, and porphyritic mafic to felsic flows. In the vicinity are late intrusive rocks of granodiorite, minor tonalite, migmatite and granite. In the God's Lake area, the lithotec dominantly consists of metamorphosed early intrusive rocks, gneisses and migmatites. Early metavolcanic and metasedimentary rocks (Rice Lake Group, Hayes River Group) occur at the north and south ends of the lake. The unit consists of basalt, minor andesite, minor sedimentary and mafic intrusive rocks, ultra mafic rocks and differentiated ultramafic/mafic intrusions. Metamorphic supracrustal rocks with amphibolite also occur (Geology of Manitoba 2016).

The surficial geology of the area is characterized by discontinuous till deposits over bedrock outcrops, organic deposits and glaciolacustrine sediments (Smith et al. 1998). Till deposits are of silt diamicton, largely derived from Phanerozoic carbonate rocks from the Hudson Bay Lowland, and are generally of low-relief. Organic deposits, in low-lying areas, are from <1 – 5 m thick and accumulate in fen, bog, swamp and marsh settings. In permafrost areas, patterned ground and peat palsas are common. The glaciolacustrine sediments are low relief, massive and laminated deposits of clay, silt and minor sand, deposited by deep water of glacial Lake Agassiz. Deposits were commonly scoured and homogenized by icebergs. Glaciofluvial sediments range from fine sand, minor gravel, thin silt and clay interbeds deposited as subaqueous outwash fans to sand and gravel complex deposits with esker ridges and kames. The bedrock outcrops are generally subglacially eroded and unweathered intrusive, metasedimentary and metavolcanic rocks with a glacially scoured irregular surface with high local relief. In areas of permafrost, frost shattered, angular boulder field occur (Matile and Keller 2006).

2.2.3 Soils

Soils are similar across ecodistricts, with mineral soils developed on till, glaciolacustrine or glaciofluvial sediments and non-frozen and frozen organic soils found in peatlands and depressions. In the God's Lake Ecodistrict, mineral soils are characterized as being dominantly well to imperfectly drained Eluviated Eutric Brunisols that have developed on loamy to sandy till deposits and Gray Luvisols that have developed on both loamy to sandy till deposits and upland clayey glaciolacustrine deposits. Vast areas of peat filled depressions form a poorly drained bog and fen complex. Soils found in poorly drained bogs are characterized as Fibrisols, with slightly decomposed sphagnum and feather moss peat and Mesisols with moderately decomposed moss and forest peat. Soils found in fens vary

with slightly decomposed to moderately well decomposed peat with deeper peat more decomposed that peat found at the surface. Organic Cryosols are found in the northern section of the ecodistrict and in peatlands where permafrost is present. To the north within the Knee Lake Ecodistrict, dominant soils are organic which include Organic Cryosols generally found in peatland areas that contain permafrost. Organic soils that are non-frozen include both Fibrisols and Mesisols found in shallow bogs, and patterned fens comprised of woody, forest peat and sedge peat. Mineral soils found in the ecodistrict include Eluviated Eutric Brunisols that have developed on loamy to sandy calcareous till and sandy gravelly fluvioglacial deposits, and Gray Luvisols found on well to imperfectly drained clayey deposits (Smith et al. 1998). Soils of the assessment area are shown in Appendix II, Map 3.

2.2.4 Topography and Drainage

Topography of the area ranges from undulating to ridged morainal plain comprised of sandy to loamy till deposits. In areas of lower slopes and depressions, bogs and fens comprised of both shallow and deep peat material are found overlying clayey glaciolacustrine deposits. Inclusions of kettled fluvioglacial deposits, in the form of eskers and esker aprons, can also be found. Elevations range from 150 metres above sea level (masl), to 274 masl (Smith et al. 1998).

Two drainage systems, the Nelson River and Hayes are found in the area, and the many small, medium and large sized lakes drain north-northeastward through a network of rivers and secondary streams.

The major lakes in the area include God's Lake, Oxford Lake and Knee Lake while major rivers of the area include the Hayes and God's Rivers. The P6 alignment is intersected at several locations by streams and creeks, shown in Appendix II, Map 4.

2.2.5 Landscape Level Vegetation

The vegetation across this region of Manitoba is primarily black spruce on both upland and organic sites. Canopies are often more open, and of medium height compared to areas further south. Forest fire has replaced some upland spruce with jack pine, often the dominant species on regenerating sites, while trembling aspen occurs occasionally. Mixed stands of white spruce, balsam fir, trembling aspen and balsam poplar are generally restricted to favorable sites along lakes and rivers. Areas of rocky outcrops favour jack pine, with an understory of ericaceous shrubs, herbs and mosses and lichens. Low growing black spruce in open canopies grow in bogs, along with ericaceous shrubs and sphagnum and other mosses. Tamarack is found in fens, and is mixed with black spruce in transitional peatlands (Smith et al. 1998). The land cover classification is shown in Appendix II, Map 5.

2.2.6 Wetlands

The distribution of wetlands across the region for the P6 study area is based on digitized data from a study on wetland types and their distribution in Manitoba (Halsey et al. 1997). Here, wetlands are distinguished by wetland class (bog, fen, marsh, swamp, shallow water), the presence/absence of a tree canopy (open, wooded, forested), and a landform modifier (e.g., patterned, non-patterned). Mapping at this scale, in many cases resulted in wetland complexes identified, rather than individual wetlands. In the wetland complex class, 30 to 70% of land is comprised of a mosaic of fen and bog habitats, while the remaining represents upland habitat, or non wetland (Appendix II, Map 6). Only bog and fen wetlands were identified in the regional assessment area, based on data from Halsey et al. (1997).

2.2.7 Quarry and Borrow Areas

Due to the widespread presence of wetlands throughout the project area, extensive aggregate for construction of the road will be pulled from other sites, and 29 potential rock quarries have been identified along the alignment, ranging in size from 0.01 km^2 to 0.47 km^2. A total of 2.51 km^2 will be cleared for quarry development, primarily within the local assessment area (2.49 km^2), including 0.70 km^2 in the project area, and an additional 0.03 km^2 beyond the local assessment area. For all quarries located off the alignment, access roads will be required.

3.0 METHODS

3.1 Sample Site Selection

Information provided by MESRA was used to select potential sites for vegetation sampling of the proposed P6 All-Season Road Project. Information included route alignment high resolution imagery (30 cm), Google Earth imagery and Project shapefiles such as the Land Cover Classification (LCC).

The LCC is a national vector database mapping layer that has been harmonized across the major federal departments involved in land management or land change detection (Agriculture and Agri-Foods Canada, Canadian Forest Service, and Canadian Centre for Remote Sensing). The LCC consists of remotely sensed imagery (Landsat data) as part of the Earth Observation for Sustainable Development of Forests Program.

The National Stratification Working Group ecological framework database (Smith et al. 1998) was used to identify and describe the ecological land classification, to the ecodistrict scale. Other available data sources used included soils (Agriculture and Agri-Food Canada 2013), water crossings (Natural Resources Canada 1999 to 2010) and wetland features (Halsey et al. 1997). Plant species of interest as identified through traditional knowledge studies and engagement activities (i.e., shapefiles) were provided by MESRA.

Potential sample sites for the proposed P6 All-Season Road Project were based on accessibility, vegetation cover type, disturbance, and areas with potential to support species of conservation concern and species of interest.

3.2 Native Vegetation and Soil Survey

Vegetation and soil surveys were planned to occur within a 1 km radius of the proposed P6 All-Season Road Project, where most direct environmental effects are likely to occur. Fieldwork was conducted to record information on the local flora, describe vegetation types and forest conditions, search for species of conservation concern, document culturally important species, and classify soils.

3.2.1 Native Vegetation Survey

A native vegetation survey was used to sample and characterize plant communities. The survey consisted of establishing temporary sample plots on sites with relatively homogeneous vegetation. These included both upland and wetland sites. The sampling of vegetation composition was based on methods outlined in Redburn and Strong (2008). A 30 m transect was used with five 2.5 m by 2.5 m quadrats with a 1 m by 1 m nested quadrat spaced at 5 m increments along the transect for shrubs 1-2.5 m tall and herbs and low

shrubs ≤1 m tall, respectively. The composition of tree cover >2.5 m tall was determined using a 20 m by 30 m plot centered on each transect. Plant species presence/absence data was recorded by subplot.

Within each plot, the tallest tree of each species was aged based on growth ring counts from a single core extracted with an increment corer at breast height (1.3 m). Diameter at breast height (DBH) was measured with a diameter tape. A clinometer was used to measure tree height at a distance of 20 m.

3.2.2 Soil Survey

One soil pit was dug inside each upland plot for description. At each soil pit, the thickness (cm) of the humus layer and soil horizons were measured. In wetland sites, a hand held Dutch auger was used to extract, measure soils.

Soils horizons, structure and texture were classified according to the Canadian System of Soil Classification (Soil Classification Working Group 1998). Dilute 10% hydrochloric acid solution was used for determining effervescence and detecting carbonates (basic soils) in the field.

3.2.3 Field Classification and Site Information

In the field, vegetation type classification for upland sites sampled followed Zoladeski et al. (1995) and Ducks Unlimited (2015) for wetlands.

Universal Transverse Mercator (UTM) geographic coordinates were recorded in the field for all temporary sample plots. Photographs were captured at each site visited.

3.3 Botanical Survey

Botanical surveys of the project area involved identification and tabulation of all observed vascular plant species including trees, shrubs, forbs and graminoids, and mosses and lichens.

3.3.1 Species of Conservation Concern

Searches for species of conservation concern concentrated on uncommon plant communities, and unusual habitats and landscape features. A meander search pattern was used when surveying for species of conservation concern.

MESRA defines plant species of conservation concern as species that are ranked as very rare (S1) to rare (S2) by the Manitoba Conservation Data Centre (MBCDC), and those listed under the Endangered Species and Ecosystems Act – Manitoba (ESEA), the federal Species

at Risk Act (SARA) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). A database search of the MBCDC provincial records for known locations of species of conservation concern in the vicinity of the Project was requested in the spring of 2016.

The global (G) and sub-national (S) rarity ranking of species used by the MBCDC, according to a standardized procedure used by all Conservation Data Centres and Natural Heritage Programs is as follows:

1: Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.

2: Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.

3: Uncommon throughout its range or in the province (21 to 100 occurrences).

4: Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (> 100 occurrences).

5: Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially impossible to eradicate under present conditions.

The conservation status categories for ESEA, SARA and COSEWIC are as follows:

Special Concern: A species that may become threatened or endangered because of a combination of biological characteristics and identified threats.

Threatened: A species likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Endangered: A species facing imminent extirpation or extinction.

Extirpated: A species no longer existing in the wild in Canada but exists elsewhere.

Extinct: A species that no longer exists.

3.3.2 Species of Interest

Plant species of interest, such as those traditionally used for medicine, subsistence and cultural purposes, were recorded in the field where observed. Prior to field studies, a list of culturally important species was compiled based on available literature. Generally these include a variety of vegetation including trees, shrubs, flowers, mosses, lichens (Davidson-Hunt et al. 2012). All plant species recorded in the field and culturally important species provided by MESRA for the Project (i.e., shapefiles) were assessed to determine which sites supported those plants. A traditional knowledge study carried was out in collaboration

with local community members using workshops and one-on-one interviews to determine culturally important species.

3.3.3 Collection Guidelines

All vascular plants were recorded and those unidentifiable in the field were collected, as voucher specimens, where the population size permits. Identification of vascular plants followed Flora of North America (1993+) and Scoggan (1957), and verification with herbarium specimens located at the Manitoba Museum. Plant nomenclature followed Flora of North America (1993+) and the Manitoba Conservation Data Centre for those plants not listed by Flora of North America (1993+). Voucher specimens will be donated to the Manitoba Museum natural history collection and credited as a donation from the MESRA. Fieldwork was conducted from June 9 to 16, 2016.

4.0 VEGETATION AND BOTANICAL RESOURCES

4.1 Native Vegetation Resources

Thirty-eight forested and wetland (i.e., bog and fen) sites were sampled between Manto Sipi, Bunibonibee and God's Lake along the P6a and P6b alignments. Appendix II, Map 7 shows the distribution of sites within the assessment area.

To summarize and characterize the local vegetation, forested and wetland sites were further classed into specific vegetation community types (Zoladeski et al. 1995; Ducks Unlimited 2015). Classification was carried out in the field based on data collected at each site, including vegetation composition, distribution and structure, and soil type and profile information. Vegetation community descriptions are presented for forested and wetland sites separately, for all vegetation strata present, (i.e. trees, tall shrub canopy, and herb and low shrub understory). Forested (and one wetland, V33) community type descriptions includes tree canopy cover and composition, and age of tallest trees for species present. Canopy cover is defined as dense (crown closure >60%), open (crown closure 26 to 60%), and sparse (crown closure 10 to 25%).

Presence/absence data was recorded for all species in the tall shrub, and the herb and low shrub strata over five quadrats at each site. The distribution of all species based on frequency of occurrence within sites is defined here as widespread (species occurs in 4-5 quadrats), frequent (occurs in 3 quadrats), or scattered (occurs in 1-2 quadrats). Species observed adjacent to or in the vicinity of sites, but not within the plot/ quadrats themselves, are included as incidental species.

Tree species are referred to by common names, all other species are referenced with common and scientific names. For all species encountered in field surveys, see the flora list found in Appendix III.

4.1.1 Forest Community Types

Twenty-six forested sites were sampled from areas of mainly deciduous (4 sites), mixedwood conifer (2 sites), and conifer (20 sites) tree canopies. Over the study area, each habitat type present is represented in the sample of sites, and the predominance of black spruce sites reflects the area's dominant coniferous forest cover. The fire history of the area suggests that some of these forests are very mature stands. Notably in four black spruce stands, the largest trees were aged at over 100 years, (101 to 156 y). Other species were also long lived, five stands had either jack pine, trembling aspen or tamarack aged at over 90 y (91 to 97 y). The oldest tree measured was 165 years, from a tree bog wetland.

Forested sites were further classed into eleven forested vegetation community types, using the Forest Ecosystem Classification for Manitoba (Zoladeski et al. 1995) based on the vegetation composition and structure, and soils present at each site. Site locations, vegetation community classification, soil type and site surface information are provided in Appendix IV, Table A. Community types are summarized in Table 4.1.1., with brief descriptions of vegetation and soils following, below.

Two sampled plots in forest communities were located in or adjacent to potential quarry sites (P6a-15 and Quarry 28, P6a-05 and Quarry 6), and two other sampled plots were located near potential quarry sites, approximately 200m away (P6a-22 and Quarry 23, P6a-02 and Quarry 13).

Table 4.1.1. Forest community types sampled in P6a Bunibonibee to God's Lake, and P6b from Manto Sipi to the junction, 2016.

Community Types	Plot Identification	#	Soil Types	Total Species	Mean Species
Mainly Deciduous Communities					
V5 Aspen Hardwood	P6b-30	1	Brunisol	24	-
V8 Trembling Aspen Mixedwood/ Tall Shrub	P6a-14, P6a-15	2	Luvisol	36	25
V9 Trembling Aspen Mixedwood/ Low Shrub	P6a-10	1	Luvisol	24	-
Mixedwood Coniferous Communities					
V18 Black spruce Mixedwood/ Feathermoss	P6a-05, P6a-08	2	Brunisol, Luvisol	30	19
Coniferous Communities					
V25 Jack pine/ Feathermoss	P6a-12	1	Brunisol	9	-
V26 Jack pine- Black spruce/ Lichen	P6b-25, P6b-27	2	Brunisol	24	13.5
V27 Black spruce/ Shrub- and herb- poor	P6b-33	1	Brunisol	27	-
V28 Jack pine- Black spruce/ Feathermoss	P6a-16	1	Brunisol	31	-
V29 Black spruce/ Feathermoss	P6a-01, P6a-13, P6a-21, P6b-31	4	Luvisol	39	18.8
V30 Black spruce/ Labrador tea/ Sphagnum	P6a-04, P6a-09, P6a-22	3	Gleysol	32	19
V32 Black spruce/ Herb poor/ Sphagnum	P6a-03, P6a-06, P6a-07, P6a-18, P6a-19, P6b-26, P6b-32, P6b-36	8	Organic	60	21.8

4.1.1.1. Mainly Deciduous Forest Community Types

Aspen Hardwood (V5)

A single site was classed as Aspen Hardwood. The canopy is dominated by open trembling aspen, with the tallest tree aged at 96 years. Black spruce is also present, the tallest among

this sub-canopy was aged 39 y. Green alder (*Alnus viridis*) is widespread in the tall shrub canopy, with scattered black spruce saplings. The understory is relatively herb rich, with twenty species of herbs and low shrubs occurring. Widespread species include Canada bunchberry (*Cornus canadensis*), prickly rose (*Rosa acicularis*), Labrador tea (*Rhododendron groenlandicum*) and pink pyrola (*Pyrola asarifolia*). One uncommon to widespread species was incidentally recorded, the round-leaved bog orchid (*Platanthera orbiculata*, S3S4). Widespread leaf litter accounts for the ground layer, along with frequent Schreber's moss (*Pleurozium schreberi*), and scattered splendid feathermoss (*Hylocomium splendens*) and unidentified mosses. No species of conservation concern were recorded in this vegetation type.

An Eluviated Dystric Brunisol was classified at this site and was characterized as having a humus form thickness of 5 cm. Soil horizons consisted of an Ahe (3 cm thick), sandy clay Bt (16 cm thick), loamy sand Bm horizon (22 cm) followed by a sandy clay C horizon 22 cm thick. Bedrock was encountered at a depth of 62 cm in the soil pit.

Trembling Aspen Mixedwood/ Tall Shrub (V8)

Two sites were classed as Trembling Aspen Mixedwood/ Tall Shrub with a canopy of open or sparse trembling aspen. Black spruce, balsam poplar and jack pine may be present. The tallest aspen trees were aged at 92 and 94 years. Black spruce (73 y), balsam poplar (85 y) and jack pine (97 y) were non-dominant, and present in one site only. Widespread green alder (*Alnus viridis*), and scattered saplings of black spruce and trembling aspen are found in the tall shrub canopy. A total of 29 herb and low shrub species make up the understory, including widespread bunchberry (*Cornus canadensis*), mooseberry (*Viburnum edule*), smooth wild strawberry (*Fragaria virginiana*), mitrewort (*Mitella nuda*), and prickly rose (*Rosa acicularis*). Ground litter is widespread, with scattered occurrences of Schreber's moss (*Pleurozium schreberi*), *Dicranum* mosses, splendid feathermoss (*Hylocomium splendens*) and other unidentified mosses recorded. No species of conservation concern were recorded in this vegetation type.

The soils associated with this vegetation type were classified as Orthic Gray Brown Luvisols. Humus form thickness ranged from 6 to 10 cm. The soils were characterized as having an Ah horizon ranging from 2 to 3 cm thick, an Ae horizon (2cm), and a silty clay to clay loam Bt horizon (17-23 cm thick). The silty clay loam/silty clay C horizons were encountered at a depth ranging from 22 to 25 cm and thickness ranged from 74 to 92 cm.

Trembling Aspen Mixedwood/ Low Shrub (V9)

One site was classed in this vegetation community with an open trembling aspen canopy (83 y), and a presence of jack pine (81-87 y). The tall shrub canopy is made up of

widespread green alder (*Alnus viridis*), with scattered Saskatoon (*Amelanchier alnifolia*) and mooseberry (*Viburnum edule*). The herb and low shrub layer consists of 19 species, including widespread green alder seedlings, bunchberry (*Cornus canadensis*), dewberry (*Rubus pubescens*), pink pyrola (*Pyrola asarifolia*), and prickly rose (*Rosa acicularis*). Round-leaved bog orchid (*Platanthera orbiculata*, S3S4) was recorded incidentally in the plot. This plant is ranked as uncommon to widespread by the MBCDC. Widespread ground litter, and scattered Schreber's moss (*Pleurozium schreberi*), splendid feathermoss (*Hylocomium splendens*) and unidentified mosses make up the ground cover. No species of conservation concern were recorded in this vegetation type.

The soil at this site was an Orthic Gray Brown Luvisol. Humus form thickness was 8 cm and soil horizons included an Ae of 5 cm, a silty clay loam Bt of 29 cm, and a clay loam C horizon 56+ cm.

4.1.1.2. Mixedwood Coniferous Forest Community Types

Black spruce Mixedwood/ Feathermoss (V18)

Two sites were classed into this vegetation type. Open black spruce and trembling aspen make up the tree canopy, while the tallest trees were aged at 64-72 y for black spruce, and 78-83 y for trembling aspen. Typically, these sites have poorly developed tall shrub canopies, and here consists of only scattered green alder (*Alnus viridis*). The herb and low shrub layer is also relatively poorly developed, and includes 27 species. Most frequently occurring is bunchberry (*Cornus canadensis*) and prickly rose (*Rosa acicularis*). Trailing club-moss (*Diphasiastrum complanatum*, S3S4) is uncommon to widespread and was recorded incidentally at one site. Widespread litter and dominant mosses of Schreber's feathermoss (*Pleurozium schreberi*) and splendid feathermoss (*Hylocomium splendens*) account for the ground layer. No species of conservation concern were recorded in this vegetation type.

Soils at these sites were classified as an Eluviated Eutric Brunisol and an Orthic Gray Brown Luvisol. The Eluviated Eutric Brunisol had s humus form thicknesses of 6 cm followed by an Ah (2 cm) and Ae (3 cm) horizon. Under the A horizon, occurred a sandy loam Bm horizon 20 cm thick, followed by a loamy sand C horizon. Bedrock was encountered at a depth of 55 cm. The Orthic Gray Brown Luvisol was characterized as having a humus form that was 6 cm thick, followed by an Ah, 2 cm thick. A clay Bt horizon underlies the A horizons and is 30 cm thick. The sandy clay C horizon was encountered at 32 cm and was 67 cm thick. Bedrock was found below the C horizon.

4.1.1.3. Coniferous Forest Community Types

Jack pine/ Feathermoss (V25)

A single site is described as Jack pine/ Feathermoss, with a tree canopy made up of very sparse jack pine (aged at 86 y), with a presence of black spruce (28 y). The tall shrub layer is absent. The poorly developed herbs and low shrub understory is composed of seven species. Most frequently occurring species are velvet-leaved blueberry (*Vaccinium myrtilloides*) and twinflower (*Linnaea borealis*). Schreber's moss (*Pleurozium schreberi*), reindeer lichens (*Cladina rangiferina* and *C. mitis*) provide a near continuous ground cover, with scattered leaf litter and open ground water. No species of conservation concern were recorded.

The soil at this site was classified as an Eluviated Eutric Brunisol with a humus form 5 cm thick followed by an Ah (3 cm), loamy sand Ae (14 cm) and loamy sand Bm (33 cm thick). The loamy sand C horizon was encountered at 50 cm and was 30+ cm thick.

Jack pine- Black spruce/ Lichen (V26)

In these two sites, the tree canopy is composed of jack pine (mean age 89.5 y), while black spruce (mean age 52 y) or paper birch may be present. Jack pine- Black spruce/ Lichen types are sparse to open canopied, with no tall shrub stratum. Twenty-one species of herbs and low shrubs are generally sparsely scattered, most frequently occurring is velvet-leaved blueberry (*Vaccinium myrtilloides*) and twinflower (*Linnaea borealis*). Parsley Fern (*Cryptogramma acrostichoides*, S3S4) was observed with scattered occurrence at one site. This species is identified as uncommon to widespread. Lichens are more frequent than mosses, and the ground layer is generally characterized by a widespread cover of reindeer lichens (*Cladina mitis*), with scattered Schreber's moss (*Pleurozium schreberi*), *Cladonia* and reindeer lichens (*Cladina rangiferina* and *C. stellaris*). Ground litter and woody debris are widespread; one site occurred on a granite outcrop. No species of conservation concern were recorded in this vegetation type.

Soils that were classified for these sites include an Eluviated Dystric Brunisol and Orthic Eutric Brunisol. The humus form thicknesses ranged from 2 to 5 cm. The humus layer was underlain by either a thin Ah horizon (1 cm) or sandy Bm horizon (12 to 15 cm thick cm), followed by a sandy to silty clay C horizon ranging from 18 to 90+ cm in thickness. At one site bedrock was encountered at 25 cm deep in the soil profile.

Black spruce/ Shrub- and herb-poor (V27)

In this single site, the tallest black spruce was aged at 156 years, the sub-canopy tamarack was aged at 34 y. The Black spruce/ Shrub- and herb-poor vegetation type is characterized

by sparse black spruce stands, with poorly a developed tall shrub layer. Bog birch (*Betula pumila*) occurs frequently as a tall shrub, with scattered black spruce and tamarack saplings. Typically floristically poor, the herbs and low shrubs are made up of 21 species, with widespread sheathed sedge (*Carex vaginata*), common juniper (*Juniperus communis*), Labrador-tea (*Rhododendron groenlandicum*), myrtle-leaved willow (*Salix myrtillifolia*), bog whortleberry (*Vaccinium uliginosum*), and bog cranberry (*Vaccinium vitis-idaea*). Alpine bearberry (*Arctous alpina*, S3S4) was observed with scattered occurrence. Widespread leaf litter, Schreber's moss (*Pleurozium schreberi*) and reindeer lichens (*Cladina rangiferina* and *C. mitis*) provide a near continuous ground layer. No species of conservation concern were recorded.

The soil found at this site was classified as an Orthic Eutric Brunisol. Soil horizons consisted of an Of (14 cm thick) followed by an Ah (5 cm thick) then a sandy loam Bm horizon (73 cm thick). Rock and coarse fragments were encountered at a depth of 78 cm and seepage was also observed at this depth.

Jack pine- Black spruce/ Feathermoss (V28)

In this single Jack pine- Black spruce/ Feathermoss site, dominant, open jack pine (to 77 y) and sparsely occurring subdominant trembling aspen (80 y), make up the canopy trees, with a presence of paper birch. The tall shrubs include widespread green alder, and scattered saplings of black spruce and white birch. The understory is composed of 25 species, including the widespread herbs, bunchberry (*Cornus canadensis*), smooth wild strawberry (*Fragaria virginiana*) and white-grained mountain rice grass (*Oryzopsis asperifolia*), and low shrubs of bog cranberry (*Vaccinium vitis-idaea*), mooseberry (*Viburnum edule*) and prickly rose (*Rosa acicularis*). The round-leaved bog orchid (*Platanthera orbiculata*, S3S4) is scattered in occurrence, recorded from one quadrat, and black twinberry (*Lonicera involucrata*, S3S4) was incidentally recorded at one site. These species are ranked as uncommon to widespread by the MBCDC. Leaf litter and Schreber's moss (*Pleurozium schreberi*) are widespread in the ground layer, followed by splendid feathermoss (*Hylocomium splendens*), and scattered *Dicranum* mosses. No species of conservation concern were recorded in this vegetation type.

The soil associated with this vegetation type was an Eluviated Eutric Brunisol. The site had a humus form thickness of 5 cm. The soil was characterized with an Ah (2 cm) followed by an Ae (2 cm) horizon. Following horizons included a silty clay loam Bt horizon of 20 cm, loamy sand Bm horizon of 21 cm, a silty clay loam C1 horizon (25 cm) and a sandy C2 horizon approximately 40+ cm thick.

Black spruce/ Feathermoss (V29)

Four sites made up this community of open black spruce stands, with the tallest trees aged to 76 y. Also present were jack pine (to 81 y), paper birch (46 y) and trembling aspen (56 y). The poorly developed tall shrub layer consists of scattered green alder and black spruce saplings, while scattered white birch and Bebb's willow (*Salix bebbii*) are occasionally present. The herb and low shrub understory has 30 species, with generally frequent occurrence of bunchberry (*Cornus canadensis*) and prickly rose (*Rosa acicularis*), and a scattered occurrence of black spruce seedlings, northern comandra (*Geocaulon lividum*), twinflower (*Linnaea borealis*), and Labrador-tea (*Rhododendron groenlandicum*). Trailing club-moss (*Diphasiastrum complanatum*, S3S4) was recorded incidentally at one site. The ground layer is made up of widespread splendid feathermoss (*Hylocomium splendens*) and Schreber's moss (*Pleurozium schreberi*), with scattered *Dicranum* mosses and plume moss (*Ptilium crista-castrensis*). No species of conservation concern were recorded.

Orthic Gray Brown Luvisols were classified at these sites. These soils had a humus form thickness of 5 cm. The uppermost soil horizons were identified as being Ah, Ae or Ahe horizons with thicknesses ranging from 2 to 9 cm. These horizons were followed by a clay loam, silty clay or silty clay loam Bt horizon ranging from 26 to 40 cm, followed by a sandy clay, clay, silty clay or clay loam C horizon. Seasonal ice was encountered in the C horizon at two of the field sites. No species of conservation concern were recorded in this vegetation type.

Black spruce/ Labrador tea/ Feathermoss Sphagnum (V30)

These three lowland sites are open black spruce stands, where tallest trees were a mean of 77 y, (max. 101 y). Tamarack (70 y) is present in one site. The tall shrub layer is moderately-well developed and composed of frequent black spruce (*Picea mariana*) and white birch (*Betula papyrifera*) saplings, green alder (*Alnus viridis*) and Bebb's willow (*Salix bebbiana*). The understory of this vegetation type can be characterized as poor to rich. Here, 23 herb and low shrub species make up the understory, most with scattered occurrence. Frequent to widespread species include Labrador tea (*Rhododendron groenlandicum*), bog cranberry (*Vaccinium vitis-idaea*), horsetails (*Equisetum arvense* and *E. scirpoides)* and black spruce seedlings. Greenland primrose (*Primula egaliksesis*, S3) was incidentally observed near one site. Schreber's moss (*Pleurozium schreberi*) and splendid feathermoss (*Hylocomium splendens*) are widespread in the ground layer, with scattered *Sphagnum* mosses, green reindeer lichen (*Cladina mitis*), and unidentified mosses. No species of conservation concern were recorded.

Three different soils were classified for this vegetation type, a Humic Luvic Gleysol, Rego Humic Gleysol and Rego Gleysol. The Humic Luvic Gleysol had a humus form thickness of

17 cm that was underlain by an Ah (30 cm thick), silty clay Btg (30 cm), then a sandy clay C horizon (40+ cm thick). Water seepage was evident in the soil pit and seasonal ice was present near to the soil pit. The Rego Humic Gleysol had an Of layer 15 cm thick followed by an Om layer 8 cm thick. Soil horizons included an Ah (12 cm) and sandy loam Cg horizon (27 cm thick) that had evidence of mottling. Bedrock was encountered at 62 cm depth. The site with the Rego Gleysol had an Of (10 cm thick), followed by an Om (15 cm thick), then an Oh (8 cm thick). The organic layers were underlain by an Ah approximately 2 cm thick followed by a Cg horizon 55+ cm thick with evidence of gleying. Seasonal ice was found with the soil profile.

Black spruce/ Herb poor/ Sphagnum (V32)

This type includes eight sites with sparse canopy of black spruce (average age 90, max. 121 y) with generally sub-dominant tamarack (average age 74, max. 93 y). White birch is present in one site only. Black spruce saplings are scattered to frequent across all plots, other tall shrubs occasionally present are speckled alder (*Alnus incana*), velvet-fruited willow (*Salix maccalliana*), and tea-leaved willow (*Salix planifolia*). Over the eight sites, an average of 17 species were recorded in the herb and low shrub understory, made up of widespread Labrador tea (*Rhododendron groenlandicum*) and frequent black spruce seedlings, bog cranberry (*Vaccinium vitis-idaea*) and small cranberry (*Vaccinium oxycoccos*). Other scattered plant species include sedges (*Carex aquatilis* and *C. gynocrates*), three-leaved Solomon's seal (*Maianthemum trifolium*) leatherleaf (*Chamaedaphne calyculata*), round-leaved sundew (*Drosera rotundifolia*) and bog-laurel (*Kalmia polifolia*). Alpine bearberry (*Arctous alpina*, S3S4) was incidentally recorded at one site. The ground layer is composed of widespread mosses (*Sphagnum* spp., *Pleurozium schreberi* and unidentified mosses) and green reindeer lichen (*Cladina mitis*), with scattered splendid feathermoss (*Hylocomium splendens*). No species of conservation concern were recorded.

The organic soils encountered included Terric Humisols, Terric Mesic Humisols, Terric Humic Fibrisol and Humic Mesisol. The Terric Humisols were classified as having an Oh horizon of 45 cm or an Of horizon (10 cm thick) followed by an Om horizon (10 cm thick) then an Oh horizon (22 cm thick). The sandy clay and clay C horizons were encountered at a depth ranging from 42 to 80 cm. The Terric Mesic Humisols encountered at some sites were classified as having an Of ranging from 10 to 230 cm thick, Om horizon (30 to 35 cm thick) and an Oh horizon ranging from 22 to 40 cm thick. The clay C horizon was encountered at a depth of 80 cm. Seasonal ice was also present in the Terric Mesic Humisols.

A Terric Humic Fibrisol and Mesic Humisol were identified at one site each. The Terric Humic Fibrosol was characterized by an Of (20 cm thick), followed by an Om (10 cm thick), and an Oh horizon (20 cm thick). The clay C horizon was encountered at 70 cm and

seasonal ice was present in the soil profile. The Mesic Humisol was comprised of an Of 9 cm thick, followed by an Om (88 cm thick), then an Oh approximately 123 cm thick. The clay C horizon was reached at a depth of 220 cm.

In addition to the organic soils characterized above, two field sites sampled, had soil profiles comprised of organic material but were unable to be classified to the great group as a result of the presence of seasonal ice which hindered augering of soils.

4.1.2 Wetland Community Types

Twelve sites sampled were considered wetlands, characterized by vegetation that is adapted to flooded or saturated conditions, with water permanently or seasonally present, at above or below the surface. Site locations, vegetation community classification, soil type and site surface information are provided in Appendix IV, Table B.

Wetland sites were further classed in to five wetland community types (Ducks Unlimited 2015), based on soil type, vegetation composition and height, and water regime, summarized in Table 4.1.2. Wetland types found along the project area include treed bog and fen communities, including treed, shrub and graminoid fens. A description of the vegetation and soils of the community types encountered follows.

Table 4.1.2. Wetland community types sampled in P6a Bunibonibee to God's Lake, and P6b from Manto Sipi to the junction, 2016.

Community Types	Plot Identification	Plots Sampled	Soil Types	Total Species	Mean Species
Treed bog (V33)	P6a-20, P6a-24, P6b-28, P6b-29, P6b-34, P6b-38	6	Organic	32	14
Treed poor fen	P6a-11	1	Organic	17	-
Shrub rich fen	P6a-02	1	Organic	16	-
Graminoid rich fen	P6b-35, P6b-37	2	Organic	17	13
Graminoid poor fen	P6a-17, P6a-23	2	Organic	24	15

Treed Bog (V33 Black spruce/ Sphagnum)

Six sites make up this vegetation type, the very open canopy is made up of black spruce (average 81 y), with a presence of tamarack (average 73 y). The oldest tree encountered during field sampling was found in a treed bog, a black spruce aged at 165 y. The tall shrub layer is composed of mainly black spruce saplings, while scattered tamarack saplings, bog birch (*Betula pumila*) and Bebb's willow (*Salix bebbiana*) may be present. The herb layer is generally floristically poor. There was a total of 32 species recorded in this vegetation type,

though many are scattered in occurrence. All sites have widespread occurrence of leather leaf (*Chamaedaphne calyculata*) Labrador tea (*Rhododendron groenlandicum*), three-leaved Solomon's seal (*Maianthemum trifolium*), and black spruce seedlings. While bog-laurel (*Kalmia polifolia*), cloudberry (*Rubus chamaemorus*) and small cranberry (*Vaccinium oxycoccos*) are frequent to scattered in occurrence. Greenland primrose (*Primula egaliksesis*, S3) was incidentally observed near one site. Ground cover is generally widespread *Sphagnum* mosses, with frequent occurrence of Schreber's moss (*Pleurozium schreberi*) and reindeer lichens (*Cladina rangiferina, C. mitis*). No species of conservation concern were recorded.

A Terric Fibrisol, Humic Mesisol, Terric Mesic Humisol and Terric Humic Fibrisols were the organic soils characterized at the treed bog sites. In addition to these soils, another organic soil was encountered, that was not able to be classified due to seasonal ice prohibiting augering past 38 cm in depth. The Terric Fibrisol had an Of (65 cm), Om (10 cm) and an Oh (10 cm) underlain by a clay Cg horizon (29+ cm thick). Seasonal ice was present at a depth of 29 cm. The Humic Mesisol was characterized as having an Of 26 cm thick, followed by an Om 74 cm thick, then an Oh 120+ cm thick. Seasonal ice was encountered at 26 cm deep in the soil profile. The Terric Mesic Humisol encountered at one of the treed bog sites was identified as having an Of (32 cm), Om (26 cm) and an Oh (35+ cm), with the organic horizons underlain by an Ah (21 cm) followed by a C horizon (6+ cm). Seasonal ice was encountered at 18 cm in depth in the soil profile. The Terric Humic Fibrisols were identified as having Of horizons ranging from 20 to 57 cm thick, followed by Om horizons (5 to 8 cm thick), then Oh horizons of 18 to 20 cm thick. An Ah horizon (8 cm thick) underlay the organic horizons in one of the sites. At both sites, the Terric Humic Fibrisols had clay to clay loam C horizons 20+ cm thick. Seasonal ice was found at depths ranging from 28 to 40 cm.

Treed Poor Fen

This is a single site, with a presence of very sparsely scattered tamarack and black spruce trees. The tall shrub canopy has frequent dwarf birch (*Betula pumila*) and scattered tamarack saplings. Thirteen species were recorded in the understory, with widespread sedges (*Carex aquatilis, C. magellanica*), marsh five-finger (*Comarum palustre*), three-leaved Solomon's seal (*Maianthemum trifolium*) and dwarf birch (*Betula pumila*). Satin willow (*Salix pellita*, S3S4) and small cranberry (*Vaccinium oxycoccos*) are frequent in occurrence. Unidentified mosses and litter are widespread throughout, with frequent occurrence of water at ground level. No species of conservation concern were recorded.

A Mesic Humisol was classified at this site and was characterized as having an Of (10 cm), Om (75 cm) and an Oh (85 cm). Seasonal ice was noted on a plateau near the site.

Shrub Rich Fen

This single site has no tree canopy, with 16 species present. The tall shrub canopy is made up of frequent dwarf birch (*Betula pumila*) and scattered tamarack saplings. Sedges are widespread (including *Carex chordorrhiza, C. magellanica* and *C. aquatilis*). Widespread low shrubs and herbs include bog rosemary (*Andromeda polifolia*), bog willow (*Salix pedicellaris*), small cranberry (*Vaccinium oxycoccos*), marsh five-finger (*Comarum palustre*) and bog bean (*Menyanthes trifoliata*). Dwarf birch (*Betula pumila*) seedlings and three-leaved Solomon's seal (*Maianthemum trifolium*) are frequently occurring in the understory. *Sphagnum* mosses and ground litter are widespread, while unidentified mosses are frequent in occurrence. No species of conservation concern were recorded.

The soil classified at this site was a Rego Gleysol which was characterized as having organic surface horizons comprised of an Of horizon 10 cm thick, followed by an Om horizon 15 cm thick, then a thin Oh horizon approximately 8 cm thick. Underlying the organic horizons, was a clay C horizon with evidence of gleying. Seasonal ice was also present at this site at a depth of approximately 25 cm.

Graminoid Rich Fen

No trees or tall shrubs are present in the two sites that make up this vegetation type. A total of 17 species were recorded. Widespread species are bog sedge (*Carex magellanica*) and bog willow (*Salix pedicellaris*), with bog rosemary (*Andromeda polifolia*), tufted clubrush (*Trichophorum caespitosum*) and dwarf birch (*Betula pumila*) seedlings present. Other herbs present include bog bean (*Menyanthes trifoliata*), seaside arrow-grass (*Triglochin maritima*), marsh five-finger (*Comarum palustre*), and sedges (*Carex chordorrhiza* and *C. aquatilis*). Oblong-leaved sundew (*Drosera anglica*, S3S4) occurs frequently in one site. This species is ranked as uncommon by the MBCDC. The ground layer is made up of unidentified mosses and litter, while ground water is widespread in one site. No species of conservation concern were recorded in this wetland type.

Soils found at the graminoid rich fens sites included a Humic Fibrisol and a Typic Humisol. The Humic Fibrisol identified had an Of horizon (90 cm), underlain by an Om (30 cm) then an Oh (100+ cm) horizon. The Typic Humisol was characterized as having an Of 10 cm thick, followed by an Om horizon 35 cm thick which was underlain by an Oh horizon 185+ cm. Seasonal ice was encountered in the soil pit at a depth of 15 cm.

Graminoid Poor Fen

The two sites in this vegetation type have no trees present, but a tall shrub canopy of scattered saplings of dwarf birch (*Betula pumila*), speckled alder (*Alnus incana*) and

tamarack (*Larix laricina*), or tea-leaved willow (*Salix planifolia*). Twenty species were recorded in the low shrub and herb understory, including widespread sedges (*Carex chordorrhiza* and *C. aquatilis*), bog willow seedlings (*Salix pedicellaris*) and marsh five-finger (*Comarum palustre*). Other species present include scattered bog sedge (*Carex magellanica*), beaked sedge (*Carex utriculata*), bog rosemary (*Andromeda polifolia*) and hoary willow (*Salix candida*). The ground cover is made up of litter, open water and unidentified mosses, with scattered *Sphagnum*. No species of conservation concern were recorded.

Soils found at the graminoid poor fens sites included a Humic Mesisol and a soil that was likely organic but could not be identified further as a result of the presence of seasonal ice that hindered augering at a depth of 30 cm. The Humic Mesisol was characterized as having an Of (40 cm), followed by an Om (70 cm), then an Oh (100+ cm) horizon. Seasonal ice was encountered at a depth of 20 cm in the soil profile.

4.2 Botanical Resources

4.2.1 Plants and Distribution of Species

Vegetation composition was recorded at 38 sites along the proposed P6 All-Season Road and quarry areas (see Appendix II, Map 7). A total of 143 plant taxa were observed in the local assessment area (Appendix III). There were 131 plants identified to the species level while 12 taxa were identified to the genus level including six vascular (shrub and herbs) and six non-vascular plants (mosses and lichens). Vascular plants identified only to the genus level were a result of absent or non-mature floral or fruiting parts when observed during the field assessment which are used for identification.

All plants were grouped by primitive vasculars (eg. ferns and horsetails), gymnosperms (conifers), angiosperms (flowering plants) and non-vascular plants. Angiosperms were divided into monocotyledons and dicotyledons with this group (angiosperms) of plants representing the greatest number of species. There were 116 angiosperms (37 monocotyledons and 79 dicotyledons), eight primitive vasculars, five gymnosperms, and 14 non-vascular plants.

Vascular plants were distributed among 40 families, with the angiosperms representing 34 of these. The sedge (Cyperaceae) family was the largest with 20 plant taxa, followed by the heath (Ericaeae) and willow (Salicaceae) families, with 11 species each. Five or more species were observed in each of the rose (Rosaceae), grass (Poaceae), honeysuckle (Caprifoliaceae) and orchid (Orchidaceae) families. The primitive vasculars are distributed among four families including the wood fern (Dryopteridaceae), horsetail (Equisetaceae), club-moss (Lycopodiaceae) and maidenhair fern (Pteridaceae). Species within the gymnosperms were members of the cypress (Cupressaceae) and pine (Pinaceae) families.

The forested and wetland communities in the project area support a wide range of species. Eight documented uncommon species (ranked by the Manitoba Conservation Data Centre) were observed during surveys, shown in Table 4.2.2. and Map 8 (Appendix II). Preferred species habitat descriptions are taken from Flora of North America (1993+) and Scoggan (1957).

Table 4.2.2. Uncommon species observed at P6 survey sites.

Family	Scientific Name	Common Name	Rank	Plot
Pteridaceae	*Cryptogramma acrostichoides*	Parsley Fern	S3S4	P6b-27
Droseraceae	*Drosera anglica*	Oblong-leaved Sundew	S3S4	P6b-35
Orchidaceae	*Platanthera orbiculata*	Round-leaved Bog Orchid	S3S4	P6a-10, P6a-16, P6b-30
Lycopodiaceae	*Diphasiastrum complanatum*	Trailing Club-moss	S3S4	P6a-05, P6b-31
Caprifoliaceae	*Lonicera involucrata*	Black Twinberry	S3S4	P6a-16
Ericaceae	*Arctous alpina*	Alpine Bearberry	S3S4	P6a-19, P6b-33
Primulaceae	*Primula egaliksesis*	Greenland Primrose	S3	P6a-09, P6a-20
Salicaceae	*Salix pellita*	Satin Willow	S3S4	P6a-11

Oblong-leaved sundew (*Drosera anglica*) is a boreal species that occurs on calcareous substrates in fens, and drainage tracks in peat bogs. It is uncommon to widespread in Manitoba (S3S4), recorded here in a single graminoid rich fen site, as a frequently occurring species.

Round-leaved bog orchid (*Platanthera orbiculata*) is found in moist coniferous and deciduous forests, and fen forests. It is uncommon to widespread in Manitoba (S3S4), observed here in three sites with scattered or incidental occurrence, under trembling aspen, trembling aspen mixed wood, and jack pine – black spruce canopies.

Parsley fern (*Cryptogramma acrostichoides*) can be found on non-calcareous cliff crevices, and rock outcrops, often in relatively dry habitats. It ranks in Manitoba as intermediate (S3S4) between uncommon and apparently widespread. It was observed in a single jack pine- black spruce site on a granite outcrop, with scattered occurrence.

Trailing club-moss (*Diphasiastrum complanatum*) occurs in dry open coniferous or mixed forests. It is uncommon to widespread in Manitoba (S3S4), observed here in two sites with incidental occurrence, under black spruce mixedwood and black spruce canopies.

Black twinberry (*Lonicera involucrata*) has been found to occur in spruce woods and on limestone ledges. It is uncommon to widespread in Manitoba (S3S4), observed in a single site with incidental occurrence, under jack pine – black spruce canopy.

Alpine bearberry (*Arctous alpina*) is found in open boggy coniferous woods, lichen heaths, gravelly beach ridges, and tundra. It is uncommon to widespread in Manitoba (S3S4), recorded here in two sites with scattered or incidental occurrence, in black spruce communities.

Greenland primrose (*Primula egaliksesis*) can be found along stream banks and in bogs. It is uncommon in Manitoba (S3), and was observed incidentally at two sites, located in the vicinity of black spruce forest and treed bog vegetation.

Satin willow (*Salix pellita*) occurs on sandy or gravelly floodplains, stream and lake margins, marshes, fens, and metamorphic or calcareous substrates. It is uncommon to widespread in Manitoba (S3S4), recorded here in a single treed poor fen site, as a frequently occurring species.

4.2.2 Species of Conservation Concern

No species listed by the federal Species at Risk Act, the Manitoba Endangered Species and Ecosystems Act or listed by the Committee on the Status of Endangered Wildlife in Canada were observed during fieldwork. Vascular species at risk were not expected to occur as the assessment area is beyond the range for these plants. Flooded jellyskin (*Leptogium rivulare*) lichen (a non-vascular species) is listed as threatened by the Species at Risk Act and special concern by the Committee on the Status of Endangered Wildlife in Canada but was not observed during field studies, nor was preferred habitat encountered for this species. No plant species ranked by the Manitoba Conservation Data Centre as very rare (S1) to rare (S2) were observed during field studies.

4.2.3 Invasive and Non-native Species

A number of introduced (non-native) and invasive species are expected to occur across the greater P6 study area. These species are ranked SNA (conservation status rank is not applicable) by Manitoba Conservation Data Centre (2016). Non-native and invasive plants in boreal habitats are commonly perennial herbs and grasses, particularly from among the Asteraceae (composites), Fabaceae (legumes), and Poaceae (grasses) plant families (Langor et al. 2014). Although not naturally found in undisturbed boreal forest habitats, many of these species are introduced along roads, rivers and streams, often following human activities. During the surveys conducted for the P6 Project, no invasive and non-native species were observed in the study plots.

4.2.4 Species of Interest

Plant species traditionally used for medicine, subsistence and cultural purposes were assessed for the study. All plant species recorded during the field surveys were assessed with the culturally important species provided by MESRA for the Project to determine their location in the local assessment area. A traditional knowledge study was carried out in collaboration with local community members using workshops and one-on-one interviews to determine culturally important species. Aboriginal communities have long histories of living on the land as well as knowledge, experience and an appreciation for the plants growing in their resource areas.

Traditional knowledge studies conducted by MESRA in 2016 identified several species of trees, shrubs and herbs as being important to the communities of Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation. As a result of workshops and personal interviews, more than 17 plants, plus wood and firewood resources were identified by participants from the communities as important for sustenance and cultural practices. Common food plants include blueberry, raspberry, strawberry, cloudberry, cranberry, cherry and Saskatoon. Over six medicinal plants were identified, including black spruce, sweet flag and Labrador tea. Firewood and willow stick collection, and wood cutting was also valued.

Plant species identified as having sustenance and cultural value to the local communities, were assessed at sites surveyed along the proposed P6 All-Season Road and quarry areas (Table 4.2.4.). From the vegetation surveys, 12 cultural plant species were observed in the local assessment area at 38 sampled sites. Of these, eight species were food plants, three were medicinal plants and three were other uses. Food plants observed included Saskatoon (*Amelanchier alnifolia*), strawberries (*Fragaria virginiana*), cherry (*Prunus* spp.), swamp gooseberries (*Ribes* spp.), cloudberries and head berries (*Rubus chamaemorus*), mossberries (*Vaccinium oxycoccus*), blueberries (*Vaccinium* spp.) and cranberries (*Vaccinium vitis-idaea*). Medicinal plants observed included juniper (*Juniperus* spp.), black spruce (*Picea mariana*) and Labrador tea (*Rhododendron* spp.), while plants of other uses were willow sticks (*Salix* spp.), strawberries and Labrador tea.

The most frequent species observed in sampled plots was black spruce, which was recorded in 31 plots. Blueberries were recorded in 28 plots followed by willows in 26 plots and Labrador tea recorded in 25 plots. Other species with high occurrences included cranberries which were recorded in 21 plots and mossberries which were recorded in 16 plots.

Several other plant species were unspecified such as berry picking areas and plant gathering locations. Firewood harvest and wood cutting areas were also identified as important areas and occur at various sites.

Table 4.2.4. Plants of sustenance and cultural value identified by members of the Manto Sipi Cree Nation (MS), Bunibonibee Cree Nation (BB) and God's Lake First Nation (GL), within the regional assessment area, observed in sample plots.

Community	Local Name	Scientific Name	Plot (P6-)
		Food Plants	
GL	*Weekes*	*Acorus americanus*	not observed
MS	Saskatoon	*Amelanchier alnifolia*	10, 16, 30, 31, 33
MS	Strawberries	*Fragaria virginiana*	1, 8, 10, 14, 15, 16, 21, 27, 30, 31
MS	Cherry	*Prunus* spp.	15, 31
GL	Swamp Gooseberries	*Ribes* spp.	1, 5, 21
BB	Cloudberries	*Rubus chamaemorus*	3, 7, 20, 28, 29, 34
MS	Head berries (*Mistegonemina*)	*Rubus chamaemorus*	3, 7, 20, 28, 29, 34
MS, BB, GL	Raspberries	*Rubus idaeus*	not observed
GL	Mossberries	*Vaccinium oxycoccus*	2, 3, 4, 6, 7, 11, 18, 19, 20, 22, 23, 24, 28, 32, 36, 38
MS, GL	Blueberries	*Vaccinium* spp.	1, 2, 3, 4, 5, 6, 7, 9, 11, 12, 16, 18, 19, 20, 22, 23, 24, 25, 27, 28, 29, 30, 31, 32, 33, 34, 36, 38
BB, GL	Cranberries	*Vaccinium vitis-idaea*	3, 4, 5, 6, 7, 9, 12, 13, 15, 16, 18, 19, 20, 22, 26, 29, 30, 32, 33, 34, 36
GL	Medicines	various, unspecified	unspecified
BB	Historic berry picking area	various, unspecified	unspecified
		Medicinal Plants	
MS, BB, GL	*Wihkes*	*Acorus americanus*	not observed
GL	Water Calla	*Calla palustris*	not observed
GL	Juniper	*Juniperus* spp.	15, 27, 33, 36
GL	Black Spruce Bark	*Picea mariana*	1, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24, 26, 27, 28, 29, 30, 31, 32, 33, 34, 36, 38
MS	Spruce	*Picea* spp.	1, 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 24, 26, 27, 28, 29, 30, 31, 32, 33, 34, 36, 38
MS, GL	Labrador Tea	*Rhododendron* spp.	1, 3, 4, 5, 6, 7, 9, 10, 13, 14, 18, 19, 20, 22, 24, 26, 28, 29, 30, 31, 32, 33, 34, 36, 38
MS, GL	Ginger Root	unknown	unknown
BB	Medicinal Plant Gathering Location	various, unspecified	unspecified
BB	Plants for Tea	various, unspecified	unspecified
GL	Berries	various, unspecified	unspecified
GL	Muskeg Leaves	various, unspecified	unspecified

Table 4.2.4. Plants of sustenance and cultural value identified by members of the Manto Sipi Cree Nation (MS), Bunibonibee Cree Nation (BB) and God's Lake First Nation (GL), within the regional assessment area, observed in sample plots.			
GL	Medicinal Plants	various, unspecified	unspecified
		Other Uses	
GL	Strawberries	*Fragaria virginiana*	1, 8, 10, 14, 15, 16, 21, 27, 30, 31
GL	Labrador Tea	*Rhododendron* spp.	1, 3, 4, 5, 6, 7, 9, 10, 13, 14, 18, 19, 20, 22, 24, 26, 28, 29, 30, 31, 32, 33, 34, 36, 38
GL	Raspberries	*Rubus idaeus*	not observed
GL	Willow Sticks	*Salix* spp.	2, 3, 4, 6, 7, 9, 11, 13, 14, 17, 18, 19, 21, 22, 23, 24, 25, 26, 30, 31, 33, 34, 35, 36, 37, 38
GL	Ginger Root	unknown	unknown
BB	Firewood Harvest	various	various
MS	Wood cutting	various	various

4.3 Environmentally Sensitive Sites

Three environmentally sensitive sites were identified from field assessments along the proposed P6 All-Season Road. Each of these sites supported older growth black spruce forest greater than 120 years age. Black spruce was aged at 121 years in plot P6a-03, 156 years in plot P6b-33 and 165 years in plot P6b-38 (Table 4.3.). Old growth forests are stands that have achieved great age without significant disturbance. Trees in the boreal forest generally live 100 years and according to the Canadian Council of Forest Ministries, with old growth onset for black spruce at 110 to 160 years. Two other plots supported black spruce trees near this onset age, with trees 101 years in Plot P6a-22 and 106 years for trees in plot P6a-18. Old growth forests serve as natural reservoirs of genetic diversity and remain important to a balanced ecosystem (Canadian Council of Forest Ministries).

No plant species of conservation concern listed by SARA, ESEA, COSEWIC or plants ranked very rare to rare by the MBCDC were observed from the field surveys. Many traditional plant species of interest were recorded from the surveys, but these species were more commonly distributed over the landscape.

Table 4.3. Environmentally sensitive sites observed during field studies.	
Environmentally Sensitive Site	**Location (Plot)**
Older growth black spruce forest age 121	P6a-03
Older growth black spruce forest age 156	P6b-33
Older growth black spruce forest age 165	P6b-38

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APPENDIX I. Definitions of Selected Technical Terms[1].

Bog – Ombrotrophic peatlands generally unaffected by nutrient-rich groundwater that are acidic and often dominated by heath shrubs and Sphagnum mosses and that may include open-growing, stunted trees.

Boreal – Pertaining to the north; a climatic and ecological zone that occurs south of the subarctic, but north of the temperate hardwood forests of eastern North America, the parkland of the Great Plains region, and the montane forests of the Canadian cordillera.

Canopy – The more or less continuous cover of branches and foliage formed by the crowns of trees.

Canopy Closure – The degree of canopy cover relative to openings.

Classification – The systematic grouping and organization of objects, usually in a hierarchical manner.

Community-Type – A group of vegetation stands that share common characteristics, an abstract plant community.

Coniferous – A cone-bearing plant belonging to the taxonomic group Gymnospermae.

Cover – The area of ground covered with plants of one or more species, usually expressed as a percentage.

Deciduous – Refers to perennial plants from which the leaves abscise and fall off at the end of the growing season.

Ecoregion – An area characterized by a distinctive regional climate as expressed by vegetation.

Family – Taxonomic grouping of plants that are related at a particular hierarchical level.

Fen – Wetland with a peat substrate, nutrient-rich waters, and primarily vegetated by shrubs and graminoids.

Flora – A list of the plant species present in an area.

Forest – A relatively large assemblage of tree-dominated stands.

Graminoid – A plant that is grass-like; the term refers to grasses and plant that look like grasses, i.e., only narrow-leaved herbs; in the strictest sense, it includes plants belonging only to the family Graminaceae.

Habitat – The place in which an animal or plant lives; the sum of environmental circumstances in the place inhabited by an organism, population or community.

Invasive – Invasive species are plants that are growing outside of their country or region of origin and are out-competing or even replacing native plants (Invasive Species Council of Manitoba).

Mixedwood – Forest stands composed of conifers and angiosperms each representing between 25 and 75% of the cover.

Old Growth – A stand of mature or over mature trees relatively uninfluenced by human activity.

Riparian – Refers to terrain, vegetation or simply a position adjacent to or associated with a stream, flood plain, or standing body of water.

Shrub – A perennial plant usually with a woody stem, shorter than a tree, often with a multi-stemmed base.

Species – A group of organisms having a common ancestry that are able to reproduce only among themselves; a general definition that does not account for hybridization.

Stand – A collection of plants having a relatively uniform composition and structure, and age in the case of forests.

Terrestrial – Pertaining to land as opposed to water.

Understory – Vegetation growing beneath taller plants such as trees or tall shrubs.

Vascular – Having tissues that transport water, sap, nutrients; refers to plants that are not mosses, lichens and algae.

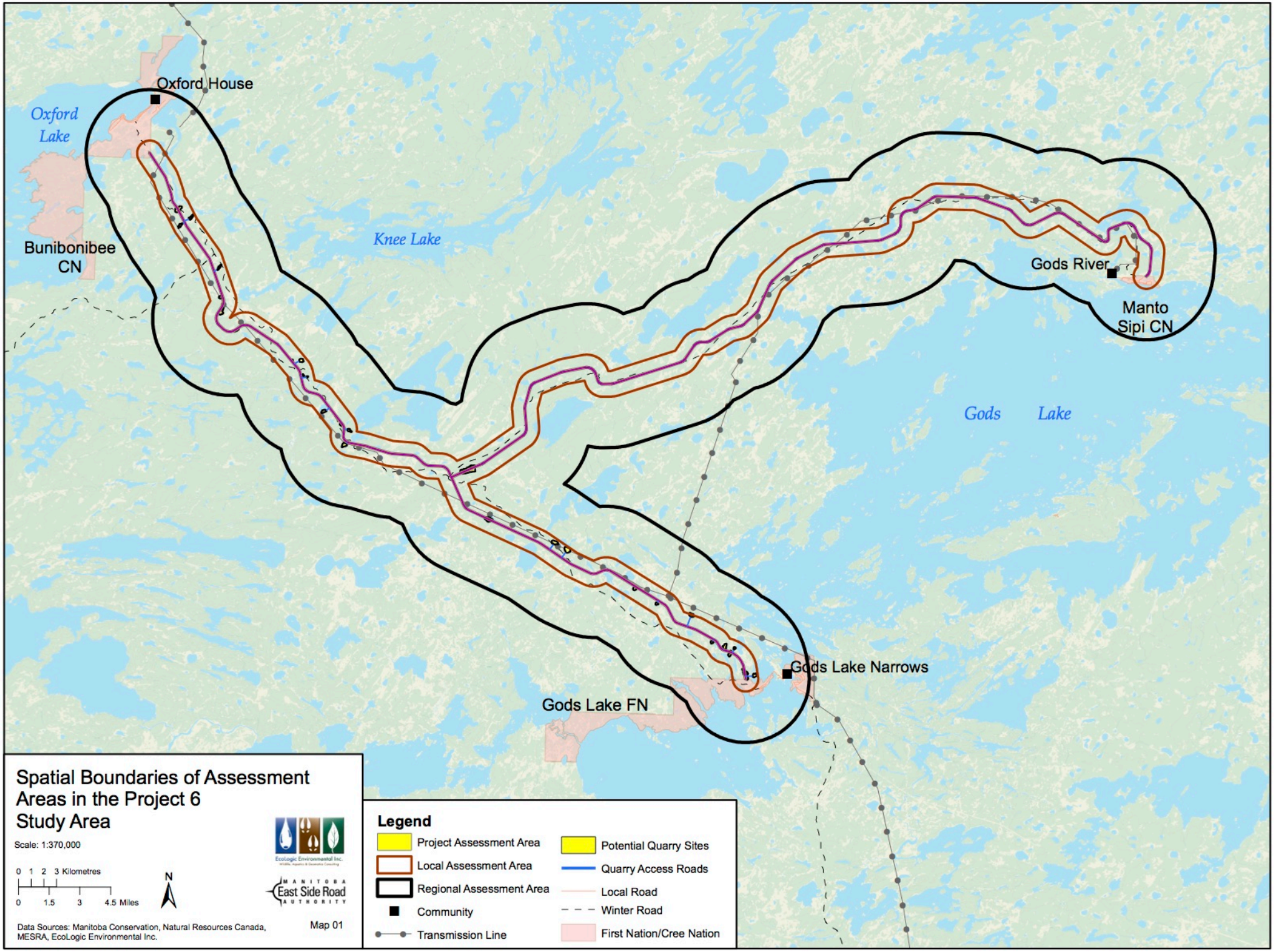
Vegetation – The general cover of plants growing on a landscape.

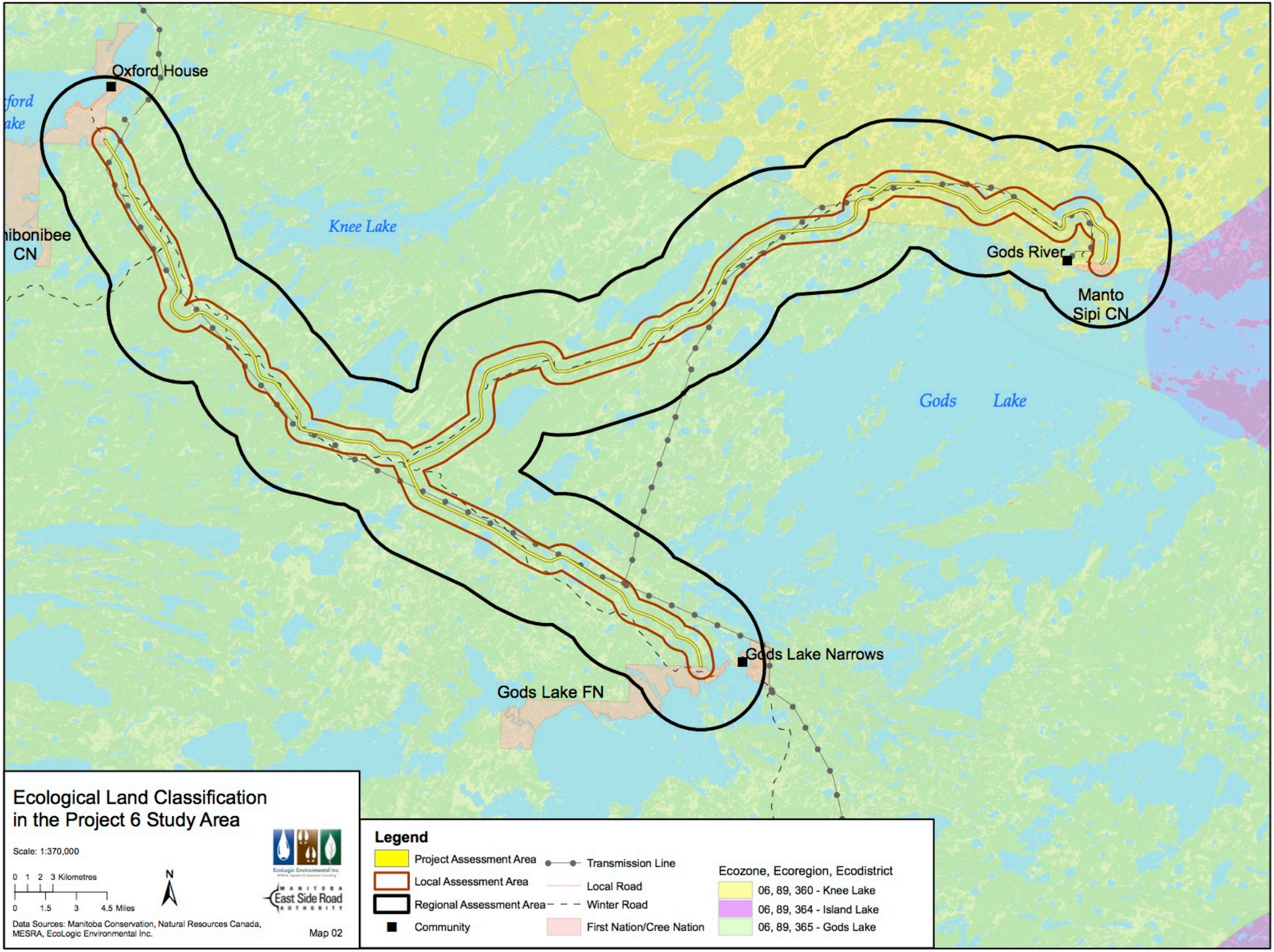
Vegetation Type – In phytosociology, the lowest possible level to be described.

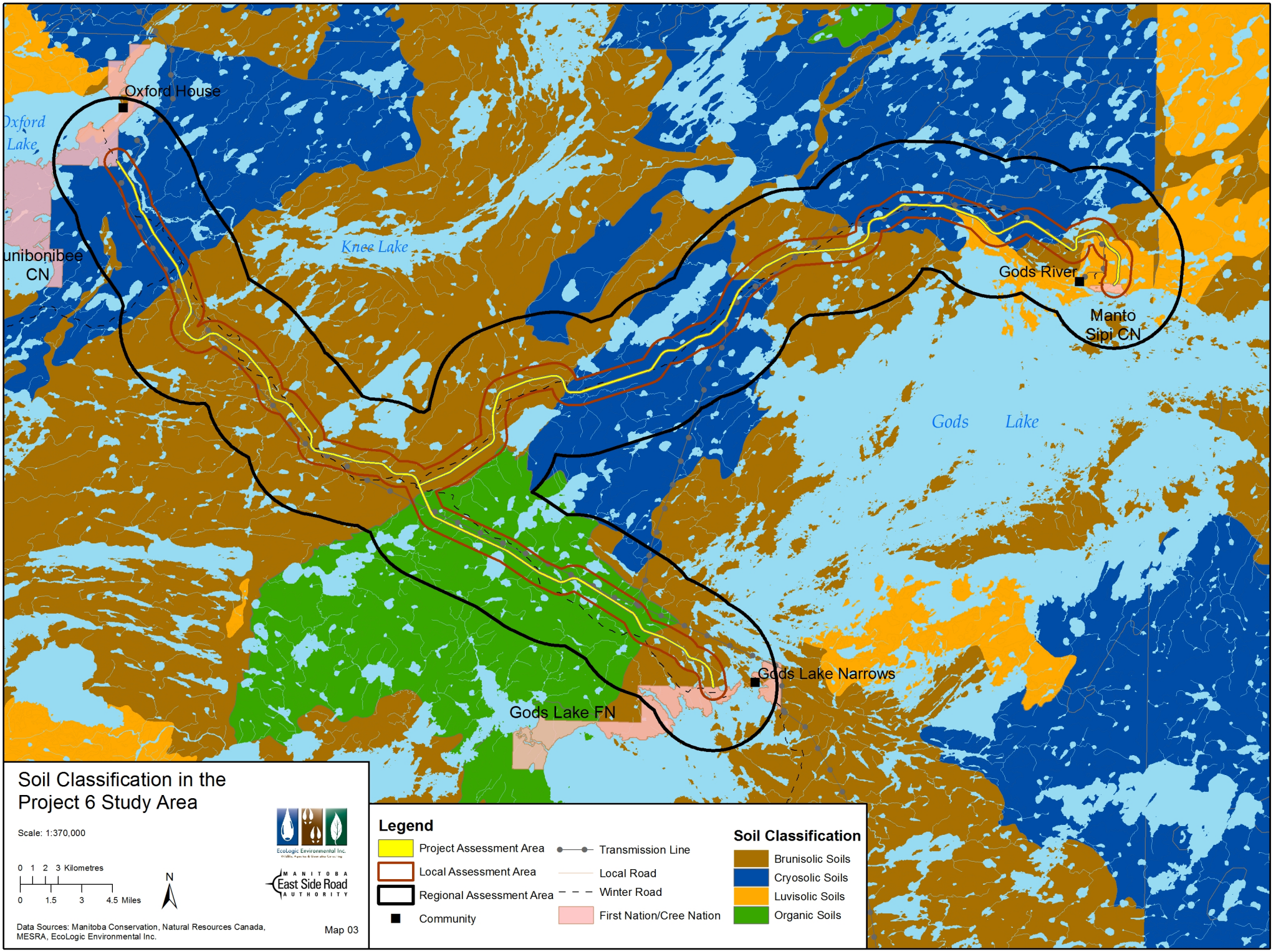
Wetland – Land that is saturated with water long enough to promote hydric soils or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation, and various kinds of biological activity that are adapted to wet environments.

[1]All references Cauboue et al. 1996, unless otherwise noted.

APPENDIX II. Report Maps.


Oxford House
Oxford Lake
Bunibonibee CN
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
Spatial Boundaries of Assessment Areas in the Project 6 Study Area
Scale: 1:370,000
0 1 2 3 Kilometres
0 1.5 3 4.5 Miles
N
EcoLogic Environmental Inc.
Manitoba East Side Road Authority
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 01
Legend
Project Assessment Area
Local Assessment Area
Regional Assessment Area
Community
Transmission Line
Potential Quarry Sites
Quarry Access Roads
Local Road
Winter Road
First Nation/Cree Nation


Oxford House
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
Ecological Land Classification in the Project 6 Study Area
Scale: 1:370,000
0 1 2 3 Kilometres
0 1.5 3 4.5 Miles
N
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 02
Legend
Project Assessment Area
Local Assessment Area
Regional Assessment Area
Community
Transmission Line
Local Road
Winter Road
First Nation/Cree Nation
Ecozone, Ecoregion, Ecodistrict
06, 89, 360 - Knee Lake
06, 89, 364 - Island Lake
06, 89, 365 - Gods Lake



Soil Classification in the Project 6 Study Area

Scale: 1:370,000

0 1 2 3 Kilometres

0 1.5 3 4.5 Miles

N

EcoLogic Environmental Inc.

Manitoba East Side Road Authority

Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.

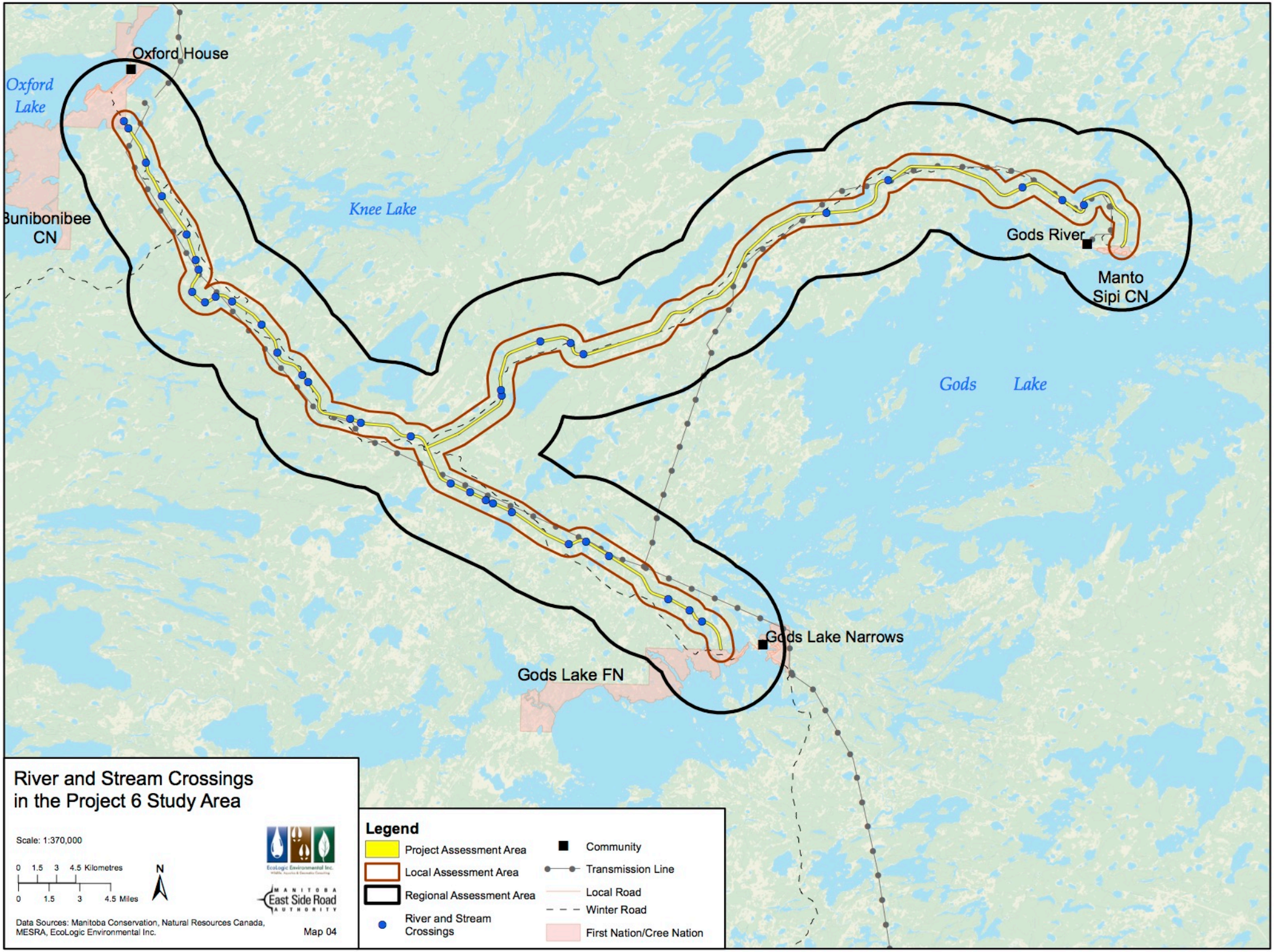
Map 03

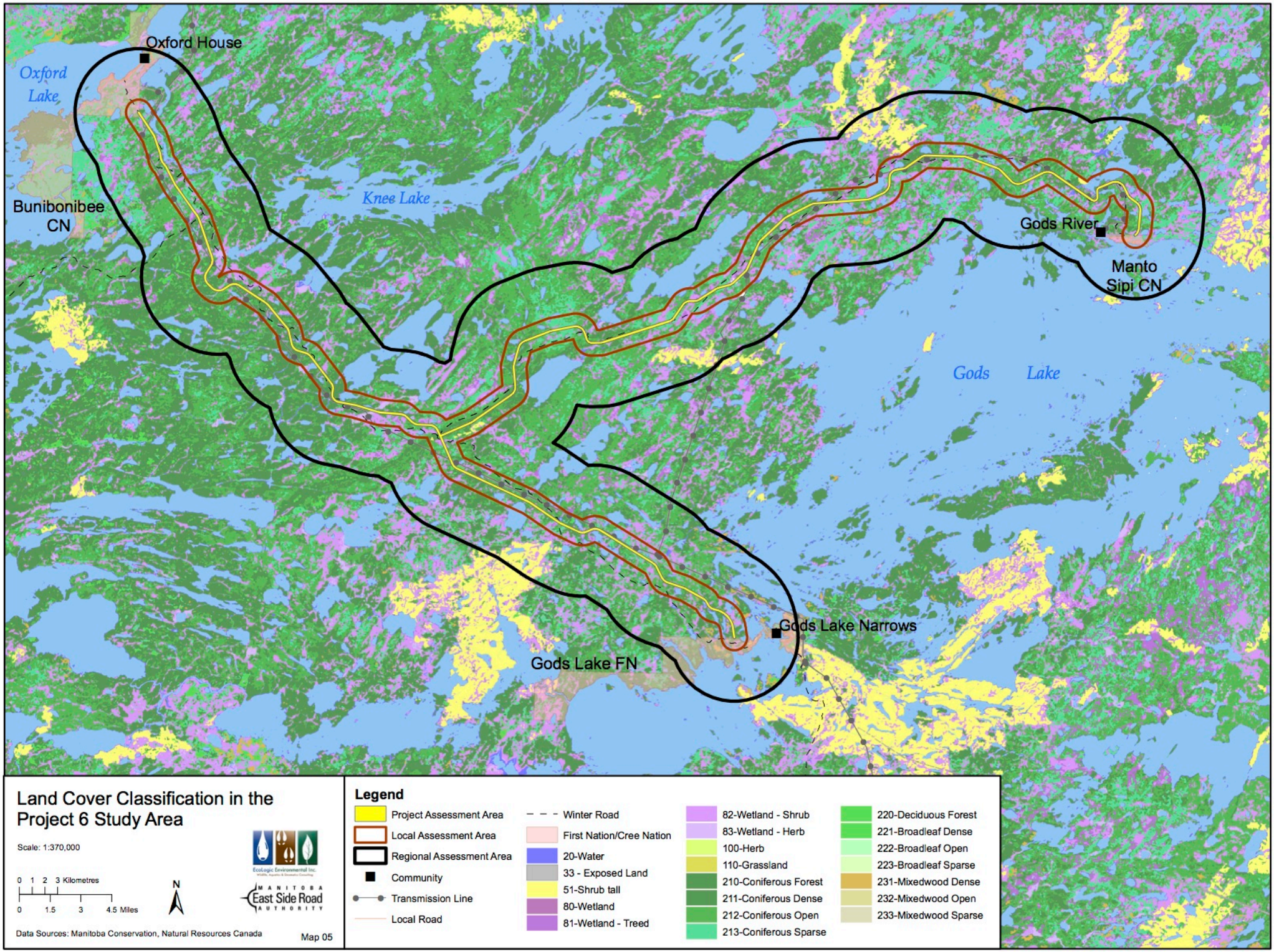
Legend

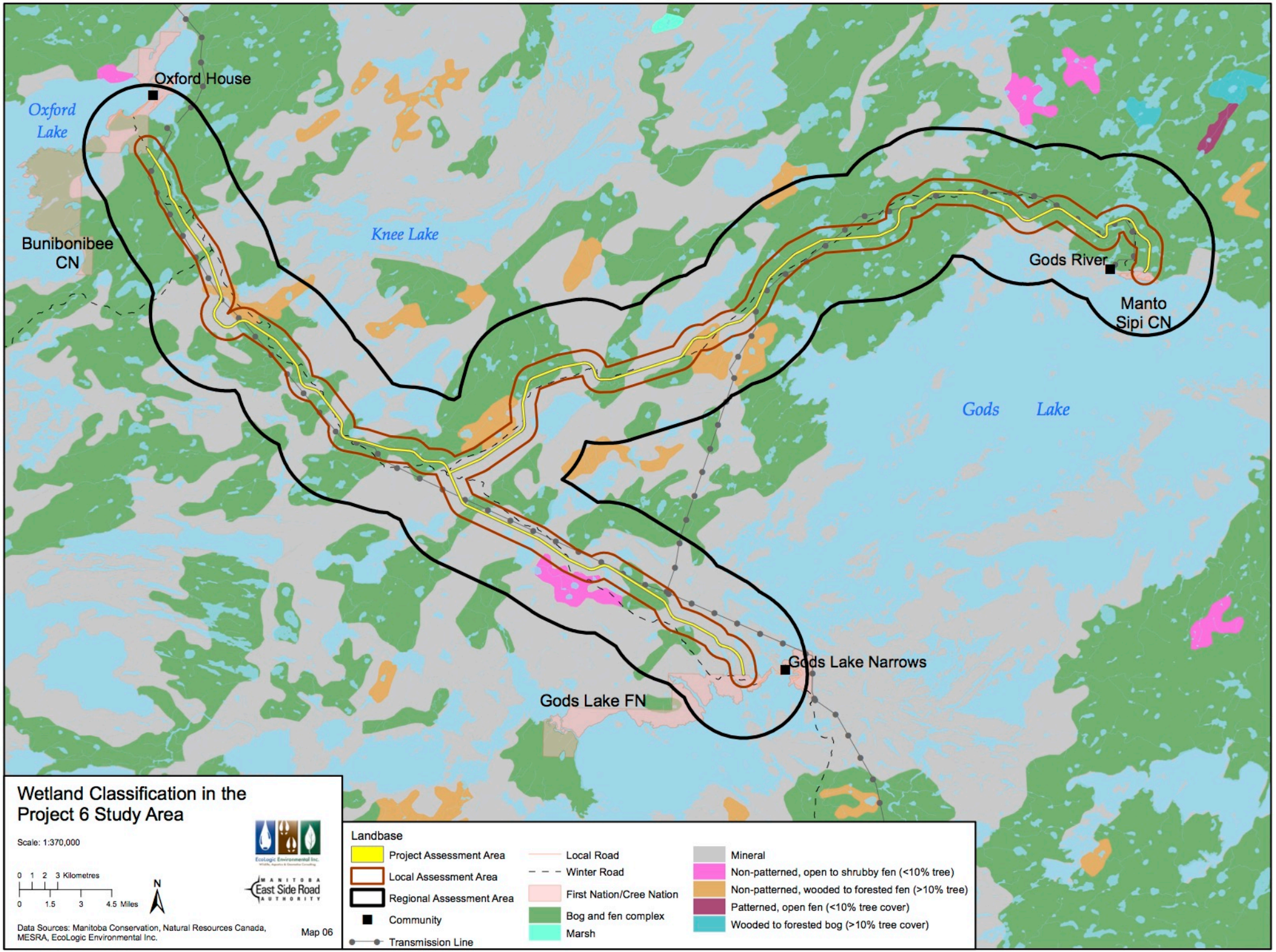
- Project Assessment Area
- Local Assessment Area
- Regional Assessment Area
- Community
- Transmission Line
- Local Road
- Winter Road
- First Nation/Cree Nation

Soil Classification

- Brunisolic Soils
- Cryosolic Soils
- Luvisolic Soils
- Organic Soils


Oxford House
Oxford Lake
Bunibonibee CN
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
River and Stream Crossings in the Project 6 Study Area
Scale: 1:370,000
0 1.5 3 4.5 Kilometres
0 1.5 3 4.5 Miles
N
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 04
Legend
Project Assessment Area
Local Assessment Area
Regional Assessment Area
River and Stream Crossings
Community
Transmission Line
Local Road
Winter Road
First Nation/Cree Nation


Oxford House
Oxford Lake
Bunibonibee CN
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
Land Cover Classification in the Project 6 Study Area
Scale: 1:370,000
0 1 2 3 Kilometres
0 1.5 3 4.5 Miles
N
Data Sources: Manitoba Conservation, Natural Resources Canada
Map 05
Legend
Project Assessment Area
Local Assessment Area
Regional Assessment Area
Community
Transmission Line
Local Road
Winter Road
First Nation/Cree Nation
20-Water
33 - Exposed Land
51-Shrub tall
80-Wetland
81-Wetland - Treed
82-Wetland - Shrub
83-Wetland - Herb
100-Herb
110-Grassland
210-Coniferous Forest
211-Coniferous Dense
212-Coniferous Open
213-Coniferous Sparse
220-Deciduous Forest
221-Broadleaf Dense
222-Broadleaf Open
223-Broadleaf Sparse
231-Mixedwood Dense
232-Mixedwood Open
233-Mixedwood Sparse



Wetland Classification in the Project 6 Study Area

Scale: 1:370,000

0 1 2 3 Kilometres

0 1.5 3 4.5 Miles

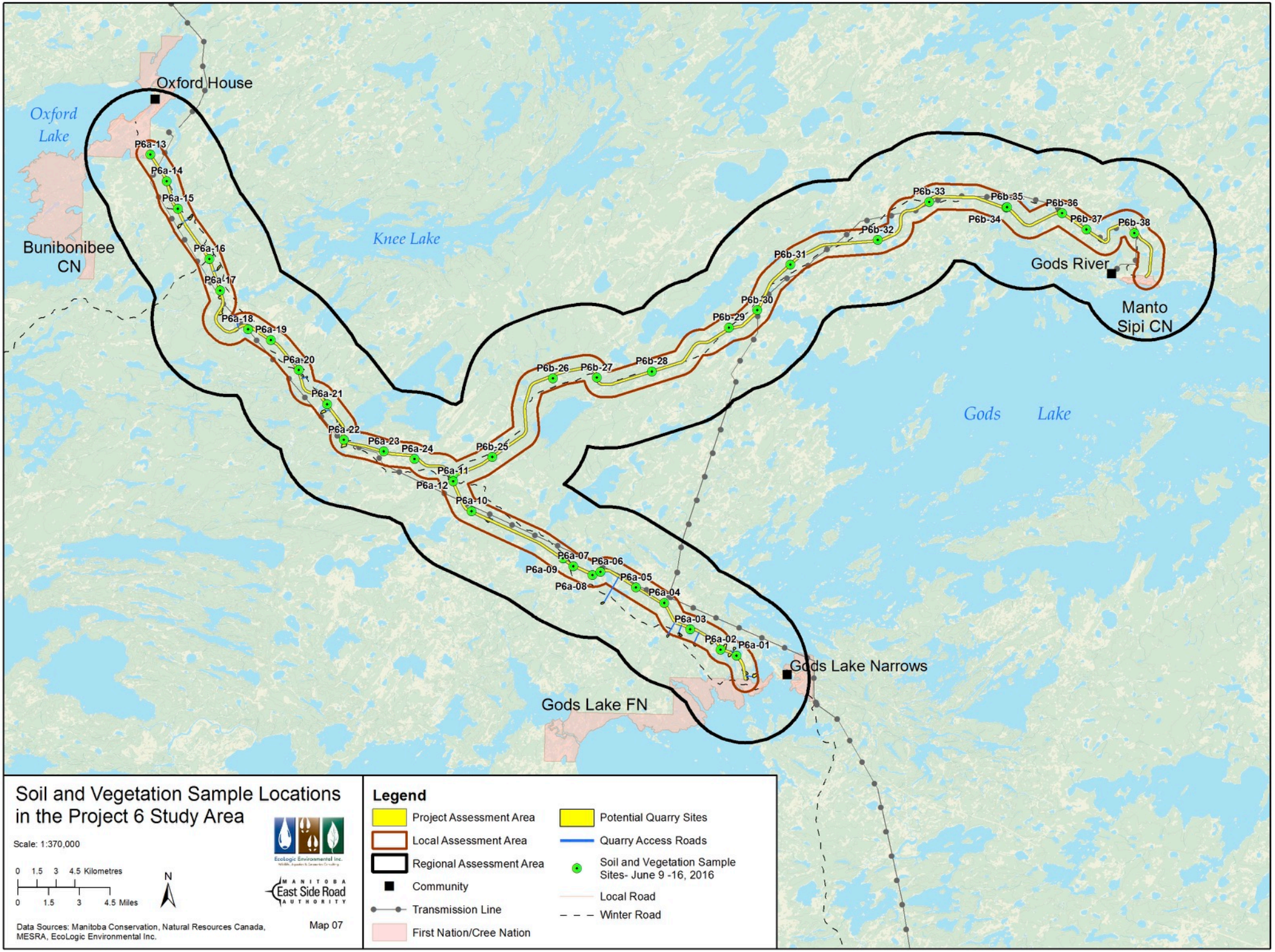
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Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.

Map 06

Landbase

- Project Assessment Area
- Local Assessment Area
- Regional Assessment Area
- Community
- Transmission Line
- Local Road
- Winter Road
- First Nation/Cree Nation
- Bog and fen complex
- Marsh
- Mineral
- Non-patterned, open to shrubby fen (<10% tree)
- Non-patterned, wooded to forested fen (>10% tree)
- Patterned, open fen (<10% tree cover)
- Wooded to forested bog (>10% tree cover)



Soil and Vegetation Sample Locations in the Project 6 Study Area

Scale: 1:370,000

0 1.5 3 4.5 Kilometres

0 1.5 3 4.5 Miles

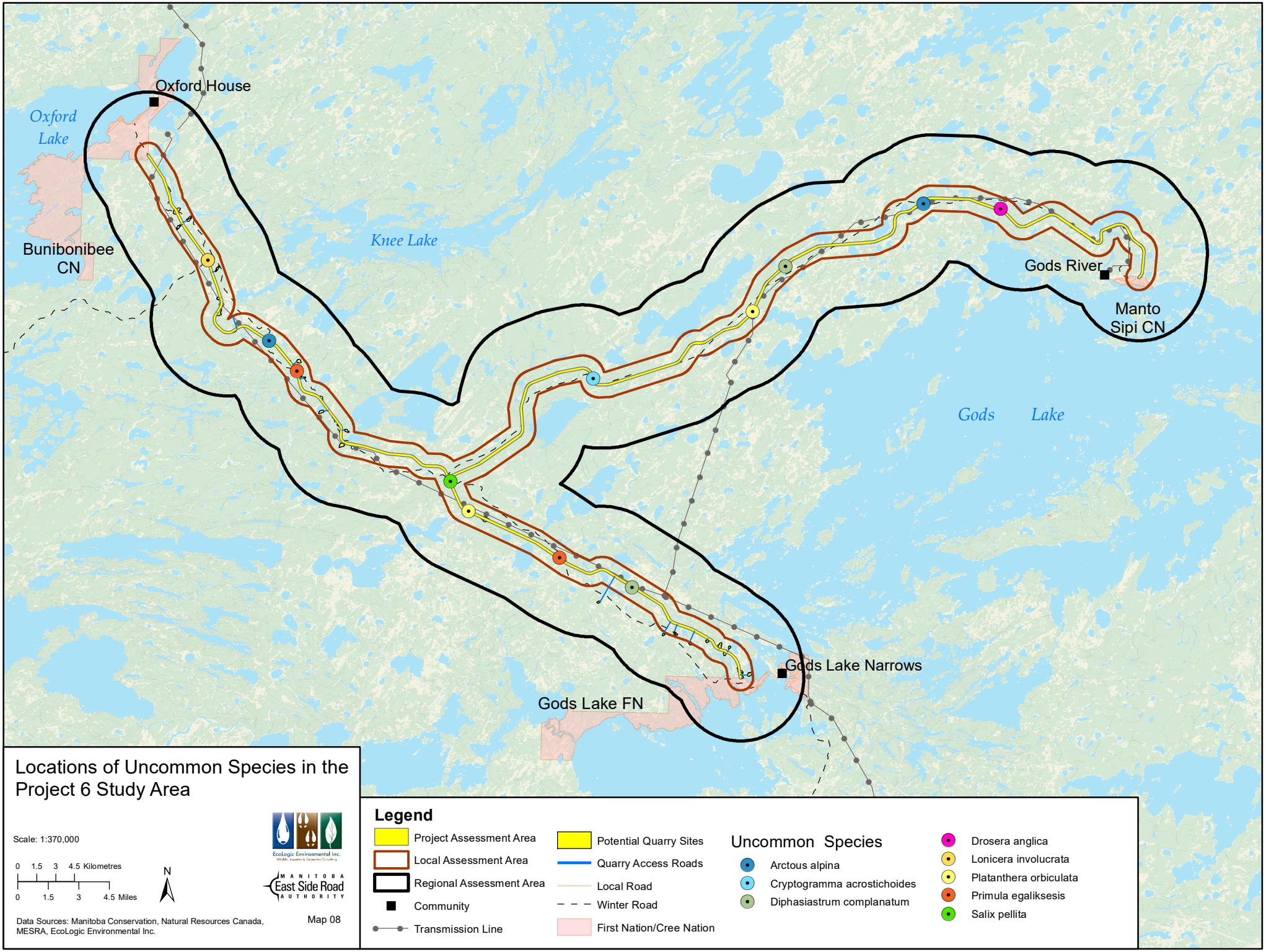
N

Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.

Map 07

Legend

- Project Assessment Area
- Local Assessment Area
- Regional Assessment Area
- Community
- Transmission Line
- First Nation/Cree Nation
- Potential Quarry Sites
- Quarry Access Roads
- Soil and Vegetation Sample Sites- June 9 -16, 2016
- Local Road
- Winter Road



Locations of Uncommon Species in the Project 6 Study Area

Scale: 1:370,000

0 1.5 3 4.5 Kilometres

0 1.5 3 4.5 Miles

N

EcoLogic Environmental Inc.

Manitoba East Side Road Authority

Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.

Map 08

Legend

- Project Assessment Area
- Local Assessment Area
- Regional Assessment Area
- Community
- Transmission Line
- Potential Quarry Sites
- Quarry Access Roads
- Local Road
- Winter Road
- First Nation/Cree Nation

Uncommon Species

- Arctous alpina
- Cryptogramma acrostichoides
- Diphasiastrum complanatum
- Drosera anglica
- Lonicera involucrata
- Platanthera orbiculata
- Primula egaliksesis
- Salix pellita

APPENDIX III. Flora of Project 6 Field Studies.

Scientific Name	Common Name	Rank
VASCULAR SPECIES		
Ferns and Allies		
DRYOPTERIDACEAE	**WOOD FERN FAMILY**	
Woodsia ilvensis	Rusty Woodsia	S5
EQUISETACEAE	**HORSETAIL FAMILY**	
Equisetum arvense	Common Horsetail	S5
Equisetum fluviatile	Swamp Horsetail	S5
Equisetum scirpoides	Dwarf Scouring-rush	S4S5
Equisetum sylvaticum	Wood Horsetail	S5
LYCOPODIACEAE	**CLUB-MOSS FAMILY**	
Diphasiastrum complanatum	Trailing Club-moss	S3S4
Lycopodium annotinum	Stiff Club-moss	S5
PTERIDACEAE	**MAIDEN-HAIR FERN FAMILY**	
Cryptogramma acrostichoides	American Parsley Fern	S3S4
Gymnosperms		
CUPRESSACEAE	**CYPRESS FAMILY**	
Juniperus communis	Common Juniper	S5
Juniperus horizontalis	Creeping Juniper	S5
PINACEAE	**PINE FAMILY**	
Larix laricina	Tamarack	S5
Picea mariana	Black Spruce	S5
Pinus banksiana	Jack Pine	S5
Angiosperms - Monocotyledons		
CYPERACEAE	**SEDGE FAMILY**	
Carex aquatilis	Water Sedge	S5
Carex capillaris	Hair-like Sedge	S5
Carex chordorrhiza	Prostrate Sedge	S4S5
Carex concinna	Beautiful Sedge	S4S5
Carex disperma	Two-seeded Sedge	S5
Carex foenea	Hay Sedge	S5
Carex gynocrates	Bog Sedge	S5
Carex lacustris	Lakeshore Sedge	S5
Carex lasiocarpa	Hairy-fruited Sedge	S5
Carex leptalea	Bristle-stalked Sedge	S5
Carex magellanica	Bog Sedge	S5
Carex scirpoidea	Rush-like Sedge	S4S5
Carex trisperma	Three-seeded Sedge	S4S5

Carex utriculata	Beaked Sedge	S5
Carex vaginata	Sheathed Sedge	S5
Carex spp.	Sedge	
Eleocharis palustris	Common Spike-rush	S5
Eriophorum brachyantherum	Closed-sheathed Cotton-grass	S4S5
Eriophorum vaginatum	Sheathed Cotton-grass	S5
Trichophorum caespitosum	Tufted Clubrush	S4
JUNCACEAE	**RUSH FAMILY**	
Juncus bufonius	Toad Rush	S5
JUNCAGINACEAE	**ARROW-GRASS FAMILY**	
Triglochin maritima	Seaside Arrow-grass	S5
LILIACEAE	**LILY FAMILY**	
Maianthemum canadense	Canada May Flower	S5
Maianthemum trifolium	Three-leaved Solomon's Seal	S5
ORCHIDACEAE	**ORCHID FAMILY**	
Calypso bulbosa	Calypso	S4
Corallorhiza trifida	Early Coral-root	S5
Goodyera repens	Lesser Rattlesnake-Plantain	S4S5
Platanthera obtusata	Small Northern Bog Orchid	S5
Platanthera orbiculata	Round-leaved Bog Orchid	S3S4
POACEAE	**GRASS FAMILY**	
Agrostis scabra	Ticklegrass	S5
Calamagrostis canadensis	Canada Reed Grass	S5
Calamagrostis sp.		
Leymus innovatus	Hairy Wild Rye	S5
Oryzopsis asperifolia	Rice Grass	S5
Piptatherum pungens	Northern Rice Grass	S4S5
Poa sp.		
TYPHACEAE	**CAT-TAIL FAMILY**	
Typha latifolia	Common Cat-tail	S4S5
Angiosperms - Dicotyledons		
ARALIACEAE	**GINSENG FAMILY**	
Aralia nudicaulis	Wild Sarsaparilla	S5
ASTERACEAE	**ASTER FAMILY**	
Achillea millefolium	Yarrow	S5
Petasites frigidus var. *palmatus*	Palmate-leaved Coltsfoot	S5
Solidago hispida	Hairy Goldenrod	S5
Symphyotrichum ciliolatum	Lindley's Aster	S5
BETULACEAE	**BIRCH FAMILY**	
Alnus incana ssp. *rugosa*	Speckled Alder	S5

Alnus viridis	Green Alder	S5
Betula papyrifera	Paper Birch	S5
Betula pumila	Dwarf Birch	S5
BORAGINACEAE	**BORAGE FAMILY**	
Mertensia paniculata	Tall Lungwort	S5
CAPRIFOLIACEAE	**HONEYSUCKLE FAMILY**	
Linnaea borealis	Twinflower	S5
Lonicera dioica	Limber or Twining Honeysuckle	S5
Lonicera involucrata	Black Twinberry	S3S4
Lonicera villosa	Blue Fly Honeysuckle	S5
Symphoricarpos albus	Snowberry	S4S5
Viburnum edule	Low-bush Cranberry	S5
CORNACEAE	**DOGWOOD FAMILY**	
Cornus canadensis	Bunchberry	S5
DROSERACEAE	**SUNDEW FAMILY**	
Drosera anglica	Oblong-leaved Sundew	S3S4
Drosera rotundifolia	Round-leaved Sundew	S4S5
ELAEAGNACEAE	**OLIVE FAMILY**	
Shepherdia canadensis	Canada Buffaloberry	S5
EMPETRACEAE	**CROWFOOT FAMILY**	
Empetrum nigrum	Black Crowberry	S5
ERICACEAE	**HEATH FAMILY**	
Andromeda polifolia	Bog-rosemary	S5
Arctostaphylos uva-ursi	Bearberry	S5
Arctous alpina	Alpine Bearberry	S3S4
Chamaedaphne calyculata	Leatherleaf	S5
Gaultheria hispidula	Creeping Snowberry	S4S5
Kalmia polifolia	Pale Laurel	S5
Rhododendron groenlandicum	Labrador Tea	S5
Vaccinium myrtilloides	Velvet-leaf Blueberry	S5
Vaccinium oxycoccos	Small Cranberry	S5
Vaccinium uliginosum	Bog Whortleberry	S5
Vaccinium vitis-idaea	Bog Cranberry	S5
FABACEAE	**PEA FAMILY**	
Lathyrus ochroleucus	Pale Vetchling	S5
FUMARIACEAE	**FUMITORY FAMILY**	
Corydalis sempervirens	Pink and Yellow Corydalis	S5
GROSSULARIACEAE	**CURRANT FAMILY**	
Ribes oxyacanthoides	Canada Wild Gooseberry	S5

Ribes triste	Wild Red Currant	S5
LENTIBULARIACEAE	**BLADDERWORT FAMILY**	
Utricularia intermedia	Flat-leaved Bladderwort	S4S5
Utricularia sp.		
MENYANTHACEAE	**BUCKBEAN FAMILY**	
Menyanthes trifoliata	Bog Bean	S5
MONOTROPACEAE	**INDIAN-PIPE FAMILY**	
Monotropa uniflora	Indian-pipe	S4
ONAGRACEAE	**EVENING PRIMROSE FAMILY**	
Chamerion angustifolium	Fireweed	S5
PRIMULACEAE	**PRIMROSE FAMILY**	
Primula egaliksesis	Greenland Primrose	S3
Primula mistassinica	Bird's-eye-primrose	S5
PYROLACEAE	**WINTERGREEN FAMILY**	
Orthilia secunda	One-sided Wintergreen	S5
Pyrola asarifolia	Pink Wintergreen	S5
Pyrola chlorantha	Green-flowered Wintergreen	S5
RANUNCULACEAE	**CROWFOOT FAMILY**	
Actaea rubra	Red Baneberry	S5
Aquilegia brevistyla	Small-flowered Columbine	S4
Caltha palustris	Marsh Marigold	S5
Ranunculus lapponicus	Lapland Buttercup	S4S5
RHAMNACEAE	**BUCKTHORN FAMILY**	
Rhamnus alnifolia	Alder-leaved Buckthorn	S5
ROSACEAE	**ROSE FAMILY**	
Amelanchier alnifolia	Saskatoon	S5
Comarum palustre	Marsh Cinquefoil	S5
Dasiphora fruticosa	Shrubby Cinquefoil	S5
Fragaria virginiana	Smooth Wild Strawberry	S5
Prunus pensylvanica	Pin Cherry	S5
Rosa acicularis	Prickly Rose	S5
Rubus arcticus ssp. *acaulis*	Stemless Raspberry	S5
Rubus chamaemorus	Cloud Berry	S5
Rubus pubescens	Trailing Dewberry	S5
Sibbaldiopsis tridentata	Three-toothed Cinquefoil	S5
RUBIACEAE	**MADDER FAMILY**	
Galium boreale	Northern Bedstraw	S5
Galium labradoricum	Northern Bog Bedstraw	S4S5
SALICAEAE	**WILLOW FAMILY**	

Populus balsamifera	Balsam Poplar	S5
Populus tremuloides	Trembling Aspen	S5
Salix bebbiana	Bebb's Willow	S5
Salix candida	Hoary Willow	S5
Salix maccalliana	Velvet-fruited Willow	S4
Salix myrtilifolia	Myrtle-leaved Willow	S5
Salix pedicellaris	Bog Willow	S5
Salix pellita	Satin Willow	S3S4
Salix planifolia	Flat-leaved Willow	S5
Salix pseudomonticola	False Mountain Willow	S4S5
Salix sp.	Willow	
SANTALACEAE	**SANDALWOOD FAMILY**	
Geocaulon lividum	Northern Comandra	S5
SAXIFRAGACEAE	**SAXIFRAGE FAMILY**	
Mitella nuda	Mitrewort	S5
VIOLACEAE	**VIOLET FAMILY**	
Viola adunca	Early Blue Violet	S5
Viola renifolia	Kidney-leaved Violet	S4S5
Viola spp.		
NON-VASCULAR SPECIES		
BRYOPHYTES		
Dicranum sp.	Dicranum Moss	
Hylocomium splendens	Splendid Feather Moss	S4S5
Pleurozium schreberi	Schreber's Moss	S4S5
Polytrichum sp.	Polytrichum Moss	
Ptillium crista-castrensis	Knights Plume Moss	S4S5
Sphagnum spp.	Peat Moss	
LICHENS		
Cladina mitis	Green Reindeer Lichen	S4
Cladina rangiferina	Grey Reindeer Lichen	S5
Cladina stellaris	Northern Reindeer Lichen	S5
Cladonia sp.	Cladonia	
Cladonia uncialis	Prickle Cladonia	S5
Peltigera sp.	Pelt Lichen	
Stereocaulon tomentosum	Woolly Coral Lichen	SU
Umbilicaria sp.	Rocktripe Lichen	

APPENDIX IV. Site Information for Forested and Wetland Sites.

Table A. Site information for forested sites sampled, P6a and P6b, 2016.

Plot ID	UTM E[1]	UTM N	Vegetation Community	Soil	Aspect (degrees)	Slope (%)	Surface expression	Tree Age[2] (yr)	Tree Height[2] (m)	Tree DBH[2] (cm)
P6a-01	0400544	6047723	V29	Luvisol	334	2	Near level	BS 56, JP 46, TA 56	BS 25, JP 20.5, TA 17.5	BS 16.6, JP 25, TA 14.2
P6a-03	0396918	6049768	V32	Organic	180	3	Undulating	TL 74, BS 121	TL 13.7, BS 14.5	TL 23.5, BS 17.6
P6a-04	0394871	6051859	V30	Gleysol	212	3	Undulating	BS 69	BS 13	BS 13.9
P6a-05	0392652	6053072	V18	Brunisol	30	5	Undulating	BS 72, TA 83	BS 19, TA 20	BS 25.9, TA 18
P6a-06	0389866	6054299	V32	Organic	190	2	Undulating	BS 67	BS 12.5	BS 11.7
P6a-07	0387737	6054741	V32	Organic	-	0	Level	BS 76, TL 76	BS 12, TL 13,	BS 12.6, TL 19.3
P6a-08	0389227	6054048	V18	Luvisol	-	0	Near Level	BS 64, TA 78	BS 15.5, TA 17	BS 25.2, TA 22
P6a-09	0386909	6055369	V30	Gleysol	112	3	Undulating	BS 61	BS 12.5	BS 12.3
P6a-10	0379750	6059070	V9	Luvisol	90	2	Undulating	JP 81, JP 87, TA 83	JP 21.5, JP 21, TA 24	JP 34.1, JP 37.5, TA 21.6
P6a-12	0378333	6061977	V25	Brunisol	46	2	Undulating	JP 86, BS 38	JP 18, BS 12.5	JP 19.3, BS 14
P6a-13	0354533	6087048	V29	Luvisol	0	0	Level	BS 69, WB 46	BS 13, WB 10.5	BS 15.6, WB 9.5
P6a-14[3]	0355792	6084967	V8	Luvisol	-	-	-	TA 94	TA 21.5	TA 26.3
P6a-15[3]	0356693	6082815	V8	Luvisol	258	2	Undulating	TA 92, BS 73, JP 97, BA 85	TA 22, BS 16.5, JP 22.5, BA 18.5	TA 39.4, BS 21.6, JP 24.2, BA 22.3
P6a-16	0359169	6078855	V28	Brunisol	196	4	-	JP 77, TA 80	JP 22.5, TA 22.5	JP 24.8, TA30.2

Table A. Site information for forested sites sampled, P6a and P6b, 2016.

Plot ID	UTM E[1]	UTM N	Vegetation Community	Soil	Aspect (degrees)	Slope (%)	Surface expression	Tree Age[2] (yr)	Tree Height[2] (m)	Tree DBH[2] (cm)
P6a-18	0362192	6073344	V32	Organic	0	0	Level	BS 106	BS 11.5	BS 14.3
P6a-19	0363995	6072499	V32	Organic	340	1	-	BS 92	BS 16.5	BS 19.6
P6a-21	0368384	6067460	V29	Luvisol	0	0	Level	BS 76, JP 81	BS 16.5, JP 21	BS 18.4, JP 20.8
P6a-22	0369710	6064654	V30	Gleysol	157	2	-	BS 101, TL 70	BS 25.5, TL 25	BS 21.3, TL 26.6
P6b-25	0381367	6063301	V26	Brunisol	20	5	-	JP 88	JP 19	JP 20.7
P6b-26	0386128	6069487	V32	Organic	254	1	Undulating	BS 88, TL 87	BS 16.5, TL 17.5	BS 15.5, TL 23.5
P6b-27	0389585	6069537	V26	Brunisol	320	1	-	JP 91, BS 52	JP 19, BS 14.5	JP 16.5, BS 16.2
P6b-30	0402164	6074833	V5	Brunisol	52	3	-	TA 96, BS 39	TA 23.5, BS 13	TA 21.4, BS 13.3
P6b-31	0404769	6078411	V29	Luvisol	18	2	-	BS 72, JP 71	BS 16.5, JP 18.5	BS 23.5, JP 27.7
P6b-32	0411617	6080351	V32	Organic	260	2	-	TL 93, BS 95	TL 21, BS 21.5	TL 19, BS 19
P6b-33	0415661	6083336	V27	Brunisol	176	1	-	BS 156, TL 34	BS 12.5, TL 10	BS 14.8, TL 8.4
P6b-36	0426091	6082450	V32	Organic	130	2	-	BS 71, TL 42	BS 12.5, TL 12	BS 15, TL 13.7

1: All UTMs are Zone 14 U, NAD 83.
2: Species include: balsam poplar (BA), black spruce (BS), jack pine (JP), trembling aspen (TA), white birch (WB).
3: Forest tent caterpillar presence.

Table B. Site information for wetland sites sampled, P6a and P6b, 2016.										
Plot ID	**UTM E[1]**	**UTM N**	**Vegetation Community**	**Soil**	**Aspect (degrees)**	**Slope (%)**	**Surface expression**	**Tree Age[2] (yr)**	**Tree Height[2] (m)**	**Tree DBH[2] (cm)**
P6a-02	0399270	6048185	Shrub Rich Fen	Organic	0	0	Level	-	-	-
P6a-11	0378289	6061413	Treed Poor Fen	Organic	0	0	Level	TL 32, BS 33	TL 7.5, BS 10.5	TL 7.7, BS 10.2
P6a-17	0359999	6076385	Graminoid Poor Fen	Organic	0	0	0	-	-	-
P6a-20	0366160	6070140	Treed Bog (V33)	Organic	354	2	Undulating	BS 89	BS 12	BS 12.7
P6a-23	0372830	6063748	Graminoid Poor Fen	Organic	258	1	Undulating	-	-	-
P6a-24	0375242	6063154	Treed Bog (V33)	Organic	268	2	Undulating	TL 62	TL 9.5, BS 6	TL 12.5, BS 5.7
P6b-28	0393888	0070023	Treed Bog (V33)	Organic	0	0	0	BS 48	BS 6	BS 7.6
P6b-29	0399933	6073480	Treed Bog (V33)	Organic	10	2	-	BS 59, TL 83	BS 7.0, TL 8.5	BS 6.9, TL 10.1
P6b-34	0421721	6082888	Treed Bog (V33)	Organic	220	2	-	BS 44	BS 7.5	BS 9
P6b-35	0421773	6082942	Graminoid rich fen	Organic	0	0	0	-	-	-
P6b-37	0428013	6081172	Graminoid rich fen	Organic	136	1	-	-	-	-
P6b-38	0431756	6080891	Treed Bog (V33)	Organic	198	5	-	BS 165	BS 8.5	BS 13.7

1: All UTMs are Zone 14 U, NAD 83.
2: Species include: black spruce (BS), tamarack (TL).

APPENDIX V. Report Photographs.



Photograph 1. Aspen hardwood



Photograph 2. Trembling aspen mixedwood/ tall shrub



Photograph 3. Trembling aspen mixedwood/ low shrub



Photograph 4. Black spruce mixedwood/ feathermoss



Photograph 5. Jack pine/ feathermoss



Photograph 6. Jack pine- black spruce/ lichen



Photograph 7. Black spruce/ shrub- and herb- poor



Photograph 8. Jack pine- black spruce/ feathermoss



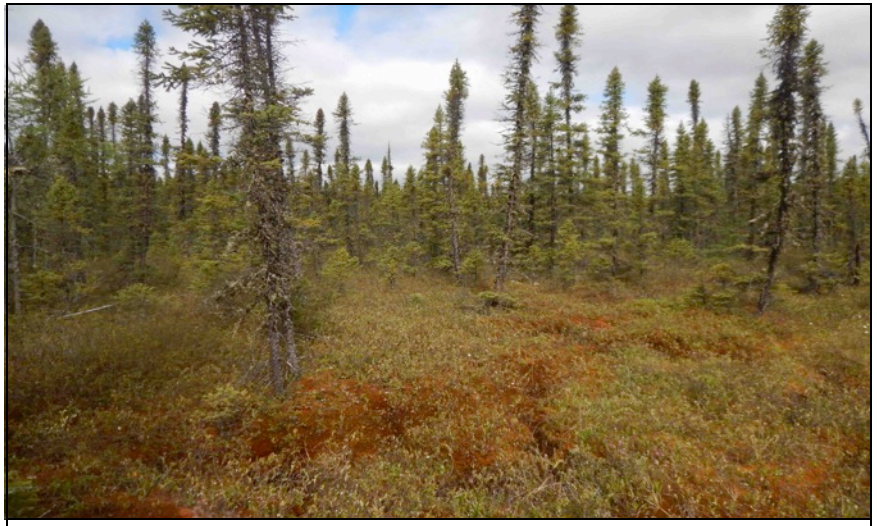
Photograph 9. Black spruce/ feathermoss



Photograph 10. Black spruce/ Labrador tea/ feathermoss (Sphagnum)



Photograph 11. Black Spruce/ herb poor/ Sphagnum (feathermoss)



Photograph 12. Treed bog



Photograph 13. Treed poor fen



Photograph 14. Shrub rich fen



Photograph 15. Graminoid rich fen



Photograph 16. Graminoid poor fen

Appendix B-2:

Vegetation Characterization and Effects Assessment of the Proposed All-Season Road Project 6 Interim Report

By Szwaluk Environmental Consulting, Karin Newman and Calyx Consulting

VEGETATION CHARACTERIZATION AND EFFECTS ASSESSMENT

OF THE PROPOSED ALL-SEASON ROAD PROJECT 6

INTERIM REPORT

Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation

Prepared for:

Manitoba East Side Road Authority



Prepared by:

Szwaluk Environmental Consulting Ltd.

Karin Newman

and

Calyx Consulting

January 2017

SUMMARY

This report provides a characterization of vegetation and an assessment of effects for the proposed P6 All-Season Road Project connecting Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation. The characterization of vegetation included a description of ecological land classification, physical environment, landscape level vegetation, local flora, and Aboriginal traditional knowledge.

The proposed Project is located in the Hayes River Upland Ecoregion, and almost entirely in the God's Lake and Knee Lake Ecodistricts. The landscape consists largely of coniferous forests on both upland and organic sites. Areas of rocky outcrops support jack pine, while mixed stands of conifer and deciduous species are generally restricted to favorable sites along lakes and rivers. Low growing black spruce occurs in bogs and tamarack is found in fens.

Valued Components for the study included plant species of conservation concern (those listed by the federal Species at Risk Act, the Manitoba Endangered Species and Ecosystems Act, the Committee on the Status of Endangered Wildlife in Canada, and those listed as very rare to rare by the Manitoba Conservation Data Centre) and key community harvest areas/ plant species of interest (those identified through traditional knowledge studies and other engagement activities).

There are an estimated 14 species of conservation concern that occur within the P6 regional assessment area and surroundings. Information on plant species important to the people in the region for sustenance and cultural practices are identified. Common food plants include blueberry, raspberry, strawberry, cloudberry, cranberry, cherry and Saskatoon. Medicinal plants including black spruce, sweet flag and Labrador tea were identified.

Potential environmental effects of the proposed Project on vegetation and soils include the following:

- Loss of species of conservation concern.
- Disturbance to or removal of key community harvest areas of plant species of interest (medicinal and cultural species).
- Disturbance to or removal of native vegetation.
- Disturbance or loss to species composition and ecology of wetlands (bogs and fens).
- Fragmentation of the local and regional vegetation communities.
- Modification of vegetation composition and structure adjacent to the disturbance zone.
- Introduction and spread of invasive and non-native species.

- Loss/impairment of vegetation from accidental releases of fuels or hazardous substances.
- Loss/impairment of desirable plant species from herbicide application.
- Impairment of vegetation in the project assessment area from dust.
- Increased risk of forest fire from clearing and construction.
- Increased access to botanical resources used by non-community members.
- Reduced floristic diversity immediately adjacent to the road.
- Loss of soil from clearing, stripping and construction.
- Compaction of soil during construction.
- Loss of soil due to erosion of cleared sites and stockpiles.
- Modification of soil moisture regime.
- Impaired soil quality from accidental releases of fuels and hazardous substances.
- Impaired soil quality from herbicide application.

Measures to address potential effects are discussed. The assessment found no likely significant effects to valued vegetation components in this study.

Additional information gathered on vegetation and soils in the assessment area from fieldwork completed in 2016 will be provided in the Project Field Report.

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1.0 INTRODUCTION

1.1 Background

The First Nation communities of Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation rely primarily on winter road and air travel to transport people and goods. In 2008, the Government of Manitoba announced a strategic initiative to provide improved, safer and more reliable transportation services to connect the remote communities on the east side of Lake Winnipeg with the rest of Manitoba. Manitoba East Side Road Authority (MESRA), formerly Manitoba Floodway and East Side Road Authority (MFESRA), was established as a provincial Crown Agency to manage the East Side Transportation Initiative with the intent of increasing transportation opportunities for communities on the east side of Lake Winnipeg. This task has since been transferred to Manitoba Infrastructure (MI).

As part of the East Side Transportation Initiative, MESRA is proposing the construction of an all-season road northeast of Lake Winnipeg between Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation, Project 6 (P6). The proposed P6 All-Season Road will occur at the northeastern extent of the Transportation Initiative network.

1.2 Project Overview

The proposed P6 All-Season Road will consist of approximately 137 km of two-lane gravel highway on new right-of-way (ROW) on provincial Crown land, connecting Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation (Map 1).

The P6 All-Season Road will be a gravel-surface public highway, with a design width of 10 m. The P6 All-Season Road will intersect two major water crossings over God's River and Magill Creek. The components of the Project include the following:

- All-Season Road on new ROW;
- Up to two bridges at water crossings (bridge replacement at God's River, possible bridge construction at Magill Creek);
- Culverts for stream crossings and drainage equalization;
- Rock quarries and granular borrow areas; and
- Temporary access trails, bridges, staging areas and camps.

The portion of the Project located on Provincial Crown Land requires an Environmental Impact Assessment under the Manitoba Environment Act as a Class II development and under the Canadian Environmental Assessment Act.

The specific objectives established for this study were:

- provide an understanding of the baseline vegetation conditions to support the effects assessment and project planning;
- contribute to the identification of the potential environmental effects of road development on vegetation species and communities; and
- contribute to the identification and implementation of environmental protection measures to avoid or minimize effects to vegetation, particularly species of conservation concern and key community harvest areas (plant species of interest).

2.0 STUDY AREA

The proposed P6 All-Season Road Project is located northeast of Lake Winnipeg, near Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation, approximately 950 km northeast of Winnipeg (by air). The P6 All-Season Road extends from Bunibonibee Cree Nation southeast to God's Lake First Nation, and approximately midway is intersected to extend northeast to Manto Sipi Cree Nation. The total distance is approximately 137 km of proposed All-Season Road. For this study, the P6 segment from Bunibonibee Cree Nation to God's Lake First Nation is referred to as P6a and the segment from the junction to Manto Sipi Cree Nation as P6b.

2.1 Spatial Boundaries

The spatial boundaries for the assessment consist of project, local and regional assessment areas and are described below, and illustrated in Map 1.

Project Assessment Area (PAA) – Footprint of the proposed P6 All-Season Road Project, including rock quarries, borrow areas and access roads. The proposed P6 All-Season Road will be centered on a 100 m ROW with a typical clearing width of 60 m and additional clearing as required at horizontal curves to maintain sight distances.

Local Assessment Area (LAA) – One km on either side of the proposed P6 All-Season Road Project, including rock quarries, borrow areas and access roads.

Regional Assessment Area (RAA) – Five km on either side of the proposed P6 All-Season Road Project.

3.0 METHODS

3.1 Desktop Methods

Existing biophysical information (e.g., Geology of Manitoba 2016; Matile and Keller 2006; Smith et al. 1998) was used to describe the environment, regionally and across all areas of assessment for the P6 All-Season Road, including available information provided by MESRA (e.g., project imagery and shapefiles). Literature searches for relevant studies in the vicinity of the Project (e.g., Terraform Environmental Consulting 1999a and 1999b; Manitoba Hydro 2000a and 2000b) and environmental assessments (e.g., MFESRA 2010 and 2011; MESRA 2016a and 2016b) were also completed.

Data Sources

The National Stratification Working Group ecological framework database (Smith et al. 1998) was used to identify and describe the ecological land classification, to the ecodistrict scale. Within the P6 assessment areas (project, local, regional), the Land Cover Classification (LCC) was used to determine vegetation cover classes (Natural Resources Canada, through 2000). The LCC is a national vector database mapping layer that has been harmonized across the major federal departments involved in land management or land change detection (Agriculture and Agri-Foods Canada, Canadian Forest Service, and Canadian Centre for Remote Sensing). The LCC consists of remotely sensed imagery (Landsat data) as part of the Earth Observation for Sustainable Development of Forests Program.

The burn history of the area was determined from provincial fire data (Manitoba Conservation 2014). Other available data sources used included soils (Agriculture and Agri-Food Canada 2013), water crossings (Natural Resources Canada 1999 to 2010) and wetland features (Halsey et al. 1997). Key community harvest areas (plant species of interest) as identified through traditional knowledge studies and engagement activities were provided by MESRA through shapefiles.

The available datasets were clipped to the three assessment areas, and for each resulting shapefile, the area of polygons was calculated. Intersecting stream and river crossings were buffered at 10 m, to account for width. Values calculated for water crossings and waterbodies were approximate.

Species of Conservation Concern

MESRA has stated that plant species of concern relevant to the proposed P6 project are:

- Species listed as Schedule 1 under the Species at Risk Act (SARA),

- Species listed as extirpated, endangered, threatened, or of special interest by The Committee on the Status of Endangered Wildlife in Canada (COSEWIC),
- Species listed as extirpated, endangered, or threatened under the Endangered Species and Ecosystems act of Manitoba (ESEA), and
- Species ranked as Very Rare (S1) and Rare (S2) by the Manitoba Conservation Data Centre (MBCDC).

A database search of the MBCDC provincial records for known locations of species of conservation concern in the vicinity of the Project was requested in March 2016.

The global (G) and sub-national (S) rarity ranking of species used by the MBCDC, according to a standardized procedure used by all Conservation Data Centres and Natural Heritage Programs is as follows:

1: Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.

2: Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.

3: Uncommon throughout its range or in the province (21 to 100 occurrences).

4: Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (> 100 occurrences).

5: Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially impossible to eradicate under present conditions.

An element with a range between two numeric ranks (e.g., S2S3) denotes a range of uncertainty about the exact rarity of the species. A question mark following the rank (e.g., S2?) denotes inexactness or uncertainty of the numeric rank.

The conservation status categories for ESEA, SARA and COSEWIC are as follows:

- Special Concern: A species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
- Threatened: A species likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
- Endangered: A species facing imminent extirpation or extinction.
- Extirpated: A species no longer existing in the wild in Canada but exists elsewhere.
- Extinct: A species that no longer exists.

Plant nomenclature for species discussed in this report will follow the MBCDC provincial species list.

4.0 EXISTING ENVIRONMENT

4.1 Ecological Land Classification

Ecological classification in Canada is a hierarchical designation describing ecologically distinct areas based on interrelationships of geology, landform, soil, water, vegetation, and human factors, with the ecozone at the coarsest level. The Boreal Shield Ecozone, the largest in Canada, stretches from northern Saskatchewan to Newfoundland, and also covers much of Manitoba (Smith et al. 1998). Within this ecozone, the Hayes River Upland Ecoregion extends from the Grass River Basin in east-central Manitoba to northwestern Ontario. The proposed All-Season Road Project connecting the communities of Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation occurs mainly within the God's Lake Ecodistrict and the Knee Lake Ecodistrict, see Map 2. The Island Lake Ecodistrict occurs at the northeastern portion of the study area. In absence of specific and detailed vegetation and soil studies for the P6 study area, the ecodistrict is used here as a detailed level of ecological reference, to describe the existing environment.

Among assessment areas (project, local and regional), the God's Lake Ecodistrict occupies the greatest area as identified in Table 4.1. The Knee Lake Ecodistrict occupies much smaller areas, and the Island Lake Ecodistrict only occurs at the regional level.

Table 4.1. Area (km²) and percent of land within ecodistricts among assessment areas.

	Project		Local		Regional	
Ecodistrict	**Area (km²)**	**%**	**Area (km²)**	**%**	**Area (km²)**	**%**
God's Lake	22.8	80.8	228.9	80.6	1,150.2	80.4
Knee Lake	5.4	19.2	55.2	19.4	277.5	19.4
Island Lake	-	-	-	-	2.9	0.3

Source: Smith et al. 1998.

4.2 Physical Environment

4.2.1 Geology and Surficial Geology

The geology of the area consists of Precambrian rock from the Archean era (Geology of Manitoba 2016). In the Oxford Lake area, the lithotec consists of late metasedimentary and metavolcanic rocks (Oxford Lake Group, Island Lake Series, San Antonio formation). The unit consists of greywacke, conglomerate, arkose and arenite, as well as mafic and felsic fragmental volcanic rocks, and porphyritic mafic to felsic flows. In the vicinity are late intrusive rocks of granodiorite, minor tonalite, migmatite and granite. In the God's Lake area, the lithotec dominantly consists of metamorphosed early intrusive rocks, gneisses and migmatites. Early metavolcanic and metasedimentary rocks (Rice Lake Group, Hayes River Group) occur at the north and south ends of the lake. The unit consists of basalt, minor andesite, minor sedimentary and mafic intrusive rocks, ultra mafic rocks and

differentiated ultramafic/mafic intrusions. Metamorphic supracrustal rocks with amphibolite also occur (Geology of Manitoba 2016).

The surficial geology of the area is characterized by discontinuous till deposits over bedrock outcrops, organic deposits and glaciolacustrine sediments (Smith et al. 1998). Till deposits are of silt diamicton, largely derived from Phanerozoic carbonate rocks from the Hudson Bay Lowland, and are generally of low-relief. Organic deposits, in low-lying areas, are from <1 – 5 m thick and accumulate in fen, bog, swamp and marsh settings. In permafrost areas, patterned ground and peat palsas are common. The glaciolacustrine sediments are low relief, massive and laminated deposits of clay, silt and minor sand, deposited by deep water of glacial Lake Agassiz. Deposits were commonly scoured and homogenized by icebergs. Glaciofluvial sediments range from fine sand, minor gravel, thin silt and clay interbeds deposited as subaqueous outwash fans to sand and gravel complex deposits with esker ridges and kames. The bedrock outcrops are generally subglacially eroded and unweathered intrusive, metasedimentary and metavolcanic rocks with a glacially scoured irregular surface with high local relief. In areas of permafrost, frost shattered, angular boulder fields occur (Matile and Keller 2006).

4.2.2 Soils

Soils are similar across ecodistricts, with mineral soils developed on till, glaciolacustrine or glaciofluvial sediments and non-frozen and frozen organic soils found in peatlands and depressions. In the God's Lake Ecodistrict, mineral soils are characterized as being dominantly well to imperfectly drained Eluviated Eutric Brunisols that have developed on loamy to sandy till deposits and Gray Luvisols that have developed on both loamy to sandy till deposits and upland clayey glaciolacustrine deposits. Vast areas of peat filled depressions form a poorly drained bog and fen complex. Soils found in poorly drained bogs are characterized as Fibrisols, with slightly decomposed sphagnum and feather moss peat and Mesisols with moderately decomposed moss and forest peat. Soils found in fens vary with slightly decomposed to moderately well decomposed peat, with deeper peat more decomposed that peat found at the surface. Organic Cryosols are found in the northern section of the ecodistrict and in peatlands where permafrost is present. To the north within the Knee Lake Ecodistrict, dominant soils are Organic which include Organic Cryosols generally found in peatland areas that contain permafrost. Organic soils that are non-frozen include both Fibrisols and Mesisols found in shallow bogs, and patterned fens comprised of woody, forest peat and sedge peat. Mineral soils found in the ecodistrict include Eluviated Eutric Brunisols that have developed on loamy to sandy calcareous till and sandy gravelly fluvioglacial deposits, and Gray Luvisols found on well to imperfectly drained clayey deposits (Smith et al. 1998).

The general distribution of the main soil classification types for the greater region of the P6 study area is shown in Map 3. The area (km^2) and percent cover of soil types within all assessment areas is shown in Table 4.2.2. Brunisols are the dominant soils among the assessment areas, followed by Cryosols and Organics.

Table 4.2.2. Area (km^2) and percent of soil classes among assessment areas.

Soil Classification	Project		Local		Regional	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
Brunisolic	13.6	48.2	135.2	47.6	695.8	48.6
Cryosolic	8.8	31.1	89.6	31.6	460.6	32.2
Luvisolic	1.4	4.8	14.4	5.1	58.3	4.1
Organic	4.5	15.8	44.8	15.8	210.6	14.7
Unclassified	-	-	-	-	5.3	0.4

Source: National Soils Database, Agriculture and Agri-food Canada 2013.

4.2.3 Topography and Drainage

Topography of the area ranges from undulating to ridged morainal plain comprised of sandy to loamy till deposits. In areas of lower slopes and depressions, bogs and fens comprised of both shallow and deep peat material are found overlying clayey glaciolacustrine deposits. Inclusions of kettled fluvioglacial deposits, in the form of eskers and esker aprons, can also be found. Elevations range from 150 m above sea level (masl), to 274 masl (Smith et al. 1998).

Two drainage systems, the Nelson River and Hayes are found in the area, and the many small, medium and large sized lakes drain north-northeastward through a network of rivers and secondary streams.

The major lakes in the area include God's Lake, Oxford Lake and Knee Lake while major rivers of the area include the Hayes and God's Rivers. Based on existing data, the P6 project assessment area is intersected by numerous streams, creeks, and rivers, shown in Map 4. The water crossings and bodies of water account for roughly 1% of the total project assessment area, of which rivers and stream crossings (buffered by 10 m) account for 0.24 km^2, or 0.9%, while other waterbodies account for approximately 0.03 km^2, or 0.1%, shown in Table 4.2.3. North/South Consultants report 54 watercourse crossings in their project assessment.

Table 4.2.3. Water crossings in the project assessment area.

Category	Crossings	Area (km^2)	%
Rivers and streams	44	0.24	0.9
Waterbody	2	0.03	0.1
No water crossing activity	-	27.95	99.0

Source: Natural Resources Canada 1999-2010.

4.2.4 Climate

This area falls within both the warmer and more humid, and colder subdivisions of the High Boreal Ecoclimatic Region (Smith et al. 1998). Short, cool summers and long, very cold winters are characteristic of this ecoclimatic region. Local climate normals recorded from the Island Lake station (1981-2010) to the south, show a mean annual temperature of -0.7˚C, with a July mean of 17.9˚C and a January mean of -21.5˚C. The average annual precipitation is 555 mm, one third of which falls as snow (Environment Canada 2015).

4.3 Fire and the Boreal Forest

In the boreal forest, fire is an important natural disturbance that drives vegetation dynamics at the landscape, stand and species levels. Forest diversity is a result of the variation of fires in frequency, intensity, severity, size, shape and season of burn (Natural Resources Canada 2016). The area burned varies greatly, and fire activity is influenced by weather and climate, fuels, ignition agents, and humans (Brandt et al. 2013). High intensity fire rejuvenates boreal ecosystems, and is the major stand renewing agent, affecting stand life cycles, patchiness and regeneration (Stocks et al. 2003). Fires improve soil conditions for germination by releasing nutrients and minerals into soils, removing live vegetation and litter matter, and increasing availability of sunlight at the forest floor (Brandt et al. 2013; Stocks et al. 2003). A mosaic of vegetation at different stages of succession from fire in the ecosystem results in greater landscape diversity and provides an array of habitats for flora and fauna (Perry 1994).

Seasons play a role in fire frequency and intensity and can affect re-growth of the ecosystem, while temperature changes and soil moisture content also affect fire intensity (Weber and Flannigan 1997). The boreal forest fire season is April through October. Lightning fires occur generally in late spring/ summer, while human caused fires tend to occur in early spring and fall (Stocks et al. 2003). In the boreal forest, lightning strikes account for about 35% of fires, although are responsible for about 85% of the total area burned (Brandt et al. 2013).

4.3.1 Fire History

The boreal forest tends to burn at different intervals. The fire cycle for jack pine is approximately 15 to 35 years, while spruce stands cycle every 50 to 100 years (Natural Resources Canada 2016). Stand-destroying crown fires occur at approximately 50 to 200 year intervals, and can reach 500 years on very moist sites. The coniferous forests (e.g., spruce, pine) of this region experience more frequent crown fires than deciduous dominated forests (Perry 1994).

The provincial fire history data available for the P6 study area dates back to the 1940s. Fire history shown is calculated for each decade by area (km^2) and percent of land, within project, local, and regional levels of assessment, in Table 4.3.

Table 4.3. Area (km^2) and percent of land burned by decade among assessment areas.

Fires by Decade	Project		Local		Regional	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
1940-1949	0.6	2.2	5.2	1.8	8.3	0.6
1950-1959	4.8	17.2	42.7	15.0	181.1	12.7
1960-1969	0.4	1.6	2.5	0.9	15.0	1.0
1970-1979	0.6	2.0	3.2	1.1	18.5	1.3
1980-1989	<0.001	<0.01	0.4	0.2	11.7	0.8
1990-1999	0.4	1.6	3.8	1.3	54.8	3.8
2000-2009	-	-	0.1	<0.1	2.2	0.2
2010-2014	-	-	<0.01	<0.01	0.2	<0.1

Source: Manitoba Conservation and Water Stewardship, through 2014.

The greatest fire activity in this area occurred during the 1950s, with 12.7% of the land within the regional assessment area cumulatively burned between 1950 and 1959. During the same time period, cumulative fire activity appears slightly more concentrated in the local (15.0%) and project (17.2%) assessment areas. From the 1960s to the present, comparatively less fire activity has been documented, with fires affecting between 0-2% of the land base in the project, local, and regional assessment areas. An exception is the slight rise in fire activity (to 3.8% seen at the regional scale during the 1990s. Although after the year 2000, there is a marked reduction in fire activity across the project, local, and regional assessment areas, according to available information. The history of fire distribution by decade is shown in Map 5.

4.4 Landscape Level Vegetation

The vegetation across this region of Manitoba is primarily black spruce on both upland and organic sites. Canopies are often more open, and of medium height compared to areas further south. Forest fire has replaced some upland spruce with jack pine, often the dominant species on regenerating sites, while trembling aspen occurs occasionally. Mixed stands of white spruce, balsam fir, trembling aspen and balsam poplar are generally restricted to favorable sites along lakes and rivers. Areas of rocky outcrops favour jack pine, with an understory of ericaceous shrubs, herbs and mosses and lichens. Low growing black spruce in open canopies grow in bogs, along with ericaceous shrubs and sphagnum and other mosses. Tamarack is found in fens, and is mixed with black spruce in transitional peatlands (Smith et al. 1998).

4.4.1 Land Cover Classification

The Land Cover Classification, generated from Landsat satellite data, details twenty-one vegetation classes, ranging in dates from 1999 to 2000 (Natural Resources Canada, through 2000). Eleven vegetation classes (plus one unclassified class) occur within the project, local and regional assessment areas, including tall shrub, wetlands, and coniferous, broadleaf and mixedwood forests. The water class includes lakes and rivers and streams. Map 6 illustrates the distribution of the land cover classes for the P6 study area and surrounding region.

The area (km^2) and percentage of land cover classes found in the project, local, and regional assessment areas is shown below in Table 4.4.1a. Much of the P6 study area is represented by coniferous growth, covering 82.8% of the RoW. Stand canopy cover is predominantly dense (38.1%) or open (31.8%), with sparse canopies occurring over 12.9% of the RoW. Coniferous cover figures are similar at the local and regional assessment scales, although the percent covers are slightly less.

Wetlands occur over 12.4-19.2% of the project, local, and regional assessment areas, and support primarily shrubby vegetation growth. Dense hardwood or mixedwood stands are relatively rare, occurring over 0.1-1.2% of all assessment areas. Water features, such as lakes and streams are present over the regional assessment area (19.8%) and local (8.9%) assessment areas, although less frequent water cover is seen on the ROW (0.6%).

Table 4.4.1a. Area (km^2) and percent cover of vegetation classes by assessment area.

Land Cover Classification	Project		Local		Regional	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
Water	0.2	0.6	25.3	8.9	283.9	19.8
Exposed Land	0.7	2.5	7.3	2.6	16.9	1.2
Shrub Tall	-	-	0.8	0.3	23.0	1.6
Wetland Treed	0.4	1.3	5.4	1.9	24.9	1.7
Wetland Shrub	3.0	10.6	46.2	16.3	193.5	13.5
Wetland Herb	0.2	0.5	2.8	1.0	12.1	0.8
Coniferous Dense	10.7	38.1	82.6	29.1	382.4	26.7
Coniferous Open	9.0	31.8	81.8	28.8	351.4	24.6
Coniferous Sparse	3.6	12.9	29.4	10.4	126.1	8.8
Broadleaf Dense	0.4	1.2	1.7	0.6	9.2	0.6
Mixedwood Dense	<0.1	0.2	0.4	0.1	6.8	0.5
Unclassified	0.1	0.3	0.2	0.1	0.4	<0.1

Source: Natural Resources Canada, through 2000.

The anticipated percent of vegetation removal from the local and regional assessment areas, due to project clearing of the ROW, is shown for each vegetation class, in Table 4.4.1b. Figures presented are calculated based on the overall percent cover for each

vegetation class that occurs directly on the ROW, as a percentage of the local and the regional assessment areas. Areas of open water and exposed land area also included, as an indication of disturbance through construction activities, rather than vegetation removal.

Table 4.4.1b. Percent (%) of vegetation removal from local and regional assessment areas due to clearing on the ROW.

Land Cover Classification	Local removal (%)	Regional removal (%)
Water	0.7	0.1
Exposed Land	9.7	4.2
Wetland Treed	6.5	1.4
Wetland Shrub	6.5	1.5
Wetland Herb	5.4	1.3
Coniferous Forest Dense	13.0	2.8
Coniferous Forest Open	11.0	2.6
Coniferous Forest Sparse	12.4	2.9
Broadleaf Forest Dense	21.1	3.8
Mixedwood Forest Dense	10.8	0.7
Tall Shrub	-	-
Unclassified	37.2	22.2

Within the local assessment area, the effect of clearing will result in a removal of an estimated total of 18.4% of local area wetland vegetation, from shrubby (6.5%), treed (6.5%) and herbaceous (5.4%) wetlands that occur on the ROW. An estimated total of 36.3% of the coniferous forest vegetation cover (dense, open and sparse) in the local assessment area will be removed due to clearing of the ROW. An estimated 21.1% of dense broadleaf forests and 10.8% of dense mixedwood forests at the local scale occur on the project RoW. The tall shrub vegetation cover class does not occur in the project assessment area.

Within the regional assessment area, an anticipated 4.2% of wetland vegetation will be removed by project clearing of the ROW. Of the regional forest types, an estimated 8.2% of the coniferous forests (dense, open and sparse cover), 3.8% of dense broadleaf forests, and 0.7% of dense mixedwood forests at the regional assessment scale occur on the RoW, and would be removed during project clearing.

4.4.2 Quarry and Borrow Areas

The construction of the P6 All-Season Road will require additional aggregate that is beyond what will be obtained from cuts from within the alignment/project footprint. Twenty-nine potential rock quarry and borrow sites have been identified along the alignment, ranging in size from 0.01 km^2 to 0.47 km^2. Quarry sites will be preferentially developed in or adjacent to the ROW, within approximately 500 m of centreline (MESRA 2016c). A total of 2.51 km^2

will be cleared for quarry development, primarily within the local assessment area (2.49 km^2), including 0.70 km^2 in the project area, and an additional 0.03 km^2 beyond the local assessment area. The area and percent of land cover classes that occur within potential quarries are shown for all levels of assessment, in Table 4.4.2a.

Table 4.4.2a. Area (km^2) and percent of land cover classes for potential quarry sites within all assessment areas.

Land Cover Class	Project		Local		Regional	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
Exposed Land	-	-	0.09	3.71	0.09	3.67
Water	-	-	0.01	0.33	0.01	0.35
Wetland Treed	<0.01	0.64	<0.01	0.19	<0.01	0.19
Wetland Shrub	0.01	1.45	0.15	5.98	0.15	5.91
Wetland Herb	-	-	0.01	0.27	0.01	0.26
Coniferous Dense	0.49	70.44	1.45	58.05	1.45	57.43
Coniferous Open	0.12	17.51	0.58	23.34	0.59	23.26
Coniferous Sparse	<0.01	0.65	0.03	1.32	0.05	2.17
Broadleaf Dense	0.06	9.18	0.17	6.76	0.17	6.69
Mixedwood Dense	<0.001	0.14	<0.01	0.07	<0.01	0.06
Total quarry clearing (km^2)	0.70	100%	2.49	100%	2.52	100%

Clearing for quarry development will occur primarily in the local assessment area, covering 2.49 km^2, or approximately 0.88% of the total local assessment area. Quarry development at the project scale amounts to 0.70 km^2, or approximately 2.49% of the total project assessment area. Dense coniferous forest is the dominant land cover throughout, and at the local scale accounts for 58.05%. Other prominent land covers are open coniferous (23.34%) and dense broadleaf (6.76%) forests. These remain the dominant forest types at all assessment scales. Exposed land accounts for <4.0% across all scales, while water accounts for <0.4% of potential quarry areas at both the local and regional scale.

The development of potential quarry sites will generally require the removal of vegetation. The anticipated percentage of vegetation removal for quarry development is shown by land cover class, as a percentage of total assessment area, in Table 4.4.2b. The overall percentage of exposed land and water that will be altered by quarry development is also included, for local and regional assessment areas.

Table 4.4.2b Percent (%) of vegetation removal from potential quarries for all assessment areas.			
	Vegetation Removal (%)		
Land Cover Class	**Project**	**Local**	**Regional**
Exposed Land	-	1.27	0.55
Water	-	0.03	<0.01
Wetland Treed	1.26	0.09	0.02
Wetland Shrub	0.34	0.32	0.08
Wetland Herb	-	0.23	0.05
Coniferous Dense	4.59	1.75	0.38
Coniferous Open	1.37	0.71	0.17
Coniferous Sparse	0.13	0.11	0.04
Broadleaf Dense	18.31	10.14	1.82
Mixedwood Dense	2.09	0.39	0.02
Total quarry clearing (%)	2.49%	0.88%	0.18%

In consulting both tables 4.4.2a and 4.4.2b, note that in proposed quarry areas, while the dominant forest cover is coniferous, the greatest percent of vegetation removal occurs for dense broadleaf forest. For example, for dense coniferous forests at the local scale, 1.45 km^2 cleared represents 1.75% of all local area dense coniferous forests. However, for dense broadleaf forests, 0.17 km^2 cleared represents 10.14% of all dense broadleaf forest that occurs in the local assessment area.

Due to the nature of wetland soils, this land cover class will be minimally affected by clearing for quarry purposes. Within the local assessment area, half of the wetlands in potential quarry areas are shrubby (0.32%), with herbaceous (0.23%) and treed (0.09%) wetlands making up the remainder of wetland cover. Within the regional assessment area, 0.59% of the coniferous forests (primarily dense, 0.38%), 1.82% of dense broadleaf forests, and 0.02% of dense mixedwood forests occur within potential quarry areas. Regionally, 0.15% of wetlands occur within potential quarry sites.

Access Roads

For eleven potential quarries (38%) situated directly on the ROW, additional access is not required. Access to 18 potential quarries (62%) is between approximately 27 and 797 m (mean distance 309 m) from center line. All access roads are located wholly within the local assessment area. Straight line access was assumed with a road width of 30 m. The area and percent of land cover classes affected by potential access roads, is shown in Table 4.4.2c, by level of assessment.

Table 4.4.2c. Area (km²) and percent of land cover classes for potential access roads within all assessment areas.				
	Project		Local	
Land Cover Class	**Area (km²)**	**%**	**Area (km²)**	**%**
Exposed Land	<0.001	1.58	<0.01	0.93
Water	-	-	<0.001	0.38
Wetland Treed	-	-	-	-
Wetland Shrub	<0.01	5.63	0.01	6.47
Wetland Herb	-	-	-	-
Coniferous Dense	0.04	66.00	0.10	55.53
Coniferous Open	0.02	26.79	0.06	31.54
Coniferous Sparse	-	-	<0.01	4.34
Broadleaf Dense	-	-	<0.01	0.81
Mixedwood Dense	-	-	-	-
Total access road clearing (km²)	0.06	100%	0.18	100%

As few potential access road sites occur on exposed land (<2%), most access roads will require further vegetation removal. Clearing for quarry access road development (0.06 km²) in the project assessment area will generally overlap clearing for the ROW. Most access roads occur within the local assessment area (0.18 km²), primarily in locations of coniferous forest with dense (55.53%) and open (31.54%) cover. Shrubby wetland accounts for 6.47% of access road area, and 4.34% is represented by sparse coniferous forest cover.

The anticipated vegetation removal for potential access roads by land cover class, as a percent of total land cover for each assessment area is shown in Table 4.4.2d. The overall percentage of exposed land and water that will be altered by access road development is also included. No access roads are placed beyond the local assessment area.

Within the local assessment area, 0.22% of the coniferous forests (primarily dense, 0.12%), and 0.09% of the dense broadleaf forests occur within potential access road sites. Shrubby wetlands account for 0.03% of potential access roads, at the local scale.

Table 4.4.2d. Vegetation removal (%) from all assessment areas on potential access roads.		
	Vegetation Removal (%)	
Land Cover Class	**Project**	**Local**
Exposed Land	0.13	0.02
Water	-	<0.01
Wetland Treed	-	-
Wetland Shrub	0.11	0.03
Wetland Herb	-	-
Coniferous Dense	0.35	0.12
Coniferous Open	0.17	0.07
Coniferous Sparse	-	0.03
Broadleaf Dense	-	0.09
Mixedwood Dense	-	-
Total access road clearing (%)	0.20%	0.06%

4.4.3 Wetlands

In Canada, approximately 85% of wetlands are located in the boreal forest (Ducks Unlimited Canada 2015). In Manitoba, Halsey et al. (1997) estimates that wetlands cover 233,340 km^2 or 43% of the terrestrial landscape, with peatlands representing 90% of all wetlands. It is well documented that boreal wetlands are ecologically important (Bond et al. 1992, Locky et al. 2005, Ducks Unlimited Canada 2015). Foster et al. (2004) noted the importance of calcareous wetlands (e.g., fens) and their potential to support species of conservation concern. Threats to wetlands include agricultural runoff, drainage, forestry activities, off-road vehicles, peat extraction, and right-of-way activities (Foster et al. 2004).

According to the Canadian Wetland Classification System (CWCS), wetlands are separated into five classes including bog, fen, marsh, swamp and shallow water (National Wetlands Working Group 1997). Ducks Unlimited Canada (2015) further identifies 19 minor wetland classes based on an enhanced wetland classification system of the five major wetland classes, which considers moisture, water movement and nutrients, as well as plant structure and cover (e.g., trees, shrubs, grasses, sedges, and mosses) to differentiate wetland sites using field-collected data.

The CWCS defines fens as peatlands with a fluctuating water table, rich in dissolved minerals due to ground and surface water movement. The greater nutrient availability in fens supports unique vegetation, related to the depth of the water table. The vegetation of nutrient poor fens, with waters low in dissolved minerals, is characterized by *Sphagnum* mosses and ericaceous shrubs, and black spruce are occasionally present. Moderately rich fens are dominated by graminoids (e.g., sedges) and brown mosses. Drier, rich fens support shrubs (birch, willow and tamarack), and trees (black spruce, tamarack) can be found on

moss hummocks up to 20cm above the water table (National Wetlands Working Group 1997).

Bogs are characterized by an accumulation of peat, with a surface that is raised or level with the surrounding terrain. Precipitation and snowmelt are primary water sources, resulting in acidic bog waters low in dissolved minerals, enhanced by the decomposition of acidic *Sphagnum* moss leaves. Vegetation largely consists of *Sphagnum*-dominated peat mosses, ericaceous shrubs (Labrador tea, leather leaf and bog cranberry) and where present, black spruce in sparse to closed stands (National Wetlands Working Group 1997).

The distribution of wetlands across the region (shown in Map 7 and Table 4.4.3), is based on digitized data from a study on wetland types and their distribution in Manitoba (Halsey et al. 1997). Here, wetlands are distinguished by wetland class (bog, fen, marsh, swamp, shallow water), the presence/absence of a tree canopy (open, wooded, forested), and a landform modifier (e.g., patterned, non-patterned). For the sake of mapping at this scale, in many cases wetland complexes, rather than individual wetlands were identified. In the wetland complex class, 30 to 70% of land is comprised of a mosaic of fen and bog habitats, (while upland habitat occupies the inversely remaining 30-70%) of a given polygon. This method results in a slight overestimation of wetland habitat area across the landscape, due to the inclusion of small mineral upland pockets within the wetland complex areas.

This roughly corresponds to the wetland cover classes of the Land Cover Classification (LCC) described earlier in Section 4.4.1, which are differentiated solely on the basis of vegetation structure (e.g., vegetation height). 'Treed wetlands' encompass treed bog and fen complexes; 'tall shrub wetlands' include shrubby bogs and fens; and 'herbaceous wetlands' include open fens (both patterned and non-patterned). Because both data sets were originally compiled differently and at different scales, the area calculations of classes are not necessarily directly comparable in this region.

Non-patterned open fens lack the presence of linear hummocky ridges and hollow depressions, and are characterized by the presence of a continuous sedge cover and sparse to no trees. Fens can be poor, or moderately to extremely rich in dissolved nutrients. Birch and willow shrubs may be present, the ground cover in wet poor fens is *Sphagnum* mosses. Non-patterned open fens can occur as collapse scars in association with peat plateaus, associated with bog islands, or as small isolated basins (Halsey et al. 1997).

Non-patterned treed fens have a variable range in tree cover (i.e., wooded >6 to 70% to forested >70%) in some combination of black spruce/ tamarack, with a common shrub understory of birch and willow, ground mosses are *Sphagnum* or brown mosses. These fens can be poor, or moderately to extremely rich in dissolved minerals.

The distribution of wetlands types in the P6 study area includes primarily bog and fen complexes, with occasional non-patterned fens classed as shrubby, or with an open (<10%), or treed (>10%) canopy, shown in Table 4.4.3. Patterned fens (as distinguished by the presence of linear hummocky ridges and hollow depressions), marshes, and treed bogs are present over the greater landscape, although not found within the P6 regional assessment area, see Map 7.

Table 4.4.3. Area (km²) and percent of wetland types among assessment areas.

Wetland Types	Project		Local		Regional	
	Area (km²)	%	Area (km²)	%	Area (km²)	%
Bog -Fen Complex, 30-70% wetland	15.6	55.3	156.0	54.9	646.4	45.2
Fen non-patterned, open-shrubby	1.0	3.7	1.6	0.6	12.3	0.9
Fen non-patterned, treed	-	-	11.4	4.0	45.0	3.1
Mineral soils, <30% wetland	11.6	41.0	115.1	40.5	726.9	50.8
Marsh	0.0	0.0	0.0	0.0	0.0	0.0
Patterned, open fen	0.0	0.0	0.0	0.0	0.0	0.0

Source: Halsey et al. 1997.

The percent cover for bog-fen complex are roughly comparable across all assessment area scales. The mosaic bog and fen wetland complexes account for 55.3%, 54.9% and 45.2% in the project, local and regional assessment areas, respectively.

The next dominant class, mineral soils, may have a wetland component present over no more than 30% of the area given. This dominantly upland class accounts for 41.0%, 40.5% and 50.8% of the project, local and regional assessment areas, respectively.

Fen habitats are minimally represented within the P6 assessment areas. Non-patterned treed fens occur in 3.1-4.0% of the local and regional scales (absent at the project scale), whereas open and shrubby non-patterned fens cover <1.0% of the local and regional scales, and 3.7% of the land base at the project scale.

4.5 Local Flora

4.5.1 Native Species

A list of potential plant species expected to occur within the P6 study area and throughout the region was compiled from available data sources including provincial data (MBCDC 2016), herbarium records from The Manitoba Museum and the University of Manitoba herbaria, regional flora (e.g., Cody 1989; Flora of North America 1993+; Scoggan 1957), and existing literature (e.g., Manitoba Hydro 2000a and 2000b; Terraform Environmental Consulting 1999a and 1999b). This preliminary flora list contains all species that have been previously collected or recorded in the P6 study area, including 241 vascular species from

60 families, which occur in terrestrial, wetland and aquatic habitats. A species list from the field component of this study (June 2016) is expected to include species identified in the preliminary species list, see Appendix II.

4.5.2 Introduced Species

A number of introduced (non-native) and invasive species are expected to occur across the greater P6 study area. Although not naturally found in undisturbed boreal forest habitats, many of these species are introduced along roads, rivers and streams, often following human activities. The boreal shield has a relatively high number of invasive plants, compared to other ecozones in Canada (CFIA 2008). Introduced species are those that grow outside of their region of origin, and generally thrive on disturbed sites, they are often prolific seed producers, and can tolerate poor or disturbed soils (Langor et al. 2014). Invasive species compete with native species, forming dense populations that may subsequently spread to other areas. Invasive species have been cited as risk factors for species of conservation concern (Canadian Food and Inspection Agency 2008). Where established, non-native and invasive plants can impact ecosystem diversity, structure, and function. The resulting displacement of native species changes the floristic composition of an ecosystem, and potentially endangers the survival of species of conservation concern. Non-native and invasive plants in boreal habitats are commonly perennial herbs and grasses, particularly from among the Asteraceae (composites), Fabaceae (legumes), and Poaceae (grasses) plant families, (Langor et al. 2014).

Of the 241 preliminary species expected to occur in the greater P6 study area, there are 13 introduced species, ranked SNA (conservation status rank is not applicable) by Manitoba Conservation Data Centre (2016), Table 4.5.2. The Invasive Species Council of Manitoba (ISCM) lists two of these species (*Arctium minus* and *Sonchus arvensis*) as invasive capable of further spread, with pathways for further spread present (ISCM 2016). Of the preliminary species previously recorded for this area, none are listed with the Global Invasive Species Database (GISD 2015).

Table 4.5.2. Potential introduced species found in the Hayes River Upland Ecoregion.			
Family	**Scientific Name**	**Common Name**	**S Rank**
Asteraceae	*Arctium minus*	Common Burdock	SNA*
Asteraceae	*Artemisia absinthimum*	Wormwood	SNA
Asteraceae	*Sonchus arvensis*	Field Sow-thistle	SNA*
Asteraceae	*Sonchus asper*	Spiny-leaved Sow-thistle	SNA
Asteraceae	*Taraxacum officinale*	Common Dandelion	SNA
Brassicaceae	*Erysimum cheiranthoides*	Wormseed Mustard	SNA
Caryophyllaceae	*Stellaria media*	Common Chickweed	SNA
Fabaceae	*Trifolium repens*	White Clover	SNA
Plantaginaceae	*Plantago major*	Common Plantain	SNA
Poaceae	*Agrostis stolonifera*	Creeping Bent	SNA
Poaceae	*Elymus repens*	Quackgrass	SNA
Polygonaceae	*Fagopyrum esculentum*	Buckwheat	SNA
Polygonaceae	*Fallopia convolvulus*	Black Bindweed	SNA

* Invasive species (ISCM 2016).

4.5.3 Species of Conservation Concern

There are currently no vascular species at risk listed in the Hayes River Upland Ecoregion, with either the Manitoba Endangered Species and Ecosystems Act (ESEA), the federal Species at Risk Act (SARA), or the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). No vascular species at risk are expected to occur within the Project 6 assessment area, as the Project is beyond known ranges for all vascular species at risk currently listed.

A single non-vascular species, the flooded jellyskin lichen (*Leptogium rivulare*) is federally listed through SARA (threatened), and with COSEWIC (special concern). Flooded jellyskin grows on periodically inundated surfaces, and is usually found on the bark of deciduous trees (e.g., ash, red maple, silver maple, American elm), along the banks of ponds and waterways, and in swampy forests that flood annually in the spring (Government of Canada 2016). According to the Environment Canada Recovery Strategy for the flooded jellyskin lichen, rocky shorelines of permanent lakes were identified as critical habitat for the eight extant populations in Manitoba. While 15 critical habitat locations within these populations have been identified in northwestern Manitoba (Environment Canada 2013), all are outside of the regional assessment area for the P6 All-Season Road Project. Although unlikely, any occurrences of the flooded jellyskin lichen during field studies (June 2016) will be noted.

There are an estimated 14 species of conservation concern that occur within the P6 regional assessment area and surroundings, based on records from the Manitoba Conservation Data Centre, georeferenced specimens housed in the Manitoba Museum and the University of Manitoba herbaria, as well as literature data available, Table 4.5.3.

Table 4.5.3. Species of conservation concern previously recorded in the God's Lake area and surrounding Hayes River Upland Ecoregion.				
Family	**Scientific Name**	**Common Name**	**S Rank**	**Record**
Balsaminaceae	*Impatiens noli-tangere*	Western Jewelweed	S1	-
Cyperaceae	*Carex loliacea*	Rye-grass Sedge	S2?	HRU
Cyperaceae	*Carex maritima*	Seaside Sedge	S2?	HRU
Cyperaceae	*Carex microglochin*	False Uncina Sedge	S2?	HRU
Dryopteridaceae	*Woodsia alpina*	Northern Woodsia	S2	GL/HRU
Fabaceae	*Astragalus bodinii*	Bodin's Milkvetch	S1	HRU
Fabaceae	*Oxytropis borealis*	Boreal Locoweed	S1S2	-
Lycopodiaceae	*Diphasiastrum sitchense*	Ground-fir	S1	HRU
Lycopodiaceae	*Huperzia selago*	Mountain Club-moss	S2S3	HRU
Ophioglossaceae	*Botrychium matricariifolium*	Daisy-leaf Moonwort	S1	HRU
Orchidaceae	*Platanthera hookeri*	Hooker's Orchid	S2S3	HRU
Poaceae	*Glyceria pulchella*	Graceful Manna Grass	S2S3	HRU
Potamogetonaceae	*Potamogeton robbinsii*	Robbin's Pondweed	S2S3	HRU
Potamogetonaceae	*Potamogeton strictifolius*	Straightleaf Pondweed	S2S3	HRU

Twelve species have been collected from the larger Hayes River Upland Ecoregion, while additional species of conservation concern have been collected from the God's Lake area or were observed in previous studies (e.g., Manitoba Hydro 2000a and 2000b).

4.6 Traditional Knowledge

Aboriginal people have been sustainably gathering and harvesting plants from the boreal forest in Canada for thousands of years, and in that time have accumulated a body of local, cultural and traditional knowledge. Aboriginal traditional knowledge can be considered a dynamic process of learning from elders and observing from nature, while adapting this knowledge to enhance the quality of life (Marles et al. 2000).

A great deal of aboriginal traditional knowledge is related to plant use as food, medicines, for handicrafts, and technology. Country foods and medicines increase dietary quality and generally consist of animals (e.g., moose, fish, deer, rabbit, birds), wild berries or nuts, and wild plants (Fieldhouse and Thompson 2012). The ability to harvest, share and consume traditional country foods is central to the food securities of aboriginal people.

Historically, many plants including trees, shrubs, flowers, mosses, lichens and fungi have been important as food and medicine sources (Davidson-Hunt et al. 2012). As an outcome of a study on indigenous plants, the Poplar River Anishinabek Plant Guide (Bruce et al. *Compilers* 2002, *In:* Asatiwisipe Aki Management Plan 2011) was produced to describe Aboriginal values and uses for local plants. The plant guide documents fifty different trees,

shrubs, herbs grasses, mosses and lichens that are used for sustenance and in traditional cultural practices.

Primarily preserved by oral traditions passed down through generations, the documentation of aboriginal traditional knowledge, particularly when led by individual Aboriginal communities, can help further preserve local knowledge and culture for generations to come. The repertory of traditional uses for plants may be widely known across communities or unique to a specific locale (Marles et al. 2000), and uses for a given species may vary from one community or region to another.

4.6.1 Plants of Cultural Importance

A traditional knowledge study was carried out in collaboration with local community members using workshops and one-on-one interviews by MESRA in 2016. Local elders, resource users and other knowledge holders were invited to take part in workshops and interviews. Topics included community knowledge of vegetation, wildlife and fish habitats; land use by community members; and areas that are particularly important or sensitive for cultural, historical, or other reasons. Each community was further involved during the study through regular and open communication with local leaders, and the use of local coordinators and translators, where required.

As a result of workshops and personal interviews, more than 17 plants, plus wood, lumber and firewood resources were identified by participants from the communities of Manto Sipi Cree Nation, Bunibonibee Cree Nation, God's Lake First Nation, and God's Lake Northern Affairs Community (NAC) as important for sustenance and cultural practices. Common food plants include blueberry, raspberry, strawberry, cloudberry, cranberry, cherry and Saskatoon. Over six medicinal plants were identified, including black spruce, sweet flag and Labrador tea. Wood cutting, and firewood and willow stick collection was also valued, shown in Table 4.6.1a. Actual numbers of plants valued are considered minimums as several plants are represented in the region by more than one related species (e.g. multiple species of blueberries, gooseberries, and Labrador tea). In addition, general descriptions such as 'plants for tea', or 'medicine plants' may refer to multiple species. Exact spelling and plants names used by participants are preserved.

Results showed little shared land use between communities, as participants identified primarily the land adjacent to their own communities, see Maps 8a-d.

Table 4.6.1a. Plants of sustenance and cultural value identified by members of the Manto Sipi Cree Nation (MS), Bunibonibee Cree Nation (BB), God's Lake First Nation (GL), and God's Lake Northern Affairs Community (GLNAC), within the regional assessment area.		
Community	**Local Name**	**Scientific Name**
	Food Plants	
GL	*Weekes*	*Acorus americanus*
MS	Saskatoon	*Amelanchier alnifolia*
MS	Strawberries	*Fragaria virginiana*
MS	Cherry	*Prunus* spp.
GL	Swamp Gooseberries	*Ribes* spp.
BB	Cloudberries	*Rubus chamaemorus*
MS	Head berries (*Mistegonemina*)	*Rubus chamaemorus*
MS, BB, GL	Raspberries	*Rubus idaeus*
GL	Mossberries	*Vaccinium oxycoccus*
MS, GL	Blueberries	*Vaccinium* spp.
BB, GL	Cranberries	*Vaccinium vitis-idaea*
GL	Medicines	various, unspecified
BB	Historic berry picking area	various, unspecified
	Medicinal Plants	
MS, BB, GL , GLNAC	*Wihkes, Weekis*	*Acorus americanus*
GL	Water Calla	*Calla palustris*
GL	Juniper	*Juniperus* spp.
GL	Black Spruce Bark	*Picea mariana*
MS	Spruce	*Picea* spp.
MS, GL, GLNAC	Labrador Tea	*Rhododendron* spp.
MS, GL	Ginger Root	unknown
BB	Medicinal Plant Gathering Location	various, unspecified
BB	Plants for Tea	various, unspecified
GL	Berries	various, unspecified
GL	Muskeg Leaves	various, unspecified
GL	Medicinal Plants	various, unspecified
GLNAC	Poplar sap	*Populus* spp.
	Other Uses	
GL	Strawberries	*Fragaria virginiana*
GL	Labrador Tea	*Rhododendron* spp.
GL	Raspberries	*Rubus idaeus*
GL, GLNAC	Willow Sticks	*Salix* spp.
GL	Ginger Root	unknown
BB	Firewood Harvest	various
MS	Wood cutting	various
GLNAC	Birch	*Betula* spp.

The total mapped area (with no overlap) including harvested areas for plants of sustenance and cultural importance to all communities covered 31.6%, 31.9% and 25.7% of the project, local and regional assessment areas, respectively (Table 4.6.1b).

Table 4.6.1b. Total mapped area for plants of sustenance and cultural value identified by community members, by assessment area.

Community	Project		Local		Regional	
	Area (km^2)	%	Area (km^2)	%	Area (km^2)	%
God's Lake First Nation	6.0	21.3	58.5	20.6	235.5	16.5
Bunibonibee Cree Nation	0.2	0.7	4.5	1.6	27.6	1.9
Manto Sipi Cree Nation	2.7	9.7	27.3	9.6	100.8	7.0
God's Lake NAC	0.0	0.0	0.2	0.1	3.8	0.3
Total	8.9	31.6	90.5	31.9	367.6	25.7

Notably, participants from each community produced a unique list of valued plant species for edible berries, medicines and other plant uses. Although, there was common use of some edible berries, (i.e. blueberries, raspberries), as well as *wihkes* used for medicinal purposes. The plant species and their uses are discussed separately for each community.

The area for each plant or groups of plants was quantified by marking known locations of plant occurrences, by area (km^2) or along a linear feature (km). In few cases, a point provides location information only, with no measure of the area occupied by a plant or plant group, as shown in the following sections for each community.

4.6.2 Manto Sipi Cree Nation

As a result of workshops and personal interviews, participants from Manto Sipi, identified at least 10 plant species used for food, medicine and other uses. Food berries include blueberries, raspberries, strawberries, Saskatoons, cherries and cloudberries. Medicinal plants include plant parts (e.g. leaves, roots) of several plants including Labrador tea, spruce and *wihkes*. Areas of occupancy (km^2) for valued plant species are shown in Table 4.6.2. In addition, two point locations for blueberry harvest were identified within the regional assessment area, see Map 8a. The regional assessment area was important for all species, while medicinal plants and wood cutting were found at all scales of assessment.

Table 4.6.2. Manto Sipi Cree Nation Aboriginal Traditional Knowledge summaries: Areas (km²) for valued plants by assessment area.				
Plant Species Valued: Area (km²)	**Plant Use**	**Project**	**Local**	**Regional**
Blueberries	Food	-	0.05	4.20
Blueberries, Raspberries	Food	-	-	0.09
Blueberries, Strawberries	Food	-	-	8.75
Blueberry, Saskatoon, Cherry, Raspberry	Food	-	-	6.62
Head berries (*Mistegonemina*)	Food	-	0.03	0.03
Raspberries	Food	-	-	1.59
Raspberry, Blueberry	Food	-	-	1.71
Saskatoon, Blueberries, Strawberries	Food	-	-	0.54
Saskatoon, Raspberries, Strawberries	Food	-	-	5.18
Labrador Tea	Medicine	0.03	0.77	0.83
Labrador Tea, Ginger Root	Medicine	1.22	16.76	62.31
Spruce	Medicine	1.53	9.89	12.69
Wihkes	Medicine	0.07	0.28	0.28
Firewood	Other	-	-	<0.001
Wood cutting	Other	0.001	0.55	4.35

4.6.3 Bunibonibee Cree Nation

Community participants in workshops and personal interviews identified areas (km² or km) for more than five valued food and medicinal plants. Edible berries include cloudberries, cranberries, and raspberries. Medicinal plants include *wihkes*, and other unspecified plant species used for medicinal teas. Further areas of historical berry gathering, medicinal plant gathering, and firewood harvest were also identified, see table 4.6.3. and Map 8b. All plants were found within the regional area, while collection of raspberries, *wihkes*, and firewood harvest also occurred in the local and project areas.

Table 4.6.3. Bunibonibee Cree Nation Aboriginal Traditional Knowledge summaries: Areas (km² or km) for valued plants by assessment area.				
Plant Species Valued: Area (km²)	**Plant Use**	**Project**	**Local**	**Regional**
Cloudberries	Food	-	-	0.72
Cranberries	Food	-	-	4.99
Raspberries	Food	0.01	1.17	5.98
Historic berry picking area	Food	-	-	0.01
Plants for Tea	Medicine	-	-	4.20
Wihkes	Medicine	0.19	3.49	7.08
Medicinal Plant Gathering Location	Medicine	-	-	0.70
Firewood Harvest	Other	-	0.11	5.61
Plant Species Valued: Linear (km)	**Plant Use**	**Project**	**Local**	**Regional**
Firewood Harvest	Other	3.25	27.64	42.99

4.6.4 God's Lake First Nation

Community participants in workshops and personal interviews identified at least 14 valued plants. All plants were located at the regional level, with the occurrence of some medicinal plants also identified at the project and local levels. Six food plants, including berries and one root; the berries, bark, roots and leaves of at least eight plants used for medicine; and five plants used for other purposes, are shown with areas (km^2 or km) in Table 4.6.4a, and Map 8c. In addition, point locations were provided for certain plants within the regional assessment area. Three locations were identified as important areas for raspberry picking. Areas known for harvesting three medicinal plants were identified: Labrador tea (2 areas); Ginger root (2 areas) and Juniper (1 area), see Table 4.6.4b.

Table 4.6.4a. God's Lake First Nation Aboriginal Traditional Knowledge summaries: Areas (km^2 or km) for valued plants by assessment area.

Plant Species Valued: Area (km^2)	Plant Use	Project	Local	Regional
Blueberries	Food	-	-	3.83
Blueberries & Swamp Gooseberries	Food	-	-	0.12
Cranberries	Food	-	-	0.73
Medicines, *weekes*	Food	-	-	0.02
Berries	Medicine	-	-	0.02
Black Spruce Bark, Labrador Tea & Muskeg Leaves	Medicine	5.87	56.58	223.51
Labrador Tea	Medicine	5.57	53.35	205.74
Medicinal Plants	Medicine	-	-	0.56
Water Calla	Medicine	-	-	0.84
Ginger root and *wihkes*	Medicine	-	-	0.33
Wihkes	Medicine	-	0.004	0.88
Labrador Tea & Ginger Root	Other	0.65	8.65	33.79
Raspberries & Strawberries	Other	-	-	0.30
Plant Species Valued: Linear (km)	**Plant Use**	**Project**	**Local**	**Regional**
Mossberries	Food	0.59	12.29	29.10
Labrador Tea	Medicine	-	-	2.70
Willow Sticks	Other	-	-	2.67

Table 4.6.4b. God's Lake First Nation Aboriginal Traditional Knowledge: Number of locations for valued food and medicine plants, in the regional assessment area.

Plant Species	Plant Use	Point Locations
Raspberries	Food	3
Labrador Tea	Medicine	2
Ginger Root	Medicine	2
Juniper	Medicine	1

4.6.5 God's Lake Northern Affairs Community

In a workshop held in June 2016, participants from God's Lake Northern Affairs Community shared their knowledge of medicinal and cultural plants as well as harvesting locations. The workshop identified several valued plant species including Labrador tea which is used to treat sore throats, poplar tree sap for healing wounds, and *weekis* for treating all types of ailments. Other plant species harvested by community members include diamond willow and birch trees, used for crafts and other purposes. Only collection of Labrador tea is shown in the local assessment area (0.22 km^2), see Map 8d.

5.0 POTENTIAL EFFECTS ASSESSMENT

The identification of potential effects of the proposed P6 All-Season Road Project was carried out based on information provided by MESRA, information from the MBCDC, literature and internet searches. Environmental assessments conducted on other recent all-season road projects in Manitoba were also reviewed. Requirements of *The Environment Act* (Manitoba) and the *Canadian Environmental Assessment Act* (2012) and regulations and guidelines were considered in the preparation of the effects assessment for the Road Project. This assessment report conforms to Manitoba Conservation and Water Stewardship's guideline for preparing an Environment Act Proposal Report (Manitoba Conservation and Water Stewardship 2015).

The environmental effects of the proposed P6 All-Season Road Project were identified from review of environmental assessment reports conducted on other all-season road projects, east of Lake Winnipeg, an interaction matrix and linkage diagram (Appendix III) and by using professional judgement. Community concerns will be considered in the effects assessment, where information is available. For the purpose of this assessment environmental effects are defined as a predicted change in the environment caused by the project and mitigation as measures to avoid, prevent, and minimize adverse environmental effects. Additionally, residual effects are defined as environmental effects predicted to remain after the application of mitigation measures. Valued Components (VCs) refer to elements of an ecosystem that are identified as having scientific, social, cultural, historical, archaeological or aesthetic importance that may be impacted by a project.

The significance of the residual environmental effects for the proposed P6 All-Season Road Project was evaluated using criteria provided by the Manitoba East Side Road Authority (Table 5.0.).

Table 5.0. Description of significance criteria used for the residual effects assessment.

VEC/Other Vegetation Component	Direction of Change (type of effect)	Duration (period of time the effect occurs)	Magnitude (degree or intensity of the change)	Extent (spatial boundary)	Frequency (how often the effect occurs)	Reversibility (the degree of permanence)	Ecological and Social Context (whether a VC is particularly sensitive to disturbance and can adapt to change)
VEC - Species of Conservation Concern	**Neutral or Negligible:** No measurable change on the environment. **Negative:** Net loss (adverse or undesirable change) on the VC. **Positive:** Net benefit (or desirable change) on the VC.	**Short-Term (Level I):** The potential effect results from short-term events or activities such as the time required to complete a discrete component, seasonal or annual construction, maintenance or rehabilitation activities (i.e., a timeframe of several months). **Medium-Term (Level II):** The potential effect is likely to persist until the completion of construction and rehabilitation activities (i.e., a timeframe of 8 to 10 years). **Long-Term (Level III):** The potential effect is likely to persist beyond the completion of construction and rehabilitation activities into the operations and maintenance phase of the Project (i.e., a timeframe of greater than 10 years).	**Negligible or Low (Level I):** A change that is not likely to have a definable, detectable or measurable potential effect above baseline (i.e., potential effect is within a normal range of variation) or is below established thresholds of acceptable change (e.g., minimal risk of loss of species of conservation concern). **Moderate (Level II):** A change that will have a potential measurable effect that can be detected with a well-designed monitoring program; but is only marginally beyond standards/guidelines or established thresholds of acceptable change (e.g., loss of species of conservation concern but not predicted to change the state of the plant community or population). **High (Level III):** A change that will have potential effects that are easily observed, measured and described (i.e., readily detectable without a monitoring program) and are well beyond guidelines or established thresholds of acceptable change (e.g., loss of species of conservation concern and is predicted to change the state of the plant community or population).	**Project Footprint (Level I):** The physical space or directly affected area on which Project components or activities are located and/or immediately adjacent area which is within the defined limits of the P6 ASR ROW (i.e., 100 m) and permanent and temporary facilities (e.g., temporary access routes and quarries) within which potential effects are likely to be measurable. **Local Assessment Area (Level II):** Area within which potential project effects are measurable and extending beyond the Project Footprint to, but not beyond, the Local Assessment Area. **Regional Assessment Area (Level III):** Area beyond the Local Assessment Area within which most potential indirect and cumulative effects would occur.	**Infrequent (Level I):** The potential effect occurs once or seldom during the life of the Project (e.g., initial clearing of the ROW). **Sporadic/Intermittent (Level II):** The potential effect occurs only occasionally and without any predictable pattern during the life of the Project (e.g., blasting at quarries; site-specific construction equipment noise; potential wildlife-vehicle collisions). **Regular/Continuous (Level III):** The potential effect occurs at regular and frequent intervals during the Project phase in which they occur or over life of the Project (e.g., construction traffic; operations traffic).	**Reversible (short-term) (Level I):** Potential effect is readily reversible over a relatively short period of time (i.e., ≤ to the Project construction phase of approximately 8 years). **Reversible (long-term) (Level II):** Potential effect is potentially reversible but over a long period of time (i.e., many years into the Project operations phase). **Irreversible (Level III):** Project-specific potential effects are permanent.	**Low (Level I):** The VC is not rare or unique and is resilient to imposed change (e.g., has little to no unique attributes and is of minor importance to ecosystems functions or relationship). **Moderate (Level II):** The VC is moderately/seasonally fragile and has some capacity to adapt to imposed change (e.g., has some unique attributes and is somewhat important to ecosystem functions or relationship). **High (Level III):** The VC is a protected/designated species or fragile with low resistance to imposed change or part of a very fragile ecosystem (e.g., is considered to be unique and involves provincially or federally protected species).

Table 5.0. Description of significance criteria used for the residual effects assessment.							
VEC/Other Vegetation Component	**Direction of Change** (type of effect)	**Duration** (period of time the effect occurs)	**Magnitude** (degree or intensity of the change)	**Extent** (spatial boundary)	**Frequency** (how often the effect occurs)	**Reversibility** (the degree of permanence)	**Ecological and Social Context** (whether a VC is particularly sensitive to disturbance and can adapt to change)
VEC – Key Community Harvest Areas (Plant Species of Interest)	**Neutral or Negligible:** No measurable change on the environment. **Negative:** Net loss (adverse or undesirable change) on the VC. **Positive:** Net benefit (or desirable change) on the VC.	**Short-Term (Level I):** The potential effect results from short-term events or activities such as the time required to complete a discrete component, seasonal or annual construction, maintenance or rehabilitation activities (i.e., a timeframe of several months). **Medium-Term (Level II):** The potential effect is likely to persist until the completion of construction and rehabilitation activities (i.e., a timeframe of 8 to 10 years). **Long-Term (Level III):** The potential effect is likely to persist beyond the completion of construction and rehabilitation activities into the operations and maintenance phase of the Project (i.e., a timeframe of greater than 10 years).	**Negligible or Low (Level I):** A change that is not likely to have a definable, detectable or measurable potential effect above baseline (i.e., potential effect is within a normal range of variation) or is below established thresholds of acceptable change (e.g., no or minimal loss of key community harvest areas). **Moderate (Level II):** A change that will have a potential measurable effect that can be detected with a well-designed monitoring program; but is only marginally beyond standards/guidelines or established thresholds of acceptable change. (e.g., loss of key community harvest areas but not predicted to change the state of the plant community). **High (Level III):** A change that will have potential effects that are easily observed, measured and described (i.e., readily detectable without a monitoring program) and are well beyond guidelines or established thresholds of acceptable change. (e.g., loss of key community harvest areas and is predicted to change the state of the plant community).	**Project Footprint (Level I):** The physical space or directly affected area on which Project components or activities are located and/or immediately adjacent area which is within the defined limits of the P6 ASR ROW (i.e., 100 m) and permanent and temporary facilities (e.g., temporary access routes and quarries) within which potential effects are likely to be measurable. **Local Assessment Area (Level II):** Area within which potential project effects are measurable and extending beyond the Project Footprint to, but not beyond, the Local Assessment Area. **Regional Assessment Area (Level III):** Area beyond the Local Assessment Area within which most potential indirect and cumulative effects would occur.	**Infrequent (Level I):** The potential effect occurs once or seldom during the life of the Project (e.g., initial clearing of the ROW). **Sporadic/Intermittent (Level II):** The potential effect occurs only occasionally and without any predictable pattern during the life of the Project (e.g., blasting at quarries; site-specific construction equipment noise; potential wildlife-vehicle collisions). **Regular/Continuous (Level III):** The potential effect occurs at regular and frequent intervals during the Project phase in which they occur or over life of the Project (e.g., construction traffic; operations traffic).	**Reversible (short-term) (Level I):** Potential effect is readily reversible over a relatively short period of time (i.e., ≤ to the Project construction phase of approximately 8 years). **Reversible (long-term) (Level II):** Potential effect is potentially reversible but over a long period of time (i.e., many years into the Project operations phase). **Irreversible (Level III):** Project-specific potential effects are permanent.	**Low (Level I):** The VC is not rare or unique and is resilient to imposed change (e.g., has little to no unique attributes and is of minor importance to ecosystems functions or relationship). **Moderate (Level II):** The VC is moderately/seasonally fragile and has some capacity to adapt to imposed change (e.g., has some unique attributes and is somewhat important to ecosystem functions or relationship). **High (Level III):** The VC is a protected/designated species or fragile with low resistance to imposed change or part of a very fragile ecosystem (e.g., is considered to be unique and involves provincially or federally protected species).

Table 5.0. Description of significance criteria used for the residual effects assessment.							
VEC/Other Vegetation Component	**Direction of Change** (type of effect)	**Duration** (period of time the effect occurs)	**Magnitude** (degree or intensity of the change)	**Extent** (spatial boundary)	**Frequency** (how often the effect occurs)	**Reversibility** (the degree of permanence)	**Ecological and Social Context** (whether a VC is particularly sensitive to disturbance and can adapt to change)
Other Vegetation and Soil Components	**Neutral or Negligible:** No measurable change on the environment. **Negative:** Net loss (adverse or undesirable change) **Positive:** Net benefit (or desirable change)	**Short-Term (Level I):** The potential effect results from short-term events or activities such as the time required to complete a discrete component, seasonal or annual construction, maintenance or rehabilitation activities (i.e., a timeframe of several months). **Medium-Term (Level II):** The potential effect is likely to persist until the completion of construction and rehabilitation activities (i.e., a timeframe of 8 to 10 years). **Long-Term (Level III):** The potential effect is likely to persist beyond the completion of construction and rehabilitation activities into the operations and maintenance phase of the Project (i.e., a timeframe of greater than 10 years).	**Negligible or Low (Level I):** A change that is not likely to have a definable, detectable or measurable potential effect above baseline (i.e., potential effect is within a normal range of variation). **Moderate (Level II):** A change that will have a potential measurable effect that can be detected with a well-designed monitoring program; but is only marginally beyond standards/guidelines of acceptable change. **High (Level III):** A change that will have potential effects that are easily observed, measured and described (i.e., readily detectable without a monitoring program) and are well beyond guidelines of acceptable change.	**Project Footprint (Level I):** The physical space or directly affected area on which Project components or activities are located and/or immediately adjacent area which is within the defined limits of the P6 ASR ROW (i.e., 100 m) and permanent and temporary facilities (e.g., temporary access routes and quarries) within which potential effects are likely to be measurable. **Local Assessment Area (Level II):** Area within which potential project effects are measurable and extending beyond the Project Footprint to, but not beyond, the Local Assessment Area. **Regional Assessment Area (Level III):** Area beyond the Local Assessment Area within which most potential indirect and cumulative effects would occur.	**Infrequent (Level I):** The potential effect occurs once or seldom during the life of the Project (e.g., initial clearing of the ROW). **Sporadic/Intermittent (Level II):** The potential effect occurs only occasionally and without any predictable pattern during the life of the Project (e.g., blasting at quarries; site-specific construction equipment noise; potential wildlife-vehicle collisions). **Regular/Continuous (Level III):** The potential effect occurs at regular and frequent intervals during the Project phase in which they occur or over life of the Project (e.g., construction traffic; operations traffic).	**Reversible (short-term) (Level I):** Potential effect is readily reversible over a relatively short period of time (i.e., ≤ to the Project construction phase of approximately 8 years). **Reversible (long-term) (Level II):** Potential effect is potentially reversible but over a long period of time (i.e., many years into the Project operations phase). **Irreversible (Level III):** Project-specific potential effects are permanent.	**Low (Level I):** The component is not rare or unique and is resilient to imposed change (e.g., has little to no unique attributes and is of minor importance to ecosystems functions or relationship). **Moderate (Level II):** The component is moderately/seasonally fragile and has some capacity to adapt to imposed change (e.g., has some unique attributes and is somewhat important to ecosystem functions or relationship). **High (Level III):** The component is a protected/designated species or fragile with low resistance to imposed change or part of a very fragile ecosystem (e.g., is considered to be unique and involves provincially or federally protected species).

5.1 Environmental Issues

Regional issues of concern for the assessment of the proposed P6 All-Season Road Project were determined from literature and professional experience; any concerns identified through future traditional knowledge workshops will be considered. Regional issues of concern include the following:

Country Foods

In remote northern regions, country food is an important part of the Aboriginal people's traditional diet. Many Aboriginal people consume a diet of foods that are fished, hunted, trapped and gathered locally. Today, foods are expensive to import and many people still rely on country foods as a portion of their diet. Plants as country foods may include berries, herbs, nuts, wild rice, and locally grown garden vegetables.

Spread of Invasive Plant Species

Invasive plant species are plants that out-compete native species when introduced outside of their natural setting. Invasive species may establish and proliferate as a result of the Project. These species are problematic because they are capable of growing under a wide range of climatic and soil conditions, produce abundant seeds, and often have vigorous growth.

5.2 Valued Components

Valued Components (VCs) refer to elements of an ecosystem that are identified as having scientific, social, cultural, historical, archaeological or aesthetic importance that may be impacted by a project. The value of a component not only relates to its role in the ecosystem, but also to the value people place on it. The value of a component may be determined on the basis of scientific, social, cultural, economic, historical, archaeological, or aesthetic importance. Canadian Environmental Assessment Agency Guidelines (CEAA 2015) for the proposed Project were also reviewed for including potential VCs.

Information on importance, environmental indicators, measurable parameters, and rationale are provided on the VCs. Environmental indicators are aspects of VCs or the environment that are subject to change by a project activity, while measurable parameters are variables used to express changes in the environmental indicators. VCs that have the potential to be adversely affected by project activities after mitigation has been applied receive special consideration in the assessment of cumulative environmental effects. VCs identified for the proposed P6 All-Season Road Project assessment include the following (see also Table 5.2.):

Species of Conservation Concern

Species of conservation concern are valued because these are plants that exist in low numbers, play a role in helping to preserve species diversity, their distribution is often restricted, and some species are protected. These include species listed by the federal Species at Risk Act (SARA), under Schedule 1, The Endangered Species and Ecosystems Act – Manitoba (ESEA), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and those species listed by the Manitoba Conservation Data Centre (MBCDC) ranked very rare to rare.

Key Community Harvest Areas

Key community harvest areas (plant species of interest) are important to the community and valued for food, ceremonies, income or medicinal purposes. These plants and areas are often identified through traditional knowledge studies and other engagement activities. Key community harvest areas (plant species of interest) may include blueberries, cranberries, raspberries, strawberries, saskatoons, cloudberries and wild rice, and many other medicinal plants and herbs (Northern Lights Heritage Services 2000).

Table 5.2. Vegetation Valued Components.

VCs	Group	Importance	Environmental Indicator	Measurable Parameter	Rationale
Species of Conservation Concern	Various Plants	• Government • Other[1]	Species occurrence	Presence/ absence	• Regulatory importance (SARA under Schedule 1; COSEWIC; ESEA; MBCDC species listed very rare to rare) • Ecological and environmental importance
Key Community Harvest Areas (Plant Species of Interest)	Various Plants	• First Nation[2] • Government • Other[1]	Species occurrence; area of resource use	Presence/ absence; hectares	• Cultural importance • Regulatory importance • Ecological and environmental importance

[1]Other (e.g., science).

[2]First Nations (Gods Lake, Bunibonibee and Manto Sipi).

5.3 Effects Analysis

The following identifies the effects on vegetation and soils for the proposed P6 All-Season Road Project.

5.3.1 Vegetation

Effects of roads on vegetation and terrestrial ecosystems have been reported on by Angold (1997), Forman and Alexander (1998), Trombulak and Frissell (1999), Hui et al. (2003), Noss (2002), Watkins et al. (2003), Li et al. (2014) and others. Effects include habitat loss, altering interior forest conditions, destroying natural vegetation along sides of the road, reduction in biomass, introduction of non-native plant species, increased erosion potential, and increased abundance of grass species near roads. Road dust affects vegetation by covering plant surfaces, affecting photosynthesis, respiration and transpiration, resulting in decreased productivity (Farmer, 1993). Brown (2009) found that fugitive dust in forested roadsides influenced plant species with the greatest effect closest to the roadway.

Potential environmental effects of similar all-season road projects have been reported on to include the loss of vegetation and other culturally important species in the project assessment area during construction; increased risk of invasive species spread, impairment of vegetation during construction and maintenance activities, and increased risk of forest fire (e.g., MESRA 2016a; MESRA 2016b; Szwaluk Environmental Consulting et al. 2015; Manitoba Floodway and East Side Road Authority 2010 and 2011; Canadian Environmental Assessment Agency 2011).

Predicated effects from other linear development projects in Manitoba's boreal forest have been reported on by Calyx Consulting (2012) and Szwaluk Environmental Consulting et al. (2011) and include loss of native forest vegetation, introduction of invasive plant species, potential loss of habitat and plants used by Aboriginal people, disruption of riparian areas and wetlands, increased fragmentation, and increased risk of wildfire.

The proposed P6 All-Season Road Project may affect vegetation and botanical resources during construction, operation and maintenance stages. Potential environmental effects prior to mitigation include the following:

1. Loss of species of conservation concern in the project assessment area due to clearing during construction. These plants include species listed by SARA, ESEA, and COSEWIC, and plants listed by the MBCDC as very rare to rare, however protected vascular plant species listed by SARA and ESEA are not expected to occur as the study area is beyond the geographic range of the listed species. Flooded jellyskin (*Leptogium rivulare*) lichen listed by SARA and COSEWIC does not occur in the ecoregion and was not found during the 2016 field studies.

2. Disturbance to or removal of key community harvest areas of plant species of interest (medicinal and cultural) in the project assessment area due to clearing during construction. The local communities use a number of plants in the area, and the P6 All-Season Road Project will result in removal of approximately 8.9 km^2 of vegetation, from road construction, that is locally valued. A potential beneficial effect from the P6 All-Season Road Project will be increased access to new botanical resource areas by local community members.

3. Disturbance to or removal of native vegetation in the project assessment area due to clearing during construction. The P6 All-Season Road Project will result in the removal of approximately 27.3 km^2 of native vegetation (excluding exposed land and water) from road construction; additionally 1.9 km^2 will be removed from quarries and access roads.

4. Disturbance or loss to species composition and ecology of wetlands (bog and fen) in the project assessment area due to clearing during construction. The Project will result in the loss of approximately 3.5 km^2 of wetland (bog and fen) area from road construction; another 0.1 km^2 will be removed from quarries and access roads. Wetlands in the boreal forest are highly connected systems that transport water and nutrients across the landscape. Water balances that have been altered in wetlands may result in increased drainage (drier moisture regime) or flooding that could affect species abundance and composition (Ecological Land Surveys Ltd. 1999). Road development has the potential to impede water flow resulting in long-term vegetation changes (Ducks Unlimited Canada et al. 2014).

5. Fragmentation of the local and regional vegetation communities due to clearing during construction. The P6 All-Season Road, quarries and access roads will result in discontinuity in the spatial distribution of native vegetation, resulting in fragments and ecosystem patches. A consequence of fragmentation is the isolation of vegetation communities that may result in reduced pollen quantity and reproduction. The continued fragmentation of an area can cause long-term reduction in species diversity and suitable habitat (Public Service Commission of Wisconsin 2009).

6. Modification of vegetation composition and structure adjacent to the disturbance zone due to clearing during construction. The removal of native vegetation and the creation of new forest edges along a disturbance zone may result in changes to the vegetation. Increased solar radiation exposure and a change in microclimate along these edges may cause changes in structure and species composition (Ecological Land Surveys Ltd. 1999). Along newly created forest edges, windfall may result due to extreme weather events (e.g., high winds).

7. Introduction and spread of invasive and non-native species in the project assessment area during construction, operation and maintenance. Construction equipment and granular material used for construction can be a source of non-native and invasive plant species which can become problematic for the native plant species in the area. Where road development occurs, a change in plant composition adjacent to the road is generally a result non-native and invasive species introduction. A large number of invasive species have the potential to be introduced during project activities.

8. Loss/impairment of vegetation in the project assessment area from accidental releases of fuels or hazardous substances during road construction, and operation and maintenance. In a past study that examined the effects of oil spills and vegetation, non-vascular plants and most dicot plants showed no recovery after oil was spilled on selected plant communities (Walker et al. 1978).

9. Loss/impairment of desirable plant species in the project assessment area from herbicide application during road operation and maintenance. Unfortunately, herbicides not only inhibit the growth of undesirable species but can also negatively affect desirable species by causing stress and possible mortality of vegetation that may be considered important for wildlife, traditional uses, or botanical value.

10. Impairment of vegetation in the project assessment area from dust during road construction, operation and maintenance. Dust can have a potential negative effect on the environment causing stress to adjacent vegetation. A covering of dust on leaf surfaces increases solar heat absorption and decreases transpiration rates resulting in a reduction of carbon uptake (Succarieh 1992).

11. Increased risk of forest fire in the local and regional assessment area during construction, and operation and maintenance. Wildfire has the potential to develop from the accumulation of slash during clearing and construction activities, and from human related causes as a result of new access during road operation.

12. Increased access to botanical resources used by non-community members during road operation. The P6 All-Season Road Project will attract people and allow access to areas that were previously unreachable. This can result in the potential adverse effects on local botanical resources. The local aboriginal people have long established traditional uses related to botanical resources, including berry picking, medicine gathering and harvesting plants.

13. Reduced floristic diversity immediately adjacent to the road due to clearing and construction. The P6 All-Season Road will be centered on a 100 m ROW with a

typical clearing width of 60 m and additional clearing as required in horizontal curves to maintain sight distances; the roadway will be constructed with a road top width of 10 m (MESRA 2016c). As a result, the flora will be temporarily reduced along the All-Season Road in the cleared RoW. Any rehabilitation plantings usually consist of a limited mix of graminoids, forbs and shrubs.

Mitigation measures for vegetation effects have been reported by Forman and Alexander (1998), Daigle (2010), Ducks Unlimited Canada et al. (2014), Szwaluk Environmental Consulting et al. (2015), and MESRA (2016a and 2016b). Best practices and environmental protection measures identified to mitigate adverse environmental effects on vegetation as a result of the proposed P6 All-Season Road Project include: limit clearing to designated area within the ROW, undertake construction activities during winter months to the extent possible, grubbing activities to end 2 m from standing timber to avoid disturbing the root system of standing trees, identify plant species of conservation concern prior to clearing, adjust the road alignment, where possible, to avoid loss of important harvest areas as identified by communities; design road and construction practices to avoid adversely affecting the functionality of bogs and fens; implement design measures to maintain existing moisture conditions that support localized vegetative communities as per the Operational Guide to Forest Road Wetland Crossings (Ducks Unlimited Canada et al. 2014), clean construction equipment and vehicles (where possible) prior to bringing them into the construction area, adhere to permit terms and conditions for herbicide use, undertake burning of slash piles during the winter months to the extent possible, and restore ground cover vegetation using natural means augmented with planting and seeding as required.

The range of evaluation criteria for potential residual effects on vegetation were determined to be adverse in direction of change, low to high ecological and societal context, medium to long-term duration, low to moderate magnitude, extent ranging from the project footprint to the regional assessment area, frequency of infrequent to continuous, and long-term reversibility of effects.

Follow-up actions identified include inspections to ensure that mitigation is implemented and effective. The residual effects on VCs (i.e., species of conservation concern, key community harvest areas/plant species of interest) were determined to have minimal risk of loss/mortality in the project assessment area. The environmental effects analysis for vegetation is summarized in Table 5.3.1.

Table 5.3.1. Vegetation effects analysis.				
Nature of Potential Effects	**Evaluation (Before Mitigation)**	**Mitigation Measures**	**Residual Effects**	**Evaluation (After Mitigation)**
Loss of species of conservation concern in the project assessment area due to clearing during construction	Direction – negative Ecological and societal context –moderate Duration – long-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term	• Identify/survey plant species of conservation concern prior to clearing • Adjust road alignment where possible to avoid loss of plant species of conservation concern • Prohibit equipment and vehicle use outside the designated cleared area	Minimal risk of loss of plant species of concern; no species of conservation concern were found during 2016 field studies	Direction – negative Ecological and societal context –moderate Duration – long-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – long-term
Loss of flooded jellyskin (*Leptogium rivulare*) lichen in the project assessment area due to clearing during construction	Direction – negative Ecological and societal context – high Duration – long-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term	• Identify and flag plant species of locations prior to clearing • Adjust road alignment where possible to avoid loss of species locations • Prohibit equipment and vehicle use outside the designated cleared area • Limit clearing to designated areas within the project assessment area	Minimal risk of loss to flooded jellyskin lichen; **flooded jellyskin was not observed during 2016 field studies**	Direction – negative Ecological and societal context – high Duration – long-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – long-term
Disturbance to or removal of key community harvest areas of plant species of interest (medicinal, cultural) in the project assessment area due to clearing during construction	Direction – negative Ecological and societal context –moderate Duration – long-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term	• Identify areas of cultural importance prior to clearing • Identify important medicinal and cultural plants and harvesting areas • Adjust road where possible to avoid to the loss of important harvesting area • Limit clearing to designated area within the project assessment area • Prohibit use of equipment and	Minimal loss of vegetation and loss confined to project assessment area	Direction – negative Ecological and societal context –moderate Duration – long-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – long-term

Table 5.3.1. Vegetation effects analysis.				
Nature of Potential Effects	**Evaluation (Before Mitigation)**	**Mitigation Measures**	**Residual Effects**	**Evaluation (After Mitigation)**
		vehicles outside the designated cleared area		
Disturbance to or removal of native vegetation in the project assessment area due to clearing during construction	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – high Extent – project footprint Frequency – infrequent Reversibility – long-term	• Limit clearing to designated areas within the project assessment area • Prohibit equipment and vehicle use outside the designated cleared area • Grubbing activities to end 2 m from standing timber to avoid disturbing the root system of standing trees • Restore ground cover vegetation along road shoulders using natural means augmented with planting and seeding of native species as required	Removal of native vegetation confined to the project assessment area	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term
Disturbance or loss to species composition and ecology of wetlands (bogs and fens) in the project assessment area due to clearing during construction	Direction – negative Ecological and societal context – moderate Duration – long-term Magnitude – high Extent – project footprint Frequency – infrequent Reversibility – long-term	• Design road and construction practices to avoid adversely affecting the functionality of bogs and fens (i.e., equalization culverts to maintain bog/fen hydraulics) • Undertake construction activities in bog/fens during winter months to extent possible • Implement design measures to maintain existing moisture conditions that support localized vegetative communities as per the Operational Guide to Forest Road Wetland Crossings (Ducks	Wetland (bog and fen) loss confined to the project assessment area	Direction – negative Ecological and societal context –moderate Duration – long-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term

Table 5.3.1. Vegetation effects analysis.				
Nature of Potential Effects	**Evaluation (Before Mitigation)**	**Mitigation Measures**	**Residual Effects**	**Evaluation (After Mitigation)**
		Unlimited Canada et al. 2014)		
Fragmentation of the local and regional vegetation communities due to clearing during construction	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – high Extent – local and regional assessment area Frequency – infrequent Reversibility – long-term	• Undertake clearing activities during winter months to extent possible • Limit clearing to designated area within the project assessment area • Prohibit equipment and vehicle use outside the designated cleared area	Fragmentation confined to the project assessment area	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term
Modification of vegetation composition and structure adjacent to the disturbance zone due to clearing during construction	Direction – negative Ecological and societal context – low Duration – medium-term Magnitude – moderate Extent – local assessment area Frequency – infrequent Reversibility – long-term	• Undertake clearing activities during winter months to extent possible • Limit clearing to designated area within the project assessment area • Prohibit equipment and vehicle use outside the designated cleared area	Minimal modification of vegetation adjacent to disturbance zone	Direction – negative Ecological and societal context – low Duration – medium-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – long-term
Introduction and spread of invasive and non-native species in the project assessment area during construction, operation and maintenance	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – high Extent – project footprint Frequency – continuous Reversibility – long-term	• Clean construction equipment and vehicles prior to bringing them into the construction site (where possible) • Undertake construction activities during winter months to the extent possible	Minimal risk of invasive and non-native species introduction	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – project footprint Frequency – continuous Reversibility – long-term
Loss/impairment of vegetation in the project assessment area from accidental releases of fuels or hazardous substances during road construction	Direction – negative Ecological and societal context – moderate Duration – long-term Magnitude – moderate Extent – project footprint Frequency – intermittent	• Construction sites to have an approved emergency response plan that includes fuel spills • Store fuel in approved containers provided with secondary containment	Minimal risk of vegetation mortality	Direction – negative Ecological and societal context –moderate Duration – long-term Magnitude – low Extent – project footprint Frequency – intermittent

Table 5.3.1. Vegetation effects analysis.				
Nature of Potential Effects	**Evaluation (Before Mitigation)**	**Mitigation Measures**	**Residual Effects**	**Evaluation (After Mitigation)**
and operation and maintenance	Reversibility – long-term	• Drip trays, blankets or pads to be used when transporting fuel		Reversibility – long-term
Loss/impairment of desirable plant species in the project assessment area from herbicide application during road operation and maintenance	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – project footprint Frequency – intermittent Reversibility – long-term	• Apply herbicides in accordance with manufacturers guidelines and adhere to permit terms and conditions • Limit herbicide application beyond road shoulder	Minimal risk of vegetation mortality	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – low Extent – project footprint Frequency – intermittent Reversibility – long-term
Impairment of vegetation in the project assessment area from dust during road construction, operation and maintenance	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – project footprint Frequency – intermittent Reversibility – short-term	• Undertake construction activities during winter months to extent possible • Use water or approved dust suppression agents that will not negatively affect plants	Minimal risk of vegetation mortality	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – low Extent – project footprint Frequency – intermittent Reversibility – short-term
Increased risk of forest fire in the local and regional assessment area during construction and operation and maintenance	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – high Extent – regional assessment area Frequency – intermittent Reversibility – long-term	• Undertake construction and burning during the winter months to the extent possible • Prohibit burning of slash piles during high forest fire conditions	Minimal risk of forest fires	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – regional assessment area Frequency – intermittent Reversibility – long-term
Increased access to botanical resources used by non-community members during road operation	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – low Extent – local assessment area Frequency – intermittent Reversibility – long-term	• Non-mitigable	Minimal loss of botanical resources	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – low Extent – local assessment area Frequency – intermittent Reversibility – long-term
Reduced floristic diversity immediately adjacent to	Direction – negative Ecological and societal context – low	• Limit clearing to designated areas within the project assessment	Reduced floristic diversity confined to the project	Direction – negative Ecological and societal context – low

Table 5.3.1. Vegetation effects analysis.				
Nature of Potential Effects	**Evaluation (Before Mitigation)**	**Mitigation Measures**	**Residual Effects**	**Evaluation (After Mitigation)**
the road due to clearing and construction	Duration – medium-term Magnitude – moderate Extent – local assessment area Frequency – infrequent Reversibility – long-term	area • Prohibit equipment and vehicle use outside the designated cleared area • Restore ground cover vegetation along road shoulders using natural means augmented with planting and seeding of native species as required	assessment area	Duration – medium-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term

5.3.2 Soils

A close relationship between soils and vegetation develop as soils begin to form. Vegetation helps break down solid materials and provides organic matter building soil. In return, soils are important to vegetation for several reasons including providing a medium for growth and the storing of nutrients. According to Hironaka et al. (1990), soils and vegetation are mutually associated with each other when reviewing basic concepts of development, both influenced by the same environmental variables. The relationship between soils and vegetation growth has been researched by several authors (e.g., Twardy and Corns 1980; Strong and La Roi 1983; Klinka et al. 1994; Szwaluk and Strong 2003).

Effects of road construction on the soil environment has been documented by a variety of authors (Bilby et al. 1989; Brown 2009; Daigle 2010; Noss 2002; Senes Consultants Ltd. 2005; Swift 1988; and Trombulak and Frissell 1999). Effects of road construction on soils include contamination from a variety of pollutants, loss of productivity, erosion, compaction, and loss of biomass. Brown (2009) found that soil chemistry was influenced from roadside dust in forested environments and dust from limestone roads had a greater effect on soils that led to an increase in roadside invasive species.

Potential environmental effects of similar all-season road projects have been reported on to include the loss of soils from construction activities, compaction, erosion, modification of the soil moisture regime, and impaired soil quality from accidental releases of hazardous materials (e.g., MESRA 2016a; MESRA 2016b; Szwaluk Environmental Consulting et al. 2015; Manitoba Floodway and East Side Road Authority 2010 and 2011; Canadian Environmental Assessment Agency 2011).

The proposed P6 All-Season Road Project may affect soils during construction, operation and maintenance stages. Potential environmental effects prior to mitigation include the following:

1. Loss of soil in the project assessment area due to clearing, stripping and construction.

2. Compaction of soil in the project assessment area due to heavy equipment use during construction.

3. Loss of soil in the project assessment area due to erosion of cleared sites during construction.

4. Loss of soil in the project assessment area due to erosion of soil stockpiles during construction.

5. Modification of soil moisture regime in the local assessment area during operation and maintenance.

6. Impaired soil quality in the project assessment area from accidental releases of fuels and hazardous substances during construction, operation and maintenance.

7. Impaired soil quality in the project assessment area from herbicide application during operation and maintenance.

Measures identified to mitigate adverse environmental effects on soils include stockpiling soils that are stripped for use in re-vegetation, minimize the amount of soil stripped in construction sites, minimize compaction of soils by heavy equipment in construction areas, provide erosion protection and sediment control, manage surface drainage at construction sites, minimize the loss of soil by covering stockpiles (i.e., impervious layer such as geotextile fabric); minimize the amount of soil stockpiled on site if possible; remove or spread excess material as soon as work is completed to minimize erosion, provide hydraulic equalization culverts to prevent ponding of water at upstream locations and drying at downstream locations, store fuels and other hydrocarbon containing substances in approved containers, use drip trays when fuelling construction equipment and vehicles, construction sites to have an approved emergency response plan that includes fuel spills, and adhere to herbicide permit terms and conditions.

The range of evaluation criteria for potential residual effects on soils were determined to be adverse in direction of change, low to moderate ecological and societal context, short to long-term duration, low to moderate magnitude, extent restricted to the project footprint and local assessment area, frequency of infrequent to intermittent, and short to long-term reversibility of effects. Follow-up actions identified include inspections to ensure that mitigation is implemented and effective. The environmental effects analysis for soils is summarized in Table 5.3.2.

Table 5.3.2. Soils effects analysis.				
Nature of Potential Effects	**Evaluation (Before Mitigation)**	**Mitigation Measures**	**Residual Effects**	**Evaluation (After Mitigation)**
Loss of soil in the project assessment area due to clearing, stripping and construction	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – long-term	• Stockpile soil stripped from the proposed road bed for re-vegetation purposes • Minimize amount of soil stripped in construction sites	Minimal loss of soils	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – long-term
Compaction of soil in the project assessment area due to heavy equipment use during construction	Direction – negative Ecological and societal context – low Duration – medium-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – short-term	• Carry out construction during the winter months to the extent possible • Minimize compaction of soils by heavy equipment in construction areas	Minimal compaction of soils	Direction – negative Ecological and societal context – low Duration – medium-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – short-term
Loss of soil in the project assessment area due to erosion of cleared sites during construction	Direction – negative Ecological and societal context – low Duration – medium-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – short-term	• Provide erosion protection and sediment control as required • Manage surface drainage at construction sites	Minimal risk of soil erosion	Direction – negative Ecological and societal context – low Duration – medium-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – short-term
Loss of soil in the project assessment area due to erosion of soil stockpiles during construction	Direction – negative Ecological and societal context – low Duration – short-term Magnitude – moderate Extent – project footprint Frequency – infrequent Reversibility – short-term	• Minimize the loss of soil by covering stockpiles (i.e., impervious layer such as geotextile fabric) • Minimize the amount of soil stockpiled on site if possible • Remove or spread excess material as soon as work is completed to minimize erosion • Provide erosion protection	Minimal risk of soil erosion	Direction – negative Ecological and societal context – low Duration – short-term Magnitude – low Extent – project footprint Frequency – infrequent Reversibility – short-term

Table 5.3.2. Soils effects analysis.				
Nature of Potential Effects	**Evaluation (Before Mitigation)**	**Mitigation Measures**	**Residual Effects**	**Evaluation (After Mitigation)**
		and sediment control as required		
Modification of soil moisture regime in the local assessment area during operation and maintenance	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – local assessment area Frequency – infrequent Reversibility – short-term	• Provide hydraulic equalization culverts to prevent ponding of water at upstream locations and drying at downstream locations	Minimal impairment to soil moisture regime	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – low Extent – local assessment area Frequency – infrequent Reversibility – short-term
Impaired soil quality in the project assessment area from accidental releases of fuels and hazardous substances during construction, operation and maintenance	Direction – negative Ecological and societal context – moderate Duration – long-term Magnitude – moderate Extent – project footprint Frequency – intermittent Reversibility – long-term	• Store fuels and other hydrocarbon containing substances in approved containers • Use drip trays, pads or sheets when fuelling construction equipment and vehicles • Construction sites to have an approved emergency response plan that includes fuel spills	Minimal risk of impaired soil quality	Direction – negative Ecological and societal context – moderate Duration – long-term Magnitude – low Extent – project footprint Frequency – intermittent Reversibility – long-term
Impaired soil quality in the project assessment area from herbicide application during operation and maintenance	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – moderate Extent – project footprint Frequency – intermittent Reversibility – long-term	• Apply herbicide in accordance with manufacturers guidelines • Adhere to herbicide permit terms and conditions	Minimal risk of impaired soil quality	Direction – negative Ecological and societal context – low Duration – long-term Magnitude – low Extent – project footprint Frequency – intermittent Reversibility – long-term

6.0 ENVIRONMENTAL PROTECTION

6.1 Environmental Protection Measures

Environmental protection measures identified in this assessment report include specific mitigation measures to avoid or minimize potential adverse effects on vegetation and soils arising from the Project. The environmental protection measures are based on best practices and guidance materials from other development projects, and are summarized from the Effects Assessment (Section 5.0).

Vegetation Mitigation Measures

- Limit clearing to designated areas within the project assessment area.
- Prohibit equipment and vehicle use outside the designated cleared area.
- Restore ground cover vegetation along road shoulders using natural means augmented with planting and seeding of native species as required.
- Grubbing activities to end 2 m from and standing timber to avoid disturbing the root system of standing trees.
- Design road and construction practices to avoid adversely affecting the functionality of bogs and fens. i.e., installation of equalization culverts
- Implement design measures to maintain existing moisture conditions that support localized vegetative communities as per the Operational Guide to Forest Road Wetland Crossings (Ducks Unlimited Canada et al. 2014).
- Undertake construction activities during winter months to extent possible.
- Identify areas of cultural importance prior to clearing.
- Identify important medicinal and cultural plants and harvesting areas.
- Identify species of conservation concern prior to clearing.
- Adjust road alignment where warranted to avoid loss of key community harvest areas.
- Wash construction equipment and vehicles prior to bringing them into the construction site.
- Construction sites to have an approved emergency response plan that includes fuel spills.
- Store fuel in approved containers provided with secondary containment.
- Use drip trays, blankets or pads when transporting fuel.
- Apply herbicides in accordance with manufacturer's guidelines and adhere to permit terms and conditions.
- Limit herbicide application beyond road shoulder.
- Use water or approved dust suppression agents that will not negatively affect plants.
- Undertake construction and burning during the winter months to the extent possible.

- Prohibit burning of slash piles during high forest fire conditions.

Soil Mitigation Measures

- Stockpile soil stripped from the proposed road bed for revegetation purposes.
- Minimize amount of soil stripped in construction sites.
- Minimize compaction of soils by heavy equipment in construction areas.
- Provide erosion protection and sediment control as required.
- Manage surface drainage at construction sites.
- Minimize the loss of soil by covering stockpiles (i.e., impervious layer such as geotextile fabric).
- Minimize the amount of soil stockpiled on site, if possible.
- Remove or spread excess material as soon as work is completed to minimize erosion.
- Provide hydraulic equalization culverts to prevent ponding of water at upstream locations and drying at downstream locations.
- Store fuels and other hydrocarbon containing substances in approved containers.
- Use drip trays, pads or sheets when fuelling construction equipment and vehicles.
- Construction sites to have an approved emergency response plan that includes fuel spills.
- Apply herbicides in accordance with manufacturer's guidelines and adhere to permit terms and conditions.
- Limit herbicide application beyond road shoulder.

6.2 Field Investigation

Vegetation and soil surveys were conducted within the proposed P6 road alignment in the spring/early summer of 2016. The field investigation gathered additional data for the Project assessment including vegetation types, forest resource information, species composition, and presence/absence of species of conservation concern and species of interest, such as those traditionally used for medicine, subsistence and cultural purposes. Surveys were also conducted to characterize and classify the associated soils. Detailed vegetation and soils field information collected in 2016 is provided in the P6 Project Field Report.

7.0 CUMULATIVE EFFECTS

Cumulative effects are the environmental effects that are likely to result from a project in combination with the environmental effects of other past, existing and future projects or activities. The environmental assessment process for cumulative environmental effects includes: scoping, analysis of effects, identification of mitigation, evaluation of significance, and follow-up.

7.1 Scoping

Regional Issues: Regional vegetation issues of concern for the assessment of cumulative effects for the P6 All-Season Road Project connecting Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation were determined to include:

- Country foods, and
- Spread of invasive plant species

Regional issues are discussed in Section 5.1 of the vegetation report.

Regional Valued Components: Regional VCs relevant to the cumulative effects assessment for the P6 All-Season Road Project connecting Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation were determined to be:

- Species of conservation concern, and
- Key community harvest areas (plant species of interest)

VCs are discussed in Section 5.2 of the vegetation report.

Spatial and Temporal Boundaries: Spatial and temporal boundaries for a cumulative effects assessment generally occur over a wide area and extend before and after the project boundaries. The spatial boundary identified for the cumulative effects assessment includes the regional assessment area, while the temporal boundary was determined to be long-term (beyond 10 years of operation).

Other Actions: Other actions that may affect the VCs were determined to include:

Past:

- Community Development
- Resource Use

Existing:

- Winter Roads

- Transmission Line Maintenance
- Resource Use
- Off-road Vehicles

Future:

- Transmission Line Maintenance
- Transmission Line Construction Projects
- Road Construction and Maintenance Projects
- Resource Use
- Off-road Vehicles
- Community Development
- Mining

Potential Effects: The potential environmental effects on VCs due to the proposed P6 All-Season Road Project and other projects and activities in the cumulative effects assessment area for the foreseeable future are shown as interactions in Table 7.1.

Table 7.1. Potential cumulative effects identification.

Projects and Activities	Valued Components		Regional Issues	
	Species of Conservation Concern	**Key Community Harvest Areas**	**Country Foods**	**Spread of Invasive Plant Species**
Proposed Project				
Project construction	X	X	X	X
Project operation	X	X	X	X
Past Projects and Activities				
Community development projects	X	X	X	X
Resource use	X	X	X	X
Existing Projects and Activities				
Winter roads	X	X	X	X
Transmission maintenance	X	X	X	X
Resource use	X	X	X	X
Off-road vehicles	X	X	X	X
Future Projects and Activities				
Transmission projects	X	X	X	X
Road projects	X	X	X	X
Mining projects	X	X	X	X
Community development projects	X	X	X	X

7.2 Effects Analysis

Eleven different cover types were recognized in the regional assessment area. Coniferous dense forest and coniferous open forest are the dominant cover types and account for 382.4 km^2 and 351.4 km^2, respectively. Other abundant types include open water (283.9 km^2), wetland shrub (193.5 km^2) and coniferous sparse forest (126.2 km^2). The remaining cover types are divided among broadleaf forest, mixedwood forest, wetland treed and herb, shrub lands, and exposed land.

In the regional assessment area, more than 17 plants, plus wood and firewood resources were identified by the communities of Manto Sipi Cree Nation, Bunibonibee Cree Nation, God's Lake First Nation, and God's Lake Northern Affairs Community as important for sustenance and cultural practices. Mapped area of occupancy for plants of sustenance and cultural value identified by community members totaled 367.6 km^2.

Up to 14 species of conservation concern may occur, of which five are very rare (S1) and nine are rare (S2) or rare/uncommon (S2S3), as ranked by the MBCDC.

The potential cumulative effects of the proposed P6 All-Season Road Project in combination with the effects of other Projects and activities in the assessment area are summarized below:

Species of Conservation Concern and Key Community Harvest Areas (Plant Species of Interest): The effects of construction and operation of the proposed P6 All-Season Road Project may act cumulatively with the effects of the existing winter roads, transmission line maintenance, resource use, and off-road vehicles. Future activities such as transmission line construction projects, road construction and maintenance projects, mining projects, and community development may adversely affect the VCs identified. Past activities have included community development projects and resource use, but past effects on VC's are anticipated to be small.

The potential cumulative effects of the proposed P6 All-Season Road Project effects in combination with the effects of other projects and activities in the assessment area are evaluated in Table 7.2. The range of evaluation criteria (see Table 5.0.) for the potential cumulative effect categories include an adverse direction of change, moderate ecological and societal context, long-term duration, low magnitude, a project footprint extent or spatial boundary, frequency of infrequent to intermittent, and reversible over the long-term. Any potential cumulative environmental effects for the Project would be very small.

Table 7.2. Potential cumulative environmental effects analysis.							
Potential Cumulative Effect Categories	**Evaluation Criteria and Rating**						
	Direction of Change	**Ecological and Societal Context**	**Duration**	**Magnitude**	**Extent**	**Frequency**	**Reversibility**
Species of Conservation Concern	Negative	Moderate	Long-term	Low	Project	Infrequent	Long-term
Key Community Harvest Areas	Negative	Moderate	Long-term	Low	Project	Intermittent	Long-term

7.3 Identification of Mitigation

No additional mitigation measures are required for any potential cumulative environmental effects beyond those mitigation measures to be implemented as a part of the P6 project as described in sections 5.3.1 and 5.3.2, and tables 5.3.1 and 5.3.2.

7.4 Evaluation of Significance

No significant cumulative environmental effects were identified for the proposed P6 All-Season Road Project, connecting Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation, in combination with the environmental effects of other projects and activities in the assessment area currently, or for the reasonably foreseeable future.

7.5 Follow-up

No additional follow-up is required for any potential cumulative environmental effects.

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APPENDIX I. Definitions of Selected Technical Terms[1].

Bog – Ombrotrophic peatlands generally unaffected by nutrient-rich groundwater that are acidic and often dominated by heath shrubs and Sphagnum mosses and that may include open-growing, stunted trees.

Boreal – Pertaining to the north; a climatic and ecological zone that occurs south of the subarctic, but north of the temperate hardwood forests of eastern North America, the parkland of the Great Plains region, and the montane forests of the Canadian cordillera.

Canopy – The more or less continuous cover of branches and foliage formed by the crowns of trees.

Canopy Closure – The degree of canopy cover relative to openings.

Classification – The systematic grouping and organization of objects, usually in a hierarchical manner.

Community-Type – A group of vegetation stands that share common characteristics, an abstract plant community.

Coniferous – A cone-bearing plant belonging to the taxonomic group Gymnospermae.

Cover – The area of ground covered with plants of one or more species, usually expressed as a percentage.

Deciduous – Refers to perennial plants from which the leaves abscise and fall off at the end of the growing season.

Ecoregion – An area characterized by a distinctive regional climate as expressed by vegetation.

Family – Taxonomic grouping of plants that are related at a particular hierarchical level.

Fen – Wetland with a peat substrate, nutrient-rich waters, and primarily vegetated by shrubs and graminoids.

Flora – A list of the plant species present in an area.

Forest – A relatively large assemblage of tree-dominated stands.

Graminoid – A plant that is grass-like; the term refers to grasses and plant that look like grasses, i.e., only narrow-leaved herbs; in the strictest sense, it includes plants belonging only to the family Graminaceae.

Habitat – The place in which an animal or plant lives; the sum of environmental circumstances in the place inhabited by an organism, population or community.

Invasive – Invasive species are plants that are growing outside of their country or region of origin and are out-competing or even replacing native plants (Invasive Species Council of Manitoba).

Mitigation – Often the process or act of minimizing the negative effects of a proposed action.

Mixedwood – Forest stands composed of conifers and angiosperms each representing between 25 and 75% of the cover.

Riparian – Refers to terrain, vegetation or simply a position adjacent to or associated with a stream, flood plain, or standing body of water.

Shrub – A perennial plant usually with a woody stem, shorter than a tree, often with a multi-stemmed base.

Species – A group of organisms having a common ancestry that are able to reproduce only among themselves; a general definition that does not account for hybridization.

Stand – A collection of plants having a relatively uniform composition and structure, and age in the case of forests.

Terrestrial – Pertaining to land as opposed to water.

Understory – Vegetation growing beneath taller plants such as trees or tall shrubs.

Vascular – Having tissues that transport water, sap, nutrients; refers to plants that are not mosses, lichens and algae.

Vegetation – The general cover of plants growing on a landscape.

Vegetation Type – In phytosociology, the lowest possible level to be described.

Wetland – Land that is saturated with water long enough to promote hydric soils or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation, and various kinds of biological activity that are adapted to wet environments.

[1]All references Cauboue et al. 1996, unless otherwise noted.

APPENDIX II. Preliminary Species List.

A preliminary list of flora expected to occur in the Project 6 All-Season Road study area, organized taxonomically by family. MBCDC provincial ranks are included, SNA species marked with an asterisk (*) indicate species invasive status (ISCM 2016).

Scientific Name	Common Name	Rank
Ferns and Allies		
DRYOPTERIDACEAE	**WOOD FERN FAMILY**	
Gymnocarpium dryopteris	Common Oak Fern	S4S5
Gymnocarpium jessoense	Northern Oak Fern	S3S4
Dryopteris carthusiana	Spinulose Wood Fern	S5
Woodsia alpina	Northern Woodsia	S2
EQUISETACEAE	**HORSETAIL FAMILY**	
Equisetum arvense	Field Horsetail	S5
Equisetum fluviatile	Swamp Horsetail	S5
Equisetum pratense	Meadow Horsetail	S4S5
Equisetum scirpoides	Dwarf Scouring-rush	S4S5
Equisetum sylvaticum	Woodland Horsetail	S5
LYCOPODIACEAE	**CLUB-MOSS FAMILY**	
Diphasiastrum sitchense	Ground-fir	S1
Diphasiastrum ×zeilleri	Zeiller's Ground Cedar	SNA
Huperzia selago	Mountain Club-moss	S2S3
Lycopodium annotinum	Stiff Club-moss	S5
Lycopodium lagopus	Running Pine	S3
OPHIOGLOSSACEAE	**ADDER'S TONGUE FAMILY**	
Botrychium matricariifolium	Daisy-leaf Moonwort	S1
Botrypus virginianus	Rattlesnake Fern	S4
SELAGINELLACEAE	**SPIKE-MOSS FAMILY**	
Selaginella rupestris	Rock Spike-moss	S4
Gymnosperms		
CUPRESSACEAE	**CYPRESS FAMILY**	
Juniperus communis	Common Juniper	S5
Juniperus horizontalis	Creeping Juniper	S5
PINACEAE	**PINE FAMILY**	
Abies balsamea	Balsam Fir	S5
Larix laricina	Tamarack	S5
Picea glauca	White Spruce	S5
Picea mariana	Black Spruce	S5
Pinus banksiana	Jack Pine	S5

Angiosperms - Monocotyledons		
ACORACEAE	**SWEET FLAG FAMILY**	
Acorus americanus	Sweet Flag	S4S5
ALISMATACEAE	**ARROWHEAD FAMILY**	
Sagittaria cuneata	Arum-leaved Arrowhead	S5
ARACEAE	**ARUM FAMILY**	
Calla palustris	Water-arum	S5
CYPERACEAE	**SEDGE FAMILY**	
Carex aquatilis	Water Sedge	S5
Carex atherodes	Awned Sedge	S5
Carex aurea	Golden Sedge	S5
Carex bebbii	Bebb's Sedge	S5
Carex brunnescens	Brownish Sedge	S5
Carex canescens	Hoary Sedge	S5
Carex capillaris	Hair-like Sedge	S5
Carex chordorrhiza	Prostrate Sedge	S4S5
Carex deflexa	Bent Sedge	S4S5
Carex diandra	Two-stamened Sedge	S4S5
Carex disperma	Two-seeded Sedge	S5
Carex gynocrates	Northern Bog Sedge	S5
Carex houghtoniana	Sand Sedge	S5
Carex leptalea	Bristle-stalked Sedge	S5
Carex limosa	Mud Sedge	S5
Carex loliacea	Rye-grass Sedge	S2?
Carex magellanica	Bog Sedge	S5
Carex maritima	Seaside Sedge	S2?
Carex media	Intermediate Sedge	S4S5
Carex microglochin	False Uncina Sedge	S2?
Carex pauciflora	Few-flowered Sedge	S3
Carex pellita	Woolly Sedge	S5
Carex retrorsa	Turned Sedge	S5
Carex siccata	Dry-spike Sedge	S4S5
Carex utriculata	Beaked Sedge	S5
Carex vaginata	Sheathed Sedge	S5
Eleocharis palustris	Creeping Spike-rush	S5
Eriophorum gracile	Slender Cotton-grass	S4S5
Eriophorum vaginatum	Tussock Cotton-grass	S5
Eriophorum viridicarinatum	Thin-leaved Cotton-grass	S4
Schoenoplectus tabernaemontani	Soft-stem Bulrush	S5

Trichophorum alpinum	Alpine Cotton-grass	S5
JUNCACEAE	**RUSH FAMILY**	
Juncus alpinoarticulatus	Alpine Rush	S5
Juncus bufonius	Toad Rush	S5
Luzula parviflora	Small-flowered Woodrush	S4S5
JUNCAGINACEAE	**ARROW-GRASS FAMILY**	
Scheuchzeria palustris	Pod-grass	S3S4
LILIACEAE	**LILY FAMILY**	
Allium schoenoprasum	Chives	S3S4
Maianthemum canadense	Two-leaved Solomon's-seal	S5
Maianthemum trifolium	Three-leaved Solomon's-seal	S5
ORCHIDACEAE	**ORCHID FAMILY**	
Calypso bulbosa	Calypso	S4
Corallorhiza trifida	Early Coral-root	S5
Galearis rotundifolia	Round-leaved Orchis	S5
Goodyera repens	Lesser Rattlesnake Plantain	S4S5
Platanthera dilatata	Bog Candle	S3S4
Platanthera hookeri	Hooker's Orchid	S2S3
Platanthera huronensis	Huron Fringed Orchid	S4S5
Platanthera obtusata	Small Northern Bog Orchid	S5
Platanthera orbiculata	Round-leaved Bog Orchid	S3S4
Spiranthes romanzoffiana	Hooded Ladies'-tresses	S5
POACEAE	**GRASS FAMILY**	
Agrostis scabra	Ticklegrass	S5
Agrostis stolonifera	Creeping Bent Grass	SNA
Alopecurus aequalis	Short-awned Foxtail	S5
Beckmannia syzigachne	Slough Grass	S5
Bromus ciliatus	Fringed Brome	S5
Calamagrostis canadensis	Marsh Reed Grass	S5
Calamagrostis stricta	Northern Reed Grass	S5
Elymus repens	Quack-grass	SNA
Glyceria borealis	Northern Manna Grass	S4S5
Glyceria grandis	Tall Manna Grass	S5
Glyceria pulchella	Graceful Manna Grass	S2S3
Hordeum jubatum	Wild Barley	S5
Oryzopsis asperifolia	White-grained Mountain Rice Grass	S5
Poa glauca	Glaucous Bluegrass	S4S5
Poa palustris	Fowl Bluegrass	S5

POTAMOGETONACEAE	**PONDWEED FAMILY**	
Potamogeton friesii	Fries Pondweed	S4
Potamogeton gramineus	Various-leaved Pondweed	S5
Potamogeton natans	Common Floating Pondweed	S5
Potamogeton richardsonii	Clasping-leaved Pondweed	S5
Potamogeton robbinsii	Robbin's Pondweed	S2S3
Potamogeton strictifolius	Straightleaf Pondweed	S2S3
SPARGANIACEAE	**BURR-REED FAMILY**	
Sparganium angustifolium	Narrow-leaved Bur-reed	S4S5
Angiosperms - Dicotyledons		
ACERACEAE	**MAPLE FAMILY**	
Acer spicatum	Mountain Maple	S5
APIACEAE	**CARROT FAMILY**	
Cicuta bulbifera	Bulb-bearing Water-hemlock	S5
Cicuta maculata	Spotted Water-hemlock	S4S5
Sium suave	Water-parsnip	S5
ARALIACEAE	**GINSENG FAMILY**	
Aralia nudicaulis	Wild Sarsaparilla	S5
ASTERACEAE	**ASTER FAMILY**	
Achillea alpina	Many-flowered Yarrow	S4S5
Achillea millefolium	Common Yarrow	S5
Anaphalis margaritacea	Pearly Everlasting	S3S4
Antennaria neglecta	Field Cat's-foot	S5
Arctium minus	Common Burdock	SNA*
Artemisia absinthium	Wormwood	SNA
Doellingeria umbellata	Flat-topped White Aster	S5
Erigeron hyssopifolius	Hyssop-leaved Fleabane	S4
Euthamia graminifolia	Flat-topped Goldenrod	S5
Hieracium umbellatum	Umbellate Hawkweed	S5
Petasites frigidus var. *palmatus*	Palmate-leaved Colt's-foot	S5
Petasites frigidus var. *sagittatus*	Arrow-leaved Colt's-foot	S5
Petasites frigidus var. *x vitifolius*	Vine-leaved Colt's-foot	SNA
Solidago hispida	Hairy Goldenrod	S5
Solidago missouriensis	Missouri Goldenrod	S5
Solidago multiradiata	Alpine Goldenrod	S4S5
Sonchus arvensis	Field Sow-thistle	SNA*
Sonchus asper	Spiny-leaved Sow-thistle	SNA
Symphyotrichum ciliolatum	Lindley's Aster	S5
Symphyotrichum lanceolatum	Panicled Aster	S4S5

Taraxacum officinale	Common Dandelion	SNA
BALSAMINACEAE	**TOUCH-ME-NOT FAMILY**	
Impatiens noli-tangere	Western Jewelweed	S1
BETULACEAE	**BIRCH FAMILY**	
Alnus incana ssp. *rugosa*	Speckled Alder	S5
Alnus viridis	Green Alder	S5
Betula papyrifera	White Birch	S5
Betula pumila	Dwarf Birch	S5
BORAGINACEAE	**BORAGE FAMILY**	
Hackelia deflexa ssp. *americana*	Beggar's Lice	S4S5
Mertensia paniculata	Tall Lungwort	S5
BRASSICACEAE	**MUSTARD FAMILY**	
Erysimum cheiranthoides	Wormseed Mustard	SNA
Rorippa palustris	Bog Yellowcress	S4S5
CAMPANULACEAE	**BELLFLOWER FAMILY**	
Campanula aparinoides	Marsh Bellflower	S5
CAPRIFOLIACEAE	**HONEYSUCKLE FAMILY**	
Diervilla lonicera	Bush-honeysuckle	S5
Linnaea borealis	Twinflower	S5
Lonicera dioica	Limber or Twining Honeysuckle	S5
Lonicera villosa	Mountain-Fly-Honeysuckle	S5
CARYOPHYLLACEAE	**PINK FAMILY**	
Moehringia lateriflora	Grove Sandwort	S5
Stellaria crassifolia	Fleshy Stitchwort	S3S4
Stellaria longifolia	Long-leaved Stitchwort	S5
Stellaria longipes	Long-stalked Stitchwort	S5
Stellaria media	Common Chickweed	SNA
CHENOPODIACEAE	**GOOSEFOOT FAMILY**	
Blitum capitatum	Strawberry Blite	S4S5
CLUSIACEAE	**MANGOSTEEN FAMILY**	
Triadenum fraseri	Marsh St. John's-wort	S3
CORNACEAE	**DOGWOOD FAMILY**	
Cornus canadensis	Bunchberry	S5
Cornus rugosa	Round-leaved Dogwood	S3
Cornus stolonifera	Red-osier Dogwood	S5
DROSERACEAE	**SUNDEW FAMILY**	
Drosera anglica	Oblong-leaved Sundew	S3S4
Drosera rotundifolia	Round-leaved Sundew	S4S5
ELAEAGNACEAE	**OLIVE FAMILY**	

Shepherdia canadensis	Canada Buffaloberry	S5
ERICACEAE	**HEATH FAMILY**	
Andromeda polifolia	Bog-rosemary	S5
Arctostaphylos uva-ursi	Common Bearberry	S5
Arctous alpina	Alpine Bearberry	S3S4
Chamaedaphne calyculata	Leatherleaf	S5
Gaultheria hispidula	Creeping Snowberry	S4S5
Kalmia polifolia	Bog Laurel	S5
Rhododendron groenlandicum	Labrador Tea	S5
Vaccinium caespitosum	Dwarf Bilberry	S3
Vaccinium myrtilloides	Velvet-leaf Blueberry	S5
Vaccinium oxycoccos	Small Cranberry	S5
Vaccinium uliginosum	Bog Whortleberry	S5
Vaccinium vitis-idaea	Bog Cranberry	S5
FABACEAE	**PEA FAMILY**	
Astragalus bodinii	Bodin's Milkvetch	S1
Astragalus canadensis	Canada Milkvetch	S5
Lathyrus ochroleucus	Pale Vetchling	S5
Oxytropis borealis	Boreal Locoweed	S1S2
Trifolium repens	White Clover	SNA
FUMARIACEAE	**FUMITORY FAMILY**	
Corydalis aurea	Golden Corydalis	S5
Capnoides sempervirens	Pink Corydalis	S5
GERANIACEAE	**GERANIUM FAMILY**	
Geranium bicknellii	Bicknell's Geranium	S5
GROSSULARIACEAE	**CURRANT FAMILY**	
Ribes glandulosum	Skunk Currant	S5
Ribes hudsonianum	Northern Wild Black Currant	S5
Ribes lacustre	Bristly Black Currant	S4
Ribes oxyacanthoides	Canada Wild Gooseberry	S5
HALORAGACEAE	**WATER-MILFOIL FAMILY**	
Myriophyllum sibiricum	Spiked Water-milfoil	S5
HIPPURIDACEAE	**MARE'S-TAIL FAMILY**	
Hippuris vulgaris	Common Mare's-tail	S5
LAMIACEAE	**MINT FAMILY**	
Dracocephalum parviflorum	American Dragon-head	S5
Lycopus asper	Western Water-horehound	S4
Lycopus uniflorus	Northern Bugleweed	S4S5
Scutellaria galericulata	Hooded Skullcap	S5
Stachys palustris	Marsh Hedge-nettle	S5

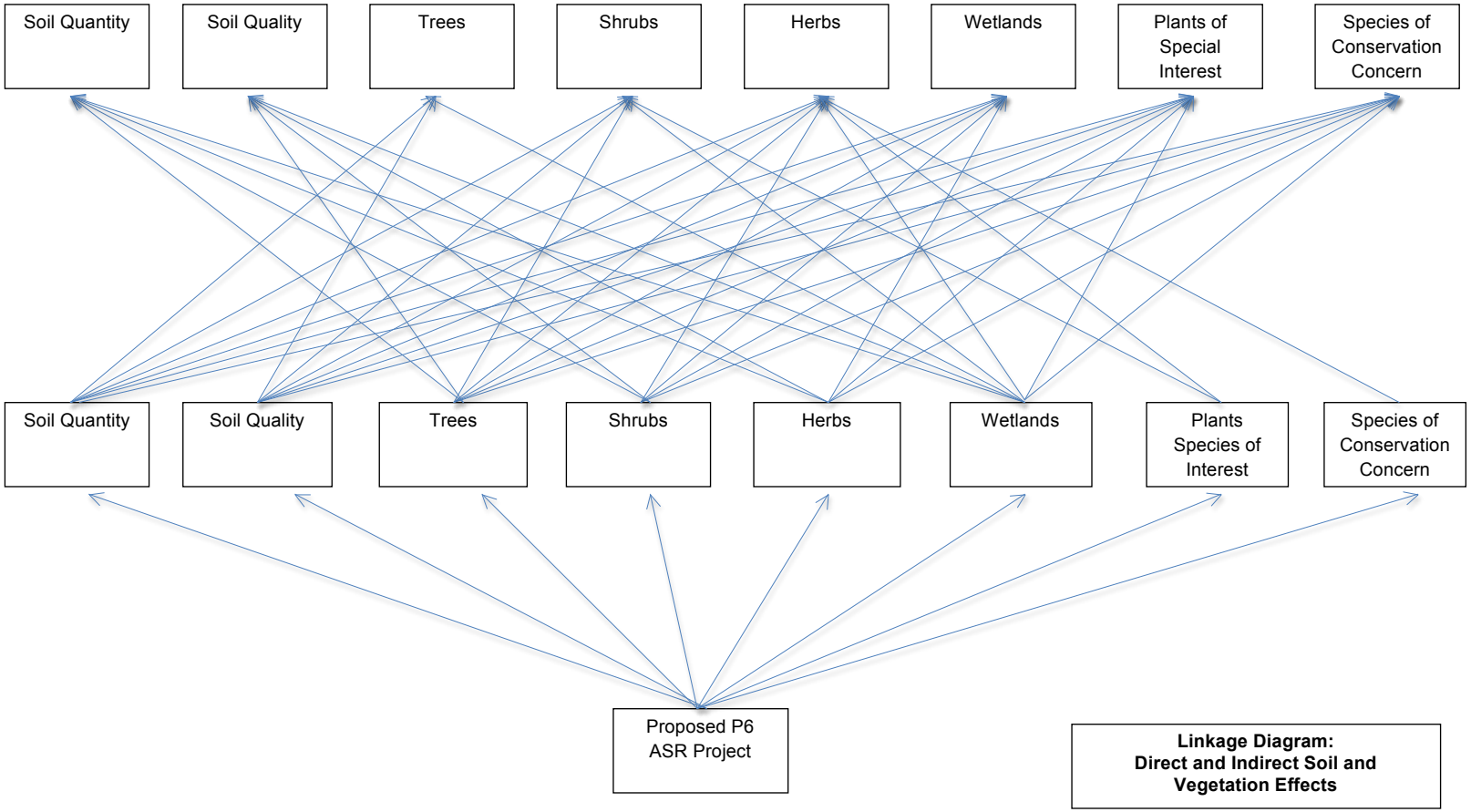
LENTIBULARIACEAE	**BLADDERWORT FAMILY**	
Utricularia cornuta	Horned Bladderwort	S3S4
MENYANTHACEAE	**BUCKBEAN FAMILY**	
Menyanthes trifoliata	Bog Bean	S5
MYRICACEAE	**WAX-MYRTLE FAMILY**	
Myrica gale	Sweet Gale	S5
NYMPHACEAE	**WATER-LILY FAMILY**	
Nuphar variegata	Yellow Pond-lily	S5
ONAGRACEAE	**EVENING PRIMROSE FAMILY**	
Epilobium ciliatum ssp. *glandulosum*	Willowherb	S5
Epilobium ciliatum ssp. *watsonii*	Willow-herb	SU
Epilobium leptophyllum	Linear-leaf Willowherb	S4S5
PLANTAGINACEAE	**PLANTAIN FAMILY**	
Plantago major	Common Plantain	SNA
POLYGONACEAE	**SMARTWEED FAMILY**	
Fagopyrum esculentum	Buckwheat	SNA
Fallopia convolvulus	Black Bindweed	SNA
Persicaria amphibia	Water Smartweed	S5
Persicaria lapathifolia	Pale Smartweed	S5
Rumex occidentalis	Western Dock	S4S5
PRIMULACEAE	**PRIMROSE FAMILY**	
Lysimachia thyrsiflora	Tufted Loosestrife	S5
PYROLACEAE	**WINTERGREEN FAMILY**	
Orthilia secunda	One-sided Wintergreen	S5
Pyrola asarifolia	Pink Pyrola	S5
RANUNCULACEAE	**CROWFOOT FAMILY**	
Anemone canadensis	Canada Anemone	S5
Anemone multifida	Cut-leaved Anemone	S5
Anemone parviflora	Small Wood Anemone	S4
Aquilegia brevistyla	Small-flowered Columbine	S4
Caltha palustris	Marsh Marigold	S5
Ranunculus aquatilis	White Water Crowfoot	S5
Ranunculus flammula	Creeping Spearwort	S4S5
Ranunculus pensylvanicus	Bristly Crowfoot	S5
Ranunculus sceleratus	Cursed Crowfoot	S5
RHAMNACEAE	**BUCKTHORN FAMILY**	
Rhamnus alnifolia	Alder-leaved Buckthorn	S5
ROSACEAE	**ROSE FAMILY**	

Amelanchier alnifolia	Saskatoon	S5
Comarum palustre	Marsh Cinquefoil	S5
Fragaria virginiana	Smooth Wild Strawberry	S5
Geum aleppicum	Yellow Avens	S5
Potentilla norvegica	Rough Cinquefoil	S5
Prunus pensylvanica	Pin Cherry	S5
Prunus virginiana	Chokecherry	S5
Rosa acicularis	Prickly Rose	S5
Rubus arcticus ssp. *acaulis*	Stemless Raspberry	S5
Rubus chamaemorus	Cloudberry	S5
Rubus idaeus	Wild Red Raspberry	S5
Rubus pubescens	Dewberry	S5
Sibbaldiopsis tridentata	Three-toothed Cinquefoil	S5
Sorbus decora	Mountain-ash	S4
RUBIACEAE	**MADDER FAMILY**	
Galium labradoricum	Ladie's Bedstraw	S4S5
Galium trifidum	Three-petal Bedstraw	S5
SALICAEAE	**WILLOW FAMILY**	
Populus balsamifera	Balsam Poplar	S5
Populus tremuloides	Trembling Aspen	S5
Salix bebbiana	Bebb's Willow	S5
Salix candida	Hoary Willow	S5
Salix exigua	Sandbar Willow	S5
Salix humilis	Gray Willow	S4
Salix maccalliana	Velvet-fruited Willow	S4
Salix pedicellaris	Bog Willow	S5
Salix pellita	Satin Willow	S3S4
Salix petiolaris	Basket Willow	S4S5
Salix planifolia	Plane-leaved Willow	S5
SANTALACEAE	**SANDALWOOD FAMILY**	
Geocaulon lividum	Northern Comandra	S5
SARRACENIACEAE	**PITCHER PLANT FAMILY**	
Sarracenia purpurea	Pitcher Plant	S4S5
SAXIFRAGACEAE	**SAXIFRAGE FAMILY**	
Mitella nuda	Mitrewort	S5
Parnassia palustris	Grass-of-Parnassus	S5
Saxifraga tricuspidata	Three-toothed Saxifrage	S4S5
SCROPHULARIACEAE	**FIGWORT FAMILY**	
Rhinanthus minor	Little Yellow Rattle	S4

APPENDIX III. Environmental Component Interaction Matrix and Linkage Diagram

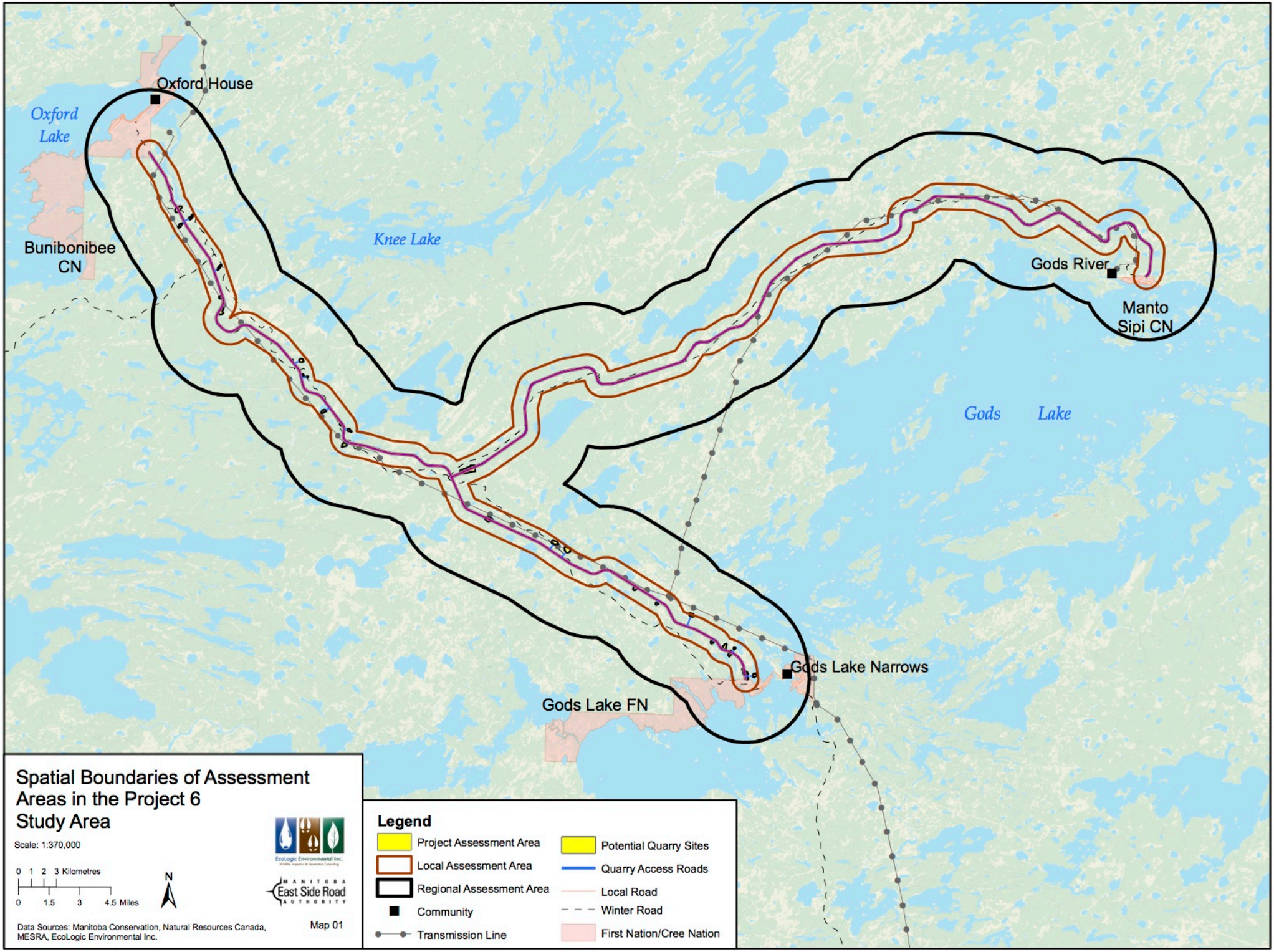
Project Activity - Environmental Component Interaction Matrix

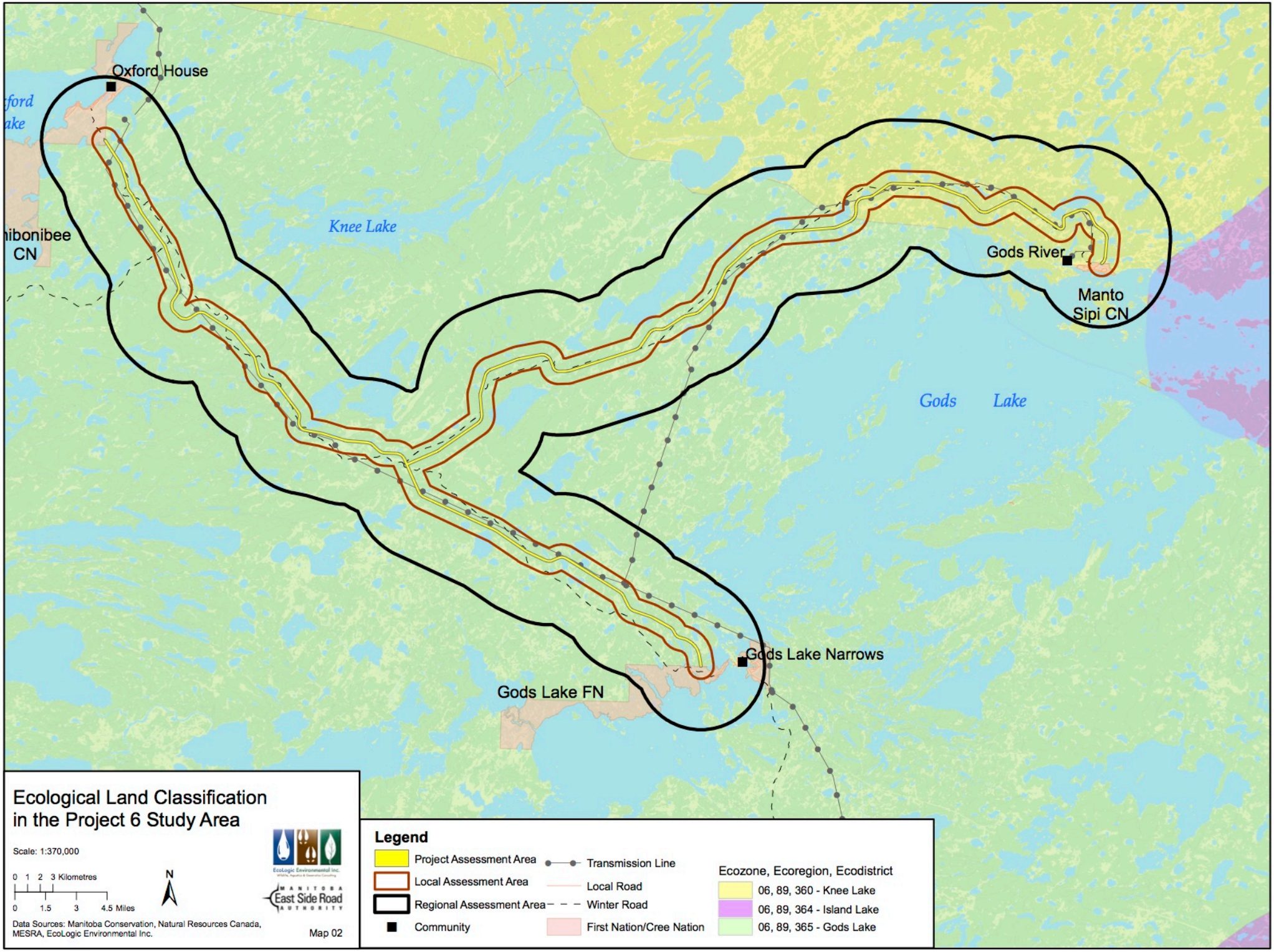
Project Activities / Environmental Components	Accessing	Surveying/Flagging	Clearing Vegetation	Removing Trees	Windrowing	Burning	Excavating	Crushing Rock	Sorting Aggregate	Filling	Stockpiling Materials	Grading/Contouring	Laying Aggregate	Compacting	Drilling	Using Explosives	Operating Equipment	Operating Vehicles/ATVs	Operating Generators	Establishing Camps	Housing Workers	Establishing Staging Areas	Erecting Fences	Transporting Equip. Suppl	Transporting Materials	Transporting Fuel	Storing Fuel	Dispensing Fuel	Crossing Streams	Cofferdamming	Controlling Erosion	Batching Concrete	Pouring Concrete	Demobilizing	Dismantling Facilities	Dismantling Bridge	Disposing Solid Waste	Disposing Haz. Waste	Disposing Liquid Waste	Restoring	Planting/Seeding	Controlling Dust	Erecting Signs	Plowing Snow	De-icing Culverts	Removing Beaver Dams	De-icing Road	Controlling Vegetation
Pre-Construction	X	X	X	X													X	X			X			X	X	X		X	X																	
Construction	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Operation/Maintenance																	X	X	X					X	X	X		X			X										X	X	X	X	X	X
Decommissioning									X		X	X				X	X	X	X	X	X			X	X	X	X	X	X		X			X	X	X	X	X	X	X	X					
Soil																																															
Soil Quantity							X						X									X										X															
Soil Quality	X		X	X		X	X	X			X	X	X	X			X	X		X		X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X		X	X
Vegetation																																														
Trees	X		X	X	X	X		X						X		X				X		X			X	X	X	X	X		X									X	X					X
Shrubs	X		X		X	X		X						X		X				X		X			X	X	X	X	X		X									X	X					X
Herbs	X		X		X	X		X						X		X				X		X			X	X	X	X	X		X									X	X			X	X	X
Wetlands			X					X						X											X	X	X	X																X		X
Plant Species of Interest			X	X	X	X		X						X											X	X	X	X																		X
Species of Conservation Concern			X		X	X		X						X		X				X		X			X	X	X	X																		X

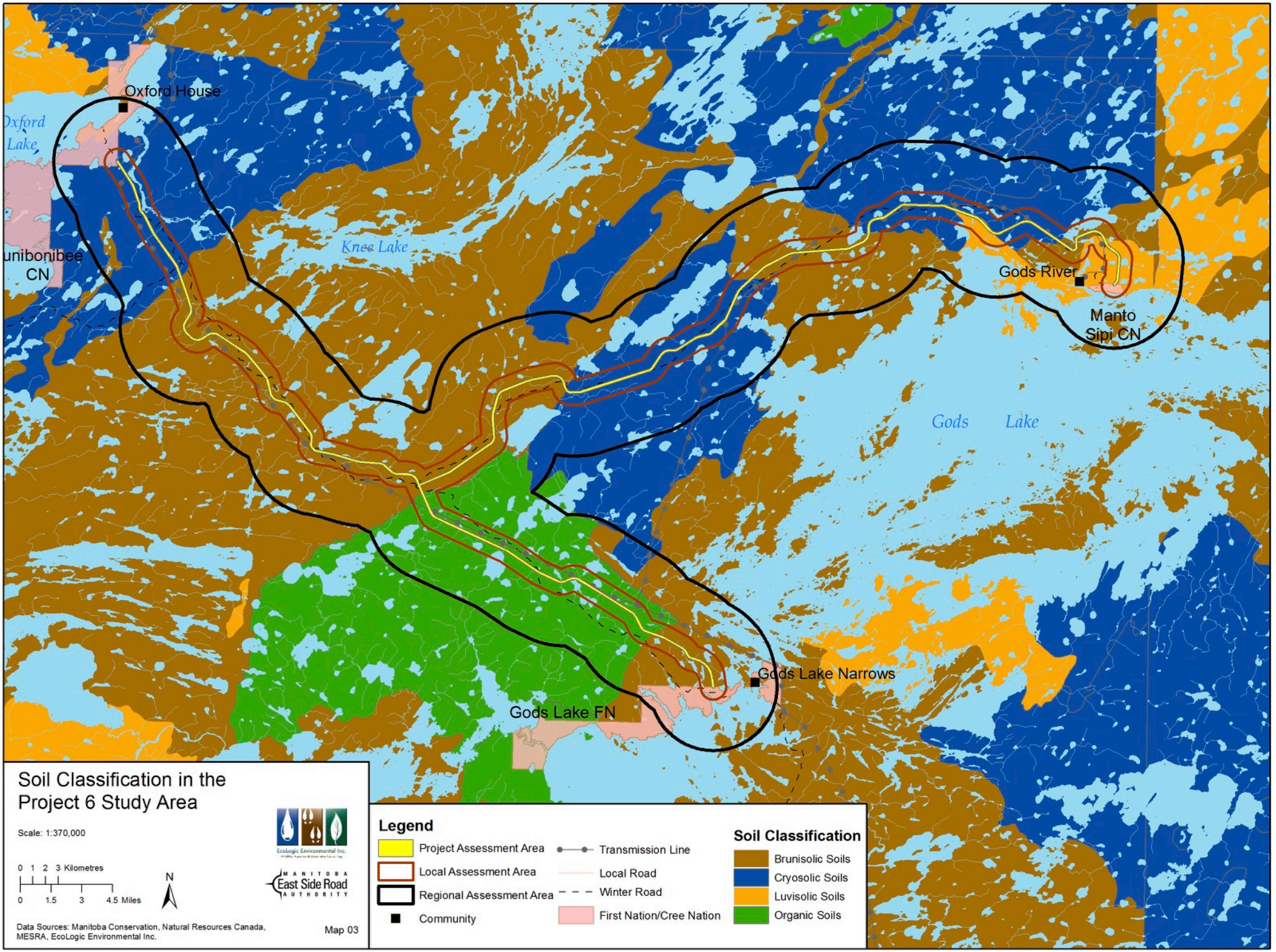


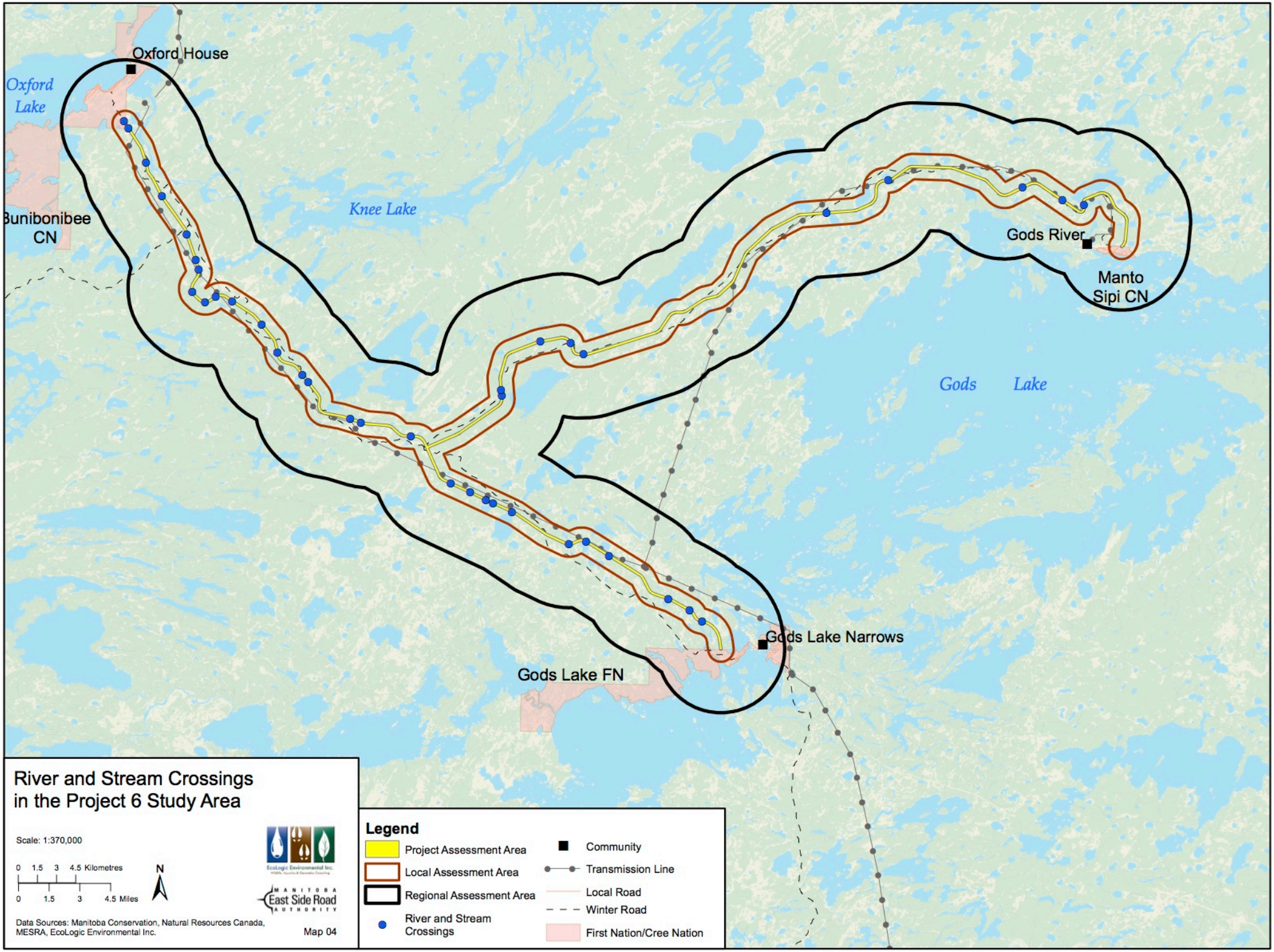
Linkage Diagram:
Direct and Indirect Soil and Vegetation Effects

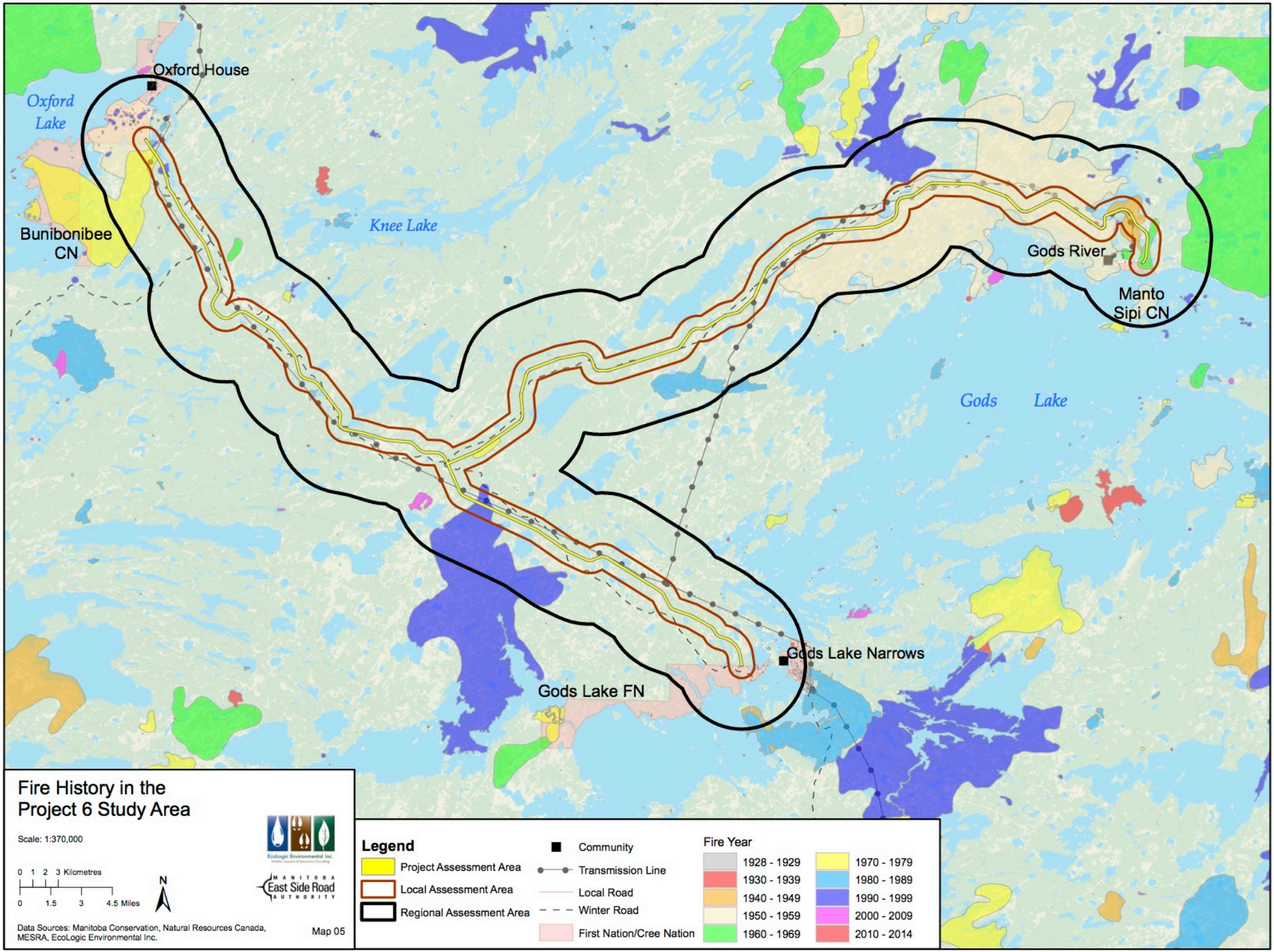
APPENDIX IV. Report Maps.

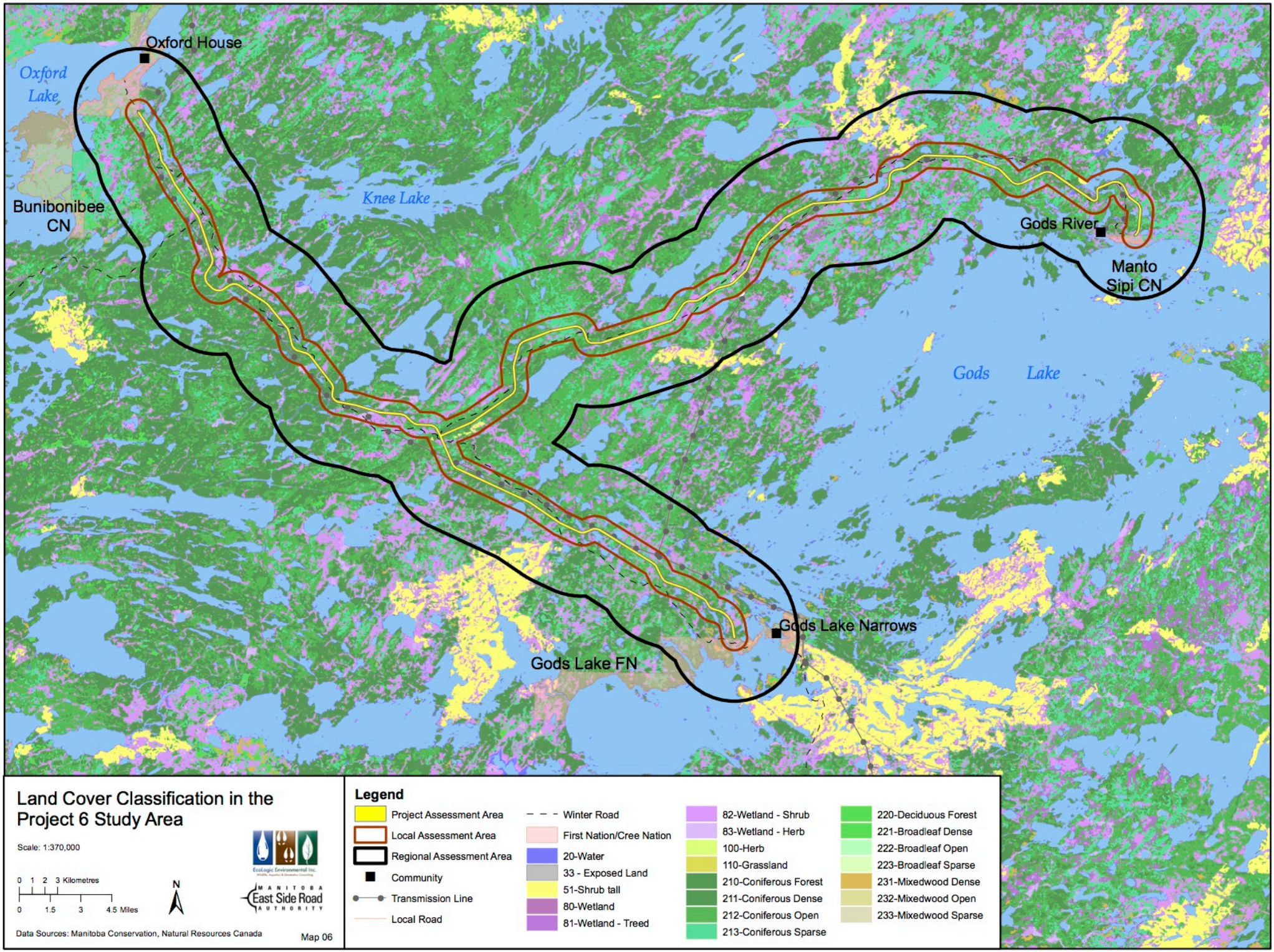

Oxford House
Oxford Lake
Bunibonibee CN
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
Spatial Boundaries of Assessment Areas in the Project 6 Study Area
Scale: 1:370,000
0 1 2 3 Kilometres
0 1.5 3 4.5 Miles
N
EcoLogic Environmental Inc.
Manitoba East Side Road Authority
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 01
Legend
Project Assessment Area
Local Assessment Area
Regional Assessment Area
Community
Transmission Line
Potential Quarry Sites
Quarry Access Roads
Local Road
Winter Road
First Nation/Cree Nation


Oxford House
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
Ecological Land Classification in the Project 6 Study Area
Scale: 1:370,000
0 1 2 3 Kilometres
0 1.5 3 4.5 Miles
N
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 02
Legend
Project Assessment Area
Local Assessment Area
Regional Assessment Area
Community
Transmission Line
Local Road
Winter Road
First Nation/Cree Nation
Ecozone, Ecoregion, Ecodistrict
06, 89, 360 - Knee Lake
06, 89, 364 - Island Lake
06, 89, 365 - Gods Lake


Oxford House
Oxford Lake
unibonibee CN
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
Soil Classification in the Project 6 Study Area
Scale: 1:370,000
0 1 2 3 Kilometres
0 1.5 3 4.5 Miles
N
Ecologic Environmental Inc.
Manitoba East Side Road Authority
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 03
Legend
Project Assessment Area
Local Assessment Area
Regional Assessment Area
Community
Transmission Line
Local Road
Winter Road
First Nation/Cree Nation
Soil Classification
Brunisolic Soils
Cryosolic Soils
Luvisolic Soils
Organic Soils


Oxford House
Oxford Lake
Bunibonibee CN
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
River and Stream Crossings in the Project 6 Study Area
Scale: 1:370,000
0 1.5 3 4.5 Kilometres
0 1.5 3 4.5 Miles
N
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 04
Legend
Project Assessment Area
Local Assessment Area
Regional Assessment Area
River and Stream Crossings
Community
Transmission Line
Local Road
Winter Road
First Nation/Cree Nation


Oxford House
Oxford Lake
Bunibonibee CN
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
Fire History in the Project 6 Study Area
Scale: 1:370,000
0 1 2 3 Kilometres
0 1.5 3 4.5 Miles
N
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 05
Legend
Project Assessment Area
Local Assessment Area
Regional Assessment Area
Community
Transmission Line
Local Road
Winter Road
First Nation/Cree Nation
Fire Year
1928 - 1929
1930 - 1939
1940 - 1949
1950 - 1959
1960 - 1969
1970 - 1979
1980 - 1989
1990 - 1999
2000 - 2009
2010 - 2014



Land Cover Classification in the Project 6 Study Area

Scale: 1:370,000

0 1 2 3 Kilometres

0 1.5 3 4.5 Miles

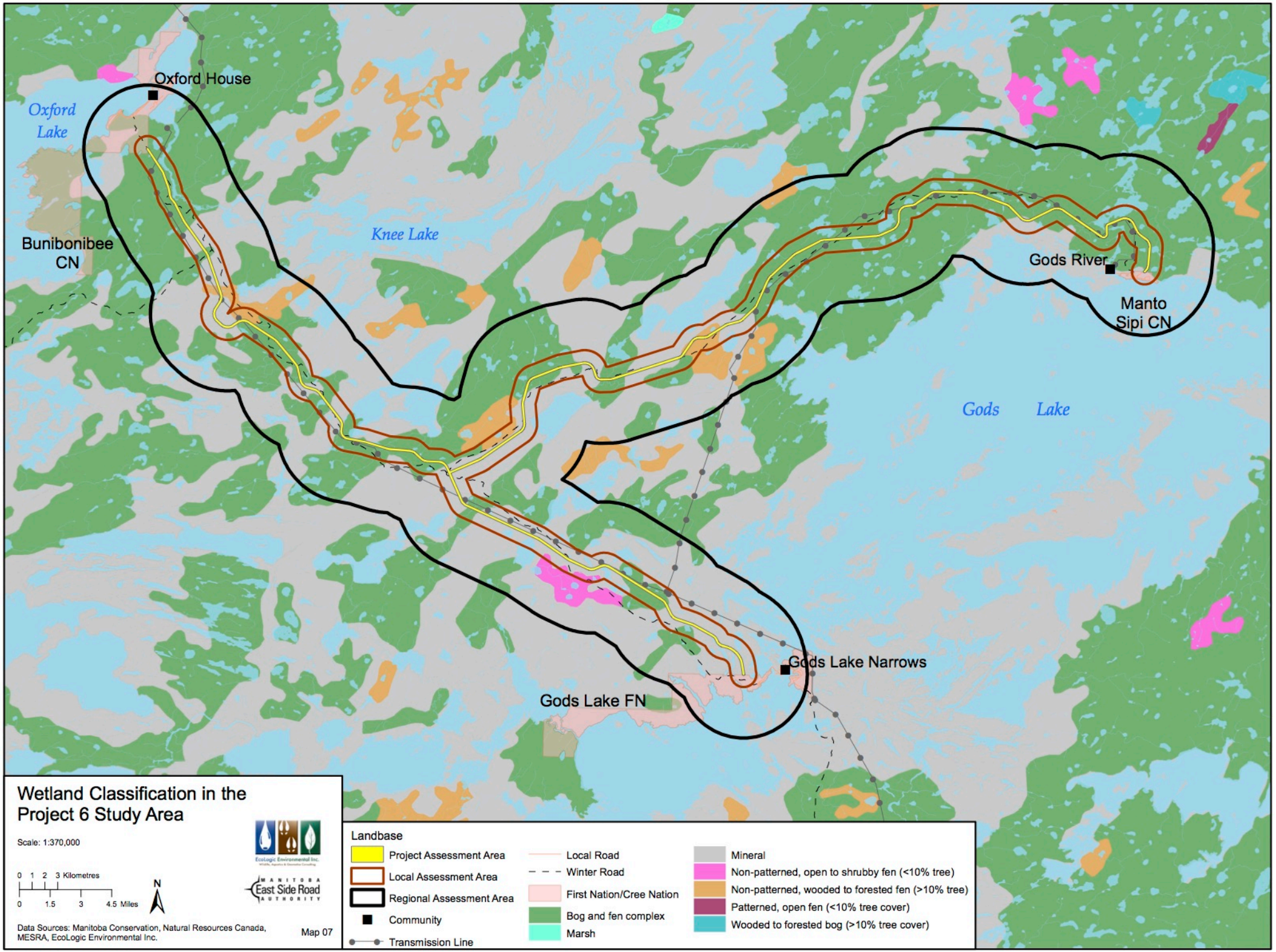
N

Data Sources: Manitoba Conservation, Natural Resources Canada

Map 06

Legend

- Project Assessment Area
- Local Assessment Area
- Regional Assessment Area
- Community
- Transmission Line
- Local Road
- Winter Road
- First Nation/Cree Nation
- 20-Water
- 33 - Exposed Land
- 51-Shrub tall
- 80-Wetland
- 81-Wetland - Treed
- 82-Wetland - Shrub
- 83-Wetland - Herb
- 100-Herb
- 110-Grassland
- 210-Coniferous Forest
- 211-Coniferous Dense
- 212-Coniferous Open
- 213-Coniferous Sparse
- 220-Deciduous Forest
- 221-Broadleaf Dense
- 222-Broadleaf Open
- 223-Broadleaf Sparse
- 231-Mixedwood Dense
- 232-Mixedwood Open
- 233-Mixedwood Sparse


Oxford House
Oxford Lake
Bunibonibee CN
Knee Lake
Gods River
Manto Sipi CN
Gods Lake
Gods Lake Narrows
Gods Lake FN
Wetland Classification in the Project 6 Study Area
Scale: 1:370,000
0 1 2 3 Kilometres
0 1.5 3 4.5 Miles
N
Data Sources: Manitoba Conservation, Natural Resources Canada, MESRA, EcoLogic Environmental Inc.
Map 07
Landbase
Project Assessment Area
Local Assessment Area
Regional Assessment Area
Community
Transmission Line
Local Road
Winter Road
First Nation/Cree Nation
Bog and fen complex
Marsh
Mineral
Non-patterned, open to shrubby fen (<10% tree)
Non-patterned, wooded to forested fen (>10% tree)
Patterned, open fen (<10% tree cover)
Wooded to forested bog (>10% tree cover)

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Appendix C:
Aquatic Environment Reports

Appendix C-1:

Project 6 – All Season Road Linking Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation, Aquatic Environment Report – Existing Environment

By North South Consultants Inc.

Manitoba Infrastructure

Remote Road Operations
Project 6 - All Season Road Linking Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation



Aquatic Environment Report: Existing Environment

March 2017

Manitoba

MANITOBA INFRASTRUCTURE – REMOTE ROAD OPERATIONS

PROJECT 6:

ALL SEASON ROAD LINKING MANTO SIPI CREE NATION, BUNIBONIBEE CREE NATION AND GOD'S LAKE FIRST NATION

Aquatic Environment Report

Existing Environment

March 2017

Prepared for

Manitoba Infrastructure – Remote Road Operations

by

North/South Consultants Inc.
Aquatic Environment Specialists

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EXECUTIVE SUMMARY

The East Side Road Authority (ESRA), whose projects were assumed by Manitoba Infrastructure – Remote Road Operations (MI-RRO) in November 2016, is designing and constructing an all season road connecting Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation. Based on the preliminary alignment, 53 watercourse crossings will be constructed including culverts at 51 unnamed watercourses, a clear-span bridge at God's River and a two-span bridge at Magill Creek.

Thirty-two species of fish are known to be present from the major waterbodies in the project area and include important commercial, recreational, and Aboriginal (CRA) fishery species such as Brook Trout, Lake Whitefish, Northern Pike and Walleye. Lake Sturgeon, designated by the Committee on the Status of Endangered Wildlife in Canada as special concern are found in the God's River.

Habitat at 28 of the 53 all season road stream crossing sites was assessed as not supporting fish. These unnamed streams are headwater wetland areas with no stream channel or channel connection to fish bearing waters. Habitat at 25 all season road stream crossing sites was assessed as supporting fish and this ranged from marginal habitat supporting forage fish only to sites with habitat supporting a greater diversity of fish species including large-bodied species. Marginal sites are located on small first or second order streams that are often poorly connected to downstream fish-bearing waters due to numerous ephemeral barriers or poor channel development. Many of these sites are considered unsuitable for large-bodied fish due to poor overwintering conditions and restricted access. Where access is less restrictive, large-bodied species such as Northern Pike are expected to make use of the crossings area for spawning, rearing and foraging. Seven stream crossing sites were assessed as important habitat including Magill Creek and God's River. Habitat at these sites was suitable for a range of life requisites for a diversity of fish species, including both forage fish and large–bodied species. Brook Trout, both adult and young of the year were captured at the God's River site.

Risk Assessment

A detailed aquatic environmental study was undertaken in summer 2016 to assess the risk that crossing construction would result in "serious harm to fish", pursuant to Section 35(1) of the *Fisheries Act* and to assess the potential impacts of the Project on aquatic habitats.

Under the *Fisheries Act*, "serious harm to fish" applies to fish and fish habitat that are part of or support a CRA fishery. The risk of serious harm to fish from crossing construction and operation was assessed using a habitat-based approach. The approach considered the impact of the

crossing on the productivity of relevant fish and fish habitat. The assessment was conducted based on the preliminary crossing design, literature review and results of field investigations.

A risk assessment was conducted for the 25 stream crossing sites assessed as fish habitat. Installation of culverts at seven crossing sites was assessed as Low Risk to fish and fish habitat as they are not expected to contribute to a CRA fishery. At these sites the habitat was characterized as boreal wetland headwater areas of small streams with poor connectivity to downstream fish bearing waters and considered to be of poor quality for the life requisites of relevant CRA fishery species. The remaining 18 crossing sites were assessed as habitats that potentially support a CRA fishery. Sixteen culvert sites, one proposed clear span bridge and one two-span bridge were assessed as Low Risk to fish habitat.

The construction of a clear span bridge would be classified as Low Risk, provided that appropriate avoidance and mitigation measures are implemented. On the Minor Impact List, construction of a clear span bridge does not require DFO review. Although habitat at the culvert and two-span bridge crossing sites is suitable for large-bodied fish such as Northern Pike and other CRA species, this habitat type is not critical or limiting to the fishery and therefore classified as Low Risk.

ACKNOWLEDGEMENTS

Manitoba Infrastructure – Remote Road Operations is thanked for the opportunity to conduct this study. Ms. Leanne Shewchuk and Ms. Jaime Clarke provided technical support and direction during the course of this study.

Fisheries studies were conducted under Manitoba Sustainable Development Scientific Collection Permit 28-16.

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1.0 INTRODUCTION

The East Side Road Authority (ESRA), whose projects were assumed by Manitoba Infrastructure – Remote Road Operations (MI-RRO) in November 2016, is undertaking the design, and in the future, the construction of an all-season road (ASR) connecting the communities of Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation (the Project). The Project is part of a larger initiative to provide improved, safe, and more reliable transportation service between all the communities on the east side of Lake Winnipeg.

The ASR Project is currently in the preliminary design phase and based on the preliminary alignment, the proposed ASR will intersect both small and medium-sized streams and one river. Detailed aquatic environmental studies were undertaken in June 2016 to identify and describe aquatic habitats potentially affected by the project and to assess the potential impacts of the Project on these habitats. This report includes:

- A description of the existing aquatic environment within the project study area;
- An assessment of risk of the project to fish and fish habitat at watercourse crossing sites relative to Section 35(1) of the federal *Fisheries Act*.

2.0 PROJECT OVERVIEW

The proposed ASR will extend from Bunibonibee Cree Nation to God's Lake First Nation (P6a) and from Manto Sipi Cree Nation to the P6a junction (P6b; figures 1 and 2) and will consist of a 10 m wide road top centered within a 60 m cleared right-of-way (RoW). The Project is currently in the preliminary planning stage and the road alignment and crossing designs are yet to be finalized. Based on the preliminary route, the ASR project will require construction of 53 watercourse crossings. Although subject to change, the crossing designs are expected to include:

- a clear-span bridge at the God's River;
- a two-span bridge at Magill Creek; and
- culverts at 51 unnamed streams.

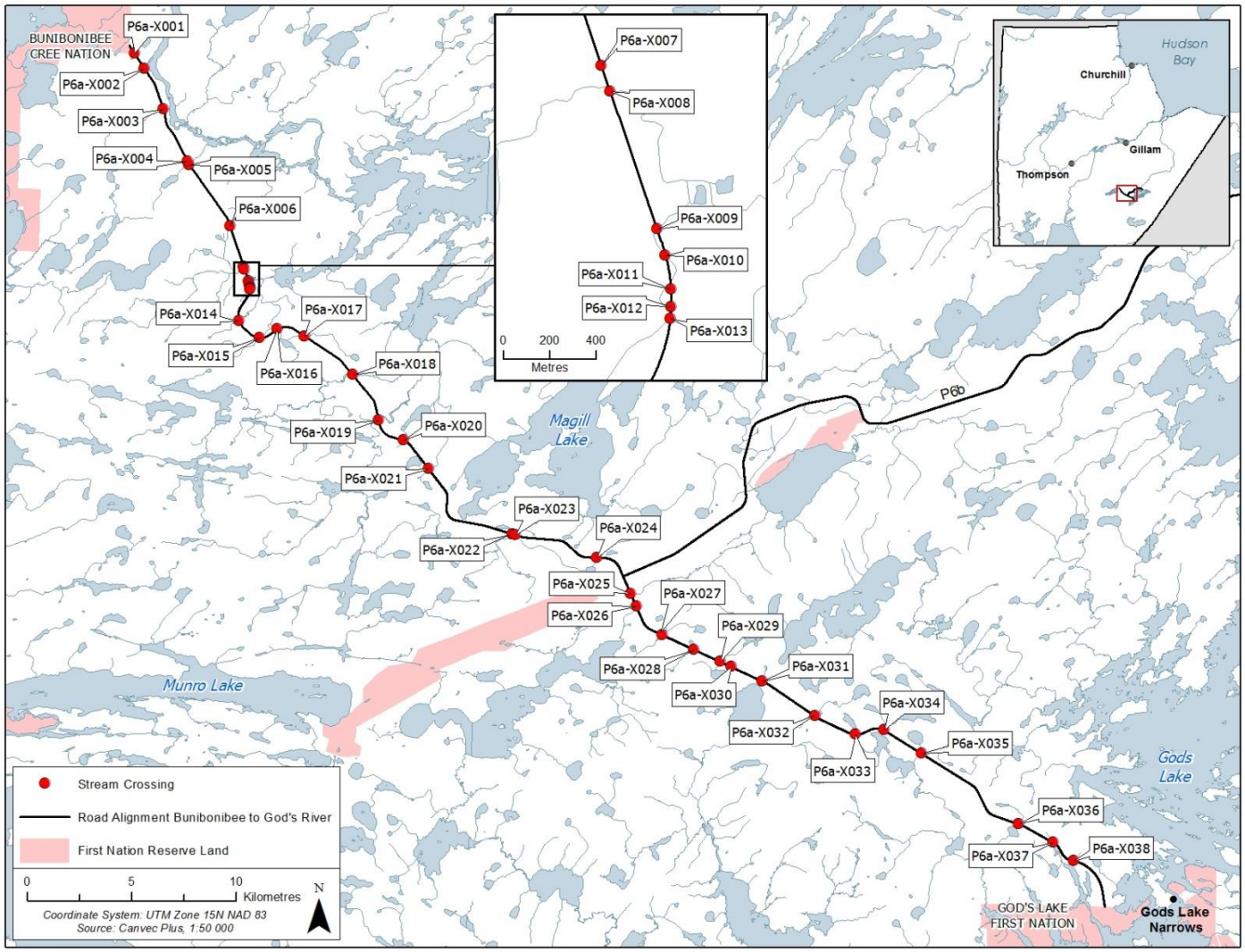


Figure 1. Project 6a – Bunibonibee Cree Nation to God's Lake First Nation All Season Road study area and watercourse crossing locations.

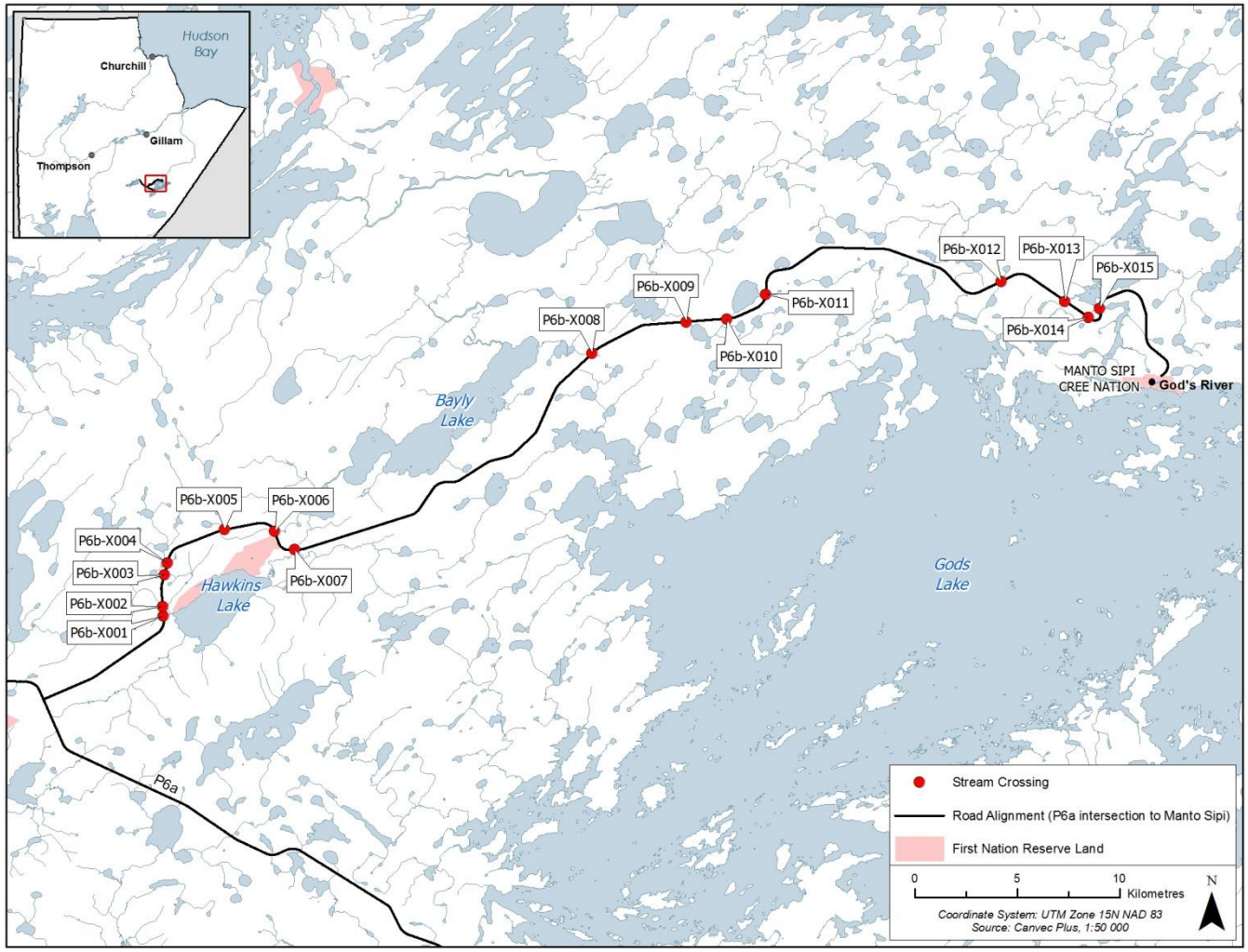


Figure 2. Project 6b – Manto Sipi Cree Nation to the P6a junction All Season Road study area and watercourse crossing locations.

3.0 EXISTING ENVIRONMENT

The Project is located on the east side of Lake Winnipeg, between the communities of God's Lake First Nation, Bunibonibee Cree Nation, and Manto Sipi Cree Nation. The east side of Lake Winnipeg is located within the Boreal Shield ecozone and encompasses the Hayes River Upland ecoregion (Smith et al. 1998). Within the ecoregion, the Project traverses two ecodistricts; God's Lake and Silsby Lake. These two ecodistricts are characterized by short, cool summers, and long, very cold winters, with highest precipitation occurring during summer.

The northern-most portion of the alignment intersects the Silsby Lake ecodistrict. This ecodistrict is characterized by undulating to subdued hummocky loamy morainal plain covered by clayey, glaciolacustrine veneers and blankets with extensive peatlands (bogs and fens) (Smith et al. 1998). Drainage is considered poor due to the gentle topography and a landscape dominated by peatlands. Black spruce with ericaceous shrubs and mosses are common in bog peatlands and sedges, brown mosses, shrubs, and stunted tamarack are common in fens.

The Project lies largely within the God's Lake ecodistrict. This ecodistrict is also dominated by undulating to hummocky morainal plain with clayey glaciolacustrine veneers and blankets, often covered by peatlands (Smith et al. 1998). Forest vegetation is dominated by black spruce, particularly in upland and transitional bog peatlands. Fens support tamarack, while mixed forests of white spruce, balsam fir, trembling aspen and balsam poplar occur along lakes and rivers.

The proposed ASR alignment extends northwest from the God's Lake Narrows community to Oxford House and extends northeastward from the P6a junction to connect to the God's River community, (figures 1 and 2). The landscape is relatively undeveloped; in addition to the Oxford House, God's Lake, and God's River communities other infrastructure developments include a winter road connecting the communities and an electrical transmission line.

3.1 AQUATIC HABITATS

Drainage within the Project area is primarily to the northeast (Smith et al. 1998). Waterbodies within the area are primarily comprised of small streams but include medium and large sized rivers, as well as small to very large lakes (the largest being God's and Oxford lakes). The smaller streams are often part of boreal wetlands such as bogs and fens that drain local areas into larger creeks, rivers or lakes and are usually less than one metre in depth. Within the study area, these types of streams typically drain to major rivers, such as the God's and Hayes rivers. Discharges during spring flows may be a number of cubic metres per second, but become entirely dependent on precipitation during summer and can often reach zero during dry periods. Water temperatures in these streams may be near 0ºC at break-up in April or May, but can rise rapidly to the mid-twenties by late May.

The smaller streams may be used as spawning and nursery areas by larger fish species (e.g., Northern Pike) in spring, while smaller forage species such as minnows and stickleback may utilize the streams through the summer if water volume is adequate. Due to shallow depths and low winter flows, small streams generally provide little or no over-wintering habitat. Medium sized streams may provide spawning habitat for larger fish such as suckers and Northern Pike. For the remainder of the year, these streams may be utilized as a nursery for young fish, as well as providing habitat for various species of minnows, darters, sticklebacks and sculpins. Over-wintering of smaller fish in these types of streams will often occur when deeper pools are available. The one large river within the Project area, God's River, provides year-round habitat for several fish species. Due to perennial flows it supports both spring and fall spawning species.

Small boreal wetlands areas also occur within the local area. These habitats generally do not have clear connection to fish bearing waters and typically become anoxic during winter. A few species of small-bodied fish that are tolerant of low oxygen levels may persist in some, but most of these wetlands are typically devoid of fish populations.

Based on existing information, including traditional knowledge studies, thirty-two fish species occur within the major watercourses in the Project area (Table 1).

3.1 WATER QUALITY

No water quality data for waterbodies in the study area were found in Manitoba Sustainable Development databases.

Table 1. Documented fish species presence in major watercourses in the Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation study area[1].

Common Name	Scientific Name	God's River	God's Lake	Knee Lake	Hayes River	Bayly Lake
Blacknose Dace	*Rhinichthys atratulus*		X			
Blacknose Shiner	*Notropis heterolepis*	X				
Blackside Darter	*Percina maculata*		X			
Brook Stickleback	*Culaea inconstans*	X	X		X	
Brook Trout	*Salvelinus fontinalis*	X	X		X	
Burbot	*Lota lota*	X	X		X	
Cisco	*Coregonus artedi*	X	X	X	X	
Deepwater Sculpin	*Myoxocephalus thompsonii*				X	
Emerald Shiner	*Notropis atherinoides*	X	X		X	
Fathead Minnow	*Pimephales promelas*	X	X		X	
Johnny Darter	*Etheostoma nigrum*	X	X		X	
Lake Chub	*Couesius plumbeus*	X	X		X	
Lake Sturgeon	*Acipenser fulvescens*	X	X		X	
Lake Trout	*Salvelinus namaycush*	X	X	X		
Lake Whitefish	*Coregonus clupeaformis*	X	X	X	X	X
Logperch	*Percina caprodes*				X	
Longnose Dace	*Rhinichthys cataractae*	X	X		X	
Longnose Sucker	*Catostomus catostomus*	X	X		X	
Mottled Sculpin	*Cottus bairdii*		X			
Ninespine Stickleback	*Pungitius pungitius*	X	X		X	
Northern Pike	*Esox lucius*	X	X	X	X	
Pearl Dace	*Margariscus margarita*		X		X	
River Darter	*Percina shumardi*				X	
Sauger	*Sander canadensis*	X	X	X		
Shorthead Redhorse	*Moxostoma macrolepidotum*	X			X	
Silver Lamprey	*Ichthyomyzon unicuspis*				X	
Slimy Sculpin	*Cottus bairdii*	X	X		X	
Spottail Shiner	*Notropis hudsonius*	X	X		X	
Troutperch	*Percopsis omiscomaycus*	X	X		X	
Walleye	*Sander vitreus*	X	X	X	X	X
White Sucker	*Catostomus commersonii*	X	X		X	
Yellow Perch	*Perca flavescens*	X	X		X	

1 – FIHCS (2016); HTFC Planning & Design (2016); Eaton (2012); COSEWIC (2006);, Stewart and Watkinson (2004).

4.0 FISH HABITAT AND RISK ASSESSMENT

The methods and results of the fish habitat assessment and subsequent *Fisheries Act* risk assessment are presented in the following sections.

4.1 METHODS

The aquatic environment data collection and analysis methods and habitat and risk assessment approach are described below.

4.1.1 Aquatic Environment Data Collection and Analysis

Aquatic environment field data were collected in June 2016 where the ASR alignment intersected watercourses. Data were collected through geographic information systems (GIS) and orthophoto analysis and during field surveys. The data were used to provide a physical description of fish habitat and assess potential fish use.

4.1.1.1 Watercourse Identification

Watercourse crossing sites were identified by MI-RRO and provided to North/South Consultants in shapefile format. The ASR alignment was also overlaid on the CanVec 1:50,000 hydrographic dataset (version 8; Natural Resources Canada 2007) using ArcGIS® 10.2 GIS software (Environmental Systems Research Institute [ESRI], Redlands, California) to identify any additional watercourse crossing sites.

4.1.1.2 Drainage Analysis

For each crossing site, the drainage area upstream of the proposed crossing and distance to the nearest downstream major waterbody were calculated. For drainage area, watershed boundaries were created using the Prairie Farm Rehabilitation Administration (PFRA) Incremental Gross Drainage Area dataset (PRFA 2008). Most watercourses crossed by the alignment are minor streams and their drainage area is located within the larger watersheds mapped in the PFRA dataset. The watershed boundaries for these smaller streams were delineated from the larger watershed using the Shuttle Radar Topography Mission (SRTM) Digital Elevation Model (DEM) (USGS, n.d.). The upstream drainage area was then calculated using ArcGIS® 10.2.

The linear distance from each crossing to the nearest major fish bearing waterbody was determined using ArcGIS® 10.2. Distances were calculated based on the CanVec 1:50,000 hydrographic dataset.

4.1.1.3 Aerial Reconnaissance

Orthophoto analysis and aerial surveys were conducted to classify each watercourse by size and connection to other fish bearing waterbodies.

4.1.1.3.1. Connectivity

The importance of fish habitat in smaller streams is often related to its connectivity to more extensive downstream habitats. For each stream crossing, downstream connectivity was assessed aerially in the field, and by orthophoto analysis. For each stream, the following features were noted:

- presence of a defined channel downstream of the crossing to the next major watercourse;
- permanent impediments to fish passage (e.g., waterfalls);
- ephemeral impediments to fish passage (e.g., beaver dams); and
- presence and extent of upstream habitat, including the three previous features.

Streams were assigned to one of four connectivity classes as presented in Table 2. The classifications were used to assess or support the known or expected migrations of large-bodied fish species. This was used in the risk assessment (Section 4.1.2) and in assessing the fish passage requirements for crossing design.

Table 2. Description of connectivity classes used to assess the connection of stream crossings to larger fish bearing waterbodies.

Connectivity Class	Class Description
Yes	Connection to downstream fish bearing waters apparent without impediments.
Yes – likely	Connection to downstream fish bearing waters apparent but permanent barrier visible but questionable if it presents a certain barrier; or ephemeral barriers present in low number and the crossing location is in close proximity to the downstream fish bearing water body.
Yes – unlikely	Connection to downstream fish bearing waters apparent, but due to the number of ephemeral barriers and the distance to the downstream water body, fish passage is considered unlikely in almost all years and, when possible, would not likely contribute to the productive capacity of the fishery.
No	Visible connection to downstream water body is not apparent, typically in the absence of a stream channel. Such streams typically diffuse into broad boreal wetlands.

4.1.1.3.2. Watercourse Classification

Based on aerial reconnaissance data, watercourses were classified as one of the following:

Class 1: Medium to Large Streams and Rivers

Class 1 streams are typically named watercourses that maintain perennial flow and contain important fish habitat.

Class 2: Small Streams

Class 2 streams are small watercourses where a distinct stream channel is visible upstream and downstream of the crossing. These include many unnamed creeks as well as smaller named streams with fish habitat ranging from Marginal to Important.

Class 3: Drains

Class 3 streams are drains that may or may not be identified as a watercourse in the CanVec hydrographic dataset. These systems do not have channel connectivity to larger fish bearing waters upstream or downstream. In some cases a small downstream channel may be present, but dissipates into a wetland before connecting to a larger watercourse. Where upstream habitat and habitat at the crossing is peatland, the site is classified as Class 3 even though a channel may be present further downstream. This reflects the lack of habitat at the site. Fish habitat is generally marginal or not present.

4.1.1.4 Channel Sinuosity

Channel sinuosity was calculated for Class 1 and larger Class 2 streams as follows:

Sinuosity = channel length / channel valley length

Channel and valley length were measured from digital orthophotos using ArcGIS® Explorer (ESRI, Redlands California). Channel length was measured along the centreline over a minimum valley length of 500 m.

4.1.1.5 Physical Assessments

Physical assessments were conducted at Class 1 and Class 2 streams. At each crossing location, two study areas were established; 400 m upstream and downstream of the proposed crossing location. The 800 m study reach was established in consideration of potential uncertainties in the location of the road alignment. In each study area a physical assessment of fish habitat was conducted.

4.1.1.5.1. General

Transects were established within the upstream and downstream study areas. The number and location of transects were determined based on the watercourse classification and site-specific conditions, respectively.

Class 1 Streams

Three transects were established within the proposed cleared RoW (60 m on centreline) to record riparian and bank conditions. Transects were typically located at the crossing centreline and 25 m upstream and downstream of the centreline. Side scan sonar was used to capture channel profile and stream bed characteristics (Section 4.1.1.5.12) therefore transects to record this information were not required as per Class 2 stream assessments.

Class 2 Streams

A minimum of five transects were established: three within the RoW; one at the centreline of the crossing; and a minimum of one each within the upstream and downstream study areas.

4.1.1.5.2. Water Quality

Due to the potential for blasting near watercourses during the construction of the ASR, water quality was sampled at sites assessed as supporting a CRA fishery.

Laboratory Samples

To minimize disturbance of streambed materials and contamination of the samples, surface water samples were collected from the center of the channel at each site by attaching a clean 500 mL plastic collection jar to an extendable fiberglass pole. The collection jar was triple rinsed with site water prior to sample collection then the laboratory bottle was filled from the collection jar. Where necessary, samples were preserved according to instructions provided by the analytical laboratory. After collection, samples were kept cool and in the dark until submission (within 48 hours) to ALS Laboratories in Winnipeg, MB (a Canadian Association for Laboratory Accreditations, Inc. [CALA] accredited laboratory). The samples were analysed for the following parameters:

- Ammonia;
- Nitrate, nitrite, and nitrate/nitrite;
- Total Kjeldahl nitrogen (TKN);
- Dissolved phosphorus (DP);

- Total phosphorus (TP);
- Total organic carbon (TOC).
- Total suspended solids (TSS);
- Turbidity; and,
- Chlorophyll *a* and phaeophytin *a*.

In situ Parameters

Several water quality parameters were measured *in situ* at each site including: temperature; dissolved oxygen (DO); pH; turbidity; specific conductance; and conductivity. Turbidity was measured using an Analite NEP-160 (McVan Instruments Pty Ltd. Scoresby, Australia); other parameters were assessed using a YSI 556 MPS multi-meter (YSI Inc., Yellow Springs, Ohio). Sample collection sites were classified by habitat type (e.g., riffle, pool, run).

4.1.1.5.3. Discharge

In Class 2 streams, discharge was measured at or near the proposed crossing at a relatively straight section of channel, free of vegetation, rocks and obstructions that may interfere with velocity measurements. Discharge was not measured in Class 1 streams as depths exceeded the range of equipment.

To measure discharge, the total wetted width was divided into parcels – typically ten parcels for small streams and a minimum of twenty for larger systems. Depending on channel width, fewer than ten parcels may have been used. The parcel width was divided by two to obtain the distance of the first measurement location from the bank (i.e., distance to the center of the first parcel). Subsequent measurement locations were determined by adding the original parcel width to the previous distance. Where the measured water depth was less than one meter, velocity was measured at 3/5 of the total depth using a Swoffer velocity meter. Where the water depth was greater than one meter, velocity was measured at 1/5 and 4/5 of the total depth.

Stream discharge was calculated as:

$Q = \Sigma\ wdv$

where, Q = discharge
w = parcel width
d = parcel depth
v = velocity

4.1.1.5.4. General Morphology

The general stream morphology, including pattern, stage, confinement, flow regime and profile of the surveyed reach of the watercourse was visually assessed and described as follows:

- *Pattern* – the channel pattern was classified as straight, sinuous, irregular wandering, irregular meandering, regular meanders and tortuous meanders or braided.
- *Stage* – describes the water level in relation to bankfull and was classified as: Low (0 – 30% bankfull); moderate (30 – 90%); or high (>90%).
- *Confinement* – describes the ability of the channel to migrate laterally on a valley flat between surrounding slopes. Channel confinement was classified as: entrenched; confined; frequently confined; occasionally confined; or unconfined.
- *Flow Regime* – describes the permanence of flow. Flow regime was classified as:
    - Perennial - Contains water at all times throughout the year, except during extreme drought;
    - Ephemeral - Stream bed is above the water table; stream flow is a direct response to a precipitation event (snowmelt or rainfall); or
    - Intermittent - Carries water a considerable portion of the time, but ceases to flow occasionally or seasonally because bed seepage and evapotranspiration exceed available water supply.
- *Channel Profile* – describes the cross sectional shape of the channel and was classified as: notched; U-shaped; V-shaped; or planar.

4.1.1.5.5. Channel Profiles

At Class 1 streams, the wetted width (water's edge) and the channel width (bank to bank) were estimated at each transect using a laser range finder (±1 m). The channel profile was determined using side scan sonar (Section 4.1.1.5.12).

At Class 2 streams, the wetted width (water's edge) and the channel width (bank to bank) were measured at each transect. Water depth at 25%, 50%, and 75% of the wetted width, starting at the left bank, and maximum depth were recorded. The left and right bank designations were determined while facing upstream.

4.1.1.5.6. Riparian Area/Floodplain

At each transect the floodplain and riparian vegetation (vegetation directly influenced by the watercourse) width was measured perpendicular from each bank. The dominant vegetation type

within the riparian zone and floodplain (if applicable) was classified as: none; grasses/sedge; shrubs; conifers; deciduous trees; or mixed forest. The riparian canopy cover over the stream was also estimated (%).

4.1.1.5.7. Substrate

At Class 1 streams, substrate composition was determined using side scan sonar (Section 4.1.1.5.12).

At Class 2 streams, substrate composition (%) was visually estimated at each transect. Substrate composition was based on the following size classifications:

Class	Size
fines	<2 mm
small gravel	2 – 16 mm
large gravel	17 – 64 mm
cobble	65 – 256 mm
boulder	>256 mm

4.1.1.5.8. Banks

At each transect, the following parameters regarding channel banks were collected:

- *Bank Materials* – Each bank was classified according to the dominant bank material. Materials were classified as: organic/mineral soils; mineral; mineral/rock; rock/boulder; and bedrock.
- *Bank Shape* – The shape of each bank was classified as follows:
    - Vertical steep sloping/vertical (45 – 90°);
    - Undercut protruding over the channel;
    - Overhaging; or
    - Sloping gradual or shallow slope (<45°).
- *Bank Stability* – Bank stability was visually assessed as follows:
    - Highly stable banks well vegetated or covered in large boulders;
    - Moderate stability >50% vegetated or rocked and some undercut banks;
    - Low stability <50% of the bank is vegetated or rocked; or
    - Unstable massive slumping, large silt deposition, exposed soil.

4.1.1.5.9. Stream Gradient

Stream gradient (%) was measured using a clinometer aimed at eye level at another crew member or at a survey rod.

4.1.1.5.10. Habitat Inventory

The percent composition of habitat types in each study area was visually assessed. Habitat types were classified as follows:

Falls	vertical drop
Cascade	high gradient and velocity, extremely turbulent, armoured substrate
Chute	area of channel constriction, typically bedrock
Rapids	high velocity, deeper than a riffle, coarse substrate
Riffle	high velocity/gradient (vs. run), surface broken, shallow (<0.5m)
Run (glide)	moderate to high velocity, surface mostly unbroken, deeper than a riffle
Flat	low velocity, near-uniform flow, differential from a pool by high channel uniformity
Pool	portion of the channel with increased depth and reduced velocity, formed by channel scour
Impoundment	pools formed behind dam (dam from debris, beaver or landslide)
Dam	creates the impoundment (debris, beaver or landslide)
Backwater	localized area of reversed flow direction
Boulder Garden	significant occurrence of large boulders, providing significant instream cover, in association with other habitat unit such as riffle or run.

4.1.1.5.11. Cover

The total available cover for fish (%) was estimated for each study reach. Within the available cover, the composition of cover types (%) was determined. Cover types included the following:

- Large woody debris (or coarse woody debris)
- Overhanging vegetation (< 1 m from the water surface)
- Instream vegetation

- Deep pool
- Boulder
- Undercut banks
- Surface turbulence
- Turbidity

4.1.1.5.12. Bathymetry and Substrate Mapping

At Class 1 streams, boat-based habitat mapping was conducted using a Lowrance® HDS-5 with StructureScan® HD sonar imaging (Navico Inc.) and internal integrated global positioning system (GPS) receiver. Side imaging sonar captures detailed information on bottom topography and fish-attracting structure orientation. This device also was used to record water depths for bathymetric mapping.

Data Collection

The two transducers (skimmer and side scan) were mounted onto the transom of the boat and connected to the HDS-5 head. Care was taken to mount the transducer in an area that was relatively free of turbulent water and as far as possible from the propeller to minimize interference from water turbulence. Mounting depth was noted and later used as a correction factor for the depths recorded.

The boat was driven across the width of the river at 15-20 m intervals, down the centerline, and along each shoreline 400 m upstream and downstream of the crossing. Boat speed was maintained under 12 km/hr to minimize interference due to water turbulence.

Depth and geographic coordinate data (UTM) were collected along transects covering the study areas and logged to a flash memory card. Ponar grab samples were collected during each survey to verify substrate data collected by side scan sonar. For each ponar grab, substrate type and UTM location were recorded using a handheld GPS. Substrate type was based on the size classifications listed in Section 4.1.1.5.7. Ponar grab data are provided in Appendix 2.

Data Analysis

Shorelines of the Class 1 streams were digitized at a scale of 1:1500 from summer 2012 colour orthophotos (50 cm pixel), provided by MI-RRO, using ArcGIS® 10.2. Stream discharge and shoreline elevation were unknown at the time of orthophoto acquisition. The digitized shorelines were assumed to be representative of a normal flow condition for the studied streams.

The recorded data were exported from a Lowrance log file format (.sl2) to a Microsoft Excel format. Depths were corrected according to the transducer mounting depth. The corrected depth files were then imported into ArcGIS and projected to a UTM Zone 15 (NAD83) projection and saved to a GIS ready ESRI® shapefile format.

Prior to the creation of the bathymetric depth surfaces, shoreline zero depth points were created along the digitized shorelines at a 5 metre interval and merged with the corrected depth data set. The inclusion of these shoreline points allows the surface model to conform to the shoreline.

Bathymetric surfaces were interpolated from the corrected transducer depths using Surfer® 11 (Golden Software Inc.). A linear kriging variogram was used to create 5 m grid surfaces covering the extents of the survey. Final Surfer 11 format grid files were exported to an ESRI ascii format for import into ArcGIS® 10.2. Depth contouring and cartographic outputs were completed using ArcGIS® 10.2.

Substrate mapping techniques followed Kaeser and Litts (2010). Side scan images of the river bottom collected during field surveys were analysed using Dr. Depth®, where the positional and bearing information from the GPS data were used to georeference the side scan images of the riverbed and display them in a seamless mosaic. The side scan image mosaic was exported to an ESRI grid format and imported into ArcGIS® 10.2. Major substrate change boundaries were delineated and digitized from the imagery and validation data (ponar grabs) obtained during field studies were used to verify the visually delineated substrate classes. Final symbolization of substrate classes and cartographic output were generated in ArcGIS® 10.2.

4.1.1.6 Biological Assessments

Fish and mollusk sampling was conducted at each site to determine species presence and potential habitat use. Results from the fish sampling were intended to supplement existing fisheries information and fish presence inferred from the type of habitat present. It was recognized in the fish habitat assessment that the fish sampling only represented a single sampling event.

Fish

Fish sampling was conducted within the study reach to confirm fish presence and in Class 1 streams, to determine species use. Gear type was selected based on site-specific conditions and included backpack electrofishing and gillnetting. Backpack electrofishing surveys were conducted at small and medium-sized watercourses that could be waded. During each survey, the start and end of each pass were recorded with a handheld GPS. Sample duration, electrofisher settings, and number of passes also were recorded.

At larger waterbodies (typically Class 1), one standard index gillnet gang and one small-mesh gillnet gang were set for approximately 24 hours. The standard index gillnet gang was 137.2 m long and consisted of five 22.9 m long by 1.8 m deep panels of 1.5, 2.0, 3.0, 3.75, 4.25 and 5.0 inch twisted nylon mesh. Small-mesh gangs were 30 m long and consisted of three 10 m x 1.8 m deep panels of 8, 10 and 12.5 mm monofilament mesh. Gillnet set locations were recorded with a handheld GPS. Set and pull time and water depth were also recorded.

Captured fish were identified and enumerated according to species. Large-bodied fish species were measured for fork length (±1mm). All fish were released into the area from which they were captured. Results of the fish sampling program presented in this report have been limited to presence, abundance and size of the species captured.

Mollusks

Mollusk sampling was conducted in Class 1 streams with sampling targeted within the crossing area (30 m length of stream). Additional sampling was conducted outside of the crossing area, based on the presence and location of suitable habitat. Sampling methodology was selected based on site-specific conditions (i.e., depth) and included mussel raking, visual inspection using a bathyscope in wadeable areas and shoreline surveys for empty valves. Captured mussels were identified and enumerated by species and replaced at the area of capture.

4.1.1.7 Fish Habitat Assessment

The potential fish use within the surveyed reach was assessed at each crossing site. The assessment was based on the field data, drainage analysis results and existing watercourse information and included:

- Assessment of fish overwintering, spawning, rearing and feeding potential (rated low [marginal], moderate or high); and
- Identification of areas that may be sensitive to disturbance, particularly downstream of the crossing site.

4.1.2 *Fisheries Act* Risk Assessment

Section 35(1) of the federal *Fisheries Act* (the Act) prohibits "serious harm" to fish and fish habitat that are part of or support a CRA fishery. "Serious harm" is defined as the death of a fish or permanent alteration to or destruction of fish habitat. The purpose of this fisheries protection provision is to "provide for the sustainability and ongoing productivity" of CRA fisheries (DFO 2013a).

Small, localized infills that are typically associated with stream crossings (e.g., culverts, multi span bridges) can directly impact fish populations and fisheries yields through habitat loss (DFO 2013b). The potential effects to fisheries productivity from such small-scale projects would be difficult to measure due to the relatively small area of impact (Randall et al. 2013). Thus, an assessment method that considers the relative amount of habitat change is the best approach to determine impacts to CRA fisheries productivity (DFO 2013b; Randall et al. 2013) and risk of serious harm.

DFO is currently developing a risk management framework to provide guidance in assessing the risk of serious harm to fish from a project or project activity. In the absence of a framework, a habitat-based approach was developed to assess the likelihood that ASR crossing construction would result in a serious harm to fish. This approach was developed based on review of the Fisheries Protection Policy Statement (DFO 2013a) and relevant Canadian Science Advisory Secretariat Science Advisory Reports (DFO 2013b; Randall et al. 2013) and considered the following:

- the type of impact;
- the amount and quality of the affected habitat for each life history stage of fish species that are present; and
- the impact of the project on relevant fish and fish habitat.

The risk assessment is based on the Impacts to Fish and Fish Habitat criteria outlined by DFO (DFO 2013a). The risk assessment considered the residual effect at each crossing assuming that the mitigation measures would be applied as necessary. Each component of the risk assessment is described in the sections below.

A risk assessment was not conducted at crossings sites that did not support fish habitat or where an existing waterbody type was identified by DFO as not requiring authorization under the *Act* (e.g., agricultural and roadside ditches). In addition, DFO has developed a list of projects and project activities near waterbodies that are considered low risk of serious harm. These listed activities, which include clear span bridge construction, do not require authorization under the *Act* provided that measures to avoid harm are implemented. Consequently, an assessment of impacts to fish and fish habitat was not conducted where the preliminary design is a clear span bridge.

4.1.3 Impacts to Fish and Fish Habitat

Impacts to Fish and Fish Habitat were assessed through a rating system using the following six criteria outlined in the *Fisheries Protection Policy Statement* (DFO 2013a) as follows:

1. Residual Impact

Following the pathway of effects, potential impacts to fish and fish habitat were identified and after the application of avoidance and mitigation measures the residual impacts remaining were identified and listed for each site.

2. Duration of Impact

Description: The amount of time that a residual effect will persist.

Scale: Short term (days; low); medium term (weeks-months; medium); long term (years-permanent; high).

3. Extent of Impact

Description: The direct footprint of the development as well as indirectly affected areas, such as downstream areas.

Scale: Site or segment (localized; low); channel reach or lake region (medium); entire watershed or lake (high).

4. Availability and Condition

Description: The relative availability of the type and quality of habitat that is being impacted in the watercourse and/watershed.

Scale: Low - The habitat is common and widespread in the region and is relatively intact.

Medium - The habitat has a limited distribution within the region or river system, or is prevalent but degraded.

High - The habitat is rare or similar habitats are present within the area, but are threatened or have been significantly degraded.

5. Impact on Relevant Fish

Description: The resulting effect to fish from the project in consideration of the first four criteria and results of fish and fish habitat studies.

Low - The habitat is used for a range of life requisites by the relevant fish and is not critical or limiting. Habitat impacts are unlikely to result in a measureable effect to local fish populations.

Medium - The habitat is important and is used for a specific life function by the relevant fish, but it is not critical or limiting habitat. Similar habitat is available within the area, but may have a limited distribution. Habitat impacts may result in a small effect on local fish populations.

High - The habitat is critical to the survival of the affected species or the affected species is sensitive or rare. Habitat impacts will likely result in decreased fish production.

6. Avoidance and Mitigation Measures

The risk assessment assumes that all standard measures to avoid and mitigate harm will be implemented and the assessment is based upon the residual impacts that remain.

4.1.4 Categorization of Risk

Risk was assigned to each stream crossing site by reviewing the ratings of the criteria outline above and providing a qualification of the determined risk.

4.1.5 Net Habitat Change

Habitat change includes loss due to destruction and/or alteration of instream and riparian habitat. Habitat change was calculated for all crossing locations that support fish habitat. In calculating habitat loss, the best available information on crossing design was used. Where information was deficient, conservative assumptions were made.

4.1.5.1 Destruction

Habitat destruction will occur where crossing design requires the construction of permanent instream structures and placement of the road bed in riparian areas. Instream habitat destruction was calculated based on the dimensions (footprint) of permanent crossing structures located below the high water mark. For culvert crossings, the road bed width was assumed to represent the width of the instream destruction. Therefore the area of destruction would equal the road bed width by the stream channel width at the crossing location.

For bridge crossings, the maximum length of a bridge span is 80 feet or 24.3 meters (pers. comm. MI-RRO). Based on this criterion, clear span bridges would be constructed over watercourses less than 24.3 m wide and multi-span bridges over those greater than 24.3 m wide, unless otherwise indicated by MI-RRO. The number of spans required for each bridge site was determined based on the channel width, maximum span length and guided by known bridge designs from MI-RRO's PR 304 to Berens River ASR Project. These include two single pier multi span bridges at Pigeon and Bradbury Rivers (AECOM 2013a,b) and a two pier multi span

bridge at Long Body Creek (AECOM 2011). Where multi-span bridges are required, it was assumed that only the bridge piers would result in instream destruction and that all remaining bridge components (e.g., abutments) would be located above the high water mark. The pier dimensions used to calculate instream habitat loss was estimated based on the bridge design for Pigeon River, MI-RRO's PR 304 to Berens River ASR Project (AECOM 2013a).

4.1.5.2 Alteration

Riparian habitat within the RoW but outside of the road bed may be altered and maintained as low growth vegetation for line of sight. Alteration of instream fish habitat may occur where rip rap placement is required to reinforce bridge piers and protect channel banks. Rock placement along stream channels is expected to diversify habitats, provide cover for fish and increase productivity, as long as it does not have a harmful effect to flow patterns. Areas of habitat alteration will be determined following final design.

4.2 RESULTS

A detailed summary of the physical and biological data at streams crossed by the proposed ASR alignment, are provided in appendices 4 and 5. These data were used to determine the potential risk to fish habitat and assess the likelihood of serious harm resulting from construction of crossing structures. The results of these assessments are discussed in the following sections.

4.2.1 Water Quality

4.2.1.1 *In situ* Parameters

In situ parameters measured at 24 stream crossings along the project route indicated that conditions were relatively similar throughout the region in June 2016. In particular, specific conductance was relatively low at every site, and pH was consistently slightly acidic to circumneutral (Table 3). The exception was that DO concentrations varied notably between sites, with particularly low concentrations measured in the headwaters of bogs or beaver flooded areas. Thirteen of the 24 streams had DO concentrations below the protection of aquatic life (PAL) objectives (6.0 or 6.5 mg/L for cool- and cold-water species, respectively; MWS 2011). In contrast, all stream crossings had pH within the Manitoba water quality guidelines for the protection of aquatic life (6.5-9.0 pH units; MWS 2011).

4.2.1.2 Laboratory Analyses

The laboratory samples collected in the study area in June 2016 indicate that the sites have relatively low nutrient concentrations as well as high clarity and low productivity (Table 4). Additionally, the sites have circumneutral pH conditions with relatively high alkalinity and low

acid sensitivity. Ammonia, nitrate, and nitrite concentrations were well within the MWQSOGs (site-specific guideline, 2.93 mg N/L, and 0.060 mg N/L, respectively; MWS 2011). The guideline for total phosphorus (TP) in streams and rivers (0.05 mg/L) was not exceeded at any site. However, because nutrient concentrations vary dramatically between seasons (e.g., during freshet), concentrations could exceed the guidelines at other times of the year or under different flow conditions.

Table 3. *In situ* water quality measured at streams crossed by the Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation All Season Road. Results in bold indicate values that do not fall within the Manitoba water quality guidelines for the protection of aquatic life.

Site ID	Watercourse	Sample Date	Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	Specific Conductance (µS/cm)	pH (pH units)
MWQSOG			-	*6.0 -6.5* [1]	-	-	*6.5-9.0* [2]
P6a-X002	Unnamed tributary of Hayes River	17-Jun-16	18.9	***3.0***	31.8	92	6.6
P6a-X005	Unnamed tributary of Hayes River	17-Jun-16	18.8	***2.2***	23.8	156	6.8
P6a-X008	Unnamed tributary of Michikanes Lake	16-Jun-16	21.7	***4.0***	45.6	137	6.6
P6a-X018	Unnamed tributary of Knee Lake	16-Jun-16	19.8	***4.1***	44.8	138	6.5
P6a-X019	Magill Creek	21-Jun-16	17.1	7.2	75.1	131	7.4
P6a-X020	Unnamed tributary of Magill Creek	15-Jun-16	12.4	***3.1***	28.6	98	6.7
P6a-X022	Unnamed tributary of Laird Lake	15-Jun-16	17.6	***1.7***	18.3	148	6.7
P6a-X023	Unnamed tributary of Laird Lake	14-Jun-16	16.5	***2.7***	27.9	101	6.6
P6a-X027	Unnamed tributary of Wanless Lake	14-Jun-16	18.5	***2.2***	23.1	118	6.7
P6a-X028	Unnamed tributary of Wanless Lake	14-Jun-16	19.6	9.7	-	95.8	7.1
P6a-X029	Unnamed tributary of Hignell Lake	15-Jun-16	15.7	6.3	-	102.3	7.3
P6a-X031	Unnamed tributary of Hignell Lake	15-Jun-16	17.4	***4.9***	-	65.1	6.8
P6a-X032	Unnamed tributary of Hignell Lake	16-Jun-16	20.6	8.6	-	75.3	6.6
P6a-X033	Unnamed tributary of an unnamed lake	17-Jun-16	19.4	***3.5***	-	153.5	6.7
P6a-X034	Unnamed tributary of an unnamed lake	18-Jun-16	18.5	***2.9***	-	124.5	6.7
P6a-X037	Unnamed tributary of an unnamed lake	17-Jun-16	16.0	***3.8***	-	105.2	6.5
P6a-X038	Unnamed tributary of an unnamed lake	16-Jun-16	18.3	7.4	-	142.8	6.6
P6b-X002	Unnamed tributary of Hawkins Lake	18-Jun-16	18.3	7.9	84.2	105	6.6
P6b-X003	Unnamed tributary of Hawkins Lake	18-Jun-16	20.1	8.8	-	139.7	6.7
P6b-X006	Unnamed tributary of Opaskaykow Lake	18-Jun-16	18.2	7.6	80.1	145	6.9
P6b-X007	Unnamed tributary of Opaskaykow Lake	19-Jun-16	17.6	7.3	-	154.9	6.9
P6b-X009	Unnamed tributary of Tapper Lake	18-Jun-16	23.5	7.9	-	101.6	6.5

Site ID	Watercourse	Sample Date	Temperature (°C)	Dissolved Oxygen (mg/L)	Oxygen Saturation (%)	Specific Conductance (µS/cm)	pH (pH units)
MWQSOG			-	*6.0 -6.5* [1]	-	-	*6.5-9.0* [2]
P6b-X013	Unnamed tributary of God's River	20-Jun-16	14.2	***5.7***	57.3	92	6.8
P6b-X015	God's River	19-Jun-16	15.4	8.0	89.3	97	7.7

1 - Cool and cold water objectives, respectively.
2 - The lower and upper limits of the guideline for protection of aquatic life.

Table 4. Laboratory water quality results for streams crossed by the all season road linking Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation. Results in bold indicate values that do not fall within the Manitoba water quality guidelines for the protection of aquatic life.

			Nitrogen						Phosphorus			
Site ID	Watercourse	Sample Date	Ammonia (mg N/L)	Nitrate/ Nitrite (mg N/L)	Nitrate-N (mg N/L)	Nitrite-N (mg N/L)	Total Kjeldahl Nitrogen (mg/L)	Total N[1] (mg/L)	Total Dissolved Phosphorus (mg/L)	Total Particulate Phosphorus (mg/L)	Total Phosphorus (mg/L)	Total Organic Carbon (mg/L)
	Detection Limit		0.010	0.0051	0.0050	0.0010	0.2	-	0.001	0.0028	0.001	0.5
MWQSOG			*1.76-39.2*[a]	*2.93*	*2.93*	*0.060*					*0.05* [2]	
P6a-X002	Unnamed	17-Jun-16	<0.010	<0.0051	<0.0050	<0.0010	0.69	0.69	0.0049	<0.0028	0.0049	16.6
P6a-X004	Unnamed	17-Jun-16	<0.010	<0.0051	<0.0050	<0.0010	0.72	0.72	0.0080	<0.0028	0.0081	15.0
P6a-X006	Unnamed	17-Jun-16	<0.010	<0.0051	<0.0050	<0.0010	0.66	0.66	0.0032	<0.0028	0.0040	17.0
P6a-X008	Unnamed	16-Jun-16	<0.010	<0.0051	<0.0050	<0.0010	0.59	0.59	0.0033	<0.0028	0.0050	14.3
P6a-X009	Unnamed	17-Jun-16	0.017	<0.0051	<0.0050	<0.0010	0.89	0.89	0.0068	0.020	0.026	16.5
P6a-X018	Unnamed	16-Jun-16	<0.010	<0.0051	<0.0050	<0.0010	0.64	0.64	0.0082	<0.0028	0.0078	13.2
P6a-X019	Magill Creek	21-Jun-16	0.010	<0.0051	<0.0050	<0.0010	0.69	0.69	0.0049	<0.0028	0.0065	10.0
P6a-X020	Unnamed	15-Jun-16	0.019	0.0085	0.0085	<0.0010	0.68	0.69	0.0069	<0.0028	0.0085	19.7
P6a-X023	Unnamed	14-Jun-16	0.015	<0.0051	<0.0050	<0.0010	0.72	0.72	0.0096	0.012	0.022	9.38
P6a-X028	Unnamed	14-Jun-16	<0.010	0.0058	0.0058	<0.0010	0.60	0.61	0.0041	<0.0028	0.0051	16.6
P6a-X032	Unnamed	16-Jun-16	<0.010	<0.0051	<0.0050	<0.0010	0.64	0.64	0.0043	<0.0028	0.0049	15.9
P6a-X033	Unnamed	17-Jun-16	0.010	0.0054	0.0054	<0.0010	0.70	0.71	0.0051	<0.0028	0.0055	17.9
P6a-X034	Unnamed	18-Jun-16	0.016	0.0209	0.0209	<0.0010	0.72	0.74	0.0083	0.0132	0.0215	12.6
P6a-X037	Unnamed	17-Jun-16	<0.010	0.0099	0.0099	<0.0010	0.65	0.66	0.0027	<0.0028	0.0052	15.4
P6a-X038	Unnamed	16-Jun-16	<0.010	<0.0051	<0.0050	<0.0010	0.71	0.71	0.0049	0.0118	0.0167	15.5
P6b-X002	Unnamed	18-Jun-16	<0.010	<0.0051	<0.0050	<0.0010	0.58	0.56	0.0028	0.0053	0.0081	13.0
P6b-X003	Unnamed	18-Jun-16	<0.010	<0.0051	<0.0050	<0.0010	0.68	0.68	0.0021	0.0035	0.0055	10.5
P6b-X006	Unnamed	18-Jun-16	<0.010	0.0083	0.0083	<0.0010	0.64	0.65	0.0030	0.0048	0.0078	13.0
P6b-X007	Unnamed	19-Jun-16	<0.010	<0.0051	<0.0050	<0.0010	0.56	0.56	0.0032	0.0060	0.0092	9.16

Site ID	Watercourse	Sample Date	Nitrogen						Phosphorus			
			Ammonia (mg N/L)	Nitrate/ Nitrite (mg N/L)	Nitrate-N (mg N/L)	Nitrite-N (mg N/L)	Total Kjeldahl Nitrogen (mg/L)	Total N[1] (mg/L)	Total Dissolved Phosphorus (mg/L)	Total Particulate Phosphorus (mg/L)	Total Phosphorus (mg/L)	Total Organic Carbon (mg/L)
	Detection Limit		0.010	0.0051	0.0050	0.0010	0.2	-	0.001	0.0028	0.001	0.5
MWQSOG			*1.76-39.2*[a]	*2.93*	*2.93*	*0.060*					*0.05* [2]	
P6b-X009	Unnamed	18-Jun-16	0.070	0.0056	0.0056	<0.0010	0.84	0.85	0.0132	0.0099	0.0230	12.5
P6b-X013	Unnamed	20-Jun-16	<0.010	<0.0051	<0.0050	<0.0010	0.71	0.71	0.0046	0.0068	0.0114	16.3
P6b-X015	God's River	19-Jun-16	<0.010	<0.0051	<0.0050	<0.0010	0.50	0.50	0.0038	0.0090	0.0128	6.6

a – the guideline is site-specific, dependent on temperature and pH at the site.

Table 4. Continued.

Site ID	Watercourse	Sample Date	Water Clarity			Alkalinity				Algal Pigments	
			Total Suspended Solids (mg/L)	Turbidity (NTU)	pH (pH units)	Total Alkalinity (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hydroxide (mg/L)	Chlorophyll *a* (µg/L)	Phaeophytin *a* (µg/L)
		Detection Limit	2.0	0.10	0.10	1.0	1.2	0.60	0.34	0.10	0.10
MWQSOG					*6.5-9.0* [3]						
P6a-X002	Unnamed	17-Jun-16	4.4	1.57	7.32	50.4	61.5	<0.60	<0.34	1.19	0.62
P6a-X004	Unnamed	17-Jun-16	2.0	0.63	7.37	97.4	119.0	<0.60	<0.34	3.91	2.37
P6a-X006	Unnamed	17-Jun-16	3.0	0.36	7.23	53.6	65.4	<0.60	<0.34	2.31	2.36
P6a-X008	Unnamed	16-Jun-16	<2.0	0.30	7.48	73.7	89.9	<0.60	<0.34	0.59	0.56
P6a-X009	Unnamed	17-Jun-16	29.2	4.23	7.38	102.0	124.0	<0.60	<0.34	23.8	10.7
P6a-X018	Unnamed	16-Jun-16	<2.0	1.11	7.64	79.5	97.0	<0.60	<0.34	1.12	1.24
P6a-X019	Magill Creek	21-Jun-16	3.2	2.68	7.84	74.7	91.1	<0.60	<0.34	1.95	1.77
P6a-X020	Unnamed	15-Jun-16	<2.0	1.13	7.56	78.7	96.0	<0.60	<0.34	0.61	0.41
P6a-X023	Unnamed	14-Jun-16	4.4	2.45	7.65	64.9	79.2	<0.60	<0.34	4.11	1.60
P6a-X028	Unnamed	14-Jun-16	<2.0	0.24	7.05	54.0	65.9	<0.60	<0.34	0.41	0.37
P6a-X032	Unnamed	16-Jun-16	<2.0	0.48	7.04	38.9	47.5	<0.60	<0.34	2.54	1.92
P6a-X033	Unnamed	17-Jun-16	<2.0	0.45	7.33	58.9	71.9	<0.60	<0.34	2.56	1.97
P6a-X034	Unnamed	18-Jun-16	<2.0	0.52	7.31	62.8	76.6	<0.60	<0.34	0.73	0.71
P6a-X037	Unnamed	17-Jun-16	<2.0	0.47	7.33	64.1	78.2	<0.60	<0.34	0.48	0.28
P6a-X038	Unnamed	16-Jun-16	<2.0	0.72	7.32	80.6	98.3	<0.60	<0.34	3.46	2.76
P6b-X002	Unnamed	18-Jun-16	<2.0	0.31	7.56	61.3	74.8	<0.60	<0.34	0.50	0.55
P6b-X003	Unnamed	18-Jun-16	<2.0	0.49	7.54	71.4	87.1	<0.60	<0.34	0.69	0.77
P6a-X006	Unnamed	18-Jun-16	5.8	0.50	7.64	93.1	114.0	<0.60	<0.34	0.84	0.53
P6b-X007	Unnamed	19-Jun-16	<2.0	0.63	7.66	89.2	109.0	<0.60	<0.34	0.82	0.8
P6b-X009	Unnamed	18-Jun-16	<2.0	1.21	6.90	52.2	63.7	<0.60	<0.34	1.35	1.43

Site ID	Watercourse	Sample Date	Water Clarity			Alkalinity				Algal Pigments	
			Total Suspended Solids (mg/L)	Turbidity (NTU)	pH (pH units)	Total Alkalinity (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Hydroxide (mg/L)	Chlorophyll *a* (µg/L)	Phaeophytin *a* (µg/L)
		Detection Limit	2.0	0.10	0.10	1.0	1.2	0.60	0.34	0.10	0.10
MWQSOG					*6.5-9.0* [3]						
P6b-X013	Unnamed	20-Jun-16	<2.0	0.34	7.28	58.9	71.9	<0.60	<0.34	0.91	0.80
P6b-X015	God's River	19-Jun-16	<2.0	0.75	7.81	61.5	75.0	<0.60	<0.34	3.19	1.28

1 – Calculated as the sum of total Kjeldahl N and nitrate/nitrite-N.
2 – Narrative guideline for streams.
3 – Lower and upper limits of the guideline for protection of aquatic life.

4.2.2 Species Presence

Fish and mollusk species and aquatic species-at-risk presence in watercourses crossed by the ASR was assessed based on field sampling and literature review.

4.2.2.1 Fish

Twenty-four fish species have been previously reported within streams and rivers crossed by the proposed alignment. These species records are limited to the God's River (Site P6b-X015) and include a variety of large-bodied fish, such as Brook Trout, Lake Sturgeon, Lake Whitefish, Northern Pike, suckers, and Walleye (FIHCS 2016, HTFC Planning & Design 2016, Eaton 2012, and Stewart and Watkinson 2004). During 2016 field surveys, Brook Trout (both adult and young-of-year), Longnose Sucker, Northern Pike, White Sucker, and sculpin spp. were captured near the crossing site (Appendix 2).

Information on species presence was not found in the literature for the remaining study streams. Field sampling identified three species in Magill Creek: Northern Pike, Shorthead Redhorse and Yellow Perch. At 19 streams, all unnamed tributaries consisting of small low gradient boreal streams, one or two species were identified, with Brook Stickleback found at 16 of the sites, Northern Pearl Dace at four sites, Northern Pike at three sites, Fathead Minnow at two sites and Burbot and Johnny Darter each at one site only (Appendix 2). Fish presence was not confirmed through field sampling at the remaining 33 streams crossed by the ASR.

4.2.2.2 Mussels

The small tributary streams crossed by the ASR alignment are unsuitable for mussels. Mussels are typically found in medium to large river systems in areas predominately composed of silt/clay and sand and to a lesser extent gravel.

Fat Mucket (*Lampsilis siliquoidea*) and Giant Floater (*Pyganodon grandis*) mussels were captured using a mussel rake or through visual surveys in Magill Creek near the crossing site and Giant Floater was captured in the God's River near the crossing site.

4.2.2.3 Species-at-Risk

The Manitoba *Endangered Species and Ecosystems Act* (MBESEA) was enacted to protect and enhance the survival of threatened and endangered species in Manitoba, to enable reintroduction of extirpated species into the province, and to designate species as threatened, endangered, extirpated, or extinct. At the federal level, the *Species at Risk Act* (SARA) is intended to protect wildlife species at risk in Canada. Within the *Act*, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was established as an independent body of experts responsible

for identifying and assessing wildlife species considered at risk. Wildlife species that have been designated by COSEWIC may then qualify for legal protection and recovery under SARA.

One at risk species, Lake Sturgeon has a distribution that overlaps the project area. The Southern Hudson Bay-James Bay population is designated as Special Concern by COSEWIC (COSEWIC 2006) and is currently under consideration for protection under SARA. Although they are not legally protected, the potential presence of sturgeon within the Project area was assessed in consideration of potential future listing under SARA.

Lake Sturgeon

Lake Sturgeon inhabit larger lakes and rivers, are typically benthic and commonly found over sand and fine substrates. They spawn in fast moving water, such as rapids or at the base of falls. In the boreal shield, with deep lakes and impassable falls and rapids, populations are naturally fragmented into the small spatial populations. Critical habitat for the species has not been identified by COSEWIC.

There is generally a poor understanding of Lake Sturgeon populations as far upstream in the Hayes drainage as the Project 6, but overall Hayes River sturgeon populations are believed to be healthy (MCWS 2012, Manitoba Hydro 2014). Harvest is currently restricted to subsistence harvest by First Nations and is considered to be at a relatively low sustainable level (MCWS 2012).

Lake Sturgeon has been reported in the upper Hayes River drainage including the upper God's River. Biological studies have documented Lake Sturgeon populations in the God's River up to its confluence with the Red Sucker River, approximately 150 km downstream of the P6b project area (Koga 2014). Traditional Knowledge from Shamattawa First Nation extends the distribution further upstream to a set of rapids 4 km downstream of the P6b God's River crossing (Eaton 2012). In addition, God's Lake First Nation TK indicates the species is found within God's Lake (HTFC Planning & Design 2016). Surveys within the Hayes River have found Lake Sturgeon upstream of the confluence with the Fox River, but not as far upstream as Knee Lake (Pisiak and McLean 2007). Traditional Knowledge from Bunibonibee Cree Nation report sporadic records from Oxford Lake (HTFC Planning & Design 2016).

The God's River crossing site provides moderate velocity run habitat with sand and rocky substrates. The immediate crossing area provides foraging habitat for adults. Potential spawning habitat is found at a set of large rapids 4 km downstream of the crossing.

4.2.3 Fish and Fish Habitat Assessment

Fish and fish habitat assessments were conducted at 53 stream crossings, 38 on P6a and 15 on P6b. A summary of the assessments is found in Table 5 and detailed assessments are available in appendices 4 and 5.

4.2.3.1 No Fish Habitat

Habitat at 28 of the 53 ASR stream crossing sites was assessed as not supporting fish and included 20 of 38 sites on P6a and eight of 15 on P6b (Table 5). These unnamed streams are headwater wetland areas with no stream channel or channel connection to fish bearing waters. Habitat at the sites was characterized as a wetland with either no visible water or stagnant pools unsuitable to support any fish. Descriptions of sites assessed as no fish habitat are available in Appendix 4.

4.2.3.2 Fish Habitat

Habitat at 25 ASR stream crossing sites was assessed as supporting fish and this ranged from marginal habitat supporting forage fish only to sites with habitat supporting a greater diversity of fish species (Table 5).

Of these 25 sites, 18 were assessed as marginal fish habitat (13 on P6a and 5 on P6b). These marginal sites are located on small first or second order streams that are often poorly connected to downstream fish-bearing waters due to numerous ephemeral barriers. These streams have small watersheds and limited flows which are often impounded by beaver dams. A defined stream channel is typically present with soft substrates, abundant instream vegetation and marshy floodplains. Site P6a-X002 was an exception, where coarse substrate (gravel/cobble) was abundant at the crossing; the coarse material presumably originating from the two existing winter road crossings. The flow conditions of theses streams may result in degraded water quality due to low dissolved oxygen and therefore habitat at the majority of these sites is considered unsuitable for large-bodied fish due to poor overwintering conditions and restricted access. Forage fish adapted to small boreal streams were frequently captured at these sites and include Brook Stickleback, Fathead Minnow and Northern Pearl Dace. Where access is less restrictive, large-bodied species such as Northern Pike are expected to make use of the crossings area for spawning, rearing and foraging. This would include sites P6a-X031, P6b-X002, P6b-X003, and P6b-X009. The coarse substrate at P6a-X002 may be used by suckers and Walleye, but the small watershed and low water levels reduce the potential of the habitat.

Seven stream crossing sites were assessed as important habitat, four on P6a and three on P6b. These streams have larger upstream watersheds and connectivity to downstream and possibly

upstream fish bearing waters. Habitat at these sites was suitable for a range of life requisites for a diversity of fish species, including both forage fish and large–bodied species.

Habitat was similar at sites P6a-X008 (Unnamed Tributary of Michikanes Lake), P6a-X018 (Unnamed Tributary of Knee Lake) P6a-X023 (Unnamed Tributary of Laird Lake), and P6b-X013 (Unnamed Tributary of God's River) comprised of flat water, fine sediments and organic substrate and instream vegetation suitable for spawning, rearing and feeding of forage fish species and Northern Pike. Though small bodied fish tolerant of low oxygen conditions may overwinter within the reach, large-bodied species (e.g., Northern Pike) likely overwinter in downstream lakes.

Magill Creek is a long stream connecting a string of smaller lakes to the receiving waterbody, Knee Lake. The P6a-X019 crossing is located 7.4 km upstream of Knee Lake. Habitat within the reach consists largely of fine sediments with boulders and instream vegetation. Habitat is suitable for spawning, rearing, and feeding for Northern Pike and forage fish. There is some gravel/cobble habitat, suitable as spawning and rearing habitat for sucker and Walleye. Overwintering of large bodied species likely occurs in deeper holes in creek or in Knee Lake.

Habitat at crossing P6b-X007, an Unnamed Tributary of Opaskaykow Lake consists of run habitat with substrates dominated by fines but including some coarse material, and abundant instream vegetation. This habitat supports a range of life requisites for Northern Pike and forage fish, including spawning, rearing and feeding and may be used by other large-bodied species such as Burbot, Walleye and suckers. Though fish species may overwinter within the reach, the lakes are better suited for overwintering of large-bodied species

The God's River is a medium sized river flowing out of God's Lake. The crossing (P6b-X015) is located 6.5 km downstream from God's Lake. The crossing is located at the existing winter road bridge where the river narrows resulting in increased water velocities. Habitat was run and pool with areas of riffle upstream. The substrate was largely coarse material with larger cobble and boulder in the centre of the river and sand along the shore as well as downstream. The diversity of habitats, pool, run and riffle provide suitable habitat for a range of species, including Northern Pike, suckers, Walleye and Brook Trout. Both adult and young-the-year Brook Trout were captured at the site indicating the presence of foraging and rearing habitat in the area as well as the likelihood of spawning habitat in the area.

Table 5. Summary of aquatic environment characteristics of watercourse crossings on the proposed Project 6 ASR alignment.

Site	Stream Name	UTM 15		Stream Type	Flow Regime	Receiving Waterbody	Distance (km)	Upstream Drainage Area (km^2)	Fish Habitat	Fish Species[a]
		Easting	Northing							
P6a-X001	Unnamed Tributary of Hayes River	354680	6086782	Stream	Ephemeral	Hayes River	2.91	0.11	No	N/A
P6a-X002	Unnamed Tributary of Hayes River	355166	6086046	Stream	Perennial	Hayes River	0.25	0.14	Yes	FF, LB
P6a-X003	Unnamed Tributary of Hayes River	356066	6084096	Stream	Ephemeral	Hayes River	0.44	2.62	No	N/A
P6a-X004	Unnamed Tributary of Hayes River	357220	6081611	Wetland	Ephemeral	Hayes River	1.71	N/A	No	N/A
P6a-X005	Unnamed Tributary of Hayes River	357317	6081440	Stream	Perennial	Hayes River	1.49	3.31	Yes	FF
P6a-X006	Unnamed Tributary of Michikanes Lake	359259	6078497	Stream	Ephemeral	Michikanes Lake	5.26	1.36	No	N/A
P6a-X007	Unnamed Tributary of Michikanes Lake	359925	6076546	Wetland	Ephemeral	Michikanes Lake	2.17	0.00	Yes	FF
P6a-X008	Unnamed Tributary of Michikanes Lake	359963	6076436	Stream	Perennial	Michikanes Lake	2.01	39.24	Yes	FF, LB
P6a-X009	Unnamed Tributary of Michikanes Lake	360165	6075841	Wetland	Ephemeral	Michikanes Lake	1.61	0.95	No	N/A
P6a-X010	Unnamed Tributary of Michikanes Lake	360202	6075729	Wetland	Ephemeral	Michikanes Lake	1.74	0.89	No	N/A
P6a-X011	Unnamed Tributary of Michikanes Lake	360225	6075583	Wetland	Ephemeral	Michikanes Lake	1.91	0.83	No	N/A
P6a-X012	Unnamed Tributary of Michikanes Lake	360226	6075505	Wetland	Ephemeral	Michikanes Lake	2.03	0.77	No	N/A
P6a-X013	Unnamed Tributary of Michikanes Lake	360222	6075456	Wetland	Ephemeral	Michikanes Lake	2.09	0.74	No	N/A
P6a-X014	Unnamed Tributary of Michikanes Lake	359702	6073936	Wetland	Perennial	Michikanes Lake	3.20	1.24	No	N/A

Site	Stream Name	UTM 15		Stream Type	Flow Regime	Receiving Waterbody	Distance (km)	Upstream Drainage	Fish Habitat	Fish Species[a]
P6a-X015	Unnamed Tributary of Michikanes Lake	360702	6073154	Wetland	Ephemeral	Michikanes Lake	4.91	4.63	No	N/A
P6a-X016	Unnamed Tributary of Michikanes Lake	361536	6073552	Wetland	Ephemeral	Michikanes Lake	4.42	12.09	No	N/A
P6a-X017	Unnamed Tributary of Michikanes Lake	362851	6073221	Stream	Ephemeral	Michikanes Lake	6.39	4.30	No	N/A
P6a-X018	Unnamed Tributary of Knee Lake	365150	6071363	Stream	Perennial	Knee Lake	4.63	68.58	Yes	FF, LB
P6a-X019	Magill Creek	366392	6069210	Stream	Perennial	Knee Lake	7.40	186.54	Yes	FF, LB
P6a-X020	Unnamed Tributary of Magill Creek	367584	6068240	Stream	Intermittent	Knee Lake	7.81	0.36	Yes	FF
P6a-X021	Unnamed Tributary of Magill Creek	368803	6066857	Stream	Ephemeral	Knee Lake	9.20	0.99	No	N/A
P6a-X022	Unnamed Tributary of Laird Lake	372798	6063748	Wetland	Ephemeral	Laird Lake	14.00	1.06	Yes	FF
P6a-X023	Unnamed Tributary of Laird Lake	372935	6063705	Stream	Perennial	Laird Lake	13.95	42.00	Yes	FF, LB
P6a-X024	Unnamed Tributary of Laird Lake	376856	6062609	Stream	Ephemeral	Laird Lake	18.92	1.03	No	N/A
P6a-X025	Unnamed Tributary of Hawkins Lake	378492	6060867	Wetland	N/A	Hawkins Lake	8.89	1.01	No	N/A
P6a-X026	Unnamed Tributary of Wanless Lake	378756	6060265	Wetland	N/A	Wanless Lake	1.97	0.03	No	N/A
P6a-X027	Unnamed Tributary of Wanless Lake	379995	6058916	Stream	Perennial	Wanless Lake	3.34	2.26	Yes	FF
P6a-X028	Unnamed Tributary of Wanless Lake	381509	6058214	Fen	Perennial	Wanless Lake	5.51	0.41	Yes	FF
P6a-X029	Unnamed Tributary of Hignell Lake	382770	6057629	Stream	Perennial	Hignell Lake	2.33	4.40	Yes	FF

Site	Stream Name	UTM 15		Stream Type	Flow Regime	Receiving Waterbody	Distance (km)	Upstream Drainage	Fish Habitat	Fish Species[a]
P6a-X030	Unnamed Tributary of Hignell Lake	383321	6057373	Creek	Ephemeral	Hignell Lake	2.06	0.09	No	N/A
P6a-X031	Unnamed Tributary of Hignell Lake	384797	6056689	Stream	Perennial	Hignell Lake	0.30	0.48	Yes	FF, LB
P6a-X032	Unnamed Tributary of Hignell Lake	387333	6055019	Stream	Perennial	Hignell Lake	3.80	2.84	Yes	FF, LB
P6a-X033	Unnamed Tributary of an Unnamed Lake	389260	6054142	Stream	Perennial	God's Lake	16.66	1.47	Yes	FF, LB
P6a-X034	Unnamed Tributary of an Unnamed Lake	390626	6054355	Fen Stream	Perennial	God's Lake	15.19	7.51	Yes	FF, LB
P6a-X035	Unnamed Tributary of an Unnamed Lake	392437	6053228	Stream	Ephemeral	God's Lake	13.12	1.58	No	N/A
P6a-X036	Unnamed Tributary of an Unnamed Lake	397092	6049844	Stream	Ephemeral	God's Lake	5.91	1.64	No	N/A
P6a-X037	Unnamed Tributary of an Unnamed Lake	398766	6048950	Stream	Perennial	God's Lake	4.06	0.54	Yes	FF
P6a-X038	Unnamed Tributary of an Unnamed Lake	399735	6048087	Stream	Perennial	God's Lake	2.90	0.28	Yes	FF, LB
P6b-X001	Unnamed Tributary of Hawkins Lake	383989	6065801	Stream	Ephemeral	Hawkins Lake	0.42	0.39	No	N/A
P6b-X002	Unnamed Tributary of Hawkins Lake	383950	6066261	Stream	Perennial	Hawkins Lake	0.59	6.55	Yes	FF, LB
P6b-X003	Unnamed Tributary of Hawkins Lake	384030	6067799	Wetland	Perennial	Hawkins Lake	3.99	16.37	Yes	FF, LB
P6b-X004	Unnamed Tributary of Hawkins Lake	384190	6068376	Stream	Ephemeral	Hawkins Lake	5.53	0.30	No	N/A
P6b-X005	Unnamed Tributary of Opaskaykow Lake	386967	6070020	Wetland	Perennial	Opaskaykow Lake	5.47	1.17	No	N/A
P6b-X006	Unnamed Tributary of Opaskaykow Lake	389409	6069930	Stream	Perennial	Opaskaykow Lake	2.14	3.68	Yes	FF

Site	Stream Name	UTM 15		Stream Type	Flow Regime	Receiving Waterbody	Distance (km)	Upstream Drainage	Fish Habitat	Fish Species[a]
P6b-X007	Unnamed Tributary of Opaskaykow Lake	390380	6069047	Stream	Perennial	Opaskaykow Lake	2.43	134.31	Yes	FF, LB
P6b-X008	Unnamed Tributary of Bayley Lake	404927	6078620	Wetland	Ephemeral	Bayley Lake	3.37	0.41	No	N/A
P6b-X009	Unnamed Tributary of Tapper Lake	409513	6080144	Stream	Perennial	Tapper Lake	1.32	16.92	Yes	FF, LB
P6b-X010	Unnamed Tributary of Tapper Lake	411494	6080295	Wetland	Ephemeral	Tapper Lake	4.06	9.00	No	N/A
P6b-X011	Unnamed Tributary of Tapper Lake	413389	6081483	Wetland	Ephemeral	Tapper Lake	6.74	1.04	No	N/A
P6b-X012	Unnamed Tributary of God's Lake	424907	6082134	Wetland	Ephemeral	God's Lake	3.86	1.91	No	N/A
P6b-X013	Unnamed Tributary of God's River	428031	6081141	Stream	Perennial	God's River	0.76	9.87	Yes	FF, LB
P6b-X014	Unnamed Tributary of God's River	429148	6080372	Stream	Ephemeral	God's River	0.59	0.31	No	N/A
P6b-X015	God's River	429706	6080809	River	Perennial	Hayes River	287	12,861	Yes	FF, LB

a – FF = Forage Fish (e.g., minnows, etc.), LB = Large Bodied (e.g., Northern Pike, Walleye, sucker spp., etc.).

4.2.4 Fisheries Act Risk Assessment

The results of the risk assessment are discussed in the following sections and presented in Table 6. The assessment is based on the existing habitat as described in section 4.2.2 and the Availability and Condition and Impact on Relevant Fish Ratings for each site assessed as having fish habitat at the crossing.

4.2.5 No Fish Habitat

Twenty eight of the 53 proposed culvert sites were assessed as No Fish Habitat based on the absence of a channel at the crossing and/or connectivity to downstream fish bearing waterbodies. A summary of these watercourses are provided in Appendix 4. These sites are not discussed further in the risk assessment.

4.2.6 Fish Habitat

Habitat at 25 ASR stream crossing sites was assessed as directly supporting fish. These crossings include culverts at small and medium-sized streams, a clear-span bridge at the God's River and a multi-span bridge at Magill Creek. The Residual Impact, Extent and Duration of Impact assessment for each type of crossing structure is discussed below. A risk assessment for each crossing site is available in Appendix 5

4.2.6.1 Culvert Crossing

In the absence of preliminary design information, culverts were assumed to be 30 m long (pers. comm. MI-RRO). Habitat loss within the footprint of the crossing will be permanent and therefore duration is rated as high, the extent of the affected habitat is small and rated as low. The overall assessment considers that some productivity will be maintained within the culvert following construction as culverts will be embedded and designed for fish passage. Crossing design was undetermined for P6a-X018, Unnamed Tributary of Knee Lake at the time of assessment, but based on previous East Side Road Authority crossing designs the crossing is assumed to be a culvert.

4.2.6.1.1. Sites Not Supporting a Commercial, Recreational or Aboriginal Fishery

Culvert crossings are proposed for twenty three sites, of which seven were assessed as not contributing to a CRA fishery (P6a-X005, P6a-X007, P6a-X020, P6a-X022, P6a-X027, P6a-X028 and P6a-X029). These seven sites were all characterized as boreal bog/fen headwater areas of small streams with poor connectivity to downstream fish bearing waters (see Section 4.2.2.2). The crossing sites support forage fish only and are considered unsuitable for large-bodied fish due to poor overwintering conditions and restricted access. At all seven sites the

habitat availability and condition was considered widespread and common in the region and the impacts to fish from the project were expected to have no measurable effect on the downstream CRA fishery productivity. Overall, the construction and operation of the culvert crossing at each of these seven sites was assessed as low risk of causing serious harm to the fishery because of the small area of impact, the low quality of habitat and abundance of similar habitat within the system.

4.2.6.1.2. Sites Supporting a Commercial, Recreational or Aboriginal Fishery

Bog/Fen Streams

Of the remaining 16 culvert crossing sites assessed as contributing to a CRA fishery, 10 of the sites, six on P6a (P6a-X031, P6a-X032, P6a-X033, P6a-X034, P6a-X037, P6a-X038) and four on P6b (P6b-X002, P6b-X003, P6b-X006, P6b-X009) support marginal fish habitat with limited use by large-bodied species such as Northern Pike due to restricted access and suitable overwintering habitat. Habitat for species such as pike was frequently available in close proximity downstream of the crossing site.

The Availability and Condition and Impacts on Relevant Fish were rated as Low. The habitat provided by these streams is common within the area and is not critical or limiting to Northern Pike or other CRA species. Northern Pike and their habitats are abundant within Project area and there are no known threats to the habitat or the species.

Based on the habitat assessment and duration and extent ratings the proposed culvert crossings are classified as Low Risk. Although each stream may support Northern Pike, suitable habitat for the species is located downstream of the crossing and outside of the anticipated cleared ROW.

P6a-X002

The crossing of the Unnamed Tributary of the Hayes River is located on an existing winter road crossing of a typical boreal bog/fen stream. However, the crossing site and areas downstream contain gravel, cobble and boulder substrates, presumably from the winter road bed which are relatively uncommon in such streams. The permanent culvert would cover some of the coarse substrate at the site but the placement of rip rap at the culvert inlet/outlet would replace the effected substrates. Because such substrates and habitat are not rare in the region and rip rap will replace affected substrates, the Availability and Condition and Impacts on Relevant Fish were rated as Low. Based on the small area of impact and replacement of affected substrates the proposed culvert is classified as Low Risk

Medium Sized Creeks

Crossing sites P6a-X008, P6a-X018, P6a-X023, P6b-X007 and P6b-X013 are located on medium sized flat streams within open canopied grass, sedge and shrub dominated floodplains. The habitat in these watercourses is generally uniform, consisting of fine substrates with moderate to abundant instream vegetation for cover. Habitat at these sites is suitable for spawning, rearing and feeding by forage fish and Northern Pike. In addition to fine sediments, crossing P6b-X007 (Unnamed Tributary of Opaskaykow Lake) areas of gravel, cobble and boulder were present both upstream and downstream of the crossing. All sites are expected to contribute to downstream CRA fisheries with unimpeded access to downstream waterbodies.

The Availability and Condition and Impacts on Relevant Fish were rated as Low. The habitat provided by these streams is common within the area and is not critical or limiting to Northern Pike or other CRA species. Northern Pike and their habitats are abundant within Project area and there are no known threats to the habitat or the species.

Based on the habitat assessment and duration and extent ratings the proposed culvert crossings are classified as Low Risk. Although each stream may support Northern Pike, suitable habitat for the species is located downstream and in most cases, upstream, of the crossing and outside of the anticipated cleared ROW.

4.2.6.2 Clear Span Bridge Crossings

A clear span bridge crossing is proposed for the God's River, located at the site of the existing winter road clear span bridge. The crossing is located at an area with run habitat over coarse substrate including cobble and boulder in the centre of the river and sand along the shore. Pool areas were found downstream of the crossings. The diversity of habitats provide suitable habitat for a range of species, including Northern Pike, suckers, Walleye and Brook Trout.

Clear span bridge construction and operation poses minimal risk to cause serious harm to fish and their habitat provided that measures to avoid harm are implemented. DFO review is not required for this type of activity and is therefore considered Low Risk.

4.2.6.3 Multi-Span Bridge Crossings

At the time of assessments, the preliminary crossing design was unconfirmed for P6a-X019, Magill Creek but included a two-span bridge, arch culvert or multiple culverts (pers. comm. MI-RRO). A two-span bridge design is assumed based on the channel width as per chosen bridge designs for the PR 304 to Berens River All Season Road Alignment Project. The habitat at the crossing site provides suitable habitat for CRA fishery species (i.e. Walleye, sucker, Northern Pike), but this type of habitat is not considered to be critical or limiting as similar habitat is

plentiful in the region. Negative impacts to fish populations from rip rap armouring around the pier are unlikely as it provides a similar substrate to current conditions.

Habitat loss within the footprint of the crossing at Magill Creek will be permanent and therefore duration is rated as high, the extent of the affected habitat is small and rated as low. Habitat impacts are expected to result in no measureable effect to local fish populations and therefore a two-span design would be classified as Low Risk to fish and fish habitat.

Table 6. Summary of Relevance to a Fishery, Scale of Negative Effects, and Risk Assessment related to construction and operation of the proposed Project 6 ASR alignment.

Site	Stream Name	Crossing Structure	Supports a CRA Fishery[a]	Extent	Duration	Availability and Condition	Impacts on Fish	Risk of Serious Harm
P6a-X002	Unnamed Tributary of Hayes River	Culvert	Yes	Low	High	Low	Low	LOW
P6a-X005	Unnamed Tributary of Hayes River	Culvert	No	Low	High	Low	Low	LOW
P6a-X007	Unnamed Tributary of Michikanes Lake	Culvert	No	Low	High	Low	Low	LOW
P6a-X008	Unnamed Tributary of Michikanes Lake	Culvert	Yes	Low	High	Low	Low	LOW
P6a-X018	Unnamed Tributary of Knee Lake	Culvert	Yes	Low	High	Low	Low	LOW
P6a-X019	Magill Creek	Two-span Bridge[c]	Yes	Low	High	Low	Low	LOW
P6a-X020	Unnamed Tributary of Magill Creek	Culvert	No	Low	High	Low	Low	LOW
P6a-X022	Unnamed Tributary of Laird Lake	Culvert	No	Low	High	Low	Low	LOW
P6a-X023	Unnamed Tributary of Laird Lake	Culvert	Yes	Low	High	Low	Low	LOW
P6a-X027	Unnamed Tributary of Wanless Lake	Culvert	No	Low	High	Low	Low	LOW
P6a-X028	Unnamed Tributary of Wanless Lake	Culvert	No	Low	High	Low	Low	LOW
P6a-X029	Unnamed Tributary of Hignell Lake	Culvert	No	Low	High	Low	Low	LOW
P6a-X031	Unnamed Tributary of Hignell Lake	Culvert	Yes	Low	High	Low	Low	LOW
P6a-X032	Unnamed Tributary of Hignell Lake	Culvert	Yes	Low	High	Low	Low	LOW
P6a-X033	Unnamed Tributary of an Unnamed Lake	Culvert	Yes	Low	High	Low	Low	LOW
P6a-X034	Unnamed Tributary of an Unnamed Lake	Culvert	Yes	Low	High	Low	Low	LOW
P6a-X037	Unnamed Tributary of an Unnamed Lake	Culvert	Yes	Low	High	Low	Low	LOW
P6a-X038	Unnamed Tributary of an Unnamed Lake	Culvert	Yes	Low	High	Low	Low	LOW
P6b-X002	Unnamed Tributary of Hawkins Lake	Culvert	Yes	Low	High	Low	Low	LOW
P6b-X003	Unnamed Tributary of Hawkins Lake	Culvert	Yes	Low	High	Low	Low	LOW
P6b-X006	Unnamed Tributary of Opaskaykow Lake	Culvert	Yes	Low	High	Low	Low	LOW

Site	Stream Name	Crossing Structure	Supports a CRA Fishery[a]	Extent	Duration	Availability and Condition	Impacts on Fish	Risk of Serious Harm
P6b-X007	Unnamed Tributary of Opaskaykow Lake	Culvert	Yes	Low	High	Low	Low	LOW
P6b-X009	Unnamed Tributary of Tapper Lake	Culvert	Yes	Low	High	Low	Low	LOW
P6b-X013	Unnamed Tributary of God's River	Culvert	Yes	Low	High	Low	Low	LOW
P6b-X015	God's River	Clear-span Bridge	Yes	N/A[b]	N/A	N/A	N/A	LOW

a – commercial, recreational or Aboriginal fishery.
b – "N/A" indicates where the crossing design does not require a review by DFO and therefor a risk assessment was not conducted
c – risk assessment was based on a crossing design of a two-span bridge that requires one instream pier.

Table 7. Net Habitat Change resulting from the Project 6 All Season Road.

Site	Watercourse	Instream Destruction (m^2)	Instream Alteration (m^2)[1]	Riparian Destruction (m)[2]	Riparian Alteration (m)[3]
P6a-X002	Unnamed Tributary of Hayes River	48.6	0	36	0[4]
P6a-X005	Unnamed Tributary of Hayes River	930.0	0	36	0[4]
P6a-X007	Unnamed Tributary of Michikanes Lake	162.0	0	36	0[4]
P6a-X008	Unnamed Tributary of Michikanes Lake	300.0	0	36	0[4]
P6a-X018	Unnamed Tributary of Knee Lake	270.0	0	36	0[4]
P6a-X019	Magill Creek	5.8	161.5	36	84
P6a-X020	Unnamed Tributary of Magill Creek	21.0	0	36	84
P6a-X022	Unnamed Tributary of Laird Lake	3.0	0	36	0[4]
P6a-X023	Unnamed Tributary of Laird Lake	300.0	0	36	0[4]
P6a-X027	Unnamed Tributary of Wanless Lake	60.0	0	36	0[4]
P6a-X028	Unnamed Tributary of Wanless Lake	234.0	0	36	84
P6a-X029	Unnamed Tributary of Hignell Lake	120.0	0	36	84
P6a-X031	Unnamed Tributary of Hignell Lake	66.0	0	36	84
P6a-X032	Unnamed Tributary of Hignell Lake	75.0	0	36	0[4]
P6a-X033	Unnamed Tributary of an Unnamed Lake	30.0	0	36	84
P6a-X034	Unnamed Tributary of an Unnamed Lake	90.0	0	36	84
P6a-X037	Unnamed Tributary of an Unnamed Lake	-	0	36	84
P6a-X038	Unnamed Tributary of an Unnamed Lake	174.0	0	36	84
P6b-X002	Unnamed Tributary of Hawkins Lake	55.8	0	36	84
P6b-X003	Unnamed Tributary of Hawkins Lake	300.0	0	36	0[4]
P6b-X006	Unnamed Tributary of Opaskaykow Lake	18.6	0	36	0[4]
P6b-X007	Unnamed Tributary of	162.0	0	36	84

Site	Watercourse	Instream Destruction (m^2)	Instream Alteration (m^2)[1]	Riparian Destruction (m)[2]	Riparian Alteration (m)[3]
	Opaskaykow Lake				
P6b-X009	Unnamed Tributary of Tapper Lake	36.0	0	36	84
P6b-X013	Unnamed Tributary of Gods River	210.0	0	36	0[4]
P6b-X015	Gods River	0	0	0[5]	0[5]

1 – instream alteration consist of the addition of rip rap below the high water mark. Rip rap is expected to increase the diversity and productivity of the stream and is therefore not considered an adverse effect.

2 – calculated as the width of the road bed on each bank.

3 – calculated based on a 60 m cleared right-of-way on each bank. Does not include the length of riparian destruction.

4 – Existing riparian consists of low growing vegetation. Alteration due to clearing for line of sight safety requirements is not expected.

5 – Existing road and bridge at the God's River crossing has previously impacted riparian vegetation.

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APPENDIX 1. SUBSTRATE VERIFICATION DATA COLLECTED BY PONAR GRAPS DURING SIDE SCAN SONAR SURVEYS AT MAJOR WATERCOURSES CROSSED BY THE ASR ALIGNMENT

Table A1-1. Site P6b-X015 – God's River substrate verification data.

	UTM (Zone 15 U)		Substrate Type											
Ponar	Easting	Northing	Clay	Silt	Clay/ Silt	Sand	Gravel	Cobble	Cobble/ Boulder	Boulder	Boulder/ Bedrock	Bedrock	Organic	Comment
1	429795	6080881	-	-	-	40	60	-	-	-	-	-	-	
2	429978	6080875	-	-	-	-	-	-	-	100	-	-	-	
3	429903	6080825	-	-	-	-	-	-	-	-	100	-	-	
4	429454	6080884	-	-	-	-	-	-	-	-	-	100	-	
5	429514	6080802	-	-	-	80	20	-	-	-	-	-	-	

Table A1-2. Site P6b-X013 – Unnamed Tributary of God's River substrate verification data.

	UTM (Zone 15 U)		Substrate Type											
Transect	Easting	Northing	Clay	Silt	Clay/ Silt	Sand	Gravel	Cobble	Cobble/ Boulder	Boulder	Boulder/ Bedrock	Bedrock	Organic	Comment
1	428369	6081316	-	-	100	-	-	-	-	-	-	-	-	
2	428075	6081182	-	-	100	-	-	-	-	-	-	-	-	Field assessment was used to determine substrate was 100% fines at each transect
3	428025	6081138	-	-	100	-	-	-	-	-	-	-	-	
4	427980	6081104	-	-	100	-	-	-	-	-	-	-	-	
5	427802	6080861	-	-	100	-	-	-	-	-	-	-	-	

Table A1-3. Site P6a-X019 – Magill Creek substrate verification data.

	UTM (Zone 15 U)		Substrate Type											
Ponar	Easting	Northing	Clay	Silt	Clay/ Silt	Sand	Gravel	Cobble	Cobble/ Boulder	Boulder	Boulder/ Bedrock	Bedrock	Organic	Comment
1	366085	6069095	-	-	-	20	10	-	-	70	-	-	-	
2	366097	6069076	-	20	-	70	10	-	-	-	-	-	-	
3	366478	6069278	-	30	-	30	-	-	-	-	-	-	40	
4	366628	6069375	-	50	-	-	-	-	-	-	-	-	50	
5	366273	6069204	-	20	-	80	-	-	-	-	-	-	-	
6	366361	6069192	-	-	-	-	-	-	-	-	-	100	-	

APPENDIX 2. SIZE AND ABUNDANCE DATA FOR FISH CAPTURED DURING THE STREAM CROSSING ASSESSMENT SURVEYS, JUNE 2016.

Site	Watercourse	Sample Date	Gear Type[1]	Species	n[2]	Fork Length (mm)
P6a-X002	Unnamed Tributary of the Hayes River	17-Jun-16	EF	Brook Stickleback	1	-
P6a-X002	Unnamed Tributary of the Hayes River	17-Jun-16	EF	Johnny Darter	1	-
P6a-X005	Unnamed Tributary of the Hayes River	17-Jun-16	DN	Brook Stickleback	1	-
P6a-X008	Unnamed Tributary of the Michikanes River	16-Jun-16	V	Brook Stickleback	1	-
P6a-X008	Unnamed Tributary of the Michikanes River	16-Jun-16	V	Northern Pike	1	>200
P6a-X008	Unnamed Tributary of the Michikanes River	16-Jun-16	V	Northern Pike	1	-
P6a-X018	Unnamed Tributary of the Knee Lake	16-Jun-16	V	Brook Stickleback	-	-
P6a-X019	Magill Creek	21-Jun-16	GN	Northern Pike	1	445
P6a-X019	Magill Creek	21-Jun-16	GN	Northern Pike	1	403
P6a-X019	Magill Creek	21-Jun-16	GN	Shorthead Redhorse	1	435
P6a-X019	Magill Creek	21-Jun-16	GN	Yellow Perch	1	69
P6a-X019	Magill Creek	21-Jun-16	GN	Yellow Perch	1	75
P6a-X019	Magill Creek	21-Jun-16	GN	Yellow Perch	1	73
P6a-X019	Magill Creek	21-Jun-16	GN	Yellow Perch	1	69
P6a-X019	Magill Creek	21-Jun-16	GN	Yellow Perch	1	62
P6a-X019	Magill Creek	21-Jun-16	GN	Yellow Perch	1	70
P6a-X019	Magill Creek	21-Jun-16	GN	Yellow Perch	1	65
P6a-X019	Magill Creek	21-Jun-16	GN	Yellow Perch	1	77
P6a-X020	Unnamed Tributary of the Magill Creek	15-Jun-16	EF	Fathead Minnow	2	-
P6a-X020	Unnamed Tributary of the Magill Creek	15-Jun-16	EF	Brook Stickleback	1	-
P6a-X023	Unnamed Tributary of the Laird Lake	14-Jun-16	EF	Brook Stickleback	1	-
P6a-X023	Unnamed Tributary of the Laird Lake	14-Jun-16	V	Northern Pike	6	4-10 inch
P6a-X027	Unnamed Tributary of the Wanless Lake	14-Jun-16	V	Brook Stickleback	1	-

1 – EF = backpack electrofisher; GN = gillnet; DN = dipnet; V = visual observation; A = rod and reel angling
2 = n = # of fish captured.

Appendix 2. Continued.

Site	Watercourse	Sample Date	Gear Type[1]	Species	n[2]	Fork Length (mm)
P6a-X027	Unnamed Tributary of the Wanless Lake	14-Jun-16	EF	Brook Stickleback	1	-
P6a-X029	Unnamed Tributary of the Hignell Lake	15-Jun-16	EF	Brook Stickleback	1	-
P6a-X031	Unnamed Tributary of the Hignell Lake	15-Jun-16	EF	Brook Stickleback	1	-
P6a-X032	Unnamed Tributary of the Hignell Lake	16-Jun-16	EF	Brook Stickleback	4	-
P6a-X033	Unnamed Tributary of the unnamed lake	17-Jun-16	EF	Northern Pearl Dace	20	-
P6a-X033	Unnamed Tributary of the unnamed lake	17-Jun-16	EF	Brook Stickleback	3	-
P6a-X034	Unnamed Tributary of the unnamed lake	18-Jun-16	EF	Brook Stickleback	3	-
P6a-X034	Unnamed Tributary of the unnamed lake	18-Jun-16	V	Northern Pearl Dace	-	-
P6a-X037	Unnamed Tributary of the unnamed lake	17-Jun-16	EF	Brook Stickleback	5	-
P6a-X037	Unnamed Tributary of the unnamed lake	17-Jun-16	EF	Northern Pearl Dace	7	-
P6a-X038	Unnamed Tributary of the unnamed lake	16-Jun-16	EF	Northern Pearl Dace	11	-
P6b-X002	Unnamed Tributary of the Hawkins Lake	18-Jun-16	V	Brook Stickleback	1	-
P6b-X003	Unnamed Tributary of the Hawkins Lake	18-Jun-16	V	Northern Pike	2	-
P6b-X006	Unnamed Tributary of the Opaskaykow Lake	18-Jun-16	DN	Brook Stickleback	9	-
P6b-X007	Unnamed Tributary of the Opaskaykow Lake	19-Jun-16	EF	Burbot	1	180
P6b-X009	Unnamed Tributary of the Tapper Lake	18-Jun-16	EF	Fathead Minnow	49	-
P6b-X009	Unnamed Tributary of the Tapper Lake	18-Jun-16	EF	Brook Stickleback	1	-
P6b-X015	God's River	19-Jun-16	A	Northern Pike	1	498
P6b-X015	God's River	19-Jun-16	A	Northern Pike	1	-
P6b-X015	God's River	19-Jun-16	A	Northern Pike	1	590
P6b-X015	God's River	19-Jun-16	A	Brook Trout	1	340
P6b-X015	God's River	19-Jun-16	GN	Longnose Sucker	1	469
P6b-X015	God's River	19-Jun-16	GN	White Sucker	1	450

1 – EF = backpack electrofisher; GN = gillnet; DN = dipnet; V = visual observation; A = rod and reel angling
2 = n = # of fish captured.

Appendix 2. Continued.

Site	Watercourse	Sample Date	Gear Type[1]	Species	n[2]	Fork Length (mm)
P6b-X015	God's River	19-Jun-16	GN	White Sucker	1	473
P6b-X015	God's River	19-Jun-16	GN	White Sucker	1	468
P6b-X015	God's River	19-Jun-16	GN	Northern Pike	1	788
P6b-X015	God's River	19-Jun-16	GN	White Sucker	1	448
P6b-X015	God's River	19-Jun-16	GN	White Sucker	1	-
P6b-X015	God's River	19-Jun-16	V	Sculpin spp.	2	-
P6b-X015	God's River	19-Jun-16	GN	Northern Pike	1	-
P6b-X015	God's River	19-Jun-16	DN	Brook Trout	1	Young of year
P6b-X015	God's River	19-Jun-16	GN	White Sucker	1	492
P6b-X015	God's River	19-Jun-16	GN	White Sucker	1	412

1 – EF = backpack electrofisher; GN = gillnet; DN = dipnet; V = visual observation; A = rod and reel angling
2 = n = # of fish captured.

APPENDIX 3. MUSSEL SPECIES CAPTURED DURING STREAM CROSSING ASSESSMENT SURVEYS, JUNE 2016.

Site	Watercourse	Sample Date	Gear Type[1]	Species	n[2]	State
P6a-X019	Magill Creek	21-Jun-16	MR, V	Giant Floater	-	-
P6a-X019	Magill Creek	21-Jun-16	MR, V	Fat Mucket	-	-
P6b-X015	God's River	19-Jun-16	MR, V	Giant Floater	20	-

1 – MR = mussel rake; V = visual observationt
2 = n = # of mussels captured.

APPENDIX 4. STREAM CROSSING ASSESSMENT SUMMARIES ASSESSED AS NO FISH HABITAT

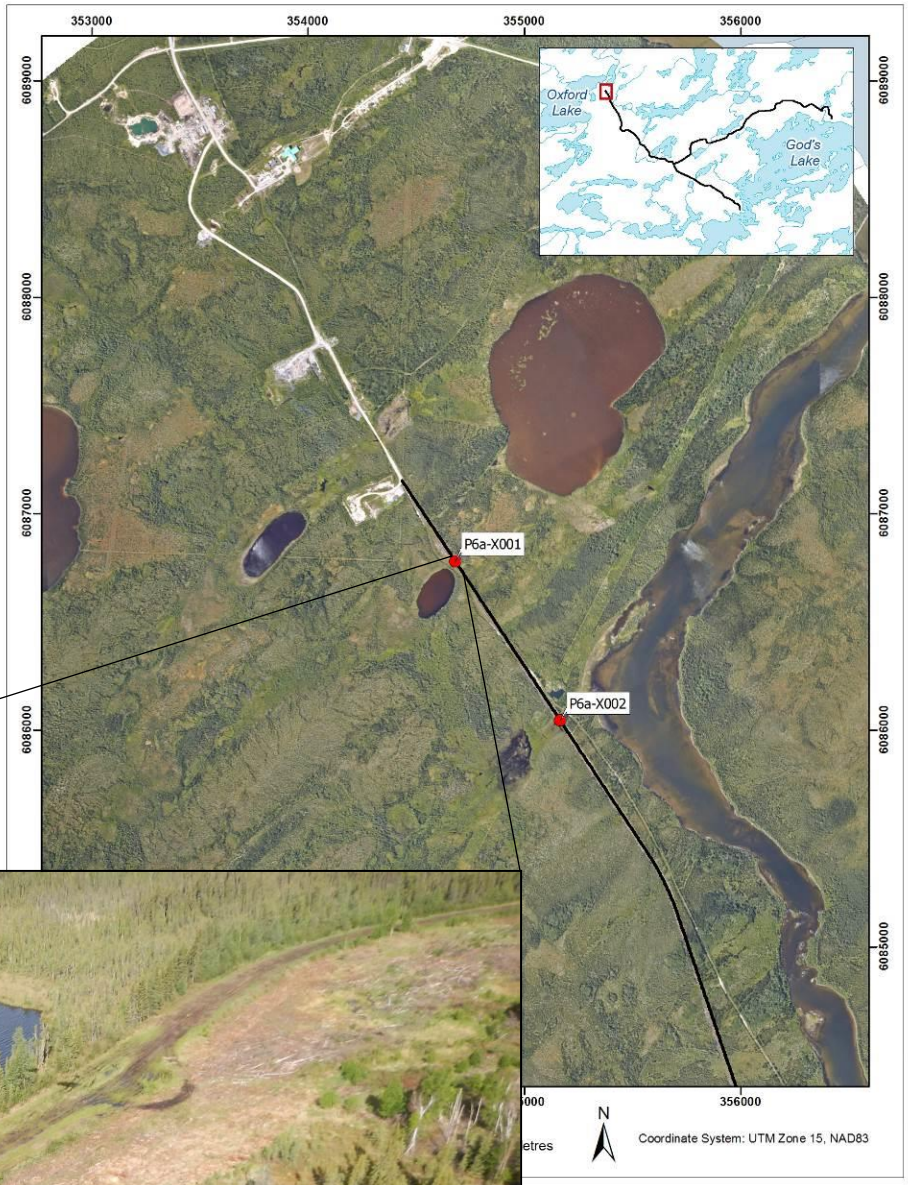
P6a-X001 Unnamed Tributary of Hayes River

Location

Datum:	NAD 83
UTM:	15U 354680 6086782

General Morphology

Type:	Stream
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	0.11
Distance to Major DS Waterbody (km):	2.91 (Hayes River)
Connectivity:	No





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Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The crossing is located in a low lying area near the headwaters of a small tributary, in close proximity to the community of Oxford House within the traditional territory of the Bunibonibee Cree Nation. This ephemeral stream connects a small unnamed lake to a second, larger, downstream unnamed lake which eventually drains into the Hayes River. No channel or connectivity was present at the time of the site visit.

The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert
Diameter (mm)	TBD
Length (m)	TBD
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA.

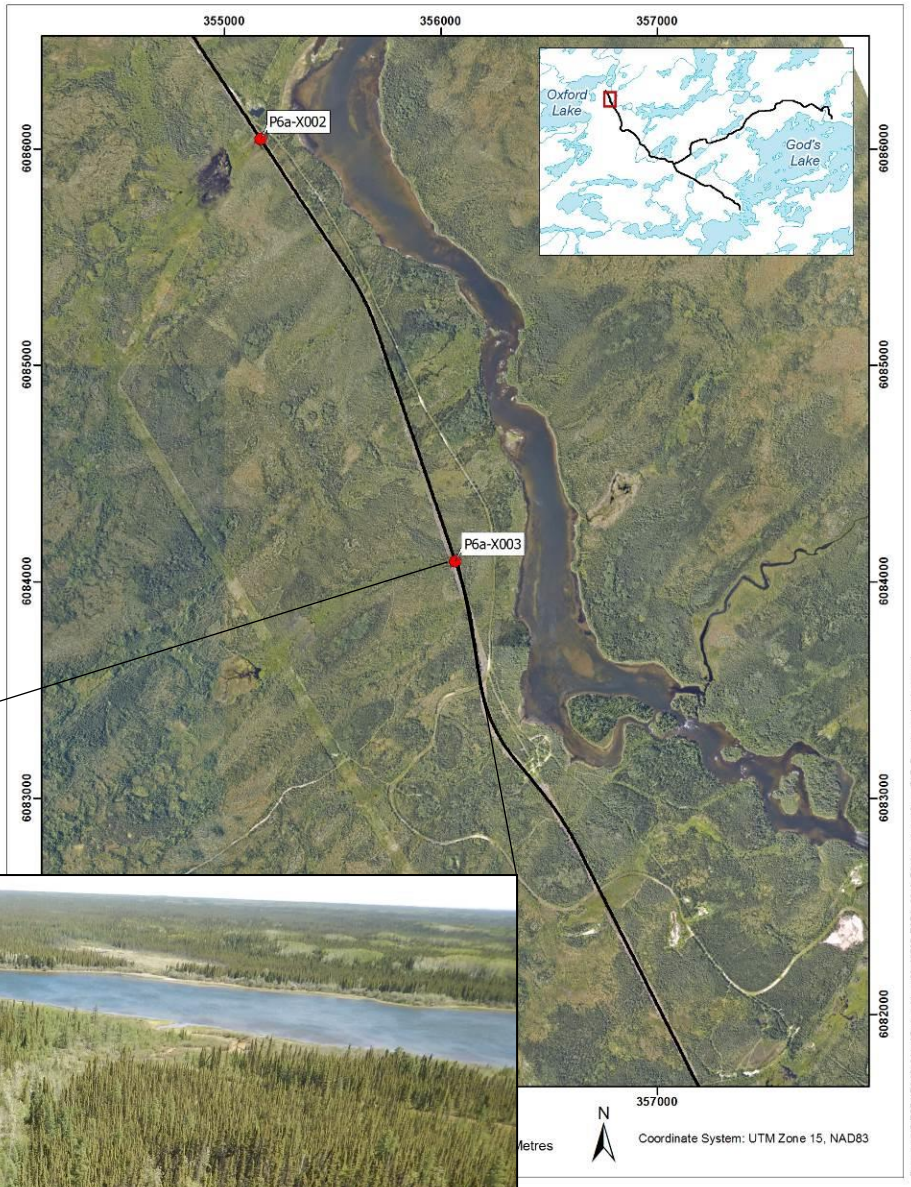
P6a-X003 Unnamed Tributary of Hayes River

Location

Datum:	NAD 83
UTM:	15U 356066 6084096

General Morphology

Type:	Stream
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	2.62
Distance to Major DS Waterbody (km):	0.44 (Hayes River)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The crossing is located in a low lying area near the headwaters of a small tributary to the Hayes River. This ephemeral stream drains upland areas into the Hayes River, contributing to a perennial channel approximately 200 m downstream of the crossing site. The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA.

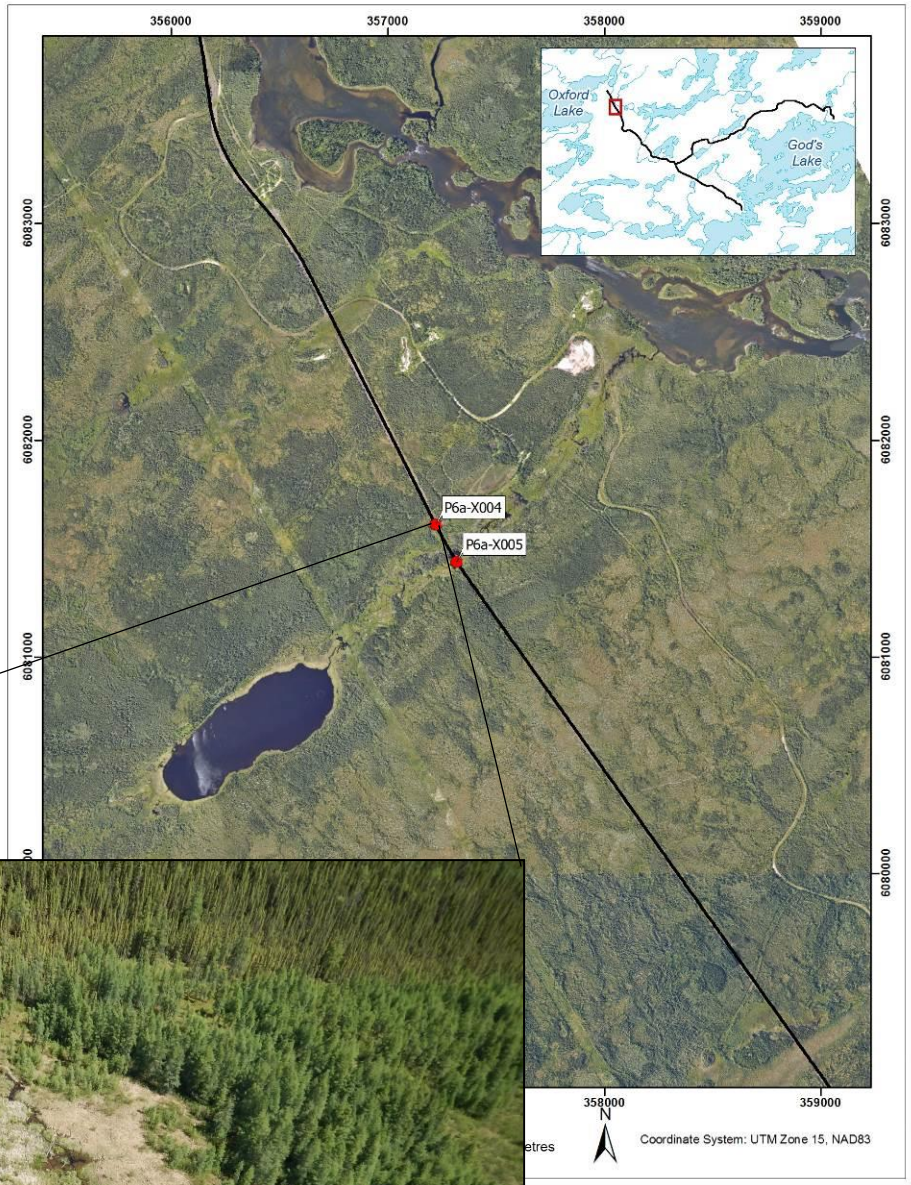
P6a-X004 Unnamed Tributary of Hayes River

Location

Datum:	NAD 83
UTM:	15U 357220 6081611

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	N/A
Distance to Major DS Waterbody (km):	1.71 (Hayes River)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The crossing is located in a low lying area of a secondary tributary of a small tributary to the Hayes River. This wetland area drains upland areas into the Hayes River with no visible channel.

The site is classified as No Fish Habitat based on the absence of a channel or clear connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA.

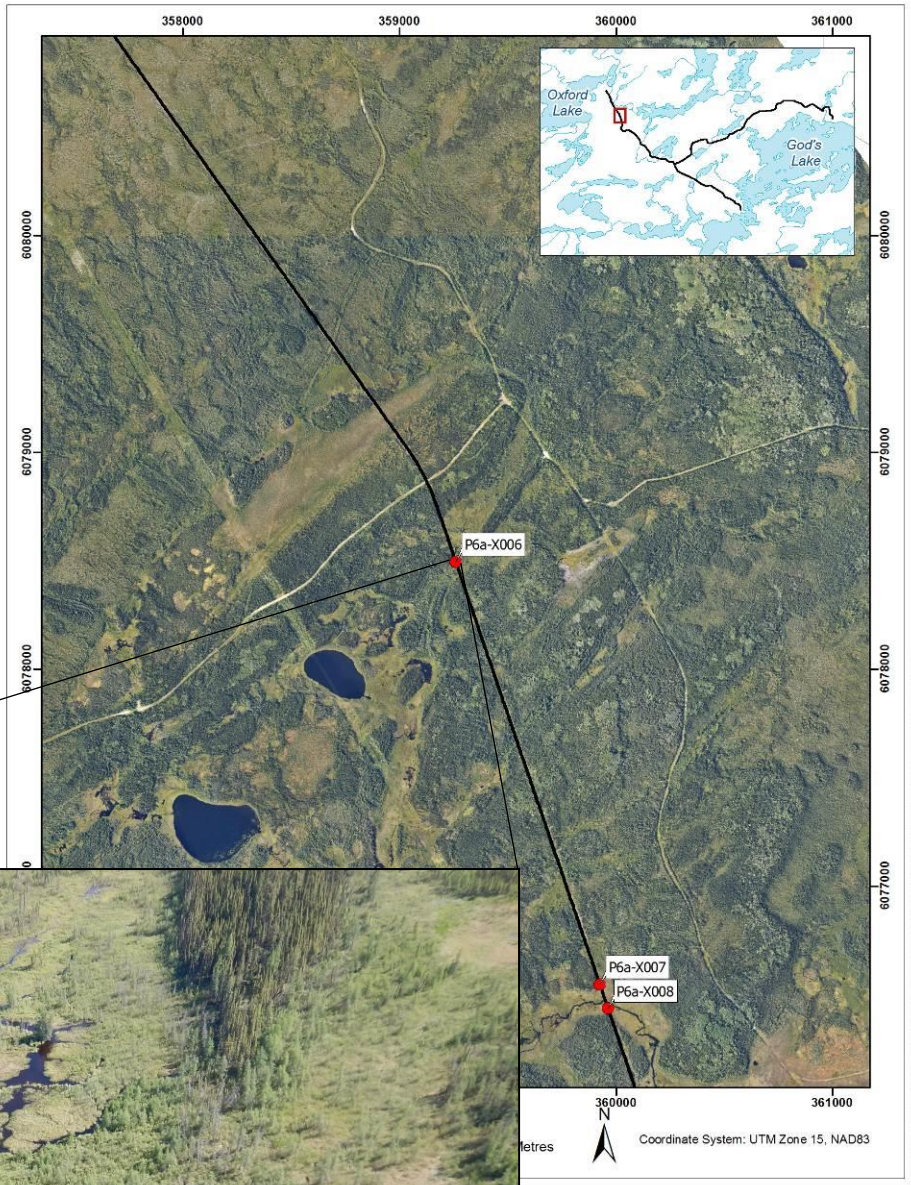
P6a-X006 Unnamed Tributary of Michikanes Lake

Location

Datum:	NAD 83
UTM:	15U 359259 6078497

General Morphology

Type:	Stream
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	1.36
Distance to Major DS Waterbody (km):	5.26 (Michikanes Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The crossing is located at the headwaters of an unnamed tributary feeding into Michikanes Lake, over 5 km downstream of the crossing. Habitat in the immediate vicinity of the crossing site does not support fish as it is situated on an elevated portion of land which may have surface water during high water events (i.e., spring melt) draining the upstream fen. Poor connectivity to the downstream fish bearing waterbody is seasonal and reliant on high water.

At the time of survey, the area at and downstream of the crossing was dry, with no visible channel.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a - pers. comm. ESRA

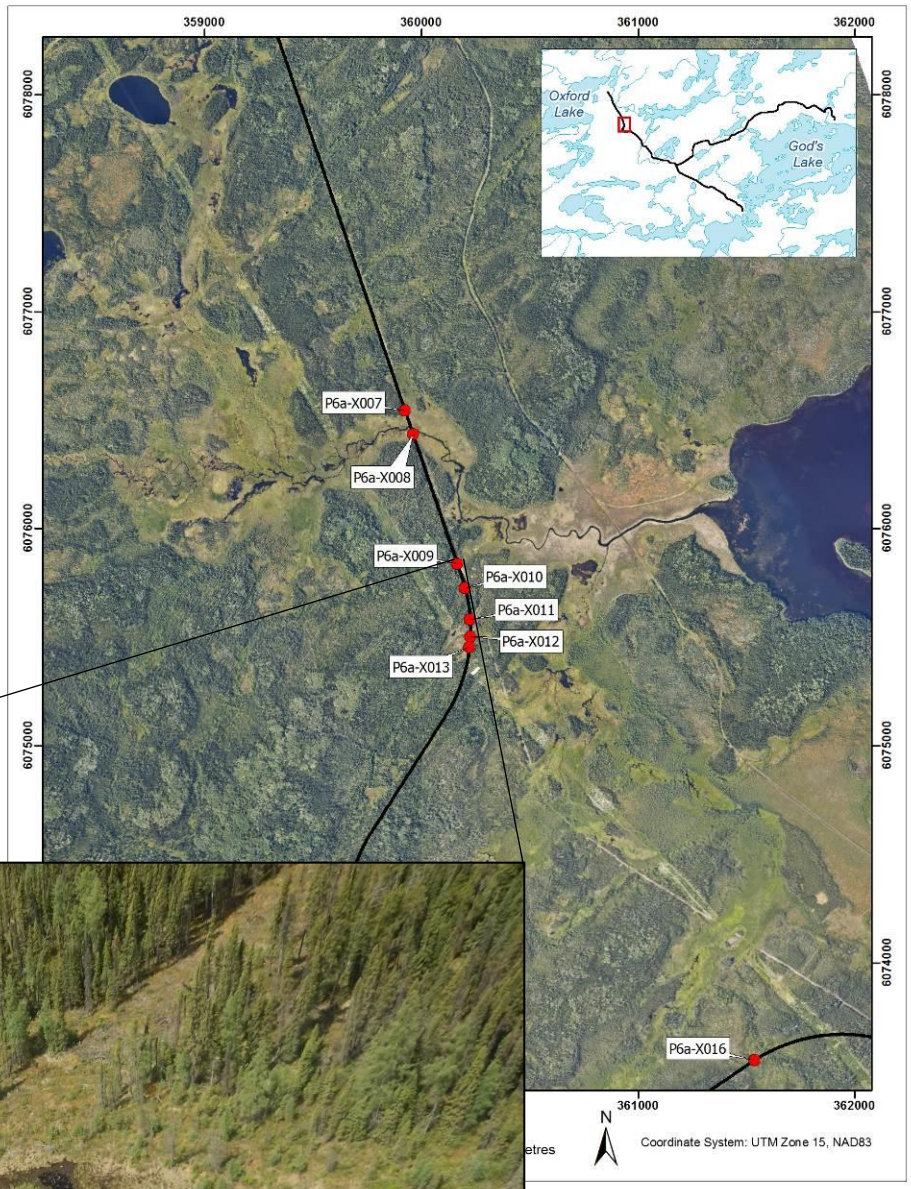
P6a-X009 Unnamed Tributary of Michikanes Lake

Location

Datum:	NAD 83
UTM:	15U 360165 6075841

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	0.95
Distance to Major DS Waterbody (km):	1.61 (Michikanes Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments

The crossing is located on boreal wetland that drains into an unnamed tributary to Michikanes Lake. There is no flow in this region and a series of beaver dams in the area limits connectivity of this upland area to the main tributary feeding into Michikanes Lake. No channel was present at the time of the site visit.

The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

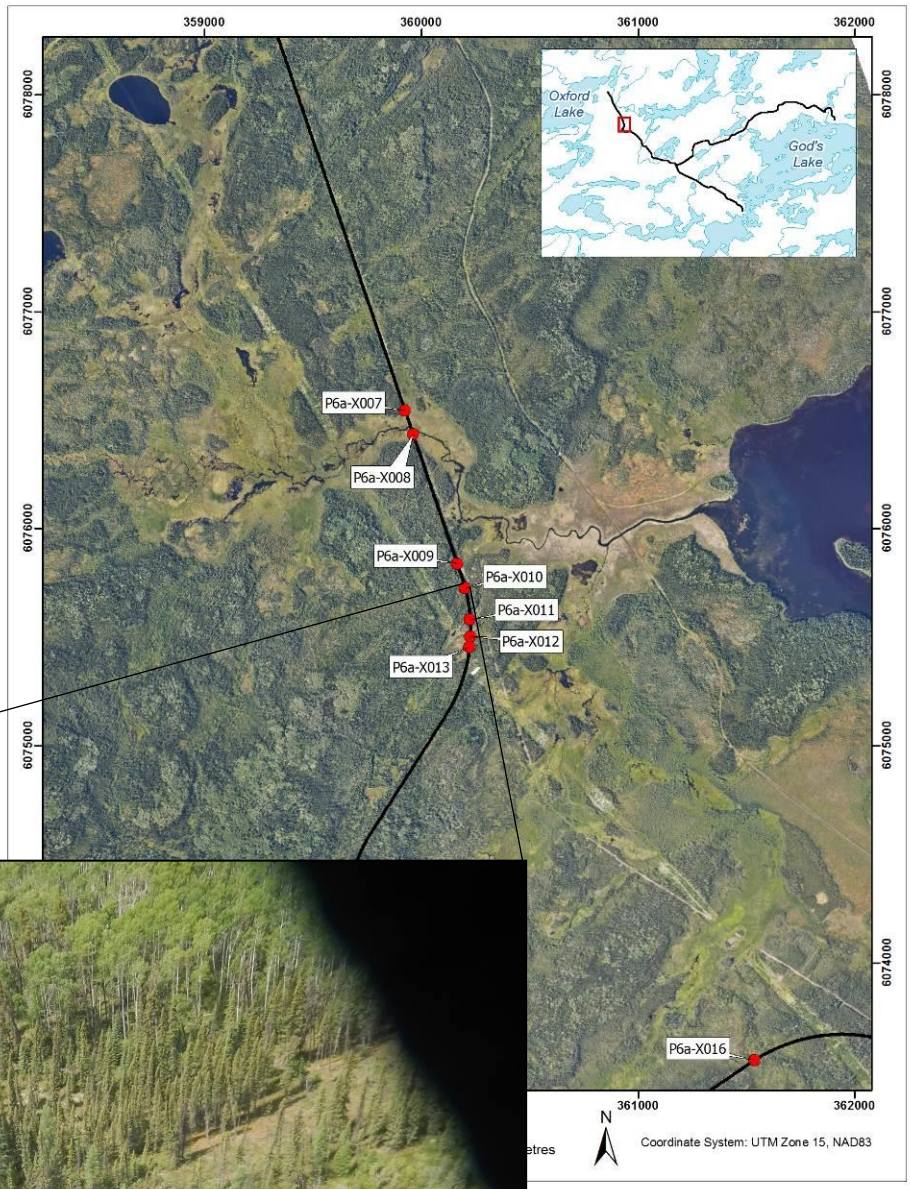
P6a-X010 Unnamed Tributary of Michikanes Lake

Location

Datum:	NAD 83
UTM:	15U 360202 6075729

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	0.89
Distance to Major DS Waterbody (km):	1.74 (Michikanes Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The crossing is located on boreal wetland that drains into an unnamed tributary to Michikanes Lake. There is no flow in this region and a series of beaver dams in the area limits connectivity of this upland area to the main tributary feeding into Michikanes Lake. No channel was present at the time of the site visit.

The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.
.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

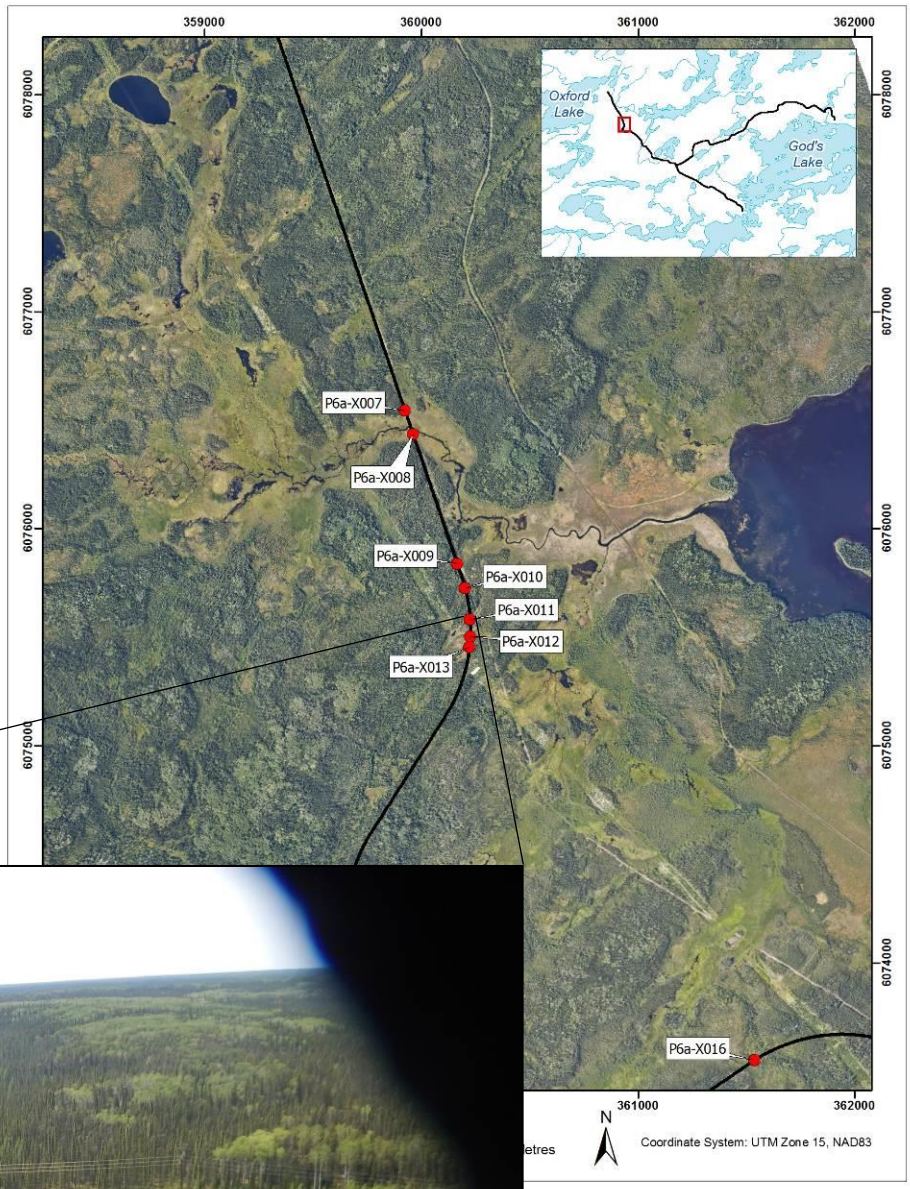
P6a-X011 Unnamed Tributary of Michikanes Lake

Location

Datum:	NAD 83
UTM:	15U 360225 6075583

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	0.83
Distance to Major DS Waterbody (km):	1.91 (Michikanes Lake)
Connectivity:	No





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Aquatic Environment Specialists

Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments

The crossing is located on boreal wetland that drains into an unnamed tributary to Michikanes Lake. There is no flow in this region and a series of beaver dams in the area limits connectivity of this upland area to the main tributary feeding into Michikanes Lake. No channel was present at the time of the site visit.

The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

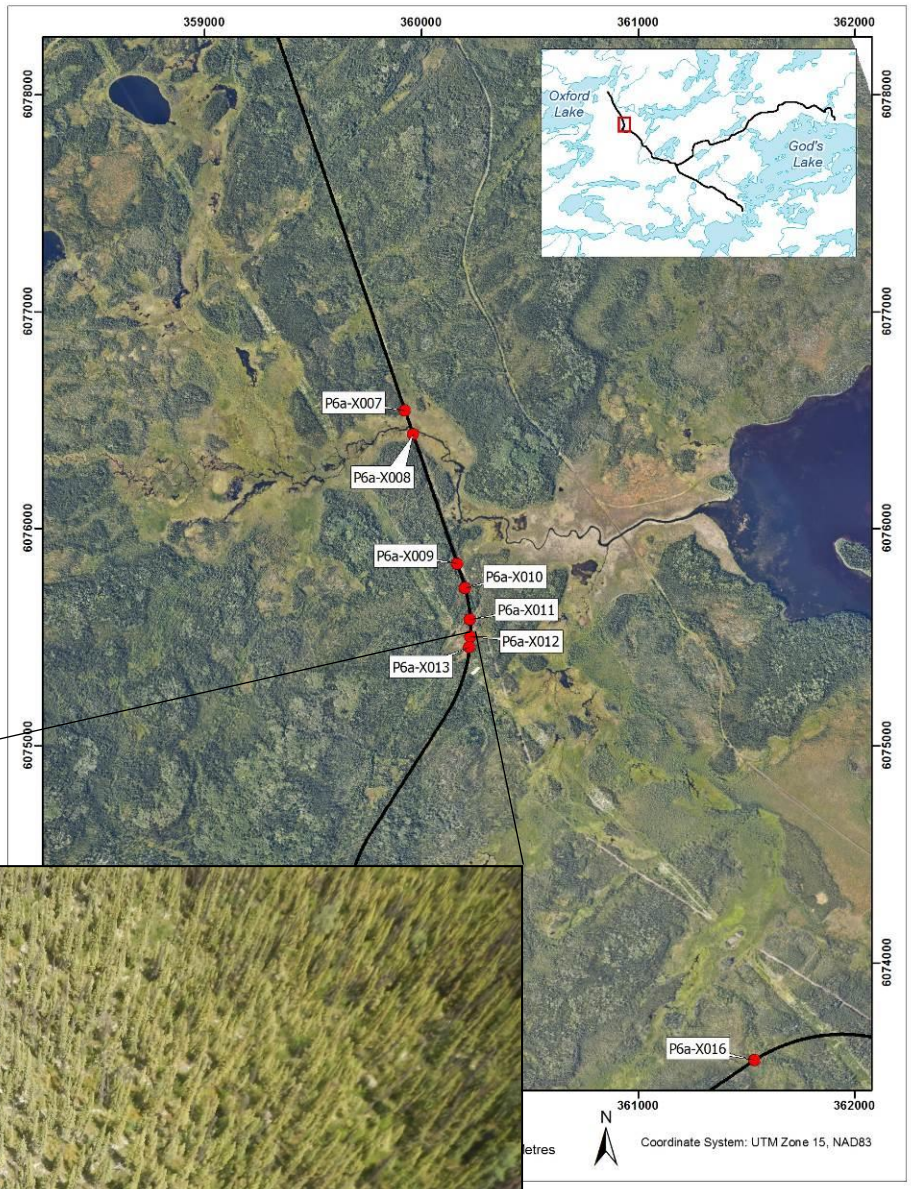
P6a-X012 Unnamed Tributary of Michikanes Lake

Location

Datum:	NAD 83
UTM:	15U 360226 6075505

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	0.77
Distance to Major DS Waterbody (km):	2.03 (Michikanes Lake)
Connectivity:	No





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Aquatic Environment Specialists

Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The crossing is located on boreal wetland that drains into an unnamed tributary to Michikanes Lake. There is no flow in this region and a series of beaver dams in the area limits connectivity of this upland area to the main tributary feeding into Michikanes Lake. No channel was present at the time of the site visit.

The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.
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Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

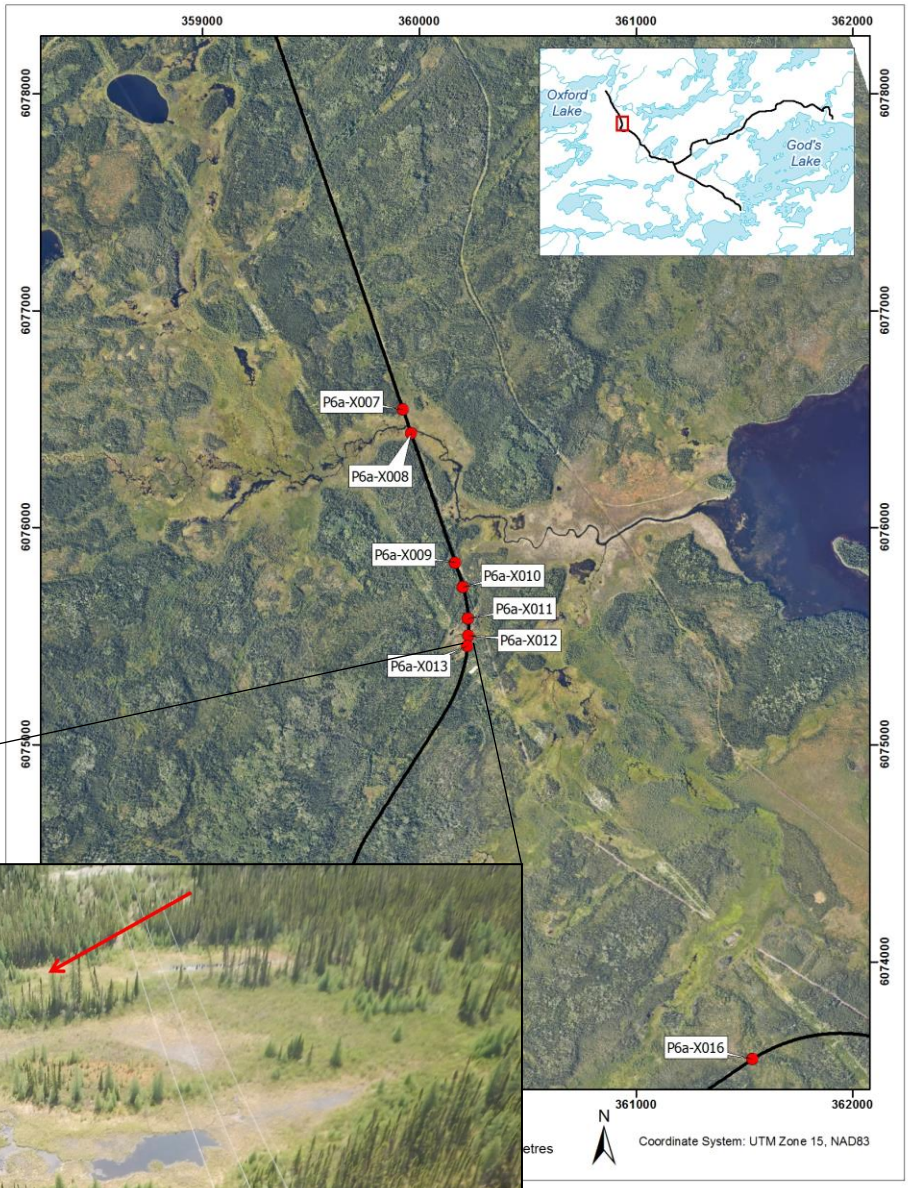
P6a-X013 Unnamed Tributary of Michikanes Lake

Location

Datum:	NAD 83
UTM:	15U 360222 6075456

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	0.74
Distance to Major DS Waterbody (km):	2.09 (Michikanes Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments

The crossing is located at the upstream end of a wetland feeding into Michikanes Lake. Although deeper pools are present here, the water appears stagnant with no flow, and habitat within this forested reach is marginal for fish species due to access and connectivity. Beaver activity is abundant within this reach. Large bodied fish, relevant to a CRA fishery, are unlikely to use this reach as fish must pass through a forested region with heavily vegetated bog/fen to reach the main tributary. Although high water events (i.e. spring run-off) may allow for occasional connectivity, connectivity to Michikanes Lake was not present at the time of the site visit.

The site is classified as No Fish Habitat based on the current absence of a channel or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

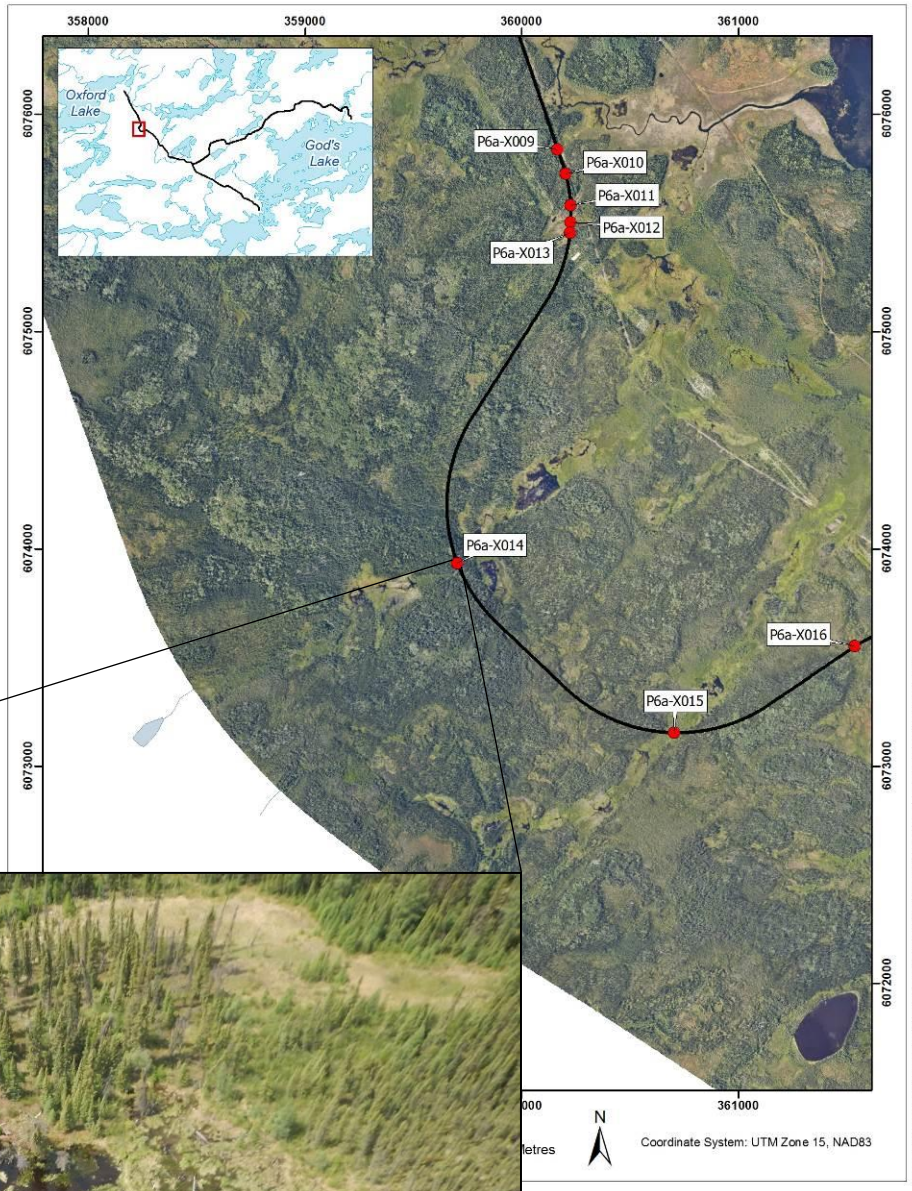
P6a-X014 Unnamed Tributary of Michikanes Lake

Location

Datum:	NAD 83
UTM:	15U 359702 6073936

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Perennial
Upstream Drainage Area (km^2):	1.24
Distance to Major DS Waterbody (km):	3.20 (Michikanes Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments

The crossing is located on a secondary tributary connecting two large wetlands, ultimately draining into Michikanes Lake 3.2 km downstream. There is no flow in this region and a series of beaver dams in the area limits connectivity of this upland area to the main tributary feeding into Michikanes Lake. No channel was present at the time of the site visit.

The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

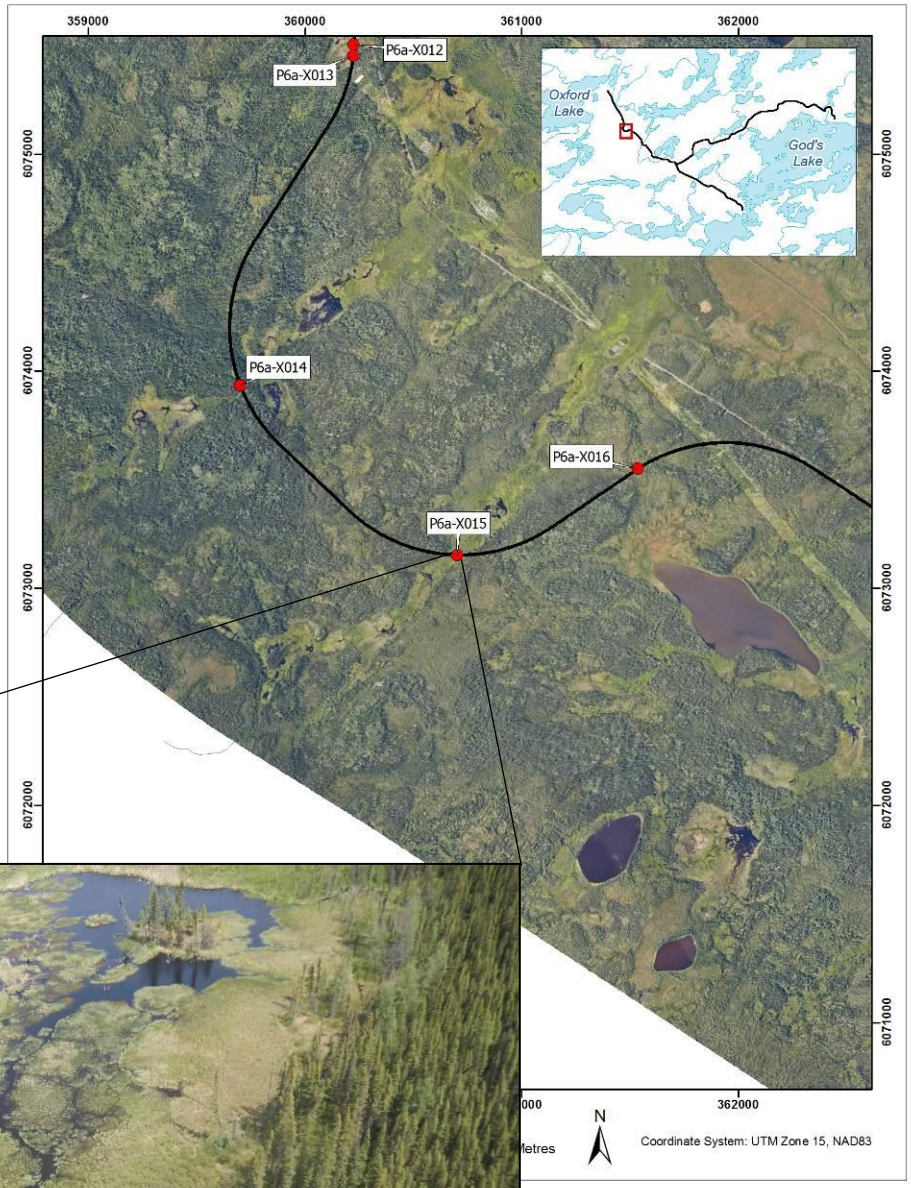
P6a-X015 Unnamed Tributary of Michikanes Lake

Location

Datum:	NAD 83
UTM:	15U 360702 6073154

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	4.63
Distance to Major DS Waterbody (km):	4.91 (Michikanes Lake)
Connectivity:	No





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Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The crossing is located on a small tributary ultimately draining into Michikanes Lake nearly 5 km downstream. No channel was present at the time of the site visit. Although there are portions of the tributary that contain small perennial pools and channels there is no clear connection to the main fish bearing waterbody, therefore contributions to the CRA fishery in Michikanes Lake are unlikely.

The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

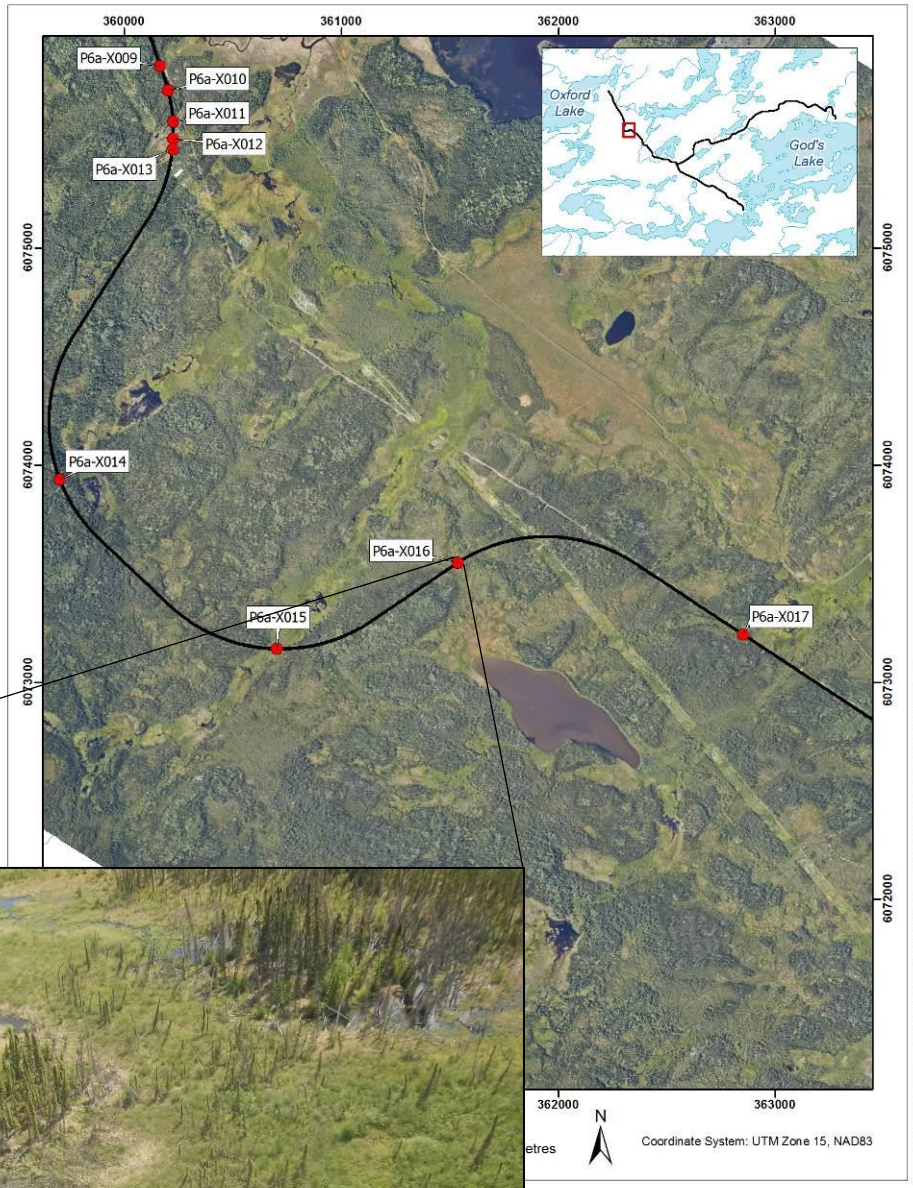
P6a-X016 Unnamed Tributary of Michikanes Lake

Location

Datum:	NAD 83
UTM:	15U 361536 6073552

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	12.09
Distance to Major DS Waterbody (km):	4.42 (Michikanes Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The crossing is located in a wetland region ultimately draining into Michikanes Lake nearly 5 km downstream. No channel was present at the time of the site visit. There is no clear connection to the main fish bearing waterbody; as such, contributions to the CRA fishery in Michikanes Lake are unlikely.

The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

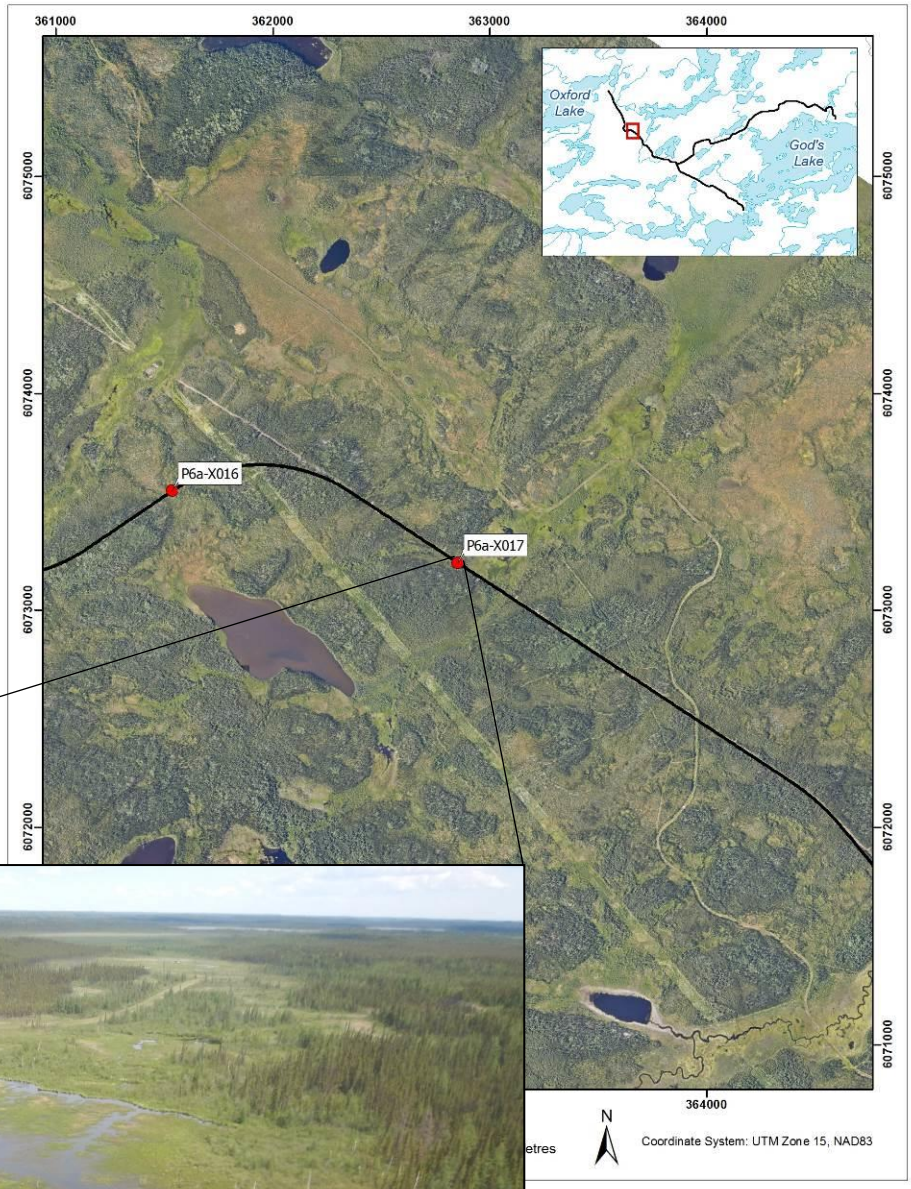
P6a-X017 Unnamed Tributary of Michikanes Lake

Location

Datum:	NAD 83
UTM:	15U 362851 6073221

General Morphology

Type:	Stream
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	4.30
Distance to Major DS Waterbody (km):	6.39 (Michikanes Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments

The crossing is located on a tributary connecting two small unnamed wetland lakes, eventually feeding into Michikanes Lake 6.4 km downstream of the crossing. A large beaver pond with a small inlet channel was present at the time of the site visit but there is no connection to the main fish bearing waterbody due to a series of beaver dams and heavily vegetated wetlands.

The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

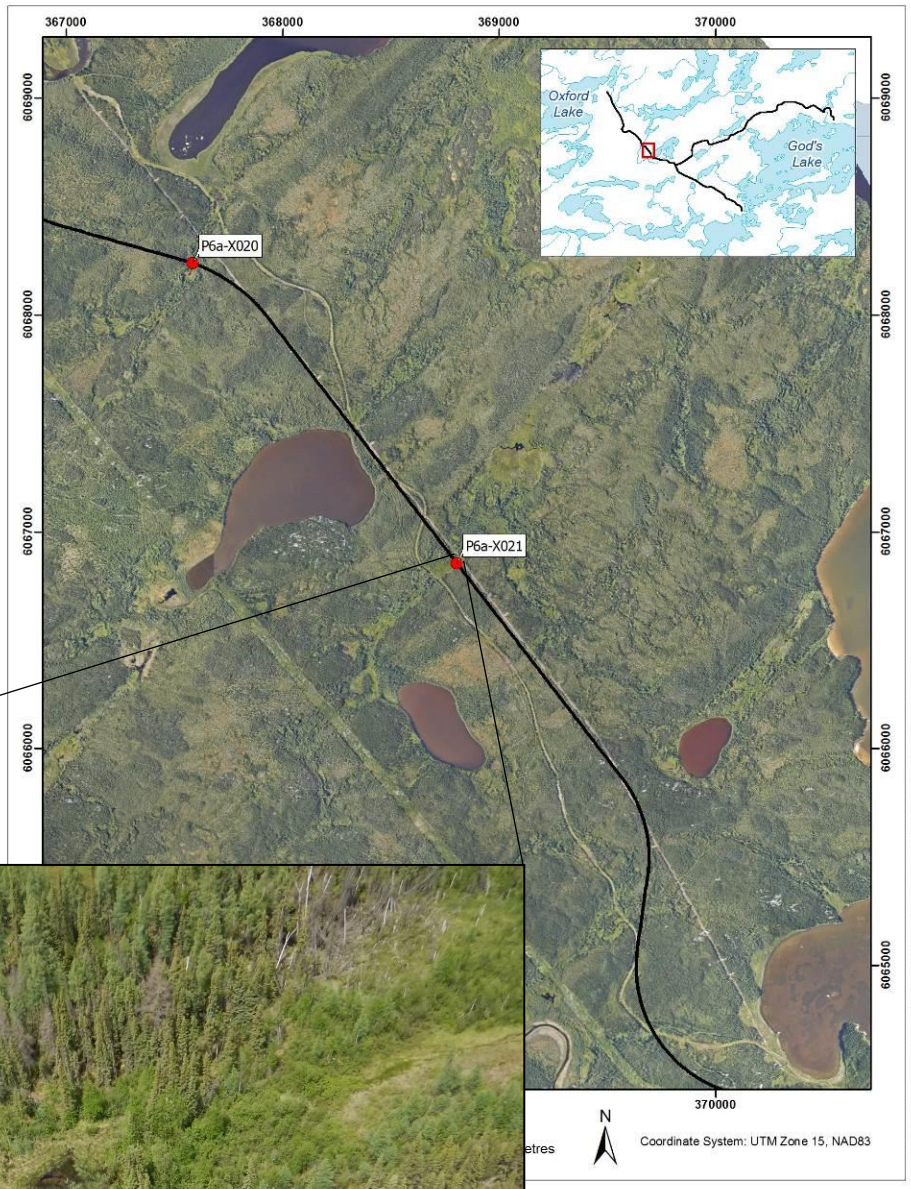
P6a-X021 Unnamed Tributary of Magill Creek

Location

Datum:	NAD 83
UTM:	15U 368803 6066857

General Morphology

Type:	Stream
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	0.99
Distance to Major DS Waterbody (km):	9.20 (Knee Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The crossing is located on an ephemeral tributary of Magill Creek, which in turn enters Knee Lake 9 km downstream. No channel was present at the time of the site visit.

The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA.

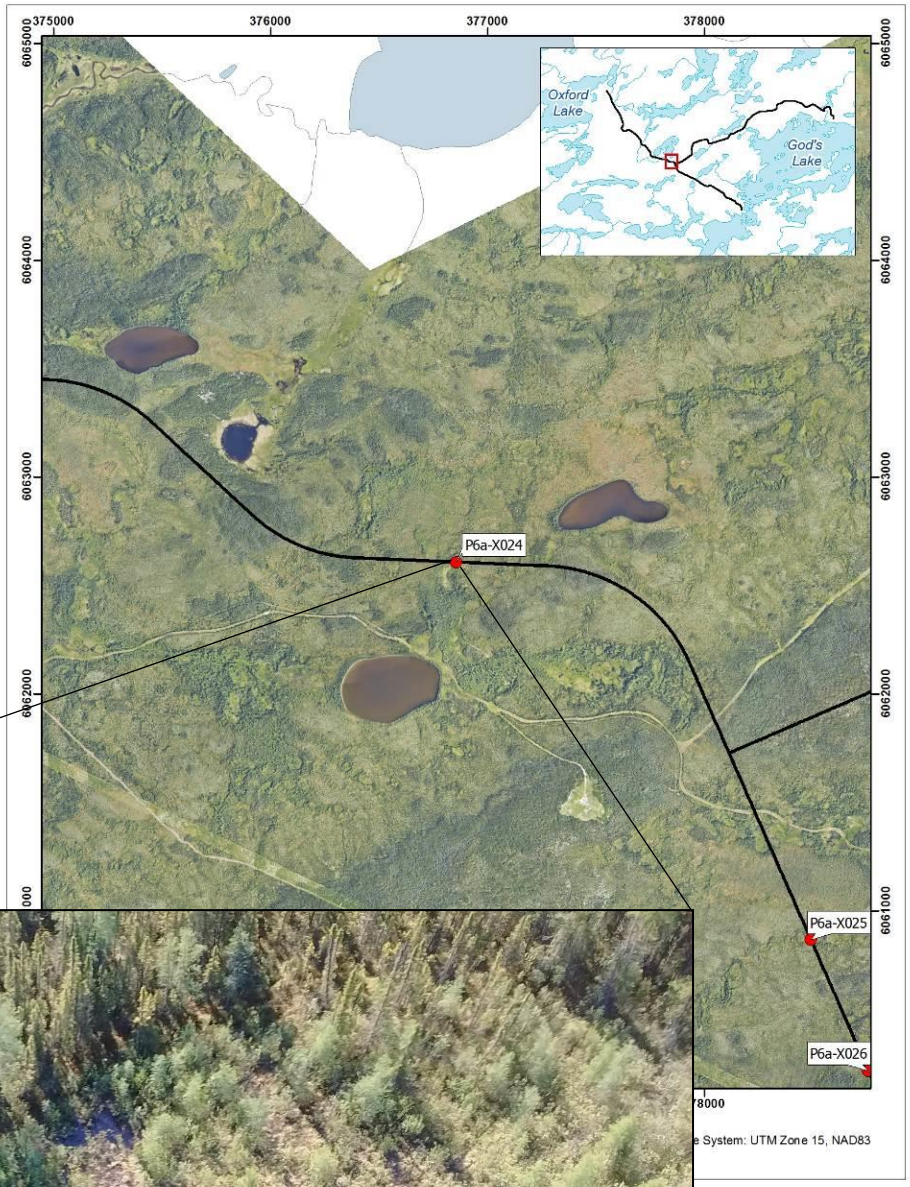
P6a-X024 Unnamed Tributary of Laird Lake

Location

Datum:	NAD 83
UTM:	15U 376856 6062609

General Morphology

Type:	Stream
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	1.03
Distance to Major DS Waterbody (km):	18.92 (Laird Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments

The crossing is located on an ephemeral tributary which drains two small ponds at the upstream-most end, and draining through a low lying area (fen) before connecting to the main tributary, and ultimately to Laird Lake, 18.92 km downstream of the crossing. No connecting channel was present at the time of the site visit.

The site is classified as No Fish Habitat based on the absence of a channel, standing water, or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA.

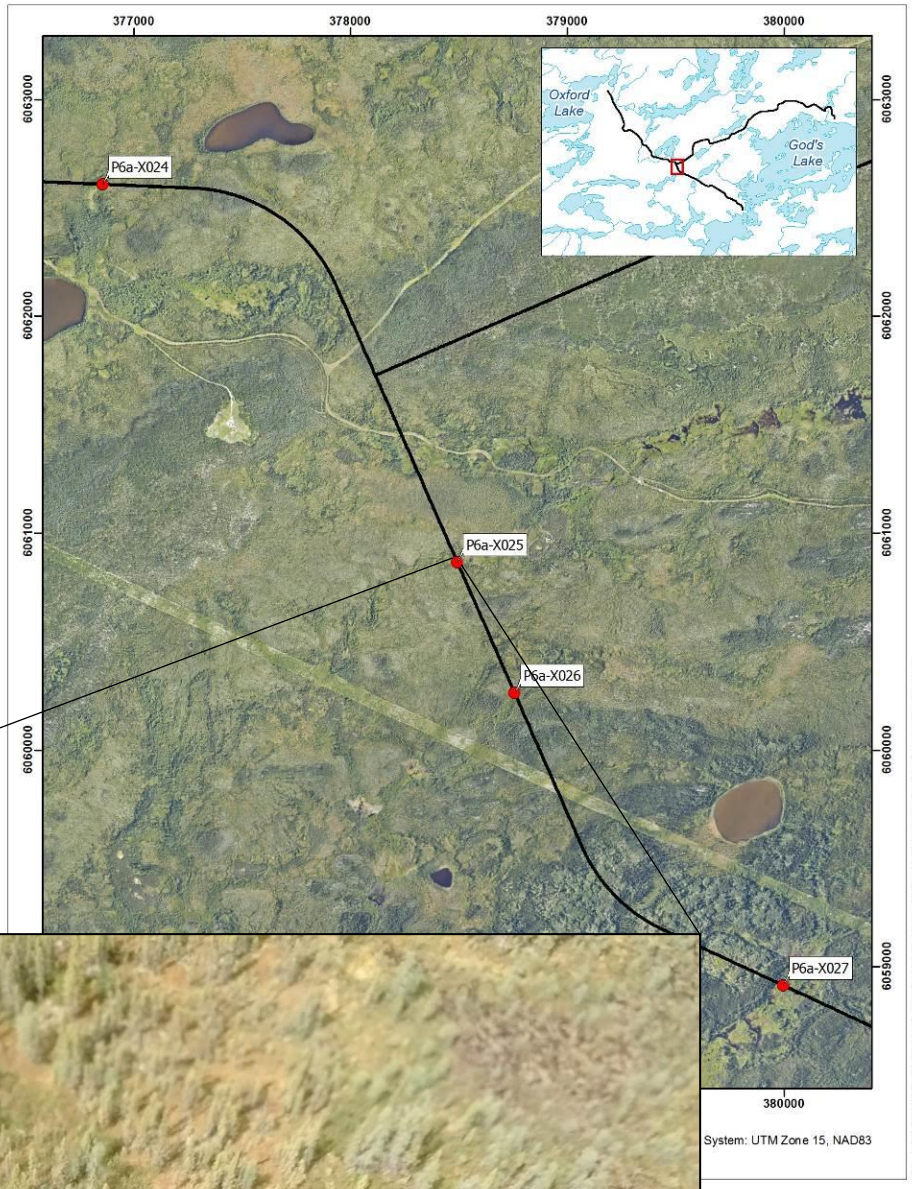
P6-X025 Unnamed Tributary of Hawkins Lake

Location

Datum:	NAD 83
UTM:	15U 378492 6060867

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	-
Upstream Drainage Area (km^2):	1.01
Distance to Major DS Waterbody (km):	8.89 (Hawkins Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments

The crossing is located on an ephemeral tributary which drains a low lying area (wetland) into Hawkins Lake, 8.89 km downstream. No channel was present at the time of the site visit.

The site is classified as No Fish Habitat based on the absence of a channel, standing water, or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA.

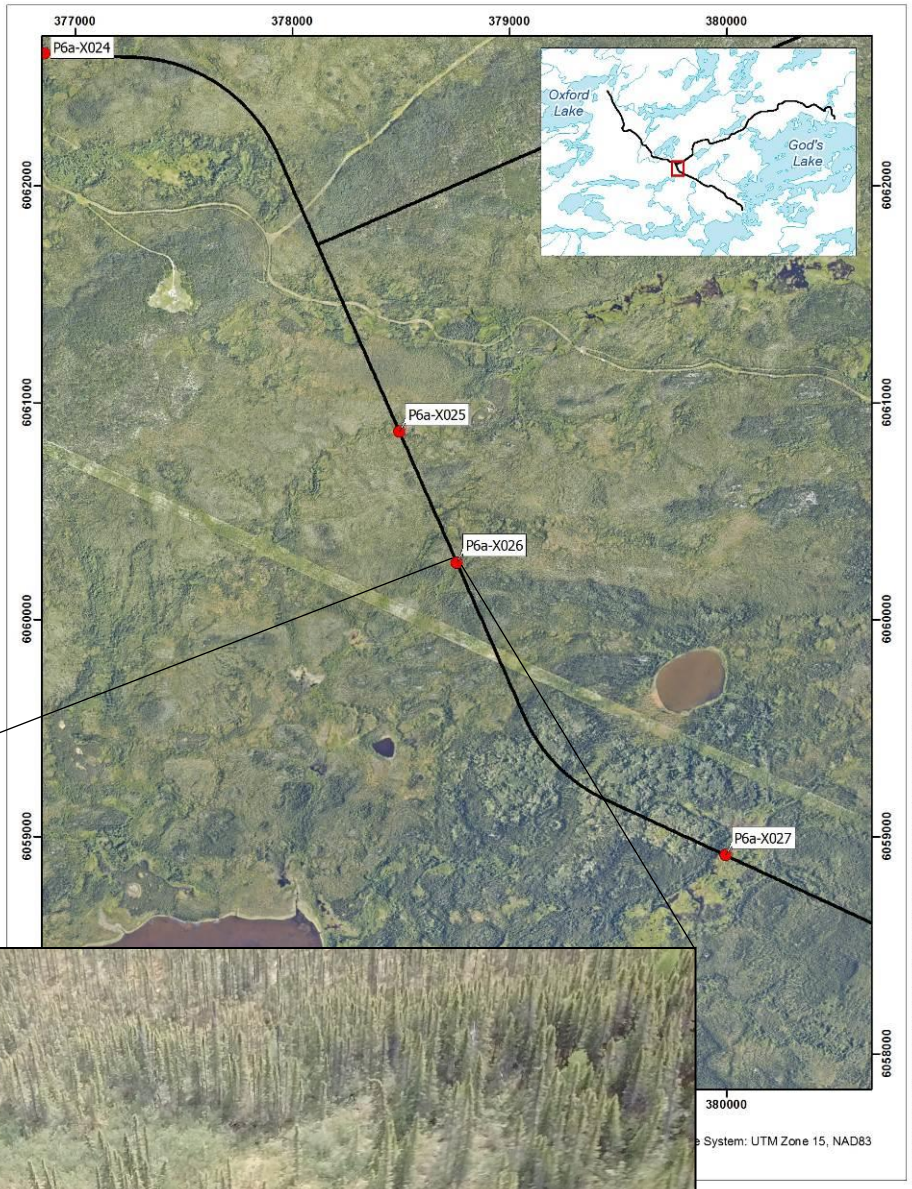
P6a-X026 Unnamed Tributary of Wanless Lake

Location

Datum:	NAD 83
UTM:	15U 378756 6060265

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	-
Upstream Drainage Area (km^2):	0.03
Distance to Major DS Waterbody (km):	1.97 (Wanless Lake)
Connectivity:	No





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Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The crossing is located on an ephemeral tributary which drains a low lying area (wetland) into Wanless Lake, 1.97 km downstream. No channel was present at the time of the site visit.

The site is classified as No Fish Habitat based on the absence of a channel, standing water, or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA.

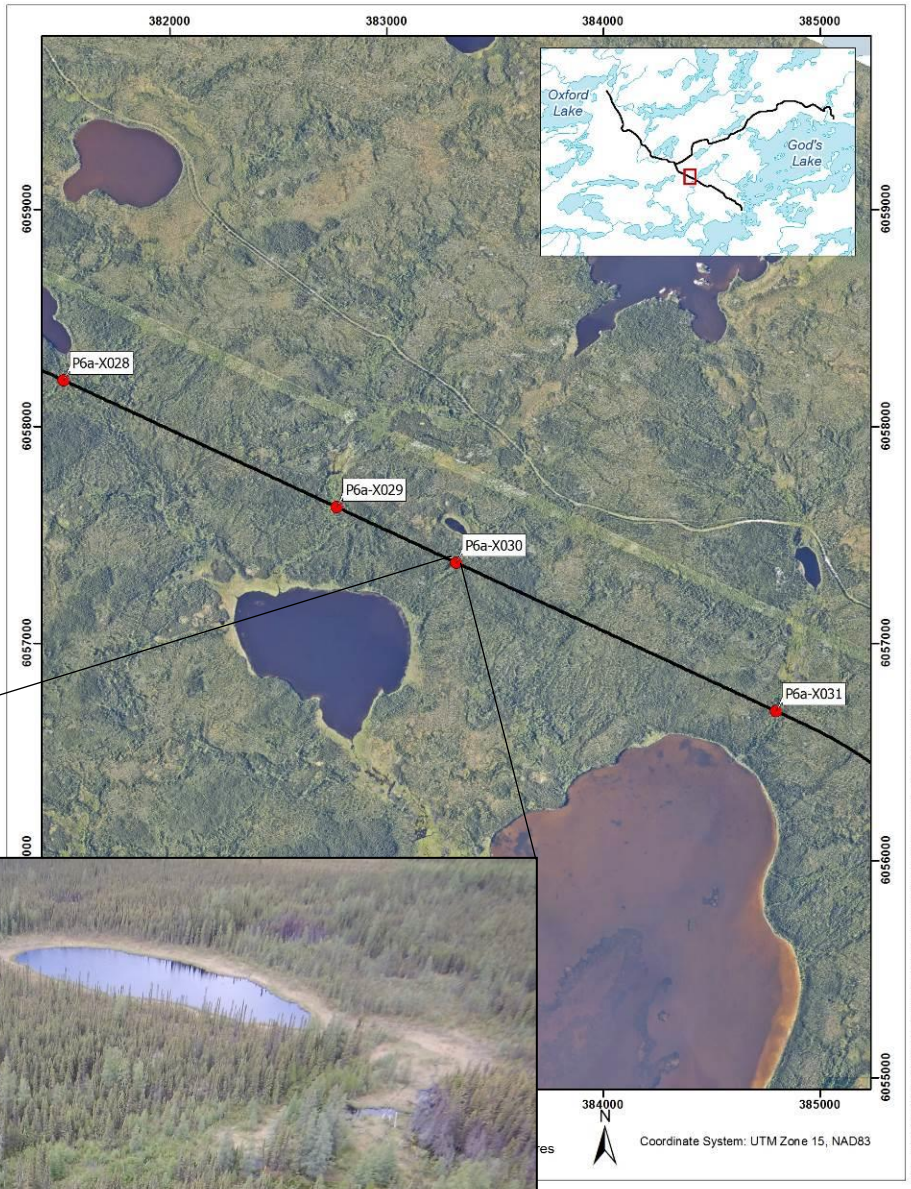
P6a-X030 Unnamed Tributary of Hignell Lake

Location

Datum:	NAD 83
UTM:	15U 383321 6057373

General Morphology

Type:	Creek
Canvec Mapped:	Yes
Pattern:	Braided
Confinement:	Unconfined
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	0.09
Distance to Major DS Waterbody (km):	2.06 (Hignell Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments

The crossing is located on an ephemeral braided tributary between a small pond and a larger unnamed lake which drains to Hignell Lake about 2 km downstream of the crossing. Braiding of the tributary was visible at the mouth of the small pond and as it entered the unnamed lake; no continual channel was present between the two waterbodies.

The site is classified as No Fish Habitat based on the absence of a distinct channel and standing water in the braided sections of the tributary, resulting to limited connectivity to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA.

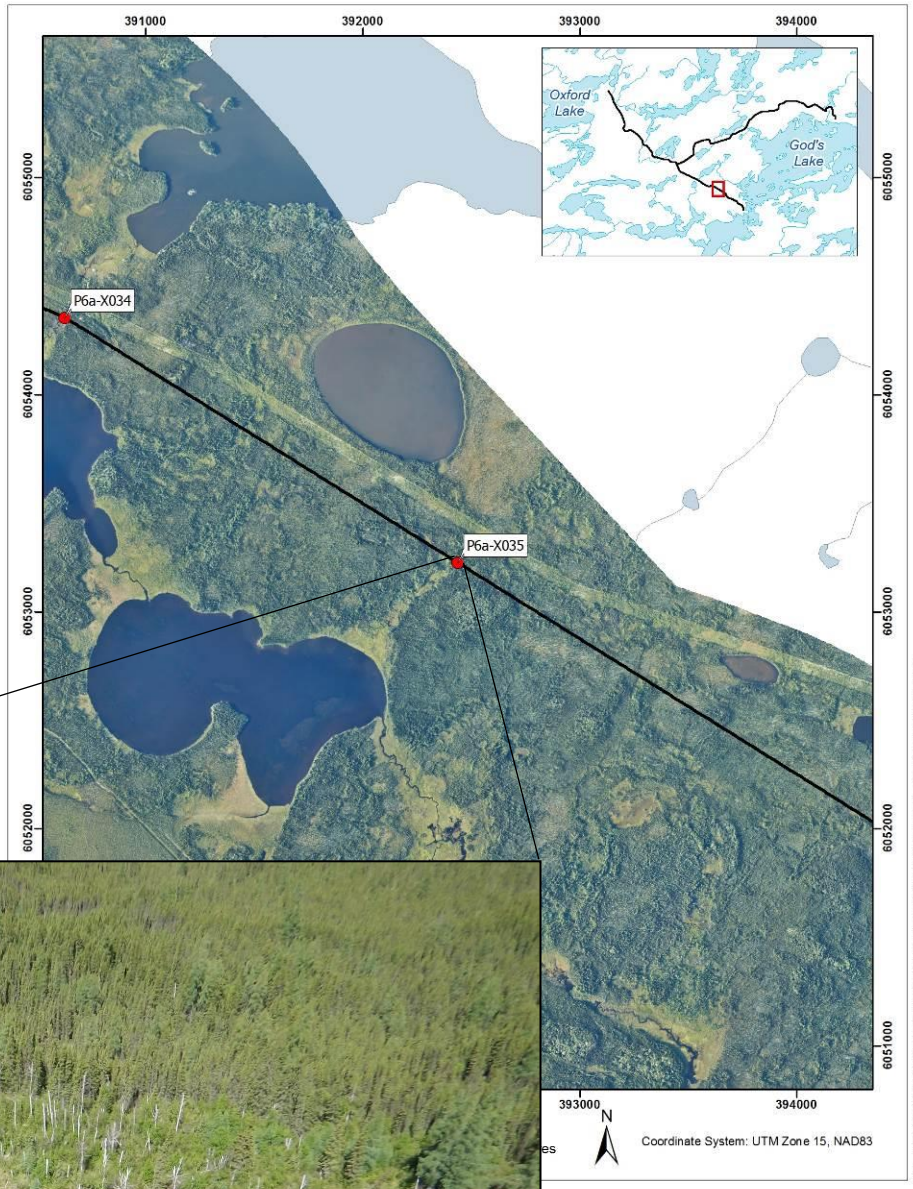
P6a-X035 Unnamed Tributary of an Unnamed Lake

Location

Datum:	NAD 83
UTM:	15U 392437 6053228

General Morphology

Type:	Stream
Canvec Mapped:	Yes
Pattern:	Sinuous
Confinement:	Occasionally Confined
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	1.58
Distance to Major DS Waterbody (km):	13.12 (Gods Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The crossing is located near the headwaters of a small unnamed creek The creek lies within a broad weltand floodplain and is heavily impacted by beaver dams. During the time of the site visit, no direct connectivity was present between the crossing site and the lake. The habitat mostly consisted of saturated fen habitat with intermittent isolated pools of standing water.

The site is classified as No Fish Habitat based on the absence of a distinct channel, resulting to limited connectivity to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

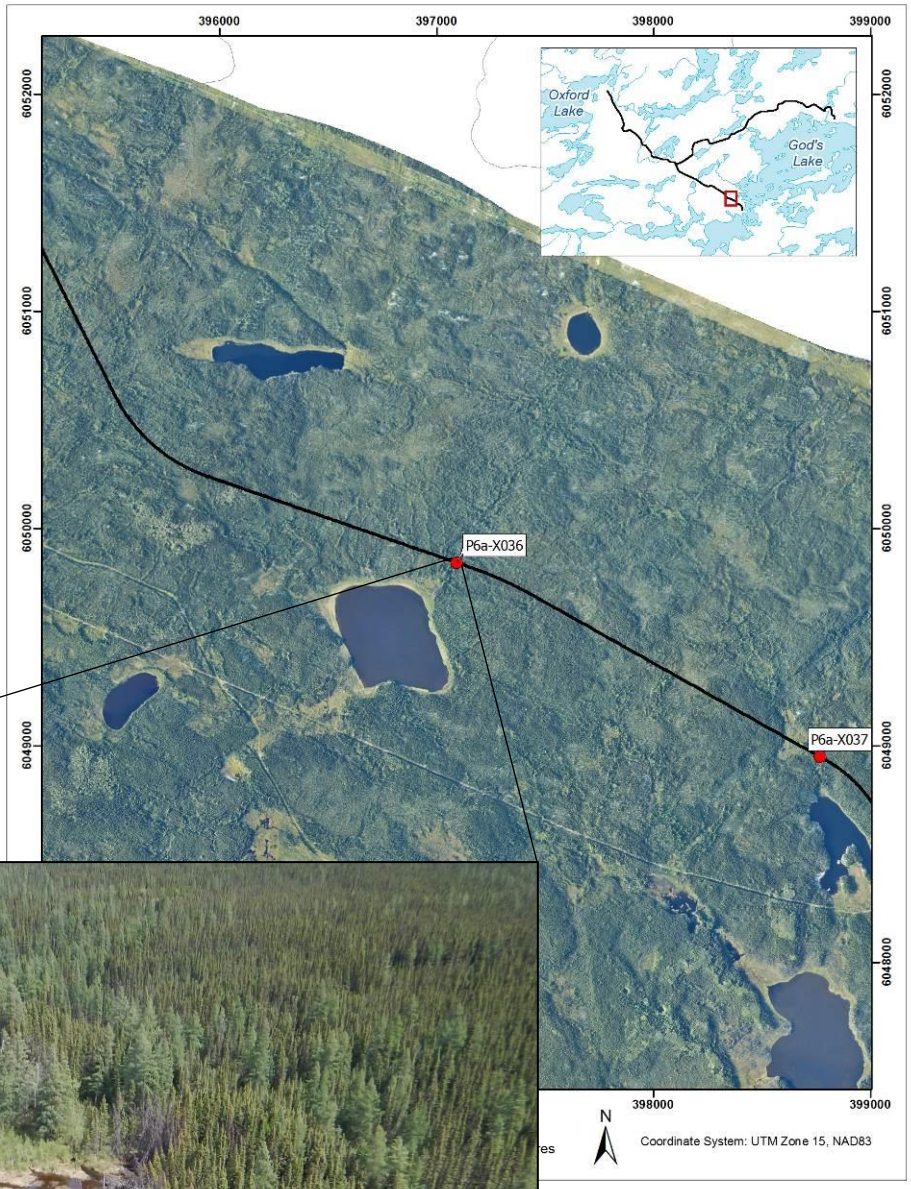
P6a-X036 Unnamed Tributary of an Unnamed Lake

Location

Datum:	NAD 83
UTM:	15U 397092 6049844

General Morphology

Type:	Stream
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	1.64
Distance to Major DS Waterbody (km):	5.91 (Gods Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments

The crossing is located in a low-lying wetland stream connecting two small unnamed lakes near the headwaters of a tributary to Gods Lake, 5.91 km downstream of the crossing. During the time of visit, no direct connectivity was present between the crossing site and the lakes. A meandering channel was visible only at the mouth of the downstream unnamed lake, and dissipated after approximately 150 m. Braiding was frequent in both the open canopy and forested areas. The habitat consisted mostly of wetland habitat further upstream of the crossing.

The site is classified as No Fish Habitat based on the absence of a distinct channel, resulting to limited connectivity to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

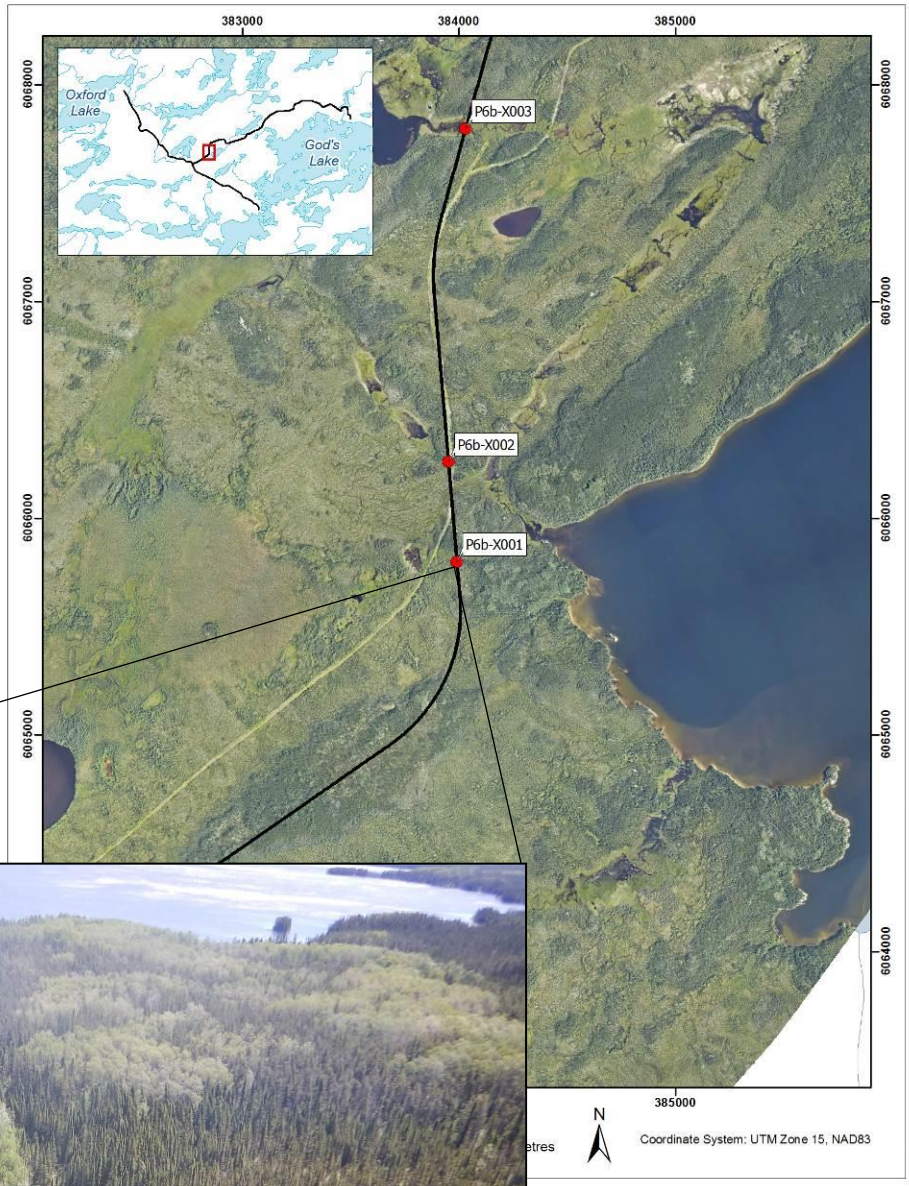
P6b-X001 Unnamed Tributary of Hawkins Lake

Location

Datum:	NAD 83
UTM:	15U 383989 6065801

General Morphology

Type:	Stream
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	0.39
Distance to Major DS Waterbody (km):	0.42 (Hawkins Lake)
Connectivity:	No





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Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The crossing is located approximately 100 m downsteam of a clearing and consists of flooded forest habitat with no defined channel. Further downstream, the channel is braided with no distrinction of a main channel. No connectivity was present at the time of the site visit.

The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

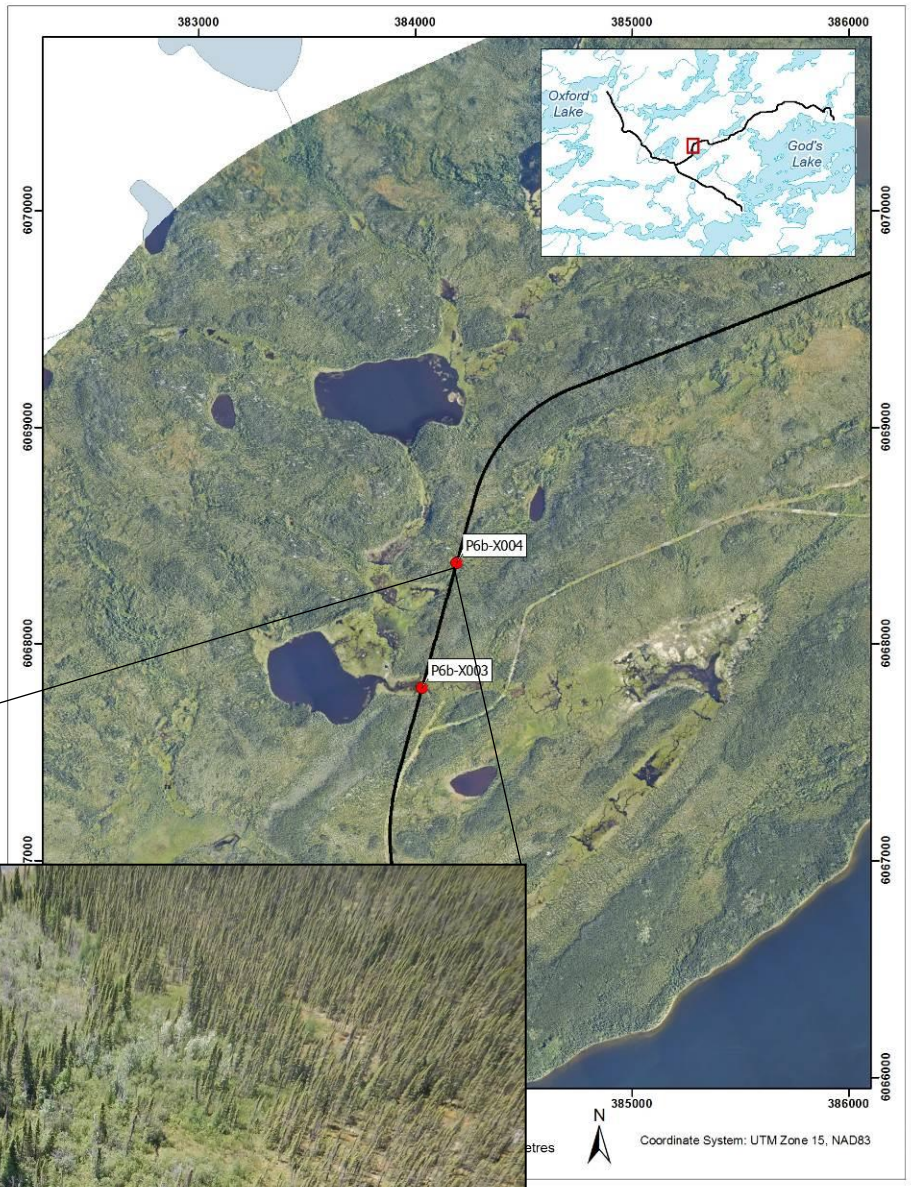
P6b-X004 Unnamed Tributary of Hawkins Lake

Location

Datum:	NAD 83
UTM:	15U 384190 6068376

General Morphology

Type:	Stream
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	0.30
Distance to Major DS Waterbody (km):	5.53 (Hawkins Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The watercourse connects two wetland areas with no stream channel.

The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA.

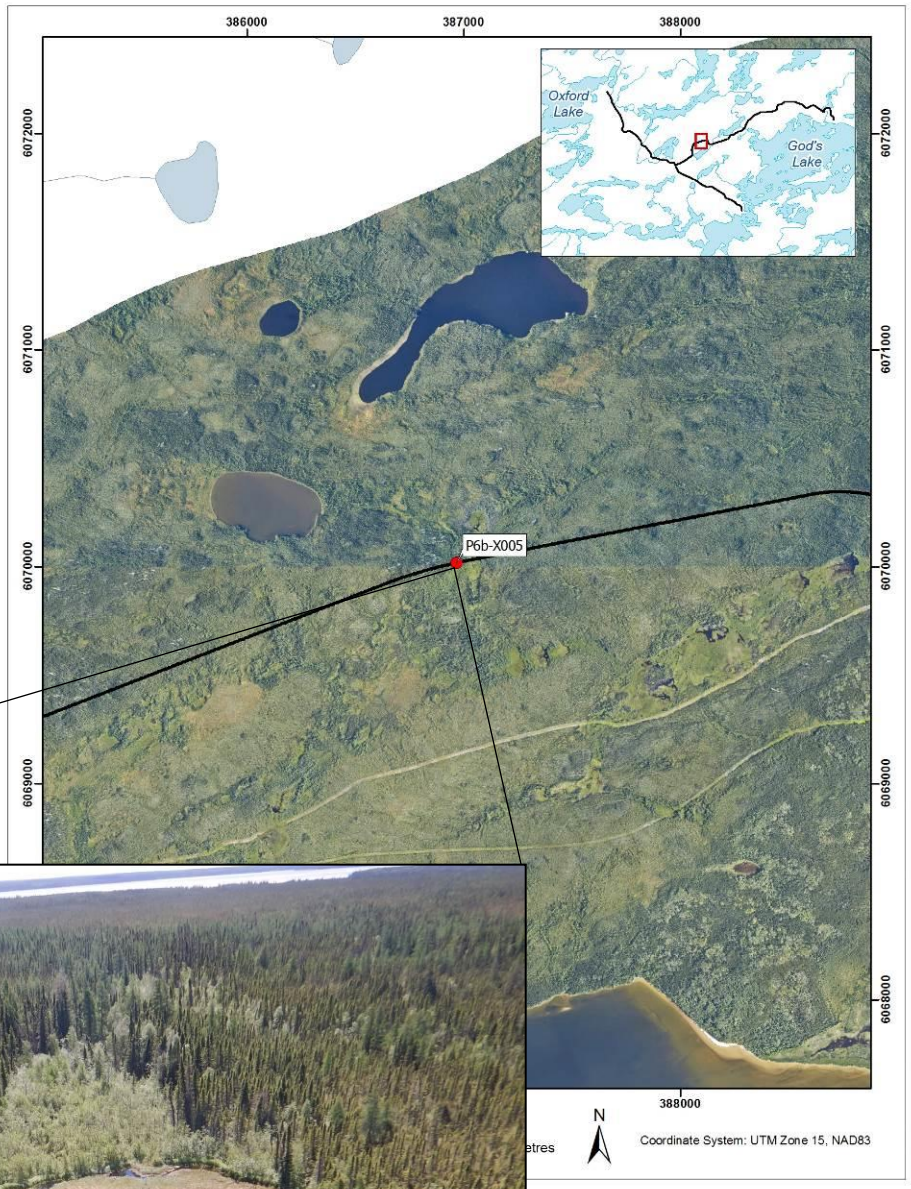
P6b-X005 Unnamed Tributary of Opaskaykow Lake

Location

Datum:	NAD 83
UTM:	15U 386967 6070020

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Perennial
Upstream Drainage Area (km^2):	1.17
Distance to Major DS Waterbody (km):	5.47 (Opaskaykow Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The area surrounding the crossing site is saturated. A defined channel was not observed among the many beaver ponds. There is not connectivity to any major waterbody.

The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA.

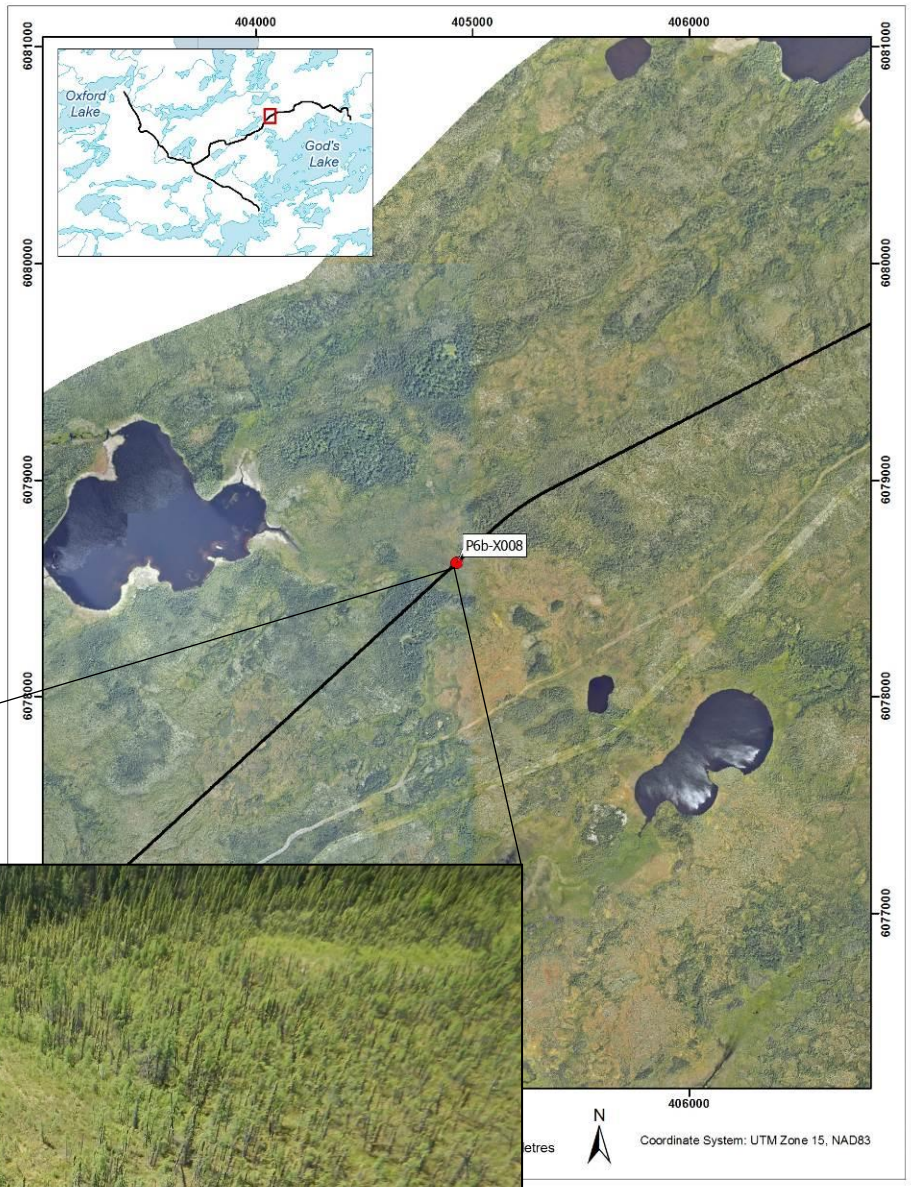
P6b-X008 Unnamed Tributary of Bayly Lake

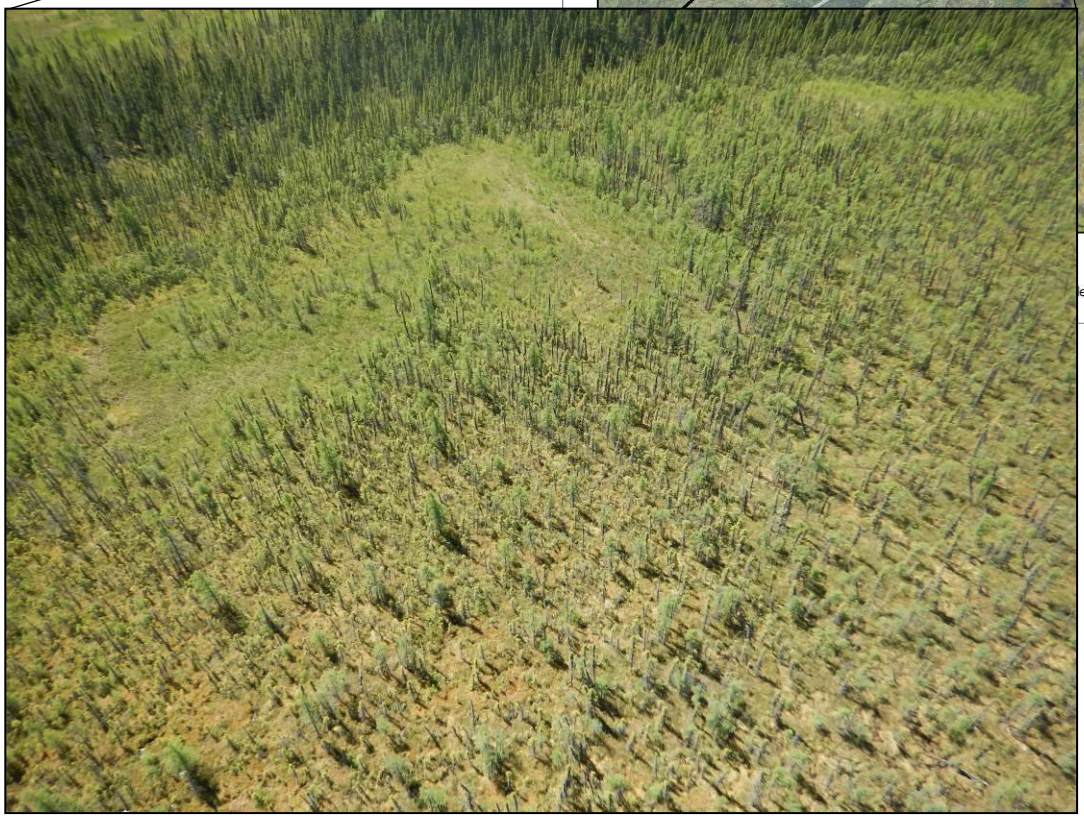
Location

Datum:	NAD 83
UTM:	15U 404927 6078620

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	0.41
Distance to Major DS Waterbody (km):	3.37 (Bayly Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments
The area consists of fen habitat. There was no discernable channel observed.

The site is classified as No Fish Habitat based on the absence of a channel or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA.

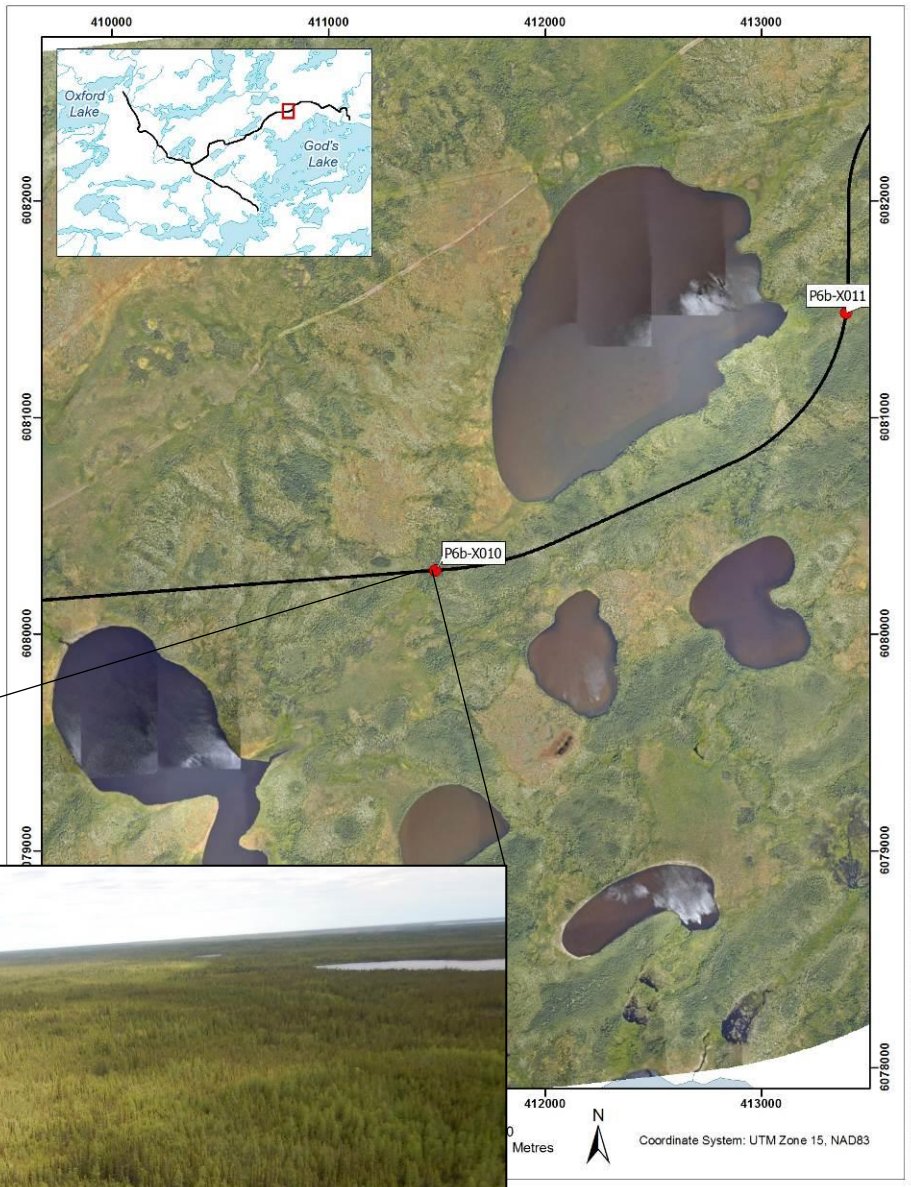
P6b-X010 Unnamed Tributary of Tapper Lake

Location

Datum:	NAD 83
UTM:	15U 411494 6080295

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	9.00
Distance to Major DS Waterbody (km):	4.06 (Tapper Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments

The crossing is located in an ephemeral tributary connecting two small unnamed lakes upstream of Tapper Lake. A defined channel was not observed at the crossing site at time of the visit.

The site is classified as No Fish Habitat based on the absence of a channel, standing water, or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

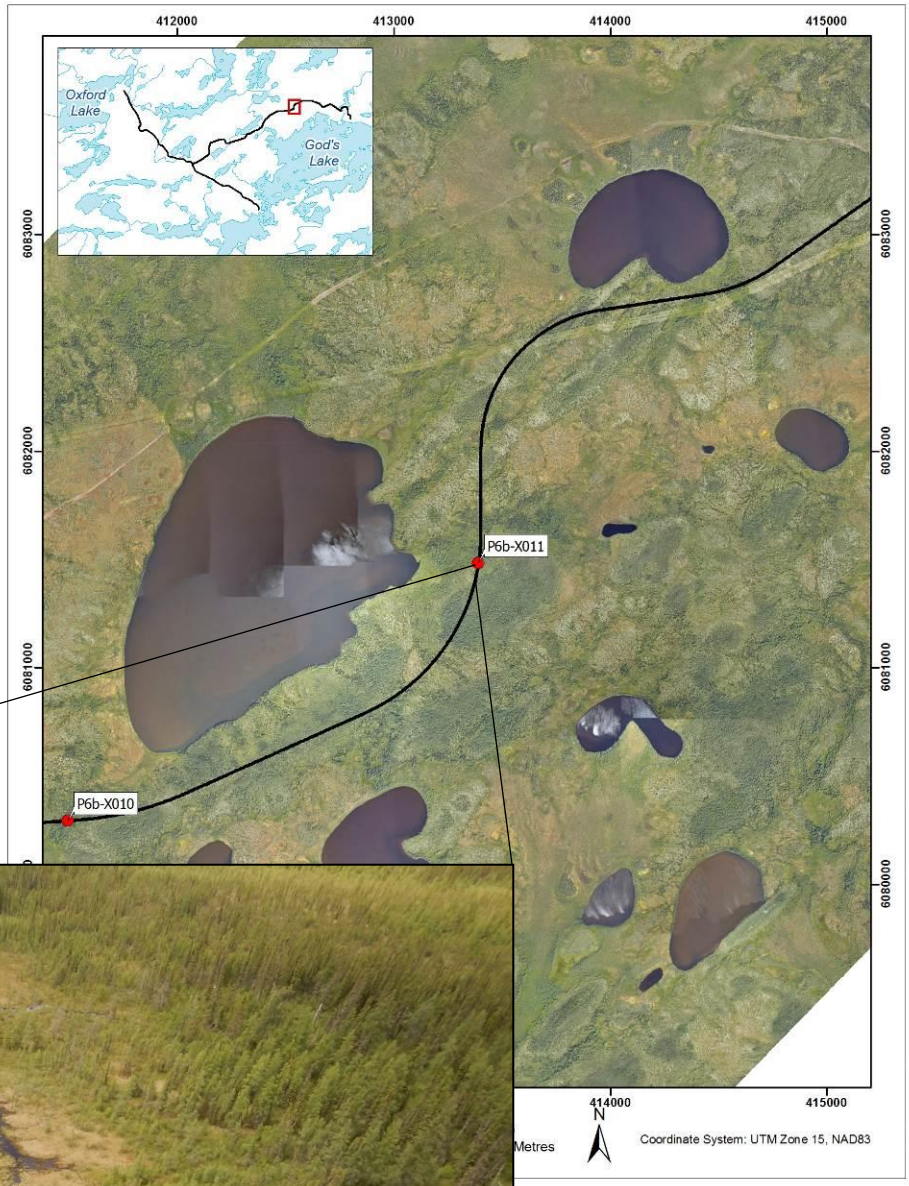
P6b-X011 Unnamed Tributary of Tapper Lake

Location

Datum:	NAD 83
UTM:	15U 413389 6081483

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	1.04
Distance to Major DS Waterbody (km):	6.74 (Tapper Lake)
Connectivity:	No





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Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments

The crossing is located in an ephemeral tributary draining into a small unnamed lake upstream of Tapper Lake. A defined channel was not observed at the crossing site at time of the visit.

The site is classified as No Fish Habitat based on the absence of a channel, standing water, or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

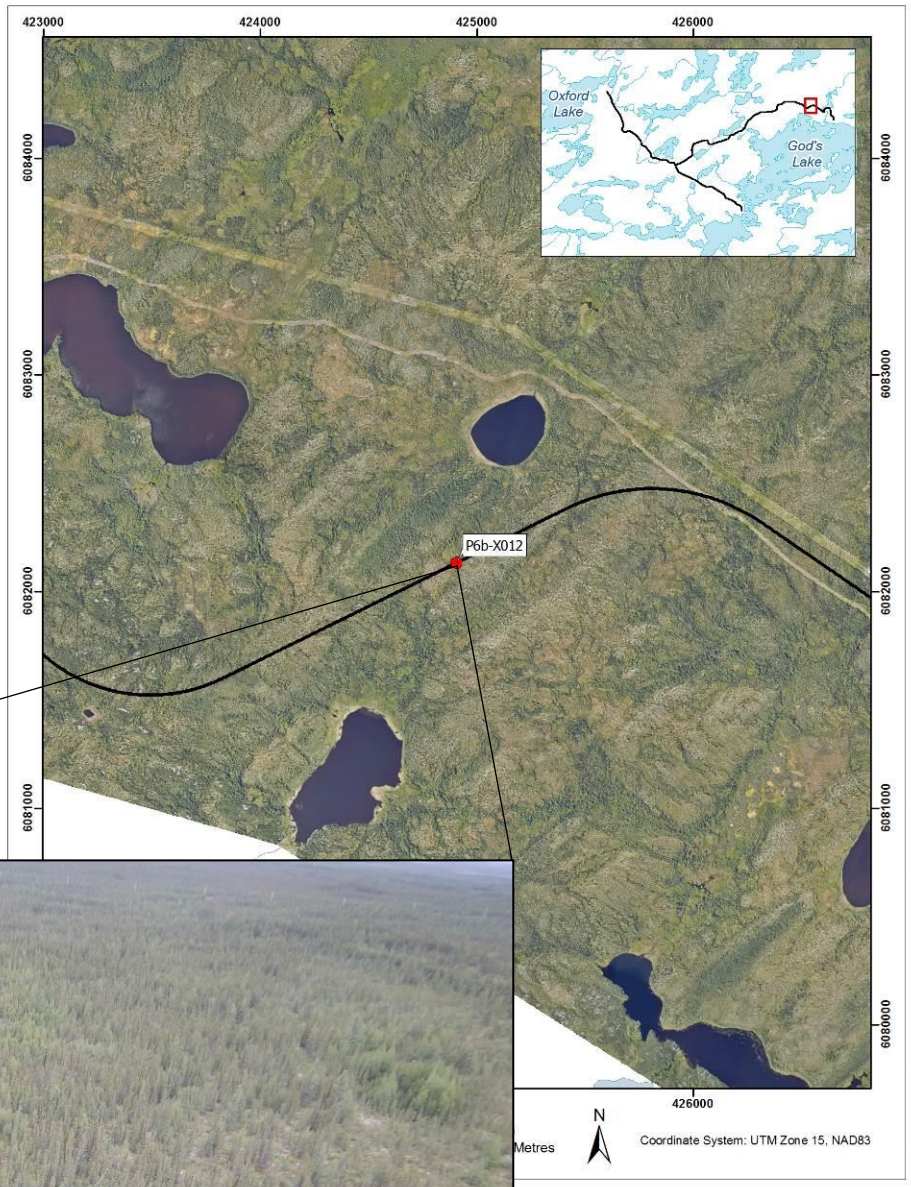
P6b-X012 Unnamed Tributary of Gods Lake

Location

Datum:	NAD 83
UTM:	15U 424907 6082134

General Morphology

Type:	Wetland
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	1.91
Distance to Major DS Waterbody (km):	3.86 (Gods Lake)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments

The crossing is located in an ephemeral tributary draining into a small unnamed lake upstream of Tapper Lake. A defined channel was not observed at the crossing site at time of the visit.

The site is classified as No Fish Habitat based on the absence of a channel, standing water, or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

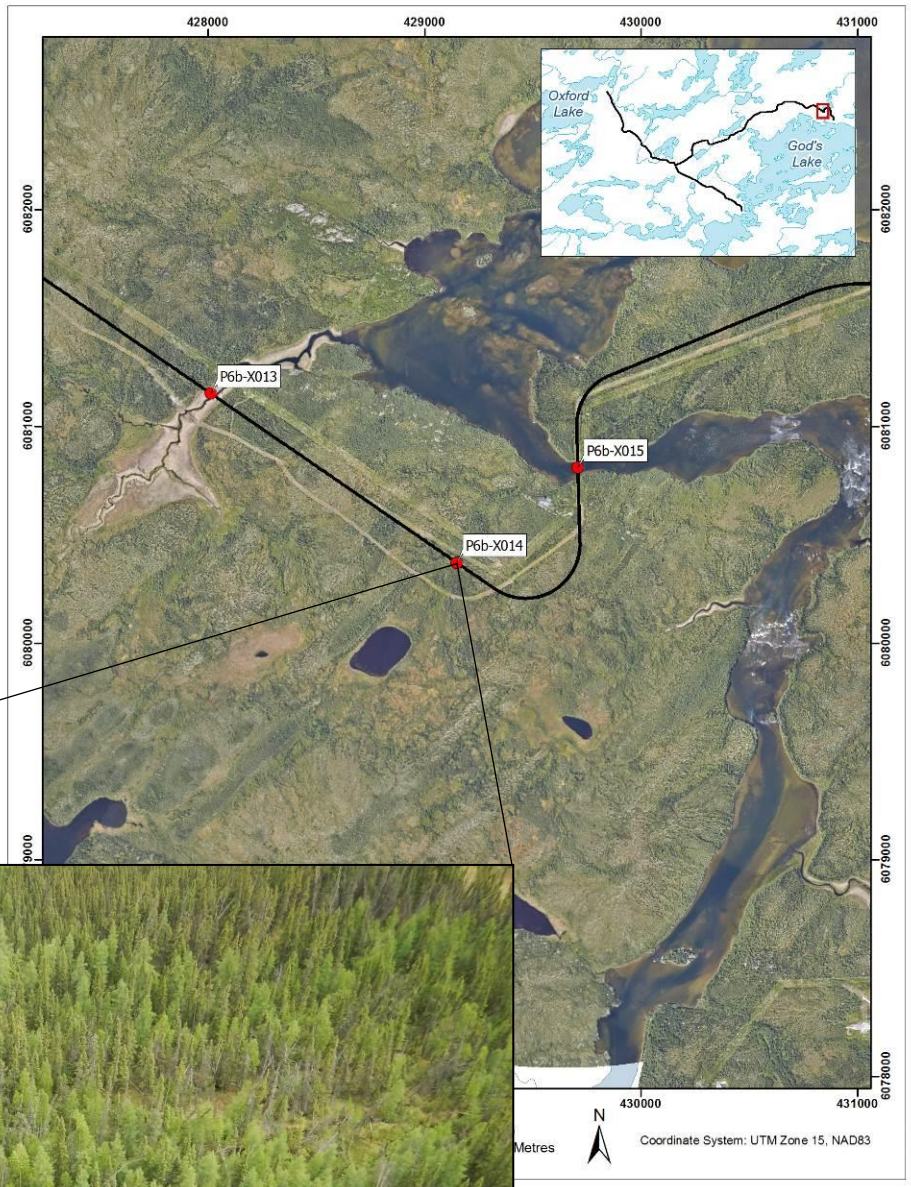
P6b-X014 Unnamed Tributary of God's River

Location

Datum:	NAD 83
UTM:	15U 429148 6080372

General Morphology

Type:	Stream
Canvec Mapped:	Yes
Pattern:	-
Confinement:	-
Flow Regime:	Ephemeral
Upstream Drainage Area (km^2):	0.31
Distance to Major DS Waterbody (km):	0.59 (Gods River)
Connectivity:	No





Fish Habitat Classification

+ Fish Habitat

Fish Habitat Present	No
Habitat Supports a CRA Fishery	No
Fish Habitat Classification	No Fish Habitat

Comments

The crossing is located in a small ephemeral tributary which passes through a forested region and connects a small unnamed lake to God's River. No channel was present within the study area.

The site is classified as No Fish Habitat based on the absence of a channel, standing water, or connection to fish-bearing waters.

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	No

Information Sources:

a – pers. comm. ESRA

APPENDIX 5. STREAM CROSSING ASSESSMENT SUMMARIES ASSESSED AS FISH HABITAT

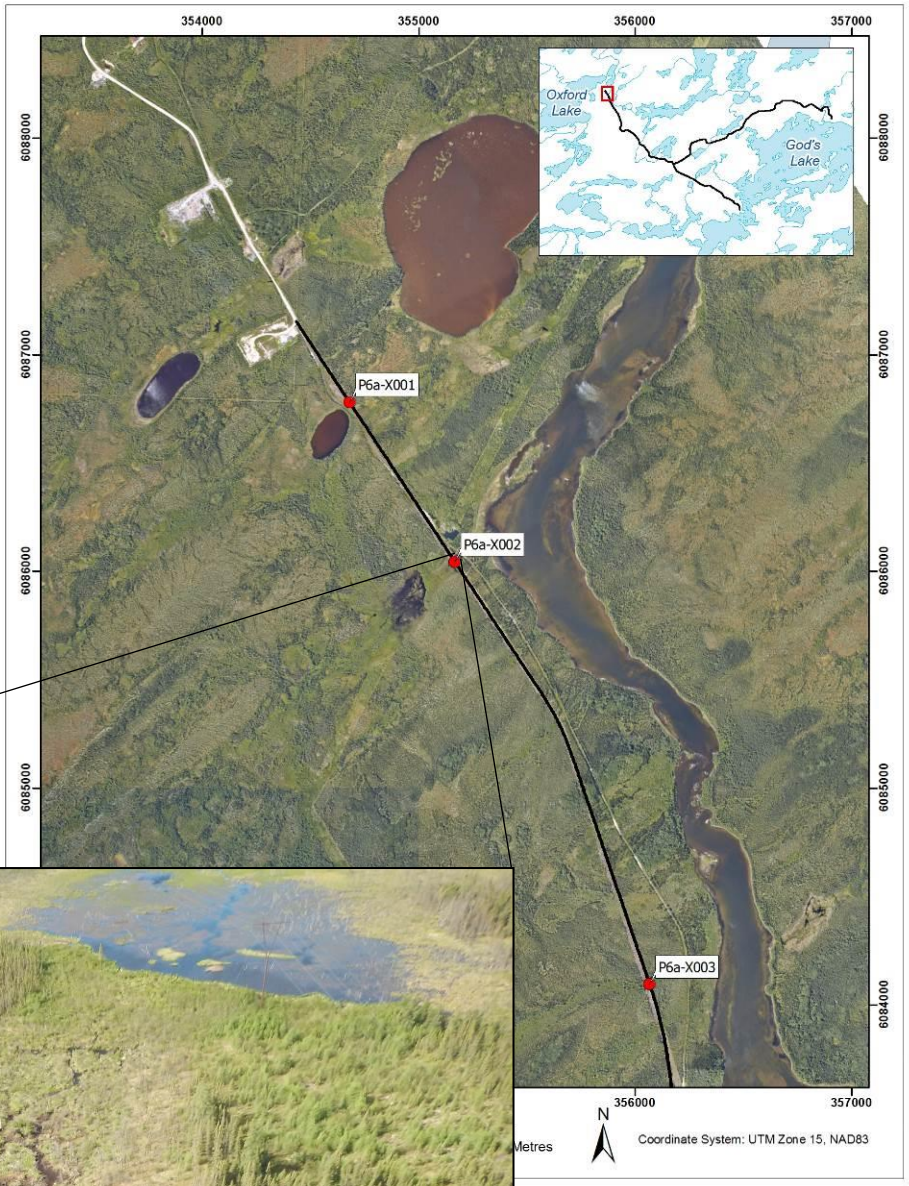
P6a-X002 Unnamed Tributary of Hayes River

Location

Datum:	NAD 83
UTM:	15U 355166 6086046

General Morphology

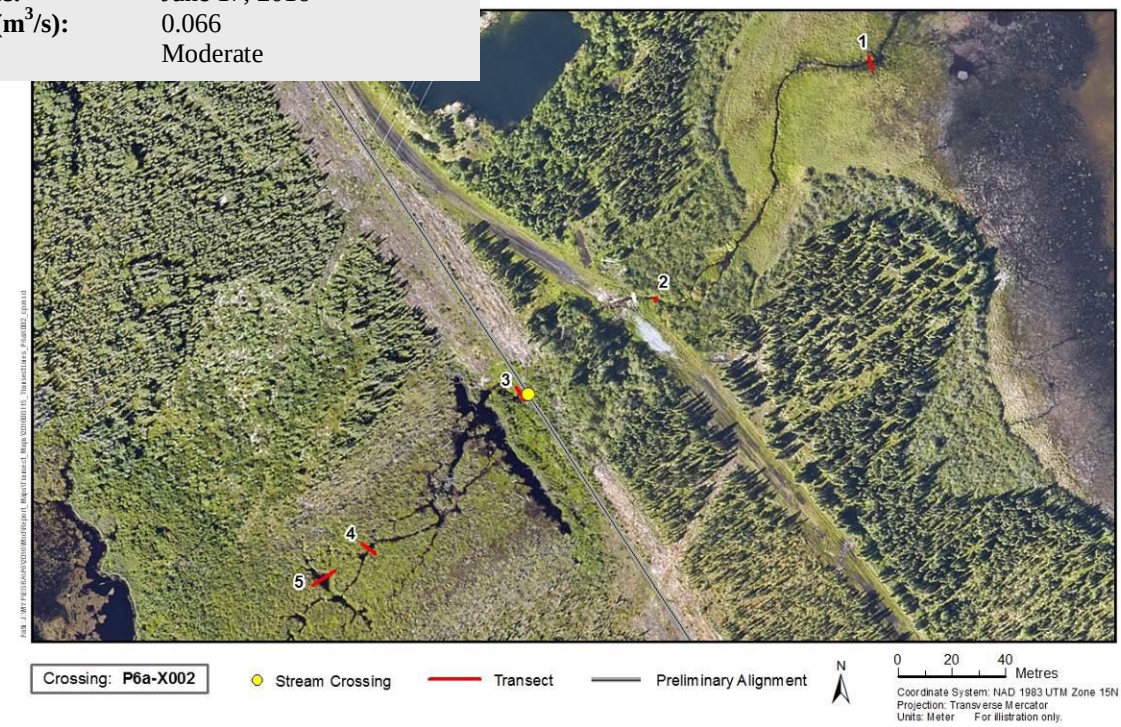
Type:	Stream
Pattern:	Irregular Braided
Channel Profile:	Notched
Sinuosity:	-
Confinement:	Frequently Confined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 17, 2016
Discharge (m^3/s): 0.066
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	180 DS	60 DS	0	60 US	100 DS
Channel and Flow					
Channel (m)	1.0	1.10	1.62	1.1	30
Wetted Width (m)	1.0	1.10	1.60	1.1	30
Depth at 25% (m)	0.38	0.22	0.22	0.25	0.3
Depth at 50% (m)	0.64	0.18	0.3	0.4	0.3
Depth at 75% (m)	0.54	0.16	0.2	0.16	0.3
Maximum Depth (m)	0.64	0.22	0.3	0.4	0.3
Gradient (%)	1	1	1	0	0
Banks					
Left Bank Height (m)	0.10	0.3	0.6	0.15	0.3
Right Bank Height (m)	0.1	0.4	0.55	0.15	0.3
Left Bank Shape	Vertical	Vertical	Vertical	Sloping	Sloping
Right Bank Shape	Vertical	Vertical	Vertical	Sloping	Sloping
Left Bank Materials	Fines	Fines/Veg	Fines	Fines/Veg	Fines
Right Bank Materials	Fines/Veg	Fines/Veg	Fines	Fines/Veg	Fines
Left Bank Stability	Moderate	High	Moderate	Moderate	Moderate
Right Bank Stability	Moderate	High	Moderate	Moderate	Moderate
Substrate Type and Distribution (%)					
Fines	100	30	40	100	100
Small Gravel	0	0	25	0	0
Large Gravel	0	0	2.5	0	0
Cobble	0	0	2.5	0	0
Boulder	0	70	30	0	0
Bedrock	0	0	0	0	0

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	68	10	10	53	53
Right Bank	47	10	10	48	48
Riparian Distance (m)					
Left Bank	68	2	4	53	48
Right Bank	47	2	4	53	48
Riparian Vegetation Type[a]	GRA	SHR/ GRA	SHR/ GRA	SHR/ GRA	SHR/ GRA
Canopy Cover (%)	0	20	0	0	5

a – GRA = grass; SHR = Shrub; DEC = deciduous; CON = coniferous; MIX = mixed

+ Habitat Type (%)

Transect	1	2	3	4	5
Pool	0	20	20	30	40
Riffle	0	0	0	0	0
Run	100	20	45	40	35
Chute	0	5	0	0	0
Dam	0	0	0	0	25
Boulder	0	55	35	30	0

+ Water Quality Data

Habitat:	Run
Temperature (°C):	18.93
pH:	6.56
Turbidity (NTU):	-
Specific Conductance (µS/cm):	92
DO (mg/L):	2.96



Upstream view at Transect 3 (0 m).



Downstream view at Transect 3 (0 m).



Bedrock riffle/chute (between Transect 2 and 3).



Downstream view from Transect 1(180 m D/S).

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	50	80
Cover Composition (% of Total)		
Large Woody Debris	20	6
Overhanging Vegetation	20	20
Instream Vegetation	30	0
Pool	5	25
Boulder	5	25
Undercut Bank	20	12
Surface Turbulence	0	6
Turbidity	0	6

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	High	High
Rearing	High	High
Overwinter	Low	Moderate
Migration	Moderate	High
Large Bodied Fish		
Spawning	Low	High
Rearing	Low	High
Overwinter	Low	Low
Migration	Low	High

Comments
The crossing is located at an existing winter road temporary crossing where the stream cuts through two separate and parallel roads and drains a small beaver impacted wetland into the Hayes River 250 m downstream of the crossing. The stream consists mostly of run habitat, with pools, some boulder gardens and a bedrock riffle/chute just downstream of the crossing. The stream is comprised mostly consists of organic substrate, with instream vegetation suitable for various life cycle stages of forage fish and for spawning and rearing of Northern Pike. Gravel/cobble substrate and riffle may provide suitable spawning substrate for sucker species and Walleye as well as some forage species. Overwintering by forage fish is expected in downstream areas due to low water levels and hypoxic conditions upstream.

+ Fish Sampling Data

Methods: Electrofishing

Fish Species Captured: Johnny Darter, Brook Stickleback

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 0.14
Distance to Major DS Waterbody (km): 0.25 (Hayes River)
Connectivity: Yes

Comments
The crossing site consists mainly of run habitat, with a mix of fine substrate and gravel/cobble and boulder likely from the road two road crossings. The presence of coarse substrate in boreal wetland streams such as this one is relatively uncommon.

+ Fishery

Fishery Area: Hayes River

Fishery Users:

Commercial[a]	No
Recreational	Yes
Aboriginal	Yes – Bunibonibee Cree Nation

Comments
The crossing is located on a small tributary to the Hayes River near the community of Oxford House, within the traditional territory of the Bunibonibee Cree Nation. The stream provides suitable spawning, rearing and feeding habitat for forage fish species, Northern Pike, and possibly suckers and Walleye.

Information Sources:

a – Manitoba Conservation and Water Stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	TBD
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The crossing contains habitat potentially suitable for spawning, rearing and feeding of forage fish species which support CRA fishery species and may also provide habitat for Northern Pike, suckers and Walleye
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	Although not abundant in this stream, the coarse substrate at the crossing is not unique in the region.
Impact on Relevant Fish	Low	The habitat at the crossing site is suitable for spawning, rearing and feeding of by large-bodied and small bodied species of fish. The area at and downstream of the winter road crossings may be the only location within the creek that contains coarse substrate and if removed would no longer be available to fish species that currently make use of it. The permanent culvert would cover some of the coarse substrate at the site and the placement of rip rap at the culvert inlet/outlet would replace effected substrate so that there is no measureable effect to downstream fisheries.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and replacement of effected substrates, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert				
Effect	**Pathway of Effect**	**Proposed Area Affected**	**Existing Area Affected**	**Loss/Gain**
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	48.6 m^2	0 m^2	- 48.6 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Culvert design unavailable at the time of assessment. Area estimated based on the length of culvert crossings constructed as part of the Provincial Road 304 to Berens River All Season Road Project (30 m) and the channel width at the crossing (1.62 m).

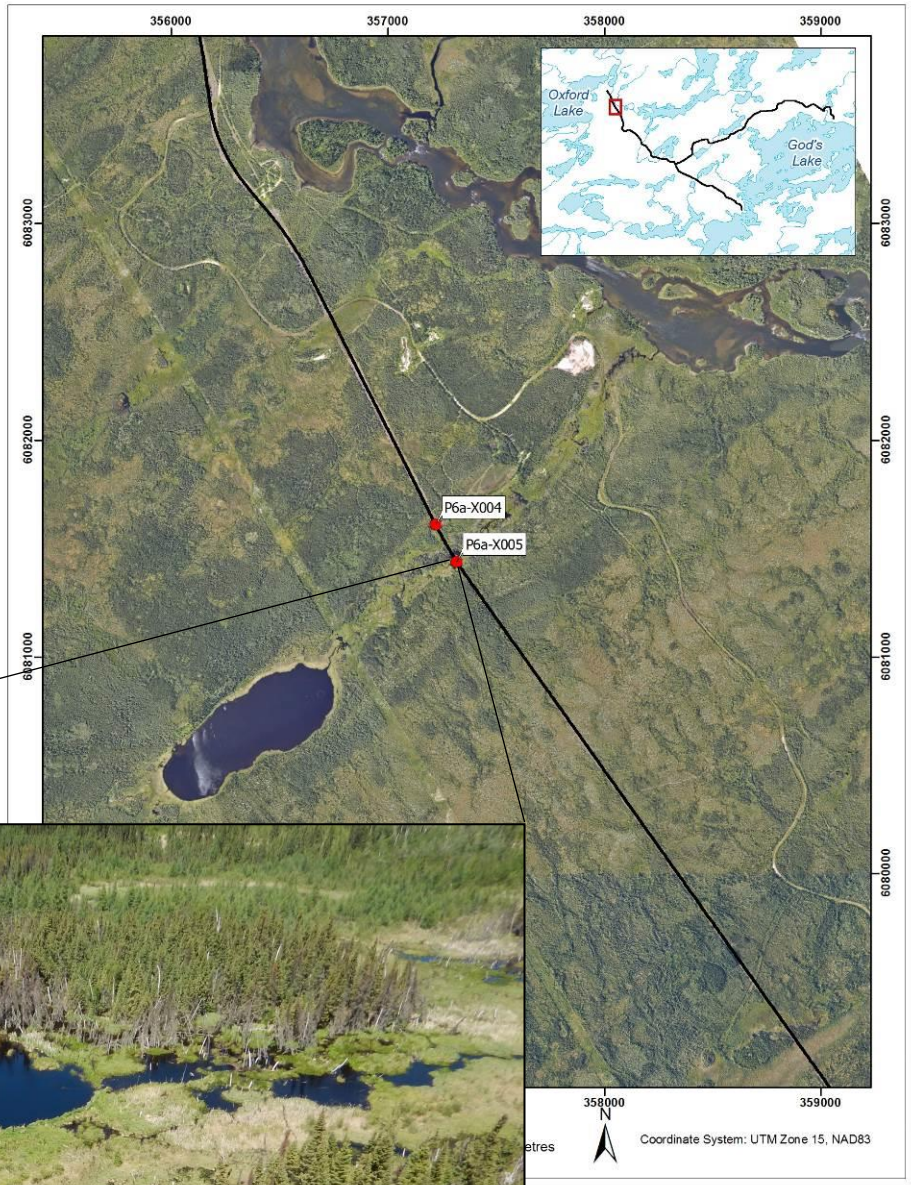
P6a-X005 Unnamed Tributary of Hayes River

Location

Datum:	NAD 83
UTM:	15U 357317 6081440

General Morphology

Type:	Stream
Pattern:	Straight
Channel Profile:	Notched
Sinuosity:	-
Confinement:	Confined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 17, 2016
Discharge (m^3/s): -
Stage: High



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	283 US	62 US	0	60 DS	120 DS
Channel and Flow					
Channel (m)	140	2	31	32	117
Wetted Width (m)	-	2	31	32	117
Depth at 25% (m)	>1	>1	>1	>1	-
Depth at 50% (m)	>1	>1	>1	-	-
Depth at 75% (m)	>1	>1	>1	-	-
Maximum Depth (m)	>1	>1	>1	-	-
Gradient (%)	-	-	-	-	-
Banks					
Left Bank Height (m)	-	0	0	0	0
Right Bank Height (m)	-	0	0	0	0
Left Bank Shape	Sloping	Vertical	Vertical	Vertical	Vertical
Right Bank Shape	Sloping	Vertical	Vertical	Vertical	Vertical
Left Bank Materials	Peat	Peat/Bog	Peat	Peat	Peat
Right Bank Materials	Peat	Bog	Peat	Peat	Peat
Left Bank Stability	High	High	Moderate	Moderate	Moderate
Right Bank Stability	High	High	Moderate	Moderate	Moderate
Substrate Type and Distribution (%)					
Fines	100	100	100	100	100
Small Gravel	0	0	0	0	0
Large Gravel	0	0	0	0	0
Cobble	0	0	0	0	0
Boulder	0	0	0	0	0
Bedrock	0	0	0	0	0

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	70	48	46	117	117
Right Bank	70	24	31	117	117
Riparian Distance (m)					
Left Bank	70	48	46	117	117
Right Bank	70	24	2	117	117
Riparian Vegetation Type[a]	GRA/ SHR	GRA/ SHR	GRA/ SHR	GRA/ SHR	GRA/ SHR
Canopy Cover (%)	20	0	10	0	-

a – GRA = grass; SHR = Shrub

+ Habitat Type (%)

Transect	1	2	3	4	5
Flat	0	0	0	0	0
Pool	70	100	90	100	100
Rapid	0	0	0	0	0
Riffle	0	0	0	0	0
Run	20	0	0	0	0
Dam	10	0	10	0	0

+ Water Quality Data

Habitat: [a]	Pool
Temperature (°C):	18.82
pH:	6.81
Turbidity (NTU):	-
Specific Conductance (µS/cm):	156
DO (mg/L):	2.22

a – BW=backwater



Downstream view at crossing site (Transect 3).



Upstream view at Transect 4, located 60 m downstream from crossing.



Upstream view from Transect 5, located 120 m downstream from crossing.



Downstream view from Transect 1, located 283 m upstream from crossing.

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	35	35
Cover Composition (% of Total)		
Large Woody Debris	15	15
Overhanging Vegetation	5	5
Instream Vegetation	65	65
Pool	15	15
Boulder	0	0
Undercut Bank	0	0
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Moderate	High
Rearing	Moderate	High
Overwinter	Moderate	Moderate
Migration	Low	Moderate
Large Bodied Fish		
Spawning	Low	Low
Rearing	Low	Low
Overwinter	Low	Low
Migration	Low	Low

Comments
The crossing is located 1.49 km upstream of the Hayes River. The reach has similar habitat both upstream and downstream of the crossing, consisting of a boreal wetland: flat water/pool habitat, organic substrates and instream vegetation. The stream connects a small unnamed lake to the Hayes River and is heavily impacted by beavers. Use by large bodied fish is unlikely as the connection to both waterbodies is hindered by beaver dams and debris. It is, however, suitable for spawning and rearing of forage fish species which may support CRA fisheries species in the Hayes River, provided there is access. Only fish species tolerant of low oxygen conditions are likely to overwinter within the reach.

+ Fish Sampling Data

Methods: Dip net

Fish Species Captured: Brook Stickleback

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 3.31
Distance to Major DS Waterbody (km): 1.49 (Hayes River)
Connectivity: Yes - unlikely

Comments
The crossing site consists mainly of flat-water habitat, dominated by organic substrates and instream vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Hayes River, Knee Lake

Fishery Users:

Commercial[a]	No
Recreational	Yes
Aboriginal	Yes – Bunibonibee Cree Nation

Comments
The crossing is located on an unnamed tributary which feeds into the Hayes River and is within the traditional territories of Bunibonibee Cree Nation. The stream provides suitable spawning, rearing, feeding and overwintering habitat for forage fish species tolerant of low oxygen conditions. Due to the barriers between the crossing and the Hayes River, contributions to the CRA fishery are expected to be minimal.

Information Sources:

a – Manitoba Conservation and Water Stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a – pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	No	The crossing contains habitat suitable for spawning, rearing and feeding of forage fish species tolerant of low oxygen conditions. Contributions to a CRA fishery would be minimal because of poor connectivity to the Hayes River.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	Construction of the crossing is expected to have no measurable effect on the CRA fishery productivity. The habitat in the immediate crossing area supports a range of life requisites primarily for forage fishes, including spawning, rearing and feeding, however, connectivity to the nearest relevant fish bearing waterbody is restricted because of the heavy beaver activity.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert				
Effect	**Pathway of Effect**	**Proposed Area Affected**	**Existing Area Affected**	**Loss/Gain**
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	930 m^2	0 m^2	- 930 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (31 m).

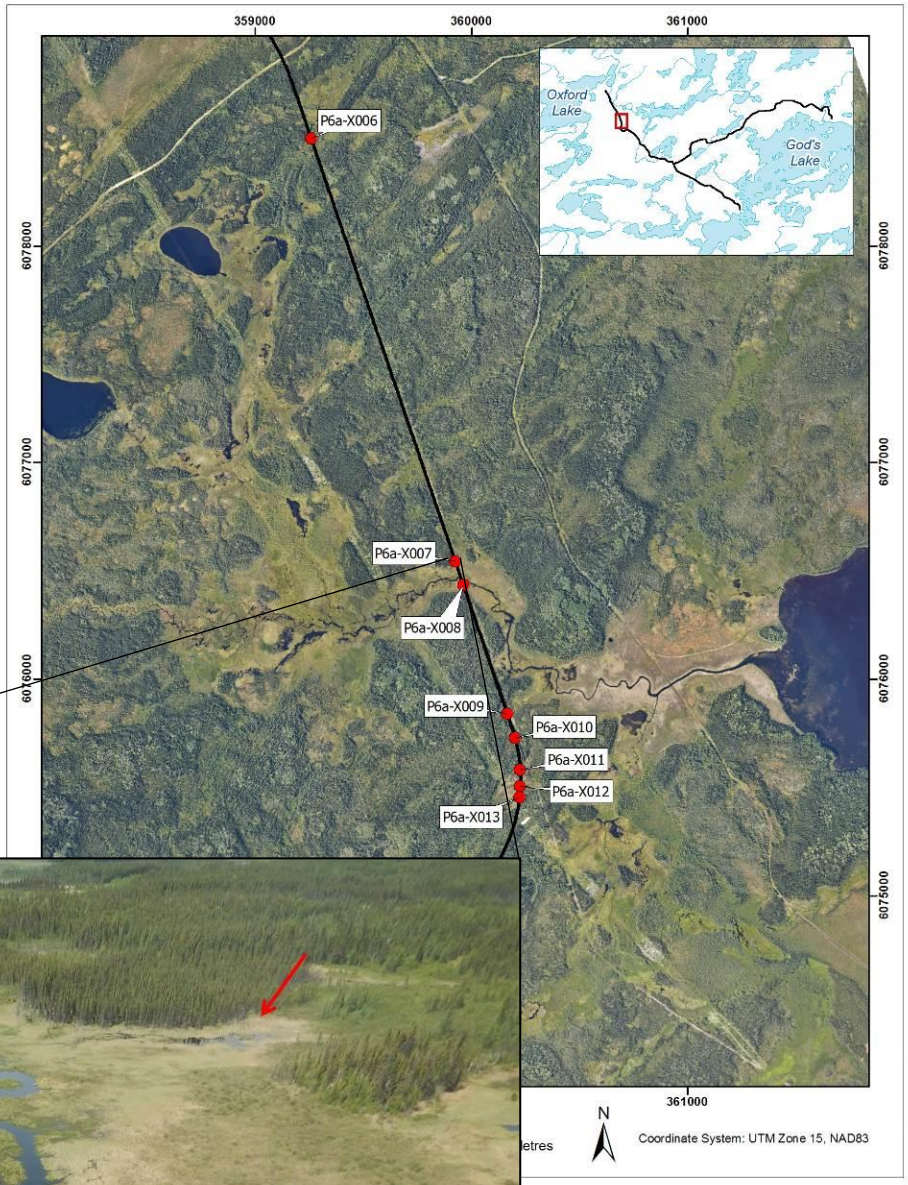
P6a-X007 Unnamed Tributary of Michikanes Lake

Location

Datum:	NAD 83
UTM:	15U 359925 6076546

General Morphology

Type:	Wetland
Pattern:	-
Channel Profile:	-
Sinuosity:	-
Confinement:	Unconfined
Flow Regime:	Ephemeral





Regional Context

+ Habitat

Upstream Drainage Area (km^2): 0.00
Distance to Major DS Waterbody (km): 2.17 (Michikanes Lake)
Connectivity: Yes - unlikely

Comments
The crossing site is located in a wetland region that drains into a tributary of Michikanes Lake. Habitat consists of flat-water habitat, dominated by organic substrates and instream vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Michikanes Lake

Fishery Users:

Commercial[a]	No
Recreational	Yes
Aboriginal	Yes – Bunibonibee Cree Nation

Comments
The crossing is located near an unnamed tributary that feeds into Michikanes Lake. It is within the traditional territories of Bunibonibee Cree Nation. The area may provide suitable spawning, rearing and feeding habitat for forage fish species tolerant of low oxygen conditions. The unnamed tributary immediately downstream of the crossing provides suitable spawning, rearing and feeding habitat for Northern Pike and small bodied fish supporting CRA fishery species.

Information Sources:

a – Manitoba Conservation and Water Stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision for Fish Passage	Yes

Information Sources:

a – pers. comm. ESRA

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	No	The crossing contains habitat suitable for spawning, rearing and feeding of forage fish species tolerant of low oxygen conditions. Contributions to a CRA fishery would be minimal because of poor connectivity to Michikanes Lake.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	Construction of the crossing is expected to have no measurable effect on the CRA fishery productivity. The habitat in the immediate crossing area supports a range of life requisites primarily for forage fishes, including spawning, rearing and feeding, however, channel development and connectivity to the nearest relevant fish bearing waterbody is limiting.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

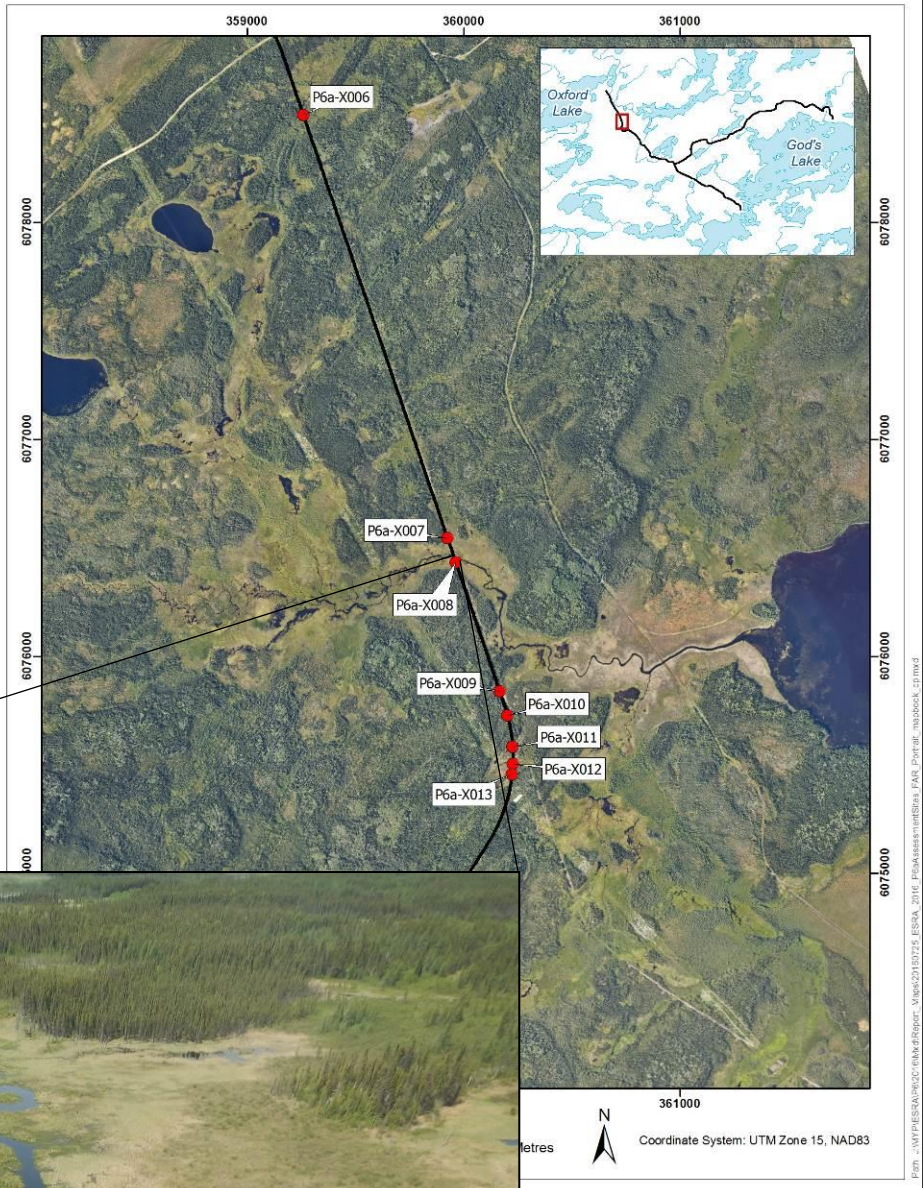
P6a-X008 Unnamed Tributary of Michikanes Lake

Location

Datum:	NAD 83
UTM:	15U 359963 6076436

General Morphology

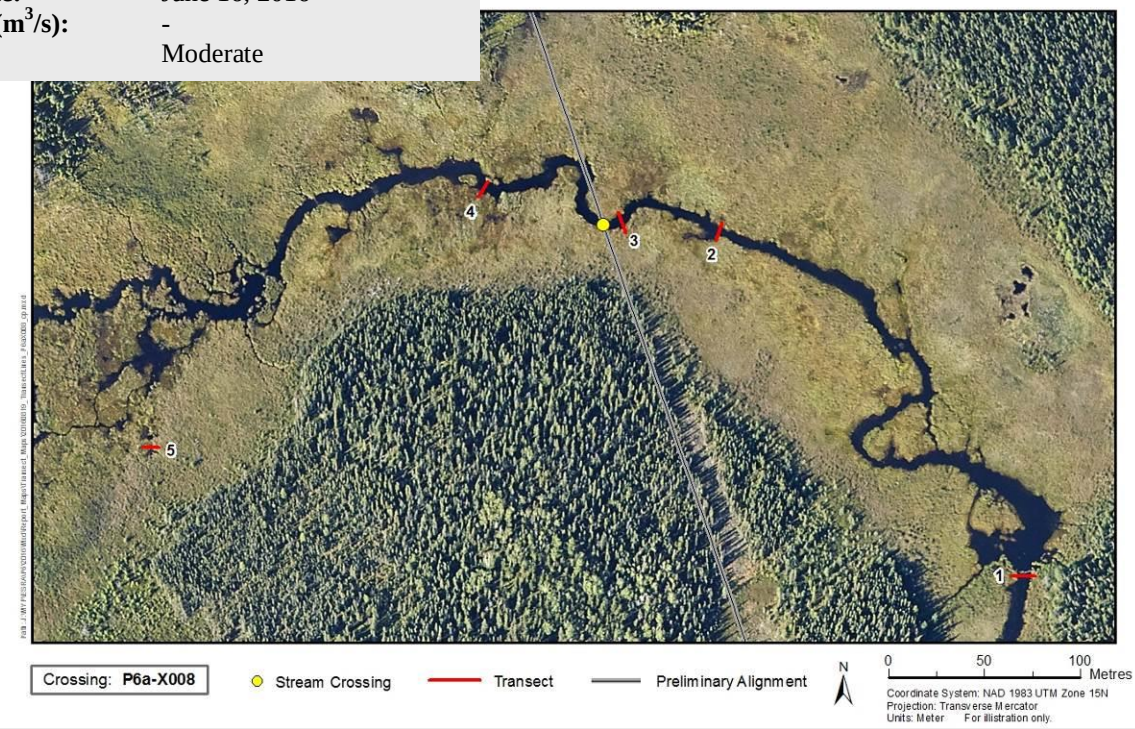
Type:	Fen Stream
Pattern:	Meandering
Channel Profile:	U-shaped
Sinuosity:	-
Confinement:	Confined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 16, 2016
Discharge (m^3/s): -
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	400 DS	60DS	0	60 US	400 US
Channel and Flow					
Channel (m)	8	8	10	8	-
Wetted Width (m)	8	8	10	8	-
Depth at 25% (m)	1	1.98	3	0.83	-
Depth at 50% (m)	>1	-	>3	>2	-
Depth at 75% (m)	0.9	1.8	0.84	-	-
Maximum Depth (m)	>1	-	>3	>2	-
Gradient (%)	-	-	-	-	-
Banks					
Left Bank Height (m)	0	0	0	0	0
Right Bank Height (m)	0	0	0	0	0
Left Bank Shape	Vertical	Vertical	Sloping	Vertical	Vertical
Right Bank Shape	Vertical	Vertical	Sloping	Vertical	Vertical
Left Bank Materials	Peat/fines	Peat	Peat	Peat	Peat
Right Bank Materials	Peat/fines	Peat	Peat	Peat	Peat
Left Bank Stability	High	High	High	High	High
Right Bank Stability	High	High	High	High	High
Substrate Type and Distribution (%)					
Fines	100	100	100	100	100
Small Gravel	0	0	0	0	0
Large Gravel	0	0	0	0	0
Cobble	0	0	0	0	0
Boulder	0	0	0	0	0
Bedrock	0	0	0	0	0

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	58	67	62	53	20
Right Bank	6	134	108	131	144
Riparian Distance (m)					
Left Bank	15	20	26	43	10
Right Bank	2	18	63	75	10
Riparian Vegetation Type[a]	GRA/ SHR	GRA/ SHR	GRA/ SHR	GRA/ SHR	GRA/ SHR
Canopy Cover (%)	0	0	0	0	0

a – GRA = grass; SHR = Shrub

+ Habitat Type (%)

Transect	1	2	3	4	5
Flat	0	70	70	-	30
Pool	50	30	30	-	70
Rapid	0	0	0	-	0
Riffle	0	0	0	-	0
Run	50	0	0	-	0
Cascade	0	0	0	-	0

+ Water Quality Data

Habitat:	Flat
Temperature (°C):	21.69
pH:	6.56
Turbidity (NTU):	-
Specific Conductance (µS/cm):	137
DO (mg/L):	4.02



Downstream view at crossing site (Transect 3).



Upstream view at Transect 1, located 400 m downstream from crossing.



Downstream view at Transect 1, located 400 m downstream from crossing.



Upstream view at Transect 5 (400 m upstream of crossing), showing upstream extent of flooded beaver pond.

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	-	45
Cover Composition (% of Total)		
Large Woody Debris	-	10
Overhanging Vegetation	-	0
Instream Vegetation	-	90
Pool	-	0
Boulder	-	0
Undercut Bank	-	0
Surface Turbulence	-	0
Turbidity	-	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	High	High
Rearing	High	High
Overwinter	High	High
Migration	High	High
Large Bodied Fish		
Spawning	High	High
Rearing	High	High
Overwinter	Moderate	Moderate
Migration	Moderate	High

Comments
The crossing is located approximately 2 km from the stream's confluence with Michikanes Lake. The upstream extent of the area (i.e. Transect 5) consists of a flooded beaver pond. Habitat within the survey reach consists of flat water, organic substrate and instream vegetation suitable for spawning, rearing and feeding of forage fish species and Northern Pike. Floating bog is abundant. Though small bodied fish tolerant of low oxygen conditions may overwinter within the reach, large bodied species (e.g. Northern Pike) likely overwinter in Michikanes Lake. There appears to be no barriers preventing access to the crossing site from the lake.

+ Fish Sampling Data

Methods: Electrofishing, Visual Survey

Fish Species Captured: Northern Pike, Brook Stickleback

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 39.24
Distance to Major DS Waterbody (km): 2.01 (Michikanes Lake)
Connectivity: Yes

Comments
The crossing site consists mainly of flat-water habitat, dominated by organic substrates and instream vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Michikanes Lake

Fishery Users:

Commercial[a]	No
Recreational	Yes
Aboriginal	Yes – Bunibonibee Cree Nation

Comments
The unnamed stream feeds into Michikanes Lake, within the traditional territories of Bunibonibee Cree Nation. The stream provides suitable spawning, rearing and feeding habitat for Northern Pike and small bodied fish supporting CRA fishery species.

Information Sources:

a – Manitoba Conservation 2014

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –ESRA pers. comm.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The crossing contains habitat suitable for spawning, rearing and feeding of Northern Pike. The crossing is approximately 1.5 km from Michikanes Lake with potential to support overwintering large bodied fish.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the immediate crossing area is expected to contribute to the downstream and upstream CRA fishery as it supports a range of life requisites for both forage fish and Northern Pike, including spawning, rearing and feeding. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish (e.g., Northern Pike) is plentiful outside of the project footprint within the stream and in the region.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert

Effect	Pathway of Effect	Proposed Area Affected	Existing Area Affected	Loss/Gain
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	300 m^2	0 m^2	- 300 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (10 m).

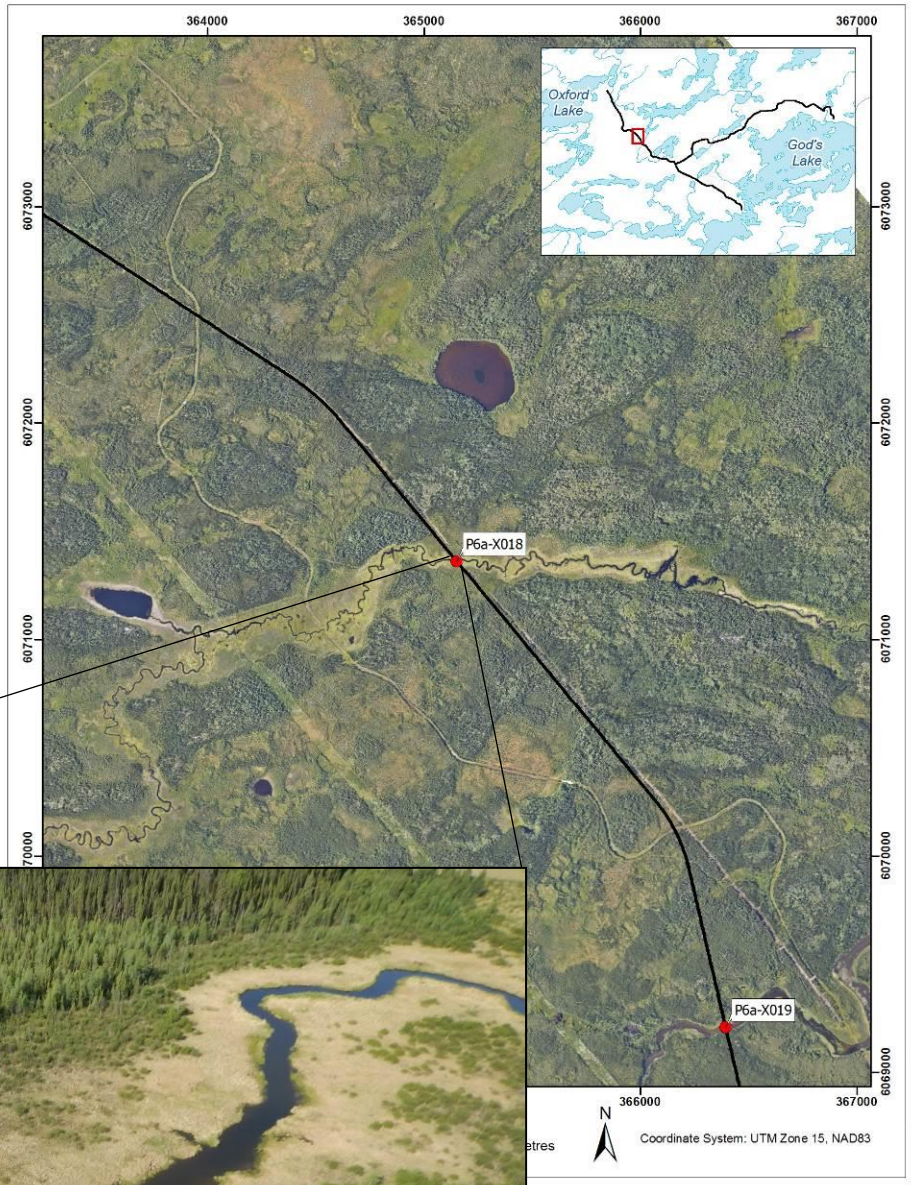
P6a-X018 Unnamed Tributary of Knee Lake

Location

Datum:	NAD 83
UTM:	15U 365150 6071363

General Morphology

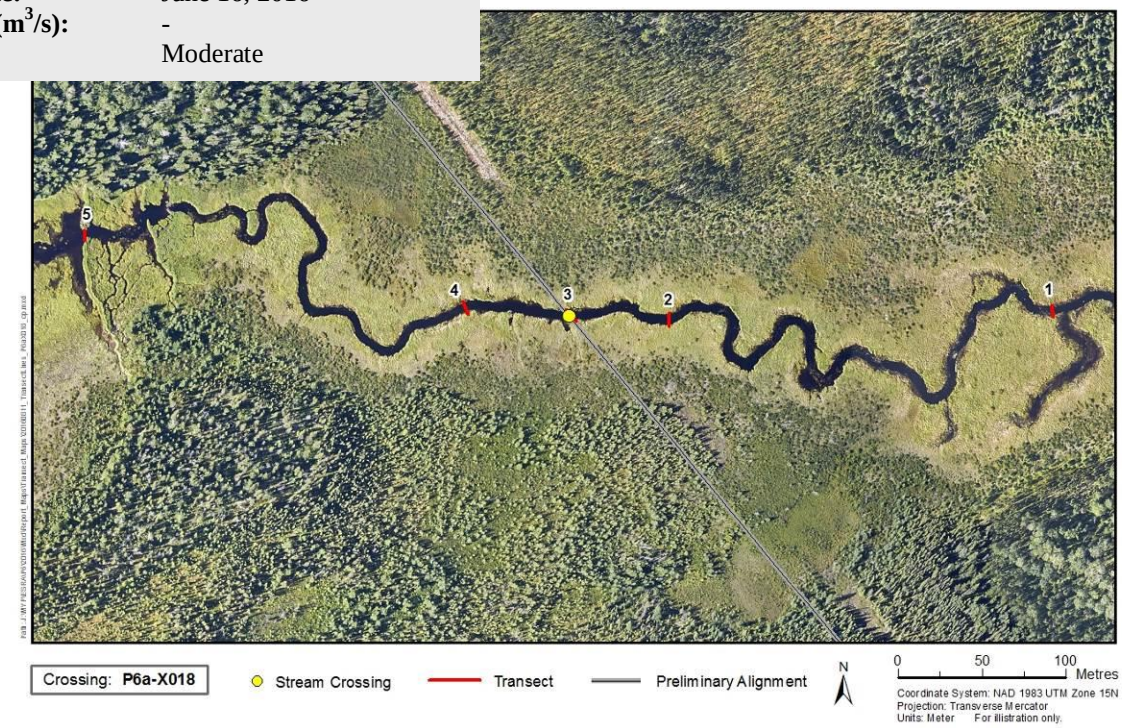
Type:	Stream
Pattern:	Meandering
Channel Profile:	U-Shape
Sinuosity:	-
Confinement:	Confined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 16, 2016
Discharge (m^3/s): -
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	300 DS	60 DS	0	60 US	300 US
Channel and Flow					
Channel (m)	8	8	9	10	6
Wetted Width (m)	8	8	9	10	6
Depth at 25% (m)	0.94	0.68	1.54	0.2	0.56
Depth at 50% (m)	>1	>1	>1	>1	>1
Depth at 75% (m)	0.67	0.9	0.16	0.6	0.6
Maximum Depth (m)	>1	>1	>1	>1	>1
Gradient (%)	1	-	-	-	-
Banks					
Left Bank Height (m)	0.1	0.2	0.1	0.2	0.55
Right Bank Height (m)	0.1	0.2	0.1	0.2	0.2
Left Bank Shape	Vertical	Vertical	Vertical	Vertical	Vertical
Right Bank Shape	Vertical	Vertical	Vertical	Vertical	Vertical
Left Bank Materials	Silt/Organics	Silt/Organics	Silt/Organics	Silt/Organics	Silt/Organics
Right Bank Materials	Silt/Organics	Silt/Organics	Silt/Organics	Silt/Organics	Silt/Organics
Left Bank Stability	High	High	High	High	High
Right Bank Stability	High	High	High	High	High
Substrate Type and Distribution (%)					
Fines	100	100	100	100	100
Small Gravel	0	0	0	0	0
Large Gravel	0	0	0	0	0
Cobble	0	0	0	0	0
Boulder	0	0	0	0	0
Bedrock	0	0	0	0	0

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	87	50	31	56	90
Right Bank	93	48	73	128	22
Riparian Distance (m)					
Left Bank	57	20	21	30	90
Right Bank	23	24	9	16	22
Riparian Vegetation Type[a]	GRA/ SHR	GRA/ SHR	GRA/ SHR	GRA/ SHR	GRA/ SHR
Canopy Cover (%)	0	0	0	0	0

a – GRA = grass; SHR = Shrub; DEC = deciduous; CON = coniferous; MIX = mixed

+ Habitat Type (%)

Transect	1	2	3	4	5
Flat	90	100	85	95	-
Pool	10	0	15	5	-
Rapid	0	0	0	0	-
Riffle	0	0	0	0	-
Run	0	0	0	0	-
Boulder	0	0	0	0	-

+ Water Quality Data

Habitat:	Flat
Temperature (°C):	19.81
pH:	6.51
Turbidity (NTU):	-
Specific Conductance (µS/cm):	138
DO (mg/L):	4.10



Upstream view at crossing site (Transect 3).



Downstream view at crossing site (Transect 3).



Downstream view at Transect 2 (60 m downstream from crossing).



Upstream view from beaver dam, located immediately downstream from Transect 5.

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	12	10
Cover Composition (% of Total)		
Large Woody Debris	10	10
Overhanging Vegetation	0	0
Instream Vegetation	70	80
Pool	0	0
Boulder	20	0
Undercut Bank	0	10
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	High	High
Rearing	High	High
Overwinter	High	High
Migration	Moderate	High
Large Bodied Fish		
Spawning	High	High
Rearing	High	High
Overwinter	Moderate	High
Migration	Moderate	High

Comments
This perennial stream is approximately 14 km long, connecting McLaughlin Lake to Knee Lake. There is a beaver dam located upstream transect (i.e., T5). The crossing is located approximately 4.6 km upstream from the stream's confluence with Knee Lake. Habitat within the reach consists of a broad channel within a grass floodplain, soft substrates and abundant instream vegetation along each shoreline, suitable for spawning, rearing and feeding by Northern Pike and forage fish. Although small bodied fish may overwinter within the reach, large bodied fish (i.e., Northern Pike) likely overwinter in either McLaughlin or Knee Lake.

+ Fish Sampling Data

Methods: Electrofishing, Visual Survey

Fish Species Captured: Brook Stickleback

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 68.58
Distance to Major DS Waterbody (km): 4.63 (Knee Lake)
Connectivity: Yes

Comments
The crossing site consists mainly of flat-water habitat, dominated by organic substrates and instream vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Knee Lake

Fishery Users:

Commercial[a]	No
Recreational	Yes – Fishing Lodge (North Star Resort)
Aboriginal	Yes – Bunibonibee Cree Nation

Comments
This unnamed tributary connects McLaughlin Lake to Knee Lake, within the traditional territories of Bunibonibee Cree Nation. The stream provides suitable spawning, rearing and feeding habitat for Northern Pike.

Information Sources:

a – Manitoba Conservation and Water Stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The crossing contains habitat suitable for spawning, rearing and feeding of Northern Pike. Overwintering habitat is present in the headwater lake as well as the receiving lake.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the immediate crossing area is expected to contribute to the downstream and upstream CRA fishery as it supports a range of life requisites for both forage fish and Northern Pike, including spawning, rearing and feeding. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish (e.g., Northern Pike) is plentiful outside of the project footprint within the stream and in the region.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert

Effect	Pathway of Effect	Proposed Area Affected	Existing Area Affected	Loss/Gain
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	270 m^2	0 m^2	- 270 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (9 m).

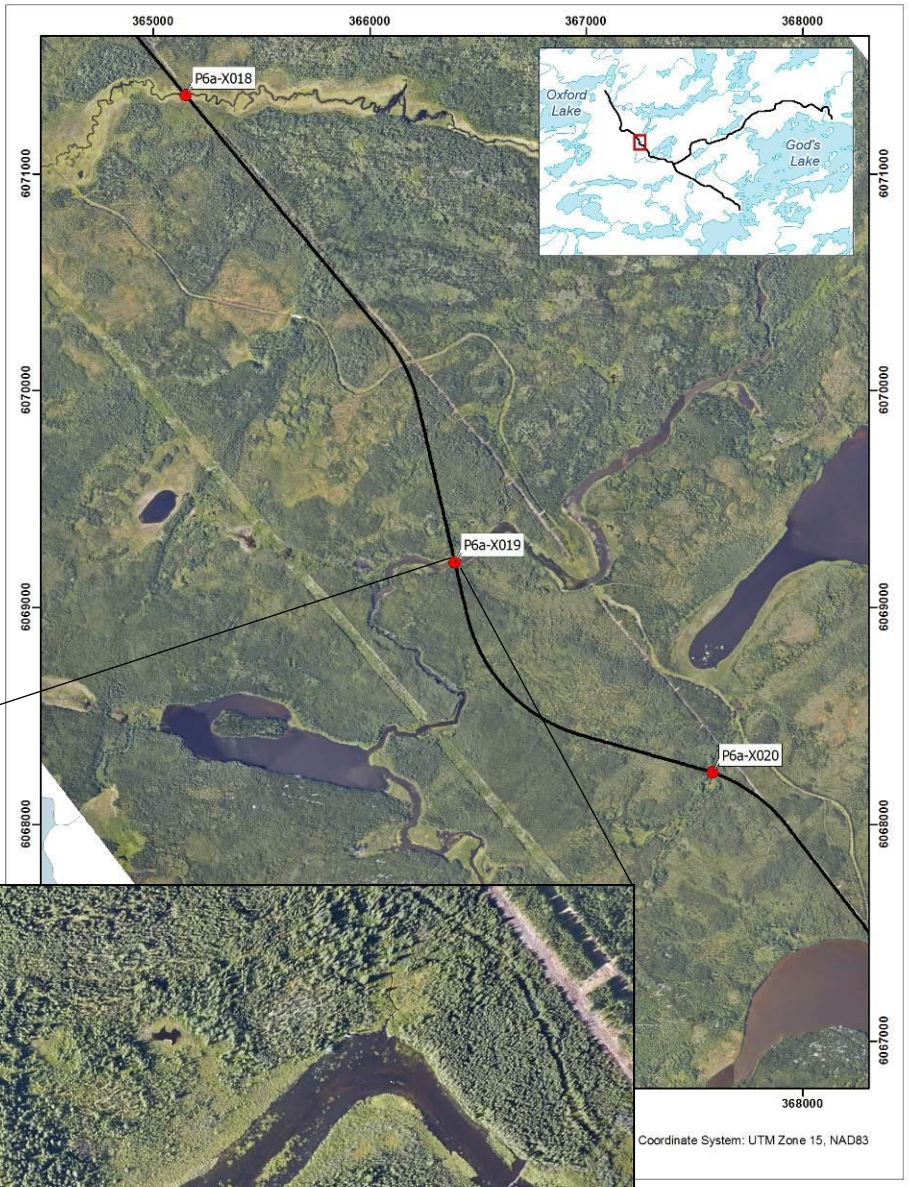
P6a-X019 Magill Creek

Location

Datum:	NAD 83
UTM:	15U 366392 6069210

General Morphology

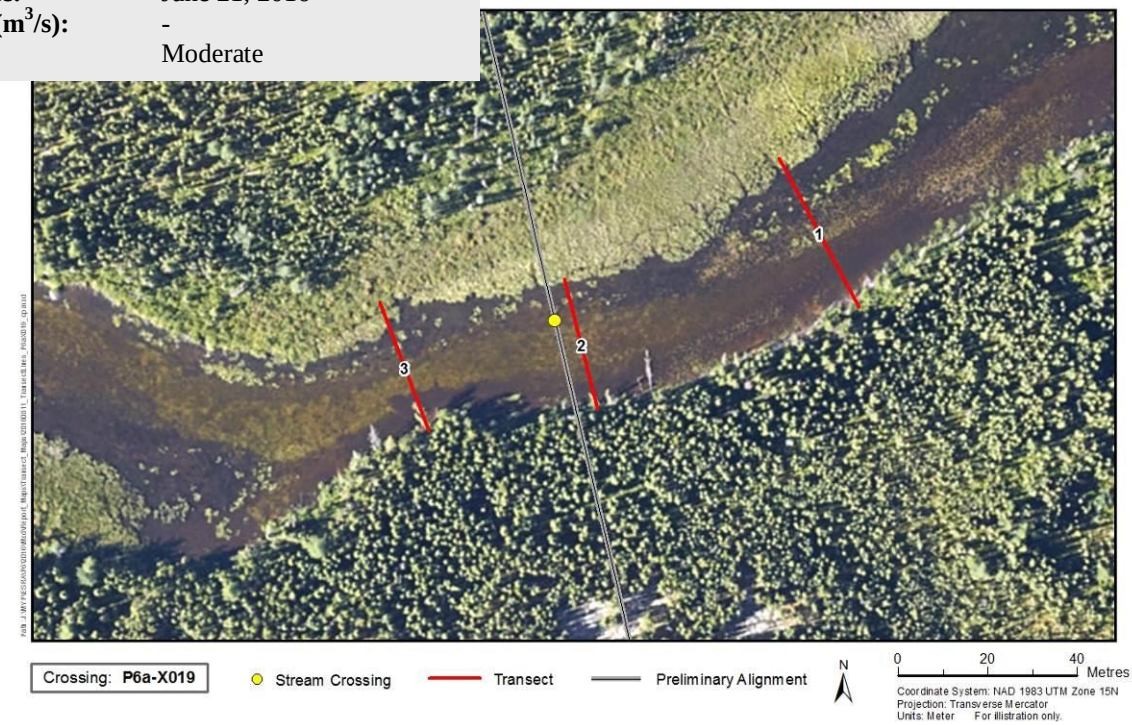
Type:	Stream
Pattern:	Sinuous
Channel Profile:	Planar
Sinuosity:	-
Confinement:	Frequently Confined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 21, 2016
Discharge (m^3/s): -
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	60 DS	0	60 US	-	-
Channel and Flow					
Channel (m)	31.7	29.5	29	-	-
Wetted Width (m)	41.7	29.5	29	-	-
Depth at 25% (m)	0.25	0.55	0.96	-	-
Depth at 50% (m)	0.93	0.8	0.85	-	-
Depth at 75% (m)	0.63	0.7	0.48	-	-
Maximum Depth (m)	1.06	0.8	0.96	-	-
Gradient (%)	1	1	1	-	-
Banks					
Left Bank Height (m)	0.6	0.6	0.9	-	-
Right Bank Height (m)	0	0	0.1	-	-
Left Bank Shape	Vertical	Undercut	Undercut	-	-
Right Bank Shape	Vertical	Vertical	Vertical	-	-
Left Bank Materials	Fines/Organics	Fines/Organics	Bedrock/Fines	-	-
Right Bank Materials	Fines/Organics	Fines/Organics	Fines/Organics	-	-
Left Bank Stability	Moderate	Moderate	Moderate	-	-
Right Bank Stability	Moderate	High	High	-	-
Substrate Type and Distribution (%)					
Fines	90	90	60	-	-
Small Gravel	0	0	2	-	-
Large Gravel	0	0	2	-	-
Cobble	0	0	6	-	-
Boulder	10	10	10	-	-
Bedrock	0	0	20	-	-

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	2	2	2	-	-
Right Bank	31	32	27	-	-
Riparian Distance (m)					
Left Bank	2	2	2	-	-
Right Bank	19	13	15	-	-
Riparian Vegetation Type[a]					
	GRA/ SHR/ -	GRA/ SHR/ CON	GRA/ SHR/ CON	-	-
Canopy Cover (%)					
	50	50	50	-	-

a – GRA = grass; SHR = Shrub; CON = coniferous

+ Habitat Type

Transect	1	2	3	4	5
Flat	0	0	0	-	-
Pool	20	20	20	-	-
Rapid	0	0	0	-	-
Riffle	0	0	0	-	-
Run	70	70	70	-	-
Boulder Garden	10	10	10	-	-

+ Water Quality Data

Habitat:	Run
Temperature (°C):	17.12
pH:	7.35
Turbidity (NTU):	-
Specific Conductance (µS/cm):	131
DO (mg/L):	7.22



Upstream view at crossing site (Transect 2).



Right bank view at crossing site (Transect 2).



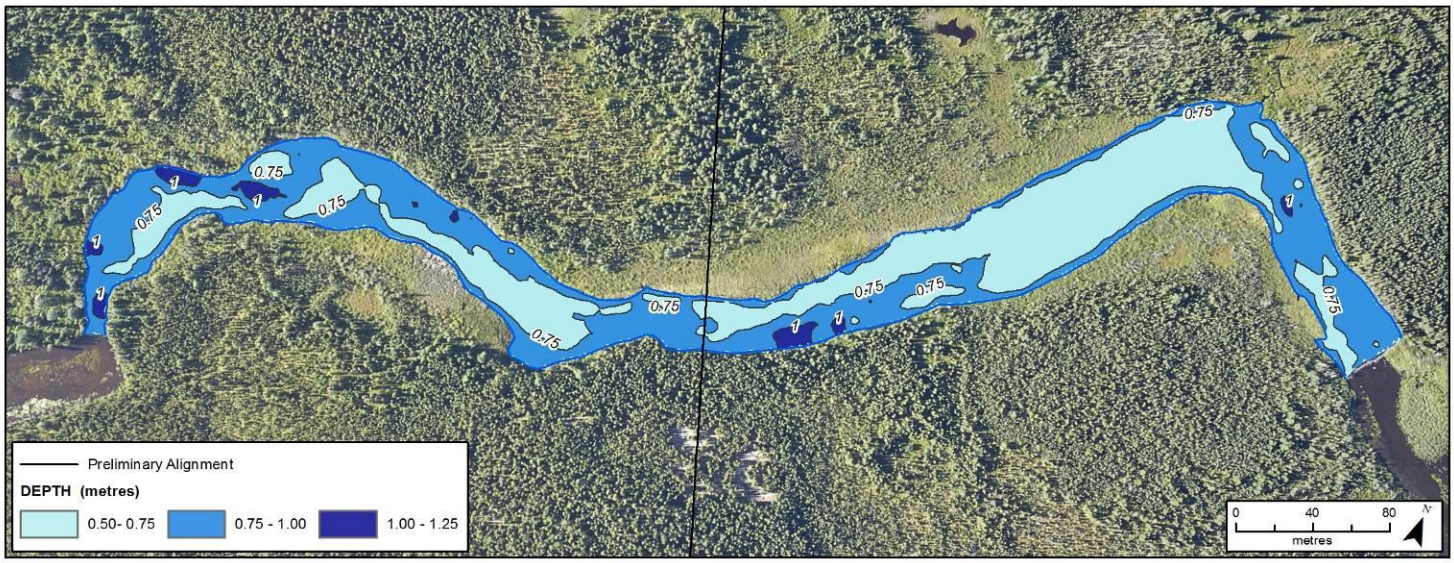
Upstream view from Transect 1 (60 m downstream).



Potential beaver dam located 400 m downstream from crossing.

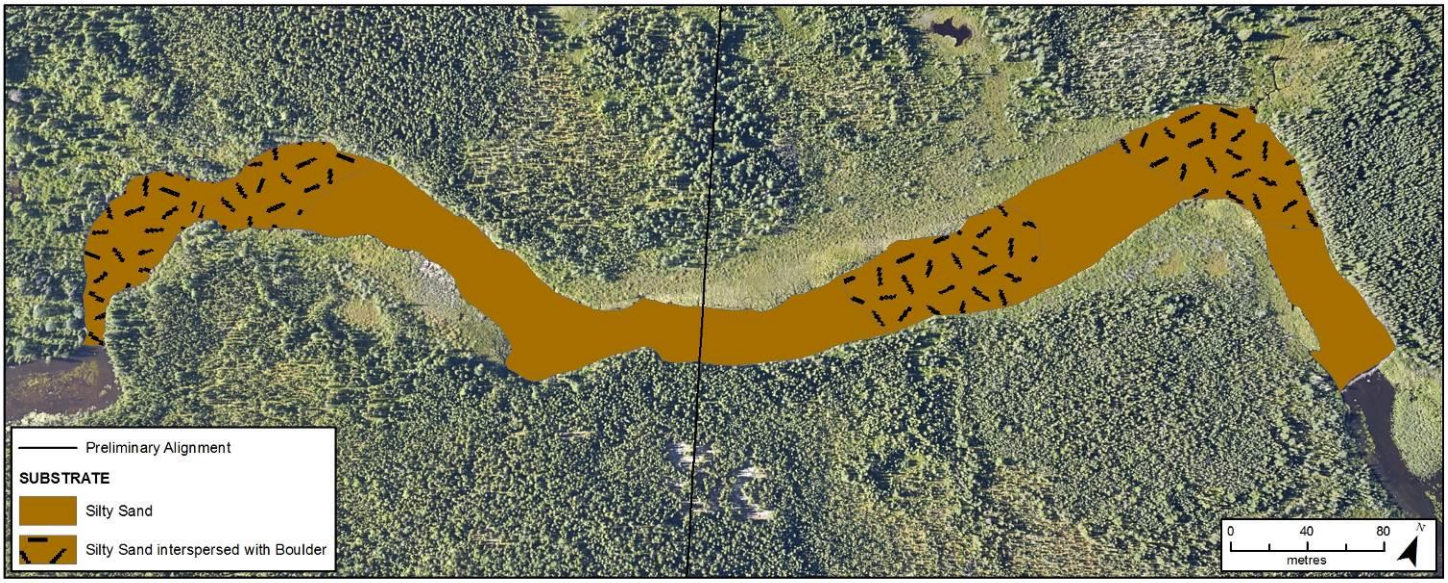
Site Conditions Continued

+ Bathymetric Map



Note: This is a generalized substrate map, intended for fish habitat assessment. It should not be used for navigation or design purposes.

+ Substrate Map



Note: This is a generalized substrate map, intended for fish habitat assessment. It should not be used for navigation or design purposes.

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	55	70
Cover Composition (% of Total)		
Large Woody Debris	20	13
Overhanging Vegetation	35	30
Instream Vegetation	20	13
Pool	0	13
Boulder	25	30
Undercut Bank	0	0
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	High	High
Rearing	High	High
Overwinter	High	High
Migration	High	High
Large Bodied Fish		
Spawning	High	High
Rearing	High	High
Overwinter	Low	Low
Migration	High	High

Comments
Magill Creek is a long stream connecting a string of smaller lakes to the receiving waterbody, Knee Lake. The crossing is located 7.4 km upstream of Knee Lake. Habitat within the reach consists largely of fine sediments with boulders and instream vegetation. There is some gravel/cobble habitat, suitable as spawning and rearing habitat may sucker and Walleye. Habitat is suitable for spawning, rearing, and feeding Northern Pike and forage fish. Overwintering of large bodied species likely occurs in the deeper waters of Knee Lake.

+ Fish Sampling Data

Methods: Gillnetting

Fish Species Captured: Northern Pike, Shorthead Redhorse, Yellow Perch

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Mussel Rake

Mussel Species Captured: Fatmucket, Giant Floater

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 186.54
Distance to Major DS Waterbody (km): 7.40 (Knee Lake)
Connectivity: Yes

Comments
The crossing site consists mainly of flat-water habitat, with a mix of fine and coarse substrates, with instream vegetation and boulders for cover. This type of habitat is not considered rare or unique within the stream or project area.

+ Fishery

Fishery Area: Knee Lake

Fishery Users:

Commercial[a]	No
Recreational	Yes – Fishing Lodge (North Star Resort)
Aboriginal	Yes – Bunibonibee Cree Nation

Comments
Magill Creek is a major tributary connecting a string of upstream lakes to the receiving Knee Lake. The crossing is located within the traditional territory of the Bunibonibee Cree Nation. The creek provides suitable spawning, rearing and feeding habitat for Northern Pike, Yellow Perch, suckers and Walleye.

Information Sources:

a – Manitoba Conservation and Water Stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	TBD[a]
Diameter (mm)	TBD
Length (m)	TBD
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –Crossing design may be either a bridge, arch culvert or multiple culverts - pers. comm. ESRA. For the purpose of the risk assessment, a two-span bridge was assumed as the crossing design.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The crossing contains habitat suitable for spawning, rearing and feeding of Northern Pike, Yellow Perch, suckers and spawning Walleye. The crossing is 5 km from Knee Lake which would support overwintering of large bodied fish.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Two-span bridge construction and operation
Minor Impact List	No
Residual Impact	Channel infilling from a single instream pier Habitat alteration from rip rap placement at base of the pier

Attribute	Rating	Comment
Extent of Impact	Low	Infilling and rip rap placement will be limited to the footprint and immediate base of the pier.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat at the crossing site provides suitable habitat for CRA fishery species (i.e. Walleye, sucker, Northern Pike). This type of habitat is not considered to be critical or limiting as similar habitat is plentiful in the region, as are the affected species. Fish are expected to fulfill their life requisites using the habitats located outside of the footprint of the pier more suited to spawning and rearing. Negative impacts to fish populations from rip rap placement are unlikely as it provides a similar substrate to current conditions. Habitat impacts are expected to result in no measureable effect to local fish populations.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact, abundance of similar habitat within the system, and absence of critical or limiting habitat, bridge construction is expected to have minimal impact on the productivity of local fish populations.

Net Habitat Change

Habitat Change				
Type of Structure: Three-span Bridge				
Effect	**Pathway of Effect**	**Proposed Area Affected**	**Existing Area Affected**	**Loss/Gain**
Instream Alteration	None[1]	161.5 m^2	0 m^2	161.5 m^2
Instream Destruction	Footprint[2]	5.84 m^2	0 m^2	-5.84 m^2

Net Habitat Change was calculated for a two-span bridge crossing that requires one instream pier. Should a different crossing design be selected, recalculation of the net habitat change is required

1 – Bridge design was unavailable at the time of assessment. Area calculated as the area rip rap armouring around the one pier and was estimated based on AECOM design drawings provided in Plans PR 304 to Berens River All Season Road Alignment Tender No. B5 Pigeon River Bridge, issued October 3, 2013.

2 – Bridge design was unavailable at the time of assessment. Habitat loss is estimated using the area of one pier from the Pigeon River bridge design (based on AECOM design drawings provided in Plans PR 304 to Berens River All Season Road Alignment Tender No. B5 Pigeon River Bridge, issued October 03, 2013)

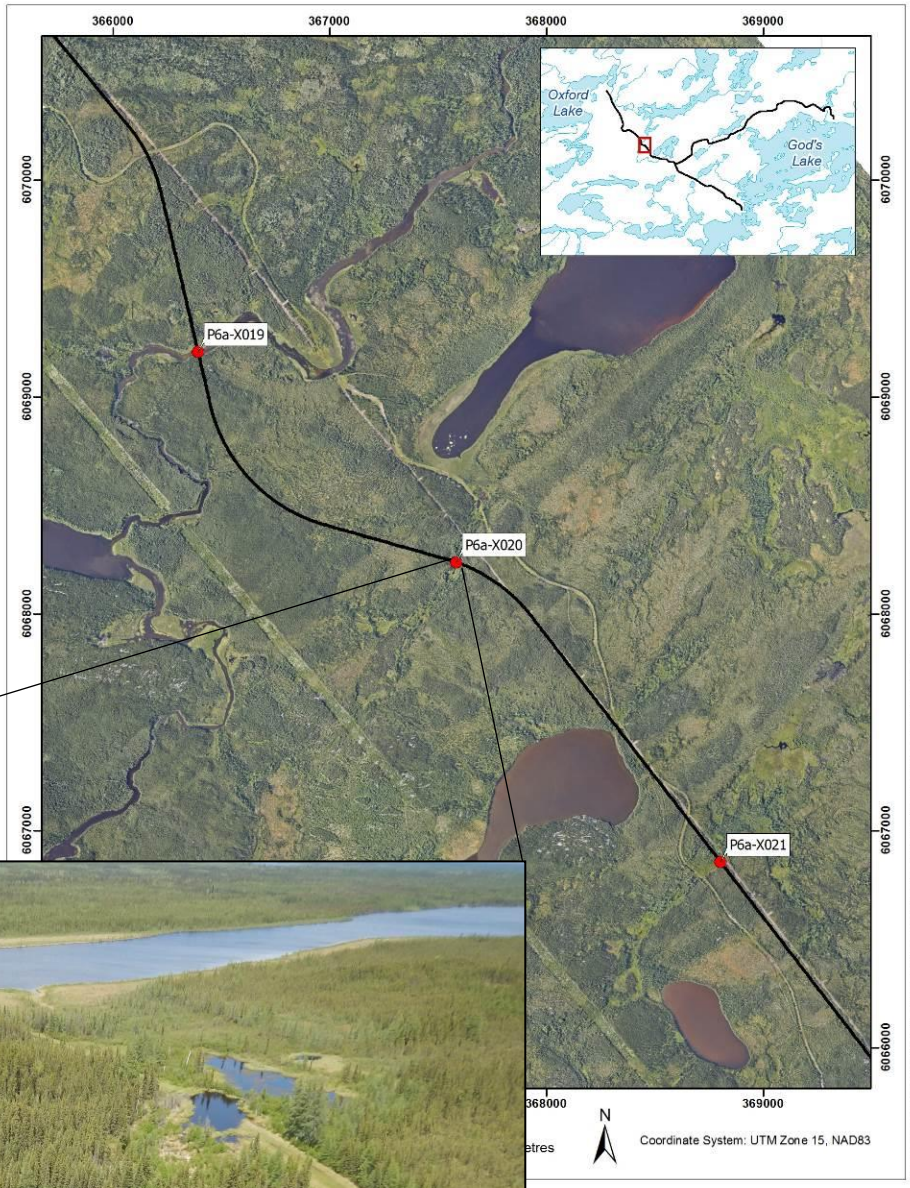
P6a-X020 Unnamed Tributary of Magill Creek

Location

Datum:	NAD 83
UTM:	15U 367584 6068240

General Morphology

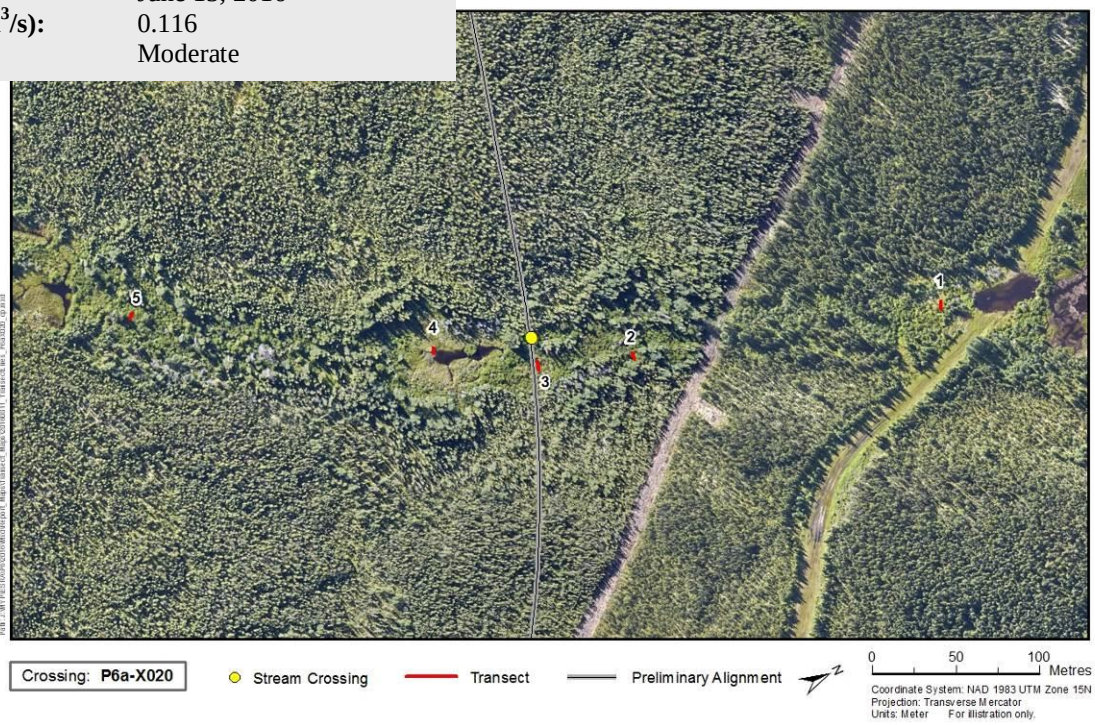
Type:	Stream
Pattern:	Irregular Meandering
Channel Profile:	Notched
Sinuosity:	-
Confinement:	Confined
Flow Regime:	Intermittent





Site Conditions

Survey Date: June 15, 2016
Discharge (m^3/s): 0.116
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	300 DS	60 DS	0	60 US	250 US
Channel and Flow					
Channel (m)	0.80	1.3	0.70	0.9	0.9
Wetted Width (m)	0.80	1.1	0.6	0.9	0.9
Depth at 25% (m)	0.24	0.05	0.1	0.05	0.2
Depth at 50% (m)	0.32	0.21	0.23	0.22	0.30
Depth at 75% (m)	0.34	0.18	0.1	0.05	0.30
Maximum Depth (m)	0.34	0.21	0.23	0.22	0.3
Gradient (%)	-	-	-	-	-
Banks					
Left Bank Height (m)	0.5	0.2	0.4	0	0.2
Right Bank Height (m)	0.1	0.04	0.4	0	0.2
Left Bank Shape	Sloping	Sloping	Vertical	Undercut	Undercut
Right Bank Shape	Vertical	Sloping	Vertical	Undercut	Vertical
Left Bank Materials	Silt	Silt	Silt/Peat	Silt/Grass	Silt
Right Bank Materials	Silt/Peat	Silt/Peat	Silt/Peat	Silt/Grass	Silt
Left Bank Stability	High	High	High	High	High
Right Bank Stability	High	High	High	High	High
Substrate Type and Distribution (%)					
Fines	100	100	100	100	100
Small Gravel	0	0	0	0	0
Large Gravel	0	0	0	0	0
Cobble	0	0	0	0	0
Boulder	0	0	0	0	0
Bedrock	0	0	0	0	0

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	10	2	5	27	20
Right Bank	10	5	5	22	20
Riparian Distance (m)					
Left Bank	-	5	25	32	20
Right Bank	20	10	15	27	20
Riparian Vegetation Type[a]	GRA/ SHR/ MIX	MIX	SHR/ GRA	GRA/ SHR	MIX
Canopy Cover (%)					
	>80	100	40	0	100

a – GRA = grass; SHR = Shrub; MIX = mixed

+ Habitat Type

Transect	1	2	3	4	5
Flat	80	20	0	10	70
Pool	20	0	0	25	30
Rapid	0	0	0	0	0
Riffle	0	80	100	45	0
Run	0	0	0	20	0
Cascade	0	0	0	0	0

+ Water Quality Data

Habitat:	Flat/Riffle
Temperature (°C):	12.36
pH:	6.65
Turbidity (NTU):	-
Specific Conductance (µS/cm):	98
DO (mg/L):	3.06



Downstream view at crossing site (Transect 3).



Upstream view at Transect 1 (>300 m DS of crossing).



Downstream view at Transect 2 (60 m downstream of crossing)



View of pool created by dam located between the crossing site and Transect 4 (60 m upstream of crossing).

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	35	95
Cover Composition (% of Total)		
Large Woody Debris	20	15
Overhanging Vegetation	40	60
Instream Vegetation	5	5
Pool	25	10
Boulder	0	0
Undercut Bank	10	10
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Moderate	Moderate
Rearing	Moderate	Moderate
Overwinter	Low	Moderate
Migration	Low	Moderate
Large Bodied Fish		
Spawning	Low	Low
Rearing	Low	Low
Overwinter	None	Low
Migration	Low	Low

Comments
The crossing is located midway through a forested section of the tributary which passes through a small unnamed lake before draining into Magill Creek, and eventually Knee Lake. Habitat consisted of organic substrates with riparian cover and good flow. Limited connectivity created by beaver activity creates pools suitable for fish but is expected to prevent access by CRA fishery species to the crossing site.

+ Fish Sampling Data

Methods: Electrofishing

Fish Species Captured: Fathead Minnow, Brook Stickleback

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 0.36
Distance to Major DS Waterbody (km): 7.81 (Knee Lake)
Connectivity: Yes - unlikely

Comments
The habitat at the crossing site consists mainly of a shallow forested stream with organic substrate. Cover consists mostly of large woody debris and overhanging vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Knee Lake

Fishery Users:

Commercial[a]	No
Recreational	Yes – Fishing Lodge (North Star Resort)
Aboriginal	Yes – Bunibonibee FN

Comments
This unnamed creek feeds into Knee Lake, within the traditional territories of the Bunibonibee Cree Nation. The creek provides habitat for forage fish species tolerant of low oxygen waters and is unlikely to provide direct habitat for CRA fishery species.

Information Sources:

a – Manitoba Conservation and Water Stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	No	The habitat at the crossing may support small bodied fish, however it is far from the main fish bearing waterbody and is unlikely to contribute to the CRA fishery in Knee Lake.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the immediate crossing area is expected to contribute minimally to the downstream CRA fishery as it is suitable for forage fish only, including spawning, rearing and feeding. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish (e.g., Northern Pike) as it is situated well downstream of the crossing site. Direct access to the crossing by large bodied species is unlikely.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert				
Effect	**Pathway of Effect**	**Proposed Area Affected**	**Existing Area Affected**	**Loss/Gain**
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	21 m^2	0 m^2	- 21 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (0.70 m).

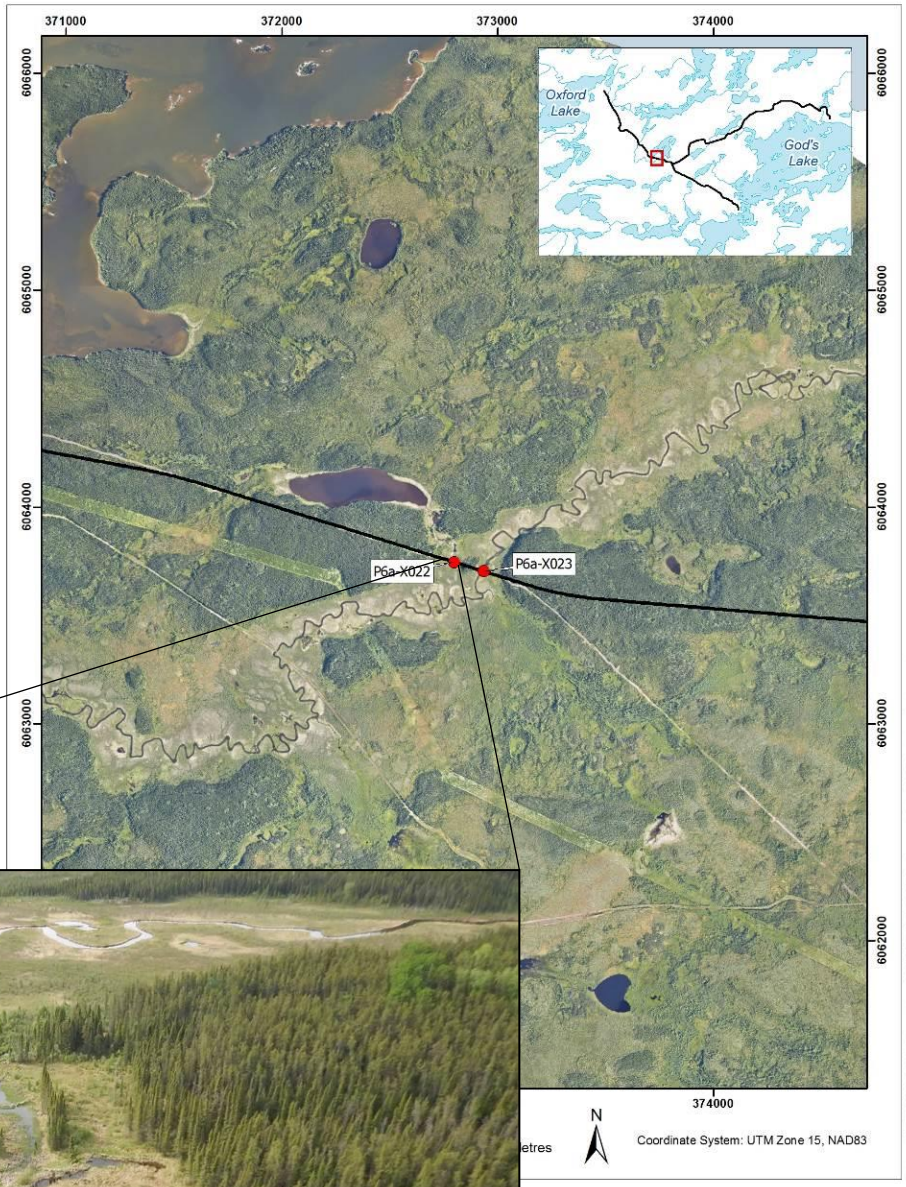
P6a-X022 Unnamed Tributary of Laird Lake

Location

Datum:	NAD 83
UTM:	15U 3727981 6063748

General Morphology

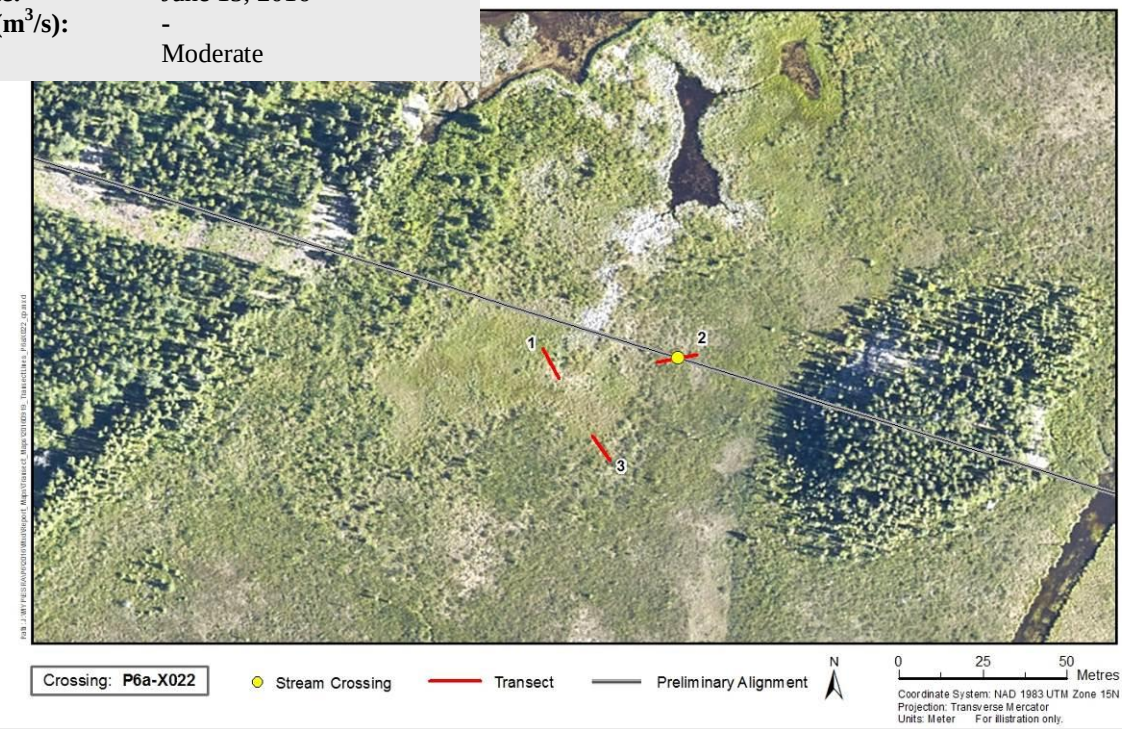
Type:	Wetland
Pattern:	Irregular Wandering
Channel Profile:	Planar
Sinuosity:	-
Confinement:	Unconfined
Flow Regime:	Ephemeral





Site Conditions

Survey Date: June 15, 2016
Discharge (m^3/s): -
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	60	0	60	-	-
Channel and Flow					
Channel (m)	N/A	0.10	N/A	-	-
Wetted Width (m)	N/A	0.10	N/A	-	
Depth at 25% (m)	-	<0.05	-	-	-
Depth at 50% (m)	-	<0.05	-	-	-
Depth at 75% (m)	-	<0.05	-	-	-
Maximum Depth (m)	-	-	-	-	-
Gradient (%)	-	-	-	-	-
Banks					
Left Bank Height (m)	N/A	0	N/A	-	-
Right Bank Height (m)	N/A	0	N/A	-	-
Left Bank Shape	N/A	N/A	N/A	-	-
Right Bank Shape	N/A	N/A	N/A	-	-
Left Bank Materials	N/A	N/A	N/A	-	-
Right Bank Materials	N/A	N/A	N/A	-	-
Left Bank Stability	N/A	High	N/A	-	-
Right Bank Stability	N/A	High	N/A	-	-
Substrate Type and Distribution (%)					
Fines	100	100	100	-	-
Small Gravel	0	0	0	-	-
Large Gravel	0	0	0	-	-
Cobble	0	0	0	-	-
Boulder	0	0	0	-	-
Bedrock	0	0	0	-	-

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	10	10	10	-	-
Right Bank	10	10	10	-	-
Riparian Distance (m)					
Left Bank	20	20	20	-	-
Right Bank	20	20	20	-	-
Riparian Vegetation Type[a]					
	GRA/ SHR	GRA/ SHR	GRA/ SHR	-	-
Canopy Cover (%)					
	-	-	-	-	-

a – GRA = grass; SHR = Shrub; DEC = deciduous; CON = coniferous; MIX = mixed

+ Habitat Type

Transect	1	2	3	4	5
Flat	N/A	100	N/A	-	-
Pool	N/A	0	N/A	-	-
Rapid	N/A	0	N/A	-	-
Riffle	N/A	0	N/A	-	-
Run	N/A	0	N/A	-	-
Cascade	N/A	0	N/A	-	-

+ Water Quality Data

Habitat:	Flat//N/A
Temperature (°C):	17.56
pH:	6.7
Turbidity (NTU):	-
Specific Conductance (µS/cm):	148
DO (mg/L):	1.72



Downstream view at crossing site (Transect 2).



Bog/wetland at Transect 1 (60 m from crossing).



Bog at Transect 3 (60 m from crossing).



At a small pond northwest of crossing site.

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	100	100
Cover Composition (% of Total)		
Large Woody Debris	0	0
Overhanging Vegetation	50	50
Instream Vegetation	50	50
Pool	0	0
Boulder	0	0
Undercut Bank	0	0
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Low	Low
Rearing	Low	Low
Overwinter	Low	Low
Migration	Low	Low
Large Bodied Fish		
Spawning	Low	Low
Rearing	Low	Low
Overwinter	Low	Low
Migration	Low	Low

Comments
The crossing is located in an ephemeral tributary/bog area which drains a small unnamed lake into an unnamed tributary of Lair Lake which lies 14 km downstream. Habitat consists of bog with very little water present and no defined channel visible. Habitat at he crossing site has overall low fish habitat potential.

+ Fish Sampling Data

Methods: Not sampled

Fish Species Captured: N/A

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 1.06
Distance to Major DS Waterbody (km): 14.00 (Laird Lake)
Connectivity: Yes- unlikely

Comments
The crossing site consists mainly of low water bog habitat, dominated by soft organic substrates, and instream and wetland vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Laird Lake

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – Bunibonibee Cree Nation

Comments
This unnamed boggy area connects an unnamed lake, upstream to Laird Lake and is located within the traditional territories of the Bunibonibee Cree Nation. The nearby ponds provide marginal fish habitat potential for forage fish species but are limited by access.

Information Sources:

a – Manitoba Conservation and Water Stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	No	The absence of a defined channel, marginal quality of habitat at the site and the distance from overwintering areas greatly limit the potential for the site to support CRA species.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the immediate crossing area is expected to contribute minimally to the downstream CRA fishery as it is marginally suitable for forage fish only. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish (e.g., Northern Pike) as it is situated well downstream of the crossing site. Direct access to the crossing by large bodied species is unlikely.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert				
Effect	**Pathway of Effect**	**Proposed Area Affected**	**Existing Area Affected**	**Loss/Gain**
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	3 m^2	0 m^2	- 3 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (0.10 m).

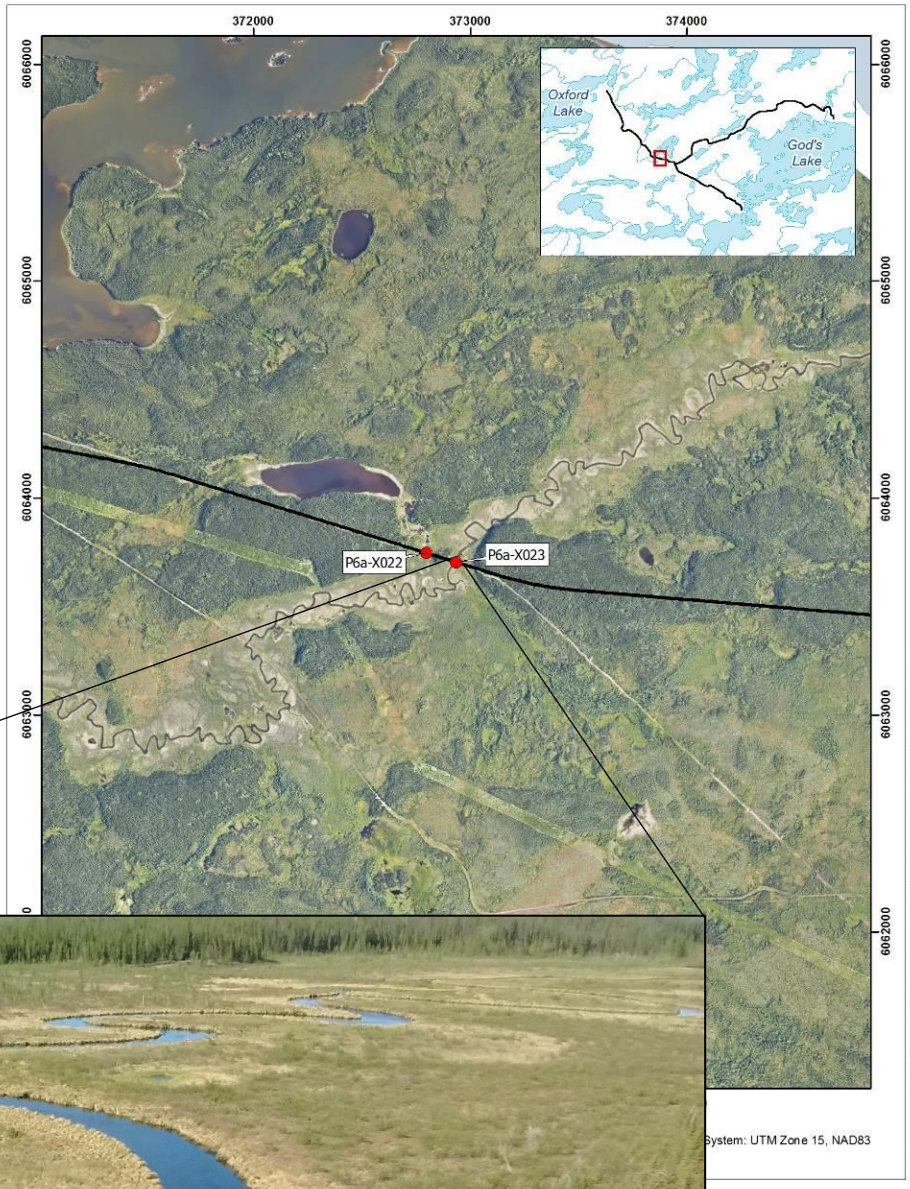
P6a-X023 Unnamed Tributary of Laird Lake

Location

Datum:	NAD 83
UTM:	15U 372935 6063705

General Morphology

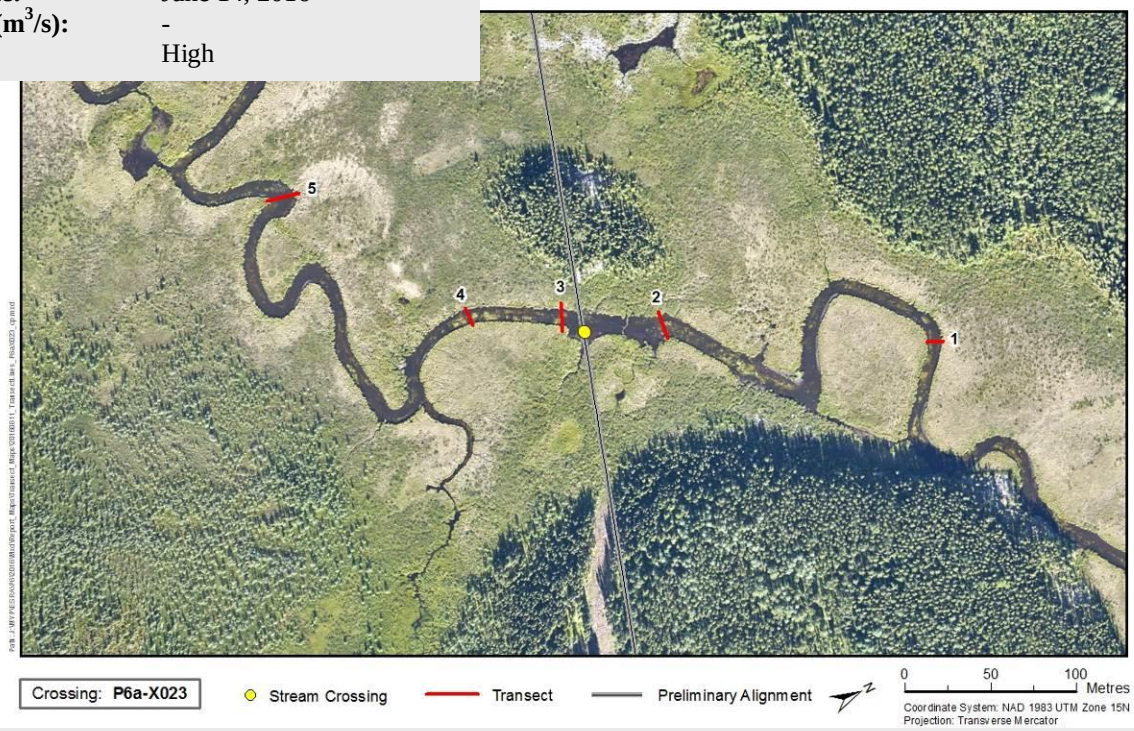
Type:	Stream
Pattern:	Irregular Meandering
Channel Profile:	U-Shape
Sinuosity:	-
Confinement:	Confined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 14, 2016
Discharge (m^3/s): -
Stage: High



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	400 US	60 US	0	60 DS	400 DS
Channel and Flow					
Channel (m)	9	18	10	10	16
Wetted Width (m)	9	18	10	10	16
Depth at 25% (m)	0.60	0.15	0.5	0.5	0.2
Depth at 50% (m)	-	-	-	-	-
Depth at 75% (m)	-	-	-	-	-
Maximum Depth (m)	-	-	-	-	-
Gradient (%)	-	-	-	-	-
Banks					
Left Bank Height (m)	0.1	0.3	0.3	0.2	0.1
Right Bank Height (m)	0.1	0.3	0.3	0.2	0.1
Left Bank Shape	Vertical	Vertical	Vertical	Vertical	Vertical
Right Bank Shape	Vertical	Vertical	Vertical	Vertical	Vertical
Left Bank Materials	Organics	Organics/Silt	Organics/Silt	Organics/Silt	Organics/Silt
Right Bank Materials	Organics	Organics/Silt	Organics/Silt	Organics/Silt	Organics/Silt
Left Bank Stability	Moderate	Moderate	Moderate	Moderate	Moderate
Right Bank Stability	Moderate	Moderate	Moderate	Moderate	Moderate
Substrate Type and Distribution (%)					
Fines	100	70	100	100	100
Small Gravel	0	0	0	0	0
Large Gravel	0	0	0	0	0
Cobble	0	0	0	0	0
Boulder	0	30	0	0	0
Bedrock	0	0	0	0	0

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	10	10	10	10	20
Right Bank	10	10	15	10	20
Riparian Distance (m)					
Left Bank	15	30	15	65	115
Right Bank	100	40	75	120	200
Riparian Vegetation Type[a]	GRA/ SHR	GRA/ SHR	GRA/ SHR	GRA/ SHR	GRA/ SHR
Canopy Cover (%)	0	1	10	1	0

a – GRA = grass; SHR = Shrub

+ Habitat Type

Transect	1	2	3	4	5
Flat	100	100	100	100	100
Pool	0	0	0	0	0
Rapid	0	0	0	0	0
Riffle	0	0	0	0	0
Run	0	0	0	0	0
Cascade	0	0	0	0	0

+ Water Quality Data

Habitat:	Flat
Temperature (°C):	16.5
pH:	6.57
Turbidity (NTU):	-
Specific Conductance (µS/cm):	101
DO (mg/L):	2.7



Upstream view at crossing site (Transect 3).



Downstream view at Transect 1 (400 m upstream of crossing).



Looking upstream at small tributary between upstream transects 1 and 2.



Upstream view at Transect 5 (400 m downstream of crossing).

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	35	31
Cover Composition (% of Total)		
Large Woody Debris	4	3
Overhanging Vegetation	0	0
Instream Vegetation	30	33
Pool	30	33
Boulder	6	0
Undercut Bank	30	33
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	High	High
Rearing	High	High
Overwinter	Moderate	Moderate
Migration	High	High
Large Bodied Fish		
Spawning	High	High
Rearing	High	High
Overwinter	Low	Low
Migration	High	High

Comments
The crossing is located on a perennial stream connecting Magill and Laird lakes, approximately 4 km downstream from its headwaters at Magill Lake. The reach has similar habitat both upstream and downstream of the crossing, consisting of slow flowing flat water, organic substrate and instream vegetation suitable for spawning, rearing and feeding by Northern Pike and forage fish. While pike likely overwinter in the lakes, forage fish may overwinter within the stream itself. White sucker may also use the creek to feed on benthic invertebrates.

+ Fish Sampling Data

Methods: Electrofishing, Visual Survey

Fish Species Captured: Brook Stickleback, Northern Pike

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 42.00
Distance to Major DS Waterbody (km): 13.95 (Laird Lake)
Connectivity: Yes

Comments
The crossing site consists mainly of slow flowing, flat-water habitat, dominated by soft organic substrates and instream vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Laird Lake, MaGill Lake

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – Bunibonibee Cree Nation

Comments
This unnamed stream connects Magill Lake, upstream, to Laird Lake and is located within the traditional territories of the Bunibonibee Cree Nation. The creek provides suitable spawning, rearing and feeding habitat for Northern Pike.

Information Sources:

a – Manitoba Conservation and Water Stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The crossing contains habitat suitable for spawning, rearing and feeding of Northern Pike.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the immediate crossing area is expected to contribute to the downstream and upstream CRA fishery as it supports a range of life requisites for both forage fish and Northern Pike, including spawning, rearing and feeding. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish (e.g., Northern Pike) is plentiful outside of the project footprint within the stream and in the region.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert

Effect	Pathway of Effect	Proposed Area Affected	Existing Area Affected	Loss/Gain
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	300 m^2	0 m^2	- 300 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (10 m).

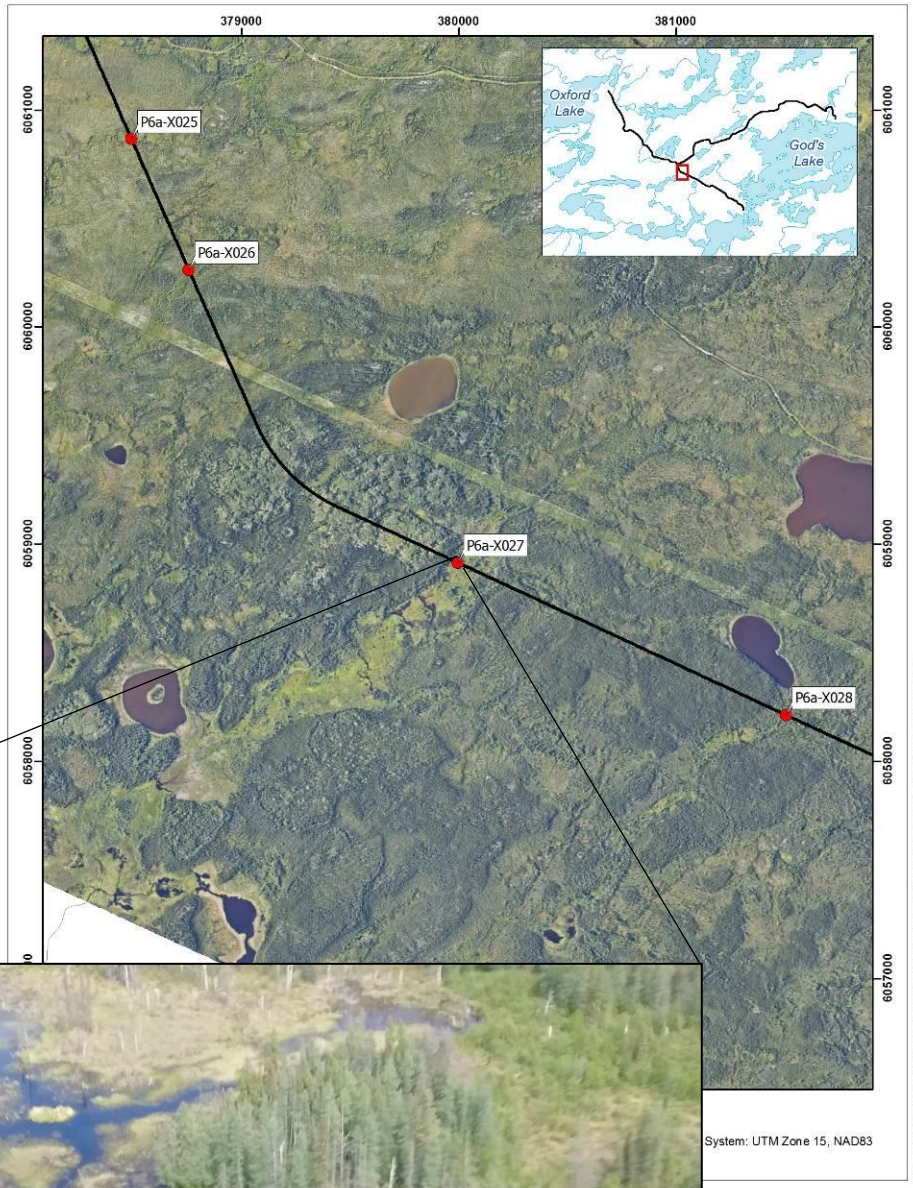
P6a-X027 Unnamed Tributary of Wanless Lake

Location

Datum:	NAD 83
UTM:	15U 379995 6058916

General Morphology

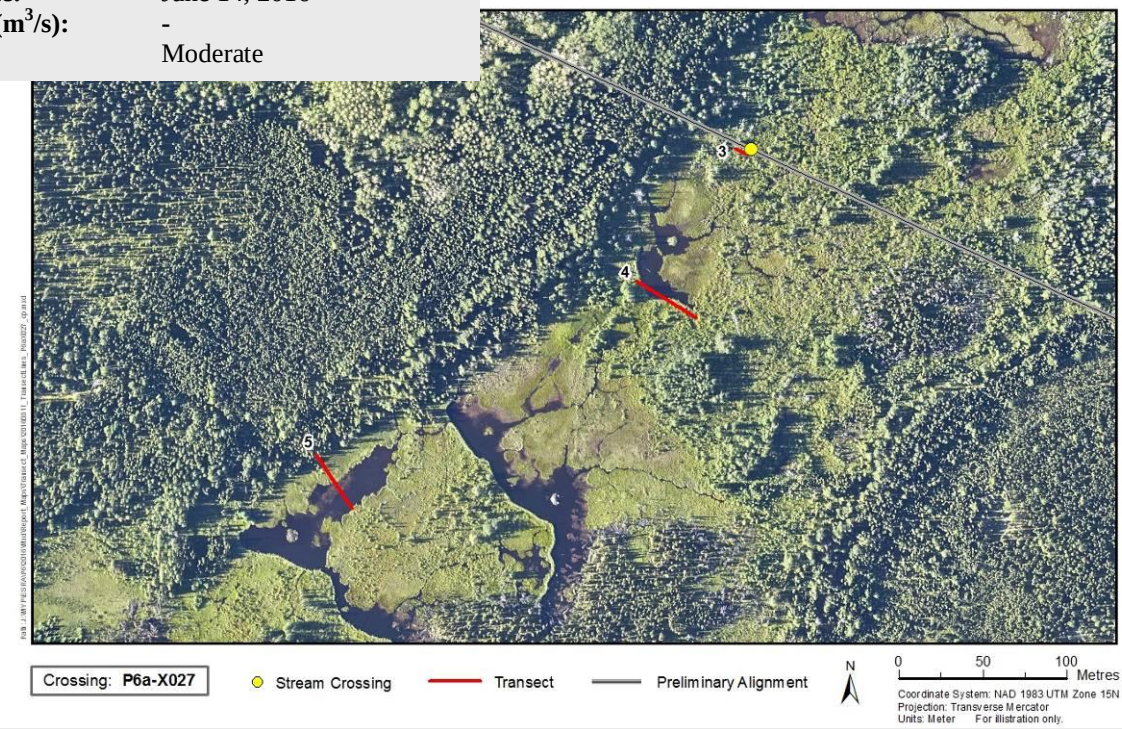
Type:	Stream
Pattern:	Straight
Channel Profile:	Planar
Sinuosity:	-
Confinement:	Unconfined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 14, 2016
Discharge (m^3/s): -
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	-	-	0	100 US	400 US
Channel and Flow					
Channel (m)	-	-	2	45	25
Wetted Width (m)	-	-	2	45	25
Depth at 25% (m)	-	-	0.1	0.3	>1
Depth at 50% (m)	-	-	0.12	>1.0	>1
Depth at 75% (m)	-	-	0.08	>1	>1
Maximum Depth (m)	-	-	0.15	>1	>1
Gradient (%)	-	-	**0**	-	-
Banks					
Left Bank Height (m)	-	-	0.1	0	0
Right Bank Height (m)	-	-	0.1	0	0
Left Bank Shape	-	-	Vertical	Vertical	Vertical
Right Bank Shape	-	-	Vertical	Vertical	Vertical
Left Bank Materials	-	-	Fines/Organics	Fines/Organics	Sedge/Peat
Right Bank Materials	-	-	Fines/Organics	Fines/Organics	Sedge/Peat
Left Bank Stability	-	-	High	High	High
Right Bank Stability	-	-	High	High	High
Substrate Type and Distribution (%)					
Fines	0	0	100	100	100
Small Gravel	0	0	0	0	0
Large Gravel	0	0	0	0	0
Cobble	0	0	0	0	0
Boulder	0	0	0	0	0
Bedrock	0	0	0	0	0

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	-	-	10	20	20
Right Bank	-	-	20	20	20
Riparian Distance (m)					
Left Bank	-	-	100	20	100
Right Bank	-	-	20	20	20
Riparian Vegetation Type[a]					
	-	-	SHR/ CON/ GRA	SHR/ CON/ GRA	SHR/ CON/ GRA
Canopy Cover (%)					
	-	-	5	5	5

a – GRA = grass; SHR = Shrub; CON = coniferous

+ Habitat Type

Transect	1	2	3	4	5
Flat	-	-	100	50	50
Pool	-	-	0	50	50
Rapid	-	-	0	0	0
Riffle	-	-	0	0	0
Run	-	-	0	0	0
Cascade	-	-	0	0	0

+ Water Quality Data

Habitat:	Flat
Temperature (°C):	18.54
pH:	6.67
Turbidity (NTU):	-
Specific Conductance (µS/cm):	118
DO (mg/L):	2.19



Upstream view at crossing site (Transect 3).



Downstream view at Transect 5 (400 m upstream from crossing).



Looking south from downstream beaver dam between Transects 4 and 5.



Looking east from downstream beaver dam between Transects 4 and 5.

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	50	100
Cover Composition (% of Total)		
Large Woody Debris	5	20
Overhanging Vegetation	5	70
Instream Vegetation	50	10
Pool	40	0
Boulder	0	0
Undercut Bank	0	0
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Moderate	Moderate
Rearing	Moderate	Moderate
Overwinter	Moderate	Moderate
Migration	High	High
Large Bodied Fish		
Spawning	Low	Low
Rearing	Low	Low
Overwinter	Low	Low
Migration	Low	Low

Comments
The crossing is located on a tributary which feeds Wanless Lake, 3.34 km downstream. The tributary is heavily impacted by beavers and access to the crossing site by fish species which would overwinter in the lake (e.g., Northern Pike) is not expected in most years. The habitat at the crossing is suitable for small bodied fish. The crossing is situated at a narrow channel connecting pools within 100 m up- and downstream of the crossing. The habitat consists of slow flowing water over soft substrates and plentiful instream vegetation providing cover for spawning, rearing, feeding and overwintering of fish species tolerant of low oxygen conditions.

+ Fish Sampling Data

Methods: Electrofishing, Visual Survey

Fish Species Captured: Brook Stickleback

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 2.26
Distance to Major DS Waterbody (km): 3.34 (Wanless Lake)
Connectivity: Yes-unlikely

Comments
The crossing site consists mainly of pools within a wetland environment; substrates are soft and dominated by organics. Cover consists of instream vegetation, large woody debris and overhanging vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Wanless Lake

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – God's Lake First Nation

Comments
This unnamed tributary feeds into Wanless Lake, within the traditional territories of Gods Lake First Nation. The crossing is not expected to support a CRA Fishery as the connection to the downstream fish bearing waterbody is obstructed by multiple beaver dams.

Information Sources:

a – Manitoba Conservation and Waterstewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a – pers. comm. ESRA

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	No	The crossing is isolated from the fish bearing water body by multiple beaver dams.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the immediate crossing area is not expected to contribute to the downstream CRA fishery as it supports a range of life requisites for local populations of forage fish. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as the crossing site is unlikely to be accessed by relevant species (e.g., Northern Pike).

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact, abundance of similar habitat within the system, and lack of direct access, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert				
Effect	**Pathway of Effect**	**Proposed Area Affected**	**Existing Area Affected**	**Loss/Gain**
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	60 m^2	0 m^2	- 60 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (2 m).

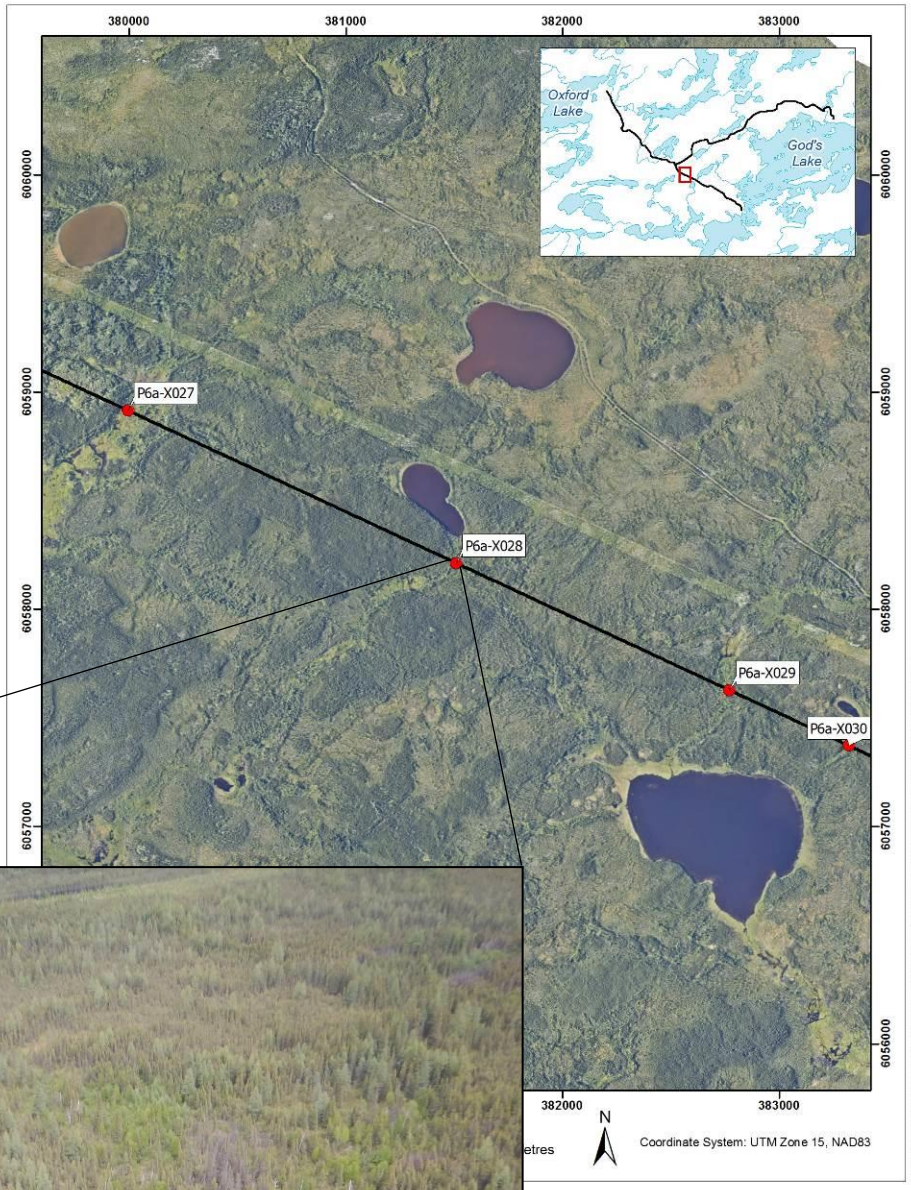
P6a-X028 Unnamed Tributary of Wanless Lake

Location

Datum:	NAD 83
UTM:	15U 381509 6058214

General Morphology

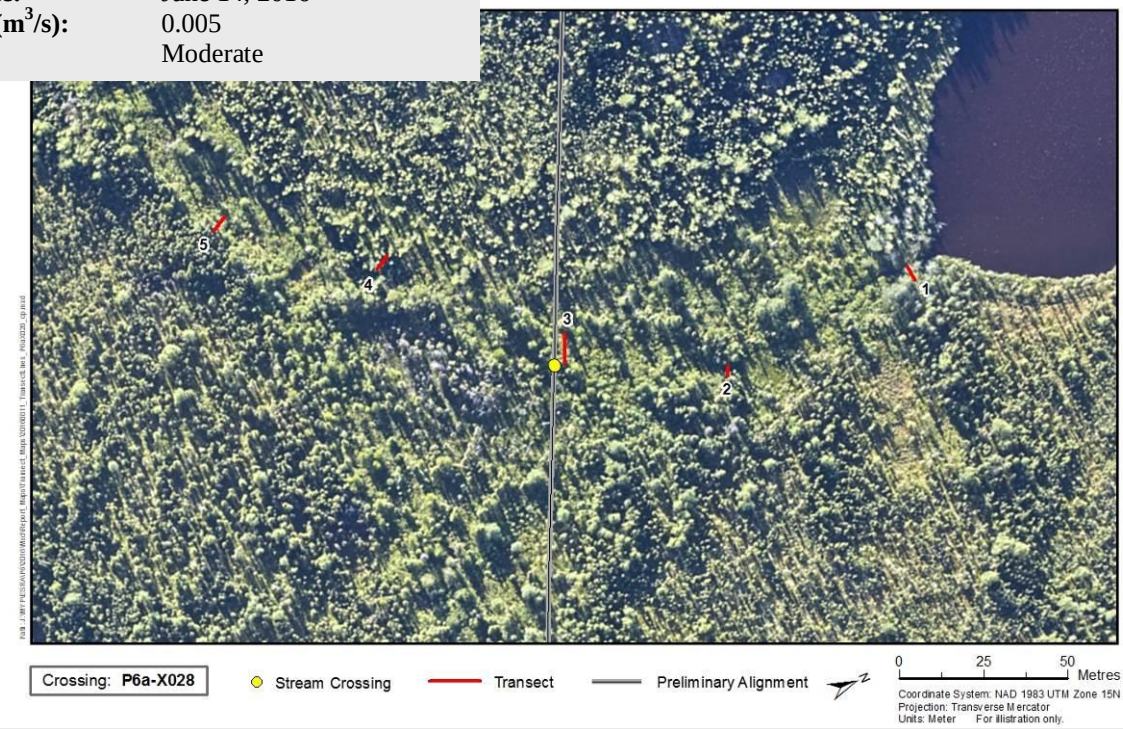
Type:	Fen
Pattern:	Braided
Channel Profile:	Planar
Sinuosity:	-
Confinement:	Unconfined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 14, 2016
Discharge (m^3/s): 0.005
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	110 US	60 US	0	60 DS	110 DS
Channel and Flow					
Channel (m)	3.3	1.6	7.8	4.4	3.3
Wetted Width (m)	3.2	0.9	0.5	2.4	2.1
Depth at 25% (m)	0.30	0.17	0.29	0.30	0.48
Depth at 50% (m)	0.47	0.20	0.32	0.33	0.53
Depth at 75% (m)	0.39	0.16	0.35	0.20	0.39
Maximum Depth (m)	0.47	0.20	0.35	0.35	0.54
Gradient (%)	0.5	0.5	0.5	0.5	0.5
Banks					
Left Bank Height (m)	0.12	0.20	0.10	0.30	0.15
Right Bank Height (m)	0.20	0.12	0.25	0.35	0.05
Left Bank Shape	Sloping	Sloping	Sloping	Vertical	Sloping
Right Bank Shape	Sloping	Sloping	Sloping	Vertical	Sloping
Left Bank Materials	Organics	Organics	Organics	Organics	Organics
Right Bank Materials	Organics	Organics	Organics	Organics	Organics
Left Bank Stability	Low	Low	Low	Low	Low
Right Bank Stability	Low	Low	Low	Low	Low
Substrate Type and Distribution (%)					
Fines	100	100	100	100	100
Small Gravel	0	0	0	0	0
Large Gravel	0	0	0	0	0
Cobble	0	0	0	0	0
Boulder	0	0	0	0	0
Bedrock	0	0	0	0	0

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	1.8	2.3	0.9	0.8	3.5
Right Bank	1.4	0.8	1.2	3.0	3.8
Riparian Distance (m)					
Left Bank	2.2	2.5	1.5	1.4	3.5
Right Bank	2.6	2.0	1.0	3.7	3.8
Riparian Vegetation Type[a]	SHR/ GRA/ CON	DEC/ GRA	DEC/ GRA	DEC/ SHR/ GRA	DEC/ SHR/ GRA
Canopy Cover (%)	10	90	95	85	90

a – GRA = grass; SHR = Shrub; DEC = deciduous; CON = coniferous; MIX = mixed

+ Habitat Type

Transect	1	2	3	4	5
Flat	100	30	30	90	100
Pool	0	70	70	10	0
Rapid	0	0	0	0	0
Riffle	0	0	0	0	0
Run	0	0	0	0	0
Cascade	0	0	0	0	0

+ Water Quality Data

Habitat:	Flat
Temperature (°C):	19.6
pH:	7.09
Turbidity (NTU):	-
Specific Conductance (µS/cm):	95.8
DO (mg/L):	9.71



Upstream view at Transect 1 (110 m upstream from crossing) at the small lake at upstream end of tributary.



Bottleneck area of main channel at Transect 2 (60 m upstream from crossing).



Open canopy section at Transect 2 (60 m upstream from crossing).



Narrow channel flowing through a thick canopy at Transect 4 (60 m downstream from crossing).

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	90	90
Cover Composition (% of Total)		
Large Woody Debris	0	0
Overhanging Vegetation	70	90
Instream Vegetation	30	10
Pool	0	0
Boulder	0	0
Undercut Bank	0	0
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	High	High
Rearing	High	High
Overwinter	High	High
Migration	Moderate	Moderate
Large Bodied Fish		
Spawning	Low	Low
Rearing	Low	Low
Overwinter	Low	Low
Migration	Low	Low

Comments
The crossing is located on a tributary feeding a small unnamed lake into and eventually into Wanless Lake, 5.51 km downstream of the site. The channel is often constricted and narrow, with thick canopy cover. Multiple beaver dams further downstream of the area may limit access to the crossing. The tributary consists mainly of slow flowing water over soft substrates and instream vegetation, suitable for providing cover for forage fish tolerant of low oxygen conditions. Multiple beaver dams further downstream of the area may, however, limit access to the crossing; forage fish may be present in the small upstream lake, but were not found in the tributary.

+ Fish Sampling Data

Methods: Electrofishing

Fish Species Captured: none

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 0.41
Distance to Major DS Waterbody (km): 5.51 (Wanless Lake)
Connectivity: Yes - unlikely

Comments
The crossing site consists of a narrow forested channel consisting of soft substrates and both instream and overhanging vegetation for cover. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Wanless Lake

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – God's Lake First Nation

Comments
This unnamed tributary feeds into Wanless Lake, within the traditional territories of Gods Lake First Nation. The stream is not expected to support the CRA fishery in Wanless Lake as access to the site by relevant fish species is hindered by multiple beaver dams.

Information Sources:

a – Manitoba Conservation and Water Stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	No	The crossing site is inaccessible to relevant CRA fishery species.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the immediate crossing area is not expected to contribute to the downstream and upstream CRA fishery. Multiple beaver dams downstream of the crossing site prevent access to the reach.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact, abundance of similar habitat within the system, and lack of direct habitat for relevant fish species, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert

Effect	Pathway of Effect	Proposed Area Affected	Existing Area Affected	Loss/Gain
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	234 m^2	0 m^2	- 234 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (7.8 m).

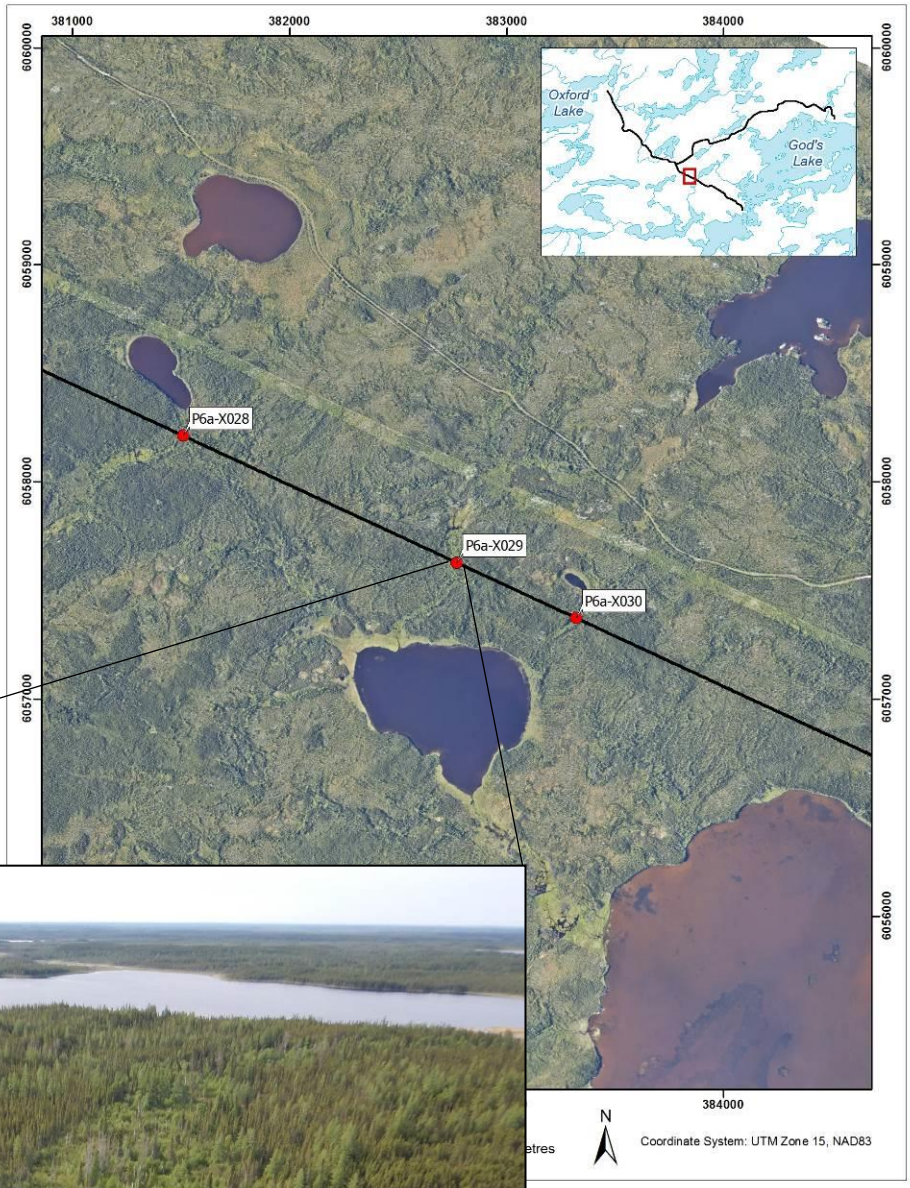
P6a-X029 Unnamed Tributary of Hignell Lake

Location

Datum:	NAD 83
UTM:	15U 382770 6057629

General Morphology

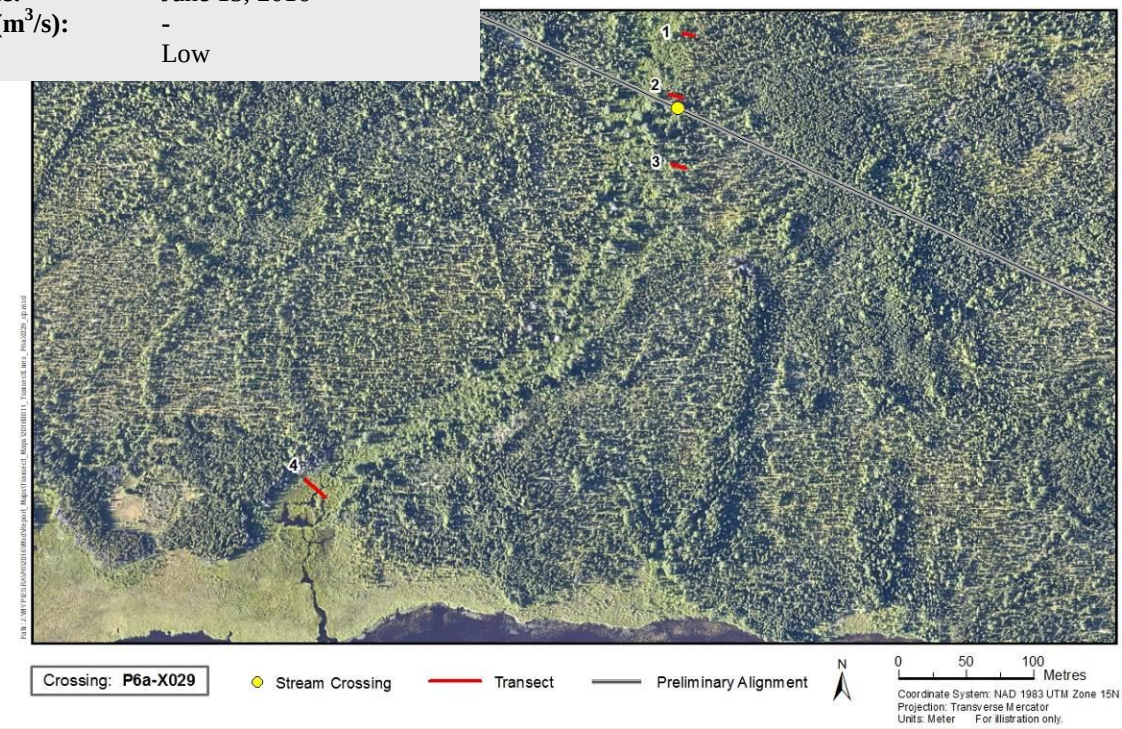
Type:	Stream
Pattern:	Braided
Channel Profile:	Planar
Sinuosity:	-
Confinement:	Unconfined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 15, 2016
Discharge (m^3/s): -
Stage: Low



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	60 US	0	60 DS	390 DS	-
Channel and Flow					
Channel (m)	4.1	4.0	-	-	-
Wetted Width (m)	3.4	4.0	-	-	-
Depth at 25% (m)	0.17	0.05	-	-	-
Depth at 50% (m)	0.14	0.14	-	-	-
Depth at 75% (m)	0.20	0.19	-	-	-
Maximum Depth (m)	0.26	0.20	-	-	-
Gradient (%)	0.5	0.5	-	-	-
Banks					
Left Bank Height (m)	0.3	0.2	-	-	-
Right Bank Height (m)	0.3	0.3	-	-	-
Left Bank Shape	Vertical	Sloping	-	-	-
Right Bank Shape	Sloping	Sloping	-	-	-
Left Bank Materials	Organics	Organics	Organics	Organics	-
Right Bank Materials	Organics	Organics	Organics	Organics	-
Left Bank Stability	Low	Low	Low	Low	-
Right Bank Stability	Low	Low	Low	Low	-
Substrate Type and Distribution (%)					
Fines	100	100	100	100	-
Small Gravel	0	0	0	0	-
Large Gravel	0	0	0	0	-
Cobble	0	0	0	0	-
Boulder	0	0	0	0	-
Bedrock	0	0	0	0	-

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	1.2	0.5	-	19	-
Right Bank	2.4	0.5	-	30	-
Riparian Distance (m)					
Left Bank	4.0	1.0	-	22	-
Right Bank	5.0	1.0	-	36	-
Riparian Vegetation Type[a]	DEC/ CON	DEC/ CON	DEC/ CON	CON/ DEC	-
Canopy Cover (%)	60	100	-	0	-

a –DEC = deciduous; CON = coniferous

+ Habitat Type

Transect	1	2	3	4	5
Flat	60	0	0	0	-
Pool	40	100	100	100	-
Rapid	0	0	0	0	-
Riffle	0	0	0	0	-
Run	0	0	0	0	-
Cascade	0	0	0	0	-

+ Water Quality Data

Habitat:	Flat/Pool
Temperature (°C):	15.7
pH:	7.27
Turbidity (NTU):	-
Specific Conductance (µS/cm):	102.3
DO (mg/L):	6.25



Upstream view at Transect 1 (60 m upstream from crossing site).



Looking at farthest braided channel and riparian vegetation of crossing site (Transect 2).



Braided tributary at Transect 3 (60 m downstream from crossing).



Mouth of tributary as it enters a small lake downstream of Transect 4 near a beaver dam (390 m DS from crossing).

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	90	90
Cover Composition (% of Total)		
Large Woody Debris	0	0
Overhanging Vegetation	60	25
Instream Vegetation	20	10
Pool	20	65
Boulder	0	0
Undercut Bank	0	0
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Low	Low
Rearing	Low	Low
Overwinter	Low	Low
Migration	Low	Low
Large Bodied Fish		
Spawning	Low	Low
Rearing	Low	Low
Overwinter	Low	Low
Migration	Low	Low

Comments
The crossing is located on a tributary connecting two unnamed lakes, ultimately feeding into Hignell Lake, over 2 km downstream of the crossing. There are beaver dames both upstream and downstream of the study reach. The reach is braided and very shallow, with similar habitat both upstream and downstream of the crossing, consisting of negligible flow, organic substrate, and both instream and overhanging vegetation. The braided channel provides limited connectivity throughout the tributary. Additionally, an abundance of beaver activity may limit access to the crossing and neighboring lakes.

+ Fish Sampling Data

Methods: Electrofishing

Fish Species Captured: Brook Stickleback

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 4.40
Distance to Major DS Waterbody (km): 2.33 (Hignell Lake)
Connectivity: Yes- unlikely

Comments
The crossing site consists mainly of a braided, flat-water/pool habitat (with negligible flow), dominated by organic substrates, and both instream and overhanging vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Hignell Lake

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – God's Lake First Nation

Comments
This unnamed tributary feeds into Hignell Lake, within the traditional territories of Gods Lake First Nation. The creek is not expected to contribute to the CRA fishery as habitat within the crossing is unsuitable for relevant fish species, and access to the site is hindered by beaver activity and limited connectivity.

Information Sources:

a – Manitoba Conservation and Waterstewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a – pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	No	The habitat within at the crossing site is suitable for local populations of small bodied fish and is not accessible to relevant fish species.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the immediate crossing area is not expected to contribute to the downstream CRA fishery as it supports a range of life requisites for local populations of forage fish including spawning rearing and feeding, but is inaccessible or unsuitable to relevant species. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish (e.g., Northern Pike) is plentiful outside of the project footprint within the stream and in the region.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert

Effect	Pathway of Effect	Proposed Area Affected	Existing Area Affected	Loss/Gain
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	120 m^2	0 m^2	- 120 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (4 m).

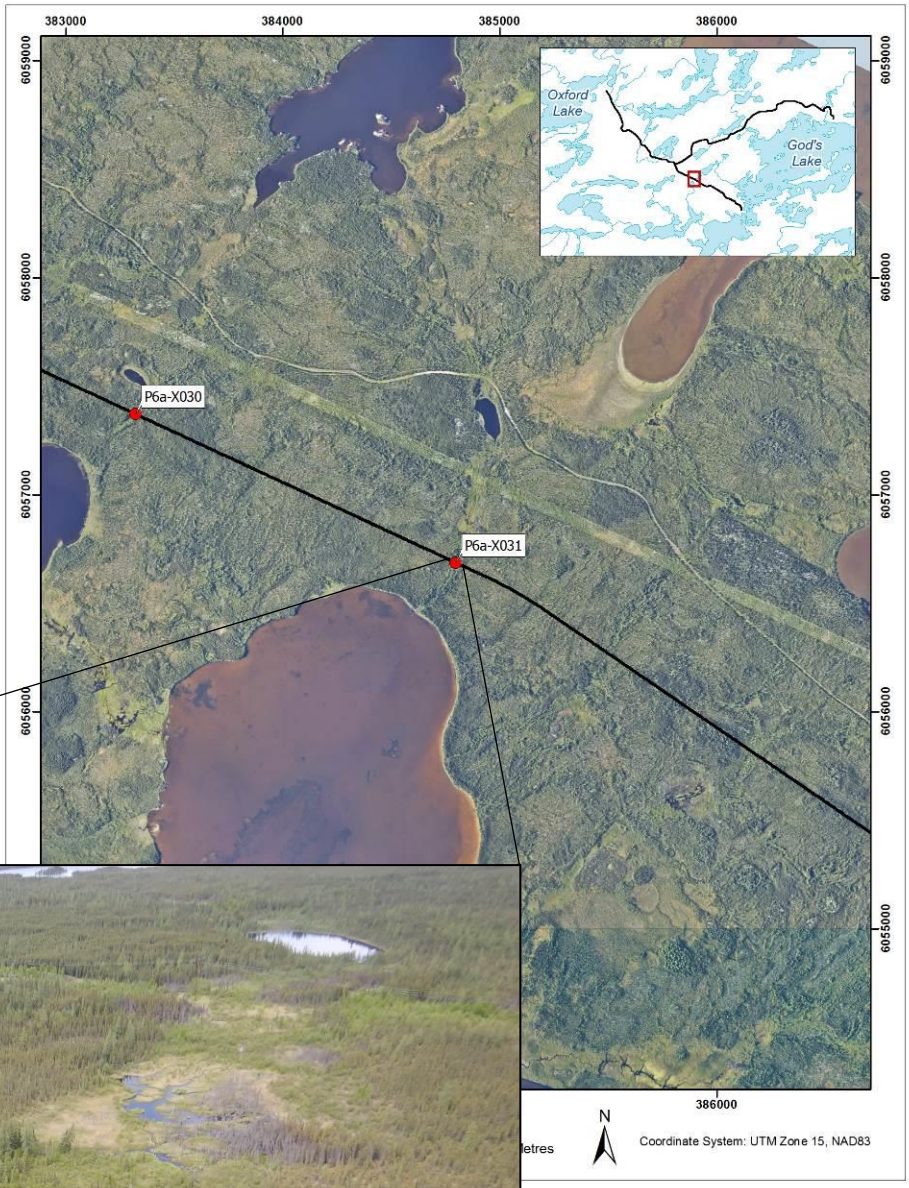
P6a-X031 Unnamed Tributary of Hignell Lake

Location

Datum:	NAD 83
UTM:	15U 384797 6056689

General Morphology

Type:	Stream
Pattern:	Sinuous
Channel Profile:	Planar
Sinuosity:	-
Confinement:	Unconfined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 15, 2016
Discharge (m^3/s): 0.040
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	110 US	40 US	0	65 DS	265 DS
Channel and Flow					
Channel (m)	-	2.8	2.2	2.9	3.6
Wetted Width (m)	-	2.5	1.6	2.5	2.2
Depth at 25% (m)	-	0.31	0.19	0.22	0.23
Depth at 50% (m)	-	0.43	0.23	0.31	0.30
Depth at 75% (m)	-	0.13	0.20	0.31	0.36
Maximum Depth (m)	-	0.43	0.23	0.32	0.39
Gradient (%)	-	0.5	0.5	0.5	0.5
Banks					
Left Bank Height (m)	-	0.20	0.15	0.20	0.10
Right Bank Height (m)	-	0.20	0.20	0.20	0.15
Left Bank Shape	-	Sloping	Vertical	Vertical	Sloping
Right Bank Shape	-	Sloping	Vertical	Sloping	Sloping
Left Bank Materials	-	Organics	Organics	Organics	Organics
Right Bank Materials	-	Organics	Organics	Organics	Organics
Left Bank Stability	-	Low	Low	Low	Low
Right Bank Stability	-	Low	Low	Low	Low
Substrate Type and Distribution (%)					
Fines	100	100	100	100	100
Small Gravel	0	0	0	0	0
Large Gravel	0	0	0	0	0
Cobble	0	0	0	0	0
Boulder	0	0	0	0	0
Bedrock	0	0	0	0	0

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	-	1.5	1.5	-	2.6
Right Bank	-	2.2	1.5	-	1.4
Riparian Distance (m)					
Left Bank	-	2.7	-	-	7.9
Right Bank	-	2.6	-	-	10.4
Riparian Vegetation Type[a]	-	CON/ DEC	DEC/ CON	CON/ DEC	DEC/ SHR
Canopy Cover (%)	-	90	90	70	25

a –SHR = Shrub; DEC = deciduous; CON = coniferous

+ Habitat Type

Transect	1	2	3	4	5
Flat	100	100	0	0	0
Pool	0	0	0	0	0
Rapid	0	0	0	0	0
Riffle	0	0	35	50	10
Run	0	0	50	50	90
Chute	0	0	15	0	0

+ Water Quality Data

Habitat:	Flat
Temperature (°C):	17.4
pH:	6.82
Turbidity (NTU):	-
Specific Conductance (µS/cm):	65.1
DO (mg/L):	4.87



View of edge of open-canopy habitat at Transect 1 (110 m upstream of crossing).



Upstream view at Transect 2 (40 m upstream of crossing), as tributary exits dense brush into RoW clearing.



Downstream view at crossing (Transect 3).



Downstream view at mouth of tributary at Hignell Lake (Transect 5, 265 m downstream of crossing).

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	80	90
Cover Composition (% of Total)		
Large Woody Debris	0	0
Overhanging Vegetation	70	50
Instream Vegetation	10	10
Pool	20	40
Boulder	0	0
Undercut Bank	0	0
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Low	Moderate
Rearing	Low	Moderate
Overwinter	Low	Low
Migration	Low	High
Large Bodied Fish		
Spawning	Low	Moderate
Rearing	Low	Moderate
Overwinter	Low	Low
Migration	Low	Low

Comments
The crossing is located on a tributary draining a small pond into Hignell Lake 300 m downstream of the crossing. The upstream portion of the reach consists of mostly uniform flat water habitat while the downstream section contains more riffle and run habitat. Both sections pass through dense riparian habitat, and contain organic substrate, and instream and overhanging vegetation. The tributary is generally braided, with only the last downstream 100 m having a defined channel, suitable for spawning, rearing and feeding by forage fish and possibly Northern Pike. The lake approximately 300 m downstream of the crossing likely supports overwintering large bodied fish.

+ Fish Sampling Data

Methods: Electrofishing

Fish Species Captured: Brook Stickleback

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 0.48
Distance to Major DS Waterbody (km): 0.30 (Hignell Lake)
Connectivity: Yes - likely

Comments
The crossing site is located in a riparian habitat, and consists of both flat-water and riffle/run habitat, dominated by organic substrates, and instream vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Hignell Lake

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – God's Lake First Nation

Comments

The crossing site is located on a tributary between a small unnamed pond and Hignell Lake, within the traditional territories of Gods Lake First Nation. The upstream portion of the tributary provides suitable spawning, rearing and feeding habitat for forage fish. The lake approximately 300 m downstream of the crossing likely supports overwintering large bodied fish.

Information Sources:

a – Manitoba Conservation and Water Stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The crossing contains habitat suitable for spawning, rearing and feeding of Northern Pike. The crossing is 320 m from the mouth of a lake with potential to support overwintering large bodied fish.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the immediate crossing area is expected to contribute to the downstream and upstream CRA fishery as it supports a range of life requisites for both forage fish and Northern Pike, including spawning, rearing and feeding. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish (e.g., Northern Pike) is plentiful outside of the project footprint within the stream and in the region.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert

Effect	Pathway of Effect	Proposed Area Affected	Existing Area Affected	Loss/Gain
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	66 m^2	0 m^2	- 66 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (2.2 m).

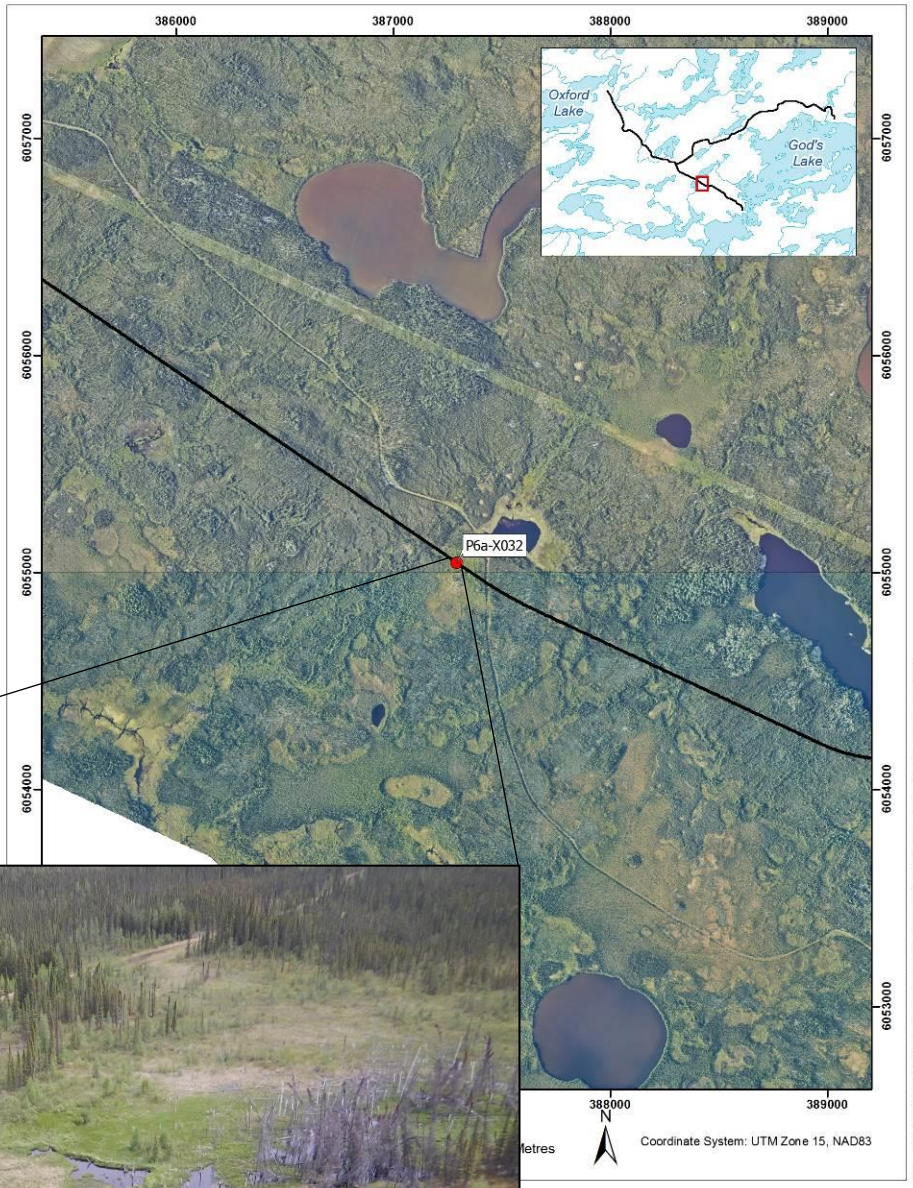
P6a-X032 Unnamed Tributary of Hignell Lake

Location

Datum:	NAD 83
UTM:	15U 387333 6055019

General Morphology

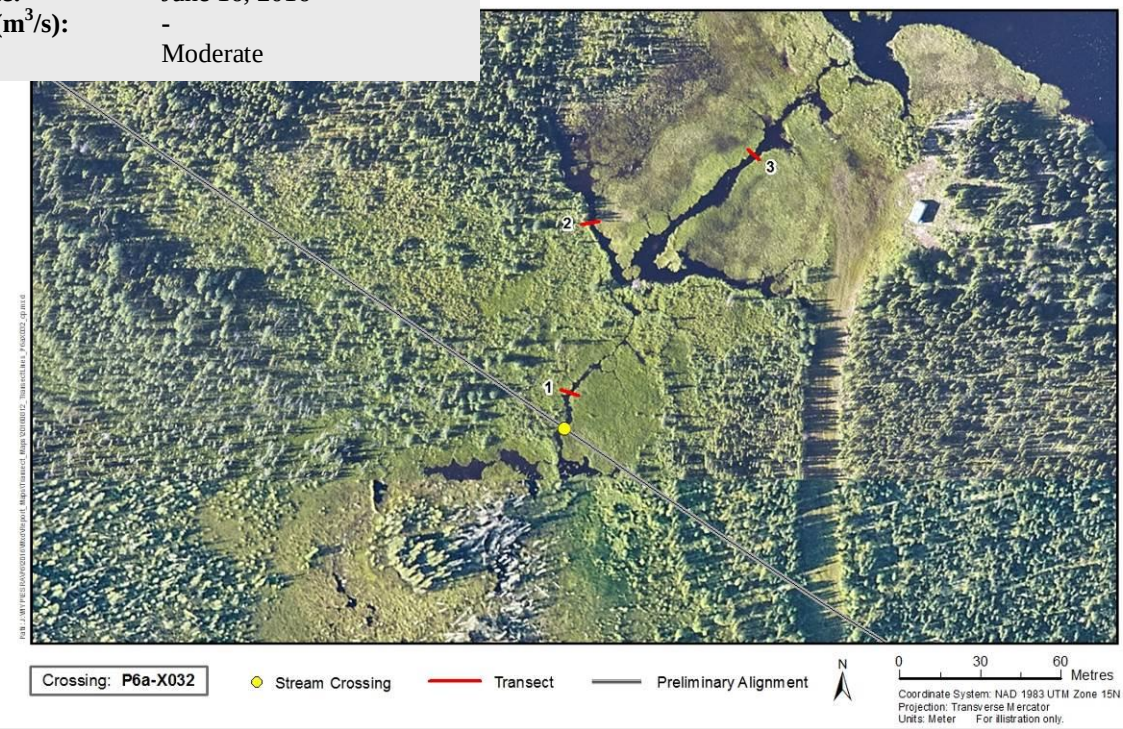
Type:	Stream
Pattern:	Braided
Channel Profile:	Notched
Sinuosity:	-
Confinement:	Unconfined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 16, 2016
Discharge (m^3/s): -
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	0	70 US	110 US	-	-
Channel and Flow					
Channel (m)	-	-	-	-	-
Wetted Width (m)	2.5	-	1.5	-	-
Depth at 25% (m)	0.32	-	0.15	-	-
Depth at 50% (m)	0.28	-	0.33	-	-
Depth at 75% (m)	0.18	-	0.19	-	-
Maximum Depth (m)	0.34	-	0.34	-	-
Gradient (%)	-	-	-	-	-
Banks					
Left Bank Height (m)	-	-	-	-	-
Right Bank Height (m)	-	-	-	-	-
Left Bank Shape	-	-	-	-	-
Right Bank Shape	-	-	-	-	-
Left Bank Materials	-	-	-	-	-
Right Bank Materials	-	-	-	-	-
Left Bank Stability	-	-	-	-	-
Right Bank Stability	-	-	-	-	-
Substrate Type and Distribution (%)					
Fines	100	100	100	-	-
Small Gravel	0	0	0	-	-
Large Gravel	0	0	0	-	-
Cobble	0	0	0	-	-
Boulder	0	0	0	-	-
Bedrock	0	0	0	-	-

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	-	-	-	-	-
Right Bank	-	-	-	-	-
Riparian Distance (m)					
Left Bank	-	-	-	-	-
Right Bank	-	-	-	-	-
Riparian Vegetation Type[a]					
	-	-	-	-	-
Canopy Cover (%)					
	-	-	-	-	-

a – GRA = grass; SHR = Shrub; DEC = deciduous; CON = coniferous; MIX = mixed

+ Habitat Type

Transect	1	2	3	4	5
Flat	100	-	-	-	-
Pool	0	-	-	-	-
Rapid	0	-	-	-	-
Riffle	0	-	-	-	-
Run	0	-	-	-	-
Cascade	0	-	-	-	-

+ Water Quality Data

Habitat:	Flat
Temperature (°C):	20.6
pH:	6.61
Turbidity (NTU):	-
Specific Conductance (µS/cm):	75.3
DO (mg/L):	8.58



Downstream view at crossing site (Transect 1).



Upstream view at beaver pond habitat just upstream of Transect 2 (70 m upstream of crossing).



Upstream view of bog at Transect 2 (70 m upstream of crossing).



Downstream view at Transect 3 (110 m upstream of crossing).

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	50	75
Cover Composition (% of Total)		
Large Woody Debris	5	0
Overhanging Vegetation	5	5
Instream Vegetation	10	5
Pool	55	50
Boulder	0	0
Undercut Bank	25	40
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Moderate	Moderate
Rearing	Moderate	Moderate
Overwinter	Low	Low
Migration	Moderate	Moderate
Large Bodied Fish		
Spawning	Low	Low
Rearing	Low	Low
Overwinter	Low	Low
Migration	Low	Low

Comments
The crossing is located in the upper reaches of an unnamed tributary of Hignell Lake, 3.8 km downstream of the crossing and drains three upstream unnamed lakes into Hignell Lake. A narrow channel is present in the immediate crossing area. Habitat is flat slow moving or still water with soft substrates and instream vegetation within a soft marshy floodplain. A few small ponds are present immediately downstream, suitable for forage fish, however, the stream becomes ephemeral and enters an elevated forested reach 270 m downstream of the crossing. There is a beaver dam between the crossing and the small upstream lake. The habitat within the reach is suitable for spawning, rearing and feeding of forage fish and Northern Pike. However, pike are not likely to be present as the upstream lake may not be sufficiently deep for overwintering of large bodied species and access to the site from Hignell Lake is unlikely.

+ Fish Sampling Data

Methods: Electrofishing

Fish Species Captured: Brook Stickleback

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 2.84
Distance to Major DS Waterbody (km): 3.80 (Hignell Lake)
Connectivity: Yes - unlikely

Comments
The crossing site consists mainly of flat-water habitat, dominated by organic substrates and instream vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Hignell Lake

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – God's Lake First Nation

Comments
This unnamed tributary connects several small unnamed lakes to Hignell Lake 3.8 km downstream of the crossing, within the traditional territories of Gods Lake First Nation. The stream provides suitable spawning, rearing and feeding habitat for forage fish and Northern Pike that may overwinter in the small lake upstream of the crossing.

Information Sources:

a – Manitoba Conservation and Water stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The crossing site is connected to a small body of water 200 upstream. Multiple barriers downstream, including dams and ephemeral reaches precludes access by large bodied fish overwintering in Hignell Lake. Fish from the upstream lake may make use of the crossing area.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish (e.g., Northern Pike) is accessible only to populations of fish in the small lake upstream; connectivity to the CRA fishery downstream is not likely except during extremely high water events.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert

Effect	Pathway of Effect	Proposed Area Affected	Existing Area Affected	Loss/Gain
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	75 m^2	0 m^2	- 75 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (2.5 m).

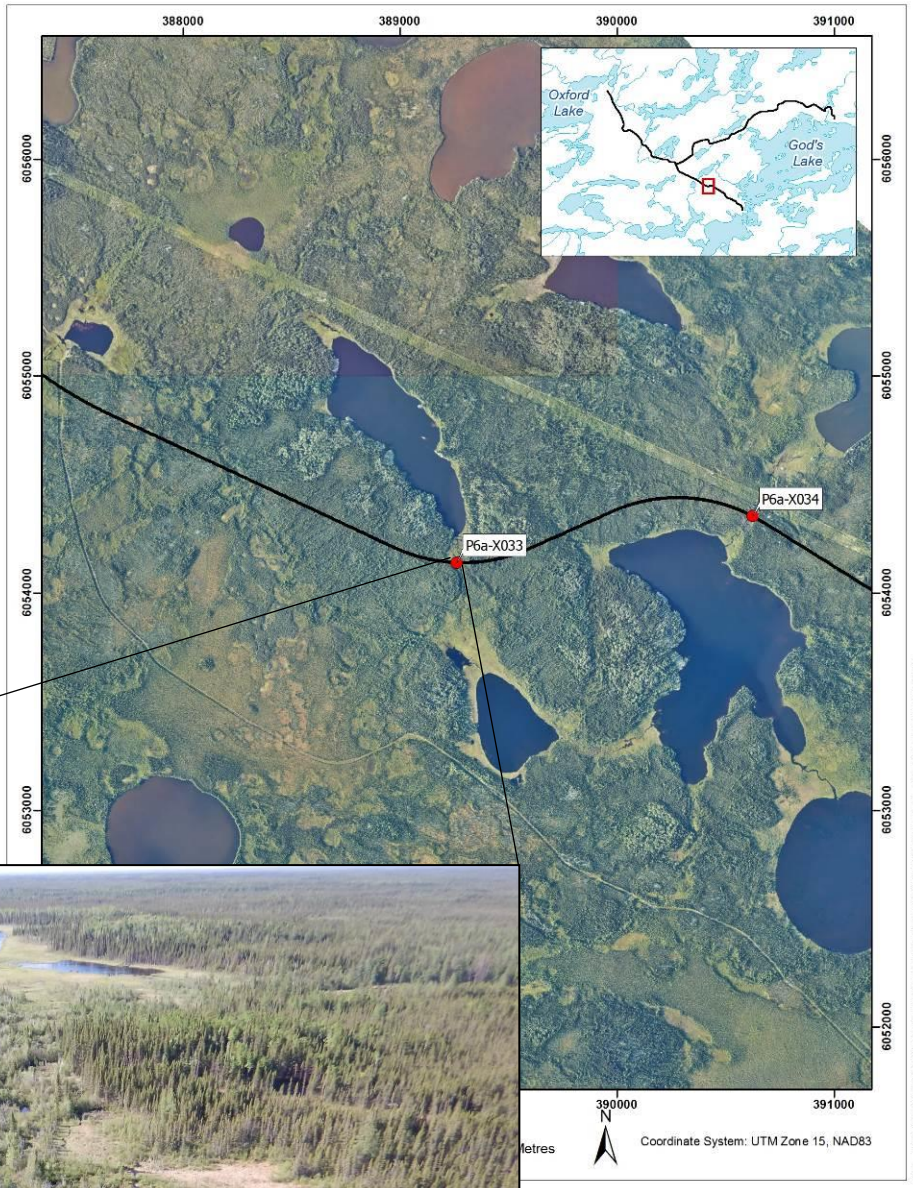
P6a-X033 Unnamed Tributary of an Unnamed Lake

Location

Datum:	NAD 83
UTM:	15U 389260 6054142

General Morphology

Type:	Stream
Pattern:	Braided
Channel Profile:	Planar
Sinuosity:	-
Confinement:	Unconfined
Flow Regime:	Perennial





Site Conditions

Survey Date:	June 17, 2016
Discharge (m^3/s):	-
Stage:	Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	70 US	0	70 DS	-	-
Channel and Flow					
Channel (m)	1.9	1.0	0.9	-	-
Wetted Width (m)	1.5	0.7	0.7	-	-
Depth at 25% (m)	0.41	0.37	0.07	-	-
Depth at 50% (m)	0.46	0.56	0.09	-	-
Depth at 75% (m)	0.23	0.50	0.09	-	-
Maximum Depth (m)	0.46	0.56	0.09	-	-
Gradient (%)	0.5	0.5	0.5	-	-
Banks					
Left Bank Height (m)	0.3	0.1	0.3	-	-
Right Bank Height (m)	0.3	0.1	0.3	-	-
Left Bank Shape	Vertical	Sloping	Vertical	-	-
Right Bank Shape	Vertical	Sloping	Vertical	-	-
Left Bank Materials	Organics	Organics	Organics	-	-
Right Bank Materials	Organics	Organics	Organics	-	-
Left Bank Stability	Low	Low	Low	-	-
Right Bank Stability	Low	Low	Low	-	-
Substrate Type and Distribution (%)					
Fines	100	100	80	-	-
Small Gravel	0	0	0	-	-
Large Gravel	0	0	0	-	-
Cobble	0	0	0	-	-
Boulder	0	0	20	-	-
Bedrock	0	0	0	-	-

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	0.8	5.0	0.5	-	-
Right Bank	1.0	2.9	1.0	-	-
Riparian Distance (m)					
Left Bank	2.8	6.1	1.5	-	-
Right Bank	1.5	6.0	2.0	-	-
Riparian Vegetation Type[a]					
	DEC/ GRA	DEC/ SHR/ GRA	DEC/ SHR/ GRA	-	-
Canopy Cover (%)					
	10	10	10	-	-

a – GRA = grass; SHR = Shrub; DEC = deciduous

+ Habitat Type

Transect	1	2	3	4	5
Flat	70	80	90	-	-
Pool	30	20	10	-	-
Rapid	0	0	0	-	-
Riffle	0	0	0	-	-
Run	0	0	0	-	-
Cascade	0	0	0	-	-

+ Water Quality Data

Habitat:	Flat
Temperature (°C):	19.4
pH:	6.73
Turbidity (NTU):	-
Specific Conductance (µS/cm):	153.5
DO (mg/L):	3.47



Upstream view at Transect 1 (70 m upstream of crossing).



Downstream view at crossing site (Transect 2).



Downstream view at Transect 3 (75 m downstream of crossing).



View from outlet of small lake upstream of transects, looking downstream at beaver pond habitat

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	90	90
Cover Composition (% of Total)		
Large Woody Debris	0	10
Overhanging Vegetation	5	5
Instream Vegetation	80	5
Pool	15	55
Boulder	0	0
Undercut Bank	0	20
Surface Turbulence	0	5
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Moderate	Moderate
Rearing	Moderate	Moderate
Overwinter	Moderate	Moderate
Migration	Low	Moderate
Large Bodied Fish		
Spawning	Low	Low
Rearing	Low	Low
Overwinter	Low	Low
Migration	Low	Low

Comments
The crossing is located near the headwaters of a low-lying forested wetland habitat prone to flooding, approximately 500 m long, connecting two small unnamed lakes. The reach consists of shallow, often braided, slow moving water over soft substrates mixed with some boulders, large woody debris and pool habitat in the downstream reach, and a more uniform flooded habitat with instream vegetation in the upstream reach. Habitat here is suitable for spawning, feeding and rearing of small bodied fish. Overwintering of both small and large bodied fishes likely occurs in the lakes. Fish passage may be hindered by beaver dams along the creek.

+ Fish Sampling Data

Methods: Electrofishing

Fish Species Captured: Brook Stickleback, Northern Pearl Dace

Existing Information: Walleye and Northern Pike in connected lakes (HTFC Planning & Design. 2016).

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 1.47
Distance to Major DS Waterbody (km): 16.66 (God's Lake)
Connectivity: Yes - likely

Comments
The crossing site consists mainly of forested. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Unnamed Lakes

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – God's Lake First Nation

Comments
The crossing lies within the traditional territories of Gods Lake First Nation. This unnamed stream connects two small lakes near the head waters of a tributary consisting of a string of small lakes feeding into God's Lake over 16 kms downstream of the crossing. The creek provides suitable spawning, rearing and feeding habitat for Northern Pike in its lower reaches closest to the downstream lake. The affected reach supports small bodied fish suited to forested stream habitats.

Information Sources:

a – Manitoba Conservation and Water stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

A – pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The crossing itself does not contain direct habitat suitable for relevant species, however, habitat suitable for spawning, rearing and feeding of Northern Pike is present downstream.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the immediate crossing area is expected to contribute to the downstream and upstream CRA fishery as it supports a range of life requisites for both forage fish, including spawning, rearing and feeding. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish (e.g., Northern Pike) is plentiful outside of the project footprint within the stream and in the region.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert				
Effect	**Pathway of Effect**	**Proposed Area Affected**	**Existing Area Affected**	**Loss/Gain**
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	30 m^2	0 m^2	- 30 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (1 m).

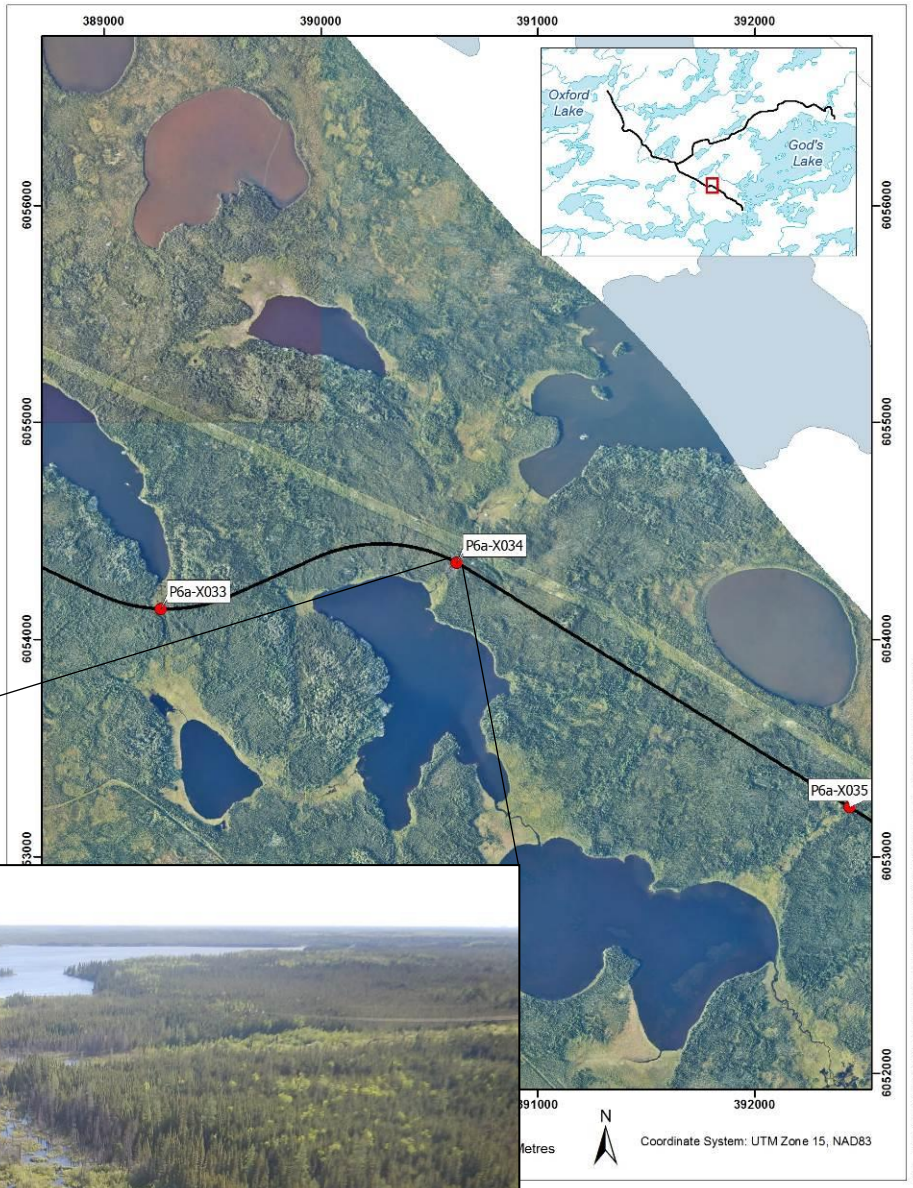
P6a-X034 Unnamed Tributary of an Unnamed Lake

Location

Datum:	NAD 83
UTM:	15U 390626 6054355

General Morphology

Type:	Fen Stream
Pattern:	Sinuous
Channel Profile:	Planar
Sinuosity:	-
Confinement:	Unconfined
Flow Regime:	Perennial

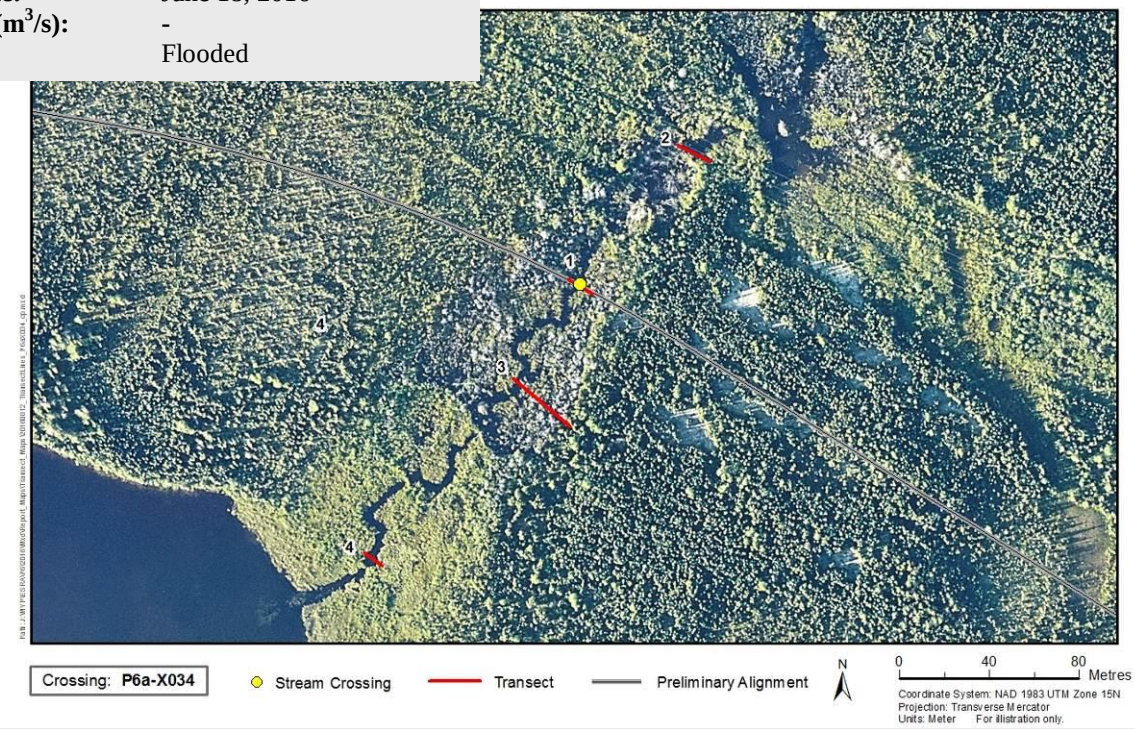




North/South Consultants Inc.
Aquatic Environment Specialists

Site Conditions

Survey Date: June 18, 2016
Discharge (m^3/s): -
Stage: Flooded



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	0	80 US	60 DS	157 DS	-
Channel and Flow					
Channel (m)	~3	-	-	6.4	-
Wetted Width (m)	-	-	-	6.4	-
Depth at 25% (m)	-	-	-	0.95	-
Depth at 50% (m)	-	-	-	0.80	-
Depth at 75% (m)	-	-	-	0.77	-
Maximum Depth (m)	-	-	-	1.0-	
Gradient (%)	-	-	-	-	-
Banks					
Left Bank Height (m)	-	-	-	0.2	-
Right Bank Height (m)	-	-	-	0.2	-
Left Bank Shape	-	-	-	Sloping	-
Right Bank Shape	-	-	-	Sloping	-
Left Bank Materials	-	-	-	Organics	-
Right Bank Materials	-	-	-	Organics	-
Left Bank Stability	-	-	-	Low	-
Right Bank Stability	-	-	-	Low	-
Substrate Type and Distribution (%)					
Fines	-	-	-	100	-
Small Gravel	-	-	-	0	-
Large Gravel	-	-	-	0	-
Cobble	-	-	-	0	-
Boulder	-	-	-	0	-
Bedrock	-	-	-	0	-

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	0.8	5.0	0.5	-	-
Right Bank	1.0	2.9	1.0	-	-
Riparian Distance (m)					
Left Bank	2.8	6.1	1.5	-	-
Right Bank	1.5	6.0	2.0	-	-
Riparian Vegetation Type[a]					
	DEC/ GRA	DEC/ SHR/ GRA	DEC/ SHR/ GRA	-	-
Canopy Cover (%)					
	10	10	10	-	-

a – GRA = grass; SHR = Shrub; DEC = deciduous

+ Habitat Type

Transect	1	2	3	4	5
Flat	0	0	0	0	0
Pool	0	0	0	0	0
Rapid	0	0	0	0	0
Riffle	0	0	0	0	0
Run	0	0	0	0	0
Impoundment	100	100	100	100	100

+ Water Quality Data

Habitat:	Flat
Temperature (°C):	18.5
pH:	6.67
Turbidity (NTU):	-
Specific Conductance (µS/cm):	124.5
DO (mg/L):	2.88



Upstream view at flooded habitat at crossing (Transect 1).



Upstream look at beaver pond habitat located upstream of beaver dam at Transect 2 (80 m upstream of crossing).



Upstream view at flooded habitat at Transect 3 (60 m downstream of crossing).



Downstream view atop beaver lodge at Transect 4 (157 m downstream of crossing)

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	-	-
Cover Composition (% of Total)		
Large Woody Debris	10	10
Overhanging Vegetation	10	5
Instream Vegetation	20	5
Pool	55	80
Boulder	5	0
Undercut Bank	0	0
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Moderate	High
Rearing	Moderate	High
Overwinter	Moderate	High
Migration	Low	High
Large Bodied Fish		
Spawning	Low	Moderate
Rearing	Low	Moderate
Overwinter	Low	Moderate
Migration	Low	Moderate

Comments
The crossing is located in a low-lying forested fen habitat prone to flooding, approximately 600 m long, connecting Hobson Lake to a series of small unnamed lakes, ultimately draining into Gods Lake over 15 km downstream of the crossing. At the time of the visit, the reach was flooded, and contains soft substrates with some boulders, large woody debris, instream and overhanging vegetation. Habitat here is suitable for spawning, feeding and rearing of select small bodied forage fish tolerant of low oxygen conditions; the impounded habitat is not suitable for most fish species. Suitable habitat for Northern Pike is available downstream of the crossing in closer proximity to the unnamed lake.

+ Fish Sampling Data

Methods: Electrofishing, Visual Survey

Fish Species Captured: Brook Stickleback, Northern Pearl Dace

Existing Information: Surrounding lakes are known to contain Walleye and Northern Pike (HTFC Planning & Design 2016).

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 7.51
Distance to Major DS Waterbody (km): 15.19 (God's Lake)
Connectivity: Yes - likely

Comments
The crossing site consists mainly of flooded forested fen habitat. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Unnamed Lakes

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – God's Lake First Nation

Comments
The crossing lies within the traditional territories of Gods Lake First Nation. This unnamed stream connects two small lakes near the head waters of a tributary consisting of a string of small lakes feeding into God's Lake over 15 km downstream of the crossing. The affected reach supports some small bodied fish species tolerant of low dissolved oxygen conditions. The surrounding lakes are fished by God's Lake First Nation (HTFC Planning & Design 2016).

Information Sources:

a – Manitoba Conservation and Water stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a – pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The crossing itself does not contain direct habitat suitable for relevant species, however, habitat suitable for spawning, rearing and feeding of Northern Pike is present downstream.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the immediate crossing area is expected to contribute to the downstream and upstream CRA fishery as it supports a range of life requisites for both forage fish, including spawning, rearing and feeding. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish (e.g., Northern Pike) is plentiful outside of the project footprint within the stream and in the region.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert

Effect	Pathway of Effect	Proposed Area Affected	Existing Area Affected	Loss/Gain
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	90 m^2	0 m^2	- 90 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (3 m)

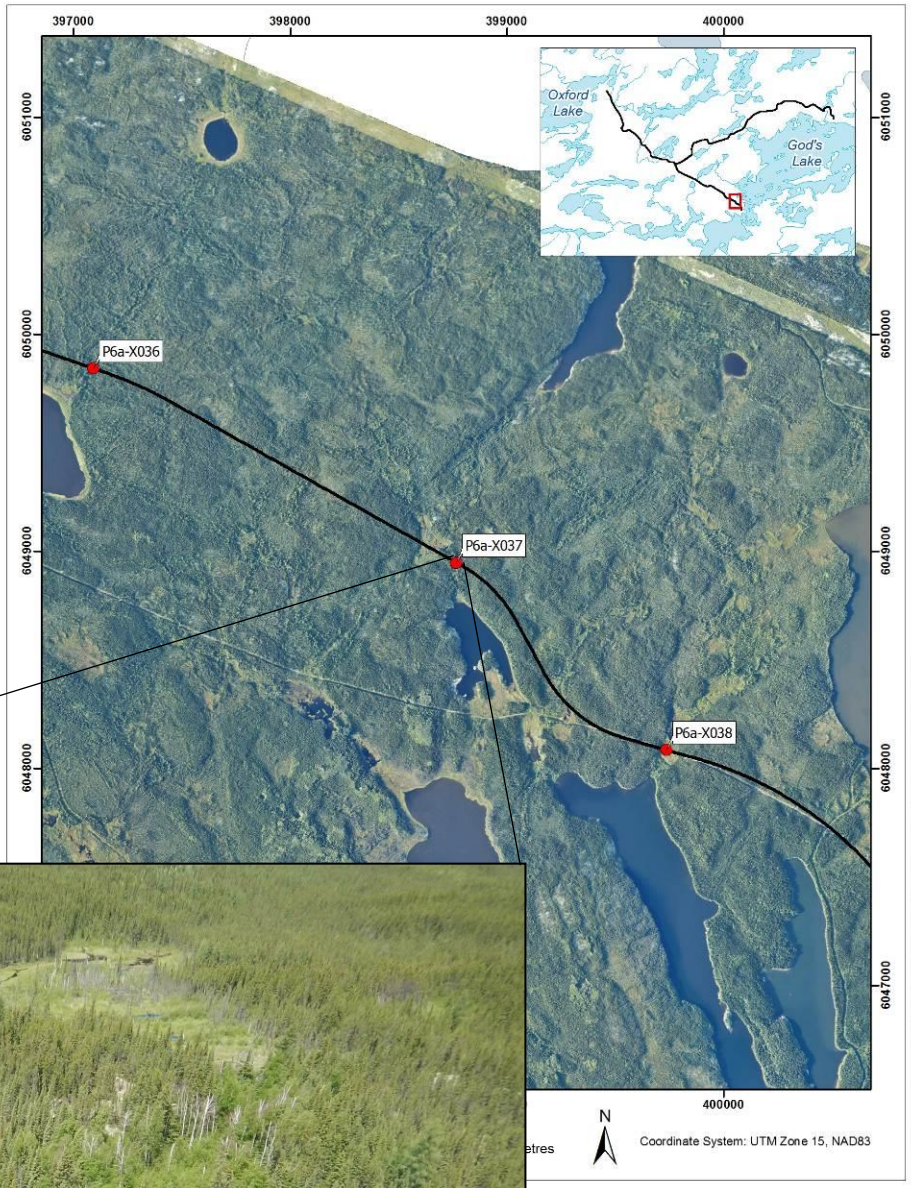
P6a-X037 Unnamed Tributary of Unnamed Lake

Location

Datum:	NAD 83
UTM:	15U 398766 6048950

General Morphology

Type:	Stream
Pattern:	Sinuous
Channel Profile:	U-Shape
Sinuosity:	-
Confinement:	Occasionally Confined
Flow Regime:	Perennial

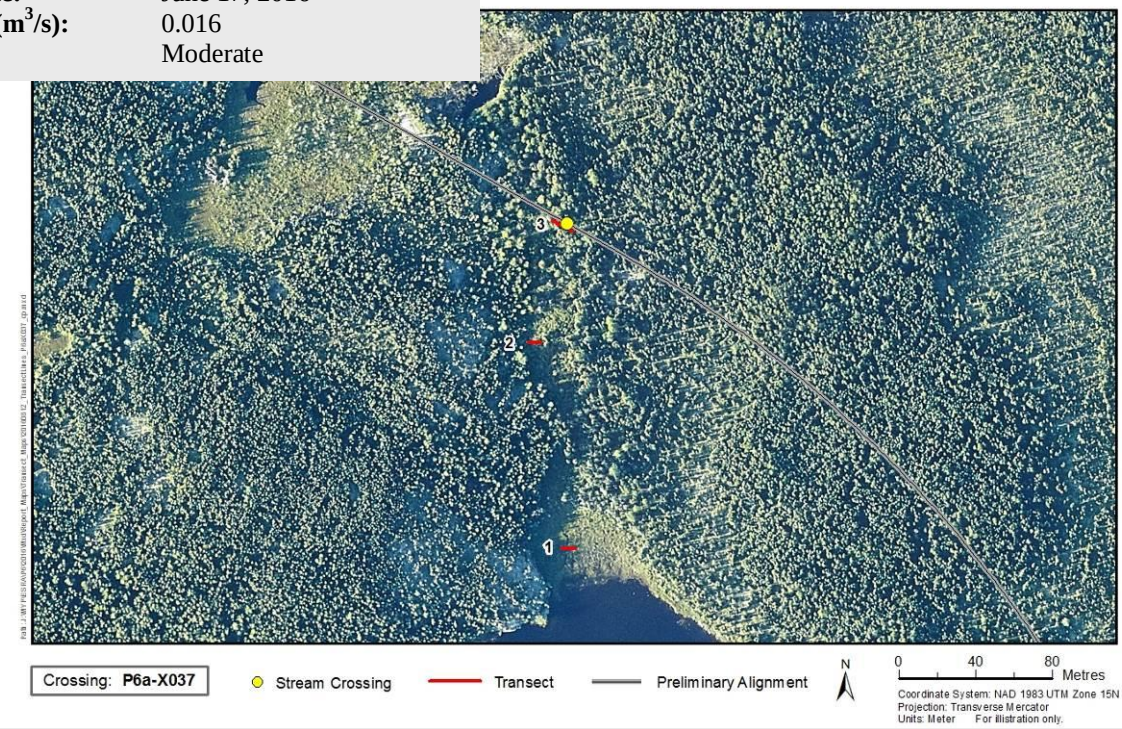




North/South Consultants Inc.
Aquatic Environment Specialists

Site Conditions

Survey Date: June 17, 2016
Discharge (m^3/s): 0.016
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	175 DS	70 DS	0	-	-
Channel and Flow					
Channel (m)	1.3	1.3	-	-	-
Wetted Width (m)	1.0	1.2	-	-	-
Depth at 25% (m)	0.16	0.10	-	-	-
Depth at 50% (m)	0.22	0.20	-	-	-
Depth at 75% (m)	0.23	0.22	-	-	-
Maximum Depth (m)	0.23	0.25	-	-	-
Gradient (%)	0.5	0.5	-	-	-
Banks					
Left Bank Height (m)	0.3	0.2	-	-	-
Right Bank Height (m)	0.3	0.3	-	-	-
Left Bank Shape	Vertical	Vertical	-	-	-
Right Bank Shape	Vertical	Vertical	-	-	-
Left Bank Materials	Organics	Organics	-	-	-
Right Bank Materials	Organics	Organics	-	-	-
Left Bank Stability	Low	Low	-	-	-
Right Bank Stability	Low	Low	-	-	-
Substrate Type and Distribution (%)					
Fines	100	95	-	-	-
Small Gravel	0	0	-	-	-
Large Gravel	0	0	-	-	-
Cobble	0	0	-	-	-
Boulder	0	5	-	-	-
Bedrock	0	0	-	-	-

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	55	0.4	-	-	-
Right Bank	12	0.1	-	-	-
Riparian Distance (m)					
Left Bank	57	3.5	-	-	-
Right Bank	13	2.5	-	-	-
Riparian Vegetation Type[a]					
	DEC/ CON	DEC/ SHR	-	-	-
Canopy Cover (%)					
	0	35	-	-	-

a – SHR = Shrub; DEC = deciduous; CON = coniferous

+ Habitat Type

Transect	1	2	3	4	5
Flat	0	0	0	-	-
Pool	30	30	100	-	-
Rapid	0	0	0	-	-
Riffle	0	0	0	-	-
Run	70	70	0	-	-
Cascade	0	0	0	-	-

+ Water Quality Data

Habitat:	Run/Pool
Temperature (°C):	16.0
pH:	6.48
Turbidity (NTU):	-
Specific Conductance (µS/cm):	105.2
DO (mg/L):	3.86



Downstream view at Transect 1 (175 m downstream of crossing).



Downstream view at Transect 2 (70 m downstream of crossing).



Downstream view at crossing (Transect 3).



Upstream view at crossing (Transect 3).

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	50	95
Cover Composition (% of Total)		
Large Woody Debris	10	5
Overhanging Vegetation	20	5
Instream Vegetation	5	10
Pool	60	60
Boulder	5	5
Undercut Bank	0	15
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Low	Moderate
Rearing	Low	Moderate
Overwinter	Low	Low
Migration	Low	Moderate
Large Bodied Fish		
Spawning	Low	Low
Rearing	Low	Low
Overwinter	Low	Low
Migration	Low	Low

Comments
The crossing is located across a series of small braided indistincts channels within a small forested stream. The tributary drains a small area of wetlands within a riparian region, into an unnamed lake and ultimately draining into God's Lake approximately 4 km downstream of the crossing. The area immediately downstream of the crossing consists mainly of slow-moving waters and pools, and soft substrates with large woody debris, some boulders, and instream and overhanging vegetation. Habitat is suitable for spawning, feeding and rearing of select small bodied forage fish but may be limited in connectivity due to several small beaver dams between the tributary and the crossing site. The crossing itself is disconnected, consisting of a braided channel not suitable as fish habitat, with water often flowing underground.

+ Fish Sampling Data

Methods: Electrofishing

Fish Species Captured: Brook Stickleback, Northern Pearl Dace (downstream of crossing).

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 0.54
Distance to Major DS Waterbody (km): 4.06 (Gods Lake)
Connectivity: Yes - likely

Comments
The crossing site consists mainly of slow moving and pool habitat, dominated by organic substrates and instream vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Gods Lake

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – God's Lake First Nation

Comments
This tributary drains a wetland into a small unnamed lake before feeding into Gods Lake, within the traditional territories of God's Lake First Nation. The creek provides suitable spawning, rearing and feeding habitat for forage fish but is limited in connectivity due to beaver activity and braiding of the channel.

Information Sources:

a – Manitoba Conservation and Water stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	Habitat at the crossing is suitable for forage fish and contributes to downstream areas that are suitable for Northern Pike. The crossing is 320 m from the mouth of a lake with potential to support overwintering large bodied fish.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat at the crossing is expected to contribute to the downstream CRA fishery as it supports a range of life requisites for forage fish and is connected to downstream habitats. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish is plentiful outside of the project footprint within the stream and in the region.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert				
Effect	**Pathway of Effect**	**Proposed Area Affected**	**Existing Area Affected**	**Loss/Gain**
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	m^2	0 m^2	- m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area affected has not been calculated because a discernable channel was not present.

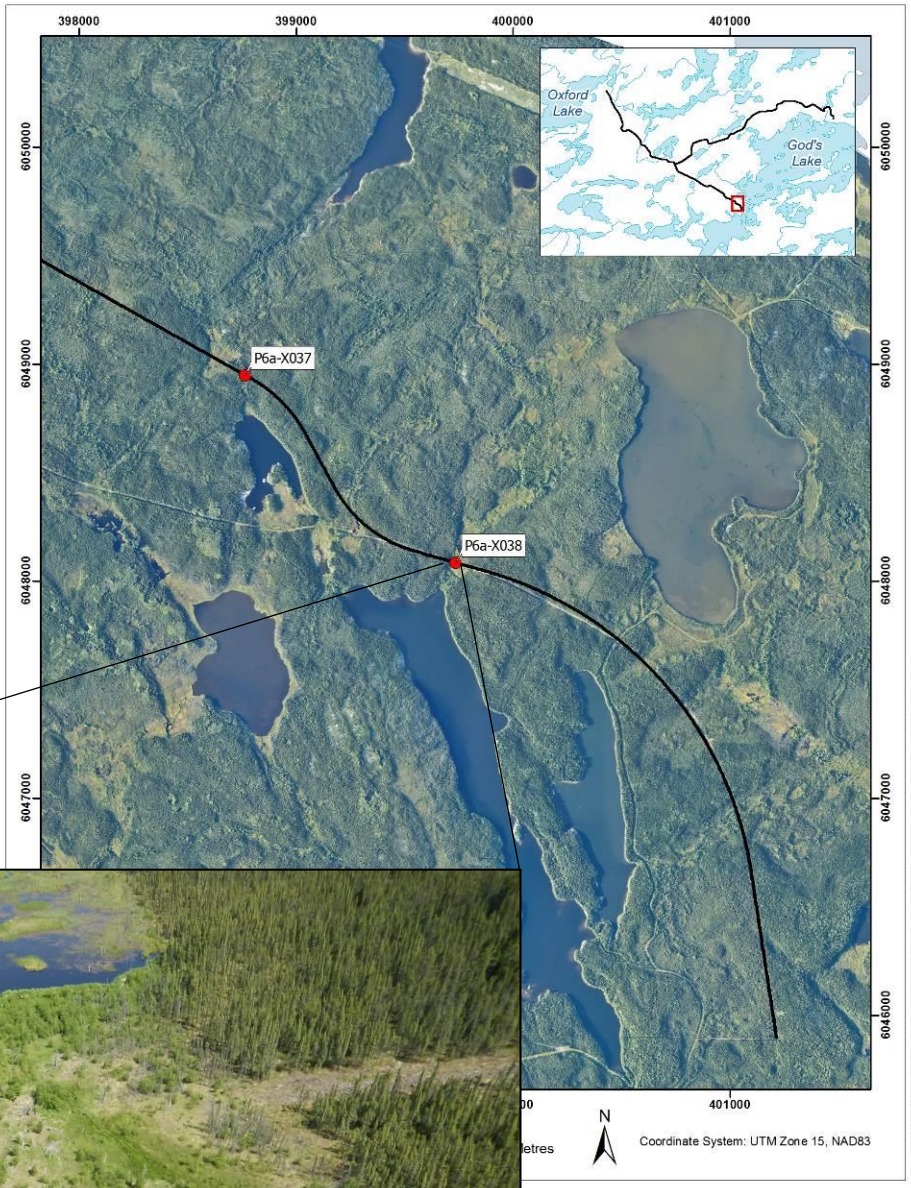
P6-X038 Unnamed Tributary of Unnamed Lake

Location

Datum:	NAD 83
UTM:	15U 399735 6048087

General Morphology

Type:	Stream
Pattern:	Braided
Channel Profile:	U-Shape
Sinuosity:	-
Confinement:	Occasionally Confined
Flow Regime:	Perennial





Site Conditions

Survey Date:	June 16, 2016
Discharge (m^3/s):	0.010
Stage:	Low



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	0	45 DS	105 DS	-	-
Channel and Flow					
Channel (m)	5.8	-	1.1	-	-
Wetted Width (m)	1.8	-	1.0	-	-
Depth at 25% (m)	0.25	-	0.14	-	-
Depth at 50% (m)	0.37	-	0.18	-	-
Depth at 75% (m)	0.21	-	0.18	-	-
Maximum Depth (m)	0.44	-	0.18	-	-
Gradient (%)	0.5	-	0.5	-	-
Banks					
Left Bank Height (m)	0.3	-	0.4	-	-
Right Bank Height (m)	0.2	-	0.4	-	-
Left Bank Shape	Sloping	-	Vertical	-	-
Right Bank Shape	Sloping	-	Vertical	-	-
Left Bank Materials	Organics	-	Organics	-	-
Right Bank Materials	Organics	-	Organics	-	-
Left Bank Stability	Low	-	Moderate	-	-
Right Bank Stability	Low	-	Moderate	-	-
Substrate Type and Distribution (%)					
Fines	100	-	95	-	-
Small Gravel	0	-	0	-	-
Large Gravel	0	-	0	-	-
Cobble	0	-	0	-	-
Boulder	0	-	5	-	-
Bedrock	0	-	0	-	-

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	3.0	-	0.3	-	-
Right Bank	2.5	-	0.3	-	-
Riparian Distance (m)					
Left Bank	106	-	1.0	-	-
Right Bank	25	-	1.2	-	-
Riparian Vegetation Type[a]					
	CON	-	DEC/ CON	-	-
Canopy Cover (%)					
	30	-	30	-	-

a – DEC = deciduous; CON = coniferous

+ Habitat Type

Transect	1	2	3	4	5
Flat	100	-	-	-	-
Pool	-	-	-	-	-
Rapid	-	-	-	-	-
Riffle	-	-	-	-	-
Run	-	-	100	-	-
Cascade	-	-	-	-	-

+ Water Quality Data

Habitat:	Flat/Run
Temperature (°C):	18.3
pH:	6.61
Turbidity (NTU):	-
Specific Conductance (µS/cm):	142.8
DO (mg/L):	7.36



Old beaver dam upstream of crossing (Transect 1).



Pooled water habitat at beaver dam at Transect 2 (45 m downstream of crossing).



Downstream view of meandering tributary at Transect 3 (105 m downstream of crossing).



Downstream view of channel entering lake downstream of Transect 3.

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	15	80
Cover Composition (% of Total)		
Large Woody Debris	5	0
Overhanging Vegetation	25	10
Instream Vegetation	70	10
Pool	0	50
Boulder	0	0
Undercut Bank	0	30
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Low	Moderate
Rearing	Low	Moderate
Overwinter	Low	Low
Migration	Low	Low
Large Bodied Fish		
Spawning	Low	Low
Rearing	Low	Low
Overwinter	Low	Low
Migration	Low	Low

Comments
The crossing site is located on the downstream side of an old passable beaver dam, draining a fen wetland area into an unnamed lake and ultimately draining into God's Lake nearly 3 km downstream of the crossing. Forage fish and large-bodied fish habitat is present downstream, towards the mouth of the tributary. Although the crossing site and upstream habitat contains soft substrate and instream vegetation, braiding and heavy vegetation of the channel results in poor connectivity, resulting in poor quality fish habitat.

+ Fish Sampling Data

Methods: Electrofishing

Fish Species Captured: Northern Pearl Dace

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 0.28
Distance to Major DS Waterbody (km): 2.90 (Gods Lake)
Connectivity: Yes - unlikely

Comments
The crossing site consists mainly of slow moving and pool habitat, dominated by organic substrates and instream vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: God's Lake

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – Gods Lake First Nation

Comments
This tributary is located in the traditional territories of the God's Lake First Nation and in close proximity to the community of God's Lake Narrows. The crossing drains a heavily vegetated fen which is poorly connected to an arm of God's Lake preventing access to upstream reaches by CRA fishery species.

Information Sources:

a – Manitoba Conservation and Water stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	Habitat at the crossing is suitable for forage fish and contributes to downstream areas that are suitable for Northern Pike. The crossing is 130 m from the mouth of a lake with potential to support overwintering large bodied fish.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat at the crossing is expected to contribute to the downstream CRA fishery as it supports a range of life requisites for forage fish and is connected to downstream habitats. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish is plentiful outside of the project footprint within the stream and in the region

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert

Effect	Pathway of Effect	Proposed Area Affected	Existing Area Affected	Loss/Gain
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	174 m^2	0 m^2	- 174 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (5.8 m).

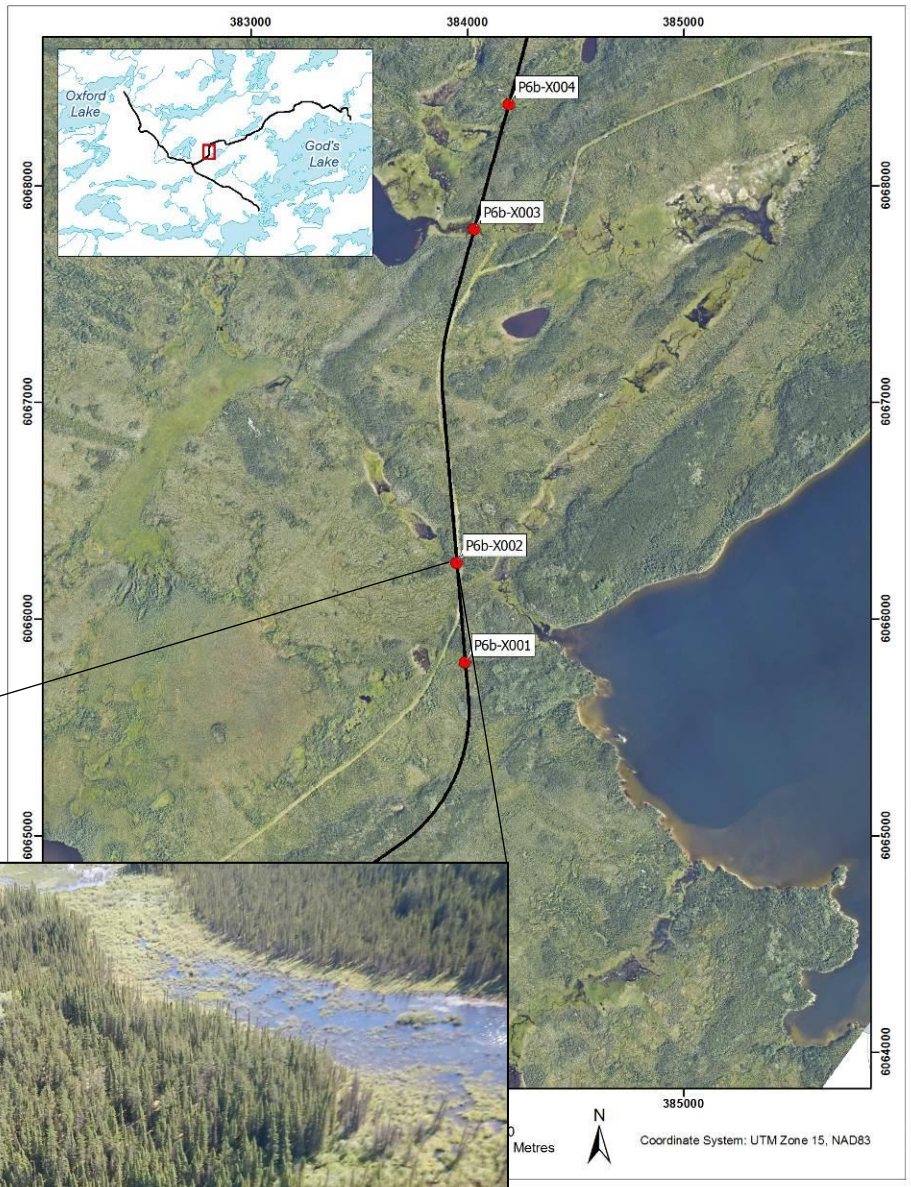
P6b-X002 Unnamed Tributary of Hawkins Lake

Location

Datum:	NAD 83
UTM:	15U 383950 6066261

General Morphology

Type:	Stream
Pattern:	Irregular Wandering
Channel Profile:	Notched
Sinuosity:	-
Confinement:	Occasionally Confined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 18, 2016
Discharge (m^3/s): 0.091
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	160 DS	60 DS	0	60 US	127 US
Channel and Flow					
Channel (m)	1.55	2.60	1.86	6.00	2.40
Wetted Width (m)	1.50	2.45	1.86	5.70	2.40
Depth at 25% (m)	0.35	0.30	0.40	0.10	0.30
Depth at 50% (m)	0.66	0.50	0.51	0.25	0.50
Depth at 75% (m)	0.65	0.35	0.45	0.30	0.35
Maximum Depth (m)	0.70	0.50	0.51	0.30	0.50
Gradient (%)	-	-	1	-	-
Banks					
Left Bank Height (m)	0.25	0.50	0.08	0.40	0.20
Right Bank Height (m)	0.20	-	0.08	0.50	0.40
Left Bank Shape	Undercut	Vertical	Undercut	Sloping	Vertical
Right Bank Shape	Undercut	Vertical	Undercut	Vertical	Vertical
Left Bank Materials	Fines/Clay	Fines/Veg	Fines/Veg	Fines	Fines
Right Bank Materials	Fines	-	Fines/Veg	Fines	Fines
Left Bank Stability	Moderate	Moderate	Moderate	High	Moderate
Right Bank Stability	Moderate	Moderate	Moderate	High	Moderate
Substrate Type and Distribution (%)					
Fines	60	75	75	98	100
Small Gravel	0	0	0	0	0
Large Gravel	0	0	0	0	0
Cobble	15	0	0	0	0
Boulder	25	25	25	2	0
Bedrock	0	0	0	0	0

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	20	10	16	10	42
Right Bank	26	10	18	8	36
Riparian Distance (m)					
Left Bank	5	1	16	1	-
Right Bank	5	1	18	1	3
Riparian Vegetation Type[a]	GRA/ SHR	CON/ SHR	GRA	CON/ SHR/ GRA	SHR/ GRA
Canopy Cover (%)	2	80	0	90	5

a – GRA = grass; SHR = Shrub; DEC = deciduous; CON = coniferous; MIX = mixed

+ Habitat Type

Transect	1	2	3	4	5
Pool	0	0	0	40	25
Riffle	0	50	0	40	0
Run	35	35	80	15	25
Chute	5	5	10	0	10
Boulder Garden	10	10	10	0	0
Backwater	50	0	0	5	40

+ Water Quality Data

Habitat:	-
Temperature (°C):	18.3
pH:	6.63
Turbidity (NTU):	105
Specific Conductance (µS/cm):	120
DO (mg/L):	7.90



Upstream view at crossing site (Transect 3).



Beaver dam upstream of transect 5.



Downstream view at crossing site (Transect 3).



Downstream view at beaver dam near transect 1.

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	-	-
Cover Composition (% of Total)		
Large Woody Debris	10	5
Overhanging Vegetation	70	40
Instream Vegetation	10	10
Pool	0	35
Boulder	5	5
Undercut Bank	5	5
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Moderate	High
Rearing	Moderate	High
Overwinter	Moderate	High
Migration	Moderate	High
Large Bodied Fish		
Spawning	Low	Moderate
Rearing	Low	Moderate
Overwinter	Low	Low
Migration	Low	Low

Comments
The crossing is situated 550 m upstream of Hawkins Lake and centered within a forested reach (150 m long) of the tributary. Cover is primarily riparian vegetation in this reach, with flowing water and sand/gravel/rock substrates suitable for small bodied fish. The stream becomes a fen stream within a broad inundated grass/shrub floodplain 75 m downstream of the crossing. Habitat within this reach is characterized by slow flowing water, pools, soft substrates and abundant instream vegetation suitable for the spawning, rearing and feeding by both small bodied fish and Northern Pike. The lake provides overwintering habitat for pike and other large bodied fish species. As series of beaver dams may hinder migration to the site.

+ Fish Sampling Data

Methods: electrofishing

Fish Species Captured: Brook Stickleback

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 6.55
Distance to Major DS Waterbody (km): 0.59 (Hawkins Lake)
Connectivity: Yes - unlikely

Comments
The crossing site is situated in a forested reach of the tributary. Habitat is characterized by coarse substrate, shallow fast flowing water with boulders and riparian vegetation provided the majority of the cover. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Hawkins Lake

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – Gods Lake First Nation

Comments
This unnamed tributary feeds into Hawkins Lake, within the traditional territories of Gods Lake First Nation. The stream downstream of the crossing provides suitable spawning, rearing and feeding habitat for Northern Pike.

Information Sources:

a – Manitoba Conservation and Water Stewardship Fisheries Branch - NE Region pers. comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The crossing itself does not contain direct habitat suitable for relevant species, however, habitat suitable for spawning, rearing and feeding of Northern Pike is present downstream.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable spawning, rearing and feeding habitat for relevant fish (e.g., Northern Pike) is situated outside of the project footprint within the stream and in the region. The habitat in the immediate crossing area is expected to support a range of life requisites for small bodied fish.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact, lack of direct habitat for relevant species, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert

Effect	Pathway of Effect	Proposed Area Affected	Existing Area Affected	Loss/Gain
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	55.8 m^2	0 m^2	- 55.8 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (1.86 m).

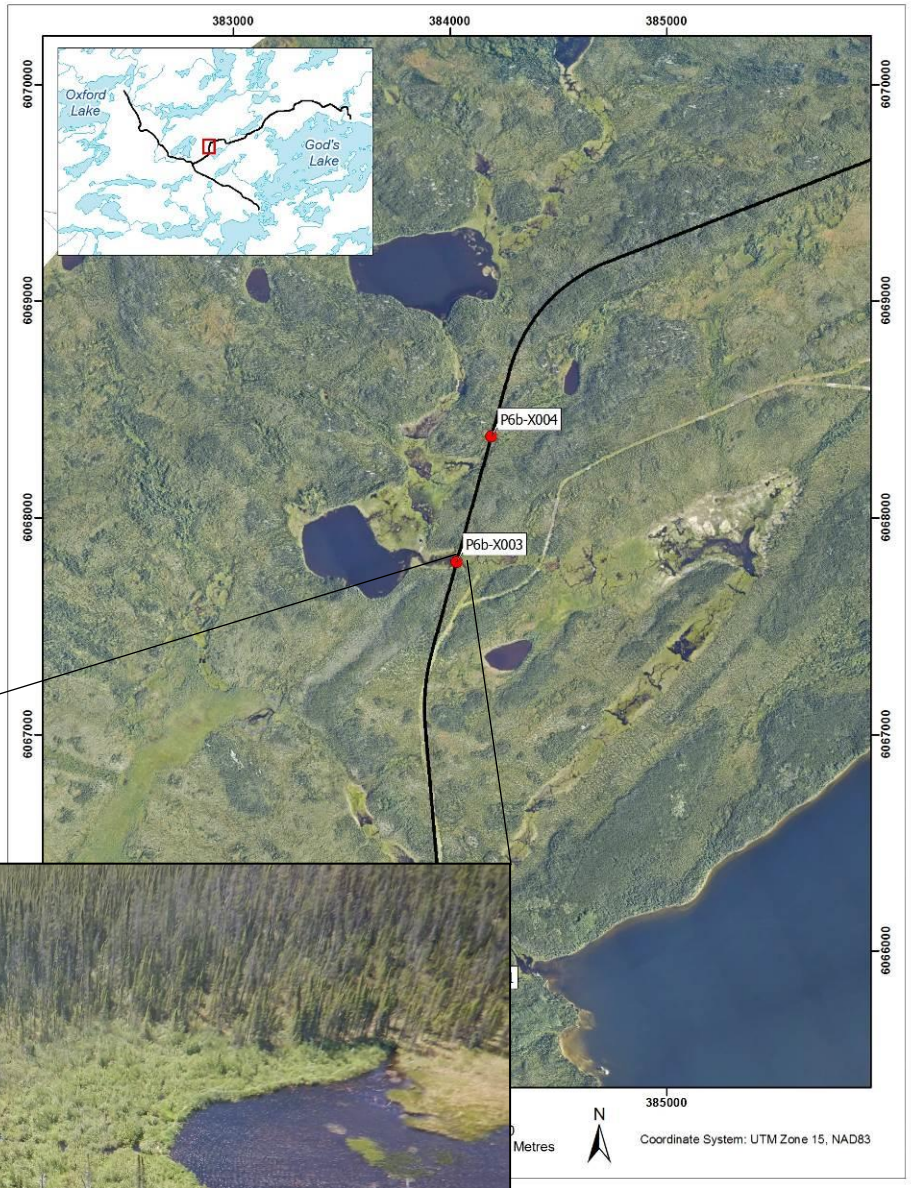
P6b-X003 Unnamed Tributary of Hawkins Lake

Location

Datum:	NAD 83
UTM:	15U 384030 6067799

General Morphology

Type:	Wetland
Pattern:	Braided
Channel Profile:	Planar
Sinuosity:	-
Confinement:	Unconfined
Flow Regime:	Perennial





Site Conditions

Survey Date:	June 18, 2016
Discharge (m^3/s):	-
Stage:	Moderate

+ Water Quality Data

Habitat:	Flat
Temperature (°C):	20.1
pH:	6.65
Turbidity (NTU):	-
Specific Conductance (µS/cm):	140
DO (mg/L):	8.75

+ Cover

	US	DS
Total Cover Available (%)	70	90
Cover Composition (% of Total)		
Large Woody Debris	5	5
Overhanging Vegetation	10	10
Instream Vegetation	5	5
Pool	60	65
Boulder	0	0
Undercut Bank	20	15
Surface Turbulence	0	0
Turbidity	0	0



Upstream view of large beaver pong habitat at crossing site.



Pond habitat where two Northern Pike were observed.



Downstream view of braided channel covered in shrub at crossing site.



View of left-hand bank from middle of beaver dam at crossing site.

Fish Presence

+ Fish Habitat Potential

Forage Fish	US	DS
Spawning	Moderate	Moderate
Rearing	Moderate	Moderate
Overwinter	Moderate	Low
Migration	Moderate	Low
Large Bodied Fish		
Spawning	Moderate	Low
Rearing	Moderate	Low
Overwinter	Low	Low
Migration	Low	Low

Comments
The alignment crosses a series of narrow channels within an inundated grass/shrub floodplain. Habitat is primarily a combination of pools and narrow low flow channels. Substrates are soft and cover consists of aquatic vegetation, suitable for supporting a range of life requisites, including spawning, rearing and feeding of forage fishes, and to a lesser degree Northern Pike. Overwintering may occur in the small upstream lake provided it is accessible. Access to the site from a small upstream lake is limited by the presence of a large beaver dam 50 m from the crossing site. Downstream, the habitat is the same, and a series of at least 13 beaver dams over a distance of nearly 4 km likely deters upstream migrations of fish from Hawkins Lake. Habitat consists of saturated grass/shrub floodplain with isolated pools of standing water. No connectivity observed between watercourse and downstream lake.

+ Fish Sampling Data

Methods: electrofishing, visual inspection

Fish Species Captured: Northern Pike

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 16.37
Distance to Major DS Waterbody (km): 3.99 (Hawkins Lake)
Connectivity: Yes - unlikely

Comments
The crossing site consists mainly of flat-water habitat, dominated by organic substrates and instream vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Hawkins Lake

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – Bunibonibee Cree Nation

Comments
While the crossing site is located within the traditional territory of the Bunibonibee Cree Nation the tributary feeds into Hawkins Lake, in the traditional territories of Gods Lake First Nation. The creek provides marginal spawning, rearing and feeding habitat for Northern Pike. Multiple ephemeral barriers downstream prohibit access to the site from the CRA fishery in Hawkins Lake.

Information Sources:

a – Manitoba Conservation and Water Stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	Habitat at the crossing site provides marginal habitat for life requisites of relevant species. Multiple ephemeral barriers (i.e., beaver dams) hinder access from Hawkins Lake; however access to the upstream lake is less impeded by beaver dams.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the immediate crossing area is expected to contribute minimally to the downstream and upstream CRA fishery. While it may support a range of life requisites for both forage fish and Northern Pike, including spawning, rearing and feeding access from larger waterbodies is restricted. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish (e.g., Northern Pike) is plentiful outside of the project footprint within the stream and in the region.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact, abundance of similar habitat within the system and lack of direct access by relevant species, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert

Effect	Pathway of Effect	Proposed Area Affected	Existing Area Affected	Loss/Gain
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	300 m^2	0 m^2	- 300 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)

2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (10 m). The stream consists of a broad floodplain with numerous braided channels. The affected instream area is highly dependent of the precise location of the crossing and the area provided is an estimate subject to refinement based on the precise crossing location.

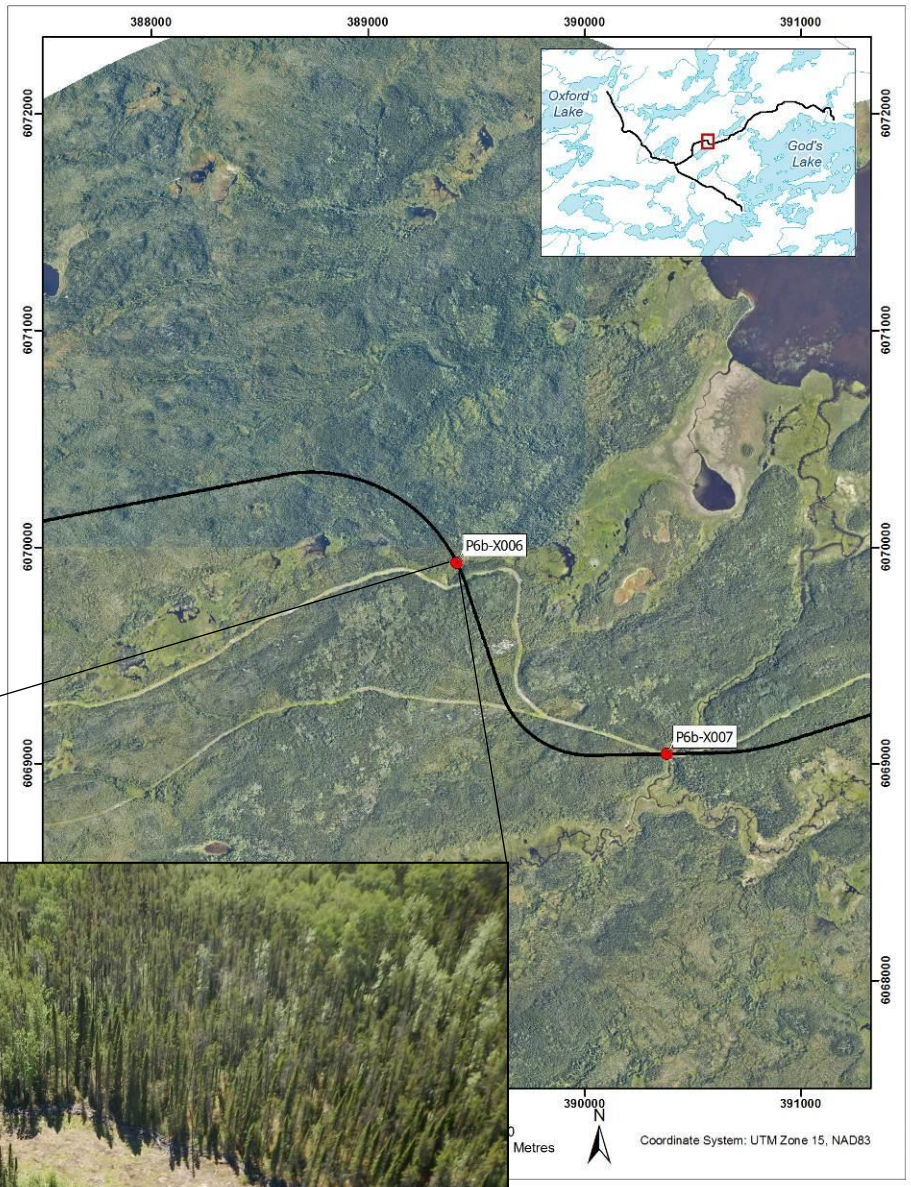
P6b-X006 Unnamed Tributary of Opaskaykow Lake

Location

Datum:	NAD 83
UTM:	15U 389409 6069930

General Morphology

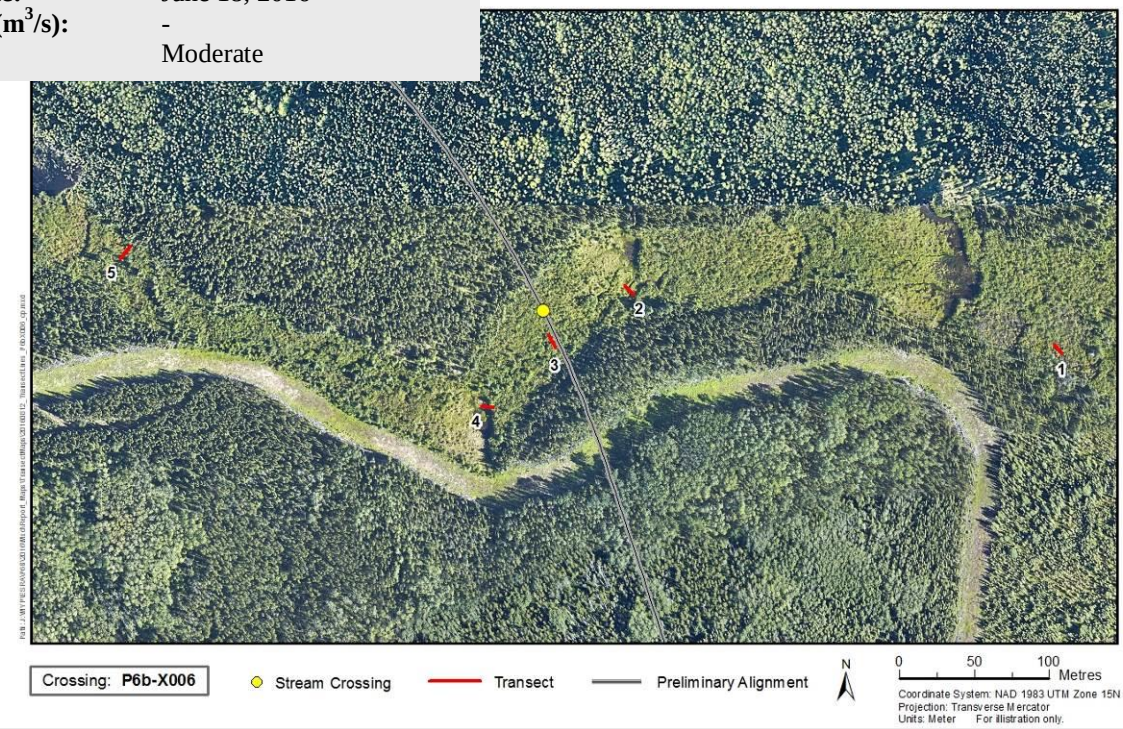
Type:	Stream
Pattern:	Irregular Wandering
Channel Profile:	Notched
Sinuosity:	-
Confinement:	Frequently Confined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 18, 2016
Discharge (m^3/s): -
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	350 DS	60 DS	23	60 US	280 US
Channel and Flow					
Channel (m)	2.50	1.55	0.62	0.75	6.90
Wetted Width (m)	2.38	1.57	0.6	0.75	6.90
Depth at 25% (m)	0.05	0.17	0.80	0.16	0.20
Depth at 50% (m)	0.20	0.22	0.40	0.19	0.36
Depth at 75% (m)	0.06	0.28	0.35	0.14	0.15
Maximum Depth (m)	0.20	0.30	0.40	0.19	0.36
Gradient (%)	-	-	-	-	-
Banks					
Left Bank Height (m)	0.05	0.45	0.50	0.45	0.05
Right Bank Height (m)	0.02	0.26	0.40	0.30	0.05
Left Bank Shape	Sloping	Undercut	Undercut	Vertical	Sloping
Right Bank Shape	Sloping	Undercut	Undercut	Vertical	Sloping
Left Bank Materials	Fines	Fines/Grv	Fines/Veg	Fines/Veg	Fines
Right Bank Materials	Fines	Fines/Grv	Fines/Veg	Fines/Veg	Fines
Left Bank Stability	Moderate	Moderate	High	Moderate	Moderate
Right Bank Stability	Moderate	Moderate	High	Moderate	Moderate
Substrate Type and Distribution (%)					
Fines	100	100	100	100	100
Small Gravel	0	0	0	0	0
Large Gravel	0	0	0	0	0
Cobble	0	0	0	0	0
Boulder	0	0	0	0	0
Bedrock	0	0	0	0	0

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	70	57	25	64	36
Right Bank	30	32	52	24	10
Riparian Distance (m)					
Left Bank	5	10	25	2	1
Right Bank	5	50	52	18	1
Riparian Vegetation Type[a]	SHR/ GRA	GRA/ SHR	GRA SHR	GRA/ SHR/	CON
Canopy Cover (%)	60	0	50	50	100

a – GRA = grass; SHR = Shrub; DEC = deciduous; CON = coniferous; MIX = mixed

+ Habitat Type

Transect	1	2	3	4	5
Pool	0	0	0	45	10
Riffle	0	0	0	10	10
Run	100	100	100	45	45
Dam	0	0	0	0	5
Boulder Garden	0	0	0	0	0
Backwater	0	0	0	0	30

+ Water Quality Data

Habitat:	Run
Temperature (°C):	18.2
pH:	6.86
Turbidity (NTU):	145
Specific Conductance (µS/cm):	166
DO (mg/L):	7.55



Upstream view at crossing site (Transect 3).



Upstream view at Transect 4 (60 m upstream of crossing site).



Downstream view at crossing site (Transect 3).



Downstream view at Transect 5 (280 m upstream from crossing site).

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	80	75
Cover Composition (% of Total)		
Large Woody Debris	4	3
Overhanging Vegetation	40	46
Instream Vegetation	16	11
Pool	0	13
Boulder	0	0
Undercut Bank	40	27
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Moderate	Moderate
Rearing	Moderate	Moderate
Overwinter	Moderate	Moderate
Migration	Low	Low
Large Bodied Fish		
Spawning	Low	Low
Rearing	Low	Low
Overwinter	Low	Low
Migration	Low	Low

Comments
The unnamed creek is a small tributary of Opaskaykow Lake. The creek is heavily impacted by beaver dams w ith several dams downstream from the crossing that may restrict fish passage from Opaskaykow Lake -to the crossing site. The stream crossing site is narrow (<1 m) and shallow within a broad marshy floodplain with dense alder. Based on poor connectivity (numerous downstream dams) and relatively small channel in areas downstream from the crossing, the crossing site is considered marginal fish habitat. The habitat is suitable for spawning, rearing and feeding by forage fish species. Large bodied fish use is not expected.

+ Fish Sampling Data

Methods: Electrofishing, dipnetting

Fish Species Captured: Brook Stickleback

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 3.68
Distance to Major DS Waterbody (km): 2.14 (Opaskaykow Lake)
Connectivity: Yes - unlikely

Comments
The crossing site consists mainly of pool habitat, dominated by fine substrate within a narrow channel. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Opaskaykow Lake

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – Gods Lake First Nation

Comments
The crossing is located on an unnamed perennial stream 2.14 km upstream of Opaskaykow Lake, within the traditional territories of Gods Lake First Nation. The creek provides habitat for forage fish, but large-bodied species such as Northern Pike are not expected to access the crossing area.

Information Sources:

a – Manitoba Conservation and Water stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The crossing itself does not contain direct habitat suitable for relevant species, however, habitat suitable for spawning, rearing and feeding of Northern Pike is present downstream.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable spawning, rearing and feeding habitat for relevant fish (e.g., Northern Pike) is situated outside of the project footprint within the stream and in the region. The habitat in the immediate crossing area is expected to support a range of life requisites for small bodied fish.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact, lack of direct habitat for relevant species, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert

Effect	Pathway of Effect	Proposed Area Affected	Existing Area Affected	Loss/Gain
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	18.6 m^2	0 m^2	- 18.6 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (0.62 m).

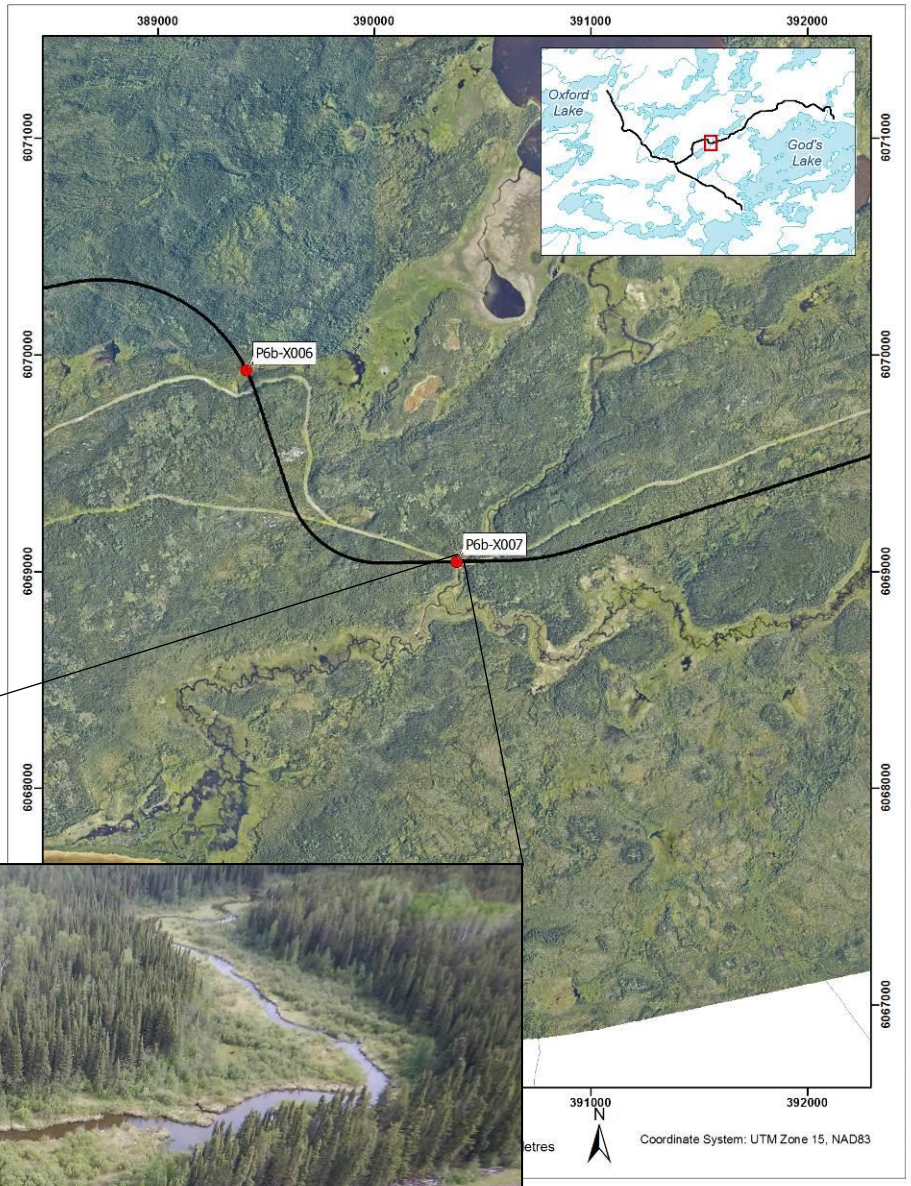
P6b-X007 Unnamed Tributary of Opaskaykow Lake

Location

Datum:	NAD 83
UTM:	15U 390380 6069047

General Morphology

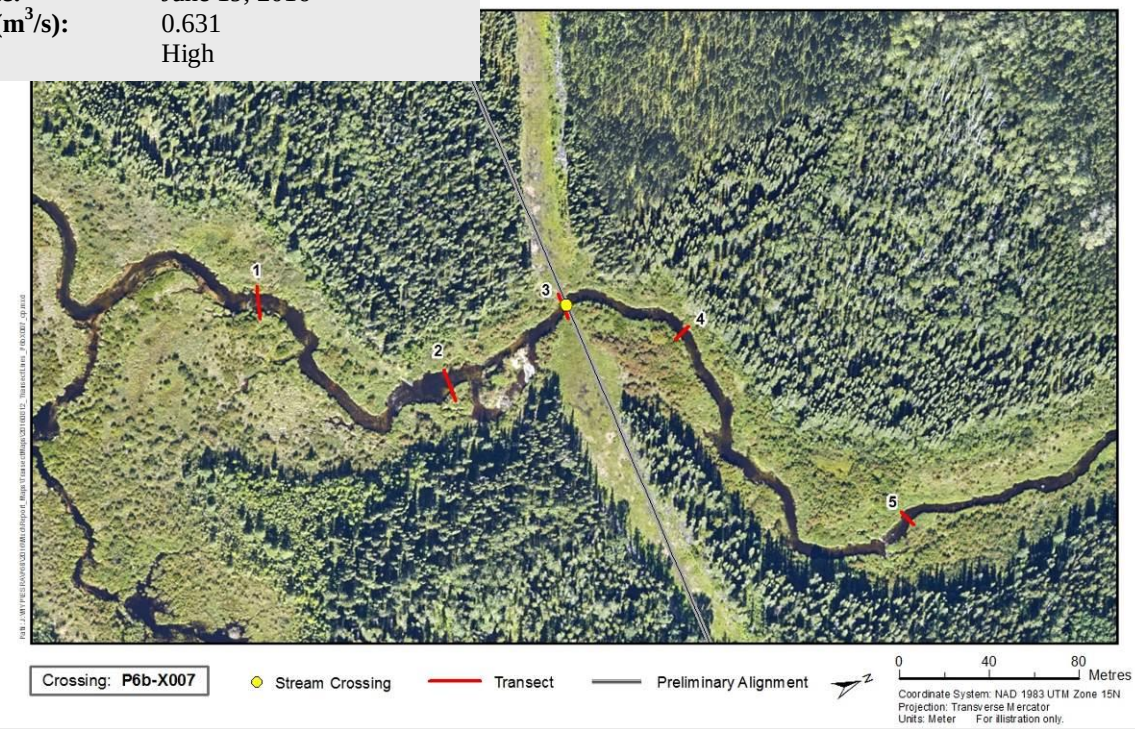
Type:	Stream
Pattern:	Irregular Wandering
Channel Profile:	U-shaped
Sinuosity:	-
Confinement:	Occasionally Confined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 19, 2016
Discharge (m^3/s): 0.631
Stage: High



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	160 US	60 US	0	60 DS	200 DS
Channel and Flow					
Channel (m)	11.6	10.1	5.4	4.6	5.1
Wetted Width (m)	9.5	9.8	5.1	4.2	4.7
Depth at 25% (m)	0.75	-	-	-	-
Depth at 50% (m)	0.70	-	-	-	-
Depth at 75% (m)	0.88	-	-	-	-
Maximum Depth (m)	0.92	-	-	-	-
Gradient (%)	0.5	1	0.5	0.5	1
Banks					
Left Bank Height (m)	0.4	0.6	0.7	0.5	0.3
Right Bank Height (m)	0.6	0.7	0.6	0.8	0.3
Left Bank Shape	Vertical	Vertical	Vertical	Vertical	Sloping
Right Bank Shape	Vertical	Vertical	Vertical	Vertical	Sloping
Left Bank Materials	Organics	Organics	Organics	Organics	Organics
Right Bank Materials	Organics	Organics	Organics	Organics	Organics
Left Bank Stability	Moderate	Moderate	Moderate	Moderate	Low
Right Bank Stability	Moderate	Moderate	Moderate	Moderate	Low
Substrate Type and Distribution (%)					
Fines	60	60	-	-	35
Small Gravel	15	20	-	-	10
Large Gravel	5	10	-	-	10
Cobble	5	0	-	-	20
Boulder	15	0	-	-	25
Bedrock	0	10	-	-	0

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	2.2	5.5	-	1.1	3.5
Right Bank	3.5	6.2	-	0.5	3.0
Riparian Distance (m)					
Left Bank	6.5	7.5	-	7.0	8.4
Right Bank	40.0	8.0	-	2.5	2.6
Riparian Vegetation Type[a]	SHR/ DEC/ GRA	MIX	-	SHR/ CON	SHR/ DEC
Canopy Cover (%)	0	5	0	5	0

a – GRA = grass; SHR = Shrub; DEC = deciduous; CON = coniferous; MIX = mixed

+ Habitat Type

Transect	1	2	3	4	5
Flat	0	0	0	0	0
Pool	0	25	0	0	0
Rapid	0	0	0	0	0
Riffle	0	15	0	0	10
Run	100	60	100	100	90
Cascade	0	0	0	0	0

+ Water Quality Data

Habitat:	Run
Temperature (°C):	17.6
pH:	6.94
Turbidity (NTU):	-
Specific Conductance (µS/cm):	155
DO (mg/L):	7.32



Downstream view at crossing site (Transect 3).



Gillnet panel set across channel near Transect 2.



Upstream view at crossing site (Transect 3).



Riffles flowing over old beaver dam upstream of Transect 5.

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	100	100
Cover Composition (% of Total)		
Large Woody Debris	15	4
Overhanging Vegetation	1	1
Instream Vegetation	15	10
Pool	50	70
Boulder	5	0
Undercut Bank	14	10
Surface Turbulence	0	5
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	High	High
Rearing	High	High
Overwinter	High	High
Migration	High	High
Large Bodied Fish		
Spawning	High	High
Rearing	High	High
Overwinter	Moderate	High
Migration	High	High

Comments
The crossing is located on a 4 km perennial stream connecting Hawkins Lake to Opaskaykow Lake and receives water from a stream upstream of the crossing. Habitat within the crossing area and the entire study reach consists largely of run habitat with substrated dominated by fines but including some coarse material, and abundant instream vegetation. This habitat supports a range of life requisites for Northern Pike and forage fish, including spawning, rearing and feeding and may be used by other large-bodied species such as Walleye and suckers. Though fish species may overwinter within the reach, the lakes are better suited for overwintering of large bodied species.

+ Fish Sampling Data

Methods: electrofishing, gillnetting

Fish Species Captured: Burbot

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled.

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 134.31
Distance to Major DS Waterbody (km): 2.43 (Opaskaykow Lake)
Connectivity: Yes

Comments
The crossing site consists mainly of runr habitat, dominated by fine substrates, instream vegetation and some coarse bed material. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: Opaskaykow Lake

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – Gods Lake First Nation

Comments
The crossing is located on an unnamed perennial stream 2.43 km upstream of Opaskaykow Lake, within the traditional territories of Gods Lake First Nation. The creek provides suitable spawning, rearing and feeding habitat for Northern Pike and possibly supports other large-bodies species.

Information Sources:

a – Manitoba Conservation and Water stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The crossing contains habitat suitable for spawning, rearing and feeding of Northern Pike and other large-bodied species of fish.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the immediate crossing area is expected to contribute to the downstream CRA fishery as it supports a range of life requisites for both forage fish and Northern Pike, including spawning, rearing and feeding. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish (i.e., Northern Pike) is plentiful outside of the project footprint within the stream and in the region.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert

Effect	Pathway of Effect	Proposed Area Affected	Existing Area Affected	Loss/Gain
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	162 m^2	0 m^2	- 162 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (5.4 m).

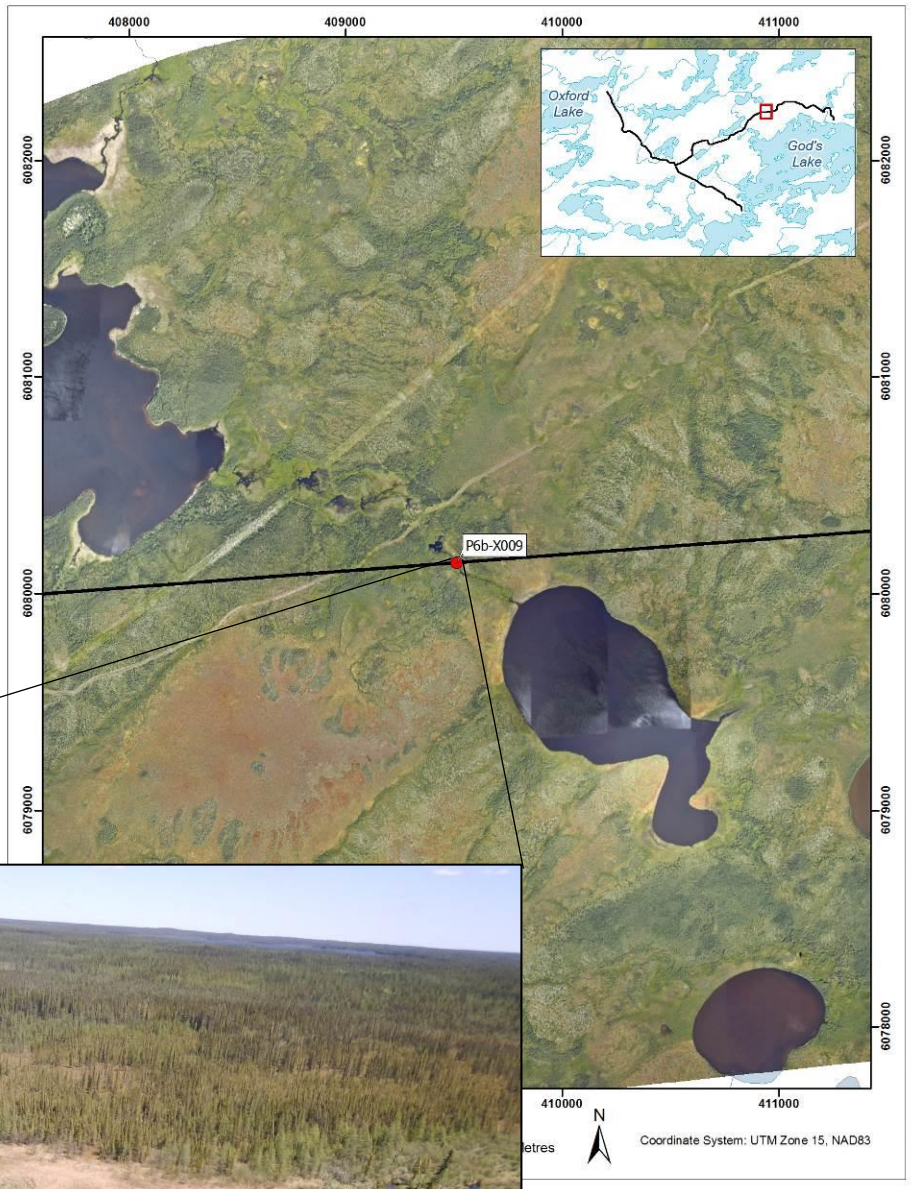
P6b-X009 Unnamed Tributary of Tapper Lake

Location

Datum:	NAD 83
UTM:	15U 409513 6080144

General Morphology

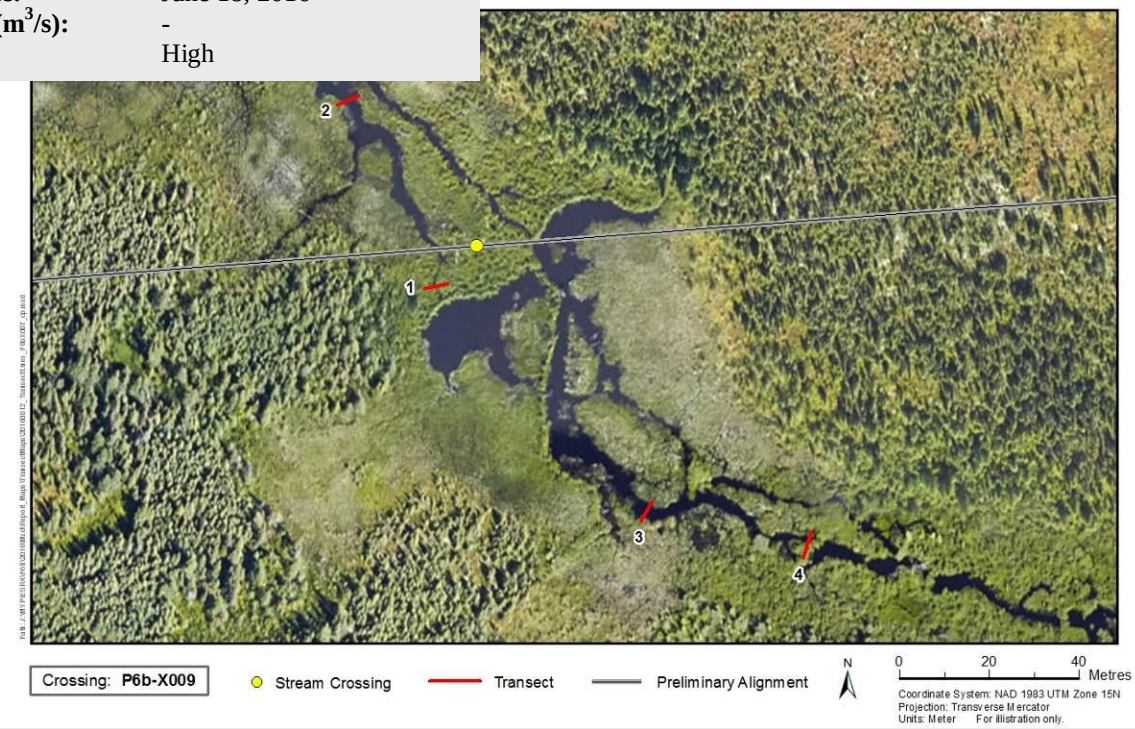
Type:	Stream
Pattern:	Sinuous
Channel Profile:	U-shape
Sinuosity:	-
Confinement:	Unconfined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 18, 2016
Discharge (m^3/s): -
Stage: High



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	0	40DS	75US	100US	-
Channel and Flow					
Channel (m)	1.2	4.2	3.2	3.1	-
Wetted Width (m)	1.0	3.7	2.8	2.4	-
Depth at 25% (m)	0.72	0.40	0.38	0.27	-
Depth at 50% (m)	0.79	1.10	0.54	0.51	-
Depth at 75% (m)	0.85	0.81	0.49	0.18	-
Maximum Depth (m)	0.86	1.15	0.59	0.58	-
Gradient (%)	-	-	-	-	-
Banks					
Left Bank Height (m)	-	-	-	-	-
Right Bank Height (m)	-	-	-	-	-
Left Bank Shape	Sloping	Sloping	Sloping	Sloping	-
Right Bank Shape	Sloping	Sloping	Sloping	Sloping	-
Left Bank Materials	Organics	Organics	Organics	Organics	-
Right Bank Materials	Organics	Organics	Organics	Organics	-
Left Bank Stability	Low	Low	Low	Low	-
Right Bank Stability	Low	Low	Low	Low	-
Substrate Type and Distribution (%)					
Fines	100	100	100	100	-
Small Gravel	0	0	0	0	-
Large Gravel	0	0	0	0	-
Cobble	0	0	0	0	-
Boulder	0	0	0	0	-
Bedrock	0	0	0	0	-

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	2.0	60.0	8.0	1.8	-
Right Bank	12.0	7.0	8.1	2.4	-
Riparian Distance (m)					
Left Bank	6.0	85.0	25.0	18.0	-
Right Bank	30.0	31.0	9.0	7.0	-
Riparian Vegetation Type[a]	CON/ GRA	CON/ GRA	SHR/ GRA/ CON	SHR/ GRA	-
Canopy Cover (%)	10	5	5	5	-

a – GRA = grass; SHR = Shrub; DEC = deciduous; CON = coniferous; MIX = mixed

+ Habitat Type

Transect	1	2	3	4	5
Impoundment	100	100	100	100	-
Pool	0	0	0	0	-
Rapid	0	0	0	0	-
Riffle	0	0	0	0	-
Run	0	0	0	0	-
Cascade	0	0	0	0	-

+ Water Quality Data

Habitat:	Impoundment
Temperature (°C):	23.5
pH:	6.47
Turbidity (NTU):	-
Specific Conductance (µS/cm):	102
DO (mg/L):	7.86



Upstream view at crossing site (Transect 1) from base of beaver dam.



Downstream view of channel separation at Transect 2.



Downstream view at crossing site (Transect 1).



Downstream view of primary tributary channel at Transect 3.

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	90	100
Cover Composition (% of Total)		
Large Woody Debris	1	0
Overhanging Vegetation	4	5
Instream Vegetation	5	15
Pool	75	60
Boulder	0	0
Undercut Bank	15	20
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	Moderate	Moderate
Rearing	Moderate	Moderate
Overwinter	Moderate	Moderate
Migration	Low	Low
Large Bodied Fish		
Spawning	Low	Low
Rearing	Low	Low
Overwinter	Low	Low
Migration	Low	Low

Comments
The crossing is located on a stream connecting a small unnamed lake, upstream, to Tapper Lake. The reach has similar habitat both upstream and downstream of the crossing, consisting of flat water, organic substrates and instream vegetation, suitable for a range of life requisites for forage fish and Northern Pike, including spawning, rearing and feeding. The stream is heavily impacted by beavers; four dams downstream (120 m, 340 m, 680 m and 1.2 km) and one upstream (25 m) precludes migrations of Northern Pike to the crossing site, except perhaps during high water events. Overwintering of small bodied fish tolerant of low oxygen conditions may occur in the study reach, but Northern Pike would overwinter in the source and receiving lakes.

+ Fish Sampling Data

Methods: Electrofisher

Fish Species Captured: Fathead Minnow, Brook Stickleback

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled; unsuitable habitat

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 16.92
Distance to Major DS Waterbody (km): 1.32 (Tapper Lake)
Connectivity: Yes - Unlikely

Comments
The crossing site consists mainly of flat-water habitat, dominated by organic substrates and instream vegetation. This type of habitat is not considered rare or unique within the project area. Connectivity to Tapper Lake is limited as there are at least four intact beaver dams downstream of the crossing site.

+ Fishery

Fishery Area: Tapper Lake

Fishery Users:

Commercial[a]	No
Recreational	No
Aboriginal	Yes – Gods Lake First Nation

Comments
The crossing is located on an unnamed tributary, within the traditional territories of Gods Lake First Nation. Contributions to a CRA fishery is limited to the upstream unnamed lake, as the creek provides suitable spawning, rearing and feeding habitat for Northern Pike within the reach upstream of the crossing site. Downstream connectivity is limited by the presence of four intact beaver dams over a distance of 1.36 km. Migrations of Northern Pike from Trapper Lake are not expected.

Information Sources:

a – Manitoba Conservation and Water stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The study reach upstream of the crossing contains accessible habitat suitable for spawning, rearing and feeding of Northern Pike.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the crossing reach is expected to contribute to the upstream CRA fishery as it supports a range of life requisites for both forage fish and Northern Pike, including spawning, rearing and feeding. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish (e.g., Northern Pike) is plentiful outside of the project footprint within the stream and in the region.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert				
Effect	**Pathway of Effect**	**Proposed Area Affected**	**Existing Area Affected**	**Loss/Gain**
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	36 m^2	0 m^2	- 36 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (1.2 m).

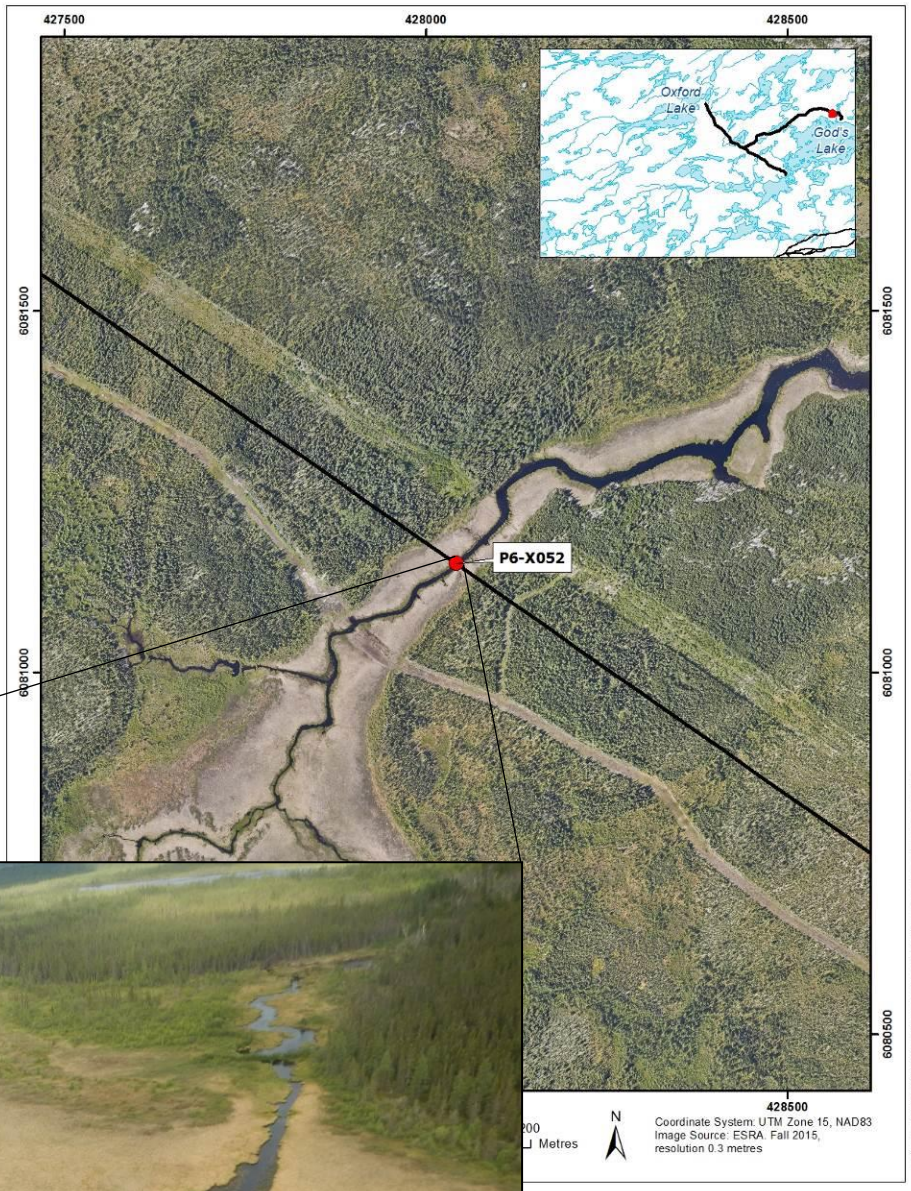
P6b-X013 Unnamed Tributary of God's River

Location

Datum:	NAD 83
UTM:	15U 428031 6081141

General Morphology

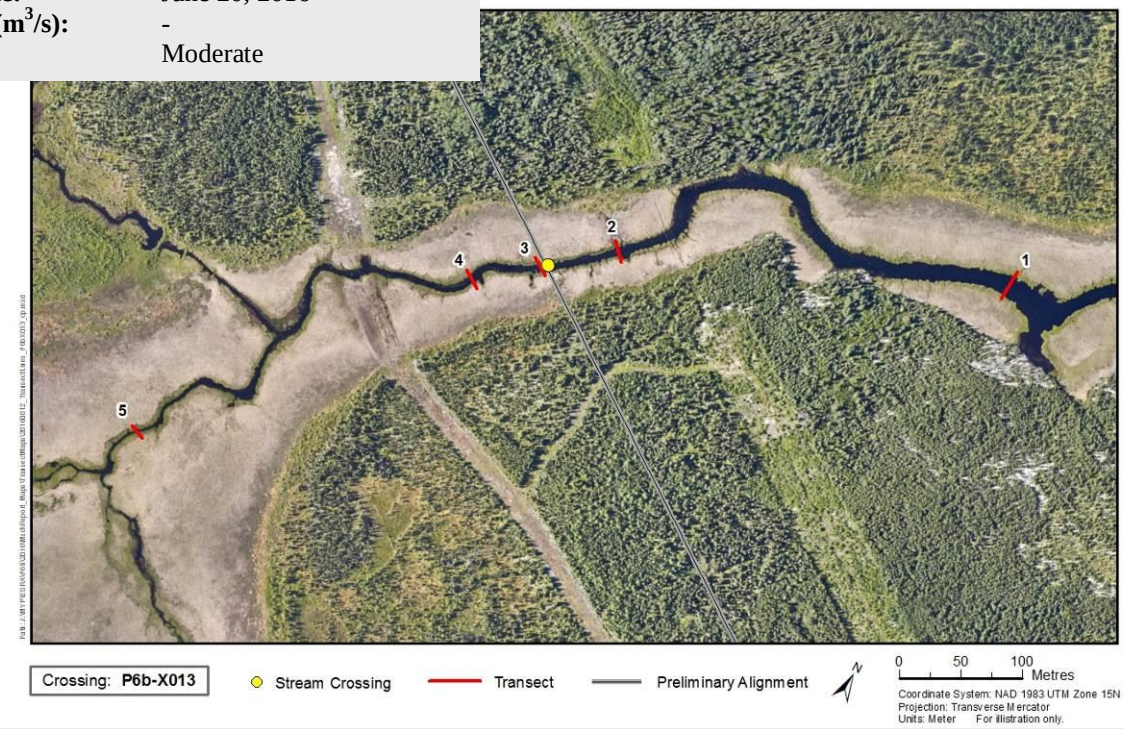
Type:	Stream
Pattern:	Regular Meanders
Channel Profile:	U-shape
Sinuosity:	-
Confinement:	Frequently Confined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 20, 2016
Discharge (m^3/s): -
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	~400 DS	66 DS	0	60 US	356 US
Channel and Flow					
Channel (m)	18	9	7	9	3
Wetted Width (m)	18	9	7	9	3
Depth at 25% (m)	0.50	0.32	0.30	0.11	0.10
Depth at 50% (m)	0.90	1.20	1.00	1.52	1.80
Depth at 75% (m)	0.74	0.10	0.21	0.16	0.10
Maximum Depth (m)	0.90	1.20	1.00	-	1.80
Gradient (%)	-	-	-	-	-
Banks					
Left Bank Height (m)	0.05	0.05	0.00	0.05	0.05
Right Bank Height (m)	0.05	0.05	0.00	0.05	0.05
Left Bank Shape	Vertical	Sloping	Vertical	Vertical	Vertical
Right Bank Shape	Vertical	Sloping	Sloping	Vertical	Vertical
Left Bank Materials	Fines/Organics	Fines/Organics	Fines/Organics	Fines/Organics	Fines/Organics
Right Bank Materials	Fines/Organics	Fines/Organics	Fines/Organics	Fines/Organics	Fines/Organics
Left Bank Stability	Moderate	Moderate	Moderate	Moderate	Moderate
Right Bank Stability	Moderate	Moderate	Moderate	Moderate	Moderate
Substrate Type and Distribution (%)					
Fines	100	100	100	100	100
Small Gravel	0	0	0	0	0
Large Gravel	0	0	0	0	0
Cobble	0	0	0	0	0
Boulder	0	0	0	0	0
Bedrock	0	0	0	0	0

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	25	30	40	150	35
Right Bank	40	55	54	100	50
Riparian Distance (m)					
Left Bank	25	25	30	150	30
Right Bank	35	50	44	100	45
Riparian Vegetation Type[a]	GRA	GRA	GRA/ SHR	GRA/ SHR	GRA/ SHR
Canopy Cover (%)	0	0	0	0	0

a – GRA = grass; SHR = Shrub; DEC = deciduous; CON = coniferous; MIX = mixed

+ Habitat Type

Transect	1	2	3	4	5
Flat	0	0	0	0	0
Pool	20	20	0	0	0
Rapid	0	0	0	0	0
Riffle	0	0	0	0	0
Run	80	80	100	100	100
Cascade	0	0	0	0	0

+ Water Quality Data

Habitat:	Run
Temperature (°C):	14.23
pH:	6.84
Turbidity (NTU):	92
Specific Conductance (µS/cm):	115
DO (mg/L):	5.72



Upstream view at crossing site (Transect 3).



Looking upstream from Transect 1 – a bedrock outcrop is visible in the background.



Downstream view at crossing site (Transect 3).



Looking downstream from Transect 4.

Site Conditions Continued

+ Bathymetric Map



Note: This map is intend Note: This map is intended for fish habitat assessments. It should not be used for navigation or design purposes.

+ Substrate Map



Note: This map is intend Note: This map is intended for fish habitat assessments. It should not be used for navigation or design purposes.

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	5	5
Cover Composition (% of Total)		
Large Woody Debris	5	2
Overhanging Vegetation	5	3
Instream Vegetation	80	80
Pool	5	10
Boulder	0	0
Undercut Bank	5	5
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	High	High
Rearing	High	High
Overwinter	Moderate	Moderate
Migration	Moderate	Moderate
Large Bodied Fish		
Spawning	Moderate	Moderate
Rearing	Moderate	Moderate
Overwinter	Moderate	Moderate
Migration	Moderate	Moderate

Comments
The crossing is located 520 m upstream of the stream's confluence with the God's River. Habitat within the study reach and at the crossing site is suitable for fulfilling the life requisites of forage fish and Northern Pike, including spawning, rearing and feeding. The channel flows through a broad grassy floodplain draining a small unnamed lake upstream. The habitat is characterized by slow flowing water over silt substrate and instream vegetation for cover.

+ Fish Sampling Data

Methods: Gillnetting

Fish Species Captured: none

Existing Information: none

Mussel Presence

+ Mussel Sampling Data

Methods: Not sampled

Mussel Species Captured: -

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 9.87
Distance to Major DS Waterbody (km): 0.76 (Gods River)
Connectivity: Yes

Comments
The crossing site consists mainly of run habitat, dominated by fine substrates and instream vegetation. This type of habitat is not considered rare or unique within the project area.

+ Fishery

Fishery Area: God's River

Fishery Users:

Commercial[a]	No
Recreational	Yes – Fishing Lodge (God's River Lodge)
Aboriginal	Yes – Manto Sipi Cree Nation

Comments
This unnamed tributary feeds into the Gods River, within the traditional territories of Manto Sipi Cree Nation. The creek provides suitable spawning, rearing and feeding habitat for Northern Pike.

Information Sources:

a – Manitoba Conservation and Water stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Culvert[a]
Diameter (mm)	TBD
Length (m)	30 m
Number of Barrels	TBD
Provision of Fish Passage	Yes

Information Sources:

a –pers. comm. ESRA.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The crossing contains habitat suitable for spawning, rearing and feeding of Northern Pike.
Species at Risk Present	No	No known species at risk.

+ Impacts to Fish and Fish Habitat

Type	Culvert construction and operation
Minor Impact List	No
Residual Impact	Channel infilling within the footprint of the culvert Habitat alteration from rip rap placement at culvert inlet and outlet

Attribute	Rating	Comment
Extent of Impact	Low	The infill of the stream bed and rip rap placement is restricted to the culvert site.
Duration of Impact	High	The infill and rip rap will be in place for approximately 50 years.
Availability & Condition	Low	The affected habitat is common and widespread within the system and the region.
Impact on Relevant Fish	Low	The habitat in the immediate crossing area is expected to contribute to the downstream CRA fishery as it supports a range of life requisites for both forage fish and Northern Pike, including spawning, rearing and feeding. Habitat impacts are expected to have no measurable effect on the CRA fishery productivity as suitable habitat for relevant fish (e.g., Northern Pike) is plentiful outside of the project footprint within the stream and in the region.

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Culvert

Type of Structure: Culvert				
Effect	**Pathway of Effect**	**Proposed Area Affected**	**Existing Area Affected**	**Loss/Gain**
Instream Alteration	None[1]	0 m^2	0 m^2	0 m^2
Instream Destruction	Footprint[2]	210 m^2	0 m^2	- 210 m^2

1 – Any habitat alterations due to rip rap included in footprint (i.e., destruction)
2 – Area calculated using length of crossing (30 m proposed) and the channel width at the crossing (7 m).

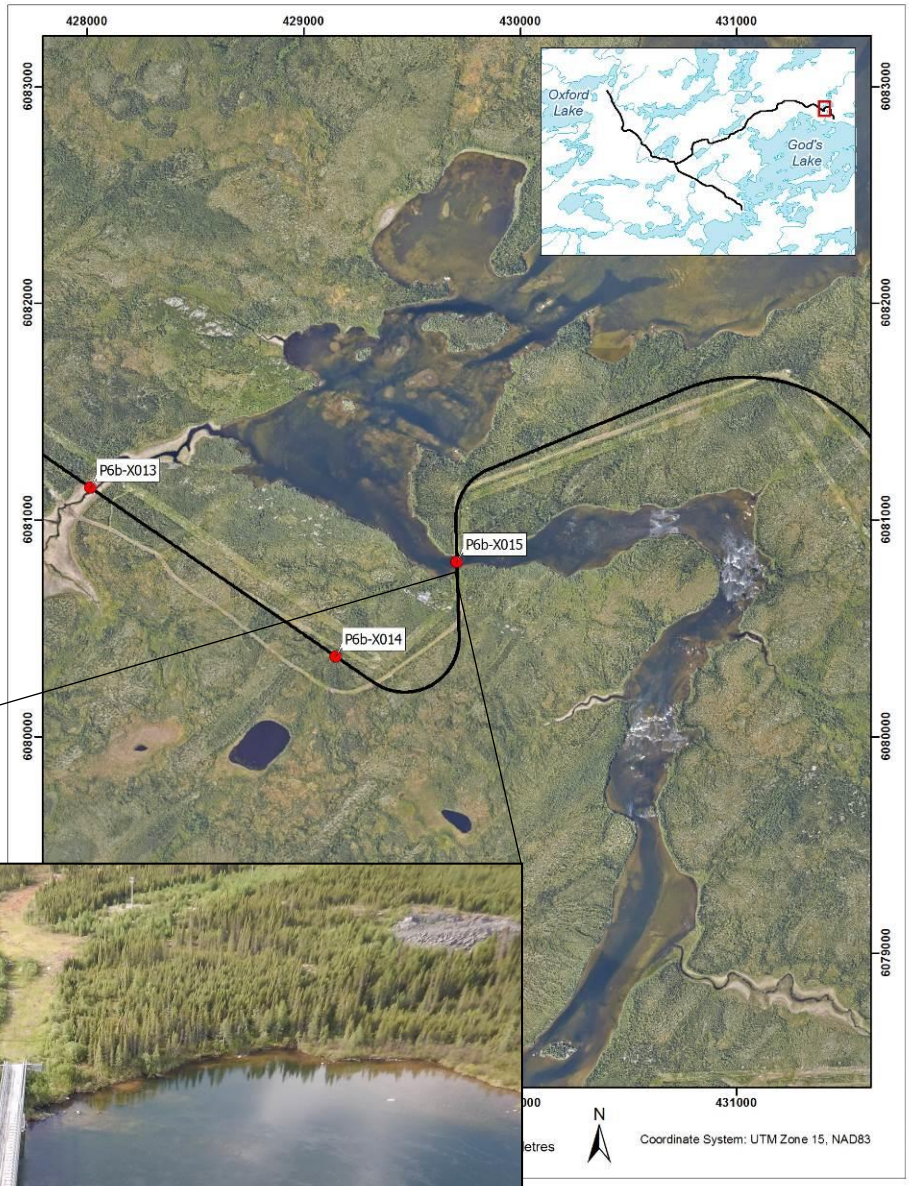
P6b-X015 God's River

Location

Datum:	NAD 83
UTM:	15U 429706 6080809

General Morphology

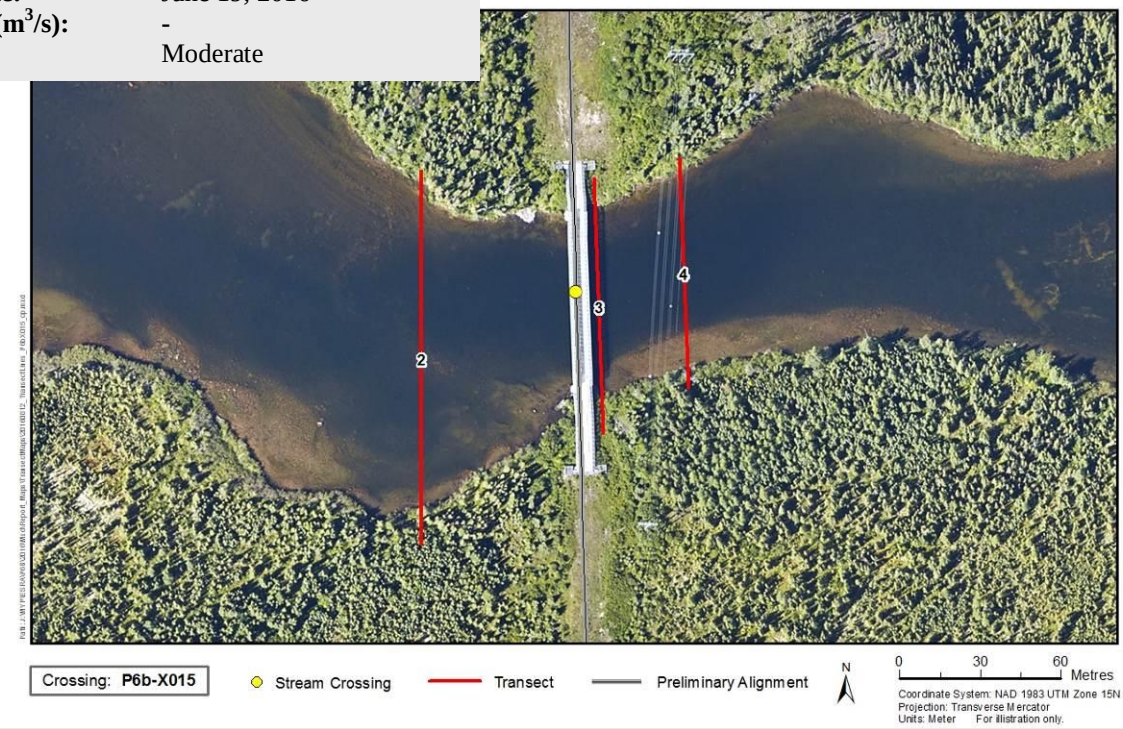
Type:	River
Pattern:	Sinuous
Channel Profile:	U-shape
Sinuosity:	-
Confinement:	Confined
Flow Regime:	Perennial





Site Conditions

Survey Date: June 19, 2016
Discharge (m^3/s): -
Stage: Moderate



+ Physical Channel Data

Transect	**1**	**2**	**3**	**4**	**5**
Distance from Crossing[a] (m)	-	60 DS	0	60 US	-
Channel and Flow					
Channel (m)	-	98	97	103	-
Wetted Width (m)	-	98	97	103	-
Depth at 25% (m)	-	-	-	-	-
Depth at 50% (m)	-	-	-	-	-
Depth at 75% (m)	-	-	-	-	-
Maximum Depth (m)	-	-	-	-	-
Gradient (%)	-	-	-	-	-
Banks					
Left Bank Height (m)	-	0.8	1.2	0.7	-
Right Bank Height (m)	-	0.8	1.2	0.6	-
Left Bank Shape	-	Undercut	Sloping	Vertical	-
Right Bank Shape	-	Vertical	Sloping	Vertical	-
Left Bank Materials	-	Organics, Fines	Cobble	Gravel, Fines	-
Right Bank Materials	-	Organics, Fines	Fines	Bedrock	-
Left Bank Stability	-	Moderate	Moderate	Moderate	-
Right Bank Stability	-	Moderate	Moderate	Moderate	-
Substrate Type and Distribution (%)					
Fines	-	15	10	25	-
Small Gravel	-	10	5	15	-
Large Gravel	-	5	5	15	-
Cobble	-	50	45	30	-
Boulder	-	10	20	10	-
Bedrock	-	10	15	5	-

a – US = upstream from crossing; DS = downstream from crossing.

Site Conditions Continued

+ Riparian Area/Floodplain

Transect	1	2	3	4	5
Floodplain Distance (m)					
Left Bank	-	2	2	5	-
Right Bank	-	2	2	5	-
Riparian Distance (m)					
Left Bank	-	2	2	5	-
Right Bank	-	2	2	5	-
Riparian Vegetation Type[a]					
	-	GRA/ SHR/ CON	SHR/ GRA	CON/ SHR/ GRA	-
Canopy Cover (%)					
	-	-	-	0	-

a – GRA = grass; SHR = Shrub; DEC = deciduous; CON = coniferous; MIX = mixed

+ Habitat Type

Transect	1	2	3	4	5
Flat	-	0	0	0	-
Pool	-	30	50	35	-
Rapid	-	0	0	0	-
Riffle	-	30	0	30	-
Run	-	40	50	35	-
Cascade	-	0	0	0	-

+ Water Quality Data

Habitat:	Run
Temperature (°C):	15.40
pH:	7.68
Turbidity (NTU):	97
Specific Conductance (µS/cm):	118
DO (mg/L):	8.86



Upstream view at crossing site (Transect 3).



Example of gravel shoreline at crossing site.



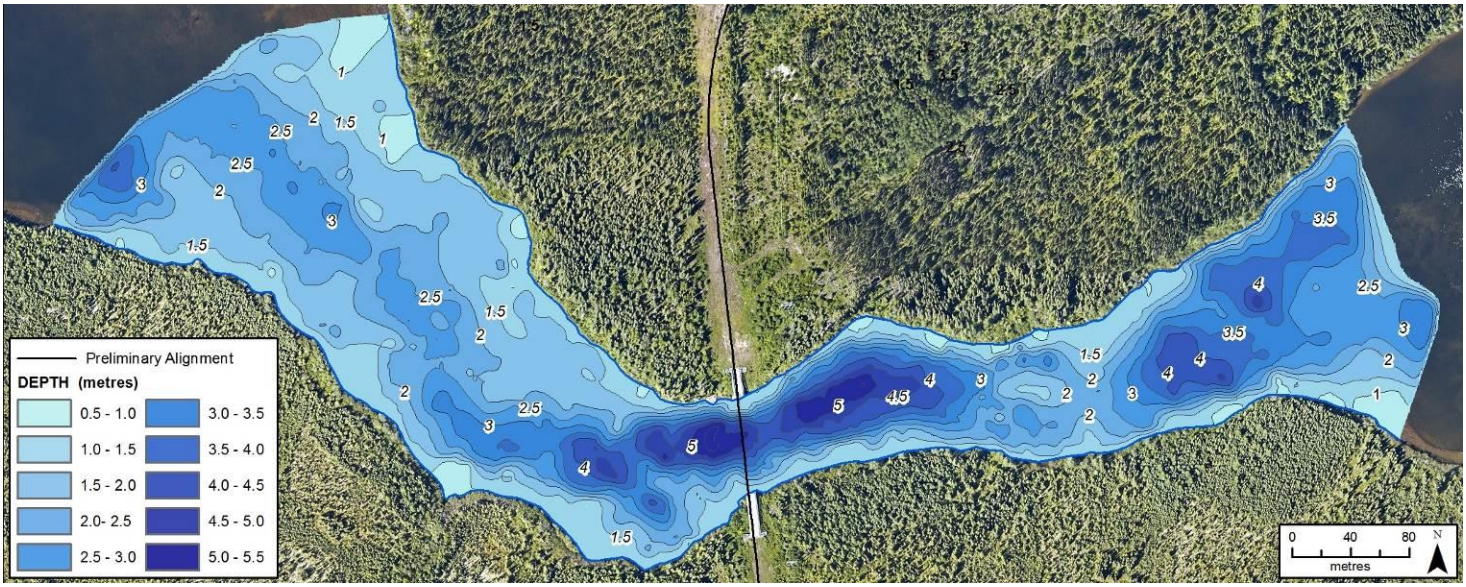
Downstream view at crossing site (Transect 3).



Looking downstream from 60 m downstream of the right bank.

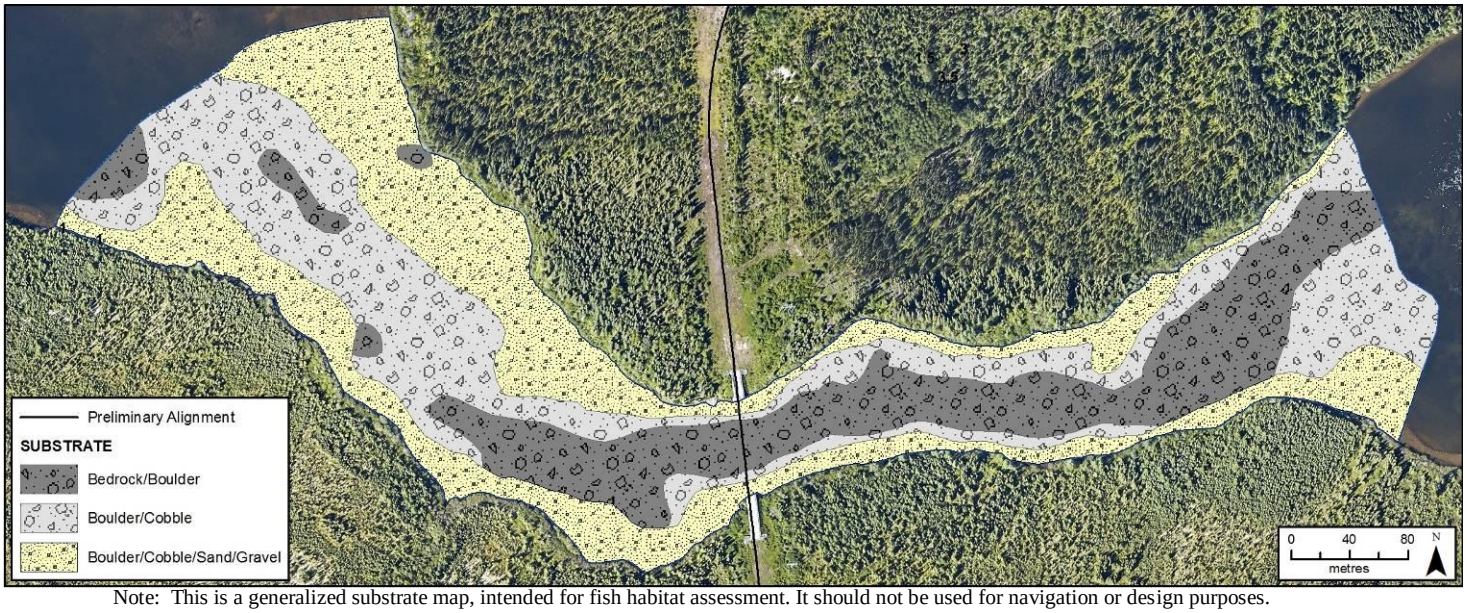
Site Conditions Continued

+ Bathymetric Map



Note: This map is intended for fish habitat assessments. It should not be used for navigation or design purposes.

+ Substrate Map



Note: This is a generalized substrate map, intended for fish habitat assessment. It should not be used for navigation or design purposes.

Site Conditions Continued

+ Cover

	US	DS
Total Cover Available (%)	65	60
Cover Composition (% of Total)		
Large Woody Debris	5	15
Overhanging Vegetation	10	10
Instream Vegetation	5	10
Pool	30	20
Boulder	35	30
Undercut Bank	15	15
Surface Turbulence	0	0
Turbidity	0	0

Fish Presence

+ Fish Habitat Potential

Forage Fish	**US**	**DS**
Spawning	High	High
Rearing	High	High
Overwinter	High	High
Migration	High	High
Large Bodied Fish		
Spawning	High	High
Rearing	High	High
Overwinter	High	High
Migration	High	High

Comments
The God's River is a major perennial watercourse that provides important fish habitat for a diverse fish community. The study reach provides a variety of habitat types including: run and riffle habitat with gravel, cobble, boulder/bedrock; and shallow shoreline areas with fine substrates and submergent macrophytes. Macrophyte beds in the shallow, off-current areas may be suitable for spawning and rearing by Northern Pike and forage fish species; whereas main channel areas with higher water velocities and coarse substrate area suitable foraging habitat for species such as suckers, Brook Trout and Walleye. Spawning by Walleye and suckers may occur over coarse substrate in riffle habitats in the study reach, but more suitable spawning habitat exists at rapids both upstream (1.5 km) and downstream (4 km) of the crossing. These rapids may be used for spawning by Lake Sturgeon.

+ Fish Sampling Data

Methods: Angling, Gillnetting, Dipnetting, Visual Observation

Fish Species Captured: Brook Trout, Longnose Sucker, Northern Pike, White Sucker, Sculpin spp.

Existing Information: Blacknose Shiner, Brook Stickleback, Brook Trout, Burbot, Cisco, Emerald Shiner, Fathead Minnow, Johnny Darter, Lake Chub, Lake Sturgeon, Lake Trout, Lake Whitefish, Longnose Dace, Longnose Sucker, Ninespine Stickleback, Northern Pike, Sauger, Shorthead Redhorse, Slimy Sculpin, Spottail Shiner, Troutperch, Walleye, White Sucker, Yellow Perch.

Information Sources:

FIHCS (2016); HTFC Planning & Design (2016); Eaton (2012); COSEWIC (2006); Stewart and Watkinson (2004).

Mussel Presence

+ Mussel Sampling Data

Methods: mussel rake, visual survey

Mussel Species Captured: Giant Floater

Existing Information: -

Regional Context

+ Habitat

Upstream Drainage Area (km^2): 12, 861
Distance to Major DS Waterbody (km): 287 (Hayes River)
Connectivity: Yes

Comments
The crossing site consists mainly of run habitat, dominated by cobble/boulder/bedrock substrates. This type of habitat is not considered rare or unique within the river.

+ Fishery

Fishery Area: God's River

Fishery Users:

Commercial[a]	No
Recreational	Yes – Fishing Lodge (God's River Lodge)
Aboriginal	Yes –Manto Sipi Cree Nation

Comments
The crossing site is located on the God's River 5 km downstream of Gods Lake, within the traditional territories of Manto Sipi Cree Nation. The river provides suitable spawning, rearing and feeding habitat for numerous CRA species including Brook Trout, Cisco, Lake Sturgeon, Lake Whitefish, Northern Pike, Walleye and suckers.

Information Sources:

a – Manitoba Conservation and Water stewardship Fisheries Branch - NE Region pers comm. Don MacDonald March 31, 2016

Crossing Information

+ Proposed Crossing

Type	Clear-span Bridge[a]
Diameter (mm)	TBD
Length (m)	TBD
Number of Barrels	TBD
Provision of Fish Passage	N/A

Information Sources:

a –pers. comm. ESRA
.

Risk Assessment

+ Preliminary Considerations

Attribute	Rating	Comments
Supports a CRA Fishery	Yes	The crossing contains habitat suitable for spawning of Walleye, sucker and Northern Pike. Habitat within the reach would also support a community of forage fish which would support a wide range of piscivorous species.
Species at Risk Present	Yes	Lake Sturgeon have been reported in this reach of the river.

+ Impacts to Fish and Fish Habitat

Type	Clear-span Bridge
Minor Impact List	Yes
Residual Impact	No residual impact to fish or fish habitat is expected with the implementation of avoidance and mitigation measures.

Attribute	Rating	Comment
Extent of Impact	N/A	
Duration of Impact	N/A	
Availability & Condition	N/A	
Impact on Relevant Fish	N/A	

+ Risk of Serious Harm to Fish

Risk Rating: LOW

Qualification: Based on the small area of impact and abundance of similar habitat within the system, culvert construction and operation is expected to have no measureable impact on the productivity of local fish populations.

Net Habitat Change

Type of Structure: Clearspan Bridge
The crossing is a clearspan bridge design; no net habitat change is expected.

Appendix C-2:

Project 6 – All Season Road Linking Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation, Aquatic Environment Report – Effects Assessment

By North South Consultants Inc.

Manitoba Infrastructure

Remote Road Operations
Project 6 - All Season Road Linking Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation



Aquatic Environment Report: **Effects Assessment**

March 2017

Manitoba

MANITOBA INFRASTRUCTURE – REMOTE ROADS OPERATIONS

PROJECT 6:

ALL SEASON ROAD LINKING MANTO SIPI CREE NATION, BUNIBONIBEE CREE NATION AND GOD'S LAKE FIRST NATION

Aquatic Environment Report

Effects Assessment

March 2017

Prepared for

Manitoba Infrastructure – Remote Roads Operations

by

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EXECUTIVE SUMMARY

The East Side Road Authority (ESRA), whose projects were assumed by Manitoba Infrastructure – Remote Road Operations (MI-RRO) in November 2016, is designing and constructing an all season road connecting Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation. Based on the preliminary alignment, 53 watercourse crossings will be constructed including culverts at 51 unnamed watercourses, a clear-span bridge at God's River and a two-span bridge at Magill Creek.

Effects Assessment

Potential project-related effects on aquatic habitat were evaluated using a Valued Component (VC) approach. Fish and fish habitat that are either part of or support a commercial, recreational or Aboriginal (CRA) fishery, and aquatic species-at-risk were selected as the aquatic VCs. Twenty four species of fish are documented to occur within streams and rivers crossed by the proposed project alignment including Lake Sturgeon which is designated as a species of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

The primary potential effects of road development on fish and fish habitat include erosion and sedimentation of streams, introduction of deleterious substances and habitat loss and alteration (riparian and instream) at watercourse crossing sites. Potential effects to species-at-risk include: the disruption of Lake Sturgeon feeding habitat due to sediment introduction and deleterious substances.

Mitigation is expected to minimize the frequency, magnitude and extent of sediment introduction into the aquatic environment during the construction phase of the Project. However, in-water construction activities, particularly during the installation and removal of coffer dams and silt curtains, may result in temporary, localized increases in total suspended solids. Additional sediment releases from right-of-way (RoW) run-off may also occur during construction. Unavoidable destruction and alteration of fish habitat will occur within the footprint of crossings and crossing approaches. Habitat loss will include approximately 3,671.8 m^2 of instream and 864 m of riparian habitat. An additional 1,008 m of riparian habitat within the cleared RoW will be altered from riparian forest to low growing vegetation and 161.5 m^2 of instream habitat will be altered as a result of rip rap placed at the base of the pier of the proposed multi-span bridge at Magill Creek. No adverse residual effects to species-at-risk are anticipated with the implementation of mitigation.

Inspection and monitoring will be conducted at stream crossing sites to ensure that the mitigation measures are effective and to identify where adaptive management is required. Environmental site inspections will be conducted before and regularly during construction to ensure that

appropriate mitigation measures are in place, properly maintained, and effective. Post-construction inspections will ensure that crossing sites have been adequately stabilized and disturbed areas are restored. Monitoring programs will include water quality monitoring to measure potential increases in total suspended solids during instream construction activities.

ACKNOWLEDGEMENTS

Manitoba Infrastructure – Remote Road Operations is thanked for the opportunity to conduct this study. Ms. Leanne Shewchuk and Ms. Jaime Clarke provided technical support and direction during the course of this study.

Fisheries studies were conducted under Manitoba Sustainable Development Scientific Collection Permit 28-16.

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1.0 INTRODUCTION

The East Side Road Authority (ESRA), whose projects were assumed by Manitoba Infrastructure – Remote Road Operations (MI-RRO) in November 2016, is undertaking the design, and in the future, the construction of an all-season road (ASR) connecting the communities of Manto Sipi Cree Nation, Bunibonibee Cree Nation and God's Lake First Nation (the Project). The Project is part of a larger initiative to provide improved, safe, and more reliable transportation service between all the communities on the east side of Lake Winnipeg.

The ASR Project is currently in the preliminary design phase and based on the preliminary alignment, the proposed ASR will intersect both small and medium-sized streams and one large river. Detailed aquatic environmental studies were undertaken in June 2016 to identify and describe aquatic habitats potentially affected by the project and to assess the potential impacts of the Project on these habitats. Specific objectives included:

- To describe the existing aquatic habitat within the project study area;
- To assess the risk of the project to fish and fish habitat and aquatic species-at-risk at watercourse crossing sites;
- To identify watercourse crossings where ASR construction may cause "serious harm to fish[1]" pursuant to Section 35(1) of the federal *Fisheries Act*;
- To assess the potential effects of the project to the aquatic environment and propose measures to mitigate the effects;
- To assess the residual effects of the project on the aquatic environment; and
- To provide inspection and monitoring recommendations related to the aquatic environment for each phase of the ASR project.

The information provided in this report is intended to assist in project design and be used in support of an Environmental Impact Statement (EIS) to be submitted and reviewed under the Manitoba *Environment Act* and the *Canadian Environmental Assessment Act, 2012* (S.C. 2012, c. 19, s. 52; CEAA).

[1] Under the *Fisheries Act*, "serious harm to fish" applies to fish and fish habitat that are part of or support a commercial, recreational or Aboriginal fishery and includes the death of a fish or any permanent alteration to or destruction of fish habitat.

2.0 PROJECT OVERVIEW

The proposed ASR will extend from Bunibonibee Cree Nation to God's Lake First Nation (P6a) and from Manto Sipi Cree Nation to the P6a junction (P6b; figures 1 and 2) and will consist of an 8.5 m wide road top centered within a 60 m cleared right-of-way (RoW). The Project is currently in the preliminary planning stage and the road alignment and crossing design are yet to be finalized. Based on the preliminary route, the ASR project will require construction of 53 watercourse crossings. Although subject to change, the crossing designs are expected to include:

- a clear-span bridge at the God's River;
- a two-span bridge at Magill Creek; and
- culverts at 51 unnamed streams.

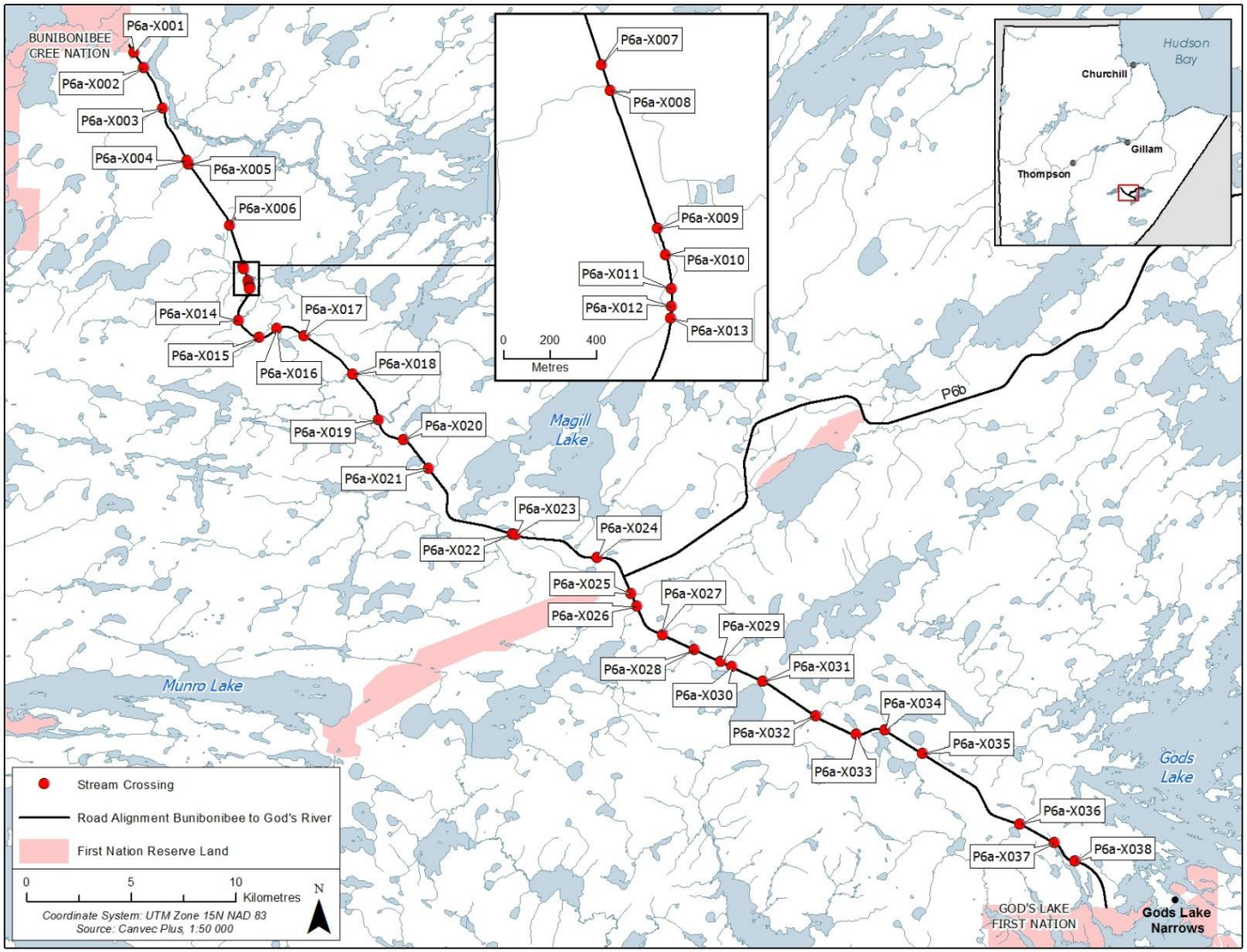


Figure 1. Project 6a – Bunibonibee Cree Nation to God's Lake Narrows First Nation All Season Road study area and watercourse crossing locations.

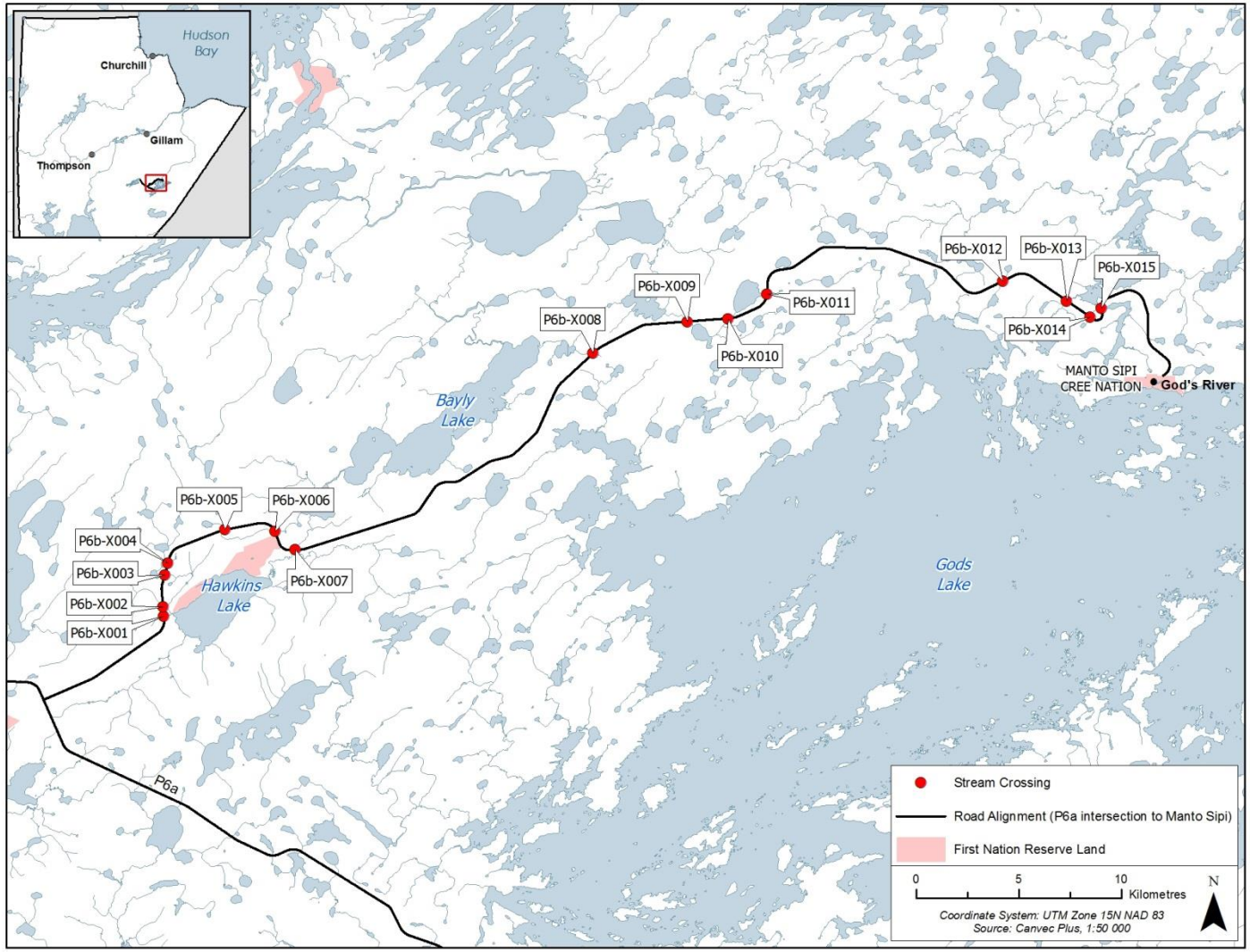


Figure 2. Project 6b – Manto Sipi Cree Nation to the P6a junction All Season Road study area and watercourse crossing locations.

3.0 EXISTING ENVIRONMENT

The Project is located on the east side of Lake Winnipeg, between the communities of God's Lake First Nation, Bunibonibee (Oxford House) Cree Nation, and Manto Sipi (God's River) Cree Nation.

The east side of Lake Winnipeg is located within the Boreal Shield ecozone and encompasses the Hayes River Upland ecoregion (Smith et al. 1998). Within the ecoregion, the Project traverses two ecodistricts: predominantly God's Lake and the northern-most portion intersecting Silsby Lake. Both the Silsby Lake and God's Lake ecodistricts are dominated by peatlands (i.e., bogs and fens) with poor drainage supporting black spruce, ericaceous shrubs and mosses in bogs, and sedges, brown mosses, shrubs and stunted tamarack in fens. However, unlike the Silsby ecodistrict, the God's Lake ecodistrict also supports mixed forests of white spruce, balsam fir, trembling aspen and balsam poplar bordering lakes and rivers. These two ecodistricts are characterized by short, cool summers, and long, very cold winters, with highest precipitation occurring during summer.

Waterbodies within the area are primarily comprised of small streams but include medium and large sized rivers, as well as small to very large lakes (the largest being God's and Oxford lakes). The smaller streams are often part of the numerous boreal wetlands such as bogs and fens that drain local areas into larger creeks, rivers or lakes, and are usually less than one metre in depth. Within the study area, these types of streams typically drain to major rivers, such as the God's and Hayes rivers which in turn drain to the northeast and ultimately Hudson's Bay. Discharges may be a number of cubic metres per second during spring, but become entirely dependent on precipitation during summer and can often reach zero during dry periods. Water temperatures in these streams may be near 0ºC at break-up in April or May, but can rise rapidly to the mid-twenties by June.

The smaller streams may be used as spawning and nursery areas by larger fish species (e.g., Northern Pike) in spring, while smaller forage species such as cyprinids (minnows) and stickleback may utilize the streams through the summer if water volume is adequate. Due to shallow depths and low winter flows, small streams generally provide little or no over-wintering habitat. Medium sized streams may provide spawning habitat for larger fish such as suckers and Northern Pike. For the remainder of the year, these streams may be utilized as a nursery for young fish, as well as providing habitat for various species of minnows, darters, sticklebacks and sculpins. Over-wintering of smaller fish in these types of streams will often occur when deeper pools are available. The one large river within the Project area, God's River, provides year-round habitat for several fish species. Due to perennial flows it supports both spring (e.g., Walleye, Northern Pike, suckers) and fall spawning species (e.g., Brook Trout and Cisco).

Small boreal wetlands also occur within the Project area. These habitats generally do not have clear connection to fish bearing waters and typically become anoxic during winter. A few species of small-bodied fish that are tolerant of low oxygen levels may persist in some, but most of these wetlands are typically devoid of fish populations.

Based on existing information, including traditional knowledge studies, thirty-two fish species occur within the major watercourses in the Project area (Table 1).

The proposed ASR alignment extends northwest from the God's Lake Narrows community to Oxford House and extends northeastward from the P6a junction to connect to the God's River community (figures 1 and 2). The landscape is relatively undeveloped; in addition to the Oxford House, God's Lake, and God's River communities other infrastructure developments include a winter road connecting the communities and an electrical transmission line.

3.1 STUDY AREA

The Project Footprint (PF) is the physical space or directly affected area on which the Project components or activities are located. The PF for the aquatic environment is the area of the watercourses directly affected by the road crossings, including the riparian zone (transition area between the aquatic and terrestrial environment) and the RoW associated with the watercourse crossing.

The Local Assessment Area (LAA) is the area within which project effects are measurable and extend beyond the PF. The LAA for the aquatic environment includes areas upstream or downstream of the alignment crossings that may be affected by the all-season road crossings, e.g., by changes in flow patterns. Project effects are expected to be restricted to a relatively short distance from the ASR alignment for small streams (1 km), but for larger streams (e.g., God's River) project effects may extend a greater distance from the ASR alignment and a 5 km buffer is applied.

The Regional Assessment Area (RAA) is the area beyond the LAA within which most indirect and cumulative effects would occur. The RAA would include areas upstream or downstream of the LAA that are connected to watercourses affected by the PF, e.g. the headwater areas of the affected streams, and downstream receiving waterbodies such as the Hayes River and God's Lake. P6a and P6b are located within the Hayes River Watershed Basin. This area would encompass most potential indirect and cumulative effects.

4.0 EFFECTS ASSESSMENT

This section outlines the approach used to assess the effects of the Project on the aquatic environment and identifies the potential effects, prescribed mitigation measures and residual effects resulting from ASR construction and operation.

4.1 APPROACH

The environmental effects assessment for the Project uses a Valued Component VC approach. The potential effects, mitigation measures, and residual effects are identified and assessed relative to the selected aquatic VCs, using the existing literature, available project information and habitat assessment results.

4.1.1 Valued Environmental Components

Fish and fish habitat and aquatic species-at-risk were selected as the VCs for the aquatic environment effects assessment as they are important environmental components that are potentially affected by the ASR.

4.1.1.1 Fish

Fish were selected as VCs because:

- they are important to people, communities and the ecosystem they inhabit in the area;
- they may be potentially affected by the Project; and
- they are protected under the federal *Fisheries Act*.

A diverse community of fish both harvested and non-harvested species occur within the Project area. Thirty-two fish species are known to occur within the study area, 24 of which occur within streams and rivers crossed by the proposed alignment (NSC 2017). The broad category of fish is consistent with protection afforded under the *Fisheries Act*, where the *Act* prohibits causing serious harm to fish or fish habitat that are part of or support a commercial, recreational or Aboriginal (CRA) fishery.

Species occurrence is the measurable parameter used to assess the potential effects of the Project on fish.

4.1.1.2 Fish Habitat

Fish habitat was defined as habitat that supports fish species that are part of or support a CRA fishery. Fish habitat was selected as a VC because:

- Section 35(1) of the federal *Fisheries Act* prohibits the permanent alteration or destruction of fish habitat that supports fish and habitat that are part of or support a CRA fishery;
- it encompasses a variety of biophysical parameters, including hydrology, channel and flow characteristics, substrate, cover, water and sediment quality, aquatic plants and benthic invertebrate communities; and
- it is often used as a surrogate for the productive capacity of aquatic habitats.

Measurable parameters to be used to assess the potential effects of the Project on fish habitat include:

- physical fish habitat (substrate composition; channel characteristics; cover for fish; habitat type);
- water quality (TSS);
- hydrology (velocity and water depth); and
- riparian vegetation (riparian vegetation composition).

4.1.1.3 Aquatic Species-at-Risk

Aquatic species-at-risk were selected as VCs because:

- they are known to occur in the area;
- they may be potentially affected by the Project; and
- they are protected under provincial (MBESEA) and federal (SARA) legislation.

Lake Sturgeon is the single aquatic species-at-risk VC identified. It is a species designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Currently, only Lake Sturgeon has been documented in God's River and God's Lake (NSC 2017). The Southern Hudson Bay-James Bay population is designated as Special Concern by COSEWIC (COSEWIC 2006) and is currently under consideration for protection under SARA. Consequently, sturgeon was included as a VC. Potential presence was assessed based on current and historical range, documented occurrences within the study area, and preferred habitats.

Measurable parameters used to assess the potential effects of the Project on aquatic species-at-risk include:

- important habitats (i.e., spawning, rearing, overwinter, migration);

- water quality (TSS); and
- species occurrence.

Lake Sturgeon critical habitat has not been identified by COSEWIC and therefore will not be included as a measurable parameter in the effects assessment.

4.1.2 Residual Effects Assessment

Residual effects are the effects remaining following the implementation of the technically and economically feasible mitigation measures.

The significance of the residual effects was determined by five key criteria as outlined in CEAA (2012): the duration of time the effect occurs, the magnitude, the geographic extent, frequency, and reversibility of the effect; and two additional criteria, the direction or nature of the effect, and the ecological and social context of the effect. With the exception of the direction and nature of the effect, three levels of significance were applied to each criterion, as described in Table 1.

Thresholds are included in Table 1 for the five criteria where available and applicable. Thresholds for the magnitude criteria would include those identified in the Manitoba Water Quality Standards, Objectives and Guidelines (MWQSOG's; MWS 2011) and in particular the guideline for Total Suspended Solids (TSS) as it relates to fish and fish habitat. The threshold for magnitude to fish and fish habitat are set by the *Fisheries Act*, where the death of fish, and alteration or destruction of fish habitat are prohibited. Lake Sturgeon critical habitat has not been identified by COSEWIC and therefore will not be included as a measurable parameter threshold in the effects assessment.

An adverse residual effect associated with a selected Valued Component is deemed significant if there is a Level III rating result for Ecological and Social Context and if a Level II or III rating is given for each of the effect attributes of Duration, Magnitude, Extent, Frequency and Reversibility. In the event a significant adverse residual effect is expected, the level of confidence in the data and methods used in the framework of the environmental analysis of the significance determination as well as the likelihood of the significant effect occurring (i.e., very unlikely, unlikely, likely, very likely) is provided.

Table 1. Residual effects assessment criteria following the Reference Guide for the *Canadian Environmental Assessment Act* (2012).

Criterion	Level I	Level II	Level III
Direction or Nature[a] (of the effect)	• Positive	• Negligible (no measureable change)	• Negative
Duration (of the effect)	• Short Term • Time required to complete seasonal or annual construction/maintenance or rehabilitation activities (i.e., several months)	• Medium Term • Effect likely to persist until completion of construction and rehabilitation (i.e., 8 to 10 years)	• Long Term • Effect likely to persist into operations and maintenance (i.e., > 10 years)
Magnitude (of the effect)	• Negligible or Low: No definable or measureable effect; below established threshold of acceptable change (*i.e.*, TSS at or below background levels.)	• Moderate: Effect can be determined with well-designed monitoring program; below established threshold of acceptable change (*i.e.*, TSS higher than background levels, but below Manitoba water quality objectives).	• High: Effect is easily observable, measured; well beyond established thresholds of acceptable change (*i.e.*, TSS higher than Manitoba water quality objectives).
Geographic Extent (of the effect)	• Project Footprint: within the defined limits of the ASR RoW; effects are likely to be measurable	• Local Assessment Area (i.e., generally a 5 km band centered on the ASR alignment): area within which Project effects are measurable.	• Regional Assessment Area: area beyond the Local Study Area within which most potential indirect and cumulative effects would occur.
Frequency (of conditions causing the effect)	• Conditions or phenomena causing the effect occur infrequently.	• Conditions or phenomena causing the effect occur at sporadic or intermittent intervals.	• Conditions or phenomena causing the effect occur at regular intervals or is continuous.
Reversibility (of effect)	• Effect is reversible over a period of time less than or equal to the Project construction.	• Effect is reversible over many years into the Project operation.	• Effect is irreversible.
Ecological and Social Context (of effect)	• Low: VC is not rare or unique, is resilient to imposed change or is of minor importance to ecosystem function (i.e., White Sucker).	• Moderate: VC has some capacity to adapt, is moderately/seasonally fragile or is somewhat important to ecosystem function (i.e., Brook Trout)	• High: VC is protected/designated species or fragile with low resistance to imposed change or part of a fragile ecosystem (i.e., Lake Sturgeon).

a – levels I, II and III dot not apply for this criterion; VC = Valuable Component

4.2 POTENTIAL EFFECTS

4.2.1 Fish

The primary potential effects of ASR construction and operation to fish include erosion and sedimentation, introduction of deleterious substances, altered flow regimes and mortality from entrapment in cofferdams.

4.2.1.1 Erosion and Sedimentation of Streams

Increased suspended sediments can negatively impact fish by impairing water clarity and respiration. Short- and long-term increases in turbidity impair feeding success by visual feeders (Berg and Northcote 1985, Gardner 1981). Suspended sediment can also be harmful to fish by clogging gills, decreasing oxygen exchange and reducing growth rates (Wood and Armitage 1997).

4.2.1.2 Introduction of Deleterious Substances

Introduction of deleterious substances into watercourses can degrade water quality, resulting in toxic effects to aquatic organisms, including fish. Harmful substances may enter the watercourses from a variety of sources during construction of the ASR through accidental spills and leaks, and in run off.

Cast-in-Place Concrete Structures

Construction of cast-in-place concrete structures such as bridge abutments, footings and bridge decks may result in accidental releases of concrete or concrete wash water into the watercourse. Uncured or partly cured concrete and other lime containing materials (e.g., Portland cement, mortar and grout) have a high pH and are extremely toxic to many aquatic organisms, including fish. Accidental discharges into an aquatic environment may result in an increase in the pH of the water. Elevated pH can damage fish tissue and increase the toxicity of other substances in the water, such as ammonia. Concrete and concrete wash water can also contain sediments and spills can result in increased turbidity and sedimentation of the stream.

Construction Vehicles, Machinery and Equipment

Hydrocarbons, such as oil, fuel, gasoline, lubricants, or hydraulic fluids can enter watercourses during the operation, maintenance and fuelling of construction vehicles and machinery near watercourses. Hydrocarbons are considered deleterious substances, may kill fish or other aquatic biota directly, or may result in impaired health, vigor, or productive capacity. Polycyclic aromatic hydrocarbons (PAHs) can persist in stream sediments resulting in chronic exposure through direct contact or indirectly through food chain interaction (Collier et al. 2002). Effects of

PAHs to fish include fin erosion, liver abnormalities, cataracts, and compromised immune systems (Fabacher et al. 1991, Weeks and Warinner 1984, 1986, O'Conner and Huggett 1988). In benthic invertebrates, PAH exposure can inhibit reproduction, delay emergence, and cause sediment avoidance and mortality.

Explosives

Explosives used in blasting use oxidizing agents such as ammonium nitrate, calcium nitrate and sodium nitrate. Nitrates from these materials may enter the watercourse due to accidental spills, leaching from wet blastholes or in run off from undetonated explosives in blast rock. Increased nitrate levels can have toxic effects on aquatic organisms and cause eutrophication of surface waters. In addition, if ammonium nitrate is introduced into water, it dissociates to form ammonia which can have both lethal and sublethal effects on fish.

4.2.1.3 Disruption of Fish due to Blasting

The compressive shock wave resulting from the detonation of explosives near watercourses can cause serious harm to fish. Shock waves with overpressure levels greater than 100 kPa can rupture the swim bladder and vital organs such as the liver and kidney (Wright and Hopky 1998). The vibrations generated by a blast can also damage incubating eggs.

4.2.1.4 Temporary Crossings

The construction and use of temporary crossings can result in loss or damage to riparian vegetation (Section 4.2.2.3), and erosion and sedimentation of streams (Section 4.2.2.1). Temporary crossings, such as fords, can directly, or indirectly (through introduction of debris or sediment) disrupt sensitive fish life stages, such as spawning and incubation, resulting in decreased reproductive success.

4.2.1.5 Improved Access to Areas Where Fish are Sensitive or Vulnerable

ASR construction may result in improved access by both work crews and the public to habitats where fish may be sensitive or vulnerable to exploitation or disturbance.

4.2.2 Fish Habitat

The primary potential effects of ASR construction and operation to fish habitat are erosion and sedimentation of streams, introduction of deleterious substances and habitat loss. These and other potential effects of the Project on fish habitat are discussed below.

4.2.2.1 Erosion and Sedimentation of Streams

Vegetation removal and improper construction practices near watercourses can result in increased erosion leading to sedimentation of streams. Clearing streamside vegetation may result in decreased bank stability and exposure of bare soils that are susceptible to erosion. Heavy machinery and equipment working near the watercourse can damage vegetative cover and cause rutting and erosion of floodplains and channel banks.

There are multiple negative effects associated with increased levels of suspended and deposited sediment, including impacts to primary producers, invertebrates, and fish. A decrease in light penetration due to higher turbidity (suspended sediment) can lead to decreased photosynthesis by primary producers. Since primary producers form the base of the food chain, decreases in photosynthesis can impact higher trophic levels, such as invertebrates and fish. Large influxes of deposited sediment can bury aquatic invertebrates, an important food item for many fish species, resulting in reduced invertebrate species diversity and abundances. Fine sediment deposition over existing larger substrates may result in habitat loss for invertebrate species that anchor to coarse substrates.

Sedimentation may result in the loss of spawning habitats and/or decreased spawning success for some fish species. Infilling of existing coarse or rocky substrates with finer materials may create unsuitable spawning habitat for some fish species, smother deposited eggs or inhibit larval emergence from spawning substrates (Kondolf 2000).

4.2.2.2 Loss of Instream Habitat

A crossing design that includes the placement of permanent structures below the high watermark will have direct effects to fish habitat. Infilling of stream substrates due to the installation of bridge piers will result in the permanent loss of instream habitat. The armouring of channel banks below the high watermark may alter the quality and productivity of instream habitat; however, depending on design, certain types of armouring such as rip rap may increase habitat productivity by providing suitable substrates for insect production (i.e. fish diet items) and cover for fish.

4.2.2.3 Loss of Riparian Vegetation

Riparian vegetation contributes nutrients to streams and lakes through litter and terrestrial insect drop. The removal of riparian vegetation to accommodate temporary crossings, bridge approaches and line of sight requirements may reduce nutrient inputs into the aquatic food web. In many streams, terrestrial insects contribute to the diet of fish. Further, leaf litter and other organic matter are consumed by aquatic invertebrates, another important food source for many fish species (Allan et al. 2003).

4.2.2.4 Introduction of Deleterious Substances

Introduction of deleterious substances into watercourses can degrade water quality, resulting in toxic effects to aquatic organisms on which fish depend. Harmful substances may enter the watercourses from a variety of sources during construction of the ASR through accidental spills and leaks and in run off.

Stormwater Runoff

Stormwater runoff from impervious surfaces, such as bridge decks and approaches can contain a number of pollutants including suspended solids, hydrocarbons, metals, nutrients and road salts. During and after significant rainfall events, stormwater runoff into streams can cause short term changes in water quality. Stormwater runoff may also result in physical impacts to streams, including bank and channel erosion and/or sediment deposition due to increased runoff frequency, velocity and volume.

4.2.2.5 Disruption of Habitat due to Blasting

The compressive shock wave resulting from the detonation of explosives near watercourses can cause impacts to fish habitat. Impacts to habitat include physical alteration of habitat, sedimentation of streams (Sections 4.2.1.1 and 4.2.2.1) from particles generated by blasting and introduction of deleterious substances (Section 4.2.1.2).

4.2.2.6 Temporary Crossings

The construction and use of temporary crossings can result in loss or damage to riparian vegetation (Section 4.2.2.3), and erosion and sedimentation of streams (Section 4.2.2.1). Temporary crossings, such as fords, can disrupt spawning habitats and block migratory corridors..

4.2.2.7 Improved Access to Sensitive Habitats

ASR construction may result in improved access to sensitive habitats by both work crews and the public. Motorized vehicles, such as ATVs may disturb stream banks and riparian areas leading to erosion and sedimentation of streams.

4.2.3 Aquatic Species-at-Risk

The primary potential effects of ASR construction and operation to aquatic species-at risk are habitat degradation and disruption. These and other potential effects of the Project on aquatic species-at risk are discussed below.

4.2.3.1 Lake Sturgeon

The God's River crossing site provides moderate velocity run habitat with sand and rocky substrates (NSC 2017). The immediate crossing area provides foraging habitat for adult lake sturgeon and potential spawning habitat is found at a set of large rapids 4 km downstream of the crossing (NSC 2017). Potential impacts to Lake Sturgeon in the God's River are not expected as a clear-span bridge is proposed for the crossing site. Clear-span bridges do not require DFO review provided measures to avoid harm are implemented, as no temporary or permanent instream destruction or alteration is expected to occur.

4.3 MITIGATION

The following section describes measures to avoid or minimize the potential impacts of the Project to fish, fish habitat and aquatic species-at-risk. These include measures to be followed when working at or near watercourses that are fish habitat or are directly connected to fish bearing waters, as well as site specific-measures based on the fish habitat and species-at-risk information collected in the field. Mitigation measures are presented by project phase including: design; construction; and operation and maintenance.

4.3.1 Design

Many potential effects of road developments, including introduction of deleterious substances and channel erosion and sedimentation, can be minimized through proper design. The following measures will be incorporated into the project design to mitigate potential disruptions to fish habitat and species-at-risk:

- Where possible, roads will be located a minimum of 100 m from waterbodies except when crossing a watercourse. Where this is not feasible, a buffer of undisturbed vegetation equal to 10 m plus 1.5 times the slope gradient will be left between the road and adjacent waterbodies. These buffers will minimize runoff velocity and volume during rain events, encouraging the settling of sediment and contaminants and will preserve riparian functions such as allochthonous inputs into streams, shading, and bank stability;

- Culvert and bridge crossings will be designed to direct stormwater runoff into a vegetated area or small retention pond to decrease the velocity and volume of runoff and encourage the settling of sediment and removal of contaminants prior to discharge to the watercourse; and

- Crossings will be designed to maintain existing flow regimes and be passable by fish.

4.3.2 Construction

4.3.2.1 Deleterious Substances

To minimize the potential introduction of deleterious substance into watercourses:

- Construction crews will be adequately trained on the handling, storage, and disposal of deleterious substances;
- Spill clean-up kits will be available on site at all times; and
- Deleterious substances will be stored a minimum of 100 m from the high water mark.

Additional measures related to construction vehicles and equipment, concrete work and explosives are provided in sections 4.3.2.2, 4.3.2.7 and 4.3.2.8, respectively.

4.3.2.2 Construction Vehicles and Equipment

To mitigate the introduction of deleterious substances and erosion and sedimentation of streams from construction vehicles and equipment:

- Materials used to construct watercourse crossings will be clean and free of debris;
- Construction vehicles and equipment will arrive on site clean and free of leaks;
- Vehicle and equipment fueling and maintenance will be conducted a minimum of 100 m from the high water mark; and
- Machinery will remain above the high water mark except where temporary fording of a watercourse is required.

4.3.2.3 Erosion and Sediment Control

To protect stream banks and floodplains from erosion and minimize sediment introduction to watercourses:

- Appropriate erosion and sediment control (ESC) measures will be in place prior to the commencement of construction;
- ESC measures will be regularly inspected and maintained to ensure effectiveness throughout construction;
- Clearing and earthworks near watercourses will be conducted under favourable weather conditions and will be temporarily suspended during storm events;

- Whenever possible, construction work over soft floodplains will be conducted under frozen conditions to minimize rutting and erosion;
- Overburden will be adequately stabilized and stored well above the high water mark;
- Disturbed areas will be stabilized through re-vegetation with native plant species or other appropriate means (e.g., erosion control blankets) following completion of works;
- Riprap placed below the high water mark will be clean and free of debris; and
- ESC measures will remain in place until all disturbed areas are re-vegetated.

4.3.2.4 Vegetation Removal

To minimize erosion in riparian areas and prevent unnecessary clearing or alteration of riparian habitats:

- Vegetation will be retained as long as possible to minimize the exposure time of disturbed/bare soils to potential erosion;
- Clearing limits will be clearly marked prior to riparian vegetation removal to avoid any unnecessary damage to or removal of vegetation;
- Necessary ESC measures will be in place prior to the start of clearing; and
- Riparian vegetation clearing within the RoW will be limited to the removal of select vegetation that is required to maintain line of sight safety requirements (i.e., trees and tall shrubs). Low growing vegetation will be maintained.

4.3.2.5 Instream Work

The following measures will be implemented during works conducted below the high water mark:

- Instream construction activities conducted in a fish bearing watercourse will be timed to avoid fish spawning and incubation periods;
- Instream construction will be conducted in isolation of flowing water to mitigate downstream sediment transfer;
- A fish salvage will be conducted within the isolated work area prior to the commencement of instream work in fish bearing waters; and
- Construction vehicles and machinery will remain above the high water mark during instream construction activities.

4.3.2.6 Temporary Crossings

General

- Whenever possible, existing trails, roads and cut lines will be used as access to temporary crossings;
- Temporary crossings will be located within the 60 m cleared ASR RoW to avoid riparian impacts outside of the RoW;
- Placement and removal of temporary crossing structures will be timed to avoid high fish migration periods;
- Approaches will be stabilized as required to protect stream banks (e.g. swamp pads, logs); and
- Temporary crossing structures will be removed when no longer required and the crossing site will be restored to its original conditions.

Fords

If fording is required to transport materials during the construction of the ASR, the following measure will be implemented:

- Fording in flowing waters will avoid periods of fish spawning, incubation and migration.

Ice Bridges and Snow Fills

If temporary ices bridges or snow fills are required to cross watercourses during construction of the ASR, the following measures will be implemented:

- Ice bridges will be constructed of clean water, ice and snow only and will not block naturally occurring flows;
- The withdrawal of water used in the construction of ice bridges will not exceed 10% of the instantaneous flow;
- When an ice bridge is no longer required or the crossing season has ended, ice bridges will be notched at the centre to prevent the obstruction of fish movement. Notching will also encourage melting at the centre of the bridge, preventing channel erosion and flooding;
- Snow fills will be constructed of clean snow and will not restrict stream flows; and

- When a snow fill is no longer required or the crossing season has ended, compact snow will be removed prior to freshet.

4.3.2.7 Concrete Work

To avoid water quality impacts from accidental releases of uncured or partly cured concrete or concrete wash water:

- Uncured or partly cured concrete will be kept in isolation from watercourses;
- Water that has contacted uncured concrete will be isolated from watercourses until it has reached a neutral pH; and
- Equipment used in concrete work will be washed away from watercourses to prevent wash water from entering waterways.

4.3.2.8 Blasting

To mitigate the accidental release of explosive materials into watercourses, erosion and sedimentation of streams, and the potential lethal and sublethal effects to fish due to shockwaves:

- Explosive materials will be handled and stored in manner to minimize accidental spills or releases into watercourses;
- Explosive materials will be stored a minimum of 100 m from the high water mark;
- Storage and transport containers will be regularly inspected and maintained;
- Crew members working with explosives will be trained in spill containment and clean-up procedures;
- Ammonium nitrate-fuel oil mixtures will not be used in or near watercourses;
- Blasting will not be conducted in watercourses;
- Explosives will be detonated at sufficient distance from the watercourse to ensure that overpressure levels do not exceed 100 kPa at the land-water interface; and
- DFO's Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters will be adhered to (Wright & Hopky 1998).

4.3.2.9 Access to Watercourses and Sensitive Areas

To mitigate the disruption of sensitive areas due to increased access:

- Construction access roads and winter roads will be decommissioned and rehabilitated;

- Unnecessary access to sensitive areas by work crews will be prohibited;
- The ASR alignment and temporary crossings will avoid sensitive habitats; and
- Access to major watercourse crossings along the ASR will be restricted using measures such as slope treatment and fencing.

4.3.3 Post-Construction

Post-construction mitigation measures will be implemented to ensure long term stability of watercourse crossing areas:

- Stream crossings will be inspected following the first storm event and first freshet to ensure that there are no visible signs of bank and channel instability;
- Disturbed areas will be re-vegetated following completion of works; and
- Stream crossings will be inspected to ensure that adequate levels of vegetation has established in disturbed areas adjacent to watercourses.

4.3.4 Operation and Maintenance

Mitigation measures related to operation and maintenance activities are discussed in the following sections.

4.3.4.1 Bridge Maintenance

Debris Removal

- Unless considered an emergency work, debris removal will be timed to avoid periods of fish spawning, incubation and migration; and
- Debris removal will be conducted by machinery operating from shore (above the high water mark) or by hand.

Protective Coatings

- Removal and application of protective coatings will be conducted in a way that prevents deleterious substances (e.g., paint, paint flakes, blasting abrasives, solvents, etc.) from entering the watercourse (e.g. use of barges or shrouding);
- Paints, solvents and other deleterious substances will be stored and mixed on land (i.e., not on bridge decks) to prevent accidental releases into watercourses;
- Equipment will be cleaned where wash water will not enter the watercourse; and

- Waste materials (e.g., paint flakes, abrasives, etc.) will be properly contained and disposed.

Structural Repairs

- In water work will be timed to avoid periods of fish spawning, incubation and migration;
- Appropriate erosion and sediment control measures will be implemented prior to commencement of repair work and will be regularly inspected to ensure their effectiveness;
- Repairs and reinforcements will be conducted in a manner that prevents bridge materials from entering the watercourse;
- Waste materials will be stabilized and/or disposed of in an appropriate manner that prevents entry into the watercourse; and
- Disturbed areas will be restored and re-vegetated to mitigate erosion and sediment introduction into the watercourse.

4.3.4.2 Vegetation Management

- Vegetation management required to maintain line of sight safety requirements within the RoW will include the removal of trees and tall shrubs. Low growing vegetation will be retained; and
- Slash or debris piles should be stabilized and stored above the high water mark until disposal.

4.3.5 Site-Specific Mitigation

Of the 53 proposed stream crossings, 25 were assessed as having habitat supporting fish. Seven of these were designated as 'important' fish habitat supporting a range of life requisites for both large (i.e. Northern Pike, Walleye, sucker, trout) and small bodied fish species (i.e., forage fish). The remaining eighteen sites were assessed as 'marginal' fish habitat consisting of typically small boreal streams with limited flow and depth with soft substrates, habitat suited to small-bodied fish adapted to low oxygen environments (e.g. Brook Stickleback, Northern Pearl Dace). Although the habitat may also be suitable for Northern Pike in some cases, direct access to the habitat from larger waterbodies supporting relevant CRA fishery species tends to be restricted due to the presence of multiple ephemeral barriers.

Site-specific mitigation measures are presented in Table 2 and include the 18 sites at which fish habitat, defined as habitats that support fish that are part of or support a CRA fishery, is present. The remaining 7 sites are 'marginal' habitat supporting solely small-bodied fish and are not

expected to support a CRA fishery. A list of the proposed crossings summarizing the presence of fish, fish habitat and contribution to a CRA fishery is presented in Appendix 1. Detailed descriptions of the habitat at each crossing are available in the Existing Environment Report (NSC 2017).

Table 2. Site-specific mitigation for watercourse crossings with fish habitat, defined as habitats that support fish that are part of or support a CRA fishery, on the Manto Sipi, Bunibonibee and God's Lake All Season Road Project.

Crossing	Watercourse	Crossing Structure	Sensitivity/Concern	Mitigation
P6a-X002	Unnamed Tributary of Hayes River	Culvert	• Habitat for spring spawning fish species (i.e., Walleye, Northern Pike, suckers) and habitat supporting a range of life requisites for fish which support a CRA fishery is present; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation. • Floodplain prone to rutting and erosion by construction machinery and equipment.	• In water activity, including construction and removal of coffer dams or placement of rip rap below the high water mark will avoid spawning and incubation periods in spring (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats. • Construction will be conducted under frozen conditions to avoid damage to floodplain.
P6a-X008	Unnamed Tributary of Michikanes Lake	Culvert	• Spawning, rearing and feeding habitat for Northern Pike and fish which support a CRA fishery is present; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation. • Soft floodplain prone to rutting and erosion by construction machinery and equipment.	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats. • Construction will be conducted under frozen conditions to avoid damage to floodplain.
P6a-X018	Unnamed Tributary of Knee Lake	Culvert	• Spawning, rearing and feeding habitat for Northern Pike and fish which support a CRA fishery is present; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation. • Soft floodplain prone to rutting and erosion by construction machinery and equipment.	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats. • Construction will be conducted under frozen conditions to avoid damage to floodplain.

Crossing	Watercourse	Crossing Structure	Sensitivity/Concern	Mitigation
P6a-X019	Magill Creek	Two-span Bridge	• Habitat for spawning and rearing of spring spawning fish species (i.e., Walleye, Northern Pike, suckers) and habitat supporting a range of life requisites for fish which support a CRA fishery is present; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation.	• In water activity, including construction and removal of coffer dams or placement of rip rap below the high water mark will avoid spawning and incubation periods in spring (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats.
P6a-X023	Unnamed Tributary of Laird Lake	Culvert	• Suitable habitat for spawning and rearing of Northern Pike, feeding of White Sucker and habitat supporting a range of life requisites for fish which support a CRA fishery is present; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation. • Soft floodplain prone to rutting and erosion by construction machinery and equipment	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats • Construction will be conducted under frozen conditions to avoid damage to floodplain.
P6a-X031	Unnamed Tributary of Hignell Lake	Culvert	• Spawning, rearing and feeding habitat for Northern Pike and fish which support a CRA fishery is present; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation.	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats.
P6a-X032	Unnamed Tributary of Hignell Lake	Culvert	• Potential Northern Pike spawning habitat and habitat supporting a range of life requisites for fish which support a CRA fishery is present; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation. • Soft floodplain prone to rutting and erosion by construction machinery and equipment	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats. • Construction will be conducted under frozen conditions to avoid damage to floodplain.

Crossing	Watercourse	Crossing Structure	Sensitivity/Concern	Mitigation
P6a-X033	Unnamed Tributary of an Unnamed Lake	Culvert	• Potential Northern Pike spawning habitat downstream of the crossing and habitat supporting a range of life requisites for fish which support a CRA fishery is present; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation. • Soft floodplain prone to rutting and erosion by construction machinery and equipment	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats. • Construction will be conducted under frozen conditions to avoid damage to floodplain.
P6a-X034	Unnamed Tributary of an Unnamed Lake	Culvert	• Habitat supporting a range of life requisites for fish which support a CRA fishery is present and potential Northern Pike spawning habitat downstream of the crossing; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation.	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats.
P6a-X037	Unnamed Tributary of an Unnamed Lake	Culvert	• Downstream habitat suitable for fish supporting a CRA fishery; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats
P6a-X038	Unnamed Tributary of an Unnamed Lake	Culvert	• Potential Northern Pike spawning habitat downstream of the crossing; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation. • Soft floodplain prone to rutting and erosion by construction machinery and equipment	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats. • Construction will be conducted under frozen conditions to avoid damage to floodplain

Crossing	Watercourse	Crossing Structure	Sensitivity/Concern	Mitigation
P6b-X002	Unnamed Tributary of Hawkins Lake	Culvert	• Habitat supporting a range of life requisites for fish which support a CRA fishery is present and potential Northern Pike spawning habitat downstream of the crossing; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation. • Soft floodplain prone to rutting and erosion by construction machinery and equipment	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats. • Construction will be conducted under frozen conditions to avoid damage to floodplain.
P6b-X003	Unnamed Tributary of Hawkins Lake	Culvert	• Habitat supporting a range of life requisites for fish which support a CRA fishery is present and potential Northern Pike spawning habitat downstream of the crossing; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation. • Soft floodplain prone to rutting and erosion by construction machinery and equipment	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats. • Construction will be conducted under frozen conditions to avoid damage to floodplain.
P6b-X006	Unnamed Tributary of Opaskaykow Lake	Culvert	• Habitat supporting a range of life requisites for fish which support a CRA fishery is present and potential Northern Pike spawning habitat downstream of the crossing; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation. • Soft floodplain prone to rutting and erosion by construction machinery and equipment	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats • Construction will be conducted under frozen conditions to avoid damage to floodplain.
P6b-X007	Unnamed Tributary of Opaskaykow Lake	Culvert	• Potential Northern Pike spawning habitat. Walleye and sucker spawning habitat may also exist; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation.	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats.

Crossing	Watercourse	Crossing Structure	Sensitivity/Concern	Mitigation
			• Floodplain prone to rutting and erosion by construction machinery and equipment	• Construction will be conducted under frozen conditions to avoid damage to floodplain.
P6b-X009	Unnamed Tributary of Tapper Lake	Culvert	• Habitat supporting a range of life requisites for fish which support a CRA fishery is present, Northern Pike spawning habitat is present upstream of the crossing site; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation. • Soft floodplain prone to rutting and erosion by construction machinery and equipment	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats. • Construction will be conducted under frozen conditions to avoid damage to floodplain.
P6b-X013	Unnamed Tributary of God's River	Culvert	• Habitat supporting a range of life requisites, including spawning for fish which support a CRA fishery and Northern Pike is present; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation. • Soft floodplain prone to rutting and erosion by construction machinery and equipment	• In water construction will avoid spawning and incubation periods for spring spawning fish (April 15-June 30) • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats. • Construction will be conducted under frozen conditions to avoid damage to floodplain.
P6b-X015	God's River	Clear-span Bridge	• Spring, summer and fall spawning fish species present; in water work could potentially disrupt fish during sensitive periods including spawning and egg incubation. • Potential Lake Sturgeon spawning habitat 4 km downstream. • Juvenile Brook Trout found in the area.	• In water activity, including construction and removal of coffer dams or placement of rip rap below the high water mark will avoid spawning and incubation periods in spring (April 15-June 30), summer (May 15-July 15), and fall (September 1 to May 15). • In water work will be conducted in isolation of flowing water to mitigate sediment transfer to downstream habitats.

4.4 RESIDUAL EFFECTS

Following the application of proven mitigation measures (Section 4.3), the adverse residual effects from the Project are limited to fish habitat and include: the introduction of sediments to streams; the alteration and destruction of riparian habitats and; and the alteration and destruction of instream habitat. A summary of the residual effects assessment is provided in Table 3. Based on the guidelines described in section 4.1.2, the effects to fish habitat are not significant.

Mitigation is expected to minimize the frequency, magnitude and extent of sediment introduction into the aquatic environment during the construction phase of the Project. However, in water construction activities, particularly during the installation and removal of coffer dams and silt curtains, may result in temporary, localized increases in total suspended solids. Additional sediment releases from RoW run-off may also occur during construction.

Unavoidable destruction and alteration of fish habitat will occur within the footprint of crossings and crossing approaches. Habitat loss will include approximately 3,671.8 m^2 of instream and 864 m of riparian habitat. An additional 1,008 m of riparian habitat within the cleared RoW will be altered from riparian forest to low growing vegetation. 161.5 m^2 of instream habitat will be altered as a result of rip rap placed at the base of the pier of the proposed multi-span bridge at Magill Creek. A description of the destruction and alteration of fish habitat at each crossing is provided in Appendix 2 and is explained in detail in the Existing Environment Report (NSC 2017).

Environment Canada (2013) has estimated that for a riparian zone to function sufficiently in its contribution to fish and fish habitat, the riparian zone for 75% of a stream length should be naturally vegetated. In consideration of the pristine nature of the project area, riparian habitat losses are well below this threshold.

Instream habitat losses will include the destruction of 3,665.96 m^2 of habitat at 22 culvert crossings and 5.84 m^2 of habitat in Magill Creek (Appendix 2). This destruction includes the loss of habitats typical of the watercourses in the Project area, consists of a relatively small area of habitat for each watercourse and does not include rare or critical habitats (NSC 2017).

No adverse residual effects to Lake Sturgeon resulting from the construction of the clear-span bridge at God's River are expected with the application of prescribed mitigation.

Table 3. Summary of adverse residual effects for watercourse crossings on the Manto Sipi, Bunibonibee and God's Lake All Season Road Project.

VC	Potential Effects	Project Phase	Evaluation (Before Mitigation)	Mitigation Measures	Residual Effect	Evaluation (After Mitigation)
Fish	Project will impair water quality as a result of sedimentation of streams from disturbed banks, right-of-way runoff, and instream works.	Construction	Direction or Nature: Negative Duration: II Magnitude: III Geographic Extent: II Frequency: II Reversibility: I Ecological and Social Context: II	• Erosion and sediment control (ESC) measures; • Instream work timed to avoid fish spawning and incubation periods • Instream construction conducted in an isolated area, and will include a fish salvage in fish bearing waters.	TSS is expected to temporarily exceed MWQSOGs thresholds (MWS 2011).	Direction or Nature: Negative Duration: I Magnitude: II Geographic Extent: II Frequency: I Reversibility: I Ecological and Social Context: II
Fish	Project will degrade water quality, and potentially have toxic effects on fish from accidental release of deleterious substances into a watercourse.	Construction Operation	Direction or Nature: Negative Duration: II Magnitude: III Geographic Extent: I Frequency: II Reversibility: II Ecological and Social Context: II	• Crews will be adequately trained on the handling, storage and disposal of deleterious substances; • An emergency response plan and spill clean-up kits will be available on site; • Deleterious substances will be stored a minimum of 100 m from the high water mark.	Minimal risk to fish	Direction or Nature: Negative Duration: I Magnitude: I Geographic Extent: I Frequency: I Reversibility: I Ecological and Social Context: II

VC	Potential Effects	Project Phase	Evaluation (Before Mitigation)	Mitigation Measures	Residual Effect	Evaluation (After Mitigation)
Fish	Compressive shock waves from blasting can seriously harm fish.	Construction	Direction or Nature: Negative Duration: I Magnitude: III Geographic Extent: I Frequency: I Reversibility: II Ecological and Social Context: II	• Blasting will not be conducted in watercourses; • DFO's Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters will be adhered to (Wright & Hopky 1998).	Minimal risk of fish mortality	Direction or Nature: Negative Duration: I Magnitude: I Geographic Extent: I Frequency: I Reversibility: I Ecological and Social Context: II
Fish	Temporary crossings will be built during construction that can directly or indirectly disrupt the sensitive life stages of fish such as spawning and incubation.	Construction	Direction or Nature: Negative Duration: I Magnitude: II Geographic Extent: I Frequency: I Reversibility: II Ecological and Social Context: II	• Movement of temporary crossing structures timed to avoid high fish migration periods; and • Approaches stabilized to protect stream banks.	Temporary increase in TSS that may exceed MWQSOGs thresholds (MWS 2011), and temporary loss of instream fish habitat.	Direction or Nature: Negative Duration: I Magnitude: I Geographic Extent: I Frequency: I Reversibility: I Ecological and Social Context: II
Fish	Project will result in increased access to fish resources during road construction and operation.	Construction Operation	Direction or Nature: Negative Duration: III Magnitude: III Geographic Extent: II Frequency: II Reversibility: III Ecological and Social Context: II	• Work crews access restricted; • ASR alignment and temporary crossings will avoid sensitive habitats; and • Major watercourse crossing access restricted using slope treatment and fencing.	Minimal loss of fish resources	Direction or Nature: Negative Duration: III Magnitude: I Geographic Extent: I Frequency: I Reversibility: II Ecological and Social Context: II

VC	Potential Effects	Project Phase	Evaluation (Before Mitigation)	Mitigation Measures	Residual Effect	Evaluation (After Mitigation)
Fish Habitat	Project will cause sedimentation of streams from disturbed banks, right-of-way runoff and instream works.	Construction	Direction or Nature: Negative Duration: II Magnitude: III Geographic Extent: II Frequency: I Reversibility: I Ecological and Social Context: II	• Erosion and sediment control (ESC); • Construction conducted under frozen and favourable weather conditions, when possible; • Disturbed areas stabilized	TSS is expected to temporarily exceed MWQSOGs thresholds (MWS 2011).	Direction or Nature: Negative Duration: I Magnitude: II Geographic Extent: II Frequency: I Reversibility: I Ecological and Social Context: II
Fish Habitat	Project will result in the alteration and destruction of riparian habitat	Construction Operation	Direction or Nature: Negative Duration: III Magnitude: II Geographic Extent: I Frequency: I Reversibility: II Ecological and Social Context: II	• Vegetation retained as long as possible to minimize erosion; • Clearing limits minimized and clearly marked; and Disturbed areas re-vegetated	Loss of riparian habitat and its contribution to fish habitat, but will not exceed Environment Canada threshold (Environment Canada 2013).	Direction or Nature: Negative Duration: II Magnitude: I Geographic Extent: I Frequency: I Reversibility: I Ecological and Social Context: II
Fish Habitat	Project will result in the alteration and destruction of instream habitat.	Construction Operation	Direction or Nature: Negative Duration: III Magnitude: III Geographic Extent: I Frequency: I Reversibility: II Ecological and Social Context: II	• Instream work timed to avoid fish spawning periods; • Instream construction conducted in an isolated area, and will include a fish salvage in fish bearing waters.	Loss of instream fish habitat.	Direction or Nature: Negative Duration: III Magnitude: II Geographic Extent: I Frequency: I Reversibility: II Ecological and Social Context: II

5.0 INSPECTION AND MONITORING

The following sections outline inspection and monitoring programs related to the aquatic environment. Inspection and monitoring is described for each stage of construction (pre-construction, construction and post-construction) for activities conducted at or near watercourses.

5.1 INSPECTION

Regular site inspections are conducted to ensure that appropriate construction best management practices and mitigation measures are implemented, adequately maintained, and effective. Site observations and conditions are documented using pre-determined checklists and photographs. Where non-compliance is observed or new issues arise, recommendations for corrective actions are provided by the inspector. The following inspection recommendations were developed based on anticipated construction activities and site conditions.

5.1.1 Pre-Construction

Where appropriate, environmental protection measures should be in place prior to the start of construction. Table 4 provides a list of pre-construction inspection requirements.

5.1.2 Construction

To be effective, environmental protection measures must be adequately maintained throughout the construction phase. Protection measures must be regularly inspected to confirm that they continue to function as intended as construction progresses and site conditions change. Table 5 provides a list of items to be inspected throughout the construction phase at sites at or near watercourses. Inspections should be conducted on a weekly basis, with additional inspections for erosion and sediment control conducted during and/or immediately after significant rain events.

Table 4. Pre-construction inspection requirements for construction sites located at or near watercourses.

PRE-CONSTRUCTION INSPECTION LIST
Deleterious Substances Storage and Spill Prevention
• Spill clean-up kits are present on site.
• Storage and waste containers, including fuel, are located a minimum of 100 m from the high water mark.
• Storage and waste containers are intact/sealed and clearly labelled.
• Waste containers are of sufficient volume for materials requiring disposal.
• Secondary containment is present where necessary.
Construction Equipment and Machinery
• Designated vehicle/equipment maintenance and wash down areas are located a minimum of 100 m from the high water mark.
• Designated vehicle/equipment fuelling areas are located a minimum of 100 m from the high water mark.
• Construction vehicles and equipment are clean and free of leaks.
Erosion and Sediment Control (ESC)
• Appropriate ESC measures are in place prior to construction.
• Extra ESC materials are on site and available for immediate use (e.g., silt fencing, polyethylene sheeting)
Sensitive Areas
• Construction limits and/or any sensitive areas are clearly marked prior to construction
• Clearing limits are clearly marked prior to vegetation removal near watercourses

Table 5. Inspection requirements for construction sites located at or near watercourses.

CONSTRUCTION INSPECTION LIST
Deleterious Substances Storage and Spill Prevention
• Spill clean-up kits are present on site.
• Hazardous waste is being removed from the site regularly.
• Required signage/labels on storage and waste containers are clear and intact.
• Waste containers are intact/sealed.
• Secondary containment is functioning as intended.
• No visible signs of spills/leaks in or near watercourses.
Construction Equipment and Machinery
• Construction vehicles and equipment are free of leaks.
• Equipment and vehicles are being maintained and refuelled a minimum of 100 m from the high water mark.
Erosion and Sediment Control (ESC)
• Visible inspection for erosion (e.g., washouts, rilling, slumping).
• Visual inspection of water quality (turbidity) (e.g., sediment plume visible in nearby watercourses; site run off is visibly turbid)
• Existing drainage is adequately managing site run off (e.g., runoff is directed away from surfaces that are susceptible to erosion)
• Stockpiled materials (e.g., overburden, soil piles) are stored away from watercourses and adequately protected.
• ESC measures have been properly installed.
• ESC measures have been adequately maintained and functioning as intended (e.g., no excessive sediment accumulation behind silt fencing and or check dams; Interceptor/diversion ditches are intact with no visible signs of channel erosion)
Sensitive Areas
• Construction limits and any sensitive areas have been identified and are clearly marked (e.g., soft floodplains, unstable banks).
• Clearing limits are clearly marked prior to vegetation removal.
• Riparian clearing has been conducted within the designated area. No vegetation damage or removal outside clearing limits.
Working In/Near Watercourses
• Heavy equipment remains above the high water mark.
• During instream works downstream flows are maintained at all times.
• Pump intakes used in fish bearing water courses are adequately screened.
• Pumps are discharged onto a non-erodible surface, such as geotextile or rock apron.

5.1.3 Post-Construction

Post-construction inspections are conducted to ensure that the site has been adequately restored and that the watercourse, including banks and approaches are physically stable. Table 6 provides a list of items to be inspected throughout the post-construction phase at sites at or near watercourses.

Table 6. Post-construction inspection requirements for sites located at or near watercourses.

POST CONSTRUCTION INSPECTION LIST
Deleterious Substances
• All waste (hazardous and non-hazardous) has been removed from site.
• No visible spills.
Construction vehicles, equipment and materials
• All construction equipment and materials have been removed
• All temporary stream crossings or diversions have been removed.
Remediation
• Disturbed areas and slopes have been adequately restored and stabilized (rip rap, seeding, plantings, etc.)
• Crossing sites are physically stable; no visible signs of channel or bank erosion, slumping, etc.[1]
• Vegetation growth/survival in seeded/planted areas

1 – physical stability assessments should be conducted following completion of site remediation, after first storm event, and after first spring freshet.

5.2 MONITORING

Monitoring will be conducted during each construction phase to ensure that environmental protection and mitigation measures are performing as intended and to identify where adaptive management is required.

5.2.1 Pre-construction

5.2.1.1 Water Quality

TSS and turbidity sampling will be conducted prior to construction to establish a TSS-turbidity relationship for the project area. This relationship will facilitate use of turbidity as a proxy for TSS allowing for rapid on-site assessment of potential water quality impacts during the construction phase of the Project.

5.2.2 Construction

A potential effect of ASR crossing construction is the degradation of water quality due to the introduction of sediment and other deleterious substances. Water quality will be monitored

during in water work that is conducted in streams that provide or are directly connected to fish habitat.

5.2.2.1 Turbidity Monitoring

The primary potential impacts from instream construction activities are sediment re-suspension and erosion in relation to the disturbance to the streambed and bank, and alterations to channel hydraulics. The primary indicator for these impacts is total suspended solids (TSS), with turbidity used as a surrogate for rapid on-site monitoring.

A turbidity monitoring program will be conducted during instream construction activities to document the spatial extent and magnitude of impacts to turbidity/TSS levels. Turbidity monitoring will use an upstream-downstream approach. Data collected at downstream sites will be compared to upstream reference sites (i.e., the background conditions) to quantify the effects of construction on TSS/turbidity and facilitate comparison of increases to MWQSOGs for the protection of aquatic life (MWS 2011).

Monitoring will consist of regular *in situ* turbidity measurements at transects and periodic measurements in the plume.

Transect Monitoring

Transect monitoring will be conducted before, during and after instream activities. A minimum of three transects will be established as follows:

- one transect upstream of the stream crossings (Transect 1), as close as feasible but distant enough so as to avoid any potential effects of construction (i.e., upstream of the cleared RoW);
- one transect downstream of the stream crossings (Transect 2), as close as practical considering safety and other considerations, such as construction activities (i.e., within the mixing zone to the extent possible); and
- one transect located at the end of the mixing zone (Transect 3), precise locations of transects will be subject to access and safety considerations.

Precise locations of transects will be determined based on site specific conditions at the time of instream construction (e.g., stream discharge, length of the mixing zone), but will cover a reach that is sufficiently large to determine the effects in the initial zone of dilution and downstream areas. Stream size may warrant establishment of additional transects located further downstream. Depending on site conditions, turbidity loggers may be deployed in the streams during construction to assist in data collection (e.g., at locations that are not readily accessible).

The numbers of sampling sites on each transect will depend upon the wetted width at the time of monitoring, but typically three sites are established per transect: left quarter channel, mid-channel, and right quarter channel. If turbidity data indicate that MWQSOGs for the protection of aquatic life are being exceeded, corrective actions will be undertaken and plume monitoring will be initiated.

The frequency of transect monitoring will be adapted to reflect the duration and nature of instream activities, and will target collection of data during both periods of peak TSS levels as well as more typical conditions.

Plume Monitoring

Plume monitoring will be conducted to estimate the downstream extent and magnitude of any sediment plume. Approximately three transects (or less, depending on conditions), will be established within the mixing zone. The number and location of transects will be determined at the time of monitoring. Laboratory TSS samples and turbidity measurements will be collected across each transect.

The frequency of plume monitoring will be determined based on the duration and intensity of the plume and nature of instream activities.

TSS-Turbidity Relationship

TSS will be measured in the laboratory and turbidity will also be measured *in situ*. A relationship between TSS and turbidity will be developed to facilitate the use of more frequent *in situ* measurements of turbidity to estimate TSS concentrations.

5.2.2.2 Cofferdam Dewatering Monitoring

Dewatering of coffer dams can result in discharges of water with excessively high TSS (e.g., at culvert placements) or pH values (at pier placements due to contact with concrete). Water pumped from coffer dams will be monitored to determine if it meets MWQSOGs. Should monitoring results indicate that guidelines were exceeded, appropriate mitigation measures will be implemented to treat the water before it re-enters the watercourse.

5.2.3 Post-Construction

Post-construction monitoring is not required.

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APPENDIX 1. LIST OF PROPOSED CROSSINGS ASSESSED FOR THE PROJECT 6 ALL SEASON ROAD

Table A.1. Summary of fish, fish habitat presence and contributions to a CRA fishery for watercourse crossings assessed on the Manto Sipi, Bunibonibee and God's Lake All Season Road, Project 6; adapted from NSC (2016).

		UTM 15				
Site	**Stream Name**	**Easting**	**Northing**	**Fish Habitat**	**Fish Species[1]**	**Supports a CRA[2] fishery**
Watercourse crossings with habitat supporting fish						
P6a-X002	Unnamed Tributary of Hayes River	355166	6086046	Yes	FF, LB	Yes
P6a-X005	Unnamed Tributary of Hayes River	357317	6081440	Yes	FF	No
P6a-X007	Unnamed Tributary of Michikanes Lake	359925	6076546	Yes	FF	No
P6a-X008	Unnamed Tributary of Michikanes Lake	359963	6076436	Yes	FF, LB	Yes
P6a-X018	Unnamed Tributary of Knee Lake	365150	6071363	Yes	FF, LB	Yes
P6a-X019	Magill Creek	366392	6069210	Yes	FF, LB	Yes
P6a-X020	Unnamed Tributary of Magill Creek	367584	6068240	Yes	FF	No
P6a-X022	Unnamed Tributary of Laird Lake	372798	6063748	Yes	FF	No
P6a-X023	Unnamed Tributary of Laird Lake	372935	6063705	Yes	FF, LB	Yes
P6a-X027	Unnamed Tributary of Wanless Lake	379995	6058916	Yes	FF	No
P6a-X028	Unnamed Tributary of Wanless Lake	381509	6058214	Yes	FF	No
P6a-X029	Unnamed Tributary of Hignell Lake	382770	6057629	Yes	FF	No
P6a-X031	Unnamed Tributary of Hignell Lake	384797	6056689	Yes	FF, LB	Yes
P6a-X032	Unnamed Tributary of Hignell Lake	387333	6055019	Yes	FF, LB	Yes
P6a-X033	Unnamed Tributary of an Unnamed Lake	389260	6054142	Yes	FF, LB	Yes
P6a-X034	Unnamed Tributary of an Unnamed Lake	390626	6054355	Yes	FF, LB	Yes
P6a-X037	Unnamed Tributary of an Unnamed Lake	398766	6048950	Yes	FF	Yes

Site	Stream Name	UTM 15 Easting	UTM 15 Northing	Fish Habitat	Fish Species[1]	Supports a CRA[2] fishery
P6a-X038	Unnamed Tributary of an Unnamed Lake	399735	6048087	Yes	FF, LB	Yes
P6b-X002	Unnamed Tributary of Hawkins Lake	383950	6066261	Yes	FF, LB	Yes
P6b-X003	Unnamed Tributary of Hawkins Lake	384030	6067799	Yes	FF, LB	Yes
P6b-X006	Unnamed Tributary of Opaskaykow Lake	389409	6069930	Yes	FF	Yes
P6b-X007	Unnamed Tributary of Opaskaykow Lake	390380	6069047	Yes	FF, LB	Yes
P6b-X009	Unnamed Tributary of Tapper Lake	409513	6080144	Yes	FF, LB	Yes
P6b-X013	Unnamed Tributary of God's River	428031	6081141	Yes	FF, LB	Yes
P6b-X015	God's River	429706	6080809	Yes	FF, LB	Yes
Watercourse crossings lacking habitat supporting fish						
P6a-X001	Unnamed Tributary of Hayes River	354680	6086782	No	N/A	N/A
P6a-X003	Unnamed Tributary of Hayes River	356066	6084096	No	N/A	N/A
P6a-X004	Unnamed Tributary of Hayes River	357220	6081611	No	N/A	N/A
P6a-X006	Unnamed Tributary of Michikanes Lake	359259	6078497	No	N/A	N/A
P6a-X009	Unnamed Tributary of Michikanes Lake	360165	6075841	No	N/A	N/A
P6a-X010	Unnamed Tributary of Michikanes Lake	360202	6075729	No	N/A	N/A
P6a-X011	Unnamed Tributary of Michikanes Lake	360225	6075583	No	N/A	N/A
P6a-X012	Unnamed Tributary of Michikanes Lake	360226	6075505	No	N/A	N/A
P6a-X013	Unnamed Tributary of Michikanes Lake	360222	6075456	No	N/A	N/A
P6a-X014	Unnamed Tributary of Michikanes Lake	359702	6073936	No	N/A	N/A
P6a-X015	Unnamed Tributary of Michikanes Lake	360702	6073154	No	N/A	N/A

Site	Stream Name	UTM 15 Easting	UTM 15 Northing	Fish Habitat	Fish Species[1]	Supports a CRA[2] fishery
P6a-X016	Unnamed Tributary of Michikanes Lake	361536	6073552	No	N/A	N/A
P6a-X017	Unnamed Tributary of Michikanes Lake	362851	6073221	No	N/A	N/A
P6a-X021	Unnamed Tributary of Magill Creek	368803	6066857	No	N/A	N/A
P6a-X024	Unnamed Tributary of Laird Lake	376856	6062609	No	N/A	N/A
P6a-X025	Unnamed Tributary of Hawkins Lake	378492	6060867	No	N/A	N/A
P6a-X026	Unnamed Tributary of Wanless Lake	378756	6060265	No	N/A	N/A
P6a-X030	Unnamed Tributary of Hignell Lake	383321	6057373	No	N/A	N/A
P6a-X035	Unnamed Tributary of an Unnamed Lake	392437	6053228	No	N/A	N/A
P6a-X036	Unnamed Tributary of an Unnamed Lake	397092	6049844	No	N/A	N/A
P6b-X001	Unnamed Tributary of Hawkins Lake	383989	6065801	No	N/A	N/A
P6b-X004	Unnamed Tributary of Hawkins Lake	384190	6068376	No	N/A	N/A
P6b-X005	Unnamed Tributary of Opaskaykow Lake	386967	6070020	No	N/A	N/A
P6b-X008	Unnamed Tributary of Bayley Lake	404927	6078620	No	N/A	N/A
P6b-X010	Unnamed Tributary of Tapper Lake	411494	6080295	No	N/A	N/A
P6b-X011	Unnamed Tributary of Tapper Lake	413389	6081483	No	N/A	N/A
P6b-X012	Unnamed Tributary of God's Lake	424907	6082134	No	N/A	N/A
P6b-X014	Unnamed Tributary of God's River	429148	6080372	No	N/A	N/A

1 – FF = Forage Fish (e.g., minnows, etc.), LB = Large Bodied (e.g., Northern Pike, Walleye, sucker spp., etc.).
2 – CRA = commercial, recreational or Aboriginal fishery

APPENDIX 2. NET HABITAT CHANGE RESULTING FROM THE PROJECT 6 ALL SEASON ROAD.

Table A.2. Net habitat change resulting from the Manto Sipi, Bunibonibee and God's Lake All Season Road, Project 6; adapted from NSC (2016).

Site	Watercourse	Instream Destruction (m^2)	Instream Alteration (m^2)[1]	Riparian Destruction (m)[2]	Riparian Alteration (m)[3]
P6a-X002	Unnamed Tributary of Hayes River	48.6	0	36	0[4]
P6a-X005	Unnamed Tributary of Hayes River	930.0	0	36	0[4]
P6a-X007	Unnamed Tributary of Michikanes Lake	162.0	0	36	0[4]
P6a-X008	Unnamed Tributary of Michikanes Lake	300.0	0	36	0[4]
P6a-X018	Unnamed Tributary of Knee Lake	270.0	0	36	0[4]
P6a-X019	Magill Creek	5.8	161.5	36	84
P6a-X020	Unnamed Tributary of Magill Creek	21.0	0	36	84
P6a-X022	Unnamed Tributary of Laird Lake	3.0	0	36	0[4]
P6a-X023	Unnamed Tributary of Laird Lake	300.0	0	36	0[4]
P6a-X027	Unnamed Tributary of Wanless Lake	60.0	0	36	0[4]
P6a-X028	Unnamed Tributary of Wanless Lake	234.0	0	36	84
P6a-X029	Unnamed Tributary of Hignell Lake	120.0	0	36	84
P6a-X031	Unnamed Tributary of Hignell Lake	66.0	0	36	84
P6a-X032	Unnamed Tributary of Hignell Lake	75.0	0	36	0[4]
P6a-X033	Unnamed Tributary of an Unnamed Lake	30.0	0	36	84
P6a-X034	Unnamed Tributary of an Unnamed Lake	90.0	0	36	84
P6a-X037	Unnamed Tributary of an Unnamed Lake	-[5]	0	36	84
P6a-X038	Unnamed Tributary of an Unnamed Lake	174.0	0	36	84
P6b-X002	Unnamed Tributary of Hawkins Lake	55.8	0	36	84
P6b-X003	Unnamed Tributary of Hawkins Lake	300.0	0	36	0[4]
P6b-X006	Unnamed Tributary of Opaskaykow Lake	18.6	0	36	0[4]

Site	Watercourse	Instream Destruction (m^2)	Instream Alteration (m^2)[1]	Riparian Destruction (m)[2]	Riparian Alteration (m)[3]
P6b-X007	Unnamed Tributary of Opaskaykow Lake	162.0	0	36	84
P6b-X009	Unnamed Tributary of Tapper Lake	36.0	0	36	84
P6b-X013	Unnamed Tributary of Gods River	210.0	0	36	0[4]
P6b-X015	Gods River	0	0	0[6]	0[6]
	TOTAL	3671.8	161.5	864.0	1008.0

1 – instream alteration consist of the addition of rip rap below the high water mark. Rip rap is expected to increase the diversity and productivity of the stream and is therefore not considered an adverse effect.
2 – calculated as the width of the road bed on each bank (18 m).
3 – calculated based on a 60 m cleared right-of-way on each bank. Does not include the length of riparian destruction.
4 – existing riparian consists of low growing vegetation. Alteration due to clearing for line of sight safety requirements is not expected.
5 – instream destruction was not calculated because a discernible stream channel was not present at the crossing.
6 - existing road and bridge at the God's River crossing has previously impacted riparian vegetation.

Appendix D:

Wildlife Reports

Appendix D-1:

Project 6: Existing Environment Wildlife Report

By Joro Consultants

PROJECT 6: EXISTING ENVIRONMENT WILDLIFE REPORT

FINAL

MARCH 19, 2018

Prepared for:

Manitoba Infrastructure
Remote Road Operations

Prepared by:

Joro Consultants

EXECUTIVE SUMMARY

Manitoba Infrastructure (MI) has undertaken a wildlife monitoring program to support all season road (ASR) development across the Large Area Transportation Network (LATN) on the east side of Lake Winnipeg since 2011. The wildlife monitoring program included desktop and literature reviews as well as specific field studies to collect baseline wildlife and habitat data for use in project planning and environmental impact assessments.

Project 6 (P6) is a proposed ASR within the LATN that will connect Bunibonibee Cree Nation, Manto Sipi Cree Nation and God's Lake First Nation (Map 1), and is the focus of this report. Field studies were conducted to document distribution and relative abundance of mammals, birds, and herptiles (i.e. reptiles and amphibians) in the Regional Assessment Area (RAA) (Map 2). This report provides a characterization of wildlife in the RAA and provides baseline data on species presence, distribution, and relative abundance for the purpose of describing the existing environment of the Project 6 area.

Monitoring and wildlife data collection methods include aerial multi-species winter track surveys to determine the distribution of moose, caribou and furbearers as well as aerial winter moose survey. Global Positioning System (GPS) collar data from woodland caribou occupying the Norway House Range (forest-dwelling ecotype), and the Pen Islands caribou (forest-tundra ecotype) are presented. Trail cameras were deployed in strategic areas to detect the distribution of moose, caribou, predators, and furbearers. In addition to these specific monitoring activities, a local trapper participation program was undertaken to provide data on furbearer occurrence in the RAA through documentation of track observations and animals harvested on traplines.

Monitoring activities for birds and amphibians included the use of autonomous recording units (ARUs) during the breeding season to determine their occupancy and diversity. Data from surveys conducted by the Manitoba Breeding Bird Atlas provided additional information on breeding bird diversity and occupancy within the RAA. Aerial surveys carried out during spring and fall in proximity to water bodies near the P6 alignment were undertaken to detect potential seasonal staging areas for waterfowl. Raptor stick nests were documented during these surveys, as well as during other winter aerial surveys.

The wildlife monitoring program for Project 6 included the gathering of local and traditional wildlife knowledge (TK) through community resource user workshops. The results of workshops and other interviews conducted in the three First Nation communities provided supplemental information verifying species presence and the identification of important wildlife areas. Local community members also participated in many of the wildlife surveys in addition to the trapper program.

Results of winter aerial surveys illustrated consistency in moose observations between two separate surveys. Confidential caribou telemetry data[1] demonstrated that seasonal occupation and migration of the Pen Islands caribou occurs through the RAA during winter. Local and traditional knowledge, trail camera

[1] Telemetry data and locational mapping for species of conservation concern and hunted species is considered sensitive and has been removed from this document, as disclosing the information may cause substantial harm to the species.

observations, and GPS collar data verified that a few forest-dwelling or forest-tundra caribou were found year-round within the RAA. The eastern extent of forest-dwelling caribou (Norway House Boreal Caribou Range) intersects a small area of the western portion of the RAA.

Four bird species of conservation concern were documented in the RAA. Species of conservation concern include those listed under; Species at Risk Act (SARA), Manitoba Endangered Species and Ecosystems Act (MESEA), Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and Manitoba Conservation Data Center (MBCDC) as S1 (very rare) or S2 (rare). Species of concern to communities such as bald eagle (*Haliaeetus leucocephalus*) and waterfowl were observed and mapped. Amphibians were also observed during surveys and included spring peeper (*Pseudacris crucifer*) and leopard frog (*Lithobates pipiens)*.

Assessment of the potential wildlife effects that may result from Project 6 construction and operation are provided in the Wildlife Characterization and Effects Report for P6 issued under separate cover. This second report provides criteria for the selection of Valued Wildlife Components (VC's) and discusses the assessment of potential effects, proposed mitigation, and residual effect related to construction and operation of the project.

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GLOSSARY OF TERMS

Brunisols - Soil formed under forest and is brown in color and may have either clay or aluminum and iron compounds, or both.

Colluvial* – A mass of sediments deposited by colluvial processes, most commonly loose rock debris.

Drumlinoid Ridges - A rock drumlin or drift deposit whose form approaches but does not fully attain that of a classic drumlin, even though it seemingly results from similar processes of moving ice.

Depressional – an area of low ground surrounded by higher ground in all directions, or a sinkhole; the depression may or may not be filled with water.

Ericaceous* – Plants in or related to the heather family (Ericaceae), typically found on acid soils.

Eutric Brunisols – Part of the Brunisolic soils, they lack a well-developed mineral-organic surface horizon and have a high pH.

Fibrisols - Organic soil contains mostly un-decomposed fibric organic material and occurs in peat deposits of Sphagnum mosses.

Glaciofluvial* – Pertaining to the channelized flow of glacier meltwater and deposits and landforms formed by meltwater streams.

Glaciolacustrine* – Pertaining to glacial lakes.

Gleysols – Soil developed under wet conditions and periods of reduction, which may have 40 cm of mixed peat or 60 cm of fibric moss peat on the surface and occurs under a range of climatic conditions.

Kettled fluvioglacial deposits* – Shallow, sediment-filled bodies of water formed by retreating glaciers.

Luvisol - Well to imperfectly drained soil in sandy to loamy sites with a layer of silicate clay and are the base saturated parent material under forest vegetation.

Mesisol – Organic soil found in peatlands at an intermediate stage of decomposition.

Moraines* – A landform that consists of un-stratified glacial drift that is usually till or, less commonly, of other drift.

Organic Cryosols – Developed primarily from organic material and are underlain by permafrost within 1 m of the surface.

Physiography* – Pertains to the factors that influence the development of landforms or a landscape, such as relief and topography, bedrock geology and structure, and geomorphological history.

Regosols – Weakly developed soils that lack recognizable primary horizons and commonly associated with unstable land surfaces.

Serotiny – Is an ecological adaptation exhibited by some seed plants, in which seed release occurs in

response to an environmental trigger, rather than spontaneously at seed maturation. The most common and best studied trigger is fire.

Stochasticity – The quality defined by a process which is random, uncertain, or unpredictable; i.e involving a random variable.

Surficial geology* – The geology of surficial materials.

*All definitions have been described in Dunster and Dunster (1996), the remainder as described in Smith *et al.* (1998).

LIST OF ACRONYMS

All Season Road - ASR

Autonomous Recording Units – ARU

Bunibonibee Cree Nation – BCN

Committee on the Status of Endangered Wildlife in Canada - COSEWIC

Environmental Impact Assessment – EIA

First Nation – FN

Forest Resource Inventory - FRI

Forest Management Unit - FMU

Game Hunting Area - GHA

Geographic Information Systems - GIS

Global Positioning System – GPS

God's Lake First Nation – GLFN

Hour - Hr

Kilometre - km

Land Cover Classification - LCC

Land Cover Classification of Canada, East Side - LCCES

Little Grand Rapids First Nation - LGRFN

Local Area Transportation Network - LATN

Local Assessment Area - LAA

Management Unit - MU

Manitoba Boreal Woodland Caribou Management Committee - MBWCMC

Manitoba Conservation Data Centre - MBCDC

Manitoba Endangered Species and Ecosystems Act - MESEA

Manitoba Infrastructure - MI

Manitoba Sustainable Development - MSD

Manto Sipi Cree Nation – MSCN

Metre - m

Ontario Ministry of Natural Resources - OMNR

Project 1 - P1

Project 6 - P6

Project Footprint - PF

Provincial Road - PR

Regional Assessment Area - RAA

Registered Traplines - RTL

Right of Way - ROW

Species at Risk Act - SARA

Traditional Knowledge - TK

Very High Frequency - VHF

Winter Road – WR

1.0 INTRODUCTION

Manitoba Infrastructure (MI) is developing an all-season road (ASR) road network to provide safer and more reliable transportation services to the remote First Nation (FN) and Northern Affairs communities on the east side of Lake Winnipeg. The ASR development detailed in this report is part of a Large Area Transportation Network (LATN; Map 1) and includes a road connecting Manto Sipi Cree Nation, Bunibonibee Cree Nation, God's Lake FN, and the community of God's Lake Narrows, collectively known as Project 6 (P6; Map 1).

Project 6 is proposed to be a two-lane gravel road located on Provincial Crown Land, approximately 138 kilometres (km) long and has a 60 metre (m) wide right-of-way (ROW; Map 2). A Manitoba Environment Act Licence (Class II) and federal approval from the Canadian Environmental Assessment Agency is required, and the P6 Project requires an Environmental Impact Assessment (EIA) to undergo both provincial and federal review.

This Existing Environment Report provides a characterization of wildlife in the Regional Assessment Area (RAA) in support of a separate Wildlife Characterization and Effects Report for P6. The data presented in this report provides baseline data on species presence, distribution, and relative abundance for the purpose of describing the existing environment. Assessment of the P6 wildlife effects are found in the Wildlife Characterization, and Effects Report for P6. The Wildlife Characterization and Assessment Report provides further detail including criteria for the selection of Valued Wildlife Components (VC's) and the assessment of potential effects related to construction and operation of the project.

The Existing Environment Report includes baseline wildlife data collected since 2011 to document the distribution and relative abundance of mammals, birds and herptiles (i.e. reptiles and amphibians) in the P6 Regional Assessment Area (RAA; Map 2). Mammal studies have included: aerial multispecies winter track surveys, aerial winter minimum count moose surveys, GPS collar data from woodland caribou occupying the Norway House (forest-dwelling ecotype) and the Pen Islands (forest-tundra ecotype) populations and trail camera studies. A local trapper participation program was undertaken to acquire local knowledge on furbearer occurrence and relative abundance.

Bird and amphibian monitoring included data collected from autonomous recording units, Manitoba Breeding Bird Atlas point count surveys, and aerial spring and fall waterfowl surveys. Local and traditional wildlife knowledge gathered from community wildlife workshops held in the three FN communities provided valuable information from community members, including hunters and trappers, to supplement wildlife monitoring results. In addition, community members participated in many of the wildlife surveys.

2.0 STUDY AREA

This report describes the environmental setting and baseline data gathered on wildlife as it relates to the P6 RAA (Figure 1; Map 2). The boundaries of the RAA, encompassing an area of 9,005 km^2 (20-km buffer) were determined by KGS and MI, with input from technical specialists including Joro, using a multi-disciplinary approach incorporating both biophysical and social factors. Species of importance to FNs were determined through workshops, open houses and community discussions and included (but not limited to), large mammals (moose and caribou), furbearers, and migratory waterfowl. The extent of the RAA boundary was selected to ensure home ranges of large ranging species such as moose were considered. Areas of traditional use in proximity to P6 were also considered, resulting in the area extending approximately 20 km beyond the alignment being identified as important.

The Pen Islands woodland caribou population are known to have a very large range, extending to the Hudson Bay coast and north of the Nelson River. The RAA includes a small portion of the Pen Islands caribou range and the Norway House woodland caribou range. Baseline data on caribou have been gathered across these ranges and are included in this report. The RAA also encompasses habitat for other species with smaller, multi-generational home ranges that are expected to exist throughout P6 (e.g., furbearers and small mammals), as well as areas important as breeding and/or staging habitat for waterfowl and other migratory birds, and areas of known or potential local resource and traditional use.

The Local Assessment Area (LAA) for P6 is defined as a 5-km buffer on either side of the proposed P6 ASR route, encompassing an area of 1,327 km^2 (Figure 1; Map 2). The Project Footprint (PF) for P6 is defined as the 100-m ASR ROW, encompassing an area <14 km^2. Administrative boundaries which intersect with the RAA are the Manitoba Sustainable Development (MSD), Wildlife and Fisheries Branch, Game Hunting Area (GHA) 3A (MSD, 2016a) or the MSD, Forestry Branch, Forest Management Unit (FMU) 76, 90, 93, 94, 95, 96, 97, 98, and 99 (MSD, 2013) (Map 3).

FN communities located within the RAA include Bunibonibee, Manto Sipi, and God's Lake, and the Northern Affairs community of God's Lake Narrows. These communities utilize sections within the RAA as traditional hunting and trapping areas for wildlife species. In addition, winter roads, hydro transmission lines, recreational trails, quarries, and traplines occur throughout the RAA. There are also several lodges and outposts which provide various services focused mainly on angling and hunting.

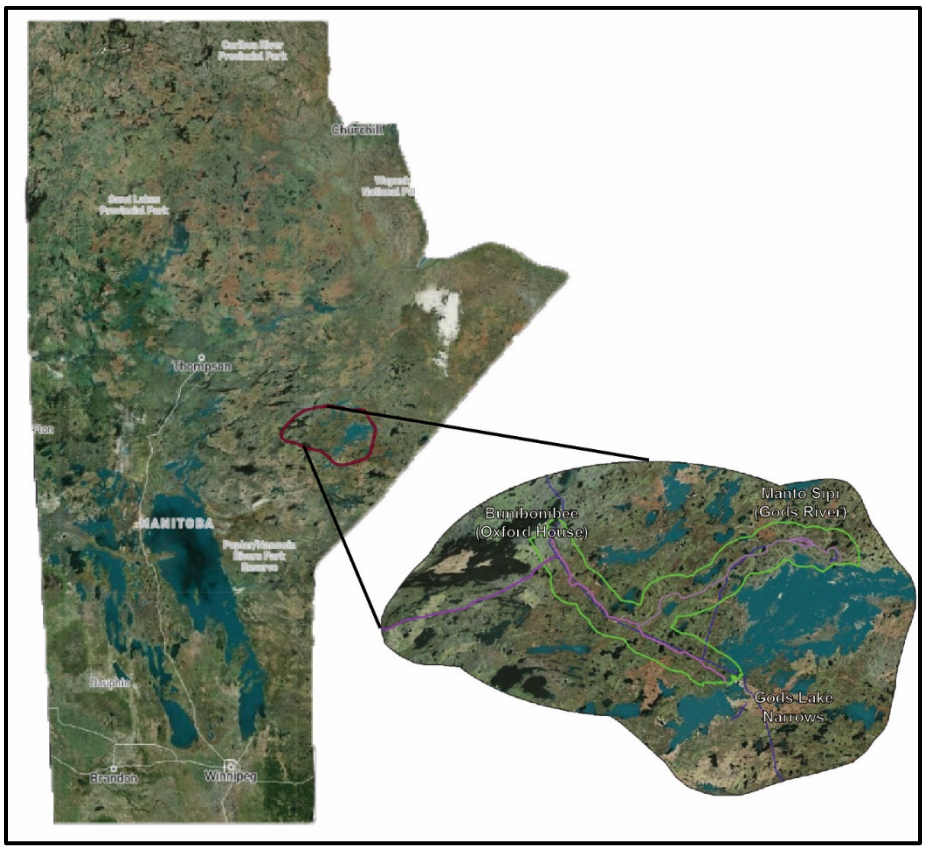


Figure 1: Location of the P6 RAA and the LAA within northeastern Manitoba

2.1 Environmental Setting

This section provides a summary of the existing environment for the P6 RAA. Further detail on the P6 environmental setting is summarized in the Wildlife Characterization and Effects Assessment of the Proposed All-Season Road Project 6 Report (Joro, 2017a).

The RAA is located within the Boreal Shield Ecozone, which is the largest ecozone in Canada. In Manitoba, it extends north from the southeast corner of the province, encompassing the area between Lake Winnipeg and the Ontario border and proceeds across the northern extent of the Lake as a broad band from the Ontario to Saskatchewan borders (Smith *et al.,* 1998). The ecozone is dominated by both lowlands and broadly rolling uplands.

The **surficial geology** [2] is composed of Precambrian granite bedrock outcrops, **moraines**, **glaciofluvial**, and **colluvial** deposits. The continental climate is typically characterized by short warm summers and cold, snowy winters. Soils are dominated by **luvisols** in the south and **brunisols** in the north (Zoladeski *et al.*, 1995). **Brunisolic** soils comprise one of three forest soil orders and can be viewed as part of a

[2] Words in bold are defined in the Glossary of Terms

prolonged evolutionary sequence that begins with an unweathered parent material (**Regosols**) and ends with development of a “mature” forested soil of the **Podzolic** or **Luvisolic** orders; the **Brunisolic** “stage” may last for several thousands of years.

The entire RAA falls within the Hayes River Upland (89) Ecoregion (Figure 2), which extends from the Grass River Basin in east-central Manitoba to the Manitoba-Ontario border. The Hayes River that flows northeast and eventually drains into Hudson Bay is the major drainage channel in the region; both Knee Lake and Oxford Lake are widened expanses of the Hayes River. The area is characterized by numerous small streams connecting a network of small lakes and wetlands between **drumlinoid ridges**, most of which have exposed bedrock. Most of the area is a mix of till blankets and till veneers over bedrock. Well to moderately-well drained till and **glaciolacustrine** parent materials are generally associated with **eluviated eutric brunisol** soils, while imperfect to poorly drained deposits are frequently overlain by **regosolic gleysols** and a mix of **cryosols** and **mesisols** (Trommelen, 2012).

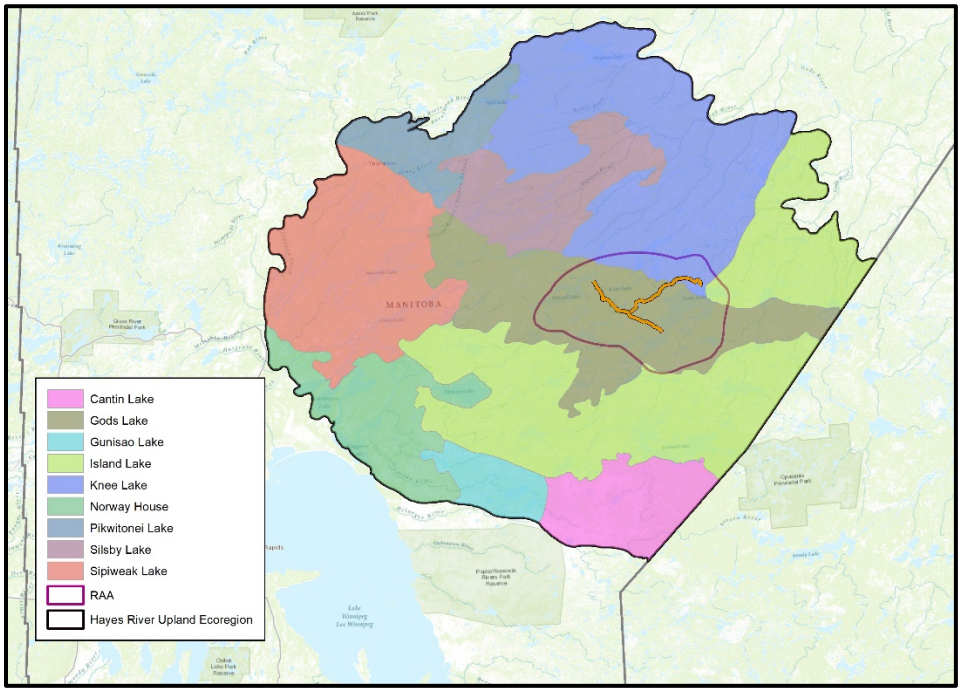


Figure 2: Location of the P6 RAA and ecodistricts within the Hayes River Upland in northeastern Manitoba (Source: Agriculture and Agri-Food Canada, 2006)

2.2 Ecodistricts

The RAA is intersected by parts of three ecodistricts, Island Lake (364), God’s Lake (365), and Knee Lake (360) (Figure 2). The God’s Lake Ecodistrict accounts for more than 85% of the total area within the RAA (Figure 3).

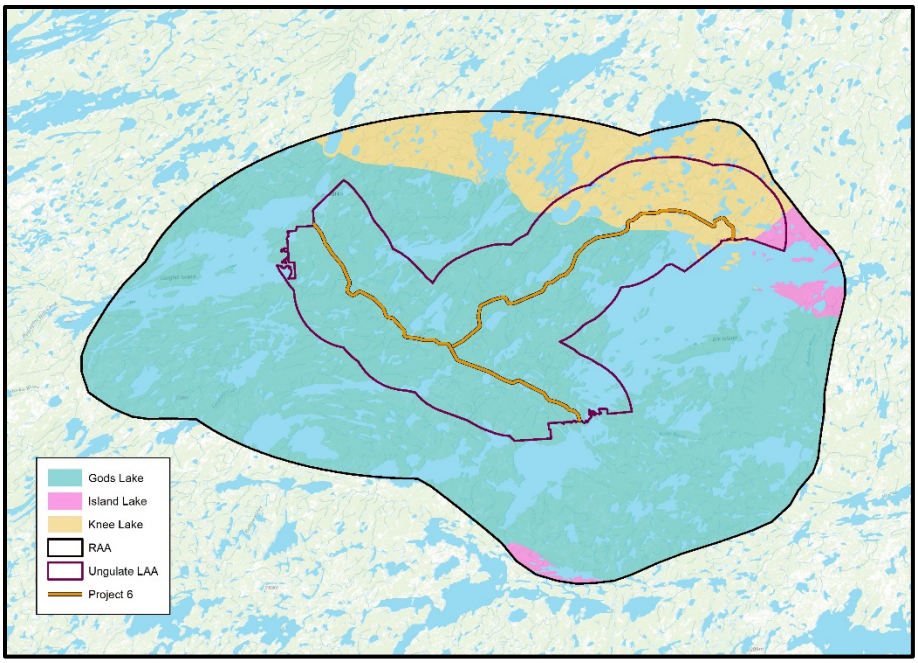


Figure 3: Location of ecodistricts that intersect the P6 RAA in northeastern Manitoba (Source: Agriculture and Agri-Food Canada, 2006)

The surficial geology, and soil to a large extent, determine the organic productivity of the landbase, including the vegetation communities and the wildlife it supports (Figure 4 and Figure 5). The glacial tills are a product of the scraping and plucking of bedrock by glacial ice resulting in variably sized rock fragments that were transported, crushed and mixed into a thin sediment layer. Till veneers and till blankets underlie most of the area accounting for almost 75% of the area in the RAA.

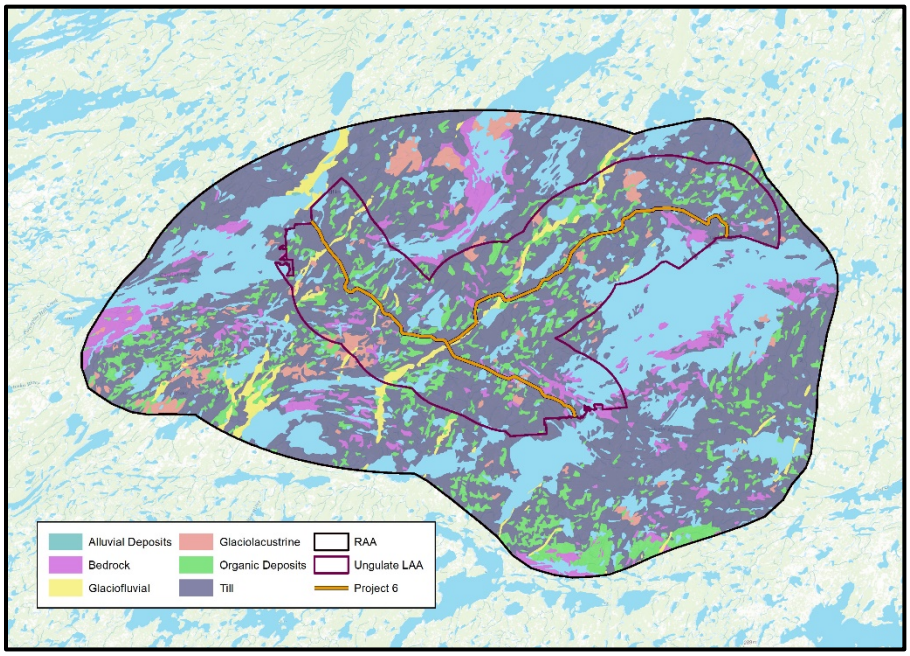


Figure 4: Surficial geology within the P6 Regional Assessment Area (Source: Natural Resources Canada, 1995)

Eutric brunisols (>71%) and **cryosols** (25%) dominate the soil profile within the RAA (Figure 5).

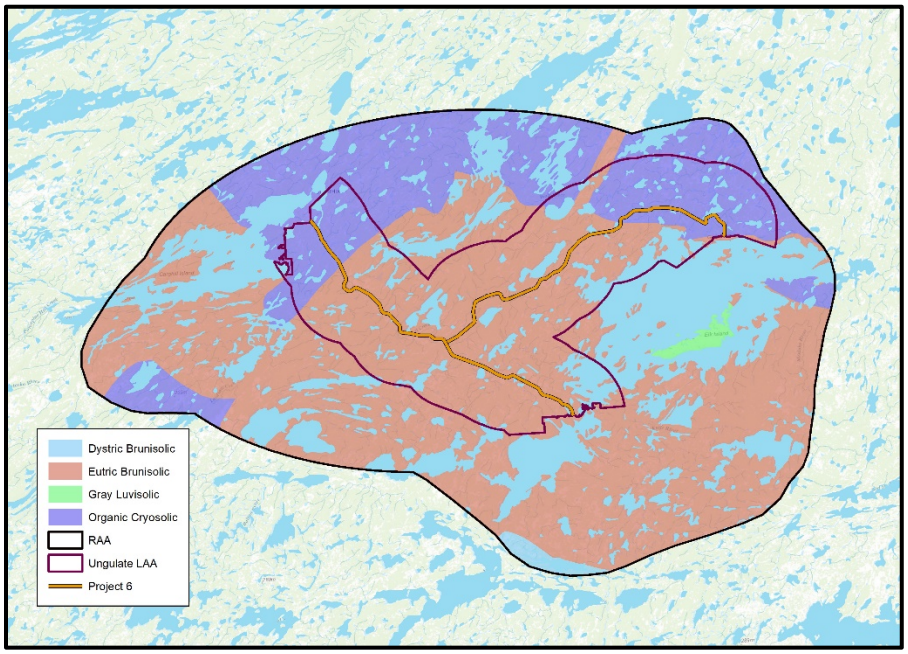


Figure 5: Distribution of major soil types within the P6 RAA (Source: Agriculture and Agri-Food Canada, 1996)

2.2.1 The God's Lake (365) Ecodistrict

This is the predominant ecodistrict in the RAA; it begins at Landing Lake and lies entirely within Manitoba except for its most eastern tip which falls in Ontario. This ecodistrict is located in the central part of the Hayes River Ecoregion and is bordered on both north and south by the Island Lake (364) Ecodistrict and also by the Knee Lake (360) Ecodistrict to the north (Smith *et al.*, 1998). The mean annual temperature is -1.5°C with an average growing season of 155 days. The mean annual precipitation is approximately 560 mm, of which less than one-third falls as snow (Smith *et al.*, 1998).

The **physiography** of the region consists of undulating to hummocky morainal plain of calcareous, sandy to loamy till deposits with clayey **glaciolacustrine** veneers and blankets all over the region, especially on lower slopes and depressions. Northern plateau bog, peat plateau bog, flat bog, patterned and horizontal fens (deep peat deposits), and veneer bog (shallow peat materials) frequently cover the fine textured glaciolacustrine sediments. There are also areas where prominent **kettled fluvioglacial deposits** occur (Smith *et al.*, 1998). Oxford Lake and God's Lake are the largest of the wide range of lakes within the ecodistrict that contribute to the region's northward flowing water (Smith *et al.*, 1998).

The God's Lake Ecodistrict has well to imperfectly drained mineral soils comprised of eluviated **eutric brunisols** and **gray luvisols** which can be found on upland clayey glaciolacustrine deposits. Peat-filled areas cover a large area on this region and are comprised of poorly drained bogs and very poorly drained fens. The soil is composed of a range of peat types including **fibrisols** (slightly decomposed sphagnum and feather moss peat), **mesisols** (moderately decomposed moss and forest peat), and **organic**

cryosols (areas with permafrost) (Smith *et al*., 1998). The deeper layers of peat are generally more decomposed than those close to the surface as is the case in peat fens.

In areas with gentle slopes, shallow peat soils with slight to moderately decomposed sphagnum, feather moss is more likely and may be associated with organic cryosols (Smith *et al.*, 1998). Black spruce (*Picea mariana*) is the dominant tree species in the God's Lake Ecodistrict; however, the upland portions are frequently replaced by jack pine (*Pinus banksiana*) followed by trembling aspen (*Populus tremuloides*) due to fire activity. Tamarack (*Larix laricina*) is common in fens and can be found mixed with black spruce in transitional bog peatlands. Successful mixed stands of white spruce (*Picea glauca*), balsam fir (*Abies balsamea*), trembling aspen, and balsam poplar (*Populus balsamifera*) can be seen along rivers and lakes (Smith *et al.*, 1998).

2.2.2 The Knee Lake (360) Ecodistrict

The Knee Lake (360) Ecodistrict is restricted to a portion of the northern edge of the RAA Figure 3, although the whole of the Knee Lake Ecodistrict forms a horseshoe-shaped area extending from Knee Lake in the south to Stevenson Lake in the north (Smith *et al.*, 1998). Mean temperatures range from a low of -25.7°C in January to a high of 15.3°C in July with an average growing season of 131 days. The mean annual precipitation is approximately 500 mm, of which more than one-third falls as snow (Smith *et al.*, 1998).

The physiography changes from undulating to ridged, (drumlins) loamy morainal plain where the drumlins have been eroded by water and may have veneer bogs on the lower slopes. Veneer bogs also appear on gently sloping glaciolacustrine blanket and veneers; whereas peat plateau bogs and patterned fens tend to be found in **depressional** terrain with clayey glaciolacustrine sediments underneath. The ecodistrict also contains sites of conspicuous eskers and esker aprons (kettled fluvioglacial deposits) which can be up to 30 m above the nearby terrain and can have eroded channels creating local relief (Smith *et al.*, 1998).

The drainage system for the northwest is the Nelson River and the south-western and eastern sections belong to the Hayes River. Lakes in this region vary from small to very large and many have shores developed in unconsolidated materials, with the smaller lakes appearing between drumlin ridges (Smith *et al.*, 1998). Much of the ecodistrict occurs on permafrost peatlands and as such the soils are organic coming from woody, forest peat, and sedge peat materials and include organic cryosols in veneer bogs and peat plateau bogs. Veneer bogs are also found in non-frozen areas and are made up of fibrisols, whereas the flat bogs and patterned fens are made up of mesisols.Knee Lake Ecodistrict has imperfectly drained mineral soils comprised of eluviated eutric brunisols on loamy to sandy calcareous till and sandy to gravelly fluvioglacial deposits and well to imperfectly drained clayey deposits in gray luvisols (Smith *et al.*, 1998).

Black spruce is the predominant tree species, but well drained upland areas are dominated by jack pine well adapted to frequent fires that characterize these dry habitats. In wetter areas, such as around lakes and rivers, white spruce appears and in bog peatlands there is black spruce, **ericaceous** shrubs, and various mosses, including sphagnum. Fens have different vegetation mostly consisting of stunted tamarack, shrubs, brown mosses, and sedges (Smith *et al.*, 1998).

2.2.3 The Island Lake (364) Ecodistrict

The Island Lake (364) Ecodistrict is separated into two sections, north and south; a very small portion of the RAA lies within the northeastern and southern sections of the ecodistrict (Figure 3). The ecodistrict is bordered by five other ecodistricts within the Hayes River Ecoregion. God's Lake Ecodistrict (365) to the north is the largest and represents the division of the two Island Lake Ecodistrict sections (Smith *et al.,* 1998). Mean temperatures range from a low of -22.8°C in January to a high of 17.6°C in July with an average growing season of 154 days. The mean annual precipitation is roughly 560 mm, with about one-third falling as snow (Smith *et al*., 1998).

The physiography of the southern section varies from an undulating to hummocky till plain where the uplands consist of granitoid rock outcrops, discontinuous blankets and veneers of acid to weakly calcareous, sandy, stony glacial till. Around Island Lake calcareous, clayey glaciolacustrine blankets and veneers are also common. In the remainder of the district, shallow to deep peat covers glaciolacustrine clayey sediments on level, gently sloping sites and in depressions (Smith *et al*., 1998). Permafrost in the northern section of the ecodistrict is widespread in deep peat bogs and discontinuous in veneer bogs and in the southern section it is confined to peat plateaus and veneer bogs and is often a relic (Smith *et al*. 1998).

Soils range from well to excessively drained and consist of dystric brunisols and stony, acid sandy till to gray luvisols, which are not as well drained. Significant areas of very poorly drained Typic (deep) and Terric (shallow) fibrisolic and mesisolic organic soils overlying loamy to clayey glaciolacustrine sediments occur in the peatlands, which are increasingly more widespread towards the west (Smith *et al*., 1998).

Most of the Island Lake Ecodistrict falls within the Hayes River watershed, with only a small western portion lying in the Nelson River watershed. The lakes range from small to very large (Island Lake) and these lakes and associated rivers and streams are the main source of water for the ecodistrict (Smith *et al*., 1998).

Jack pine and, to a lesser extent, trembling aspen are common on upland sites, due to extensive, repeated fires; however, black spruce is the dominant tree species and is especially widespread on imperfectly drained uplands and peatlands. In river valleys and around lakes where drainage is good, white spruce, balsam fir and trembling aspen form mixed stands. Stunted black spruce, sphagnum, and other mosses and ericaceous shrubs are found in bog peatlands and sedges, brown mosses, shrubs and stunted tamarack are found in fens (Smith *et al*., 1998).

2.3 Forest Cover and Vegetation

The Boreal forest within which the RAA is located forms a continuous belt from Newfoundland to the Rocky Mountains and comprises the greater part of the forested areas of Canada (Rowe, 1972). The Boreal forest is primarily coniferous with white and black spruce as characteristic species, although balsam fir and jack pine are prominent in the eastern and central portions; tamarack is only absent in the far north (LGRFN and OMNR, 2011). There is also an admixture of broadleaf trees such as white birch (*Betula papyrifera*), trembling aspen, and balsam poplar (LGRFN and OMNR, 2011).

Within the P6 RAA, the forest is further classified into the Northern Coniferous section (B.22a) (Rowe, 1972). These coniferous stands tend to have a feather moss groundcover. Bedrock outcrops have patchy tree growth with an understory of low shrubs and a groundcover of low ericaceous shrubs, mosses, and lichens. Poorly to very poorly drained fens have sedge and brown moss vegetation and may have a shrub layer or may support a tamarack-dominated tree cover with varying components of shrubs, herbs, and sedges. Poorly drained bogs generally support open to closed stands of stunted to medium tall black spruce, with an understory of dwarf birch, ericaceous shrubs, and a moss ground cover.

Peatlands that are transitional in development from fen to bog are common and the vegetation reflects the transitional aspects in its community composition (Smith *et al.*, 1998). The *Forest Ecosystem Classification for Manitoba, Field Guide* (Zoladeski *et al.*, 1995) provides a detailed species relationship, for productive forest types, in terms of their commercial tree species compositions and common relationships for understory shrubs, herbs, and mosses. Figure 6 illustrates the forest cover habitat in the RAA.

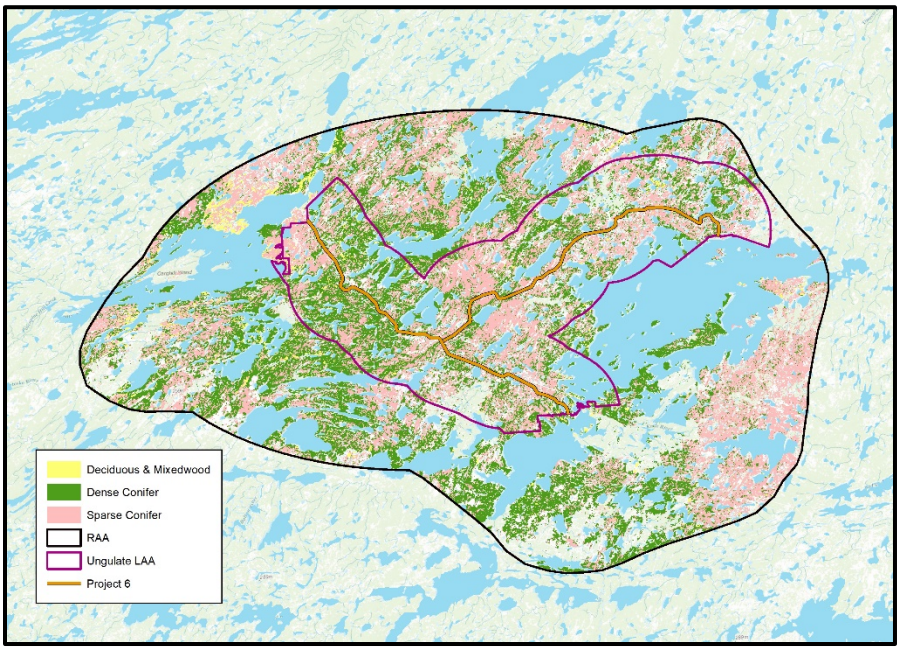


Figure 6: Distribution of deciduous and mixedwoods, sparse conifer and dense conifer within the P6 RAA (Source: Natural Resources Canada, 2003)

2.4 Habitat

The RAA vegetation community typically represents species mixes shaped by disturbance events, post-disturbance renewal and stand succession processes. The ability to adapt and occupy forest habitats at various stages of succession essentially dictates the species of wildlife that inhabit this area at any point in time, as described in Section 2.5. The area is comprised of a mosaic of different aged forest stands, plant communities and floral species that reflect the climate, topography, soils, drainage, disturbance history and forest succession of the region. Forests provide the habitats within which wildlife live and the degree and complexity of this structure determines the diversity of species and their respective abundance (Keenan *et al.*, 2009).

2.4.1 Fire History

The record of the fire history for the P6 RAA going back 100 years was mapped from the Canadian National Fire Database compiled by Natural Resources Canada (NRC, 2015). A lower rate of fire frequency is visible within the RAA than in areas to the west and south (Figure 7).

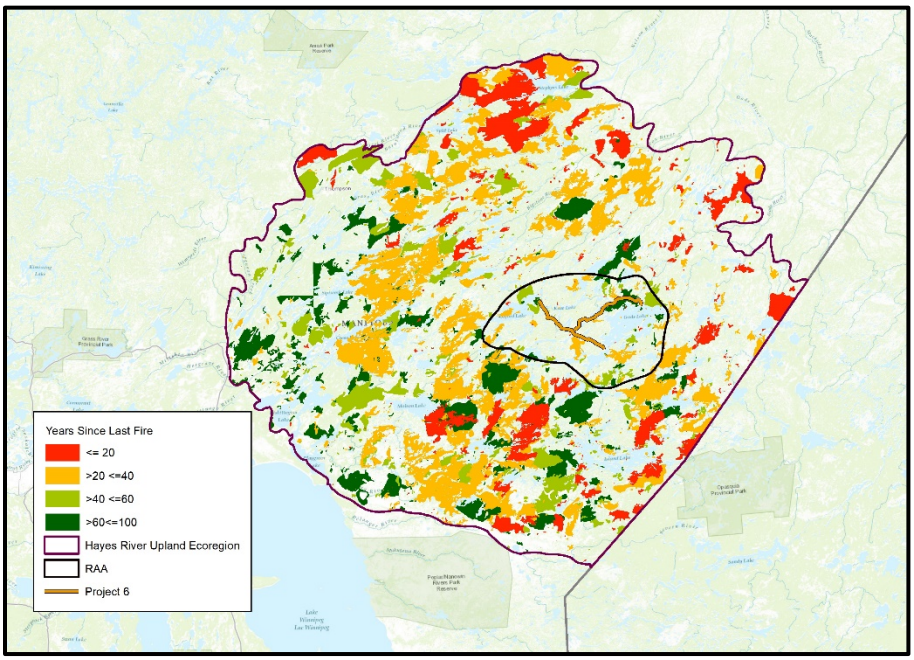


Figure 7: History of reported fires within the Hayes River Upland Ecoregion (Source: Natural Resources Canada, 2015, Agriculture and Agri-Food Canada)

Most fires within the ecoregion over the last century are <40 years of age (Figure 8), thereby favouring those wildlife species that may benefit from younger regenerating forest structures. However, within the RAA itself, a lower burn rate has resulted in a somewhat more mature forest (Figure 6).

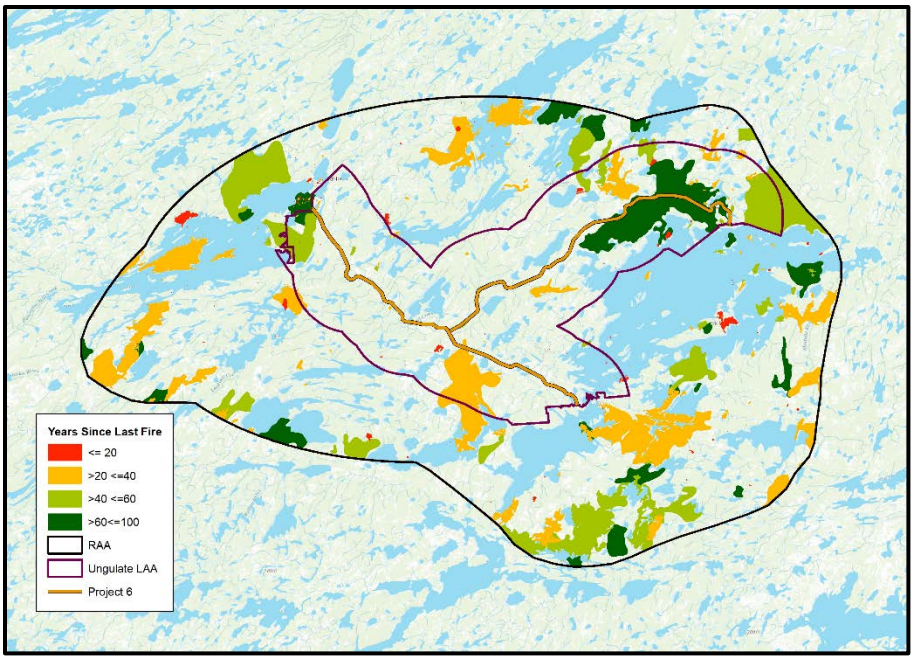


Figure 8: History of reported fires within the P6 RAA (Source: Natural Resources Canada, 2015)

Fire is the major disturbance factor shaping the patterns and distribution of forest age classes and communities within the Boreal Shield Ecozone. The forest landscape within the RAA does not present a highly complex forest covertype structure, but rather a classical Boreal shield forest defined by a mix of treed and open wetlands surrounded by higher elevation black spruce and jack pine forest communities in a range of age classes shaped by the patterns created by frequent natural fires.

Fire is the primary source of disturbance and the Boreal Shield Ecozone that extends across the region is generally characterized by fire events that periodically burn the landscape with varying degrees of intensity. In the case of black spruce, fuel loads to carry fire can include the trees, coarse woody debris and organic materials that comprise the forest floor; the most intense fires essentially leave no woody debris on the forest floor (Dyrness and Norum, 1983).

Burton *et al.* (2008) categorized the hierarchy of scales of diversity associated with large fires in the boreal forest: (1) within the entire boreal forest of North America as a function of climatic and topographic effects on both the rates of burning leading to inter-regional and/or inter-landscape differences; (2) differences within a landscape caused by specific landscape environmental attributes and **stochasticity**; and (3) a diversity within a fire that can be described in terms of burn severity, the latter of which essentially defines the structure of the post-fire forest. Black spruce and jack pine are both fire-adapted species given their **serotiny** in which fire triggers seed release and dispersal. In the case of severe fires that also burn the forest floor, there is a rapid and dense regeneration to the dominant forest type.

Hall *et al.* (2008) viewed a broad application of burn severity maps, particularly in the assessment of the consequences for varying severity regimes for wildlife suggesting, for example, that a level of burn severity that may preclude the post-fire use of the landscape by caribou may be quite different than the level of severity that would render the area unusable by other species, e.g., marten, migratory birds, or predatory birds.

The sequences of ecological processes within the RAA are a product of the repetitive burn patterns, the severity of which is linked to the combination of fuel loads combined with a host of meteorological variables. At the ecozone level, wildlife has evolved and adapted to the broad patterns of vegetative communities that provide a constant supply of habitat types that meet the life history needs for resident species and the seasonal requirements of many transient species. The ebb and flow of how species fare at the level of discrete populations is linked to the constantly shifting spatial distributions of habitats upon which species depend. Within small evaluation areas, utilization by wildlife is a direct product of the recent fire history (< 60 yrs.) that defines the complexity of mix of stand types that define the study area forest.

2.5 Wildlife in the RAA

The following sections provide an overview of important species common to the RAA. A listing of all mammals, birds, and herptiles, including species of conservation concern and species of importance to First Nations people, that may occur in the RAA is also presented in Appendices A-C, respectively.

2.5.1 Mammals

Ungulates, furbearers, and small mammals comprise the 39 species that may occur within the RAA. See Appendix A for a comprehensive list of mammals that may occur and their conservation status.

2.5.1.1 Woodland Caribou

The Pen Islands (Eastern Migratory) and Norway House (Boreal Caribou) caribou ranges/populations overlap with the P6 RAA. The animals occupying both ranges are woodland caribou (*Rangifer tarandus caribou*), but due to differences in several important life characteristics they are recognized as belonging to different ecotypes. Pen Islands caribou are categorized as the migratory ecotype, also referred to as “forest-tundra” ecotype, whereas Norway House caribou are classified as the sedentary ecotype, also referred to as “forest-dwelling” or “boreal forest” ecotype (Committee on the Status of Endangered Wildlife in Canada or COSEWIC, 2011; Manitoba Boreal Woodland Caribou Management Committee or MBWCMC, 2015).

The forest-tundra ecotype is differentiated from the forest-dwelling ecotype by their migratory and calving behaviour. Forest-tundra (Pen Islands) caribou traditionally migrate and assemble in large groups near the Hudson Bay coast to calve. This is in contrast to forest-dwelling caribou that disperse and separate over large areas during calving. Forest-tundra caribou more closely resemble migration characteristics of barren-ground caribou (*Rangifer tarandus groenlandicus*), moving large distances between winter range and spring calving areas (COSEWIC, 2011; Berglund *et al*., 2014; Pond *et al.*, 2016). FN communities in the RAA have supported the understanding of a diverse caribou population within the RAA and have described two types of caribou as identified by the behavioural characteristics described.

Pen Islands Caribou Range/Population (Forest-tundra)

COSEWIC (2011) currently identifies the Pen Islands caribou range as part of Designatable Unit 4 (DU4): Eastern Migratory Caribou. COSEWIC has assessed all subpopulations of the Eastern Migratory Caribou,

including the Southern Hudson Bay subpopulation (i.e. the Pen Islands range), as “Endangered” (COSEWIC, 2017). MBCDC (2016a) lists the population as S4. See Appendix A for further detail/definitions on conservation status listing.

The Pen Islands caribou population has a range extending from northeastern Manitoba to northwestern Ontario within the Hudson Bay and Boreal Shield Ecozones (Magoun *et al.*, 2005; Gunn *et al.*, 2011; Abraham *et al.*, 2012; Berglund *et al*., 2014). In recent years, caribou from the Pen Islands caribou population have been observed in the same geographical area as the proposed P6 road alignment, and to the area north and east within the P6 RAA on occasion. However, the actual numbers and frequency of Pen Islands caribou occupying and/or migrating through the P6 RAA has likely varied considerably over time.

Due to the migratory nature of the Pen Islands population, the use of this area by animals has been primarily on a seasonal basis (the winter months from November through to late April), though a very small number of female caribou may have remained in the RAA during the summer months. The P6 RAA would be on the southern limit of the population’s normal range. Within the RAA the animals would primarily be found in forested areas, but most commonly mature coniferous forests where quantities of lichen are available.

Norway House Caribou Range/Population (Forest-dwelling)

COSEWIC (2011) currently identifies the Norway House caribou range as part of Designatable Unit 6 (DU6): Boreal Caribou and are assessed as “Threatened”, similarly they are listed as “Threatened” under SARA. Boreal caribou are also listed as “Threatened” under MESEA and a process for developing an Action Plan for the Management Unit (MU) is provided in Manitoba’s Boreal Woodland Caribou Recovery Strategy (MBWCMC, 2015). MBCDC (2016a) lists the population as S2S3. See Appendix A for further detail/definitions on conservation status listing.

The Norway House population range overlaps slightly with the RAA and is restricted to the extreme western portion of the RAA. Historical information on the forest-dwelling ecotype within the P6 RAA is sporadic and limited. Current range data have been gathered since 2011 as part of baseline wildlife monitoring. Both government reports and traditional ecological knowledge indicate the presence of caribou within the general geographical area but detailed information on historic distribution and numbers is lacking. As a result, the range delineation of this boreal caribou population has gone through several changes since the early 1990’s (Johnson, 1993; Rebizant et al., 2000; Manitoba Conservation, 2006; MBWCMC, 2015). Currently MSD, the provincial department responsible for boreal woodland caribou management, shows the western portion of the P6 RAA as being in the Molson Lake MU and a small part of the Norway House caribou range overlapping it (MBWCMC, 2015). The Norway House range lies entirely within the Boreal Shield Ecozone.

2.5.1.2 Moose

Moose (*Alces alces*) are distributed across much of forested Canada (Banfield, 1974) and are common within the boreal forest across Manitoba including the RAA. Moose are most commonly found in association with wetlands and lakes in summer feeding on both herbaceous plants and emergent aquatic

vegetation rooted in mineral soils, and in winter seek woody browse provided by a variety of shrubs and young deciduous trees (Renecker and Schwartz; 1998, Gillingham and Parker, 2008). Moose tend to benefit from large stand renewal events, most of which are caused by wildfires in the Boreal Shield Ecozone. Within the RAA, moose are highly valued primarily for rights-based subsistence hunting and, as the largest prey species, are an integral component of the food chain (MSD, 2016a). FN communities in the RAA indicated moose to be an important source of food for local community members, with hunters sharing the moose harvested with family and community members. Moose populations in the RAA are not considered a conservation concern.

2.5.1.3 Furbearers and Small Mammals

Grey wolves (*Canis lupus*) inhabit forested areas with sufficient prey species such as moose, beaver, and snowshoe hare to sustain packs. Given the low biological productivity of the Boreal Shield ecozone, wolf home ranges tend to be large and are found throughout the RAA. Wolf populations are monitored by MI to study their movement patterns and prey selection, particularly in relation to boreal woodland caribou due to it being a threatened species listed under the federal Species at Risk legislation. Most wolf kill sites investigated within the boreal shield on the east side of Manitoba have been of moose. Wolf populations in the RAA are not considered a conservation concern.

American black bears (*Ursus americanus*) are found across most wooded habitats in North America and are relatively common through the boreal forest (Latham 2009, Tigner *et al.* 2014, DeMars 2015), including the RAA. Population densities tend to be highest in diverse forests at relatively early stages of succession and lowest where soils are thinner and plant growth generally poorer (Kolenosky and Strathearn, 1987). Bears are well known significant predators of neonate ungulates in northern temperate ecosystems and may be a factor in low recruitment rates of moose and caribou (Stewart *et al.* 1985, Bastille-Rousseau *et al.* 2011, Latham *et al.* 2011). Black bear populations in the RAA are not considered a conservation concern.

Large and small furbearers of importance to trappers in the RAA include American beaver (*Castor canadensis*), American marten (*Martes americana*), American mink (*Neovison vison*), Canada lynx (*Lynx Canadensis*), ermine (*Mustela erminea*), fisher (*Martes pennanti*), muskrat (*Ondatra zibethicus*), Northern river otter (*Lontra Canadensis*), red fox (*Vulpes vulpes*), red squirrel (*Tamiasciurus hudsonicus*), snowshoe hare (*Lepus americanus*), and wolverine (*Gulo gulo*). Marten and beaver, in particular, are valued species to trappers. Marten can be found in most of Manitoba's boreal forest and generally inhabit mature coniferous or mixedwood forests. They feed on small mammals such as hares, some birds, fruit, nuts, carrion, rodents, shrews, and insects (Reid, 2006). Beaver can also be found throughout Manitoba's boreal forest close to water, and feed on bark and twigs of softwood trees, along with aquatic plants and grasses (Caras, 1967). There are no furbearer species of conservation concern in the RAA.

Commercial trapping of furbearers is administered by MSD through the Registered Trapline (RTL) system (MSD, 2016b). There are 51 RTLs that fall (fully or partially) within the P6 RAA and 10 RTLs specifically intersect the P6 alignment. Further detail on trapping in the P6 RAA can be found in section 3.7.2.

There are several other species of small furbearers or mammals that may be residents, migrants, or incidental occasional visitors to the RAA. These include, but are not limited to, least chipmunk (*Eutamias*

minimus), least weasel (*Mustela nivalis*), masked shrew (*Sorex cinereus*), meadow jumping mouse (*Zapus hudsonius*), Northern bog lemming (*Synaptomys borealis*), porcupine (*Erethizon dorsatum*), pygmy shrew (*Sorex hoyi*), raccoon (*Procyon lotor*), short-tailed shrew (*Blarina brevicauda*), silver-haired bat (*Lasionycteris noctivagans*), southern red-backed vole (*Clethrionomys gapperi*), striped skunk (*Mephitis mephitis*), and woodchuck (*Marmota monax*).

2.5.2 **Birds**

Waterbirds and forest birds comprise most of the species that are migratory in the RAA; while some non-migratory forest birds (grey jays) and upland game birds (grouse) also may occur. See Appendix B for a comprehensive list of birds that may occur in the RAA and their conservation status.

2.5.2.1 Migratory Forest Birds

A number of migratory songbird species may be located in various forest habitats within the RAA (Bezener and De Smet, 2000; Peterson and Peterson, 2002; Manitoba Avian Research Committee, 2003; Cornell Lab of Ornithology, 2015); a selection of those that commonly frequent the area include Alder flycatcher (*Empidonax alnorum*), American robin (*Turdus migratorius*), blue-headed vireo (*Vireo solitaries*), cedar waxwing (*Bombycilla cedrorum*), chipping sparrow (*Spizella passerine)*, common raven (*Corvus corax*), Connecticut warbler (*Oporornis agilis*), dark-eyed junco (*Junco hyemalis*), downy woodpecker (*Picoides pubescens*), fox sparrow (*Passerella iliaca*), gray jay (*Perisoreus canadensis*), hermit thrush (*Catharus guttatus*), least flycatcher (*Empiodnax minimus*), Lincoln's sparrow (*Melospiza lincolnii*), magnolia warbler (*Setophaga magnolia*), Nashville warbler (*Oreothlypis ruficapilla*), Northern waterthrush (*Parkesia noveboracensis*), olive-sided flycatcher (*Contopus cooperi*), orange-crowned warbler (*Oreothlypis celata*), ovenbird (*Seiurus aurocapilla*), palm warbler (*Setophaga palmarum*), ruby-crowned kinglet (*Regulus calendula*), rusty blackbird (*Euphagus carolinus*), swamp sparrow (*Melospiza georgiana*), Tennessee warbler (*Oreothlypis peregrine*), white-throated sparrow (*Calidris fuscicollis*), white-winged crossbill (*Loxia leucoptera*), Wilson's snipe (*Gallingo delicate*), Wilson's warbler (*Cardellina pusilla*), winter wren (*Troglodytes hiemalis*), yellow-bellied flycatcher (*Empidonax flaviventris*), yellow-bellied sapsucker (*Sphyrapicus varius*), and yellow-rumped warbler (*Setophaga coronate*).

2.5.2.2 Non-Migratory Forest Birds

Non-migratory forest birds that also occur in forest habitats in the RAA include: American three-toed woodpecker (*Picoides dorsalis*), black-backed woodpecker (*Picoides arcticus*), blue jay (*Cyanocitta* cristata), common raven (*Corvus corax*), downy woodpecker (*Picoides pubescens*), European starling (*Sturnus vulgaris*), evening grosbeak (*Coccothraustes vespertinus*), gray jay (*Perisoreus canadensis*), hairy woodpecker (*Picoides villosus*), pileated woodpecker (*Dryocopus pileatus*), pine grosbreak (*Pinicola enucleator*), and pine siskin (*Spinus pinu*s).

2.5.2.3 Migratory Waterbirds and Waterfowl

Many species of migratory waterbirds occur in wetlands, or along shorelines and riparian areas within the

RAA. Some common examples are American bittern (*Botaurus lentiginosus*), American wigeon (*Anas americana),* Bonaparte's gull (*Chroicocephalus philadelphia*), bufflehead (*Bucephala albeola*), Canada goose (*Branta canadensis*), common loon (*Gavia immer*), Forester's tern (*Sterna forsteri*), greater yellowlegs (*Tringa melanoleuca*), green-winged teal (*Anas crecca*), herring gull (*Larus argentatus*), least sandpiper (*Calidris minutilla*), mallard (*Anas platyrhynchos*), red-breasted merganser (*Mergus serrator*), ring-billed gull (*Larus delawarensis*), ring-necked duck (*Aythya collaris*), sandhill crane (*Grus canadensis*), solitary sandpiper (*Tringa solitaria*), sora (*Porzana Carolina*), and yellow rail (*Coturnicops noveboracensis)*.

2.5.2.3 Raptors

American kestrel (*Falco sparverius*), bald eagle (*Haliaeetus leucocephalus*), barred owl (*Strix varia*), boreal owl (*Aegolius funereus*), broad-winged hawk (*Buteo platypterus*), great gray owl (*Strix nebulosi*), long-eared owl (*Asio otus*), Northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), sharp-shinned hawk (*Accipter striatus*), and osprey (*Pandion haliaetus*) are some of the common non-migratory raptors that may be found in the RAA.

2.5.2.4 Non-Migratory Upland Game Birds

Birds of Prey (Raptors)

American kestrel (*Falco sparverius*), bald eagle (*Haliaeetus leucocephalus*), barred owl (*Strix varia*), boreal owl (*Aegolius funereus*), broad-winged hawk (*Buteo platypterus*), great gray owl (*Strix nebulosi*), long-eared owl (*Asio otus*), Northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), sharp-shinned hawk (*Accipter striatus*), and osprey (*Pandion haliaetus*) are some of the common raptors that may be found in the RAA.

2.5.3 **Reptiles and Amphibians**

Several species of frogs and toads may occur within the RAA and they include: American toad (Bufo americanus), boreal chorus frog (Pseudacris triseriata maculata), green frog (Lithobates clamitans), northern spring peeper (*Hyla crucifer crucifer*), northern leopard frog (*Lithobates pipiens*), and wood frog (*Lithobates sylvaticus*) (Conant and Collins, 1991). These species generally require shallow ponds and puddles for breeding and moist environments in shrubby and wooded areas for the rest of the year. No amphibian species of conservation concern occur in the RAA.

The only reptile known to occur in the RAA is the red-sided garter snake (*Thamnophis sirtalis parietalis*) and it is commonly found in moist woodlands and the edges of wetlands. None of these species are of conservation concern in the RAA. See Appendix C for further detail/definitions on their conservation status listing.

2.5.4 Species of Conservation Concern

Fourteen species of conservation concern, 11 birds and three mammals may occur within the RAA. These include:

Species	SARA Listing	COSEWIC Assessment	MESEA Listing	MBCDC Rank*
Canada warbler (***Cardellina canadensis***)	Threatened	Threatened	Threatened	S3B
Common nighthawk (***Chordeiles minor***)	Threatened	Threatened	Threatened	S3B
Olive-sided flycatcher (Contopus cooperi)	Threatened	Threatened	Threatened	S3B
Short-eared owl (***Asio flammeus***)	Special Concern	Special Concern	Threatened	S2S3B
Rusty blackbird (***Euphagus carolinus***)	Special Concern	Special Concern	Not listed	S4B
Peregrine falcon (***Falco peregrinus***)	Special Concern	Special Concern	Endangered	S1B
Yellow rail (***Coturnicops noveboracensis***)	Special Concern	Special Concern	Not listed	S3B
Bank swallow (***Riparia riparia***)	Threatened, Schedule 1	Threatened	Not listed	S5B
Barn swallow (***Hirundo rustica***)	Threatened, Schedule 1	Threatened	Not listed	S4B
Horned grebe (***Podiceps auritus***)	No Schedule, No Status	Special Concern	Not listed	S4B
Eastern wood-pewee (***Contopus virens***)	Special Concern, Schedule 1	Special Concern	Not listed	S4B
Boreal woodland caribou* (***Rangifer tarandus caribou***)	Threatened, Schedule 1	Threatened	Threatened	S2S3
Eastern migratory caribou* (***Rangifer tarandus caribou***)	No Schedule, No Status	Endangered	Not listed	S4
Little brown bat (***Myotis lucifugus***)	Endangered	Endangered	Endangered	S2N, S5B
Wolverine (***Gulo gulo***)	No Status	Special Concern	Not listed	S3S4

- Both ecotypes, migratory and non-migratory woodland caribou are addressed as a single species
- Ranges of several of the listed species overlap with the RAA

- Short-eared owl inhabits open areas including grasslands, marshes, muskeg, and tundra (Bezener and De Smet, 2000)
- Olive-sided flycatcher inhabits semi-open mixed and coniferous forests near water and/or burned areas and boggy sites with standing dead conifers (Bezener and De Smet, 2000)
- Common nighthawk and barn swallow are found throughout Manitoba with exception of the extreme north. Both species select open and semi-open habitats such as fields, forest edges, meadows, lakeshores, and wetlands (Cornell Lab of Ornithology, 2015)
- Bank swallow can also be found throughout Manitoba and inhabit low areas along riverbanks with vertical cliffs or banks for nesting (Cornell Lab of Ornithology, 2015)
- Canada warbler inhabits a variety of forest types, but typically prefer wet, mixedwood forests with a well-developed shrub layer (Cornell Lab of Ornithology, 2015)
- Rusty blackbird is found throughout Manitoba and prefer swamps, marshes and pond edges (Cornell Lab of Ornithology, 2015)
- Horned grebe and yellow rail both inhabit shallow ponds and marshes or wet meadows (Cornell Lab of Ornithology, 2015) and
- Little brown bat overwinters in hibernacula (caves/mines) and females inhabit maternity colonies such as buildings or large trees in summer; foraging occurs over water along waterways and forest edges, avoiding large open fields (COSEWIC, 2013).

Peregrine falcon, however, is considered a potential migrant within the RAA. It is typically found in urban areas of southern Manitoba, perching or nesting on skyscrapers, water towers, cliffs, power poles, and other tall structures (Cornell Lab of Ornithology, 2015). The range of the Eastern wood-pewee also does not overlap with the RAA and occurs typically in the far southern portion of Manitoba, but has been recorded on a species listing for the Hayes River Upland Ecoregion (MBCDC, 2016b). It inhabits forested habitat, primarily deciduous forest and woodland, and smaller open woodlots (Cornell Lab of Ornithology, 2015). No observations of Eastern wood-peewee were recorded during surveys undertaken for this project.

3.0 METHODS AND RESULTS

The following section describes methods for habitat evaluation and wildlife studies for selected mammals, birds, reptiles, and amphibians within the P6 RAA, and the results of those investigations.

3.1 Habitat

The evaluation of habitat utilized the national Land Cover Classification of Canada (LCC) spatial database that has been harmonized across the major federal departments including Agriculture and Agri-Food Canada, the Canadian Forest Service, and the Canadian Centre for Remote Sensing (NRC, 2003). The LCC dataset provides vegetated and non-vegetated land cover classes that identify the primary ecological and vegetation or habitat conditions of an area. Analysis of information for the P6 RAA, LAA, and PF evaluation areas was also undertaken using ALCES (A Land and Cumulative Effects Simulator) that incorporates the LCC. The data library used in ALCES contains indicator datasets including: water and wetlands, and forest cover types (Table 1). The following section provides an overview of landscape characteristics within the RAA.

3.1.1 LCC Evaluation Methods

Summary statistics were generated using the LCC in ALCES. A summary of major LCC covertypes and their proportional abundance within the RAA, LAA and PF were calculated. These general habitat categories were also utilized in the planning of field activities and monitoring for birds (ARU placement, waterfowl surveys), trail camera deployments, and the trapper program.

3.1.2 LCC Evaluation Results

Coniferous forest and water together accounted for approximately 80% of the surface cover areas within the RAA, LAA, and PF compared to approximately 1% broadleaf (deciduous) and mixedwood forest combined. Wetland classes (shrub, herbaceous, and tree) were associated with approximately 17% of the LAA, 14% of the RAA, and 12% of the PF surface area. Shrub lands comprised approximately 6.5% of the RAA, 1.6% of the LAA, and 0.0% of the PF (Table 1).

The homogeneity of the landscape favours wildlife species that benefit from associations with large and small lakes, large and small rivers, and bogs and fens as represented by the wetland classification. Species that depend on more complex vegetation structures (e.g. moose) are largely restricted to wetland edges that may provide woody browse and emergent aquatic vegetation and to younger regenerating post-fire forest areas. The major cover types as defined by the LCC database are provided in Table 1 and Figure 9. These data were used in the modelling of habitat within the PF, LAA, and RAA in the assessment of effects on important wildlife species (Joro, 2017b).

Table 1: LCC covertypes and area of coverage within the RAA, LAA, and PF

Cover Type	RAA Area (km^2)	% Total RAA	LAA Area (km^2)	% Total LAA	PF Area (km^2)	% Total PF
Broadleaf Dense	88.01	0.98	7.87	0.59	0.18	1.28
Broadleaf Open	0.26	0.00	0.00	0.00	0.00	0.00
Coniferous Open or Sparse	2,160.99	24.03	465.65	35.09	6.10	43.52
Coniferous Dense	2,049.20	22.79	371.76	28.02	5.59	39.93
Barren Land	23.68	0.26	10.99	0.83	0.35	2.52
Mixedwood Dense	45.52	0.50	3.89	0.29	0.01	0.10
Shrub Tall	581.25	6.46	21.80	1.64	0.00	0.00
Water	2,778.42	30.90	220.03	16.58	0.06	0.41
Wetland Herb	71.70	0.90	12.06	0.91	0.07	0.53
Wetland Shrub	1,037.14	11.53	187.66	14.14	1.47	10.50
Wetland Treed	154.51	1.72	24.80	1.87	0.17	1.20
Other	0.71	0.01	0.36	0.03	0.05	0.30
Total*	**8,991.40**	**100.0**	**1,326.9**	**100.0**	**14.1**	**100.0**

* Estimates of gross areas using the ALCES land classification software system.

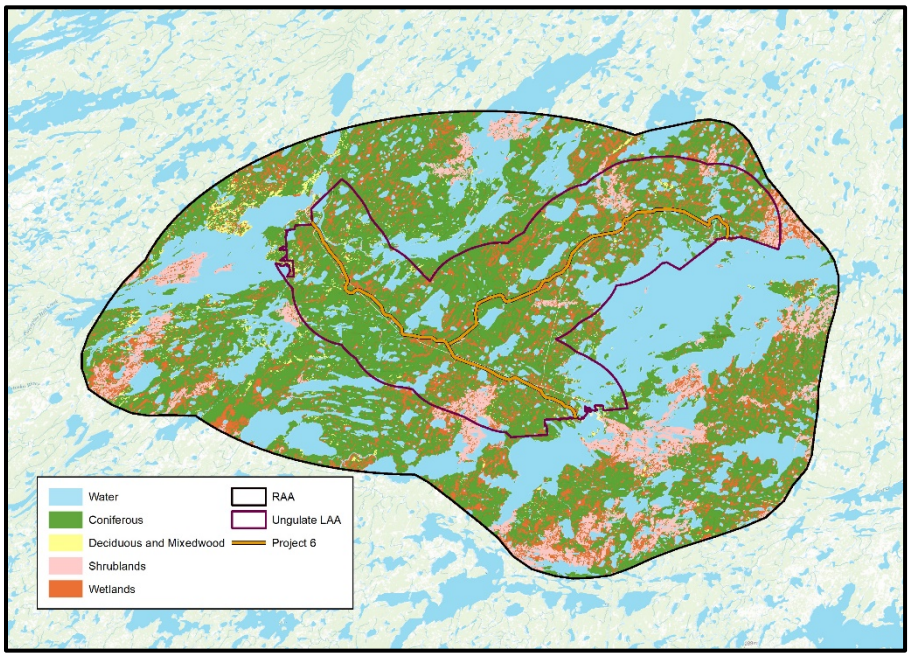


Figure 9: Distribution of major cover types in the RAA as defined by the LCC database (Source: Natural Resources Canada)

3.2 General Wildlife Field Studies

3.2.1 Trail Camera Methods

As part of a suite of baseline monitoring methods to map wildlife distribution within the RAA, trail camera studies were designed to detect ungulate, predator, and furbearer occupancy. Beginning in 2016, trail camera site selection has been based on a hexagonal sampling grid overlain the RAA. Trail cameras were located across the RAA (Map 4). A typical deployment of a trail camera within the RAA is presented in Appendix E: Photograph 1.

Hexagon sampling units facilitate spatial analysis of habitat attributes that are useful in determining wildlife occupancy (Rempel *et al.*, 2012). Sampling grids are used extensively to determine wildlife occupancy through aerial and ground surveys in boreal forest settings (e.g. Gardner *et al.*, 2010; Whittington and Heuer, 2012; Hornseth and Rempel, 2016). The application of trail camera trap event (photo) data were used to support other wildlife distribution data collected from aerial multispecies surveys, total minimum count aerial moose surveys, and trapper programs.

Trail camera placements were based on a hexagon grid of approximately 21 km^2. Sample unit size was based on maximizing the detection and occupancy of mammals with large home ranges. Trail cameras were placed within individual hexagon cells with the objective of maintaining a minimum separation of 2.5 km between camera locations. Camera trap locations were also distributed across various representative habitat types based on habitat mapping using the Land Cover Classification of Canada, East Side (LCCES), an enhanced version of the LCC layer that includes the addition of the historical fire history since 1920. Camera trap sites were placed near the proposed alignment and along existing natural and anthropogenic linear features, and game trails to provide optimum opportunity to document target species that tend to use these features for travel. The presence of a suitable helicopter landing area was also a consideration to ensure effective maintenance and retrieval of cameras.

Wildlife occurrence by hexagons was summarized by species and the total number of camera trap events. The number of camera trap events often reflects multiple animals of the same species being captured in a single photograph, however, distinguishing individuals through pelage (fur patterns), size, and/or other markings was not considered feasible due to the one-year duration of camera placement, given that animals shed hair and antlers. Also, bear tampering often results in cameras being tipped, resulting in only partial photographs of individuals. For camera coding and occupancy determination, multiple photos of the same animal were only counted once. Multiple animals in a single photograph were counted (for example, if a group of 2 moose were caught on camera in 5 separate new events, the number of camera trap events is 10) (Lyra-Jorge *et al.*, 2008; Rosatte, 2011).

Caribou, moose, wolves, and black bears were analyzed by season to identify seasonal occupancy of the RAA by each species. Differences in gradient scale and shading illustrated on maps is reflective of species observation rates as some species (such as caribou) are more commonly observed (including larger groups) than others (i.e. wolf). Seasonal mapping dates were based on general terrestrial and avian wildlife distribution for spring, summer, autumn, and winter. Trail camera data collected by seasons, similar to telemetry data for caribou and wolves, are mapped based on the dates provided below:

- Spring: March 20th – June 19th;
- Summer: June 20th – September 19th;
- Autumn: September 20th – December 19th; and
- Winter: December 20th – March 19th

3.2.2 Trail Camera Results

Results of trail camera data analysis for ungulates and furbearers are presented in Table 2 to Table 4. Caribou and moose were the most common species observed from separate camera trap events in 98 hexagons within the P6 RAA (Table 2 and Table 3; Maps 5-8). Snowshoe hare was the most common furbearer species in the P6 RAA (Table 4). The trap events are not of independent observations, as observations may include multiple sightings of the same individual. No bird species were observed on any of the trail camera data collected. A selection of species images captured by trail cameras is presented in Appendix E (Photos 2-6).

Table 2: Trail Camera data for caribou, moose, wolf, and bear in the P6 RAA, March 1, 2016 to August 15, 2017

	Number of Camera Trap Events by Season				
Species	**Spring**	**Summer**	**Autumn**	**Winter**	**Total**
Caribou	207 (87%)	17 (7%)	0 (0%)	14 (6%)	**238**
Moose	14 (21%)	43 (64%)	4 (6%)	6 (9%)	**67**
Grey Wolf	9 (41%)	9 (41%)	3 (14%)	1 (5%)	**22**
Black Bear	11 (55%)	7 (35%)	1 (5%)	1 (5%)	**20**
Total	**241 (69%)**	**76 (22%)**	**8 (2%)**	**22 (6%)**	**347**

Table 3: Trail Camera data collected on trail cameras for caribou, moose, wolf, and bear in the P6 RAA, March 1, 2016 to March 31, 2017

Species	Hexes with cameras in the RAA	Number of Hexes with Trap Events by Season				
		Spring	Summer	Autumn	Winter	Total
Caribou	98	10 (45.5%)	2 (9.1%)	0 (0%)	10 (45.5%)	**22**
Moose	98	5 (21.7%)	11 (47.8%)	4 (17.4%)	3 (13.0%)	**23**
Grey Wolf	98	3 (27.3%)	5 (45.5%)	2 (18.2%)	1 (9.1%)	**11**
Black Bear	98	4 (33.3%)	5 (41.7%)	2 (16.7%)	1 (8.3%)	**12**
Total	**98**	**22 (32.4%)**	**23 (33.8%)**	**8 (11.8%)**	**15 (22.1%)**	**68**

Table 4: Furbearer data collected on trail cameras in the P6 RAA, March 1, 2016 to March 31, 2017

Camera Trap Events for Furbearers			
Species	**Hexes with cameras in the RAA**	**Camera Trap Events - All Seasons in the RAA**	**Number of Hexes with Trap Events**
Snowshoe Hare	98	10 (66.7%)	1
Lynx	98	1 (6.7%)	1
Marten	98	1 (6.7%)	1
Otter	98	1 (6.7%)	1
Wolverine	98	2 (13.3%)	2
Total	**98**	**15**	**-**

3.2.3 Aerial Multispecies Survey Methods

An aerial multispecies distribution survey was conducted within portions of the P6 RAA 2012-2016 (Map 9). A Long Ranger helicopter crewed by three Joro biologists skilled at differentiating species tracks in the snow by flying east to west transects, spaced 5 km apart at approximately 120 km/hr and at an altitude of around 120 m. Two observers on each side of the helicopter, called out track observations within a 250 m wide strip along each side of the transect line, while the 3rd member of the team maintained detailed data sheets respecting species and location (GPS positions) of each observation, and assisted with navigation along the transect line. The data was exported to a GIS software for analysis.

3.2.4 Aerial Multispecies Survey Results

Results of the aerial multispecies surveys 2012-2016 for wildlife within the P6 RAA are presented in Table 5 and Map 9.

Table 5: Aerial Multi-Species Surveys conducted in portions of the RAA, 2012 - 2016

***VC Species**

		2012			2014			2015			2016			Total		
Species	**Scientific name**	**Tracks**	**Animals**	**Total**	**Tracks**	**Animals**	**Total**	**Tracks**	**Animals**	**Total**	**Tracks**	**Animals**	**Total**	**Tracks**	**Animals**	**Tracks+ Animals**
Caribou	*Rangifer tarandus*	N/A	33	33	283	31	314	726	116	842	235	13	248	1244	193	1437
Moose	*Alces alces*	108	16	124	N/A	N/A	N/A	27	4	31	240	0	240	395	108	16
Snowshoe Hare	*Lepus americanus*	464	0	464	120	0	120	60	0	60	173	0	173	817	0	817
Marten*	*Martes americana*	353	0	353	53	0	53	61	0	61	344	0	344	811	0	811
Otter	*Lontra canadensis*	139	0	139	37	0	37	27	0	27	130	0	130	333	0	333
Beaver lodge, dams*		N/A	N/A	N/A	0	131	131	4	73	77	0	41	41	4	4	249
Wolf	*Canis lupus*	12	3	15	5	0	5	11	0	11	192	0	192	220	3	223
Lynx	*Lynx canadensis*	21	0	21	23	0	23	3	0	3	205	0	205	252	0	252
Fox	*Vulpes vulpes*	2	0	2	0	0	0	0	0	0	132	0	132	134	0	134
Fisher	*Martes pennanti*	8	0	8	1	0	1	2	0	2	51	0	51	62	0	62
Mink	*Neovison vison*	0	0	0	0	0	0	0	0	0	4	0	4	4	0	4
Wolverine	*Gulo gulo*	1	0	1	1	0	1	0	0	0	0	0	0	2	0	2

Note: Aerial multi-species surveys were conducted for several proposed ASR projects in the region which include portions of the RAA, therefore comparisons between years is not possible. However, these data provide an account of species relative abundance and distribution for characterization purposes.

3.2.5 Incidental Wildlife Observation Methods

Incidental sightings including large stick nests, caribou, moose, and furbearers were also recorded on both GPS and field notes during all aerial and ground-based wildlife surveys conducted between 2011 and 2017 in the P6 RAA. Incidental wildlife was defined as those qualitative observations that were secondarily recorded, but were not the primary focus of the individual survey; for example, while following transect lines during winter aerial moose surveys, animal and track observations for moose were recorded primarily, but additional caribou animal and track observations and raptor stick nests were also noted.

3.2.6 Incidental Wildlife Observation Results

Results of incidental wildlife observations recorded during all surveys is presented in Table 6; a total of 366 observations of various species were documented (Map 10).

Table 6: Incidental Wildlife Observations during all 2012-2017 wildlife surveys

Survey	Observation	Tracks	Grand Total
2012 Northern Baseline Multispecies Survey		5	5
Wolverine		5	5
2014 P6 Furbearer Survey	20	7	27
Grouse	13	4	17
Stick nest	6		6
Wolverine	1	3	4
2015 Multispecies Survey	8		8
Stick nest	8		8
2016 Multispecies Survey	1		1
Stick nest	1		1
2017 P6 Moose Survey	146		146
Caribou	134		134
Mergansers	5		5
Stick nest	5		5
Wolf	2		2
Moose Survey 2016	4	23	27
Caribou	4	21	25
Wolf		2	2
Northern ASR Aerial Scouting Flight	11	109	120
Grouse	1		1
Hare		1	1
Lynx		11	11

Survey	Observation	Tracks	Grand Total
Marten		8	8
Moose	3	66	69
Wolf	6	20	26
Wolverine	1	3	4
Trapper Program	1	2	3
Skunk	1		1
Wolverine		2	2
Waterfowl Survey	64		64
Bald eagle	57		57
Caribou	1		1
Golden eagle	3		3
Hawk (unknown)	1		1
Northern Harrier	1		1
Turkey Vulture	1		1
Grand Total	**255**	**146**	**401**

3.3 Caribou

3.3.1 Collaring Methods

Pen Islands Caribou Range/Population (Forest-tundra)

Eight caribou from the Pen Islands population were captured and collared by MI within the God's Lake area of the RAA using a contracted helicopter net-gun capture crew under the authority of MSD annual scientific permits and MSD direction during January 31 to February 3, 2011. Joro staff were involved with collar initialization and testing, reconnaissance flights to locate target animals and groups, field logistics, and data management. Once animal groupings were located, the capture crew targeted select animals that were netted, restrained with hobbles, and blindfolded.

Caribou were fitted with collars that began to transmit data immediately post-release. GPS fixes were acquired every three hours, and data transmitted every 1.5 days via the Iridium satellite network. Collars also had very high frequency (VHF) radio beacons for relocation by radio-telemetry tracking. No immobilizing drugs were used during any capture operations. Following physical immobilization, measurements and biological samples were taken (blood, feces, and hair), satellite collars were fastened, and the animals were then released.

Additional collaring by MI beyond 2011 was not undertaken as per the direction of MSD due to the existence of historical telemetry and collaring data (2010-2016) for the Pen Islands population. This data was subsequently provided to MI confirming Pen Islands animals ranged near the P6 area of interest (i.e. God's Lake). All collaring data collected by MI for and made available by MSD for 39 Pen Islands caribou are found in Table 7.

Norway House Caribou Range/Population (Forest-dwelling)

A total of 61 Norway House caribou, part of the Molson MU, were captured and collared between 2011 and 2016 using the same methods and approvals as described for the Pen Islands animals (Table 7).

Table 7: Total number of caribou collars annually deployed and active collars between 2010 and 2017 in the Norway House (MI data) and Pen Islands populations (MI and MSD data)

Year	Norway House Population		Pen Islands Population	
	# Collars Deployed	# Active Collars	# Collars Deployed	# Active Collars
2010	N/A	N/A	4	4
2011	N/A	N/A	9*	13
2012	20	20	8	17
2013	11	21	10	15
2014	14	30	6	20
2015	6	32	2	17
2016	10	35	0	11
2017	0	34	N/A	N/A

N/A = MI collaring began in 2012 and ended in 2016, but some collars were still active in 2017; MSD collaring began in 2010 and the data cut-off provided was November 28, 2016

*2011 data includes 8 animals collared by MI and 1 collared by MSD

3.3.2 Collaring Results

The number of recorded telemetry location points and number of animals by season by year for the Pen Islands and Norway House populations, respectively, for the entire range are presented in Table 8 and Table 9.

Pen Islands Caribou Range/Population

Pen Islands caribou reside in the RAA primarily during the winter and spring (Map 11), migrating from the Hudson Bay shoreline in northeast Manitoba and northwest Ontario during the winter (Map 12). Pen Islands caribou migrate inland (closer to the RAA) during the winter and spring and return towards the coastline in summer and autumn. Only one animal calved in the RAA from 2010-2017.

Table 8: Number of recorded telemetry location points and number of animals by season by year for the Pen Islands population (MI and MSD data)

Year	Spring (Mar 20 – June 19)		Summer (June 20 – Sep 19)		Fall (Sep 20 – Dec 19)		Winter (Dec 29 – Mar 19)	
	Point Locations	Caribou Count	Point Locations	Caribou Count	Point Locations	Caribou Count	Point Locations	Caribou Count
2010	2894	4	2867	4	2828	4	1618	4
2011	8061	12	7433	11	6064	10	4632	13
2012	9308	17	6177	11	4186	8	9001	17
2013	11035	15	11021	15	10639	15	8374	15
2014	13928	19	12721	19	10726	16	11088	20
2015	10743	15	9767	14	8774	13	10345	17
2016	3243	6	2324	4	1727	4	5304	11

Norway House Caribou Range/Population

Norway House caribou reside in the RAA in spring, north of Bunibonibee (Oxford House FN) and Manto Sipi (Map 13). Very few telemetry points are located within the RAA, with most of the Norway House caribou residing to the southwest of the RAA, near Norway House FN in proximity to Lake Winnipeg, and to the west of the RAA, north of Cross Lake FN (Map 14). No calving of Norway House animals was documented in the RAA during 2012-2016.

Table 9: Number of recorded telemetry location points and number of animals by season by year for the Norway House population (MI data)

Year	Spring (Mar 21 – June 20)		Summer (June 21 – Sep 20)		Fall (Sep 21 – Dec 20)		Winter (Dec 21 – Mar 20)	
	Point Locations	Caribou Count	Point Locations	Caribou Count	Point Locations	Caribou Count	Point Locations	Caribou Count
2012	13582	19	10849	19	9335	15	8585	20
2013	13553	20	11777	18	10778	16	10943	21
2014	19906	28	18808	27	16008	25	13499	30
2015	20976	32	18893	28	16677	26	18690	32
2016	21224	30	40135	30	26604	28	17974	35

3.4 Moose

3.4.1 Minimum Count Aerial Survey Methods

Total minimum count aerial moose surveys were conducted in the winter of 2016 and 2017 to acquire

baseline information on areas of high moose concentration and provide an estimate of the moose population count (Map 15). Moose surveys were conducted on February 18-19, 2016 and February 6-9, 2017 within a 2,430 km^2 survey area. Kernel density methodology was used to identify high use areas near the ASR alignments.

Surveys were based on MSD's standard three-minute grid used for aerial moose surveys; grid blocks measured 3.5 x 5.0 km and extended 10 km on each side of the proposed P6 ASR alignment. Each survey was flown at 100 percent coverage in a north/south direction using a Bell Long Ranger, along transects spaced 1 km apart, at an altitude of approximately 120 m above ground level. The average air speed for the surveys was 100 km/hr. The survey team was comprised of three biologists (i.e. two observers and one recorder). When fresh moose tracks were encountered, a reasonable effort was made to find the animal(s). The number of individuals, age classification, and gender were recorded for all animals.

3.4.2 Minimum Count Aerial Survey Results

Results of the February 18-19, 2016 and February 6-9, 2017 aerial moose surveys are presented in Table 10 (Map 16 and 17).

Table 10: Results from the February 2016 and February 2017 aerial moose surveys in the P6 RAA

Year	Cows	Bulls	Calves	Total Count	Calf-Cow Ratio (CCR)	CCR Standard Error	Calves Per Adults (CPA)	CPA Standard Error	Density Per Km^2
2016	30	23	10	63	0.33	0.09	0.19	0.05	0.02
2017	33	11	24	68	0.73	0.08	0.55	0.08	0.04

3.5 Songbirds and Amphibians

3.5.1 Autonomous Recording Unit Methods

Autonomous recording units (ARUs) are an effective tool used to detect vocalizations from bird and amphibian sources to supplement on-site surveys. ARUs offer the capability of determining presence of bird and amphibian species in survey areas over longer time periods, without human interaction. By using ARUs within the RAA, Joro acquired a far more comprehensive assessment of birds and amphibians within the area, species that may only call during certain times of the day and that may be otherwise missed during on-site field surveys.

ARUs were deployed in 2016 within the different habitat types present in the P6 RAA representing the preferred habitat of a variety of different bird and amphibian species (Map 18; Appendix D: Table D-1 to Table D-3). Each ARU (model SM2+, supplied by Wildlife Acoustics Inc.) was encased in a weather-proof enclosure with four D-cell batteries, up to four 16-gigabyte memory cards, and two external microphones.

The recording units were scheduled for specific start and shut off times to capture peak bird and amphibian call times. ARUs were also programmed to record low frequency sounds down to 3 Hz (at a

gain of 48 dB) to capture all vocalizations of target species. The units were scheduled to record daily at different times of day based on the species being sampled: 1) from March to May, in the evening and night when owls and amphibians are potentially calling; and 2) from May to September, during the morning, evening and night when various songbirds and other species are calling (Appendix D: Table D-2).

Sounds files were later interpreted on the computer using Song Scope™ software (Wildlife Acoustics Inc.) to identify recorded birds and amphibians to species. Song Scope presents recorded calls on a spectrogram and allows annotation of specific vocalizations to be saved within the audio file, facilitating the process of locating and discerning species type and presence. The spectrogram plot displays a graphical representation of the audio signal in what is known as the “frequency domain”, meaning that it shows the relative power levels of the different frequency components of the sound wave over time.

3.5.2 Autonomous Recording Units Results

The sampling locations, periods, and bird and amphibian observation results for the P6 RAA are found in Appendix D: Table D-3 to D-5. The ARUs recorded over 66 species of birds in 2016 and results indicate that Sandhill crane (*Grus canadensis*), Canada goose (*Branta canadensis*), and Wilson’s snipe (*Gallinago delicate*) species were among the most commonly species recorded (Appendix D: Table D-4).

Four species of amphibians were recorded in 2016; wood frog (*Lithobates sylvaticus*) were the most common (Appendix D: Table D-5).

3.5.3 Manitoba Breeding Bird Atlas Methods

The Manitoba Breeding Bird Atlas (MBBA) completed a series of bird surveys in the summer of 2014 and recorded bird observations within survey grid blocks contained within 100 m x 100 m survey squares (MBBA, 2010). These survey blocks encompassed the P6 RAA as described in the *Manitoba Breeding Bird Atlas: Report to ESRA 2014 Surveys* (MBBA, 2014a; Map 19). Species abundance was determined through point-count surveys to provide a rough measure of how many birds were in each survey block (i.e., where they are breeding). Each point count involved standing in a pre-determined location (usually along the ROW, but a small number of off-road sites in different habitat types were also completed), waiting a 1-minute calming period prior to the survey, and recording all birds heard or seen in an exact 5-minute period (MBBA, 2010). All point count raw data for P6 was submitted to ESRA (MBBA, 2014b).

3.5.4 Manitoba Breeding Bird Atlas Results

The MBBA point count surveys recorded 2138 observations for 74 species of birds in the P6 RAA (Appendix D: Table D-6). Three of the 74 recorded were species of conservation concern: common nighthawk, rusty blackbird, and olive-sided flycatcher. The most common species observed were white-throated sparrow, Tennessee warbler, ruby-crowned kinglet, hermit thrush, chipping sparrow, and dark-eyed junco. Forty-two of the 74 species observed were also recorded by the ARU program reported in Section 3.5.2. Bird point count observations recorded in the P6 RAA are listed in Appendix D: Table D-6.

3.6 Waterfowl

3.6.1 Waterfowl Survey Methods

An aerial waterfowl survey was conducted within the P6 RAA during the period of waterfowl breeding, June 16-17, 2016 and brooding, July 20-21, 2016. Flight transects, using a Long Ranger helicopter, were located along and within 5 km on either side of the alignment (Map 20). The helicopter travelled at 30-40 m above the ground, with a ground speed of approximately 80-100 km/hr. Three biologists scanned the areas surveyed for wildlife as well as large stick nests; one of the biologists recorded the information collected onto data sheets. Survey data collection sites were recorded using hand-held GPS devices and imported to GIS software for mapping and analysis. While survey design followed Canadian Wildlife Service protocol for surveying waterfowl, other species of birds and wildlife were observed.

A second survey was conducted within the P6 RAA on October 12-14, 2016, during the period of fall waterfowl migration (Map 21). The objective of this survey was to document general areas of migratory waterfowl staging. The area of survey was similar to the June and July survey, where flight transects along major waterbodies were surveyed within the RAA. Staging waterfowl (typically rafts of diving species) were documented and mapped, providing additional qualitative data pertaining to potential waterfowl staging areas near the P6 alignment.

3.6.2 Waterfowl Survey Results

June Survey

Over 800 birds representing more than 20 species were observed during aerial waterfowl surveys conducted in mid-June 2016 (Table 11; Appendix D: Table D-7). The most commonly observed group of species observed in the RAA were waterfowl (85.1%), half of which were ring-necked ducks (*Aythya collaris*, 37.0%) and common mergansers (*Mergus merganser*, 17.0%). The remaining species included other waterbirds, shorebirds and other birds; the latter of which was mainly raptors.

Table 11: Aerial Survey Results of Bird Species Observed June 16-17, 2016 in the P6 RAA

Species	Scientific Name	Number	%
Ring-necked duck	*Aythya collaris*	303	37.0%
Common merganser	*Mergus merganser*	139	17.0%
Mallard	*Anas platyrhynchos*	124	15.1%
Canada goose	*Branta canadensis*	66	8.1%
Sandhill crane	*Antigone canadensis*	37	4.5%
Common loon	*Gavia immer*	26	3.2%
Bald eagle	*Haliaeetus leucocephalus*	23	2.8%
Scaup	*Aythya spp.*	21	2.6%
Blue-winged teal	*Anas discors*	19	2.3%

Species	Scientific Name	Number	%
Greater yellowlegs	*Tringa melanoleuca*	21	2.0%
Northern pintail	*Anas acuta*	11	1.3%
Swan	*Cygnus spp.*	9	1.1%
Bufflehead	*Bucephala albeola*	6	0.7%
Green-winged teal	*Anas crecca*	6	0.7%
Golden eagle[1]	*Aquila chrysaetos*	3	0.4%
American wigeon	*Anas americana*	1	0.1%
Duck	unknown species	1	0.1%
Shorebird	unknown species	1	0.1%
Swainsons hawk	*Buteo swainsoni*	1	0.1%
Wilson's snipe	*Gallinago delicata*	1	0.1%
Total		**819**	**100.0%**

[1] Possible non-breeding first or second year golden eagle, or misidentified juvenile bald eagle

There were 48 young of the year amongst the 12 broods observed during the June aerial surveys; the average brood size was 4.0 (±2.5). Most of the 48 young within identified broods were Canada geese, (32), mallards (11), or swans (4) as strong evidence that they were nesting within the RAA. In addition to the broods, several adult pairs of ring-necked ducks, mallards, and Canada geese were observed.

Of the 819 birds observed during the June survey, they were almost equally distributed bogs/marshes (33%), open water or lake shorelines (32%), and ponds (35%). The detailed observation results from the June 2016 waterfowl survey are given in Appendix D: Table D-7 and Map 22.

July Survey

A total of 328 birds representing over 12 species were observed during aerial waterfowl surveys conducted in mid-July 2016 (Table 12; Appendix D: Table D-8). Waterfowl were most abundant (84%); rounded out by a small sample of waterbirds (10%), bald eagles (3%), and other birds (3%) comprised mainly shorebirds and sandhill cranes. Ring-necked ducks and mergansers comprised 37% and 17% each respectively of the total observations.

Table 12: Aerial Survey Results of Bird Species Observed July 16-17, 2016 in the P6 RAA

Species	Scientific Name	Number	%
Ring-necked duck	*Aythya collaris*	110	33.5%
Duck (*spp*.)		84	25.6%
Canada goose	*Branta canadensis*	45	13.7%
Mallard	*Anas platyrhynchos*	26	7.9%
Common loon	*Gavia immer*	15	4.6%
Bald eagle	*Haliaeetus leucocephalus*	10	3.0%
Common tern	*Sterna hirundo*	10	3.0%
Tundra swan	*Cygnus columbianus*	8	2.4%
Common merganser	*Mergus merganser*	7	2.1%
Sandhill crane	*Antigone canadensis*	6	1.8%
Green-winged teal	*Anas crecca*	4	1.2%
Greater yellowlegs	*Tringa melanoleuca*	3	0.9%
Total		328	100.0%

There were 75 young of the year amongst the 25 broods observed during the July aerial surveys; the average brood size was 4.4 (±2.2). Of the broods identified to species, 36% were Canada geese, 21% ring-necked ducks, and 11% mallards; over half of the broods not identified to species (32%) were diving ducks. The results provide substantial evidence that they are nesting within or near the RAA. In addition to the broods observed, there were several adult pairs of ring-necked ducks, mallards, and Canada geese.

Open water or shorelines of lakes accounted for 55% of the 78 bird observations, compared to 36% and 9% respectively for each of creeks and rivers. The detailed observation results from the July 2016 waterfowl survey are given in Appendix D: Table D-8 and Map 23.

October Overflight

Approximately 2,200 birds representing at least three waterfowl species were observed during reconnaissance-level aerial waterfowl surveys conducted between October 12-14, 2016 (Appendix D: Table D-9). Bufflehead (*Bucephala albeola)* and common goldeneye (*Bucephala clangula*) together accounted for >83% of all the species observed; scoters accounted for the remainder.

Most of the birds (>96%) observed during the October surveys were associated with the open water or shorelines of lakes; the remainder were associated with ponds. The detailed observation results are provided in Appendix D: Table D-9 and Map 24.

3.7 Local and Traditional Knowledge

Local information[3] respecting wildlife resources was obtained through open house workshops within the FN communities of God's Lake, Bunibonibee, and Manto Sipi. Specific information pertaining to hunting and trapping, and knowledge pertaining to wildlife including rare species within the RAA, was incorporated where appropriate to guide wildlife studies, the identification of VCs, and the assessment of effects.

3.7.1 Wildlife Workshops

Wildlife workshops were conducted with local resource users (trappers and hunters) in the community of God's Lake First Nation (GLFN) on January 6, 2016, Bunibonibee Cree Nation (BCN) on February 17, 2016 and Manto Sipi Cree Nation (MSCN) on March 24, 2016. The purpose of the wildlife workshops was to have an open dialogue with community members to gather information on wildlife movement and distribution, to establish those species that are important to community members and to better understand those habitats and other variables that may affect wildlife populations and distribution. Equally important, the workshop promoted a positive opportunity to share knowledge on wildlife issues that may arise from the P6 ASR development to the benefit of both planners and community members alike, and ultimately contribute to the development of a more comprehensive environmental impact assessment report.

Resource users from the community, including Elders and youth, were invited to attend the wildlife workshop. The workshop began with a presentation highlighting the details of the ASR purpose, process, and the Project Description and Schedule, followed by information on the rare species of concern. After the information session, an open forum was held providing participants with the opportunity to comment and ask questions. Workshop participants were asked to contribute to a group mapping exercise focused on providing a visual account of local wildlife knowledge. Wildlife information collected through the workshop was recorded, compiled, and mapped digitally using GIS.

The wildlife information provided by workshop participants ranged from site specific breeding and denning locations to movement corridors and hunting/trapping areas. Highlights of the information shared included perspectives on perceived changes in certain wildlife species populations as compared to the past. The information collected at the wildlife workshops will contribute to:

- the road alignment (route), design, and construction;
- environmental studies (wildlife research);
- assessment of project effects;
- plans for mitigating, reducing and managing potential effects; and
- key topics for further discussion.

[3] Local knowledge is confidential to those communities from which it is collected and is not part of the public record without the formal consent of the participating communities.

The following sections summarize the insights and observations of the resource users that attended the workshops in the three FN communities. While the information was generally provided in response to specific questions, some of the information was provided unsolicited.

God's Lake First Nation

Wildlife typically observed in and near the GLFN community include: mallard ducks, sandpipers, herring gulls, red-sided garter snakes, wolverine, leopard frogs, snowshoe hare, bears (brown and black), bats, flying squirrels, and chipmunks. Pelicans, cormorants and skunks are generally observed near the community. Red-sided garter snakes have not historically been observed near the community, yet their populations appear to have increased over the last 10 years and are now abundant in the region. A participant shared that historically a large snowshoe hare population typically corresponds to an abundance of owls; however, this relationship has not been observed recently.

Participants shared that several new birds have been observed recently (in the last few years) including barn swallows, common swallows, and the Canada warbler. It was suggested that the northern range is extending further north for these species. Some participants believe that colonizing species are moving northward in search of cleaner environments to avoid the pollution in the south.

Trapping or shooting wild game is not allowed within the reserve boundaries. Trapping takes place near the GLFN airstrip, along the winter road heading north towards Bunibonibee Cree Nation and in the area around Webber Lake and Torchwood Lake. Registered Trap Line (RTL) 27, which extends from the East End Lodge west to the Ontario Border, has not been trapped for the last ten years. Interest in trapping has declined in recent years given low prices of pelts. Wolverines are occasionally observed near the community and along the winter road; they are known to travel large distances and mate at specific locations. Some community members actively trap wolverines.

Species important for community foods include caribou, moose, beaver, snowshoe hare, bear, goose (in the spring), duck, and muskrat. Some participants stated that wild game meat tastes different than it did in the past; the flavour of whitefish, muskrat, moose, and caribou meat is muted and less flavourful than in past years.

Resource users that attended the workshop suggested that wildlife populations were declining notably snowshoe hare, muskrat, weasel, porcupine, frogs, butterflies, small birds (Canada warbler), and the masked shrew. The latter two species were identified while reviewing a Species of Interest handbook. In the past, the porcupine population had a noticeable decline, but now appear to be recovering. Historically, roasted porcupines were a source of community food and the quills were valued by artisans. In the past, groundhog was also eaten. Snapping turtles and moles are not observed in or near the community.

Bunibonibee Cree Nation

The BCN workshop participants shared that moose and geese are the most important species hunted by community members. The winter road provides community members additional access to resource use areas. Wildlife tracks, including moose and wolf, are often observed along the winter road. Participants shared numerous moose observations along with hunting and habitat information. Caribou are known to migrate through the region, typically moving northeast to southwest and calving on islands. Participants

noted that caribou are observed year-round northwest and southwest of the community.

Participants shared their perspectives with respect to population dynamics and habitat preferences of furbearers such as beaver, muskrat, marten, fisher, wolverine, fox, and wolf. Wolf observations, trapping locations and denning sites along the northeast shoreline of Opiminegoka Lake were mapped. Some participants indicated muskrat and fisher populations appear to be declining, while the marten and wolverine populations are increasing.

Waterfowl hunting occurs in the spring and the fall and habitat information was mapped by participants. Birds not typically consumed by community members include loons, gulls, pelicans, herons, bitterns, and swans, all of which are observed in the region. Snipe and sandpiper are also observed; however, populations have decreased over the last few years.

Ruffed and spruce grouse are abundant in the region. Although the ptarmigan population has appeared to decrease, a large number of them along with sharp-tailed grouse have been observed north of Windy Lake. Bald eagles and owls are abundant in the region. Observations and nest locations were shared by workshop participants.

Manto Sipi Cree Nation

Participants from MSCN shared that moose hunting is an extremely important food source activity for community members. Successful hunters will share the moose harvested with family and community members Community members travel large distances to preferred moose hunting areas east of Edmund Lake, south of Wapapiskwatayo Lake and north of Semmens Lake and Fish Lake. The moose population is perceived to be in decline over the past 20 years as suggested through the reduced number of track observations. While hunting moose, community members opportunistically hunt and fish for other species. Caribou are known to migrate through the region, typically moving northeast to southwest and calving on nearby islands. Participants noted that caribou are observed year-round, east of the community near Edmund Lake.

Participants shared their perspectives with respect to population dynamics and habitat preferences of furbearers including beaver, muskrat, marten, fisher, otter, snowshoe hare, wolverine, fox, lynx, and wolf. Beaver trapping, wolf and wolverine observations and bear den locations were mapped. A few participants indicated that the fisher and lynx populations appear to be declining while the beaver, muskrat, and marten populations are increasing.

Spruce and ruffed grouse are commonly hunted, but recently populations appear to be declining in the MSCN area. Ptarmigan are also observed in the MSCN area. Barn and bank swallows, along with nesting colonies, are frequently observed in the community and surrounding area. Bald eagles are abundant in the region with observations and nest locations shared by workshop participants and mapped. Peregrine falcons, osprey, and snowy owl sightings were also shared by workshop participants.

Rare and uncommon wildlife observations including lizards or salamanders, skunks, porcupine and a historical observation of deer were discussed, along with access trail locations, camps, and outposts. Changes to the land (which also includes water and the air in the participant's region) over time and perspectives on the proposed ASR routes, including concern for wildlife habitat and increased access,

were also discussed. See Table 13 for a summary of the species discussed within each community at the three wildlife workshops:

Table 13: P6 Wildlife Workshops – Species List

Species	Scientific Name	Observed by Community
Mammals		
American beaver	*Castor canadensis*	GLFN, BCN, MSCN
American black bear	*Ursus americanus*	GLFN, MSCN
American marten	*Martes americana*	GLFN, BCN, MSCN
American mink	*Neovison vison*	GLFN
Canada lynx	*Lynx canadensis*	GLFN, BCN, MSCN
Chipmunk	*Neotamias minimus*	GLFN
Coyote	*Canis latrans*	GLFN
Fisher	*Martes pennanti*	GLFN, BCN, MSCN
Gray wolf	*Canis lupus*	GLFN, BCN, MSCN
Groundhog	*Marmota monax*	GLFN
Little brown bat	*Myotis lucifugus*	GLFN, BCN, MSCN
Least weasel	*Mustela nivalis*	GLFN
Masked shrew	*Sorex cinereus*	GLFN
Moose	*Alces alces*	GLFN, BCN, MSCN
Muskrat	*Ondatra zibethicus*	GLFN, BCN, MSCN
North American porcupine	*Erethizon dorsatum*	GLFN, BCN, MSCN
Northern flying squirrel	*Glaucomys sabrinus*	GLFN, MSCN
Northern river otter	*Lontra canadensis*	GLFN, MSCN
Polar bear	*Ursus maritimus*	BCN
Raccoon	*Procyon lotor*	BCN
Red fox	*Vulpes vulpes*	GLFN, BCN, MSCN
Red squirrel	*Tamiasciurus hudsonicus*	GLFN
Snowshoe hare	*Lepus americanus*	GLFN, BCN, MSCN

Species	Scientific Name	Observed by Community
Striped skunk	*Mephitis mephitis*	GLFN, BCN, MSCN
White-tailed deer	*Odocoileus virginianus*	
Wolverine	*Gulo gulo*	GLFN, BCN, MSCN
Woodland caribou	*Rangifer tarandus caribou*	GLFN, BCN, MSCN
Birds		
American bittern	*Botaurus lentiginosus*	BCN
American crow	*Corvus brachyrhychos*	GLFN
American white pelican	*Pelecanus erythrorhynchos*	GLFN, BCN, MSCN
Bald eagle	*Haliaeetus leucocephalus*	GLFN, BCN, MSCN
Bank swallow	*Riparia riparia*	MSCN
Barn swallow	*Hirundo rustica*	GLFN, MSCN
Bonaparte's gull or Black tern	*Chroicocephalus philadelphia/ Childonias niger*	BCN
Boreal owl	*Aegolius funereus*	BCN
Canada goose	*Branta canadensis*	GLFN, BCN, MSCN
Canada warbler	*Cardellina canadensis*	GLFN
Common loon	*Gavia immer*	GLFN, BCN
Common nighthawk	*Chordeiles minor*	BCN, MSCN
Common raven	*Corvus corax*	GLFN
Double-crested cormorant	*Phalacrocorax auritus*	GLFN
Ducks	*Spp.*	GLFN, BCN, MSCN
Ducks, Long-tailed "sea ducks"	*Clangula hyemalis*?	MSCN
Golden eagle	*Aquila chrysaetos*	GLFN
Gray jay	*Perisoreus canadensis*	GLFN
Great blue heron	*Ardea herodias*	GLFN, BCN
Great horned owl	*Bubo virginianus*	GLFN

Species	Scientific Name	Observed by Community
Gull	*Laridae sp.*	GLFN, BCN, MSCN
Herring gull	*Larus argentatus*	GLFN
Mallard	*Anas platyrhynchos*	GLFN
Olive-sided flycatcher	*Contopus cooperi*	GLFN
Osprey	*Pandion haliaetus*	GLFN, BCN, MSCN
Peregrine falcon	*Falco peregrinus*	BCN, MSCN
Ruffed grouse	*Bonasa umbellus*	GLFN, BCN, MSCN
Rusty blackbird	*Euphagus carolinus*	MSCN
Sandpiper	*Scolopacidae sp.*	GLFN, BCN
Sharp-tailed grouse	*Tympanuchus phasianellus*	GLFN, BCN
Short-eared owl	*Asio flammeus*	GLFN, BCN
Snowy owl	*Bubo scandiacus*	GLFN, BCN, MSCN
Spruce grouse	*Falcipennis canadensis*	GLFN, BCN, MSCN
Swallow	*Hirundinidae sp.*	BCN
Swan /Snow Goose	*Cygnus sp./ Chen caerulescens*	BCN
Tern	*Sternidae sp.*	GLFN
Tundra swan	*Cygnus columbianus*	GLFN, BCN, MSCN
Turkey vulture	*Cathartes aura*	GLFN, MSCN
Willow ptarmigan	*Lagopus lagopus*	GLFN, BCN, MSCN
Wilson's snipe	*Gallinago delicata*	BCN
Song birds (various)		GLFN
Herptiles		
Brown-coloured frog	*Spp.*	MSCN
Common garter snake (possibly non-red variation of red-sided subspecies)	*Thamnophis sirtalis*	BCN
Lizard/salamander	*Spp.*	MSCN

Species	Scientific Name	Observed by Community
Northern leopard frog	*Lithobates pipiens*	GLFN, BCN, MSCN
Red-sided garter snake	*Thamnophis sirtalis parietalis*	GLFN, MSCN

3.7.2 Trapper Program

The P6 RAA falls mainly within portions of the God's Lake section (380) and Oxford Lake section (370) trapping areas within the Northern RTL Area 6 (Map 25). The Trapper Program (TP) was developed to study the potential effects of ASR construction in the RAA on trapline harvest and furbearer abundance and distribution. Its main goals were to initiate trapper involvement; acquire baseline data through local and regional furbearer distribution, habitat preferences and current and traditional land-uses by community members and to promote collaboration with the local trapping community. Fall/Winter 2016/2017 was the first year the TP was initiated with P6 trappers.

A local Community Coordinator (CC) was selected by Chief and Council within each P6 community to collaborate and identify active trapper participants, coordinate meetings and workshops, assist with the collection of field results, liaise between trappers and the Chief and Council and review draft reports and mapping. The CC, with the advice of the Chief and Council, selected trappers within their communities based on the geographic location of their RTL with respect to the ASR Project and the RTL recent harvest history, and willingness to participate in the program.

Compliance with humane trapping standards and use of approved humane trapping equipment was outlined as a critical component of participation in the TP. In return for their participation, trappers were paid a daily honorarium. Table 14 shows the RTLs within the RAA that were potentially used to assist with trapper selection. Of note, there are a total of 51 RTLs which occur fully or partially within the RAA (Map 25), but only a small number (i.e. 4) were sampled by participating trappers in 2016-2017 (Table 15; Map 26).

Table 14: Registered traplines within the RAA potentially used in trapper selection

District	Section Name	RTLs
Northern RTL District	Oxford House	52, 54, 55, 64
	God's Lake	2,3, 4, 5, 6, 8, 9, 10 and 12

Table 15: Registered traplines sampled in the RAA in the 2016-2017 season

District	Section Name	RTLs
Northern RTL District	Oxford House	54,64
	God's Lake	2,3

Participating trappers were asked to be involved in several activities such as trapper journal recordings, track/sign surveys and scat and hair sample collection for stable isotope analysis (SIA). At the beginning of the trapping season, trappers were provided a trapper kit, which included a digital pocket camera, SD memory card, hand-held GPS unit, extra batteries, USB cord, instruction manuals, laminated maps of their RTL (ortho or topo), labelled sample bags, trapper journal, pencils and sharpener and permanent markers within a waterproof, hard-shell case.

The trapper journal was used to record trapping catches and observations (i.e. furbearer activity, tracks, and signs including scat) along their RTLs during the trapping season. Trapper journal data collected included the date, weather description, type of traps or snares used, what species and sex were caught, what type of samples were collected, location, and/or any other wildlife observations/tracks. A comment section also detailed any other significant observations made during the visits to the traplines. Completed journals were returned to Joro at the end of the trapping season and reviewed with the trapper (or the CC) for clarification. The hand-held GPS unit, digital pocket camera, and RTL maps on ArcGIS (ESRI, 2012) were used to record locations of traps and furbearer observations.

The trapper survey was designed to gain insights into trapper perspectives and knowledge regarding furbearer abundance and distribution in the RAA. Survey materials were distributed to trappers at the beginning of the trapping season and collected once trapping activities ended in approximately in mid-February (at the end of marten season). To augment information respecting wolf/prey relationships within the RAA, trappers were requested to collect hair samples from wolves, any wolf/bear feces, as well as hair or fecal samples of other prey species (smaller furbearers) along their traplines.

Table 16 displays the result of the trapper harvest and other wildlife observations/tracks. Trapper results indicate that marten (71) are the most abundant species trapped followed by otter (18); the remaining species were harvested in totals of five (5) or less (Table 16). Trappers also recorded wildlife observations or tracks (Table 18). Marten, otter, and wolverine tracks were observed equally, with ten (10) tracks each; moose (8) and mink (7) observations closely followed. The remaining species were observed in totals of five (5) or less. A skunk was also harvested in the Oxford House section.

Appendix E: Photographs 9-10 demonstrates the process of a trapper working on their RTL line. See Appendix F for all harvest data collected by individual trappers including a GPS waypoint number, which was input into Arc-GIS for mapping.

Table 16: Species summary - Oxford House/God's Lake

Species	Scientific Name	Total Harvest	Track Observation
Marten	*Martes americana*	71	10
Otter	*Lontra canadensis*	18	10
Beaver	*Castor canadensis*	5	--
Fisher	*Martes pennanti*	3	2
Mink	*Neovison vison*	3	7
Lynx	*Lynx canadensis*	2	4

Species	Scientific Name	Total Harvest	Track Observation
Muskrat	*Ondatra zibethicus*	1	--
Hare	*Lepus americanus*	1	--
Skunk	*Mephitis mephitis*	1	--
Caribou	*Rangifer tarandus caribou*	--	1
Moose	*Alces alces*	--	8
Fox	*Vulpes vulpes*	--	5
Wolf	*Canis lupus*	--	5
Weasel	*Mustela nivalis*	--	1
Wolverine	*Gulo gulo*	--	10
Total		**105**	**63**

Many of the trapper journals returned with data stated that this past trapping season was slow for fur production. This could have some reflection on the weather patterns of the 2016-2017 season; i.e. the month of January experienced higher than normal rainfall in winter. However, no comparison can be made to previous year's trapping efforts as this was the first year of data collection. Information provided by the trappers will allow some comparison to following years' trapping seasons.

3.7.3 Other TK Data

Traditional Knowledge (TK) interviews and community workshops were conducted by HTFC Planning & Design with community members from God's Lake First Nation (GLFN) on October 6, 2015 and November 18-24, 2015, Bunibonibee Cree Nation (BCN) on February 3, 2016, March 29, 2016, and April 3, 2016, and Manto Sipi Cree Nation (MSCN) on January 13-18, 2016 and September 24, 2016. Raw GIS information collected by HTFC regarding fishing, trapping, hunting, and wildlife habitat was provided to Joro for review and interpretation. The associated P6 TK summary text is included below.

God's Lake First Nation

Moose hunting occurs throughout the God's Lake area. Moose winter habitat was identified northwest of the community extending to Oxford House. Summer moose habitat was identified west of the community. In addition, moose calving sites were identified along the northern shoreline in the southern basin of God's Lake.

Caribou and caribou sign are often observed by GLFN community members. Participants shared general caribou movement patterns with animals originating northwest of the community traveling southeast in large herds through God's Lake and continuing southeast towards Red Sucker Lake. Smaller caribou movement patterns north of the community heading northeast to Oxford House and northeast towards Manto Sipi have been observed. Large herds (i.e. tens to hundreds) are known to migrate across God's Lake in January and February. Some animals from these large herds stay behind as the larger group

migrates. These animals will stay west of the community for about a year and will leave with the larger herd the following year.

Caribou were noted to cross over the winter road near the transmission line at the junction to Manto Sipi. In the spring, caribou are known to be in Ontario and move northwest, travelling northwest towards Knee Lake. Caribou habitat, including calving locations, was identified east and northeast from the community. Community members noted caribou have been harvested both east and west of the community.

A variety of furbearers are trapped in the God's Lake area. Species noted include snowshoe hare, beaver, muskrat, mink, marten, lynx, fisher, otter, fox, wolf, and wolverine. Trapping occurs throughout sections of the RTLs.

Ducks, geese, grouse, ptarmigan, spruce grouse, merganser, black ducks (scoter), and fall ducks (ring necked ducks) are hunted by community members.

Bunibonibee Cree Nation

Community members identified moose hunting areas as spanning entire watersheds and along the winter roads. Migratory caribou are harvested by community members and participants distinguished between resident and migratory caribou in the Oxford House area. In general, resident caribou have been observed year-round west of the community and are known. Resident caribou are known to be larger animals than migratory caribou and typically observed in herds of only 6 to 8 animals with a maximum herd size of approximately 15 animals.

Migratory caribou, originating from Shamattawa typically move south in December and follow the same migration route north in March or April. They are also known to have migratory movements in a west/east direction north of the community. Herds have been observed in numbers of 50 to 100 caribou. Caribou hunting has historically occurred north of the community. Caribou migration routes often come right through the community of BCN which provides opportunistic hunting opportunities.

A variety of furbearers are trapped in the Oxford House area. Species noted include snowshoe hare, muskrat, marten, mink, fox, otter, fisher, wolf, wolverine, lynx, and beaver. Black bears have been observed along with a single sighting of a porcupine near a trapper's cabin. Trapping occurs throughout sections of RTLs within the Oxford House area.

Wolves, foxes, and wolverines are known to begin using the winter road under frozen conditions before it opens in the winter. Once the road opens these furbearers shift to using the river as a transportation corridor.

Waterfowl hunting occurs on lakes and rivers in the Oxford House area. Hunted species include ducks, geese, mallards, blue bills or scaup and ring-necked ducks. Game bird hunting occurs south of the community in the general Oxford House area and includes spruce grouse and ptarmigan. Participants shared locations for bald eagle nests and indicated that they are very sensitive to human disturbance and will abandon nests if even slightly disturbed. Additional observations include garter snakes and a historic polar bear sighting.

Manto Sipi Cree Nation

Moose hunting has been extremely important as a source of food for MSCN community members. Successful hunters will share the moose harvested with family and community members. Moose hunting primarily occurs in the fall along the shoreline of lakes and river in the area and east to the Ontario border. Large groups of moose are often observed in old burn areas with beginnings of vegetation re-growth. Moose are known to move around between the transmission line and the winter road. Participants also indicated that moose use the winter road to escape wolf predation.

Caribou are known to move into the God's River area in large herds of 100 to 500 animals. These caribou typically come from Shamattawa in the winter, originating in the east they move across God's Lake to the northwest. Caribou appear to use the same migratory routes to travel north in the spring. Caribou herds migrating are thought to be a mix of barren-ground and woodland caribou as some of the animals observed were deemed too large to be barren-ground caribou. Community members know woodland caribou to be larger and darker than barren-ground caribou which are smaller and have white spots on their chest. Caribou migration routes often come right through the community of MSCN which provides opportunistic hunting opportunities. A participant mentioned that this was the first year (2016) he had not observed caribou on God's Lake. Caribou are also observed following the winter road as they move north from God's Lake.

A variety of furbearers are abundant and trapped within the MSCN area. The community has a long history of trapping and selling furs at the Hudson Bay Company post in God's Narrow. Species noted include beaver, snowshoe hare, muskrat, mink, marten, fisher, otter, lynx, fox, silver fox, wolverine, and wolf. Trapping has primarily been a source of income for community members. Marten are the primary furbearer targeted as they are easy to trap and process and provide the best fur price for harvest effort. Beaver are abundant, and trapping occurs along rivers and creeks in the MSCN area. Beaver pelt prices have decreased over time, leading to an associated drop in trapper efforts to harvest beaver. Beaver are more difficult to trap and skin when compared to marten.

Wolverine have been observed north of the community and are not abundant; trappers report only harvesting 1 or 2 per year. Lynx is a furbearer that is often harvested not only for fur but also for food. Wolves are common throughout the God's River area yet are not targeted in the trapping season due to the difficulty to harvest. Trappers have been known to shoot at wolves to scare them off as opposed to trap for them. Wolves are observed following caribou herds throughout the MSCN area and follow the winter road hunting moose. Trapping occurs throughout sections of RTLs within the MSCN area.

Waterfowl hunting in MSCN takes place in the spring and early summer months, capitalizing on the spring migration of waterfowl throughout the area. Large migrations of Canada geese pass through the MSCN area. Spring and early summer waterfowl are preferred due to body condition of migrating birds. Grouse, or prairie chickens as they are known to community members, are hunted south of the community. Spruce grouse have also been observed travelling from island to island across God's Lake.

Additional wildlife observations include great blue heron, loons, eagles and eagle nests.

Table 17 summarizes the species identified through the community interview process.

Table 17: P6 Traditional Knowledge (TK) Community Interviews/Workshops – Species list

Species	Scientific Name
Mammals	
American beaver	*Castor canadensis*
American black bear	*Ursus americanus*
American marten	*Martes americana*
American mink	*Neovison vison*
Canada lynx	*Lynx canadensis*
Fisher	*Martes pennanti*
Gray wolf	*Canis lupus*
Moose	*Alces alces andersoni*
Muskrat	*Ondatra zibethicus*
North American porcupine	*Erethizon dorsatum*
Northern river otter	*Lontra canadensis*
Polar bear	*Ursus maritimus*
Red fox	*Vulpes vulpes*
Snowshoe hare	*Lepus americanus*
Wolverine	*Gulo gulo*
Woodland Caribou	*Rangifer tarandus caribou*
Birds	
Bald eagle	*Haliaeetus leucocephalus*
Black scoter	*Melanitta americana*
Canada goose	*Branta canadensis*
Common loon	*Gavia immer*
Common merganser	*Mergus merganser*
Ducks	*Spp.*
Great blue heron	*Ardea herodias*
Mallard	*Anas platyrhynchos*
Ruffed grouse	*Bonasa umbellus*

Species	Scientific Name
Spruce grouse	*Falcipennis canadensis*
Willow ptarmigan	*Lagopus lagopus*
Herptiles	
Red-sided garter snake	*Thamnophis sirtalis parietalis*

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APPENDIX A: LIST OF POTENTIAL MAMMALS FOR THE P6 REGIONAL ASSESSMENT AREA

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
American beaver[2,3]	*Castor canadensis*			S5	
American black bear[3]	*Ursus americanus*			S5	
American deer mouse	*Peromyscus maniculatus*			S5	
American marten[2,3]	*Martes americana*			S5	
American mink[2,3]	*Neovison vison*			S5	
American water shrew	*Sorex palustris*			S5	
Arctic shrew	*S. arcticus*			S5	
Boreal caribou* (woodland, coastal)[1,2,3]	*Rangifer tarandus caribou*	THR	THR	S2S3, S4	THR
Canada lynx[2,3]	*Lynx canadensis*			S5	
Coyote[3]	*Canis latrans*			S5	
Eastern heather vole	*Phenacomys ungava*			S5	
Ermine (short-tailed weasel)	*Mustela erminea*			S5	
Fisher[2,3]	*Martes pennanti*			S5	
Gray wolf[2,3]	*Canis lupus*			S5	
Hoary bat	*Lasiurus cinereus*			S3B	
House mouse	*Mus musculus*			SNA	
Least chipmunk[3]	*Neotamias minimus*			S5	
Least weasel[2,3]	*Mustela nivalis*			S3S4	
Little brown bat[3]	*Myotis lucifugus*	END	END	S2N,S5B	END
Masked shrew[3]	*Sorex cinereus*			S5	
Meadow jumping mouse	*Zapus hudsonius*			S5	
Meadow vole	*Microtus pennsylvanicus*			S5	
Moose[2,3]	*Alces alces*			S5	
Muskrat[2,3]	*Ondatra zibethicus*			S5	
North American porcupine[3]	*Erethizon dorsatum*			S5	
Northern bog lemming	*Synaptomys borealis*			S5	
Northern flying squirrel[3]	*Glaucomys sabrinus*			S5	
Northern river otter[2,3]	*Lontra canadensis*			S5	

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
Pygmy shrew	*Sorex hoyi*			S5	
Raccoon[3]	*Procyon lotor*			S5	
Red fox[2,3]	*Vulpes vulpes*			S5	
Red squirrel	*Tamiasciurus hudsonicus*			S5	
Short-tailed shrew	*Blarina brevicauda*			S5	
Snowshoe hare[2,3]	*Lepus americanus*			S5	
Southern red-backed vole	*Clethrionomys gapperi*			S5	
Star-nosed mole	*Condylura cristata*			S3	
Striped skunk[2,3]	*Mephitis mephitis*			S5	
Wolverine (western pop.)[2,3]	*Gulo gulo*	No status	Non-active	S3S4	Not listed
Woodchuck	*Marmota monax*			S5	

Sources: Banfield, 1974; Caras, 1967; Cornell Lab of Ornithology, 2015; COSEWIC, 2017; MBCDC, 2016a; MESEA, 2017, SARA, 2017; Smithsonian (n.d.)

Bolded species are Species of Conservation Concern: **THR** – Threatened, **SC** – Special Concern, **END** – Endangered; NAR – Not at Risk

*****The P6 RAA includes the woodland (forest-dwelling) and coastal (forest-tundra) populations of boreal caribou in Manitoba; woodland caribou are listed as threatened while coastal caribou are not listed.

[1]Species occurrence listed on the Manitoba Conservation Data Centre for the Hayes River Upland Ecoregion,

[2]Observation during Joro Field Programs, [3]Species of First Nation Interest

MBCDC (2017 n.d.) Definitions for Status Listing:

1 Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.

2 Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.

3 Uncommon throughout its range or in the province (21 to 100 occurrences).

4 Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (> 100 occurrences).

5 Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially impossible to eradicate under present conditions.

U Possibly in peril, but status uncertain; more information needed.

H Historically known; may be rediscovered.

X Believed to be extinct; historical records only, continue search.

SNR A species not ranked. A rank has not yet assigned, or the species has not been evaluated.

SNA A conservation status rank is not applicable to the element.

S#S# Numeric range rank: A range between two of the numeric ranks. Denotes range of uncertainty about the exact rarity of the species.

? Inexact or uncertain; for numeric ranks, denotes inexactness.

B Breeding status of a migratory species. Example: S1B, SZN - breeding occurrences for the species are ranked S1 (critically imperilled) in the province, nonbreeding occurrences are not ranked in the province.

N Non-breeding status of a migratory species. Example: S1B, SZN - breeding occurrences for the species are ranked S1 (critically imperilled) in the province, nonbreeding occurrences are not ranked in the province.

Q Taxonomic questions or problems involved, more information needed; appended to the global rank.

T Rank for subspecific taxon (subspecies, variety, or population); appended to the global rank for the full species.

A modifier to SX or SH; the species has been reintroduced, but the population is not yet established.

SARA (2017) Definitions for Status Listing:

Schedule 1: the official list of species that are classified as extirpated, endangered, threatened, and of special concern.

Schedule 2: species listed in Schedule 2 are species that had been designated as endangered or threatened and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1.

Schedule 3: species listed in Schedule 3 are species that had been designated as special concern and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1.

Special Concern: a wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

Threatened: a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

COSEWIC (2017) Definitions for Status Listing:

Extinct: A wildlife species that no longer exists.

Extirpated: A wildlife species that no longer exists in the wild in Canada but exists elsewhere.

Endangered: A wildlife species facing imminent extirpation or extinction.

Threatened: A wildlife species that is likely to become an endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Special Concern: A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.

Not At Risk: A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

MESEA (2017) Definitions for Status Listing:

Extirpated: A species formerly indigenous to Manitoba no longer exists in the wild in Manitoba but exists elsewhere.

Endangered: A species threatened with imminent extirpation or with extinction throughout all or a significant portion of its Manitoba range.

Threatened: A species indigenous to Manitoba that is either: a) likely to become endangered; or b) is, because of low or declining numbers in Manitoba, particularly at risk if the factors affecting its vulnerability do not become reversed.

Special Concern: A species indigenous to Manitoba is at risk of becoming a threatened or endangered species because of a combination of biological characteristics and identified threats to the species.

APPENDIX B: LIST OF POTENTIAL BIRDS FOR THE P6 REGIONAL ASSESSMENT AREA

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
Alder flycatcher[2,3]	*Empidonax alnorum*			S5B	
American bittern[2,6]	*Botaurus lentiginosus*			S5B	
American black duck[1,6]	*Anas rubripes*			S3B	
American crow[2,3,6]	*Corvus brachyrhychos*			S5B SUN	
American golden-plover[1]	*Pluvialis dominica*			S4B SUM	
American goldfinch[2]	*Spinus tristis*			S5B	
American kestrel	*Falco sparverius*			S4B	
American pipit[1]	*Anthus rubescens*			S3B	
American redstart	*Setophaga ruticilla*			S5B	
American robin[2,3]	*Turdus migratorius*			S5B	
American three-toed woodpecker[3]	*Picoides dorsalis*			S5	
American tree sparrow[1,3]	*Spizella arborea*			S5B SUM	
American white pelican[6]	*Pelecanus erythrorhynchos*			S4B	
American wigeon[5]	*Anas americana*			S4B	
Baird's sandpiper[1]	*Calidris bairdii*			SUM	
Bald eagle[5,6]	*Haliaeetus leucocephalus*			S5B SUN	
Bank swallow[6]	*Riparia riparia*	No schedule, no status	THR	S5B	Not listed
Barn swallow[4,6]	*Hirundo rustica*	No schedule, no status	THR	S4B	Not listed
Barred owl[4]	*Strix varia*			S4	
Bay-breasted warbler	*Setophaga castanea*			S5B	
Belted kingfisher[2]	*Megaceryle alcyon*			S5B	
Black scoter[1,6]	*Melanitta americana*			S4B	
Black tern[5,6]	*Childonias niger*			S4B	
Black-and-white warbler[2]	*Mniotilta varia*			S5B	
Black-backed woodpecker[2]	*Picoides arcticus*			S5	
Black-bellied plover[1]	*Pluvialis squatarola*			SUM	
Black-capped chickadee[2,3]	*Poecile atricapillus*			S5	
Black-throated green warbler	*Setophaga virens*			S4B	
Blackburnian warbler[2]	*Setophaga fusca*			S5B	
Blackpoll warbler[2]	*Setophaga striata*			S5B SUM	
Blue jay[3]	*Cyanocitta cristata*			S5	

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
Blue-headed vireo[2,3]	*Vireo solitarius*			S5B	
Blue-winged teal[5]	*Anas discors*			S4B	
Bohemian waxwing	*Bombycilla garrulus*			S4B SUN	
Bonaparte's gull[2,6]	*Chroicocephalus philadelphia*			S5B	
Boreal chickadee[3]	[2]*Poecile hudsonicus*			S4	
Boreal owl[6]	*Aegolius funereus*			S4	
Broad-winged hawk	*Buteo platypterus*			S5B	
Brown creeper[2,3]	*Certhia americana*			S5B	
Bufflehead[5]	*Bucephala albeola*			S4B	
Cackling goose	*Branta hutchinsii*				
Canada goose[2,3,5,6]	*Branta canadensis*			S5B	
Canada warbler[4,6]	*Cardellina canadensis*	THR	THR	S3B	THR
Cape May warbler[2]	*Setophaga tigrina*			S5B	
Cedar waxwing[2,3]	*Bombycilla cedrorum*			S5B SUN	
Chipping sparrow[2,3]	*Spizella passerina*			S5B	
Clay-colored sparrow[2]	*Spizella pallida*			S5B	
Cliff swallow	*Petrochelidon pyrrhonota*			S4B	
Common goldeneye[5]	*Bucephala clangula*			S5B SUN	
Common grackle[2,3]	*Quiscalus quiscula*			S5B	
Common loon[2,3,5,6]	*Gavia immer*			S5B	
Common merganser[5,6]	*Mergus merganser*			S5B	
Common nighthawk[2,3,4,6]	*Chordeiles minor*	THR	THR	S3B	THR
Common raven[2,3,6]	*Corvus corax*			S5	
Common redpoll[3]	*Acanthis flammea*			S4B S5N	
Common tern[5]	*Sterna hirundo*			S5B	
Common yellowthroat[2]	*Geothlypis trichas*			S5B	
Connecticut warbler[2,3]	*Oporornis agilis*			S4B	
Dark-eyed junco[2,3]	*Junco hyemalis*			S5B SUN	
Double-crested cormorant[1,6]	*Phalacrocorax auritus*			S5B	
Downy woodpecker[2,3]	*Picoides pubescens*			S5	
Dunlin[1]	*Calidris alpina*			S3B SUM	
Eastern kingbird[2]	*Tyrannus tyrannus*			S4B	
Eastern phoebe	*Sayornis phoebe*			S5B	
Eastern wood-peewee[4]	*Contopus virens*	No schedule, no status	SC	S4B	Not listed
European starling	*Sturnus vulgaris*			SNA	

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
Evening grosbeak[3]	*Coccothraustes vespertinus*			S3	
Forster's Tern[2]	*Sterna forsteri*			S4B	
Fox sparrow[2]	*Passerella iliaca*			S5B S4M	
Gadwall[1]	*Anas strepera*			S5B	
Golden eagle[1,5,6]	*Aquila chrysaetos*		NAR	S1B S4N	
Golden-crowned kinglet	*Regulus satrapa*			S4B	
Gray catbird[3]	*Dumetella carolinensis*			S5B	
Gray jay[2,3,6]	*Perisoreus canadensis*			S5	
Gray-cheeked thrush	*Catharus minimus*			S5B S5M	
Great blue heron[4,6]	*Ardea herodias*			S5B	
Great gray owl[2,3]	*Strix nebulosa*			S4	
Great horned owl[6]	*Bubo virginianus*			S4	
Greater scaup[1,5,6]	*Aythya marila*			S5B SUM	
Greater white-fronted goose[1]	*Anser albifrons*			SUM	
Greater yellowlegs[2,5]	*Tringa melanoleuca*			S5B SUM	
Green-winged teal[5]	*Anas crecca*			S4B	
Gyrfalcon[1]	*Falco rusticolus*		NAR	SUN	
Hairy woodpecker[2,3]	*Picoides villosus*			S5	
Harris's sparrow[3]	*Zonotrichia querula*			S4B S5M	
Hermit thrush[2,3]	*Catharus guttatus*			S5B	
Herring gull[2,6]	*Larus argentatus*			S4B	
Hoary redpoll[3]	*Acanthis hornemanni*			S3B S5N	
Hooded merganser[1]	*Lophodytes cucullatus*			S5B	
Horned grebe[4]	*Podiceps auritus*	No schedule, no status	SC	S4B	Not listed
Horned lark[1]	*Eremophila alpestris*			S3B SUM	
House sparrow	*Passer domesticus*			SNA	
Killdeer	*Charadrius vociferus*			S5B	
Lapland longspur[1]	*Calcarius lapponicus*			S4B SUM SUN	
Le Conte's sparrow[2,3]	*Ammodramus leconteii*			S5B	
Least flycatcher[2]	*Empiodnax minimus*			S5B	

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
Least sandpiper[2]	*Calidris minutilla*			S4B SUM	
Lesser scaup[5,6]	*Aythya affinis*			S5B	
Lesser yellowlegs[3]	*Tringa flavipes*			S4B SUM	
Lincoln's sparrow[2,3]	*Melospiza lincolnii*			S5B	
Long-eared owl	*Asio otus*			S4B	
Long-tailed duck[1,6]	*Clangula hyemalis*			S4B	
Magnolia warbler[2]	*Setophaga magnolia*			S5B	
Mallard[2,3,5,6]	*Anas platyrhynchos*			S5B	
Merlin[2]	*Falco columbarius*		NAR	S5B SUN	
Nashville warbler[2,3,5]	*Oreothlypis ruficapilla*			S5B	
Northern flicker[2,3]	*Colaptes auratus*			S5B	
Northern goshawk	*Accipiter gentilis*			S4B S5N	
Northern harrier[2,5]	*Circus cyaneus*			S5B	
Northern hawk owl	*Surnia ulula*			S4	
Northern pintail[5]	*Anas acuta*			S5B	
Northern shoveler	*Anas clypeata*			S5B	
Northern shrike	*Lanius excubitor*			S3B S5N SUM	
Northern waterthrush[2]	*Parkesia noveboracensis*			S5B	
Olive-sided flycatcher[2,3,4,6]	*Contopus cooperi*	THR	THR	S3B	THR
Orange-crowned warbler[2,3]	*Oreothlypis celata*			S5B	
Osprey[6]	*Pandion haliaetus*			S4B	
Ovenbird[2,3]	*Seiurus aurocapilla*			S5B	
Palm warbler[2]	*Setophaga palmarum*			S5B	
Pectoral sandpiper[1]	*Calidris melanotos*			S4M	
Peregrine falcon[1,6]	*Falco peregrinus*	SC	SC	S1B	END
Philadelphia vireo	*Vireo philadelphicus*			S4B	
Pied-billed grebe[2,3]	*Podilymbus podiceps*			S5B	
Pileated woodpecker[2,3]	*Dryocopus pileatus*			S5	
Pine grosbeak[3]	*Pinicola enucleator*			S4	
Pine siskin[2]	*Spinus pinus*			S5	
Purple finch[2]	*Haemorhous purpureus*			S5B	
Red crossbill[3]	*Loxia curvirostra*			S4B SUN	
Red-breasted merganser[2]	*Mergus serrator*			S4B	
Red-breasted nuthatch[2,3]	*Sitta canadensis*			S5	
Red-eyed vireo[2]	*Vireo olivaceus*			S5B	

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
Red-necked phalarope[1]	*Phalaropus lobatus*			S4B SUM	
Red-tailed hawk[2]	*Buteo jamaicensis*			S5B	
Red-throated loon[1]	*Gavia stellata*			S3B, SUM	
Red-winged blackbird[2,3,6]	*Agelaius phoeniceus*			S5B	
Ring-billed gull[3]	*Larus delawarensis*			S5B	
Ring-necked duck[3,5]	*Aythya collaris*			S5B	
Rose-breasted grosbeak[3]	*Pheucticus ludovicianus*			S5B	
Ross's goose[1]	*Chen rossii*			S3S4B S4M	
Rough-legged hawk[1]	*Buteo lagopus*		NAR	S3B SUM	
Ruby-crowned kinglet[2,3]	*Regulus calendula*			S5B	
Ruddy turnstone[1]	*Arenaria interpres*			SUM	
Ruffed grouse[2,3,5,6]	*Bonasa umbellus*			S4S5	
Rusty blackbird[2,4,6]	*Euphagus carolinus*	SC	SC	S4B	Not listed
Sanderling[1]	*Calidris alba*			SUM	
Sandhill crane[2,3,5,6]	*Grus canadensis*			S5B	
Savannah sparrow[2]	*Passerculus sandwichensis*			S5B	
Semipalmated plover	*Charadrius semipalmatus*			S4B SUM	
Semipalmated sandpiper[1,6]	*Calidris pusilla*			S3B SUM	
Sharp-shinned hawk	*Accipter striatus*			S4B	
Sharp-tailed grouse[5,6]	*Tympanuchus phasianellus*			S5	
Short-billed dowitcher[1]	*Limnodromus griseus*			S4B	
Short-eared owl[1,3,6]	*Asio flammeus*	SC	SC	S2S3B	THR
Smith's longspur[1]	*Calcarius pictus*			S3B SUM	
Snow bunting[1]	*Plectrophenax nivalis*			S4N SUM	
Snow goose[1,6]	*Chen caerulescens*			S5B S5M	
Snowy owl[6]	*Bubo scandiacus*			S4N	
Solitary sandpiper[2]	*Tringa solitaria*			S4B SUM	
Song sparrow[2]	*Melospiza melodia*			S5B	
Sora[3]	*Porzana carolina*			S5B	
Spotted sandpiper	*Actitis macularius*			S5B	
Spruce grouse[3,5,6]	*Falcipennis canadensis*			S4	
Stilt sandpiper[1]	*Calidris himantopus*			S4B SUM	

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
Surf scoter[1]	*Melanitta perspicillata*			S3B	
Swainson's thrush[3,5]	*Catharus ustulatus*			S5B	
Swamp sparrow[3]	*Melospiza georgiana*			S5B	
Tennessee warbler[2,3]	*Oreothlypis peregrina*			S5B	
Tree swallow[6]	*Tachycineta bicolor*			S4B	
Tundra swan[1,5,6]	*Cygnus columbianus*			S4B SUM	
Turkey vulture[6]	*Cathartes aura*			S4B	
Vesper sparrow	*Pooecetes gramineus*			S5B	
White-crowned sparrow[1,3]	*Zonotrichia leucophrys*			S5B	
White-rumped sandpiper[1]	*Calidris fuscicollis*			SUM	
White-throated sparrow[2,3]	*Zonotrichia albicollis*			S5B	
White-winged crossbill[2,3]	*Loxia leucoptera*			S5	
White-winged scoter	*Melanitta fusca*			S4B	
Willow ptarmigan[1,6]	*Lagopus lagopus*			S4B SUN	
Wilson's snipe[2,3,5,6]	*Gallingo delicata*			S5B	
Wilson's warbler[2]	*Cardellina pusilla*			S5B SUM	
Winter wren[2,3]	*Troglodytes hiemalis*			S5B	
Woodchuck[6]	*Marmota monax*			S5	
Yellow rail[2]	*Coturnicops noveboracensis*	SC	SC	S3B	Not listed
Yellow warbler[2,3]	*Setophaga petechia*			S5B	
Yellow-bellied flycatcher[2]	*Empidonax flaviventris*			S5B	
Yellow-bellied sapsucker[2,3]	*Sphyrapicus varius*			S5B	
Yellow-rumped warbler[2,3]	*Setophaga coronata*			S5B	

Sources: Manitoba Avian Research Committee, 2003; MBBA, 2014; Cornell Lab of Ornithology, 2015; COSEWIC, 2017; Joro, 2017b; MBCDC, 2016a; MESEA, 2017, SARA, 2017.

Bolded species are Species of Conservation Concern: THR – Threatened, SC – Special Concern, END – Endangered; NAR – Not at Risk

[1]Species is a migrant or non-breeding visitor in the RAA; [2]Observation during the Manitoba Breeding Bird Atlas Surveys, [3]Observation heard on ARU recordings, [4]Species occurrence listed on the Manitoba Conservation Data Centre for the Hayes River Upland Ecoregion [5]Observation during Joro Field Programs, [6]Species of First Nation Interest

MBCDC (n.d.) Definitions for Status Listing:

1 Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.

2 Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.

3 Uncommon throughout its range or in the province (21 to 100 occurrences).

4 Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (> 100 occurrences).

5 Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially impossible to eradicate under present conditions.

U Possibly in peril, but status uncertain; more information needed.

H	Historically known; may be rediscovered.
X	Believed to be extinct; historical records only, continue search.
SNR	A species not ranked. A rank has not yet assigned, or the species has not been evaluated.
SNA	A conservation status rank is not applicable to the element.
S#S#	Numeric range rank: A range between two of the numeric ranks. Denotes range of uncertainty about the exact rarity of the species.
?	Inexact or uncertain; for numeric ranks, denotes inexactness.
B	Breeding status of a migratory species. Example: S1B, SZN - breeding occurrences for the species are ranked S1 (critically imperilled) in the province, nonbreeding occurrences are not ranked in the province.
N	Non-breeding status of a migratory species. Example: S1B, SZN - breeding occurrences for the species are ranked S1 (critically imperilled) in the province, nonbreeding occurrences are not ranked in the province.
Q	Taxonomic questions or problems involved, more information needed; appended to the global rank.
T	Rank for subspecific taxon (subspecies, variety, or population); appended to the global rank for the full species.
#	A modifier to SX or SH; the species has been reintroduced, but the population is not yet established.

SARA (2017) Definitions for Status Listing:

Schedule 1: the official list of species that are classified as extirpated, endangered, threatened, and of special concern.

Schedule 2: species listed in Schedule 2 are species that had been designated as endangered or threatened and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1.

Schedule 3: species listed in Schedule 3 are species that had been designated as special concern and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1.

Special Concern: a wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

Threatened: a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

COSEWIC (2017) Definitions for Status Listing:

Extinct: A wildlife species that no longer exists.

Extirpated: A wildlife species that no longer exists in the wild in Canada but exists elsewhere.

Endangered: A wildlife species facing imminent extirpation or extinction.

Threatened: A wildlife species that is likely to become an endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Special Concern: A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.

Not At Risk: A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

MESEA (2017) Definitions for Status Listing:

Extirpated: A species formerly indigenous to Manitoba no longer exists in the wild in Manitoba but exists elsewhere.

Endangered: A species threatened with imminent extirpation or with extinction throughout all or a significant portion of its Manitoba range.

Threatened: A species indigenous to Manitoba that is either: a) likely to become endangered; or b) is, because of low or declining numbers in Manitoba, particularly at risk if the factors affecting its vulnerability do not become reversed.

Special Concern: A species indigenous to Manitoba is at risk of becoming a threatened or endangered species because of a combination of biological characteristics and identified threats to the species.

APPENDIX C: LIST OF POTENTIAL HERPTILES FOR THE P6 REGIONAL ASSESSMENT AREA

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
American toad	*Anaxyrus americanus*			S4S5	
Boreal chorus frog	*Pseudacris maculata*			*S5*	
Northern leopard frog*[2]	*Lithobates pipiens*		NAR	S4	
Northern spring peeper[2]	*Pseudacris crucifer*			*S5*	
Wood frog	*Lithobates sylvaticus*			*S5*	
Red-sided garter snake[1,2]	*Thamnophis sirtalis parietalis*			S4	

Sources: Preston, 1982; Canadian Herpetological Society, 2016; Nature North, 2017; COSEWIC, 2017; Joro, 2017b; MBCDC, 2016a; MESEA, 2017, SARA, 2017

*COSEWIC (2009) indicates the western population (that is Special Concern under COSEWIC and SARA) is west of the Project 6 RAA

Bolded species are Species of Conservation Concern: THR – Threatened, SC – Special Concern, END – Endangered; NAR – Not at Risk

[1]Species occurrence listed on the Manitoba Conservation Data Centre for the Hayes River Upland Ecoregion, [2] Species of First Nation Interest

MBCDC (n.d.) Definitions for Status Listing:

1 Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.

2 Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.

3 Uncommon throughout its range or in the province (21 to 100 occurrences).

4 Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (> 100 occurrences).

5 Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially impossible to eradicate under present conditions.

U Possibly in peril, but status uncertain; more information needed.

H Historically known; may be rediscovered.

X Believed to be extinct; historical records only, continue search.

SNR A species not ranked. A rank has not yet assigned, or the species has not been evaluated.

SNA A conservation status rank is not applicable to the element.

S#S# Numeric range rank: A range between two of the numeric ranks. Denotes range of uncertainty about the exact rarity of the species.

? Inexact or uncertain; for numeric ranks, denotes inexactness.

B Breeding status of a migratory species. Example: S1B, SZN - breeding occurrences for the species are ranked S1 (critically imperilled) in the province, nonbreeding occurrences are not ranked in the province.

N Non-breeding status of a migratory species. Example: S1B, SZN - breeding occurrences for the species are ranked S1 (critically imperilled) in the province, nonbreeding occurrences are not ranked in the province.

Q Taxonomic questions or problems involved, more information needed; appended to the global rank.

T Rank for subspecific taxon (subspecies, variety, or population); appended to the global rank for the full species.

A modifier to SX or SH; the species has been reintroduced, but the population is not yet established.

SARA (2017) Definitions for Status Listing:

Schedule 1: the official list of species that are classified as extirpated, endangered, threatened, and of special concern.

Schedule 2: species listed in Schedule 2 are species that had been designated as endangered or threatened and

have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1.

Schedule 3: species listed in Schedule 3 are species that had been designated as special concern and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1.

Special Concern: a wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

Threatened: a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

COSEWIC (2017) Definitions for Status Listing:

Extinct: A wildlife species that no longer exists.

Extirpated: A wildlife species that no longer exists in the wild in Canada but exists elsewhere.

Endangered: A wildlife species facing imminent extirpation or extinction.

Threatened: A wildlife species that is likely to become an endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Special Concern: A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.

Not At Risk: A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

MESEA (2017) Definitions for Status Listing:

Extirpated: A species formerly indigenous to Manitoba no longer exists in the wild in Manitoba but exists elsewhere.

Endangered: A species threatened with imminent extirpation or with extinction throughout all or a significant portion of its Manitoba range.

Threatened: A species indigenous to Manitoba that is either: a) likely to become endangered; or b) is, because of low or declining numbers in Manitoba, particularly at risk if the factors affecting its vulnerability do not become reversed.

Special Concern: A species indigenous to Manitoba is at risk of becoming a threatened or endangered species because of a combination of biological characteristics and identified threats to the species

APPENDIX D: ARU METHODS AND BIRD DATA

Scoping of Target Species

Determination of the methods to be followed prior to the first deployment of ARUs in March 2016 initially involved the scoping of target species. Information on preferred breeding habitats and mating schedules were identified after determining that the prime focus of ARU studies as being to identify presence/absence of species listed under COSEWIC, SARA, MESEA and MBCDC. See Appendix B for further detail/definitions on conservation status listing.

While the field priority was initially focused on birds of conservation concern, other birds and amphibians were expected to be recorded by ARUs within the suite of habitat types sampled. Spring peeper and northern leopard frogs were amongst the amphibian species targeted through the habitat-based placement of ARUs.

Spring peepers prefer forested habitat near ponds and other wetlands and are most commonly found east of Lake Winnipeg in southeastern Manitoba (Nature North, 2017). The northern leopard frog- eastern population, which occurs in the RAA, is ranked as S4 by the MBCDC (2016a) and courts in permanent ponds lacking large fish. COSEWIC (2009) indicates the western population (listed as “Special Concern” under COSEWIC and SARA) is west of the RAA. Some of these species generally occupy habitats that are used by other amphibians, such as boreal chorus frogs and wood frogs, which breed in various wetland types and occupy a wide range of summering habitats (Nature North, 2017).

The RAA is expected to be well north of the breeding locales of some rare species, but the designed habitat sampling protocol was developed to permit the detection of species such as the green frog (*Lithobates clamitans*, S1/S2) and mink frog (*Lithobates septentrionalis,* S3).The former is a shallow water late spring breeder has been reported as far north as Nopiming Provincial Park (Nature North, 2017) while the latter is a late spring breeder resident to bogs, large cold permanent ponds, lakes and slow moving rivers with abundant vegetation

The timing and location of ARU deployment assumed that amphibians in the region would initiate vocalizations in late April and early May following snow melt and warming temperatures. Bird vocalizations were sampled at various times and locations based on known breeding cycles of diurnal (e.g., passerines), crepuscular (e.g., common nighthawks), and nocturnal (e.g., owls) species that breed as early as March and as late as late August or September.

A list of bird and amphibian species initially targeted for sampling by ARUs in 2016 is given in Appendix D: Table D-1. While these include species of conservation concern listed under federal and/or provincial legislation, their habitats overlap those of several other species; e.g., mixedwood and coniferous forests sampled in March and April potentially support breeding populations of both great gray owls and boreal owls.

Table D-1: Target Bird Species, habitat, and timing preferences used in ARU deployment planning in the P6 RAA

Bird Species	Habitat Preference	Mating Call Period (Dates/Times)
Bank swallow (*Riparia riparia*)	Vertical sandy banks near water (rivers/streams)	Mid-May to mid-August
Barn swallow (*Hirundo rustica*)	Marshy areas with structures for nesting	Mid-May to late Sept; Sunrise-10:30
Barred owl (*Strix varia*)	Mature boreal and riparian forests; mature hardwood-dominated stands, especially in low-lying areas near marsh and rivers	First mild nights in March to June; nocturnal
Canada warbler (*Cardellina canadensis*)	Deciduous or mixed-wood, often on sloping terrain near lake in dense shrubbery	Mid-May to August (June peak); Pre-Sunrise-10:30
Common nighthawk (*Chordeiles minor*)	Forests with extensive rock outcrops, clearings or burns	Early June-mid August; crepuscular late afternoon/evening
Horned grebe (*Podiceps auritus*)	Permanent potholes with vegetation	Mid-May to Mid-June
Olive-sided flycatcher (*Contopus cooperi*)	Open coniferous forests near edge of bogs/wetlands	June-mid-July; Sunrise-10:00
Rusty blackbird (*Euphagus carolinus*)	Wet areas (e.g., treed muskeg)	Mid-May to mid-July; Sunrise-10:00
Short-eared owl (*Asio flammeus*)	Open areas such as marshes and fens with tall dense vegetation with cover, bog, muskeg, and open boreal forest	Mid-April to late June; nocturnal
Yellow rail (*Coturnicops noveboracensis*)	Wetlands – shallow, grassy marsh or sedge fen; wet sedge meadows where sedge species are selected for and water depth around the nest is 10 cm	Mid-May to August; primarily nocturnal (will call during day)
Northern leopard frog (*Lithobates pipiens*)	Grasslands or forests near lakes, ponds, or other wetlands	Late April and early May, following snow melt and warming temperatures
Spring Peeper (*Pseudacris crucifer*)	Forested habitat near ponds and other wetlands	Late April and early May, following snow melt and warming temperatures

*See Appendix B for definitions on conservation status listing. Sources: Altman and Sallabanks 2000, Avery 1995, Bookhout and Stenzel 1987, Bookhout 1995, Clark 1975, Conway 1999, Godfrey 1986, Holland and Taylor 2003a,b, Koonz and Taylor 2003, Nero and Taylor 2003, Poulin *et al.* 1996, Taylor 2003, Wilson and Watts 2008

Site Selection and Temporal Settings

Knowledge respecting species present in the RAA enhances the assessment of potential Project activities to impact specific birds and/or amphibians. Throughout the Project 6 assessment history, ARUs have been deployed within appropriate habitats to ensure the best opportunity for detection of the targeted birds and amphibians (Map 18; Appendix D: Table D-1); aerial reconnaissance surveys were undertaken to assist in the selection of the most appropriate forest covertypes prior to placement of the ARUs (Appendix E: Photographs 7-8). Key criteria governing the placement of ARUs included:

- All ARUs deployed along/adjacent to proposed road infrastructure
- Habitats were selected using existing habitat information (LCCES)
- Potential sites selected were mapped using LCCES data at a 1:10,000 scale; and
- ARUs were typically set up within or near clearings close to suitable habitat that facilitates deployment and monitoring.

ARUs were securely attached to trees on the edge of a clearing; barbed wire was wrapped around the tree underneath the ARU as a deterrent to black bear destructive curiosity. The seasonal deployment of ARU's was based on known species-specific habitat requirements during the breeding season (Appendix D: Table D-2 and Table D-3). The periodicity for operation of the recording units was based on an evaluation of the most efficient use of time resources. ARUs were programmed to record for certain peak activity periods when species were most active, e.g., dusk or night for common nighthawks. Recording units were left in place for 2-4 weeks before being moved to another location, this assured increased probability of recording a rare species and correcting for recording times when weather interfered with recordings and animal detection.

The proposed periods for which the ARUs deployed in 2016 recorded various species of birds are outlined in Appendix D: Table D-2. The ARUs were set to record half an hour before sunset, recording for 10 minutes each hour for four hours (for a total of four 10-minute recordings). For habitats potentially supporting rare species during the sampling period, a minimum of 3 ARUs, with a minimum of 4 km of separation between units, were placed in each habitat types interspersed along/near the Project infrastructure sites. Sampling dates in the P6 RAA assured adequate recording coverage of the beginning, middle, and end phases of breeding cycles.

Table D-2: Temporal Settings for ARUs Deployed in the P6 RAA

Sampling* Period	Temporal Setting	Frequency	Habitat	Focal Species
March 21 - May 27	1900h-0100h	10 min/hr	Moist mixedwood and riparian forests with dense understory; mature hardwood-dominated stands, esp. in low- lying areas near marsh and rivers	Barred owl
April 11 - June 3	1900h-0100h	10 min/hr	Open areas such as marshes and fens with tall dense vegetation with cover. Likely non-breeder (*reduce/avoid sample size*).	Short-eared owl
June 6-20	0430h-1000h	10 min/hr	Wet areas (e.g., treed muskeg); bogs, fens, riparian areas	Rusty blackbird
June 6-20	2130h-0500h	10 min/hr	Wetlands – shallow, grassy marsh or sedge fen; wet sedge meadows where sedge species are selected for and water depth around the nest is 10 cm	Yellow rail
June 6-20	0430h-1000h	10 min/hr	Deciduous or mixed-wood with dense and diverse understory, often on sloping terrain near lake	Canada warbler
June 6-20	0430h-1000h	10 min/hr	Deciduous woods, large aspen bluffs, beach ridges, riparian sites and open tall jack pine stands	Eastern Wood-peewee
June 6-20	0430h-1000h	10 min/hr	Mature mixed-wood forest, swampland interspersed with rocky outcrops	Northern parula
June 6-20	2100h-0530h	10 min/hr	Open upland deciduous and mixed-wood forest; edge of regenerating woodlands	Whip-poor-will
June 6-20	0430h-1000h	10 min/hr	Open coniferous forests near edge of bogs/wetlands and recently burned stands (standing dead trees)	Olive-sided flycatcher
June 6-20	1800h-2300h	10 min/hr	Forests with extensive rock outcrops, clearings or burns–openings such as gravel pits	Common nighthawk

*Timeframes consider the early spring in 2016 and were adjusted as daylight hours increase

To augment the information collected by ARUs, observations of birds and unique or sensitive habitat (e.g., heron rookery or eagle nest) were collected during the ARU deployment phase. This assisted in collecting information on species not readily heard on ARUs but more likely to be seen visually, e.g., waterfowl and waterbirds such as horned grebes.

ARUs were initially deployed within the P6 RAA in different months (i.e. March to June) to assure that other species (listed in Appendix D: Table D1 - Table D3) would be potentially recorded if present. Once units were retrieved, the ARU data was collected, and new data storage cards were inserted. Recording units were then relocated to new locations along the P6 routes to survey a greater area for the same species (Map 18). For example, the ARUs used to sample owls and frogs were redeployed in May to assure there was adequate sampling for rare species of migratory neotropical songbirds that potentially breed in the area. ARUs that were used to sample for owls were retained in habitats that would be sampled for other species (e.g., the barred owl breeding sites were in habitats similar to the location of many other neotropical migrants. Redeployment of the owl ARUs to habitats well suited to passerines occupation was done in late May/early June coinciding with breeding season activity.

Sampling Protocol

The intent of the analysis was to determine presence/absence of species. ARUs were set to record during the early, peak, and late phases of the breeding periods for birds and amphibians. The following are some of the key factors considered in the analyses of data generated by the ARUs:

- Prior to listening to recordings, reviewers would listen to the calls of the species in question; and
- Reviewers listened to a minimum of 3-5, 10-minute pre-selected sample units/period (morning, evening, night) to assure that analyses occurred during the:
    - onset of owl breeding (late March/early April), during the middle (late April/early May), and near the end of the recording cycle (late May).
    - onset of amphibian courtship (late April) and throughout the breeding period; and
    - onset of songbird breeding (May) and throughout the breeding cycle (until mid-August).

Table D-3: P6 ARU Sampling Locations and Periods in 2016

Project	Site	Latitude	Longitude	Date Start	Date End	Time Start	Time End	Data	Habitat Type*
P6-1	SM06	54.86742	-94.04983	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	Standing water in marsh, short spruce trees
P6-2	SM06	54.89451	-94.102482	2016-04-20	2016-05-18	0500, 1730	0700, 2030	Yes	Marsh grass, ~1 km from open lake. Surrounded by willow, TM with spruce farther away
P6-3	SM06	54.89451	-94.102482	2016-05-18	2016-06-16	1950	0815	No	
P6-4	SM06	54.85342	-94.390482	2016-06-16	2016-07-07	2030	0800	No	15km west along a large pond/lake, 15m of grass from treeline to creek, edge of treeline is mixed with willow
P6-5	SM06	54.85859	-94.41464	2016-07-07	2016-07-19	2030	0800	No	50% mature spruce-40% TM-10% MW in 0.5 hectare on TM
P6-6	SM06	54.85859	-94.41464	2016-07-19	2016-08-15	1900	1100	Yes	
P6-1	SM07	54.7075	-94.97585	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	Small lake with marshy area, standing dead trees, MW nearby
P6-2	SM07	54.79071	-95.142422	2016-04-20	2016-05-17	0500, 1730	0700, 2030	Yes	On road alignment: Dry upland MW, large poplar trees 30 m tall
P6-1	SM09	54.61548	-94.70279	2016-03-22	2016-04-20	0500, 1730	0700, 2030	Yes	Grassy swamp with standing dead trees, willows, TM, boggy with standing water near small lake
P6-2	SM09	54.59844	-94.677759	2016-04-20	2016-05-16	0500, 1730	0700, 2030	Yes	Road alignment, small marshy area with willows
P6-3	SM09	54.59844	-94.677759	2016-05-16	2016-06-16	1950	0515	No	
P6-4	SM09	54.60544	-94.690866	2016-06-16	2016-07-07	2030	0800	No	Along winter road: no grass on the road peaty hummock, TM on either side; spruce trees are spaced out.
P6-5	SM09	54.61176	-94.697552	2016-07-07	2016-07-19	2030	0800	No	1 hectare (ha) 80% mature spruce, 20% tamarack north of alignment
P6-6	SM09	54.61176	-94.697552	2016-07-19	2016-09-28	350, 1820	1200, 2230	Yes	
P6-1	SM10	54.88281	-95.22083	2016-03-21	2016-04-20	0415, 1800	0715, 2100	Yes	Marshy area near small creek. Surrounded by tall MW
P6-2	SM10	54.87019	-95.233527	2016-04-20	2016-05-16	0300, 1800	0600, 2100	Yes	Clearcut road alignment, tall spruce and poplar
P6-3	SM10	54.87019	-95.233527	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM10	54.86431	-95.22567	2016-06-16	2016-07-07	2030	0500	Yes	Opening along the proposed road, TM edge, 0.1ha opening with willows and small spruce
P6-5	SM10	54.87757	-95.258227	2016-07-07	2016-07-19	1900	0600	Yes	3 ha opening: 70% tamarack-30% mature spruce south of hydro line

Project	Site	Latitude	Longitude	Date Start	Date End	Time Start	Time End	Data	Habitat Type*
P6-6	SM10	54.87757	-95.258227	2016-07-19	2016-08-11	2000	1030	Yes	
P6-3	SM11	54.89374	-94.227372	2016-05-18	2016-06-16	1950	0815	No	3 ha opening: 70% TM-30% mature spruce south of hydro line
P6-4	SM11	54.89275	-94.202343	2016-06-19	2016-07-02	2030	0800	Yes	Spruce-TM mix along the winter road
P6-5	SM11	54.8732	-94.125998	2016-07-08	2016-07-10	2030	0800	No	Winter road north side of road on black spruce
P6-6	SM11	54.8732	-94.125998	2016-07-19	2016-10-05	1715	1230	Yes	
P6-1	SM13	54.84902	-94.48282	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	Small bog, grassy surrounded by spruce
P6-2	SM13	54.81203	-94.52219	2016-04-20	2016-05-16	0500, 1730	0700, 2030	Yes	Two deciduous stands nearby: small bog, short spruce trees
P6-3	SM13	54.81203	-94.52219	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM13	54.82782	-94.508197	2016-06-16	2016-07-07	2030	0800	No	Winter road, small spruce intermixed with small clumps of willows
P6-5	SM13	54.83643	-94.484291	2016-07-19	2016-07-20	2030	0800	Yes	70% mature spruce-30% MW
P6-6	SM13	54.83643	-94.484291	2016-07-20	2016-08-11	1930	1100	Yes	
P6-3	SM14	54.88816	-94.164111	2016-05-18	2016-06-16	1950	0815	No	No record
P6-4	SM14	54.88306	-94.151188	2016-06-16	2016-07-07	2030	0800	No	Along winter road: taller spruce to the north with small spruce and TM to the south and willows mixed throughout
P6-5	SM14	54.88577	-94.171495	2016-07-08	2016-07-08	0200	0800	No	1 ha opening: 50% mature spruce-50% TM east side of opening
P6-6	SM14	54.88577	-94.171495	2016-08-07	2016-10-04	1730	1230	Yes	
P6-1	SM15	54.78535	-94.58913	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	Short grass, dead standing spruce, next to large marsh
P6-2	SM15	54.68213	-94.850282	2016-04-20	2016-05-16	0500, 1730	0700, 2030	Yes	Marshy area with dead trees. Grassy next to spruce/TM forest
P6-3	SM15	54.68213	-94.850282	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM15	54.68483	-94.882681	2016-06-16	2016-07-07	2030	0800	No	On winter road: 20m opening, short grass, spruce to the west and willow on the other side of the road
P6-5	SM15	54.69168	-94.902335	2016-07-08	2016-07-19	2030	0800	No	0.25 ha on TM, cell phone tower to the south: 10% mature spruce-60% tamarack-30% MW
P6-6	SM15	54.69168	-94.902335	2016-07-19	2016-10-05	1730	1230	Yes	
P6-1	SM16	54.56897	-94.57143	2016-03-22	2016-04-20	0500, 1730	0700, 2030	Yes	Grassy marsh with willows near small lake. Beaver lodge and dam 50m

Project	Site	Latitude	Longitude	Date Start	Date End	Time Start	Time End	Data	Habitat Type*
									away
P6-2	SM16	54.55623	-94.584884	2016-04-20	2016-05-16	0500, 1730	0700, 2030	Yes	In swamp 70m from beaver lodge. Large upland ridges, dry with poplar
P6-3	SM16	54.55623	-94.584884	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM16	54.55184	-94.571153	2016-06-16	2016-07-07	2030	0800	No	Along winter road: short grass on road with willows all around
P6-5	SM16	54.55942	-94.567564	2016-07-07	2016-07-19	2030	0800	No	0.5 ha water hole surrounded by mature spruce
P6-1	SM18	54.84853	-95.17338	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	Marshy grassy area surrounded by small dry ridges with large spruce trees, MW
P6-2	SM18	54.84067	-95.188263	2016-04-20	2016-05-16	0500, 1730	0700, 2030	Yes	Road crossroad: Large MW forest stand
P6-3	SM18	54.84067	-95.188263	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM18	54.83161	-95.177001	2016-06-16	2016-07-07	2030	0800	No	Further down road: mixed with TM and spruce, road is grassy
P6-5	SM18	54.81994	-95.137241	2016-07-07	2016-07-19	2030	0800	No	Mature spruce grassy opening 1.5 hectare
P6-6	SM18	54.81994	-95.137241	2016-07-19	2016-08-18	1900	1100	Yes	
P6-1	SM19	54.76307	-94.72947	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	Small grassy bog near large MW upland habitat
P6-2	SM19	54.73235	-94.802118	2016-04-20	2016-05-16	0500, 1730	0700, 2030	Yes	On road alignment: large MW stand
P6-3	SM19	54.73235	-94.802118	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM19	54.74198	-94.801174	2016-06-16	2016-07-07	2030	0800	No	Spruce on either side: small willows along the edge with short grass on the road, with a pond/swamp to the north
P6-5	SM19	54.75288	-94.782273	2016-07-08	2016-07-19	2030	0800	No	0.5 hectare: 70% mature spruce-30% MW, grassy open area on black spruce tree north side of opening
P6-6	SM19	54.75288	-94.782273	2016-07-19	2016-08-26	1900	1100	Yes	
P6-1	SM21	54.76981	-95.07153	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	In stream bed with lots of grass by very large MW upland area
P6-2	SM21	54.76237	-95.088228	2016-04-20	2016-05-16	0500, 1730	0700, 2030	Yes	On road alignment: upland dry site near a small marsh by large upland MW
P6-3	SM21	54.76237	-95.088228	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM21	54.75157	-95.065879	2016-06-16	2016-07-07	2030	0800	No	Further down road at a Junction: .1ha opening, short grass, spruce with willow

Project	Site	Latitude	Longitude	Date Start	Date End	Time Start	Time End	Data	Habitat Type*
P6-5	SM21	54.7424	-95.047382	2016-07-07	2016-10-12	2030	0800	No	North side of winter road at 215 km marker
P6-6	SM21	54.7424	-95.047382	2016-07-19	2016-10-05	1730	1230	Yes	
P6-1	SM23	54.89395	-94.25981	2016-03-21	2016-04-20	0420, 1810	0720, 2150	Yes	Small marsh, grassy with willows
P6-2	SM23	54.88602	-94.277192	2016-04-20	2016-05-16	0300, 1900	0600, 2220	Yes	Very grassy, wet, standing dead trees in marsh, small creek
P6-3	SM23	54.88602	-94.277192	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM23	54.88178	-94.249176	2016-06-16	2016-07-07	2030	0800	No	Along edge of a 2.5 ha pond: there is 10m of grass from the edge of pond to tree line, willows along the edge with spruce and TM
P6-5	SM23	54.88869	-94.270919	2016-07-08	2016-07-19	2030	0800	No	North side of pond on TM
P6-6	SM23	54.88869	-94.270919	2016-07-19	2016-09-02	2000	1130	Yes	
P6-1	SM24	54.6574	-94.86872	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	Marsh surrounded by MW, willows, grass, TM

*TM= Tamarack, MW -= Mixedwood

Table D-4: ARU Bird Species Heard March 21-October 12, 2016

Species	SM06			SM07		SM09			SM10					SM11	SM13						SM14		SM15				SM16			SM18				SM19						SM21			SM23				SM24
	1	2	6	1	2	1	2	6	1	3	4	5	6	6	1	2	3	5	6	6	1	2	3	6	1	2	3	1	2	3	6	1	2	3	4	5	6	1	2	6	1	2	3	6	1
Alder flycatcher			√					√		√		√	√					√							√											√										
American Crow		√			√			√			√	√				√	√									√	√			√						√			√	√						
American robin		√					√											√												√	√			√						√						
American Three-toed Woodpecker						√																								√									√						
American tree sparrow		√																																											
Unknown blackbird		√			√																																								
Black-capped Chickadee						√																√						√										√			√				
Blue jay					√											√	√					√	√											√											
Blue-headed vireo																			√																										
Boreal chickadee							√						√	√					√				√																						
Brown creeper																																		√											
Canada goose		√		√	√		√		√	√		√				√	√					√				√			√	√			√						√			√			
Cedar waxwing																													√				√											
Chipping sparrow										√	√	√	√				√	√				√	√	√		√	√						√		√				√	√		√		√	
Common loon		√			√		√	√		√	√			√		√		√	√	√						√	√			√	√		√	√		√		√	√		√		√	
Common nighthawk														√										√										√						√						
Common raven	√	√		√					√	√		√		√	√		√				√	√	√		√	√	√				√	√		√			√		√		√				√
Common redpoll							√			√			√						√			√				√			√				√	√		√									
Common grackle		√																																												
Connecticut warbler		√			√		√						√									√		√		√			√				√						√						
Dark-eyed junco							√							√																										√	√					
Downy woodpecker																													√																
Unknown duck		√						√																																						
Evening grosbeak													√									√				√																				
Gray catbird							√			√																								√											

Species	SM06			SM07		SM09			SM10					SM11	SM13						SM14		SM15				SM16			SM18				SM19						SM21			SM23			SM24
	1	2	6	1	2	1	2	6	1	3	4	5	6	6	1	2	3	5	6	6			1	2	3	6	1	2	3	1	2	3	6	1	2	3	4	5	6	1	2	6	1	2	3	6	1
Gray jay																√			√	√																		√			√						
Great gray owl																	√										√																				
Hairy woodpecker							√										√																							√							
Harris's sparrow								√				√						√																													
Hermit thrush			√		√			√		√	√	√		√			√	√	√				√		√		√			√		√		√		√		√		√	√						
Hoary redpoll																														√																	
Le Conte's sparrow		√											√																						√	√										
Lesser yellowlegs		√			√		√						√										√	√			√			√				√											
Lincoln’s sparrow		√			√																																									
Mallard		√						√		√																										√										
Nashville warbler																								√																						
Northern flicker																														√									√			√				
Olive-sided flycatcher								√			√									√					√																			√		
Orange-crowned warbler																																													√		
Ovenbird					√					√		√					√							√				√				√				√	√			√	√					
Pied-billed grebe												√																						√												
Pileated woodpecker					√						√					√							√				√																			
Pine grosbeak						√																												√												
Red crossbill																																							√							
Red-breasted nuthatch		√																																												
Red-winged blackbird		√																																												
Ring-billed gull		√	√									√															√							√											
Ring-necked duck																																										√				
Rose-breasted grosbeak														√				√																√												
Ruby-crowned kinglet		√			√		√			√	√					√	√						√	√			√	√		√	√			√	√				√						
Ruffed grouse										√																				√	√														
Sandhill crane		√			√		√				√	√		√		√			√				√	√			√	√		√	√	√		√		√		√		√			√	√		

Species	SM06			SM07		SM09			SM10					SM11	SM13						SM14		SM15				SM16			SM18				SM19						SM21			SM23				SM24
	1	2	6	1	2	1	2	6	1	3	4	5	6	6	1	2	3	5	6	6	1	2	3	6	1	2	3	1	2	3	6	1	2	3	4	5	6	1	2	6	1	2	3	6	1
Short-eared owl											√												√																								
Sora																											√																				
Spruce grouse																√									√																√				√				
Swainson's thrush																√							√																								
Swamp sparrow		√					√	√		√																							√		√												
Tennessee warbler												√						√																														
Unknown bird		√	√		√	√	√	√	√	√	√	√	√	√	√		√	√	√	√		√	√	√	√	√	√	√		√	√	√	√		√		√	√	√	√	√	√	√		√
White-crowned sparrow										√												√				√			√				√						√							
White-throated sparrow		√								√	√		√	√					√					√											√		√			√				√		
White-winged crossbill						√																										√														
Wilson's snipe		√	√		√		√	√	√	√	√	√		√		√	√	√				√	√	√	√		√	√	√	√		√		√		√		√	√		√	√			√
Winter wren										√	√													√																						
Unknown woodpecker					√			√			√		√		√	√	√						√	√		√		√		√	√	√		√	√					√	√					
Yellow warbler																									√					√				√												
Yellow-bellied sapsucker																												√											√							
Yellow-rumped warbler																																													√		

Table D-5: ARU Amphibian Species Heard March 21-October 12, 2016

Species	ARU: Site Where Species Heard At Least Once																								
	SM6:			SM9:		SM10:				SM11:	SM13:		SM14:	SM15:			SM16:		SM18:			SM19:		SM21:		SM23:
	P6-1	P6-2	P6-6	P6-2	P6-6	P6-3	P6-4	P6-5	P6-6	P6-6	P6-2	P6-3	P6-6	P6-2	P6-6	P6-2	P6-3	P6-2	P6-6	P6-3	P6-4	P6-6	P6-2	P6-2	P6-3
Boreal chorus frog				√	√	√	√			√				√	√				√			√	√	√	
Eastern American toad						√																			
Spring peeper				√		√	√			√		√		√			√			√			√	√	√
Wood frog	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√	√	√			√		√	√	√

Table D-6: Data Collected During the Manitoba Breeding Bird Atlas Surveys, 2014

Species/Grid Block Observed	Total Observed
Alder Flycatcher	**48**
American Crow	**1**
15UA85	1
American Goldfinch	**1**
15UA76	1
American Robin	**48**
15UA57	3
15UA58	3
15UA67	4
15UA76	9
15UA85	6
15UA86	5
15UA95	2
15UA97	3
15VA07	5
15VA18	8
Bald Eagle	**1**
15VA07	1
Belted Kingfisher	**1**
15UA58	1
Black-backed Woodpecker	**3**
15UA86	1
15UA97	2
Black-capped Chickadee	**1**
15UA58	1
Blackburnian Warbler	**2**
15UA58	1
15UA95	1
Blackpoll Warbler	**2**
15UA86	1
15UA97	1
Blue-headed Vireo	**27**
15UA57	3
15UA58	5
15UA67	3
15UA85	2
15UA86	1
15UA95	6
15UA97	3
15VA07	1
15VA18	3

Species/Grid Block Observed	Total Observed
Bonaparte's Gull	**20**
15UA67	1
15UA85	9
15UA86	7
15VA07	3
Boreal Chickadee	**7**
15UA57	2
15UA58	1
15UA85	1
15UA86	2
15UA95	1
Brown Creeper	**5**
15UA57	1
15UA86	2
15UA95	2
Canada Goose	**5**
15UA58	5
Cedar Waxwing	**10**
15UA85	2
15UA86	2
15UA95	2
15UA97	3
15VA07	1
Chipping Sparrow	**141**
15UA57	11
15UA58	12
15UA67	9
15UA76	16
15UA85	15
15UA86	20
15UA95	16
15UA97	8
15VA07	23
15VA18	11
Clay-colored Sparrow	**1**
15VA18	1
Common Grackle	**3**
15UA67	2
15VA07	1
Common Loon	**34**
15UA57	2
15UA58	2
15UA67	4
15UA76	1

Species/Grid Block Observed	Total Observed
15UA85	4
15UA95	2
15UA97	4
15VA07	9
15VA18	6
Common Nighthawk	**1**
15UA58	1
Common Raven	**13**
15UA85	1
15UA86	4
15UA97	6
15VA07	2
Common Yellowthroat	**3**
15UA67	1
15UA76	1
15VA18	1
Connecticut Warbler	**10**
15UA58	1
15UA67	1
15UA76	1
15UA85	1
15UA95	2
15VA18	4
Dark-eyed Junco	**135**
15UA57	6
15UA58	6
15UA67	8
15UA76	18
15UA85	11
15UA86	20
15UA95	17
15UA97	16
15VA07	19
15VA18	14
Eastern Kingbird	**1**
15UA58	1
Forster's Tern	**3**
15UA97	3
Fox Sparrow	**38**
15UA76	2
15UA85	4
15UA86	8
15UA97	10
15VA07	1

Species/Grid Block Observed	Total Observed
15VA18	13
Gray Jay	**88**
15UA57	8
15UA58	15
15UA67	9
15UA76	8
15UA85	7
15UA86	10
15UA95	7
15UA97	3
15VA07	10
15VA18	11
Great Gray Owl	**2**
15UA97	2
Greater Yellowlegs	**56**
15UA58	1
15UA67	2
15UA76	2
15UA85	3
15UA86	7
15UA95	8
15UA97	10
15VA07	14
15VA18	9
Hairy Woodpecker	**1**
15UA95	1
Hermit Thrush	**146**
15UA57	16
15UA58	14
15UA67	13
15UA76	15
15UA85	7
15UA86	14
15UA95	22
15UA97	18
15VA07	21
15VA18	6
Herring Gull	**3**
15UA97	2
15VA07	1
Le Conte's Sparrow	**1**
15UA67	1
Least Flycatcher	**10**
15UA57	1

Species/Grid Block Observed	Total Observed
15UA67	3
15UA85	1
15UA95	4
15VA07	1
Lincoln's Sparrow	**115**
15UA57	4
15UA58	7
15UA67	12
15UA76	11
15UA85	9
15UA95	20
15UA97	13
15VA07	20
15VA18	19
Magnolia Warbler	**24**
15UA57	2
15UA58	1
15UA67	4
15UA76	3
15UA85	3
15UA86	3
15UA95	3
15UA97	3
15VA18	2
Mallard	**1**
15UA67	1
Nashville Warbler	**11**
15UA58	2
15UA76	2
15UA85	3
15UA86	2
15UA95	1
15VA07	1
Northern Flicker	**8**
15UA58	1
15UA67	1
15UA85	2
15UA86	2
15UA95	1
15UA97	1
Northern Harrier	**1**
15UA85	1
Northern Waterthrush	**10**
15UA57	2

Species/Grid Block Observed	Total Observed
15UA95	1
15VA07	1
15VA18	6
Olive-sided Flycatcher	**27**
15UA67	3
15UA76	5
15UA85	1
15UA95	3
15UA97	2
15VA07	5
15VA18	8
Orange-crowned Warbler	**46**
15UA57	3
15UA58	1
15UA67	1
15UA76	7
15UA85	4
15UA86	14
15UA95	1
15UA97	6
15VA07	7
15VA18	2
Ovenbird	**20**
15UA57	4
15UA58	1
15UA67	7
15UA86	3
15UA95	5
Palm Warbler	**90**
15UA58	3
15UA67	3
15UA76	7
15UA85	10
15UA86	11
15UA95	12
15UA97	14
15VA07	13
15VA18	17
Pied-billed Grebe	**1**
15UA97	1
Pileated Woodpecker	**1**
15UA85	1

Species/Grid Block Observed	Total Observed
Pine Siskin	**2**
15UA57	1
15UA67	1
Purple Finch	**1**
15VA07	1
Red-breasted Nuthatch	**1**
15UA67	1
Red-eyed Vireo	**6**
15UA58	1
15UA95	4
15UA97	1
Red-tailed Hawk	**3**
15UA58	1
15UA97	1
15VA18	1
Red-winged Blackbird	**5**
15UA67	4
15UA95	1
Ruby-crowned Kinglet	**147**
15UA57	10
15UA58	21
15UA67	8
15UA76	19
15UA85	13
15UA86	18
15UA95	10
15UA97	18
15VA07	14
15VA18	16
Rusty Blackbird	**10**
15UA58	1
15UA67	4
15UA85	2
15VA18	3
Sandhill Crane	**11**
15UA58	3
15UA67	2
15UA85	3
15VA18	3
Savannah Sparrow	**2**
15UA67	2
Solitary Sandpiper	**35**
15UA57	2
15UA58	2

Species/Grid Block Observed	Total Observed
15UA67	5
15UA76	1
15UA85	3
15UA86	3
15UA95	3
15VA07	4
15VA18	12
Spruce Grouse	**7**
15UA58	6
15VA18	1
Swainson's Thrush	**29**
15UA57	7
15UA58	2
15UA67	5
15UA76	2
15UA85	1
15UA86	1
15UA95	5
15VA07	1
15VA18	5
Swamp Sparrow	**28**
15UA57	2
15UA58	4
15UA67	4
15UA76	3
15UA85	4
15UA86	1
15UA95	2
15UA97	1
15VA07	1
15VA18	6
Tennessee Warbler	**162**
15UA57	25
15UA58	23
15UA67	21
15UA76	18
15UA85	6
15UA86	24
15UA95	23
15UA97	3
15VA07	6
15VA18	13
White-throated Sparrow	**203**
15UA57	23

Species/Grid Block Observed	Total Observed
15UA58	14
15UA67	11
15UA76	28
15UA85	14
15UA86	29
15UA95	17
15UA97	23
15VA07	26
15VA18	18
White-winged Crossbill	**42**
15UA57	3
15UA58	5
15UA67	2
15UA76	2
15UA86	1
15UA95	2
15UA97	12
15VA07	14
15VA18	1
Wilson's Snipe	**48**
15UA58	6
15UA67	7
15UA85	9
15UA86	3
15UA95	1
15UA97	7
15VA07	2
15VA18	13
Wilson's Warbler	**16**
15UA57	1
15UA58	4
15UA67	1
15UA76	1
15UA85	1
15UA86	1
15UA95	1
15VA18	6
Winter Wren	**11**
15UA57	5
15UA58	1
15UA76	3
15VA07	1
15VA18	1
Yellow Warbler	**1**

Species/Grid Block Observed	Total Observed
15UA97	1
Yellow-bellied Flycatcher	**55**
15UA57	5
15UA58	1
15UA67	2
15UA76	9
15UA85	2
15UA86	16
15UA95	6
15UA97	8
15VA07	5
15VA18	1
Yellow-bellied Sapsucker	**10**
15UA57	1
15UA58	1
15UA67	6
15UA76	1
15UA86	1
Yellow-rumped Warbler	**75**
15UA57	16
15UA58	5
15UA67	9
15UA76	5
15UA85	8
15UA86	12
15UA95	5
15UA97	8
15VA07	2
15VA18	5
Least Sandpiper	**1**
15UA67	1
Grand Total	**2138**

Table D-7: Data Collected During the Aerial Waterfowl Survey of Project 6, June 15-17

Waypoint	Species	Number	Activity	Habitat	Comments
090	Sandhill crane	2	LO	pond	
091	Mallard	3	LO	lake/shore	Brood (1P 1S)
092	Common merganser	1	FL	pond	
093	Canada Goose	2	LO	pond	Brood
094	Swainson's hawk	1	LO	pond	
095	Mallard	1	FL	pond	
096	Ring necked duck	3	SW	bog/marsh	1P 1S
097	Mallard	1	SW	bog/marsh	
098	Unknown diver	1	SW	bog/marsh	
098	Common merganser	1	SW	bog/marsh	
099	Green winged teal	2	FL	bog/marsh	
099	Ring necked duck	1	FL	bog/marsh	
101	Common merganser	1	FL	lake/shore	
101	Ring necked duck	4	FL	lake/shore	
101	Common merganser	1	FL	lake/shore	
102	Wilsons snipe	1	FL	bog/marsh	
103	Mallard	1	FL	bog/marsh	
104	Sandhill crane	1	FL	pond	
105	Mallard	2	FL	lake/shore	1P
106	Mallard	1	FL	lake/shore	
107	Sandhill crane	1	LO	lake/shore	
108	Swan	6	SW	lake/shore	Unknown white; Brood (4 off spring)
109	Common merganser	2	SW	lake/shore	
110	Common merganser	2	SW	lake/shore	
111	Loon	1	NE	lake/shore	
112	Mallard	1	FL	lake/shore	
113	Bald eagle	3	FL	lake/shore	
114	Sandhill crane	2	Lo	pond	1P
115	Scaup	2	SW	pond	1P
115	Sandhill crane	2	LO	pond	1P
116	Sandhill crane	1	LO	pond	
117	Scaup	2	FL	pond	
118	Ring necked duck	1	SW	pond	
119	Bufflehead	5	SW	pond	
120	Mallard	2	FL	lake/shore	
121	Bald eagle	2	FL	lake/shore	
122	Common merganser	1	SW	lake/shore	
123	Loon	1	SW	lake/shore	
124	Sandhill crane	2	LO	pond	
125	Golden eagle	1	FL	lake/shore	
126	Mallard	1	FL	lake/shore	

Waypoint	Species	Number	Activity	Habitat	Comments
127	Ring necked duck	3	SW	lake/shore	
128	Common merganser	1	SW	lake/shore	
129	Mallard	1	FL	pond	
129	Ring necked duck	1	SW	pond	
130	Mallard	6	FL	pond	
130	Ring necked duck	1	SW	pond	
131	Mallard	1	SW	pond	
132	Sandhill crane	1	FL	bog/marsh	
133	Mallard	2	FL	bog/marsh	1P
134	Ring necked duck	1	SW	bog/marsh	
135	Mallard	1	SW	pond	
136	Scaup	3	SW	pond	
137	Common merganser	3	SW	lake/shore	
138	Mallard	5	SW	lake/shore	
138	Blue winged Teal	2	SW	lake/shore	
138	Ring necked duck	5	SW	lake/shore	
138	Canada Goose	1	FL	lake/shore	
138	Common merganser	3	SW	lake/shore	
139	Mallard	4	SW	lake/shore	
140	Ring necked duck	2	FL	lake/shore	
141	Common merganser	11	FL	pond	
141	Mallard	1	FL	pond	
141	Mallard	3	FL	pond	
142	Mallard	1	FL	lake/shore	
143	Common merganser	5	SW	lake/shore	
144	Common merganser	5	SW	lake/shore	
145	Bald eagle	1	FL	lake/shore	
146	Common merganser	2	FL	pond	
147	Mallard	1	FL	pond	
147	Blue winged Teal	3	FL	pond	
148	Mallard	1	FL	pond	
149	Ring necked duck	3	FL	pond	
149	Common merganser	3	FL	pond	
150	Common merganser	5	FL	pond	
151	Ring necked duck	4	FL	bog/marsh	
151	Mallard	1	FL	bog/marsh	
152	Blue winged Teal	2	FL	bog/marsh	1P
153	Ring necked duck	2	FL	bog/marsh	1P
154	Mallard	1	FL	bog/marsh	
154	Mallard	2	FL	bog/marsh	
155	Ring necked duck	4	FL	bog/marsh	
156	Ring necked duck	1P	FL	bog/marsh	1P
157	Mallard	4	FL	pond	

Waypoint	Species	Number	Activity	Habitat	Comments
158	Ring necked duck	8	FL	bog/marsh	
158	Ring necked duck	2	FL	pond	
158	Mallard	1	FL	pond	
158	Blue winged Teal	3	FL	pond	
159	Ring necked duck	2	FL	bog/marsh	
160	Ring necked duck	1	FL	bog/marsh	
161	Ring necked duck	4	FL	bog/marsh	
162	Swan	2	SW	lake/shore	Uknown white
162	Mallard	1	SW	lake/shore	
163	Scaup	1	SW	lake/shore	
164	Ring necked duck	8	SW	lake/shore	
165	Mallard	1	SW	pond	
165	Scaup	1	SW	pond	
166	Ring necked duck	2	SW	pond	1P
167	Sandhill crane	2	LO	pond	
168	Ring necked duck	7	SW	pond	
169	Blue winged Teal	4	SW	bog/marsh	
169	Scaup	2	SW	bog/marsh	
169	Mallard	2	SW	bog/marsh	
169	Mallard	2	FL	lake/shore	
169	Ring necked duck	3	FL	lake/shore	
169	Canada Goose	8	FL	lake/shore	Brood (3 off spring)
170	Sandhill crane	1	FL	pond	
171	Greater yellow legs	2	FL	bog/marsh	1P
172	Mallard	1	FL	lake/shore	
173	Greater yellow legs	1	SW	lake/shore	
174	Sandhill crane	2	FL	lake/shore	
174	Unknown	1	SW	lake/shore	Brood
175	Mallard	3	FL	lake/shore	1P 1S
176	Common merganser	2	FL	pond	1P
177	Common merganser	3	FL	lake/shore	
178	Wigeon	1	SW	pond	
179	Buffelhead	1	FL	lake/shore	
180	Mallard	1	FL	pond	
180	Ring necked duck	3	FL	pond	
180	Mallard	4	FL	pond	
180	Greater yellow legs	1	FL	pond	
181	Blue winged Teal	2	FL	pond	
182	End of survey				Day 1
183	Ring necked duck	5	FL	bog/marsh	
184	Canada Goose	1	FL	pond	
184	Sandhill crane	2	FL	pond	
185	Loon	2	SW	pond	

Waypoint	Species	Number	Activity	Habitat	Comments
186	Mallard	2	FL	lake/shore	
187	Ring necked duck	1	SW	bog/marsh	
188	Sandhill crane	1	FL	bog/marsh	
189	Loon	1	NE	bog/marsh	
190	Sandhill crane	1	LO	pond	
191	Loon	2	SW	lake/shore	
192	Mallard	2	SW	bog/marsh	
192	Scaup	2	SW	bog/marsh	
193	Ring necked duck	8	SW	lake/shore	
194	Loon	3	SW	bog/marsh	
195	Canada Goose	6	SW	bog/marsh	Brood (4 off spring)
196	Mallard	1	SW	pond	
196	Greater yellow legs	1	LO	pond	
197	Mallard	1	SW	pond	
198	Loon	2	SW	lake/shore	
199	Mallard	2	SW	bog/marsh	1P
199	shore bird (unknown)	1	SW	lake/shore	
199	Greater yellow legs	1	LO	lake/shore	
200	Mallard	1	FL	bog/marsh	
200	Ring necked duck	1	FL	bog/marsh	
201	Ring necked duck	2	SW	bog/marsh	1P
202	Sandhill crane	1	LO	bog/marsh	
203	Ring necked duck	15	SW	bog/marsh	
204	Mallard	2	SW	bog/marsh	1P
204	Ring necked duck	3	SW	bog/marsh	
205	Ring necked duck	5	SW	bog/marsh	
206	Ring necked duck	9	SW	bog/marsh	
206	Mallard	2	SW	bog/marsh	1P
207	Common merganser	2	SW	bog/marsh	
208	Ring necked duck	1	SW	lake/shore	
209	Ring necked duck	5	SW	bog/marsh	
209	Mallard	2	SW	bog/marsh	
210	Green winged teal	1	SW	bog/marsh	
211	Northern pintail	6	SW	pond	
212	Common merganser	2	SW	bog/marsh	
212	Ring necked duck	19	SW	bog/marsh	
213	Northern pintail	5	SW	bog/marsh	
213	Ring necked duck	7	SW	bog/marsh	
213	Green winged teal	2	SW	bog/marsh	
214	Common merganser	2	SW	bog/marsh	
215	Mallard	1	FL	pond	
216	Sandhill crane	2	LO	bog/marsh	
217	Ring necked duck	2	SW	bog/marsh	1P

Waypoint	Species	Number	Activity	Habitat	Comments
218	Ring necked duck	6	SW	pond	
219	Swan	1	SW	pond	Unknown white
220	Scaup	2	SW	pond	1P
221	Bald eagle	1	FL	bog/marsh	
222	Ring necked duck	1	FL	bog/marsh	
223	Bald eagle	1	FL	pond	
224	Ring necked duck	2	SW	pond	
225	Canada Goose	7	SW	pond	Brood (6 off spring)
226	Green winged teal	1	SW	pond	
227	Ring necked duck	5	SW	pond	
228	Bald eagle	2	FL	pond	
228	Greater yellow legs	1	FL	pond	
229	Golden eagle	2	FL	pond	
230	Loon	2	SW	bog/marsh	
231	Mallard	3	FL	bog/marsh	
232	Canada Goose	5	SW	bog/marsh	Brood (3 off spring)
233	Sandhill crane	2	LO	pond	
234	Mallard	3	FL	bog/marsh	
235	Ring necked duck	3	SW	pond	
236	Ring necked duck	1	SW	pond	
236	Mallard	2	SW	pond	1P
237	Ring necked duck	1	SW	pond	
238	Mallard	1	SW	pond	
239	Ring necked duck	1	SW	lake/shore	
240	Loon	2	SW	lake/shore	
241	Canada Goose	1	SW	bog/marsh	
242	Canada Goose	2	SW		
243	Ring necked duck	1	SW	bog/marsh	
244	Ring necked duck	5	SW	bog/marsh	
244	Sandhill crane	1	LO	bog/marsh	
245	Ring necked duck	6	FL	bog/marsh	
246	Greater yellow legs	3	LO	bog/marsh	
247	Canada Goose	9	SW	lake/shore	Brood (4 off spring)
248	Ring necked duck	2	SW	pond	
249	Canada Goose	8	SW	pond	Brood (6 off spring)
250	Canada Goose	6	SW	lake/shore	Brood (4 off spring)
251	Mallard	3	FL	lake/shore	
252	Mallard	2	FL	lake/shore	
253	Common merganser	1	SW	pond	
254	Ring necked duck	6	SW	pond	
255	Ring necked duck	5	SW	pond	
256	Ring necked duck	27	SW	pond	
257	Mallard	1	FL	pond	

Waypoint	Species	Number	Activity	Habitat	Comments
258	Sandhill crane	2	LO	pond	
258	Moose	1	Walk	pond	Bull
258	Common merganser	36	SW	pond	
259	Bald eagle	1	FL	lake/shore	
260	Loon	1	SW	pond	
261	Ring necked duck	4	SW	lake/shore	
262	Common merganser	1	SW	lake/shore	
263	Mallard	1	FL	bog/marsh	
264	Mallard	1	FL	bog/marsh	
265	Ring necked duck	3	SW	bog/marsh	
266	Ring necked duck	5	SW	bog/marsh	
267	Ring necked duck	2	SW	lake/shore	
268	Greater yellow legs	4	LO	bog/marsh	
269	Greater yellow legs	1	LO	bog/marsh	
270	Scaup	2	SW	pond	
271	Bald eagle	1	FL	pond	
272	Canada Goose	2	SW	pond	1P
273	Ring necked duck	6	SW	pond	
274	Loon	1	SW	pond	
274	Canada Goose	2	SW	pond	
275	Loon	1	SW	lake/shore	
276	Ring necked duck	6	SW	bog/marsh	
277	Mallard	1	SW	bog/marsh	
278	Ring necked duck	5	SW	bog/marsh	
279	Mallard	1	SW	bog/marsh	
279	Ring necked duck	2	SW	bog/marsh	1P
280	Common merganser	5	SW	lake/shore	
281	Mallard	2	SW	lake/shore	
281	Ring necked duck	5	SW	lake/shore	
282	Mallard	11	SW	lake/shore	Brood (10 off spring)
283	Ring necked duck	4	SW	bog/marsh	2P
284	Mallard	2	SW	bog/marsh	
285	Greater yellow legs	1	SW	bog/marsh	
285	Common merganser	1	SW	bog/marsh	
285	Ring necked duck	4	SW	bog/marsh	2P
285	Mallard	1	SW	bog/marsh	
285	Scaup	2	SW	bog/marsh	
286	Scaup	2	SW	bog/marsh	
287	Mallard	1	SW	lake/shore	
288	Greater yellow legs	2	LO	bog/marsh	
289	Blue winged Teal	3	SW	bog/marsh	
290	Sandhill crane	2	LO	lake/shore	
291	Mallard	4	FL	lake/shore	

Waypoint	Species	Number	Activity	Habitat	Comments
292	Sandhill crane	2	LO	bog/marsh	
292	Greater yellow legs	1	LO	lake/shore	
293	Ring-necked duck	4	FL	bog/marsh	2P
293	Sandhill crane	2	FL	bog/marsh	1P
294	Canada Goose	2	FL	pond	1P
295	Mallard	2	FL	pond	
295	Common merganser	6	FL	lake/shore	
296	Common merganser	26	FL	lake/shore	
297	Bald eagle	6	FL	lake/shore	
298	Sandhill crane	2	FL	pond	
299	Ring necked duck	10	FL	bog/marsh	
300	Mallard	2	FL	lake/shore	1P
301	Bald eagle	1	FL	lake/shore	
302	Bald eagle	2	FL	lake/shore	
303	Common merganser	3	FL	lake/shore	
304	Ring necked duck	2	FL	lake/shore	
305	Loon	1	SW	lake/shore	
306	Bald eagle	1	FL	lake/shore	
307	Loon	1	SW	lake/shore	
308	Loon	5	SW	lake/shore	
309	Ring necked duck	2	SW	lake/shore	1P
310	Common merganser	2	SW	lake/shore	
311	Ring necked duck	6	SW	lake/shore	
312	Greater yellow legs	1	LO	lake/shore	
312	Bald eagle	1	FL	lake/shore	
313	Greater yellow legs	1	LO	lake/shore	
314	Canada Goose	2	SW	pond	1P
315	Ring necked duck	3	SW	pond	
315	Canada Goose	2	SW	pond	1P

Note: Habitat designators - 2=marsh/bog; 4= pond; 7=lake / lakeshore; FL=Flying, LO=Loafing, ST=Stand (Loafing), SW=Swimming; WA=Walk; P=Pair

Table D-8: Data Collected During the Aerial Waterfowl Survey of Project 6, July 16, 2016

Waypoint	Species	Number	Activity	Habitat	Comments
54	Unknown duck	5	SW		1A 4J old brood
55	Sandhill cranes	2	FL		
56	Canada geese	5	SW		1pair 3J
57	Canada geese	12	SW		1Pair 10J
58	Diving ducks	4	SW		1A 3J
59	Canada geese	10	SW		1pair 8j
60	Diving ducks	3	SW		1A 2J
61	Ring-necked duck	7	SW		1A 6J
62	Ring-necked duck	4	SW		
63	Diving Ducks	4	SW		1A 3J
64	Mallard	1	FL		
65	WATER COMMENT				LOW
66	Terns	10			
67	Tundra swans	2	SW		
68	Ring-necked duck	6	SW		1A 5J OLD BROOD
69	Scratch				
70	Common merganser	1	SW		
71	Diving Ducks	6	SW		1A 5J
72	Diving Ducks	4	SW		1A 3J
73	Bald eagle	1			
74	Ring-necked duck	3	SW		
75	Bald eagle	1			
75	Ring-necked duck	7	SW		1A 6J
76	Common merganser	4	SW		
77	Greater yellowlegs	3	FL		
78	Ring-necked duck	30	SW		
79	caribou	1			bull swimming across the lake
80	Scratch				
81	Common Merganser	1	SW		
82	Mallard	3	SW		
83	Bald eagle	1	FL	river	
84	brood	5	SW	river	Brood
85	Sandhill cranes	1	FL		

Waypoint	Species	Number	Activity	Habitat	Comments
86	Bald eagle	1	FL		
87	Tundra swans	2	SW	lake	
88	Bald eagle	1	FL		FL river
89	brood	5	SW	creek	Brood
90	Ring-necked duck	2	SW	creek	
91	brood	5	SW	creek	duck brood
92	Unknown Duck	1	SW	creek	
93	brood	4	SW	creek	duck brood
94	Canada Geese	10	SW	creek	1pair 8j
95	Bald eagle	1	FL		
96	Loon	1	SW	river	
97	Mallard	4	SW	lake	
97	Ring-necked duck	30	SW	lake	
98	Sandhill cranes	1	ST	creek	
99	moose	2			calf cow
100	Mallard	3	SW	lake	
101	Tundra swans	2	SW	lake	
102	Bald eagle	1	FL	lake	
103	Common merganser	1	SW	lake	
104	Scratch				
1	scratch				
2	scratch				
3	scratch				
4	scratch				
5	Loon	1	SW		
6	Mallard	4			1A 3J
7	Unknown diver	1	SW		
8	Mallard	2			
8	Unknown diver	1	SW		
9	Mallard	3			
9	Unknown diver	4			1A 3J
10	Ring-necked duck	3			
11	Unknown diver	1	FL		
12	Bald eagle	1			
13	Canada geese	8	SW		1pair 6J

Waypoint	Species	Number	Activity	Habitat	Comments
14	Ring-necked duck	3	FL		
14	Sandhill crane	2	FL		
14	Loon	2	SW		
15	Loon	2	SW		
16	Ring-necked duck	1	SW		
16	Green-winged teal	4	FL		
17	Ring-necked duck	8	FL		
18	Loon	2	SW		
19	moose	1	ST		cow
20	Unknown diver	8	SW		
20	Unknown duck	5	SW		brood
21	Unknown duck	3	SW		brood
22	Unknown dabblers	6	FL		
23	Loon	1	SW		
24	scratch				
25	Loon	1	SW		
26	Loon	1	SW		
27	Loon	3	SW		
28	Bald eagle	1	FL		
29	Mallard	6	SW		1A 5J
30	Bald eagle	1	FL		
31	Ring-necked duck	6	SW		1A 5J
32	Loon	1	SW		
33	Tundra swan	2	SW		
34	scratch				
35	Unknown duck	5	SW		brood
36	Unknown duck	4	SW		

Note: Habitat designators - 2=marsh/bog; 4= pond; 7=lake / lakeshore; Scratch = point marked in error; FL=Flying, LO=Loafing, ST=Stand (Loafing), SW=Swimming; WA=Walk; A=Adult; J=Juvenile

Table D-9: Data Collected During the Aerial Waterfowl Survey of Project 6, October 12-14, 2016

Waypoint	Species	Number	Habitat
16	bufflehead/goldeneye	30	marsh/pond
17	bufflehead/goldeneye	350	lake
25	bufflehead/goldeneye	30-40	marsh/pond
26	bufflehead/goldeneye	10	marsh/pond
27	bufflehead/goldeneye	10	lake
28	bufflehead/goldeneye	30	lake
29	bufflehead/goldeneye	10	lake
31	bufflehead/goldeneye	30-40	lake
32	bufflehead/goldeneye	30	lake
34	bufflehead/goldeneye	70-100	lake
36	bufflehead/goldeneye	40-50	lake
42	bufflehead/goldeneye/scoters	20	lake
43	bufflehead/goldeneye	40	lake
44	bufflehead/goldeneye	400-500	lake
45	scoters	130	lake
46	bufflehead/goldeneye	130	lake
49	scoters	120	lake
51	scoters	40	lake
53	bufflehead/goldeneye/ scoters	230-250	lake
54	bufflehead/goldeneye	160-170	lake
55	bufflehead/goldeneye	130	lake
59	bufflehead/goldeneye	20	lake
62	bufflehead/goldeneye	15	lake
66	bufflehead/goldeneye	30	lake

APPENDIX E: PHOTOGRAPHS



Photo 1: Trail camera deployed within the P6 RAA



Photo 2: Woodland caribou herd captured on a trail camera in the P6 RAA



Photo 3: Single moose captured on a trail camera in the P6 RAA



Photo 4: A very large black bear (with brown features) captured on a trail camera in the P6 RAA



Photo 5: Family of black bears captured on a trail camera in the P6 RAA



Photo 6: Single wolverine captured on a trail camera in the P6 RAA



Photo 7: ARU deployed within the P6 RAA



Photo 8: Joro staff installing an ARU within the P6 RAA



Photo 9: Trapper collecting his harvest along the RTL in the Oxford House area



Photo 10: Trapper setting his line under the ice for beaver along the RTL in the Oxford House area

APPENDIX F: TRAPPER PROGRAM RESULTS

DN: Table to be reviewed/updated by Joro

RTL #	Section	Date	Lat	Long	Waypoint	Trap	Trap type	Sample number	Temp	Snow Depth	Snowing	Raining	Cloudy	Sunny	Species	Sex	Hair/scat
2	God's Lake		54.50677300	-95.16137000	003	2	120	1	-27	n/a	no	no	no	yes	marten	male	Hair
2	God's Lake		54.50840500	-95.16173200	4	3	120	12	0	n/a	no	no	yes	yes	marten	male	Hair
2	God's Lake	Jan 28,2017	54.51199200	-95.17669800	5	4	330	22	-20	n/a	no	no	yes	no	marten	male	Hair
2	God's Lake	Jan 26,2017	54.51353900	-95.18041000	6	5	120	20	-10	n/a	no	no	no	yes	marten	female	Hair
2	God's Lake		54.51023700	-95.19402500	10	9	120	19	0	n/a	no	yes	yes	no	marten	male	Hair
2	God's Lake		54.50267000	-95.20914900	13	12		2	-27	n/a	no	no	yes	yes	marten	female	Hair
2	God's Lake		54.49631100	-95.22175000	20	19		3	-19	1"	yes	no	yes	no	marten	male	Hair
2	God's Lake		54.48111100	-95.22281700	25	24	120	9	-26		no	no	no	yes	marten	n/a	Hair
2	God's Lake		54.48111100	-95.22281700	25	24	120	10	-26		no	no	no	yes	marten	n/a	Scat
2	God's Lake	Feb 19,2017	54.48111100	-95.22281700	25	24	120	25	-8		no	no	yes	no	marten	female	Hair
2	God's Lake	Jan 20 2017	54.47400800	-95.29252000	39	37	120	13	-3		no	no	yes	no	marten	male	Hair
2	God's Lake	Jan 20 2017	54.47400800	-95.29252000	39	37	120	14	-3		no	no	yes	no	marten	male	Hair
2	God's Lake		54.46927100	-95.34592400	48	46		5	-31		no	no	no	yes	marten	male	Hair
2	God's Lake		54.46911200	-95.35008100	49	47	120	15	-3		no	no	yes	yes	marten	male	Hair
2	God's Lake		54.46487500	-95.34904600	50	48	120	6	-31		no	no	yes	no	marten	male	Hair
2	God's Lake	Feb 19,2017	54.46691900	-95.36305100	52	50	120	26	-8		no	no	yes	no	marten	male	Hair
2	God's Lake		54.46678800	-95.36830900	54	52	120	7	-31		no	no	yes	no	marten	male	Hair
2	God's Lake	Jan 20,2017	54.46678800	-95.36830900	54	52	120	16	-3		no	no	yes	no	marten	male	Hair
2	God's Lake		54.45895400	-95.33681400	057	55	120	8	-31		NO	no	no	yes	marten	female	Hair
2	God's Lake	Jan 22,2017	54.45895400	-95.33681400	57	55	120	18	0		no	yes	yes	no	marten	male	Hair
2	God's Lake		54.45895400	-95.33681400	57	55	120	27	-8		no	no	yes	no	fisher	female	Hair
2	God's Lake		54.45551000	-95.33112700	58	56	120	11	-7	1''	no	no	no	yes	marten	female	Hair
2	God's Lake	Jan 20,2017	54.50870700	-95.23987100	66	60	120	17	-3		no	no	yes	no	fisher	female	Hair
2	God's Lake	Feb 6,2017	54.50870700	-95.23987100	66	60	120	23	-34		no	no	no	yes	marten	female	Hair
2	God's Lake	Feb 12,2017	54.50870700	-95.23987100	66	60	120	24	-15		no	no	yes	yes	marten	female	Hair

RTL #	Section	Date	Lat	Long	Waypoint	Trap	Trap type	Sample number	Temp	Snow Depth	Snowing	Raining	Cloudy	Sunny	Species	Sex	Hair/scat
2	God's Lake		54.50926500	-95.23756000	67	61		4	-19	1"	yes	no	yes	no	marten	male	hair
2	God's Lake	Jan 26,2017	54.30239000	-95.12474000	72	64	120	21	-10		no	no	no	yes	marten	female	Hair
54	Oxford House	Feb 1,2017	54.82159000	-95.23281300	003	trap									marten	male	Hair
54	Oxford House	Jan 7,2017	54.78958200	-95.23101200	005	trap									marten	male	Hair
54	Oxford House	Jan 21,2017	54.78958200	-95.23101200	5	trap									marten	male	Hair
54	Oxford House	Jan 2,2017	54.75826200	-95.23786700	011	trap									otter	male	Hair
54	Oxford House	Dec 31,2016	54.75826200	-95.23786700	11	trap									marten	female	Hair
54	Oxford House	Dec 31,2016	54.75826200	-95.23786700	11	trap									otter	female	Hair
54	Oxford House	Jan 16,2017	54.76426900	-95.29483400	016	trap									otter	male	Hair
54	Oxford House	Jan 3,2017	54.76480700	-95.29522000	017	trap									otter	female	Hair
54	Oxford House	Feb 17,2017	54.76325200	-95.27864900	018	trap									marten	male	Hair
54	Oxford House	Jan 2,2017	54.75767700	-95.19408200	019	trap									beaver	n/a	Hair
54	Oxford House	Feb 17,2017	54.75769100	-95.19416300	020	trap									beaver	n/a	Hair
54	Oxford House	Feb 1,2017	54.75769100	-95.19416300	20	trap									beaver	n/a	Hair
54	Oxford House	Jan 21,2017	54.71152200	-95.20735900	021	trap									marten	male	Hair
54	Oxford House	Jan 25,2017	54.71152200	-95.20735900	21	trap									marten	male	Hair
54	Oxford House	Feb 17,2017	54.70131100	-95.20409600	024	trap									otter	female	Hair
54	Oxford House	Feb 7,2017	54.70131100	-95.20409600	24	trap									otter	male	Hair
54	Oxford House	Feb 17,2017	54.70018800	-95.20832500	026	trap									marten	male	Hair
54	Oxford House	Jan 11,2017	54.70018800	-95.20832500	26	trap									otter	male	Hair
54	Oxford House	Jan 21,2017	54.69189400	-95.21967800	029	trap									marten	male	Hair
54	Oxford House	Feb 17,2017	54.68498700	-95.22608200	031	trap									marten	male	Hair
54	Oxford House	Jan 21,2017	54.68498700	-95.22608200	31	trap									marten	male	Hair
54	Oxford House	Jan 25,2017	54.67765400	-95.22747900	032	trap									marten	male	Hair
54	Oxford House	Jan 16,2017	54.67608100	-95.21280400	035	trap									marten	male	Hair
54	Oxford House	Dec 31,2016	54.80524200	-95.25970100	036	trap									marten	female	Hair
54	Oxford House	Jan 25,2017	54.80524200	-95.25970100	36	trap									marten	male	Hair
54	Oxford House	Dec 28,2016	54.81663000	-95.28891200	037	trap									otter	male	Hair
54	Oxford House	Feb 17,2017	54.67638200	-95.30523200	078	trap									mink	female	hair

RTL #	Section	Date	Lat	Long	Waypoint	Trap	Trap type	Sample number	Temp	Snow Depth	Snowing	Raining	Cloudy	Sunny	Species	Sex	Hair/scat
54	Oxford House	Feb 17,2017	54.72948900	-95.20890400	080	trap									beaver	n/a	Hair
54	Oxford House	Feb 17,2017	54.72948900	-95.20890400	80	trap									beaver	n/a	Hair
54	Oxford House	Feb 1,2017	54.67377800	-95.28020900	047	trap									marten	female	Hair
54	Oxford House	Jan 16,2017	54.66870800	-95.27397600	050	trap									marten	male	Hair
54	Oxford House	Feb 17,2017	54.76668800	-95.22617900	051	trap									marten	male	Hair
54	Oxford House	Jan 25,2017	54.76668800	-95.22617900	51	trap									Skunk	N/a	Hair
54	Oxford House	Jan 21,2017	54.76668800	-95.22617900	51	trap									marten	male	Hair
54	Oxford House	Jan 21,2017	54.73706300	-95.20377700	052	trap									marten	male	Hair
54	Oxford House	Jan 21,2017	54.68143000	-95.29182500	053	trap									marten	female	Hair
54	Oxford House	Feb 17,2017	54.67563800	-95.31308000	055	trap									muskrat	female	Hair
54	Oxford House	Jan 25,2017	54.67563800	-95.31308000	55	trap									otter	male	Hair
64	Oxford House	Feb 4,2017	54.71003600	-95.75263500	251	trap									marten	n/a	Hair
64	Oxford House	Feb 4,2017	54.68386000	-95.84599600	253	trap									otter	n/a	Hair
64	Oxford House	Jan 29,2017	54.75816800	-95.68880200	123	trap									marten	n/a	Hair
64	Oxford House	Jan 06,2017	54.75816500	-95.68880300	124	trap									marten	n/a	Hair
64	Oxford House	Jan 11,2017	54.77905700	-95.78123900	165	trap									marten	n/a	Hair
64	Oxford House	Jan 20,2017	54.76570000	-95.71509700	200	trap									marten	n/a	Hair
64	Oxford House	Jan 19,2017	54.76570000	-95.71509700	200	trap									otter	male	Hair
64	Oxford House	Jan 20,2017	54.70335600	-95.84593500	211	trap									marten	n/a	Hait
64	Oxford House	Jan 20,2017	54.66676000	-95.85442000	213	trap									marten	n/a	Hair
64	Oxford House	Jan 21,2017	54.73940500	-95.65813700	221	trap									marten	n/a	Hair
64	Oxford House	Jan 15,2017	54.78002500	-95.66113200	230	trap									otter	n/a	Hair
64	Oxford House	Jan 28,2017	54.76148100	-95.76964700	235	trap									otter	n/a	Hair
64	Oxford House	Jan 19,2017	54.70642300	-95.77114800	243	trap									otter	n/a	Hair
64	Oxford House	Jan 28,2017	54.70642300	-95.77114800	243	trap									marten	n/a	Hair
64	Oxford House	Dec 29,2017	54.74454400	-95.80129000	019	trap	snare	4	-26	10''	no	no	no	yes	Lynx	male	hair/meat
64	Oxford House	Dec 29,2017	54.73249200	-95.82322700	020	trap	120	10	-26	10''	no	no	no	yes	Fisher	male	hair/meat
64	Oxford House	Jan 19,2017	54.71199300	-95.82233500	022	trap									marten	n/a	hair
64	Oxford House	Dec 29,2016	54.71733700	-95.72349100	036	trap	120	16	-26	10''	no	no	no	yes	marten	male	hair/meat

RTL #	Section	Date	Lat	Long	Waypoint	Trap	Trap type	Sample number	Temp	Snow Depth	Snowing	Raining	Cloudy	Sunny	Species	Sex	Hair/scat
64	Oxford House	Dec 29,2017	54.72485400	-95.68611900	041	trap	280	1	-24	10''	yes	no	yes	yes/am	otter	female	Hair
64	Oxford House		54.72485400	-95.68611900	41	trap	280	13	-24	10''	yes	no	yes	yes/am	otter	female	Hair
64	Oxford House	Dec 29,2016	54.72802500	-95.67172700	043	trap	120	43	-26	10''	no	no	no	yes	marten	male	hair/meat
64	Oxford House	Feb 5,2017	54.75023400	-95.76028800	047	trap									marten	n/a	Hair
64	Oxford House	Feb 12,2017	54.75023400	-95.76028800	47	trap									lynx	n/a	Hair
64	Oxford House	Feb 12,2017	54.75023400	-95.76028800	47	trap									otter	n/a	Hair
64	Oxford House	Jan 29,2017	54.76598100	-95.69355100	247	trap									otter	n/a	Hair
64	Oxford House	Dec 30,2016	54.76820100	-95.78233800	049	trap	280	5	-24	10''	yes	no	yes	yes/am	marten	male	Hair
64	Oxford House	Jan 4,2017	54.76820100	-95.78233800	49	trap									mink	n/a	Hair
64	Oxford House	Jan 15,2017	54.78725300	-95.67345900	058	trap									marten	male	Hair
64	Oxford House	Jan 8,2017	54.78725300	-95.67345900	58	trap									marten	n/a	Hair
64	Oxford House	Jan 6,2017	54.77884500	-95.65997300	059	trap									marten	n/a	Hair
54	Oxford House	Feb 12,2017	54.56095000	-95.18545000	255	trap									marten	n/a	Hair
3	God's Lake	Dec 27,2016	54.46047400	-95.01723400	015	trap		1	-23	5''	no	no	yes	no	marten	male	n/a
3	God's Lake	Dec 27,2016	54.49323900	-95.06866900	010	trap		2	-23	5''	no	no	yes	no	marten	male	n/a
3	God's Lake	Dec 30,2016				trap		n/a	-20	5''	no	no	yes	no	marten	male	n/a
3	God's Lake	Jan 15,2017				trap			n/a	8''	yes	no	yes	yes	marten	n/a	n/a
3	God's Lake	Jan 25 ,2017				trap			-12	1''	no	no	no	yes	marten	n/a	n/a
3	God's Lake	Jan 29,2017				trap			-19	1''	no	no	yes	no	marten	n/a	n/a
3	God's Lake	Jan 29,2017				trap			-19	1''	no	no	yes	no	mink	n/a	n/a
3	God's Lake	Jan 29,2017				trap			-19	1''	no	no	yes	no	rabbit	n/a	n/a
3	God's Lake	Feb 05,2017				trap			-24	1''	no	no	yes	yes	marten	n/a	n/a



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: February 23,2018

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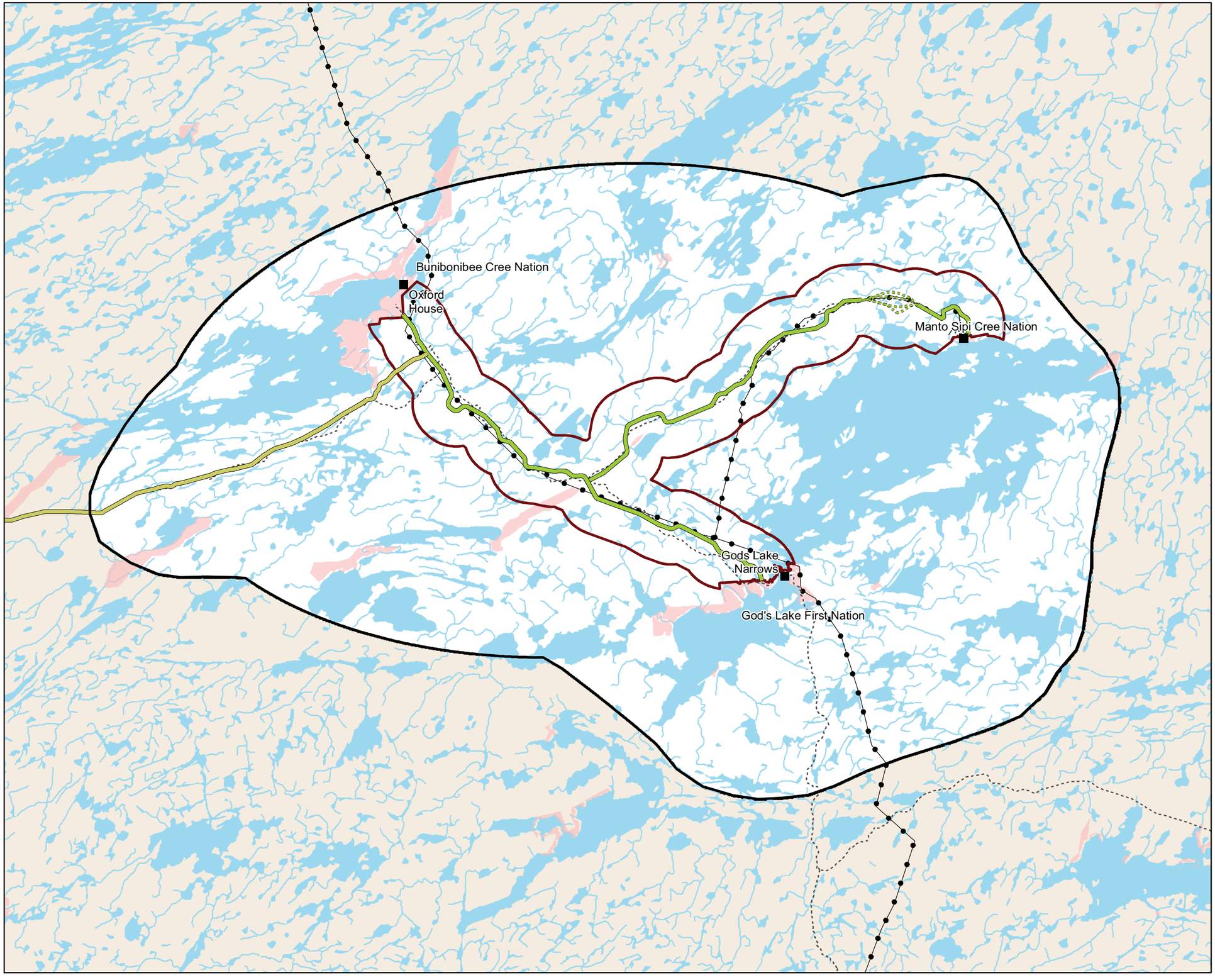
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Large Area Transportation Network

Project 6 Existing Environment Wildlife Report

Map 1



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Project 6 Local Assessment Area
Project 6 Regional Assessment Area

Proposed Road Alignments
- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options

Base Data
- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: March 12,2018

N

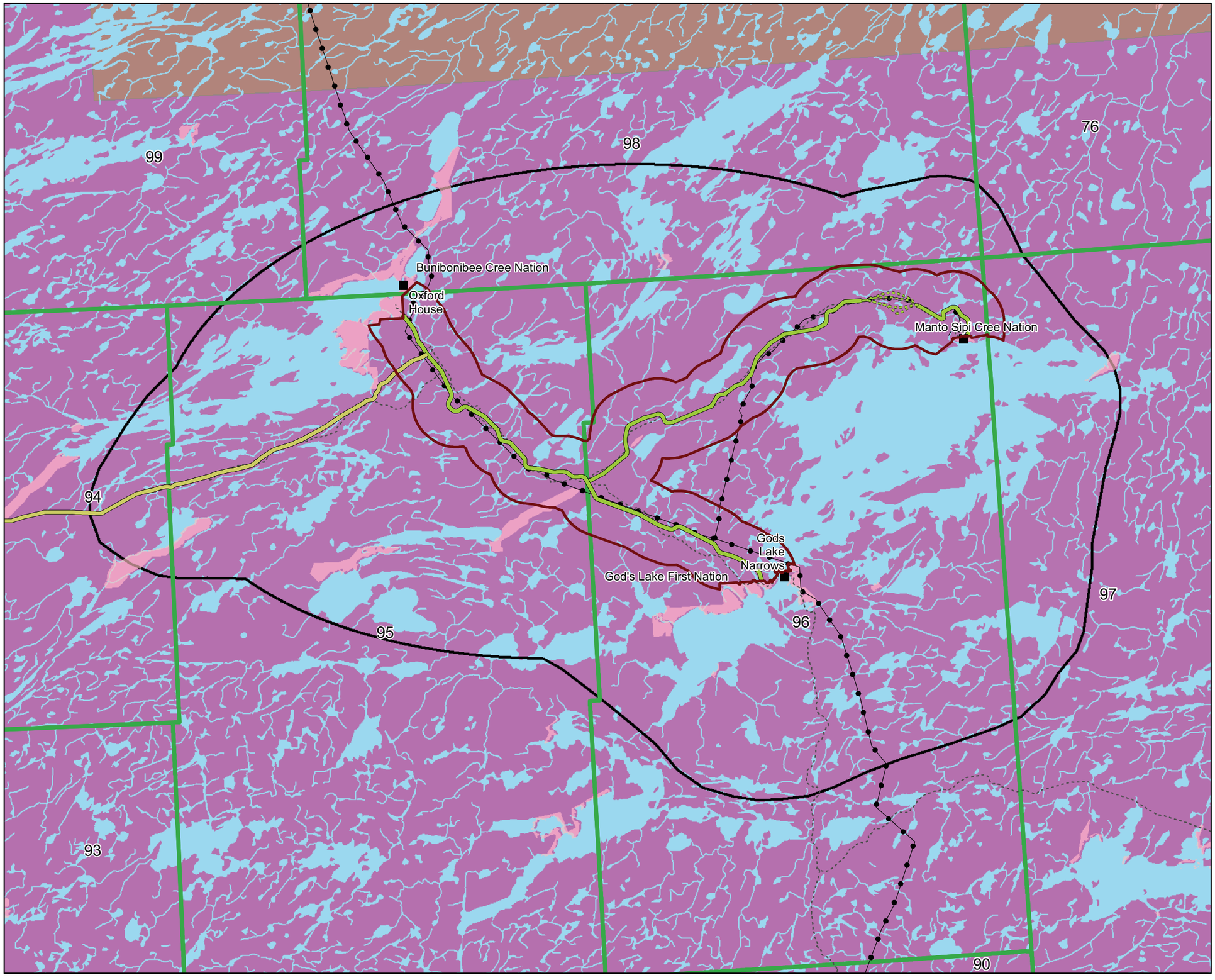
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0 5 10 Miles

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Local and Regional Assessment Areas

Project 6 Existing Environment Wildlife Report

Map 2



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Forest Management Units

Game Hunting Areas
- 3
- 3A

Proposed Road Alignments
- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data
- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: March 15,2018

N

0 10 20 Kilometres
0 5 10 Miles

1:525,000

Game Hunting Areas and Forest Management Units

Project 6 Existing Environment Wildlife Report

Map 3

Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Oxford House
Bunibonibee Cree Nation
Manto Sipi Cree Nation
Gods Lake Narrows
God's Lake First Nation

Trail Camera Deployments
- 2016
- 2017

Proposed Road Alignments
- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options

- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data
- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: February 26,2018

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0 10 20 Kilometres
0 5 10 Miles

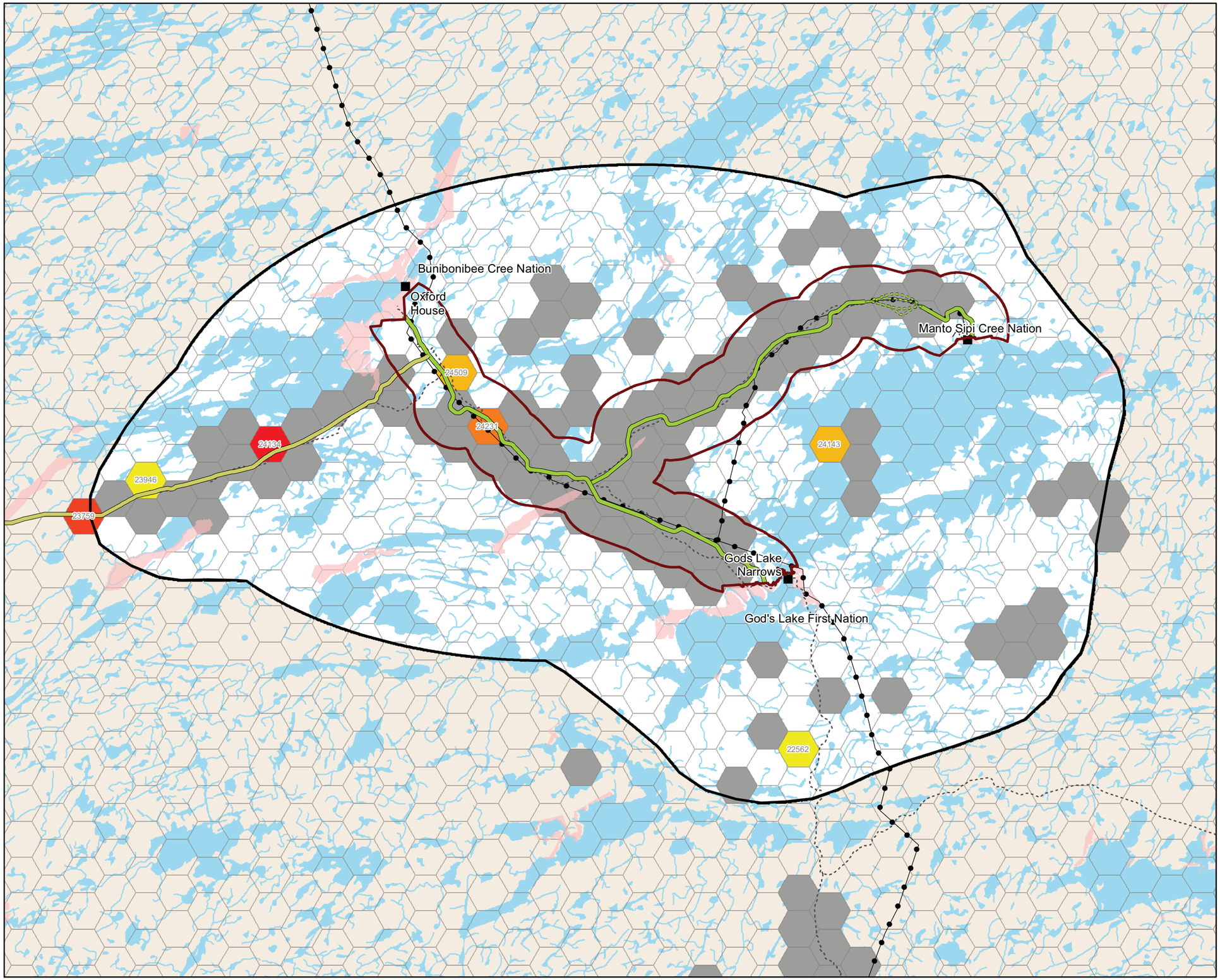
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Trail Camera Deployment Locations 2016 - 2017

Project 6 Existing Environment Wildlife Report

Map 4

Maps 5 to 7 removed due to sensitive wildlife information



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Number of Camera Trap Events
- 1
- 2
- 3-4
- 5
- 6-12
- No Camera Trap Events

Proposed Road Alignments
- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data
- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: February 26,2018

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0 5 10 Miles

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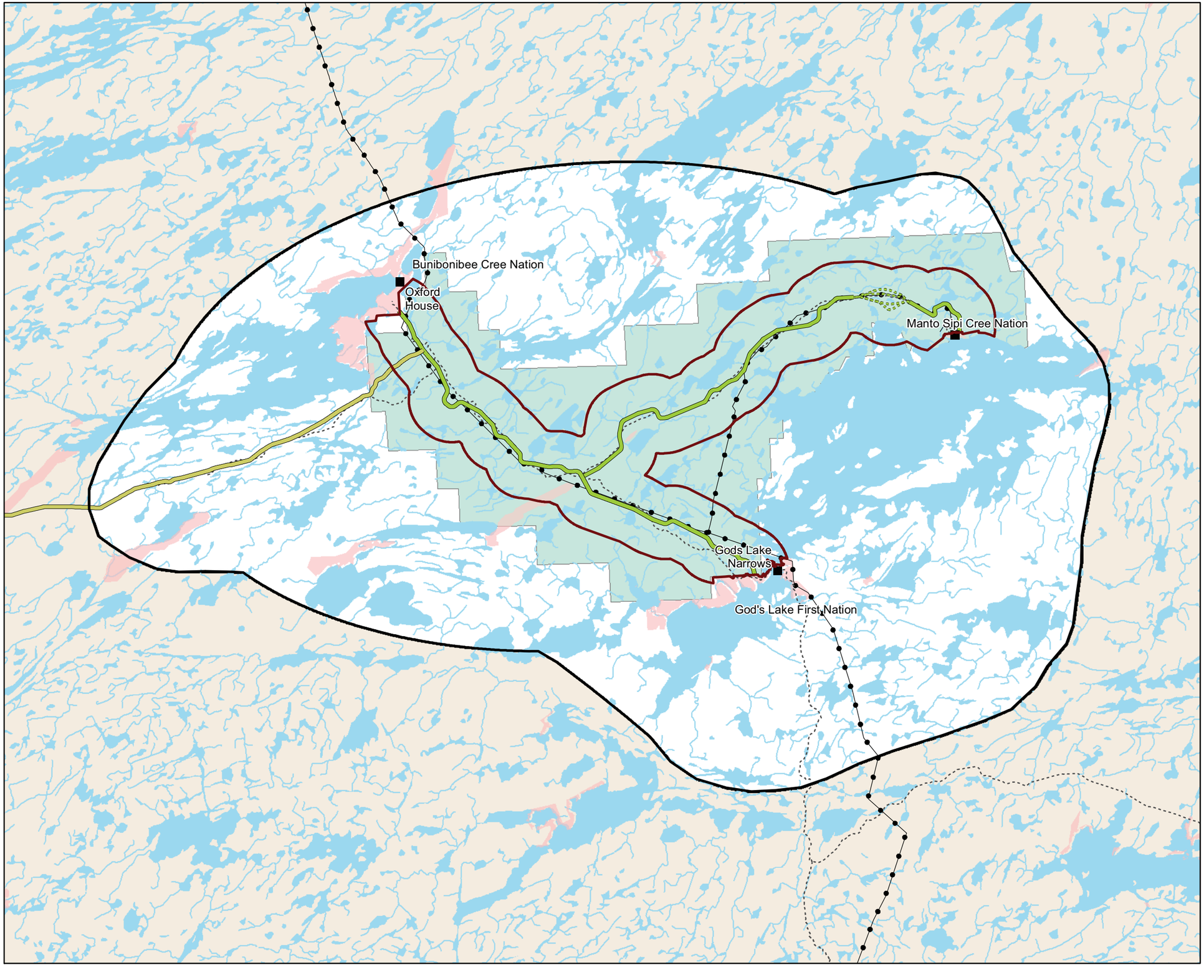
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Black Bear Camera Occurrences March 1, 2016 to March 31, 2017 - All Seasons

Project 6 Existing Environment Wildlife Report

Map 8

Maps 9 to 14 removed due to sensitive wildlife information



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

2016 - 2017 Moose Survey Area

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: March 12,2018

N

0 10 20 Kilometres
0 5 10 Miles

1:525,000

2016 and 2017 Aerial Moose Survey Area

Project 6 Existing Environment Wildlife Report

Map 15

Maps 16 to 17 removed due to sensitive wildlife information

Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Bunibonibee Cree Nation
Oxford House
Manto Sipi Cree Nation
Gods Lake Narrows
God's Lake First Nation

- 2016 ARU Deployment Locations

Proposed Road Alignments
- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data
- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: March 12,2018

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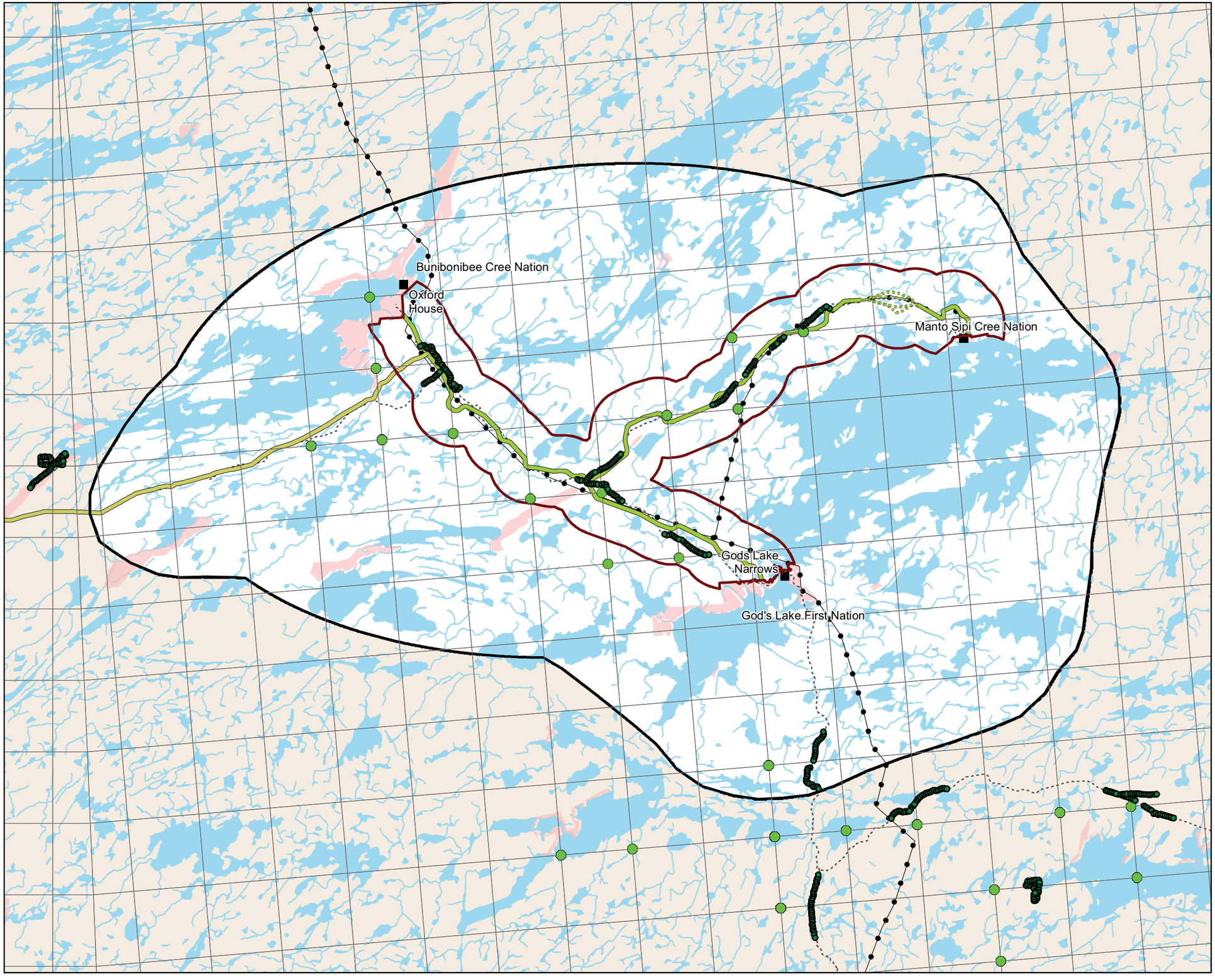
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0 5 10 Miles

1:525,000

Project 6 2016 ARU Deployments

Project 6 Existing Environment Wildlife Report

Map 18



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

- Breeding Bird Atlas Point Count
- Bird Atlas Locations
- Manitoba Bird Atlas Grid

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: March 12,2018

0 10 20 Kilometres
0 5 10 Miles

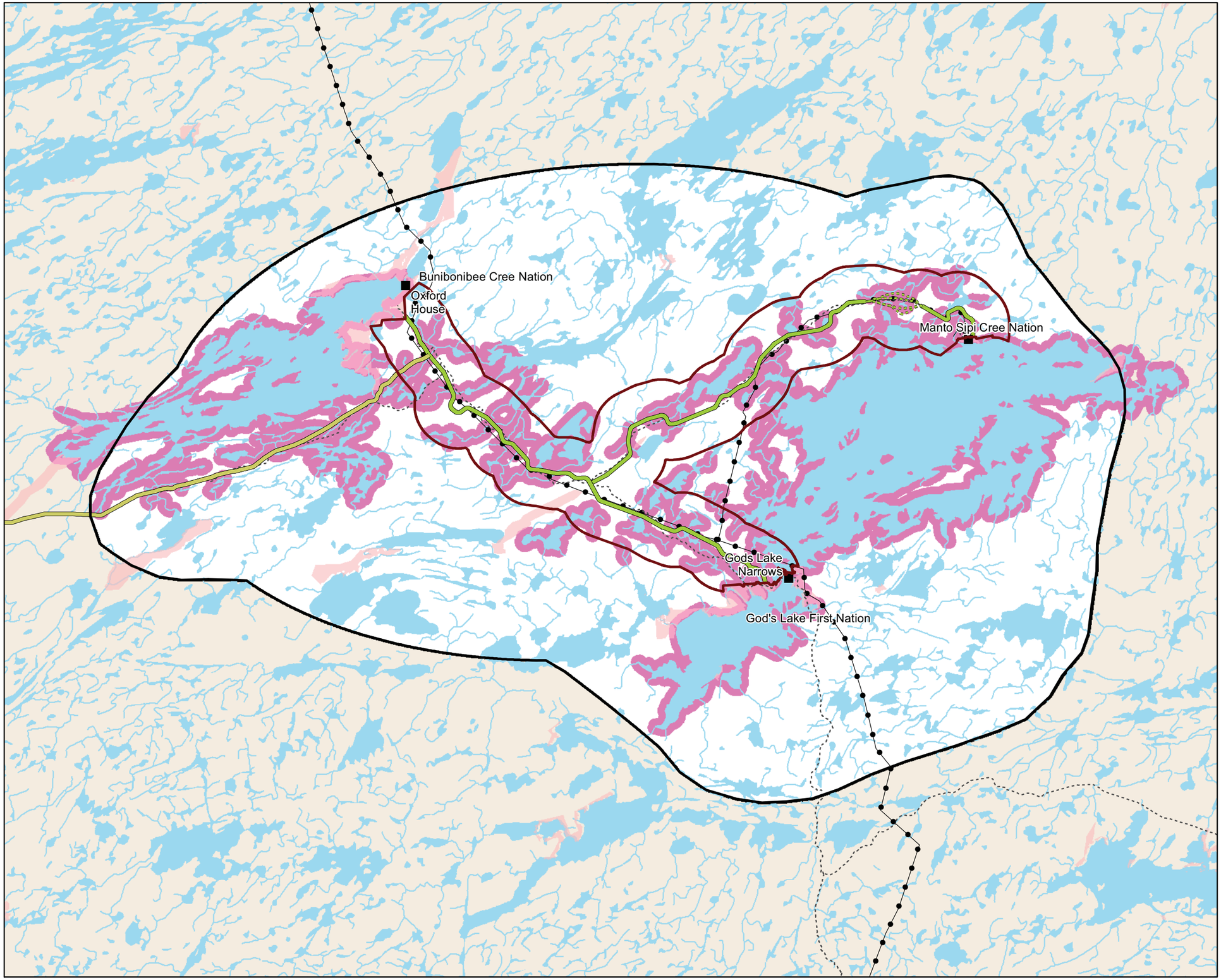
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Breeding Bird Atlas

Project 6 Existing Environment Wildlife Report

Map 19



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

June and July Waterfowl Survey Area

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: May 29,2017

0 10 20 Kilometres
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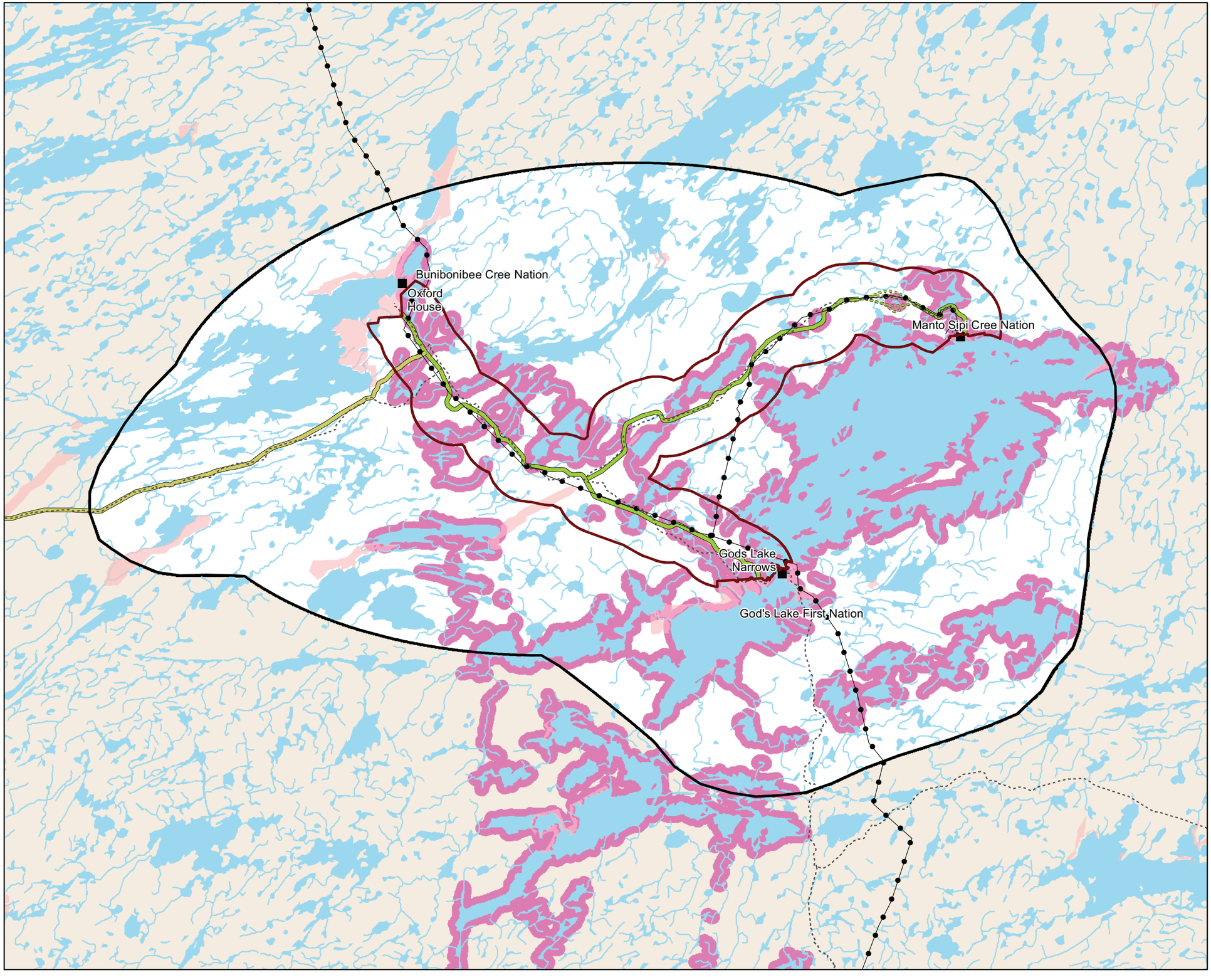
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June and July 2016 Aerial Waterfowl Survey Area

Project 6 Existing Environment Wildlife Report

Map 20



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

October Waterfowl Survey Area

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: May 29,2017

0 10 20 Kilometres
0 5 10 Miles

N

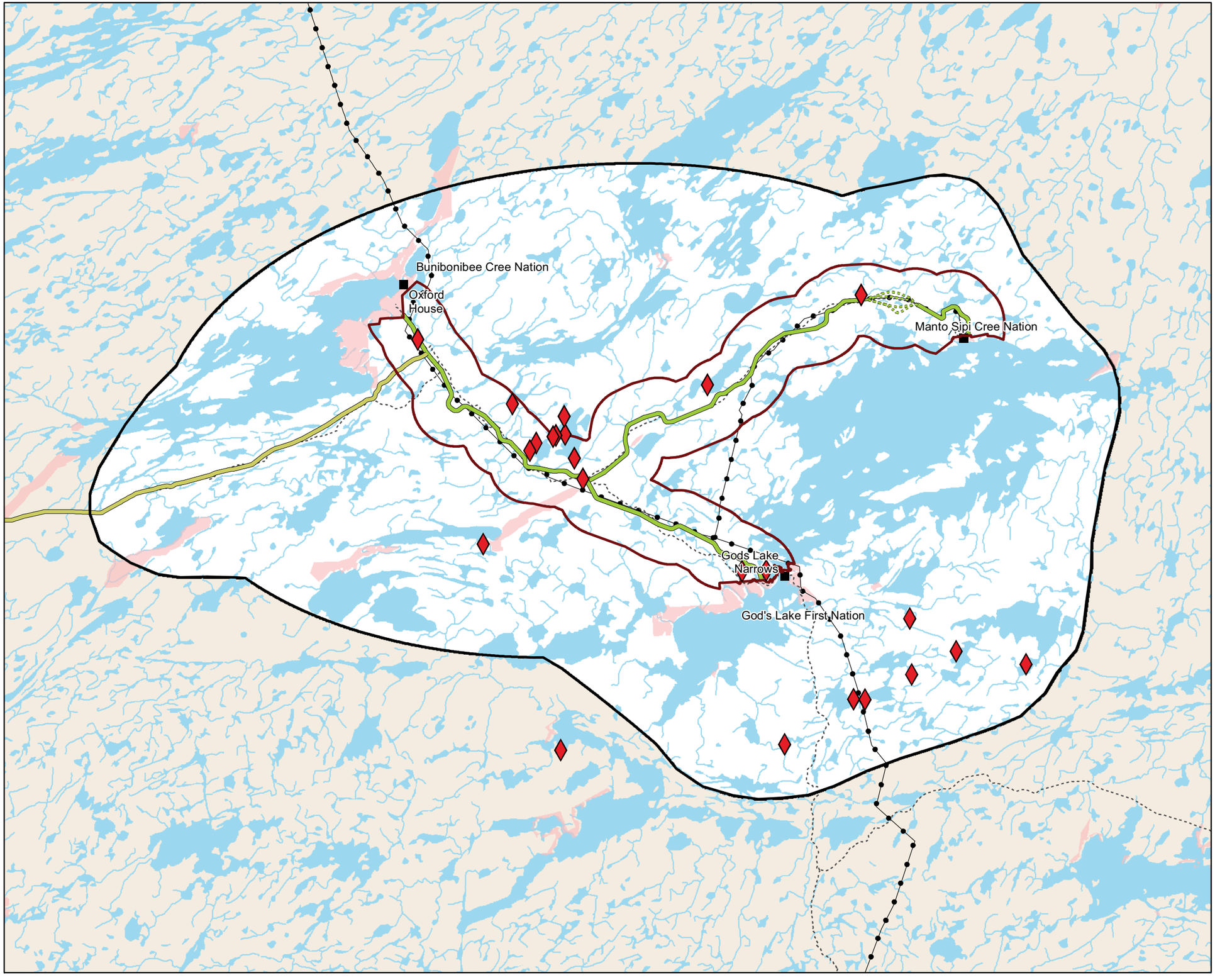
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October 2016 Aerial Waterfowl Survey Area

Project 6 Existing Environment Wildlife Report

Map 21

Maps 22 to 23 removed due to sensitive wildlife information



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Diving Duck Observations

Proposed Road Alignments
- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data
- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: March 12,2018

N

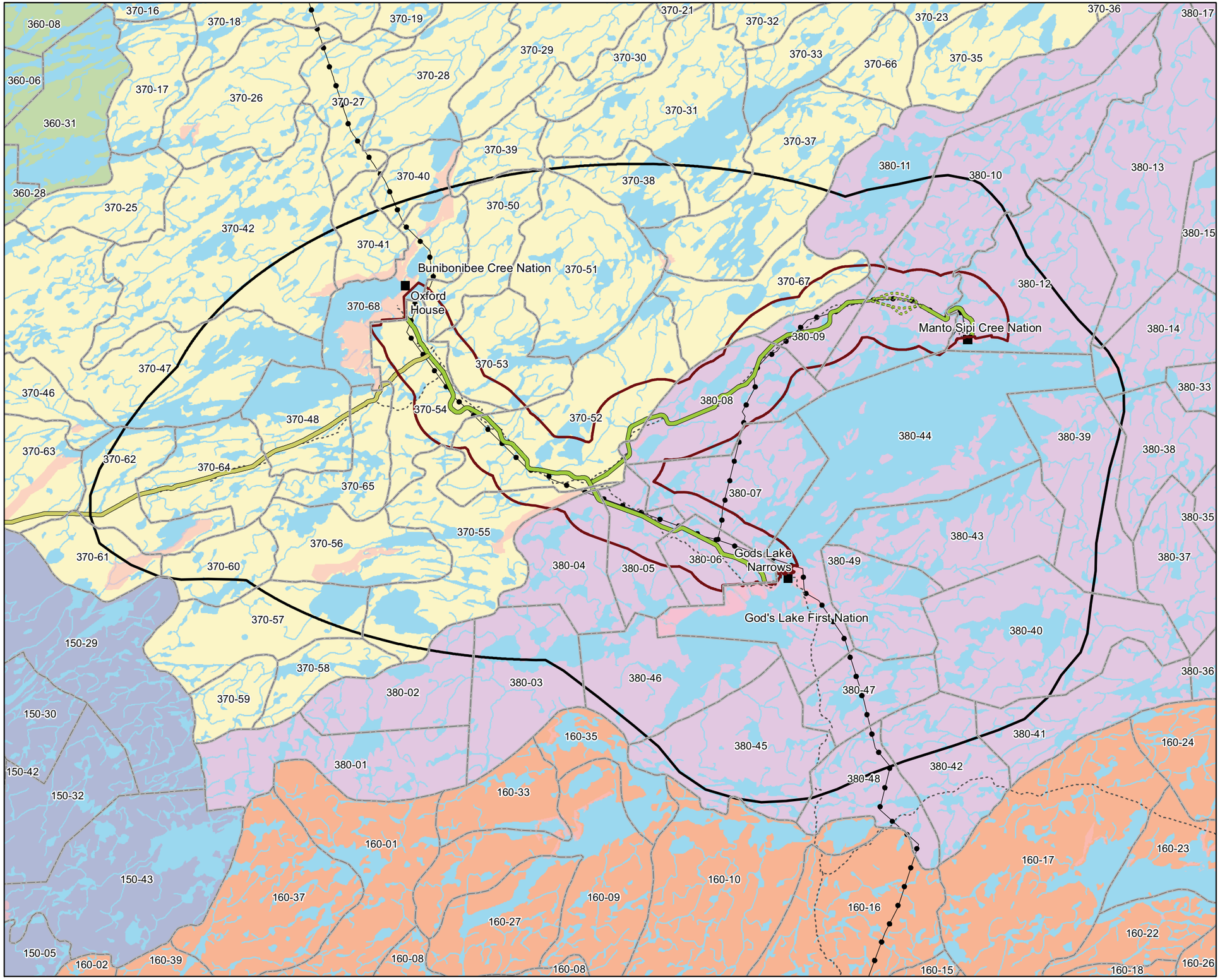
0 10 20 Kilometres
0 5 10 Miles

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October 2016 Aerial Waterfowl Survey - Observations

Project 6 Existing Environment Wildlife Report

Map 24



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Registered Traplines

Registered Trapline Sections
- Cross Lake (360)
- God's Lake (380)
- Island Lake (160)
- Norway House (150)
- Oxford House (370)

Proposed Road Alignments
- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data
- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: March 12,2018

0 10 20 Kilometres
0 5 10 Miles

N

1:525,000

Registered Traplines in the Northern RTL Area 6

Project 6 Existing Environment Wildlife Report

Map 25

Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Bunibonibee Cree Nation

Oxford House

Manto Sipi Cree Nation

Gods Lake Narrows

God's Lake First Nation

- Registered Traplines
- Registered Traplines Sampled

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: March 13,2018

N

0 10 20 Kilometres

0 5 10 Miles

1:525,000

Registered Traplines Sampled

Project 6 Existing Environment Wildlife Report

Map 26

Appendix D-2:

Wildlife Characterization and Effects Assessment of the Proposed All-Season Road Project 6

By Joro Consultants

WILDLIFE CHARACTERIZATION AND EFFECTS ASSESSMENT OF THE PROPOSED ALL-SEASON ROAD PROJECT 6

FINAL REPORT

APRIL 13, 2018

Prepared for:

Manitoba Infrastructure
Remote Road Operations

Prepared by:

Joro Consultants

EXECUTIVE SUMMARY

This report provides the results and analysis of wildlife studies and assessment of effects and potential mitigation measures for the proposed Project 6 (P6 or the Project) All-Season Road (ASR). P6 is a proposed ASR connecting Bunibonibee Cree Nation, Manto Sipi Cree Nation and God's Lake First Nation. P6 will also provide access to the Northern Affairs community of God's Lake Narrows that is connected to God's Lake First Nation via an existing all-season road. Included in this report is a description of baseline wildlife information, rationales for determination of the wildlife species to be considered as valued components (VC) and Species of Conservation Concern (SOCC) for use in the Environmental Impact Statement for Project 6. Reporting includes the evaluation of potential environmental effects, before and after mitigation, identification of feasible mitigation measures and the characterization of residual effects after mitigation.

The RAA is located within the Boreal Shield Ecozone, which is the largest ecozone in Canada. In Manitoba, it extends north from the southeast corner of the province, encompassing the area between Lake Winnipeg and the Ontario border, and proceeds across the northern extent of the Lake as a broad band from the Ontario to Saskatchewan borders (Smith *et al*., 1998). The ecozone is dominated by both lowlands and broadly rolling uplands. The surficial geology is composed of Precambrian granite bedrock outcrops, moraines, glaciofluvial, and colluvial deposits.

The entire RAA lies within the Hayes River Upland (89) Ecoregion, which extends from the Grass River Basin in east-central Manitoba to the Manitoba-Ontario border. The Hayes River that flows northeast and eventually drains into Hudson Bay is the major waterway in the region. Both Knee Lake and Oxford Lake are widened expanses of the Hayes River. The area is characterized by numerous small streams connecting a network of small lakes and wetlands between drumlinoid ridges, most of which haves exposed bedrock. The RAA is intersected by parts of three ecodistricts, Island Lake (364), God's Lake (365), and Knee Lake (360). The God's Lake Ecodistrict accounts for more than 85% of the total area within the RAA.

Baseline data included in this report are results of desktop literature reviews on wildlife and their habitats and specific studies conducted to document distribution and relative abundance of mammals, birds, and herptiles (i.e. reptiles and amphibians) and local and Aboriginal Traditional Knowledge (TK) in the Regional Assessment Area (RAA) related to wildlife. Baseline field data gathered on mammals has been acquired for P6 from a number of specific monitoring techniques and individual studies, including:

- Aerial multispecies winter track surveys, conducted in the winters of 2012 and 2016, aerial scouting flight in the winters of 2011 and 2014, and aerial group count in winter of 2012 to determine distribution of moose (*Alces alces*), caribou (*Rangifer tarandus caribou)*, and furbearers;
- Aerial winter minimum count moose surveys near the P6 alignment conducted in the winter of 2016 and 2017;

- GPS collar data from woodland caribou captured and collared between 2010 and 2016 occupying the Norway House Range (forest-dwelling ecotype), and the Pen Islands caribou (forest-tundra ecotype);
- GPS collar data for Pen Islands caribou (forest-tundra ecotype) from 2010 to 2016 that came near the P6 RAA shared by Manitoba Sustainable Development (MSD); and
- Trail camera studies beginning in 2016 to detect distribution of moose, caribou, predators, and furbearers.

In addition to these specific monitoring activities, a local trapper participation program was undertaken in the fall/winter of 2016/2017 to provide data on furbearer occurrence in the RAA through documentation of track observations and animals harvested on traplines.

Monitoring activities for birds and amphibians included the use of Autonomous Recording Units (ARUs) deployed during the 2016 breeding season to determine their occupancy and diversity. Data from surveys conducted by the Manitoba Breeding Bird Atlas also provided additional information on breeding bird diversity and occupancy within the RAA. Aerial surveys were conducted during the spring and fall of 2016 in proximity to waterbodies near the P6 alignment to detect potential seasonal staging areas for waterfowl. Raptor stick nests (mainly eagles) were documented during these surveys, as well as during other winter aerial surveys as “incidental wildlife observations”.

The wildlife monitoring program also included the documentation of local and traditional wildlife knowledge pertaining to mammals, birds, and herptiles learned through community wildlife workshops and interviews. The results of workshops and interviews conducted in 2015 and 2016 in the three First Nation communities (Bunibonibee Cree Nation, Manto Sipi Cree Nation, and God’s Lake First Nation) provided supplemental information verifying species presence and the identification of important habitats for caribou, moose, furbearers, birds, and amphibians. Local community members also participated in many of the wildlife surveys in addition to the trapper program.

Results of the bird monitoring studies revealed the diversity of bird species and their abundance within the RAA. Four bird species of conservation concern (SOCC)[1] were documented in the RAA using wildlife monitoring methods outlined above.

Results of winter aerial surveys illustrated consistency in moose observations between two separate surveys, thereby providing a precise baseline estimate with little associated uncertainty. The caribou telemetry data[2] demonstrated that seasonal occupation and migration of the Pen Islands caribou occurs through the RAA during winter. Local and traditional knowledge, trail camera observations, and GPS collar data verified that a few caribou established year-round residency within the RAA. The eastern extent of the range of the Norway House Boreal woodland caribou population intersects a very small portion of the western extreme of the RAA. Local and traditional knowledge also identified that some

[1] Species of conservation concern include those listed under Species at Risk Act (SARA), Manitoba Endangered Species and Ecosystems Act (MESEA), Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and as S1 (very rare) or S2 (rare) by Manitoba Conservation Data Center (MBCDC).

[2] Telemetry data and locational mapping for species of conservation concern and hunted species is considered sensitive and has been removed from this document, as disclosing the information may cause substantial harm to the species.

species such as raccoons (*Procyon lotor*) and polar bear (*Ursus maritimus*), which are outside of their normal range, occur occasionally in the RAA.

Wildlife valued component (VC) species for the study included wildlife species known or likely to occur in the RAA, which are measurable for project effects over the long term, and identified as important by First Nations, science and/or government regulators. The 14 species selected as wildlife VCs include: caribou (*Forest-tundra and Forest-dwelling)*, moose, beaver (*Castor canadensis*), marten (*Martes americana*), Canada goose (*Branta canadensis*), mallard (*Anas platyrhynchos)*, ring-necked ducks (*Aythya collaris*), bald eagle (Haliaeetus leucocephalus), ruffed grouse (*Bonasa umbellus*), magnolia warbler (*Setophaga magnolia)*, ovenbird (*Seiurus aurocapilla)*, yellow-bellied flycatcher (*Empidonax flaviventris)*, palm warbler (*Setophaga palmarum)*, and northern spring peeper (*Hyla crucifer crucifer)*.

A separate evaluation conducted for Species of Conservation Concern (SOCC), comparable to that of VCs, included a determination of potential effects, and appropriate mitigation if required. Fourteen SOCC may also occur within the RAA. These include 11 birds and 3 mammals (Appendices A-C). Further detail on conservation status listing for species within the RAA are provided in Section 4.3.4.

The potential effects to wildlife VCs and SOCC from construction and operation of Project 6, before and after mitigation, were identified by Joro Consultants Inc. and included:

Ungulates (VCs: caribou and moose):

- Habitat loss / alteration / fragmentation
- Sensory disturbance and displacement including calving areas
- Increased mortality due to vehicle collisions
- Increased mortality due to changes in hunting access
- Increased mortality due to changes in predation
- Introduction of disease from white-tailed deer (i.e., brainworm [*P. tenuis*])

Furbearers (VCs: beaver and marten):

- Habitat loss / alteration from changes in local drainage
- Sensory disturbance
- Increased mortality due to vehicle collision, winter water drainage, and problem wildlife removal

Birds (VCs: Canada goose, mallard**,** ring-necked duck, bald eagle, ruffed grouse, magnolia warbler, ovenbird, yellow-bellied flycatcher, palm warbler):

- Habitat loss / alteration/ fragmentation
- Loss of nests, mortality to young
- Sensory disturbance
- Increased mortality due to project infrastructure and vehicle collisions

Reptiles and Amphibians (northern spring peeper VC):

- Habitat loss/alteration/fragmentation
- Winter mortality from compaction

These effects were evaluated before and after mitigation using criteria (duration, magnitude, extent, frequency, reversibility and ecological and socio-economic context) identified by the Canadian Environmental Assessment Agency (the Agency) guidelines issued for Project 6 and the results of baseline studies, habitat modeling and pertinent literature. Key mitigation measures include the timing of

clearing and construction to avoid key breeding and reproduction periods for VC species and the maintenance of vegetative buffers and water flow patterns. Potential residual effects to wildlife VC and SOCC that may remain after mitigation are also identified and include habitat loss.

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We would like to thank the First Nation communities of God's Lake, Bunibonibee and Manto Sipi for welcoming the Manitoba Infrastructure (MI) Wildlife Program Team into their communities and for participating in the Wildlife Workshops. We appreciated the opportunity to speak with a number of local resource users and the openness for which they shared their knowledge and understanding. In addition, we would like to thank local trapper participants who assisted with collecting baseline furbearer data. Select caribou data was shared by Indigenous and Northern Relations, Resource Management Boards which allowed for a more robust assessment. We are grateful for the Breeding Bird Atlas' participation in baseline data gathering in the Project 6 area. We would also like to acknowledge and appreciate the data contributions of the Boreal Avian Modelling (BAM) Project, its data partners, funding agencies (including Environment Canada and the U.S. Fish & Wildlife Service) and Technical Committee members, listed in full at www.borealbirds.ca/index.php/acknowledgements.

GLOSSARY OF TERMS

Brunisols - Soil formed under forest and is brown in color and may have either clay or aluminum and iron compounds, or both.

Colluvial* – A mass of sediments deposited by colluvial processes, most commonly loose rock debris.

Drumlinoid Ridges - A rock drumlin or drift deposit whose form approaches but does not fully attain that of a classic drumlin, even though it seemingly results from similar processes of moving ice.

Depressional – an area of low ground surrounded by higher ground in all directions, or a sinkhole; the depression may or may not be filled with water.

Ericaceous* – Plants in or related to the heather family (Ericaceae), typically found on acid soils.

Eutric Brunisols – Part of the Brunisolic soils, they lack a well-developed mineral-organic surface horizon and have a high pH.

Fibrisols - Organic soil contains mostly un-decomposed fibric organic material and occurs in peat deposits of Sphagnum mosses.

Glaciofluvial* – Pertaining to the channelized flow of glacier meltwater and deposits and landforms formed by meltwater streams.

Glaciolacustrine* – Pertaining to glacial lakes.

Gleysols – Soil developed under wet conditions and periods of reduction, which may have 40 cm of mixed peat or 60 cm of fibric moss peat on the surface and occurs under a range of climatic conditions.

Kettled fluvioglacial deposits* – Shallow, sediment-filled bodies of water formed by retreating glaciers.

Luvisol - Well to imperfectly drained soil in sandy to loamy sites with a layer of silicate clay and are the base saturated parent material under forest vegetation.

Mesisol – Organic soil found in peatlands at an intermediate stage of decomposition.

Moraines* – A landform that consists of un-stratified glacial drift that is usually till or, less commonly, of other drift.

Organic Cryosols – Developed primarily from organic material and are underlain by permafrost within 1 m of the surface.

Pathway of effect – mechanism through which an affect to Valued Component (change in evnironment) occurs as a result of a project activity**.**

Physiography* – Pertains to the factors that influence the development of landforms or a landscape, such as relief and topography, bedrock geology and structure, and geomorphological history.

Regosols – Weakly developed soils that lack recognizable primary horizons and commonly associated with unstable land surfaces.

Serotiny – An ecological adaptation exhibited by some seed plants, in which seed release occurs in response to an environmental trigger, rather than spontaneously at seed maturation. The most common and best studied trigger is fire.

Stochasticity – The quality defined by a process which is random, uncertain, or unpredictable; i.e involving a random variable.

Surficial geology* – The geology of surficial materials.

*All definitions have been described in Dunster and Dunster (1996), the remainder as described in Smith *et al. (*1998).

1.0 INTRODUCTION

Manitoba Infrastructure is developing an all-season road (ASR) network to the remote First Nation (FN) and Northern Affairs communities on the east side of Lake Winnipeg. ASR development is part of a Large Area Transportation Network (LATN; Map 1) that includes Manto Sipi Cree Nation, Bunibonibee Cree Nation, God's Lake FNcollectively known as Project 6 (P6 or the Project; Map 2). P6 will also provide access to the community of God's Lake Narrows via an existing all-season road connection from God's Lake First Nation. Project 6 is proposed to be a two-lane gravel road located on Provincial Crown Land, approximately 138 kilometres (km) long and has a 60 metre (m) wide right-of-way (ROW; Map 2). An Environment Act Licence (Class II) is required, and the P6 Project may require an Environmental Impact Assessment (EIA) is expected to undergo both provincial and federal review.

This report identifies and evaluates potential Project effects associated with wildlife in the RAA and mitigation. It includes a summary of the existing environment, criteria for the selection of Valued Wildlife Components (VC's) and rationale for the assessment of potential effects and mitigation related to construction and operation of the project. Additional detail on baseline data collected in the RAA and on data collection methods, on which the effects assessment is founded, is described in a separate report titled Project 6: Existing Environment Wildlife Report (Joro, 2017).

Baseline wildlife data collected over the last six years (2011 - 2017) were used to characterize the distribution and relative abundance of mammals, birds, and herptiles (i.e. reptiles and amphibians) in the P6 Regional Assessment Area (RAA; Map 2). The data collected supported the identification and evaluation of potential effects related to P6. Mammal studies to delinate ranges, habitat types and seasonal use, and abundance were conducted and included:

- GPS collar data from woodland caribou occupying the Norway House (forest-dwelling ecotype) and the Pen Islands (forest-tundra ecotype) populations,
- aerial multispecies winter track surveys, aerial winter minimum count moose surveys, and
- trail camera studies.

Bird and amphibian studies, to determine potential for SCC, occupancy and relative abundance of avifauna included data collected from Autonomous Recording Units (ARUs), Manitoba Breeding Bird Atlas (MBBA) point count surveys, and aerial spring and fall waterfowl surveys.

A local trapper participation program was also undertaken to acquire local knowledge on furbearer occurrence and relative abundance. Local and traditional wildlife knowledge gathered from community wildlife workshops held in the three FN communities (Manto Sipi, Bunibonibee, and God's Lake) provided valuable information from community members, including hunters and trappers, to supplement wildlife monitoring results. In addition, community members participated in many of the wildlife field surveys.

Results of data analyses on baseline wildlife data collected on mammals, birds, amphibians and herptiles, summarized in this report and detailed in a Project 6 Existing Environment Wildlife Report (Joro, 2017), were used to identify and assess potential project-related effects including: habitat loss, disturbance, mortality and invasive species. Specific criteria, identified by the Canadian Environmental Assessment Agency (CEAA) (including duration, magnitude, geographic extent frequency, reversibility and ecological

and social context) were used to evaluate and rank the degree of potential project-related effects on wildlife. This report documents the additional information on data analysis, results and supporting documentation for the rankings that were derived.

2.0 STUDY AREA

The RAA, encompassing an area of 9,005 km^2 P6 RAA (Figure 1; Map 2). The boundaries of the RAA were determined by KGS and MI, with input from technical specialists including Joro, using a multi-disciplinary approach incorporating both biophysical and social factors resulting in the area extending approximately 20 km beyond the alignment. Species of importance to FNs were determined through workshops, open houses and community discussions and included (but not limited to), large mammals (moose and caribou), furbearers, and migratory waterfowl. The extent of the RAA boundary was selected with consideration of home ranges of large ranging species such as moose and areas of traditional use in proximity to P6. Administrative boundaries that best describe the RAA are the MSD, Wildlife and Fisheries Branch, Game Hunting Area (GHA) 3A (MSD, 2016a) or the MSD, Forestry Branch, Forest Management Unit (FMU) 76, 94, 95, 96, 97, 98, and 99 (MSD, 2013) (Map 3).

The RAA includes a small portion of the Pen Islands (Eastern Migratory) caribou range and the Norway House woodland caribou range. The Pen Islands migratory caribou population are known to have a very large range, extending to the Hudson Bay coast and north of the Nelson River. The Norway House woodland caribou population occurs north east of Lake Winnipeg, ranging from the northeastern coast of Lake Winnipeg north to Bunibonibee Cree Nation and east towards the Ontario border. Baseline data on caribou have been gathered across these ranges and are included in this report. The RAA also encompasses habitat for other species with smaller, multi-generational home ranges that are expected to exist throughout P6 (e.g., furbearers and small mammals), as well as areas important as breeding and/or staging habitat for waterfowl and other migratory birds, and areas of known or potential local resource and traditional use.

FN communities located within the RAA include Bunibonibee, Manto Sipi, and God's Lake. God's Lake Narrows Northern Affairs community is also located within the RAA. These communities utilize sections within the RAA as traditional hunting and trapping areas for wildlife species. In addition, winter roads, hydro transmission lines, recreational trails, quarries, and traplines occur throughout the RAA. There are also several lodges and outposts which provide various services focused mainly on angling and hunting.

The Local Assessment Area (LAA) for P6 is defined as a 5-km buffer on either side of the proposed P6 ASR route, encompassing an area of 1,327 km^2 (Figure 1; Map 2). For caribou and moose, the LAA is defined as a 10 km buffer extending from the Project footprint, an area of 2,503 km^2 while the 5 km buffer was maintained for all other wildlife VCs. This expanded 10 km buffer LAA is shown as the Ungulate LAA within subsequent figures in this report. The Project Footprint (PF) for P6 is defined as the 100 m ASR ROW, encompassing an area <14 km^2.

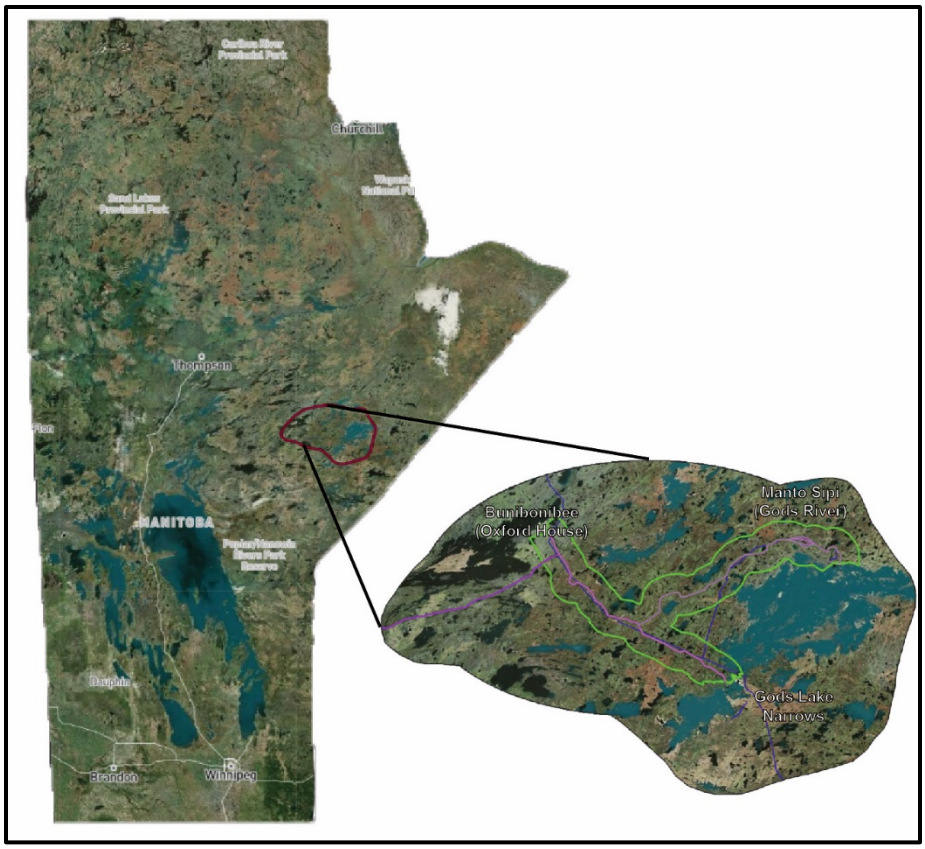


Figure 1: Location of the P6 RAA and the LAA within northeastern Manitoba

3.0 METHODS

3.1.1 Desktop Methods

Biophysical information for the P6 RAA including ecodistrict information, surficial geology, soil types, forest cover, and fire history was reviewed from various sources (Rowe, 1972; Zoladeski *et al.,* 1995; Smith *et al*., 1998; NRC, 2003; LGRFN and OMNR, 2011; Trommelen, 2012). See sections 4.1 and 4.2 for detailed biophysical information in the RAA.

Species' range maps and conservation status information was also utilized to determine listings of potential wildlife that may occur in the area (Caras, 1967; Banfield, 1974; Smithsonian (n.d.); Preston, 1982; Manitoba Avian Research Committee, 2003; MBBA, 2014a; Cornell Lab of Ornithology, 2015; Canadian Herpetological Society, 2016; Nature North, 2017), and their current conservation ranking (Committee on the Status of Endangered Wildlife in Canada or COSEWIC, 2017; Manitoba Conservation Data Centre or MBCDC, 2016a; Manitoba Endangered Species and Ecosystems Act or MESEA, 2017; Species at Risk Act or SARA, 2017). See Section 4.5 for a detailed overview of wildlife present in the RAA.

3.1.2 Wildlife Monitoring and Assessment Methods

As part of a suite of baseline monitoring methods to map wildlife distribution, characterize habitat use and movement patterns within the RAA, various methods were used to record species of ungulates, predators, furbearers, birds and herptiles, including:

- GPS collaring of woodland caribou to obtain detailed telemetry data to provide information on distribution and seasonal occupation (February 2010 - March 2017);
- Trail camera studies to detect ungulate, predator, and furbearer occupancy (2016);
- Aerial multispecies distribution surveys to record tracks and observations of ungulates, furbearers, and large stick nest surveys (winters of 2011, 2012, 2014, 2015 and 2016);
- Incidental wildlife observations recorded during all aerial and ground-based surveys and studies (2011 - 2017);
- Total minimum count aerial moose surveys to acquire baseline information on areas of high moose concentration and provide an estimate of moose densities and distribution within a baseline survey area associated with the preferred P6 alignment (winters of 2016 and 2017), ARUs deployed in selected habitat types to detect vocalizations from a variety of bird and amphibian species (spring 2016);
- Aerial waterfowl surveys to record waterfowl species presence during breeding and staging periods in spring and fall (2016);
- TK workshops and interviews with First Nation community members to gather information on wildlife movement and distribution, and identify species that are important to community members (2016); and
- The trapper program was conducted in 2016 - 2017 to initiate trapper involvement, acquire furbearer baseline data through local and regional distribution, and promote collaboration with the local trapping community (2016 - 2017).

Additional detail on field data methods utilized to collect data on individual species can be found in Sections 6.1 to 6.6 of this report, and further detail on general methods can be found in the Project 6 Existing Environment Wildlife Report (Joro, 2017). This report also provides methods and results of assessments on wildlife Valued Components (VCs) based on criteria for wildlife VC selection and assessment of project related effects before and after mitigation. Wildlife VC habitat modelling was also conducted to determine amount and location of high quality habitat within the RAA, LAA and project footprint areas (Section 6.0).

4.0 EXISTING ENVIRONMENT

4.1 Environmental Setting

This section provides a summary of the existing environment for the P6 RAA and describes the environmental setting and baseline data gathered on wildlife as it relates to P6 RAA (Figure 1; Map 2). Information on the environmental setting for the P6 RAA is also summarized in the Project 6 Existing Environment Wildlife Report (Joro, 2017).

The RAA is located within the Boreal Shield Ecozone, which is the largest ecozone in Canada. In Manitoba, it extends north from the southeast corner of the province, encompassing the area between Lake Winnipeg and the Ontario border, and proceeds across the northern extent of the Lake as a broad band from the Ontario to Saskatchewan borders (Smith *et al.,* 1998). The ecozone is dominated by both lowlands and broadly rolling uplands.

The **surficial geology**[3] is composed of Precambrian granite bedrock outcrops, **moraines**, **glaciofluvial**, and **colluvial** deposits. The continental climate is typically characterized by short warm summers and cold, snowy winters. Soils are dominated by **luvisols** in the south and **brunisols** in the north (Zoladeski *et al.*, 1995). Brunisolic soils comprise one of three forest soil orders and can be viewed as part of a prolonged evolutionary sequence that begins with an unweathered parent material (**Regosols**) and ends with development of a “mature” forested soil of the Podzolic or Luvisolic orders; the Brunisolic “stage” may last for several thousands of years.

The entire RAA falls within the Hayes River Upland (89) Ecoregion (Figure 2), which extends from the Grass River Basin in east-central Manitoba to the Manitoba-Ontario border. The Hayes River that flows northeast and eventually drains into Hudson Bay is the major drainage channel in the region; both Knee Lake and Oxford Lake are widened expanses of the Hayes River. The area is characterized by numerous small streams connecting a network of small lakes and wetlands between **drumlinoid ridges**, most of which have exposed bedrock. Most of the area is a mix of till blankets and till veneers over bedrock. Well to moderately-well drained till and glaciolacustrine parent materials are generally associated with eluviated eutric brunisol soils, while imperfect to poorly drained deposits are frequently overlain by regosolic gleysols and a mix of cryosols and mesisols (Trommelen, 2012).

[3] Words in bold are defined in the Glossary of Terms

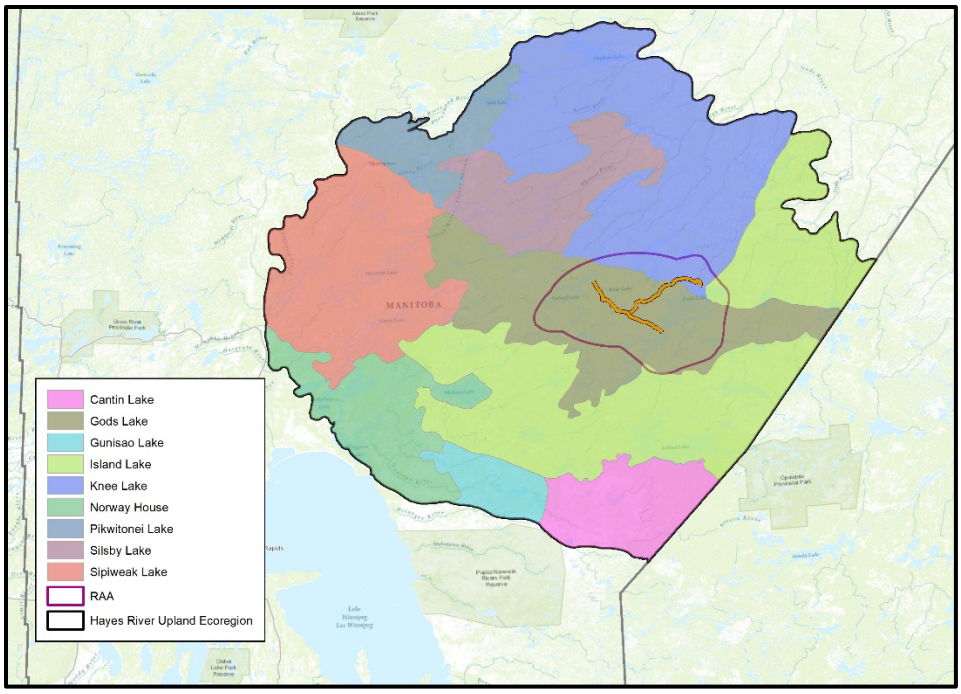


Figure 2: Location of the P6 RAA and ecodistricts within the Hayes River Upland in northeastern Manitoba

4.2 Ecodistricts

The RAA is intersected by parts of three ecodistricts, Island Lake (364), God's Lake (365), and Knee Lake (360) (Figure 3). The God's Lake Ecodistrict accounts for more than 85% of the total area within the RAA (Figure 3).

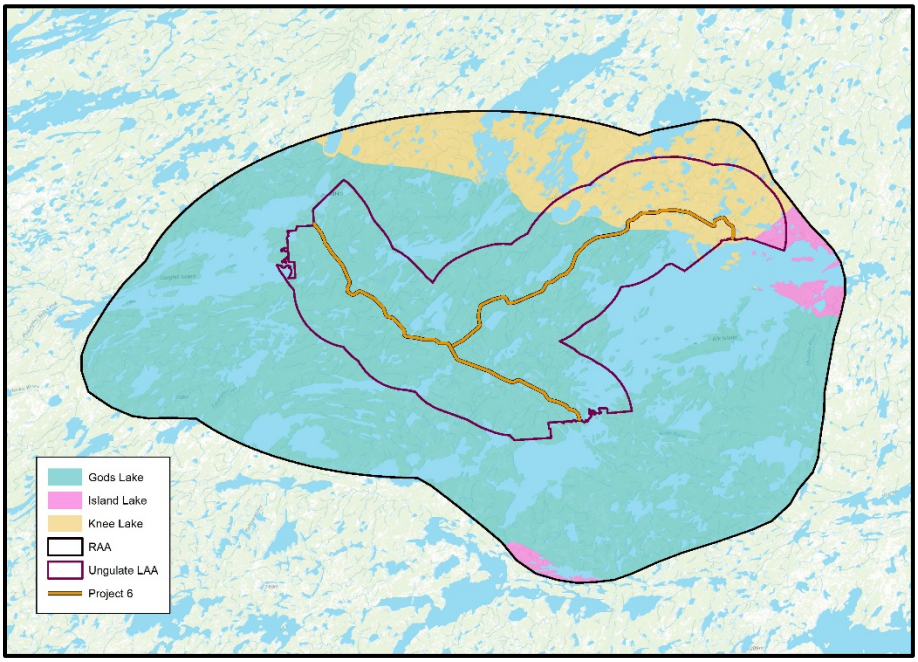


Figure 3: Location of ecodistricts that intersect the P6 RAA in northeastern Manitoba

The surficial geology and soil to a large extent determine the organic productivity of the landbase, including the vegetation communities and the wildlife it supports (Figure 4 and Figure 5). The glacial tills are a product of the scraping and plucking of bedrock by glacial ice resulting in variably sized rock fragments that were transported, crushed and mixed into a thin sediment layer. Till veneers and till blankets underlie most of the area accounting for almost 75% of the whole RAA area.

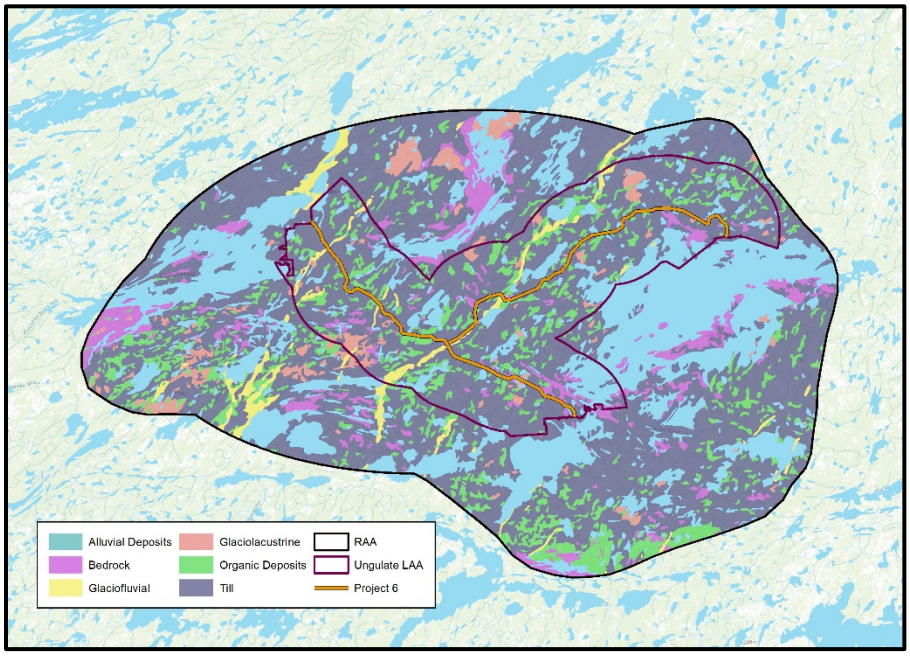


Figure 4: Surficial geology within the P6 Regional Assessment Area

Eutric brunisols (>71%) and cryosols (25%) dominate the soil profile within the RAA (Figure 5).

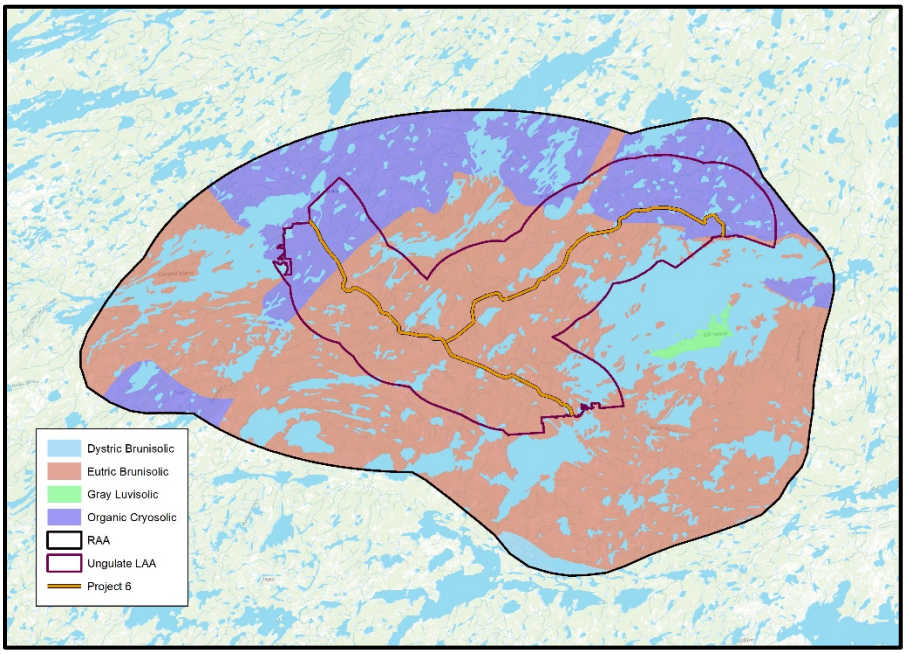


Figure 5: Distribution of major soil types within the P6 RAA

4.2.1 The God's Lake (365) Ecodistrict

This is the predominant ecodistrict in the RAA; it begins at Landing Lake and lies entirely within Manitoba except for its most eastern tip which falls in Ontario. This ecodistrict is located in the central part of the Hayes River Ecoregion and is bordered on both north and south by the Island Lake (364) Ecodistrict and also by the Knee Lake (360) Ecodistrict to the north (Figure 3) (Smith *et al.*, 1998). The mean annual temperature is -1.5°C with an average growing season of 155 days. The mean annual precipitation is approximately 560 mm, of which less than one-third falls as snow (Smith *et al.*, 1998).

The **physiography** of the region consists of undulating to hummocky morainal plain of calcareous, sandy to loamy till deposits with clayey **glaciolacustrine** veneers and blankets all over the region, especially on lower slopes and depressions. Northern plateau bog, peat plateau bog, flat bog, patterned and horizontal fens (deep peat deposits), and veneer bog (shallow peat materials) frequently cover the fine textured glaciolacustrine sediments. There are also areas where prominent **kettled fluvioglacial deposits** occur (Smith *et al.*, 1998). Oxford Lake and God's Lake are the largest of the wide range of lakes within the ecodistrict that contribute to the region's northward flowing water (Smith *et al.*, 1998).

The God's Lake Ecodistrict has well to imperfectly drained mineral soils comprised of eluviated **eutric brunisols** and **gray luvisols** which can be found on upland clayey glaciolacustrine deposits. Peat-filled areas cover a large area on this region and are comprised of poorly drained bogs and very poorly drained fens. The soil is composed of a range of peat types including **fibrisols** (slightly decomposed sphagnum and feather moss peat), **mesisols** (moderately decomposed moss and forest peat), and **organic cryosols** (areas with permafrost) (Smith *et al*., 1998). The deeper layers of peat are generally more decomposed than those close to the surface as is the case in peat fens. In areas with gentle slopes, shallow peat soils with slight to moderately decomposed sphagnum, feather moss is more likely and may be associated with organic cryosols (Smith *et al.*, 1998). Black spruce (*Picea mariana*) is the dominant tree species in the God's Lake Ecodistrict; however, the upland portions are frequently replaced by jack pine (*Pinus banksiana*) followed by trembling aspen (*Populus tremuloides*) due to fire activity. Tamarack (*Larix laricina*) is common in fens and can be found mixed with black spruce in transitional bog peatlands. Successful mixed stands of white spruce (*Picea glauca*), balsam fir (*Abies balsamifera*), trembling aspen, and balsam poplar (*Populus balsamifera*) can be seen along rivers and lakes (Smith *et al.*, 1998).

4.2.2 The Knee Lake (360) Ecodistrict

The Knee Lake (360) Ecodistrict is restricted to a portion of the northern edge of the RAA (Figure 3), although the whole of the Knee Lake Ecodistrict forms a horseshoe-shaped area extending from Knee Lake in the south to Stevenson Lake in the north (Smith *et al.*, 1998). Mean temperatures range from a low of -25.7°C in January to a high of 15.3°C in July with an average growing season of 131 days. The mean annual precipitation is approximately 500 mm, of which more than one-third falls as snow (Smith *et al.*, 1998).

The physiography changes from undulating to ridged, (drumlins) loamy morainal plain where the drumlins have been eroded by water and may have veneer bogs on the lower slopes. Veneer bogs also appear on gently sloping glaciolacustrine blanket and veneers; whereas peat plateau bogs and patterned fens tend to be found in **depressional** terrain with clayey glaciolacustrine sediments underneath. The ecodistrict

also contains sites of conspicuous eskers and esker aprons (kettled fluvioglacial deposits) which can be up to 30 m above the nearby terrain and can have eroded channels creating local relief (Smith *et al.*, 1998).

The drainage system for the northwest is the Nelson River and the south-western and eastern sections belong to the Hayes River. Lakes in this region vary from small to very large and many have shores developed in unconsolidated materials, with the smaller lakes appearing between drumlin ridges (Smith *et al.*, 1998). Much of the ecodistrict occurs on permafrost peatlands and as such the soils are organic coming from woody, forest peat, and sedge peat materials and include organic cryosols in veneer bogs and peat plateau bogs. Veneer bogs are also found in non-frozen areas and are made up of fibrisols, whereas the flat bogs and patterned fens are made up of mesisols. Knee Lake Ecodistrict has imperfectly drained mineral soils comprised of eluviated eutric brunisols on loamy to sandy calcareous till and sandy to gravelly fluvioglacial deposits and well to imperfectly drained clayey deposits in gray luvisols (Smith *et al.*, 1998). Black spruce is the predominant tree species, but well drained upland areas are dominated by jack pine well adapted to frequent fires that characterize these dry habitats. In wetter areas, such as around lakes and rivers, white spruce appears, and in bog peatlands there is black spruce, **ericaceous** shrubs, and various mosses, including sphagnum. Fens have different vegetation mostly consisting of stunted tamarack, shrubs, brown mosses, and sedges (Smith *et al.*, 1998).

4.2.3 The Island Lake (364) Ecodistrict

The Island Lake (364) Ecodistrict is separated into two sections, north and south; a very small portion of the RAA lies within the northeastern and southern sections of the ecodistrict (Figure 3). The ecodistrict is bordered by five other ecodistricts within the Hayes River Ecoregion. God's Lake Ecodistrict (365) to the north is the largest, and represents the division of the two Island Lake Ecodistrict sections (Smith *et al*., 1998). Mean temperatures range from a low of -22.8°C in January to a high of 17.6°C in July with an average growing season of 154 days. The mean annual precipitation is roughly 560 mm, with about one-third falling as snow (Smith *et al*., 1998).

The physiography of the southern section varies from an undulating to hummocky till plain where the uplands consist of granitoid rock outcrops, discontinuous blankets and veneers of acid to weakly calcareous, sandy, stony glacial till. Around Island Lake calcareous, clayey glaciolacustrine blankets and veneers are also common. In the remainder of the district, shallow to deep peat covers glaciolacustrine clayey sediments on level, gently sloping sites and in depressions (Smith *et al*., 1998). Permafrost in the northern section of the ecodistrict is widespread in deep peat bogs and discontinuous in veneer bogs and in the southern section it is confined to peat plateaus and veneer bogs and is often a relic (Smith *et al.,* 1998).

Soils range from well to excessively drained and consist of dystric brunisols and stony, acid sandy till to gray luvisols which are not as well drained. Large areas of very poorly drained Typic (deep) and Terric (shallow) fibrisolic and mesisolic organic soils overlying loamy to clayey glaciolacustrine sediments occur in the peatlands, which are increasingly more widespread towards the west (Smith *et al*., 1998).

Most of the Island Lake Ecodistrict falls within the Hayes River watershed, with only a small western portion lying in the Nelson River watershed. The lakes range from small to very large (Island Lake) and

these lakes and associated rivers and streams are the main source of water for the ecodistrict (Smith *et al*., 1998). Jack pine and, to a lesser extent, trembling aspen are common on upland sites, due to extensive, repeated fires; however, black spruce is the dominant tree species and is especially widespread on imperfectly drained uplands and bog peatlands. In river valleys and around lakes where drainage is good, white spruce, balsam fir, and trembling aspen form mixed stands. Stunted black spruce, sphagnum, and other mosses and ericaceous shrubs are found in bog peatlands and sedges, brown mosses, shrubs, and stunted tamarack are found in fens (Smith *et al*., 1998).

4.3 Forest Cover and Vegetation

The Boreal forest within which the RAA is located forms a continuous belt from Newfoundland to the Rocky Mountains and comprises the greater part of the forested areas of Canada (Rowe, 1972). The Boreal forest is primarily coniferous with white and black spruce as characteristic species, although balsam fir and jack pine are prominent in the eastern and central portions; tamarack is only absent in the far north (LGRFN and OMNR, 2011). There is also an admixture of broadleaf trees such as white birch (*Betula papyrifera*), trembling aspen, and balsam poplar (LGRFN and OMNR, 2011).

Within the P6 RAA, the forest is further classified into the Northern Coniferous section (B.22a) (Rowe, 1972). These coniferous stands tend to have a feather moss groundcover. Bedrock outcrops have patchy tree growth with an understory of low shrubs and a groundcover of low ericaceous shrubs, mosses, and lichens. Poorly to very poorly drained fens have sedge and brown moss vegetation and may have a shrub layer, or may support a tamarack-dominated tree cover with varying components of shrubs, herbs, and sedges. Poorly drained bogs generally support open to closed stands of stunted to medium tall black spruce, with an understory of dwarf birch, ericaceous shrubs, and a moss ground cover.

Peatlands that are transitional in development from fen to bog are common and the vegetation reflects the transitional aspects in its community composition (Smith *et al.*, 1998). The *Forest Ecosystem Classification for Manitoba, Field Guide* (Zoladeski *et al.*, 1995) provides a detailed species relationship, for productive forest types, in terms of their commercial tree species compositions and common relationships for understory shrubs, herbs, and mosses. Figure 6 illustrates the forest cover habitat in the RAA.

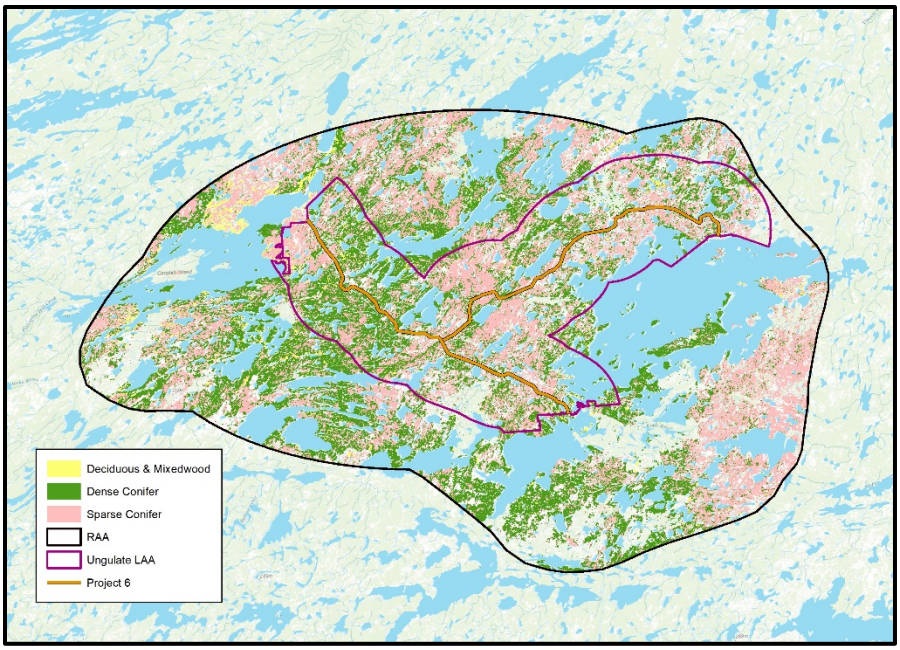


Figure 6: Distribution of deciduous and mixedwoods, sparse conifer and dense conifer within the P6 RAA

4.4 Habitat

The RAA vegetation community typically represents species mixes shaped by disturbance events and post-disturbance renewal and stand succession processes. The ability to adapt and occupy forest habitats, at various stages of succession, essentially dictate the species of wildlife that inhabit this area at any point in time as described in Section 4.5. The area is comprised of a mosaic of different aged forest stands, plant communities, and floral species that reflect the climate, topography, soils, drainage, disturbance history, and forest succession of the region. Forests provide the habitats within which wildlife live, and the degree and complexity of this structure determines the diversity of species and their respective abundance (Keenan *et al.*, 2009).

4.4.1 Fire History

The record of the fire history for the P6 RAA going back 100 years was mapped from the Canadian National Fire Database compiled by Natural Resources Canada (NRC, 2015). A lower rate of fire frequency is visible within the RAA than in areas to the west and south (Figure 7).

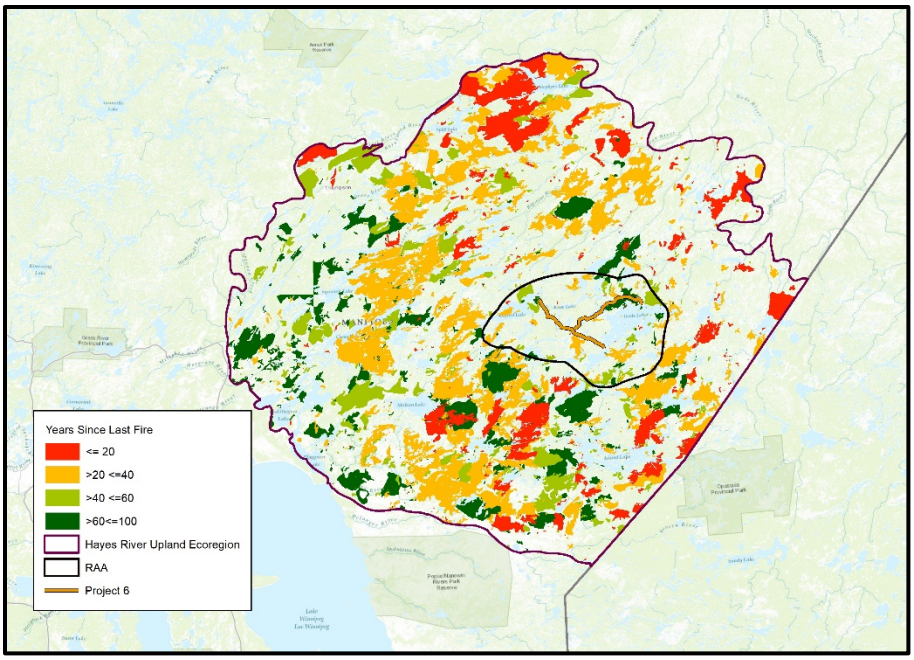


Figure 7: History of reported fires within the Hayes River Upland Ecoregion

Most fires within the ecoregion over the last century are <40 years of age (Figure 8), thereby favoring those wildlife species that may benefit from younger regenerating forest structures. However, within the RAA itself (Figure 8), a lower burn rate has resulted in a somewhat more mature forest (Figure 6).

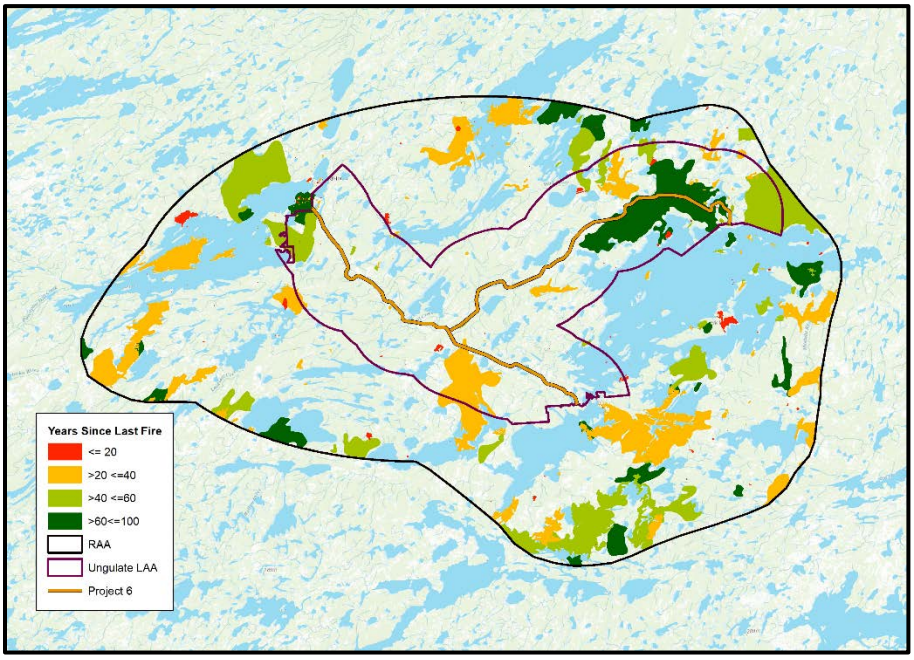


Figure 8: History of reported fires within the P6 RAA

Fire is the major disturbance factor shaping the patterns and distribution of forest age classes and communities within the Boreal Shield Ecozone. The forest landscape within the RAA does not present a highly complex forest covertype structure, but rather a classical Boreal shield forest defined by a mix of

treed and open wetlands surrounded by higher elevation black spruce and jack pine forest communities in a range of age classes shaped by the patterns created by frequent natural fires.

Fire is the primary source of disturbance and the Boreal Shield Ecozone that extends across the region is generally characterized by fire events that periodically burn the landscape with varying degrees of intensity. In the case of black spruce fuel loads to carry fire can include the trees, coarse woody debris and organic materials that comprise the forest floor; the most intense fires essentially leave no woody debris on the forest floor (Dyrness and Norum, 1983).

Burton *et al.* (2008) categorized the hierarchy of scales of diversity associated with large fires in the boreal forest: (1) within the entire boreal forest of North America as a function of climatic and topographic effects on both the rates of burning leading to inter-regional and/or inter-landscape differences; (2) differences within a landscape caused by specific landscape environmental attributes and **stochasticity**; and (3) a diversity within a fire that can be described in terms of burn severity, the latter of which essentially defines the structure of the post-fire forest. Black spruce and jack pine are both fire-adapted species given their **serotiny** in which fire triggers seed release and dispersal. In the case of severe fires that also burn the forest floor, there is a rapid and dense regeneration to the dominant forest type.

Hall *et al.* (2008) viewed a broad application of burn severity maps, particularly in the assessment of the consequences of varying severity regimes for wildlife. A level of burn severity that may preclude the post-fire use of the landscape by caribou may be quite different than the level of severity that would render the area unusable by other species, e.g., marten, migratory birds, or predatory birds.

The sequences of ecological processes within the RAA are a product of the repetitive burn patterns, the severity of which is linked to the combination of fuel loads combined with a host of meteorological variables. At the ecozone level, wildlife has evolved and adapted to the broad patterns of vegetative communities that provide a constant supply of habitat types that meet the life history needs for resident species and the seasonal requirements of many transient species. The ebb and flow of how species fare at the level of discrete populations is linked to the constantly shifting spatial distributions of habitats upon which species depend. Within small evaluation areas, utilization by wildlife is a direct product of the recent fire history (<60 yrs.) that defines the complexity of mix of stand types that define the study area forest.

4.5 Wildlife in the RAA

The following sections provide an overview of important species common to the RAA. A listing of all mammals, birds, and herptiles, including species of conservation concern and species of importance to First Nations people, that may occur in the RAA is also presented in Appendices A-C, respectively.

4.5.1 Mammals

Ungulates, furbearers, and small mammals comprise the 39 species that may occur within the RAA. See Appendix A for a comprehensive list of mammals that may occur and their conservation status.

4.5.1.1 Woodland Caribou

The Pen Islands (Eastern Migratory) and Norway House (Boreal Woodland) caribou ranges/populations overlap with the P6 RAA. The animals occupying both ranges are woodland caribou (*Rangifer tarandus caribou*), but due to differences in several important life characteristics they are recognized as belonging to different ecotypes. Pen Islands caribou are categorized as the migratory ecotype, also referred to as "forest-tundra" ecotype, whereas Norway House caribou are classified as the sedentary ecotype, also referred to as "forest-dwelling" or "boreal forest" ecotype (COSEWIC, 2011a; Manitoba Boreal Woodland Caribou Management Committee or MBWCMC, 2015).

The forest-tundra ecotype is differentiated from the forest-dwelling ecotype by their migratory and calving behaviour. Forest-tundra (Pen Islands) caribou traditionally migrate and assemble in large groups near the Hudson Bay coast to calve. This is in contrast to forest-dwelling caribou that disperse and separate over large areas during calving. Forest-tundra caribou more closely resemble migration characteristics of barren-ground caribou (*Rangifer tarandus groenlandicus*), moving large distances between winter range and spring calving areas (COSEWIC, 2011a; Berglund *et al*., 2014; Pond *et al.*, 2016).

Pen Islands Eastern Migratory Caribou Range/Population (Forest-tundra)

COSEWIC (2011a) currently identifies the Pen Islands caribou range as part of Designatable Unit 4 (DU4): Eastern Migratory Caribou. COSEWIC has assessed all subpopulations of the Eastern Migratory Caribou, including the Southern Hudson Bay subpopulation (i.e. the Pen Islands range), as "Endangered" (COSEWIC 2017). MBCDC (2016a) lists the population as S4. See Appendix A for further detail/definitions on conservation status listing.

The Pen Islands caribou population has a range extending from northeastern Manitoba to northwestern Ontario within the Hudson Bay and Boreal Shield Ecozones (Magoun *et al.*, 2005; Gunn *et al.*, 2011; Abraham *et al.*, 2012; Berglund *et al*., 2014). In recent years, caribou from the Pen Islands caribou population have been observed in the same geographical area as the proposed P6 road alignment, and to the area north and east within the P6 RAA on occasion. However, the actual numbers and frequency of Pen Islands caribou occupying and/or migrating through the P6 RAA has likely varied considerably over time.

Due to the migratory nature of the Pen Islands population, the use of this area by animals has been primarily on a seasonal basis (the winter months from November through to late April), though a very

small number of female caribou may have remained in the RAA during the summer months. The P6 RAA would be on the southern limit of the population's normal range. Within the RAA the animals would primarily be found in forested areas, but most commonly mature coniferous forests where quantities of lichen are available.

Norway House Boreal Woodland Caribou Range/Population (Forest-dwelling)

COSEWIC (2011a) currently identifies the Norway House caribou range as part of Designatable Unit 6 (DU6): Boreal Caribou and are assessed as "Threatened", similarily they are listed as "Threatened" under SARA. Boreal caribou are also listed as "Threatened" under MESEA and a process for developing an Action Plan for the Management Unit (MU) is provided in Manitoba's Boreal Woodland Caribou Recovery Strategy (MBWCMC, 2015. MESEA, n.d.). MBCDC (2016a) lists the population as S2S3. See Appendix A for further detail/definitions on conservation status listing.

The Norway House population range overlaps slightly with the RAA, and is restricted to the extreme western portion of the RAA. Historical information on the forest-dwelling ecotype within the P6 RAA is sporadic and limited. Current range data provided by Manitoba Sustainable Development (MSD) (2011 - 2017) have been reviewed as part of baseline wildlife monitoring. Both government reports and traditional ecological knowledge indicate the presence of caribou within the general geographical area but detailed information on historic distribution and numbers is lacking. As a result, the range delineation of this boreal caribou population has gone through several changes since the early 1990's (Johnson, 1993; Rebizant *et al*., 2000; Manitoba Conservation, 2006; MBWCMC, 2015). Currently MSD, the provincial department responsible for boreal woodland caribou management, shows the western portion of the P6 RAA as being in the Molson Lake Management Unit (MU) and a small part of the Norway House caribou range overlapping it (MBWCMC, 2015). The Norway House range lies entirely within the Boreal Shield Ecozone.

4.5.1.2 Moose

Moose (*Alces alces*) are distributed across much of forested Canada (Banfield, 1974) and are common within the boreal forest across Manitoba including the RAA. Moose are most commonly found in association with wetlands and lakes in summer feeding on both herbaceous plants and emergent aquatic vegetation rooted in mineral soils, and in winter seek woody browse provided by a variety of shrubs and young deciduous trees (Renecker and Schwartz, 1998; Gillingham and Parker, 2008). Moose tend to benefit from large stand renewal events, most of which are caused by wildfires in the Boreal Shield Ecozone. Within the RAA moose are highly valued primarily for rights-based subsistence hunting and, as the largest prey species, are an integral component of the food chain (MSD, 2016a). Moose populations in the RAA are not considered a conservation concern.

4.5.1.3 Furbearers and Small Mammals

Grey wolves (*Canis lupus*) inhabit forested areas with sufficient prey species such as moose, beaver, and snowshoe hare to sustain packs. Given the low biological productivity of the Boreal Shield ecozone, wolf home ranges tend to be large and are found throughout the RAA. Wolf populations are monitored by MI to study their movement patterns and prey selection, particularly in relation to boreal woodland caribou due to it being a threatened species listed under the federal SARA legislation. Most wolf kill sites

investigated within the boreal shield on the east side of Manitoba have been comprised of moose. Wolf populations in the RAA are not considered a conservation concern.

American black bears (*Ursus americanus*) are found across most wooded habitats in North America and are relatively common through the boreal forest (Latham, 2009; Tigner *et al.,* 2014; DeMars, 2015), including the RAA. Population densities tend to be highest in diverse forests at relatively early stages of succession and lowest where soils are thinner and plant growth generally poorer (Kolenosky and Strathearn, 1987). Bears are well known significant predators of neonate ungulates in northern temperate ecosystems and may be a factor in low recruitment rates of moose and caribou (Stewart *et al.,* 1985; Bastille-Rousseau *et al.,* 2011; Latham *et al.,* 2011a). Black bear populations in the RAA are not considered a conservation concern.

Large and small furbearers of importance to trappers in the RAA include American beaver (*Castor canadensis*), American marten (*Martes americana*), American mink (*Neovison vison*), Canada lynx (*Lynx canadensis*), ermine (*Mustela erminea*), fisher (*Martes pennanti*), muskrat (*Ondatra zibethicus*), Northern river otter (*Lontra canadensis*), red fox (*Vulpes vulpes*), red squirrel (*Tamiasciurus hudsonicus*), snowshoe hare (*Lepus americanus*), and wolverine (*Gulo gulo*). Marten and beaver, in particular, are valued species to trappers. Marten can be found in most of Manitoba's boreal forest and generally inhabit mature coniferous or mixedwood forests. They feed on small mammals such as hares, some birds, fruit, nuts, carrion, rodents, shrews, and insects (Reid, 2006). Beaver also occur throughout Manitoba's boreal forest close to water, and feed on bark and twigs of softwood trees, along with aquatic plants and grasses (Caras, 1967). Other than wolverine, currently listed as a species of special concern by COSEWIC (2014), there are no other furbearer species of conservation concern in the RAA.

Commercial trapping of furbearers is administered by MSD through the Registered Trapline (RTL) system (MSD, 2016b). There are 51 RTLs that fall (fully or partially) within the P6 RAA and 10 RTLs specifically intersect the P6 alignment. Further detail on trapping in the P6 RAA can be found in Section 6.3.

There are several other species of small furbearers or mammals that may be residents, migrants, or incidental occasional visitors to the RAA. These include, but are not limited to, least chipmunk (*Eutamias minimus*), least weasel (*Mustela nivalis*), masked shrew (*Sorex cinereus*), meadow jumping mouse (*Zapus hudsonius*), Northern bog lemming (*Synaptomys borealis*), porcupine (*Erethizon dorsatum*), pygmy shrew (*Sorex hoyi*), raccoon (*Procyon lotor*), short-tailed shrew (*Blarina brevicauda*), silver-haired bat (*Lasionycteris noctivagans*), southern red-backed vole (*Clethrionomys gapperi*), striped skunk (*Mephitis mephitis*), and woodchuck (*Marmota monax*).

4.5.2 Birds

Waterbirds and forest birds comprise most of the species that are migratory in the RAA; while some non-migratory forest birds (grey jays) and upland game birds (grouse) also may occur. See Appendix B for a comprehensive list of birds that may occur in the RAA and their conservation status.

4.5.2.1 Migratory Forest Birds

A number of migratory songbird species may be located in various forest habitats within the RAA (Bezener and De Smet, 2000; Peterson and Peterson, 2002; Manitoba Avian Research Committee, 2003; Cornell Lab of Ornithology, 2015); a selection of common songbirds that characterize the area include alder flycatcher (*Empidonax alnorum*), American robin (*Turdus migratorius*), blue-headed vireo (*Vireo solitaries*), cedar waxwing (*Bombycilla cedrorum*), chipping sparrow (*Spizella passerine)*, Connecticut warbler (*Oporornis agilis*), dark-eyed junco (*Junco hyemalis*), downy woodpecker (*Picoides pubescens*), fox sparrow (*Passerella iliaca*), hermit thrush (*Catharus guttatus*), least flycatcher (*Empiodnax minimus*), Lincoln's sparrow (*Melospiza lincolnii*), magnolia warbler (*Setophaga magnolia*), Nashville warbler (*Oreothlypis ruficapilla*), Northern waterthrush (*Parkesia noveboracensis*), olive-sided flycatcher (*Contopus cooperi*), orange-crowned warbler (*Oreothlypis celata*), ovenbird (*Seiurus aurocapilla*), palm warbler (*Setophaga palmarum*), ruby-kinged kinglet (*Regulus calendula*), rusty blackbird (*Euphagus carolinus*), swamp sparrow (*Melospiza georgiana*), Tennessee warbler (*Oreothlypis peregrine*), white-throated sparrow (*Calidris fuscicollis*), white-winged crossbill (*Loxia leucoptera*), Wilson's snipe (*Gallingo delicate*), Wilson's warbler (*Cardellina pusilla*), winter wren (*Troglodytes hiemalis*), yellow-bellied flycatcher (*Empidonax flaviventris*), yellow-bellied sapsucker (*Sphyrapicus varius*), and yellow-rumped warbler (*Setophaga coronate*).

4.5.2.2 Non-Migratory Forest Birds

Non-migratory forest birds that also occur in forest habitats in the RAA include: American three-toed woodpecker (*Picoides dorsalis*), black-backed woodpecker (*Picoides arcticus*), blue jay (*Cyanocitta* cristata), common raven (*Corvus corax*), downy woodpecker (*Picoides pubescens*), European starling (*Sturnus vulgaris*), evening grosbeak (*Coccothraustes vespertinus*), gray jay (*Perisoreus canadensis*), hairy woodpecker (*Picoides villosus*), pileated woodpecker (*Dryocopus pileatus*), pine grosbreak (*Pinicola enucleator*), and pine siskin (*Spinus pinu*s).

4.5.2.3 Migratory Waterbirds and Waterfowl

Many species of migratory waterbirds occur in wetlands, or along shorelines and riparian areas within the RAA. Some common examples are American bittern (*Botaurus lentiginosus*), American wigeon (*Anas americana),* Bonaparte's gull (*Chroicocephalus philadelphia*), bufflehead (*Bucephala albeola*), Canada goose (*Branta canadensis*), common loon (*Gavia immer*), Forester's tern (*Sterna forsteri*), great yellowlegs (*Tringa melanoleuca*), green-winged teal (*Anas crecca*), herring gull (*Larus argentatus*), least sandpiper (*Calidris minutilla*), mallard (*Anas platyrhynchos*), red-breasted merganser (*Mergus serrator*), ring-billed gull (*Larus delawarensis*), ring-necked duck (*Aythya collaris*), sandhill crane (*Grus canadensis*),

solitary sandpiper (*Tringa solitaria*), sora (*Porzana Carolina*), and yellow rail (*Coturnicops noveboracensis)*.

4.5.2.4 Migratory Raptors

American kestrel (*Falco sparverius*), bald eagle (*Haliaeetus leucocephalus*), barred owl (*Strix varia*), boreal owl (*Aegolius funereus*), broad-winged hawk (*Buteo platypterus*), great gray owl (*Strix nebulosi*), long-eared owl (*Asio otus*), Northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), sharp-shinned hawk (*Accipter striatus*), and osprey (*Pandion haliaetus*) are some of the common non-migratory raptors that may be found in the RAA.

4.5.2.5 Non-Migratory Upland Game Birds

Sharp-tailed grouse (*Tympanuchus phasianellus*), spruce grouse (*Falcipennis canadensis*), ruffed grouse (*Bonasa umbellus*), and willow ptarmigan (*Lagopus lagopus*) are common species of non-migratory upland game birds that may occur in the RAA.

4.5.3 Reptiles and Amphibians

Several species of frogs and toads may occur within the RAA and include: American toad (*Bufo americanus*), boreal chorus frog (*Pseudacris triseriata maculata*), northern spring peeper (*Hyla crucifer crucifer*), northern leopard frog (*Lithobates pipiens*), and wood frog (*Lithobates sylvaticus*) (Conant and Collins, 1991). These species generally require shallow ponds and puddles for breeding and moist environments in shrubby and wooded areas for the rest of the year. The only reptile known to occur in the RAA is the red-sided garter snake and it is commonly found in moist woodlands and the edges of wetlands. None of these species are of conservation concern in the RAA. See Appendix C for further detail/definitions on their conservation status listing.

4.5.4 Species of Conservation Concern

Fourteen Species of Conservation Concern (SOCC), 11 birds and 3 mammal species, may occur within the RAA. These include:

Species	SARA Listing	COSEWIC Assessment	MESEA Listing	MBCDC Rank*
Canada warbler (*Cardellina canadensis*)	Threatened	Threatened	Threatened	S3B
Common nighthawk (*Chordeiles minor*)	Threatened	Threatened	Threatened	S3B
Olive-sided flycatcher (*Contopus cooperi*)	Threatened	Threatened	Threatened	S3B
Short-eared owl	Special Concern	Special Concern	Threatened	S2S3B

Species	SARA Listing	COSEWIC Assessment	MESEA Listing	MBCDC Rank*
(*Asio flammeus*)				
Rusty blackbird (*Euphagus carolinus*)	Special Concern	Special Concern	Not listed	S4B
Peregrine falcon (*Falco peregrinus*)	Special Concern	Special Concern	Endangered	S1B
Yellow rail (*Coturnicops noveboracensis*)	Special Concern	Special Concern	Not listed	S3B
Bank swallow (*Riparia riparia*)	Schedule 1, Threatened	Threatened	Not listed	S5B
Barn swallow (*Hirundo rustica*)	Schedule 1, Threatened	Threatened	Not listed	S4B
Horned grebe (*Podiceps auritus*)	Schedule 1, Special Concern	Special Concern	Not listed	S4B
Eastern wood-pewee (*Contopus virens*)	Schedule 1, Special Concern	Special Concern	Not listed	S4B
Boreal woodland caribou **(***Rangifer tarandus caribou***)**	Schedule 1, Threatened	Threatened	Threatened	S2S3
Eastern migratory caribou (*Rangifer tarandus caribou*)	No Schedule, No Status	Endangered	Not listed	S4
Little brown bat (*Myotis lucifugus*)	Endangered	Endangered	Endangered	S2N, S5B
Wolverine (*Gulo gulo*)	No Status	Special Concern	Not listed	S3S4

*MBCDC 2016a Rank

See Appendices A-C for further detail/definitions on conservation status listing.

Ranges of several of the listed species overlap with the RAA:

- Short-eared owl inhabits open areas including grasslands, marshes, muskeg, and tundra (Bezener and De Smet, 2000);
- Olive-sided flycatcher inhabits semi-open mixed and coniferous forests near water and/or burned areas and boggy sites with standing dead conifers (Bezener and De Smet, 2000);
- Common nighthawk and barn swallow are found throughout Manitoba with exception to the extreme north. Both species select open and semi-open habitats such as fields, forest edges, meadows, lakeshores, and wetlands (Cornell Lab of Ornithology, 2015);

- Bank swallow can also be found throughout Manitoba and inhabit low areas along riverbanks with vertical cliffs or banks for nesting (Cornell Lab of Ornithology, 2015);
- Canada warbler inhabits a variety of forest types, but typically prefer wet, mixedwood forests with a well-developed shrub layer (Cornell Lab of Ornithology, 2015);
- Rusty blackbird is found throughout Manitoba and prefer swamps, marshes, and pond edges (Cornell Lab of Ornithology, 2015)
- Horned grebe and yellow rail both inhabit shallow ponds and marshes or wet meadows (Cornell Lab of Ornithology, 2015); and
- Little brown bat overwinters in hibernacula (caves/mines) and females inhabit maternity colonies such as buildings or large trees in summer; foraging occurs over water along waterways and forest edges, avoiding large open fields (COSEWIC, 2013a).

Peregrine falcon, however, is considered a potential migrant within the RAA. It is typically found in urban areas of southern Manitoba, perching or nesting on skyscrapers, water towers, cliffs, power poles, and other tall structures (Cornell Lab of Ornithology, 2015). The range of the Eastern wood-pewee also does not overlap with the RAA and occurs typically in the far southern portion of Manitoba, but has been recorded on a species listing for the Hayes River Upland Ecoregion (MBCDC, 2016b). It inhabits forested habitat, primarily deciduous forest and woodland, and smaller open woodlots (Cornell Lab of Ornithology, 2015).

4.5.5 Local and Traditional Knowledge

Local and Traditional Knowledge (TK) on wildlife was collected through several means in the RAA. MI gathered local and TK through open house sessions, workshops, and interviews within the FN communities of God's Lake, Bunibonibee, and Manto Sipi. TK on hunting, trapping, wildlife, and rare species in the RAA was incorporated where appropriate to guide the wildlife studies and assessment of effects.

Highlights of the information shared on important wildlife include:

- Local FN communities have supported the understanding of a diverse caribou population within the RAA and have described two types of caribou as identified by physical and FN communities have indicated moose to be an important source of food for local community members, with hunters sharing the moose harvested with family and community members.
- Additional species important for community foods include caribou, moose, beaver, snowshoe hare, bear, goose (in the spring), duck, lynx, and muskrat.
- FN community members have indicated that wolves are common throughout the RAA and are known to follow caribou herds and hunt moose along the winter roads. Wolves are typically not targeted for trapping by community members.
- A variety of furbearers are abundant and trapped within the RAA. FN trappers have indicated that fisher and lynx populations have been observed to be declining, while beaver, marten, and wolverine populations have been observed to be increasing. Results of a Trapper Program indicate there is a thriving marten population, followed by otter and wolverine. These population trends were confirmed either by local harvest counts or track observations.

- Waterfowl hunting primarily occurs in the spring and fall. FN communities have indicated that hunting for geese and ducks is an important community activity.
- Bald eagles are abundant in the RAA. Observations and nest locations were shared by FN community members. Local resource users indicated that eagle nests are sensitive to human disturbance and will be abandoned if even slightly disturbed.
- Spruce and ruffed grouse are commonly hunted throughout the RAA, however FN community members indicated that populations appear to be declining in the Manto Sipi Cree Nation area.
- Ravens, crows, gray jays, swallows and common nighthawks have all been observed near the communities in the RAA.

5.0 POTENTIAL EFFECTS ASSESSMENT

5.1 Valued Wildlife Components

The following section outlines the rationale and process utilized in the selection of VC species for the P6 effects assessment. The wildlife species identified as VCs are all known to occur within the RAA.

5.1.1 Data Sources

Prior to conducting the VC screening process, all existing information sources were evaluated to determine which wildlife species occur in the P6 RAA. Information on species distribution and abundance were obtained from existing sources and include published range maps, Manitoba Conservation Data Centre (MBCDC), Breeding Bird Atlas, Boreal Avian Modelling Project, and caribou data provided by Manitoba Sustainable Development (MSD). Data from baseline studies undertaken specifically for this project were also utilized and included; aerial moose and caribou surveys, multispecies aerial winter track surveys, trail camera studies, aerial spring and fall waterfowl surveys and breeding bird occurrence from ARUs.

Local and traditional knowledge (TK) provided by local First Nation resource users at focused wildlife workshops and interviews conducted in the P6 Communities (Gods Lake, Bunibonibee and Manto Sipi) on wildlife in the RAA were also considered in the process of selecting wildlife VC species.

5.1.2 Wildlife VC Selection Process

The selection of VCs considers technical guidance from the Canadian Environmental Assessment Agency (CEAA, 2014), builds on methodology/criteria suggested by KGS and examples from other environmental assessments for which CEAA has been involved. The proposed wildlife VCs complies with federal guidance, as described by CEAA (2014, 2015), e.g.:

> "*VCs refer to environmental features that may be affected by a project and that have been identified to be of concern by the proponent, government agencies, Aboriginal people, or the public. The value of a component not only relates to its role in the ecosystem, but also to the value of people place on it*". "*The VCs will be described in sufficient detail to allow the reviewer to understand their importance and to assess for environmental effects arising from the project activities. The EIS will provide a rationale for selecting specific VCs and for excluding any VCs or information specific in these guidelines."* (CEAA, 2015).

A list of all wildlife species known or likely to occur in the RAA and their conservation status is provided in Appendices A to C. Terrestrial wildlife species likely to occur in the RAA first underwent a screening process. To be put forward as a candidate wildlife VC, the species or wildlife component first needs to be measurable for project effects over the long term (pre-construction, construction, and operation) and be identified as important in at least one category (Figure 9).

Species not considered for nomination as a VC were those that are difficult to detect or not measurable using standard scientific methods (Figure 9). SOCC species were considered for inclusion as a VC only if they met the selection criteria, i.e., having potential for project-related effects and being measurable over the long-term. Rare or listed species are typically not recommended as VCs as these species usually occur at very low densities, have low populations, have potentially limited distribution, and are difficult to observe during surveys.

In the comments on the Project 4 (P4) ASR Project, CEAA (2016) advises that SOCC be evaluated although they are typically not suitable as VCs because "…species that are rare, uncommon or associated with habitat types not prevalent in the Project Footprint do not adequately represent that Migratory Bird species which may be found within the Project Footprint during construction and operation activities" (Pg. 35). It is hard to collect sufficient data required for long-term monitoring for most SOCC and thus are generally not used for monitoring trends; however, wildlife SOCC not selected as VCs have been assessed separately to identify potential adverse effects of the propose project on SOCC and any unique mitigation required (see Section 6.6).

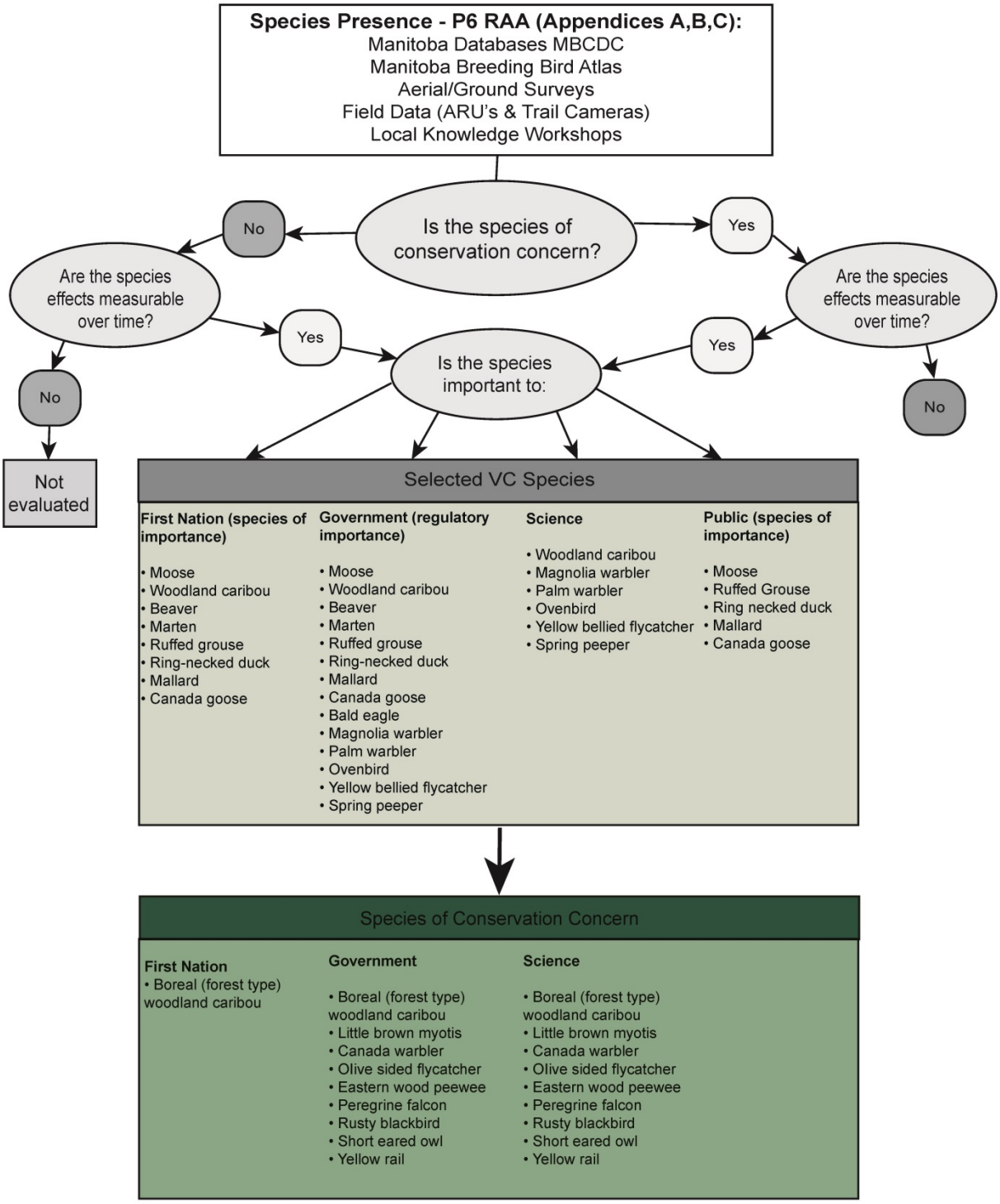


Figure 9: Pathway Process Followed in Selecting Wildlife VCs

Species that are measurable for project effects pass the first step in the screening process (shown as "yes" in Figure 9) and become a candidate wildlife VC species. While the exact nature of the project effect on the VC species may not be fully known at the time of VC selection, there needs to be a linkage (potential for effect) between the P6 development and the species. For each VC considered, the pathway

of effects was assessed to determine if there are linkages between project activities and potential effects such as change in abundance or distribution. Figure 10 provides an illustration of potential project effects on ring-necked duck, mallard and Canada goose demonstrating potential project activities that could affect their habitat or distribution.

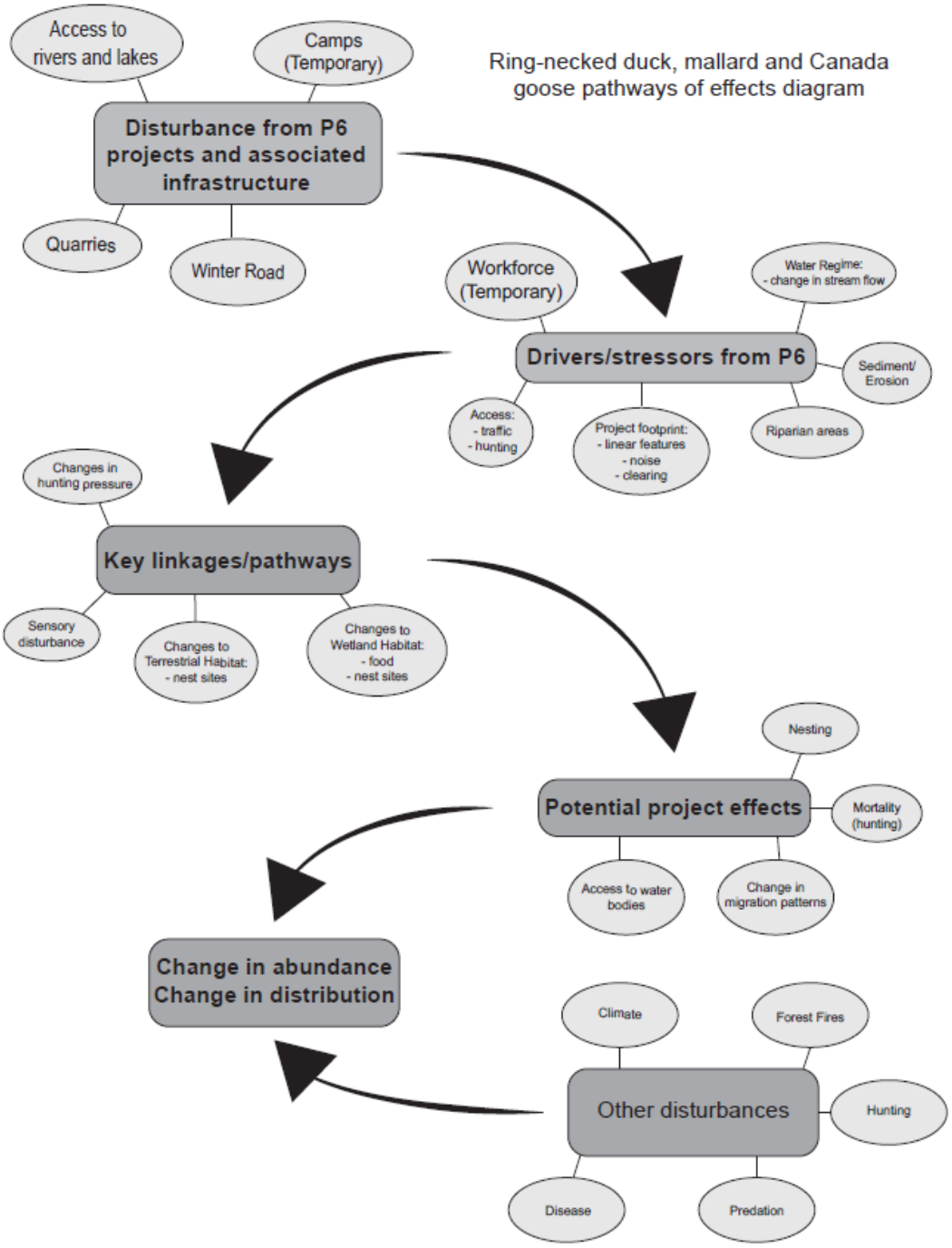


Figure 10: Example of waterfowl (ring-necked duck, mallard, and Canada goose) VC selection

The next selection criteria consider whether the wildlife component or species fulfills one or more of the following:

- Environmental component identified by local First Nations or other Aboriginal communities as having cultural, social, or economic importance.
- Environmental component identified by government regulators.
- Environmental component identified by public and stakeholders as being important.
- Environmental component identified by science – typically due to their ecosystem function and/or being representative of a broad range of species/habitat types in the RAA. Existing data, professional judgment, and habitat models commonly assist in this process.

The species that meet the abovementioned criteria remain as wildlife VCs. They are excluded only when another species from the list has similar life history and habitat characteristics and is considered a more suitable VC candidate.

The list of candidate VC species presented in Table 1 represent those terrestrial wildlife species that were selected following the process outlined in Figure 9. One of the final steps in determining the suitability for a species to be used as a VC involved an assessment of habitat preferences, as illustrated in Appendix D, to ensure major wildlife habitat types used by SOCC were represented by one or more of the proposed wildlife species VCs. Species identified in the Species-Habitat Association column of the table in Appendix D are those whose primary habitat preferences are most similar to the VC listed.

Only species known or expected to commonly occur in the RAA (based on in-field data and/or range maps provided through literature) are listed in the habitat association column of the table. These habitat preferences were then associated with the main habitat types in the RAA as identified through the Land Cover Classification of Canada (LCC) cover types (Map 4) and ALCES model (A Land and Cumulative Effects Simulator) described in Section 5.1.3 and noted in the wildlife habitat column. Consideration was also given to the landscape features associated with those habitat types in the RAA; most of the RAA is comprised of a mix of upland coniferous forests including predominantly jack pine and black spruce and lowland black spruce peatlands, such as fens, swamps and bogs.

Table 1: Candidate wildlife valued component (VC) species

VCs	Group	Importance IDd by:[1]				Indicator	Parameter	Rationale
		FN	Gv	PS	Ot			
MAMMALS								
Caribou	Ungulate	√	√		√	Distribution and abundance of caribou and habitat (including critical habitat)	Amount and locations of habitat (including critical habitat); presence/absence and density; factors contributing to Project effects (e.g., predation); trends	• Some First Nations (FNs) harvest • Regulatory need to assess critical habitat for woodland caribou. • Ecological importance/function as prey to wolf
Moose	Ungulate	√			√	Distribution and abundance of moose	Amount and locations of habitat (including important habitat);	• FNs and others hunt/ harvest

VCs	Group	Importance IDd by:[1] FN	Gv	PS	Ot	Indicator	Parameter	Rationale
						and habitat (including important habitat)	presence/absence and relative density; factors contributing to Project effects (e.g., predation); trends (e.g., habitat changes, use and mortality)	• Ecological importance/function as prey to wolf • Habitat indicator - generalist, represents habitat requirements for large species group
Beaver	Aquatic Furbearer	√			√	Distribution and abundance of habitat (including important habitat)	Amount and locations of habitat and key habitat parameters; presence /absence and lodge number/location; trends, e.g., changes in habitat, trapping and mortality	• Commercial harvest by FN and others • Keystone and representative aquatic furbearer
Marten	Furbearer	√			√	Distribution and abundance of marten and habitat (including important habitat)	Amount and locations of habitat and key habitat parameters; presence/absence and/or density of marten relating to habitat types and Project effects; changes in habitat or trapping during Project; mortality levels	• Commercial harvest for FN and others • Top-level predator characteristic of upland terrestrial environments • Important predator/prey species
BIRDS								
Bald eagle	Raptor	√	√		√	Distribution and abundance of bald eagles and habitat, e.g., nest trees	Number of bald eagles, location of active nesting trees, trends	• Culturally important species to FNs • Top predator • *Wildlife Act* for nests and nesting trees
Canada goose	Waterfowl[2]	√	√		√	Distribution and abundance of Canada geese and habitat; access	Amount and locations of habitat (including important habitat); presence/absence and relative density; factors contributing to Project effects (e.g., predation); trends (e.g., habitat	• *Migratory Birds Convention Act* (MBCA) • FN identified as important hunted species spring/fall • Hunting and license (*Wildlife Act*) and MBCA • Food web function

VCs	Group	Importance IDd by:[1] FN	Gv	PS	Ot	Indicator	Parameter	Rationale
							use and mortality and wetland productivity)	
Mallard	Waterfowl[2]: Dabbling Duck	√	√		√	Distribution and abundance of mallards and habitat; access	Number of mallards, breeding locations, trends (e.g., habitat use and mortality, and wetland productivity)	• MBCA • Boreal Conservation Region (BCR) 8 and North American Wildlife Management Plan (NAWMP) priority species (DU, 2012) • FN hunt • Migratory bird that use shallow marshes and wetlands with emergent vegetation
Ring-necked duck	Waterfowl[2]: Diving Duck	√	√		√	Distribution and abundance of ring-necked ducks and habitat; access	Number of ducks, breeding locations, trends (e.g., habitat use and mortality, and wetland productivity)	• MBCA • BCR 8 and NAWMP priority species (DU, 2012) • FN hunt • Migratory bird that use meadows adjacent to water or emergent vegetation
Ruffed grouse	Upland game bird	√	√		√	Distribution and abundance of ruffed grouse and habitat	Number of ruffed grouse, breeding locations, trends	• FN hunt • Hunting and license (*Wildlife Act*) • Prey species represent deciduous forest
Magnolia warbler	Migratory songbird		√		√	Distribution and abundance of magnolia warbler and habitat	Number of magnolia warbler, breeding locations, trends	• MBCA • Found in sufficient numbers during the MBBA surveys (2014) to monitor • Other studies to compare – Increases during spruce budworm outbreaks

VCs	Group	Importance IDd by:[1] FN	Gv	PS	Ot	Indicator	Parameter	Rationale
Ovenbird	Migratory Songbird		√		√	Distribution and abundance of ovenbird and habitat	Number of ovenbird, breeding locations, trends	• MBCA • Well studied (e.g., fragmentation) • Boreal Avian Monitoring[3] (BAM) Project test case and area-sensitive species • BCR 8 strategy Priority species list for stewardship
Palm warbler	Migratory Songbird		√		√	Distribution and abundance of palm warbler and habitat	Amount and locations of habitat; presence/absence	• MBCA • Neotropical migrant songbird occupying bogs & open coniferous forests
Yellow-bellied flycatcher	Migratory Songbird		√		√	Distribution and abundance of yellow-bellied flycatcher and habitat	Number of yellow-bellied flycatcher, breeding locations, trends	• MBCA • Ground nesting • BCR8 strategy Priority species list for stewardship
AMPHIBIANS and REPTILES								
Spring peeper	Amphibian		√		√	Distribution and abundance of spring peeper and habitat	Amount and locations of habitat and important habitat parameters; presence/absence and/or density of marten relating to habitat types and Project effects	• Numerous in the RAA, characteristic of woodland ponds, near northern range, which generally extends east of Lake Winnipeg • Food web function

[1]FN=First Nations (Gods Lake, Bunibonibee and Manto Sipi); Gv=Government; PS =Public/Stakeholder; Ot=Other (e.g., science);

[2] Waterfowl (geese and ducks) suggested will cover off wetland, open water and near shore environments during the effects assessment;

[3] The Boreal Avian Modelling (BAM) Project is an international research collaboration for the ecology, management and conservation of boreal birds with multiple federal, provincial and private funding partners (BAM, n.d.).

The final step in confirming the appropriateness of the species selected for use as a VC involved determining habitat associations with other wildlife species known to occur in the RAA. A review of habitat associations for the VCs selected is found in Appendix E. This process assisted in confirming the validity of selected VCs as representative proxies for other commonly occurring species in the RAA. Species that are transient or occur in very low numbers and/or have restricted distribution are likely to be considered in the VC assessment.

Among the mammal species that were mentioned by local resource users for consideration as VCs were moose, caribou, beaver and marten. These species are of importance to local resource users for hunting and trapping. Beaver, a species that is trapped and considered locally as important; represents the

habitat requirements for other aquatic furbearers, such as mink, muskrat and otter. Marten were selected as a terrestrial furbearer VC, which also represents habitat suitable for fisher. Wolverine did not qualify as a VC due to their very low numbers, extremely large home ranges, and dependence on carrion, making modelling and monitoring extremely difficult.

For bird species selected as VCs, the ring-necked duck, mallard and Canada goose were identified as important to the P6 communities for hunting. These species also represent the habitat needs of many other waterbirds found in the RAA (Appendix E). Ruffed grouse were identified as a species that are hunted by locals, and they are also representative of upland game birds. Bald eagle is culturally important to First Nations.

Each of the migratory songbirds selected as VCs represents groupings of songbirds with differing habitat requirements (see Appendix E for species associations). Magnolia warbler inhabit pure coniferous forests as well as mixed-wood forests with abundant coniferous saplings. Palm warbler breed in open habitats such as open spruce-tamarack bogs or fens and regenerating areas, where they prefer low ground-cover. Ovenbird inhabit mature forested habitats, including jack pine, mixedwood or deciduous stands with open understories. Yellow-bellied flycatcher inhabit large tracts of lowland black spruce (wetland) areas.

Selected VC species include:

- Caribou
- Moose
- Marten
- Beaver
- Bald eagle
- Canada goose
- Ring-necked duck
- Mallard
- Ruffed grouse
- Palm warbler
- Magnolia warbler
- Yellow-bellied flycatcher
- Ovenbird
- Spring peeper

5.1.3 Habitat Evaluation and VC Modelling

The RAA is typical of Boreal Shield ecosystems dominated by a mix of upland coniferous forests including predominantly jack pine and black spruce and lowland black spruce. Dense and sparse conifer stands together cover almost half of the total area within the RAA, while deciduous and mixed forest are found in smaller patches across the landscape (Figure 6).

5.1.3.1 Habitat Evaluation

Habitat was evaluated in the RAA utilizing the national LCC spatial database that has been harmonized across the major federal departments including Agriculture and Agri-Food Canada, the Canadian Forest Service, and the Canadian Centre for Remote Sensing (NRC, 2003). The LCC dataset provides vegetated and non-vegetated land cover classes that identify the primary ecological and vegetation or habitat conditions of an area. Analysis of information for the P6 RAA, LAA, and PF evaluation areas was also undertaken using ALCES (2017) that incorporates the LCC. The data library used in ALCES contains indicator datasets including: water and wetlands, and forest cover types. The following section provides an overview of landscape characteristics within the RAA.

Summary statistics were generated using the LCC in ALCES. A summary of major LCC covertypes and their proportional abundance within the RAA, LAA, and PF were calculated. These general habitat

categories were also utilized in the planning of all field activities and monitoring for birds (ARU placement, waterfowl surveys), trail camera deployments, and the trapper program.

Coniferous forest and water together accounted for approximately 80% of the surface cover areas within the RAA, LAA, and PF compared to approximately 1% broadleaf (deciduous) and mixedwood forest combined. Wetland classes (shrub, herbaceous, and tree) were associated with approximately 17% of the LAA, 14% of the RAA, and 12% of the PF surface area. Shrub lands comprised approximately 6.5% of the RAA, 1.6% of the LAA, and 0.0% of the PF (Table 2).

The homogeneity of the landscape favours wildlife species that benefit from associations with large and small lakes, large and small rivers, and bogs and fens as represented by the wetland classification. Figure 11 demonstrates the distribution of wetland types within the RAA.

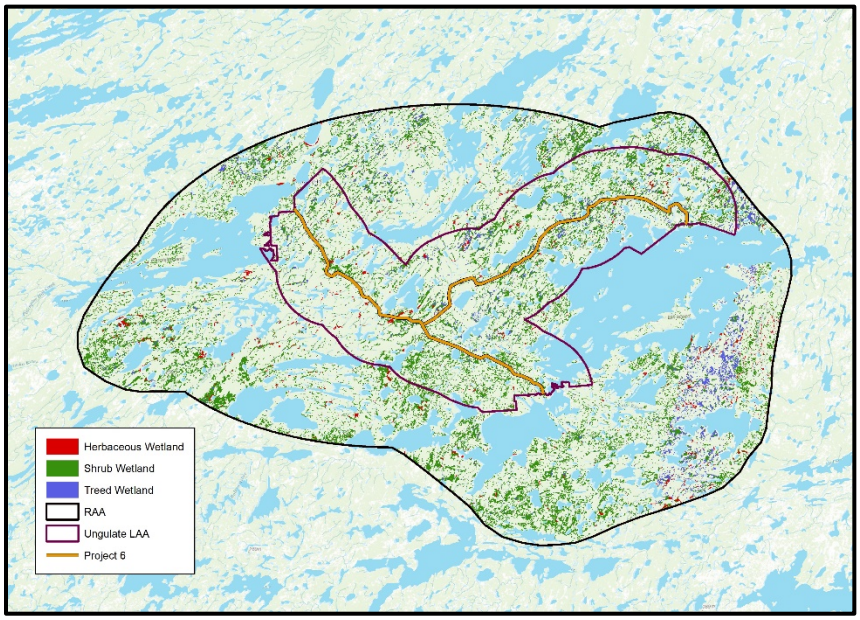


Figure 11: Distribution of herbaceous and shrub wetlands within the P6 RAA

Species that depend on more complex vegetation structures (e.g. moose) are largely restricted to wetland edges that may provide woody browse and emergent aquatic vegetation, and to younger regenerating post-fire forest areas. The major cover types as defined by the LCC database are provided in Table 2 and shown in Figure 12. These data were used in the modelling of habitat within the PF, LAA, and RAA in the assessment of effects on important wildlife species.

Table 2: LCC cover types and area of coverage within the RAA, LAA, and PF

Cover Type	RAA Area (km^2)	% Total RAA	LAA Area (km^2)	% Total LAA	PF Area (km^2)	% Total PF
Broadleaf Dense	88.01	0.98	7.87	0.59	0.18	1.28
Broadleaf Open	0.26	0.00	0.00	0.00	0.00	0.00
Coniferous Open or Sparse	2160.99	24.03	465.65	35.09	6.10	43.52
Coniferous Dense	2049.20	22.79	371.76	28.02	5.59	39.93
Barren Land	23.68	0.26	10.99	0.83	0.35	2.52
Mixedwood Dense	45.52	0.50	3.89	0.29	0.01	0.10
Shrub Tall	581.25	6.46	21.80	1.64	0.00	0.00
Water	2778.42	30.90	220.03	16.58	0.06	0.41
Wetland Herb	71.70	0.90	12.06	0.91	0.07	0.53
Wetland Shrub	1037.14	11.53	187.66	14.14	1.47	10.50
Wetland Treed	154.51	1.72	24.80	1.87	0.17	1.20
Other	0.71	0.01	0.36	0.03	0.05	0.30
Total*	**8991.4**	**100.0**	**1,326.9**	**100.0**	**14.1**	**100.0**

* Estimates of gross areas using the ALCES land classification software system.

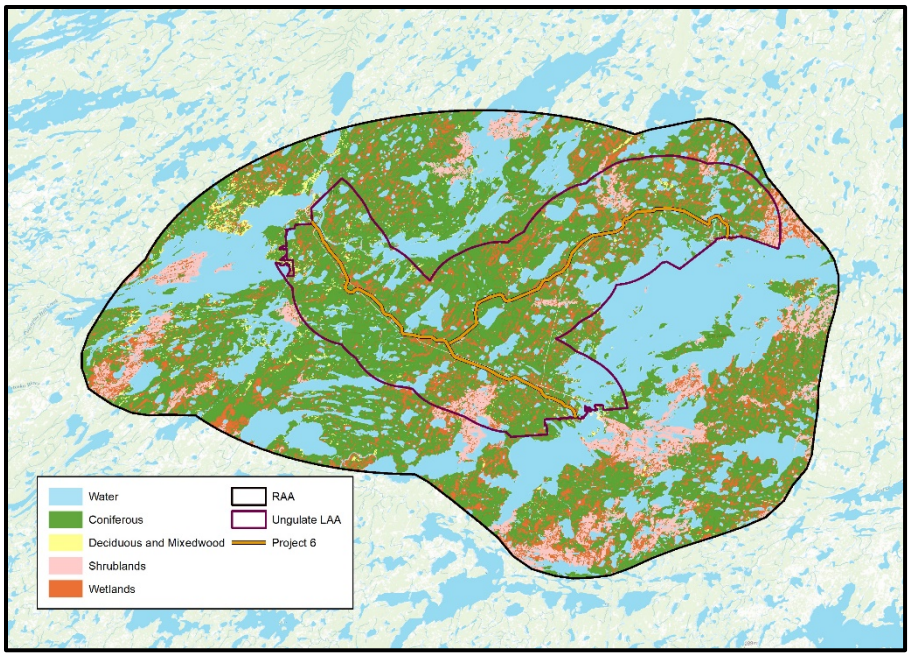


Figure 12: Distribution of major vegetation cover types in the RAA as defined by the LCC database

5.1.3.2 Habitat Modelling

Habitat Suitability Modelling in ALCES

Habitat modelling for selected VCs was undertaken using ALCES (A Landscape and Cumulative Effects Simulator). ALCES incorporates a broad suite of environmental and anthropogenic indicators into landscape spatial analysis. Land base composition and resource production attributes are translated into indicator variables using coefficients, with indicators such as wildlife habitat and populations, water quality and quantity, and biotic carbon storage (Carlson *et al*., 2010). ALCES can take the tabular and graphical output and augment the data into maps illustrating the plausible future condition of landscapes and indicators by dividing the study area into grid cells of user-defined size, and calculating the initial landscape and footprint composition within each cell (Carlson *et al*., 2010).

Habitat models were developed based on published habitat requirements, known attributes of avoidance (distance to disturbance), and professional judgement. Models are based on a raster “grid” containing 100% unity of all landscape and human footprint types. See Appendix F for a full description of attributes contained in the ALCES database. Models were developed using algorithms to best describe relationships between vegetation communities, landscape types, wetlands, water and human footprint variables. Caribou and moose habitat models utilized observational data to derive Resource Selection Models and are described in their appropriate section.

Boreal Avian Modelling Project (BAM)

For a number of bird species, models developed by the Boreal Avian Modelling Project (BAM, 2012) were provided to the P6 Project as part of a data sharing agreement. The BAM project was developed to improve the understanding of the ecology of boreal birds and their habitats, and the impact from industrial development and climate change in the boreal forest on bird populations (BAM, 2012). The BAM dataset comprises boreal bird data collated from existing inventory, monitoring and research projects provided by scientists from across Canada and the United States, and this data combined with biophysical data provided answers to questions regarding species’ life histories and habitats (BAM, 2012).

BAM plots habitat associations of species to understand habitat selection by birds. Relative density by habitat plots were created for each species using BAM’s density estimates, illustrating the relative use of habitats by a species. BAM defined their habitat categories based on the 2005 Land Cover Classification (LCC05) from Natural Resources Canada, obtained using Moderate Resolution Imaging Spectroradiometer (MODIS) imagery via satellite (Latifovic *et al*., 2009).

Current avian distributions were predicted by the BAM team using observational data (such as point count, BBS and breeding bird atlas data), mapped climates variables, and landcover information using Maxent, a powerful species-distribution modelling tool (Phillips *et al*., 2006; Phillips and Dudik, 2008). The Maxent models produces maps that estimate the probability of a species being present at a given location, of which BAM transformed into a cumulative or percentile form, with each pixel showing the proportion of all other pixels in the study region having less suitable habitat, creating “class rankings” that facilitate comparisons among species (BAM, 2012). Maxent models are bioclimatic/niche models that are meant to describe the current potential distribution of species, constrained by climate and vegetation.

Maxent models are more reliable than spatial interpolation models as they incorporate environmental conditions as well as purely spatial factors (BAM, 2012).

The resulting predictions from Maxent cannot be interpreted as occurrence probabilities, but as robust representations of relative habitat suitability. Locations with high Maxent values are on average better habitats for the modelled species (BAM, 2012). BAM constrained their background data to surveyed locations. Due to the high spatial aggregation of survey locations and the resulting potential for bias, BAM aggregated occurrence records at the 4 km by 4 km grid cell level, which corresponds to the resolution of their climate data. The modelled species was considered present in a grid cell if at least one individual of the modelled species was counted over all point-count surveys contained in the grid cell, with the model background defined as all cell having at least one survey location (BAM, 2012). These models were brought into ArcGIS and each were given a consistent scale of 1 (low) and 10 (high) for habitat suitability. These scaled values were divided into four equal (25%) quantiles with the top two quantiles (7.5 - 10, 5 - 7.5) deemed Primary and Secondary Habitat, respectively.

As BAM models are at a much coarser scale (4 km by 4 km), they likely show a higher proportion of habitat for a given species than would the ALCES model. It is likely that not all habitat within a 4 km by 4 km grid cell listed as primary is actually used, however there is sufficient habitat within the cell for it to be categorized as such.

Resource Selection Function (RSF) Modelling

Resource Selection Functions (RSFs) were utilized in the modelling of caribou calving, caribou winter and moose winter habitat selection likelihood. Modelling for boreal caribou was undertaken using telemetry data from collared female caribou in the Norway House boreal caribou range that intersects the RAA. Moose RSF modelling utilized moose locations observed from winter aerial surveys in the moose LAA. RSF analysis is based on the assumption that usage reflects the resources required during the seasons identified (Manly *et al.*, 2002).

In the analyses undertaken, “used” and “unused” sample cells were extracted from the ALCES 1 km dataframe. All grid cells not containing animal observations were considered in the full pool of “unused” cells. As there were substantially more “unused” than “used” cells in the study area, a sample of random “unused” cells were selected from the ALCES 1 km dataframe (following Manly *et al.*, 2002). For each species, a random sample of a size equal to the number of “used” cells was extracted. Table 3 provides a summary of observational data and seasons utilized in the development of RSF models for caribou and moose.

The variables used for the RSF are indicators of habitat and disturbance built into the ALCES database and are described in Appendix E. The variables were permuted using the dredge function from package MuMin (Barton, 2016) and assessed using Akaike Information Criterion (Bozdogan, 1987). Candidate models used Genralized Linear Models (glm function) with a binomial distribution. The most parsimonious model, with a ΔAIC of 0, provided coefficients for indicators that best explained the simplest model with the least assumptions and variables and the greatest explanatory power.

The coefficients generated for each RSF model were input into ALCES to produce prediction maps based on the weightings of indicator coefficients in the ALCES 1 km grid cells for the study area. For caribou

likelihood, maps were generated for the Hayes River Upland Ecoregion, as well as the RAA, the Ungulate LAA and Project Footprint. Moose RSF likelihood was generated for the RAA, Ungulate LAA and Project Footprint.

Threshold values to identify suitable habitat were based on validating cell values that contained observations. Minimum and average cell values were calculated, and high likelihood habitat was determined by assessing average value of occupied cells for both caribou and moose. Symbology was based on a yellow-red 'heat' color. The bin classes were used to calculate the potential area of high quality habitat within the RAA, LAA, and Project Footprint. Comparisons of caribou calving and winter habitat were also undertaken to compare habitat quantity and quality within the RAA and LAA to the overall Molson Boreal Woodland Caribou Management Unit. Table 3 provides a summary of data used in the RSF analyses for caribou and moose.

Table 3: Summary of RSF model parameters

Parameter	Caribou Calving	Caribou Winter	Moose Winter
Season dates	April 28 - May 28, 2012 May 12 - June 26, 2013 May 6 - June 27, 2014 May 11 - June 12, 2015 May 7 - June 14, 2016	January 1 - March 21, 2012 - 2016	February 18 - 19, 2016 February 6 - 9, 2017
Number of animals	2012 = 20 2013 = 22 2014 = 30 2015 = 32 2016 = 35	2012 = 19 2013 = 15 2014 = 25 2015 = 25 2016 = 28	2016 = 63 2017 = 68
Total cells in study area	62,285 (Molson MU)	62,285 (Molson MU)	2,516 (Moose Aerial Survey Area)
Total used cells in study area	82	2,958	90

6.0 WILDLIFE VC EVALUATION

The following sections provide additional detail on data collection and analysis methods applied in the assessment of potential effects and to also identify appropriate mitigation measures where required. The

purpose data collection for VC Species. (i.e., include mammals, birds, amphibians and reptiles and SOCC species) included caribou collaring, moose and caribou surveys, multispecies track surveys, trail cameras, ARUs (birds), Breeding Bird Atlas, as well as desktop studies and modeling etc. Distribution and relative abundance were assessed as well as to identify important or unique areas within the RAA and LAA to determine significance of potential effects.

6.1 Caribou (*Rangifer tarandus*)

Baseline field data were collected on woodland caribou and eastern migratory caribou (hereafter referred to as “caribou”) across the region that include two separate ecotypes of caribou as described by COSEWIC (2017). COSEWIC currently assess the Norway House caribou range as part of Designatable Unit 6 (DU6): Boreal Caribou and are assessed as “Threatened”. COSEWIC has also assessed all subpopulations of the Eastern Migratory caribou, including the Southern Hudson Bay subpopulation (i.e. the Pen Islands range), as “Endangered” (COSEWIC 2017). For the purpose of this report, caribou are described as either “forest-tundra” (Pen Islands/Eastern Migratory) or boreal (Norway House Range/Boreal) ecotypes as described in the Manitoba Boreal Woodland Caribou Strategy (2015). The RAA is located on the eastern edge of the Molson Boreal Caribou Management Unit and includes a smaller area known as the Norway House boreal caribou range.

The objectives of field data collection was to determine the spatial and temporal extent of caribou occupancy within the RAA. Baseline data collection included GPS collar telemetry, aerial multispecies winter track surveys, trail camera traps and TK gathered during the community wildlife workshops described in Section 4.5.5, Section 6.7, as well as the Project 6: Existing Environment Wildlife Report (Joro, 2017).

In contrast to other wildlife VCs with a 5 km buffer LAA, the LAA for caribou and moose was extended to include a 10 km buffer from the PF to facilitate the assessment of potential effects for these larger ranging species. Other rationale includes boundaries for baseline aerial surveys that have been approved by MSD based on sampling within a standard three-minute grid (2.5 x 5 km) for all moose surveys in Manitoba. All grid cells contained within the 10-km buffer of P6 are included in the baseline aerial moose surveys and provides for future construction and operation monitoring to confirm predicted effects of the project on moose densities, moose cohort composition and calf recruitment in the LAA. The LAA designed for moose, was considered suitable for assessing local effects on caribou, providing a larger area to assess use and occupancy during construction and operation through aerial surveys, trail camera studies and multi-species surveys.

6.1.1 Collaring

Pen Islands Caribou Range/Population (Forest-tundra)

Eight caribou from the Pen Islands population were captured and collared by MI within the God's Lake area of the RAA using a contracted helicopter net-gun capture crew under the authority of MSD annual scientific permits and MSD direction during January 31 - February 3, 2011. Joro staff were involved with collar initialization and testing, reconnaissance flights to locate target animals and groups, field logistics, and data management.

Once animal groupings were located, the capture crew targeted select animals that were netted, restrained with hobbles, and blindfolded. Caribou were fitted with collars that began to transmit data immediately post-release. GPS fixes were acquired every three hours, and data transmitted every 1.5 days via the Iridium satellite network. Collars also had very high frequency (VHF) radio beacons for relocation by radio-telemetry tracking. No immobilizing drugs were used during any capture operations. Following physical immobilization, measurements and biological samples were taken (blood, feces, and hair), satellite collars were fastened, and the animals were then released.

Additional collaring by MI beyond 2011 was not undertaken as per the direction of MSD due to the existence of historical telemetry and collaring data (2010 - 2016) for the Pen Islands population. This data was subsequently provided to MI confirming Pen Islands animals ranged near the P6 area of interest (i.e. God's Lake). All collaring data collected by MI for and made available by MSD for 39 Pen Islands caribou are found in Table 4.

Norway House Caribou Range/Population (Forest-dwelling)

A total of 61 Norway House caribou, part of the Molson MU, were captured and collared between 2011 and 2016 using the same methods and approvals as described for the Pen Islands animals (Table 4).

The following table provides a summary of collar deployments and data utilized. These telemetry data have been used in various analyses including: the identification of core use areas by season, identification of calving areas, and general movement patterns relative to the RAA, LAA and P6 ASR alignment.

Table 4: Total number of caribou collars annually deployed, and active collars between 2010 and 2017 in the Norway House (MI data) and Pen Islands populations (MI and MSD data)

Year	Norway House Population		Pen Islands Population	
	# Collars Deployed	# Active Collars	# Collars Deployed	# Active Collars
2010	N/A	N/A	4	4
2011	N/A	N/A	9*	13
2012	20	20	8	17
2013	11	21	10	15
2014	14	30	6	20
2015	6	32	2	17
2016	10	35	0	11
2017	0	34	N/A	N/A

N/A = MI collaring began in 2012 and ended in 2016, but some collars were still active in 2017; MSD collaring began in 2010 and the data cut-off provided was November 28, 2016

*2011 data includes eight animals collared by MI and 1 collared by MSD

6.1.2 Core Use Analysis

Spatial analysis of movement data from collared animals was performed to be utilized in evaluating potential effects that may result from the development of the P6 ASR. Volume-density kernels were created in Environmental Systems Research Institute's (ESRI) ArcGIS (ESRI, 2011) using the Home Range Tools extensions with data collected from all years (2010 - 2017) during winter telemetry surveys and GPS data in the Pen Islands and Norway House range.

For seasonal core use area analysis, five 40-day seasons were used as defined by Pond *et al*. (2016): calving (May 1st - June 9th), breeding (September 9th - October 19th), which proceeds the calving season by a 234-day gestation period (Bergerud *et al*., 2012), early winter (January 1st - February 9th), late winter (February 10th - March 21st) and summer (July 23rd - August 31st). Caribou core use areas were determined to be within the boundary of the 70% contour of the areas of caribou concentrations (i.e. 70% of the telemetry point locations are concentrated in the 70% contour of the winter and summer core use area).

6.1.3 Aerial Multispecies Surveys

Multiple aerial multispecies surveys have been conducted as part of broader baseline wildlife surveys in support of ASR planning and assessment to provide baseline data on the general distribution of caribou, moose, and furbearers during winter. Winter track surveys have been employed in assessing occupancy of large and small carnivores as well as ungulates (Stanley and Bart, 1991; Magoun *et al.*, 2007; Gardner *et al.*, 2010). Aerial multispecies surveys were conducted in portions of the RAA within a previously designated survey area for Project 6 on January 4-14, 2012; February 23-25, 2014; and February 20-21,

2016 (Map 5). Surveys were conducted during January and February, when snow and light conditions were favorable for observing tracks and larger wildlife (caribou and moose). Other wildlife occurrence included large and small carnivores through visual identification of track size and patterns. Species surveyed included moose, caribou, wolf, wolverine, martin, fisher, lynx, and fox.

Transects were spaced 5 km apart and were flown in an east-west direction using a helicopter, flying at an average speed of 90 km/hr. A crew of three biologists utilized hand-held GPS units to record locations of all tracks, animal observations, habitat type, and other notable observations such as large stick nests. Two observers on each side of the helicopter, called out track observations within a 250 m wide strip along each side of the transect line, while the third member of the team maintained detailed data sheets respecting species and location (GPS positions) of each observation, and assisted with navigation along the transect line. The data were exported to a GIS and adaptive kernels were applied to each species to map areas of relative occupancy near the ASR alignment.

Limitations included variable weather and snow conditions between years surveyed as well as inconsistent timing with the 2012 survey being conducted earlier in winter. These factors contribute to potential variation in distribution of some species. However, at the scale intended, the results provided opportunity to assess routing options relative to species distribution. The results should not be associated with species density, as kernels provide a visual representation of higher track occurrence compared to the area surveyed.

6.1.4 Other Aerial Surveys (e.g. Pre-collaring Surveys, Group Count Surveys)

Caribou group counts from other aerial surveys include pre-collaring reconisiance flights and telemetry surveys. Group and herd counts were random or based on tracking collared animals. Data on winter group sizes provides context to the numbers of caribou that could potentially occur in the RAA during construction and operation of Project 6. Data from surveys include:

- Group count surveys were conducted on March 27-29, 2012, March 19-21, 2013, and March 11-12, 2016.
- Aerial moose surveys on February 18-19, 2016 and February 6-9, 2017.

These surveys provided general information on approximate numbers near the RAA as well as some limited information on demographics. All observations of caribou were recorded during the survey on hand-held GPS units and on detailed data sheets, including the date, species observed, group size, age, and sex (when possible).

6.1.5 Trail Camera Studies

As part of a suite of baseline monitoring methods to map wildlife distribution within the RAA, trail camera studies were designed to focus on larger prey and predator species (ie; caribou, moose, wolves, and bears). Incidental observations of other small furbearers were also noted. Beginning in 2016, trail camera

site selection has been based on a hexagonal sampling grid overlain over the RAA. Trail cameras were located across the RAA and LAA (Map 6).

Hexagon sampling units facilitate spatial analysis of habitat attributes that are useful in determining wildlife occupancy (Rempel *et al.*, 2012). Sampling grids are used extensively to determine wildlife occupancy through aerial and ground surveys in boreal forest settings (e.g. Gardner *et al.*, 2010; Whittington and Heuer, 2012; Hornseth and Rempel, 2016). The application of trail camera trap event (photo) data were used to support other wildlife distribution data collected from aerial multispecies surveys, total minimum count aerial moose surveys, and trapper programs.

Trail camera placements were based on a hexagon grid of approximately 21 km^2. Sample unit size was based on maximizing the detection and occupancy of mammals with large home ranges. Trail cameras were placed within individual hexagon cells with the objective of maintaining a minimum separation of 2.5 km between camera locations. Camera trap locations were also distributed across various representative habitat types based on habitat mapping using the Land Cover Classification of Canada, East Side (LCCES), an enhanced version of the LCC layer that includes the addition of the historical fire history since 1920. Camera trap sites were placed near the proposed alignment and along existing natural and anthropogenic linear features, and game trails to provide optimum opportunity to document target species that tend to use these features for travel. The presence of a suitable helicopter landing area was also a consideration to ensure effective maintenance and retrieval of cameras.

Wildlife occurrence by hexagons was summarized by species and the total number of camera trap events. The number of camera trap events often reflects multiple animals of the same species being captured in a single photograph, however, distinguishing individuals through pelage (fur patterns), size, and/or other markings was not considered feasible due to the one year duration of camera placement, given that animals shed hair and antlers. Also, bear tampering often results in cameras being tipped, resulting in only partial photographs of individuals. For camera coding and occupancy determination, multiple photos of the same animal were only counted once. Multiple animals in a single photograph were counted (for example, if a group of two moose were caught on camera in five separate new events, the number of camera trap events is 10) (Lyra-Jorge *et al.*, 2008; Rosatte, 2011).

Caribou, moose, wolves, and black bears were analyzed by season to identify seasonal occupancy of the RAA by each species. Differences in gradient scale and shading illustrated on maps is reflective of species observation rates as some species (such as caribou) are more commonly observed (including larger groups) than others (i.e. wolf). Seasonal mapping dates were based on general terrestrial and avian wildlife distribution for spring, summer, autumn, and winter. Trail camera data collected by seasons, similar to telemetry data for caribou and wolves, are mapped based on the dates provided below:

- Spring: March 21st - June 20th;
- Summer: June 21st - September 20th;
- Autumn: September 21st - December 20th; and
- Winter: December 21st - March 20th

6.1.6 Path Trajectory Analysis

Forest-tundra and forest-dwelling caribou show very different annual movement patterns, with forest-tundra caribou demonstrating extensive movement patterns, while forest-dwelling caribou make small and concentrated annual movements (Berglund *et al*., 2014). Characterization of movement patterns can identify life-history strategies and the amount of land used annually. Preliminary analysis of caribou crossings was undertaken on existing linear features associated with ASRs to provide baseline data for future comparisons of animal movement.

Caribou GPS locations were converted into path segments by connecting successive locations. Home Range Tools 2.0 (HRT) and Geospatial Modelling Environment (GME) were used for creating path trajectories for animals. Path trajectories do not reflect the exact travel route taken by an animal, but provide a good approximation useful for investigating large-scale movement patterns. Path trajectory analysis was done seasonally to account for seasonal movement patterns of caribou, as outlined in Berglund *et al*. (2014).

Caribou exhibit a substantial decrease in daily movement rates during the calving season (May and early June), with the length of this decrease varying between animals, from a few days to more than two weeks. For path trajectory analysis, five 40-day seasons were used as defined by Pond *et al*. (2016): calving (May 1st - June 9th), breeding (September 9th - October 19th), which proceeds the calving season by a 234-day gestation period (Bergerud *et al*., 2012), early winter (January 1st - February 9th), late winter (February 10th - March 21st) and summer (July 23rd - August 31st).

6.1.7 Time and Movement Analysis

Preliminary analysis of caribou crossings was undertaken on existing linear features associated with the P6 RAA to provide baseline data for future comparisons of animal movement. Caribou GPS locations were converted into path segments by connecting successive locations. Crossing events were identified when path segments intersected linear features and separated into five 40-day seasons as described in the path trajectory section above.

6.1.7.1 Identification of Calving Sites

Joro is in the process of refining methods of identifying caribou calf mortality based on Step Analysis developed by DeMars *et al.* (2013). Caribou telemetry data from reproductive-aged female caribou from the Pen Islands population and Norway House population was analyzed to determine daily movements to identify calving and calf mortality sites from April 15th - June 30th during the years of 2011 - 2016. Based on DeMars *et al.* (2013), caribou calf step lengths increase with age after birth and are similar to adults after one month and therefore mortalities cannot be detected effectively after June 30th.

Three *a priori* movement models were used: female did not calve; female calved and calf survived to four weeks; and female calved and calf did not survive to four weeks. All three models assume step lengths are exponentially distributed, and only differ in their scale parameter (i.e. mean step length). For females that did not calve, mean step length remains constant over time. For females that calved and the calf survived to four weeks of age, the mean step length abruptly drops at calving, creating a calving break

point; the mean step length linearly increases after calving until the calf reaches adult movement rates, indicating the calf survived past four weeks and has reached adult movement rates. For females that calved and the calf did not survive to four weeks of age, the mean step length abruptly drops at calving, creating a calving break point; the mean step length begins to linearly increase until there is a second abrupt change, and the mean step length recovers to its pre-calving value, indicating a calf loss.

Models were run in program R (R Core Team, 2016) using script provided in the DeMars *et al.* (2013) appendices, and through personal communication with C. DeMars (2016). Movement graphs were generated to visually confirm that the statistical predictions match the animal's movement behavior. All calf mortality analyses are from model M2. The analysis is designed to find a mortality date within four weeks after calving (i.e. the calf is up to four weeks old), as after this point calves are traveling at the same speed as females, and collared females reach their pre-calving mean step length. Mortality dates were found up until June 30th as this was the last day of our data.

Note that linkages to this new analysis include the refinement of calving habitat models and potential resource selection models for calf mortality sites. Potential for evaluating and comparing resource selection of wolves and caribou during the critical calving and calf rearing period are being investigated for works that will be conducted in 2017 and 2018.

6.1.7.2 Fidelity Analysis

Caribou calving sites are a significant component of critical habitat. Understanding site fidelity for calving provides insight into the potential effect on individual caribou as a result of ASR routing or other anthropogenic linear features and disturbances. Calving behaviours also differ between forest and tundra forest ecotypes (Pen Islands caribou), with forest ecotypes (boreal woodland caribou) illustrating higher fidelity to calving locations.

Caribou calving sites were identified through ongoing baseline data collection efforts using GPS collar data from caribou collected according to the methods described previously. GPS collar data from the Pen Islands population and Norway House population gathered from 2010 to 2016 were used in assessing calving site fidelity. Fidelity analysis involved determining the distance between the annual calving locations (the date of least movement) to determine if caribou return to the same location to calve (Berglund *et al*., 2014). A box plot was used to show the median distance between calving site locations over consecutive calving years. Only data from animals that calved in consecutive years were used in this analysis.

6.1.8 **Habitat Modeling**

Although collar and survey data suggest that the Norway House caribou range is outside of the RAA, the Molson Boreal Caribou Management Unit intersects the RAA and LAA. In consideration of potential for boreal woodland caribou (forest-dwelling) occupancy (likely at very low densities), predictive habitat modeling was undertaken using existing telemetry data outside the RAA through resource selection functions (RSF's) modeling to examine potential habitat within the RAA, LAA and PF. Specific modeling methods are described in Section 5.1.3 and the following provides an overview of general habitat

requirements for forest-dwelling caribou. The results of RSF modeling to predict potential calving and winter habitat occurring in the RAA are presented illustrating habitat availability and potential effects to high quality habitat.

6.1.9 Habitat Disturbance Analysis

The intent of the disturbance analysis is to determine total habitat disturbance within the Molson MU relative to the sustainable threshold of 65% undisturbed (35% disturbed) habitat identified by Environment Canada (2012). Disturbance was broken into two major components consistent with those described by Environment Canada (2012) and included natural disturbance (mainly fire less than 40 years old) and anthropogenic disturbance including linear features such as Winter Roads (WR), transmission lines, as well as other footprint disturbance including forestry and quarry development. It should be noted that this Cumulative Effects Assessment (CEA) analysis was based on available data.

The road layer used for this CEA consisted of the National Road Network Roads (federal data), Class 2 (year-round secondary gravel roads, graded and ditched) access roads, Class 3a (summer access high ground road, graded and gravelled when required) community roads, highways, and park roads.

Natural disturbance area was calculated from fire data derived from the LCCES provincial fire data, to include the updated 1928 - 2015 fire layer with the time period of 1975 - 2015 for the 40-year timeframe. Anthropogenic disturbance was assessed using all linear development including transmission lines and WRs. These features were buffered by 500 m on either side of the feature based on the Environment Canada (2012) approach. Using the LCCES data, areas of harvested forests within the previous 40 years were identified and an area of disturbance was calculated for each range. Drill holes, obtained from Manitoba Growth, Enterprise and Trade (2013), were assigned a buffer with a radius of 250 m for the Molson MU.

6.1.10 Results – Caribou

6.1.10.1 Seasonal Occupation

Core Use Analysis – From Telemetry

Pen Islands Caribou Range/Population (Forest-tundra)

The Pen Islands caribou range extends across northeastern Manitoba along the Hudson Bay coastline to northwestern Ontario, including the RAA (Map 7). Early and late winter core use areas occur inland (Maps 8 and 9), while the calving core use area extends along the Hudson Bay coastline across Manitoba and Ontario (Map 10). The Pen Islands core use area move slightly more inland during summer (Map 11), and slightly further east during breeding (Map 12). Pen Islands animals occur within the RAA during all five 40-day seasons with the largest portion of a seasonal core use area occurring in the RAA in late winter (6.24%, Table 5). Pen Islands animals overlap the LAA during early and late winter (Map 8 and 9; Table 5). Only a small proportion of its seasonal core use areas occur within the LAA, with the largest portion of a seasonal core use area occurring in the LAA in early winter (1.22%; Table 5).

Norway House Caribou Range/Population (Forest-dwelling)

The Norway House core use areas occur to the west of the RAA, with no seasonal core use areas occurring within the RAA (Map 13-17; Table 6). There is little seasonal movement in the Norway House caribou core use areas (Maps 13-17).

Table 5: Pen Islands core use area in the RAA and LAA

Season	Number of core use areas	Total core use area (km^2)	Amount of core use area in RAA (km^2)	Amount of core use area in LAA (km^2)
Early Winter	4	23144.95	1098.61 (4.75%)	446.63 (1.93%)
Late Winter	5	23876.2	1490.73 (6.24%)	467.16 (1.96%)
Calving	10	28025.97	512.19 (1.83%)	0 (0%)
Summer	10	23872.95	334.29 (1.40%)	0 (0%)
Breeding	6	28677.62	416.42 (1.45%)	0 (0%)

Table 6: Norway House core use area in the RAA and LAA

Season	Number of core use areas	Total core use area (km^2)	Amount of core use area in RAA (km^2)	Amount of core use area in LAA (km^2)
Early Winter	7	2766.53	0 (0%)	0 (0%)
Late Winter	5	2039.79	0 (0%)	0 (0%)
Calving	13	5006.98	0 (0%)	0 (0%)
Summer	16	4775.50	0 (0%)	0 (0%)
Breeding	12	5353.13	0 (0%)	0 (0%)

6.1.10.2 Caribou Observations and Relative Numbers

Pen Islands Caribou Range/Population (Forest-tundra)

Caribou observations from other surveys conducted in support of ASR development across the northern portion of the LATN area provide insight into the relative spatial and temporal distribution of the Pen Islands forest-tundra caribou in the RAA. These data augment telemetry data by providing context into the numbers of caribou potentially occurring. Observation data from surveys conducted include multispecies, group counts (of collared caribou in the Gods Lake area), and incidental observations of caribou during aerial moose surveys. These surveys were conducted on various dates from 2012 - 2017 and included areas within the RAA. Surveys included group-counts and searches for non-Pen Islands

animals as part of pre-collaring surveys to determine potential areas for capture of forest dwelling caribou if present[4].

Counts of caribou ranged from 13 in 2016 to 220 in 2012. During the 2012 multispecies survey, caribou observations were most evident in the north half of the survey area, with a small concentration found to the west of Bunibonibee Cree Nation (Map 18). Similar distributions were found during the 2014 multispecies survey, with a small concentration found north of God's Lake First Nation (Map 19). During the 2016 multispecies survey, caribou tracks and observations were distributed north and west of God's Lake (Map 20). Caribou observations during moose surveys were constrained to the moose survey area which is described in Section 6.2.1.1.

These variable results are expected due to unpredictability in the timing of Pen Islands caribou migration. The results from all aerial multispecies surveys aerial caribou group count and moose surveys are found in Table 7, and provide context to the numbers of forest-tundra caribou that migrate through the RAA.

[4] Pre-collaring flights in 2012 and 2013 were intended to locate potential forest-dwelling caribou prior to Pen Islands caribou migration into the RAA for collaring as there were no provincial approvals to collar additional Pen Islands caribou. No forest-dwelling caribou could be verified as Pen Islands animals were present and no additional collaring beyond Gods Lake caribou collaring in 2011.

Table 7: Norway House caribou observations during northern multispecies surveys and other aerial surveys from 2011 - 2016

Survey Year	Tracks	Number of observed caribou	Number of observed caribou in the RAA
January 2012 Multispecies survey	-	94	33
March 2012 Group count survey	-	437	220
March 2013 Group count survey	-	148	24
February 2014 Multispecies survey	283	42	31
March 2015 Multispecies survey	726	315	116
February 2016 Multispecies survey	235	59	13
March 2016 Group count survey	-	107	0
February 2016 Moose survey	21	15	15
February 2017 Moose survey	-	142	122

6.1.10.3 Trail Camera Studies

A total of 98 trail cameras were deployed in the RAA (includes LAA) as described in Section 6.1.5. Of those deployed, 48 hexagons were sampled in the LAA. A total of 238 caribou camera trap events were recorded, of which 212 (89%) recorded caribou occurrences in the LAA. The majority of observations were recorded in the spring with 87-96%, however each camera trap does not represent separate individual caribou as there is low confidence in individual identification. The data do suggest more caribou activity during the winter. Caribou occupancy within the LAA and RAA on the hexagons sampled indicates higher levels of caribou activity in winter and spring, however, the differences in seasonal occupation cannot be statistically substantiated due to the low frequency of observations and numbers of hexagons occupied.

Results of caribou occupancy in the RAA and LAA are illustrated in Maps 21-23. Table 8 provides a summary of the percentage of camera traps events for those hexagons that were occupied for spring, summer, autumn and winter.

Table 9 provides a breakdown of the number of hexagons and percentage of total hexagons sampled within the RAA along with separate totals for the LAA. Most caribou trail camera occurrences during the spring occurred on cameras near Manto Sipi Cree Nation (Map 21), with large numbers of caribou captured together in groups. Fewer caribou were observed during the summer months, with most caribou camera occurrences occurring southeast of God's Lake First Nation (Map 22). Several cameras throughout the northern portion of the RAA caught caribou during winter, with several cameras near Manto Sipi Cree Nation and cameras east of Bunibonibee Cree Nation capturing caribou (Map 23).

Table 8: Trail camera data for caribou in the P6 LAA and RAA, March 1, 2016 – August 15, 2017

Study Area	Number of Camera Trap Events by Season*				
	Spring	Summer	Autumn	Winter	Total
LAA	204 (96%)	2 (1%)	0 (0%)	6 (3%)	**212**
RAA	207 (87%)	17 (7%)	0 (0%)	14 (6%)	**238**

*Spring = March 21st - June 20th; Summer = June 21st - September 20th; Autumn = September 21st - December 20th; Winter = December 21st - March 20th

Table 9: Trail camera hex distribution for caribou in the P6 LAA and RAA, March 1, 2016 – August 15, 2017

Study Area	Hexes with Cameras	Number of Hexes with Trap Events by Season*			
		Spring	Summer	Autumn	Winter
LAA	48	10 (59%)	2 (12%)	0 (0%)	5 (29%)
RAA	98	12 (48%)	3 (12%)	0 (0%)	10 (40%)

*Spring = March 21st - June 20th; Summer = June 21st - September 20th; Autumn = September 21st - December 20th; Winter = December 21st - March 20th

6.1.11 Movements

6.1.11.1 Annual Movement Patterns

Pen Islands Caribou

Path trajectory data were generated for those Pen Islands animals that had sufficient annual movement locational data to determine annual movement patterns. Of 42 collared Pen Islands caribou, a total of 32 animals had sufficient data for estimating annual measures, representing a total of 70 caribou-years of data. Pen Islands caribou travel large distances over the annual cycle with the average annual minimum path length estimated at 3,536 km (Std. Deviation 920 km) (Table 10). Maps 24-28 illustrate these large movements and overall annual seasonal movement patterns of Pen Islands caribou.

Results of the path trajectory analysis indicate that Pen Islands caribou gradually move inward from the Hudson Bay coast during November and December, reaching the farthest inland from the coast by mid-January and February (Map 24), then slowly returning to the Hudson Bay coast in March (Map 25) and

arriving at calving grounds in April (Abraham and Thompson, 1998; Berglund *et al*., 2014). During the calving season, Pen Islands caribou migrate large distances towards the Hudson Bay coast to calve (Map 26). Caribou continue to approach the coast during summer but do not aggregate on the coast (Map 27; Abraham *et al*., 2012; Berglund *et al*., 2014). During the breeding season, Pen Islands caribou are found at the edge of the Hudson Bay Lowlands boundary (Map 28; Abraham and Thompson, 1998).

Norway House Caribou

Of 60 collared Norway House caribou, 50 individuals had sufficient data for estimating annual measures of movement representing a total of 100 caribou-years (collective number of years monitored for the 60 caribou). Norway House caribou show smaller scale seasonal movement patterns than Pen Islands caribou and move independently (Berglund *et al*., 2014). Norway House caribou calve farther from the Hudson Bay coast than Pen Islands caribou and move from winter aggregations (Maps 29 and 30) to calve in isolation (Map 31). The average annual path length for these animals was 1,520 (Std. Deviation 297 km) (Table 10). Maps 29-33 show the annual seasonal movement patterns of Norway House caribou.

Table 10: Average annual movement path lengths for Pen Islands and Norway House caribou

Population	Number of Caribou	Total caribou-years	Average annual path length (km)
Pen Islands	32	70	3536.36 (± 919.76)
Norway House	50	100	1520.07 (± 297.38)

6.1.11.2 Time and Movement Analysis

Crossing event analysis utilized path trajectory data from the Pen Islands and Norway House populations to assess frequency of potential crossings of linear features in the RAA, including the proposed Project 6 ASR alignment, winter roads, and transmission lines (Table 11 to Table 13). Travel paths of the Norway House caribou range did not intersect the RAA, although they were observed to cross winter roads and transmission lines throughout the year within their main range. Pen Islands caribou only crossed the proposed ASR alignment and winter road during early and late winter (Table 11 and Table 12), and most caribou crossing events for the transmission line occurred in early and late winter, with two crossings occurring during the calving season (Table 13). Linear crossings occurred by only a few caribou, with a maximum of seven animals crossing transmission lines during early winter, with only one or two caribou crossing linear features seasonally.

Table 11: Project 6 proposed ASR crossing events by Pen Islands caribou from 2011 - 2016

Season	Crossing Events	Caribou with Crossings	Average Crossings per Caribou
Early Winter	11	5	2.2
Late Winter	8	2	4

Table 12: Project 6 Winter Road crossing events by Pen Islands caribou from 2011 - 2016

Season	Crossing Events	Caribou with Crossings	Average Crossings per Caribou
Early Winter	12	5	2.4
Late Winter	4	2	2

Table 13: Project 6 Transmission line crossing events by Pen Islands caribou from 2011 - 2016

Season	Crossing Events	Caribou with Crossings	Average Crossings per Caribou
Early Winter	12	7	1.7
Late Winter	1	1	1
Calving	2	1	2

Pen Islands caribou were primarily present in the RAA during early and late winter, spending an average of 10.4 and 16.7 days of the 40-day seasons in the RAA, respectively (Table 14). One Pen Islands caribou, animal “GODS05”, was present in the eastern fringe of the RAA during all five seasons and was the only collared animal present during the calving, summer, and breeding seasons.

Table 14: Time spent in the Regional Assessment Area by Pen Islands caribou from 2011 - 2016

Season	Number of Caribou	Total caribou-years	Average Number of Days spent in RAA
Early Winter	10	11	10.4 (± 8.9)
Late Winter	10	12	16.7 (± 11.8)
Calving*	1	2	22.8 (± 24.3)
Summer*	1	1	40.0
Breeding*	1	1	40.0

*Indicates that only one animal of the original ten recorded in the winter seasons during the five-year time period spent time in the RAA during the calving, summer and breeding seasons. Note that Norway House caribou were not observed to cross any linear features in the RAA as it is on the fringe of the known range.

6.1.11.3 Calving Behaviours

Identification of Calving Site Analysis

Figure 13 provides an example of the individual-based method of inferring parturition and offspring survival status in female woodland caribou described in DeMars *et al.* (2013). The black line illustrates the daily movement pattern of animal “Pen37” from May 15 to June 30, 2013 (the caribou calving period),

who gave birth (May 25, 2013) and lost her calf (June 8, 2013). The red horizontal line represents the mean step length. The vertical dashed red lines represent the estimated break points in the time series. Animal “Pen37” has two break points, indicating that the female calved and then lost the calf. The lower mean step length between the two vertical lines represents the depression in mean step length while the female is with her calf, as the mean step length of a calf is significantly lower than an adult female.

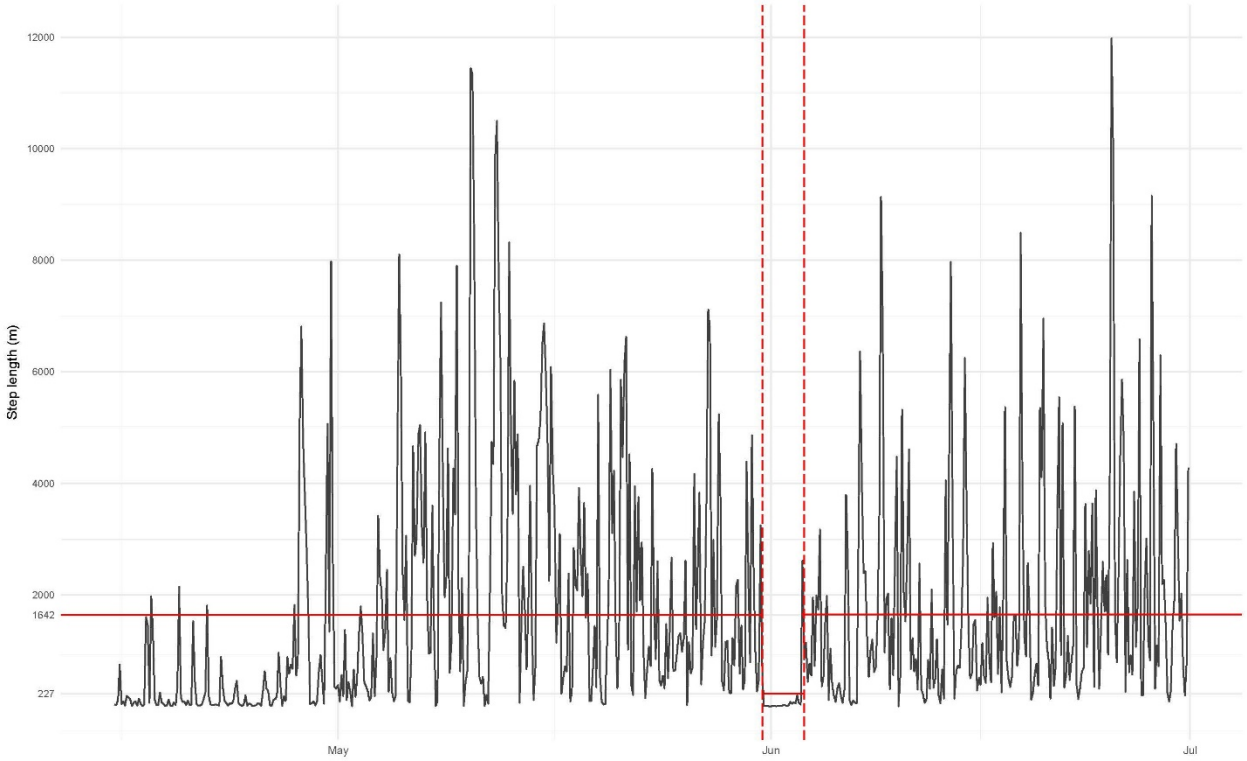


Figure 13: Total daily step length (m) for animal “Pen37” from May 15 - June 30, 2013

Figure 14 illustrates an example of a female caribou that had a calf that survived past four weeks. Animal “NorwayHouse51” has only one break point, indicating that the female calved and the calf survived past four weeks. After four weeks of age, mean step length of the calf is the same as the female. The lower mean step length after the vertical line represents the depression in mean step length while the female is with her calf, with the mean step length gradually increasing until mean step length with the calf returns to the pre-calving daily movement rate and calf mortality can no longer be detected.

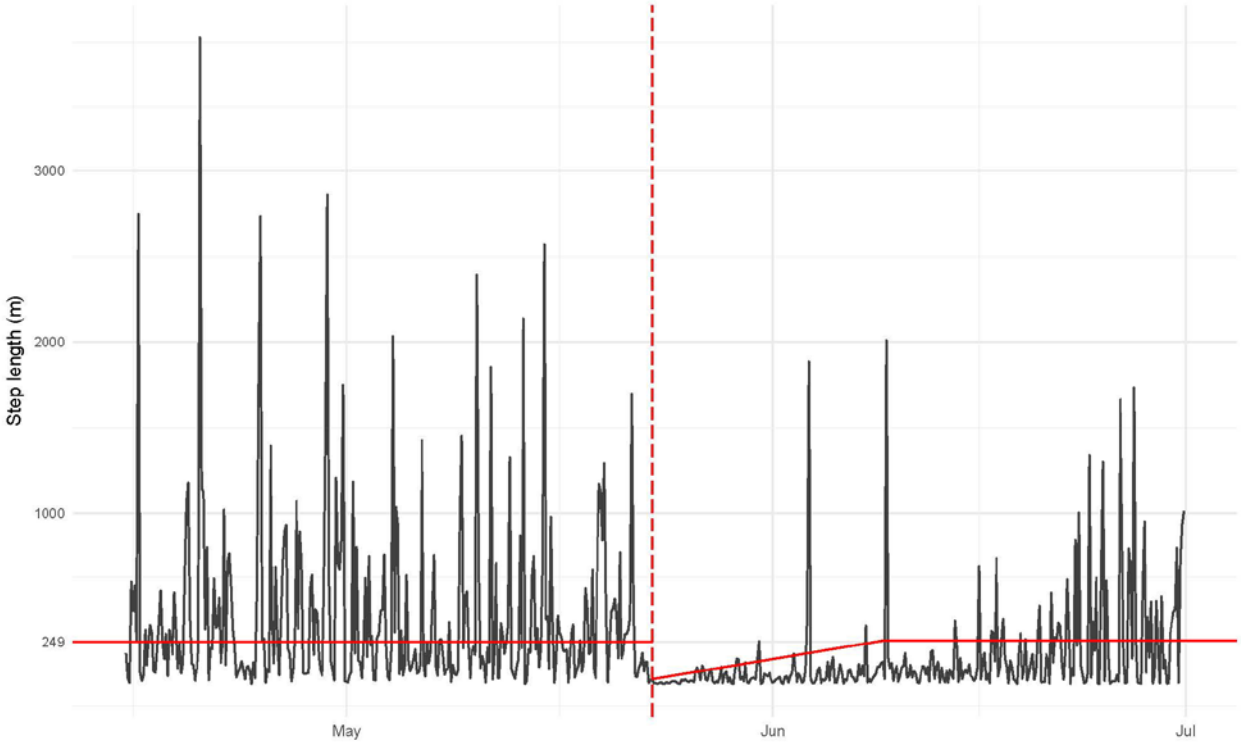


Figure 14: Total daily step length (m) for animal "NorwayHouse51" from May 15 - June 30, 2015

From 2010 - 2016, 60 female caribou were modeled from the Pen Islands population and 112 from the Norway House population. Of these 60 females, seven caribou did not calve, 12 females calved and the calf survived past four weeks of age, and 41 calved with the calf not surviving past four weeks of age (Table 15). The mean calving date for Norway House was on or within five days of May 17th each year, while the mean calving date for Pen Islands was on or within four days of May 23rd each year. Only one female was shown to calve in the RAA, with one caribou calving in the RAA in 2011. Map 34 depicts the spatial locations of modeled calving sites across both the Pen Islands and Norway House ranges. The yearly calving model results from 2010 - 2016 are shown in Table 15 illustrating that the average calving date for forest-tundra animals was later (3 - 8 days, depending on year) than forest-dwelling animals.

Table 15: Caribou calving model results from 2010 - 2016

Population	M0	M1	M2	Total	Mean calving date
Pen Islands	7	12	41	60	May 23
Norway House	17	34	61	112	May 17
Total	24	46	102	172	May 19

M0 = females did not calve; M1 = calves survived past four weeks; M2 = females calved lost within four weeks

6.1.11.4 Fidelity Analysis

The distance between calving locations in successive years was consistently smaller for Norway House caribou (Figure 15). The distances between successive calving locations for the Pen Islands and Norway House are summarized in Figure 15 and Norway House only in Figure 16. The median, minimum and maximum distances between consecutive calving sites for Pen Islands and Norway House are shown in Table 16. 27 of 31 Pen Islands caribou had calving sites more than 10 km away from previous calving sites, with only one caribou having consecutive calving sites under 1 km away from its previous calving site (Table 17). 31 of 41 Norway House caribou had calving sites less than 10 km away from previous calving sites, with 12 of those calving sites occurring under 1 km away from previous calving sites (Table 17).

This data indicates that forest-dwelling (Norway House) caribou show some degree of site fidelity. Forest-tundra (Pen Islands) caribou do not show the same degree of site fidelity, but the larger distances between calving sites may reflect the scale at which forest-tundra caribou perceive and use the landscape (Schaefer *et al*., 2000; Berglund *et al*., 2014). Forest-tundra caribou travel considerably longer distances to reach their traditional calving grounds, meaning 50 km may well be considered high fidelity when compared to the spatial extent of their whole range (Schaefer *et al*., 2000).

Table 16: Median, minimum and maximum distances between consecutive calving sites for Pen Islands and Norway House caribou

	Pen Islands (n = 31)	Norway House (n = 41)
Median Distance	92.70 km	8.23 km
Minimum Distance	0.98 km	0.004 km
Maximum Distance	277.58 km	51.95 km

Table 17: Distance of consecutive year calving sites for Pen Islands and Norway House caribou from 2010 - 2016

	Pen Islands		Norway House	
Distance between consecutive calving sites	Number of calving sites	Number of animals	Number of calving sites	Number of animals
<1 km	1	1	12	10
1-2 km	0	0	4	3
2-10 km	3	3	15	12
>10 km	27	17	10	8

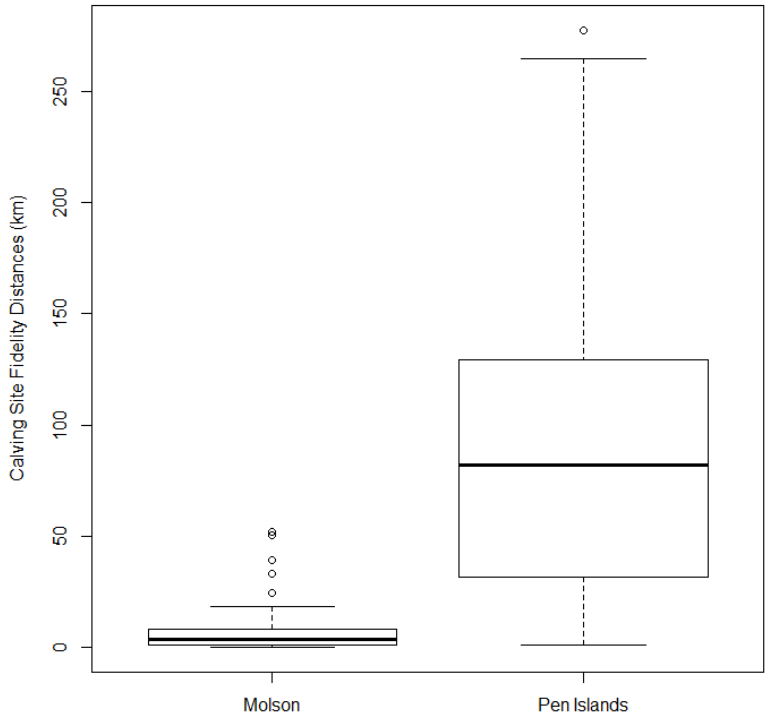


Figure 15: Calving site fidelity from 2010 - 2016 for the Pen Islands and Norway House caribou on the east side of Manitoba; boxplots showing the median distance between consecutive year calving locations

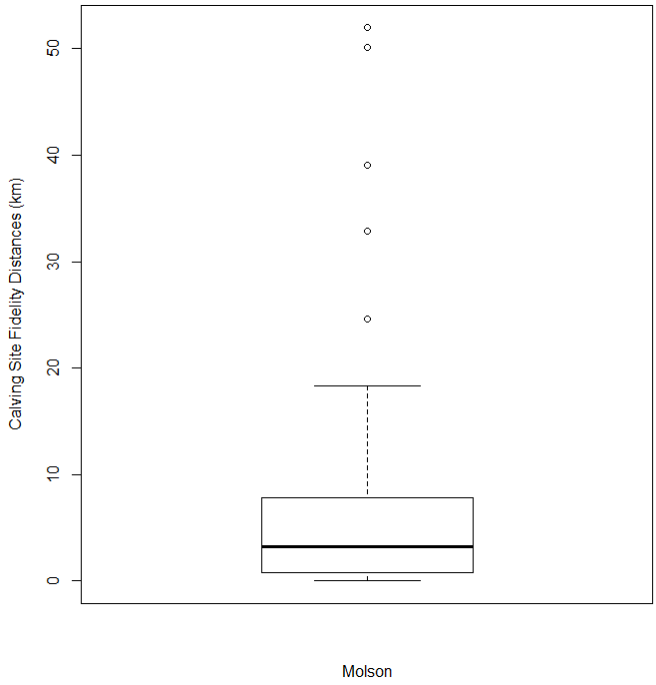


Figure 16: Calving site fidelity from 2012 - 2016 for the Norway House caribou on the east side of Manitoba; boxplots showing the median distance between consecutive year calving locations

6.1.12 Habitat Modeling

Habitat Requirements

Boreal woodland caribou are typically found in large, un-fragmented tracts of mature coniferous dominated boreal forest with low densities of interspecific competitors and their predators (Holt, 1977; Wittmer *et al.,* 2005b; Latham, 2009; Boutin *et al.*, 2012). Various boreal forest caribou habitat studies, specific to Manitoba and similar ecoregions in Saskatchewan, have revealed winter habitat selection in mature upland spruce and/or pine forests supporting arboreal and/or terrestrial lichens and multi-season association with open and treed spruce peatlands while avoiding deciduous forest (Rettie and Messier, 1998; Rettie and Messier, 2000; Brown *et al*., 2000; Lander, 2006; Schindler, 2006; Metsaranta and Mallory, 2007). Boreal woodland caribou occur at very low densities across landscapes, congregate into small groups during winter in traditional wintering areas, but during a period spanning late-April to mid-May, parturient females individually 'space-out' within lowlands in search of isolated calving and rearing sites (Bergerud *et al.*, 1990).

Calving sites are frequently associated with nutrient poor fens that support an early flush of herbaceous plants including bogbean (*Menyanthes trifoliata*), three-leafed False Soloman's Seal (*Maianthemum trifolium*), horsetails (*Equisetum spp.*) sedges (*Carex lasiocarpa*), bog willow (*Salix pedicellaris*) and bog birch (*Betula pumila*) (Cumming and Beange, 1987). Calving females have also been observed to use small islands in addition to large peatlands as isolated calving and rearing sites in northwestern Manitoba (Shoesmith and Storey, 1977; Hillis *et al*., 1998, Armstrong *et al*., 2000; Pearce and Eccles, 2004; Lander, 2006). Cows with calves tend to maintain their pattern of isolation until mid- to late- summer, after which they begin to search for conspecifics forming small groups (Malasiuk, 1999; Metsaranta and Mallory, 2007). During winter, caribou select lichen rich mature upland spruce and pine stands and/or treed muskeg and avoid deciduous forests (Hillis *et al*., 1998; Malasiuk, 1999; Armstrong *et al*., 2000; Pearce and Eccles, 2004; Metsaranta and Mallory, 2007).

Results

The variables used for the RSFs included habitat and landcover data contained in the LCC (Appendix E), as well as natural and anthropogenic disturbance (winter roads, transmission lines, etc.). Candidate models used Generalized Linear Models (glm function) with a binomial distribution. The most parsimonious mode, l with a ΔAIC of 0, provided coefficients for indicators that best explained the simplest model with the least assumptions and variables and the greatest explanatory power. The coefficients generated for each RSF model were then input into ALCES to produce prediction maps based on the weightings of indicator coefficients.

For caribou likelihood, illustrations were developed for the Hayes River Upland Ecoregion to provide a broader illustration of caribou habitat suitability across the Molson MU and a portion of the Pen Islands range. To assess the potential effect of Project 6 on habitat availability during the calving season and critical winter period, grid cell values generated from the model coefficients were categorized into three equal quantiles (bins). Area and proportion of high quality habitat (higher likelihood) within the RAA, LAA and PF were then calculated and illustrated in the tables below.

Table 18 and Table 19 illustrate the indicators (i.e., mixed forest and coniferous sparse forests) and associated weighting coefficients that represent the most parsimonious RSF model in CranR applied in ALCES to generate likelihood maps and habitat values for evaluation and assessment. Maps 35-36 illustrate the distribution of boreal caribou calving and winter habitat for the Hayes River Upland Ecoregion in relation to the Molson MU, RAA and LAA. Large areas of high likelihood boreal caribou calving habitat occurs primarily in the southern and western portions of the Hayes River Ecoregion, while there are small areas of high likelihood boreal caribou calving habitat spread throughout the RAA (Map 35). The majority of the Hayes River Ecoregion consists of high likelihood boreal caribou winter habitat, with the northern and eastern portions of the RAA containing large areas of high likelihood habitat (Map 36).

Table 18: Boreal woodland caribou RSF calving model indicators and coefficients

LCC Class	Criteria
Mixedwood Forest	-0.7094
Conifer Sparse	0.1958
Water	0.1762

Table 19: Boreal woodland caribou winter model indicators and coefficients

LCC Class	Criteria
Conifer Dense	-0.0551
Conifer Sparse	0.5416
Deciduous Forest	-0.3812
Mixedwood Forest	-0.0868
Shrubland	-0.1598
Wetland	0.6834

Results of RSF modelled habitat for boreal (forest dwelling ecotype) are illustrated in Table 20 and 21. The data illustrates the relative proportion of habitat within the Hayes River Upland Ecoregion and within the Molson Management Unit to the RAA and LAA as well as PF.

Table 20: Area and relative proportions of modeled caribou calving habitat within the Hayes River Upland Ecoregion, Molson MU, RAA, LAA and PF

Assessment Area Region	Hayes River Upland Ecoregion	Molson MU	RAA	LAA	PF
Total Area (km^2)	115,555 km^2	61,369 km^2	9,005 km^2	1,329 km^2	14 km^2
Primary Habitat (km^2)	14,752 km^2	7,867 km^2 [a]	804 km^2	250 km^2	1.57 km^2
% in Hayes River Upland Ecoregion	12.76%	6.81%	0.70%	0.22%	0.001%
% in Molson MU	NA	12.82%	0.76%[b]	0.19%[c]	NA
% in RAA	NA	NA	8.93%	2.78%	0.02%
% in LAA	NA	NA	NA	18.81%	0.12%

[a] The northern portion of the Molson Management Unit (50,754 km^2) overlaps with the Hayes River Upland Ecoregion. Within the overlap, 7,867 km^2 are primary calving habitat for caribou.

[b] Only the western portion of the RAA overlaps with the Molson Management Unit. Within that overlap, 466 km^2 are primary calving habitat for caribou.

[c] Only a small portion on the west end of the LAA overlaps with the Molson Management Unit. Within that overlap, 118 km^2 are primary calving habitat for caribou.

Table 21: Area and relative proportions of modeled caribou winter habitat within the Hayes River Upland Ecoregion, Molson MU, RAA, LAA and PF

Assessment Area Region	Hayes River Upland Ecoregion	Molson MU	RAA	LAA	PF
Total Area (km^2)	115,555 km^2	61,369 km^2	9,005 km^2	1,329 km^2	14 km^2
Primary Habitat (km^2)	43,087 km^2	15,695 km^2 [a]	2,636 km^2	968 km^2	5.9km^2
% in Hayes River Upland Ecoregion	37.29%	13.58%	2.28%	0.84%	0.005%
% in Molson MU	NA	25.57%	0.76%[b]	0.19%[c]	NA
% in RAA	NA	NA	29.27%	10.75%	0.07%
% in LAA	NA	NA	NA	72.84%	0.44%

[a] The northern portion of the Molson Management Unit (50,754 km^2) overlaps with the Hayes River Upland Ecoregion. Within the overlap, 15,695 km^2 are primary winter habitat for caribou.

[b] Only the western portion of the RAA overlaps with the Molson Management Unit. Within that overlap, 594 km^2 are primary winter habitat for caribou.

[c] Only a small portion on the west end of the LAA overlaps with the Molson Management Unit. Within that overlap, 102 km^2 are primary winter habitat for caribou.

Due to limited data on the Pen Islands/Eastern Migratory caribou range, the analysis on relative proportions of modelled habitat within the RAA and LAA could not be completed. The Pen

Islands/Eastern Migratory caribou population only use a small portion of the RAA as wintering habitat, as such the percentages of wintering habitat lost is expected to be negligible.

6.1.13 Habitat Disturbance

Pen Islands Caribou Range/Population (Forest-tundra)

There is currently no sustainable threshold of undisturbed habitat identified by Environment Canada for eastern migratory caribou. Environment Canada (2012) identified a sustainable threshold of 65% undisturbed (35%) disturbed habitat for boreal woodland caribou population, which was used for the disturbance assessment for the eastern migratory Pen Islands population. Disturbance was broken into two major components consistent with those described by Environment Canada (2012) and included natural disturbance (mainly fire less than 40 years old) and anthropogenic disturbance including linear features such as WRs, transmission lines, as well as other footprint disturbance including forestry, borrow pits and quarry development. It should be noted that this CEA analysis was based on available data.

The total area (including water) for the Pen Islands range of available data was 113,151 km^2. For disturbance analysis, we used the total area not including water, which was 90,971 km^2. The Pen Islands range has a total disturbance of 23% in 2015. The disturbance threshold within the Pen Islands range is below the 35% disturbance threshold identified by Environment Canada (2012) for boreal woodland caribou. Based on these analyses, the overall loss of habitat due to the P6 ASR footprint is a small contributor to the overall effect with fire being the greatest contributor to disturbance. Table 22 illustrates the disturbance factors and extent of disturbance of the Pen Islands range (based on available data).

Norway House Caribou Range/Population (Forest-dwelling)

The boreal woodland caribou MU included in this effects assessment is the Molson MU. The analysis conducted provides an assessment of total habitat disturbance within the MU relative to the sustainable threshold of 65% undisturbed (35% disturbed) habitat identified by Environment Canada (2012). Disturbance was broken into two major components consistent with those described by Environment Canada (2012) and included natural disturbance (mainly fire less than 40 years old) and anthropogenic disturbance including linear features such as WRs, transmission lines, as well as other footprint disturbance including forestry, borrow pits and quarry development. It should be noted that this CEA analysis was based on available data.

The total area (including water) of the Molson MU was 61,391 km^2. For disturbance analysis, we used the total area not including water, which was 51,775 km^2. The Molson MU has a total disturbance of 28% in 2015. The disturbance threshold within the Molson MU is below the 35% disturbance threshold identified by Environment Canada (2012). Based on these analyses, the overall loss of habitat due to the P6 ASR footprint is a small contributor to the overall effect with fire being the greatest contributor to disturbance.

Table 23 illustrates the disturbance factors and extent of disturbance of the Molson MU (based on available data).

Table 22: Disturbance factors and extent of disturbance of the Pen Islands range (based on available data)

Land Cover Category	Area (km^2)		Difference (km^2) (Scenario 2 - Scenario 1)	Difference as a percentage of Total Non-Water Area
	Scenario 1: Existing Winter Road	Scenario 2: New P6 ASR		
Fires	18,396	18,395	-1.10	-0.001%
Forest Harvest (less than 40 years)	0	0	0	0%
Drill Holes (less than 40 years)	222	221	-0.82	-0.001%
Mines	0.76	0.76	0	0%
Rail Active	183	183	0	0%
Transmission Line	901	853	-48	-0.052%
Roads Minor	367	501	134	0.147%
Roads Major	245	245	0	0%
Winter Road	173	93	-80	-0.088%
Disturbed Total	**20,488 (23%)**	**20,492 (23%)**	**4.23**	**0.005%**
Undisturbed Area, Non-Water	70,483	70,478	-4.23	-0.005%
Total Area, Non-Water	90,971	90,971	0	0.000%

Table 23: Disturbance factors and extent of disturbance of the Molson Management Unit (based on available data)

Land Cover Category	Area (km^2)		Difference (km^2) (Scenario 2 - Scenario 1)	Difference as a percentage of Total Non-Water Area
	Scenario 1: Existing Winter Road	Scenario 2: New P6 ASR		
Fires	12,893.87	12,893.86	-0.01	0%
Forest Harvest (less than 40 years)	61.21	61.21	0	0%
Drill Holes (less than 40 years)	173.27	172.56	-0.71	-0.001%
Mines	1.97	1.97	0	0%
Rail Active	19.69	19.69	0	0%
Transmission Line	410.32	399.51	-10.81	-0.02%
Roads Minor	99.15	119.05	19.90	0.04%
Roads Major	163.36	163.36	0	0%
Winter Road	763.15	747.73	-15.43	-0.03%
Disturbed Total	**14,586 (28%)**	**14,579 (28%)**	**-7.05**	**-0.01%**
Undisturbed Area, Non-Water	37,189	37,196	7.05	0.01%
Total Area, Non-Water	51,775	51,775	0	0%

6.1.14 Summary of Caribou Study Results

The following provides a summary of the study and survey results for both forest dwelling and forest-tundra caribou in the RAA. Evaluation of effects are provided in Section 7 (Potential Effects Assessment):

- Results of telemetry, aerial surveys, assessment of core use areas, and modeled calving sites, confirms that the RAA is on the fringes of both the Norway House and Pen Islands caribou ranges. Additionally:
    - The RAA and LAA intersect a very small portion of Pen Islands caribou core areas defined by telemetry and aerial multi species surveys.
    - No core areas of Norway House caribou intersect the RAA.
- Telemetry data indicates winter use by Pen Islands caribou during the winter, which is supported by kernel analysis from multispecies surveys conducted within the RAA.
- TK, telemetry and trail camera data indicate episodic migrations of Pen Islands caribou into the northeastern portion of the RAA during winter and low densities during other seasons.
- Both Pen Islands and Norway House caribou have low site fidelity during calving, potentially providing opportunities for calving in other areas, such as those identified through RSF modeling.
- Results of trail camera studies, aerial multispecies surveys and information from the local trapper program indicate low densities of predators (bears and wolves).
- Potential for increased populations of white tailed deer, and exposure to parasites and disease are extremely low and not expected with a high degree of confidence due to the northern limit of white-tailed deer persistence being greater than 350 km south of the RAA.
- Evidence of caribou calving is limited to one potential occurrence in 2012 of a suspected Pen Islands animal within in the RAA that occurred east of Gods Lake, well outside the LAA (10 km buffer).TK and trail camera studies confirm summer occupation at low densities in the LAA. Studies could not determine if these were forest-dwelling or forest-tundra ecotypes. Also, no calves were captured on any trail cameras in the RAA.
- Calving habitat is not limiting in the LAA, RAA or within the Molson Management Unit based on habitat modeling results, which conclude that:
    - The LAA contains 2.8% of the high-quality calving habitat within the RAA.
    - The LAA contains 0.19% of the high-quality calving habitat within the Molson MU
    - The RAA contains 0.76% of the high-quality calving habitat within the Molson MU
- Winter habitat is not limiting in the LAA, RAA or within the Molson Management Unit based on habitat modeling, which conclude that:
    - The LAA contains 10.7% of the high-quality winter habitat within the RAA.
    - The LAA contains 0.17% of the high-quality winter habitat within the Molson MU.
    - The RAA contains 1.0% of the high-quality winter habitat within the Molson MU.
- Although disturbance thresholds are not applied to eastern migratory caribou, as a precautionary evaluation we assessed Pen Islands caribou based on the 35% disturbed threshold identified by Environment Canada (2012) for boreal woodland caribou. The current overall disturbance is 23% for the Pen Islands range, with 0.005% disturbance contributed to the P6 ASR.

- For boreal woodland caribou (forest-tundra) the total disturbance regime in the Pen Islands range remains under the Environment Canada threshold (35%), and the P6 Project accounts for a small percentage of the overall disturbance in the Pen Islands range (<1%) with natural disturbance being the major factor (20%).
- The current overall disturbance is 28% for the Molson MU, which falls below the 35% disturbed threshold identified by Environment Canada (2012) for boreal woodland caribou. Additionally:
    - The LAA and the Project Footprint do not intersect the Norway House range.
    - Within the Molson MU, the combination of winter road decommissioning and the reduction of minor roads resulted in a slight decrease (-0.01%) in the overall disturbance (no change).
- For boreal woodland caribou (forest dwelling) the total disturbance regime in the Molson Management Unit remains under the Environment Canada threshold (35%), and the P6 Project accounts for a small percentage of the overall disturbance in the Molson Management Unit (<1%) with natural disturbance being the major factor (25%).

6.2 Moose

The purpose of baseline data collection on moose was to determine pre-project density estimates of moose near Project 6 and to understand the distribution, relative numbers and to assess the potential effects on moose (Section 7). Data gathered on moose were derived from a combination of sources including aerial total minimum count moose surveys, aerial multispecies winter track surveys, and trail camera seasonal occupancy studies as well as the incorporation of TK information. In contrast to other wildlife VCs with a 5 km buffer LAA, the LAA for moose evaluation was a 10 km buffer extending from the PF based on expected effects and home range characteristics of moose as well as consultation with Manitoba Sustainable Development.

6.2.1 Distribution and Abundance

6.2.1.1 Aerial Moose Surveys

Total minimum count aerial moose surveys were conducted in the winter of 2016 and 2017 to acquire baseline information on areas of high moose concentration and provide an estimate of the moose population count (Map 37). Moose surveys were conducted on February 18-19, 2016 and February 6-9, 2017 within a 2,430 km^2 survey area. Kernel density methodology was used to identify high use areas near the ASR alignments.

Surveys were based on MSD's standard three-minute grid used for aerial moose surveys; grid blocks measured 3.5 x 5.0 km and extended 10 km on each side of the proposed P6 ASR alignments. Each survey was flown at 100 percent coverage in a north/south direction using a Bell Long Ranger, along transects spaced 1 km apart, at an altitude of approximately 120 m above ground level. The average air speed for the surveys was 100 km/hr. The survey team was comprised of three biologists (i.e. two observers and one recorder). When fresh moose tracks were encountered, a reasonable effort was made to find the animal(s). The number of individuals, age classification, and gender were recorded for all animals.

6.2.1.2 Aerial Multispecies Survey

Multispecies aerial surveys to record moose distribution in the RAA were conducted in the manner described for caribou in Section 6.1.

6.2.1.3 Trail Camera Studies

Trail camera occupancy studies to determine moose distribution in the RAA were conducted according to the methods described for caribou in Section 6.1.

6.2.1.4 Access Density

Roads are known to affect wildlife movement by providing human access to previously remote areas (Heckbert *et al*., 2010). There are both positive and negative aspects of increased access. Roads provide opportunities for sustainable traditional and recreational activities. Although moose have been extensively studied, there is little research on access or disturbance thresholds. Salmo *et al.* (2004) identified a target threshold for linear disturbance on a landscape scale at 0.4 km/km^2 and a critical threshold of 0.9 km/km^2 for moose based on studies across Canada. Beazley *et al.* (2004) identified a road density threshold of 0.6 km/km^2 for moose in Nova Scotia.

Other examples include thresholds developed for sustainable forestry. A similar linear disturbance threshold was identified by the Greater Fundy Ecosystem Research Group (2005) for active roads as a criteria and indicator of sustainability. A similar threshold of 0.58 km/km^2 was developed for Forest Management Licence Area (FMLA) 1, through the Manitoba Model Forest initiative to identify indicators of sustainability in forest management (Keenan and Munn, 2008).

The density of access (winter and all-weather roads) was calculated in ALCES, to illustrate the degree of fragmentation for several Game Hunting Areas (GHAs) in Eastern Manitoba and the P6 RAA using all available data for linear development and included; major roads, minor roads, winter roads and transmission lines.

The results of past moose surveys conducted by MSD provides additional context regarding the distribution of moose in Manitoba in comparison with the P6 RAA. An examination of historical moose surveys in Eastern Manitoba provide a comparison of moose densities within the P6 area to other areas in Eastern Manitoba. Lower densities of moose are similarly observed at more northerly latitudes in Ontario, as indicated within the Ontario Ministry of Natural Resources (OMNR) ecological framework on policy advice that addresses cervid (deer family, including moose) management at the landscape scale (OMNR, 2009). In northern latitudes, (similar to the P6 RAA), moose are considered to exist at lower densities compared to more southerly latitudes.

6.2.1.5 Modeling

Modeling of habitat was conducted to assess habitat availability and distribution across the RAA and the 10 km LAA to determine potential effects of habitat loss on moose. Modeling was based on winter observation data from winter surveys conducted in 2016 and 2017. Moose observations were

incorporated into the resource selection function (RSF) model as per methods described in Section 5.1.3, to identify high through low likelihood areas of winter habitat quality. Calculations and proportions of the amount of high quality habitat within the PF, LAA (10 km buffer) and the RAA provided data to assess the magnitude of effect on habitat through removal or loss of functional habitat.

6.2.2 Results - Moose

Results presented below describe the results of total count aerial moose surveys within the baseline survey area as well as general distribution and abundance of moose within the RAA through aerial transect multispecies surveys.

6.2.2.1 Aerial Total Count Moose Surveys

Results of the February 18-19, 2016 and February 6-9, 2017 aerial moose surveys in the P6 RAA are presented in Table 24, and Maps 38 and 39. Total moose counts in each year were 63 and 68, respectively, and illustrate little variation between the two total count estimates, which provides confidence in the data. Also illustrated are the cohort classification counts and estimates for cow/calf ratios, as well as the density of moose per km^2.

Table 24: Results from the February 2016 and February 2017 aerial moose surveys in the P6 RAA

Year	Cows	Bulls	Calves	Total Count	Calf-Cow Ratio (CCR)	CCR Standard Error	Calves Per Adults (CPA)	CPA Standard Error	Density Per Km^2
2016	30	23	10	63	0.33	0.09	0.19	0.05	0.02
2017	33	11	24	68	0.73	0.08	0.55	0.08	0.04

6.2.2.2 Regional Aerial Multispecies Survey

Moose track and observation data collected during the four aerial multispecies surveys conducted in 2012, 2015, and 2016 were used to overview the distribution of moose concentrations within the Project 6 assessment areas. General distribution of moose in the RAA was determined through kernel density estimates of moose and track observations for data in, and adjacent to, the RAA.

The following provides a summary of the data utilized in mapping areas of moose use and relative density in the RAA. The general distribution of moose for each survey are illustrated in Maps 40-42. The results for 2012 and 2014 shows higher densities of moose in the southeast portion of the P6 RAA and an even distribution throughout the western portion of the RAA. Conversely, the 2016 multispecies survey illustrates a higher density in the central region of the P6 LAA. A summary of observations of moose and tracks are provided in Table 25 below.

Table 25: Moose observations during multispecies surveys from 2012, 2015 and 2016

Survey Year	Tracks	Number of observed moose
January 2012 Multispecies survey	108	16
March 2015 Multispecies survey	27	4
February 2016 Multispecies survey	240	0

6.2.2.3 Trail Camera Studies

A total of 98 trail cameras were deployed in the RAA (includes LAA) as described in Section 6.1.5. Of those deployed, 48 hexagons were sampled in the LAA. A total of 87 moose camera trap events were recorded, of which 67 recorded moose occurrences in the LAA. The majority of observations were recorded during summer with 69-70% of camera trap events occurring during summer, however, each camera trap event does not represent separate individual moose as there is low confidence in individual identification. The data do suggest more moose activity during the summer. Moose occupancy within the LAA and RAA on the hexagons sampled, do indicate higher levels of moose activity in summer, however the differences in seasonal occupation cannot be statistically substantiated due to the low frequency of observations and numbers of hexagons occupied.

Results of moose occupancy in the RAA and LAA are illustrated in Maps 43-46. During spring and summer, moose were observed on several cameras throughout the RAA, with several cameras south of Bunibonibee Cree Nation in close proximity of each capturing high numbers of moose (Maps 43-44). Few moose were observed on cameras in autumn and winter, with all moose captured during winter observed in the central region of the RAA (Maps 45-46). Table 26 provides a summary of the percentage of camera traps events for those hexagons that were occupied for spring, summer, autumn, and winter. Table 27 provides a breakdown of the number of hexagons and percentage of total hexagons sampled within the RAA, and separate totals for the RAA.

Table 26: Trail camera data for moose in the P6 LAA and RAA, March 1, 2016 - March 31, 2017

Study Area	Percent of Camera Trap Events by Season*				
	Spring	Summer	Autumn	Winter	Total
LAA	11 (16%)	46 (69%)	4 (6%)	6 (9%)	67
RAA	15 (17%)	61 (70%)	5 (6%)	6 (7%)	87

*Spring = March 21st - June 20th; Summer = June 21st - September 20th; Autumn = September 21st - December 20th; Winter = December 21st - March 20th

Table 27: Trail camera data for moose in the P6 LAA and RAA, March 1, 2016 - March 31, 2017

Study Area	Hexes with Cameras	Number of Hexes with Trap Events by Season*			
		Spring	Summer	Autumn	Winter
LAA	48	4 (8%)	6 (13%)	3 (6%)	3 (6%)
RAA	98	7 (7%)	12 (12%)	4 (4%)	3 (3%)

*Spring = March 21st - June 20th; Summer = June 21st - September 20th; Autumn = September 21st - December 20th; Winter = December 21st - March 20th

6.2.2.4 Moose Densities and Access

Table 28 illustrates the relative densities of moose across eastern Manitoba, indicating generally lower densities at more northern latitude Game Hunting Areas (GHAs) shown on Map 47. Note that survey and sampling methods varied among the years reported, which could conflict comparisons of densities between areas and years. However, these data provide a general overview of moose densities across the region, allowing for comparisons to fragmentation described below.

Table 28: Summary of moose densities in eastern Manitoba based on aerial surveys conducted from 1995 - 2017

GHA	Years	Moose/km^2
17 South*	1995 - 1996	0.0969
17 North*	1996 - 1997	0.1196
Average Density		**0.1083**
17A	2011	0.1493
17A	1999 - 2000	0.1770
17A	2006 - 2007	0.1460
Average Density		**0.1574**
26	1999 - 2000	0.2430
26	2006	0.2234
Average Density**		**0.2332**
26	2010	0.1069
26	2013	0.1677
Average Density***		**0.1373**
P6 Moose Aerial Survey	2016	**0.02**
P6 Moose Aerial Survey	2017	**0.04**
Average Density		**0.03**

* Due to the size of the area, surveys were flown in subsequent years

**Pre-population decline period

***Moose recovery period

Source: Personal Communication: Kelly Leavesley, Regional Wildlife Manager, Eastern Region, Manitoba Conservation and Water Stewardship (February 2016)

Fragmentation

Results of the analysis are presented in Table 29 and Figure 17, and illustrate the low density of roads in the RAA compared to other more southerly GHAs in eastern Manitoba. The results indicate that the more northerly areas have less disturbance than southern areas, thereby supporting a less diverse foraging opportunity for moose, generally translating into lower population densities typical of harsh northern climates with less productive ranges and shorter growing seasons (Schwartz and Renecker, 1998; OMNR, 2009; Stewart and Komers, 2012). Therefore, moose densities are not necessarily linked to disturbance, but more so to habitat productivity and climate.

Table 29: Comparison of linear footprint densities in eastern Manitoba Game Hunting Areas

GHA	Linear Footprint Density km/km^2
RAA	**0.06**
17 (>200 km south of the RAA)	**0.05**
17-B (>200 km south of the RAA)	**0.09**
17-A (>300 km south of the RAA)	**0.18**
26 (>400 km south of the RAA)	**0.26**

Figure 17 provides a visual context to the linear density analysis in the RAA.

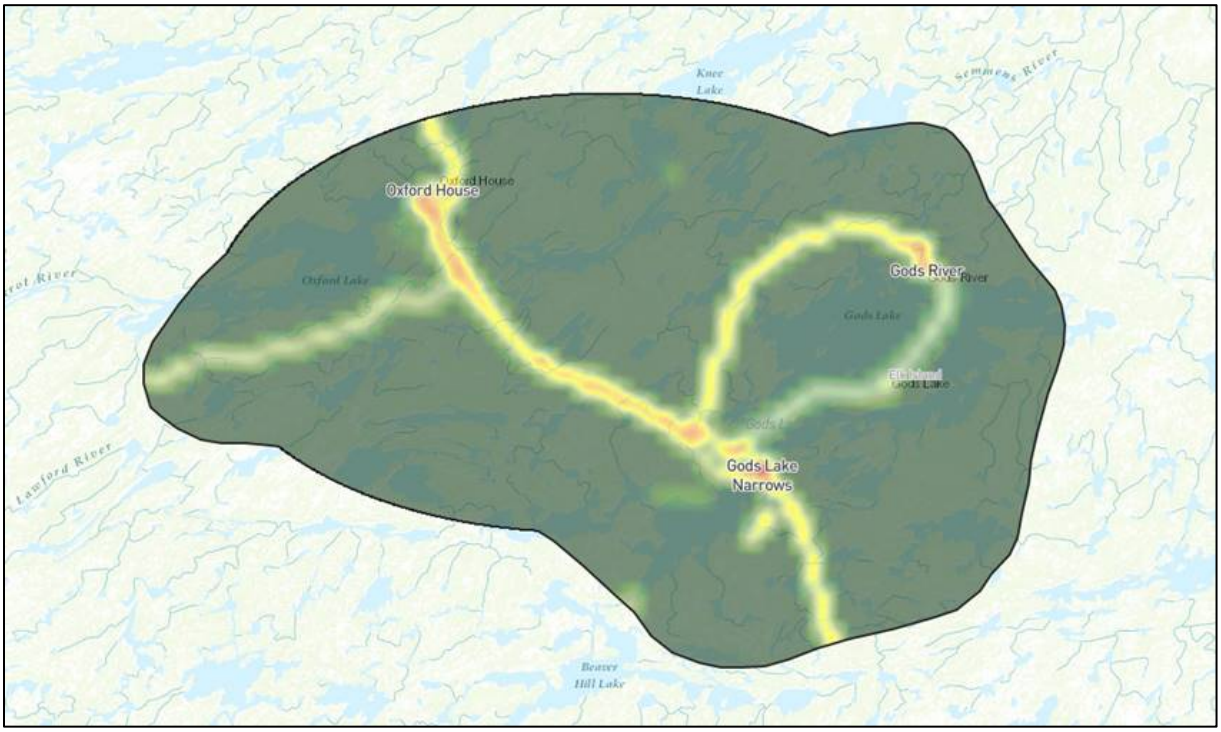


Figure 17: Linear Density Analysis in the RAA

6.2.3 Habitat Modeling

Habitat Requirements

Moose are generalist ruminant herbivores and consume large quantities of a wide variety of plant material of relatively low nutritional value; total forage consumption is limited only by digestive rate and rumen volume. Digestible energy and crude protein are considered to be the most frequently limiting food elements supplied by forage (Timmerman and McNicol, 1988).

Spring and Summer Habitat

The green period is a time when leaf material is available to moose and is highly variable depending on the dates of plant emergence, or green up in the spring and leaf drop in the fall. During summer, moose eat three to four times as much and the food is higher in digestible nutrients and crude protein than in winter. Energy requirements of pregnant cows and calves may triple or quadruple typical dietary needs. During this season, pregnant cows and calves may ingest more than 200% the energy required for maintenance. This surplus provides the energy demands of lactation, growth and maturation, antler development, breeding, and essential stores of body fat to supplement poor quality winter diets. Aquatics plants are used proportionally to their availability, and therefore, proximity to water with those resources weights highly to habitat selections by moose in the late spring and early summer months (Timmerman and McNicol, 1988).

Winter Habitat

Moose typically balance food consumption against energy expenditure. Between leaf abscission in the fall and spring green up, moose subsist on a low protein, low energy diet resulting in a state of negative energy balance. In late fall and early winter, prior to snow accumulation, moose are free to move among the best food patches (regenerating stands, riparian areas, etc.), but as winter progresses, moose may be restricted to mature coniferous stands that provide thermal cover and refugia from predators (Timmerman and McNicol, 1988).

Results

The amount of habitat removal is 5.5 km^2 which represents 0.4% within the LAA and 0.06% within the RAA. The results indicate that habitat is not limiting in the RAA and is also distributed across the RAA. Map 48 provides a representation of the spatial distribution of high likelihood/quality habitat. The mapping does illustrate that areas of potentially high-quality habitat are found throughout the LAA and RAA. The results of the analysis of moose habitat within the RAA, LAA, and PF are presented in Table 30 below.

Table 30: Evaluation of moose habitat illustrating area and proportion of habitat in the RAA, LAA, and PF

Assessment Area Region	**RAA (km^2/%)** **9,005 km^2**	**LAA (km^2/%)** **1,329 km^2**	**PF (km^2/%)** **14 km^2**
Habitat Value	Area and % RAA	Area and % of RAA	Area and % of LAA and RAA
Primary	1987 (22.1%)	495 (5.5%)	5.5 (0.4%) (0.06%)
Secondary	1726 (19.2%)	331 (3.7%)	3.1 (0.2%) (0.03%)
Total	3713 (41.2%)	826 (9.2%)	8.6 (0.6%) (0.09%)

6.2.4 Summary of Moose Study Results

The following provides a summary of the study and survey results for both forest dwelling and forest-tundra caribou in the RAA. Evaluation of effects are provided in Section 7 (Potential Effects Assessment).

- The proportion of habitat loss within the RAA was found to be 0.06 percent of available modeled high-quality habitat, suggesting habitat is not limiting.
- No unique or critical moose areas were observed during baseline studies in the LAA or RAA.
- Conducting clearing and construction activities in winter will mitigate potential impacts to calving moose during the parturition period.
- Baseline population estimate for moose was calculated and provides opportunity for monitoring potential effects.
- Moose densities are low compared to more southerly GHA observed densities. As there are very low road densities in the RAA (0.06 km/km^2), compared to the access density thresholds discussed, effects of fragmentation on moose in the RAA is expected to be negligible.
- Aerial multispecies surveys illustrate a broad distribution of moose across the RAA at low densities.
- Results of trail camera studies further confirm the general broad distribution of moose near the PF and within the LAA, suggesting mitigation will be required (described in Section 7).
- Results from local trapper program indicate low densities of predators (bears and wolves). Increased predation on moose is not expected to result from development of the P6 project.
- No white-tailed deer were observed during any field surveys, on trail cameras, or reported by local resource users, suggesting that exposure to parasites and disease as a result of deer expansion north from the current range of persistence is not expected.

6.3 Furbearers

Baseline data were gathered for a number of furbearer species of interest, including those important to local resource users within the P6 RAA. For the purpose of this assessment, marten was selected as the terrestrial furbearer VC and beaver as an aquatic furbearer VC. Information on other furbearers is found in the Existing Environment Report. Data on marten and beaver were gathered using a combination of sources including aerial multispecies winter track surveys, trail camera studies, and from observations provided by trappers and other local resource users.

6.3.1 Aerial Multispecies Survey

Multispecies aerial surveys to record furbearer distribution in the RAA were conducted as per methods described for caribou in Section 6.1.3.

6.3.2 Trail Camera Studies

Although trail camera studies were not specifically conducted to determine furbearer distribution in the RAA, incidental furbearer observations were recorded. Trail camera occupancy studies were conducted according to the methods described for caribou in Section 6.1.5.

6.3.3 Trapper Program

The P6 RAA falls mainly within portions of the God's Lake section (380) and Oxford Lake section (370) trapping areas within the Northern RTL Area 6 (Map 49). The Trapper Program (TP) was developed to study the potential effects of ASR construction in the RAA on trapline harvest and furbearer abundance and distribution. Its main goals were to initiate trapper involvement, acquire baseline data through local and regional furbearer distribution, determine habitat preferences, record current and traditional land-uses by community members, and promote collaboration with the local trapping community. Fall/winter 2016/2017 was the first year the TP was initiated with P6 trappers.

6.3.4 Modeling

Occurrence and Distribution

Modeling of marten and beaver habitat was conducted to assess habitat availability and distribution across the RAA and the LAA to determine potential effects of habitat loss. Modeling was undertaken as described in Section 5.1.3 based on habitat requirements and professional opinion. Calculations and proportions of the amount of high quality habitat within the PF, LLA and the RAA provided data to assess the magnitude of effect on habitat as a result of removal or disturbance resulting in a potential loss of functional habitat.

6.3.5 Results – Furbearers

Aerial Multispecies Survey

Marten track and beaver lodge observation data collected during the four aerial multispecies surveys conducted in 2012, 2014, 2015, and 2016 were analyzed to assess distribution concentrations or known locations relative to the Project 6 assessment areas, including the final alignment.

General distribution of beaver in relation to the LAA and RAA is illustrated in Map 50. Beaver dams and lodges occur throughout the northern and eastern portions of the RAA and occur throughout the eastern portion of the LAA (Map 50).

General distribution of marten in the RAA was determined through kernel density estimates of tracks. The general distribution of marten for each survey are illustrated in Maps 51-53. The results of the 2012 multispecies survey (Map 51) show high densities of marten in the central and western portions of the RAA and an even distribution throughout the LAA. Marten distribution during the 2014 multispecies survey were localized in the northeastern portion of the LAA and RAA near Manto Sipi Cree Nation (Map 52). Conversely, the 2016 multispecies survey showed marten distribution was primarily in the northern and central portions of the RAA and spread throughout the LAA (Map 53).

Beaver lodges and dams were found to be distributed across the RAA during surveys conducted in 2014 through to 2016. Beaver dam and lodge counts ranged from 131 in 2014 to 41 in 2016. Results of aerial multispecies surveys for furbearers in the P6 RAA are presented in Appendix G.

Trail Camera Studies

Trail camera studies designed for larger species (i.e.; moose, caribou, bear, etc.), provided incidental observation data that verified the presence of both marten and beaver within the RAA and LAA. One marten was captured in the LAA during the study period (March 2016 - March 2017). Results of trail camera studies for furbearers in the P6 RAA are presented in Appendix H.

Trapper Program

The result of the trapper harvest and other wildlife observations/tracks are provided in Table 31. Marten were the most abundant species trapped, with 71 animals harvested, followed by otter with 18 animals harvested; the remaining species were harvested in totals of five or less. Trappers also recorded wildlife observations or tracks. Marten, otter, and wolverine tracks were observed equally, with ten tracks each; moose (8) and mink (7) observations closely followed. The remaining species were observed in totals of five or less. A single skunk was also harvested in the Oxford House section. See Appendix I for all trapper harvest data.

Table 31: Trapper program species summary - Oxford House/God's Lake

Species	Scientific Name	Total Harvest	Track Observation
Marten*	*Martes americana*	71	10
Otter	*Lontra canadensis*	18	10
Beaver*	*Castor canadensis*	5	--
Fisher	*Martes pennanti*	3	2
Mink	*Neovison vison*	3	7
Lynx	*Lynx canadensis*	2	4
Muskrat	*Ondatra zibethicus*	1	--
Hare	*Lepus americanus*	1	--
Skunk	*Mephitis mephitis*	1	--
Caribou	*Rangifer tarandus caribou*	--	1
Moose	*Alces alces*	--	8
Fox	*Vulpes vulpes*	--	5
Wolf	*Canis lupus*	--	5
Weasel	*Mustela nivalis*	--	1
Wolverine	*Gulo gulo*	--	10
Total		105	63

* VC species

6.3.6 Habitat Modelling

6.3.6.1 Beaver

Habitat Requirements

Beaver are wholly dependent on water situated in close proximity to preferred food sources (Vincent, 2010). Beavers can exploit habitats where their preferred food is lacking, but they cannot survive in areas where the water supply fluctuates or is fast moving (Novak, 1987). Beavers will colonize aquatic habitats where water depth and stability can be controlled and where the water supply is permanent, but where these factors cannot be controlled (e.g., large rivers or lakes), beavers can only find refuge in isolated protected bays and islands adjacent to suitable riparian or deciduous forest stands (Allen, 1982). Stream gradient is the principal factor governing occupation of riverine habitats, and gradients greater than 15% render streams unsuitable for beaver (Retzer *et al.*, 1956). Allen (1982) also suggested that a minimum area of 0.8 km of stream length of 1.3 km^2 of either lakes or marshland were prerequisites for their consideration as beaver habitat.

Preferred food resources include trembling aspen (*Populus tremuloides*), paper birch (*Betula papyifera*), a variety of willows (*Salix* spp.), and numerous other woody shrubs as food and/or construction materials for dams and lodges (Allen, 1982; Gallant *et al.*, 2004). The foraging requirements of beaver extends beyond requirements for food in that beaver also must process woody vegetation for construction of lodges, dams, and winter food storage. However, during the growing season, more than 55% of their annual diet is comprised of aquatic vegetation (floating and emergent). As a Central Place Forager (CPF), an animal that gathers food and bring it to a central place for later consumption or use, they must balance the benefit of foraging in any particular area against the costs of energy expenditure and increased risks of predation (Severud *et al.,* 2013).

Model Development

A model for beaver was developed using ALCES as described in Section 5.1.3. Beaver require water in close proximity to deciduous trees and/or shrubs for habitat, with an assumption that these forage resources should be within 200 m of the edge of suitable water (Manitoba Forestry Wildlife Management Project, 1994). Each habitat class presented in Table 32 was assigned a coefficient in the model.

Table 32: LCC and criteria used for beaver model

LCC Class	Criteria
Deciduous Forest	Include areas of LCC class types that are located within 200 m of lakes, and large and small rivers
Mixedwood Forest	
Shrub Land	
Wetland Shrub	
Wetland Treed	

Results

The results of the analysis of beaver habitat within the RAA, LAA and PF are presented in Map 54 and Table 33. Primary beaver habitat is found in small patches throughout the LAA near water, and larger concentrations of habitat occur in the eastern portions of the RAA (Map 54).

Table 33: Distribution of beaver habitat within the RAA, LAA, and PF

Assessment Area Region	**RAA (km^2/%)** **9,005 km^2**	**LAA (km^2/%)** **1,329 km^2**	**PF (km^2/%)** **14 km^2**
Habitat Value	Area and % of RAA	Area and % of RAA	Area and % of LAA and RAA
Primary	598 (6.6%)	57 (0.6%)	0.23 (0.02%) (0.002%)
Secondary	430 (4.8%)	72 (0.8%)	0.53 (0.04%) (0.005%)
Total	1,028 (11.4%)	129 (1.4%)	0.76 (0.06%) (0.008%)

6.3.6.2 Marten

Habitat Requirements

Marten are frequently associated with dense coniferous forests with more than 60% crown cover. In an occupancy study in Ontario, Hodson *et al.* (2004) challenged the idea that marten were a habitat specialist locked into mature coniferous forest habitats and demonstrated that deciduous forest cover types were primarily used. An additional study in British Columbia examined a stable marten population (moderate-density and low mortality rate), exploiting 30 to 40-year-old regenerating stands of trembling aspen (Poole *et al.*, 2004). The small home ranges of 3.3 km^2 for males and 2.0 km^2 for females was indicative of good habitat, a fidelity that was maintained even following the removal of 17% of the mature overstory. While there was still an obvious preference for mature coniferous stands and avoidance of non-forested habitats, marten utilized all mature forest types regardless of the tree species mixture. Mature coniferous forests provide access to subnivean habitat for winter food, thermal cover and refugia from predators. In summer, marten tend to exploit the forest canopies that provide resting sites safe from

most terrestrial predators. Conversely, open and disturbed areas are generally avoided despite the availability of food and debris, particularly during the winter months (Steventon and Major, 1982).

Marten, as opportunistic foragers of small mammals, amphibians, and insects, are dependent on the coarse woody debris that creates hunting habitat below the snow layer. It accrues from broken tree limbs, logs, and stumps; the amount of which is related to both cover type and age of the forest. Small mammal prey adaptation to predator avoidance is another factor important to governing habitat selection by martens. Andruskiw *et al.* (2008) demonstrated that voles responded behaviorally to habitat-mediated vulnerability to predation by exercising caution about foraging in more open areas than under cover.

The RAA is typical of boreal shield forest, defined by a rather simple mix of treed and open wetlands, and surrounded by higher elevation stands of black spruce and jack pine with a range of age classes. Wildfire is the dominant factor driving the forest species composition and age class structure within the boreal shield ecozone (Stocks *et al.*, 2002). As there is a mix of mature forest with regenerating forests and wetlands, a relatively low proportion of area is the RAA is suitable habitat for Marten.

Model Development

A model for marten was developed using ALCES as described in Section 5.1.3. Marten are associated with mature coniferous stands and, to a lesser extent, mid-aged coniferous stands that provide less downed woody debris. Mature mixedwood and deciduous stands also serve as habitat for marten and their prey, but not to the extent that would be expected for the mature coniferous stands. Each habitat class, presented in Table 34, was weighted to reflect marten's association with mature coniferous stands.

Table 34: LCC and criteria used for marten model

LCC Class	Weight
Conifer dense (Greater than 80 years of age)	1
Conifer dense (Between 60 and 80 years of age)	0.75
Conifer dense (Between 40 and 60 years of age)	0.5
Deciduous dense (Greater than 80 years of age)	1

Results

The results of the analysis of marten habitat within the RAA, LAA and PF are presented in Map 55 and Table 35. Small patches of primary marten habitat occurred throughout the RAA, with larger concentrations of marten habitat occurring in the central and southern portions of the RAA (Map 55).

Table 35: Distribution of marten habitat within the RAA, LAA, and PF

Assessment Area Region	RAA (km^2/%) 9,005 km^2	LAA (km^2/%) 1,329 km^2	PF (km^2/%) 14 km^2
Habitat Value	Area and % of RAA	Area and % of RAA	Area and % of LAA and RAA
Primary	227 (2.5%)	30 (0.33%)	0.2 (0.02%) (0.002%)
Secondary	875 (9.7%)	167 (1.9%)	2.3 (0.18%) (0.03%)
Total	1,102 (12.2%)	197 (2.2%)	2.5 (0.19%) (0.028%)

6.3.7 Summary of Beaver and Marten Study Results

- Results of multispecies surveys, trapper program, TK, and incidental trail camera data, confirm general beaver and marten occupancy within the LAA and RAA. The proportion of habitat loss within the RAA was found to be 0.008% and 0.028% percent of available modeled high-quality habitat for beaver and marten respectively, suggesting habitat is not limiting.
- Multispecies surveys and trapper program data support occupancy and areas of high use by marten across the RAA.
- Trappers indicate beaver are plentiful, with pelt prices being a constraint to harvest.

6.4 Birds

The purpose of baseline data collection on birds was to determine pre-project occurrence and relative distribution and abundance of birds and to assess the potential effects from the P6 Project that are described in Section 7. Field sampling was undertaken for bird species of interest within the P6 RAA, including bald eagle, Canada goose, mallard, ring-necked duck, ruffed grouse, palm warbler, magnolia warbler, ovenbird, and yellow-bellied flycatcher, using a combination of sources for data including autonomous recording units (ARUs), aerial waterfowl surveys, and breeding bird survey data collected thorough the Manitoba Breeding Bird Atlas. TK gained from wildlife workshops also contributed to the understanding of bird presence and the selection of bird VCs for this project.

Autonomous Recording Units

ARUs are an effective tool used to detect vocalizations from bird and amphibian species to supplement on-site surveys. During deployment, ARUs offer the capability of determining presence of bird and amphibian species in the P6 RAA survey areas, over a daily cycle and for extended periods (many months). The use of ARUs for sampling enabled a more comprehensive assessment of birds and amphibians within the area. The goals for this survey technique were to:

- Supplement field studies by sampling species that breed as early as March and as late as August or September;
- Target provincial and federal SOCC;

- Sample species during various active periods through the day such as; diurnal (e.g., songbirds/passerines), crepuscular (e.g., common nighthawks), and nocturnal (e.g., owls); and
- Sample remote locations that are logistically difficult and expensive to sample with point counts.

ARUs were deployed in the RAA between March and July 2016 within pre-selected habitat types (Appendix J: Table J-3) and retrieved from the field by October 2016 (Map 56, see Appendix J for further detail). Aerial reconnaissance surveys were undertaken to assist in the selection and verification of forest covertypes prior to placement of the ARUs. Key criteria governing the placement of ARUs included:

- ARUs deployed along/adjacent to proposed road infrastructure;
- Habitats were selected using existing habitat information (LCCES); and
- Potential sites selected were mapped using LCCES data at a 1:10,000 scale.

The field team determined exact ARU deployment locations based on stand level habitat characteristics and logistics, where ARUs were typically set up within or near clearings close to suitable habitat to facilitate timely deployment and maintenance visits.

Expected species associations with various habitat types are found in Appendix J: Table J-1. Each ARU (model SM2+, supplied by Wildlife Acoustics Inc.) was encased in a weather-proof enclosure with four D-cell batteries, up to four 16-gigabyte memory cards, and two external microphones. Detection range of the ARU units are influenced by many factors, including humidity, temperature, source volume and directionality, and surrounding clutter. Additionally, no two microphones have the same sensitivity (Agranat, 2014). The recording units were scheduled for specific start and shut off times (Appendix J: Table J-3) to capture peak bird and amphibian call times over the breeding season. ARUs were programmed to record low frequency sounds down to 3 Hz (at a gain of 48 dB) to capture all possible vocalizations. The units were scheduled to record daily at different times of day based on the species being sampled: from March to May, in the evening and night when owls and amphibians are potentially calling; and from May to September, during the morning, evening and night when various songbirds and other species are calling (Appendix J: Table J-1).

For sample data processing and collection, sound files were downloaded and interpreted using Song Scope™ software (Wildlife Acoustics Inc.) to identify recorded birds and amphibians to species.

Detailed methods for ARU deployment and sample data protocol can be found in Appendix J.

Manitoba Breeding Bird Atlas

The Manitoba Breeding Bird Atlas (MBBA) completed a series of bird surveys in the summer of 2014 and recorded bird observations within survey grid blocks contained within 100 m x 100 m survey squares (MBBA, n.d.). These survey blocks encompassed the P6 RAA as described in the *Manitoba Breeding Bird Atlas: Report to ESRA 2014 Surveys* (MBBA, 2014b; Map 57). Species abundance was determined through point-count surveys to provide a rough measure of how many birds were in each survey block (i.e., where they are breeding). Each point count involved standing in a pre-determined location (usually along the ROW, but a small number of off-road sites in different habitat types were also completed), waiting a 1-minute calming period prior to the survey, and recording all birds heard or seen in an exact 5-minute period (MBBA, n.d.). All point count raw data for P6 was submitted to MI (MBBA, 2014a).

Aerial Waterfowl Surveys

An aerial waterfowl survey was conducted within the P6 RAA during the period of waterfowl breeding (June 16-17, 2016) and brooding (July 20-21, 2016). Aerial waterfowl surveys, using a helicopter, were conducted along and within 5 km on either side of the alignment (Map 58). The helicopter travelled at 30-40 m above the ground, with a ground speed of approximately 80-100 km/hr. Three biologists scanned the areas surveyed for all waterfowl as well as large stick nests; one of the biologists recorded the information collected onto data sheets. Survey data collection sites were recorded using hand-held GPS devices and imported to GIS software for mapping and analysis. While survey design followed Canadian Wildlife Service protocol for surveying waterfowl, other species of birds and wildlife were observed.

A reconnaissance survey was conducted within the P6 RAA on October 12-14, 2016, during the period of fall waterfowl migration (Map 59). The objective of this survey was to document general areas of migratory waterfowl staging. The area of reconnaissance was similar to the June and July survey, where flight transects along major waterbodies were surveyed within the RAA. Staging waterfowl (typically rafts of diving species) were documented and mapped, providing additional qualitative data pertaining to potential waterfowl staging areas near the P6 alignment.

Table 36: Number of birds observed along flight lines during the aerial waterfowl survey of P6, June 15-17, 2016

Species	Project Footprint (1 km buffer)	LAA	Total P6 Survey Area
Bald Eagle	2	17	23
Blue-winged Teal	0	7	17
Bufflehead	0	0	6
Canada Goose	15	63	58
Common Loon	17	24	26
Common Merganser	1	49	137
Golden Eagle	0	2	3
Greater Yellow Legs	0	19	19
Green-winged Teal	1	2	6
Mallard	9	65	106
Northern Pintail	0	11	11
Ring-necked Duck	15	248	276
Sandhill Crane	0	21	31
Scaup spp.	2	13	17
Shore bird (unknown)	0	1	1
Swainson's Hawk	0	0	1
Swan spp.	0	1	9
Unknown duck	0	0	2
Wigeon	0	0	1
Wilson's Snipe	0	0	1

Table 37: Number of birds observed along flight lines during the aerial waterfowl survey of P6, July 16, 2016

Species	Project Footprint (1 km buffer)	LAA	Total P6 Survey Area
Bald Eagle	3	4	10
Canada Goose	13	45	45
Common Loon	2	10	15
Common Merganser	0	6	7
Greater Yellow Legs	0	3	3
Green-winged Teal	0	4	4
Mallard	6	17	26
Ring-necked Duck	20	108	110
Sandhill Crane	3	5	6
Tundra Swan	2	4	6
Tern spp.	0	0	10
Unknown duck	6	55	75

Avian Desktop Studies

As part of desktop studies, BAM models were used along with ALCES to model VC songbird species, as described in Section 5.1.3, provides existing bird data, density estimates, and habitat suitability modeling. BAM models provide existing bird data, density estimates, and habitat suitability models. MBCDC species occurrence listing and conservation status ranking for the Hayes River Upland Ecoregion was also reviewed during bird desktop studies and VC modelling as indicated in Sections 3.1.1 and 5.1.1, respectively.

6.4.1 General Bird Observations and Occurrence

Of the total 6,760 individual bird observations from MBBA, ARU's, and waterfowl surveys, the majority of birds were observed in wetland shrub (28.5%) or coniferous open (25.4%) habitat (Table 38; see Appendix J for the raw data). Table 38 shows the number of birds observed during all surveys. Due to different methods of collection data during the different surveys, the numbers cannot be directly compared, but are included to show the relative number of species observed during surveys in the P6 RAA.

Table 38: Total number of bird observations by habitat type

Habitat Type	ARU	MBBA Incidental Observations	MBBA Point Count Survey	Waterfowl Surveys	Total	Number of Species	Percent of Observations
Broadleaf Dense	146	0	11	11	168	37	2.20%
Broadleaf Open	0	0	0	0	0	0	0.00%
Coniferous Dense	316	240	298	188	1042	83	13.67%
Coniferous Open	329	543	749	169	1790	88	23.48%
Coniferous Sparse	72	68	366	24	530	58	6.95%
Exposed Land	0	0	32	1	33	20	0.43%
Mixedwood Dense	0	0	0	0	0	0	0.00%
Shrub Tall	0	61	0	3	64	17	0.84%
Water	21	128	43	1481	1673	57	21.95%
Wetland Herb	128	92	40	53	313	55	4.11%
Wetland Shrub	541	184	882	268	1875	95	24.60%
Wetland Treed	0	0	127	8	135	32	1.77%
Grand Total	1553	1316	2548	2206	7623	-	100.00%

The most frequently observed birds during MBBA surveys (incidental and point count) were chipping sparrow, white throated sparrow, ruby-crowned kinglet, hermit thrush and Tennessee warbler. SOCC observed during MBBA surveys include common nighthawk, olive-sided flycatcher, yellow rail and rusty blackbird,

For the June waterfowl survey, the most frequently observed species were ring-necked duck, common merganser and mallard, while during the July survey the most frequently observed species were ring-

necked duck, Canada goose and mallard. During the October waterfowl surveys, bufflehead and goldeneye were most frequently observed. No SOCC were observed during waterfowl surveys.

The birds most frequently recorded on the ARSs include sandhill crane, Canada goose, Wilson's snipe, ruby-crowned kinglet and common raven. As all of these birds have loud vocalizations and can be heard from further distances than many other species, their relative abundance may be exaggerated compared to quieter species. The migratory forest birds most frequently recorded on the ARUs include ruby-crowned kinglet, chipping sparrow, hermit thrush, Connecticut warbler and alder flycatcher. SOCC recorded on the ARUs include short-eared owl, common nighthawk and olive-sided flycatcher.

6.4.2 Non-Migratory Raptors

6.4.2.1 Bald Eagle

Occurrence and Distribution

During aerial waterfowl surveys, 33 bald eagles were observed, one was observed during MBBA point count surveys along with two MBBA incidental observations (Map 60) (see Appendix J for the raw data). Bald eagles were primarily observed on rivers and the shores of small lakes in coniferous habitat during the MBBA point count survey and aerial waterfowl surveys, and incidental observations occurred in the west-central region of the RAA (Map 60).

Habitat Requirements

Results of literature review indicate that bald eagles select areas with a suitable nesting and roosting forest structure, accessibility to prey, low human disturbance, and close proximity to water (Johnsgard, 1990; Buehler, 2000). They use mature and old-growth forests (e.g. conifers), with open canopies and habitat edges or high degrees of foliage-height diversity to allow easy access to nest trees (Buehler, 2000). The size of the forest stand surrounding the nest tree may not be as important as distance from human disturbance (Andrew and Mosher, 1982; Livingston *et al*., 1990; Koonz, 2003); in most cases, the distance to human disturbance is more than 500 m (Buehler, 2000), while the distance to water varies (Buehler, 2000). Eagles are often located within 200 m of shorelines (Peterson, 1986), and nest or roost optimally along or near shallow streams where they can forage for live fish. Territory sizes in boreal regions of Manitoba are 5-10 km^2 (Koonz, 2003).

Model Development

A model for bald eagle breeding habitat was developed using ALCES as described in Section 5.1.3. Bald eagles prefer riparian habitats that are old enough to have large trees for nesting and perching opportunities. Forests within 200 m of lakes and large rivers greater than 70 years of age were selected in ALCES. Each habitat class was assigned a coefficient as presented in Table 39. For this model, habitat was determined as to be yes (suitable) or not and is referred to as a Boolean model approach. The results of the analysis of bald eagle habitat within the RAA, LAA and PF are presented in Table 40 and

Map 61. Primary bald eagle breeding habitat occurs throughout the LA and RAA along the shores of lakes and large rivers (Map 61).

Table 39: Model criteria for bald eagle

LCC Class	Criteria
Forest (Greater than 70 years of age)	Include total forest at least 70 years of age within 200 m of lakes and large rivers

Results

The results of the analysis of bald eagle habitat within the RAA, LAA and PF are presented in Map 61 and Table 40. Primary habitat for bald eagles makes up 23.2% of the P6 RAA, occurring through the RAA, LAA, and PF near lakes and rivers. No secondary habitat for bald eagle was found in the RAA. (Table 40, Map 61).

Table 40: Distribution of bald eagle habitat within the RAA, LAA, and PF

Assessment Area Region	**RAA (km^2/%)** **9,005 km^2**	**LAA (km^2/%)** **1,329 km^2**	**PF (km^2/%)** **14 km^2**
Habitat Value	Area and % of RAA	Area and % of RAA	Area and % of LAA and RAA
Primary	2,086.4 (23.2%)	309.2 (3.4%)	2.0 (0.15%) (0.02%)
Total	2,086.4 (23.2%)	309.2 (3.4%)	2.0 (0.15%) (0.02%)

6.4.3 Migratory Waterfowl

6.4.3.1 Canada Goose

Occurrence and Distribution

During aerial waterfowl surveys, 103 Canada geese were observed, 20 were recorded during MBBA point count surveys along with 20 MBBA incidental observations, and 112 total were identified in 16 of 45 ARU sampling sites (Map 62) (see Appendix J for the raw data). Canada geese were observed near rivers and small lakes in wetland and coniferous habitat during the MBBA point count survey and aerial waterfowl surveys, and MBBA incidental observations occurred south of Bunibonibee Cree Nation and east of Manto Sipi Cree Nation. Canada geese occurred on ARUs throughout the LAA (Map 62).

Habitat Requirements

Canada geese are found in a wide variety of habitats near water, including open and forested areas; prairies and parklands; flat, featureless arctic coastal plains and high mountain meadows; as well as a variety of managed refuge conditions and areas of human habitation (Mowbrey *et al*., 2002). They nest individually or semi-colonially on the ground; nests are large open cups made from plant material and lined with down. The birds tend to place their nests on sites with good visibility on lakes, ponds, marshes,

muskegs, wet hummocky areas and larger streams (Mowbray *et al*., 2002). Nest site microhabitats vary among subspecies. River, stream, pond, slough and mudflat habitats used by Canada goose broods are characterized by sloping shorelines and abundant plant food (reviewed by Mowbray *et al.*, 2002).

During migration, Canada geese are typically found in open areas adjacent to waterbodies, including lakes, slow-moving rivers, freshwater marshes, coastal salt marshes, bays and shallow brackish ponds; they also commonly use agricultural fields, upland heath and grassy fields (Godfrey, 1986; Sedinger and Bollinger, 1987; Reed *et al*., 1996a summarized in Mowbray *et al*., 2002).

Canada geese are herbivores. The foods consumed, and foraging areas are dependent on seasonal variation in both availability and nutritional quality of potential foods as well as on changing nutritional requirements of the birds (Mowbray *et al*., 2002). During the breeding season and spring migration, Canada geese feed predominantly on grasses, sedges, and berries (Mowbray *et al*., 2002). Studies of diet during brood-rearing are limited: goslings of the Mississippi Valley population feed almost exclusively on green leaves of grasses, sedges and rushes (Bruggink *et al*., 1994). Following fledging and during fall migration, geese tend to switch to berries and seeds (Mowbray *et al*., 2002). Agricultural crops are an important part of the diet when available.

Model Development

A model for Canada goose breeding habitat was developed using ALCES as described in detail in Section 5.1.3. Canada goose nest around lakes, rivers, ponds and small islands. Forest types within 100 m of lakes and large rivers were considered to be most favorable as was selected in ALCES. Each habitat class was assigned a coefficient as presented in Table 41. For this model, habitat was determined as to be yes (suitable) or not and is referred to as a Boolean model approach.

The results of the analysis of Canada goose habitat within the RAA, LAA and PF are presented in Map 63 and Table 42. Primary habitat for Canada goose makes up 14.9% of the P6, occurring through the RAA, LAA, and PF. No secondary habitat for Canada goose was found in the RAA. Very little Canada goose habitat will be lost within the PF and is widely available in the RAA.

Table 41: Model criteria for Canada goose

LCC Class	Criteria
Forest	Include total forest within 100 m of lakes and large rivers

Results

Table 42: Distribution of Canada goose habitat within the RAA, LAA, and PF

Assessment Area Region	RAA (km^2/%) 9,005 km^2	LAA (km^2/%) 1,329 km^2	PF (km^2/%) 14 km^2
Habitat Value	Area and % of RAA	Area and % of RAA	Area and % of LAA and RAA
Primary	1,340.0 (14.9%)	194.0 (2.2%)	0.5 (0.03%) (0.01%)
Total	1,340.0 (14.9%)	194.0 (2.2%)	0.5 (0.03%) (0.01%)

6.4.3.2 Mallard

Occurrence and Distribution

During aerial waterfowl surveys, 132 mallards were observed, there was one MBBA incidental observation, and nine total were identified in four of 45 ARU sampling sites (Map 64) (see Appendix J for the raw data). Mallards were observed throughout the LAA and the western portion of the RAA in dense coniferous, wetland shrub and water habitat during aerial waterfowl surveys. Mallards occurred on ARUs deployed near small rivers (Map 64).

Habitat Requirements

Mallards use a diversity of habitats that vary across the species' range (Drilling *et al*., 2017). Drilling *et al*. (2017) note that the success of the mallard is a reflection of its habitat preference plasticity and tolerance to cold climates. In the Ontario boreal forest, mallards tend to use fertile vegetated wetlands with areas of open water (Merendino and Ankney, 1994). A study of mallards in forested regions of Minnesota reported that females are typically found in temporary wetlands and bogs and along lake edges with emergent or overhanging vegetation (Gilmer *et al*., 1975; Kirby *et al*., 1985). The females roosted in river channels amidst dense vegetation. Mallard broods generally use edges or shallow water areas of wetlands that have emergent vegetation and open water (Gilmer *et al.,* 1975). During migration, mallards are typically found on shallow ponds and marshes as well as on flooded agricultural fields (Boreal Songbird Initiative, 2017).

Mallards nest in marshes, bogs, river floodplains, grasslands and dikes as well as a number of habitats associated with agriculture such as pastures and cropland; dense cover and proximity to water are critical attributes (Lokemoen *et al*., 1984). Upland nests are generally found within 150 m of water (Dzus and Clark, 1996; Clark and Shutler, 1999). In Manitoba, most mallards nest on dry ground, but some use over-water nests (Baydack and Taylor, 2003). Baydack and Taylor (2003) note that mallards in Manitoba "readily use enclosed over-water nest platforms as well as old stick nests in willow shrubs".

Mallards are dabblers that feed on a wide variety of foods at or just below the water surface. During the breeding season, mallards forage in shallow wetlands, shallow areas of deeper wetlands and in shoreline vegetation (Drilling *et al*., 2017). During spring migration, they feed in standing water in stubble or

sprouting grain fields (Baydack and Taylor, 2003). During fall migration, they are often found feeding in croplands.

Mallards are omnivorous generalists. They shift from predominantly animal foods (insects, aquatic invertebrates and earthworms) during the breeding season to mainly vegetation (seeds from moist-soil plants, aquatic vegetation, cereal crops and acorns) during the rest of the year (Drilling *et al*., 2017).

Model Development

A model for mallard breeding habitat was developed using ALCES as described in detail in Section 5.1.3. Mallards nest around waterbodies. Habitat within 100 m of small waterbodies was selected in ALCES. Each habitat class was assigned a coefficient as presented in Table 43. Primary habitat was derived from Boolean model results are determined as to be yes (suitable) or not. Small lakes were selected and habitat including the small lakes was included. Mallard habitat was considered less suitable on larger lakes.

Table 43: Model criteria for mallard

LCC Class	Criteria
Lake	Habitat within 100 m of small waterbodies <0.5km^2 in size

Results

The results of the analysis of mallard habitat within the RAA, LAA and PF are presented in Map 65 and Table 44. Primary habitat for mallards makes up 18.1% of the P6 RAA, occurring through the RAA, LAA and PF near lakes and rivers (Table 44, Map 65). No secondary habitat for mallard was found in the RAA.

Table 44: Distribution of mallard habitat within the RAA, LAA, and PF

Assessment Area Region	**RAA (km^2/%)** **9,005 km^2**	**LAA (km^2/%)** **1,329 km^2**	**Project Footprint (km^2/%)** **14 km^2**
Habitat Value	Area and % of RAA	Area and % of RAA	Area and % of LAA and RAA
Primary	1,628 (18.1%)	264 (2.9%)	4.0 (0.30%) (0.04%)
Total	1,628 (18.1%)	264 (2.9%)	4.0 (0.30%) (0.04%)

6.4.3.3 Ring-necked Duck

Occurrence and Distribution

During aerial waterfowl surveys, 386 ring-necked duck were observed. Ring-necked ducks were identified inone of 45 ARU sampling sites (Map 66) (see Appendix J for the raw data). Ring-necked ducks were observed throughout the LAA and the western portion of the RAA in dense coniferous, wetland shrub,

and water habitats along rivers during aerial waterfowl surveys. Ring-necked ducks occurred on one ARU deployed in sparse coniferous habitat west of Manto Sipi Cree Nation (Map 66).

Habitat Requirements

Roy *et al*. (2012) describe ring-necked duck habitat as “freshwater wetlands, especially marshes, fens, and bogs that are generally shallow (depth <1.5 m) and acidic to near-neutral (pH 5.0-8.8), with fringes of flooded or floating emergents, predominantly sedges (*Carex* spp.) interspersed with other herbaceous vegetation and shrubs; also open-water zones vegetated with abundant submerged or floating aquatic plants (e.g., water lilies, Stoudt, 1940; Mendall, 1958; Shelfox, 1977)”. Impoundments are also used (Holland and Taylor, 2003a; Stevens *et al*., 2003). Wetlands used by ring-necked ducks tend to have “relatively stable water levels, low specific conductivity (18–66 µ siemens/cm), low to moderate alkalinity (5.6–369 µ equivalents/liter), and high organic content in water” (McCauley, 1986; Eberhardt and Riggs, 1995 cited in Roy *et al*., 2012). Although the birds use wetlands with 5-75% open water in boreal regions (Rempel *et al*., 1997), they prefer small wetlands with more open water (Brown *et al*., 1996). In northern Alberta, ring-necked ducks tend to be found in fishless lakes (Paszkowski and Tonn, 2000).

Analyses of data from boreal and southern Canada identified associations between ring-necked duck abundance and amounts of deciduous forest, open water, and shoreline; other relevant factors influencing their abundance were Gross Primary Productivity (GPP), variability in minimum June temperature, and water body density (Barker *et al*., 2014). In Manitoba during the breeding season, ring-necked ducks are predominantly observed in wooded habitat on “marshy sloughs and backwaters, slow-flowing rivers, beaver ponds and lake fringes” (Holland and Taylor, 2003a); they are also found on sewage lagoons and gravel pits.

Postbreeding habitats are similar to breeding habitats and are wetlands with “fringes of flooded or floating emergents and open-water zones vegetated with abundant submerged or floating plants” (Roy *et al*., 2012). In southern boreal lakes in Manitoba, the main emergent vegetation includes hard-stem bulrush (*Scirpus acutus*) and broad-leafed cattail (*Typha latifolia*) and the predominant submergent vegetation includes of fennel-leaf pondweed (*Potamogeton pectinatus*), widgeon grass (*Ruppia occidentalis*), and muskgrass (*Chara* spp.; Bailey, 1983).

Model Development

A model for ring-necked duck breeding habitat was developed using ALCES as described in detail in Section 5.1.3. Ring-necked ducks use forest and wetland habitats near bodies of water for nesting and rearing. Each habitat class was assigned a coefficient as presented in Table 45. Primary and secondary habitat were derived from model results, with the top 25% quartile (76-100%) representing primary habitat, and the second 25% quartile (51-75%) representing secondary habitat.

Table 45: Model criteria for ring-necked duck nesting habitat

LCC Class	Criteria
Deciduous Dense	Include areas of all LCC class types that are located within 100 m of lakes and small rivers.
Deciduous Sparse	
Wetland Shrub	
Wetland Undifferentiated	
Wetland Herb	
Mixedwood Forest	
Wetland Treed	
Shrubland	

Results

The results of the analysis of ring-necked duck habitat within the RAA, LAA and PF are presented in Map 67 and Table 46. Primary habitat for ring-necked ducks makes up 22.8% of the P6 RAA, occurring through the RAA, LAA and PF near lakes and rivers (Table 46, Map 67). No secondary habitat for of ring-necked duck was found in the RAA.

Table 46: Distribution of ring-necked duck nesting habitat within the RAA, LAA, and PF

Assessment Area Region	**RAA (km²/%)** **9,005 km²**	**LAA (km²/%)** **1,329 km²**	**Project Footprint (km²/%)** **14 km²**
Habitat Value	Area and % of RAA	Area and % of RAA	Area and % of LAA and RAA
Primary	2,053.2 (22.8%)	407.5 (4.5%)	4.0 (0.3%) (0.04%)
Secondary	0	0	0
Total	2,053.2 (22.8%)	407.5 (4.5%)	4.0 (0.3%) (0.04%)

6.4.4 Non-Migratory Upland Game Birds

6.4.4.1 Ruffed Grouse

Occurrence and Distribution

Observations of ruffed grouse were limited during all bird related studies. They are considered to exist at low densities across the RAA and are also exhibit cycles in populations, which is consistent with local resource users and TK knowledge in the area. One ruffed grouse was recorded during MBBA point count surveys and identified on three of 45 ARU sampling sites (Map 68) (see Appendix J for the raw data).

Habitat Requirements

Ruffed grouse are mainly found in early-successional deciduous and mixed-wood forests and are less abundant in mature forests and in coniferous forests; thick understory and small (<0.4 ha) clearings are important attributes (Sharp, 1963; Rusch *et al*., 2000), while areas with very thick ground cover are not used. Evidence shows that large contiguous areas of forest are preferred to small or fragmented areas (Rusch *et al.,* 2000).

Ruffed grouse was found in all regenerating habitats and forest age classes in the Manitoba Model Forest and had high relative densities in all habitat types except harvested black spruce and jack pine stands (Wildlife Resource Consulting Services MB Inc and Silvitech Consulting, 1996).

Ruffed grouse nest on the ground in areas with little ground cover but dense overstory (Rusch *et al*., 2000). The nest is a shallow depression, often under a bush or at the base of a tree, stump or rock and is lined with vegetation (Rusch *et al*., 2000; Holland and Taylor, 2003b). Nests may also be built in brush piles, or in the bases of partially open, hollowed-out stumps (Cornell Lab of Ornithology, 2017).

The diet of ruffed grouse varies throughout the year. The summer diet is more varied and incorporates insects and seeds as well as deciduous leaves, buds and fruit (Rusch *et al*., 2000). Chicks forage mainly on insects and other invertebrates (Bump *et al*., 1947). In Manitoba, birds feed on high-bush cranberries (*Viburnum opulus*) in the fall (Holland and Taylor, 2003b). Important winter foods in Canada include twigs, buds and catkins of aspen, willows (*Salix spp.*) and birches (*Betula spp.*), especially aspen (Rusch *et al*., 2000). In Manitoba, ruffed grouse pick up grit from roadsides in all seasons (Holland and Taylor, 2003b).

Model Development

A model for ruffed grouse was developed using BAM as described in detail in Section 5.1.3. Primary and secondary habitat were derived from model results, with the top 25% quartile (76-100%) representing primary habitat, and the second 25% quartile (51-75%) representing secondary habitat.

Results

The results of the analysis of ruffed grouse habitat within the RAA, LAA and PF are presented in Map 69 and Table 47. No primary habitat for ruffed grouse occurs within the P6 RAA, LAA or PF while secondary habitat covers 8.4% of the RAA (Table 47, Map 69).

Table 47: Distribution of ruffed grouse habitat within the RAA, LAA, and PF

Assessment Area Region	RAA (km^2/%) 9,005 km^2	LAA (km^2/%) 1,329 km^2	PF (km^2/%) 14 km^2
Habitat Value	Area and % of RAA	Area and % of RAA	Area and % of LAA and RAA
Secondary	548.8 (8.4%)	6.7 (0.1%)	0
Total	548.8 (8.4%)	6.7 (0.1%)	0

6.4.5 Migratory Forest Birds

6.4.5.1 Palm Warbler

Occurrence and Distribution

Palm warblers were recorded 135 times during MBBA point count surveys along with 51 MBBA incidental observations (Map 70) (see Appendix J for the raw data). Palm warblers were primarily observed in wetland shrub habitat and coniferous forests in the eastern portion of the LAA and in the central and southern portion of the RAA during MBBA point count surveys and MBBA incidental observations (Map 70).

Habitat Requirements

Palm warblers are typically found in open coniferous forest, bogs and partly open habitat with scattered trees (Wilson, 2013). Across British Columbia, Albert and Minnesota, palm warblers are typically found in black spruce bogs with tamarack, alder and willow (Semenchuk, 1992; Wilson, 2013; Zlonis *et al*., 2017). Areas near water and with dense shrub cover (1-2 m tall) are typically selected (Godfrey, 1986) and birds are commonly observed in large peatlands as compared to small, isolated ones (Calmé and Desrochers, 2000). Palm warblers are insectivorous typically feeding on the ground, in shrubs or in trees (Bent, 1953; Wilson, 2013).

In Manitoba, nesting habitats include “open spruce tamarack bogs and fens, coniferous scrub and regenerating areas of cut or burned coniferous forest” (Holland *et al*., 2003a). Palm warblers nest on the ground with grass nests typically positioned in *Sphagnum* moss near the edges of bogs (Wilson, 2013), often located at the base of a shrub or small conifer tree (Wilson, 2013; Boreal Songbird Initiative, 2017).

Model Development

A model for palm warbler was developed using BAM as described in detail in Section 5.1.3. Primary and secondary habitat were derived from model results, with the top 25% quartile (76-100%) representing primary habitat, and the second 25% quartile (51-75%) representing secondary habitat.

Results

The results of the analysis of palm warbler habitat within the RAA, LAA and PF are presented in Map 71 and Table 48. Primary habitat for palm warblers covers 39.2% of the P6 RAA, occurring throughout the

RAA, LAA and PF (Table 48, Map 71). Secondary habitat for palm warblers covers 29.6% of the RAA, for a total of 68.8% of the RAA being suitable habitat for palm warblers. Almost all the PF and LAA are suitable palm warbler habitat, with 84.6% of the LAA and 98.6% of the Project Footprint being primary or secondary habitat (Table 48, Map 71).

Table 48: Distribution of palm warbler habitat within the RAA, LAA, and PF

Assessment Area Region	**RAA (km^2/%)** **9,005 km^2**	**LAA (km^2/%)** **1,329 km^2**	**PF (km^2/%)** **14 km^2**
Habitat Value	Area and % of RAA	Area and % of RAA	Area and % of LAA and RAA
Primary	3,525.3 (39.2%)	871.1 (9.7%)	11.1 (0.8%) (0.1%)
Secondary	1,947.2 (29.6%)	253.0 (2.8%)	2.7 (0.2%) (0.03%)
Total	5,472.5 (68.8%)	1,124.0 (12.5%)	13.8 (100%) (0.2%)

6.4.5.2 Magnolia Warbler

Occurrence and Distribution

Sixty-one magnolia warblers were recorded during MBBA point count surveys along with one MBBA incidental observation, and none identified on ARU recordings (Map 72) (see Appendix J for the raw data). Magnolia warblers were observed in wetland shrub habitats and coniferous forests during MBBA point count surveys throughout the LAA and in the southern portion of the RAA. MBBA incidental observations occurred south of Bunibonibee Cree Nation and in the central and southern portions of the RAA (Map 72).

Habitat Requirements

Magnolia warblers are primarily found in areas of dense young understory, mixed wood forests with abundant young conifers and pure stands of young conifers (Holland *et al*., 2003b; Dunn and Hall, 2010). Young second growth spruce are known to support the highest concentrations of birds (Hall, 1984). A preference for contiguous forest has also been observed (Hobson and Bayne, 2000b). A study in central Saskatchewan indicated the species to be abundant in white spruce-dominated stands while absent from black spruce and jackpine stands (Hobson and Bayne, 2000a).

Magnolia warblers in the Manitoba Model Forest occupied all five primary habitat types, but preferred harvested aspen mixed-woods and harvested black spruce (Wildlife Resource Consulting Services MB Inc. and Silvitech Consulting, 1996). In the Boreal Conservation Region (BCR) 8 of Manitoba, survey results indicate that magnolia warblers are associated with closed mature deciduous forest, closed young mixed forest and closed mature mixed forest (BAM, 2016).

Nests in the northern portion of the species' range are located in dense small spruce or balsam fir with the majority of nests built near the trunk at a height of less than 3 m above the ground (Dunn and Hall, 2010). Nests are typically constructed with twigs and grass (Boreal Songbird Initiative, 2017).

During the breeding season, magnolia warblers' main foraging habitats are dense conifer foliage and dense broad-leaved shrubs, foraging at mid-tree height in conifers and in low bushes close to the ground (Dunn and Hall, 2010; Boreal Songbird Initiative, 2017). Primary food items include arthropods and caterpillars with beetles and other insects also consumed (Dunn and Hall, 2010). Magnolia warblers opportunistically feed extensively on spruce budworm (*Choristoneura* sp.) during epidemics (Crawford *et al*., 1983).

Model Development

A model for magnolia warbler was developed using BAM as described in detail in Section 5.1.3. Primary and secondary habitat were derived from model results, with the top 25% quartile (76-100%) representing primary habitat, and the second 25% quartile (51-75%) representing secondary habitat.

Results

The results of the analysis of magnolia warbler habitat within the RAA, LAA and PF are presented in Map 73 and Table 49. Very little primary habitat occurs within the P6 RAA, with only 0.4% of the RAA considered primary habitat, and no primary habitat occurring in the LAA or PF (Table 49, Map 73). Secondary habitat for magnolia warblers covers 35.7% of the RAA, with most secondary habitat occurring in the southern portion of the RAA (Table 49, Map 73).

Table 49: Distribution of magnolia warbler habitat within the RAA, LAA, and PF

Assessment Area Region	**RAA (km^2/%)** **9,005 km^2**	**LAA (km^2/%)** **1,329 km^2**	**PF (km^2/%)** **14 km^2**
Habitat Value	Area and % of RAA	Area and % of RAA	Area and % of LAA and RAA
Primary	39.6 (0.4%)	0	0
Secondary	2,348.6 (35.7%)	275.4 (3.0%)	3.4 (0.3%) (0.04%)
Total	2,388.2 (36.1%)	275.4 (3.0%)	3.4 (0.3%) (0.04%)

6.4.5.3 Ovenbird

Occurrence and Distribution

Thirty-one ovenbirds were recorded during MBBA point count surveys along with 13 MBBA incidental observations and identified on 10 of 45 ARU sampling sites (Map 74) (see Appendix J for the raw data). Ovenbirds were primarily observed in wetland shrub habitat and coniferous forests south of Bunibonibee Cree Nation and west of God's Lake Narrows during MBBA point count surveys along with MBBA incidental observations. Ovenbirds occurred on ARUs deployed in the central portion of the RAA (Map 74).

Habitat Requirements

Ovenbirds primarily occur in large contiguous tracts of deciduous or mixed deciduous/coniferous forest typically in areas with canopy heights of 16-22 m and percent canopy closure of 60-90% (Porneluzi *et al*., 2011). Avoiding wet or swampy habitats, ovenbirds typically occur in areas with considerable open forest floor, thicker leaf litter layer and higher prey biomass than average (Porneluzi *et al*., 2011).

Ovenbirds require large areas of forest with the minimum requirements varying by region; a study in southern Ontario indicated that ovenbirds need an area greater than 500 ha as a minimum habitat requirement (Burke and Nol, 2000). Ovenbirds are negatively affected by forest edges and fragmentation as displayed through numerous studies examining the impacts of forest fragmentation. Studies in Saskatchewan and Ontario have shown that adult annual survival and productivity, respectively, are higher in contiguous forest than in large or small fragments (Burke and Nol, 1998; Bayne and Hobson, 2002). In contrast, fragmentation in mainly forested landscapes in New Brunswick did not impact density and nesting success (Porneluzi *et al*., 2011).

In the BCR 8 region of Manitoba, survey results indicate that ovenbirds are associated with closed young mixed forests, closed mature deciduous forests, closed mature mixed forests and mixed forest/crop habitat (BAM, 2017).

The habitat of ovenbirds during the breeding season is well-described over much of the species' range. In Alberta, ovenbirds breed in deciduous forests or mixed-woods comprised of extensive aspen or poplar with sparse undergrowth (Semenchuk, 1992). Cumming and Diamond (2002) reported higher abundance in 50-90 year old mixed-wood forest stands than in 100-140 year old stands in Central Saskatchewan. In Manitoba, they are found in a range of mature forest habitats with little understory (Holland *et al*., 2003c).

Ovenbirds are ground-nesters and tend to situate their nests in areas with deep leaf litter on relatively open forest floors with high canopy cover while avoiding areas of dense woody understory (Burke and Nol, 1998; Porneluzi *et al*., 2011).

Foraging primarily on the ground in leaf litter (Stenger, 1958), ovenbird prey include leaf-litter arthropods, forest insects and other invertebrates; adults feed nestlings carabid beetles and larvae (Porneluzi *et al*., 2011). During outbreaks of spruce budworm, the birds may shift to foraging in trees to take advantage of the unusual food source (Zach and Falls, 1975).

Model Development

A model for ovenbird was developed using BAM as described in detail in Section 5.1.3. Primary and secondary habitat were derived from model results, with the top 25% quartile (76-100%) representing primary habitat, and the second 25% quartile (51-75%) representing secondary habitat.

Results

The results of the analysis of ovenbird habitat within the RAA, LAA and PF are presented in Map 75 and Table 50. No ovenbird primary habitat occurs within the P6 RAA (Table 50). Very little ovenbird secondary habitat occurs within the RAA, with only 0.22% of the RAA comprised of secondary habitat, and no secondary habitat occurring in the Project Footprint or LAA (Table 50, Map 75).

Table 50: Distribution of ovenbird habitat within the RAA, LAA, and PF

Assessment Area Region	**RAA (km^2/%)** **9,005 km**		
Habitat Value	Area and % of RAA	Area and % of RAA	Area and % of LAA and RAA
Secondary	14.5 (0.22%)	0	0
Total	14.5 (0.22%)	0	0

6.4.5.4 Yellow-Bellied Flycatcher

Occurrence and Distribution

Seventy-four yellow-bellied flycatchers were recorded during MBBA point count surveys along with 31 MBBA incidental observations, and none were identified on ARU records (Map 76) (see Appendix J for the raw data). Yellow-bellied flycatchers were primarily observed in open coniferous and wetland shrub areas throughout the LAA and in the southern portion of the RAA during MBBA point count surveys along with MBBA incidental observations (Map 76).

Habitat Requirements

In Canada, yellow-bellied flycatchers typically use well-stratified spruce, fir or mixed forests, peatlands, and on some occasions drier coniferous forests (Gross and Lowther, 2011). Forest habitats are characterized by open canopy, dense understory, thick moss groundcover and cool, moist conditions (Gross and Lowther, 2011; Boreal Songbird Initiative, 2017). In addition, Burris and Haney (2005) noted the importance of coarse woody debris.

Yellow-bellied flycatchers are commonly found in black spruce peatlands in Saskatchewan and Alberta (Semenchuk, 1992; Smith, 1996). In Newfoundland, yellow-bellied flycatchers were significantly more common in interior forest than in riparian zones (Darroch and Montevecchi, 1997). The results from a study in lowland conifer forests in northern Minnesota suggest that yellow-bellied flycatchers are somewhat of a habitat generalist (Zlonis *et al*., 2017). According to Errington (1933), densities of yellow-bellied flycatchers were higher in medium-mature to mature coniferous forests than in young forests in Wisconsin. In the BCR 8 region of Manitoba, survey results indicate that yellow-bellied flycatchers are primarily associated with closed mature deciduous and open northern habitats; lower relative densities are found in poorly drained/riparian, mixed forest/crop and closed mature coniferous habitats (BAM, 2017).

Yellow-bellied flycatcher's nests, built primarily of moss or rootlets, are typically on or near the ground in flat or poorly drained areas of forests, bogs, swamps and muskegs (Gross and Lowther, 2011). Vegetation in the centre of the territory is dense and the nest site is cool, moist and shady (Gross and Lowther, 2011). Yellow-bellied flycatchers feed primarily in the low dense understory, in conifers and shrubs foraging on plant leaves or by catching prey, flying insects and arthropods, in the air (Gross and Lowther, 2011).

Model Development

A model for yellow-bellied flycatcher was developed by BAM as described in detail in Section 5.1.3. Primary and secondary habitat were derived from model results, with the top 25% quartile (76-100%) representing primary habitat, and the second 25% quartile (51-75%) representing secondary habitat.

Results

The results of the analysis of yellow-bellied flycatcher habitat within the RAA, LAA and PF are presented, Map 77 and Table 51. No yellow-bellied flycatcher primary habitat occurs within the P6 RAA (Table 51). Secondary habitat for yellow-bellied flycatchers covers 34.5% of the RAA, with a large concentration of secondary habitat occurring in the southeast corner of the RAA (Table 51, Map 77).

Table 51: Distribution of yellow-bellied flycatcher habitat within the RAA, LAA, and PF

Assessment Area Region	**RAA (km^2/%)** **9,005 km^2**	**LAA (km^2/%)** **1,329 km^2**	**PF (km^2/%)** **14 km^2**
Habitat Value	Area and % of RAA	Area and % of RAA	Area and % of LAA and RAA
Secondary	2,267.8 (34.5%)	416.7 (4.6%)	5.3 (0.06%) (0.4%)
Total	2,267.8 (34.5%)	416.7 (4.6%)	5.3 (0.06%) (0.4%)

6.4.6 Summary of Bird Study Results

Raptors

- Presence of bald eagles confirmed to occur across the LAA and RAA.
- Total of one nest documented within the LAA in proximity to the Project Footprint requiring attention during environmental protection planning.
- The proportion of habitat loss within the RAA was found to be less than 0.02% of available modeled high-quality habitat for bald eagle, illustrating that potential habitat availability in the RAA and LAA is not limited to the PF.

Migratory Waterfowl

- Canada geese are confirmed to be both resident (during summer) and migratory/staging during spring and fall (based on TK, aerial waterfowl surveys and ARU data), with many of the staging areas identified by through local resource users and TK are away from the PF and LAA.
- Mallard and ringed-neck duck are among the waterfowl species confirmed to nest during spring and stage in the RAA during spring and fall migrations.
- Habitat modelling indicates that nesting habitat is not limiting across the LAA or RAA, providing opportunity for nesting and staging by waterfowl.
- The proportion of habitat loss within the RAA was found to be less than 0.01% of available modeled high-quality habitat for Canada goose, 0.02% for mallard, and 0.04% for ring-necked duck, illustrating that potential habitat availability in the RAA and LAA is not limited to the PF.

Non-migratory Forest Birds

- Ruffed grouse is confirmed through ARUs, Breeding Bird Atlas field work, TK and incidental observations as occurring in the RAA at generally low densities.
- The lower quality habitat found in the RAA may be limiting this species abundance.
- Populations are known to be cyclical and may benefit from natural or other habitat disturbance.
- Modeled ruffed grouse habitat was found to be outside the Project Footprint, illustrating that potential habitat availability in the RAA and LAA is not limited to the PF.

Migratory Forest Birds

- Presence of VC migratory forest birds (song birds) is confirmed through ARUs, Breeding Bird Atlas field work, TK and incidental observations.
- General observations of birds throughout the baseline field studies illustrates the diversity and distribution of many species.
- The proportion of habitat loss within the RAA was found to be less than 0.2% of available modeled high-quality habitat for palm warbler, 0.04% for magnolia warbler, and 0.4% for yellow-bellied flycatcher.
- Modeled ovenbird habitat was found to be outside the Project Footprint, illustrating that potential habitat availability in the RAA and LAA is not limited to the PF.

6.5 Reptiles and Amphibians

Field sampling was undertaken for amphibian species of interest within the P6 RAA, including spring peeper, using one source for data: ARUs. Reptile species, such as the red-sided garter snake potentially found in the RAA, were searched for during other field activities to document incidental occurrences when discovered and included site sweeps during trail camera deployment and maintenance activities. Information from local resource users and TK also provided confirmation that red-sided garter observations have occurred in the RAA. Desktop research was also undertaken to determine any known areas of importance such as hibernaculum/den sites.

Autonomous Recording Units

The prime focus of ARU studies was to identify presence/absence of bird and amphibian species that were listed under COSEWIC, SARA, MESEA and MBCDC (also see Appendix B for further information respecting conservation status listing), and to tailor the deployment of the ARUs to those habitats sensitive to detection of the selected species as described in Appendix J: Table J-10. ARUs were deployed in the RAA between March and July 2016 within pre-selected habitat types (Appendix J: Table J-3) and retrieved from the field by October 2016 (Map 56, see Appendix J for further detail). Northern leopard frog, known to potentially be found in the RAA, were considered in the design of the habitat-based placement of the ARUs.

The eastern population of the northern leopard frog is known to occur in the RAA is ranked as S4 by the MBCDC (2016a) and breeds in permanent ponds lacking large fish. The RAA is well north of the expected breeding locales of most rare species of amphibians in Manitoba, but habitat sampling protocol was designed to permit the detection of species such as the green frog (*Lithobates clamitans*, S1/S2), a shallow water, late spring breeder that has been reported as far north as Nopiming Provincial Park (Nature North, 2017), and the mink frog (*Lithobates septentrionalis,* S3) is a late spring breeder resident to bogs, large cold permanent ponds, lakes, and slow moving rivers with abundant vegetation.

While no leopard frogs were recorded by the ARUs sampled in the P6 LAA, several other amphibian species were observed. Spring peeper was selected for a closer examination as a VC partly because it is not as widely distributed across habitats throughout Manitoba as with the boreal chorus frog (*Pseudacris maculata*) and wood frog but located primarily in regions east of Lake Winnipeg. It prefers forested habitats near shallow ponds and other wetlands and are most frequently found east of Lake Winnipeg in southeastern Manitoba (Nature North, 2017).

The timing and location of ARU deployment assumed that amphibians in the region would initiate vocalizations in late April and early May following snow melt and warming temperatures.

A more detailed summary respecting of the deployment of ARUs is provided in Appendix J.

6.5.1 Distribution

Data collection respecting information regarding populations and/or distribution of amphibians was limited to recorded vocalizations obtained from ARU stations. Of five potential species of amphibians identified as possible residents within the region (Appendix C), four were recorded as present within the RAA (Table 52; see Appendix J for the raw data).

Four amphibians were recorded with ARUs within the RAA in the spring of 2016, including the boreal chorus frog, Eastern American toad (*Anaxyrus americanus*), the spring peeper, and wood frog. Wood frogs were the most commonly recorded species, and Eastern American toad, the least observed. The RAA is at the northwest extent of the range of the Eastern American toad.

Table 52: Number of ARU sampling sites where amphibian species were identified

Amphibian Species	ARU Station Recording
Boreal chorus frog	8
Eastern American toad	1
Spring peeper	11
Wood frog	20

6.5.2 Amphibian VC - Spring Peeper

Occurrence and Distribution

Spring peepers were identified on 11 of 45 ARU sampling sites (Table 52; Map 78).

Habitat Requirements

Spring peepers are typically found associated with small wetlands in forested habitats but may occur in a wide range of habitats avoiding floodplain forest and not tolerating extensive urbanization (Frog Watch, 2014; Largett *et al*., 2017). In the Manitoba Model Forest, peeper calls often come from shallow marshy areas or near freshwater pools and ponds (Lees *et al*., 2008). In Indiana, the optimal habitat was found to be moist, upland woods with shallow ponds with the occurrence of spring peepers in forest patches related to the degree of wetland permanency (Kolozsvary and Swihart, 1999; Minton, 2001). Additionally, a landscape-level study in Maine found no association between spring peeper and the amount of forested land (Guerry and Hunter, 2002).

Spring peepers are usually found on the ground or in leaf litter (Largett *et al*., 2017). Although they are able to climb, they are rarely found more than a meter above the ground (Ontario Nature, 2016). Spring peepers undergo short distance migrations, but individuals tend to breed, feed and hibernate within the vicinity of forested wetlands (Butterfield *et al*., 2005). During fall and winter, spring peepers hibernate under logs, behind loose bark and in tree- or knot-holes (Frog Watch, 2014; Ontario Nature, 2016).

The frogs require marshes, ponds or swamps to provide an aquatic environment for their eggs and tadpoles. During the breeding season, spring peepers are found primarily in forests and regenerating woodlands near temporary or semi-permanent freshwater wetlands (including swamps, temporary pools, marshes, ponds and flooded ditches) in which they lay their eggs (Ontario Nature, 2016; Largett *et al*., 2017).

Adult spring peepers are primarily insectivores feeding in low vegetation on small invertebrates such as beetles, ants, flies, and spiders (Largett *et al*., 2017). Diet is based on prey availability and ease of capture rather than on preference (Oplinger, 1967). Spring peeper larvae (tadpoles) are suspension feeders that graze on algae, detritus, and micro-organisms (Oplinger, 1967; Butterfield *et al*., 2005).

Model Development

A model for spring peeper was developed using ALCES as described in detail in Section 5.1.3. Spring Peeper habitat was modeled to capture all forest area within a 99 m buffer of small rivers and wetland

habitats developed at a resolution of 1 km^2. Each habitat class was assigned a coefficient as presented in Table 53.

Table 53: Model criteria for spring peeper

LCC Class	Criteria
Forest	Include total forest within 99 m of small rivers/wetlands

Results

The results of the analysis of spring peeper habitat within the RAA, LAA and PF are presented in Map 79 and Table 54. Primary habitat for spring peeper covers 40.7% of the P6 RAA, occurring throughout the RAA, LAA, and PF (Table 54, Map 79).

Table 54: Distribution of spring peeper habitat within the RAA, LAA, and PF

Assessment Area Region	**RAA (km^2/%)** **9,005 km^2**	**LAA (km^2/%)** **1,329 km^2**	**PF (km^2/%)** **14 km^2**
Habitat Value	Area and % of RAA	Area and % of RAA	Area and % of LAA and RAA
Primary	2,677.7 (40.7%)	563.0 (47.9%)	8.1 (0.6%) (0.09%)
Secondary	2,028.4 (30.8%)	416.8 (4.6%)	5.0 (0.4%) (0.06%)
Total	2,353.0 (71.6%)	979.9 (52.2%)	13.1 (0.99%) (0.15%)

6.5.3 Summary of Spring Peeper Study Results

- Results of ARU's indicate spring peepers are present in the LAA.
- Habitat area associated with the PF represents less than 1% of available habitat in the LAA.

6.6 Species of Conservation Concern

All provincially and federally listed wildlife species potentially occurring in the P6 RAA, described in Section 4.5.4, were assessed. Species accounts regarding habitat, life history, and any potential issues relative to critical habitat were developed for all 14 SOCC as listed below. Field sampling was undertaken for all SOCC birds within the P6 RAA, using a combination of sources for data including ARUs, aerial waterfowl surveys, and breeding bird point count surveys.

- Bank swallow
- Barn swallow
- Canada warbler
- Common nighthawk
- Eastern wood-pewee
- Horned grebe
- Olive-sided flycatcher
- Peregrine falcon
- Rusty blackbird
- Short-eared owl
- Yellow rail
- Little brown bat
- Wolverine
- Norway House Boreal Woodland Caribou
- Pen Islands Caribou (Eastern Migratory)

Potential project associated effects were considered and described for each SOCC species with known ranges within the P6 RAA. Appendix D, and Table D-1 provides a list of the terrestrial SOCC, along with their current conservation status, a brief description of preferred habitat, potential occurrence, potential effects, mitigation opportunities, and conclusions regarding assessment in the summary of effects description has been included to verify effects assessment results in the RAA.

6.6.1 Bank Swallow

Occurrence and Distribution

No bank swallows were observed during aerial waterfowl surveys, MBBA point count surveys, MBBA incidental observations, and none identified on ARU records.

Habitat Requirements

Bank swallows breed in a variety of low-elevation natural and artificial man-made habitats such as lake and ocean bluffs, stream and river banks, reservoirs, sand and gravel pits, road cuts, sand piles, topsoil, sawdust, coal ash, and other materials (Peck and James, 1987; Garrison, 1999; Grieef, 2003a; COSEWIC, 2013b). Nest burrows are almost always in vertical or near-vertical cliffs, banks and bluffs (at least 0.75 m high with a slope between 75˚ and 105˚) in alluvial, friable soils (Hjertaas, 1984; Garrison,

1999). Bank swallows also nest in drain pipes and nesting structures specifically design for bank swallows (Garrison, 1999; Grieef, 2003a; Gulickx *et al*., 2007).

A large proportion of nesting locations occur in artificial sites across Canada; they were the dominant nesting habitat in British Columbia (87%; Erskine, 1979); while in the Maritimes, only 25% of nests were in artificial sites (Erskine, 1979). The Prairie provinces (including Manitoba) were more similar, with 43% of nests in artificial sites (Erskine, 1979). Artificial islands created at Oak Hammock Marsh in Manitoba for waterfowl breeding provide nesting sites for hundreds of bank swallows (Grieef, 2003a). Bank swallows tend to avoid woodlands, deserts, montane areas, and alpine areas due to scarcity of suitable nesting habitat (Garrison, 1999; Grieef, 2003a). Bank swallow breeding density and distribution is correlated to the distribution of exposed unconsolidated deposits of glacial lacustrine origin, such as in large areas were post-glacial lakes existed, especially in areas with thick sediment deposits (Garrison, 1999).

Bank swallows require eroding, vertical banks composed of unconsolidated substrates such as silty fine sands for nesting (Silver and Griffin, 2009; COSEWIC, 2013b). Substrate penetrability and the proportions of substrate particle sizes are imperative for burrowing (Garrison, 1999). Bank swallows use wide banks composed of well-drained, very fine sands (<900 µm) such as fine sandy loam soils (Hjertaas, 1984; Lind *et al*., 2002; Heneberg, 2003; Heneberg, 2009; Silver and Griffin, 2009). Bank swallow colony sizes are generally larger in areas with the greatest proportion of silt to sand (Hjertaas, 1984; Garrison, 1999).

Bank swallows are locally abundant breeders occurring throughout Manitoba, but with few northern breeding locations (Grieef, 2003a). Bank swallows are a common and locally distributed summer resident of southern Manitoba (Thompson, 1890; Grieef, 2003a).

6.6.2 Barn Swallow

Occurrence and Distribution

No barn swallows were observed during aerial waterfowl surveys, MBBA point count surveys, MBBA incidental observations, and none identified on ARU records.

Habitat Requirements

Prior to European settlement, barn swallows nested in natural features such as caves, crevices, holes, and ledges associated with rocky cliff faces (Speich *et al.*, 1986; Peck and James, 1987; Grieef, 2003b; COSEWIC, 2011b). With the rapid expansion of the human population post-European settlement, barn swallows have shifted from natural to artificial nesting sites, with it being suggested that only 1% of barn swallows in Canada using natural nesting sites (Speich *et al.*, 1986; Erskine, 1979; COSEWIC, 2011b). Barn swallows may continue to nest in traditional natural situations but are more closely associated with human situations in rural areas, nesting on a variety of artificial structures that provide a horizontal nesting surface (such as a ledge) or a vertical face with an overhang that provides shelter (COSEWIC, 2011b). Barn swallows will nest in and around open barns, garages, sheds, boat houses, bridges, road culverts, verandahs and wharfs, and on beams, posts, light fixtures, and ledges over windows and doors

(Brown and Brown, 1999; Grieef, 2003b; COSEWIC, 2011b). Barn swallows require wet sites with a nearby body of water that provides mud for nest-building (Brown and Brown, 1999).

Barn swallows were relatively rare in southern Manitoba in the late 19th century; their range now extends over nearly the entire province (Thompson, 1890; Grieef, 2003b). Barn swallows are now widespread throughout Manitoba in agricultural regions, locally common in inhabited areas of the boreal forest, and rare in or near northern communities (Brown and Brown, 1999; Grieef, 2003b).

6.6.3 Canada Warbler

Occurrence and Distribution

No Canada warblers were observed during MBBA point count surveys, MBBA incidental observations, and none were identified on ARU records.

Habitat Requirements

Canada warblers inhabit a wide range of deciduous, coniferous, and mixed forests with well-developed shrub layers and structurally complex forest floors (Conway, 1999; COSEWIC, 2008a; Reitsma *et al.*, 2010; Environment Canada, 2016a). They are often found in shrub marshes, cedar stands, coniferous swamps dominated by black spruce (*P. mariana*) and tamarack (*L. laricina*), red maple (*Acer rubrum*) stands, moist spruce-birch (*Betula* spp.) forests, and larch and riparian woodlands along rivers and lakes, often on steep brushy slopes and ravines near these habitats (Peck and James, 1987; Brauning, 1992; Semenchuk, 1992; Larue *et al*., 1995; Cooper *et al*., 1997; Wildlife Resource Consulting Service MB Inc. and Silvitech Consulting, 1997; Conway, 1999; Drapeau *et al*., 2000; Reitsma *et al.*, 2010). Suitable habitat often has a developed layer of moss with an uneven forest floor (Reitsma *et al.*, 2010).

Canada warblers breed in mature upland forests, with canopy gaps that have a well-developed shrub layer (Schieck *et al*., 1995; Enns and Siddle, 1996; Cooper *et al*., 1997; Hobson and Bayne, 2000a; Schieck and Hobson, 2000; Hannon *et al*., 2004; Lambert and Faccio, 2005). They can also be locally abundant throughout their breeding range in regenerating forests (6-30 years post-disturbance) following forest fires or anthropogenic disturbances (Wildlife Resource Consulting Service MB Inc. and Silvitech Consulting, 1997; Schieck and Hobson, 2000; Hobson and Bayne, 2000b; Reitsma *et al.*, 2010).

Female Canada warblers select nesting areas consisting of dense shrubs that provide high concealment, and coarse woody debris and higher tree stem density are main structural features (Peck and James, 1987; Conway, 1999; Reitsma *et al.*, 2010). Canada warblers nest on or near the ground, often on slopes, knolls, in earthen banks, rotting tree stumps, holes of root masses, clumps of grass, or rocky areas (Peck and James, 1987; Reitsma *et al.*, 2010; Environment Canada, 2016a).

6.6.4 Common Nighthawk

Occurrence and Distribution

No common nighthawks were observed during aerial waterfowl surveys, one was recorded during MBBA point count surveys along with two MBBA incidental observations, and 11 total identified on two of 45 ARU sampling sites (see Appendix J for the raw data).

Habitat Requirements

Common nighthawks require open ground or clearings for nesting, and breed in a variety of open habitats including open forests (such as mixedwood and coniferous stands, burns, and clearcuts), grasslands (such as short-grass prairies, pastures, and grassy plains), sandy areas (such as eskers, dunes and beaches), sagebrush, wetlands (such as bogs, marshes, lakeshores and riverbanks), gravelly or rocky areas (such as outcrops, barrens, gravel roads, gravel rooftops, railway beds, quarries, mines, bare mountain tops and ridges) and cultivated or landscaped areas (Campbell *et al.*, 2006; COSEWIC, 2007a; Brigham *et al.*, 2011; Environment Canada, 2016b).

Common nighthawk nests have been observed near other common nighthawk nests (25 to 75 m apart), suggesting that small patches of suitable nesting habitat are not limited to only one breeding pair (Sutherland, 1963). Common nighthawks do not make nests, but eggs are laid on the ground on sand, gravel, or rock in shaded areas with low or no vegetation, adequate camouflage from predators (Godfrey, 1986; Lohnes, 2010; Allen and Peters, 2012).

Common nighthawks forage for flying insects in open areas during crepuscular periods, and sometimes foraging during the day. Foraging habitat needs are met in a wide range of habitats, but open water and artificial lighting are favoured, attracting flocks as large as several hundreds of individuals (Campbell *et al.*, 2006; COSEWIC, 2007a). Tree limbs, the ground, fenceposts, and rooftops with adequate shade and camouflage from predators are suitable roost sites (Fisher *et al.*, 2004; Campbell *et al.*, 2006).

6.6.5 Eastern Wood-pewee

Occurrence and Distribution

No eastern wood-pewees were observed during aerial waterfowl surveys, MBBA point count surveys, MBBA incidental observations, and none identified on ARU records. However, the eastern wood-pewee is a SOCC in the Hayes River Upland Ecoregion.

Habitat Requirements

In Canada, eastern wood-pewees primarily breed in mature and intermediate-age deciduous and mixed forests having an open understory, occasionally selecting more open coniferous woodland (Godfrey 1986; Peck and James, 1987; Falconer, 2010; Burke *et al.*, 2011). Eastern wood-pewees are often associated with sugar maple (*Acer saccharum*), elm (*Ulmus* sp.) and oak (*Quercus* sp.) forests and are often associated with forest clearings and edges near nesting sites (Hespenheide, 1971; Peck and James, 1987; McCarty, 1996; COSEWIC, 2012). Eastern wood-pewee select territory with fewer trees

and greater forest openness, allowing for bouts of aerial foraging activity (Falconer, 2010; COSEWIC, 2012). Although often found in riparian areas in the Midwest, eastern wood-pewees reach higher breeding densities in upland sites than lowland forests, and nesting in wet forests likely reflects preference for open space near the nest site (Murray, 1969; Peck and James, 1987; McCarty, 1996; Newell and Rodewall, 2011; COSEWIC, 2012).

The size of forest fragments likely is not an important factor in habitat selection, but eastern wood-pewees occur less frequently in woodlots surrounded by residential development than in woodlots without houses (Stauffer and Best, 1980; Blake and Karr, 1987; Robbins *et al.*, 1989; Keller and Yahner, 2007; COSEWIC, 2012).

The northwestern range limit of the eastern wood-pewee is southern Manitoba and extreme southeastern Saskatchewan and is a fairly common breeder in the southern fifth of the province (Holland *et al*., 2003d).

6.6.6 Horned Grebe

Occurrence and Distribution

No horned grebes were observed during aerial waterfowl surveys, MBBA point count surveys, MBBA incidental observations, and none were identified on ARU records.

Habitat Requirements

Horned grebes primarily breed in temperate zones such as parklands and prairies but can also be found in boreal and subarctic zones (COSEWIC, 2009a). Nesting occurs in freshwater (and occasionally in brackish water) on small ponds, shallow bays and marshes on lake borders (Faaborg, 1976; Kantrud and Stewart, 1984; Holland and Taylor, 2003c). Horned grebes select ponds in both open and forested areas (Godfrey, 1986). Horned grebes that inhabit the prairies prefer lakes and permanent or semi-permanent natural ponds lasting until autumn, as well as artificial ponds and reservoirs created by road excavation for construction, river damming, or for retaining rain (Stedman, 2000; COSEWIC, 2009a). Horned grebes prefer small- to moderate-sized but will use a broad range of pond sizes (some as large as 18.2ha), and ponds need to contain large areas of open water (over 40%) and beds of emergent vegetation (Godfrey, 1986; Ulfvens, 1988; Fournier and Hines, 1999; Stedman, 2000; Holland and Taylor, 2003c).

Horned grebes construct a nest comprised of a floating or emergent mass of plant material in the fringes of emergent vegetation in shallow water (Godfrey, 1986; Ulfvens, 1988; Fournier and Hines, 1999). Horned grebes primarily use eutrophic environments, but they can also successfully breed in oligotrophic ponds (Ulfvens, 1988).

6.6.7 Olive-sided Flycatcher

Occurrence and Distribution

No olive-sided flycatchers were observed during aerial waterfowl surveys, 36 were recorded during MBBA point count surveys along with eight MBBA incidental observations, and 13 total identified on three of 45 ARU sampling sites (see Appendix J for the raw data).

Habitat Requirements

Olive-sided flycatchers are widely observed in open coniferous or mixed-coniferous forests, open to semi-open forest stands, and forest edges near natural openings such as wetlands (Holland *et al*., 2003e; COSEWIC, 2007b; Altman and Sallabanks, 2012; Environment Canada, 2016c). Tall snags and residual live trees are essential for foraging, nesting and advertising territory (Godfrey, 1986; Holland *et al*., 2003e; Altman and Sallabanks, 2012).

Olive-sided flycatchers prefer open areas such as post-burn areas or wetlands for foraging, often occurring where standing dead trees are present and natural edge habitat occurs, such as wooded shores of streams, lakes, rivers, beaver ponds, bogs, and muskegs (Hutto, 1995; Kotliar *et al.*, 2002; Altman and Sallabanks, 2012). In the boreal forest portion of its range, olive-sided flycatchers are most common in open habitats of muskegs, swamps and bogs that are dominated by spruce (*Picea* spp.) and tamarack (*L. laricina*) (Altman and Sallabanks, 2012).

The highest densities of olive-sided flycatchers are supported in mature conifer stands within patchy landscapes that have been influenced by natural disturbance (Haché *et al.*, 2014). Although wet areas have a positive effect on olive-sided flycatcher density on a landscape scale, it has a negative effect at a local scale (Haché *et al*., 2014).

Olive-sided flycatchers place nests near the tip of coniferous branches and are constructed of twigs, rootlets, and arboreal lichens and may be lined with pine needles and grasses (Altman and Sallabanks, 2012).

6.6.8 Peregrine Falcon

Occurrence and Distribution

No peregrine falcons were observed during aerial waterfowl surveys, MBBA point count surveys, MBBA incidental observations, and none identified on ARU records.

Habitat Requirements

Peregrine falcons occur in a wide range of habitats, from Arctic tundra to coastal islands, desert canyons and major urban centres (COSEWIC, 2007c; Environment Canada, 2015a). During the breeding season, peregrine falcons generally nest on cliff ledges or crevices (ranging from 50 to 200 m high) near good foraging areas (Sliworsky and Nero, 2003; COSEWIC, 2007c; Environment Canada, 2015a). Peregrine falcons can nest on several different sites, including escarpments, in quarries, open-pit mines, in trees, common raven (*Corvus corax*) nests, and anthropogenic features such as transmission towers, churches,

bridges, skyscrapers, open-pit mines, and industrial stacks (Cade *et al.*, 1996; White *et al.*, 2002; COSEWIC 2007c). Peregrine falcons primary feed on birds captured in the air, and will select sites near seabird colonies, shorebird and waterfowl staging and nesting areas, and areas with large numbers of songbirds or pigeons (Environment Canada, 2015a). Peregrine falcons have been known to feed on small mammals in Labrador (Environment Canada, 2015a).

Peregrine falcons are considered a potential transient migrant within the RAA. The peregrine falcon has never been a common breeder in Manitoba; Thompson (1890) recorded most observations during the fall migration period. A pair of peregrine falcons were observed nesting in Churchill in 1957, and the species was considered to be a fairly common transient and summer resident in Churchill in the 1930s (Taverner and Sutton, 1934; Jehl and Smith, 1970; Sliworsky and Nero, 2003). During migration, peregrine falcons use a broad array of habitats (including urban areas), using leading lines such as barrier islands, sea coasts, lake edges, or mountain ranges (White *et al.*, 2002). Peregrine falcons are commonly seen near concentrations of shorebirds and waterfowl during migration (Sliworsky and Nero, 2003).

6.6.9 Rusty Blackbird

Occurrence and Distribution

No rusty blackbirds were observed during aerial waterfowl surveys, 13 were recorded during MBBA point count surveys along with six MBBA incidental observations, and none identified on ARU records (see Appendix J for the raw data).

Habitat Requirements

The breeding range of rusty blackbirds corresponds with the boreal forest and taiga terrestrial ecozones (Godfrey, 1986; COSEWIC, 2006). Rusty blackbird habitat is generally characterized by conifer forest wetlands, frequenting fens, muskegs, beaver ponds, alder (*Alnus*)-willow (*Salix*) bogs, and other forest openings such as swampy shores along streams and lakes (Godfrey, 1986; COSEWIC, 2006; Avery, 2013). Rusty blackbirds are generally not present in wetlands in regions above the tree line (such as the alpine tundra and Arctic tundra), and is uncommon in high mountain wetlands (COSEWIC, 2006, Environment Canada, 2015b). Rusty blackbirds use strictly riparian habitat in forested areas, rarely using the forest interior (Whitaker and Montevecchi, 1999). They are primarily observed in wetlands associated with recent burns, peat bogs with or without ponds, wooded heathland, riparian scrub, open moss- and lichen-spruce woodlands, sedge meadows, alder and willow thickets, marshes, and estuaries (COSEWIC, 2006; Environment Canada, 2015b).

Rusty blackbirds select breeding sites in areas with a combination of freshwater bodies that have shallow water and emergent vegetation for foraging, adjacent to wetlands with conifers or tall shrubs with cover for nesting (Matsuoka *et al.*, 2010a; Matsuoka *et al.*, 2010b; Environment Canada, 2015b). Nesting occurs in low conifers, living and dead trees, and atop stumps, at heights usually less than 3 m, generally near water (Godfrey, 1986; Avery, 2013).

6.6.10 Short-eared Owl

Occurrence and Distribution

No short-eared owls were observed during aerial waterfowl surveys, MBBA point count surveys, MBBA incidental observations, and two total identified on two of 45 ARU sampling sites (see Appendix J for the raw data).

Habitat Requirements

Short-eared owls breed in a variety of open habitats including grasslands, taiga, bogs, marshes, old pastures, Arctic tundra, coastal wetlands, coastal barrens, estuaries and grasslands dominated by sand-sage (*Artemisia filifolia*) (COSEWIC, 2008b; Environment Canada, 2016d). Short-eared owls are often associated with open habitats that support cyclic small animals (such as voles and lemmings) (Wiggins *et al*., 2006). The density of prey populations is the primary indicator of short-eared owl habitat occupancy; the meadow vole (*Microtus pennsylvanicus*) is a primary prey item of short-eared owls and prefers natural prairie or meadows with large areas of vegetative cover (Peles and Barrett, 1996; Lin and Batzli, 2001; Environment Canada, 2016d). A mosaic of grasslands and wetlands provide optimal breeding and foraging habitats, with medium-to-tall grasses (higher than 30 cm), some dry upland for nesting, and hunting perches are all characteristics of sites occupied by short-eared owls (Clark, 1975; Clayton, 2000; Wiggins *et al*., 2006; Keyes, 2011).

In Manitoba, short-eared owls primarily breed in southern farmland and northern tundra, rarely lingering in the intervening forest during migration, but likely breed in extensive marshes and fens in the boreal plains (Holland and Taylor, 2003d). Short-eared owls select areas with small willows in the tundra of Churchill, Manitoba (Jehl, 2004). Clark (1975) identified the mean territory size of short-eared owls in Manitoba as 74 and 121 ha in successive years, with smaller territories in years with higher food abundance. Nests from multiple breeding pairs may be clustered in areas where food resources are abundant (Clark, 1975; Environment Canada, 2016d).

Short-eared owls nest on the ground, with females scraping out nest bowls and lined with grasses and downy features (Clark, 1975; Holt, 1992; Wiggins *et al.*, 2006; COSEWIC, 2008b; Environment Canada, 2016d). In wet nesting areas, short-eared owls build their nests on a small rise or knoll (COSEWIC, 2008b). Short-eared owls select areas to nest where the previous year’s residual vegetation is dead and matted down (Holt, 1992).

6.6.11 Yellow Rail

Occurrence and Distribution

No yellow rails were observed during aerial waterfowl surveys, one was recorded during MBBA point count surveys, there were no MBBA incidental observations, and none were identified on ARU records.

Habitat Requirements

Yellow rails inhabit shallow wetlands and other wet areas with extensive short, grassy vegetation, usually sedges (Cyperaceae, especially *Carex* spp.) as well as grasses (Poaceae) and rushes (Juncaceae) (COSEWIC, 2009b; Environment Canada, 2013; Leston and Bookhout, 2015). Yellow rails breed in various wetland habitats, including damp hay fields, damp meadows, floodplains, bogs, sedge meadows, salt marshes, upper levels of estuaries, shallow prairie wetlands, and wet montane meadows (Peabody, 1922; Alvo and Robert, 1999; Popper and Stern, 2000; COSEWIC, 2009b).

Yellow rails typically nest in sites with less than 15 cm of standing water but may breed in areas with up to 50 cm of standing water (COSEWIC, 2009b; Environment Canada, 2013; Leston and Bookhout, 2015). Yellow rail abundance varies dramatically year to year due to the yellow rails' narrow tolerance for shallow water levels (Robert and Laporte, 1999; Lindgren, 2001). Yellow rail breeding habitat requires an overlying layer of dead grass-like vegetation in order to create roofing over the nest, and for hiding movements from predatory birds (Robert and Laporte, 1999; COSEWIC, 2009b; Environment Canada, 2013).

Yellow rails are uncommon and local breeders in wetlands throughout Manitoba (Holland and Taylor, 2003e). The species' range extends northeastward to Churchill and the Hudson Bay coast (Holland and Taylor, 2003e).

6.6.12 Little Brown Bat

Occurrence and Distribution

No little brown bat were observed during aerial waterfowl surveys, MBBA point count surveys, MBBA incidental observations, and none identified on ARU records.

Habitat Requirements

Little brown bats' habitat requirements vary by season. The species requires overwintering habitat (hibernacula) for hibernation and overwinter survival; summering habitat including roosting habitat and foraging habitat (Sasse and Perkins, 1996; Norquay *et al.*, 2013); and swarming habitat in late summer and early fall for mating and socialization (Fenton, 1969; Randall and Broders, 2014; Environment Canada, 2015c). Swarming sites are typically used as hibernacula as well (Fenton, 1969; Randall and Broders, 2014).

As little brown bats are year-round residents, overwintering habitat is necessary for little brown batssurvival in regions where ambient temperature declines and insects are not available in winter (Environment Canada, 2015c). Hibernating bats are able to decrease their metabolic rate and body temperature within a few degrees of the hibernaculum ambient temperature (Henshaw and Folk, 1966). Underground openings such as caves, abandoned mines, wells, and tunnels with an ambient temperature range from 2˚C and 10˚C and relative humidity levels greater than 80% are used as hibernacula (Fenton, 1970; Anderson and Robert, 1971; Cryan *et al.*, 2010; Vanderwolf *et al.*, 2012). Structural features such as the number of openings, cave length and size, and angle of chambers can influence the stability of the hibernacula and the levels humidity and temperature (Raesly and Gates 1987). Little brown bat will use

hibernacula year after year due to the specific, stable microclimates required for overwintering habitat (Environment Canada, 2015c).

Little brown bat' congregate in swarming habitat (often in and around entrances of hibernacula) in late summer and early fall, with swarming habitat functioning as mating sites, stopover locations during migration, social sites for information transfer, and allow individuals to assess potential sites for overwintering (Fenton, 1969; Randall and Broders, 2014; Environment Canada, 2015c).

Roosts provide shelter from weather and predation, thermal regulation, and provide social interaction (Environment Canada, 2015c). Selection of roosting habitat occurs at several spatial scales (Fabianek *et al.*, 2011). At the scale of the roosting structure, tree species, height, diameter, stage of decay, sun exposure, and availability of roosting medium affect roost selection (Garroway and Broders, 2008; Slough, 2009; Olson and Barclay, 2013). At the stand scale, roosting habitat selection may be a function of number of available snags, tree density, proximity to water, and canopy gaps (Garroway and Broders, 2008; Environment Canada, 2015c). Forest age, composition, and degree of fragmentation are all factors of roost selection at the landscape scale (Henderson and Broders, 2008; Fabianek *et al.*, 2011). Little brown bat may also use forested areas and man-made structures in urban and suburban areas for roosting; little brown bat is one of the few bat species that uses buildings and other anthropogenic features (such as bridges, barns and bat boxes) to roost (Environment Canada, 2015c). Little brown bat' preferentially roost in older forest stands over young forests as they likely provide increased snag availability for roosting and foraging habitat (Crampton and Barclay, 1996; Krusic *et al.*, 1996).

Foraging habitat for little brown bat is associated with open habitat such as ponds, roads, open canopy forests, and vegetation along lake and stream margins (Ratcliffe and Dawson, 2003; Jung *et al.*, 2014; Segers and Broders, 2014; Environment Canada, 2015c). Little brown bat is a short-distance migrant. In Manitoba and Ontario, little brown bat migrated regional 35 to 554 km (Fenton, 1970; Norquay *et al.*, 2013).

6.6.13 Wolverine

Occurrence and Distribution

Two wolverines (*Gulo gulo*) were observed on trail cameras in the RAA, one wolverine track observed during the 2012 multispecies survey in the RAA, one wolverine track was observed during the 2014 multispecies survey, and ten tracks were observed during the trapper program (see Appendix I for the raw trapper data).

Habitat Requirements

Wolverines use a wide variety of forested and tundra habitats at all elevations that contain an adequate year-round supply of small prey such as rodents and snowshoe hare, as well as carcasses of moose and caribou (COSEWIC, 2014). Wolverines are associated with wolves, caribou, and grizzly bears (*Ursus arctos*), as viable populations of large carnivores are an important source of ungulate carrion (COSEWIC, 2014).

Female wolverines require snow-covered rocks, logs or snow tunnels for denning, and reproduce in areas with snow cover persisting until April (COSEWIC, 2014). Dens can be constructed in talus boulders, along eskers, under deadfall and logs, and snow tunnels in higher elevations (Copeland, 1996; Magoun and Copeland, 1998; Cardinal, 2004; Inman *et al.*, 2007; COSEWIC, 2014). Male wolverines primarily select habitat based on summer and winter food availability, while females select habitat based on food, predation risk, and disturbance (Krebs *et al.*, 2007; COSEWIC, 2014).

Adequate snow cover is critical for wolverine denning, as snow cover needs to be deep enough (i.e. greater than one metre deep) to provide adequate insulation late into spring (Magoun and Copeland, 1998). Female wolverines leave their kits for long foraging trips and will select denning sites in talus, avalanche debris, or snowdrifts which are typically found in ravines and leeward slopes; dens with spring snow cover allow thermoregulation for kits, provide protection from predators, and have an abundance of small-mammal prey (Magoun, 1985; Copeland, 1996; Inman *et al.*, 2007). Wolverines are known to reoccupy denning sites for several consecutive years (Magoun, 1985).

6.6.14 Norway House Boreal Woodland Caribou

Occurrence and Distribution

Occurence and Distribution of the Boreal Caribou is detailed in section 6.1.10.

Habitat Requirements

Boreal woodland caribou require large, undisturbed tracts of habitat. They prefer mature to old-growth coniferous forests with abundant lichens, or peatland mixed with upland areas and tend to avoid disturbed habitats or those at early succestional stages (Environment Canada 2012). They generally have large ranges and low-population densities, which reduces predation risk (Environement Canada 2012). Boreal caribou select habitat with abundant food supply where they feed on terrestrial and arboreal lichens. During calving, cows travel to isolated and relatively predator free areas (e.g. islands, peatlands, muskegs, lakeshores) where there is nutritious forage, as degraded or inadequate habitat reduces calving success (Environment Canada 2012). Further detail on habitat requirements for Boreal Woodland Caribou are detailed in section 6.1.12.

6.6.15 Pen Islands Caribou (Eastern Migratory)

Occurrence and Distribution

Occurence and Distribution of the Pen Islands caribou is detailed in section 6.1.10.

Habitat Requirements

COSEWIC (2011a) currently identifies the Pen Islands caribou range as part of Designatable Unit 4 (DU4): Eastern Migratory Caribou. COSEWIC has assessed all subpopulations of the Eastern Migratory Caribou, including the Southern Hudson Bay subpopulation (i.e. the Pen Islands range), as “Endangered” (COSEWIC 2017). MBCDC (2016a) lists the population as S4. See Appendix A for further detail/definitions on conservation status listing. The Pen Islands caribou population has a range extending

from northeastern Manitoba to northwestern Ontario within the Hudson Bay and Boreal Shield Ecozones (Magoun *et al.*, 2005; Gunn *et al.*, 2011; Abraham *et al.*, 2012; Berglund *et al*., 2014). Pen Islands caribou perform long bi-annual migrations, spending the calving and summer seasons in tundra with sparse vegetation and migrating to boreal forest for the fall and winter seasons (COSEWIC 2016). During calving and in the summer, they select habitat in peatland complexes which is rich in graminoids and deciduous shrubs (COSEWIC 2016). Cows migrate to calve together as an anti-predator defence strategy. With high density of prey in one location, there is a lower probability for individuals to lose calves to predators (COSEWIC 2016).

6.7 Species of Importance to First Nations

Resource users with the P6 FN communities of God's Lake, Bunibonibee, and Manto Sipi shared local knowledge on hunting, trapping, wildlife, and rare species in the RAA. Information included detail on VC species including caribou, moose, beaver, marten, eagle, Canada goose, mallard, ringed-neck duck, and grouse. This information was incorporated where appropriate to guide the wildlife studies that were conducted as well as being incorporated into the assessment of effects. Sites of importance (IE known dens sites) were identified and used in the assessment to ensure these were avoided, however, no critical sites were found in proximity to the PF. For additional detail on local and traditional knowledge see the P6 Existing Environment Report (Joro, 2017).

Caribou

Caribou are known to be an important hunted species for a number of community members in the P6 RAA. Caribou are known to move southward from Churchill and Shamattawa First Nation in the winter to the P6 RAA, typically maintaining the same route annually. Community members indicated that caribou typically move from northwest to southeast, with large herds (tens to hundreds) migrating across God's Lake in January and February.

Smaller herds of migrating caribou (Pen Islands caribou) are known to stay behind and overwinter, staying near the P6 communities throughout the summer. These summering herds re-connect with the larger herd in the following spring migration. Caribou calving is known to occur along the eastern edge of Edmund Lake and northwest towards Knee Lake.

Local FN communities have supported the understanding of a diverse caribou population within the RAA and have described two types of caribou as identified by physical and behavioural characteristics. Community members distinguish between resident and migratory caribou. Resident caribou tend to be larger as opposed to migratory herds observed in the region. These resident caribou are typically observed in herds of only six to eight animals with a maximum herd size of approximately 15 animals.

Moose

As with caribou, moose are an important species hunted by community members in the P6 RAA. Moose are typically hunted in the fall; however, hunting occurs opportunistically year-round. Moose are typically found inland from the shoreline of lakes and other waterbodies. Moose are known to thrive in old burn

and re-growth areas that provide good foraging habitat and use the habitat along the winter roads in the RAA. Community members have noted that as compared to historic moose hunting effort, present day moose hunting requires travel further away from their communities and further inland from shorelines. Community members mentioned that at present there are fewer moose and an overabundance of hunters. The perceived decline in moose population has been observed over the last 20 years.

Furbearers

Although trapping is an important activity for resource users in the P6 RAA, only a number of Registered Trap Lines (RTL) are well used in the P6 RAA. Fur pelts currently sell for much less as compared to in the past, decreasing the interest in trapping.

Beaver, muskrat, and otter are trapped from spring (May) through to fall (August) as the fur is still prime. Community members indicated that despite their high population, beaver are not actively trapped due to the large amount of work and very low pelt price. Beaver play a key role in children experiencing and getting involved with trapping and occasionally trapped for Elders to eat. Although otter are historically one of the most important species trapped, primarily based on fur value, participants indicated there is currently no market for pelts.

Community members indicated that the mink population is abundant and stable, yet the market for mink pelts has been decreasing, and as such, the species is not typically trapped.

Marten were historically not observed in the P6 RAA until the 1970's when they moved into the area and significantly decreased the rabbit population. In present day, marten are abundant, easy to trap, and the pelt prices are good (higher than otter), which leads them to be one of the most important species trapped. Predator and prey dynamics may affect the marten population. Current predator populations appear to be low, while prey, including squirrel and rabbit, are high, resulting in an abundant marten population.

Although previously low, lynx population numbers in the P6 RAA area have returned, likely as a result of limits put on trapping. Reproducing quickly and having up to three litters a year, rabbits provide an important food source for lynx and marten.

Historically a common observation, wolf tracks are now a rare sighting throughout the P6 RAA. Wolf pack observations tend to be cyclic in nature lending to an assumption that they are following big game movement. Wolves are currently not trapped, however, denning site locations, travel corridors, and hunting patterns were shared by community members. Community members noted that wolves are hunting caribou more so than in the past. They suggested that this may be a result of the decreasing moose population.

Birds

Waterfowl hunting, an important activity for resource users, is typically a spring and fall activity for the communities. Community participants indicated that geese and ducks are frequently in abundance in key habitat areas associated with waterbodies such as creeks and lakes. Geese typically congregate near rapids, close to open water in the spring, and will pass by these same areas in the fall and find alternate locations to stage. Community members typically hunt mallard ducks in nearby creek habitats. Community members suggested that duck populations are declining possibly due to the lack of wild rice growing on the local lakes.

Loons and gulls are frequently observed near the communities. Loons may be hunted for food, and gull eggs are occasionally harvested and eaten by community members. Community members indicated that bittern is harvested for eating with tundra swan, and blue heron being typically eaten by Elders in the community.

Grouse, including ruffed, spruce, and sharp-tailed, are abundant in the RAA. They can be heard drumming in swampy habitat and are often observed and hunted in the fall on islands in nearby lakes. Ptarmigan, also referred to locally as white chickens, prefer muskeg habitat and have historically had large winter populations in the RAA. Participants indicated that although ptarmigan have been observed the RAA, populations are considered to be decreasing.

During discussions on raptors, workshop participants mentioned that bald eagles maintain a healthy population along lakes and rivers in the RAA. Eagles migrate and return to the area every spring to breed, preferring shoreline habitat where fish are available as a valuable food source for young. A number of community members mentioned having observed golden eagles near the communities. Ospreys have also been observed by community members; however, sightings are less frequent than in the past. Peregrine falcons are only occasionally observed along riverbanks. Owl populations in the RAA have decreased over the past several years. Participants would historically hear owls calling every night – this no longer happens. Snowy owls are often observed in the winter, great horned owls and short-eared owls have been sighted in multiple locations near communities, and northern saw-whet owls are often heard calling.

Rare Wildlife

Community members shared observations of rare wildlife, including brown bat sightings. Participants also mentioned that they have observed an increase in the skunk and vulture populations over the last few years. Community participants shared a rare sighting of a Bonaparte’s gull or a black tern. Other noted observations shared by participants include olive-sided flycatchers, short-eared owls, flying squirrels, leopard frogs, brown frogs, lizards and salamanders, and red-sided garter snakes. Rare wildlife observed in the region also included skunks, raccoons, porcupine, and polar bear.

7.0 POTENTIAL EFFECTS ASSESSMENT

Potential environmental effects on the Wildlife VC's were based on extensive baseline wildlife data gathered in support of ASR development in the northern portion of the LATN as well as caribou telemetry data including forest-dwelling (Norway House range) and forest-tundra (Pen Islands caribou) from studies conducted from 2011 to 2017. Other information sources included Manitoba Breeding Bird Atlas, desktop studies including MBCDC data, information from community wildlife workshops and local trappers. Other desktop research and habitat modeling provided quantitative assessment of effects on habitat that are incorporated into the overall assessment.

The following sections provide a summary assessment for the identified potential effects associated with each wildlife VC. The wildlife assessment criteria and effects assessment tables in Appendix K provide the associated rankings of significance before and after proposed mitigation. This assessment defines effects that are a result of changes to the environment resulting from the project, and identifies mitigation measures to avoid, and minimize adverse environmental effects. Note that in some cases below, multiple effects are dealt with simultaneously based on linkages between effects, literature and study results supporting the conclusions on residual effects.

Table 55 provides a list of the VC's assessed in the following sections. Species of Conservation Concern are dealt with in Section 7.6, and their associated assessments are also included in Appendix K.

Table 55: Listing of wildlife VC's and associated effects assessment

Mammals	Birds
Caribou **Moose** **Furbearer** • Marten (representing terrestrial furbearers) • Beaver (representing aquatic furbearers)	**Raptors** • Bald eagle **Migratory Waterfowl** • Canada goose • Ring-necked duck • Mallard **Non-Migratory Game Birds** • Ruffed grouse **Migratory Forest Birds** • Palm warbler • Magnolia warbler • Yellow-bellied flycatcher • Ovenbird **Amphibians** • Spring Peeper

7.1 Caribou

Potential effects of the project were identified based on past environmental assessments in Manitoba, literature, field studies and professional judgement regarding the potential effects of an all-season road on caribou These effects were identified as; habitat loss/alteration, sensory disturbance and displacement, increased mortality due to vehicle collisions, hunting and predation and the possible introduction of parasites from white-tailed deer expansion (i.e., Brainworm [*P. tenuis*] *and liver fluke [Fascioloides magna]*). These potential effects were evaluated for relevance to the P6 Project and the following section provides the rationale for the determination of level assigned to each CEAA criteria as described in Appendix K as a result of the P6 Project.

For the purpose of this assessment, forest-dwelling (Norway House/Molson MU boreal caribou) and forest-tundra (Pen Islands caribou/Eastern Migratory) were assessed as one VC. As described in this report, the RAA is on the fringes of both the Norway House and Pen Islands caribou ranges and intersect a very small portion of known core areas defined by telemetry and aerial multi species surveys for both ecotypes. Results of studies suggest low densities of caribou occupying the RAA during all seasons with TK and telemetry data indicating episodic migrations of Pen Islands caribou into the northeastern portion of the RAA during winter. Evidence of Norway House caribou occupation is weak, however, there is evidence of all season occupation of caribou at low densities in the RAA.

Range based disturbance assessments were undertaken on both ecotypes, as well as habitat modeling and assessments of potential caribou habitat loss associated with the project. The following sections

provide a summary of potential effects and summarize residual effects after mitigation. Detailed assessments and significance rankings are found in Appendix K (Wildlife Assessment Criteria and Effects Assessment).

Habitat Loss/Alteration/Fragmentation

Based on the results of multi-species surveys and the acquired telemetry data, the RAA is on the fringe of both the Norway House boreal caribou range and the Pen Islands caribou range. The location of seasonal core areas as defined by kernel analysis indicate approximately 1.4-6.24% of the total area of use for the Pen Islands range and 0% of the total area of use for the Norway House range overlap the RAA. Based on the results of telemetry, trail camera and TK information, a small number of woodland caribou have been observed in the RAA during summer. These data indicate primarily winter use by the Pen Islands animals in the northeast corner of the RRA, and winter occupation of the Norway House animals in a small fraction of the north-west portion of the RAA (Maps 8 to 17).

Based on the results of the calving and winter habitat modeling, high quality habitat is not limiting in the RAA or across the larger region including the Molson Boreal Woodland Caribou Management Unit (MU) and the Hayes River Upland Ecoregion. The Molson MU overlaps with the western portion of the RAA and LAA, with 594 km^2 of high quality caribou winter habitat occurring in the area of overlap with the RAA, and 102 km^2 of high quality winter habitat occurring in the overlap with the LAA (Table 21). Of the high-quality caribou calving habitat, 466 km^2 overlaps with the RAA, and 119 km^2 of high quality caribou calving habitat occurs in the overlap with the LAA (Table 20).

Habitat disturbance in the Molson MU and Pen Islands caribou range are both below the 35% disturbed habitat threshold for boreal woodland caribou identified by Environment Canada (2012). As there is currently no disturbance threshold defined for eastern migratory caribou, the boreal woodland caribou disturbance threshold was used for Pen Islands habitat disturbance analysis. The Pen Islands range has a total disturbance of 23% and the Molson MU has a total disturbance of 28%, with natural disturbance from fires being the greatest contributors to overall disturbance (Table 22 and Table 23).

Proposed mitigation measures to minimize effects on habitat loss and alteration include:

- Clearing and grubbing of the road and ROW will be avoided during normal parturition times (i.e. May 18 to June 28) as per ES130.17 – Clearing and Grubbing and ES130.19 – Wildlife.
- Conducting wildlife habitat features pre-construction surveys and utilize telemetry collar data to identify if calving areas are present.
- Using existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES130.6 – General and ES130.8 – Designated Areas and Access.
- Limiting clearing and construction to designated areas within the Project Footprint and Local Assessment Area (e.g. quarries and borrow pits) as per ES130.17 – Clearing and Grubbing.
- Prohibiting equipment and limiting access outside the designated cleared area throughout construction as per ES130.6 – General and ES130.8 – Designated Areas and Access.

- Decommissioning temporary access routes, trails, and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES130.8 – Designated Areas and Access.
- Undertaking ROW (i.e. brushing and clearing), bridge, and culvert maintenance activities during fall and winter to the extent feasible to avoid parturition times (i.e. May 10 to June 15).

In summary, the effects of the project on habitat loss are minor in nature with proposed mitigation measures. Additionally, providing some protection to important habitat features such as mineral licks, if discovered, as well as minimizing the footprint during construction and operation will also mitigate potential project effects.

7.1.1 Sensory Disturbance

Behaviour strategies and avoidance of anthropogenic disturbance, including sensory, are known to be associated with predator avoidance. Leclerc *et al.* (2014) found that female caribou that calved near cutovers with associated high road densities had fewer calves than those that calved away from these features. However, results of fidelity analysis also illustrates that female caribou exhibit large movements between calving site selection from year to year, and if present, would select other potential high quality calving habitat available throughout the RAA and LAA. Modeled caribou calving habitat is not limiting as described above, and there is only one known calving site within the RAA in 2011.

Results of the Path Trajectory Analysis (annual movement), illustrates that the Pen Islands caribou travel on average more than 3,500 km per year, which is approximately 2.3 times the annual movements calculated for the Norway House boreal caribou population. This is consistent with recorded movement data for the Pen Island caribou, indicating the migratory nature of this herd (Abraham *et al*., 2012; Berglund *et al*., 2014). This, in combination with the analysis of time all collared Pen Island caribou were found in the RAA (27.1 days), provides rationale for the low predicted effect for sensory disturbance and displacement. It should be noted that one female caribou was suspected of calving in the RAA well outside the LAA south and east of Gods Lake, which is not unexpected, given the RAA borders the Molson Boreal Woodland Caribou Management Unit intersecting the RAA.

The following mitigation measures to minimize sensory disturbance effects include:

- Staging construction activities (sections) such as clearing, grubbing, and construction to limit noise disturbance to defined areas.
- Scheduling to avoid construction ROW clearing and quarry blasting during normal parturition times in habitats known to be high quality caribou calving habitats (i.e. May 18 to June 28) as per ES130.17 – Clearing and Grubbing and ES130.19 – Wildlife.
- Using existing access routes, trails, or cut lines where feasible and keep new access routes, trails, or cut lines as short and narrow as feasible as per ES130.6 – General and ES130.8 – Designated Areas and Access and 130.15.3.4 Disturbance to Stream beds and Stream Banks
- Limiting clearing and construction to designated areas within the Project Footprint as per ES130.17 – Clearing and Grubbing.

- Prohibiting equipment and limit access outside the designated cleared area throughout construction as per ES130.6 – General and ES130.8 – Designated Areas and Access.
- Appling feasible noise and dust suppression techniques as per ES130.11- Dust and Particulate Control and ES130.12 – Noise and Noise Limitations.

The presence and use of the winter road for several decades has generally coincided with the timing of annual caribou migration through the area. Seasonal occupation of caribou in the RAA is low based the studies conducted and is confirmed through the information gathered through the wildlife workshops and TK. Given the overall low density of roads in the project area and absence of other disturbances in the LAA, effects of increased access on sensory disturbance is not expected. The mitigation measures outline also contribute to minimizing this effect during construction as well as operation.

7.1.2 Increased mortality due to vehicle collisions

The predicted effect of increased access may result in higher rates of mortality on caribou. However, caribou/vehicle collisions can be mitigated through reduced speeds in known migration areas during times when migration occurs, through appropriate signage. Construction equipment will also be traveling at low speeds which will further minimize the risk of wildlife collision (Jaarsma *et al.,* 2006; van Langevelde and Jaarsma, 2009). Presence of highway salts can also increase incidence of ungulate vehicle collisions but can be mitigated with the reduction or removal of salt pool deposits (Grosman *et al.*, 2009).

Mitigation measures intended to minimize effects of vehicle collisions include:

- Staging construction activities during clearing, grubbing, and construction to limit disturbance to defined areas.
- Limiting vegetation clearing within the right-of-way to the removal of trees and tall shrubs (to maintain line of sight safety requirements).
- Restricting access to the ASR corridor to construction personnel as per ES130.6 – General and ES130.8 – Designated Areas and Access.
- Designing road to optimize line of sight.
- Providing information about wildlife awareness to road construction workers to reduce vehicle speeds and the risk of wildlife-vehicle collisions.
- Installing crossing and/or speed reduction signs where necessary (i.e. detected problem areas) to reduce the potential of wildlife-vehicle collisions.
- Avoid using wildlife-attracting road salts.

The residual effect of increased vehicle collisions is considered to be minor and not measurable at the population level. The application of mitigation measures including no use of highway salts, signage and reduced speeds where needed will further minimize any observable effect.

7.1.3 Increased Harvest

Results of baseline surveys and TK workshops indicate that caribou are important as a seasonal domestic food source and are culturally important to First Nations communities throughout the RAA. Based on the TK gathered as part of this study, caribou hunting occurs mainly in winter and in proximity to existing winter roads. Caribou are known to migrate through the area, however, there are years when the Pen Islands caribou do not occupy areas near Gods Lake (Trim, *pers com*., 2017).

The following mitigation measures, which will minimize potential of overharvest during periods of construction and operation include:

- Staging construction activities (sections) during clearing, grubbing, and construction to limit disturbance to defined areas.
- Prohibiting hunting by employees and agents of MI and employees, agents and contractors while working on the construction or maintenance of the road as per ES130.19 – Wildlife.
- Prohibiting possession of firearms by workers in camps and at work sites to reduce caribou mortality due to hunting during road construction.
- Limiting road access during construction to reduce hunting opportunities as per ES130.6 – General and ES130.8 – Designated Areas and Access.
- Designing road designed with no pullouts or parking areas.
- Promoting stewardship and caribou conservation with construction staff.
- Decommissioning temporary access routes, trails, and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES130.8 – Designated Areas and Access.
- Implementing access controls at quarry sites during the operation and maintenance phase to limit access and reduce hunting opportunities as per ES130.6 – General and ES130.8 – Designated Areas and Access.
- Liaising with Manitoba Sustainable Development and participate on committees and working groups (e.g., caribou committees) to which they are invited and will share wildlife information obtained through monitoring efforts.

The likelihood of major increased harvest of caribou as a result of the new ASR is not expected as hunting access during winter currently exists. The overall predicted effects of the project on caribou mortality through increased hunting is not considered significant given the time portions of the herd spend in the RAA, and the potential harvest relative to the population of the Pen Island caribou which is estimated at approximately greater than 16,000 (COSEWIC, 2017).

7.1.4 Predation

Various studies have illustrated that linear corridors can increase a wolf's travel speed, increasing interactions with prey species, distribution and travel routes (Thomas, 1995; James and Stuart-Smith, 2000; Courbin *et al*., 2009). This change in landscape can result in decreased search times for prey, increased predation efficiency and increase access to areas where prey were previously safe due to low access (Thomas, 1995). The threat of mortality to wolves from vehicles, human shooting and trapping can

also reduce wolf use of roads (Mech *et al*., 1998) which could counteract wolf activity along the road. James and Stuart –Smith (2000), found that increases in linear disturbance, resulting in an increase in predation by wolves caused an increase in caribou mortality, however, this was observed in a highly fragmented landscape.

Despite a potential increase in wolves using the P6 ASR, there is counter evidence that prey tend to avoid these linear features (usually by 250 m (Dyer *et al*., 2001)), potentially minimizing the effects of wolf use, though they may on occasion use the corridors for ease of travel, and high quality forage (James and Stuart-Smith, 2000; Latham *et al*., 2011b). This is also consistent with ongoing MI monitoring in areas south of the RAA, where wolf predation monitoring has shown that caribou are not a major prey species with mostly moose kill sites found near natural linear features where moose habitat exists (Johnstone, 2016; Joro, 2017). Ongoing monitoring of collared wolves in other ASR projects has not illustrated evidence of wolf predation on caribou near ASRs or other linear features (Johnstone, 2016; Joro, 2017). The density of linear disturbance in the RAA is not expected to result in similar effects to predator/prey dynamics, such as increased mortality on caribou.

In addition to the standard wildlife mitigation measures described in Appendix K, potential increased predation effects will be mitigated by applying the following key mitigation measures, which include:

- Decommissioning temporary access routes, trails, and existing winter road required for road construction, operation and maintenance to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES130.8 – Designated Areas and Access. This practice will also reduce wolf mobility and subsequent predation risk.

In summary, increased predation on caribou in the RAA is not expected to be measurable due to the very low density of linear features, combined with their short duration of occupancy and movement through the RAA.

7.1.5 Disease Transmission

The occurrence of Brainworm and giant liver fluke are associated with the sympatric presence of white tailed deer (WTD). Results of base line surveys conducted from 2011 – 2017, as well as TK information from resource users, no WTD have been observed in the RAA. Longer winters and deeper snow compared to conditions found in southern Manitoba make it unlikely for the northern extent of WTD persistence to extend near the RAA in any foreseeable future. Mitigation to reduce the potential for white-tailed deer occupancy includes:

- Use existing access routes, trails, or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES130.6 – General and 130.8 – Designated Areas and Access.
- Decommission temporary access routes, trails, and existing winter road required for road construction, operation and maintenance to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES130.8 – Designated Areas and Access.

Potential for increased transmission of parasites including brainworm and liver fluke are not expected and extremely unlikely.

7.2 Moose

Potential effects on moose include, habitat loss/alteration, disturbance, fragmentation, mortality (vehicle collisions, predation and hunting), and potential for introduction of parasites e.g. Brainworm and liver flukes from expanding white-tailed deer populations. These potential effects were evaluated for relevance to the P6 project and the following section provides the rationale for the determination of level assigned to each CEAA criteria as described in Appendix K as a result of the P6 Project.

7.2.1 Habitat Loss/Alteration/Fragmentation

The results of habitat modeling estimate the amount of winter habitat removal is 5.5 km^2 which represents 0.4 % of habitat within the LAA and 0.1 % of available habitat within the RAA. The results indelicate that habitat is not limiting in the RAA and is also distributed across the RAA. Map 48 provides a representation of the spatial distribution of high likelihood/quality habitat. The mapping does illustrate that areas of potentially high-quality habitat are found within the LAA with concentrations located throughout the RAA.

Estimates of moose densities determined through aerial surveys of 0.02 moose/km^2 (2016) and 0.04 moose/km^2 (2017) in the LAA are relatively low compared to more southerly moose populations. This combined with the low road density after construction (0.04 km/km^2), as described in Section 6.2.1, is not expected to result in any measurable effect on the moose population within the RAA. However, there is some uncertainty to the degree of effect within the 10 km LAA for moose. Also considering the low moose densities described above, effects on individual animals would be expected, however at an infrequent rate that would not be measurable.

Issues related to fragmentation relate to moose avoidance of roads resulting in habitat or range fragmentation. However there is evidence that moose will cross roads regularly. Laurian *et al*. (2008), who conducted telemetry studies on moose to examine road crossings and avoidance, found that moose avoid highways at a course scale, and use them at a finer scale, and in some cases to acquire road-side salts. Moose are also known to be attracted to linear feature ROWs due to improved forage opportunities resulting from vegetation disturbance and increased forage (Ballard *et al.,* 1981; Ricard and Doucet, 1999).

Based on the assessment of potential fragmentation in Section 6.2.1, it is illustrated that overall road densities in the RAA and within GHA 3A are very low, and well below the published suggested thresholds of access density. Fragmentation affecting the moose population is not expected based on the overall low density of roads. The predicted fragmentation effects on moose is expected to be minor as moose will adapt to the presence of the road, likely avoiding or moving across the road to avoid vehicles.

Mitigation described for caribou to minimize potential effects on habitat loss/alteration/fragmentation are applicable to moose. The results of habitat modeling illustrate that the amount of habitat being removed is minimal and will not affect habitat availability in the LAA or RAA. Due to the remote nature of this area

and the inherently low densities of linear features in the RAA (below identified thresholds), effects of fragmentation are very low within the RAA.

7.2.2 Sensory Disturbance

Given that the existing winter road has been part of the LAA landscape for several decades, moose are likely accustomed to the present and level of activities associated with traffic and hunting during winter. Sensory effects would include moose avoidance of high quality habitats near the ROW during construction and to a lesser extent during operation. Clearing during winter could result in limited displacement of moose, however, as described above, the low densities of moose observed during winter would suggest that a low number of individual animals would potentially be affected. During operation, access normally restricted to winter would result in year-round traffic, however, at anticipated low levels. Typically, winter traffic volumes are higher due to the linkage with other winter roads when much of the larger truck traffic hauling goods would occur. Other activities such as increase ATV traffic or access to lakes or rivers for fishing may result in higher rates of disturbance in proximal moose habitat that are accessed from the ASR. Mitigation described for caribou to minimize potential effects on sensory disturbance are applicable to moose.

7.2.3 Increased mortality due to vehicle collisions

As described in Section 7.2.1, moose may avoid roads at a course scale but do cross roads, resulting in potential for vehicle collisions. Laurian *et al*. (2008), show that both forestry roads and highways were crossed by a small fraction of collared moose, mostly between May and July indicating that moose tend to avoid road corridors, which in the long term likely reduces their chance of mortality by way of wolves, hunters and vehicles (Laurian *et al*., 2008; Shanley and Pyare, 2011).

The predicted effect of increased access that may result in higher rates of mortality is reduced due to the combination of low moose densities and overall low road density in the LAA. Moose/vehicle collisions can be mitigated through reduced speeds in areas where moose have been observed through appropriate signage. Construction equipment will also be traveling at low speeds which will further minimize the risk of wildlife collision (Jaarsma *et al*., 2006; van Langevelde and Jaarsma, 2009). Presence of highway salts can possibly increase incidence of moose vehicle collisions (Grosman *et al.*, 2009).

The mitigation measures described for minimizing effects of vehicle collisions for caribou are applicable to moose. The potential effects of vehicle collisions on moose is expected to be very low and not measurable due to signage, speed reductions where necessary and no use of road salts.

7.2.4 Increased mortality due to changes in hunting access

Mortality to moose because of increased hunting access has been well documented, and in some areas, has resulted in high rates of overharvest. In consideration of the discussion regarding the existing winter road being in operation for decades, local hunters have had ongoing access to moose for traditional and domestic use. During summer and fall, there would be opportunities for local resource users to gain better

access to rivers and lakes, which may provide additional hunting opportunities away from Project 6. Information from wildlife workshops and the trapper program also verify that moose hunting does occur across the RAA and LAA and the rivers and lakes are currently important hunting areas during open water periods,

Due to the remoteness of the area, and that the P6 Project is not linking to year-round all-weather access outside the RAA, influxes of hunters from other areas is not expected. There is little licensed harvest of moose in the area, and the combination of low moose densities and overall low fragmentation as described above is not expected to result in a significant increase of moose in the RAA.

The mitigation measures to minimize hunting mortality described for caribou are applicable to moose.

The likelihood of major increased harvest of moose resulting in declining populations in GHA 3 as a result of the new ASR would not result due to the large geographic area. Moose populations in the RAA are likely to not be impacted, however the degree to which moose numbers in the LAA respond to long term harvest near the ASR are unknown.

7.2.5 Increased mortality due to changes in predation

The potential effect described for caribou is applicable to moose. In addition, the results of trail camera studies and multispecies surveys verified general distribution of moose and predators in the RAA and LAA. The mitigation measures described for caribou are also applicable to moose.

In summary, moose, wolves and bears were observed at low frequencies and increased predation as a result of wolves utilizing the new ASR is predicted to be minimal. Increased predation on moose in the RAA is not expected to be measurable due to the very low density of linear features. Mortality due to increased predator mobility and higher than normal rates of predation are not expected to affect local moose numbers in the LAA.

7.2.6 Introduction of disease from white-tailed deer

Please see parasite section for caribou above. No effects are likely.

7.3 Beaver

Beaver were selected as a VC to represent aquatic furbearers. Potential effects include habitat loss/alteration/fragmentation from changes in local drainage, sensory disturbance, mortality due to vehicle collisions and winter water drainage and problem wildlife removal. These potential effects were evaluated for relevance to the P6 Project and the following section provides the rationale for the determination of level assigned to each CEAA criteria as described in Appendix K as a result of the P6 Project.

7.3.1 Habitat loss/alteration/fragmentation

The results of habitat modeling illustrate the subsequent loss of habitat as a result of the project are insignificant due to the amount of habitat available within the LAA and RAA. Approximately 0.23 km^2 of

primary or high-quality habitat being removed or altered within the project footprint represents 0.02% of available habitat within the LAA (1,329 km^2) and 0.002% percent of overall habitat contained in the RAA (9,005 km^2).

Key mitigation measures aimed at minimizing potential effects on habitat loss and alteration for beaver include:

- Scheduling to avoid construction ROW clearing during normal parturition times (i.e. April to June months) as per ES130.17 – Clearing and Grubbing and ES130.19 – Wildlife.
- Conducting wildlife habitat feature pre-construction surveys prior to any clearing to identify if lodges are present.
- Lodges and Dams found during pre-construction surveys that require removal shall be removed gradually and with authorization with MSD as per ES130.15.10 – Beaver Dam Removal.
- Following standards for MSD protocols for problem beaver.
- Aligning the all-season road to avoid wetland habitat including lakes, rivers, streams, and ponds or locate a minimum of 100 m from waterbodies except when crossing a watercourse, where feasible.
- Using existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES130.6 – General and ES130.8 – Designated Areas and Access.
- Limiting clearing and construction to designated areas within the Project Footprint as per ES130.17 – Clearing and Grubbing.
- Maintaining a vegetated buffer zone between construction, operation and maintenance activities and lakes, rivers, streams, and ponds throughout operation of the road as per ES130.15 – Working within or near water.
- Retaining a vegetated buffer zone in riparian areas between construction activities and lakes, rivers, streams and ponds throughout construction as per ES130.15 – Working within or near water.

Effects of construction on beaver habitat is considered negligible due to the small area and mitigation measures to protect beaver habitat including standards for MDS protocols for problem beaver.

7.3.2 Sensory Disturbance and Mortality

Results of trapping program and information from local resource users indicate that low pelt prices provide little incentive to commercially harvest beaver. However, beaver is a valued component of the ecosystem and indicator for other aquatic furbearers including otter, mink and muskrat. Mitigation activities that reduce disturbance on beavers include construction activities, development of drainage (ditches) and borrow areas as well as clearing and blasting that occurs during construction which could result in disturbance to beavers, removal of dams and lodges resulting in winter freeze outs and mortality. Removal of problem beavers will also occur during 0perational activities that include maintenance of culverts and water crossings.

Important mitigation measures that will minimize sensory disturbance on beaver are outlined below. Other standard wildlife mitigation measures will also augment protection to beaver, and include:

- Staging construction activities (sections) during clearing, grubbing, and construction to limit disturbance to defined areas.
- Limiting riparian vegetation clearing within the right-of-way to the removal of trees and tall shrubs (to maintain line of sight safety requirements) beyond road and ditching.
- Maintaining existing water flow patterns, levels, and wetland hydrologic regimes as per ES130.15.3 – Disturbance to Stream Beds and Stream Banks and design and install equalization culverts
- Retaining a vegetated buffer zone in riparian areas between the cleared ASR ROW and lakes, rivers, streams and ponds throughout construction, operation and maintenance as per ES130.15 – Working within or near water.
- Restricting access to the ASR corridor to construction personnel as per ES130.6 – General and ES130.8 – Designated Areas and Access.
- Providing information about wildlife awareness to road construction workers to reduce vehicle speeds and the risk of wildlife-vehicle collisions.
- Dams found during pre-construction surveys that require removal shall be removed gradually, but not in winter, and with authorization with MSD as per ES130.15.10 – Beaver Dam Removal.
- Where feasible, problem beaver will be trapped.

Beavers are a very adaptable and prolific species. It is anticipated that beavers will occupy areas near the PF when construction and operation occur. With the application of the mitigation measures described, the effect of sensory disturbance and associated potential mortality (such as draining dams during winter) is minimal and will not affect populations in the LAA or near the project footprint.

7.4 Marten

Marten were selected as the representative terrestrial furbearer and potential effects include habitat loss/alteration/fragmentation and sensory disturbance. These potential effects were evaluated for relevance to the P6 Project and the following section provides the rationale for the determination of level assigned to each CEAA criteria as described in Appendix K as a result of the P6 Project.

7.4.1 Habitat Loss and Fragmentation

The results of habitat modeling illustrate the subsequent loss of marten habitat as a result of the project are insignificant due to the amount of habitat available within the LAA and RAA. Approximately 0.20 km^2 of primary or high-quality habitat being removed or altered within the project footprint which represents 0.02% of available habitat within the LAA (1,329 km^2) and 0.002% percent of overall habitat contained in the RAA (9,005 km^2).

Research on marten fragmentation and habitat use provides insight into potential project effects. Fryxell *et al.* (2004) presented evidence from a multi-year study that challenges the long-standing observation

(Novak, 1987) that marten were habitat specialists. Fryxell *et al.* (2004) observed that the abundance of marten harvested by trappers remained unchanged, despite a 50-year landscape scale habitat change due to industrial logging throughout much of the marten trapping area in Ontario. The study demonstrated significant post-logging use of regenerating stands by marten, and that such post-logged areas met life requisites for sustainable marten populations. These observations disprove the notion that martens require mature forest to survive and reproduce successfully. A low amount of ancillary access and lack of other intensive industrial activities such as forestry within the P6 RAA leaves the landscape relatively intact for marten habitat.

Results of multispecies surveys and information obtained through the trapper program as well as information from resource users illustrates that marten are wide spread and abundance across the RAA. Although results of kernel analysis indicate areas of relative high occupancy compared to other areas, annual variation in marten distribution is likely related to snow conditions and prey distribution (Wiebe *et al.,* 2014). Marten populations are also known to be cyclic, which would also contribute to annual variation Fryxell *et al.* (2004). Less than half of 1% of the total marten habitat within the RAA is predicted to be located within the 200 m buffer centred on the project footprint. It is not anticipated that marten populations will be negatively impacted by the physical process and associated activity to construct an all-season road (ASR).

The following mitigation measures have been identified to further minimize the effects of the project include:

- Avoiding clearing and construction of road and ROW during normal denning and parturition times (i.e. late March to April months) as per ES130.17 – Clearing and Grubbing and ES130.19 – Wildlife where feasible
- Using existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES130.6 – General and ES130.8 – Designated Areas and Access.
- Limiting clearing and construction to designated areas within the Project Footprint as per ES130.17 – Clearing and Grubbing.
- Decommissioning temporary access routes, trails, and existing winter road required for road construction, operation and maintenance to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES130.8 – Designated Areas and Access.

The P6 Project will result in a negligible effect on overall habitat removal/alteration or fragmentation as the RAA has very low road and linear feature density as described in the moose section. Mitigation described further minimizes habitat loss at the local level and reduces overall potential effects of fragmentation.

7.4.2 Sensory Disturbance

In disturbed forests, human activities have been found to result in higher rates of mortality, assumingly due to sensory disturbance. Johnson *et al.* (2009) compared mortality rates for marten dispersing from natal den sites located within regenerating and mature forest areas, and observed that juveniles of both sexes faced mortality rates twice of those animals dispersing from the uncut landscape. They

hypothesized that immature animals dispersing from regenerating landscapes were less able to cope with the higher energetic demands of life in the disturbed forest. As there is no commercial forestry in the area, the additional energetic demands resulting from construction or operation of the project are not expected to have an effect on individuals.

Mitigation on sensory disturbance are similar to those described above. Sensory disturbance effects may be neutral during winter given the pre-existing clearing of rights-of-way associated with the winter roads that have been in use for decades. Also given that a winter road currently exists, additional effects of an all-season road are considered incremental and primarily associated with increased annual use of the road, particularly during the non-winter months. There may be some associated impact should the ASR increase access of trappers to the area thereby resulting in higher trapping pressure on the resource, but there is no evidence nor reason to speculate that martens will be negatively impacted to any measurable extent.

7.5 Birds

The following sections provides the potential effects assessment for birds as described above. For the purpose of this assessment, birds have been assessed by category as described in the VC Selection 5.1. The VC birds have been assessed within individual categories and have been amalgamated by group. Habitat models for all individual species have been developed to compare high quality habitat in the PF to both the LAA and RAA. The following birds and categories have been included. These potential effects were evaluated for relevance to the P6 Project and the following section provides the rationale for the determination of level assigned to each CEAA criteria as described in Appendix K as a result of the P6 Project.

7.6 Raptors

The bald eagle was selected as the raptor VC for this project. The potential project effects examined include habitat loss/ alteration, fragmentation, loss of nests, mortality to young, and sensory disturbance near nests. The following provides results for the potential effects assessment on bald eagle. The main threat to bald eagles relates to destruction of nesting and roosting trees near suitable foraging habitat, which is typically near rivers and lakes (Buehler, 2000). The P6 road project may impact bald eagles if road construction or operation activities impact these important habitats. Results of aerial surveys determined that there are no known nesting sites near the PF. Although many bald eagle nests are generational, it is possible that new nests could be established near the PF prior to or during construction.

7.6.1 Habitat loss/alteration/fragmentation, loss of nest and mortality to young, and sensory disturbance

The results of habitat modeling for bald eagle illustrate the subsequent loss of habitat as a result of the project are insignificant due to the amount of habitat available within the LAA and RAA. Approximately 2.0 km^2 of primary or high-quality habitat being removed or altered within the project footprint represents 0.15% of available habitat within the LAA (1,329 km^2) and 0.02% percent of overall habitat contained in the RAA (9,005 km^2).

Multi-species aerial surveys conducted in 2015 documented resulted in the seven stick nests observations within the RAA, and one within the PF. Surveys conducted for spring staging waterfowl during June 15-17, 2016, resulted in a single incidental nest observation and 36 individual eagles. A fall waterfowl staging survey on October 12-14, 2016 yielded no observations of bald eagles.

Eagles make seasonal movements during fall and winter and their abundance would decline during this period. Winter occupation would be sporadic and occur only if open water and a food source were available (Manitoba Avian Research Committee, 2003); there were no observations of bald eagles during winter surveys nor were winter bald eagle observations mentioned by local resource users interviewed at the Wildlife Workshops and ATK meetings conducted in the communities. Similarly, trappers did not report presence of bald eagle during winter.

Direct loss of bald eagle nests and potential mortality to young could occur during construction. However, by applying the following mitigation measures, it is unlikely that any effects would be anticipated. Bald eagle nests are typically easy to detect during pre-construction surveys and the application of set back distances will result in little or no mortality to young eagles.

The following are the key migration measures determined to minimize potential effects on bald eagle habitat, minimize sensory disturbance (nest abandonment) and mortality to young include:

- Scheduling to avoid and/or suspend ROW clearing, bridge, and culvert maintenance activities during normal breeding and nesting times (i.e. April to June months) as per ES130.17 – Clearing and Grubbing and ES130.19 – Wildlife.
- Stage construction activities during clearing, grubbing, and construction to limit disturbance to defined areas.
- Prohibit equipment and limit access outside the designated cleared area throughout construction as per ES130.6 – General and 130.8 – Designated Areas and Access.
- Using existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES130.6 – General and ES130.8 – Designated Areas and Access.
- Limiting clearing and construction to designated areas within the Project Footprint as per ES130.17 – Clearing and Grubbing.
- Maintaining existing water flow patterns, levels, and wetland hydrologic regimes as per ES130.15.3 – Disturbance to Stream Beds and Stream Banks and design and install equalization culverts
- Decommissioning temporary access routes, trails, and existing winter road required for road construction, operation and maintenance to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES130.8 – Designated Areas and Access.
- Apply feasible noise and dust suppression techniques as per ES130.11 – Dust and Particulate Control and ES130.12 – Noise and Noise Limitations.

Mitigation and guidelines for eagles will also benefit other species of raptors, if stick nests are discovered during monitoring or other project activities. Baseline data on bald eagles collected for the P6 Project are consistent with literature and current knowledge and suggest populations within the RAA are within normal expected levels. Timing of clearing and construction, the application of set back and timing

restrictions are expected to minimize or eliminate any potential project effects. Mitigation and guidelines for eagles will also benefit other species of raptors, if stick nests are discovered during monitoring or other project activities.

7.7 Migratory Waterfowl

Baseline data for waterfowl were collected during spring and fall migration surveys as well as through TK workshops and other incidental observations. Waterfowl of interest included the **Canada goose**, which is hunted during spring and fall migrations, however, some resident geese are known to breed in the RAA. Species of VC duck included the **mallard** (dabbler) and the **ring-necked duck** (diver) and are known as both migratory to the RAA as well as breeding residents. Community members expressed interest in “fall ducks” on larger lakes and rivers during spring and fall that provide opportunities for domestic harvest. Potential Project effects examined included increased harvest, habitat loss/ alteration, fragmentation, loss of nests, mortality to young and mortality from collisions.

7.7.1 Habitat loss/alteration/fragmentation

7.7.1.1 Mallard

The results of habitat modeling illustrate the subsequent loss of mallard habitat as a result of the project are insignificant due to the amount of habitat available within the LAA and RAA. Approximately 2.3 km^2 of primary or high-quality habitat being removed or altered within the PFrepresents 0.17% of available habitat within the LAA (1,329 km^2) and 0.02% percent of overall habitat contained in the RAA (9,005 km^2).

7.7.1.2 Canada goose

The results of habitat modeling illustrate the subsequent loss of Canada goose habitat as a result of the project are insignificant due to the amount of habitat available within the LAA and RAA. Approximately 0.05 km^2 of primary or high-quality habitat being removed or altered within the project footprint represents 0.01% of available habitat within the LAA (1,329 km^2) and 0.03% percent of overall habitat contained in the RAA (9,005 km^2).

7.7.1.3 Ring-necked duck

The results of habitat modeling illustrate the subsequent loss of habitat as a result of the project are insignificant due to the amount of habitat available within the LAA and RAA. Approximately 4 km^2 of primary or high-quality habitat being removed or altered within the project footprint represents 0.3% of available habitat within the LAA (1,329 km^2) and 0.04% percent of overall habitat contained in the RAA (9,005 km^2).

Mitigation measures to minimize effects on nesting and staging habitat include:

- Avoiding and/or suspend ROW clearing, bridge, and culvert maintenance activities during normal breeding and nesting times (i.e. May to July months) as per ES130.17 – Clearing and Grubbing and ES130.19 - Wildlife.
- Aligning all-season road to avoid wetland habitat where feasible.
- Using existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES130.6 – General and ES130.8 – Designated Areas and Access.
- Limiting clearing and construction to designated areas within the Project Footprint as per ES130.17 – Clearing and Grubbing.
- Maintaining existing water flow patterns, levels, and wetland hydrologic regimes as per ES130.15.3 – Disturbance to Stream Beds and Stream Banks and design and install equalization culverts.
- Retain a vegetated buffer zone in riparian areas between construction, operation and maintenance activities and lakes, rivers, streams and ponds throughout construction as per ES130.15– Working within or near water.

The results of habitat modelling for Canada goose, mallard and ringed-neck duck all demonstrate the P6 Project will not impact habitat availability within the LAA or RAA. Timing of clearing and construction and the application of setback restrictions during the breeding and nesting season are expected to minimize or eliminate any potential project effects on waterfowl. Mitigation and guidelines for waterfowl will also serve to mitigate effects for waterbird species that share similar habitat associations

7.7.2 Loss of nests, mortality to young

Although the nesting habits may vary between Canada goose, mallard and ring-neck ducks, the potential for loss of nests and mortality to young would occur during construction and during the nesting period. Canada geese nest earlier than other waterfowl and nests are generally easy to detect during pre-construction surveys. Mallards are an adaptable nester and could be expected in a variety of habitats, but typically nest in uplands. Ring-necked ducks will be found along the edges of water associated with sedge and cattail found in shallow lakes and streams.

The following key mitigation measures will minimize potential impacts on nests and survival of young birds include:

- Staging construction activities (sections) during clearing, grubbing, and construction to limit disturbance to defined areas.
- Avoiding and/or suspend ROW clearing, bridge, and culvert maintenance activities during normal breeding and nesting times (i.e. May to July months) as per ES130.17 – Clearing and Grubbing and ES130.19 – Wildlife.
- Using existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES 130.6 – General and 130.8 – Designated Areas and Access.

- Maintaining existing water flow patterns, levels, and wetland hydrologic regimes as per ES130.15.3 – Disturbance to Stream Beds and Stream Banks and design and install equalization culverts
- Retaining a vegetated buffer zone in riparian areas between construction activities and lakes, rivers, streams and ponds throughout construction as per ES130.15– Working within or near water.

Loss of nests and mortality to young waterfowl requires the application of the mitigation measures described above. Based on the timing of clearing and construction restrictions, setbacks from wetlands will result in little to no mortality on nesting waterfowl, eggs or young birds. Project effects are likely not measurable and expected to be negligible.

7.7.3 Sensory Disturbance

Sensory disturbance could occur in areas of high activity near wetlands and waterbodies where nesting or staging occur (spring and fall). Disturbance could result in local abandonment or avoidance of wetlands near active areas. The following mitigation measures proposed to minimize potential effects of sensory disturbance include:

- Staging construction activities (sections) during clearing, grubbing, and construction to limit disturbance to defined areas.
- Avoiding and/or suspend ROW clearing, bridge, and culvert maintenance activities during the normal breeding and nesting times (i.e. May to July months) as per ES130.17 – Clearing and Grubbing and ES130.19 – Wildlife.
- Using existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES130.6 – General and 130.8 – Designated Areas and Access.
- Limiting clearing and construction to designated areas within the Project Footprint as per ES130.17 – Clearing and Grubbing.
- Prohibiting equipment and limit access outside the designated cleared area throughout construction as per ES130.6 – General and 130.8 – Designated Areas and Access.
- Applying feasible noise and dust suppression techniques as per ES130.11 – Dust and Particulate Control and ES130.12 – Noise and Noise Limitations.

Results of habitat modeling above illustrate habitat is not limited to areas near the PF and LAA. If displaced due to disturbance, waterfowl are adaptable and will find refuge throughout the LAA and RAA. The mitigation measures described will minimize local effects. Overall there is potential for occasional sensory disturbance near areas being utilized by waterfowl, with potential short term periodic effects of waterfowl movement away from project activities.

7.7.4 Increased mortality due to project infrastructure and vehicle collisions

A review of reported non-hunting mortality in waterfowl (Stout and Cornwell, 1976) estimated collision mortality (vehicles, powerlines, buildings, etc.) represented 0.1% of the total annual mortality. Roads that pass within 1 km of waterbird concentrations increase the mortality risk, however, a survey of utility companies (Stocek, 1981) found that most transmission line-related mortality is never reported, and this is likely the case with road-related collisions as well. Given the low traffic volumes, and other mitigations including aquatic and riparian buffers, this effect is not expected to be a measurable impact on local or regional waterfowl populations. A recommended mitigation item beyond the standard measures found in Appendix K include providing information about wildlife awareness to road construction workers to reduce vehicle speeds and the risk of wildlife-vehicle collisions.

7.7.5 Increased harvest

Waterfowl are potentially vulnerable to intensive hunting (overharvest) and ingesting spent lead shot which may cause toxicity. Increasing the accessibility of the region by improving the quality of roads may increase hunting pressure on waterfowl, however, DeStefano *et al.* (1995) suggested that although lead exposure was still an indirect cause of hunting mortality, exposure should decrease as hunters switched to steel shot. As the P6 Project is in a remote area, in combination with an alignment that avoids aquatic wetlands, the potential for this effect is minimal.

With increased access during the spring and summer staging periods, increased local resource use of waterfowl could potentially occur. However, current access to waterfowl lakes and rivers is restricted and with the presence of the ASR, opportunities for increased harvest and benefit to local resource users is possible. With the availability of habitat throughout the RAA and LAA, any effects on waterfowl related to overharvest are expected to be minor.

7.8 Non-Migratory Upland Game Birds – Ruffed Grouse

Ruffed grouse are considered an important game bird species and are valued by local communities and resource users. Baseline data for ruffed grouse is limited, however, their presence was validated through observations from trail cameras, ARU's, Breeding Bird Atlas, incidental observations and through TK workshops. Potential Project effects examined included increased harvest, habitat loss/alteration, fragmentation, loss of nests, mortality to young and mortality.

7.8.1 Habitat loss/alteration/fragmentation

The results of habitat modeling illustrate the subsequent loss of ruffed grouse habitat as a result of the project are insignificant due to the amount of habitat available within the LAA and RAA. There is no primary or high-quality habitat located within the project footprint. The RAA (9,005 km^2) contains 0.22% of the primary habitat for ruffed grouse.

Ruffed grouse are also known to be cyclic in nature and are most abundant in early-succession forests (Zimmerman and Gutierrez, 2008; Zimmerman *et al.,* 2009). Roadside habitat created by the P6 Project will also have a positive impact on grouse through disturbances that promote aspen and other early-succession species. Mitigation measures include:

- Limit clearing and construction to designated areas within the Project Footprint and Local Assessment Area (quarries) as per ES 130.17 – Clearing and Grubbing.
- Undertake ROW (i.e. brushing, and clearing), bridge, and culvert maintenance activities during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. April 1 to September 1).

7.8.2 Loss of nests, mortality to young

Potential for loss of nests and mortality to young would occur during the nesting period with construction and ROW maintenance. Although the LAA does not have large areas of high quality habitat grouse nesting could occur in microhabitats that contain deciduous forest near the PF.

The following key mitigation measures will minimize potential impacts on nests and survival of young birds. These mitigation activities are applied to all nesting bird species and generally apply to ruffed grouse as well include:

- Staging construction activities during clearing, grubbing, and construction to limit disturbance to defined areas.
- Avoiding and/or suspend ROW clearing, bridge, and culvert maintenance activities during normal breeding and nesting times (i.e. May to June months) as per ES130.17 – Clearing and Grubbing and ES130.19 – Wildlife.

Loss of nests and mortality to young waterfowl requires the application of the mitigation measures described above. If applied, mortality to young and or destruction to nests is likely not measurable and is expected to be negligible.

7.8.3 Sensory Disturbance and Increased mortality due to project infrastructure and vehicle collisions

In Manitoba, Ruffed Grouse are frequently killed by vehicles as they fly low across roads (Holland and Taylor, 2003b). A study in Minnesota found a negative relationship between road density and grouse density (Kouffeld *et al.,* 2013). The authors suggested that grouse numbers were affected either by hunting pressure along roads or changes in cover associated with the roads. However, these studies relate to regions of high road density and traffic volume. Given the low density of roads within the LAA and RAA, road mortality is not expected to have any effect on local populations.

7.8.4 Increased Harvest

Increased accessibility of as a result of the P6 Project may increase hunting opportunity for grouse hunters and may provide an economic benefit for local communities (Knoche and Lupi, 2013). In contrast, Rusch *et al*. (2000), suggests that ruffed grouse populations are not usually limited by hunting, but rather by forest succession. Habitat conditions near the PF are likely to improve and attract ruffed grouse and would likely benefit local resource users. The remote nature of the RAA in combination with the low density of linear features and access, impacts to populations in the LAA or RAA would not be measurable. The cyclic nature of ruffed grouse populations is likely to result in fluctuating hunting opportunities as populations climb and decline through time, which was verified through local knowledge and resource users participating in the wildlife workshop.

7.9 Migratory Forest Birds

Baseline data for migratory forest birds (song birds) was obtained from the Breeding Bird Atlas, ARU deployments, incidental observations and TK. Results of baseline studies and TK substantiated the presence of VC songbirds. This VC was evaluated as a specific species group and project effects examined included habitat loss/alteration, fragmentation, loss of nests, mortality to young and vehicle collisions.

7.9.1 Habitat loss/alteration/fragmentation

Habitat loss, alteration and potential fragmentation was evaluated through the modeling described in Section 5. The following provides a summary of the potential habitat loss associated with the construction and operation of the project.

7.9.1.1 Magnolia warbler

Sixty-one magnolia warblers were recorded during MBBA point count surveys along with one MBBA incidental observation, and none identified on ARU recordings (Map 72). Magnolia warblers were observed in wetland shrub habitats and coniferous forests during MBBA point count surveys throughout the LAA and in the southern portion of the RAA. The MBBA incidental observation occurred south of Bunibonibee Cree Nation and in the central and southern portions of the RAA.

The results of habitat modeling illustrate the subsequent loss of habitat as a result of the project are insignificant due to the amount of habitat available within the LAA and RAA. Approximately 3.4 km^2 of primary or high-quality habitat being removed or altered within the PF represents 0.3% of available habitat within the LAA (1,329 km^2) and 0.04% percent of overall habitat contained in the RAA (9,005 km^2).

7.9.1.2 Ovenbird

Thirty-one ovenbirds were recorded during MBBA point count surveys along with 13 MBBA incidental observations and identified on 10 of 45 ARU sampling sites (Map 74). Ovenbirds were primarily observed in wetland shrub habitat and coniferous forests south of Bunibonibee Cree Nation and west of God’s Lake

Narrows during MBBA point count surveys along with MBBA incidental observations. Ovenbirds occurred on ARUs deployed in the central portion of the RAA.

Habitat modeling illustrate the subsequent loss of habitat as a result of the project are insignificant due to the amount of habitat available within the LAA and RAA. There is no primary or high-quality habitat located within the PF. The RAA (9,005 km^2) contains 0.22% of the primary habitat for ovenbird.

7.9.1.3 Palm warbler

Palm warblers are numerous with 135 observations during MBBA point count surveys along with 51 MBBA incidental observations (Map 70). Palm warblers were primarily observed in wetland shrub habitat and coniferous forests in the eastern portion of the LAA and in the central and southern portion of the RAA during MBBA point count surveys and MBBA incidental observations.

The results of habitat modeling illustrate the subsequent loss of habitat as a result of the project are insignificant due to the amount of habitat available within the LAA and RAA. Approximately 11.1 km^2 of primary or high-quality habitat being removed or altered within the PF represents 0.8% of available habitat within the LAA (1,329 km^2) and 0.1% percent of overall habitat contained in the RAA (9,005 km^2).

7.9.1.4 Yellow-bellied flycatcher

Seventy-four yellow-bellied flycatchers were recorded during MBBA point count surveys along with 31 MBBA incidental observations, and none were identified on ARU records (Map 76). Yellow-bellied flycatchers were primarily observed in open coniferous and wetland shrub areas throughout the LAA and in the southern portion of the RAA during MBBA point count surveys along with MBBA incidental observations.

Habitat modeling illustrates the subsequent loss of habitat as a result of the project are insignificant due to the amount of habitat available within the LAA and RAA. There is no primary or high-quality habitat located within the PF. A total of 0.22% of the RAA (9,005 km^2) consists of primary habitat.

Although habitat for the VC migratory forest birds is generally abundant, mitigation on habitat and fragmentation is intended to minimize impacts near the PF and in the LAA. These mitigation measures include:

- Avoiding and/or suspend ROW clearing, bridge, and culvert maintenance activities during normal breeding and nesting times (i.e. May to July months) as per ES130.17 – Clearing and Grubbing and ES130.19 – Wildlife.
- Aligning all-season road to avoid/minimize the loss of habitat where feasible.
- Using existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES130.6 – General and ES130.8 – Designated Areas and Access.
- Limiting clearing and construction to designated areas within the Project Footprint as per ES130.17 – Clearing and Grubbing.

- Maintaining existing water flow patterns, levels, and wetland hydrologic regimes as per ES130.15.3 – Disturbance to Stream Beds and Stream Banks and design and install equalization culverts.
- Decommissioning temporary access routes, trails, and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES130.8 – Designated Areas and Access.

When considering the effects of habitat loss or alteration, the localized extent of clearing required for the P6 Project is minimal, and effects on habitat in the LAA or RAA is well below that of any expected impact. Edge characteristics currently exist along the winter road. However, the clearing for the ASR will be wider, with similar edge metrics (length of edge). This edge effect could negatively affect some forest songbirds' species, while positively affecting others (e.g. generalist and edge species).

Localized low level habitat impacts are anticipated and within the physical ROW, however, habitat availability with the LAA and RAA are abundant. Also, the overall density of linear features and other landscape disturbances is very low. With the mitigation measures implemented, overall effects on habitat and fragmentation would be considered a local effect, but not affecting habitat at the LAA scale.

7.9.2 Loss of nests, mortality to young

Although the nesting habits may vary between song bird species, the potential for loss of nests and mortality to young would occur during constructing and during the nesting period. Based on the timing of clearing and construction restrictions, pre-construction nest sweeps and setbacks from wetlands will result in little to no mortality on nesting birds, eggs or young. The following key mitigation measures will minimize potential impacts on nests and survival of young birds:

- Staging construction activities (sections) during clearing, grubbing, and construction to limit disturbance to defined areas.
- Avoiding and/or suspend ROW clearing, bridge, and culvert maintenance activities during normal breeding and nesting times (i.e. May to July months) as per ES130.17 – Clearing and Grubbing and ES130.19 – Wildlife.
- Conducting pre-construction and nest sweep surveys prior to any clearing necessary during critical nesting periods as described above to identify if nesting areas are present.
- Using existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES130.6 – General and 130.8 – Designated Areas and Access.

7.9.3 Sensory Disturbance

Sensory disturbance could occur in areas of high activity in all habitat types during the breeding and nesting period. Disturbance and noise could result in disruption to local breeding bird territories and local abandonment or avoidance nesting or feeding areas. The following mitigation measures are proposed to minimize potential effects of sensory disturbance:

- Stage construction activities (sections) during clearing, grubbing, and construction to limit disturbance to defined areas.
- Avoid and/or suspend ROW clearing and quarry blasting during the normal breeding and nesting times (i.e. May to July months) as per ES130.17 – Clearing and Grubbing and ES130.19 – Wildlife.
- Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES130.6 – General and 130.8 – Designated Areas and Access.
- Limit clearing and construction to designated areas within the Project Footprint as per ES130.17 – Clearing and Grubbing.
- Prohibit equipment and limit access outside the designated cleared area throughout construction as per ES130.6 – General and 130.8 – Designated Areas and Access.
- Apply feasible noise and dust suppression techniques as per ES130.11 – Dust and Particulate Control and ES130.12 – Noise and Noise Limitations.

Increased mortality due to project infrastructure and vehicle collisions Effects related to vehicle mortality are not expected to be measurable due to low traffic volumes and construction restrictions during the breeding and nesting season that may result in disorientation of breeding male territories. Mitigation and guidelines for this VC will also serve to mitigate effects for other songbirds that share similar habitat associations. The overall effect of the project on sensory disturbance is minor in nature. The overall density of roads and other linear features in the RAA will also serve to reduce this effect on local and regional populations.

7.10 Reptiles and Amphibians – Spring Peeper

Baseline data for spring peeper were acquired through ARU deployments, incidental observations and TK. Results of baseline studies verified the presence of this VC throughout the LAA. Project effects examined included habitat loss/alteration and potential winter mortality through compaction of soils in potential spring peeper habitat.

7.10.1 Habitat loss/alteration

The results of habitat modeling illustrate the subsequent loss of habitat as a result of the project are insignificant due to the amount of habitat available within the LAA and RAA. Approximately 8.1 km^2 of primary or high-quality habitat being removed or altered within the PF represents 0.6% of available habitat within the LAA (1,329 km^2) and 0.09% percent of overall habitat contained in the RAA (9,005 km^2).

7.10.2 Winter mortality through soil compaction

There is a potential for mortality during winter through compaction and freezing of soils in habitat where amphibians (spring peeper) may be over wintering. The following mitigation measures, which will result in the reduction of potential for both habitat loss and mortality as a result of winter compaction include:

- Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES130.6 – General and 130.8 – Designated Areas and Access.
- Limit clearing and construction to designated areas within the Project Footprint as per ES130.17 – Clearing and Grubbing.
- Prohibit equipment and limit access outside the designated cleared area throughout construction, operation and maintenance as per ES130.6 – General and 130.8 – Designated Areas and Access.
- Retain and maintain a vegetated buffer zone in riparian areas between construction activities and lakes, rivers, streams and ponds throughout construction, operatations and maintenance as per ES130.15– Working within or near water.
- Retention of some slash piles and coarse woody debris (i.e. snags and logs) on the forest floor during construction would potentially benefit spring peepers by providing cover. This is temporary until the slash can be burned. Note that slash will not be left on the ground.

In summary, some local effects may be expected, and mortality will be reduced and considered minor, however, the extent to which mortality would occur is uncertain. Habitat loss as a result of the project is also minimal and will not affect populations within the RAA.

7.11 Species of Conservation Concern

In Appendix D, Table D-1 provides a list of the terrestrial Species of Conservation Concern, along with their current conservation status, a brief description of preferred habitat, and potential occurrence in the RAA. The potential Species of Conservation Concern were reviewed in terms of their known range and any identified critical habitat with the RAA. Potential presence was determined based on field studies conducted in the area; review of habitat data, COSEWIC reports, Manitoba Avian Research Committee (2003), Manitoba Breeding Bird Atlas (MBBA, 2014a), Cornell Lab of Ornithology (2015), Manitoba Conservation Data Center (2016b), Manitoba Endangered Species and Ecosystems Act (MESEA, 2017) and the Species at Risk Public Registry (2017); and professional knowledge and experience in the area.

In Appendix K, Tables K-2 and Table K-12 provide information on how SOCC potentially occurring in the RAA are potentially affected by the Project, including the assessment criteria used to determine level of effect and the proposed mitigation to avoid potential adverse effects to those species. No critical habitat as defined in Recovery Strategies and Action Plans developed as required under the federal *Species at Risk Act* were identified within or near the RAA, with the exception of a small portion of the Molson Boreal Caribou Management Unit and the Norway House range contained in the RAA. Caribou effects and disturbance assessments are found in Section 7.1. Mitigation described within available Recovery Strategies and Action Plans are important tools that form an integral component of the proposed mitigation for the protected Species at Risk and their critical habitat potentially affected by the Project, as described in Appendix K, Table K-12.

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APPENDIX A: LIST OF POTENTIAL MAMMALS FOR THE P6 REGIONAL ASSESSMENT AREA

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
American beaver[2,3]	*Castor canadensis*			S5	
American black bear[3]	*Ursus americanus*			S5	
American deer mouse	*Peromyscus maniculatus*			S5	
American marten[2,3]	*Martes americana*			S5	
American mink[2,3]	*Neovison vison*			S5	
American water shrew	*Sorex palustris*			S5	
Arctic shrew	*S. arcticus*			S5	
Boreal caribou* (woodland)[1,2,3]	*Rangifer tarandus caribou*	THR	THR	S2S3,	THR
Boreal caribou* (eastern migratory)[1,2,3]	*Rangifer tarandus caribou*		END	SNR	
Canada lynx[2,3]	*Lynx canadensis*			S5	
Coyote[3]	*Canis latrans*			S5	
Eastern heather vole	*Phenacomys ungava*			S5	
Ermine (short-tailed weasel)	*Mustela erminea*			S5	
Fisher[2,3]	*Martes pennanti*			S5	
Gray wolf[2,3]	*Canis lupus*			S5	
Hoary bat	*Lasiurus cinereus*			S3B	
House mouse	*Mus musculus*			SNA	
Least chipmunk[3]	*Neotamias minimus*			S5	
Least weasel[2,3]	*Mustela nivalis*			S3S4	
Little brown bat[3]	*Myotis lucifugus*	END	END	S2N,S5B	END
Masked shrew[3]	*Sorex cinereus*			S5	
Meadow jumping mouse	*Zapus hudsonius*			S5	
Meadow vole	*Microtus pennsylvanicus*			S5	
Moose[2,3]	*Alces alces*			S5	
Muskrat[2,3]	*Ondatra zibethicus*			S5	
North American porcupine[3]	*Erethizon dorsatum*			S5	
Northern bog lemming	*Synaptomys borealis*			S5	
Northern flying squirrel[3]	*Glaucomys sabrinus*			S5	
Northern river otter[2,3]	*Lontra canadensis*			S5	
Pygmy shrew	*Sorex hoyi*			S5	
Raccoon[3]	*Procyon lotor*			S5	
Red fox[2,3]	*Vulpes vulpes*			S5	
Red squirrel	*Tamiasciurus hudsonicus*			S5	

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
Short-tailed shrew	*Blarina brevicauda*			S5	
Snowshoe hare[2,3]	*Lepus americanus*			S5	
Southern red-backed vole	*Clethrionomys gapperi*			S5	
Star-nosed mole	*Condylura cristata*			S3	
Striped skunk[2,3]	*Mephitis mephitis*			S5	
Wolverine (western pop.)[2,3]	*Gulo gulo*	No status	SC	S3S4	Not listed
Woodchuck	*Marmota monax*			S5	

Sources: Banfield, 1974; Caras, 1967; COSEWIC, 2017; MBCDC, 2016a; MESEA, n.d., SARA, 2017; Smithsonian (n.d.)

Bolded species are Species of Conservation Concern: **THR** – Threatened, **SC** – Special Concern, **END** – Endangered; NAR – Not at Risk

*****The P6 RAA includes the woodland (forest-dwelling) and coastal (forest-tundra) populations of boreal caribou in Manitoba; woodland caribou are listed as threatened while coastal caribou are not listed.

[1]Species occurrence listed on the Manitoba Conservation Data Centre for the Hayes River Upland Ecoregion, [2]Observation during Joro Field Programs, [3]Species of First Nation Interest

MBCDC (2016c) Definitions for Status Listing:

1 Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.

2 Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.

3 Uncommon throughout its range or in the province (21 to 100 occurrences).

4 Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (> 100 occurrences).

5 Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially impossible to eradicate under present conditions.

U Possibly in peril, but status uncertain; more information needed.

H Historically known; may be rediscovered.

X Believed to be extinct; historical records only, continue search.

SNR A species not ranked. A rank has not yet assigned or the species has not been evaluated.

SNA A conservation status rank is not applicable to the element.

S#S# Numeric range rank: A range between two of the numeric ranks. Denotes range of uncertainty about the exact rarity of the species.

? Inexact or uncertain; for numeric ranks, denotes inexactness.

B Breeding status of a migratory species. Example: S1B, SZN - breeding occurrences for the species are ranked S1 (critically imperilled) in the province, nonbreeding occurrences are not ranked in the province.

N Non-breeding status of a migratory species. Example: S1B, SZN - breeding occurrences for the species are ranked S1 (critically imperilled) in the province, nonbreeding occurrences are not ranked in the province.

Q Taxonomic questions or problems involved, more information needed; appended to the global rank.

T Rank for subspecific taxon (subspecies, variety, or population); appended to the global rank for the full species.

A modifier to SX or SH; the species has been reintroduced but the population is not yet established.

SARA (2017) Definitions for Status Listing:

Schedule 1: the official list of species that are classified as extirpated, endangered, threatened, and of special concern.

Schedule 2: species listed in Schedule 2 are species that had been designated as endangered or threatened, and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1.

Schedule 3: species listed in Schedule 3 are species that had been designated as special concern, and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1.

Special Concern: a wildlife species that may become a threatened or an endangered species because of a

combination of biological characteristics and identified threats.

Threatened: a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

COSEWIC (2017) Definitions for Status Listing:

Extinct: A wildlife species that no longer exists.

Extirpated: A wildlife species that no longer exists in the wild in Canada, but exists elsewhere.

Endangered: A wildlife species facing imminent extirpation or extinction.

Threatened: A wildlife species that is likely to become an endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Special Concern: A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.

Not At Risk: A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

MESEA (2017) Definitions for Status Listing:

Extirpated: A species formerly indigenous to Manitoba no longer exists in the wild in Manitoba but exists elsewhere.

Endangered: A species threatened with imminent extirpation or with extinction throughout all or a significant portion of its Manitoba range.

Threatened: A species indigenous to Manitoba that is either: a) likely to become endangered; or b) is, because of low or declining numbers in Manitoba, particularly at risk if the factors affecting its vulnerability do not become reversed.

Special Concern: A species indigenous to Manitoba is at risk of becoming a threatened or endangered species because of a combination of biological characteristics and identified threats to the species.

APPENDIX B: LIST OF POTENTIAL BIRDS FOR THE P6 REGIONAL ASSESSMENT AREA

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
Alder flycatcher[1,2,3]	*Empidonax alnorum*			S5B	
American bittern[1,2,6]	*Botaurus lentiginosus*			S5B	
American black duck[1,2, 6]	*Anas rubripes*			S3B	
American crow[1,2,3,6]	*Corvus brachyrhychos*			S5B SUN	
American golden-plover[1,2]	*Pluvialis dominica*			S4B SUM	
American goldfinch[1,2]	*Spinus tristis*			S5B	
American kestrel[1,2]	*Falco sparverius*			S4B	
American pipit[1,2]	*Anthus rubescens*			S3B	
American redstart[1,2]	*Setophaga ruticilla*			S5B	
American robin[1,2,3]	*Turdus migratorius*			S5B	
American three-toed woodpecker[3]	*Picoides dorsalis*			S5	
American tree sparrow[1,3]	*Spizella arborea*			S5B SUM	
American white pelican[1,2,6]	*Pelecanus erythrorhynchos*			S4B	
American wigeon[1,2,5]	*Anas americana*			S4B	
Baird's sandpiper[1]	*Calidris bairdii*			SUM	
Bald eagle[1,5,6]	*Haliaeetus leucocephalus*			S5B SUN	
Bank swallow[1,6]	*Riparia riparia*	THR	THR	S5B	Not listed
Barn swallow[1,4,6]	*Hirundo rustica*	THR	THR	S4B	Not listed
Barred owl[1,4]	*Strix varia*			S4	
Bay-breasted warbler[1,]	*Setophaga castanea*			S5B	
Belted kingfisher[1,2]	*Megaceryle alcyon*			S5B	
Black scoter[1,6]	*Melanitta americana*			S4B	
Black tern[1,5,6]	*Childonias niger*			S4B	
Black-and-white warbler[1,2]	*Mniotilta varia*			S5B	
Black-backed woodpecker[2]	*Picoides arcticus*			S5	
Black-bellied plover[1]	*Pluvialis squatarola*			SUM	
Black-capped chickadee[1,2,3]	*Poecile atricapillus*			S5	
Black-throated green warbler[1]	*Setophaga virens*			S4B	

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
Blackburnian warbler[1,2]	*Setophaga fusca*			S5B	
Blackpoll warbler[1,2]	*Setophaga striata*			S5B SUM	
Blue jay[3]	*Cyanocitta cristata*			S5	
Blue-headed vireo[1,2,3]	*Vireo solitarius*			S5B	
Blue-winged teal[1,5]	*Anas discors*			S4B	
Bohemian waxwing[1]	*Bombycilla garrulus*			S4B SUN	
Bonaparte's gull[1,2,6]	*Chroicocephalus philadelphia*			S5B	
Boreal chickadee[1,3]	[2]*Poecile hudsonicus*			S4	
Boreal owl[1,6]	*Aegolius funereus*			S4	
Broad-winged hawk[1]	*Buteo platypterus*			S5B	
Brown creeper[1,2,3]	*Certhia americana*			S5B	
Bufflehead[1,5]	*Bucephala albeola*			S4B	
Cackling goose[1]	*Branta hutchinsii*			S5B	
Canada goose[1,2,3,5,6]	*Branta canadensis*			S5B	
Canada warbler[1,4,6]	*Cardellina canadensis*	THR	THR	S3B	THR
Cape May warbler[1,2]	*Setophaga tigrina*			S5B	
Cedar waxwing[1,2,3]	*Bombycilla cedrorum*			S5B SUN	
Chipping sparrow[1,2,3]	*Spizella passerina*			S5B	
Clay-colored sparrow[1,2]	*Spizella pallida*			S5B	
Cliff swallow[1]	*Petrochelidon pyrrhonota*			S4B	
Common goldeneye[1,5]	*Bucephala clangula*			S5B SUN	
Common grackle[1,2,3]	*Quiscalus quiscula*			S5B	
Common loon[1,2,3,5,6]	*Gavia immer*			S5B	
Common merganser[1,5,6]	*Mergus merganser*			S5B	
Common nighthawk[1,2,3,4,6]	*Chordeiles minor*	THR	THR	S3B	THR
Common raven[2,3,6]	*Corvus corax*			S5	
Common redpoll[1,3]	*Acanthis flammea*			S4B S5N	
Common tern[1,5]	*Sterna hirundo*			S5B	
Common yellowthroat[1,2]	*Geothlypis trichas*			S5B	
Connecticut warbler[1,2,3]	*Oporornis agilis*			S4B	
Dark-eyed junco[1,2,3]	*Junco hyemalis*			S5B SUN	
Double-crested cormorant[1,6]	*Phalacrocorax auritus*			S5B	
Downy woodpecker[2,3]	*Picoides pubescens*			S5	
Dunlin[1]	*Calidris alpina*			S3B SUM	
Eastern kingbird[1,2]	*Tyrannus tyrannus*			S4B	
Eastern phoebe[1]	*Sayornis phoebe*			S5B	

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
Eastern wood-pewee[1,4]	*Contopus virens*	Schedule 1, SC	SC	S4B	Not listed
European starling	*Sturnus vulgaris*			SNA	
Evening grosbeak[3]	*Coccothraustes vespertinus*			S3	
Forster's Tern[1,2]	*Sterna forsteri*			S4B	
Fox sparrow[1,2]	*Passerella iliaca*			S5B S4M	
Gadwall[1]	*Anas strepera*			S5B	
Golden eagle[1,5,6]	*Aquila chrysaetos*		NAR	S1B S4N	
Golden-crowned kinglet[1]	*Regulus satrapa*			S4B	
Gray catbird[1,3]	*Dumetella carolinensis*			S5B	
Gray jay[2,3,6]	*Perisoreus canadensis*			S5	
Gray-cheeked thrush[1]	*Catharus minimus*			S5B S5M	
Great blue heron[1,4,6]	*Ardea herodias*			S5B	
Great gray owl[1,2,3]	*Strix nebulosa*			S4	
Great horned owl[1,6]	*Bubo virginianus*			S4	
Greater scaup[1,5,6]	*Aythya marila*			S5B SUM	
Greater white-fronted goose[1]	*Anser albifrons*			SUM	
Greater yellowlegs[1,2,5]	*Tringa melanoleuca*			S5B SUM	
Green-winged teal[1,5]	*Anas crecca*			S4B	
Gyrfalcon[1]	*Falco rusticolus*		NAR	SUN	
Hairy woodpecker[3]	*Picoides villosus*			S5	
Harris's sparrow[1,3]	*Zonotrichia querula*			S4B S5M	
Hermit thrush[1,2,3]	*Catharus guttatus*			S5B	
Herring gull[1,2,6]	*Larus argentatus*			S4B	
Hoary redpoll[1,3]	*Acanthis hornemanni*			S3B S5N	
Hooded merganser[1]	*Lophodytes cucullatus*			S5B	
Horned grebe[4]	*Podiceps auritus*	SC	SC	S4B	Not listed
Horned lark[1]	*Eremophila alpestris*			S3B SUM	
House sparrow[1]	*Passer domesticus*			SNA	
Killdeer[1]	*Charadrius vociferus*			S5B	
Lapland longspur[1]	*Calcarius lapponicus*			S4B SUM SUN	
Le Conte's sparrow[1,2,3]	*Ammodramus leconteii*			S5B	
Least flycatcher[1,2]	*Empiodnax minimus*			S5B	
Least sandpiper[1,2]	*Calidris minutilla*			S4B SUM	
Lesser scaup[1,5,6]	*Aythya affinis*			S5B	
Lesser yellowlegs[1,3]	*Tringa flavipes*			S4B SUM	
Lincoln's sparrow[1,2,3]	*Melospiza lincolnii*			S5B	
Long-eared owl[1]	*Asio otus*			S4B	

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
Long-tailed duck[1,6]	*Clangula hyemalis*			S4B	
Magnolia warbler[1,2]	*Setophaga magnolia*			S5B	
Mallard[1,2,3,5,6]	*Anas platyrhynchos*			S5B	
Merlin[1,2]	*Falco columbarius*		NAR	S5B SUN	
Nashville warbler[1,2,3,5]	*Oreothlypis ruficapilla*			S5B	
Northern flicker[1,2,3]	*Colaptes auratus*			S5B	
Northern goshawk[1]	*Accipiter gentilis*			S4B S5N	
Northern harrier[1,2,5]	*Circus cyaneus*			S5B	
Northern hawk owl[1]	*Surnia ulula*			S4	
Northern pintail[1,5]	*Anas acuta*			S5B	
Northern shoveler[1]	*Anas clypeata*			S5B	
Northern shrike[1]	*Lanius excubitor*			S3B S5N SUM	
Northern waterthrush[1,2]	*Parkesia noveboracensis*			S5B	
Olive-sided flycatcher[1,2,3,4,6]	*Contopus cooperi*	THR	THR	S3B	THR
Orange-crowned warbler[1,2,3]	*Oreothlypis celata*			S5B	
Osprey[1,6]	*Pandion haliaetus*			S4B	
Ovenbird[1,2,3]	*Seiurus aurocapilla*			S5B	
Palm warbler[1,2]	*Setophaga palmarum*			S5B	
Pectoral sandpiper[1]	*Calidris melanotos*			S4M	
Peregrine falcon[1,6]	*Falco peregrinus*	SC	SC	S1B	END
Philadelphia vireo[1]	*Vireo philadelphicus*			S4B	
Pied-billed grebe[1,2,3]	*Podilymbus podiceps*			S5B	
Pileated woodpecker[2,3]	*Dryocopus pileatus*			S5	
Pine grosbeak[3]	*Pinicola enucleator*			S4	
Pine siskin[2]	*Spinus pinus*			S5	
Purple finch[1,2]	*Haemorhous purpureus*			S5B	
Red crossbill[1,3]	*Loxia curvirostra*			S4B SUN	
Red-breasted merganser[1,2]	*Mergus serrator*			S4B	
Red-breasted nuthatch[1,2,3]	*Sitta canadensis*			S5	
Red-eyed vireo[1,2]	*Vireo olivaceus*			S5B	
Red-necked phalarope[1]	*Phalaropus lobatus*			S4B SUM	
Red-tailed hawk[1,2]	*Buteo jamaicensis*			S5B	
Red-throated loon[1]	*Gavia stellata*			S3B, SUM	
Red-winged blackbird[1,2,3,6]	*Agelaius phoeniceus*			S5B	
Ring-billed gull[1,3]	*Larus delawarensis*			S5B	
Ring-necked duck[1,3,5]	*Aythya collaris*			S5B	

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
Rose-breasted grosbeak[1,3]	*Pheucticus ludovicianus*			S5B	
Ross's goose[1]	*Chen rossii*			S3S4B S4M	
Rough-legged hawk[1]	*Buteo lagopus*		NAR	S3B SUM	
Ruby-crowned kinglet[1,2,3]	*Regulus calendula*			S5B	
Ruddy turnstone[1]	*Arenaria interpres*			SUM	
Ruffed grouse[2,3,5,6]	*Bonasa umbellus*			S4S5	
Rusty blackbird[1,2,4,6]	*Euphagus carolinus*	SC	SC	S4B	Not listed
Sanderling[1]	*Calidris alba*			SUM	
Sandhill crane[1,2,3,5,6]	*Grus canadensis*			S5B	
Savannah sparrow[1,2]	*Passerculus sandwichensis*			S5B	
Semipalmated plover[1]	*Charadrius semipalmatus*			S4B SUM	
Semipalmated sandpiper[1,6]	*Calidris pusilla*			S3B SUM	
Sharp-shinned hawk[1]	*Accipter striatus*			S4B	
Sharp-tailed grouse[5,6]	*Tympanuchus phasianellus*			S5	
Short-billed dowitcher[1]	*Limnodromus griseus*			S4B	
Short-eared owl[1,3,6]	*Asio flammeus*	SC	SC	S2S3B	THR
Smith's longspur[1]	*Calcarius pictus*			S3B SUM	
Snow bunting[1]	*Plectrophenax nivalis*			S4N SUM	
Snow goose[1,6]	*Chen caerulescens*			S5B S5M	
Snowy owl[1,6]	*Bubo scandiacus*			S4N	
Solitary sandpiper[1,2]	*Tringa solitaria*			S4B SUM	
Song sparrow[1,2]	*Melospiza melodia*			S5B	
Sora[1,3]	*Porzana carolina*			S5B	
Spotted sandpiper[1]	*Actitis macularius*			S5B	
Spruce grouse[3,5,6]	*Falcipennis canadensis*			S4	
Stilt sandpiper[1]	*Calidris himantopus*			S4B SUM	
Surf scoter[1]	*Melanitta perspicillata*			S3B	
Swainson's thrush[1,3,5]	*Catharus ustulatus*			S5B	
Swamp sparrow[1,3]	*Melospiza georgiana*			S5B	
Tennessee warbler[1,2,3]	*Oreothlypis peregrina*			S5B	
Tree swallow[1,6]	*Tachycineta bicolor*			S4B	
Tundra swan[1,5,6]	*Cygnus columbianus*			S4B SUM	
Turkey vulture[1,6]	*Cathartes aura*			S4B	
Vesper sparrow[1]	*Pooecetes gramineus*			S5B	
White-crowned sparrow[1,3]	*Zonotrichia leucophrys*			S5B	

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
White-rumped sandpiper[1]	*Calidris fuscicollis*			SUM	
White-throated sparrow[1,2,3]	*Zonotrichia albicollis*			S5B	
White-winged crossbill[1,2,3]	*Loxia leucoptera*			S5	
White-winged scoter[1]	*Melanitta fusca*			S4B	
Willow ptarmigan[1,6]	*Lagopus lagopus*			S4B SUN	
Wilson's snipe[1,2,3,5,6]	*Gallingo delicata*			S5B	
Wilson's warbler[1,2]	*Cardellina pusilla*			S5B SUM	
Winter wren[1,2,3]	*Troglodytes hiemalis*			S5B	
Yellow rail[1,2]	*Coturnicops noveboracensis*	SC	SC	S3B	Not listed
Yellow warbler[1,2,3]	*Setophaga petechia*			S5B	
Yellow-bellied flycatcher[1,2]	*Empidonax flaviventris*			S5B	
Yellow-bellied sapsucker[1,2,3]	*Sphyrapicus varius*			S5B	
Yellow-rumped warbler[1,2,3]	*Setophaga coronata*			S5B	

Sources: Manitoba Avian Research Committee, 2003; MBBA, 2014b; Cornell Lab of Ornithology, 2015; COSEWIC, 2017; Joro, 2017; MBCDC, 2016a; MESEA, 2017, SARA, 2017.

Bolded species are Species of Conservation Concern: **THR** – Threatened, **SC** – Special Concern, **END** – Endangered; NAR – Not at Risk

[1]Species is a migrant (summer-breeding) or non-breeding visitor in the RAA; [2]Observation during the Manitoba Breeding Bird Atlas Surveys, [3]Observation heard on ARU recordings, [4]Species occurrence listed on the Manitoba Conservation Data Centre for the Hayes River Upland Ecoregion [5]Observation during Joro Field Programs, [6]Species of First Nation Interest

MBCDC (2016c) Definitions for Status Listing:

1 Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.

2 Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.

3 Uncommon throughout its range or in the province (21 to 100 occurrences).

4 Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (> 100 occurrences).

5 Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially impossible to eradicate under present conditions.

U Possibly in peril, but status uncertain; more information needed.

H Historically known; may be rediscovered.

X Believed to be extinct; historical records only, continue search.

SNR A species not ranked. A rank has not yet assigned or the species has not been evaluated.

SNA A conservation status rank is not applicable to the element.

S#S# Numeric range rank: A range between two of the numeric ranks. Denotes range of uncertainty about the exact rarity of the species.

? Inexact or uncertain; for numeric ranks, denotes inexactness.

B Breeding status of a migratory species. Example: S1B, SZN - breeding occurrences for the species are ranked S1 (critically imperilled) in the province, nonbreeding occurrences are not ranked in the province.

N Non-breeding status of a migratory species. Example: S1B, SZN - breeding occurrences for the species are ranked S1 (critically imperilled) in the province, nonbreeding occurrences are not ranked in the province.

Q Taxonomic questions or problems involved, more information needed; appended to the global rank.

T Rank for subspecific taxon (subspecies, variety, or population); appended to the global rank for the full species.

A modifier to SX or SH; the species has been reintroduced but the population is not yet established.

SARA (2017) Definitions for Status Listing:

Schedule 1: the official list of species that are classified as extirpated, endangered, threatened, and of special concern.

Schedule 2: species listed in Schedule 2 are species that had been designated as endangered or threatened, and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1.

Schedule 3: species listed in Schedule 3 are species that had been designated as special concern, and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1.

Special Concern: a wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

Threatened: a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

COSEWIC (2017) Definitions for Status Listing:

Extinct: A wildlife species that no longer exists.

Extirpated: A wildlife species that no longer exists in the wild in Canada, but exists elsewhere.

Endangered: A wildlife species facing imminent extirpation or extinction.

Threatened: A wildlife species that is likely to become an endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Special Concern: A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.

Not At Risk: A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

MESEA (2017) Definitions for Status Listing:

Extirpated: A species formerly indigenous to Manitoba no longer exists in the wild in Manitoba but exists elsewhere.

Endangered: A species threatened with imminent extirpation or with extinction throughout all or a significant portion of its Manitoba range.

Threatened: A species indigenous to Manitoba that is either: a) likely to become endangered; or b) is, because of low or declining numbers in Manitoba, particularly at risk if the factors affecting its vulnerability do not become reversed.

Special Concern: A species indigenous to Manitoba is at risk of becoming a threatened or endangered species because of a combination of biological characteristics and identified threats to the species.

APPENDIX C: LIST OF POTENTIAL REPTILES AND AMPHIBIANS FOR THE P6 REGIONAL ASSESSMENT AREA

Common Name	Scientific Name	SARA	COSEWIC	MBCDC	MESEA
American toad	*Anaxyrus americanus*			S4S5	
Boreal chorus frog	*Pseudacris maculata*			S5	
Northern leopard frog (Eastern population)*[2]	*Lithobates pipiens*		NAR	S4	
Northern spring peeper[2]	*Pseudacris crucifer*			S5	
Wood frog	*Lithobates sylvaticus*			S5	
Red-sided garter snake[1,2]	*Thamnophis sirtalis parietalis*			S4	

Sources: Preston, 1982; Canadian Herpetological Society, 2016; Nature North, 2017; COSEWIC, 2017; Joro, 2017; MBCDC, 2016a; MESEA, n.d., SARA, 2017

**COSEWIC (2009c) indicates the western population (that is Special Concern under COSEWIC and SARA) is west of the Project 6 RAA*

Bolded species are Species of Conservation Concern: THR – Threatened, SC – Special Concern, END – Endangered; NAR – Not at Risk

[1]Species occurrence listed on the Manitoba Conservation Data Centre (2016b) for the Hayes River Upland Ecoregion, [2] Species of First Nation Interest

MBCDC (2016c) Definitions for Status Listing:

1 Very rare throughout its range or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.

2 Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.

3 Uncommon throughout its range or in the province (21 to 100 occurrences).

4 Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long-term concern (> 100 occurrences).

5 Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially impossible to eradicate under present conditions.

U Possibly in peril, but status uncertain; more information needed.

H Historically known; may be rediscovered.

X Believed to be extinct; historical records only, continue search.

SNR A species not ranked. A rank has not yet assigned or the species has not been evaluated.

SNA A conservation status rank is not applicable to the element.

S#S# Numeric range rank: A range between two of the numeric ranks. Denotes range of uncertainty about the exact rarity of the species.

? Inexact or uncertain; for numeric ranks, denotes inexactness.

B Breeding status of a migratory species. Example: S1B, SZN - breeding occurrences for the species are ranked S1 (critically imperiled) in the province, nonbreeding occurrences are not ranked in the province.

N Non-breeding status of a migratory species. Example: S1B, SZN - breeding occurrences for the species are ranked S1 (critically imperiled) in the province, nonbreeding occurrences are not ranked in the province.

Q Taxonomic questions or problems involved, more information needed; appended to the global rank.

T Rank for subspecific taxon (subspecies, variety, or population); appended to the global rank for the full species.

A modifier to SX or SH; the species has been reintroduced but the population is not yet established.

SARA (2017) Definitions for Status Listing:

Schedule 1: the official list of species that are classified as extirpated, endangered, threatened, and of special concern.

Schedule 2: species listed in Schedule 2 are species that had been designated as endangered or threatened, and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1.

Schedule 3: species listed in Schedule 3 are species that had been designated as special concern, and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1.

Special Concern: a wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

Threatened: a wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

COSEWIC (2017) Definitions for Status Listing:

Extinct: A wildlife species that no longer exists.

Extirpated: A wildlife species that no longer exists in the wild in Canada, but exists elsewhere.

Endangered: A wildlife species facing imminent extirpation or extinction.

Threatened: A wildlife species that is likely to become an endangered if nothing is done to reverse the factors leading to its extirpation or extinction.

Special Concern: A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.

Not At Risk: A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

MESEA (2017) Definitions for Status Listing:

Extirpated: A species formerly indigenous to Manitoba no longer exists in the wild in Manitoba but exists elsewhere.

Endangered: A species threatened with imminent extirpation or with extinction throughout all or a significant portion of its Manitoba range.

Threatened: A species indigenous to Manitoba that is either: a) likely to become endangered; or b) is, because of low or declining numbers in Manitoba, particularly at risk if the factors affecting its vulnerability do not become reversed.

Special Concern: A species indigenous to Manitoba is at risk of becoming a threatened or endangered species because of a combination of biological characteristics and identified threats to the species.

APPENDIX D: REGULATORY AND ECOLOGICAL CONTEXT FOR SPECIES OF CONSERVATION CONCERN THAT POTENIALLY OCCUR IN THE P6 REGIONAL ASSESSMENT AREA

Table D-1: Regulatory and Ecological Context for Species of Conservation Concern that Potentially occur in the P6 Region

Species Common Name	Scientific Name	Species Status (Federal and Provincial)					Ecological Context / Habitat Description	Is Critical Habitat in RAA?	Potential Occurrence in Local Assessment Area (LAA) or Regional Assessment Area (RAA)
		SARA	COSEWIC	MBCDC	MESEA	Recovery Strategy Plan			
Forest Birds									
Bank swallow	*Riparia riparia*	Schedule 1, Threatened	Threatened	S5B	Not listed	COSEWIC Status report only	Occurs most commonly across grassland, aspen parkland, and plains ecoregions. It occurs throughout other regions (e.g., Boreal forest) of these provinces, but is recorded infrequently.	No – Environment Canada (EC) does not identify specific critical habitat.	Low Potential: May occur in RAA but the species were not observed during field studies (Appendix J: Table J-10).
Barn swallow	*Hirundo rustica*	Schedule 1, Threatened	Threatened	S4B	Not listed	COSEWIC Status report only	Barn Swallows typically select nesting and foraging sites close to open habitats such as farmlands of various description, wetlands, road rights-of-way, large forest clearings, cottage areas, islands, sand dunes, and subarctic tundra.	No - EC does not identify specific critical habitat.	Low Potential: May occur in RAA but the species was not observed during field studies (Appendix J: Table J-10).

Species Common Name	Scientific Name	Species Status (Federal and Provincial)					Ecological Context / Habitat Description	Is Critical Habitat in RAA?	Potential Occurrence in Local Assessment Area (LAA) or Regional Assessment Area (RAA)
		SARA	COSEWIC	MBCDC	MESEA	Recovery Strategy Plan			
Canada Warbler	*Cardellina canadensis*	Schedule 1, Threatened	Threatened	S3B	Threatened	Yes (2016)	Canada Warbler breeds in various habitats across its range, but is almost always associated with moist forests with a dense, deciduous shrub layer, complex understory, and available perch trees. Nests are built on or near the ground (Reitsma *et al*., 2010). They are placed on moss and raised hummocks, within holes of root masses, rotting tree stumps, clumps of grass, rock cavities, etc. (Reitsma *et al.,* 2010).	No - Recovery strategy says information lacking with schedule determined in future.	Low Potential: May occur in the RAA but the species were not observed during field studies (Appendix J: Table J-10).

Species Common Name	Scientific Name	Species Status (Federal and Provincial)					Ecological Context / Habitat Description	Is Critical Habitat in RAA?	Potential Occurrence in Local Assessment Area (LAA) or Regional Assessment Area (RAA)
		SARA	COSEWIC	MBCDC	MESEA	Recovery Strategy Plan			
Common Nighthawk	*Chordeiles minor*	Schedule 1, Threatened	Threatened	S3B	Threatened	Yes (2016)	Common Nighthawks require open ground or clearings for nesting. The species breeds in a wide range of open habitats including sandy areas (e.g., dunes, eskers, and beaches), open forests (e.g., mixedwood and coniferous stands, burns, and clearcuts), grasslands (e.g., short-grass prairies, pastures, and grassy plains), sagebrush, wetlands (e.g., bogs, marshes, lakeshores, and riverbanks), gravelly or rocky areas (e.g., outcrops, barrens, gravel roads, gravel rooftops, railway beds, mines, quarries, and bare mountain tops and ridges), and some cultivated or landscaped areas (e.g., parks, military bases, airports, blueberry fields, orchards, cultivated fields) (Hunt, 2005; Campbell *et al.,* 2006; COSEWIC, 2007a).	No - Recovery strategy indicates information lacking with schedule determined in future.	High Potential: No species were observed during aerial waterfowl surveys however 1 was recorded during MBBA point count surveys along with 2 MBBA incidental observations, and 11 total identified on 2 of the 45 ARU sampling sites (Appendix J: Table J-10).

Species Common Name	Scientific Name	Species Status (Federal and Provincial)					Ecological Context / Habitat Description	Is Critical Habitat in RAA?	Potential Occurrence in Local Assessment Area (LAA) or Regional Assessment Area (RAA)
		SARA	COSEWIC	MBCDC	MESEA	Recovery Strategy Plan			
Eastern Wood-pewee	*Contopus virens*	Schedule 1, Special Concern	Special Concern	S4B	Not listed	COSEWIC Status report only	In Canada, the Eastern Wood-Pewee breeds mostly in mature and intermediate-age deciduous and mixed forests (less often in coniferous forest) having an open understory (Ouellet, 1974; Godfrey, 1986; Peck and James, 1987; Gauthier and Aubry, 1995; Falconer, 2010; Burke *et al*., 2011). It is often associated with forests dominated by Sugar Maple (Acer saccharum), elm (Ulmus sp.) and oak (Quercus sp.; Graber *et al*., 1974). It is usually associated with forest clearings and edges within the vicinity of its nest (Hespenheide, 1971; Peck and James, 1987).	No - EC does not identify specific critical habitat; RAA on northern fringe of range - COSEWIC	Low Potential: May occur in RAA however, the species was not observed during field studies (Appendix J: Table J-10).
Olive-Sided Flycatcher	*Contopus cooperi*	Schedule 1, Threatened,	Threatened	S3B	Threatened	Yes (2016)	In Canada, Olive-sided Flycatcher breeds primarily in boreal, sub-boreal, interior, and coastal forest regions of the country.	No - EC does not identify specific critical habitat.	Moderate Potential: The RAA is within the range maps for the species, and habitat occurs in the LAA. No species were observed during aerial waterfowl surveys however 36 were recorded during MBBA point count surveys along with 8 MBBA incidental observations, and 13 total identified on 3 of the 45 ARU sampling sites (Appendix J: Table J-10).

Species Common Name	Scientific Name	Species Status (Federal and Provincial)					Ecological Context / Habitat Description	Is Critical Habitat in RAA?	Potential Occurrence in Local Assessment Area (LAA) or Regional Assessment Area (RAA)
		SARA	COSEWIC	MBCDC	MESEA	Recovery Strategy Plan			
Peregrine Falcon	*Falco peregrinus*	Schedule 1, Special Concern	Special Concern	S1B	Endangered	Management plan (2015)	Peregrine Falcons generally nest on cliff ledges or crevices. Cliffs ranging from 50 to 200 m high are preferred (Cade 1960; White and Cade 1971). The species is highly adaptable in nest site selection.	No – Known to migrate through the area; Management Plan illustrates breeding range.	Low Potential: Expected to be an occasional transient (not breeding) migrant within the RAA. May occur in the RAA but the species were not observed during field studies (Appendix J: Table J-10).
Rusty Blackbird	*Euphagus carolinus*	Schedule 1, Special Concern	Special Concern	S4B	Not listed	Management plan (2015)	Rusty Blackbird has been observed in many riparian habitats including (but not limited to) wetlands associated with recent burns, peat bogs, riparian scrub, open moss- and lichen-spruce woodlands, sedge meadows, marshes, alder and willow thickets, and estuaries (COSEWIC 2006).	No - EC does not identify specific critical habitat.	Moderate Potential: May occur in RAA. No species were observed during aerial waterfowl surveys however 13 were recorded during MBBA point count surveys along with 6 MBBA incidental observations, and none total identified on ARU records (Appendix J: Table J-10).
Short-eared Owl	*Asio flammeus*	Schedule 1, Special Concern	Special Concern	S2S3B	Threatened	No - Management plan (2016)	Short-eared owls occur in a variety of open native habitats: grasslands, Arctic tundra, taiga, bogs, marshes, coastal wetlands, coastal barrens, estuaries and grasslands dominated by sand-sage (Artemisia filifolia). There is little specific information regarding habitat preferences at the landscape scale, but a mosaic of grasslands and wetlands provides optimal breeding and foraging habitats (Wiggins, 2004).	No - EC does not identify specific critical habitat.	High Potential: Migrate through the RAA in low numbers. No species were observed during aerial waterfowl surveys, MBBA point count surveys or through MBBA incidental observations, however 2 total were identified on 2 or 45 ARU sampling sites (Appendix J: Table J-10).
Waterbirds									

Species Common Name	Scientific Name	Species Status (Federal and Provincial)					Ecological Context / Habitat Description	Is Critical Habitat in RAA?	Potential Occurrence in Local Assessment Area (LAA) or Regional Assessment Area (RAA)
		SARA	COSEWIC	MBCDC	MESEA	Recovery Strategy Plan			
Horned Grebe	*Podiceps auritus*	Schedule 1, Special Concern	Special Concern	S4B	Not listed	COSEWIC Status Report only	In Manitoba, the Horned Grebe breeds throughout the province with the exception of certain eastern regions. It is probably more common in the Minnedosa region, but its abundance in the Prairie region fluctuates according to the water level. The species is generally less abundant in summer in the southeastern part of the province. Some individuals breed in Churchill, mainly in marshes near Akudlik and in the Goose Creek region (Holland and Taylor, 2003).	No - EC does not identify specific critical habitat.	Moderate Potential: May occur in RAA in low numbers. The species were not observed during field studies (Appendix J: Table J-10).

Species Common Name	Scientific Name	Species Status (Federal and Provincial)					Ecological Context / Habitat Description	Is Critical Habitat in RAA?	Potential Occurrence in Local Assessment Area (LAA) or Regional Assessment Area (RAA)
		SARA	COSEWIC	MBCDC	MESEA	Recovery Strategy Plan			
Yellow Rail	*Coturnicops noveboracensis*	Schedule 1, Special Concern	Special Concern	S3B	Not listed	No - Management plan	Yellow Rails inhabit shallow wetlands and other wet areas with grass-like vegetation. Breed in wetlands such as damp hay fields or meadows, floodplains, bogs, upper levels of estuaries, salt marshes (Bookhout 1995, Alvo and Robert 1999, COSEWIC 2009b), shallow prairie wetlands, and wet montane meadows (Peabody 1922, Sherrington 1994, Popper and Stern 2000). Preferred wetlands are generally dominated by short, fine-stemmed herbaceous vegetation, especially sedges, as well as other graminoid vegetation of the families Cyperaceae, Poaceae, and Juncaceae. Vegetation structure (e.g. short, grass-like, and dense) is likely more important than its taxon (Robert *et al*. 2000). Breeding habitats may have up to 50 cm of standing water, but typically nesting sites are less than 15 cm deep (Bookhout 1995, Robert *et al*. 2000, Wilson 2005). The species' narrow tolerance for shallow water levels likely explains why its abundance at any given site varies dramatically annual (Robert and Laporte 1999, Kehoe *et al*. 2000, Lindgren 2001).	No- EC does not identify specific critical habitat.	Very Low Potential: May breed in the low numbers in RAA. The species were not observed during field studies (Appendix J: Table J-10).

Species Common Name	Scientific Name	Species Status (Federal and Provincial)					Ecological Context / Habitat Description	Is Critical Habitat in RAA?	Potential Occurrence in Local Assessment Area (LAA) or Regional Assessment Area (RAA)
		SARA	COSEWIC	MBCDC	MESEA	Recovery Strategy Plan			
Mammals									
Boreal woodland caribou	*Rangifer tarandus caribou*	Schedule 1, Threatened	Threatened	S2S3	Threatened	Yes (2012)	Boreal caribou require large range areas comprised of continuous tracts of undisturbed habitat. In general, boreal caribou prefer habitat consisting of mature to old-growth coniferous forest (e.g. jack pine (Pin*us banksiana*), black spruce (*Picea mariana*)) with abundant lichens, or muskegs and peat lands intermixed with upland or hilly areas (Stuart-Smith *et al*., 1997; Rettie and Messier, 2000; Courtois, 2003; Brown *et al*., 2007; Boreal Caribou ATK Reports, 2010-2011).	Yes - A small portion of the Molson Boreal Caribou Management Unit and the Norway House range are contained in the RAA. Caribou effects and disturbance assessments are found in Section 7.1.	Very Low Potential: Differentiation between boreal woodland caribou and eastern migratory caribou observations could not be confirmed. Low potential for boreal woodland caribou occurrence as the Norway House population range only overlaps slightly with the RAA.
Eastern migratory caribou	*Rangifer tarandus caribou*	No Schedule, No Status	Endangered	SNR	Not listed	COSEWIC Status report only (2017)	Eastern migratory caribou primarily use tundra during the calving and summer periods, while using taiga and boreal forest during the winter.	Yes – The majority of the RAA and the entire LAA are included in the Pen Islands caribou range. Caribou effects and disturbance assessments are found in Section 7.1.	High potential: Pen Islands caribou occur within the RAA during all five 40 day seasons with the largest portion of seasonal core use area occurring in the RAA in late winter. Only a small proportion of its seasonal core use area occur within the LAA, with the largest portion of a seasonal core use are occurring in the LAA in early winter.

Species Common Name	Scientific Name	Species Status (Federal and Provincial)					Ecological Context / Habitat Description	Is Critical Habitat in RAA?	Potential Occurrence in Local Assessment Area (LAA) or Regional Assessment Area (RAA)
		SARA	COSEWIC	MBCDC	MESEA	Recovery Strategy Plan			
Little Brown Myotis (Bat)	*Myotis lucifugus*	Schedule 1, Endangered	Endangered	S2N,S5B	Endangered	Yes - combined for little brown, northern myotis and tricolord bat (2015)	Typically, hibernacula for these species are subterranean features, such as caves, abandoned mines, hand-dug wells, cellars, or tunnels where light and noise levels are low; typically contain sections that have relatively stable temperatures (2-10 ˚C) and stable, high humidity levels (>80 %). Hibernacula generally identified in MB, but none identified in the RAA.	No critical habitat in RAA (Recovery Strategy); closest is concentrated in the northwest of Lake Winnipeg, north of Grand Rapids.	Low Potential: Very low potential for hibernacula in RAA. Some potential to be used during the summer as roosting sites within the forested areas; habitat exists but there were no sightings of the species or hibernacula.
Wolverine	*Gulo gulo*	No schedule, no status	Special concern	S3S4	Not listed	N/A	A wide variety of forested and tundra vegetation associations are used by wolverines. Habitats must have an adequate year-round supply of food, mainly consisting of smaller prey such as rodents and snowshoe hares, and the carcasses of large ungulates, like moose, caribou, and muskox. Females den under snow-covered rocks, logs or within snow tunnels. Wolverines reproduce in areas where snow cover persists at least into April.	No - EC does not identify specific critical habitat.	High Potential: May occur in very low numbers dispersed in the RAA. Four species observations and nine track observations were recorded through aerial multispecies surveys during 2011 – 2016 field studies (Appendix G – Table G-1). The trapper program (2016/2017) also recorded 10 occurrences of wolverine tracks within the RAA (Section 6.3.5).

APPENDIX E: VC SELECTION

Table E-1: Habitat Preference for Candidate Valued Component (VC) Species and Other Wildlife

VCs	Group	Habitat Preference*	Wildlife Habitat	Species-Habitat Associations
MAMMALS				
Caribou	Ungulate	Boreal woodland caribou are typically found in large, un-fragmented tracts of mature coniferous-dominated boreal forest with inherently low ecological diversity and low predator densities (Manitoba Hydro, 2011b). Forests containing a mixture of jackpine and treed muskeg provide good overall caribou habitat and are often associated with spruce stands (Schindler, 2006).	Mixedwood Coniferous	American black bear, Northern flying squirrel, silver haired bat, American tree sparrow, Lincoln's sparrow, rusty blackbird, swamp sparrow, black backed woodpecker, boreal owl, Cooper's hawk, great grey owl, Northern saw-whet owl, sharp-shinned hawk, spruce grouse, alder flycatcher, American goldfinch, American redstart, least flycatcher, long-eared owl, merlin, Nashville warbler, Northern hawk owl, palm warbler, pileated woodpecker, pine grosbeak, pine siskin, purple finch, red-breasted nuthatch, red-eyed vireo, red-tailed hawk, ruby-crowned kinglet, sharp-tailed grouse, snowy owl, song sparrow, Swainsons' thrush, Tennessee warbler, turkey vulture, white-throated sparrow, winter wren, yellow-rumped warbler, blackburnian warbler, blackpoll warbler, bohemian waxwing, boreal chickadee, broad-winged hawk, Cape May warbler, cedar waxwing, common nighthawk, dark-eyed junco, downy woodpecker, Eastern phoebe, Eastern wood-pewee, evening grosbeak, fox sparrow, hairy woodpecker, Harris's sparrow, hermit thrush, hoary redpoll, American robin, American three-toed woodpecker, American tree sparrow, bald eagle, barred owl, bay-breasted warbler, black-and-white warbler, black-throated green warbler, American deer mouse, Canada lynx, Eastern heather vole, ermine, gray wolf

VCs	Group	Habitat Preference*	Wildlife Habitat	Species-Habitat Associations
Moose	Ungulate	Typically found in forested areas and edges, with tall shrubs and re-generating vegetation for browse (Manitoba Hydro, 2011a; 2011b). Moose often occur near streams and rivers and edges of shallow lake. In the summer they prefer cool, moist lowland habitat providing suitable forage and escape cover. They often travel further inland to rut and feed on shrubs in the fall. In late winter, they typically use dense coniferous forest (Austman, 2015).	Wetland Shrubland Coniferous (Dense)	American black bear, Canada lynx, North American porcupine, raccoon, gray wolf, wolverine, alder flycatcher, American kestrel, American redstart, black-and-white warbler, black-capped chickadee, blue jay, chipping sparrow, common raven, downy woodpecker, gray tree frog, wood frog, American black duck, American goldfinch, killdeer, least sandpiper, lesser scaup, lesser yellowlegs, Lincoln's sparrow, long-eared owl, merlin, Northern harrier, Northern shoveler, Northern waterthrush, pine siskin, purple finch, red-eyed vireo, red-necked phalarope, red-tailed hawk, red-throated loon, red-winged blackbird, rose-breasted grosbeak, ruby-crowned kinglet, ruddy turnstone, rusty blackbird, semipalmated plover, sharp-tailed grouse, snow bunting, snowy owl, solitary sandpiper, song sparrow, spotted sandpiper, Swainsons' thrush, Tennessee warbler, tree swallow, turkey vulture, white-crowned sparrow, willow ptarmigan, Wilson's warbler, winter wren, yellow-rumped warbler, blue-headed vireo, blue-winged teal, Cape May warbler, cedar waxwing, clay-colored sparrow, common yellowthroat, Eastern phoebe, Eastern wood-pewee, fox sparrow, golden eagle, gray-cheeked thrush, great blue heron, great gray owl, Harris's sparrow, hermit thrush, hoary redpoll, American three-toed woodpecker, American tree sparrow, American white pelican, American wigeon, Baird's sandpiper, bald eagle, bank swallow, barn swallow, barred owl, belted kingfisher, black tern, American beaver, American marten, American mink, fisher, gray wolf, red-sided garter snake
Beaver	Aquatic Furbearer	Prefer riparian areas including lakes, creeks, rivers, and other water bodies with nearby forests used to build dams and lodges (Manitoba Hydro 2011a). Prefer habitat containing willows, aspen, and other deciduous trees along with mixedwood forests with trees large enough for browse and building material (Kunke and Watkins, 1999).	Wetland Deciduous Mixedwood	Masked shrew, meadow vole, American mink, pygmy shrew, Northern river otter, American water shrew, yellow warbler, great blue heron, lesser yellowlegs, Northern waterthrush, sora, yellow rail, boreal chorus frog, wood frog, Northern leopard frog, alder flycatcher, American bittern, American black duck, American gold finch, American kestrel, American pipit, American redstart, killdeer, least

VCs	Group	Habitat Preference*	Wildlife Habitat	Species-Habitat Associations
				sandpiper, lesser scaup, Lincoln's sparrow, long-eared owl, Northern harrier, Northern hawk owl, Northern shoveler, pileated woodpecker, pine siskin, purple finch, red-eyed vireo, red-necked phalarope, red-tailed hawk, red-throated loon, red-winged blackbird, ring-billed gull, rose-breasted grosbeak, rough-legged hawk, ruddy turnstone, rusty blackbird, sanderling, Savannah sparrow, semipalmated plover, sharp-shinned hawk, Smith's longspur, snow bunting, snowy owl, solitary sandpiper, spotted sandpiper, Tennessee warbler, tree swallow, white-crowned sparrow, white-throated sparrow, willow ptarmigan, yellow-bellied sapsucker, blackpoll warbler, blue-winged teal, broad-winged hawk, common loon, common merganser, common nighthawk, common yellowthroat, downy woodpecker, dunlin, Eastern wood-pewee, Forster's tern, fox sparrow, golden eagle, great gray owl, hairy woodpecker, Harris's sparrow, hoary redpoll, horned grebe, American tree sparrow, American white pelican, American wigeon, Baird's sandpiper, bald eagle, bank swallow, barn swallow, barred owl, belted kingfisher, black tern, black-and-white warbler, black-capped chickadee, American black bear, American deer mouse, American marten, fisher, gray wolf, red-sided garter snake
Marten	Furbearer	Prefer old growth forests for denning (Manitoba Hydro, 2011a). Mature coniferous forests (especially undisturbed) featuring structural complexity - high canopy closure and vertical and horizontal woody structure, (Kunke and Watkins, 1999).	Coniferous	Ermine, fisher, American black bear, North American porcupine, silver-haired bat, red squirrel, wolverine, gray wolf, American three-toed woodpecker, spruce grouse, ruby crowned kinglet, Northern hawk owl, gray jay, boreal owl, common redpoll, American black duck, American kestrel, American redstart, least flycatcher, long-eared owl, Magnolia warbler, Nashville warbler, olive-sided flycatcher, palm warbler, pileated woodpecker, pine grosbeak, pine siskin, purple finch, red crossbill, red-breasted nuthatch, red-tailed hawk, ruby-crowned kinglet, sharp-tailed grouse, Swainsons' thrush, Tennessee warbler, white-throated sparrow, white-winged crossbill, yellow-rumped

VCs	Group	Habitat Preference*	Wildlife Habitat	Species-Habitat Associations
				warbler, blackpoll warbler, bohemian waxwing, boreal chickadee, brown creeper, Cape May warbler, cedar waxwing, dark-eyed junco, downy woodpecker, evening grosbeak, hairy woodpecker, Harris's sparrow, hermit thrush, hoary redpoll, American robin, bald eagle, barred owl, bay-breasted warbler, black-backed woodpecker, black-throated green warbler, American beaver, American deer mouse, American mink, Canada lynx, gray wolf, hoary bat
BIRDS				
Bald eagle	Raptor	Nests are commonly found in mature forests, usually within 200 m of a water body (Manitoba Hydro 2011c). Common near lakes, reservoirs, rivers, marshes, and coasts. Nest in trees near water (Kunke and Watkins, 1999; Manitoba Avian Research Committee, 2003; Cornell Lab of Ornithology, 2015).	Wetland Coniferous	Common snapping turtle, Brewer's blackbird, double-crested cormorant, great crested flycatcher, hooded merganser, killdeer, northern pintail, osprey, ovenbird, red-breasted merganser, hoary bat, little brown bat, raccoon, alder flycatcher, American bittern, American black duck, American goldfinch, American kestrel, American redstart, least sandpiper, lesser scaup, lesser yellowlegs, long-eared owl, merlin, Northern harrier, Northern shoveler, Northern waterthrush, olive-sided flycatcher, pectoral sandpiper, peregrine falcon, pine siskin, purple finch, red-tailed hawk, red-throated loon, rose breasted grosbeak, rough-legged hawk, ruby-crowned kinglet, ruddy turnstone, rusty blackbird, sanderling, semipalmated plover, snow bunting, snow goose, solitary sandpiper, surf scoter, tree swallow, white-throated sparrow, blackburnian warbler, cliff sparrow, common loon, common merganser, common nighthawk, evening grosbeak, golden eagle, great blue heron, greater scaup, greater yellowlegs, American three-toed woodpecker, American tree sparrow, American white pelican, American wigeon, Baird's sandpiper, bank swallow, barn swallow, barred owl, belted kingfisher, black tern, black-bellied plover, black-throated green warbler, American deer mouse, American water shrew, gray wolf, hoary bat, red-sided garter snake

VCs	Group	Habitat Preference*	Wildlife Habitat	Species-Habitat Associations
Canada geese	Waterfowl	Often near lakes, rivers, ponds, or other small or large bodies of water (Kunke and Watkins, 1999; Manitoba Avian Research Committee, 2003; Cornell Lab of Ornithology, 2015).	Wetland	Wood frog, boreal chorus frog, Northern spring peeper, Northern leopard frog, bufflehead, common goldeneye, lesser yellowlegs, sandhill crane, short-billed dowitcher, short-eared owl, white-winged scoter, yellow rail, northern bog lemming, southern bog lemming, American bittern, American black duck, American golden plover, American goldfinch, American kestrel, American pipit, killdeer, least sandpiper, lesser scaup, long-tailed duck, mallard, Northern pintail, Northern shoveler, pectoral sandpiper, pied-billed grebe, red-breasted merganser, red-throated loon, red-winged blackbird, ring-billed gull, ring-necked duck, Ross's goose, ruddy turnstone, sanderling, semipalmated plover, snow goose, solitary sandpiper, spotted sandpiper, stilt sandpiper, tree swallow, tundra swan, white-rumped sandpiper, blue-winged teal, Bonaparte's Gull, cackling goose, Canada goose, cliff sparrow, common grackle, common loon, common merganser, common tern, dunlin, Forster's tern, gadwall, greater scaup, greater white-fronted goose, greater yellow legs, green-winged teal, herring gull, hooded merganser, horned grebe, American tree sparrow, American white pelican, American wigeon, Baird's sandpiper, bald eagle, bank swallow, barn swallow, barred owl, belted kingfisher, black scoter, black tern, black-bellied plover
Mallard	Waterfowl	Breed near small or large bodies of water; where open water is limited in spring, will frequent large rivers and marshes (Kunke and Watkins, 1999; Manitoba Avian Research Committee, 2003; Cornell Lab of Ornithology, 2015).	Wetland	Wood frog, boreal chorus frog, Northern spring peeper, Northern leopard frog, bufflehead, common goldeneye, lesser yellowlegs, sandhill crane, short-billed dowitcher, short-eared owl, white-winged scoter, yellow rail, northern bog lemming, southern bog lemming, American bittern, American black duck, American golden plover, American goldfinch, American kestrel, American pipit, American redstart, killdeer, least sandpiper, lesser scaup, long-tailed duck, Northern pintail, Northern shoveler, pectoral sandpiper, red-breasted merganser, red-throated loon, red-winged blackbird, ring-billed gull, ring-necked duck, Ross's goose, ruddy

VCs	Group	Habitat Preference*	Wildlife Habitat	Species-Habitat Associations
				turnstone, sanderling, semipalmated plover, snow goose, solitary sandpiper, spotted sandpiper, stilt sandpiper, tree swallow, tundra swan, white-rumped sandpiper, Wilson's snipe, blue-winged teal, Bonaparte's Gull, cackling goose, Canada goose, common grackle, common loon, common merganser, common tern, dunlin, Forster's tern, gadwall, great blue heron, greater scaup, greater white-fronted goose, greater yellow legs, green-winged teal, herring gull, hooded merganser, horned grebe, American tree sparrow, American white pelican, American wigeon, Baird's sandpiper, bald eagle, bank swallow, barn swallow, barred owl, belted kingfisher, black scoter, black tern, black-bellied plover
Ring-necked Duck	Waterfowl	Like wet meadow, swamp, shallow water/ pond & marsh. Common on smaller bodies of water than other diving ducks, e.g., beaver ponds and small lakes. Breed in freshwater marshes, bogs, and other shallow, often acidic wetlands (Kunke and Watkins, 1999; Manitoba Avian Research Committee, 2003; Cornell Lab of Ornithology, 2015).	Wetland	American wigeon, blue-winged teal, green-winged teal, gadwall, horned grebe, lesser scaup, Northern harrier, pied-billed grebe, ruddy duck, Wilson's phalarope, American bittern, American black duck, American golden plover, American goldfinch, American kestrel, American redstart, killdeer, least sand piper, lesser yellowlegs, mallard, Northern harrier, Northern pintail, Northern shoveler, pectoral sandpiper, red-breasted merganser, red-necked phalarope, red-throated loon, red-winged blackbird, ring-billed gull, Ross's goose, ruddy turnstone, sanderling, sandhill crane, semipalmated plover, short-billed dowitcher, snow goose, solitary sandpiper, spotted sandpiper, stilt sandpiper, tree swallow, tundra swan, white-rumped sandpiper, Wilson's snipe, Bonaparte's Gull, bufflehead, cackling goose, Canada goose, common grackle, common loon, common merganser, common tern, dunlin, Forster's tern, greater scaup, greater white-fronted goose, greater yellow legs, herring gull, hooded merganser, horned grebe, American tree sparrow, American white pelican, American wigeon, Baird's sandpiper, bald eagle, bank swallow, barn swallow, barred owl, belted kingfisher, black scoter, black tern, black-bellied plover

VCs	Group	Habitat Preference*	Wildlife Habitat	Species-Habitat Associations
Ruffed grouse	Upland game bird	Occupy mixed deciduous and coniferous forest interiors with scattered clearings. They also live along forested streams and in areas growing back from burning or logging (Kunke and Watkins, 1999; Manitoba Avian Research Committee, 2003; Cornell Lab of Ornithology, 2015). Ruffed grouse inhabit deciduous and mixedwoods forests and coniferous forests (Manitoba Hydro, 2011c).	Mixedwood Decidouous Wetland Coniferous	American goldfinch, American tree sparrow, black-capped chickadee, blue jay, Canada warbler, chipping sparrow, clay-coloured sparrow, Connecticut warbler, Eastern kingbird, Eastern wood-pewee, golden-winged warbler, gray catbird, great crested flycatcher, great horned owl, Lincoln's sparrow, long-eared owl, northern saw-whet owl, Northern waterthrush, red-eyed vireo, song sparrow, yellow-bellied flycatcher, yellow warbler, American beaver, ermine, fisher, masked shrew, meadow vole, American mink, Northern river otter, pygmy shrew, silver-haired bat, star-nosed mole, American water shrew, Alder flycatcher, American bittern, American black duck, American golden plover, American kestrel, American pipit, American redstart, killdeer, lesser scaup, long-eared owl, merlin, Nashville warbler, Northern flicker, Northern goshawk, Northern harrier, Northern hawk owl, Northern shrike, olive-sided flycatcher, palm warbler, peregrine falcon, pileated woodpecker, pine grosbeak, pine siskin, purple finch, red-breasted nuthatch, red-tailed hawk, red-throated loon, rose-breasted grosbeak, rough-legged hawk, ruby-crowned kinglet, ruddy turnstone, rusty blackbird, sandhill crane, savannah sparrow, sharp-shinned hawk, sharp-tailed hawk, Smith's longspur, snow bunting, snowy owl, spotted sandpiper, Swainsons' thrush, Tennessee warbler, tree swallow, turkey vulture, vesper sparrow, white-crowned sparrow, white-throated sparrow, Wilson's snipe, winter wren, yellow-bellied sapsucker, yellow-rumped warbler, blackburnian warbler, blackpoll warbler, bohemian waxwing, brown creeper, Cape May warbler, cedar waxwing, common nighthawk, common yellowthroat, dark-eyed junco, downy woodpecker, Eastern phoebe, Eastern wood-pewee, European starling, fox sparrow, golden eagle, great gray owl, gyrfalcon, hairy woodpecker, Harris's sparrow, hoary redpoll, horned lark, coyote, arctic shrew, American robin, American three-toed woodpecker,

VCs	Group	Habitat Preference*	Wildlife Habitat	Species-Habitat Associations
				American tree sparrow, American white pelican, American wigeon, Baird's sandpiper, bald eagle, bank swallow, barn swallow, barred owl, black-and-white warbler
Magnolia Warbler	Migratory songbird	Breed in small conifers, especially young spruces, in purely coniferous stands or mixed forest (Kunke and Watkins, 1999; Manitoba Avian Research Committee, 2003; Cornell Lab of Ornithology, 2015).	Coniferous	Common snapping turtle, Brewer's blackbird, double-crested cormorant, great crested flycatcher, hooded merganser, killdeer, osprey, ovenbird, red-breasted merganser, hoary bat, little brown bat, raccoon, alder flycatcher, American black duck, American kestrel, American redstart, least flycatcher, long-eared owl, Nashville warbler, Northern shrike, olive-sided flycatcher, pileated woodpecker, pine grosbeak, pine siskin, purple finch, red-breasted nuthatch, red-tailed hawk, ruby-crowned kinglet, sharp-tailed grouse, Swainsons' thrush, Tennessee warbler, white-throated sparrow, white-winged crossbill, winter wren, yellow-bellied sapsucker, yellow-rumped warbler, blackburnian warbler, blackpoll warbler, bohemian waxwing, boreal chickadee, brown creeper, Cape May warbler, cedar waxwing, dark-eyed junco, downy woodpecker, hairy woodpecker, Harris's sparrow, hermit thrush, hoary redpoll, American robin, American three-toed woodpecker, American tree sparrow, bald eagle, barred owl, bay-breasted warbler, black-backed woodpecker, black-throated green warbler
Ovenbird	Migratory Songbird	Breed in closed-canopy forests, particularly deciduous and mixed deciduous-coniferous woods. They avoid wet or swampy areas (Kunke and Watkins, 1999; Manitoba Avian Research Committee, 2003; Cornell Lab of Ornithology, 2015).	Deciduous Mixedwood	Common snapping turtle, American kestrel, bald eagle, Brewer's blackbird, killdeer, magnolia warbler, osprey, orange-crowned warbler, hoary bat, little brown bat, racoon, alder flycatcher, American crow, American goldfinch, American redstart, lapland longspur, Le conte's sparrow, least flycatcher, long-eared owl, merlin, Nashville warbler, Northern flicker, Northern goshawk, Philadelphia vireo, pileated woodpecker, pine grosbeak, pine siskin, purple finch, red-eyed vireo, red-necked phalarope, red-tailed hawk, rough-legged hawk, ruby-crowned kinglet, savannah sparrow, sharp-shinned hawk, sharp-

VCs	Group	Habitat Preference*	Wildlife Habitat	Species-Habitat Associations
				tailed grouse, Smith's longspur, snow bunting, snowy owl, song sparrow, Tennessee warbler, turkey vulture, vesper sparrow, white-crowned sparrow, white-throated sparrow, willow ptarmigan, winter wren, yellow-bellied sapsucker, yellow-rumped warbler, blackburnian warbler, blackpoll warbler, bohemian waxwing, boreal chickadee, broad-winged hawk, cedar waxwing, clay-colored sparrow, cliff sparrow, dark-eyed junco, downy woodpecker, Eastern wood-pewee, fox sparrow, gray-cheeked thrush, great gray owl, hairy woodpecker, Harris's sparrow, hermit thrush, hoary redpoll, house sparrow, American robin, American three-toed woodpecker, American tree sparrow, barred owl, black-and-white warbler, black-capped chickadee, house mouse, Eastern heather vole
Palm warbler	Migratory Songbird	Breed in bogs, open boreal coniferous forest, and partly open situations with scattered trees and heavy undergrowth, usually near water (Kunke and Watkins, 1999; Manitoba Avian Research Committee, 2003; Cornell Lab of Ornithology, 2015).	Wetland Coniferous	Boreal chorus frog, Northern spring peeper, Northern waterthrush, sharp tailed grouse, spruce grouse, yellow-rumped warbler, ermine, fisher, Alder flycatcher, American bittern, American black duck, American goldfinch, American redstart, least sandpiper, lesser scaup, lesser yellowlegs, long-eared owl, merlin, olive-sided flycatcher, pine siskin, purple finch, red-breasted merganser, red-tailed hawk, red-throated loon, ring-necked duck, rose-breasted grosbeak, rough-legged hawk, golden-crowned kinglet, rusty blackbird, tree swallow, white-throated sparrow, common nighthawk, common yellowthroat, American white pelican, American wigeon, Baird's sandpiper, bald eagle, barred owl, red-sided garter snake
Yellow-Bellied flycatcher	Migratory Songbird	Breed in boreal coniferous forests and peatlands. Nests in cool, moist forests, bogs, swamps, and muskegs (Kunke and Watkins, 1999; Manitoba Avian Research Committee, 2003; Cornell Lab of Ornithology, 2015).	Wetland Coniferous	American goldfinch, American tree sparrow, black-capped chickadee, blue jay, Canada warbler, chipping sparrow, clay-coloured sparrow, Connecticut warbler, Eastern kingbird, Eastern wood-pewee, golden-winged warbler, gray catbird, great crested flycatcher, great horned owl, Lincoln's sparrow, long-eared owl, northern saw-whet owl, northern waterthrush, red-eyed vireo, ruffed grouse, song sparrow, yellow warbler, American beaver, ermine,

VCs	Group	Habitat Preference*	Wildlife Habitat	Species-Habitat Associations
				fisher, masked shrew, meadow vole, American mink, northern river otter, pygmy shrew, silver-haired bat, star-nosed mole, American water shrew, alder flycatcher, American bittern, American black duck, American kestrel, American redstart, least sandpiper, lesser scaup, lesser yellowlegs, Northern water thrush, pine siskin, purple finch, red-breasted merganser, red-tailed hawk, red-throated loon, rose breasted grosbeak, rough-legged hawk, golden-crowned kinglet, rusty blackbird, semipalmated plover, Swainsons' thrush, tree swallow, white-throated sparrow, blue-winged teal, bufflehead, common merganser, common yellowthroat, great blue heron, American white pelican, American wigeon, Baird's sandpiper, bald eagle, barred owl, black tern, red-sided garter snake
AMPHIBIANS and REPTILES				
Spring peeper	Amphibian	Associated with a wide range of wet habitats: characteristic of temporary woodland ponds. Peepers reach their highest density in brushy secondary growth or cutover woodlands. They apparently cannot withstand extensive urbanization (Nature North, 2017).	Wetland Mixedwood Shrubland	Wood frog, boreal chorus frog, Northern leopard frog, sandhill crane, alder flycatcher, American tree sparrow, Canada goose, Wilson's snipe, Connecticut warbler, great horned owl, horned grebe, mallard, marsh wren, northern saw-whet owl, Northern shoveler, Northern waterthrush, olive-sided flycatcher, red-winged blackbird, ring-necked duck, rusty blackbird, short-eared owl, sora, swamp sparrow, yellow rail, yellow-headed blackbird, American beaver, masked shrew, American mink, muskrat, southern bog lemming, star-nosed mole, American water shrew, American black duck, American golden plover, American goldfinch, American kestrel, American pipit, American redstart, killdeer, lapland longspur, Le conte's sparrow, lesser scaup, lesser yellowlegs, Lincoln's sparrow, long-eared owl, Northern hawk owl, orange-crowned warbler, Philadelphia vireo, pileated woodpecker, pine siskin, purple finch, red-necked phalarope, red-tailed hawk, red-throated loon, ring-billed gull, rose-breasted grosbeak, golden-crowned kinglet, ruddy turnstone, savannah sparrow, semipalmated plover, sharp-shinned hawk, snow

VCs	Group	Habitat Preference*	Wildlife Habitat	Species-Habitat Associations
				bunting, snowy owl, Tennessee warbler, tree swallow, turkey vulture, vesper sparrow, white-crowned sparrow, white-throated sparrow, willow ptarmigan, Wilson's warbler, winter wren, yellow-bellied sapsucker, yellow-rumped warbler, blackburnian warbler, blackpoll warbler, boreal chickadee, broad-winged hawk, brown creeper, cedar waxwing, clay-colored sparrow, cliff sparrow, common nighthawk, dark-eyed junco, downy woodpecker, Eastern phoebe, Eastern wood-pewee, gray-cheeked thrush, Hairy woodpecker, Harris's sparrow, Hermit thrush, Hoary redpoll, house sparrow, American robin, American tree sparrow, American white pelican, American wigeon, Baird's sandpiper, barn swallow, barred owl, belted kingfisher, red-sided garter snake

APPENDIX F: ALCES

Indicators		
Footprint Types		
Airstrips	Rail Abandoned	Small Pits - Gravel sites, dugouts
Developed Land	Rail Active	Town City
Industrial - Includes Processing Plants, Refineries, Electrical Facilities, Penitentiary, Military Base, lagoons, waste sites, landfills	Recreation	Tracks - Curlines, Seismic lines, recreational trails, fencelines (the 20k data indicates trails and tracks but does not associate any of the features as recreational. Seismic and cutline data is not available or does not exist)
Mineral Mines	Roads Major	Transmission Line
Peat Mines	Roads Minor - Non-paved Roads, agricultural roads, wellsite, access roads	Water Management Structure
Pipelines	Rural Residential - acreages and farmyards	Wellsites
Landscape Types		
Barren Land Undifferentiated	Deciduous Sparse	Wetland Herb
Bryoids	Grassland	Wetland Shrub
Conifer Dense	Mixedwood Forest	Wetland Treed
Conifer Sparse	Shrub Land	Wetland Undifferentiated
Deciduous Dense	Undefined Landcover	
Water and Wetlands		
Canal	Marine	Rivers Small
Dugouts	Reservoir	Water Undifferentiated
Lakes	Rivers Large	
Manitoba - Geology and Soils		
Soil Development Class - Black Chernozemic	Soil Development Class - Mesisol	Surficial Geology - Fine Grained (Glacio) Lacustrine

Indicators		
Soil Development Class - Black Solonetzic	Soil Development Class - Not Applicable	Surficial Geology - Fine Grained (Glacio) Marine
Soil Development Class - Brunisolic Static Cryosolic	Soil Development Class - Organic Cryosolic	Surficial Geology - Glaciofluvial Complex
Soil Development Class - Dark Gray Chernozemic or Dark Gray Luvisolic	Soil Development Class - Orthic Turbic Cryosolic	Surficial Geology - Glaciofluvial Plain
Soil Development Class - Dystric Brunisolic	Soil Development Class - Regosolic	Surficial Geology - Marine Mud
Soil Development Class - Eutric Brunisolic	Soil Development Class - Turbic Cryosolic	Surficial Geology - Marine Sand
Soil Development Class - Fibrisol	Surficial Geology - Alluvial Deposits	Surficial Geology - Organic Deposits
Soil Development Class - Gleysolic	Surficial Geology - Coarse Grained (Glacio) Lacustrine	Surficial Geology - Till Blanket
Soil Development Class - Gleysolic Turbic Cryosolic	Surficial Geology - Coarse Grained (Glacio) Marine	Surficial Geology - Till Veneer
Soil Development Class - Gray Luvisolic	Surficial Geology - Eolian Deposits	Surficial Geology - Undivided

APPENDIX G: FURBEARER AERIAL MULTISPECIES SURVEY DATA

Table G-1: Furbearer Aerial Multispecies Survey Data Collected Within RAA, from 2012 to 2016

		2012			2014			2015			2016			Total		
Species	**Scientific name**	**Tracks**	**Animals**	**Total**	**Tracks**	**Animals**	**Total**	**Tracks**	**Animals**	**Total**	**Tracks**	**Animals**	**Total**	**Tracks**	**Animals**	**Tracks + Animals**
Snowshoe Hare	*Lepus americanus*	464	0	464	120	0	120	60	0	60	173	0	173	817	0	817
Marten*	*Martes americana*	353	0	353	53	0	53	61	0	61	344	0	344	811	0	811
Otter	*Lontra canadensis*	139	0	139	37	0	37	27	0	27	130	0	130	333	0	333
Beaver (lodge, dams)*		N/A	N/A	N/A	0	131	131	4	73	77	0	41	41	4	4	249
Wolf	*Canis lupus*	12	3	15	5	0	5	11	0	11	192	0	192	220	3	223
Lynx	*Lynx canadensis*	21	0	21	23	0	23	3	0	3	205	0	205	252	0	252
Fox	*Vulpes vulpes*	2	0	2	0	0	0	0	0	0	132	0	132	134	0	134
Fisher	*Martes pennanti*	8	0	8	1	0	1	2	0	2	51	0	51	62	0	62
Mink	*Neovison vison*	0	0	0	0	0	0	0	0	0	4	0	4	4	0	4
Wolverine	*Gulo gulo*	1	0	1	1	0	1	0	0	0	0	0	0	2	0	2

* VC species

APPENDIX H: TRAIL CAMERA DATA

Table H-1: Trail camera trap events for wolf by season in the P6 LAA and RAA, March 1, 2016 to March 31, 2017

Study Area	Number of Camera Trap Events by Season				
	Spring	Summer	Autumn	Winter	Total
LAA	47.4% (9)	36.8% (7)	15.8% (3)	0% (0)	19
RAA	40.9% (9)	40.9% (9)	13.6% (3)	4.5% (1)	22

Table H-2: Number of hexes with trail camera trap events for wolf in the P6 LAA and RAA, March 1, 2016 to March 31, 2017

Study Area	Hexes with Cameras	Number of Hexes with Camera Trap Events by Season			
		Spring	Summer	Autumn	Winter
LAA	48	6.3% (3)	6.3% (3)	4.2% (2)	0% (0)
RAA	98	3.1% (3)	5.1% (5)	2.0% (2)	1.0% (1)

Table H-3: Trail camera trap events for black bear by season in the P6 LAA and RAA, March 1, 2016 to March 31, 2017

Study Area	Number of Camera Trap Events by Season				
	Spring	Summer	Autumn	Winter	Total
LAA	100% (4)	0% (0)	0% (0)	0% (0)	4
RAA	52.0% (13)	36.0% (9)	8.0% (2)	4.0% (1)	25

Table H-4: Number of hexes with trail camera trap events for black bear P6 LAA and RAA, March 1, 2016 to March 31, 2017

Study Area	Hexes with Cameras	Number of Hexes with Camera Trap Events by Season			
		Spring	Summer	Autumn	Winter
LAA	48	4.2% (2)	0% (0)	0% (0)	0% (0)
RAA	98	4.1% (4)	5.1% (5)	2.0% (2)	1.0% (1)

Table H-5: Number of trail camera trap events and hexes for furbearers in the P6 LAA and RAA, March 1, 2016 to March 31, 2017

Species	Hexes with cameras in the LAA	Hexes with cameras in the RAA	Camera Trap Events - All Seasons in the LAA	Camera Trap Events - All Seasons in the RAA	Number of Hexes with Trap Events
Snowshoe Hare	48	98	10	10	1
Wolverine	48	98	1	2	2
Marten*	48	98	1	1	1
Lynx	48	98	0	1	1
Otter	48	98	0	1	1

* VC species

APPENDIX I: TRAPPER PROGRAM METHODS AND FURBEARER DATA

A local Community Coordinator (CC) was selected by Chief and Council within each P6 community to collaborate and identify active trapper participants, coordinate meetings and workshops, assist with the collection of field results, liaise between trappers and the Chief and Council, and review draft reports and mapping. The CC, with the advice of the Chief and Council, selected trappers within their communities based on the geographic location of their RTL with respect to the P6 ASR Project and the RTL recent harvest history, and willingness to participate in the program. Compliance with humane trapping standards and use of approved humane trapping equipment was outlined as a critical component of participation in the TP. In return for their participation, trappers were paid a daily honorarium. Table H-1 shows the RTLs within the RAA that were used to assist with trapper selection. Of note, there are a total of 51 RTLs which occur fully or partially within the RAA, but only a small number (i.e. 4) were sampled by participating trappers in 2016 - 2017 (Table I-2).

Table I-1: Registered traplines within the RAA potentially used in trapper selection

District	Section Name	RTLs
Northern RTL District	Oxford House	52, 54, 55, 64
	God's Lake	2,3, 4, 5, 6, 8, 9, 10 and 12

Table I-2: Registered traplines sampled in the RAA in the 2016-2017 season

District	Section Name	RTLs
Northern RTL District	Oxford House	54,64
	God's Lake	2,3

Participating trappers were asked to be involved in several activities such as trapper journal recordings, track/sign surveys, and scat and hair sample collection for stable isotope analysis (SIA). At the beginning of the trapping season, trappers were provided a trapper kit which included a digital pocket camera, SD memory card, hand-held GPS unit, extra batteries, USB cord, instruction manuals, laminated maps of their RTL (ortho or topo), labelled sample bags, trapper journal, pencils and sharpener, and permanent markers within a waterproof, hard-shell case.

The trapper journal was used to record trapping catches and observations (i.e. furbearer activity, tracks, and signs including scat) along their RTLs during the trapping season. Trapper journal data collected included the date, weather description, type of traps or snares used, what species and sex was caught, what type of samples were collected, location, and/or any other wildlife observations/tracks. A comment section also detailed any other significant observations made during the visits to the traplines. Completed journals were returned to Joro at the end of the trapping season and reviewed with the trapper (or the

CC) for clarification. The hand-held GPS unit, digital pocket camera, and RTL maps on ArcGIS (ESRI, 2012) were used to record locations of traps and furbearer observations.

The trapper survey was designed to gain insights into trapper perspectives and knowledge regarding furbearer abundance and distribution in the RAA. Survey materials were distributed to trappers at the beginning of the trapping season and collected once trapping activities ended in approximately in mid-February (at the end of marten season). To augment information respecting wolf/prey relationships within the RAA, trappers were requested to collect hair samples from wolves, any wolf/bear feces, as well as hair or fecal samples of other prey species (smaller furbearers) along their traplines. Table I-3 demonstrates all harvest data collected by individual trappers.

Table I-3: Trapper Program Results

RTL #	Section	DATE	Waypoint	Trap	Trap type	sample number	TEMP °C	Snow Depth	Snowing	Raining	Cloudy	Sunny	Species	Sex	hair/scat
2	God's Lake		003	2	120	1	-27	n/a	no	no	no	yes	marten	male	Hair
2	God's Lake		4	3	120	12	0	n/a	no	no	yes	yes	marten	male	Hair
2	God's Lake	Jan 28,2017	5	4	330	22	-20	n/a	no	no	yes	no	marten	male	Hair
2	God's Lake	Jan 26,2017	6	5	120	20	-10	n/a	no	no	no	yes	marten	female	Hair
2	God's Lake		10	9	120	19	0	n/a	no	yes	yes	no	marten	male	Hair
2	God's Lake		13	12		2	-27	n/a	no	no	yes	yes	marten	female	Hair
2	God's Lake		20	19		3	-19	1"	yes	no	yes	no	marten	male	Hair
2	God's Lake		25	24	120	9	-26		no	no	no	yes	marten	n/a	Hair
2	God's Lake		25	24	120	10	-26		no	no	no	yes	marten	n/a	Scat
2	God's Lake	Feb 19,2017	25	24	120	25	-8		no	no	yes	no	marten	female	Hair
2	God's Lake	Jan 20 2017	39	37	120	13	-3		no	no	yes	no	marten	male	Hair
2	God's Lake	Jan 20 2017	39	37	120	14	-3		no	no	yes	no	marten	male	Hair
2	God's Lake		48	46		5	-31		no	no	no	yes	marten	male	Hair
2	God's Lake		49	47	120	15	-3		no	no	yes	yes	marten	male	Hair
2	God's Lake		50	48	120	6	-31		no	no	yes	no	marten	male	Hair
2	God's Lake	Feb 19,2017	52	50	120	26	-8		no	no	yes	no	marten	male	Hair

RTL #	Section	DATE	Waypoint	Trap	Trap type	sample number	TEMP °C	Snow Depth	Snowing	Raining	Cloudy	Sunny	Species	Sex	hair/scat
2	God's Lake		54	52	120	7	-31		no	no	yes	no	marten	male	Hair
2	God's Lake	Jan 20,2017	54	52	120	16	-3		no	no	yes	no	marten	male	Hair
2	God's Lake		057	55	120	8	-31		NO	no	no	yes	marten	female	Hair
2	God's Lake	Jan 22,2017	57	55	120	18	0		no	yes	yes	no	marten	male	Hair
2	God's Lake		57	55	120	27	-8		no	no	yes	no	fisher	female	Hair
2	God's Lake		58	56	120	11	-7	1"	no	no	no	yes	marten	female	Hair
2	God's Lake	Jan 20,2017	66	60	120	17	-3		no	no	yes	no	fisher	female	Hair
2	God's Lake	Feb 6,2017	66	60	120	23	-34		no	no	no	yes	marten	female	Hair
2	God's Lake	Feb 12,2017	66	60	120	24	-15		no	no	yes	yes	marten	female	Hair
2	God's Lake		67	61		4	-19	1"	yes	no	yes	no	marten	male	hair
2	God's Lake	Jan 26,2017	72	64	120	21	-10		no	no	no	yes	marten	female	Hair
54	Oxford House	Feb 1,2017	003	trap									marten	male	Hair
54	Oxford House	Jan 7,2017	005	trap									marten	male	Hair
54	Oxford House	Jan 21,2017	5	trap									marten	male	Hair
54	Oxford House	Jan 2,2017	011	trap									otter	male	Hair
54	Oxford House	Dec 31,2016	11	trap									marten	female	Hair
54	Oxford House	Dec 31,2016	11	trap									otter	female	Hair

RTL #	Section	DATE	Waypoint	Trap	Trap type	sample number	TEMP °C	Snow Depth	Snowing	Raining	Cloudy	Sunny	Species	Sex	hair/scat
54	Oxford House	Jan 16,2017	016	trap									otter	male	Hair
54	Oxford House	Jan 3,2017	017	trap									otter	female	Hair
54	Oxford House	Feb 17,2017	018	trap									marten	male	Hair
54	Oxford House	Jan 2,2017	019	trap									beaver	n/a	Hair
54	Oxford House	Feb 17,2017	020	trap									beaver	n/a	Hair
54	Oxford House	Feb 1,2017	20	trap									beaver	n/a	Hair
54	Oxford House	Jan 21,2017	021	trap									marten	male	Hair
54	Oxford House	Jan 25,2017	21	trap									marten	male	Hair
54	Oxford House	Feb 17,2017	024	trap									otter	female	Hair
54	Oxford House	Feb 7,2017	24	trap									otter	male	Hair
54	Oxford House	Feb 17,2017	026	trap									marten	male	Hair
54	Oxford House	Jan 11,2017	26	trap									otter	male	Hair
54	Oxford House	Jan 21,2017	029	trap									marten	male	Hair
54	Oxford House	Feb 17,2017	031	trap									marten	male	Hair
54	Oxford House	Jan 21,2017	31	trap									marten	male	Hair
54	Oxford House	Jan 25,2017	032	trap									marten	male	Hair
54	Oxford House	Jan 16,2017	035	trap									marten	male	Hair

RTL #	Section	DATE	Waypoint	Trap	Trap type	sample number	TEMP °C	Snow Depth	Snowing	Raining	Cloudy	Sunny	Species	Sex	hair/scat
54	Oxford House	Dec 31,2016	036	trap									marten	female	Hair
54	Oxford House	Jan 25,2017	36	trap									marten	male	Hair
54	Oxford House	Dec 28,2016	037	trap									otter	male	Hair
54	Oxford House	Feb 17,2017	078	trap									mink	female	hair
54	Oxford House	Feb 17,2017	080	trap									beaver	n/a	Hair
54	Oxford House	Feb 17,2017	80	trap									beaver	n/a	Hair
54	Oxford House	Feb 1,2017	047	trap									marten	female	Hair
54	Oxford House	Jan 16,2017	050	trap									marten	male	Hair
54	Oxford House	Feb 17,2017	051	trap									marten	male	Hair
54	Oxford House	Jan 25,2017	51	trap									Skunk	N/a	Hair
54	Oxford House	Jan 21,2017	51	trap									marten	male	Hair
54	Oxford House	Jan 21,2017	052	trap									marten	male	Hair
54	Oxford House	Jan 21,2017	053	trap									marten	female	Hair
54	Oxford House	Feb 17,2017	055	trap									muskrat	female	Hair
54	Oxford House	Jan 25,2017	55	trap									otter	male	Hair
64	Oxford House	Feb 4,2017	251	trap									marten	n/a	Hair
64	Oxford House	Feb 4,2017	253	trap									otter	n/a	Hair

RTL #	Section	DATE	Waypoint	Trap	Trap type	sample number	TEMP °C	Snow Depth	Snowing	Raining	Cloudy	Sunny	Species	Sex	hair/scat
64	Oxford House	Jan 29,2017	123	trap									marten	n/a	Hair
64	Oxford House	Jan 06,2017	124	trap									marten	n/a	Hair
64	Oxford House	Jan 11,2017	165	trap									marten	n/a	Hair
64	Oxford House	Jan 20,2017	200	trap									marten	n/a	Hair
64	Oxford House	Jan 19,2017	200	trap									otter	male	Hair
64	Oxford House	Jan 20,2017	211	trap									marten	n/a	Hait
64	Oxford House	Jan 20,2017	213	trap									marten	n/a	Hair
64	Oxford House	Jan 21,2017	221	trap									marten	n/a	Hair
64	Oxford House	Jan 15,2017	230	trap									otter	n/a	Hair
64	Oxford House	Jan 28,2017	235	trap									otter	n/a	Hair
64	Oxford House	Jan 19,2017	243	trap									otter	n/a	Hair
64	Oxford House	Jan 28,2017	243	trap									marten	n/a	Hair
64	Oxford House	Dec 29,2017	019	trap	snare	4	-26	10''	no	no	no	yes	Lynx	male	hair/meat
64	Oxford House	Dec 29,2017	020	trap	120	10	-26	10''	no	no	no	yes	Fisher	male	hair/meat
64	Oxford House	Jan 19,2017	022	trap									marten	n/a	hair
64	Oxford House	Dec 29,2016	036	trap	120	16	-26	10''	no	no	no	yes	marten	male	hair/meat
64	Oxford House	Dec 29,2017	041	trap	280	1	-24	10''	yes	no	yes	yes/am	otter	female	Hair

RTL #	Section	DATE	Waypoint	Trap	Trap type	sample number	TEMP °C	Snow Depth	Snowing	Raining	Cloudy	Sunny	Species	Sex	hair/scat
64	Oxford House		41	trap	280	13	-24	10''	yes	no	yes	yes/am	otter	female	Hair
64	Oxford House	Dec 29,2016	043	trap	120	43	-26	10''	no	no	no	yes	marten	male	hair/meat
64	Oxford House	Feb 5,2017	047	trap									marten	n/a	Hair
64	Oxford House	Feb 12,2017	47	trap									lynx	n/a	Hair
64	Oxford House	Feb 12,2017	47	trap									otter	n/a	Hair
64	Oxford House	Jan 29,2017	247	trap									otter	n/a	Hair
64	Oxford House	Dec 30,2016	049	trap	280	5	-24	10''	yes	no	yes	yes/am	marten	male	Hair
64	Oxford House	Jan 4,2017	49	trap									mink	n/a	Hair
64	Oxford House	Jan 15,2017	058	trap									marten	male	Hair
64	Oxford House	Jan 8,2017	58	trap									marten	n/a	Hair
64	Oxford House	Jan 6,2017	059	trap									marten	n/a	Hair
54	Oxford House	Feb 12,2017	255	trap									marten	n/a	Hair
3	God's Lake	Dec 27,2016	015	trap		1	-23	5''	no	no	yes	no	marten	male	n/a
3	God's Lake	Dec 27,2016	010	trap		2	-23	5''	no	no	yes	no	marten	male	n/a
3	God's Lake	Dec 30,2016		trap		n/a	-20	5''	no	no	yes	no	marten	male	n/a
3	God's Lake	Jan 15,2017		trap			n/a	8''	yes	no	yes	yes	marten	n/a	n/a
3	God's Lake	Jan 25 ,2017		trap			-12	1''	no	no	no	yes	marten	n/a	n/a

RTL #	Section	DATE	Waypoint	Trap	Trap type	sample number	TEMP °C	Snow Depth	Snowing	Raining	Cloudy	Sunny	Species	Sex	hair/scat
3	God's Lake	Jan 29,2017		trap			-19	1"	no	no	yes	no	marten	n/a	n/a
3	God's Lake	Jan 29,2017		trap			-19	1"	no	no	yes	no	mink	n/a	n/a
3	God's Lake	Jan 29,2017		trap			-19	1"	no	no	yes	no	rabbit	n/a	n/a
3	God's Lake	Feb 05,2017		trap			-24	1"	no	no	yes	yes	marten	n/a	n/a

APPENDIX J: ARU METHODS AND BIRD DATA

Scoping of Target Species

Determination of the methods to be followed prior to the first deployment of Autonomous Recording Units (ARUs) in March 2016 initially involved the scoping of target species. Information on preferred breeding habitats and mating schedules were identified after determining that the prime focus of ARU studies as being to identify presence/absence of species listed under COSEWIC, SARA, MESEA and MBCDC (Appendix B).

While the field priority was initially focused on SAR, other birds and amphibians were expected to be recorded by ARUs within the suite of habitat types sampled. Spring peeper and northern leopard frogs were amongst the amphibian species targeted through the habitat-based placement of ARUs. The timing and location of ARU deployment assumed that amphibians in the region would initiate vocalizations in late April and early May following snow melt and warming temperatures. Bird vocalizations were sampled at various times and locations based on known breeding cycles of diurnal (e.g., passerines), crepuscular (e.g., common nighthawks), and nocturnal (e.g., owls) species that breed as early as March and as late as late August or September.

A list of bird and amphibian species initially targeted for sampling by ARUs in 2016 is given in Table J-1. While these include species of conservation concern listed under federal and/or provincial legislation, their habitats overlap those of several other species; e.g., mixedwood and coniferous forests sampled in March and April potentially support breeding populations of both great gray owls and boreal owls.

Table J-1: Bird and amphibian species of interest in the P6 RAA

Species (Scientific Name)	Habitat Preference	Mating Call Period (Dates/Times)
BIRDS		
Bank swallow (*Riparia riparia*)	Vertical sandy banks near water (rivers/streams)	Likely N/A; mid-May to mid-August
Barn swallow (*Hirundo rustica*)	Marshy areas with structures for nesting	Mid-May to late Sept; Sunrise-10:30
Barred owl (*Strix varia*)	Mature boreal and riparian forests; mature hardwood-dominated stands, especially in low-lying areas near marsh and rivers	First mild nights in March to June; nocturnal
Canada warbler (*Cardellina canadensis*)	Deciduous or mixed-wood, often on sloping terrain near lake in dense shrubbery	Mid-May to August (June peak); Pre-Sunrise-10:30
Common nighthawk (*Chordeiles minor*)	Forests with extensive rock outcrops, clearings or burns	Early June-mid August; crepuscular late afternoon/evening
Horned grebe (*Podiceps auritus*)	Permanent potholes with vegetation	Likely N/A – Mid-May to Mid-June
Olive-sided flycatcher (*Contopus cooperi*)	Open coniferous forests near edge of bogs/wetlands	June-mid-July; Sunrise-10:00
Rusty blackbird (*Euphagus carolinus*)	Wet areas (e.g., treed muskeg)	Mid-May to mid-July; Sunrise-10:00
Short-eared owl (*Asio flammeus*)	Open areas such as marshes and fens with tall dense vegetation with cover, bog, muskeg, and open boreal forest	Mid-April to late June; nocturnal

Species (Scientific Name)	Habitat Preference	Mating Call Period (Dates/Times)
BIRDS		
Yellow rail (*Coturnicops noveboracensis*)	Wetlands – shallow, grassy marsh or sedge fen; wet sedge meadows where sedge species are selected for and water depth around the nest is 10 cm	Mid-May to August; primarily nocturnal (will call during day)
AMPHIBIANS		
Spring peeper (*Pseudacris crucifer*)	Forested habitat near ponds and other wetlands	Late April and early May, following snow melt and warming temperatures
Northern leopard frog (*Lithobates pipiens*)	Grasslands or forests near lakes, ponds, or other wetlands	Late April and early May, following snow melt and warming temperatures

*See Appendices B and C for definitions on conservation status listing. Sources: Altman and Sallabanks, 2000, Avery 1995, Bookhout and Stenzel 1987, Bookhout 1995, Clark 1975, Conway 1999, Godfrey 1986, Holland and Taylor 2003a,b, Koonz and Taylor 2003, Nature North 2017, Nero and Taylor 2003, Poulin *et al.,* 1996, Taylor 2003.

Site Selection and Temporal Settings

Knowledge respecting species present in the RAA enhances the assessment of potential Project activities to impact specific birds and/or amphibians. Throughout the Project 6 assessment history, ARUs have been deployed within appropriate habitats to ensure the best opportunity for detection of the targeted birds and amphibians; aerial reconnaissance surveys were undertaken to assist in the selection of the most appropriate forest covertypes prior to placement of the ARUs. Key criteria governing the placement of ARUs included:

- All ARUs deployed along/adjacent to proposed road infrastructure
- Habitats were selected using existing habitat information (LCCES)
- Potential sites selected were mapped using LCCES data at a 1:10,000 scale; and
- ARUs were typically set up within or near clearings close to suitable habitat that facilitates deployment and monitoring.

ARUs were securely attached to trees on the edge of a clearing; barbed wire was wrapped around the tree underneath the ARU as a deterrent to black bear destructive curiosity. The seasonal deployment of ARU's was based on known species-specific habitat requirements during the breeding season (Table I-1 and I-2). The periodicity for operation of the recording units was based on an evaluation of the most efficient use of time resources. ARUs were programmed to record for certain peak activity periods when species were most active, e.g., dusk or night for common nighthawks. Recording units were left in place for 2-4 weeks before being moved to another location, this assured increased probability of recording a rare species and correcting for recording times when weather interfered with recordings and animal detection.

The proposed periods for which the ARUs deployed in 2016 recorded various species of birds are outlined in Table J-2. The ARUs were set to record half an hour before sunrise and sunset, recording for 10 minutes each hour for four hours (for a total of four 10-minute recordings). For habitats potentially supporting rare species during the sampling period, a minimum of three ARUs, with a minimum of 4 km of separation between units, were placed in each habitat types interspersed along/near the Project infrastructure sites. Sampling dates in the P6 RAA assured adequate recording coverage of the beginning, middle, and end phases of breeding cycles.

Table J-2: Temporal settings for ARUs deployed in the P6 RAA

Sampling* Period	Temporal Setting	Frequency	Habitat	Focal Species
March 21 - May 27	1900h-0100h	10 min/hr	Moist mixedwood and riparian forests with dense understory; mature hardwood-dominated stands, esp. in low- lying areas near marsh and rivers	Barred owl
April 11 - June 3	1900h-0100h	10 min/hr	Open areas such as marshes and fens with tall dense vegetation with cover. Likely non-breeder (*reduce/avoid sample size*).	Short-eared owl
June 6-20	Incidental with other ARU recordings	10 min/hr	Permanent potholes with vegetation, small ponds, sloughs, and shallow, protected inlets on lakes	Horned grebe
June 6-20	0430h-1000h	10 min/hr	Wet areas (e.g., treed muskeg); bogs, fens, riparian areas	Rusty blackbird
June 6-20	2130h-0500h	10 min/hr	Wetlands – shallow, grassy marsh or sedge fen; wet sedge meadows where sedge species are selected for and water depth around the nest is 10 cm	Yellow rail
June 6-20	0430h-1000h	10 min/hr	Deciduous or mixed-wood with dense and diverse understory, often on sloping terrain near lake	Canada warbler
June 6-20	0430h-1000h	10 min/hr	Deciduous woods, large aspen bluffs, beach ridges, riparian sites and open tall jack pine stands	Eastern Wood-pewee
June 6-20	0430h-1000h	10 min/hr	Open coniferous forests near edge of bogs/wetlands and recently burned stands (standing dead trees)	Olive-sided flycatcher
June 6-20	1800h-2300h	10 min/hr	Forests with extensive rock outcrops, clearings or burns– openings such as gravel pits	Common nighthawk

*Timeframes consider the early spring in 2016 and can be adjusted as spring progresses

To augment the information collected by ARUs, observations of birds and unique or sensitive habitat (e.g., heron rookery or eagle nest) were collected during the ARU deployment phase. This assisted in collecting information on species not readily heard on ARUs but more likely to be seen visually, e.g., waterfowl and waterbirds such as horned grebes.

ARUs were initially deployed within the P6 RAA in different months (i.e. March to June) to assure that other species (listed in Table J-1 and Table J-2) would be potentially recorded if present. Once units were retrieved, the ARU data was collected and new data storage cards were inserted. Recording units were then relocated to new locations along the P6 routes to survey a greater area for the same species. For example, the ARUs used to sample owls and frogs were redeployed in May to assure there was adequate sampling for rare species of migratory neotropical songbirds that potentially breed in the area. ARUs that were used to sample for owls were retained in habitats that would be sampled for other species (e.g., the barred owl breeding sites were in habitats similar to the location of many other neotropical migrants. Redeployment of the owl ARUs to habitats well suited to passerines occupation was done in late May/early June coinciding with breeding season activity.

Sampling Protocol

The intent of the analysis was to determine presence/absence of species. ARUs were set to record during the early, peak, and late phases of the breeding periods for birds and amphibians. The following are some of the key factors considered in the analyses of data generated by the ARUs:

- Prior to listening to recordings, reviewers would listen to the calls of the species in question; and
- Reviewers listened to a minimum of 3-5, 10-minute pre-selected sample units/period (morning, evening, night) to assure that analyses occurred during the:
    - onset of owl breeding (late March/early April), during the middle (late April/early May), and near the end of the recording cycle (late May);
    - onset of amphibian courtship (late April) and throughout the breeding period; and
    - onset of songbird breeding (May) and throughout the breeding cycle (until mid-August).

Table J-3: P6 ARU sampling locations and periods in 2016

Project	Site	Latitude	Longitude	Date Start	Date End	Time Start	Time End	Data	Habitat Type*
P6-1	SM06	54.86742	-94.04983	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	Standing water in marsh, short spruce trees
P6-2	SM06	54.89451	-94.102482	2016-04-20	2016-05-18	0500, 1730	0700, 2030	Yes	Marsh grass, ~1 km from open lake. Surrounded by willow, TM with spruce farther away
P6-3	SM06	54.89451	-94.102482	2016-05-18	2016-06-16	1950	0815	No	
P6-4	SM06	54.85342	-94.390482	2016-06-16	2016-07-07	2030	0800	No	15km west along a large pond/lake, 15m of grass from treeline to creek, edge of treeline is mixed with willow
P6-5	SM06	54.85859	-94.41464	2016-07-07	2016-07-19	2030	0800	No	50% mature spruce-40% TM-10% MW in 0.5 hectare on TM
P6-6	SM06	54.85859	-94.41464	2016-07-19	2016-08-15	1900	1100	Yes	
P6-1	SM07	54.7075	-94.97585	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	Small lake with marshy area, standing dead trees, MW nearby
P6-2	SM07	54.79071	-95.142422	2016-04-20	2016-05-17	0500, 1730	0700, 2030	Yes	On road alignment: Dry upland MW, large poplar trees 30 m tall
P6-1	SM09	54.61548	-94.70279	2016-03-22	2016-04-20	0500, 1730	0700, 2030	Yes	Grassy swamp with standing dead trees, willows, TM, boggy with standing water near small lake
P6-2	SM09	54.59844	-94.677759	2016-04-20	2016-05-16	0500, 1730	0700, 2030	Yes	Road alignment, small marshy area with willows
P6-3	SM09	54.59844	-94.677759	2016-05-16	2016-06-16	1950	0515	No	
P6-4	SM09	54.60544	-94.690866	2016-06-16	2016-07-07	2030	0800	No	Along winter road: no grass on the road peaty hummock, TM on either side; spruce trees are spaced out.
P6-5	SM09	54.61176	-94.697552	2016-07-07	2016-07-19	2030	0800	No	1 hectare (ha) 80% mature spruce, 20% tamarack north of alignment
P6-6	SM09	54.61176	-94.697552	2016-07-19	2016-09-28	350, 1820	1200, 2230	Yes	
P6-1	SM10	54.88281	-95.22083	2016-03-21	2016-04-20	0415, 1800	0715, 2100	Yes	Marshy area near small creek. Surrounded by tall MW
P6-2	SM10	54.87019	-95.233527	2016-04-20	2016-05-16	0300, 1800	0600, 2100	Yes	Clearcut road alignment, tall spruce and poplar
P6-3	SM10	54.87019	-95.233527	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM10	54.86431	-95.22567	2016-06-16	2016-07-07	2030	0500	Yes	Opening along the proposed road, TM edge, 0.1ha opening with willows and small spruce
P6-5	SM10	54.87757	-95.258227	2016-07-07	2016-07-19	1900	0600	Yes	3 ha opening: 70% tamarack-30% mature spruce south of hydro line

Project	Site	Latitude	Longitude	Date Start	Date End	Time Start	Time End	Data	Habitat Type*
P6-6	SM10	54.87757	-95.258227	2016-07-19	2016-08-11	2000	1030	Yes	
P6-3	SM11	54.89374	-94.227372	2016-05-18	2016-06-16	1950	0815	No	3 ha opening: 70% TM-30% mature spruce south of hydro line
P6-4	SM11	54.89275	-94.202343	2016-06-19	2016-07-02	2030	0800	Yes	Spruce-TM mix along the winter road
P6-5	SM11	54.8732	-94.125998	2016-07-08	2016-07-10	2030	0800	No	Winter road north side of road on black spruce
P6-6	SM11	54.8732	-94.125998	2016-07-19	2016-10-05	1715	1230	Yes	
P6-1	SM13	54.84902	-94.48282	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	Small bog, grassy surrounded by spruce
P6-2	SM13	54.81203	-94.52219	2016-04-20	2016-05-16	0500, 1730	0700, 2030	Yes	Two deciduous stands nearby: small bog, short spruce trees
P6-3	SM13	54.81203	-94.52219	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM13	54.82782	-94.508197	2016-06-16	2016-07-07	2030	0800	No	Winter road, small spruce intermixed with small clumps of willows
P6-5	SM13	54.83643	-94.484291	2016-07-19	2016-07-20	2030	0800	Yes	70% mature spruce-30% MW
P6-6	SM13	54.83643	-94.484291	2016-07-20	2016-08-11	1930	1100	Yes	
P6-3	SM14	54.88816	-94.164111	2016-05-18	2016-06-16	1950	0815	No	No record
P6-4	SM14	54.88306	-94.151188	2016-06-16	2016-07-07	2030	0800	No	Along winter road: taller spruce to the north with small spruce and TM to the south and willows mixed throughout
P6-5	SM14	54.88577	-94.171495	2016-07-08	2016-07-08	0200	0800	No	1 ha opening: 50% mature spruce-50% TM east side of opening
P6-6	SM14	54.88577	-94.171495	2016-08-07	2016-10-04	1730	1230	Yes	
P6-1	SM15	54.78535	-94.58913	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	Short grass, dead standing spruce, next to large marsh
P6-2	SM15	54.68213	-94.850282	2016-04-20	2016-05-16	0500, 1730	0700, 2030	Yes	Marshy area with dead trees. Grassy next to spruce/TM forest
P6-3	SM15	54.68213	-94.850282	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM15	54.68483	-94.882681	2016-06-16	2016-07-07	2030	0800	No	On winter road: 20m opening, short grass, spruce to the west and willow on the other side of the road
P6-5	SM15	54.69168	-94.902335	2016-07-08	2016-07-19	2030	0800	No	0.25 ha on TM, cell phone tower to the south: 10% mature spruce-60% tamarack-30% MW
P6-6	SM15	54.69168	-94.902335	2016-07-19	2016-10-05	1730	1230	Yes	
P6-1	SM16	54.56897	-94.57143	2016-03-22	2016-04-20	0500, 1730	0700, 2030	Yes	Grassy marsh with willows near small lake. Beaver lodge and dam 50m away

Project	Site	Latitude	Longitude	Date Start	Date End	Time Start	Time End	Data	Habitat Type*
P6-2	SM16	54.55623	-94.584884	2016-04-20	2016-05-16	0500, 1730	0700, 2030	Yes	In swamp 70m from beaver lodge. Large upland ridges, dry with poplar
P6-3	SM16	54.55623	-94.584884	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM16	54.55184	-94.571153	2016-06-16	2016-07-07	2030	0800	No	Along winter road: short grass on road with willows all around
P6-5	SM16	54.55942	-94.567564	2016-07-07	2016-07-19	2030	0800	No	0.5 ha water hole surrounded by mature spruce
P6-1	SM18	54.84853	-95.17338	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	Marshy grassy area surrounded by small dry ridges with large spruce trees, MW
P6-2	SM18	54.84067	-95.188263	2016-04-20	2016-05-16	0500, 1730	0700, 2030	Yes	Road crossroad: Large MW forest stand
P6-3	SM18	54.84067	-95.188263	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM18	54.83161	-95.177001	2016-06-16	2016-07-07	2030	0800	No	Further down road: mixed with TM and spruce, road is grassy
P6-5	SM18	54.81994	-95.137241	2016-07-07	2016-07-19	2030	0800	No	Mature spruce grassy opening 1.5 hectare
P6-6	SM18	54.81994	-95.137241	2016-07-19	2016-08-18	1900	1100	Yes	
P6-1	SM19	54.76307	-94.72947	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	Small grassy bog near large MW upland habitat
P6-2	SM19	54.73235	-94.802118	2016-04-20	2016-05-16	0500, 1730	0700, 2030	Yes	On road alignment: large MW stand
P6-3	SM19	54.73235	-94.802118	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM19	54.74198	-94.801174	2016-06-16	2016-07-07	2030	0800	No	Spruce on either side: small willows along the edge with short grass on the road, with a pond/swamp to the north
P6-5	SM19	54.75288	-94.782273	2016-07-08	2016-07-19	2030	0800	No	0.5 hectare: 70% mature spruce-30% MW, grassy open area on black spruce tree north side of opening
P6-6	SM19	54.75288	-94.782273	2016-07-19	2016-08-26	1900	1100	Yes	
P6-1	SM21	54.76981	-95.07153	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	In stream bed with lots of grass by very large MW upland area
P6-2	SM21	54.76237	-95.088228	2016-04-20	2016-05-16	0500, 1730	0700, 2030	Yes	On road alignment: upland dry site near a small marsh by large upland MW
P6-3	SM21	54.76237	-95.088228	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM21	54.75157	-95.065879	2016-06-16	2016-07-07	2030	0800	No	Further down road at a Junction: .1ha opening, short grass, spruce with willow
P6-5	SM21	54.7424	-95.047382	2016-07-07	2016-10-12	2030	0800	No	North side of winter road at 215 km marker
P6-6	SM21	54.7424	-95.047382	2016-07-19	2016-10-05	1730	1230	Yes	

Project	Site	Latitude	Longitude	Date Start	Date End	Time Start	Time End	Data	Habitat Type*
P6-1	SM23	54.89395	-94.25981	2016-03-21	2016-04-20	0420, 1810	0720, 2150	Yes	Small marsh, grassy with willows
P6-2	SM23	54.88602	-94.277192	2016-04-20	2016-05-16	0300, 1900	0600, 2220	Yes	Very grassy, wet, standing dead trees in marsh, small creek
P6-3	SM23	54.88602	-94.277192	2016-05-16	2016-06-16	1950	0815	No	
P6-4	SM23	54.88178	-94.249176	2016-06-16	2016-07-07	2030	0800	No	Along edge of a 2.5 ha pond: there is 10m of grass from the edge of pond to tree line, willows along the edge with spruce and TM
P6-5	SM23	54.88869	-94.270919	2016-07-08	2016-07-19	2030	0800	No	North side of pond on TM
P6-6	SM23	54.88869	-94.270919	2016-07-19	2016-09-02	2000	1130	Yes	
P6-1	SM24	54.6574	-94.86872	2016-03-21	2016-04-20	0500, 1730	0700, 2030	Yes	Marsh surrounded by MW, willows, grass, TM

*TM= Tamarack, MW -= Mixedwood

See Map 56 for ARU deployment locations

Table J-4: ARU bird species heard March 21 - October 12, 2016

Species	SM06			SM07		SM09			SM10					SM11	SM13					SM14	SM15				SM16			SM18				SM19						SM21			SM23				SM24
	1	2	6	1	2	1	2	6	1	3	4	5	6	6	1	2	3	5	6	6	1	2	3	6	1	2	3	1	2	3	6	1	2	3	4	5	6	1	2	6	1	2	3	6	1
Alder flycatcher			√					√		√		√	√					√						√										√											
American Crow		√			√			√			√	√				√	√								√	√			√						√			√	√						
American robin		√					√											√											√	√			√						√						
American Three-toed Woodpecker						√																							√									√						
American tree sparrow		√																																										
Unknown blackbird		√			√																																							
Black-capped Chickadee						√																√						√									√			√				
Blue jay					√											√	√					√	√											√										
Blue-headed vireo																			√																									
Boreal chickadee							√						√	√					√				√																					
Brown creeper																																	√											
Canada goose		√		√	√		√		√	√		√				√	√					√				√			√	√			√					√			√			
Cedar waxwing																													√				√											
Chipping sparrow										√	√	√	√				√	√				√	√	√		√	√						√		√				√	√		√		√	
Common loon		√			√		√	√		√	√			√		√		√	√	√						√	√			√	√		√		√		√		√	√		√		√	
Common nighthawk														√										√										√								√			
Common raven	√	√		√					√	√		√		√	√		√				√	√	√		√	√	√				√	√		√				√		√				√
Common redpoll							√			√			√						√			√				√			√				√	√			√							
Common grackle		√																																										
Connecticut warbler		√			√		√						√									√		√		√			√				√					√						
Dark-eyed junco							√							√																								√	√					
Downy woodpecker																													√															
Unknown duck		√						√																																				
Evening grosbeak													√								√								√															
Gray catbird							√			√																							√											

Species	SM06			SM07		SM09			SM10					SM11	SM13					SM14	SM15				SM16			SM18				SM19						SM21			SM23				SM24
	1	2	6	1	2	1	2	6	1	3	4	5	6	6	1	2	3	5	6	6	1	2	3	6	1	2	3	1	2	3	6	1	2	3	4	5	6	1	2	6	1	2	3	6	1
Gray jay																√			√	√															√						√					
Great gray owl																	√								√																				
Hairy woodpecker							√										√																					√							
Harris's sparrow								√				√						√																												
Hermit thrush			√		√			√		√	√	√		√			√	√	√			√		√		√			√		√			√		√		√	√						
Hoary redpoll																												√																	
Le Conte's sparrow		√											√																				√			√								
Lesser yellowlegs		√			√		√						√									√	√			√			√				√										
Lincoln's sparrow		√			√																																								
Mallard		√						√		√																									√										
Nashville warbler																							√																						
Northern flicker																										√												√			√				
Olive-sided flycatcher								√			√									√				√																		√		
Orange-crowned warbler																																											√		
Ovenbird					√					√		√					√					√				√				√				√				√	√					
Pied-billed grebe												√																						√										
Pileated woodpecker					√						√					√					√					√																		
Pine grosbeak						√																										√												
Red crossbill																																						√							
Red-breasted nuthatch		√																																										
Red-winged blackbird		√																																										
Ring-billed gull		√	√									√														√																		
Ring-necked duck																																									√				
Rose-breasted grosbeak														√				√														√												
Ruby-crowned kinglet		√			√		√			√	√					√	√					√	√			√	√		√	√			√	√				√					
Ruffed grouse										√																		√	√															
Sandhill crane		√			√		√				√	√		√		√			√		√	√				√	√		√	√	√		√		√		√			√		√		

Species	SM06			SM07		SM09			SM10					SM11	SM13					SM14	SM15				SM16			SM18				SM19						SM21			SM23				SM24
	1	2	6	1	2	1	2	6	1	3	4	5	6	6	1	2	3	5	6	6	1	2	3	6	1	2	3	1	2	3	6	1	2	3	4	5	6	1	2	6	1	2	3	6	1
Short-eared owl											√											√																						
Sora																											√																	
Spruce grouse																√								√														√				√			
Swainson's thrush																√						√																					
Swamp sparrow		√					√	√		√																							√		√								
Tennessee warbler												√						√																									
Unknown bird		√	√		√	√	√	√	√	√	√	√	√	√	√		√	√	√	√	√	√	√	√	√	√	√	√		√	√	√	√		√		√	√	√	√	√		√
White-crowned sparrow										√																√			√			√						√						
White-throated sparrow		√								√	√		√	√					√					√										√		√			√			√	
White-winged crossbill						√																										√											
Wilson's snipe		√	√		√		√	√	√	√	√	√		√		√	√	√			√	√	√	√		√	√	√	√		√		√		√		√	√		√	√		√
Winter wren										√	√												√																				
Unknown woodpecker					√			√			√		√		√	√	√				√	√		√		√		√	√	√		√	√				√	√					
Yellow warbler																														√				√									
Yellow-bellied sapsucker																													√														
Yellow-rumped warbler																																											√	

Table J-5: ARU amphibian species heard March 21 - October 12, 2016

Species	ARU: Site Where Species Heard At Least Once																							
	SM6:			SM9:		SM10:				SM11:	SM13:		SM14:	SM15:		SM16:		SM18:		SM19:			SM21:		SM23:
	P6-1	P6-2	P6-6	P6-2	P6-6	P6-3	P6-4	P6-5	P6-6	P6-6	P6-2	P6-3	P6-6	P6-2	P6-6	P6-2	P6-3	P6-2	P6-6	P6-3	P6-4	P6-6	P6-2	P6-2	P6-3
Boreal chorus frog				√	√	√	√			√				√	√				√			√	√	√	
Eastern American toad						√																			
Spring peeper				√		√	√			√		√		√			√			√			√	√	√
Wood frog	√	√	√	√	√	√	√	√	√	√	√	√	√	√		√	√	√			√		√	√	√

Table J-6: Data collected during the Manitoba Breeding Bird Atlas surveys, 2014

Species/Grid Block Observed	Point Count Observations	Incidental Observations	Total Observed
Alder Flycatcher	**20**	**22**	**42**
15UA57	3		3
15UA58	2		2
15UA76	1		1
15UA85	3		3
15UA86	1		1
15UA97	4		4
15VA07	6	14	20
15VA08		1	1
15VA18		7	7
American Crow	**1**	**1**	**2**
15UA59		1	1
15UA85	1		1
American Goldfinch	**1**	**0**	**1**
15UA76	1		1
American Robin	**11**	**26**	**37**
15UA57	1	2	3
15UA58	3	2	5
15UA59		1	1
15UA76	1	9	10
15UA85	3	1	4
15UA86		6	6
15UA95		2	2
15UA97	3		3
15VA07		3	3
Bald Eagle	**1**	**2**	**3**
15UA57		1	1
15UA76		1	1
15VA07	1		1
Bay-breasted Warbler		**1**	**1**
15UA58		1	1
Belted Kingfisher	**1**		**1**
15UA58	1		1
Black-and-white Warbler		**1**	**1**
15UA58		1	1
Black-backed Woodpecker	**2**		**2**
15UA97	2		2
Blackburnian Warbler	**1**		**1**
15UA58	1		1
Black-capped Chickadee	**1**		**1**
15UA58	1		1
Blackpoll Warbler	**1**		**1**
15UA97	1		1
Blue-headed Vireo	**11**		**11**
15UA58	5		5
15UA85	1		1
15UA86	1		1

Species/Grid Block Observed	Point Count Observations	Incidental Observations	Total Observed
15UA97	3		3
15VA07	1		1
Bonaparte's Gull	**8**	**4**	**12**
15UA59		1	1
15UA85	5		5
15UA95		1	1
15VA07	3		3
15VA18		2	2
Boreal Chickadee	**2**	**10**	**12**
15UA57		2	2
15UA58	1		1
15UA76		1	1
15UA85	1	1	2
15UA86		1	1
15UA95		4	4
15UA97		1	1
Brown Creeper	**1**		**1**
15UA86	1		1
Canada Goose	**5**	**20**	**25**
15UA58	5		5
15VA07		20	20
Cedar Waxwing	**5**	**16**	**21**
15UA57		3	3
15UA58		9	9
15UA76		2	2
15UA85	2		2
15UA95		2	2
15UA97	3		3
Chipping Sparrow	**1338**	**89**	**1427**
15UA57	80	12	92
15UA58	12	7	19
15UA59		1	1
15UA67	193	7	200
15UA76	129	8	137
15UA85	86	8	94
15UA86	209	7	216
15UA95	221	7	228
15UA97	8	7	15
15VA07	145	16	161
15VA08		2	2
15VA18	255	7	262
Common Grackle		**3**	**3**
15UA58		3	3
Common Loon	**14**	**7**	**21**
15UA57	2	3	5
15UA58	2		2
15UA76		1	1
15UA97	4		4
15VA07	6	3	9

Species/Grid Block Observed	Point Count Observations	Incidental Observations	Total Observed
Common Nighthawk	**1**	**2**	**3**
15UA57		1	1
15UA58	1		1
15VA07		1	1
Common Raven	**9**	**8**	**17**
15UA57		2	2
15UA58		1	1
15UA59		1	1
15UA76		1	1
15UA85	1		1
15UA95		1	1
15UA97	6		6
15VA07	2		2
15VA18		2	2
Common Tern		**6**	**6**
15UA57		3	3
15UA59		3	3
Common Yellowthroat	**1**		**1**
15UA76	1		1
Connecticut Warbler	**2**	**3**	**5**
15UA58	1		1
15UA67		1	1
15UA76	1		1
15VA07		1	1
15VA08		1	1
Dark-eyed Junco	**39**	**65**	**104**
15UA57	2	4	6
15UA58	6	7	13
15UA67		7	7
15UA76	4	6	10
15UA85	4		4
15UA86		7	7
15UA95		4	4
15UA97	16	7	23
15VA07	7	15	22
15VA08		1	1
15VA18		7	7
Eastern Kingbird	**1**		**1**
15UA58	1		1
Forster's Tern	**3**		**3**
15UA97	3		3
Fox Sparrow	**16**	**25**	**41**
15UA57		1	1
15UA76	1		1
15UA85	4		4
15UA86		7	7
15UA97	10	7	17
15VA07	1	3	4
15VA18		7	7

Species/Grid Block Observed	Point Count Observations	Incidental Observations	Total Observed
Gray Jay	**38**	**6**	**44**
15UA57	4	3	7
15UA58	15		15
15UA76	5	2	7
15UA85	4		4
15UA86	3		3
15UA97	3		3
15VA07	4		4
15VA08		1	1
Great Gray Owl	**2**	**2**	**4**
15UA97	2		2
15VA08		2	2
Greater Yellowlegs	**25**	**6**	**31**
15UA57		1	1
15UA58	1	1	2
15UA76		2	2
15UA86	3		3
15UA97	10		10
15VA07	11	1	12
15VA08		1	1
Hairy Woodpecker		**2**	**2**
15UA76		1	1
15UA97		1	1
Hermit Thrush	**62**	**90**	**152**
15UA57	7	18	25
15UA58	14	7	21
15UA67		7	7
15UA76	6	8	14
15UA85	2		2
15UA86	3	7	10
15UA95		14	14
15UA97	18	7	25
15VA07	12	15	27
15VA18		7	7
Herring Gull	**3**	**3**	**6**
15UA57		1	1
15UA58		1	1
15UA59		1	1
15UA97	2		2
15VA07	1		1
Least Flycatcher	**2**		**2**
15UA57	1		1
15VA07	1		1
Lincoln's Sparrow	**45**	**58**	**103**
15UA57	1		1
15UA58	7	7	14
15UA76	8	8	16
15UA85	4		4
15UA95		14	14

Species/Grid Block Observed	Point Count Observations	Incidental Observations	Total Observed
15UA97	13	7	20
15VA07	12	14	26
15VA08		1	1
15VA18		7	7
Magnolia Warbler	**10**	**1**	**11**
15UA57	1		1
15UA58	1		1
15UA76	1	1	2
15UA85	2		2
15UA86	2		2
15UA97	3		3
Nashville Warbler	**7**	**1**	**8**
15UA58	2		2
15UA76	2		2
15UA85	2		2
15UA95		1	1
15VA07	1		1
Northern Flicker	**2**	**6**	**8**
15UA58	1		1
15UA59		1	1
15UA76		1	1
15UA97	1	1	2
15VA07		2	2
15VA08		1	1
Northern Harrier	**1**		**1**
15UA85	1		1
Northern Waterthrush	**3**	**2**	**5**
15UA57	2		2
15UA97		1	1
15VA07	1		1
15VA08		1	1
Olive-sided Flycatcher	**4**	**8**	**12**
15UA76	1	1	2
15UA85	1		1
15UA97	2		2
15VA18		7	7
Orange-crowned Warbler	**15**	**21**	**36**
15UA57	2		2
15UA58	1		1
15UA76	3		3
15UA85	2		2
15UA86		7	7
15UA97	6	7	13
15VA07	1	7	8
Osprey		**1**	**1**
15UA57		1	1
Ovenbird	**5**	**13**	**18**
15UA57	1	5	6
15UA58	1		1

Species/Grid Block Observed	Point Count Observations	Incidental Observations	Total Observed
15UA67		7	7
15UA85		1	1
15UA86	3		3
Palm Warbler	**28**	**51**	**79**
15UA58	3		3
15UA76	1		1
15UA85	5	7	12
15UA86		7	7
15UA95		7	7
15UA97	14	7	21
15VA07	5	16	21
15VA18		7	7
Pied-billed Grebe	**1**		**1**
15UA97	1		1
Pine Siskin	**1**	**1**	**2**
15UA57	1		1
15UA95		1	1
Purple Finch	**1**		**1**
15VA07	1		1
Red-eyed Vireo	**2**	**4**	**6**
15UA58	1		1
15UA59		4	4
15UA97	1		1
Red-tailed Hawk	**2**	**5**	**7**
15UA58	1		1
15UA76		1	1
15UA85		1	1
15UA95		1	1
15UA97	1		1
15VA07		2	2
Ring-billed Gull		**8**	**8**
15UA57		3	3
15UA59		1	1
15UA76		2	2
15VA07		1	1
15VA08		1	1
Ruby-crowned Kinglet	**73**	**86**	**159**
15UA57	7	12	19
15UA58	21	7	28
15UA67		7	7
15UA76	10	8	18
15UA85	8	7	15
15UA86	4	7	11
15UA95		7	7
15UA97	18	7	25
15VA07	5	16	21
15VA08		1	1
15VA18		7	7

Species/Grid Block Observed	Point Count Observations	Incidental Observations	Total Observed
Rusty Blackbird	**3**	**6**	**9**
15UA58	1		1
15UA76		1	1
15UA85	2	3	5
15UA86		1	1
15VA08		1	1
Sandhill Crane	**5**	**8**	**13**
15UA57		8	8
15UA58	3		3
15UA85	2		2
Solitary Sandpiper	**8**	**9**	**17**
15UA57	1		1
15UA58	2		2
15UA67		1	1
15UA76		6	6
15UA85	3		3
15UA86	1		1
15VA07	1	1	2
15VA08		1	1
Song Sparrow		**3**	**3**
15UA59		2	2
15UA97		1	1
Spruce Grouse	**6**	**30**	**36**
15UA58	6		6
15UA76		8	8
15UA85		9	9
15UA86		1	1
15UA95		1	1
15UA97		10	10
15VA08		1	1
Swainson's Thrush	**9**	**7**	**16**
15UA57	5	7	12
15UA58	2		2
15UA76	1		1
15UA85	1		1
Swamp Sparrow	**13**		**13**
15UA57	1		1
15UA58	4		4
15UA76	2		2
15UA85	3		3
15UA86	1		1
15UA97	1		1
15VA07	1		1
Tennessee Warbler	**55**	**85**	**140**
15UA57	13	15	28
15UA58	23	7	30
15UA59		2	2
15UA67		7	7
15UA76	9	16	25

Species/Grid Block Observed	Point Count Observations	Incidental Observations	Total Observed
15UA85	1	1	2
15UA86	2	7	9
15UA95		14	14
15UA97	3		3
15VA07	4	7	11
15VA08		2	2
15VA18		7	7
Tree Swallow		**1**	**1**
15UA59		1	1
White-throated Sparrow	**95**	**115**	**210**
15UA57	15	16	31
15UA58	14	7	21
15UA59		1	1
15UA67		7	7
15UA76	14	15	29
15UA85	10	8	18
15UA86	7	14	21
15UA95		14	14
15UA97	23	7	30
15VA07	12	17	29
15VA08		2	2
15VA18		7	7
White-winged Crossbill	**21**	**75**	**96**
15UA57	3		3
15UA58	5		5
15UA67		58	58
15UA76	1	8	9
15UA85		3	3
15UA86		2	2
15UA97	12		12
15VA07		4	4
Wilson's Snipe	**19**	**18**	**37**
15UA57		5	5
15UA58	6		6
15UA76		2	2
15UA85	5	2	7
15UA86	1	1	2
15UA95		1	1
15UA97	7		7
15VA07		4	4
15VA18		3	3
Wilson's Warbler	**5**	**8**	**13**
15UA57	1		1
15UA58	4		4
15UA86		1	1
15VA18		7	7
Winter Wren	**7**	**9**	**16**
15UA57	5	7	12
15UA58	1		1

Species/Grid Block Observed	Point Count Observations	Incidental Observations	Total Observed
15UA85		1	1
15VA07	1	1	2
Yellow Warbler	**1**	**16**	**17**
15UA59		15	15
15UA97	1		1
15VA18		1	1
Yellow-bellied Flycatcher	**23**	**31**	**54**
15UA57	5	2	7
15UA58	1		1
15UA76	2	8	10
15UA85	2		2
15UA86	4	7	11
15UA95		7	7
15UA97	8	7	15
15VA07	1		1
Yellow-bellied Sapsucker	**4**	**2**	**6**
15UA57	1	2	3
15UA58	1		1
15UA76	1		1
15UA86	1		1
Yellow-rumped Warbler	**36**	**41**	**77**
15UA57	11	10	21
15UA58	5		5
15UA67		7	7
15UA76		1	1
15UA85	7	8	15
15UA86	3	7	10
15UA97	8	7	15
15VA07	2	1	3

See Map 57 for MBBA survey locations

Table J-7: Data collected during the aerial waterfowl survey of Project 6, June 15-17

Waypoint	Species	Number	Activity	Habitat	Comments
090	Sandhill crane	2	LO	pond	
091	Mallard	3	LO	lake/shore	Brood (1P 1S)
092	Common merganser	1	FL	pond	
093	Canada Goose	2	LO	pond	Brood
094	Swainson's hawk	1	LO	pond	
095	Mallard	1	FL	pond	
096	Ring necked duck	3	SW	bog/marsh	1P 1S
097	Mallard	1	SW	bog/marsh	
098	Unknown diver	1	SW	bog/marsh	
098	Common merganser	1	SW	bog/marsh	
099	Green winged teal	2	FL	bog/marsh	
099	Ring necked duck	1	FL	bog/marsh	
101	Common merganser	1	FL	lake/shore	
101	Ring necked duck	4	FL	lake/shore	
101	Common merganser	1	FL	lake/shore	
102	Wilsons snipe	1	FL	bog/marsh	
103	Mallard	1	FL	bog/marsh	
104	Sandhill crane	1	FL	pond	
105	Mallard	2	FL	lake/shore	1P
106	Mallard	1	FL	lake/shore	
107	Sandhill crane	1	LO	lake/shore	
108	Swan	6	SW	lake/shore	Unknown white; Brood (4 off spring)
109	Common merganser	2	SW	lake/shore	
110	Common merganser	2	SW	lake/shore	
111	Loon	1	NE	lake/shore	
112	Mallard	1	FL	lake/shore	
113	Bald eagle	3	FL	lake/shore	
114	Sandhill crane	2	Lo	pond	1P
115	Scaup	2	SW	pond	1P
115	Sandhill crane	2	LO	pond	1P
116	Sandhill crane	1	LO	pond	
117	Scaup	2	FL	pond	
118	Ring necked duck	1	SW	pond	
119	Bufflehead	5	SW	pond	
120	Mallard	2	FL	lake/shore	
121	Bald eagle	2	FL	lake/shore	
122	Common merganser	1	SW	lake/shore	
123	Loon	1	SW	lake/shore	
124	Sandhill crane	2	LO	pond	
125	Golden eagle	1	FL	lake/shore	
126	Mallard	1	FL	lake/shore	
127	Ring necked duck	3	SW	lake/shore	
128	Common merganser	1	SW	lake/shore	
129	Mallard	1	FL	pond	
129	Ring necked duck	1	SW	pond	
130	Mallard	6	FL	pond	
130	Ring necked duck	1	SW	pond	
131	Mallard	1	SW	pond	
132	Sandhill crane	1	FL	bog/marsh	
133	Mallard	2	FL	bog/marsh	1P
134	Ring necked duck	1	SW	bog/marsh	
135	Mallard	1	SW	pond	
136	Scaup	3	SW	pond	
137	Common merganser	3	SW	lake/shore	

Waypoint	Species	Number	Activity	Habitat	Comments
138	Mallard	5	SW	lake/shore	
138	Blue winged Teal	2	SW	lake/shore	
138	Ring necked duck	5	SW	lake/shore	
138	Canada Goose	1	FL	lake/shore	
138	Common merganser	3	SW	lake/shore	
139	Mallard	4	SW	lake/shore	
140	Ring necked duck	2	FL	lake/shore	
141	Common merganser	11	FL	pond	
141	Mallard	1	FL	pond	
141	Mallard	3	FL	pond	
142	Mallard	1	FL	lake/shore	
143	Common merganser	5	SW	lake/shore	
144	Common merganser	5	SW	lake/shore	
145	Bald eagle	1	FL	lake/shore	
146	Common merganser	2	FL	pond	
147	Mallard	1	FL	pond	
147	Blue winged Teal	3	FL	pond	
148	Mallard	1	FL	pond	
149	Ring necked duck	3	FL	pond	
149	Common merganser	3	FL	pond	
150	Common merganser	5	FL	pond	
151	Ring necked duck	4	FL	bog/marsh	
151	Mallard	1	FL	bog/marsh	
152	Blue winged Teal	2	FL	bog/marsh	1P
153	Ring necked duck	2	FL	bog/marsh	1P
154	Mallard	1	FL	bog/marsh	
154	Mallard	2	FL	bog/marsh	
155	Ring necked duck	4	FL	bog/marsh	
156	Ring necked duck	1P	FL	bog/marsh	1P
157	Mallard	4	FL	pond	
158	Ring necked duck	8	FL	bog/marsh	
158	Ring necked duck	2	FL	pond	
158	Mallard	1	FL	pond	
158	Blue winged Teal	3	FL	pond	
159	Ring necked duck	2	FL	bog/marsh	
160	Ring necked duck	1	FL	bog/marsh	
161	Ring necked duck	4	FL	bog/marsh	
162	Swan	2	SW	lake/shore	Unknown white
162	Mallard	1	SW	lake/shore	
163	Scaup	1	SW	lake/shore	
164	Ring necked duck	8	SW	lake/shore	
165	Mallard	1	SW	pond	
165	Scaup	1	SW	pond	
166	Ring necked duck	2	SW	pond	1P
167	Sandhill crane	2	LO	pond	
168	Ring necked duck	7	SW	pond	
169	Blue winged Teal	4	SW	bog/marsh	
169	Scaup	2	SW	bog/marsh	
169	Mallard	2	SW	bog/marsh	
169	Mallard	2	FL	lake/shore	
169	Ring necked duck	3	FL	lake/shore	
169	Canada Goose	8	FL	lake/shore	Brood (3 off spring)
170	Sandhill crane	1	FL	pond	
171	Greater yellow legs	2	FL	bog/marsh	1P
172	Mallard	1	FL	lake/shore	
173	Greater yellow legs	1	SW	lake/shore	

Waypoint	Species	Number	Activity	Habitat	Comments
174	Sandhill crane	2	FL	lake/shore	
174	Unknown	1	SW	lake/shore	Brood
175	Mallard	3	FL	lake/shore	1P 1S
176	Common merganser	2	FL	pond	1P
177	Common merganser	3	FL	lake/shore	
178	Wigeon	1	SW	pond	
179	Bufflehead	1	FL	lake/shore	
180	Mallard	1	FL	pond	
180	Ring necked duck	3	FL	pond	
180	Mallard	4	FL	pond	
180	Greater yellow legs	1	FL	pond	
181	Blue winged Teal	2	FL	pond	
182	End of survey				Day 1
183	Ring necked duck	5	FL	bog/marsh	
184	Canada Goose	1	FL	pond	
184	Sandhill crane	2	FL	pond	
185	Loon	2	SW	pond	
186	Mallard	2	FL	lake/shore	
187	Ring necked duck	1	SW	bog/marsh	
188	Sandhill crane	1	FL	bog/marsh	
189	Loon	1	NE	bog/marsh	
190	Sandhill crane	1	LO	pond	
191	Loon	2	SW	lake/shore	
192	Mallard	2	SW	bog/marsh	
192	Scaup	2	SW	bog/marsh	
193	Ring necked duck	8	SW	lake/shore	
194	Loon	3	SW	bog/marsh	
195	Canada Goose	6	SW	bog/marsh	Brood (4 off spring)
196	Mallard	1	SW	pond	
196	Greater yellow legs	1	LO	pond	
197	Mallard	1	SW	pond	
198	Loon	2	SW	lake/shore	
199	Mallard	2	SW	bog/marsh	1P
199	shore bird (unknown)	1	SW	lake/shore	
199	Greater yellow legs	1	LO	lake/shore	
200	Mallard	1	FL	bog/marsh	
200	Ring necked duck	1	FL	bog/marsh	
201	Ring necked duck	2	SW	bog/marsh	1P
202	Sandhill crane	1	LO	bog/marsh	
203	Ring necked duck	15	SW	bog/marsh	
204	Mallard	2	SW	bog/marsh	1P
204	Ring necked duck	3	SW	bog/marsh	
205	Ring necked duck	5	SW	bog/marsh	
206	Ring necked duck	9	SW	bog/marsh	
206	Mallard	2	SW	bog/marsh	1P
207	Common merganser	2	SW	bog/marsh	
208	Ring necked duck	1	SW	lake/shore	
209	Ring necked duck	5	SW	bog/marsh	
209	Mallard	2	SW	bog/marsh	
210	Green winged teal	1	SW	bog/marsh	
211	Northern pintail	6	SW	pond	
212	Common merganser	2	SW	bog/marsh	
212	Ring necked duck	19	SW	bog/marsh	
213	Northern pintail	5	SW	bog/marsh	
213	Ring necked duck	7	SW	bog/marsh	
213	Green winged teal	2	SW	bog/marsh	

Waypoint	Species	Number	Activity	Habitat	Comments
214	Common merganser	2	SW	bog/marsh	
215	Mallard	1	FL	pond	
216	Sandhill crane	2	LO	bog/marsh	
217	Ring necked duck	2	SW	bog/marsh	1P
218	Ring necked duck	6	SW	pond	
219	Swan	1	SW	pond	Unknown white
220	Scaup	2	SW	pond	1P
221	Bald eagle	1	FL	bog/marsh	
222	Ring necked duck	1	FL	bog/marsh	
223	Bald eagle	1	FL	pond	
224	Ring necked duck	2	SW	pond	
225	Canada Goose	7	SW	pond	Brood (6 off spring)
226	Green winged teal	1	SW	pond	
227	Ring necked duck	5	SW	pond	
228	Bald eagle	2	FL	pond	
228	Greater yellow legs	1	FL	pond	
229	Golden eagle	2	FL	pond	
230	Loon	2	SW	bog/marsh	
231	Mallard	3	FL	bog/marsh	
232	Canada Goose	5	SW	bog/marsh	Brood (3 off spring)
233	Sandhill crane	2	LO	pond	
234	Mallard	3	FL	bog/marsh	
235	Ring necked duck	3	SW	pond	
236	Ring necked duck	1	SW	pond	
236	Mallard	2	SW	pond	1P
237	Ring necked duck	1	SW	pond	
238	Mallard	1	SW	pond	
239	Ring necked duck	1	SW	lake/shore	
240	Loon	2	SW	lake/shore	
241	Canada Goose	1	SW	bog/marsh	
242	Canada Goose	2	SW		
243	Ring necked duck	1	SW	bog/marsh	
244	Ring necked duck	5	SW	bog/marsh	
244	Sandhill crane	1	LO	bog/marsh	
245	Ring necked duck	6	FL	bog/marsh	
246	Greater yellow legs	3	LO	bog/marsh	
247	Canada Goose	9	SW	lake/shore	Brood (4 off spring)
248	Ring necked duck	2	SW	pond	
249	Canada Goose	8	SW	pond	Brood (6 off spring)
250	Canada Goose	6	SW	lake/shore	Brood (4 off spring)
251	Mallard	3	FL	lake/shore	
252	Mallard	2	FL	lake/shore	
253	Common merganser	1	SW	pond	
254	Ring necked duck	6	SW	pond	
255	Ring necked duck	5	SW	pond	
256	Ring necked duck	27	SW	pond	
257	Mallard	1	FL	pond	
258	Sandhill crane	2	LO	pond	
258	Moose	1	Walk	pond	Bull
258	Common merganser	36	SW	pond	
259	Bald eagle	1	FL	lake/shore	
260	Loon	1	SW	pond	
261	Ring necked duck	4	SW	lake/shore	
262	Common merganser	1	SW	lake/shore	
263	Mallard	1	FL	bog/marsh	
264	Mallard	1	FL	bog/marsh	

Waypoint	Species	Number	Activity	Habitat	Comments
265	Ring necked duck	3	SW	bog/marsh	
266	Ring necked duck	5	SW	bog/marsh	
267	Ring necked duck	2	SW	lake/shore	
268	Greater yellow legs	4	LO	bog/marsh	
269	Greater yellow legs	1	LO	bog/marsh	
270	Scaup	2	SW	pond	
271	Bald eagle	1	FL	pond	
272	Canada Goose	2	SW	pond	1P
273	Ring necked duck	6	SW	pond	
274	Loon	1	SW	pond	
274	Canada Goose	2	SW	pond	
275	Loon	1	SW	lake/shore	
276	Ring necked duck	6	SW	bog/marsh	
277	Mallard	1	SW	bog/marsh	
278	Ring necked duck	5	SW	bog/marsh	
279	Mallard	1	SW	bog/marsh	
279	Ring necked duck	2	SW	bog/marsh	1P
280	Common merganser	5	SW	lake/shore	
281	Mallard	2	SW	lake/shore	
281	Ring necked duck	5	SW	lake/shore	
282	Mallard	11	SW	lake/shore	Brood (10 off spring)
283	Ring necked duck	4	SW	bog/marsh	2P
284	Mallard	2	SW	bog/marsh	
285	Greater yellow legs	1	SW	bog/marsh	
285	Common merganser	1	SW	bog/marsh	
285	Ring necked duck	4	SW	bog/marsh	2P
285	Mallard	1	SW	bog/marsh	
285	Scaup	2	SW	bog/marsh	
286	Scaup	2	SW	bog/marsh	
287	Mallard	1	SW	lake/shore	
288	Greater yellow legs	2	LO	bog/marsh	
289	Blue winged Teal	3	SW	bog/marsh	
290	Sandhill crane	2	LO	lake/shore	
291	Mallard	4	FL	lake/shore	
292	Sandhill crane	2	LO	bog/marsh	
292	Greater yellow legs	1	LO	lake/shore	
293	Ring-necked duck	4	FL	bog/marsh	2P
293	Sandhill crane	2	FL	bog/marsh	1P
294	Canada Goose	2	FL	pond	1P
295	Mallard	2	FL	pond	
295	Common merganser	6	FL	lake/shore	
296	Common merganser	26	FL	lake/shore	
297	Bald eagle	6	FL	lake/shore	
298	Sandhill crane	2	FL	pond	
299	Ring necked duck	10	FL	bog/marsh	
300	Mallard	2	FL	lake/shore	1P
301	Bald eagle	1	FL	lake/shore	
302	Bald eagle	2	FL	lake/shore	
303	Common merganser	3	FL	lake/shore	
304	Ring necked duck	2	FL	lake/shore	
305	Loon	1	SW	lake/shore	
306	Bald eagle	1	FL	lake/shore	
307	Loon	1	SW	lake/shore	
308	Loon	5	SW	lake/shore	
309	Ring necked duck	2	SW	lake/shore	1P
310	Common merganser	2	SW	lake/shore	

Waypoint	Species	Number	Activity	Habitat	Comments
311	Ring necked duck	6	SW	lake/shore	
312	Greater yellow legs	1	LO	lake/shore	
312	Bald eagle	1	FL	lake/shore	
313	Greater yellow legs	1	LO	lake/shore	
314	Canada Goose	2	SW	pond	1P
315	Ring necked duck	3	SW	pond	
315	Canada Goose	2	SW	pond	1P

Note: Habitat designators - 2=marsh/bog; 4= pond; 7=lake / lakeshore; FL=Flying, LO=Loafing, ST=Stand (Loafing), SW=Swimming; WA=Walk; P=Pair

Table J-8: Data collected during the aerial waterfowl survey of Project 6, July 16, 2016

Waypoint	Species	Number	Activity	Habitat	Comments
54	Unknown duck	5	SW		1A 4J old brood
55	Sandhill cranes	2	FL		
56	Canada geese	5	SW		1pair 3J
57	Canada geese	12	SW		1Pair 10J
58	Diving ducks	4	SW		1A 3J
59	Canada geese	10	SW		1pair 8j
60	Diving ducks	3	SW		1A 2J
61	Ring-necked duck	7	SW		1A 6J
62	Ring-necked duck	4	SW		
63	Diving Ducks	4	SW		1A 3J
64	Mallard	1	FL		
65	WATER COMMENT				LOW
66	Terns	10			
67	Tundra swans	2	SW		
68	Ring-necked duck	6	SW		1A 5J OLD BROOD
69	Scratch				
70	Common merganser	1	SW		
71	Diving Ducks	6	SW		1A 5J
72	Diving Ducks	4	SW		1A 3J
73	Bald eagle	1			
74	Ring-necked duck	3	SW		
75	Bald eagle	1			
75	Ring-necked duck	7	SW		1A 6J
76	Common merganser	4	SW		
77	Greater yellowlegs	3	FL		
78	Ring-necked duck	30	SW		
79	Caribou	1			bull swimming across the lake
80	Scratch				
81	Common Merganser	1	SW		
82	Mallard	3	SW		
83	Bald eagle	1	FL	river	
84	Duck Brood	5	SW	river	Brood
85	Sandhill cranes	1	FL		
86	Bald eagle	1	FL		
87	Tundra swans	2	SW	lake	
88	Bald eagle	1	FL		FL river
89	brood	5	SW	creek	Brood
90	Ring-necked duck	2	SW	creek	
91	brood	5	SW	creek	duck brood
92	Unknown Duck	1	SW	creek	
93	brood	4	SW	creek	duck brood
94	Canada Geese	10	SW	creek	1pair 8j
95	Bald eagle	1	FL		
96	Loon	1	SW	river	

Waypoint	Species	Number	Activity	Habitat	Comments
97	Mallard	4	SW	lake	
97	Ring-necked duck	30	SW	lake	
98	Sandhill cranes	1	ST	creek	
99	Moose	2			calf cow
100	Mallard	3	SW	lake	
101	Tundra swans	2	SW	lake	
102	Bald eagle	1	FL	lake	
103	Common merganser	1	SW	lake	
104	Scratch				
1	Scratch				
2	Scratch				
3	Scratch				
4	Scratch				
5	Loon	1	SW		
6	Mallard	4			1A 3J
7	Unknown diver	1	SW		
8	Mallard	2			
8	Unknown diver	1	SW		
9	Mallard	3			
9	Unknown diver	4			1A 3J
10	Ring-necked duck	3			
11	Unknown diver	1	FL		
12	Bald eagle	1			
13	Canada geese	8	SW		1pair 6J
14	Ring-necked duck	3	FL		
14	Sandhill crane	2	FL		
14	Loon	2	SW		
15	Loon	2	SW		
16	Ring-necked duck	1	SW		
16	Green-winged teal	4	FL		
17	Ring-necked duck	8	FL		
18	Loon	2	SW		
19	Moose	1	ST		cow
20	Unknown diver	8	SW		
20	Unknown duck	5	SW		brood
21	Unknown duck	3	SW		brood
22	Unknown dabblers	6	FL		
23	Loon	1	SW		
24	Scratch				
25	Loon	1	SW		
26	Loon	1	SW		
27	Loon	3	SW		
28	Bald eagle	1	FL		
29	Mallard	6	SW		1A 5J
30	Bald eagle	1	FL		
31	Ring-necked duck	6	SW		1A 5J

Waypoint	Species	Number	Activity	Habitat	Comments
32	Loon	1	SW		
33	Tundra swan	2	SW		
34	Scratch				
35	Unknown duck	5	SW		brood
36	Unknown duck	4	SW		

Note: Habitat designators - 2=marsh/bog; 4= pond; 7=lake / lakeshore; Water comment=Low water noticed during survey; Scratch = point marked in error; FL=Flying, LO=Loafing, ST=Stand (Loafing), SW=Swimming; WA=Walk; A=Adult; J=Juvenile

Table J-9: Data collected during the aerial reconnaissance survey of Project 6, October 12-14, 2016

Waypoint	Species	Number	Habitat
16	bufflehead/goldeneye	30	marsh/pond
17	bufflehead/goldeneye	350	lake
25	bufflehead/goldeneye	30-40	marsh/pond
26	bufflehead/goldeneye	10	marsh/pond
27	bufflehead/goldeneye	10	lake
28	bufflehead/goldeneye	30	lake
29	bufflehead/goldeneye	10	lake
31	bufflehead/goldeneye	30-40	lake
32	bufflehead/goldeneye	30	lake
34	bufflehead/goldeneye	70-100	lake
36	bufflehead/goldeneye	40-50	lake
42	bufflehead/goldeneye/scoters	20	lake
43	bufflehead/goldeneye	40	lake
44	bufflehead/goldeneye	400-500	lake
45	scoters	130	lake
46	bufflehead/goldeneye	130	lake
49	scoters	120	lake
51	scoters	40	lake
53	bufflehead/goldeneye/ scoters	230-250	lake
54	bufflehead/goldeneye	160-170	lake
55	bufflehead/goldeneye	130	lake
59	bufflehead/goldeneye	20	lake
62	bufflehead/goldeneye	15	lake
66	bufflehead/goldeneye	30	lake

Table J-10: Combined results of ARU, MBBA point count, MBBA incidental, and waterfowl bird observations by species.

Bird Types/Families	ARU	MBBA Incidental Observations	MBBA Point Count Survey	Waterfowl Surveys	Total
Migratory Waterfowl	**442**	**61**	**203**	**959**	**1665**
Anseriformes	**125**	**20**	**22**	**899**	**1066**
Canada Goose	112	20	20	103	255
Common Merganser				144	144
Mallard	9		1	132	142
Northern Pintail				11	11
Red-breasted Merganser			1		1
Ring-necked Duck	1			386	387
Unknown Duck	3			57	60
Wigeon				1	1
Blue-winged Teal				17	17
Bufflehead				6	6
Green-winged Teal				10	10
Scaup spp.				17	17
Swan spp.				9	9
Tundra Swans				6	6
Charadriiformes	**126**	**33**	**165**	**23**	**347**
Greater Yellowlegs		6	63	22	91
Least Sandpiper			1		1
Lesser Yellowlegs	30				30
Solitary Sandpiper		9	41		50
Spotted Sandpiper			1		1
Wilson's Snipe	96	18	59	1	174
Gruiformes	**191**	**8**	**16**	**37**	**252**
Sandhill Crane	190	8	15	37	250
Sora	1				1
Yellow Rail			1		1
Migratory Forest Birds	**767**	**1021**	**2737**		**4525**
Caprimulgiformes	**11**	**2**	**1**		**14**
Common Nighthawk	11	2	1		14
Passeriformes	**578**	**994**	**2549**		**4121**

Bird Types/Families	ARU	MBBA Incidental Observations	MBBA Point Count Survey	Waterfowl Surveys	Total
Alder Flycatcher	30	22	56		108
American Crow	42	1	1		44
American Goldfinch			1		1
American Robin	22	26	54		102
American Tree Sparrow	2				2
Bay-breasted Warbler		1			1
Black-and-white Warbler		1	10		11
Blackburnian Warbler			3		3
Black-capped Chickadee	9		5		14
Blackpoll Warbler			2		2
Blue-headed Vireo	1		54		55
Boreal Chickadee	9	10	14		33
Brown Creeper	3		6		9
Cape May Warbler			1		1
Cedar Waxwing	4	16	14		34
Chipping Sparrow	75	89	184		348
Clay-colored Sparrow			2		2
Common Grackle	2	3	5		10
Common Redpoll	30				30
Common Yellowthroat			8		8
Connecticut Warbler	34	3	12		49
Dark-eyed Junco	3	65	185		253
Eastern Kingbird			1		1
Fox Sparrow		25	51		76
Gray Catbird	4				4
Harris's Sparrow	9				9
Hermit Thrush	65	90	216		371
Hoary Redpoll	1				1
Le Conte's Sparrow	12		2		14
Least Flycatcher			16		16
Lincoln's Sparrow	5	58	133		196
Magnolia Warbler		1	61		62
Nashville Warbler	2	1	27		30

Bird Types/Families	ARU	MBBA Incidental Observations	MBBA Point Count Survey	Waterfowl Surveys	Total
Northern Waterthrush		2	14		16
Olive-sided Flycatcher	13	8	36		57
Orange-crowned Warbler		21	61		82
Ovenbird	18	13	31		62
Palm Warbler		51	135		186
Purple Finch			1		1
Red Crossbill	2				2
Red-breasted Nuthatch	3		1		4
Red-eyed Vireo		4	20		24
Red-winged Blackbird	6		5		11
Rose-breasted Grosbeak	3				3
Ruby-crowned Kinglet	93	86	209		388
Rusty Blackbird		6	13		19
Savannah Sparrow			2		2
Song Sparrow		3	1		4
Swainson's Thrush	3	7	66		76
Swamp Sparrow	15		39		54
Tennessee Warbler	5	85	244		334
Tree Swallow		1			1
White-throated Sparrow	24	115	270		409
White-winged Crossbill	4	75	54		133
Wilson's Warbler		8	19		27
Winter Wren	12	9	30		51
Yellow Warbler	4	16	2		22
Yellow-bellied Flycatcher		31	74		105
Yellow-rumped Warbler		41	98		139
White-crowned Sparrow	7				7
blackbird spp.	2				2
Piciformes	**13**	**8**	**32**		**53**
Northern Flicker	11	6	14		31
Yellow-bellied Sapsucker	2	2	18		22
Migratory Waterbirds and Waterfowl	**70**	**28**	**90**	**51**	**239**

Bird Types/Families	ARU	MBBA Incidental Observations	MBBA Point Count Survey	Waterfowl Surveys	Total
Charadriiformes	**16**	**21**	**38**	**10**	**85**
Bonaparte's Gull		4	32		36
Common Tern		6			6
Forster's Tern			3		3
Herring Gull		3	3		6
Ring-billed Gull	16	8			24
Tern spp.				10	10
Gaviiformes	**48**	**7**	**51**	**41**	**147**
Common Loon	48	7	51	41	147
Passeriformes	**104**	**15**	**143**		**262**
Blue Jay	7				7
Common Raven	79	8	14		101
Evening Grosbeak	8				8
Gray Jay	6	6	123		135
Pine Grosbeak	4				4
Pine Siskin		1	6		7
Piciformes	**61**	**2**	**12**		**75**
American Three-toed Woodpecker	4				4
Black-backed Woodpecker			3		3
Downy Woodpecker	3		2		5
Hairy Woodpecker	6	2	6		14
Pileated Woodpecker	7		1		8
Woodpecker spp.	41				41
Podicipediformes	**6**		**1**		**7**
Pied-billed Grebe	6		1		7
Non-migratory Birds	**12**	**40**	**17**	**37**	**106**
Accipitriformes			**1**		**1**
Northern Harrier			1		1
Coraciiformes			**1**		**1**
Belted Kingfisher			1		1
Falconiformes		**8**	**5**	**37**	**50**
Bald Eagle		2	1	33	36

Bird Types/Families	ARU	MBBA Incidental Observations	MBBA Point Count Survey	Waterfowl Surveys	Total
Golden Eagle				3	3
Merlin			1		1
Osprey		1			1
Red-tailed Hawk		5	3		8
Swainsons Hawk				1	1
Galliformes	**9**	**30**	**8**		**47**
Ruffed Grouse	5		1		6
Spruce Grouse	4	30	7		41
Strigiformes	**3**	**2**	**2**		**7**
Great Gray Owl	1	2	2		5
Short-eared Owl	2				2
Grand Total	**1291**	**1150**	**3047**	**1047**	**6535**

APPENDIX K: WILDLIFE ASSESSMENT CRITERIA AND EFFECTS ASSESSMENT TABLES

Table K-1: Description of Standard Wildlife Assessment Criteria and Levels of Potential Environmental Effects

Assessment Criteria	Range of Criteria	Level of Effect and Definition[5]
Direction of Change **(type of effect)**	Neutral or Negligible	No measurable change on the VC.
	Negative	Net loss (adverse or undesirable change) on the VC.
	Positive	Net benefit (or desirable change) on the VC.
Duration **(period of time the effect occurs)**	Short-Term	**Level I** - The potential effect results from short-term events or activities such as the time required to complete a discrete component of construction, maintenance, or rehabilitation activities (i.e., a timeframe of several months up to one year).
	Medium-Term	**Level II** - The potential effect is likely to persist until the completion of construction and rehabilitation activities (i.e., 1 year to 10 years).
	Long-Term	**Level III** -The potential effect is likely to persist beyond the completion of construction and rehabilitation activities into the operations and maintenance phase of the Project (i.e., a timeframe of greater than 10 years).
Magnitude[6] **(degree or intensity of the change)**	Negligible or Low	**Level I** - A change that is not likely to have a definable, detectable or measurable potential effect above baseline (i.e., potential effect is within a normal range of variation) or is below established thresholds of acceptable change (e.g., water quality guideline).
	Moderate	**Level II** – A change that will have a potential measurable effect that can be detected with a well-designed monitoring program; but is only marginally beyond standards/guidelines or established thresholds of acceptable change.
	High	**Level III** – A change that will have potential effects that are easily observed, measured, and described (i.e., readily detectable without a monitoring program) and are well beyond guidelines or established thresholds of acceptable change.
Extent **(Spatial Boundary)**[7]	Project Footprint	**Level I** - The physical space or directly affected area on which Project components or activities are located and/or immediately adjacent area which is within the defined limits of the P6-ASR ROW (i.e., 100 m) and permanent and temporary facilities (e.g., temporary access routes and quarries) within which potential effects are likely to be measurable.
	LAA	**Level II** - Area within which potential Project effects are measurable and extending beyond the Project Footprint to, but not beyond, the LAA.
	RAA	**Level III** - Area beyond the LAA within which most potential indirect effects would occur.
Frequency **(how often the effect occurs)**	Infrequent	**Level I** - The potential effect occurs once or seldom during the life of the Project (e.g., initial clearing of the ROW).
	Sporadic/Intermittent	**Level II** - The potential effect occurs only occasionally and without any predictable pattern during the life of the Project (e.g., blasting at quarries; site-specific construction equipment noise; potential wildlife-vehicle collisions).

5 **Section 7** outlines VC specific definitions for the three-level ranking system.

6 Magnitude is considered species-specific. Refer to Table K-2 to for individual VC criteria definitions for magnitude.

7 Spatial boundaries of the LAA and RAA vary between VC species and are discussed in greater detail in **Section 2.0**.

Assessment Criteria	Range of Criteria	Level of Effect and Definition[5]
	Regular/Continuous	**Level III** – The potential effect occurs at regular and frequent intervals during the Project phase in which they occur or over the life of the Project (e.g., construction traffic; operations traffic).
Reversibility **(the degree of permanence)**	Fully Reversible	**Level I** – Project-specific potential effects are fully reversible.
	Partially Reversible	**Level II** – Project-specific potential effects are partially reversible but over a long period of time (i.e., over eight years).
	Not Reversible	**Level III** - Project-specific potential effects are permanent.
Ecological and Social Context **(resilience of a VC to adapt to changes as a result of the project)**	Low	**Level I** – The VC is not rare or unique and is resilient to imposed change.
	Moderate	**Level II** – The VC is moderately/seasonally fragile and has some capacity to adapt to imposed change.
	High	**Level III** – The VC is a protected/designated species or fragile with low resistance to imposed change or part of a very fragile ecosystem.

Table K-2: Description of VC Magnitude Assessment Criteria and Levels of Potential Environmental Effects

VC	Magnitude (degree or intensity of the change)		
	Negligible or Low	**Moderate**	**High**
Moose	Level I - A change that is not likely to have a definable, detectable or measurable potential effect and considered to occurs at the individual level, not affecting population or habitat availability.	Level II – A change that will have a potential measurable effect on population (i.e., readily detectible with a well-designed monitoring program), and considered to be moderate relative to habitat availability.	Level III – A change that will have potential population effects that are easily observed, measured, and described (i.e., readily detectible with a well-designed monitoring program), and considered to have a major impact on habitat availability.
Caribou	Level I - A change that is not likely to have a definable, detectable or measurable potential effect and considered to occurs at the individual level, not affecting population or habitat availability.	Level II – A change that will have a potential measurable effect on population (i.e., readily detectible with a well-designed monitoring program), and considered to be moderate relative to habitat availability.	Level III – A change that will have potential population effects that are easily observed, measured, and described (i.e., readily detectible with a well-designed monitoring program), and considered to have a major impact on habitat availability.
Birds • Migratory Forest Birds (Palm warbler, Magnolia warbler, Ovenbird, Yellow-bellied flycatcher) • Migratory Raptor (Bald eagle) • Migratory waterfowl (Canada goose, mallard, ring-necked duck) • Non-migratory game Bird (Ruffed grouse)	Level I - A change that is not likely to have a definable, detectable or measurable potential effect and considered to occurs at the individual level, not affecting population or nesting habitat availability.	Level II – A change that will have a potential measurable effect on population (i.e., readily detectible with a well-designed monitoring program), and considered to be moderate relative to nesting habitat availability.	Level III – A change that will have potential population effects that are easily observed, measured, and described (i.e., readily detectible with a well-designed monitoring program), and considered to have a major impact on nesting habitat availability.

VC	Magnitude (degree or intensity of the change)		
	Negligible or Low	**Moderate**	**High**
Beaver	Level I - A change that is not likely to have a definable, detectable or measurable potential effect and considered to occurs at the individual level, not affecting population or water flow patterns.	Level II – A change that will have a potential measurable effect on population (i.e., readily detectible with a well-designed monitoring program), and considered to be moderate relative to water flow patterns.	Level III – A change that will have potential population effects that are easily observed, measured, and described (i.e., readily detectible with a well-designed monitoring program), and considered to have a major impact on water flow patterns.
Marten	Level I - A change that is not likely to have a definable, detectable or measurable potential effect and considered to occurs at the individual level, not affecting population or denning habitat availability.	Level II – A change that will have a potential measurable effect on population (i.e., readily detectible with a well-designed monitoring program), and considered to be moderate relative to denning habitat availability.	Level III – A change that will have potential population effects that are easily observed, measured, and described (i.e., readily detectible with a well-designed monitoring program), and considered to have a major impact on denning habitat availability.
Spring peeper	Level I - A change that is not likely to have a definable, detectable or measurable potential effect and considered to occurs at the individual level, not affecting population or breeding habitat availability.	Level II – A change that will have a potential measurable effect on population (i.e., readily detectible with a well-designed monitoring program), and considered to be moderate relative to breeding habitat availability.	Level III – A change that will have potential population effects that are easily observed, measured, and described (i.e., readily detectible with a well-designed monitoring program), and considered to have a major impact on breeding habitat availability.

Table K-3: Caribou Effects Analysis

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Caribou – Boreal Woodland and Eastern Migratory	**Habitat loss/ alteration/ fragmentation**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level II Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	• Clearing and grubbing of the road and ROW will be avoided during normal parturition times (i.e. May 18 to 28) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife and EP1 – Clearing and Grubbing. • Conduct wildlife habitat features pre-construction surveys and utilize telemetry collar data to identify if calving areas are present. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible. • Limit clearing and construction to designated areas within the Project Footprint and Local Assessment Area (e.g. quarries and borrow pits) as per ES 130.17 – Clearing and Grubbing and EP1 –Clearing and Grubbing. • Prohibit equipment and limit access outside the designated cleared area throughout construction as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Decommission temporary access routes, trails and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access and EP22 – Temporary Site Decommissioning.	Direction – Negligible Duration – Level II Magnitude – Level II Extent – Level I Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	Effects of the project on habitat loss are minor in nature with proposed mitigation measures providing some protection to mineral licks if discovered as well as minimizing the footprint during construction.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Caribou – Boreal Woodland and Eastern MigratoryMigratory	**Habitat loss/ alteration/ fragmentation**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level II Extent – Level II Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level II	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid parturition times (i.e. May 10 to June 15). • Use existing access routes, trails, or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible. • Decommission temporary access routes, trails and existing winter road not required for road operations and maintenance to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure Plan and EP22 – Temporary Site Decommissioning.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	Effects of the project on habitat loss are minor in nature with proposed mitigation measures providing some protection to mineral licks if discovered as well as minimizing the footprint during operation and maintenance.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Caribou – Boreal Woodland and Eastern Migratory	**Sensory Disturbance**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level II Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	• Stage construction activities (sections) such as clearing, grubbing and construction to limit noise disturbance to defined areas. • Use scheduling to avoid construction ROW clearing and quarry blasting during normal parturition times in habitats known to be high quality caribou calving habitats (i.e. May 18 to 28) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Use existing access routes, trails, or cut lines where feasible and keep new access routes, trails, or cut lines as short and narrow as feasible. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 – Clearing and Grubbing • Prohibit equipment and limit access outside the designated cleared area throughout construction as per ES 130.6 – General and ES130.8 – Designated Areas and Access. • Apply feasible noise and dust suppression techniques as per ES130.11 – Dust and Particulate Control, ES 130.12 – Noise and Noise Limitations, EP4 – Nosie Control, EP18 – Dust Suppression Procedures.	Direction – Negative Duration – Level I Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level I Eco. & Soci. Con.– Level II	Given the overall low density of roads in the project area and absence of other disturbances in the LAA, effects of increased access on sensory disturbance is not expected. The mitigation measures outline also contribute to minimizing this effect during construction.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Caribou – Boreal Woodland and Eastern Migratory	**Sensory Disturbance**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level II Extent – Level II Frequency – Level III Reversibility – Level III Eco. & Soci. Con.– Level II	• Undertake ROW (i.e. brushing, clearing or herbicide application), bridge and culvert maintenance activities and operations quarry blasting during fall and winter to the extent feasible to avoid parturition times (i.e. May 18 to 28) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 Clearing and Grubbing and EP14 - Wildlife. • Apply feasible noise and dust suppression techniques as per ES 130.11 – Dust and Particulate Control, ES 130.12 – Noise and Noise Limitations, EP4 – Nosie Control, EP18 – Dust Suppression Procedures.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level III Reversibility – Level II Eco. & Soci. Con.– Level II	Given the overall low density of roads in the project area and absence of other disturbances in the LAA, effects of increased access on sensory disturbance is not expected. The mitigation measures outline also contribute to minimizing this effect during operation and maintenance.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Caribou – Boreal Woodland and Eastern Migratory	**Increased mortality due to vehicle collisions**	Construction			
		Direction – Negligible Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	• Stage construction activities during clearing, grubbing and construction to limit disturbance to defined areas. • Limit vegetation clearing within the right-of-way to the removal of trees and tall shrubs (to maintain line of sight safety requirements). • Restrict access to the ASR corridor to construction personnel as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Design road to optimize line of sight. • Provide information about wildlife awareness to road construction workers to reduce vehicle speeds and the risk of wildlife-vehicle collisions. • Install crossing and/or speed reduction signs where necessary (i.e. detected problem areas) to reduce the potential of wildlife-vehicle collisions.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level II	The residual effect of increased vehicle collisions is considered to be minor and not measurable at the population level.
		Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level II	• Install crossing and/or speed reduction signs where necessary to reduce the potential of wildlife-vehicle collisions. • Avoid using wildlife-attracting road salts.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level II	The residual effect of increased vehicle collisions is considered to be minor and not measurable at the population level.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Caribou – Boreal Woodland and Eastern Migratory	**Increased mortality due to changes in hunting access**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level II Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	• Stage construction activities (sections) during clearing, grubbing and construction to limit disturbance to defined areas • Prohibit hunting by employees and agents of MI and employees, agents and contractors while working on the construction of the road as per ES 130.19 – Wildlife and EP14 – Wildlife. • Prohibit possession of firearms by workers in camps and at work sites to reduce caribou mortality due to hunting during road construction. • Limit road access during construction to reduce hunting opportunities as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Design road designed with no pullouts or parking areas. • Promote stewardship and caribou conservation with construction staff. • Decommission temporary access routes, trails and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negative Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level I Eco. & Soci. Con.– Level II	The likelihood of major increased harvest of caribou as a result of the new ASR is not expected as rights based and licensed hunting access during winter currently exists. The overall predicted effects of the project on caribou mortality through increased hunting are minor given the time periods the herd spend in the RAA (winter) and the size of potential harvest relative to the population of the Pen Islands caribou which is estimated at greater than 16,000 (COSEWIC, 2017).

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Caribou – Boreal Woodland and Eastern Migratory	**Increased mortality due to changes in hunting access**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level II Extent – Level II Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level II	• Prohibit hunting by employees and agents of MI and employees and agents of Contractors while working on the maintenance of the road as per ES 130.19 – Wildlife and EP14 – Wildlife. • Implement access controls at quarry sites during the operation and maintenance phase to limit access and reduce hunting opportunities as per ES 130.6 – General and EP130.8 – Designated Areas and Access. • Liaise with Manitoba Sustainable Development, participate on committees and working groups (e.g., caribou committees), and share wildlife information obtained through monitoring efforts. • Decommission temporary access routes, trails and existing winter road required for road operations and maintenance to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	The likelihood of major increased harvest of caribou as a result of the new ASR is not expected as rights based and licensed hunting access during winter currently exists. The overall predicted effects of the project on caribou mortality through increased hunting are minor given the time periods the herd spend in the RAA (winter) and the size of potential harvest relative to the population of the Pen Islands caribou which is estimated at greater than 16,000 (COSEWIC, 2017).

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Caribou – Boreal Woodland and Eastern Migratory	**Increased mortality due to changes in predation**	Construction			
		Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	• Decommission temporary access routes, trails and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning. (This practice will also reduce wolf mobility and subsequent predation risk.)	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level I Eco. & Soci. Con.– Level II	Increased predation on caribou in the RAA is not expected to be measurable due to the very low density of linear features, combined with their short duration of occupancy and movement through the RAA.
		Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	• Decommission temporary access routes, trails and existing winter road required for road operations and maintenance to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	Increased predation on caribou in the RAA is not expected to be measurable due to the very low density of linear features, combined with their short duration of occupancy and movement through the RAA.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Caribou – Boreal Woodland and Eastern Migratory	**Introduction of disease from white-tailed deer (i.e., brainworm [P. tenuis], liverfluke)**	Construction			
		Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level III Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level II	• Use existing access routes, trails, or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible. Decommission temporary access routes, trails and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level III Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level II	Potential for increased transmission of parasites including brainworm and liver fluke are not expected and extremely unlikely because project area is well past the northern limit of the white-tailed deer range. Even with climate change, the range of white-tailed deer will be south of project boundaries.
		Operations & Maintenance			
		Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level III Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level II	• Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible. Decommission temporary access routes, trails and existing winter road required for road operations and maintenance to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level III Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level II	Potential for increased transmission of parasites including brainworm and liver fluke are not expected and extremely unlikely because project area is well past the northern limit of the white-tailed deer range. Even with climate change, the range of white-tailed deer will be south of project boundaries.

Table K-4: Moose Effects Analysis

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Moose	**Habitat loss/ alteration/ fragmentation**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level II Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	• Schedule to avoid construction ROW clearing during normal parturition times (i.e. May 10 to June 15) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 Wildlife. • Conduct wildlife habitat features pre-construction surveys to identify if mineral licks are present. Leave a vegetated buffer between sensitive wildlife habitat features as per ES130.17 – Clearing and Grubbing. • Align all-season road to avoid/minimize the loss of habitat (riparian areas, potential aquatic feeding areas, wetlands) where feasible. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES 130.15.3.4 – Disturbance to Stream beds and Stream Banks. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 Clearing and Grubbing. • Retain a vegetated buffer zone in riparian areas between construction activities and lakes, rivers, streams and ponds throughout. construction as per as per ES 130.15 – Working Within or Near Water and EP6 Working Within or Near Fish Bearing Waters. • Design and install equalization culverts. • Maintain existing water flow patterns, levels and wetland hydrologic regimes. • Decommission temporary access routes, trails and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access and EP22 – Temporary Site Decommissioning.	Direction – Negligible Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	Habitat modeling illustrates that the amount of habitat being removed is minimal and will not affect habitat availability in the LAA or RAA. Due to the remote nature of this area and the inherently low densities of linear features in the RAA (below identified thresholds), effects of fragmentation are very low within the RAA.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Moose	**Habitat loss/ alteration/ fragmentation**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level II Extent – Level II Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level II	• Maintain a vegetated buffer zone between construction activities and lakes, rivers, streams and ponds throughout operation of the road as per as per ES 130.15 – Working Within or Near Water and EP6 Working Within Or Near Fish Bearing Waters. • Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid parturition times (i.e. May 10 to June 15) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	Habitat modeling illustrates that the amount of habitat being removed is minimal and will not affect habitat availability in the LAA or RAA. Due to the remote nature of this area and the inherently low densities of linear features in the RAA (below identified thresholds), effects of fragmentation are very low within the RAA.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Moose	**Sensory Disturbance**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level II Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	• Stage construction activities during clearing, grubbing and construction to limit disturbance to defined areas as per ES 130.19 – Wildlife and EP14 – Wildlife. • Schedule to avoid construction ROW clearing and quarry blasting during normal parturition times in habitats known to be high quality moose calving habitats (i.e. May 10 to June15) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Use existing access routes, trails, or cut lines where feasible and keep new access routes, trails, or cut lines as short and narrow as feasible ES 130.15.3.4 Disturbance to Stream Beds and Stream Banks • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 – Clearing and Grubbing. • Prohibit equipment and limit access outside the designated cleared area throughout construction as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Apply feasible noise and dust suppression techniques as per ES 130.11- Dust and Particulate Control, ES 130.12 – Noise and Noise Limitations EP4 – Noise Control and EP18 – Dust suppression Techniques.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level I Eco. & Soci. Con.– Level II	Low moose densities combined with low road densities after construction is not expected to result in any measurable effect on the moose population within the RAA. Effects on individual animals would be expected, however at an infrequent rate that would not be measurable.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Moose	**Sensory Disturbance**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level II Extent – Level II Frequency – Level III Reversibility – Level III Eco. & Soci. Con.– Level II	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities and operations quarry blasting during fall and winter to the extent feasible to avoid parturition times (i.e. May 10 to June 15) as per ES 130.17 – Clearing and Grubbing and ES 130.19 – Wildlife EP1 – Clearing and Grubbing and EP14 - Wildlife. • Apply feasible noise and dust suppression techniques as per ES 130.11- Dust and Particulate Control, ES 130.12 – Noise and Noise Limitations EP4 – Noise Control and EP18 – Dust suppression Techniques.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level III Reversibility – Level II Eco. & Soci. Con.– Level II	Low moose densities combined with low road densities after construction is not expected to result in any measurable effect on the moose population within the RAA. Effects on individual animals would be expected, however at an infrequent rate that would not be measurable.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
		Construction			
Moose	**Increased mortality due to vehicle collisions**	Direction – Negligible Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	• Stage construction activities during clearing, grubbing and construction to limit disturbance to defined areas as per ES 130.17 – Clearing and Grubbing and ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Limit vegetation clearing within the right-of-way to the removal of trees and tall shrubs (to maintain line of sight safety requirements). • Restrict access to the ASR corridor to construction personnel as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Design road to optimize line of sight. • Provide information about wildlife awareness to road construction workers to reduce vehicle speeds and the risk of wildlife-vehicle collisions. • Install crossing and/or speed reduction signs where necessary (i.e. detected problem areas) to reduce the potential of wildlife-vehicle collisions. • Avoid using wildlife-attracting road salts.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level II	The potential effects of vehicle collisions on moose are expected to be very low and not measurable due to signage, speed reductions where necessary and no use of road salts.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Moose	**Increased mortality due to vehicle collisions**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level II	• Install crossing and/or speed reduction signs where necessary to reduce the potential of wildlife-vehicle collisions. • Avoid using wildlife-attracting road salts.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level II	The potential effects of vehicle collisions on moose are expected to be very low and not measurable due to signage, speed reductions where necessary and no use of road salts.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
	Increased mortality due to changes in hunting access	Construction			
Moose		Direction – Negative Duration – Level II Magnitude – Level II Extent – Level III Frequency – Level III Reversibility – Level II Eco. & Soci. Con.– Level II	• Stage construction activities during clearing, grubbing and construction to limit disturbance to defined areas as per ES 130.17 – Clearing and Grubbing and ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife. • Prohibit hunting by employees and agents of MI and employees, agents and contractors while working on the construction of the road as per ES 130.19 – Wildlife and EP14 – Wildlife. • Prohibit possession of firearms by workers in camps and at work sites to reduce moose mortality due to hunting during road construction. • Control road access control during construction to limit access and reduce hunting opportunities as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Design road with no pullouts or parking areas. • Promote stewardship and moose conservation with construction staff. • Decommission temporary access routes, trails and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negative Duration – Level I Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level II	The likelihood of major increased harvest of moose resulting in declining populations in GHA 3 as a result of the new ASR would not result due to the large geographic area. Staging in sections rather than clearing and having access through many sections will significantly reduce access and travel by hunters and allow for better control of hunting across long stretches of the ASR. Moose populations in the RAA are likely to not be impacted, however the degree to which moose numbers in the LAA respond to long-term harvest near the ASR are unknown.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Moose	**Increased mortality due to changes in hunting access**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level III Extent – Level III Frequency – Level III Reversibility – Level III Eco. & Soci. Con.– Level II	• Prohibit hunting by employees and agents of MI and employees and agents of Contractors while working on the maintenance of the road as per ES 130.19 – Wildlife and EP14 - Wildlife. • Implement access controls at quarry sites during the operation and maintenance phase to limit access and reduce hunting opportunities as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Liaise with Manitoba Sustainable Development and participate on committees and working groups (e.g., moose committees) • Share wildlife information obtained through monitoring efforts. • Decommission temporary access routes, trails and existing winter road required for road operations and maintenance to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access.	Direction – Negative Duration – Level III Magnitude – Level II Extent – Level II Frequency – Level III Reversibility – Level II Eco. & Soci. Con.– Level II	The likelihood of major increased harvest of moose resulting in declining populations in GHA 3 as a result of the new ASR would not result due to the large geographic area. Moose populations in the RAA are likely to not be impacted, however the degree to which moose numbers in the LAA respond to long-term harvest near the ASR are unknown.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Moose	**Increased mortality due to changes in predation**	Construction			
		Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	• Decommission temporary access routes, trails and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, ES21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level I Eco. & Soci. Con.– Level II	Increased predation on moose in the RAA is not expected to be measurable due to the very low density of linear features. Mortality due to increased predator mobility are not expected to result in higher than normal rates of predation and are not expected to affect local moose numbers in the LAA or in the RAA.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Moose	**Increased mortality due to changes in predation**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	• Decommission temporary access routes, trails and existing winter road required for road operations and maintenance to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level II	Increased predation on moose in the RAA is not expected to be measurable due to the very low density of linear features. Mortality due to increased predator mobility are not expected to result in higher than normal rates of predation and are not expected to affect local moose numbers in the LAA or in the RAA.
	Introduction of disease from white-tailed deer (i.e., brainworm [P. tenuis], liverfluke)	Construction			
		Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level III Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level II	• Use existing access routes, trails, or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible to minimize edge habitat. • Decommission temporary access routes, trails and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level III Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level II	Potential for increased transmission of parasites including brainworm and liver fluke are not expected and extremely unlikely because project area is well past the northern limit of the white-tailed deer range. Even with climate change, the range of white-tailed deer will be south of project boundaries.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
		Operations & Maintenance			
Moose	**Introduction of disease from white-tailed deer (i.e., brainworm [P. tenuis], liverfluke)**	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level III Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level II	• Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible • Decommission temporary access routes, trails and existing winter road required for road operations and maintenance to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level III Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level II	Potential for increased transmission of parasites including brainworm and liver fluke are not expected and extremely unlikely because project area is well past the northern limit of the white-tailed deer range. Even with climate change, the range of white-tailed deer will be south of project boundaries.

Table K-5: Beaver Effects Analysis

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Beaver	**Habitat loss/ alteration / fragmentation from changes in local drainage**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	• Schedule to avoid construction ROW clearing during normal parturition times (i.e. April to June months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife. • Conduct wildlife habitat feature pre-construction surveys prior to any clearing to identify if lodges are present. • Lodges and dams found during pre-construction surveys that require removal shall be removed gradually and with authorization with MSD as per ES 130.15.10 – Beaver Dam Removal. • Following standards for MSD protocols for problem beaver. • Align all-season road to avoid wetland habitat including lakes, rivers, streams and ponds or locate a minimum of 100 m from waterbodies except when crossing a watercourse, where feasible as per ES 130.15 – Working Within or Near Water and EP6 – Working Within or Near Fish Bearing Waters. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES 130.15.3.4 – Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 – Clearing and Grubbing. • Maintain a vegetated buffer zone between construction activities and lakes, rivers, streams and ponds throughout operation of the road as per ES 130.15 – Working Within or Near Water and EP6 – Working Within or Near Fish Bearing Waters.	Direction – Negligible Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	Effects of construction on beaver habitat are considered very low due to the small area that will be disturbed and mitigation measures to protect beaver lodges.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Beaver	**Habitat loss/ alteration / fragmentation from changes in local drainage**	Operations & Maintenance			
		Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level I	• Maintain a vegetated buffer zone in riparian areas between the cleared ASR ROW and lakes, rivers, streams and ponds throughout operations and maintenance as per ES 130.15 – Working Within or Near Water and EP6 – Working Within or Near Fish Bearing Waters.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	Effects of construction on beaver habitat are considered very low due to the small area that will be disturbed and mitigation measures to protect beaver lodges.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Beaver	**Mortality due to project effects**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level I	• Stage construction activities (sections) during clearing, grubbing and construction to limit disturbance to defined areas. • Limit riparian vegetation clearing within the right-of-way to the removal of trees and tall shrubs (to maintain line of sight safety requirements) beyond road and ditching. • Maintain existing water flow patterns, levels and wetland hydrologic regimes as per ES 130.15.3 – Disturbance to Stream Beds and Stream Banks and design and install equalization culverts. • Retain a vegetated buffer zone in riparian areas between the cleared ASR ROW and lakes, rivers, streams and ponds throughout construction as per ES 130.15 – Working Within or Near Water and EP6 Working Within Or Near Fish Bearing Waters. • Restrict access to the ASR corridor to construction personnel as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Provide information about wildlife awareness to road construction workers to reduce vehicle speeds and the risk of wildlife-vehicle collisions. • Dams found during pre-construction surveys that require removal shall be removed gradually, but not in winter and with authorization with MSD as per ES 130.15.10 – Beaver Dam Removal. • Where feasible, problem beaver will be trapped.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level I Eco. & Soci. Con.– Level I	With the application of the mitigation measures described, the effect of sensory disturbance and associated potential mortality (such as dam removal) is minimal and will not affect populations in the LAA or near the project footprint.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Beaver	**Mortality due to project effects**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level III Reversibility – Level III Eco. & Soci. Con.– Level I	• Maintain a vegetated buffer zone in riparian areas between the cleared ASR ROW and lakes, rivers, streams and ponds throughout operations and maintenance as per ES 130.15 – Working Within or Near Water and EP6 Working Within Or Near Fish Bearing Waters.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level III Reversibility – Level II Eco. & Soci. Con.– Level I	With the application of the mitigation measures described, the effect of sensory disturbance and associated potential mortality (such as dam removal) is minimal and will not affect populations in the LAA or near the project footprint.

Table K-6: Marten Effects Analysis

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Marten	**Habitat loss/ alteration/ fragmentation**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	• Avoid clearing and construction of road and ROW during normal denning and parturition times (i.e. late March to April months) as per ES 130.17 – Clearing and Grubbing and ES 130.19 – Wildlife where feasible. • Conduct pre-construction surveys prior to any clearing necessary during denning and parturition periods as described above to identify if denning areas are present. • Denning areas found during pre-construction surveys will be marked and isolated and setbacks from construction activities will be implemented to the extent possible as per ES 130.17 – Clearing and Grubbing. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing. • Decommission temporary access routes, trails and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negligible Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	The P6 Project will result in a small effect on overall marten habitat (removal/alteration or fragmentation) as the RAA has very low road and linear feature density as described in the moose section. Mitigation described further minimizes habitat loss at the local level and reduces overall potential effects of fragmentation.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Marten	**Habitat loss/ alteration/ fragmentation**	Operations & Maintenance			
		Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level I	• Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible. • Decommission temporary access routes, trails and existing winter road required for road operations and maintenance to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	The P6 Project will result in a small effect on overall marten habitat (removal/alteration or fragmentation) as the RAA has very low road and linear feature density as described in the moose section. Mitigation described further minimizes habitat loss at the local level and reduces overall potential effects of fragmentation.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Marten	**Sensory Disturbance**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level I	• Stage construction activities during clearing, grubbing and construction to limit disturbance to defined areas. • Schedule to avoid construction ROW clearing during parturition and rearing period (April - September) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Use existing access routes, trails, or cut lines where feasible and keep new access routes, trails, or cut lines as short and narrow as feasible. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 – Clearing and Grubbing. • Prohibit equipment and limit access outside the designated cleared area throughout construction as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Apply feasible noise and dust suppression techniques as per ES 130.11 – Dust and Particulate Control, ES 130.12 – Noise and Noise Limitations, EP4 – Noise Control and EP18 – Dust Suppression Procedures.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level I Eco. & Soci. Con.– Level I	Sensory disturbance effects may be neutral during winter given the pre-existing activity of clearing of rights-of-way associated with the winter roads that have been in use for decades. Also given that a winter road currently exists, additional effects of an all-season road are considered incremental and primarily associated with increased annual use of the road, particularly during the non-winter months.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Marten	**Sensory Disturbance**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level III Reversibility – Level III Eco. & Soci. Con.– Level I	• Apply feasible noise and dust suppression techniques as per EP130.11 – Dust and Particulate Control, ES 130.12 – Noise and Noise Limitations, EP4 – Noise Control and EP18 – Dust Suppression Procedures.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level III Reversibility – Level III Eco. & Soci. Con.– Level I	Sensory disturbance effects may be neutral during winter given the pre-existing activity of clearing of rights-of-way associated with the winter roads that have been in use for decades. Also given that a winter road currently exists, additional effects of an all-season road are considered incremental and primarily associated with increased annual use of the road, particularly during the non-winter months.

Table K-7: Migratory Raptors Effects Analysis

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Raptor	**Habitat loss/ alteration/ fragmentation**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	• Schedule to avoid and/or suspend ROW clearing during normal breeding and nesting times (i.e. April to June months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES 130.15.3.4 – Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 – Clearing and Grubbing. • Maintain existing water flow patterns, levels and wetland hydrologic regimes as per ES 130.15.3 – Disturbance to Stream Beds and Stream Banks. • Design and install equalization culverts • Decommission temporary access routes, trails and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning. • Mitigation and guidelines for eagles will also benefit other species of raptors, if stick nests are discovered during monitoring or other project activities.	Direction – Negligible Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	Timing of clearing and construction, the application of set back and timing restrictions are expected to minimize or eliminate any potential project effects.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Raptors	**Habitat loss/ alteration/ fragmentation**	Operations & Maintenance Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. April to June months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife EP1 – Clearing and Grubbing and EP14 – Wildlife. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as ES 130.15.3.4 Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters. • Decommission temporary access routes, trails and existing winter road required for road operations and maintenance to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	Timing of clearing and construction, the application of set back and timing restrictions are expected to minimize or eliminate any potential project effects.
	Loss of nests, mortality to young	Construction Direction – Negative Duration – Level II Magnitude – Level II Extent – Level I Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level I	• Stage construction activities during clearing, grubbing and construction to limit disturbance to defined areas. • Schedule to avoid and/or suspend ROW clearing during normal breeding and nesting times (i.e. April to June months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Mitigation and guidelines for eagles will also benefit other species of raptors, if stick nests are discovered during monitoring or other project activities. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as ES 130.15.3.4 Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Timing of clearing and construction, the application of set back and timing restrictions are expected to minimize or eliminate any potential project effects.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Raptors	**Loss of nests, mortality to young**	Operations & Maintenance			
		Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing application), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. April to June months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible ES 130.15.3.4 – Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters.	Direction –Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Timing of clearing and construction, the application of set back and timing restrictions are expected to minimize or eliminate any potential project effects.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Raptors	**Sensory Disturbance**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level I	• Stage construction activities during clearing, grubbing and construction to limit disturbance to defined areas. • Schedule to avoid and/or suspend ROW clearing during the normal breeding and nesting times (i.e. spring months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife EP1 – Clearing and Grubbing and EP14 – Wildlife. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 – Clearing and Grubbing. • Prohibit equipment and limit access outside the designated cleared area throughout construction as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Apply feasible noise and dust suppression techniques as per ES 130.11 – Dust and Particulate Control, ES 130.12 – Noise and Noise Limitations, EP4 – Noise Control and EP18 – Dust Suppression Procedures.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level I Eco. & Soci. Con.– Level I	Timing of clearing and construction, the application of set back and timing restrictions are expected to minimize or eliminate any potential project effects.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Raptors	**Sensory Disturbance**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level III Reversibility – Level III Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities and operations quarry blasting during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. spring months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14– Wildlife. • Apply feasible noise and dust suppression techniques as per ES 130.11 – Dust and Particulate Control, ES 130.12 – Noise and Noise Limitations, EP4 – Noise Control and EP18 – Dust Suppression Procedures.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level III Reversibility – Level II Eco. & Soci. Con.– Level I	Timing of clearing and construction, the application of set back and timing restrictions are expected to minimize or eliminate any potential project effects.

Table K-8: Migratory Waterfowl Effects Analysis (including Canada goose, Mallard, Ring-necked duck)

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Waterfowl	**Habitat loss/ alteration/ fragmentation**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	• Avoid and/or suspend ROW clearing during normal breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 - Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife. • Align all-season road to avoid wetland habitat where feasible. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible ES 130.15.3.4 – Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 – Clearing and Grubbing and EP1 – Clearing and Grubbing. • Maintain existing water flow patterns, levels and wetland hydrologic regimes as per ES 130.15.3 – Disturbance to Stream Beds and Stream Banks. • Design and install equalization culverts • Retain a vegetated buffer zone in riparian areas between construction activities and lakes, rivers, streams and ponds throughout construction as per ES 130.15 – Working Within or Near Water and EP6 – Working Within Or Near Fish Bearing Waters.	Direction – Negligible Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	The results of habitat modelling for Canada goose, mallard and ringed-neck duck all demonstrate the P6 Project will have a minimal impact on habitat availability within the LAA or RAA.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Waterfowl	**Habitat loss/ alteration/ fragmentation**	Operations & Maintenance			
		Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Maintain a vegetated buffer zone in riparian areas between the cleared ASR ROW and lakes, rivers, streams and ponds throughout construction as per as per ES 130.15 – Working Within or Near Water and EP6 Working Within Or Near Fish Bearing Waters.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	The results of habitat modelling for Canada goose, mallard and ringed-neck duck all demonstrate the P6 Project will have a minimal impact on habitat availability within the LAA or RAA.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Waterfowl	**Loss of nests, mortality to young**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level I	• Stage construction activities (sections) during clearing, grubbing and construction to limit disturbance to defined areas. • Avoid and/or suspend ROW clearing during normal breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow ES 130.15.3.4 – Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters. • Maintain existing water flow patterns, levels and wetland hydrologic regimes as per ES 130.15.3 – Disturbance to Stream Beds and Stream Banks. • Design and install equalization culverts • Retain a vegetated buffer zone in riparian areas between construction activities and lakes, rivers, streams and ponds throughout construction as per as per ES 130.15 – Working Within or Near Water and EP6 Working Within Or Near Fish Bearing Waters.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Based on the timing of clearing and construction restrictions and setbacks from wetlands will result in little to no mortality on nesting waterfowl, eggs or young birds. Project effects are likely not measurable and expected to be negligible.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
		Operations & Maintenance			
Migratory Waterfowl	**Loss of nests, mortality to young**	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES 130.15.3.4 Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters. • Maintain a vegetated buffer zone in riparian areas between the cleared ASR ROW and lakes, rivers, streams and ponds throughout construction as per ES 130.15 – Working Within or Near Water and EP6 Working Within Or Near Fish Bearing Waters.	Direction –Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Based on the timing of maintenance activites, restrictions and setbacks from wetlands will result in little to no mortality on nesting waterfowl, eggs or young birds. Project effects are likely not measurable and expected to be negligible.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Waterfowl	**Sensory Disturbance**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level I	• Stage construction activities (sections) during clearing, grubbing and construction to limit disturbance to defined areas. • Avoid and/or suspend ROW clearing during the normal breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES 130.15.3.4 Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 – Clearing and Grubbing. • Prohibit equipment and limit access outside the designated cleared area throughout construction as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Apply feasible noise and dust suppression techniques as per ES 130.11 – Dust and Particulate Control, ES 130.12 – Noise and Noise Limitations, EP4 – Noise Control and EP18 – Dust Suppression Procedures.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level I Eco. & Soci. Con.– Level I	Results of habitat modeling illustrate habitat is not limited to areas near the PF and LAA. If displaced due to disturbance, waterfowl are adaptable and will find refuge throughout the LAA and RAA. The mitigation measures described will minimize local effects. Overall there is potential for occasional sensory disturbance near areas being utilized by waterfowl, with potential short term periodic effects of waterfowl movement away from project activities.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Waterfowl	**Sensory Disturbance**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level III Reversibility – Level III Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities and operations quarry blasting during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife. • Apply feasible noise and dust suppression techniques as per ES 130.11 – Dust and Particulate Control, EP130.12 – Noise and Noise Limitations, EP4 – Noise Control and EP18 – Dust Suppression Procedures.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level III Reversibility – Level II Eco. & Soci. Con.– Level I	Results of habitat modeling illustrate habitat is not limited to areas near the PF and LAA. If displaced due to disturbance, waterfowl are adaptable and will find refuge throughout the LAA and RAA. The mitigation measures described will minimize local effects. Overall there is potential for occasional sensory disturbance near areas being utilized by waterfowl, with potential short term periodic effects of waterfowl movement away from project activities.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
		Construction			
Migratory Waterfowl	**Increased mortality due to project infrastructure and vehicle collisions**	Direction – Negligible Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	• Stage construction activities (sections) during clearing, grubbing and construction to limit disturbance to defined areas. • Avoid and/or suspend ROW clearing during normal breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Limit vegetation clearing within the right-of-way to the removal of trees and tall shrubs (to maintain line of sight safety requirements). • Restrict access to the ASR corridor to construction personnel as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Design road to optimize line of sight. • Provide information about wildlife awareness to road construction workers to reduce vehicle speeds and the risk of wildlife-vehicle collisions.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Given the low traffic volumes and other mitigations including aquatic and riparian buffers, this effect is not expected to be a measurable impact on local or regional waterfowl populations.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Waterfowl	**Increased mortality due to project infrastructure and vehicle collisions**	Operations & Maintenance Direction –Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Given the low traffic volumes and other mitigations including aquatic and riparian buffers, this effect is not expected to be a measurable impact on local or regional waterfowl populations.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
		Construction			
Migratory Waterfowl	**Increased mortality due to changes in hunting access**	Direction – Negative Duration – Level II Magnitude – Level II Extent – Level II Frequency – Level III Reversibility – Level II Eco. & Soci. Con.– Level II	• Avoid and/or suspend ROW clearing during normal breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Restrict access to the ASR corridor to construction personnel as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Prohibit hunting by employees and agents of MI and employees, agents and contractors while working on the construction of the road as per ES 130.19 – Wildlife and EP14 – Wildlife. • Prohibit Possession of firearms by workers in camps and at work sites to reduce waterfowl mortality due to hunting during road construction. • Control road access during construction to limit access and reduce hunting opportunities as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Road designed with no pullouts or parking areas. • Decommission temporary access routes, trails and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negative Duration – Level I Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level II	With increased access during the spring and summer staging periods, increased local resource use of waterfowl could potentially occur. However, current access to waterfowl lakes and rivers is restricted and with the presence of the ASR, opportunities for increased harvest and benefit to local resource users are possible. With the availability of habitat throughout the RAA and LAA, any effects on waterfowl related to overharvest are not anticipated and expected to be minor.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Waterfowl	**Increased mortality due to changes in hunting access**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level III Extent – Level II Frequency – Level III Reversibility – Level III Eco. & Soci. Con.– Level II	• Decommissioning of access trails and roads required for temporary operation and maintenance activities that are near wetlands, rivers and lakes as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negative Duration – Level III Magnitude – Level II Extent – Level II Frequency – Level III Reversibility – Level II Eco. & Soci. Con.– Level II	With increased access during the spring and summer staging periods, increased local resource use of waterfowl could potentially occur. However, current access to waterfowl lakes and rivers is restricted and with the presence of the ASR, opportunities for increased harvest and benefit to local resource users are possible. With the availability of habitat throughout the RAA and LAA, any effects on waterfowl related to overharvest are not anticipated and expected to be minor.

Table K-9: Non-migratory Upland Game Birds Analysis (including Ruffed Grouse)

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Non-migratory Upland Game Bird	**Habitat loss/ alteration/ fragmentation**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	• Avoid and/or suspend ROW clearing during normal breeding and nesting times (i.e. May and June months in particular) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 – Clearing and Grubbing.	Direction – Positive Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	Effects on ruffed grouse habitat are minimal and potentially positive with the creation of roadside habitat and regeneration of deciduous shrubs and trees.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Non-migratory Upland Game Birds	**Habitat loss/ alteration/ fragmentation**	Operations & Maintenance			
		Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. May to June months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	Effects on ruffed grouse habitat are minimal and potentially positive with the creation of roadside habitat and regeneration of deciduous shrubs and trees.
	Loss of nests, mortality to young	Construction			
		Direction – Negligible Duration – Level II Magnitude – Level II Extent – Level I Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level I	• Stage construction activities during clearing, grubbing and construction to limit disturbance to defined areas. • Avoid and/or suspend ROW clearing during normal breeding and nesting times (i.e. May to June months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Loss of nests and mortality to upland birds requires the application of the mitigation measures described. If applied, mortality to young and or destruction to nests is likely not measurable and is expected to be negligible.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Non-migratory Upland Game Birds	**Loss of nests, mortality to young**	Operations & Maintenance			
		Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. May to June months) as per ES 130.17 – Clearing and Grubbing and ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Loss of nests and mortality to upland birds requires the application of the mitigation measures described. If applied, mortality to young and or destruction to nests is likely not measurable and is expected to be negligible.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Non-migratory Upland Game Birds	**Sensory Disturbance**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level I	• Stage construction activities during clearing, grubbing and construction to limit disturbance to defined areas. • Avoid and/or suspend ROW clearing during the normal breeding and nesting times (i.e. May to June months) as per ES 130.17 – Clearing and Grubbing and ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 – Clearing and Grubbing. • Prohibit equipment and limit access outside the designated cleared area throughout construction as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Apply feasible noise and dust suppression techniques as per ES 130.11 – Dust and Particulate Control, ES 130.12 – Noise and Noise Limitations, EP4 – Noise Control and EP18 – Dust Suppression Procedures.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level I Eco. & Soci. Con.– Level I	Given the low density of roads within the LAA and RAA, sensory disturbance is not expected to have any effect on local populations of upland game birds.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Non-migratory Upland Game Birds	**Sensory Disturbance**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level III Reversibility – Level III Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities and operations quarry blasting during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. May to June months) as per ES 130.17 – Clearing and Grubbing and ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Apply feasible noise and dust suppression techniques as per ES 130.11 – Dust and Particulate Control, ES 130.12 – Noise and Noise Limitations, EP4 – Noise Control and EP18 – Dust Suppression Procedures.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level III Reversibility – Level II Eco. & Soci. Con.– Level I	Given the low density of roads within the LAA and RAA, sensory disturbance is not expected to have any effect on local populations of upland game birds.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Non-migratory Upland Game Birds	**Increased mortality due to project infrastructure and vehicle collisions**	Construction			
		Direction – Negligible Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	• Stage construction activities (sections) during clearing, grubbing and construction to limit disturbance to defined areas. • Avoid and/or suspend ROW clearing during normal breeding and nesting times (i.e. May to June months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife. • Restrict access to the ASR corridor to construction personnel as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Design road to optimize line of sight. • Install road signage regarding speed and identification of wildlife crossing areas. • Provide information about wildlife awareness to road construction workers to reduce vehicle speeds and the risk of wildlife-vehicle collisions.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Given the low density of roads within the LAA and RAA, road mortality is not expected to have any effect on local populations of upland game birds.
		Operations & Maintenance			
		Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. May to June months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife. • Install road signage regarding speed and identification of wildlife crossing areas.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Given the low density of roads within the LAA and RAA, road mortality is not expected to have any effect on local populations of upland game birds.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
		Construction			
Non-migratory Upland Game Birds	**Increased mortality due to changes in hunting access**	Direction – Negative Duration – Level II Magnitude – Level II Extent – Level II Frequency – Level III Reversibility – Level II Eco. & Soci. Con.– Level II	• Stage construction activities during clearing, grubbing and construction to limit disturbance to defined areas. • Avoid and/or suspend ROW clearing during normal breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife. • Restrict access to the ASR corridor to construction personnel as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Prohibit hunting by employees and agents of MI and employees, agents and contractors while working on the construction of the road as per ES 130.19 – Wildlife and EP14 - Wildlife. • Prohibit possession of firearms by workers in camps and at work sites to reduce game bird mortality due to hunting during road construction. • Control road access control during construction to limit access and reduce hunting opportunities as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Road designed with no pullouts or parking areas. • Decommission temporary access routes, trails and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negative Duration – Level I Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level II	Habitat conditions near the PF are likely to improve and attract ruffed grouse and would likely benefit local resource users. The remote nature of the RAA in combination with the low density of linear features and access, impacts to populations in the LAA or RAA would not be measurable. The cyclic nature of ruffed grouse populations is likely to result in fluctuating hunting opportunities as populations increase and decline through time, which was verified through local knowledge and resource users participating in the wildlife workshop.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Non-migratory Upland Game Birds	**Increased mortality due to changes in hunting access**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level III Extent – Level II Frequency – Level III Reversibility – Level III Eco. & Soci. Con.– Level II	• Decommissioning of access trails and roads required for temporary operation and maintenance activities as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negative Duration – Level III Magnitude – Level II Extent – Level II Frequency – Level III Reversibility – Level II Eco. & Soci. Con.– Level II	Habitat conditions near the PF are likely to improve and attract ruffed grouse and would likely benefit local resource users. The remote nature of the RAA in combination with the low density of linear features and access, impacts to populations in the LAA or RAA would not be measurable. The cyclic nature of ruffed grouse populations is likely to result in fluctuating hunting opportunities as populations increase and decline through time, which was verified through local knowledge and resource users participating in the wildlife workshop.

Table K-10: Migratory Forest Birds Effects Analysis (including Palm warbler, Magnolia warbler, Yellow-bellied flycatcher, Ovenbird)

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Forest Birds	**Habitat loss/ alteration/ fragmentation**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level II Extent – Level II Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	• Avoid and/or suspend ROW clearing during normal breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible ES 130.15.3.4 – Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 – Clearing and Grubbing. • Maintain existing water flow patterns, levels and wetland hydrologic regimes as per ES 130.15.3 – Disturbance to Stream Beds and Stream Banks. • Design and install equalization culverts. • Decommission temporary access routes, trails and existing winter road required for road construction to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning.	Direction – Negligible Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	Localized low level habitat impacts are anticipated and within the physical ROW, however, habitat availability with the LAA and RAA are abundant. Also, the overall density of linear features and other landscape disturbances is very low. With the mitigation measures implemented, overall effects on habitat and fragmentation would be considered a local effect, but not affecting habitat at the LAA scale.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Forest Birds	**Habitat loss/ alteration/ fragmentation**	Operations & Maintenance			
		Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES 130.15.3.4 Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters. • Decommission temporary access routes, trails and existing winter road required for road operations and maintenance to allow for the regeneration of vegetation and to restrict/limit off-road access by vehicles as per ES 130.8 – Designated Areas and Access.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	Localized low level habitat impacts are anticipated and within the physical ROW, however, habitat availability with the LAA and RAA are abundant. Also, the overall density of linear features and other landscape disturbances is very low. With the mitigation measures implemented, overall effects on habitat and fragmentation would be considered a local effect, but not affecting habitat at the LAA scale.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Forest Birds	**Loss of nests, mortality to young**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level II Extent – Level I Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level I	• Stage construction activities (sections) during clearing, grubbing and construction to limit disturbance to defined areas. • Avoid and/or suspend ROW clearing during normal breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES 130.15.3.4 – Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Based on the timing of clearing and construction restrictions and setbacks from wetlands will result in little to no mortality on nesting birds, eggs or young.
		Operations & Maintenance			
		Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES 130.15.3.4 – Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters.	Direction –Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Based on the timing of maintenance activities, restrictions and setbacks from wetlands will result in little to no mortality on nesting birds, eggs or young.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Forest Birds	**Sensory Disturbance**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level II Eco. & Soci. Con.– Level I	• Stage construction activities (sections) during clearing, grubbing and construction to limit disturbance to defined areas. • Avoid and/or suspend ROW clearing and quarry blasting during the normal breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES 130.15.3.4 – Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 – Clearing and Grubbing. • Prohibit equipment and limit access outside the designated cleared area throughout construction as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Apply feasible noise and dust suppression techniques as per ES 130.11 – Dust and Particulate Control, ES 130.12 – Noise and Noise Limitations, EP4 – Noise Control and EP18 – Dust Suppression Procedures.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level I Eco. & Soci. Con.– Level I	Majority of sensory disturbance will occur during the non-breeding period (winter) and will be localized to the PF. Mitigation measures proposed to minimize potential effects of sensory disturbance and will result in no measurable effect.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Forest Birds	**Sensory Disturbance**	Operations & Maintenance			
		Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level III Reversibility – Level III Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. May to July months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife. • Apply noise reduction and dust suppression techniques as per ES 130.11 – Dust and Particulate Control, ES 130.12 – Noise and Noise Limitations, EP4 – Noise Control and EP18 – Dust Suppression Procedures.	Direction –Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level III Reversibility – Level II Eco. & Soci. Con.– Level I	Majority of sensory disturbance will occur during the non-breeding period (winter) and will be localized to the PF. Mitigation measures proposed to minimize potential effects of sensory disturbance and will result in no measurable effect.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Migratory Forest Birds	**Increased mortality due to project infrastructure and vehicle collisions**	Construction			
		Direction – Negligible Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	• Stage construction activities (sections) during clearing, grubbing and construction to limit disturbance to defined areas. • No ROW clearing or construction will ocurr during during normal breeding and nesting times (April 1 – September 1), minimize disorientation to breeding birds and territories as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Limit vegetation clearing within the right-of-way to the removal of trees and tall shrubs (to maintain line of sight safety requirements). • Restrict access to the ASR corridor to construction personnel as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Design the road and ROW to optimize line of sight. • Provide information about wildlife awareness to road construction workers to reduce vehicle speeds and the risk of wildlife-vehicle collisions.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Effects related to vehicle mortality are not expected to be measurable due to low traffic volumes and construction restrictions during the breeding and nesting season that may result in disorientation of breeding male territories.
		Operations & Maintenance			
		Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing, clearing or herbicide application), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. May to July months) to minimize disorientation of breeding birds as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Road signage identifying speed reduction and wildlife concentration/crossing areas.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Effects related to vehicle mortality are not expected to be measurable due to low traffic volumes and construction restrictions during the breeding and nesting season that may result in disorientation of breeding male territories.

Table K-11: Spring Peeper Effects Analysis

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Spring Peeper	**Habitat loss/ alteration/ fragmentation**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	• Avoid and/or suspend ROW clearing during normal breeding times (i.e. late April to early May months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 – Wildlife. • Align all-season road to avoid wetland habitat (shallow ponds and forest edges) where feasible. • Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES 130.15.3.4 – Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 – Clearing and Grubbing. • Maintain existing water flow patterns, levels and wetland hydrologic regimes as per ES 130.15.3 – Disturbance to Stream Beds and Stream Banks • Design and install equalization culverts • Retain a vegetated buffer zone in riparian areas between construction activities and lakes, rivers, streams and ponds throughout construction as per as per ES 130.15 – Working Within or Near Water and EP6 Working Within Or Near Fish Bearing Waters	Direction – Negligible Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level II Eco. & Soci. Con.– Level I	Habitat modeling illustrates the subsequent loss of habitat as a result of the project is minor due to the amount of habitat available within the LAA and RAA.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Spring Peeper	**Habitat loss/ alteration/ fragmentation**	Operations & Maintenance			
		Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level I	• Undertake ROW (i.e. brushing and clearing), bridge and culvert maintenance activities during fall and winter to the extent feasible to avoid breeding and nesting times (i.e. late April to early May months) as per ES 130.17 – Clearing and Grubbing, ES 130.19 – Wildlife, EP1 – Clearing and Grubbing and EP14 - Wildlife. • Maintain a vegetated buffer zone in riparian areas between the cleared ASR ROW and lakes, rivers, streams and ponds throughout operations and maintenance as per ES 130.15 – Working Within or Near Water and EP6 Working Within Or Near Fish Bearing Waters.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level I	Habitat modeling illustrates the subsequent loss of habitat as a result of the project is minor due to the amount of habitat available within the LAA and RAA.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Spring Peeper	**Winter mortality from compaction**	Construction			
		Direction – Negative Duration – Level II Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level I	• Use existing access routes, trails or cut lines where feasible and keep new access routes, trails or cut lines as short and narrow as feasible as per ES 130.15.3.4 Disturbance to Stream Beds and Stream Banks and EP6 – Working Within or Near Fish Bearing Waters. • Limit clearing and construction to designated areas within the Project Footprint as per ES 130.17 – Clearing and Grubbing and EP1 – Clearing and Grubbing. • Prohibit equipment and limit access outside the designated cleared area throughout construction as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Retain a vegetated buffer zone in riparian areas between construction activities and lakes, rivers, streams and ponds throughout construction as per as per ES 130.15 – Working Within or Near Water and EP6 Working Within Or Near Fish Bearing Waters.	Direction – Negligible Duration – Level I Magnitude – Level I Extent – Level I Frequency – Level II Reversibility – Level I Eco. & Soci. Con.– Level I	Some local effects may be expected. With mitigation measures employed, mortality will be reduced and considered minor. However, the extent to which mortality would occur is uncertain. Habitat loss as a result of the project is also minimal and will not affect populations within the RAA.

	Nature of Potential Effects	Evaluation (Before Mitigation)	Specific Mitigation Procedures	Evaluation (After Mitigation)	Residual Effect
Spring Peeper	**Winter mortality from compaction**	Operations & Maintenance			
		Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	• Prohibit equipment and limit access outside the designated cleared area throughout operations and maintenance as per ES 130.6 – General and ES 130.8 – Designated Areas and Access. • Maintain a vegetated buffer zone between the cleared ASR ROW and lakes, rivers, streams and ponds throughout operations and maintenance as per ES 130.15 – Working Within or Near Water and EP6 – Working Within Or Near Fish Bearing Waters.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level I Eco. & Soci. Con.– Level I	Some local effects may be expected. With mitigation measures employed, mortality will be reduced and considered minor. However, the extent to which mortality would occur is uncertain. Habitat loss as a result of the project is also minimal and will not affect populations within the RAA.

Table K-12: SOCC Effects Analysis

Biophysical Environmental Component	Nature of Potential Effects	Evaluation (Before Mitigation)	Species Specific Mitigation General mitigation applicable to all SOCC are identified in footnotes	Evaluation (After Mitigation)	Residual Effect
Mammals					
Boreal woodland caribou ** Effects assessment would apply to Eastern Migratory Caribou should they be listed in the future*	Potential effects on population and or habitat on boreal woodland caribou resulting from construction and operation activities.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level III	• Mitigation measures described for VC caribou apply.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	Negligible effects
Wolverine	Potential effects on population and or habitat on wolverine resulting from construction and operation activities.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level III	• General and specific mitigation measures will apply to wolverine. • Provide construction staff with Species of Conservation Concern handbooks to facilitate identification if present. • All SOCC observations to be documented and reported.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	Negligible effects

Biophysical Environmental Component	Nature of Potential Effects	Evaluation (Before Mitigation)	Species Specific Mitigation General mitigation applicable to all SOCC are identified in footnotes	Evaluation (After Mitigation)	Residual Effect
Little Brown Bat	Potential effects on population and or habitat on little brown bat resulting from construction and operation activities.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	• Provide construction staff with information on potential bat hibernacula, such as abandon mine shafts if observed during construction. • General guidelines regarding restrictions to clearing in summer provide protection to potential roosting sites. • Provide construction staff with Species of Conservation Concern handbooks to facilitate identification if present. • All SOCC observations to be documented and reported.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	Negligible effects
Forest Birds					
Bank Swallow	Potential effects on population and or habitat on bank swallow resulting from construction and operation activities.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	• General and specific mitigation measures will apply to bank swallow. • Identify and avoid vertical and near vertical faces for road routing where possible. • Consider high quality habitat as part of quarry site selection criteria. • Prior to reinstating a quarry or borrow site for maintenance, surveys of the rock or face will be conducted. If bank swallow nests are identified they will not be disturbed during the breeding season. • Provide construction staff with Species of Conservation Concern handbooks to facilitate identification if present. • All SOCC observations to be documented and reported.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	Negligible effects

Biophysical Environmental Component	Nature of Potential Effects	Evaluation (Before Mitigation)	Species Specific Mitigation General mitigation applicable to all SOCC are identified in footnotes	Evaluation (After Mitigation)	Residual Effect
Barn Swallow	Potential effects on population and or habitat on barn swallow resulting from construction and operation activities.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	• General and specific mitigation measures will apply to barn swallow. • Identify and avoid vertical and near vertical faces, ledges or overhangs for road routing where possible. • Inspect temporary structures prior to removal for presence of nests during the breeding and rearing. If barn swallow nests are identified they will not be disturbed during the breeding season (May-September). • Provide construction staff with Species of Conservation Concern handbooks to facilitate identification if present. • All SCC observations to be documented and reported.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	Negligible effects
Canada Warbler	Potential effects on population and/or habitat on Canada warbler resulting from construction and operation activities.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level III	• General and specific mitigation measures will apply to Canada warbler. • Provide construction staff with Species of Conservation Concern handbooks to facilitate identification if present. • All SOCC observations to be documented and reported.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	Negligible effects

Biophysical Environmental Component	Nature of Potential Effects	Evaluation (Before Mitigation)	Species Specific Mitigation General mitigation applicable to all SOCC are identified in footnotes	Evaluation (After Mitigation)	Residual Effect
Common Nighthawk	Potential effects on population and or habitat on common nighthawk resulting from construction and operation activities.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level III	• General and specific mitigation measures regarding clearing and construction will apply to common nighthawk. • Prior to reinstating a quarry or borrow site for maintenance, surveys will be conducted. If common nighthawk nests are identified they will not be disturbed during the breeding season (May to September). • Provide construction staff with Species of Conservation Concern handbooks to facilitate identification if present. All SOCC observations to be documented and reported.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	Negligible effects As common nighthawk selects for open spaces, quarry areas and cleared roadsides may provide additional habitat.
Eastern Wood-pewee	Potential effects on population and or habitat on eastern wood-pewee resulting from construction and operation activities.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	• The P6 RAA is well outside the published range. • General and specific mitigation measures regarding timing of clearing and construction will apply to eastern wood - peewee. • Provide construction staff with Species of Conservation Concern handbooks to facilitate identification if present. • All SOCC observations to be documented and reported.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	Negligible effects

Biophysical Environmental Component	Nature of Potential Effects	Evaluation (Before Mitigation)	Species Specific Mitigation General mitigation applicable to all SOCC are identified in footnotes	Evaluation (After Mitigation)	Residual Effect
Olive-Sided Flycatcher	Potential effects on population and or habitat on olive-sided flycatcher resulting from construction and operation activities.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level III	• General and specific mitigation measures will apply to olive-sided flycatcher. • General and specific mitigation measures pertaining to wetland, water-crossings (which include adjacent mature forests) clearing specifications will apply to olive-sided flycatcher. • Provide construction staff with Species of Conservation Concern handbooks to facilitate identification if present. • All SOCC observations to be documented and reported.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	Negligible effects As olive-sided flycatcher like mature forest in proximity to forest openings, the clearings/quarries may create habitat.
Peregrine Falcon	Potential effects on population and or habitat on peregrine falcon resulting from construction and operation activities.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	• The P6 RAA is well outside the known breeding range, but may migrate through the region. • Provide construction staff with SOCC handbooks to facilitate identification if present. All SCC observations to be documented and reported.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	Negligible effects

Biophysical Environmental Component	Nature of Potential Effects	Evaluation (Before Mitigation)	Species Specific Mitigation General mitigation applicable to all SOCC are identified in footnotes	Evaluation (After Mitigation)	Residual Effect
Rusty Blackbird	Potential effects on population and or habitat on rusty blackbird resulting from construction and operation activities.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level III	• General and specific mitigation measures pertaining to wetland and water-crossings and clearing will apply to rusty blackbird. • Provide construction staff with SOCC handbooks to facilitate identification if present. All SCC observations to be documented and reported.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	Negligible effects
Short-Eared Owl	Potential effects on population and or habitat on short-eared owl resulting from construction and operation activities.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level III	• General and specific mitigation measures pertaining to wetland and water-crossings and clearing will apply to the short-eared owl. • Provide construction staff with Species of Conservation Concern handbooks to facilitate identification if present. • All SCC observations to be documented and reported.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	Negligible effects Open areas may create additional foraging areas for short-eared owls.

Biophysical Environmental Component	Nature of Potential Effects	Evaluation (Before Mitigation)	Species Specific Mitigation General mitigation applicable to all SOCC are identified in footnotes	Evaluation (After Mitigation)	Residual Effect
Waterbirds					
Horned Grebe	Potential effects on population and or habitat on horned grebe resulting from construction and operation activities.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level III	• General and specific mitigation measures pertaining to wetland and water-crossings and maintenance of surface water flows will apply to horned grebe. • Reclaim disturbed areas and encourage natural re-vegetation and slope excavations to promote retention of water for creation of ponds as per ES 130.8 – Designated Areas and Access, EP21 – Winter Road Closure and Reclamation Plan and EP22 – Temporary Site Decommissioning. • Provide construction staff with Species of Conservation Concern handbooks to facilitate identification if present. All SOCC observations to be documented and reported.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	Negligible effects
Yellow Rail	Potential effects on population and or habitat on yellow rail resulting from construction and operation activities.	Direction – Negative Duration – Level III Magnitude – Level I Extent – Level II Frequency – Level II Reversibility – Level III Eco. & Soci. Con.– Level III	• General and specific mitigation measures pertaining to wetland and water-crossings and maintenance of surface water flows will apply to horned grebe. • Reclaim disturbed areas and encourage natural re-vegetation and slope excavations to promote retention of water for creation of ponds. • Provide construction staff with Species of Conservation Concern handbooks to facilitate identification if present. • All SCC observations to be documented and reported.	Direction – Negligible Duration – Level III Magnitude – Level I Extent – Level I Frequency – Level I Reversibility – Level III Eco. & Soci. Con.– Level III	Negligible effects

Notes:

General mitigation applicable to all SOCC:

- Pre-construction survey to identify stick nests and nesting colonies.
- Right-of-way selected to avoid sensitive sites such as raptor nests, multi-generational stick nests and nesting colonies.
- Road routing avoids waterbodies except at crossing locations.
- Clearing activities will occur between September 1 and March 31 (outside breeding season) where feasible; clearing activities restricted near active bird nests or nest cavities.
- Reclaim disturbed areas or encourage natural re-vegetation augmented by native plants and seeds if required; block abandoned access roads and encourage natural re-vegetation; rehabilitation of trails and winter roads to offset habitat loss.
- Use existing disturbed or cleared areas for road right-of-way where practical.
- Existing water flow patterns, water levels and wetland hydrologic regimes will be maintained via ES 130 requirements and design.
- Leave vegetated buffers between road and disturbed areas such as quarries and borrow pits.
- Inspectors and Contract Administrators will receive training and handbooks to identify all potential SOCC that could be encountered - the Environmental Inspector will be advised when encounters occur, and management strategies applied if required.
- Prohibit herbicide application near identified environmentally sensitive sites or beyond road ROW and apply by hand within 30 m of any waterbody.

Additional mitigation measures outlined in:

ES 130.6 General

ES 130.8 Designated Areas and Access

ES 130.9 Materials Handling, Storage and Disposal

ES 130.10 Spills and Remediation and Emergency Response

ES 130.11 Dust and Particulate Control

ES 130.12 Noise and Noise Limitations

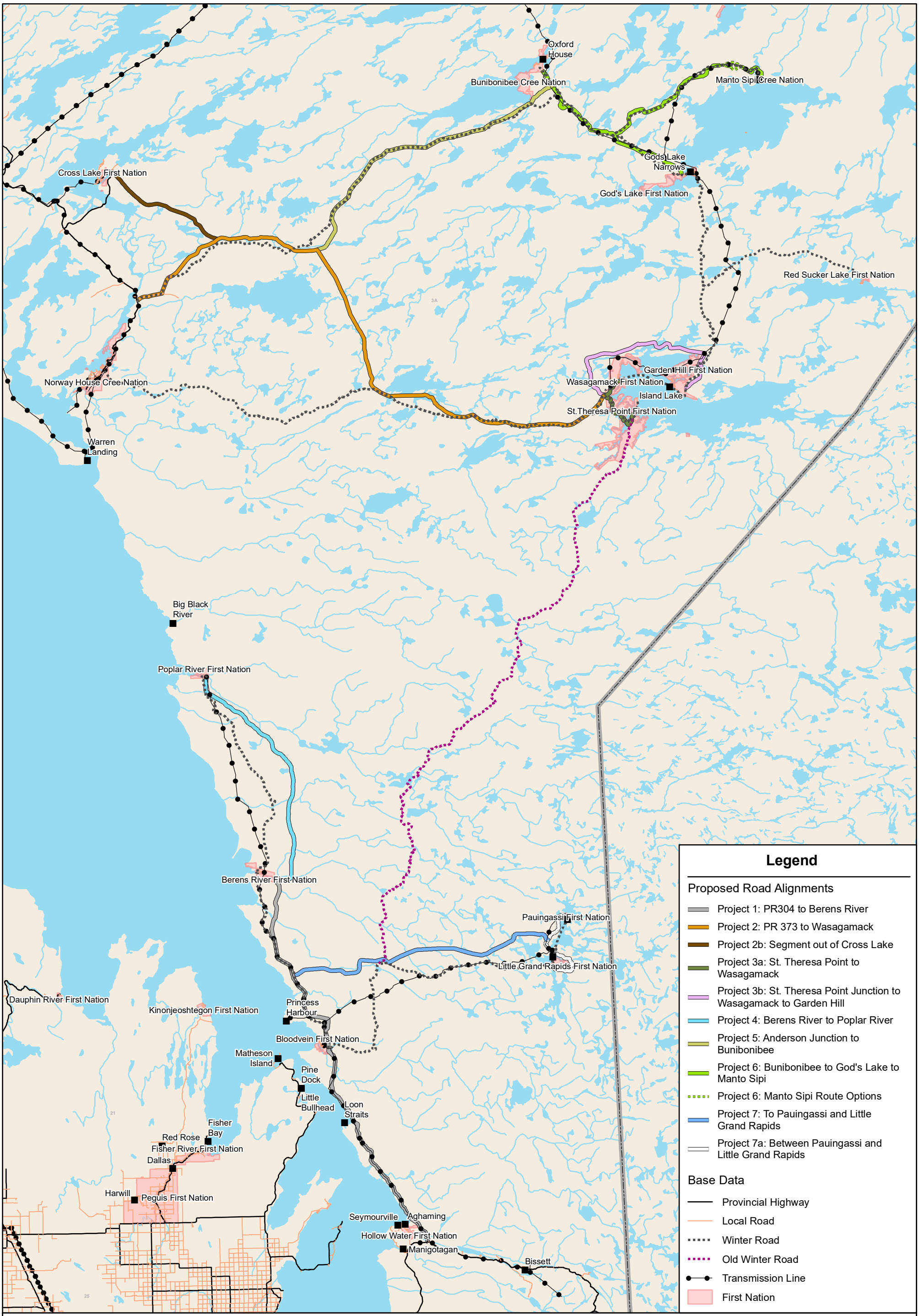
ES 130.14 Staff Training and Awareness

ES 130.15 Working Within or Near Water

ES 130.17 Clearing and Grubbing

ES 130.19 Wildlife

ES 130.21 Cement Batch Plan and Concrete Wash-Out Area



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: January 03,2018

N

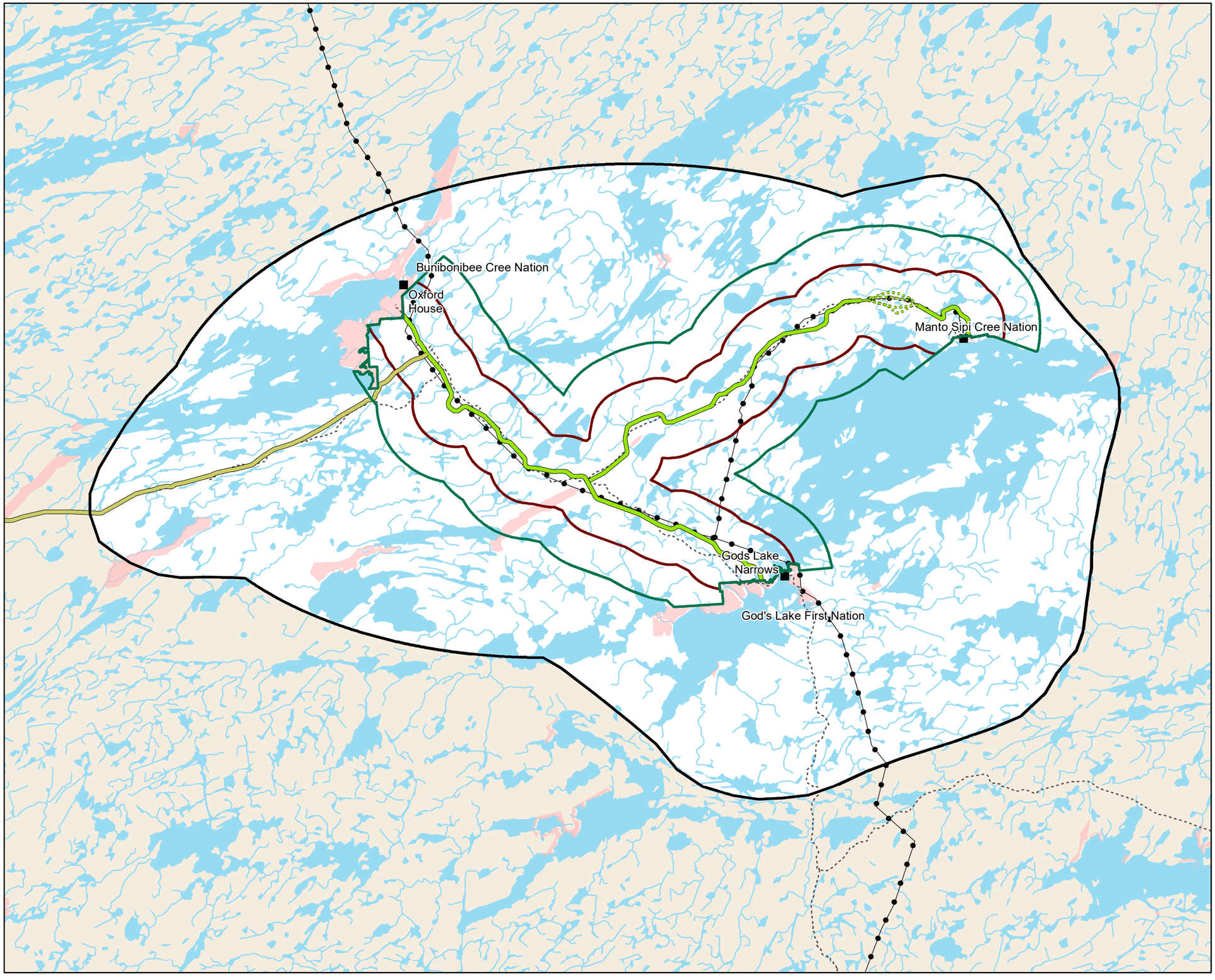
0 10 20 Kilometres
0 10 20 Miles

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Large Area Transportation Network

Project 6 Wildlife Characterization and Effects Assessment

Map 1



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

- Project 6 Local Assessment Area
- Project 6 Moose and Caribou Local Assessment Area
- Project 6 Regional Assessment Area

Proposed Road Alignments

- Project 5: Anderson Junction to
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: January 03,2018

0 10 20 Kilometres
0 5 10 Miles

N

1:525,000

Local and Regional Assessment Areas

Project 6 Wildlife Characterization and Effects Assessment

Map 2

Manitoba Infrastructure
Remote Road Operations

Joro Consultants

99
98
76
97
96
95
94
93
90

Bunibonibee Cree Nation
Oxford House
Manto Sipi Cree Nation
Gods Lake Narrows
God's Lake First Nation

- Forest Management Units
- Game Hunting Areas
  - 3
  - 3A
- Proposed Road Alignments
  - Project 5: Anderson Junction to Bunibonibee
  - Project 6: Bunibonibee to God's Lake to Manto Sipi
  - Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area
- Base Data
  - Winter Road
  - Transmission Line
  - First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: January 03,2018

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0 5 10 Miles

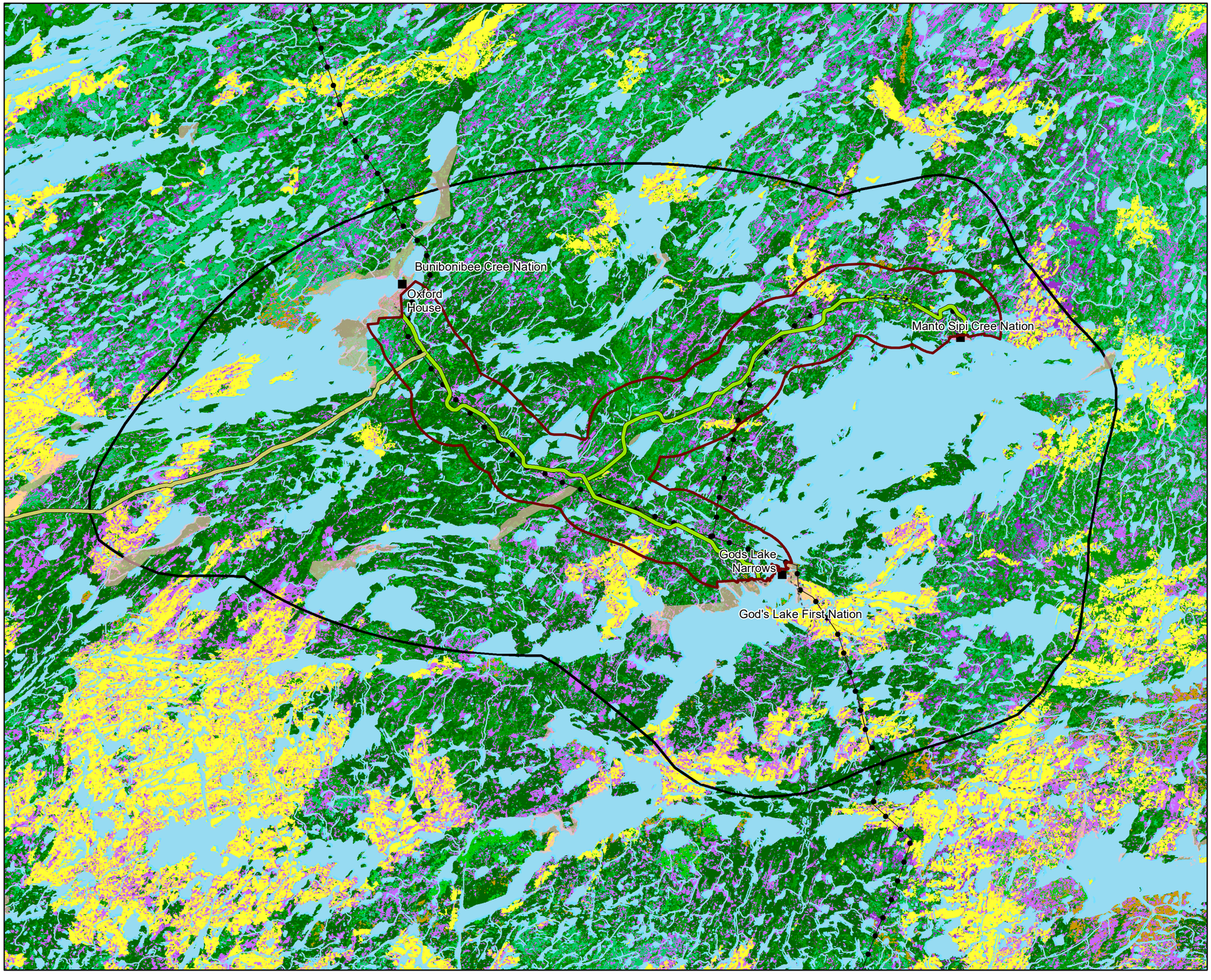
N

1:525,000

Game Hunting Areas and Forest Management Units

Project 6 Wildlife Characterization and Effects Assessment

Map 3



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

- 20-Water
- 33-Exposed land
- 51-Shrub tall
- 81-Wetland - Treed
- 82-Wetland - Shrub
- 83-Wetland - Herb
- 211-Coniferous Dense
- 212-Coniferous Open
- 213-Coniferous Sparse
- 221-Broadleaf Dense
- 222-Broadleaf Open
- 223-Broadleaf Sparse
- 231-Mixedwood Dense

Proposed Road Alignments

- Project 5: Anderson Junction to
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options

- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: January 03,2018

0 10 20 Kilometres
0 5 10 Miles

N

1:525,000

Land Cover Classification

Project 6 Wildlife Characterization and Effects Assessment

Map 4

Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Bunibonibee Cree Nation
Oxford House
Manto Sipi Cree Nation
Gods Lake Narrows
God's Lake First Nation

Multispecies Survey Area

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: January 03,2018

0 10 20 Kilometres
0 5 10 Miles

N

1:525,000

Aerial Multispecies Survey Area

Project 6 Wildlife Characterization and Effects Assessment

Map 5

Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Bunibonibee Cree Nation
Oxford House
Manto Sipi Cree Nation
Gods Lake Narrows
God's Lake First Nation

Trail Camera Deployments
- 2016
- 2016-2017
- 2017

Proposed Road Alignments
- Project 5: Anderson Junction to
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options

- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data
- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: January 04,2018

N

0 10 20 Kilometres
0 5 10 Miles

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Trail Camera Deployment Locations 2016 - 2017

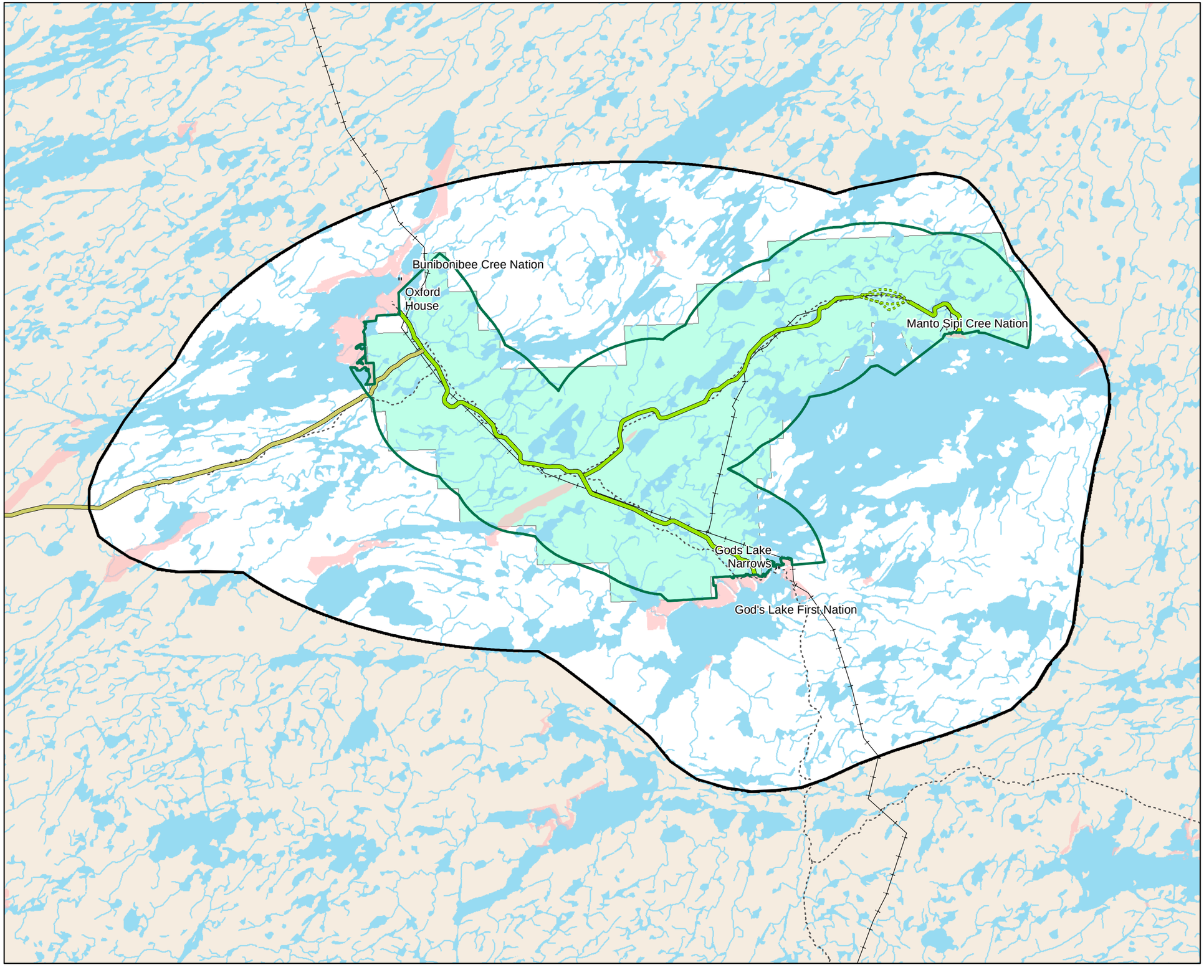
Project 6 Wildlife Characterization and Effects Assessment

Map 6

Maps 7 to 35 removed due to sensitive wildlife information

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Manitoba Infrastructure
Remote Road Operations

Joro Consultants

2016 - 2017 Moose Survey Area

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Regional Assessment Area
- Project 6 Moose and Caribou Local Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: December 11,2017

0 10 20 Kilometres
0 5 10 Miles

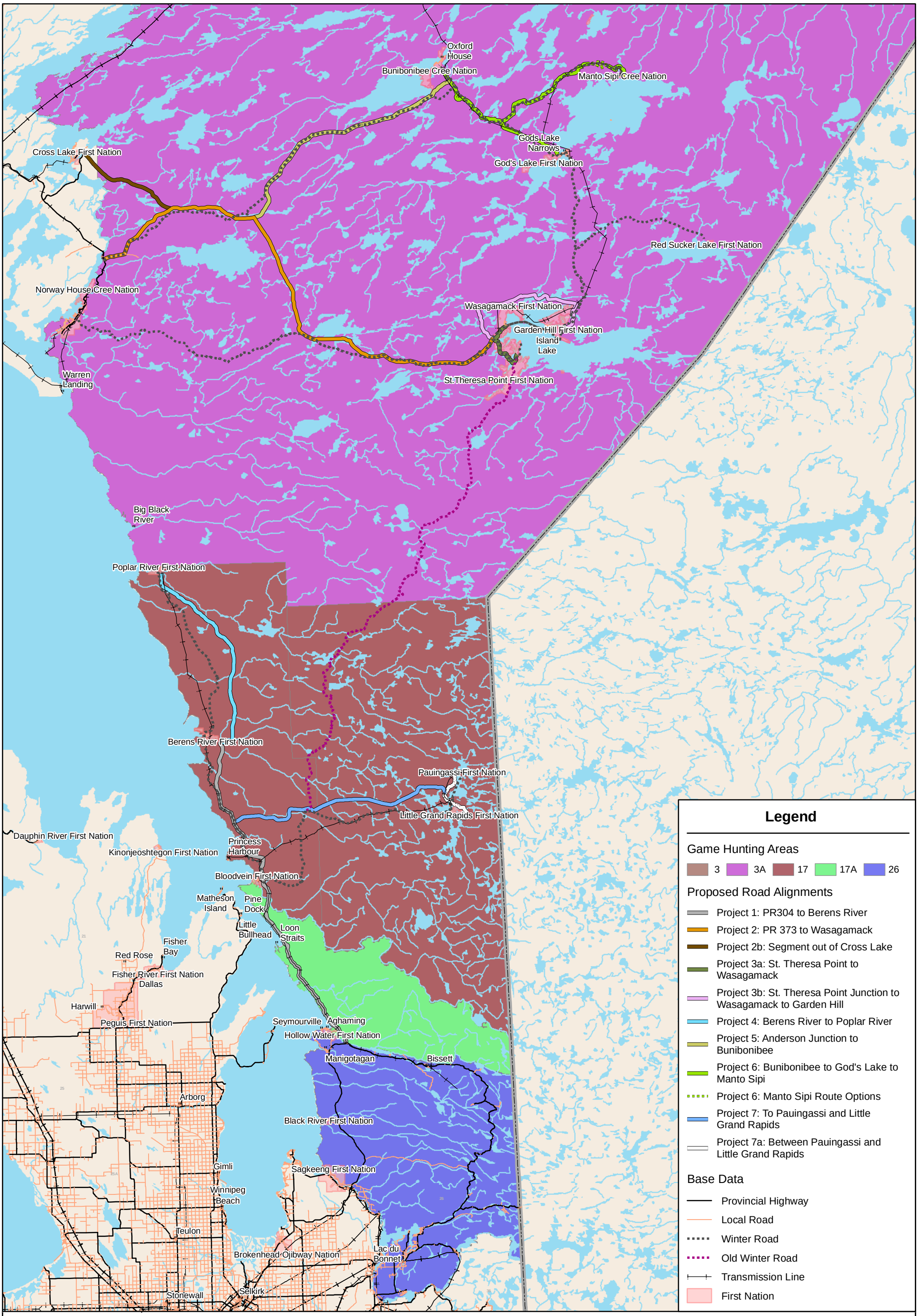
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2016 and 2017 Aerial Moose Survey Area

Project 6 Wildlife Characterization and Effects Assessment

Map 37

Maps 38 to 46 removed due to sensitive wildlife information



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: December 08,2017

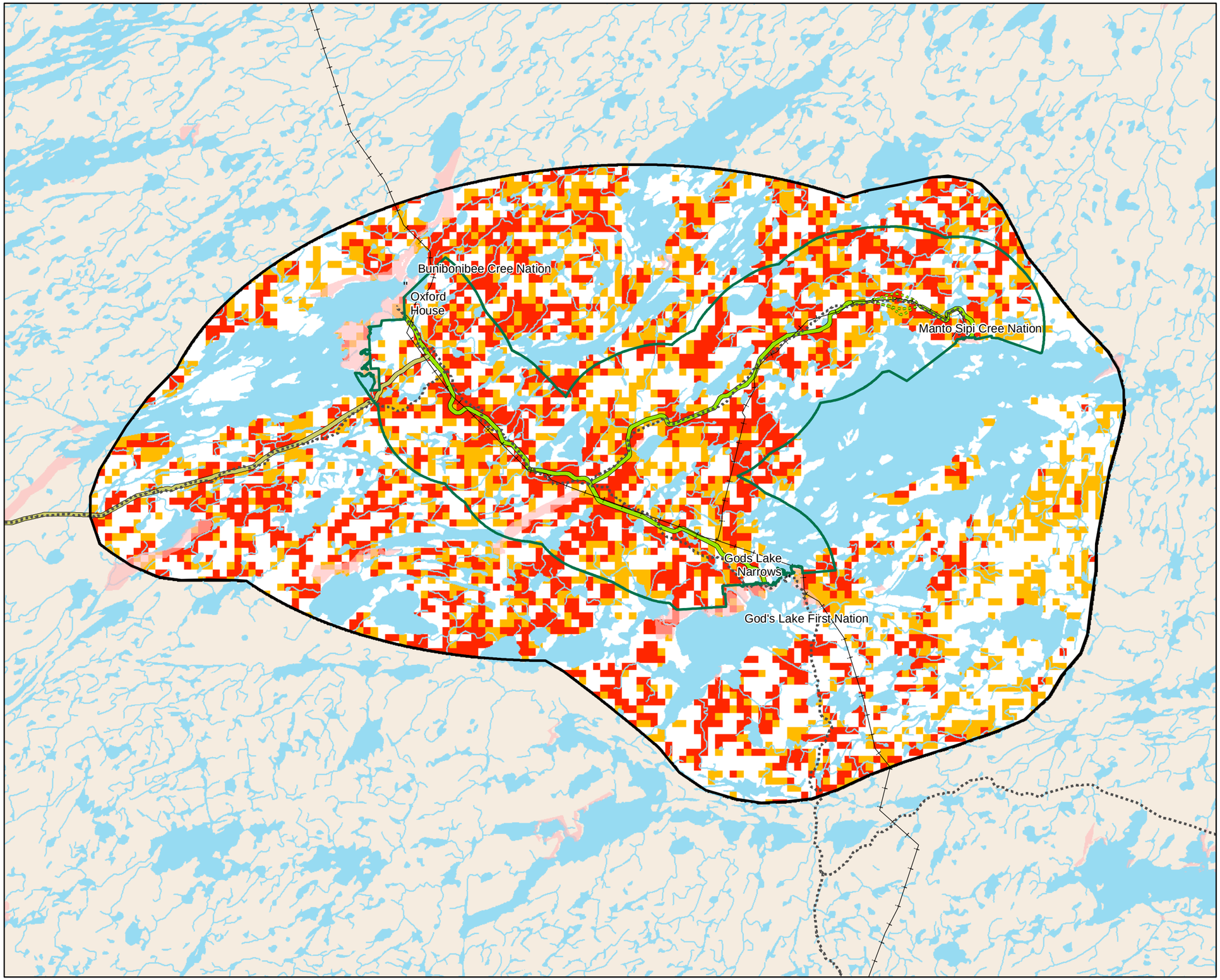
0 10 20 Kilometres
0 10 20 Miles

1:1,500,000

Game Hunting Areas - Eastern Manitoba

Project 6 Wildlife Characterization and Effects Assessment

Map 47



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Primary Habitat
Secondary Habitat

Proposed Road Alignments

Project 5: Anderson Junction to Bunibonibee
Project 6: Bunibonibee to God's Lake to Manto Sipi
Project 6: Manto Sipi Route Options

Project 6 Regional Assessment Area
Project 6 Moose and Caribou Local Assessment Area

Base Data

Winter Road
Transmission Line
First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: December 11,2017

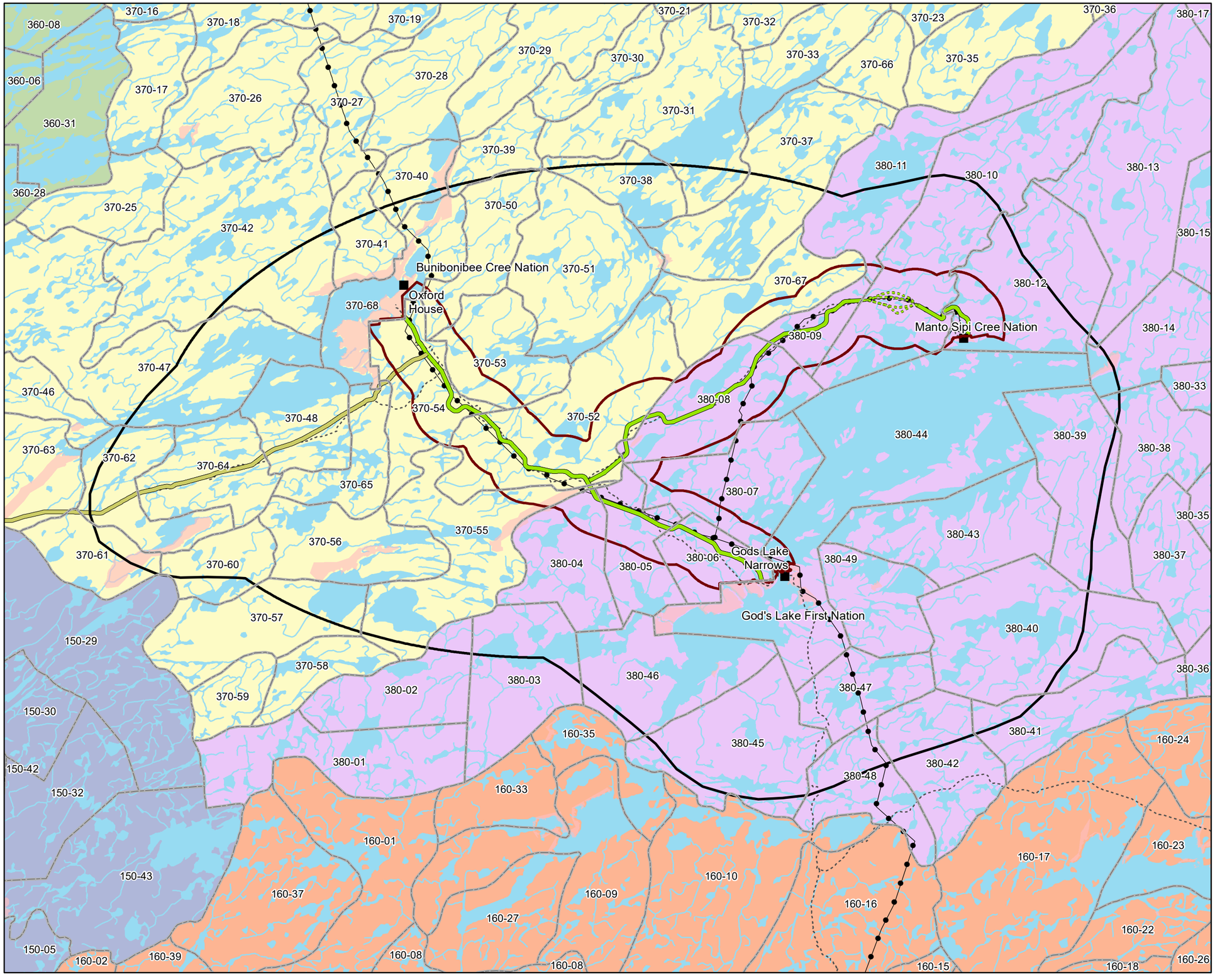
0 10 20 Kilometres
0 5 10 Miles

1:525,000

Moose Habitat Suitability

Project 6 Wildlife Characterization and Effects Assessment

Map 48



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

- Registered Traplines

Registered Trapline Sections
- Cross Lake (360)
- God's Lake (380)
- Island Lake (160)
- Norway House (150)
- Oxford House (370)

Proposed Road Alignments
- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data
- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: September 21,2017

0 10 20 Kilometres
0 5 10 Miles

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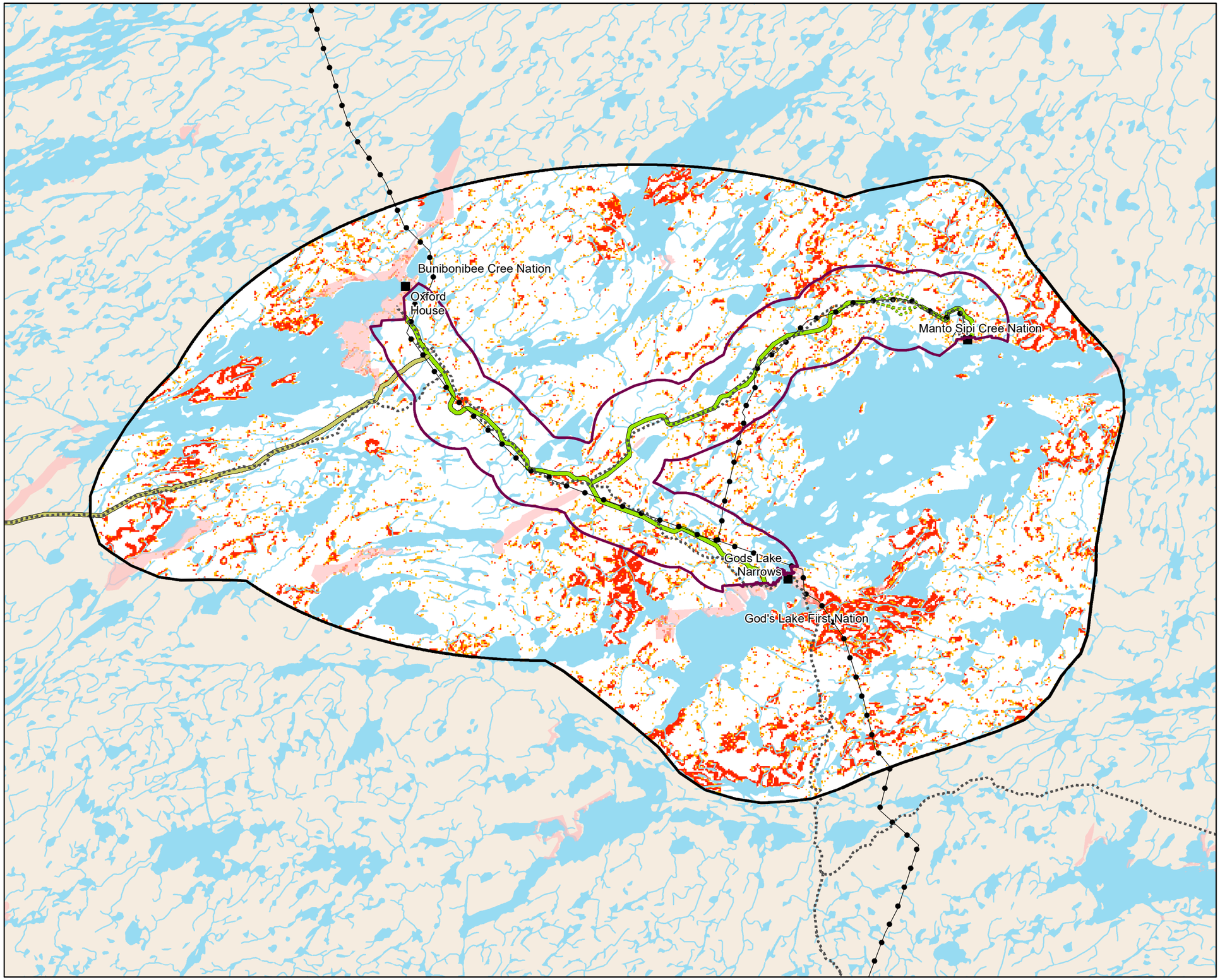
1:525,000

Registered Traplines in the Northern RTL Area 6

Project 6 Wildlife Characterization and Effects Assessment

Map 49

Maps 50 to 53 removed due to sensitive wildlife information



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Primary Habitat
Secondary Habitat

Proposed Road Alignments

Project 5: Anderson Junction to Bunibonibee
Project 6: Bunibonibee to God's Lake to Manto Sipi
Project 6: Manto Sipi Route Options
Project 6 Local Assessment Area
Project 6 Regional Assessment Area

Base Data

Winter Road
Transmission Line
First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: September 20,2017

0 10 20 Kilometres
0 5 10 Miles

N

1:525,000

Beaver Habitat Suitability

Project 6 Wildlife Characterization and Effects Assessment

Map 54

Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Bunibonibee Cree Nation
Oxford House
Manto Sipi Cree Nation
Gods Lake Narrows
God's Lake First Nation

Primary Habitat
Secondary Habitat

Proposed Road Alignments
- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data
- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: September 20,2017

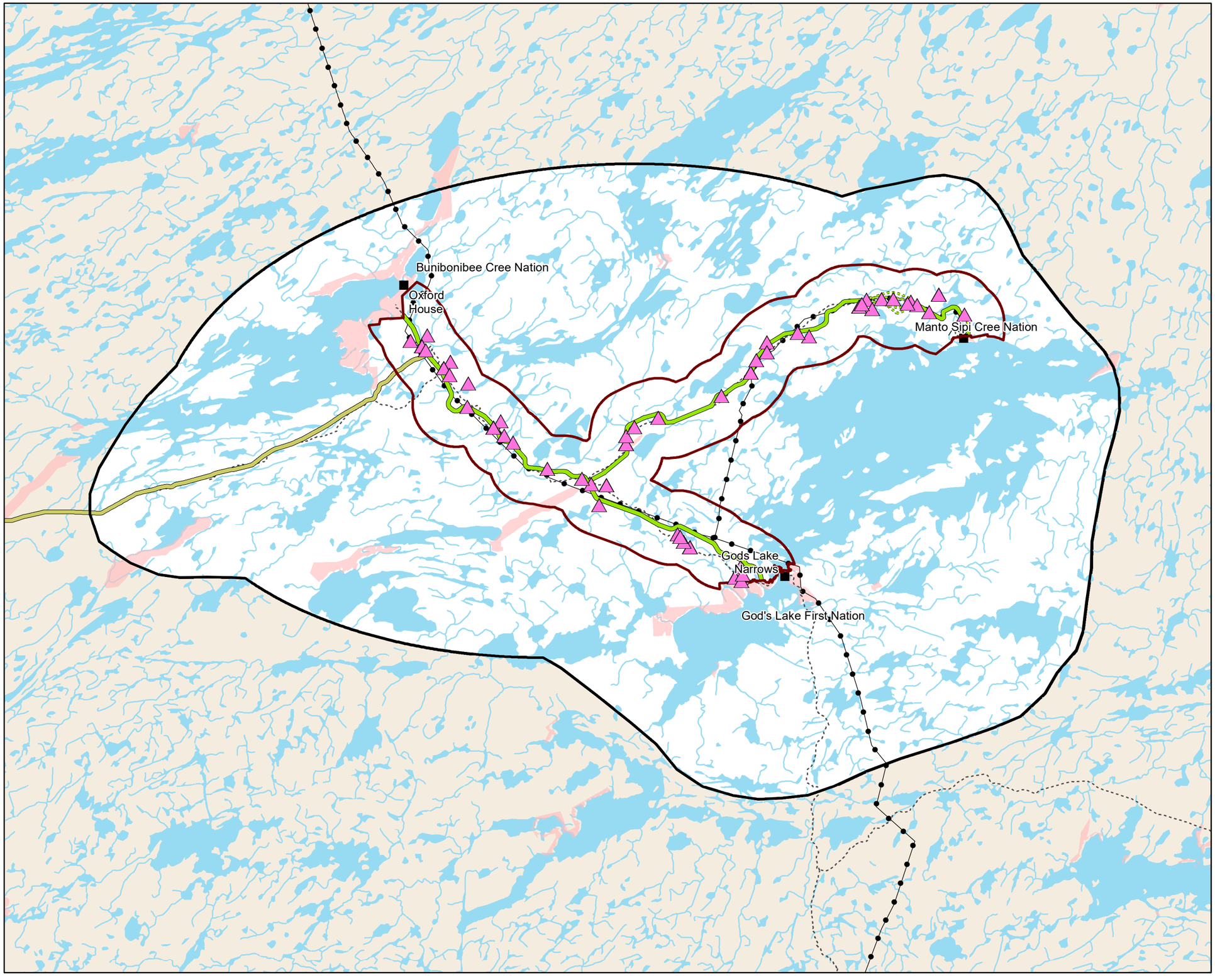
0 10 20 Kilometres
0 5 10 Miles

N

1:525,000

Marten
Habitat Suitability
Project 6 Wildlife Characterization and Effects Assessment

Map 55



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

2016 ARU Deployment Locations

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: September 21,2017

0 10 20 Kilometres
0 5 10 Miles

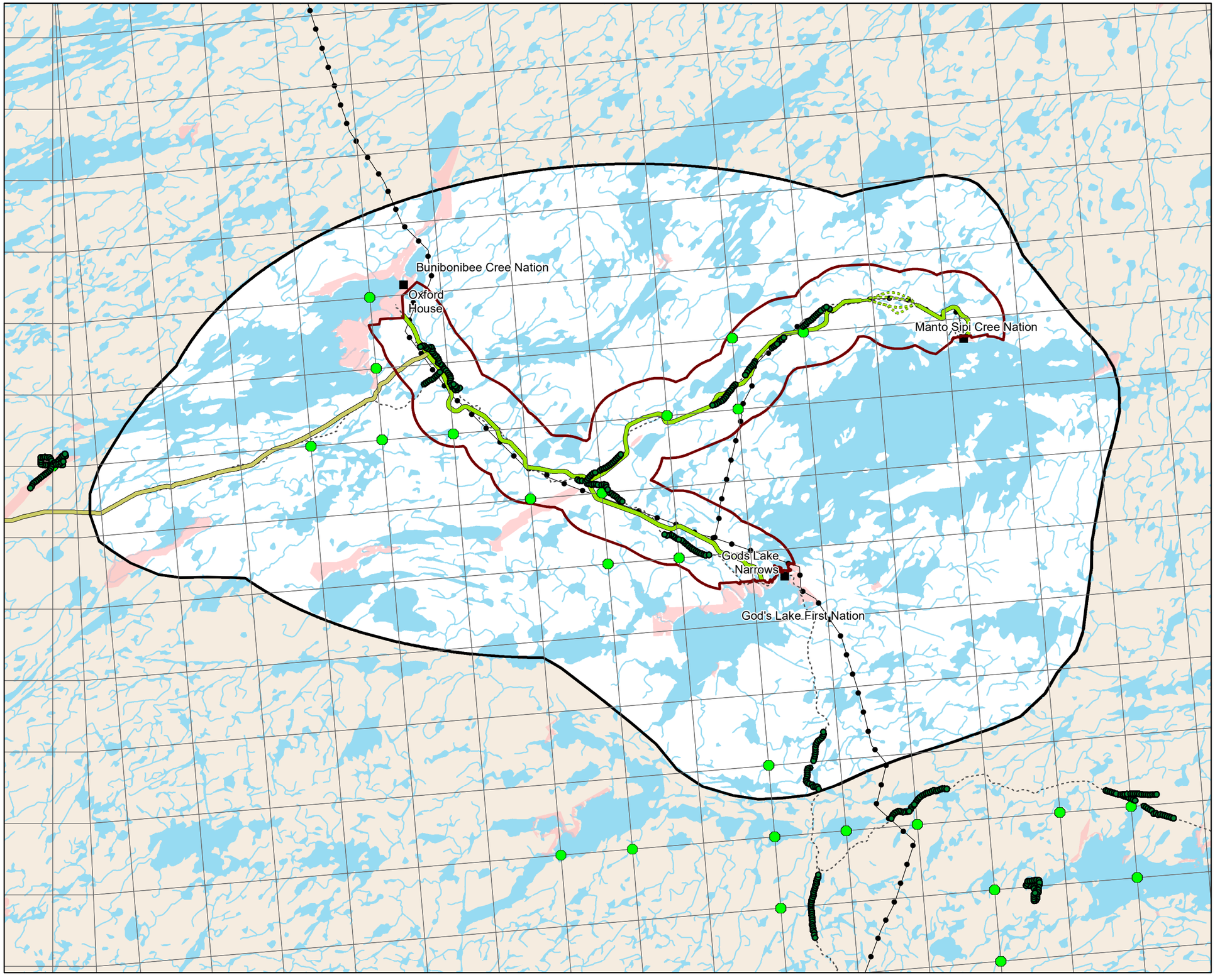
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Project 6 2016 ARU Deployments

Project 6 Wildlife Characterization and Effects Assessment

Map 56



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

- Breeding Bird Atlas Point Count
- Bird Atlas Locations
- Manitoba Bird Atlas Grid

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MBBA 2014, MI - RRO, Joro, NRCAN, MLI
Date Created: January 05,2018

0 10 20 Kilometres
0 5 10 Miles

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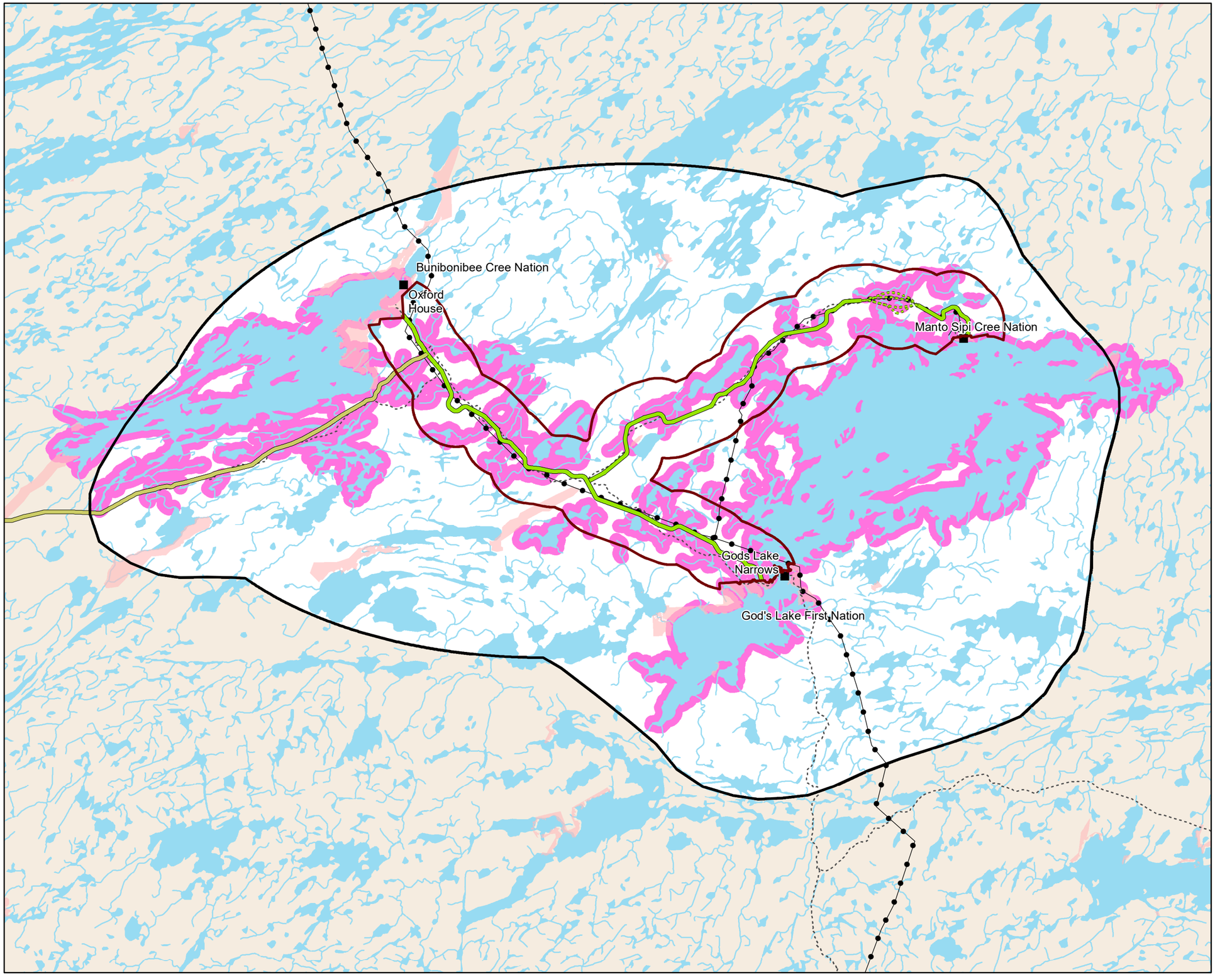
1:525,000

Breeding Bird Atlas

Project 6 Wildlife Characterization and Effects Assessment

Confidential:
For Discussion Purposes Only

Map 57



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

June and July Waterfowl Survey Area

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: December 08,2017

0 10 20 Kilometres
0 5 10 Miles

N

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June and July 2016 Aerial Waterfowl Survey Area

Project 6 Wildlife Characterization and Effects Assessment

Map 58

Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Bunibonibee Cree Nation
Oxford House
Manto Sipi Cree Nation
Gods Lake Narrows
God's Lake First Nation

October Waterfowl Survey Area

Proposed Road Alignments
- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data
- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: December 08,2017

0 10 20 Kilometres
0 5 10 Miles

N

1:525,000

October 2016 Aerial Waterfowl Reconnaissance Survey Area

Project 6 Wildlife Characterization and Effects Assessment

Map 59

Map 60 removed due to sensitive wildlife information

Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Bunibonibee Cree Nation
Oxford House
Manto Sipi Cree Nation
Gods Lake Narrows
God's Lake First Nation

- Primary Habitat

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: September 22,2017

0 10 20 Kilometres
0 5 10 Miles

N

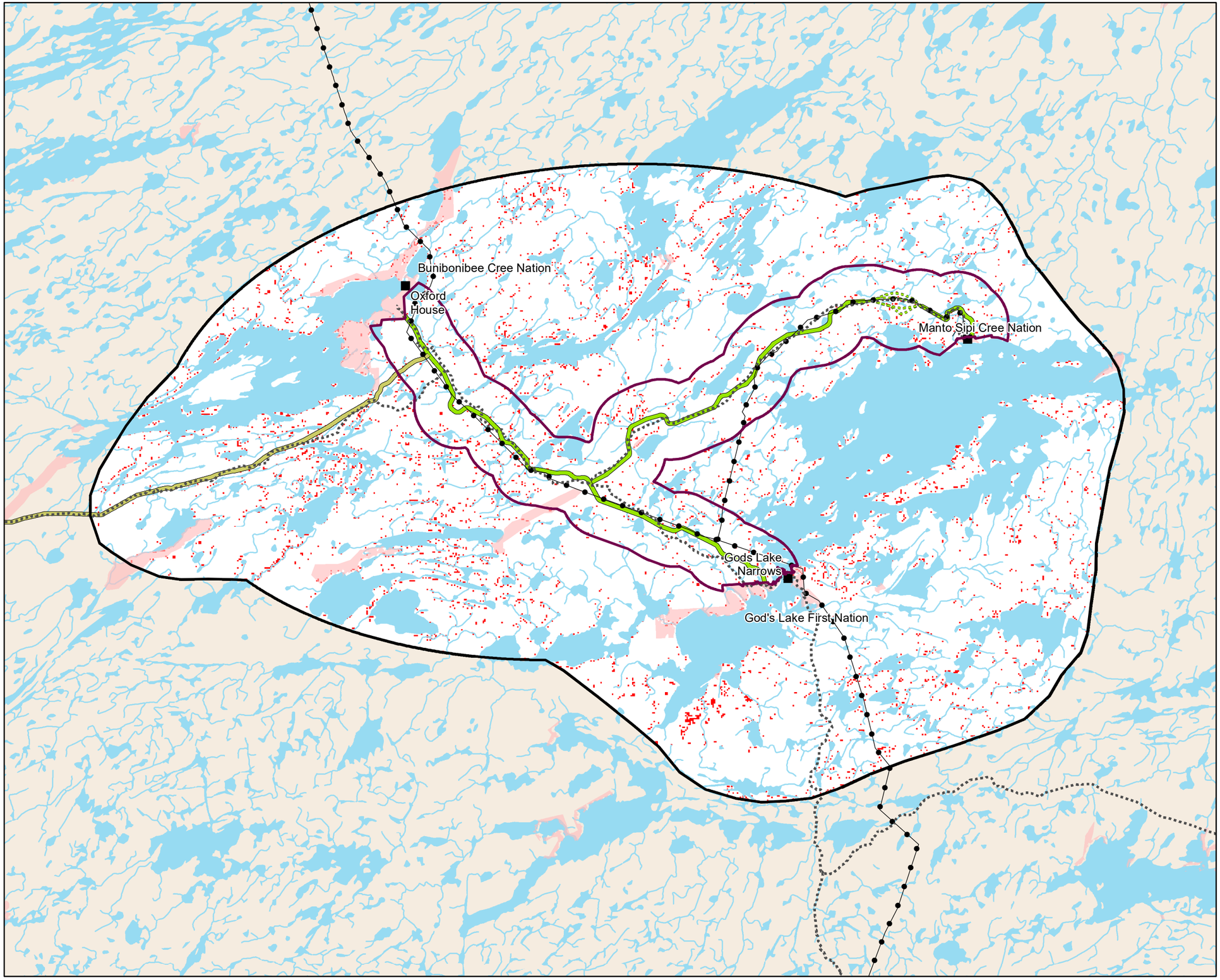
1:525,000

Bald Eagle Habitat Suitability

Project 6 Wildlife Characterization and Effects Assessment

Map 61

Map 62 removed due to sensitive wildlife information



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Primary Habitat

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options

- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: September 22,2017

0 10 20 Kilometres
0 5 10 Miles

N

1:525,000

Canada Goose Habitat Suitability

Project 6 Wildlife Characterization and Effects Assessment

Map 63

Map 64 removed due to sensitive wildlife information

Bunibonibee Cree Nation

Oxford House

Manto Sipi Cree Nation

Gods Lake Narrows

God's Lake First Nation

Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Primary Habitat

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options

- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: December 13,2017

0 10 20 Kilometres
0 5 10 Miles

1:525,000

Mallard Habitat Suitability

Project 6 Wildlife Characterization and Effects Assessment

Map 65

Map 66 removed due to sensitive wildlife information

Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Bunibonibee Cree Nation
Oxford House
Manto Sipi Cree Nation
Gods Lake Narrows
God's Lake First Nation

- Primary Habitat

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options
- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: September 22,2017

0 10 20 Kilometres
0 5 10 Miles

N

1:525,000

Ring-necked Duck Habitat Suitability

Project 6 Wildlife Characterization and Effects Assessment

Map 67

Map 68 removed due to sensitive wildlife information

Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Bunibonibee Cree Nation
Oxford House
Manto Sipi Cree Nation
Gods Lake Narrows
God's Lake First Nation

Secondary Habitat

Proposed Road Alignments

- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options

- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data

- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N
NAD83 Data Source: BAM ,MI - RRO, Joro, NRCAN, MLI
Date Created: September 22,2017

N

0 10 20 Kilometres
0 5 10 Miles

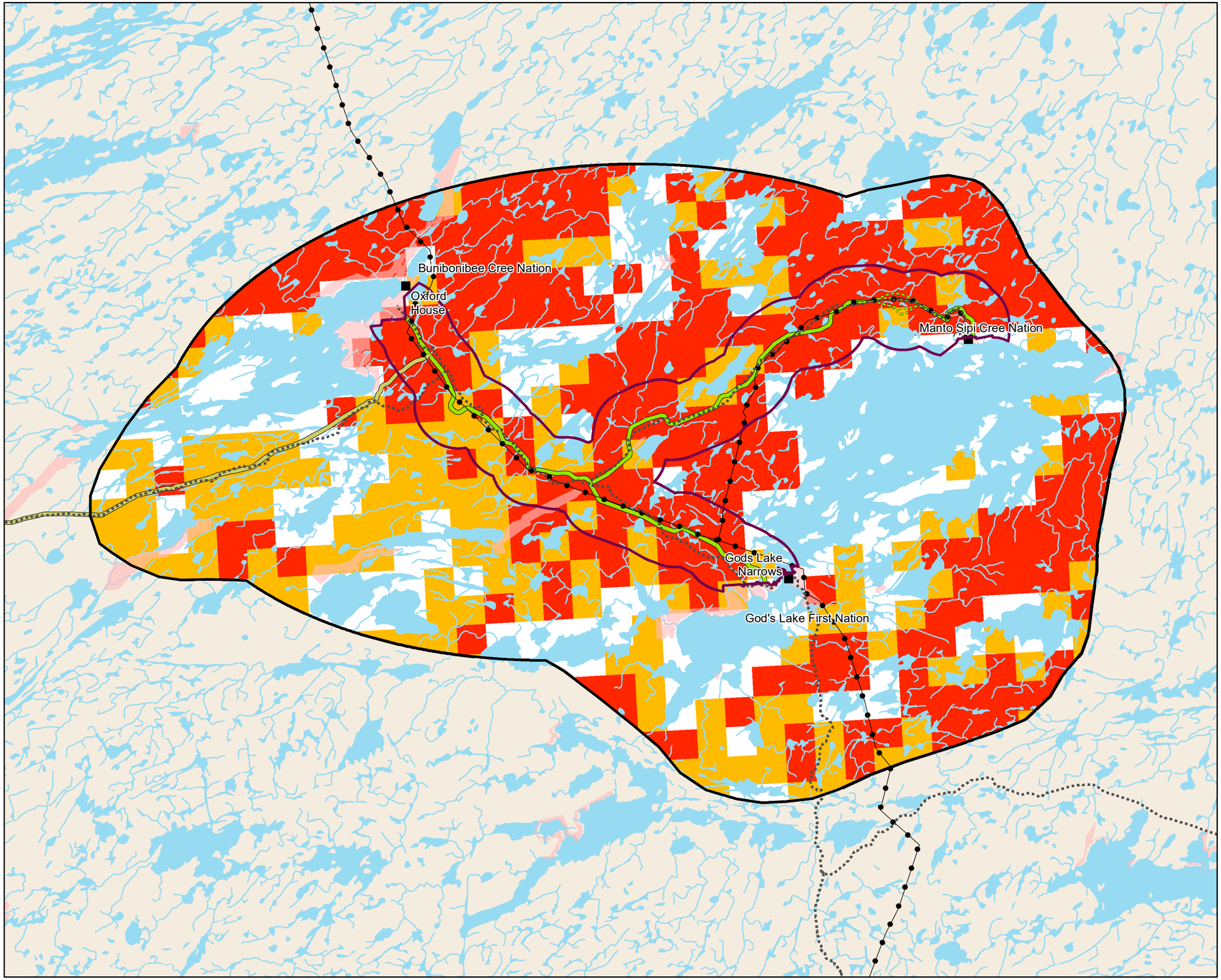
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Ruffed Grouse Habitat Suitability

Project 6 Wildlife Characterization and Effects Assessment

Map 69

Map 70 removed due to sensitive wildlife information



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Primary Habitat
Secondary Habitat

Proposed Road Alignments
- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options

- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data
- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: BAM, MI - RRO, Joro, NRCCAN, MLI
Date Created: September 22,2017

0 10 20 Kilometres
0 5 10 Miles

N

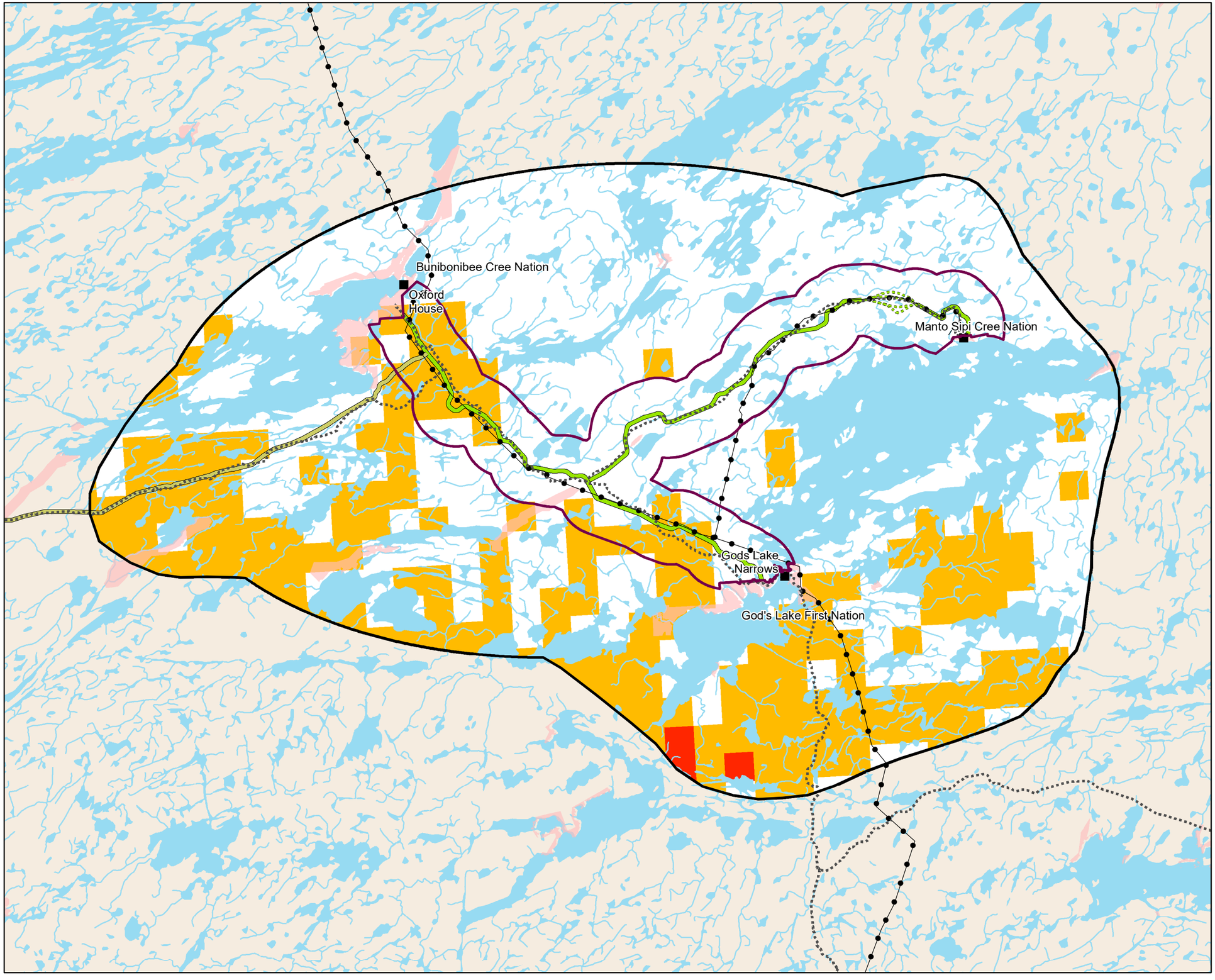
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Palm Warbler Habitat Suitability

Project 6 Wildlife Characterization and Effects Assessment

Map 71

Map 72 removed due to sensitive wildlife information



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Primary Habitat
Secondary Habitat

Proposed Road Alignments
- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options

- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data
- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: BAM, MI - RRO, Joro, NRCAN, MLI
Date Created: September 22, 2017

0 10 20 Kilometres
0 5 10 Miles

N

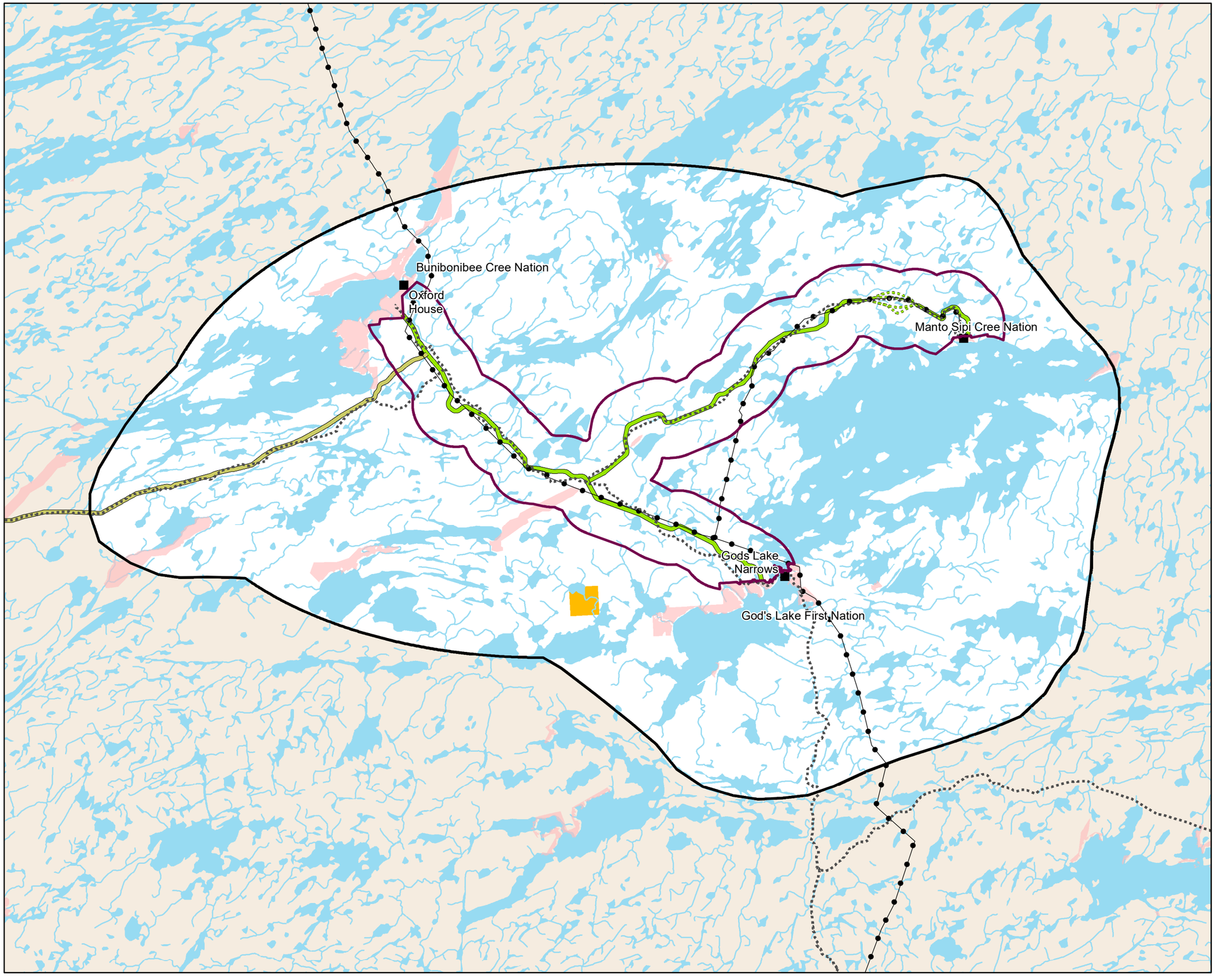
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Magnolia Warbler Habitat Suitability

Project 6 Wildlife Characterization and Effects Assessment

Map 73

Map 74 removed due to sensitive wildlife information



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Primary Habitat
Secondary Habitat

Proposed Road Alignments
- Project 5: Anderson Junction to Bunibonibee
- Project 6: Bunibonibee to God's Lake to Manto Sipi
- Project 6: Manto Sipi Route Options

- Project 6 Local Assessment Area
- Project 6 Regional Assessment Area

Base Data
- Winter Road
- Transmission Line
- First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: BAM, MI - RRO, Joro, NRCAN, MLI
Date Created: September 22, 2017

0 10 20 Kilometres
0 5 10 Miles

N

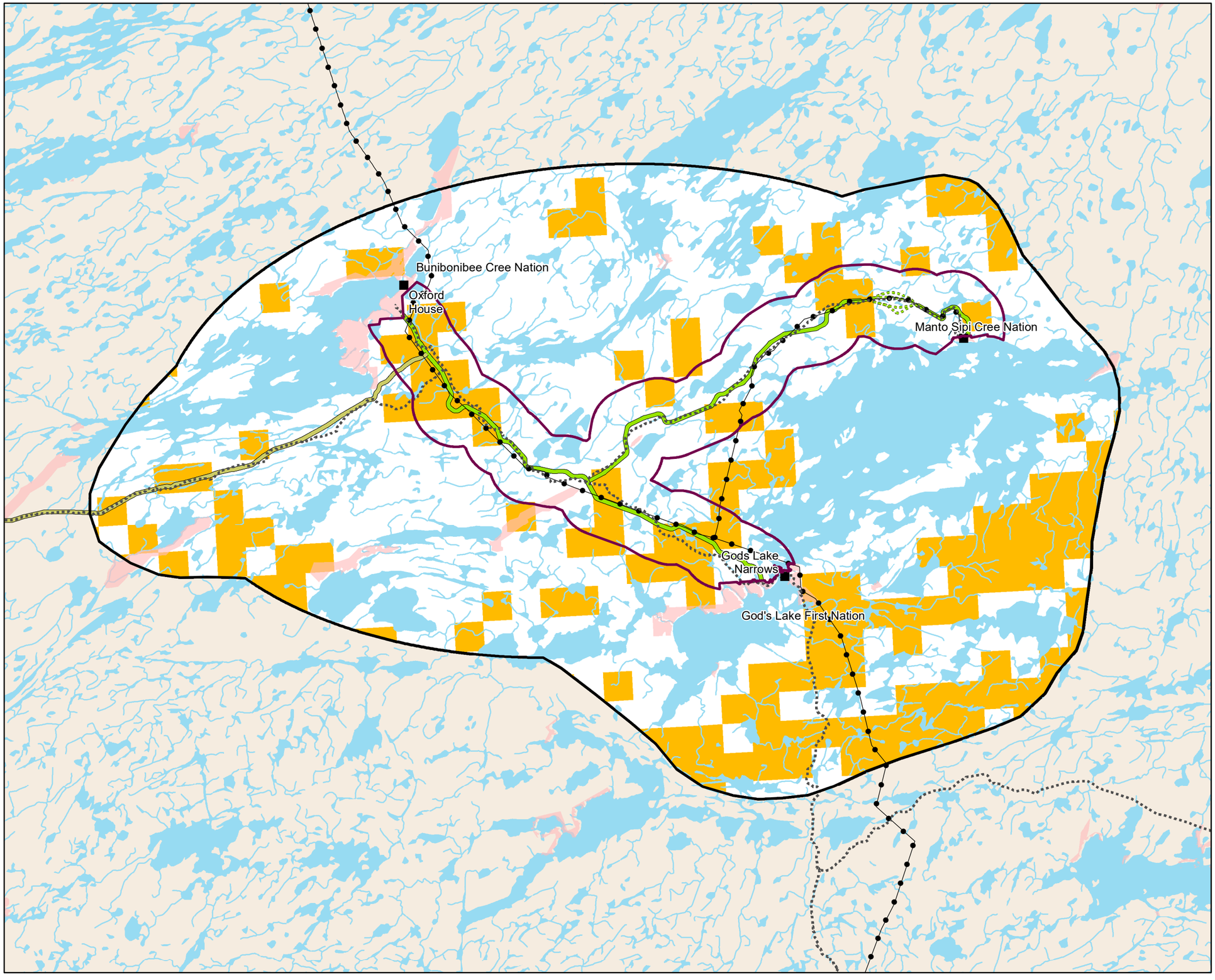
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Ovenbird Habitat Suitability

Project 6 Wildlife Characterization and Effects Assessment

Map 75

Map 76 removed due to sensitive wildlife information



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Secondary Habitat

Proposed Road Alignments

Project 5: Anderson Junction to Bunibonibee

Project 6: Bunibonibee to God's Lake to Manto Sipi

Project 6: Manto Sipi Route Options

Project 6 Local Assessment Area

Project 6 Regional Assessment Area

Base Data

Winter Road

Transmission Line

First Nation

Coordinate System: UTM Zone 14N
NAD83 Data Source: BAM, MI - RRO, Joro, NRCAN, MLI
Date Created: September 22,2017

0 10 20 Kilometres
0 5 10 Miles

N

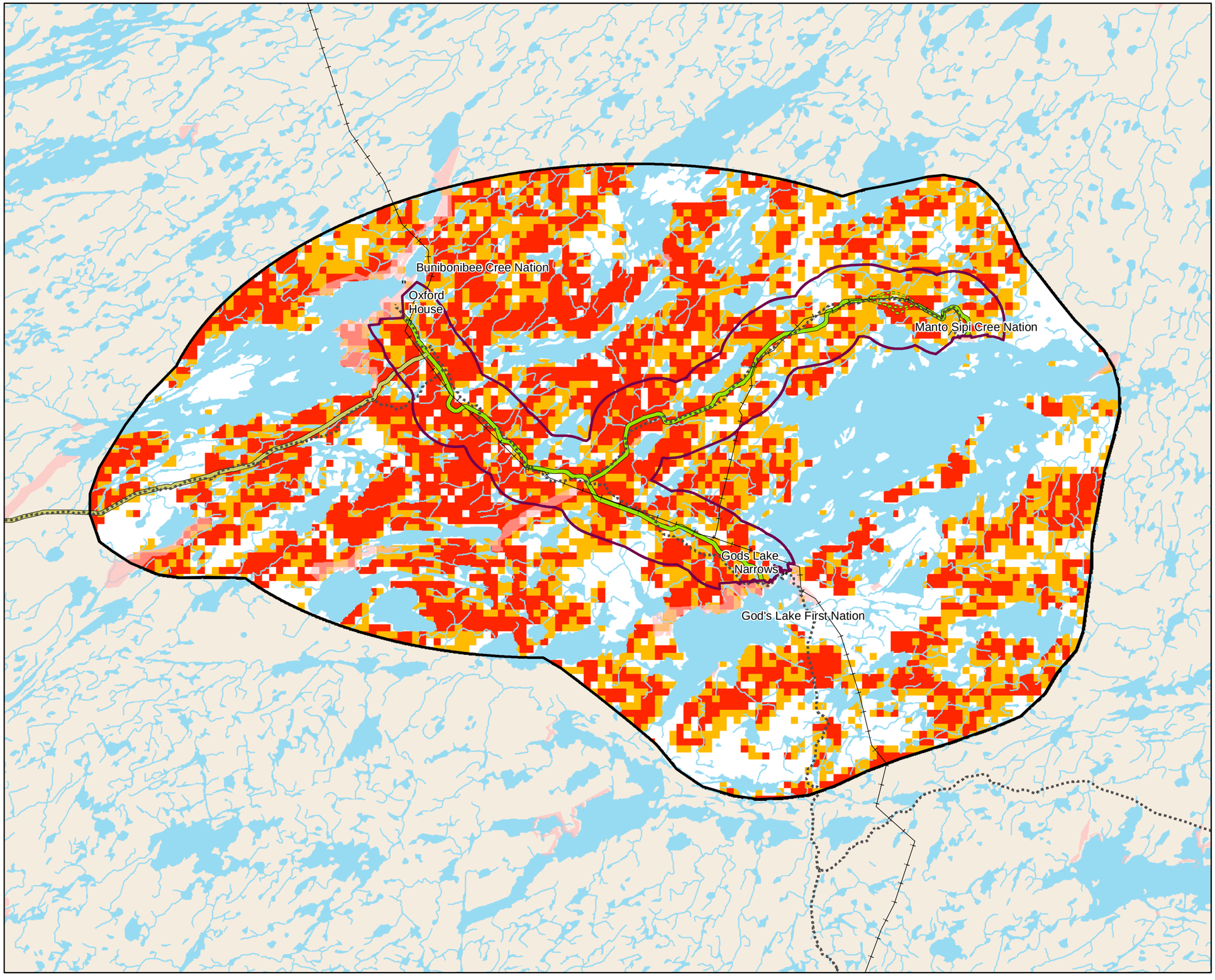
1:525,000

Yellow-bellied Flycatcher Habitat Suitability

Project 6 Wildlife Characterization and Effects Assessment

Map 77

Map 78 removed due to sensitive wildlife information



Manitoba Infrastructure
Remote Road Operations

Joro Consultants

Primary Habitat
Secondary Habitat

Proposed Road Alignments

Project 5: Anderson Junction to Bunibonibee
Project 6: Bunibonibee to God's Lake to Manto Sipi
Project 6: Manto Sipi Route Options
Project 6 Local Assessment Area
Project 6 Regional Assessment Area

Base Data

Winter Road
Transmission Line
First Nation

Coordinate System: UTM Zone 14N NAD83
Data Source: MI - RRO, Joro, NRCAN, MLI
Date Created: December 11,2017

0 10 20 Kilometres
0 5 10 Miles

1:525,000

Spring Peeper Habitat Suitability

Project 6 Wildlife Characterization and Effects Assessment

Map 79