APPENDIX D

Prairie River Environmental Baseline Report

September 2018
Report No. 1547160/P005

Berger Golder Associates

September 2017

ENVIRONMENTAL BASELINE REPORT

PRAIRIE RIVER PEAT HARVEST PROJECT

Submitted to:
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Attention: Alexandre Brisson
(Director - Logistics and Resource)

REPORT

Report Number: 1547160

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List of Abbreviations

Abbreviation	Term
ADV	Acoustic Doppler Velocimeter
AEP	Alberta Environment and Parks
AET	actual evapotranspiration
ARU	acoustic recording unit
ATV	all-terrain vehicle
BBS	breeding birds survey
Berger	Berger Peat Moss Ltd.
BLDC	Blacknose Dace
BP	before present
BRST	Brook Stickleback
BSA	baseline study area
CH_4	methane
CO	carbon monoxide
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	catch-per-unit-effort
CRCH	Creek Chub
DBH	diameter at breast height
DEM	digital elevation model
DNR	Department of Natural Resources
DOC	dissolved organic carbon
DVI	detailed vegetation inventory
EAS	Environmental Assessment and Stewardship
ECCC	Environment and Climate Change Canada
EIS	Environmental Impact Statement
ELC	Ecological Land Classification
FCA	Fur Conservation Area
FMA	Forest Management Agreement
FTMN	Fathead Minnow
GHG	greenhouse gas
GIS	Geographic Information Systems
Golder	Golder Associates Ltd.

Abbreviation	Term
GPS	global positioning system
GWP	global warming potential
HABISask	Hunting, Angling, and Biodiversity Information of Saskatchewan
HCB	Heritage Conservation Branch
HRIA	Heritage Resource Impact Assessment
IBA	Important Bird Areas
INAC	Indigenous and Northern Affairs
IR	Indian Reserve
MBCA	*Migratory Birds Convention Act*
MNRF	Ministry of Natural Resources and Forestry
MOE	Ministry of Environment
NAD	North American Datum
NO_2	nitrogen dioxide
NRC	National Research Council of Canada
NRDC	Northern Redbelly Dace
NTS	National Topographic System
OSB	Oriented Strand Board
PET	potential evapotranspiration
PFRA	Prairie Farm Rehabilitation Administration
PM	particulate matter
$PM_{2.5}$	particulate matter smaller than 2.5 micrometres
PM_{10}	particulate matter smaller than 10 micrometres
PPIFLUP	Pasquia-Porcupine Integrated Forest Land Use Plan
QA/QC	quality assurance/quality control
RAN	Representative Areas Network
RCMP	Royal Canadian Mounted Police
RM	Rural Municipality
SAQMG	Saskatchewan Air Quality Modelling Guideline
SARA	*Species at Risk Act*
SGS	Saskatchewan Geological Survey
SKCDC	Saskatchewan Conservation Data Centre
SO_2	sulfur dioxide
SPRR	Saskatchewan Parks and Renewable Resources

Abbreviation	Term
SRC	Saskatchewan Research Council
the Project	the Prairie River Peat Harvest Project
TSP	total suspended particulate
UTM	Universal Transverse Mercator
WHPA	*Wildlife Habitat Protection Act*
WMZ	Wildlife Management Zone
WSA	Water Security Agency
WSC	Water Survey of Canada

List of Units

Abbreviation	Term
%	percent
<	less than
>	greater than
°C	degrees Celsius
µg/m^3	micrograms per cubic metre
1σ	one standard deviation of the mean
cm	centimetre
g	gram
g-C/m^2/y	grams of carbon per metre squared per year
g-CO_{2e}/m^2/y	grams of carbon dioxide equivalents per metre squared per year
ha	hectare
IPGM	imperial gallons per minute
km	kilometre
km/h	kilometres per hour
km^2	square kilometre
kt	kilotonne
L/s	litres per second
m	metre
m ASL	metres above sea level
m/s	metres per second
m^2	square metre
m^3	cubic metre
m^3/s	cubic metres per second
m^3/s/km^2	cubic metres per second per square kilometre
mm	millimetre
Pg	petagram
ppm	parts per million

Table of Contents

1.0 INTRODUCTION 1

1.1 Overview 1

1.2 Purpose 5

1.3 Baseline Scope 5

2.0 CLIMATE AND AIR QUALITY 7

2.1 Climate 7

2.1.1 Introduction 7

2.1.2 Methods 7

2.1.3 Results 7

2.1.3.1 Air Temperature 7

2.1.3.2 Total Precipitation 9

2.1.3.3 Wind Speed and Direction 10

2.2 Air Quality 13

2.2.1 Introduction 13

2.2.2 Methods 13

2.2.3 Results 14

2.2.3.1 Criteria Air Contaminants 14

2.2.3.2 Greenhouse Gases 15

2.3 Summary 16

3.0 TERRAIN, SOIL, GEOLOGY AND HYDROGEOLOGY 17

3.1 Introduction 17

3.2.1 Geology and Hydrogeology 17

3.2.2 Terrain and Surficial Soils 17

3.3 Methods 17

3.4 Results 19

3.4.1 Bedrock Geology and Hydrogeology 19

3.4.1.1 Manville Group / Swan River Formation 19

3.4.1.2 Lower Colorado Group / Ashville Formation 19

3.4.1.3 Favel Formation 21
3.4.1.4 Morden Shale and Niobrara Formation 21
3.4.1.5 Pierre Shale 21
3.4.2 Tertiary-Quaternary Geology and Hydrogeology 21
3.4.2.1 Tertiary 22
3.4.2.2 Intertill Aquifers 22
3.4.3 Water Well Database 25
3.4.4 Terrain and Surficial Soils 26
3.4.4.1 Terrain 26
3.4.4.2 Soils 26
4.0 HYDROLOGY 28
4.1 Introduction 28
4.2 Baseline Study Area 28
4.3 Methods 28
4.3.1 Compiling Precipitation and Evapotranspiration Records 28
4.3.2 Timing of Field Visits 30
4.3.3 Watershed Boundaries 30
4.3.4 Water Level Surveys and Monitoring 30
4.3.5 Discharge Measurement 31
4.3.6 Establishing a Local Streamflow Record 31
4.3.7 Regional Streamflow Station Evaluation 31
4.3.8 Establishing Long-term Records for the Study Area 32
4.3.9 Flood and Low Flow Calculations 32
4.4 Precipitation and Evapotranspiration Results 33
4.4.1 Precipitation 33
4.4.2 Lake Evaporation and Evapotranspiration 34
4.5 Hydrology Results 35
4.5.1 Field Measurements 35
4.5.2 Greenbush River Hydrometric Station 36
4.5.3 Regional Flow Characteristics 37
4.5.4 Flood Frequency Analysis 41

4.5.5 Annual Low Flow Statistics 43
4.6 Summary 43
5.0 SURFACE WATER QUALITY 44
5.1 Introduction 44
5.2 Baseline Study Area 44
5.3 Methods 46
5.3.1 Study Design and Sampling Methods 46
5.3.1.1 Sampling Dates and Locations 46
5.3.1.2 Physico-chemical Data and Sample Collection 48
5.3.1.3 Sample Analysis 48
5.3.1.4 Quality Assurance/Quality Control 48
5.3.2 Data Analysis 49
5.3.2.1 Characterizing Each Sampling Station 49
5.3.2.2 Comparison to Environmental Quality Guidelines 50
5.4 Results 53
5.4.1 PR01 53
5.4.2 PRX1 to PRX5 56
5.4.3 Quality Assurance/Quality Control 56
5.5 Summary 59
6.0 FISH AND FISH HABITAT 60
6.1 Introduction 60
6.2 Baseline Study Area 60
6.3 Methods 60
6.3.1 Fish Habitat Assessment 60
6.3.1.1 Data Entry and Analysis 63
6.3.1.2 Quality Assurance/Quality Control 63
6.3.2 Fish Inventory 63
6.3.2.1 Data Entry and Analysis 64
6.3.2.2 Quality Assurance/Quality Control 64
6.4 Results 64
6.4.1 Fish Habitat Assessment 64

6.4.1.1 PRX1 64
6.4.1.2 PRX2 66
6.4.1.3 PRX2.5 68
6.4.1.4 PRX4 70
6.4.1.5 PRX5 72
6.4.1.6 PR01 75
6.4.2 Fish Inventory 77
6.4.2.1 PRX1 77
6.4.2.2 PRX2 80
6.4.2.3 PRX2.5 80
6.4.2.4 PRX4 80
6.4.2.5 PRX5 80
6.4.2.6 PR01 81
6.5 Summary 81
7.0 VEGETATION 83
7.1 Introduction 83
7.2 Baseline Study Area 83
7.3 Methods 85
7.3.1 Detailed Vegetation Inventory Surveys 85
7.3.2 Ecological Land Classification 85
7.3.3 Rare Plant Species Survey 85
7.3.4 Weed Species 86
7.3.5 Traditional Use Plants 87
7.4 Results 88
7.4.1 Detailed Vegetation Inventory 88
7.4.2 Ecological Land Classifications 88
7.4.3 Rare Plant Species Survey 97
7.4.3.1 Historical Plant Species Occurrences 97
7.4.3.2 Rare Plant Species Observations 98
7.4.4 Weed Species 102
7.4.5 Traditional Use Plants 102

7.5 Summary 103
8.0 WILDLIFE 105
8.1 Introduction 105
8.2 Baseline Study Area 106
8.3 Methods 106
8.3.1 Protected Species, Protected Areas, and Wildlife Habitat 106
8.3.1.1 Protected Species 106
8.3.1.2 Protected Areas 113
8.3.1.3 Wildlife Habitat 113
8.3.2 Amphibians 115
8.3.3 Upland Breeding Birds 117
8.3.4 Incidental Observations 119
8.4 Results 119
8.4.1 Protected Species, Protected Areas, and Wildlife Habitat 119
8.4.1.1 Protected Species 119
8.4.1.2 Protected Areas 126
8.4.1.3 Wildlife Habitat 127
8.4.2 Amphibians 127
8.4.3 Upland Breeding Birds 127
8.4.4 Incidental Observations 130
8.5 Summary 132
9.0 HERITAGE RESOURCES 133
9.1 Introduction 133
9.2 Baseline Study Area 133
9.3 Methods 133
9.3.1 Existing Literature and Databases 133
9.3.2 Field Assessment 135
9.4 Results 136
9.4.1 Cultural Setting 136
9.4.1.1 Precontact Period 136
9.4.1.2 Protohistoric and Historic Period 136

9.4.2 Previous Archaeological Research 138
9.4.3 Field Assessment 139
9.5 Summary 145
10.0 LAND AND RESOURCE USE 146
10.1 Introduction 146
10.1.1 Pasquia-Porcupine Integrated Forest Land Use Plan 146
10.2 Baseline Study Area 146
10.3 Traditional Land and Resource Use 148
10.3.1 Methods 150
10.3.2 Results 151
10.3.2.1 Historical Setting of Traditional Land Use 151
10.3.2.2 Current Traditional Land Use 152
10.3.2.2.1 Hunting and Trapping 152
10.3.2.2.2 Traditional Use Plants 152
10.4 Non-Traditional Land and Resource Use 154
10.4.1 Methods 154
10.4.2 Results 154
10.4.2.1 Communities and Infrastructure 154
10.4.2.2 Parks, Protected Areas, Recreation 154
10.4.2.3 Hunting and Fishing 155
10.4.2.4 Agriculture 155
10.4.2.5 Commercial 156
10.4.2.5.1 Trapping 156
10.4.2.5.2 Outfitters and Lodges 156
10.4.2.5.3 Forestry and Forest Products 156
10.4.2.5.4 Peat Harvesting 156
10.5 Summary 156
11.0 SOCIO-ECONOMIC ENVIRONMENT 157
11.1 Introduction 157
11.2 Baseline Study Area 157
11.3 Methods 159

11.4 Results 159
11.4.1 Historical Setting 159
11.4.2 Population and Demographics 160
11.4.2.1 Communities and Rural Municipalities in the Socio-Economic Baseline Study Area 160
11.4.2.2 First Nation and Métis Communities 161
11.4.3 Labour Force Characteristics 162
11.4.4 Economy 164
11.4.5 Services and Physical Infrastructure 165
11.4.5.1 Traffic 165
11.4.5.2 Emergency and Protective Services 166
11.4.5.3 Physical Infrastructure 167
12.0 GLOSSARY 169
13.0 REFERENCES 172

TABLES

Table 2.1-1: Monthly Air Temperature Statistics for the Hudson Bay Meteorology Station 8
Table 2.1-2: Monthly Total Precipitation Statistics for the Hudson Bay Meteorology Station 9
Table 2.1-3: Monthly Averaged Wind Speed and Direction Statistics for the Hudson Bay Meteorology Station 11
Table 2.2-1: Natural Greenhouse Gas Emissions from an Eastern Canadian Bog 14
Table 2.2-2: Background Concentrations of Criteria Air Contaminants 15
Table 2.2-3: Baseline Greenhouse Gas Emissions from Prairie River Peat Harvest Project 16
Table 3.4-1: Water Wells or Testholes within the Geology and Hydrogeology Baseline Study Area 25
Table 4.3-1: Description of Regional Hydrometric Stations used to Characterize Hydrology 32
Table 4.5-1: 2016 Field Measurements in the Hydrology Baseline Study Area 36
Table 4.5-2: Mean Monthly Flow Statistics for Selected Locations in the Hydrology Baseline Study Area (Open-Water Period of 1975 to 2016) 39
Table 4.5-3: Daily Flood Magnitude and Frequency Estimates for the Prairie River Harvest Area Outflows based on Regional Flood Frequency Analysis 41
Table 4.5-4: Annual Low Flow Statistics for selected locations in the Hydrology BSA 43
Table 5.3–1: Surface Water Quality Sampling Dates and Stations 46
Table 5.3–2: Definitions of Waterbody Characteristics 49
Table 5.3–3: Water Quality Guidelines for the Protection of Aquatic Life, Human Health, Wildlife Health, and Irrigation 50

Table 5.4–1: Water Quality Results for the Greenbush River, June 2016 53
Table 5.4–3: Water Quality Results for Quality Control Samples, June 2016 57
Table 6.4-1: Fishing Locations 78
Table 6.4-2: Minnow Trap Catch-Per-Unit-Effort by Species and Station 79
Table 6.4-3: Backpack Electrofishing Catch-Per-Unit-Effort by Species and Station 80
Table 6.4-4: Gill Netting Catch-Per-Unit-Effort by Species and Station 81
Table 7.3-1: Density Distribution Guide for Ranking Weed Infestation 87
Table 7.4-1: Total Area and Percent Cover of Ecosite Types within the Vegetation Baseline Study Area 88
Table 7.4-2: Historical Provincially Tracked Plant Species Occurrences within 20 km of the Vegetation Baseline Study Area 97
Table 7.4-3: Provincially Tracked Vascular Plant Species Observed During the 2016 Field Surveys 99
Table 7.4-4: Provincially Designated Weed Species Observed during the 2016 Field Surveys 102
Table 7.4-5: Summary of Traditional Use Plants in the Vegetation Baseline Study Area 102
Table 8.1-1: 2016 Wildlife Studies Conducted for the Prairie River Peat Harvest Project 105
Table 8.4-1: Federally Listed and Provincially Tracked Species with the Potential to Occur in the Wildlife Baseline Study Area, 2016 120
Table 8.4-2: Candidate Maternity Roost Habitat Results, 2016 125
Table 8.4-3: Upland Breeding Bird Species Detected During Breeding Bird Surveys 2016 128
Table 8.4-4: Incidental Wildlife Species Recorded in the Baseline Study Area during 2016 Wildlife Surveys 131
Table 9.4-1: Previous Heritage Resource Impact Assessments in Baseline Study Area 138
Table 10.3-3: Hunting Season Dates in Wildlife Management Zone 59 155
Table 11.4-1: Population and Demographic Characteristics of the Non-Indigenous Baseline Study Area Communities and Rural Municipalities (2011 and 2016) 160
Table 11.4-2: Population and Demographic Characteristics of Indigenous Communities in the Baseline Study Area (2006 and 2011) 161
Table 11.4-3: Labour Force Characteristics of the Non-Indigenous Baseline Study Area Communities (2011) 162
Table 11.4-4: Labour Force Characteristics of the Indigenous Baseline Study Area Communities (2011) 163
Table 11.4-5: Average Annual Daily Traffic Count in the Baseline Study Area (2015) 165
Table 11.4-6: 2015 Traffic Collision Data in the Socio-Economic Baseline Study Area 166

FIGURES

Figure 1.1-1: Location of the Proposed Prairie River Peat Harvest Project 2
Figure 1.1-2: Conceptual Site Development Plan 3
Figure 1.1-3: Proposed Prairie River Access Road 4
Figure 1.3-1: Preliminary and Revised Harvest Area and Proposed Lease Boundary 6

Figure 2.1-1: Monthly Air Temperature for the Hudson Bay Meteorology Station 8
Figure 2.1-2: Monthly Total Precipitation for the Hudson Bay Meteorology Station 10
Figure 2.1-3: Seasonal Wind Speed and Direction at Hudson Bay Meteorology Station, 1994 to 2016 12
Figure 3.2-1: Geology and Hydrogeology Baseline Study Area 18
Figure 3.4-1: Bedrock Geology within the Geology and Hydrogeology Baseline Study Area....20
Figure 3.4-2: Surficial Geology within the Baseline Study Area 23
Figure 3.4-3: Stratigraphic Column for the Geology and Hydrogeology Baseline Study Area....24
Figure 4.2-1: Hydrology Baseline Study Area 29
Figure 4.4-1: Monthly Precipitation for 2016 compared to Average Precipitation (Adjusted and Not-adjusted) at Hudson Bay, Saskatchewan....33
Figure 4.4-2: Monthly Precipitation for the Past Two Hydrological Years Compared to Long-Term Records 34
Figure 4.4-3: Monthly Lake Evaporation at Hudson Bay, Saskatchewan compared with Actual Evapotranspiration Monitored with a Flux Tower in a Fen Peatland in Central Saskatchewan (2006 to 2007)....35
Figure 4.5-1: Water Levels at the Greenbush River Hydrology Station in 2016 37
Figure 4.5-2: Discharge at the Greenbush River Hydrology Station in 2016....37
Figure 4.5-3: Average Open-Water Period Discharge at Prairie River (05LB010) from 1975 to 2016....38
Figure 4.5-4: Monthly Flow Statistics at Prairie River (05LB010) from 1975 to 2016 compared with Monthly Mean Flow in 2016 38
Figure 4.5-5: Monthly Derived Flow Statistics for the Greenbush River from 1975 to 2016 compared with Monthly Mean Measured and Derived Flow in 2016 39
Figure 4.5-6: Daily Precipitation and Daily Mean Discharge at Regional Streamflow Stations near the Project in 2016....40
Figure 4.5-7: Unit Runoff at Regional Streamflow Stations near the Project in 2016 40
Figure 4.5-8: Regional Flood Frequency Analysis....41
Figure 4.5-9: Instantaneous versus Daily Mean Flood Peaks for the Prairie River 42
Figure 5.2-1: Surface Water Quality Baseline Study Area....45
Figure 5.3-1: Water Quality Sampling Stations....47
Figure 6.2-1: Fish and Fish Habitat Baseline Study Area....61
Figure 6.3-1: Fish and Fish Habitat Sampling Stations 62
Figure 6.4-1: Fish Habitat Map for Sampling Station PRX1 65
Figure 6.4-2: Fish Habitat Map for Sampling Station PRX2 67
Figure 6.4-3: Fish Habitat Map for Sampling Station PRX2.5 69
Figure 6.4-4: Fish Habitat Map for Sampling Station PRX4 71
Figure 6.4-5: Fish Habitat Map for Sampling Station PRX5 73
Figure 6.4-6: Fish Habitat Map for Sampling Station PR01....76
Figure 7.2-1: Vegetation Baseline Study Area 84

Figure 7.4-1: Vegetation Survey Locations within the Vegetation Baseline Study Area 90
Figure 7.4-2: Ecological Land Classification of the Vegetation Baseline Study Area 91
Figure 7.4-3: Provincially Tracked Plant Species Observed during the 2016 Field Surveys 101
Figure 8.2-1: Wildlife Baseline Study Area 108
Figure 8.3-1: Locations of Yellow Rail Surveys, 2016 111
Figure 8.3-2: Locations of Common Nighthawk Surveys, 2016 112
Figure 8.3-3: Location of Maternity Roost Habitat Survey, 2016 114
Figure 8.3-4: Locations of Amphibian Calling Surveys, 2016 116
Figure 8.3-5: Locations of Upland Breeding Bird Point Count Surveys, 2016 118
Figure 8.4-1: Locations of Listed Species Observed during Wildlife Surveys in the Baseline Study Area, 2016 123
Figure 9.2-1: Heritage Resources Baseline Study Area 134
Figure 9.4-1: Regional Chronology of the Mixedwood Boreal Forest of Northern Saskatchewan 137
Figure 9.4-2: Prairie River Lease, Assessed Areas and Shovel Probes 140
Figure 9.4-3: Prairie River Access Road, Assessed Areas and Shovel Probes 141
Figure 10.2-1: Land and Resource Use Baseline Study Area 147
Figure 10.2-2: Overall View of Land and Resource Use Baseline Study Area 149
Figure 11.2-1: Socio-economic Baseline Study Area 158

PHOTOS

Photograph 6.4-1: Representative habitat for Sampling Station PRX1 66
Photograph 6.4-2: Representative Habitat for Sampling Station PRX2 68
Photograph 6.4-3: Representative Habitat for Sampling Station PRX2.5 70
Photograph 6.4-4: Representative Habitat for Sampling Station PRX4 72
Photograph 6.4-5: Representative Run Habitat Upstream of Sampling Station PRX5 74
Photograph 6.4-6: Representative Flat Habitat Downstream of Sampling Station PRX5 74
Photograph 6.4-7: Representative Habitat for Sampling Station PR01 75
Photograph 9.4-1: General view of northern portion of Prairie River bog, looking north 142
Photograph 9.4-2: General view of southern portion of Prairie River bog, looking southwest. 143
Photograph 9.4-3: View of northern access route traversing gentle slope descending into boggy terrain, looking south 143
Photograph 9.4-4: View of clearing prior to ephemeral creek crossing along northern access route, looking southeast. 144
Photograph 9.4-5: View of beaver dam and associated run off along northern access route, looking northwest. 144
Photograph 9.4-6: View of dilapidated hunting cabin adjacent to northern access route option, looking east. 145

APPENDICES

APPENDIX A
Fish Capture Data

APPENDIX B
Vegetation Data

APPENDIX C
Wildlife Data

APPENDIX D
Heritage Requirement Letter

1.0 INTRODUCTION

1.1 Overview

Berger Peat Moss Ltd. (Berger) is proposing to harvest the Prairie River bog located approximately 61 km southeast of Carrot River, Saskatchewan and 51 km northwest of Hudson Bay, Saskatchewan (Figure 1.1-1). The Prairie River Peat Harvest Project (the Project) is located on Crown Resource Land administered by the Ministry of Environment (MOE) and is also within the Pasquia-Porcupine Integrated Forest Land Use Plan. The projected Project Footprint is 1,059 ha (2,619 acres) contained within a 2,144 ha (5,299 acre) lease (Figure 1.1-2). The following components are included in the Project Footprint:

- a projected harvest area of 782 ha (1,932 acres);
- an additional 69 ha (170 acres) to be used for non-harvestable components of the Project, which includes the drainage system, stockpile area, staging area, and site service roads to the harvest areas; and
- a 30 m buffer (208 ha, 517 acres) around the harvest areas that will not be harvested; however, has the potential to be affected by the Project (for example by indirect effects from dust or drainage) (Figure 1.1-2).

The Project includes all aspects that relate to the construction (i.e., site preparation), operation, maintenance, and closure (i.e., decommissioning and reclamation). Once the required approvals, permits, and lease agreements are in place, the first phase of the Project will include site preparation (i.e., vegetation clearing, mulching). Berger will work with the Forest Management Agreement (FMA) holders within the Pasquia-Porcupine FMA Area, Edgewood Forest Products and Weyerhaeuser, to determine if there is interest in any merchantable timber within the harvest area should it be present. Non-merchantable timber cleared from the harvest area will be stockpiled for use in the construction of site service roads, and construction of a parking lot and equipment storage area.

The Project will require an access road to accommodate the movement of heavy equipment and vehicles to and from the harvest site and to transport the harvested peat from the site. Berger is proposing to access the Project from Carrot River which will include the use of approximately 38 km of existing gravel road maintained by the Rural Municipality (RM) of Moose Range No. 486 and approximately 23 km of an existing road and trail previously used as a haul road for forestry and currently used to access the surrounding Crown Resource Land. Approximately 17 km of trail would require upgrades to allow for all-season access to the Project (Figure 1.1-3). The right-of-way required to complete the necessary upgrades and construction for the all-season access road will be 37 m wide for a total area of 0.63 km^2 or 63 ha (156 acres); however, the final road surface is expected to be between 7 m and 10 m wide.

The second phase of the Project includes the construction of sedimentation ponds, drainage ditches, and site service roads for the first phase of harvesting, and other support infrastructure (e.g., site office). Harvesting operations include clearing/mulching of the surface vegetation layer, construction of field ditches, field preparation (i.e., profiling and harrowing), peat harvesting and stockpiling, and transportation of harvested peat to a packaging plant.

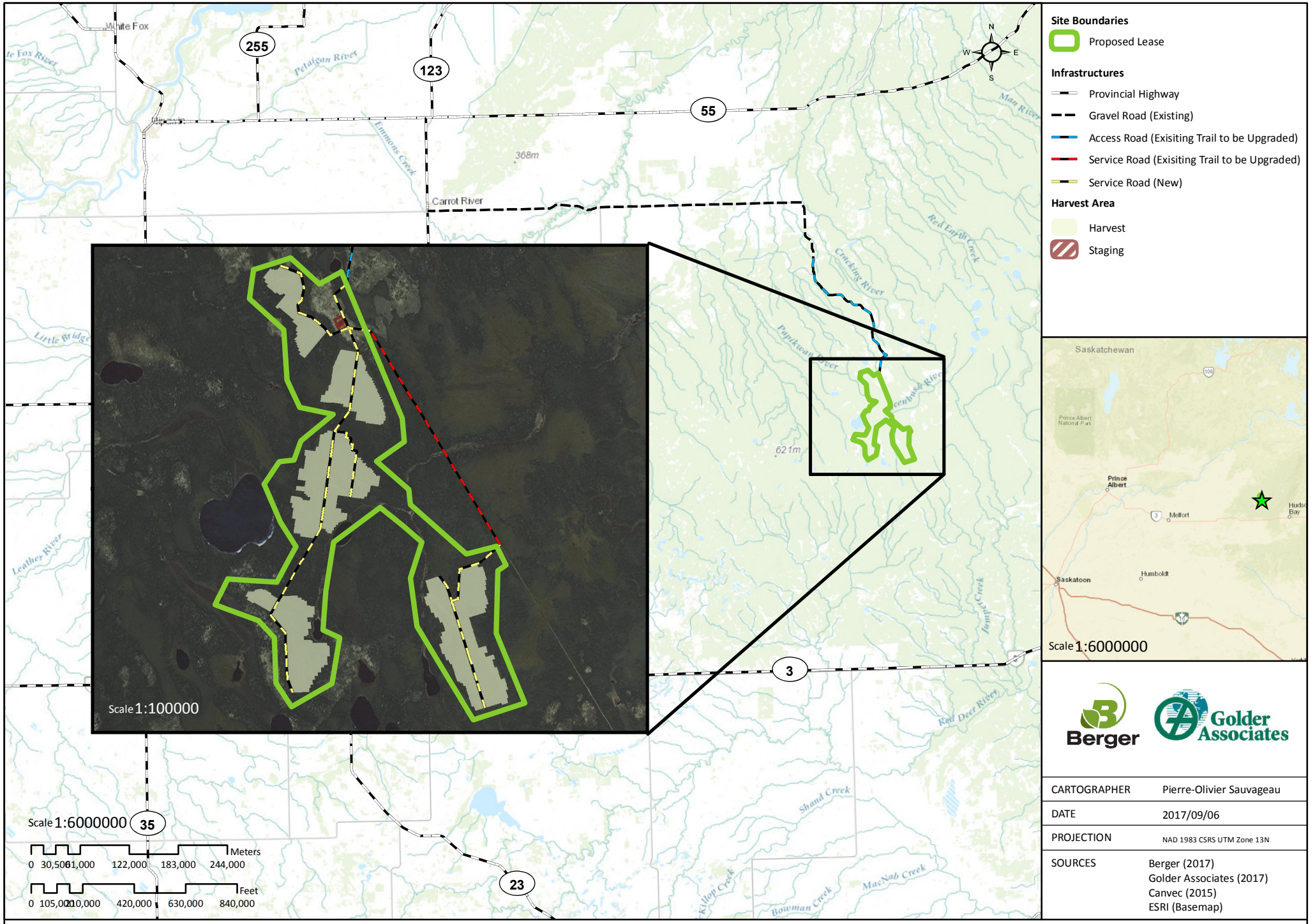


Figure 1.1-1 : Location of the Proposed Prairie River Peat Harvest Project | Prairie River Bog

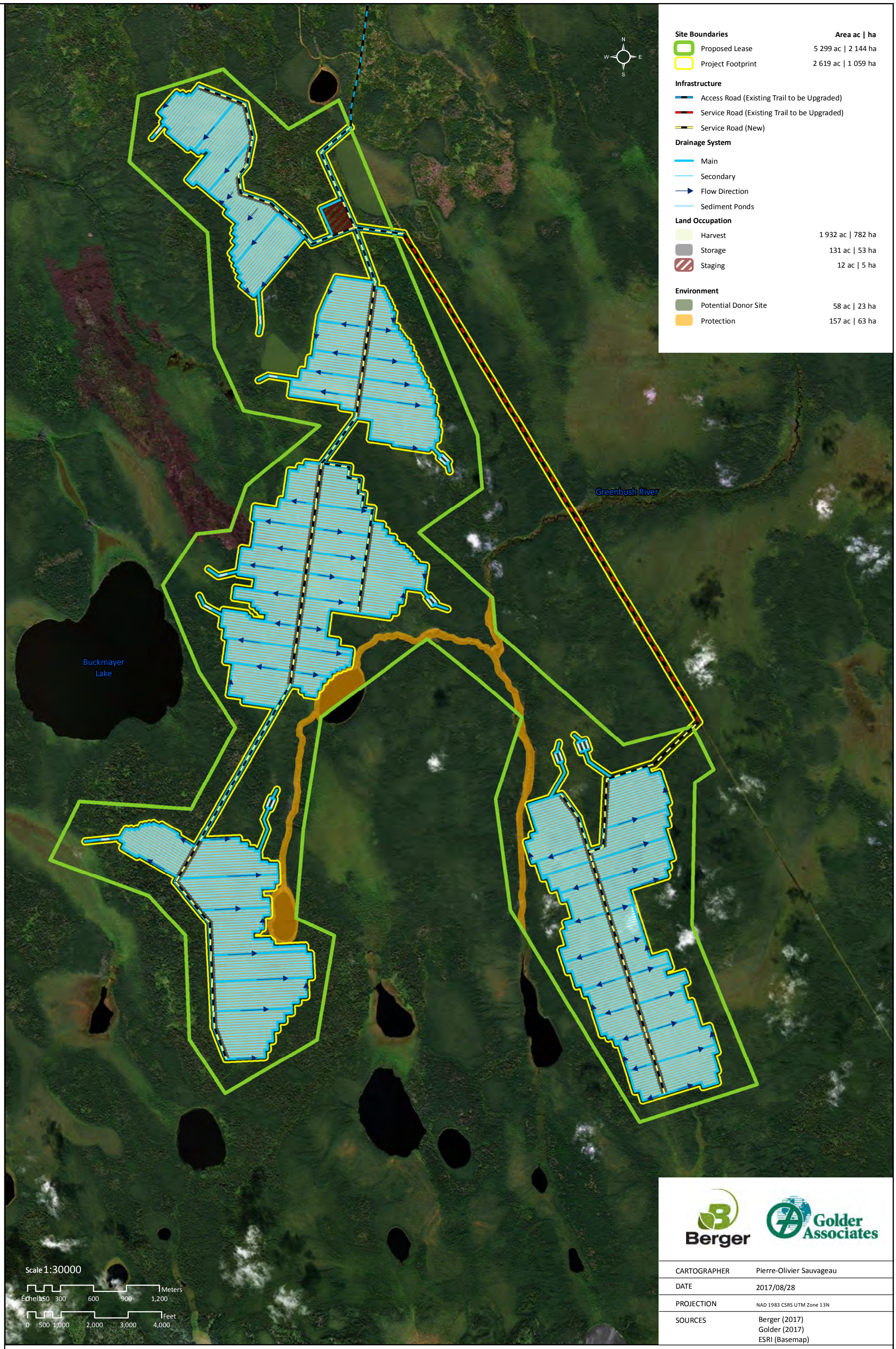
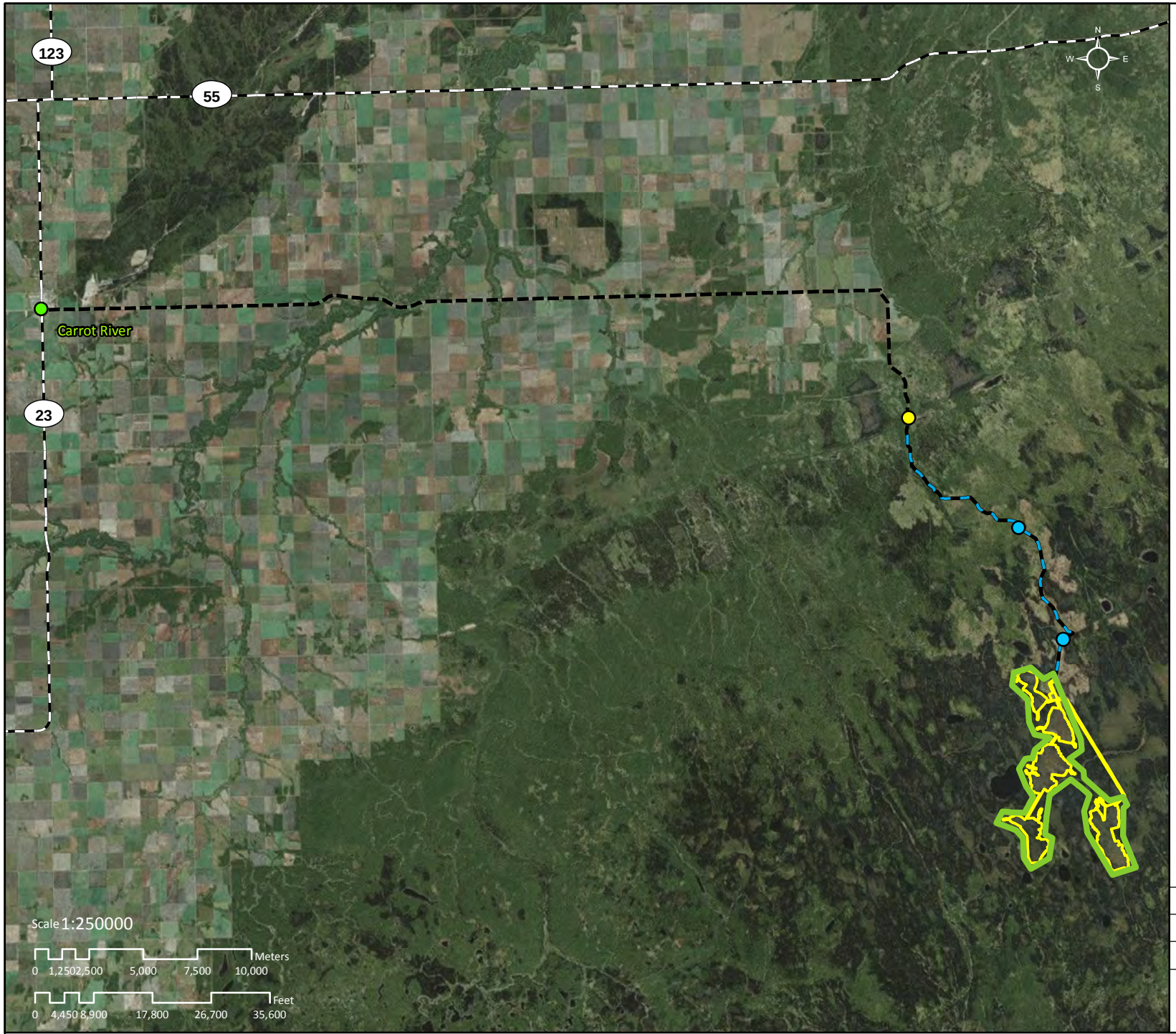


Figure 1.1-2: Conceptual Site Development Plan |

Prairie River Bog



Site Boundaries

- Proposed Lease
- Project Footprint

Infrastructures

- Provincial Highway
- Gravel Road (Existing)
- Access Road (Existing Trail to be Upgraded)
- Constructed Culverts
- Upgraded Culverts

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Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/30
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 1.1-3 : Proposed Prairie River Access Road |

Prairie River Bog

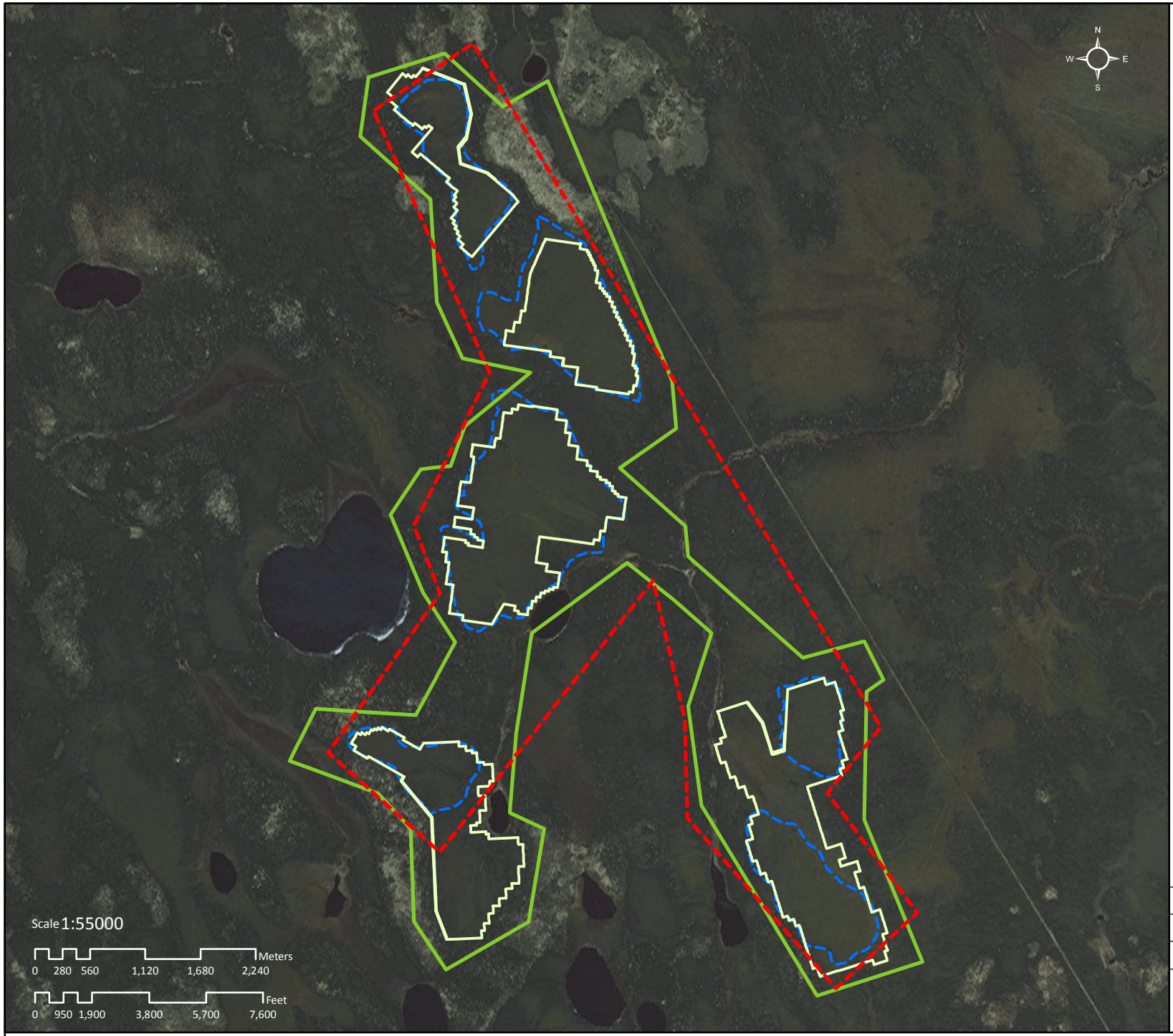
To limit the Project Footprint, Berger is proposing to harvest the Prairie River bog in five phases. New harvest areas are established progressively over time and Project infrastructure is also expanded as required, which would include extending the main drainage ditch, field drainage ditches and site service roads. Reclamation will also occur progressively. A progressive reclamation plan is developed for the site so that harvested areas are actively being reclaimed as other areas are being harvested. Integrated harvest and reclamation planning enables Berger to optimize management of the peat resource and coordinate that work with reclamation monitoring and adaptive management to further support restoring the harvest area. The final phase of the Project will be closure, which includes decommissioning of infrastructure and reclamation of the disturbance area.

1.2 Purpose

Following review of the Technical Proposal submitted for the Project, the MOE Environmental Assessment and Stewardship (EAS) Branch determined that the Project met the criteria of section 2(d)(i) of *The Environmental Assessment Act* (2013) and was considered a “development” and therefore was required to undergo an environmental assessment (MOE File # 2016-006). The purpose of this baseline report is to document the biophysical, cultural, and socio-economic environments surrounding the Project in support of the Environmental Impact Statement (EIS) being prepared to meet the review requirements of under *The Environmental Assessment Act* (2013). The baseline report integrates local and regional data collected from sources such as previous studies, literature, and Project-specific baseline investigations. This information will be used to support the assessment of Project effects on the biophysical, cultural, and socio-economic environments and will help to identify mitigation and protective actions that could be implemented to avoid or reduce the effects.

1.3 Baseline Scope

Baseline studies were initiated with preliminary details from Berger on the location of the harvest areas and the proposed lease boundary. Following completion of the baseline studies and as Berger began working on the site specific development plan, the harvest area and proposed lease boundary were refined. Figure 1.3-1 shows the preliminary and revised harvest area and lease boundary. The revised lease boundary was used to define the baseline study area in subsequent discipline sections. The data collected within the proposed lease boundary are comprehensive and considered adequate to cover the revised lease boundary area.



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CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/09/06
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 1.3-1 : Preliminary and Revised Harvest Area and Proposed Lease Boundary |

Prairie River Bog

2.0 CLIMATE AND AIR QUALITY

2.1 Climate

2.1.1 Introduction

The Prairie River Peat Harvest Project (the Project) Footprint is located in the Pasquia Plateau Landscape area of the Mid-Boreal Upland Ecoregion within the Boreal Plain Ecozone (Acton et al. 1998). The access road crosses through the Pasquia Plateau and Pasquia Escarpment Landscape areas of the Mid-Boreal Upland Ecoregion and the Mistatim Upland Landscape area of the Boreal Transition Ecoregion within the Boreal Plain Ecozone (Acton et al. 1998). The climate of the Boreal Plain Ecozone is humid continental at lower elevations and in southern areas, but is characterized by subarctic climate conditions at higher elevations and throughout northern areas. The Mid-Boreal Upland Ecoregion has a subarctic climate and is characterized by cold winters and short, cool summers. Maximum precipitation in this area usually occurs from May to September. Mean annual temperatures in this area are near zero degrees Celsius (°C). The summers are cool and short, having an average frost-free period of 114 days and 1,395 degree-days above 5°C (Acton et al. 1998).

2.1.2 Methods

The Hudson Bay, Saskatchewan meteorology station (Environment and Climate Change Canada [ECCC] 2017a) is approximately 50 km southeast of the Project. Canadian climate normal data for the 1981 to 2010 period is not available for the Hudson Bay meteorology station. However, daily and hourly meteorological data from this station including temperature, precipitation, wind speed, and wind direction are available from 1994 to 2016 (a total of 23 years) from ECCC (2017a).

To evaluate baseline climate conditions for the Project, the 23-year daily average, maximum, and minimum air temperatures for each month were computed from the meteorological data using the same method as that used to compute 30-year Canadian climate normals. Daily precipitation data were used to compute monthly averages and hourly wind data were used to produce seasonal summarizes for wind speed and direction. Following the World Meteorological Organization (WMO) “3 and 5 rule” (WMO 1989), if there are three or more consecutive, or more than five total missing daily temperature data in a month, this month was excluded from the monthly average temperature calculation. For monthly average of total precipitation, the months with one or more missing daily data values were excluded from the calculation. For the hourly wind data, any month with less than 90% complete hourly data was excluded from the average calculation. Most frequent wind direction is based on the total number of occurrences of each of 36 possible directions (in 10's of degrees) for each month, converted into one of eight compass directions. The classification of the eight compass directions was found from the ECCC Canadian climate normal calculation information document (ECCC 2017b).

2.1.3 Results

2.1.3.1 Air Temperature

Monthly air temperatures recorded at the Hudson Bay meteorology station are summarized in Table 2.1-1 and illustrated in Figure 2.1-1. The annual average daily temperature is 1.1°C, and monthly average air temperatures are below zero from November to March. January is the coldest month with a daily average of -17.3°C while July is the warmest month with a daily average of 17.8°C.

Table 2.1-1: Monthly Air Temperature Statistics for the Hudson Bay Meteorology Station

Month	Daily Maximum (°C)	Daily Minimum (°C)	Daily Average (°C)
January	-11.9	-22.6	-17.3
February	-8.3	-20.7	-14.6
March	-1.4	-14.4	-7.9
April	8.8	-4.6	2.1
May	16.3	1.7	9.0
June	21.4	7.9	14.7
July	24.4	11.1	17.8
August	23.2	9.5	16.4
September	18.0	4.3	11.2
October	8.8	-2.1	3.3
November	-1.8	-10.9	-6.3
December	-10.1	-19.4	-14.8
Annual	7.3	-5.0	1.1

°C = degrees Celsius.

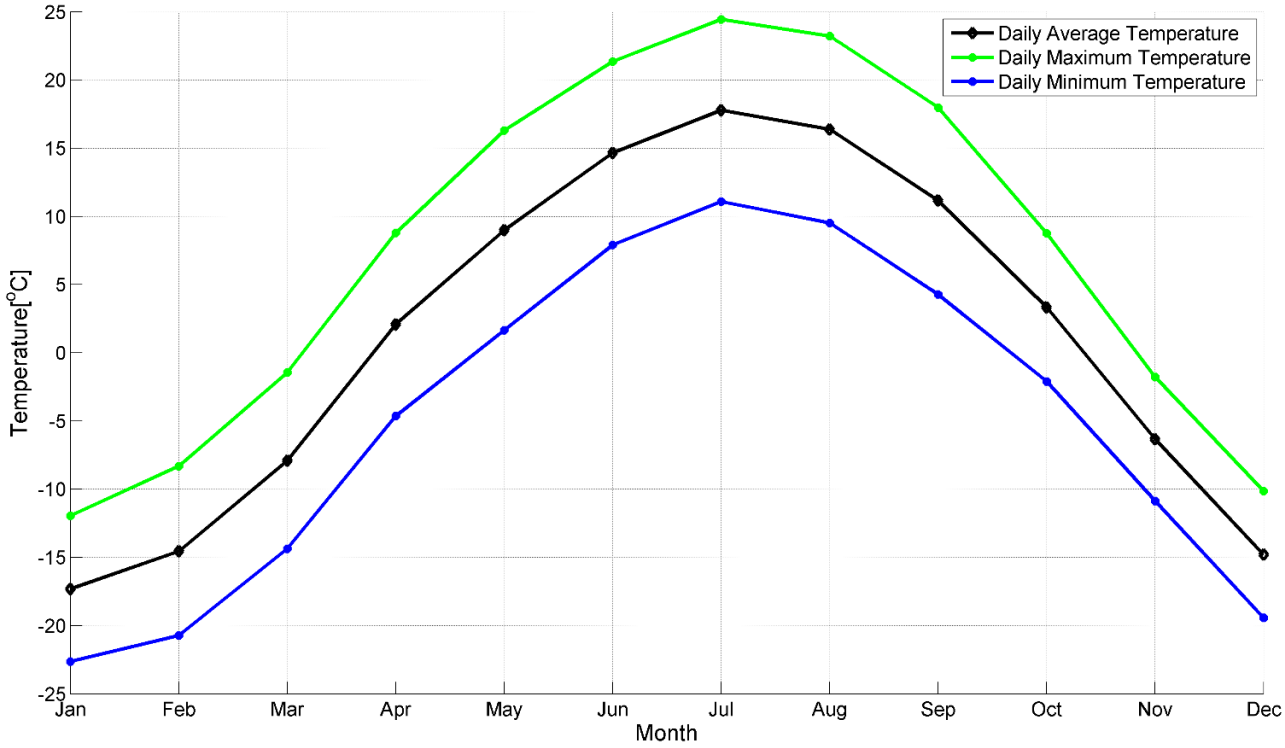


Figure 2.1-1: Monthly Air Temperature for the Hudson Bay Meteorology Station

2.1.3.2 Total Precipitation

Precipitation observations at the Hudson Bay station only include total precipitation and do not differentiate between rain and snow (ECCC 2017a). The monthly and annual total precipitation observed at the Hudson Bay meteorology station are summarized in Table 2.1-2 and illustrated in Figure 2.1-2. The average annual precipitation is 454.2 mm. The highest monthly precipitation is in August with a long-term average of 79.4 mm. February has the least precipitation with a long-term average of 17.4 mm.

Table 2.1-2: Monthly Total Precipitation Statistics for the Hudson Bay Meteorology Station

Month	Total Precipitation (mm)
January	21.1
February	17.4
March	19.5
April	23.5
May	34.7
June	72.2
July	73.2
August	79.4
September	38.4
October	31.3
November	23.2
December	20.5
Annual	454.2

Note: The sum of the values may appear different from the actual due to rounding.
mm = millimetre

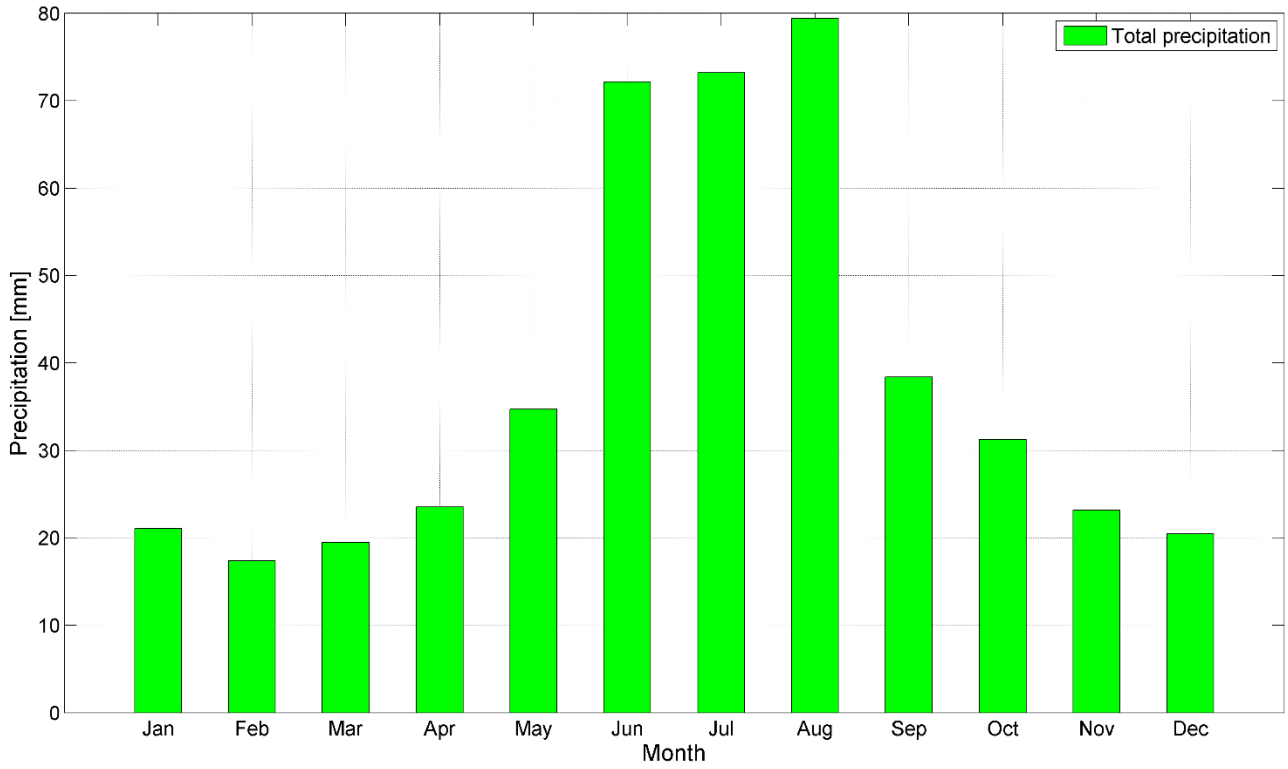


Figure 2.1-2: Monthly Total Precipitation for the Hudson Bay Meteorology Station

2.1.3.3 Wind Speed and Direction

The Mid-Boreal Upland region experiences relatively low variability in wind speeds throughout the year, with mean monthly values ranging from 2.7 to 3.6 metres per second (m/s). Wind direction varies seasonally and is predominately from the southwest in winter, northeast in spring and west in summer (Table 2.1-3). The month of May typically has the highest average wind speeds, while August has the lowest (Table 2.1-3).

Seasonal wind roses summarizing wind speed and wind direction at Hudson Bay for the years 1994 to 2016 are illustrated in Figure 2.1-3. The data show that winds oscillate between the northeast and west/southwest during most of the year, but that the relative frequency and intensity of the winds from these directions varies seasonally. Periods of calm (i.e., wind speeds below 0.3 m/s or 1 kilometre per hour [km/hr]) are evenly distributed throughout the year and occur on average of 5.3% of the time. Strong winds are most common in spring, but are infrequently above 6 m/s (22 km/hr).

Table 2.1-3: Monthly Averaged Wind Speed and Direction Statistics for the Hudson Bay Meteorology Station

Month	Average Wind Speed		Most Frequent Direction
	m/s	km/h	
January	3.1	11.0	Southwest
February	3.1	11.1	Southwest
March	3.3	11.8	Northeast
April	3.5	12.4	Northeast
May	3.6	13.0	Northeast
June	3.0	10.9	Northeast
July	2.8	10.2	Southwest
August	2.7	9.9	Southwest
September	3.0	10.9	Southwest
October	3.0	11.0	West
November	3.0	10.9	Southwest
December	2.9	10.4	Southwest
Annual	3.1	11.1	Southwest

m/s = metres per second; km/h = kilometre per hour

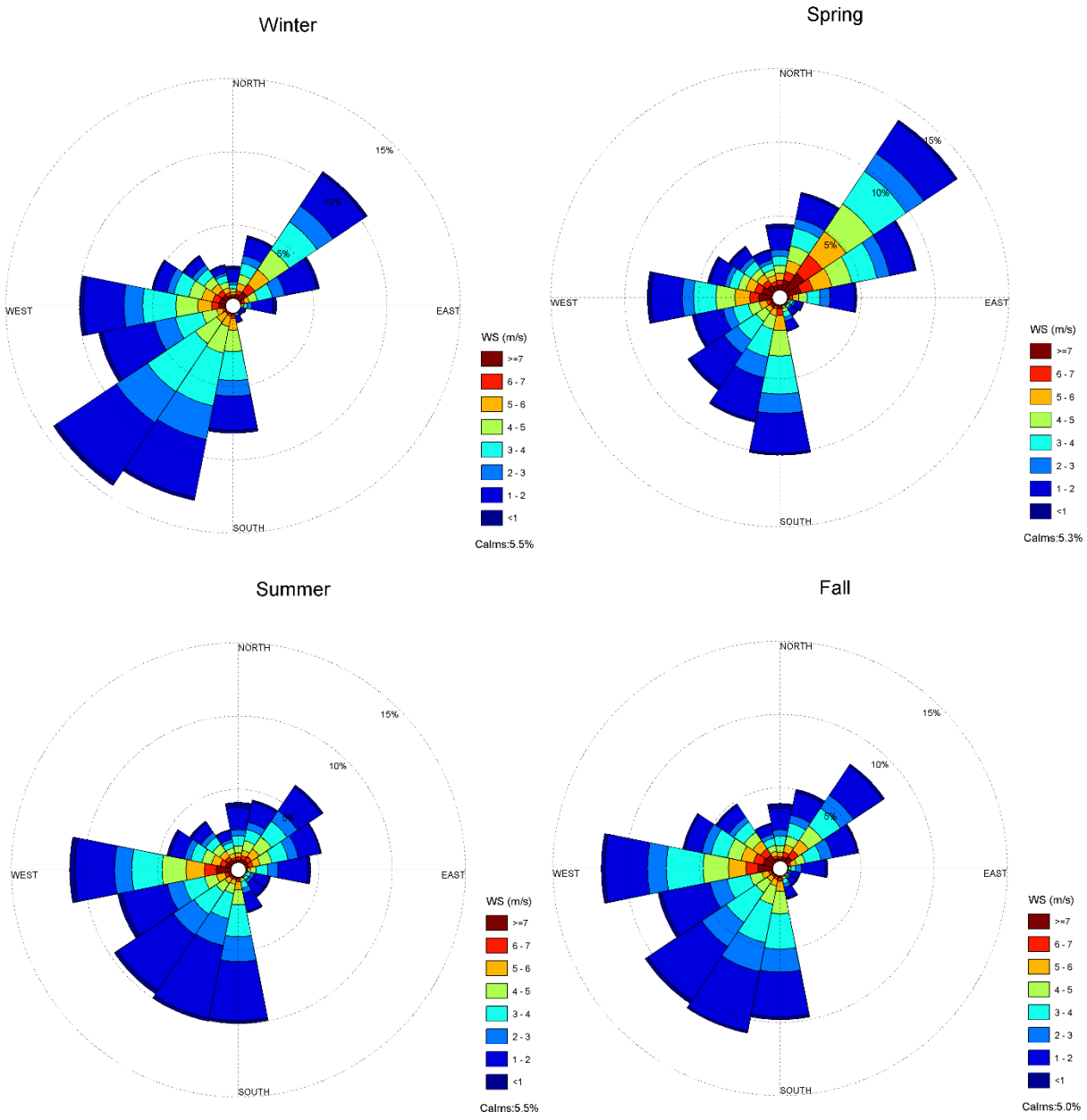


Figure 2.1-3: Seasonal Wind Speed and Direction at Hudson Bay Meteorology Station, 1994 to 2016

2.2 Air Quality

2.2.1 Introduction

Air quality, including ground level concentrations and surface deposition rates for trace gases and particulate matter (PM), are linked to other biophysical disciplines such as surface water quality, fish habitat, vegetation, and wildlife habitat. Air quality baseline data provides historical context for air quality within Saskatchewan's Boreal Airshed. Comparison to baseline data is the most objective way to determine the contributions of the Project's emissions to the over-all emissions within the region.

2.2.2 Methods

The Province of Saskatchewan and the Saskatchewan Ministry of Environment (MOE) have established regional air zones for the purpose of monitoring air quality in Saskatchewan. Air zones are defined as geographic regions within Saskatchewan that share similar air quality characteristics and challenges. Their boundaries consider local topography, meteorology, economic activities and sources of natural (e.g., forest fires) and man-made air emissions (e.g., fossil fuel combustion). The Project resides near the proposed boundaries of the East Central Airshed and the Boreal Airshed. At this time, neither of these airsheds have airshed associations actively monitoring/managing air quality.

The Project resides within the north-central Saskatchewan air dispersion modelling zone (MOE 2012). Background concentrations of criteria air contaminants for this modelling zone have been tabulated by the MOE for use in estimating changes to air quality as a result of proposed developments. The recommended background values of criteria air contaminants included in the Saskatchewan Air Quality Modelling Guideline ([SAQMG]; MOE 2012) are used for the Project.

The Project may affect emissions of greenhouse gases (GHG) produced by the Prairie River bog. The dynamics and time scales of GHG emissions from bog ecosystems are complex, and require special consideration for proposed peat harvesting operations. The probable baseline GHG emissions from the Prairie River bog are evaluated using estimates provided in peer-reviewed scientific literature.

Peatlands (bogs and fens) of continental western Canada (Alberta, Saskatchewan and Manitoba) cover approximately 365,000 km^2 and store 48.0 petagrams (Pg) of carbon (1 Pg is equal to 10^{15} grams [g]). This represents 2.1% of the global terrestrial carbon reservoir, but only 0.25% of the global land area (Vitt et al. 2000). The Prairie River bog is a non-permafrost bog. This bog type accounts for 8.5% (31,000 km^2) of the peatlands in continental western Canada.

Peatlands are a large net carbon sink, sequestering between 10 and 35 grams of carbon per metre squared per year (g-C/m^2/y) (Ovenden 1990; Roulet et al. 2007; Strack et al. 2016; Vitt et al. 2000;). Carbon dynamics in bogs includes uptake of atmospheric carbon dioxide (CO_2), release of methane (CH_4) to the atmosphere, and export of dissolved organic carbon (DOC) in water. The study by Roulet et al. (2007) examined net carbon exchange between the atmosphere and an undisturbed ombrotrophic bog near Ottawa, Canada over a 6-year period. Their observed rates of carbon accumulation varied annually, indicating natural peatlands can be sources or sinks of carbon over short time scales. However, their average rate of carbon accumulation (a net sink) was found to be indistinguishable to the carbon accumulation rates observed in peat cores integrating the bog's growth from 400 to 3000 years before present. The recent study by Strack et al. (2016) brought together plot-scale growing season fluxes of CO_2 and CH_4 from six Canadian peatlands restored by the moss layer transfer technique and compared them with fluxes from adjacent unrestored and natural peatlands. The CO_2 and CH_4 fluxes for the natural peatlands and restored peatlands from these studies (Roulet et al. 2007; Strack et al. 2016) were used as the basis for

estimating the Base Case GHG emissions for the Project. The export and fate of DOC is not considered as part of the GHG assessment for the Project because the sequestering of DOC and the time scales for this carbon to return to the atmosphere are highly uncertain.

The global warming potential (GWP) of CO_2 is defined as 1, whereas the GWP of CH_4 is 28 and 34 with and without inclusion of climate-carbon feedbacks (IPCC 2013). That is, on a mass basis, atmospheric methane's contribution to global radiative forcing over a 100-year interval is 28 or 34 times of that of CO_2 over the same 100-year interval. Left undisturbed and, depending on the study (i.e., Roulet et al. 2007 vs. Strack et al. 2016) and the GWP selected for CH_4 (i.e., 28 vs. 34), northern peatlands may either represent a net carbon sink, (-8.9 grams of carbon dioxide equivalents per metre squared per year [g-CO_{2e}/m^2/y]) of GHG's to the atmosphere or represent a small net source of GHG's (Total = 35 g-CO_{2e}/m^2/y) (Table 2.2-1).

Table 2.2-1: Natural Greenhouse Gas Emissions from an Eastern Canadian Bog

Greenhouse Gas	GWP of 28 (Roulet et al. 2007)	GWP of 34 (Strack et al. 2016)
	g-CO_{2e}/m^2/y	g-CO_{2e}/m^2/y
CO_2	-147	-78
CH_4	138	113
Total	-8.9	35

CO_2 = carbon dioxide; CH_4 = methane; GWP = global warming potential; g-C/m^2/y = grams of carbon per metre squared per year; 1σ = one standard deviation of the mean; g-CO_{2e}/m^2/y = grams of carbon dioxide equivalents per metre squared per year.

2.2.3 Results

2.2.3.1 Criteria Air Contaminants

Table 2.2-2 summarizes the background concentrations, based on the SAQMG, for the following criteria air contaminants:

- carbon monoxide (CO);
- nitrogen dioxide (NO_2);
- sulfur dioxide (SO_2);
- particulate matter smaller than 2.5 micrometres ($PM_{2.5}$);
- particulate matter smaller than 10 micrometres (PM_{10}); and
- total suspended particulate matter (TSP).

No background concentrations of CO or PM_{10} are listed in the SAQMG for the north central air dispersion modelling zone, but because the site is rural, the values for the northern (i.e., boreal) air dispersion modelling zone are used as background concentrations. No background concentrations of TSP are listed for any of the Saskatchewan air dispersion modelling zones, because this is an important emissions type for the Project, the background PM_{10} values are used for TSP.

Table 2.2-2: Background Concentrations of Criteria Air Contaminants

Criteria Air Contaminant	Averaging Period	Percentile	Background Concentration
CO (ppm)	1-hour	90th	0.5
	8-hour	90th	0.5
NO_2 (ppm)	1-hour	90th	0.017
	24-hour	90th	0.015
	Annual	50th	0.003
SO_2 (ppm)	1-hour	90th	0.001
	24-hour	90th	0.001
	Annual	50th	0
$PM_{2.5}$ (µg/m^3)	24-hour	90th	6.6
	Annual	50th	3
PM_{10} (µg/m^3)	24-hour	90th	23.1[(a)]
	Annual	50th	23.1[(a)]
TSP (µg/m^3)	24-hour	90th	23.1[(a)]
	Annual	50th	23.1[(a)]

[(a)] 90th percentile PM_{10} value for 24-hour average from northern air dispersion modelling zone.
CO = carbon monoxide; NO_2 = nitrogen dioxide; SO_2 = sulfur dioxide; $PM_{2.5}$ = particulate matter smaller than 2.5 micrometres; PM_{10} = particulate matter smaller than 10 micrometres; TSP = total suspended particulate matter; ppm = parts per million; µg/m^3 = micrograms per cubic metre.

2.2.3.2 Greenhouse Gases

The Project Footprint of the project is 1,059 ha (2,619 acres) and is proposed to be harvested for 47 years including construction, operations, and closure phases. The access road will be upgraded within a 37 m wide right-of-way (ROW) for a total area of 0.63 km^2 or 63 ha (156 acres); however, the final road surface is expected to be between 7 and 10 m wide. Prairie river bog will be harvested in phases and the maximum harvest area open at one time will be 253 ha (624 acres), the Project Footprint was used to conservatively represent the area of disturbance for baseline GHG study. During this approximately 47-year interval, the peatland will become a net source of both atmospheric CO_2 and CH_4. Post-harvest, this assessment considers an additional 50-year time period, which is estimated as the time required for the bog to return to its pre-disturbance conditions as a small net carbon sink (Cleary et al. 2005). If left undisturbed, the Prairie river bog is expected to sequester 9.2 kilotonnes (kt) or produce 35.9 kt of carbon dioxide equivalents (CO_{2e}) over a 97-year period (Table 2.2-3).

This range in estimates of the net sequestration versus net release of GHG from the Prairie River bog depends on the study (i.e., Roulet et al. 2007 vs. Strack et al. 2016) and the selection of the GWP for CH_4; however, left undisturbed, the net gain or loss of carbon by the bog will vary inter-annually due to seasonal and annual variations in local weather. Thus the range of -9.2 kt to +35.9 kt of CO_{2e} represents a conservative estimate of the range of potential total GHG fluxes over a 97-year period.

Table 2.2-3: Baseline Greenhouse Gas Emissions from Prairie River Peat Harvest Project

Greenhouse Gas	CO_{2e} @ CH_4 GWP of 28 [kt] (Roulet et al. 2007)	CO_{2e} @ CH_4 GWP of 34 [kt] (Strack et al. 2016)
CO_2	-151.3	-80.1
CH_4	142.1	116.0
Total	-9.2	35.9

CO_2 = carbon dioxide; CH_4 = methane; CO_{2e} = carbon dioxide equivalents; GWP = global warming potential; kt = kilotonnes.

2.3 Summary

Climate at the Project location was evaluated by summarizing the available 23-year daily average values for air temperature using the same method as that used to compute 30-year Canadian climate normals. Daily precipitation data were used to compute monthly averages and hourly wind data were used to produce seasonal summarizes for wind speed and direction. All of the data used in the summary were sourced from the Hudson Bay meteorology station located approximately 50 km to the southeast of the Project. The average daily temperature ranges from -17.3°C in January to +17.8°C in July. The region experiences approximately 454.2 mm of precipitation, most of which falls as rain in the summer months of June, July and August. Wind conditions are consistent in the area with average wind speeds common near 10 km/hr year-round and with seasonally variability in direction. Winds are most frequently observed from the northeast in the winter and spring seasons and from the southwest in the fall and winter.

Because there is little background data available on existing air quality conditions at the Project site, the baseline air quality conditions to be used in the air quality dispersion modelling assessment were established using the recommended background values of criteria air contaminants included in the Saskatchewan Air Quality Modelling Guideline ([SAQMG]; MOE 2012). Air quality compounds to be evaluated include CO, NO_2, SO_2, $PM_{2.5}$, PM_{10} and TSP.

Because no background concentrations of CO or PM_{10} are listed in the SAQMG for the north central air dispersion modelling zone and since the site is rural, values for the northern (i.e., boreal) air dispersion modelling zone are used as background concentrations. No background concentrations of TSP are listed for any of the Saskatchewan air dispersion modelling zones, because this is an important emissions type for the Project, the background PM_{10} values are used.

The Project may affect emissions of greenhouse gases (GHGs) produced by the Prairie River bog. The probable baseline GHG emissions from the Prairie River bog are evaluated using estimates provided in peer-reviewed scientific literature. Depending on the study (i.e., Roulet et al. 2007 vs. Strack et al. 2016) and GWP of methane used (28 or 34 × CO_2), if left undisturbed, the baseline CO_{2e} flux potential ranges from -9.2 (potential sink) to 35.9 (potential source) kt.

3.0 TERRAIN, SOIL, GEOLOGY AND HYDROGEOLOGY

3.1 Introduction

This section describes the terrain, soil, geology and hydrogeology for the Prairie River Peat Harvest Project (the Project) and surrounding area. Terrain and soils considers the existing physical features and surficial soils located near the Project. Geology considers both the shallow and deep deposits remaining after the Cretaceous and Quaternary Periods. Hydrogeology of peatlands considers the groundwater flow system, and describes typical hydrogeological processes.

3.2 Baseline Study Area

3.2.1 Geology and Hydrogeology

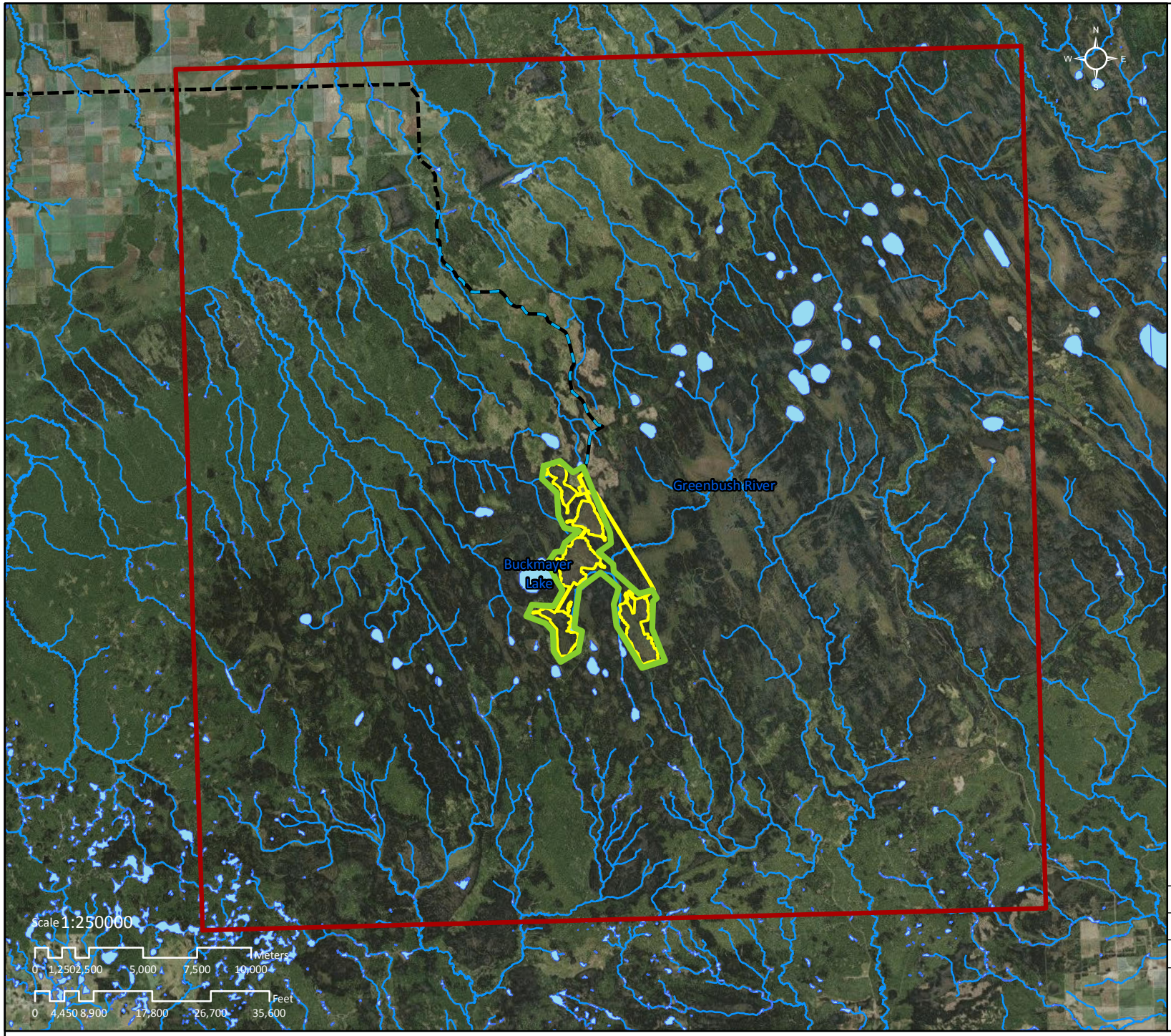
The spatial boundaries of the geology and hydrogeological baseline study area (BSA) are shown in Figure 3.2-1. The assessment of potential Project effects on hydrogeology considers topographic and geologic features, which are assumed to control the movement of surface and groundwater within the defined boundaries. The Prairie River peatland is located within the Pasquia Hills about 20 km north of the town of Prairie River, Saskatchewan. These geologic features are part of the Manitoba Escarpment. The boundaries of the BSA were selected more locally, the southern and western boundaries were set based on topographic relief relating to the upland or Pasquia Hills. The northern boundary was set to include the access road. The eastern boundary of the BSA was set to an arbitrary distance of 16 km from the proposed Prairie River lease boundary.

3.2.2 Terrain and Surficial Soils

The terrain and soils baseline describes key characteristics and existing conditions of terrain and soil in the BSA. The potential Project effects on terrain and surficial soils will be limited to the area of disturbance; therefore, the terrain and soils BSA includes the Project Footprint (1,059 ha, 2,619 acres) and the access road (63 ha, 156 acres).

3.3 Methods

Existing surface and subsurface information were compiled through a desktop study to provide a geological, hydrogeological and terrain and soils characterization of the lease boundary and surrounding area. Compilation of existing information included the collection of existing geologic and soils maps, water well records, study reports, and publications. Existing borehole and water well information was collected from sources such as Saskatchewan Research Council (SRC 1990) and Water Security Agency (WSA 2017). Map Information was collected from the Department of Natural Resources (DNR) Maps and SRC. Additional study reports and publications were also retrieved from the Saskatchewan Geological Survey (SGS 1999).



Site Boundaries

- Proposed Lease
- Project Footprint
- Geology and Hydrogeology Baseline Study Area

Hydrology

- Waterbody
- Watercourse

Infrastructures

- Gravel Road (Existing)
- Access Road (Existing Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/28
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 3.2-1: Geology and Hydrogeology Baseline Study Area |

Prairie River Bog

3.4 Results

3.4.1 Bedrock Geology and Hydrogeology

Hydrogeological studies for the Hudson Bay and Pasquia Hills area (mapsheet 63D and 63E, respectively) have delineated the geology for the BSA (Millard 1996). Figure 3.4-1 shows the bedrock surface in the BSA. The following geologic units are present in the BSA, in ascending order:

- Manville Group/Swan River Formation (not shown on Figure 3.4-1; deeper than other formations listed);
- Lower Colorado Group/Ashville Formation;
- Favel Formation;
- Morden Shale and Niobrara Formation;
- Pierre Shale; and
- Tertiary-Quaternary Sediments.

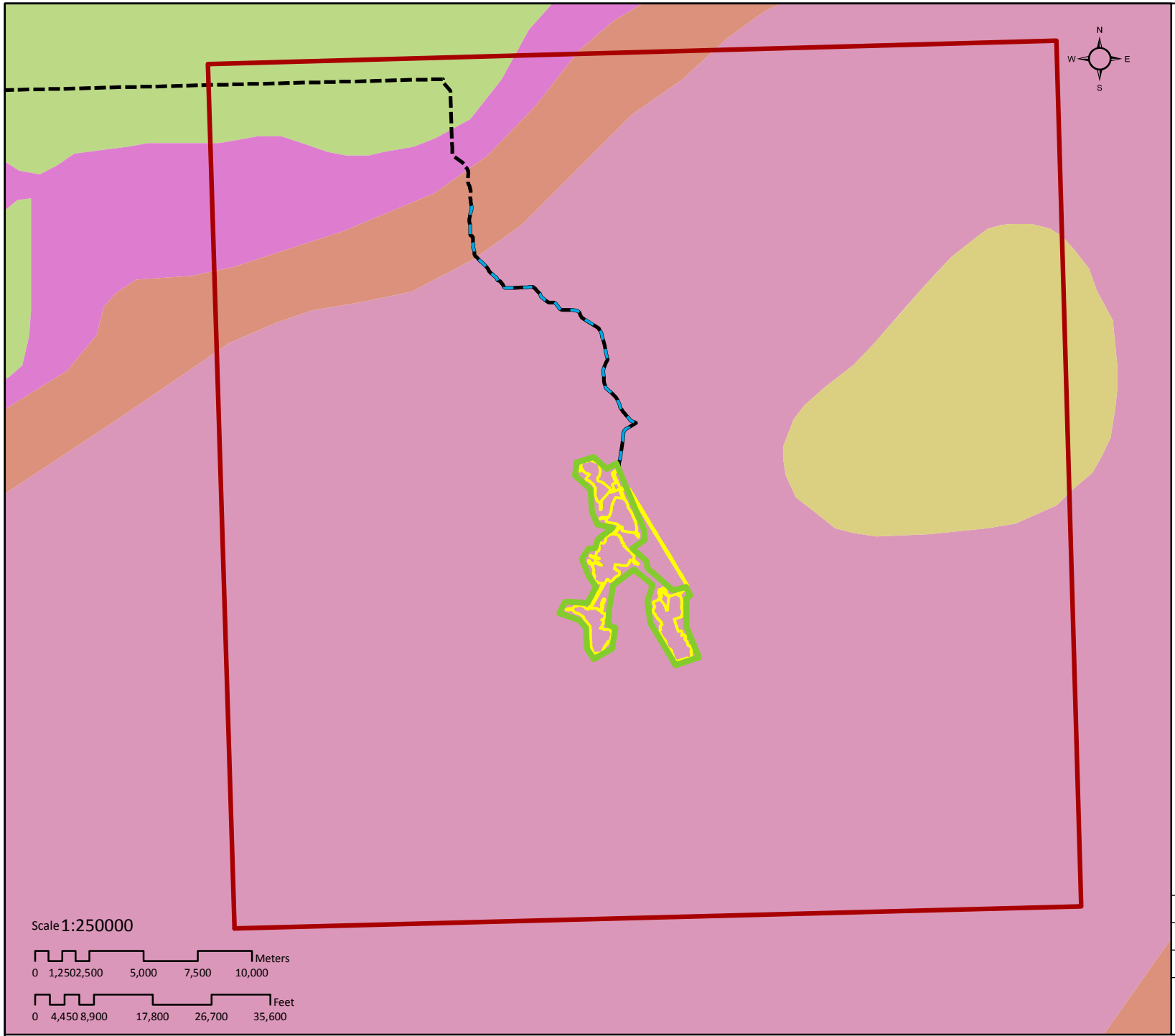
As shown in Figure 3.4-1, the bedrock geology underlying the BSA includes mainly the Pierre Shale - silty marine claystone and shale with concretionary zones common near the base with the exception of the northwest corner of the BSA where the Pierre Shale has been eroded and the surface consists of a transition from Niobrara Formation and Morden Shale to the Favel Formation to the Ashville Formation. The bedrock surface in an area in the east-northeast corner of the BSA is made up of undifferentiated Tertiary deposits (gravels, sands and silts) known to be deposited on the Cretaceous uplands.

3.4.1.1 Manville Group / Swan River Formation

The stratigraphically oldest (lowest) unit present in the BSA is the Swan River Formation. The Swan River Formation consists of locally cemented, fine to medium grained sand, silt, and clay, and is considered the lithostratigraphic equivalent of the Manville Group of western Saskatchewan. The Swan River Formation can vary in thickness from approximately 75 metres (m) to 140 m. The Swan River Formation is the most extensive aquifer in the Pasquia Hills. In the Pasquia Hills this aquifer is rarely used for domestic water supplies due to its depth (310^{+} m below ground surface). In the northwest of the BSA this aquifer is used as a water supply with the surface elevation ranging from 314 to 362 m above sea level (ASL). The depth below ground surface of the Formation ranges from 27 m to 98 m, with a piezometric head around 20 m below ground surface.

3.4.1.2 Lower Colorado Group / Ashville Formation

The Ashville Formation directly overlies the Swan River Formation and is primarily comprised of noncalcareous dark grey or black silt and clay and is the lithostratigraphic equivalent of the lower Colorado Group of western Saskatchewan (Millard 1997). The Ashville Formation is known to be a poor aquifer due to its heterogeneous nature (McNeil and Caldwell 1981). The unit's maximum thickness of about 70 m is present in the Pasquia Hills.



Site Boundaries

- Proposed Lease
- Project Footprint
- Geology and Hydrogeology Baseline Study Area

Bedrock Geology

- Lower Colorado Group/Ashville Formation
- Favel Formation
- Modern Shale and Niobrara Formation
- Pierre Shale
- Tertiary-Quaternary Sediments

Infrastructures

- Gravel Road (Existing)
- Access Road (Existing Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/09/08
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017)

Figure 3.4-1: Bedrock Geology within the Geology and Hydrogeology Baseline Study Area | Prairie River Bog

3.4.1.3 Favel Formation

The Favel Formation is the lithostratigraphic equivalent of the Second White Speckled Shale that marks the base of the upper Colorado Group farther to the west. This unit consists of dark grey, calcareous shale with thin beds of clayey limestone and is about 20 m thick in the Pasquia Hills. The Favel Formation is not known for use as an aquifer.

3.4.1.4 Morden Shale and Niobrara Formation

The Morden Shale and Niobrara Formation are considered a single unit for the purposes of this report. These units were formerly known collectively as the Vermillion River Formation (Moran and Whitaker 1969). The lower part of the unit (Morden Shale) is comprised of black, noncalcareous shale with thin bentonite beds. The upper part of the unit (Niobrara Formation) consists of chalky or speckled shale and is lithostratigraphically equivalent to the First White Speckled Shale of western Saskatchewan (McNeil and Caldwell 1981). This unit is expected to be about 25 m thick in the Pasquia Hills and forms the bedrock surface near the northwest and southeast corners of the BSA where the Pasquia Hills tend to recede. The Morden and Niobrara Formations are not known for use as an aquifer.

3.4.1.5 Pierre Shale

The Bearpaw and Lea Park Formations of western Saskatchewan are separated by the Judith River Formation. Where the Judith River Formation is not present, the Bearpaw and Lea Park Formations are indistinguishable and are collectively referred to as the Pierre Shale Formation. This unit is comprised mainly of noncalcareous silts and clays that form most of the bedrock surface in the BSA. The Pierre Shale is not present outside of the Pasquia Hills in the northwest corner of the BSA. The bedrock surface within the BSA is encountered between 300 m ASL in the northwest corner and over 500 m ASL directly below the proposed lease area. The southeast corner of the BSA bedrock surface is about 450 m while the southwest corner is about 475 m ASL. The Pierre Shale is not known for use as an aquifer.

3.4.2 Tertiary-Quaternary Geology and Hydrogeology

The surficial geology of the BSA is characterized by undifferentiated stratified drift that is predominantly glacial in origin. The glacial ice eroded pre-existing sediments and deposited stratified layers of unsorted sand, silt, clay, pebbles, and boulders accumulated by the glacier (Millard 1997). Several cycles of glacial advance and retreat has deposited distinguishable layers of glacial drift. As the ice retreated from the area much meltwater was released resulting in deposition of stratified gravels, sands, silts and clays. This process of erosion and deposition of till and stratified deposits occurred several times as the ice repeatedly advanced and retreated over the area. This sequence of events resulted in the drift stratigraphy that presently exists (Millard 1996). The drift can be up to 150 m thick in the BSA.

In the area immediately surrounding the Project, the predominant surficial geology is organic plain and morainal ridge (Geological Atlas of Saskatchewan Viewer [GASV] 2017). The surficial geology of the BSA does also include ranges from morainal, morainal hummocky, morainal undulating and glaciofluvial and glaciolacustrine. The surface elevation in the BSA ranges from approximately 400 m ASL to 620 m ASL, but is closer to 590 m ASL within the lease boundary. The surface geology of the BSA is presented in Figure 3.4-2.

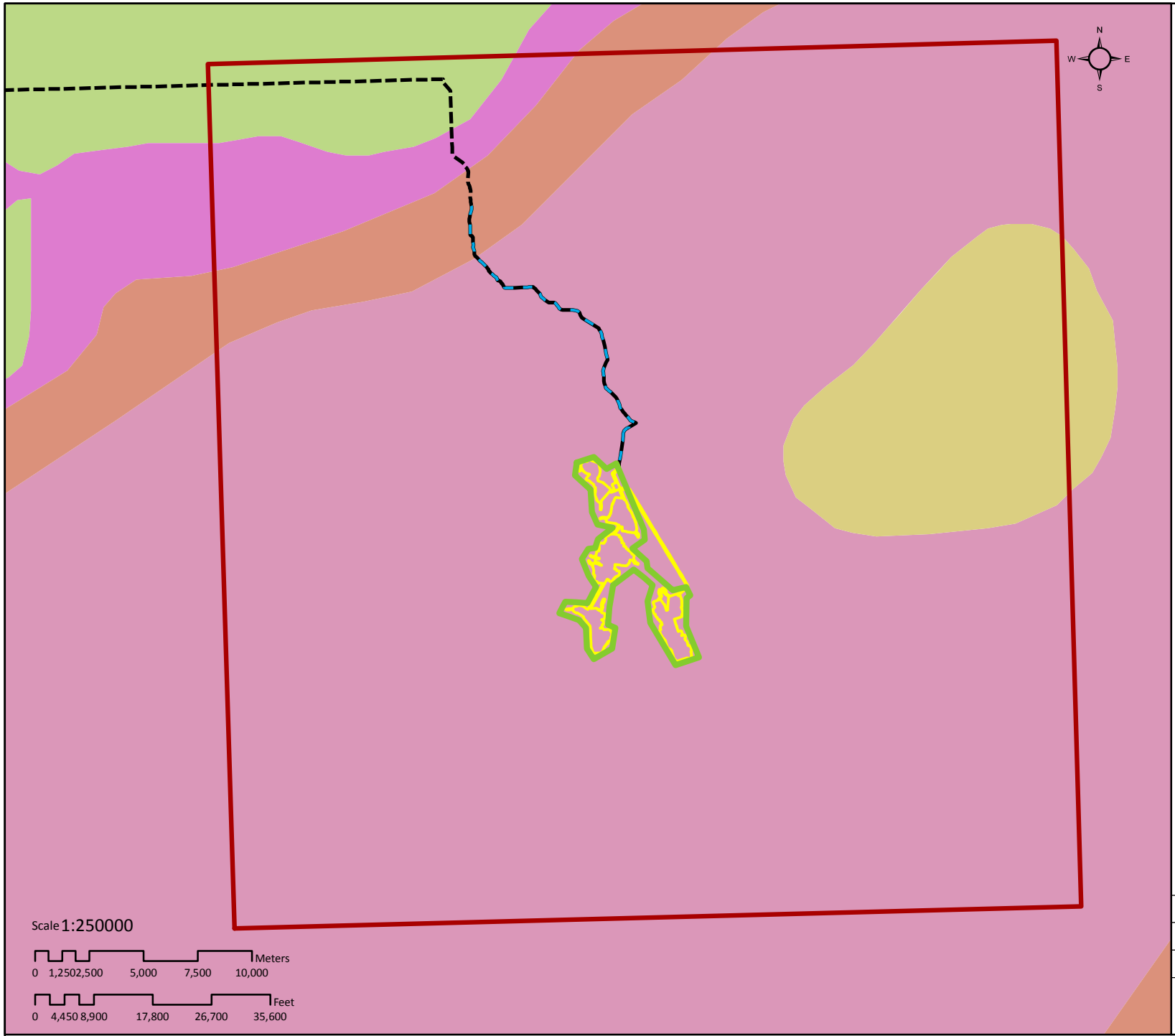
3.4.2.1 Tertiary

The youngest bedrock deposits in the Pasquia Hills area consist of about 3 m of yellowish brown, noncalcareous sand that lie upon the Pierre Shale uplands. This upland bedrock deposit is known as the undifferentiated Tertiary deposit. The Tertiary sand grades increase with elevation above 3 m to about 1 m in thickness of black chert gravel. These sediments have been confirmed in one location only within the BSA in Section 5, Township 48, Range 5, West of the 2nd Meridian and therefore are not considered to be an aquifer based on the limited extent (~ 4 m in thickness and minimal testhole information; Millard 1997).

3.4.2.2 Intertill Aquifers

Within the BSA, the Sutherland Group and Saskatoon Group are undifferentiated. Intertill aquifers are stratigraphically located between the Sutherland and Saskatoon Group tills. Interill aquifers can vary in depth and thickness and are poorly mapped in the BSA. In the Pasquia Hills map sheet, the intertill aquifers occur northwest of the Pasquia Hills primarily between this upland and the Saskatchewan River (Millard 1997).

The stratigraphic column for the geology and hydrogeological BSA is presented in Figure 3.4-3.



Site Boundaries

- Proposed Lease
- Project Footprint
- Geology and Hydrogeology Baseline Study Area

Bedrock Geology

- Lower Colorado Group/Ashville Formation
- Favel Formation
- Modern Shale and Niobrara Formation
- Pierre Shale
- Tertiary-Quaternary Sediments

Infrastructures

- Gravel Road (Existing)
- Access Road (Existing Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/09/08
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017)

Figure 3.4-1: Bedrock Geology within the Geology and Hydrogeology Baseline Study Area | Prairie River Bog

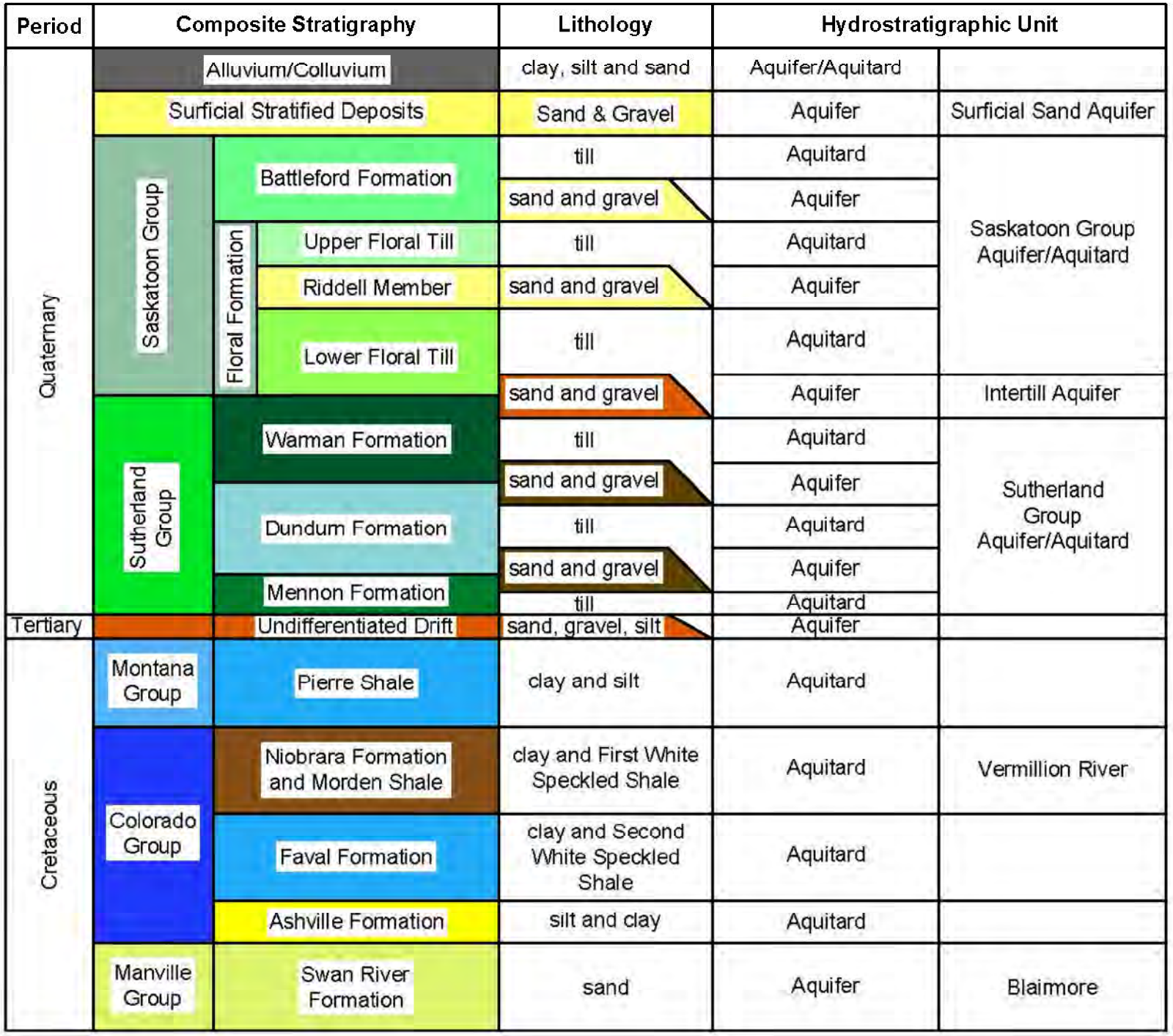


Figure 3.4-3: Stratigraphic Column for the Geology and Hydrogeology Baseline Study Area | Prairie River Bog

3.4.3 Water Well Database

A query of the WSA Water Well Database (WSA 2017) includes a total of 25 boreholes recorded within the geology and hydrogeological BSA of which 24 are for domestic purpose and one borehole for research. The relevant information from the WSA databases for the water wells and test holes is included in Table 3.4-1. The locations have not been verified in the field.

The wells and borehole located within the geology and hydrogeological BSA range in depth from a few metres to 134.1 m. The wells with sufficient installation details that are located within the Pasquia Hills have been installed within the undifferentiated till. Most of the water wells in Table 3.4-1 are located in the northwest corner of the BSA. The locations within 49-08-W2 have a surface elevation of about 382.8 m ASL where the topography dips and the Pasquia Hills begin to depart. With 49-08-W2 and 50-08-W2, many of the deeper wells (>50 m in depth) are likely installed within the Swan River Formation and the shallower wells are likely targeted within the drift intertill aquifers. Due to its depth (over 200 m) and other readily available water sources, no wells are installed in the Swan River Formation within the Pasquia Hills.

Table 3.4-1: Water Wells or Testholes within the Geology and Hydrogeology Baseline Study Area

Water Well Driller Record	Location		UTM Zone	Legal Land Description (Quarter - Section – Township – Range – Meridian)	Surface Elevation (m ASL)	Completion Date	Borehole Depth (m)	Pumping Rate (IGPM)	Well Use
	Northing	Easting							
116883	5886548	654735	13U	SE-05-48-05-W2	591.0	1988.08.30	134.1	N/A	Soil Test Hole
84740	5894242	635559	13U	SW-33-48-07-W2	556.3	Unknown	21.3	22	Withdrawal
85577	5886207	637420	13U	SW-03-48-07-W2	571.5	1987.08.08	27.4	35	Withdrawal
22480	5894382	626176	13U	33-48-08-W2	Unknown	Unknown	Unknown	N/A	Withdrawal
12561	5903855	632023	13U	SW-31-49-07-W2	382.8	1973.12.04	45.1	4	Withdrawal
24766	5905217	622236	13U	SW-06-50-08-W2	382.8	1964.07.08	74.4	5	Withdrawal
86500	5905217	622236	13U	SW-06-50-08-W2	382.8	1986.11.21	82.3	50	Withdrawal
51125	5902117	627188	13U	SW-27-49-08-W2	417.6	1977.09.13	10.7	2	Withdrawal
112088	5905307	625484	13U	SW-04-50-08-W2	382.8	2000.09.13	80.8	10	Withdrawal
118227	5901292	627209	13U	NW-22-49-08-W2	408.9	2002.06.22	81.7	10	Withdrawal
59375	5904527	627129	13U	NW-34-49-08-W2	382.8	1979.09.25	15.2	N/A	Water Test Hole
59376	5904527	627129	13U	NW-34-49-08-W2	382.8	1979.09.25	4.6	N/A	Water Test Hole
59377	5904527	627129	13U	NW-34-49-08-W2	382.8	1979.09.25	3.0	N/A	Water Test Hole
59378	5904527	627129	13U	NW-34-49-08-W2	382.8	1979.09.25	1.8	N/A	Water Test Hole
59379	5904527	627129	13U	NW-34-49-08-W2	382.8	1979.07.01	6.1	N/A	Water Test Hole
59380	5904527	627129	13U	NW-34-49-08-W2	382.8	1979.09.25	1.5	N/A	Water Test Hole
59381	5904527	627129	13U	NW-34-49-08-W2	382.8	1979.09.25	6.1	N/A	Water Test Hole
118021	5904527	627129	13U	NW-34-49-08-W2	382.8	2002.11.07	74.7	12	Withdrawal
109617	5905285	624661	13U	SE-05-50-08-W2	382.8	1998.08.07	79.9	10	Withdrawal
117616	5902095	626366	13U	SE-28-49-08-W2	400.2	2002.08.04	83.8	12	Withdrawal
85716	5901158	622337	13U	NW-19-49-08-W2	400.2	1987.08.25	97.5	30	Withdrawal
74781	5905432	630355	13U	SW-01-50-08-W2	382.8	1983.05.16	19.5	N/A	Withdrawal

Table 3.4-1: Water Wells or Testholes within the Geology and Hydrogeology Baseline Study Area

Water Well Driller Record	Location		UTM Zone	Legal Land Description (Quarter - Section – Township – Range – Meridian)	Surface Elevation (m ASL)	Completion Date	Borehole Depth (m)	Pumping Rate (IGPM)	Well Use
	Northing	Easting							
229818	5904393	622257	13U	NW-31-49-08-W2	389.1	2013.10.16	73.2	16	Withdrawal
46442	5904506	626307	13U	NE-33-49-08-W2	382.8	1974.12.02	82.3	N/A	Water Test Hole
22479	5901607	638598	13U	NW-23-49-07-W2	522.0	1944.07.15	7.0	N/A	Withdrawal

UTM = Universal Transverse Mercator; m ASL = m above sea level; m = metre; IPGM = imperial gallons per minute; N/A = not applicable.
Source: WSA 2017.

3.4.4 Terrain and Surficial Soils

Terrain and soils are important to functioning ecosystems. Terrain is one of the factors that influences development and distribution of soils across the landscape. Soil is a complex heterogeneous medium consisting of variable amounts of minerals, organic matter, water and air, and supports organisms, including bacteria, fungi, invertebrates, and other animal life. Soil macro- and micro-organisms are responsible for organic matter decomposition, nutrient cycling, and organic waste decomposition, which in turn influence ecosystem health.

3.4.4.1 Terrain

The Project is located in the Pasquia Plateau Landscape Area of the Mid-Boreal Upland Ecoregion within the Boreal Plain Ecozone (Acton et al. 1998). The access road crosses through the Pasquia Plateau and Pasquia Escarpment Landscape Areas of the Mid-Boreal Upland Ecoregion and the Mistatim Upland Landscape Area of the Boreal Transition Ecoregion within the Boreal Plain Ecozone (Acton et al. 1998). The Boreal Plain in Saskatchewan extends in a band from the Precambrian Shield south to the aspen parkland and is dominated by northern boreal forest. It is an area of level to gently rolling plain based on sedimentary rock and covered by thick glacial deposits, interspersed by lakes and glacial kettles. The Mid-Boreal Upland Ecoregion has uplands with hummocky morainal landscapes surrounded by adjacent plains dominated by level glaciofluvial and glaciolacustrine deposits with wetlands and peatlands. The Boreal Transition Ecoregion is undulating to gently sloping glacial till, glaciolacustrine and glaciofluvial plains with hummocky morainal uplands.

3.4.4.2 Soils

Soils in the Boreal Plain Ecozone are dominantly Luvisolic, with Brunisolic soils in higher elevations and Organic soils or peatlands in lower elevations. Organic soils and peatlands are typically found in low-lying areas where drainage is restricted. Peatlands are found throughout the ecozone especially within the mid-boreal ecoregions. Some of these peatlands have layers of peat that remain frozen into the summer months.

Soils in the BSA are largely organic moss peat overlying glacial till within a low-lying, poorly drained, depressional area. Organic soils within the BSA may range from relatively undecomposed fibric organic material to humic material in advanced stages of decomposition. Upland Gray Luvisol soils have formed on glacial till parent material and are very stony (Acton et al. 1998).

3.5 Summary

A review of the groundwater resources for the region indicates the major aquifer that exists within BSA is the Swan River Formation (Millard 1997). There are no records of water wells or boreholes within the BSA Swan River Formation with the exception of the northwest corner of the BSA where the Pasquia Hills depart. Within this area of the BSA (49/50-8-W2), the elevation of the Swan River Formation is closer to ground surface making it more feasible as a utilized a water source. The till within the BSA is undifferentiated. Although intertill aquifers have the potential to exist between the till stratigraphic layers, they are not mapped in the BSA. There are several shallow water wells completed within the BSA undifferentiated till, likely within a local unmapped intertill aquifer.

Soils in the BSA are largely organic peat overlying glacial till within a low-lying, poorly drained, depressional area.

4.0 HYDROLOGY

4.1 Introduction

This report describes the field and desktop studies completed to characterize the hydrology of the Prairie River Peat Harvest Project (the Project) and the surrounding region. Harvesting of the peat resource will require construction of drainage ditches and drainage of water from the bog into the surrounding environment. The field and desktop studies will be used to support the assessment of potential effects to hydrology from the Project.

4.2 Baseline Study Area

The Project is located in the Pasquia Hills on the drainage divide between the Red Deer and Carrot rivers in Saskatchewan. The north and west part of the lease area is within the Papikwan River watershed that flows to the Carrot River, while the southern part is within the Greenbush River watershed that flows eventually to the Red Deer River (Figure 4.2-1). The access road that will lead north from the lease area is primarily within the Cracking River watershed, which eventually flows to the Carrot River.

The hydrology baseline study area (BSA) covers 37.3 km^2 and includes the lease area plus the areas in the Greenbush and Papikwan River watersheds that are immediately downstream of the proposed Project outlet ditches for the five phases of development (Figure 4.2-1). The hydrology BSA also includes 50 m wide buffers on either side of the proposed access road and stream channels downstream of the Project. The projected harvest area is 782 ha (7.82 km^2) and the Project lease is 2,144 ha (21.44 km^2).

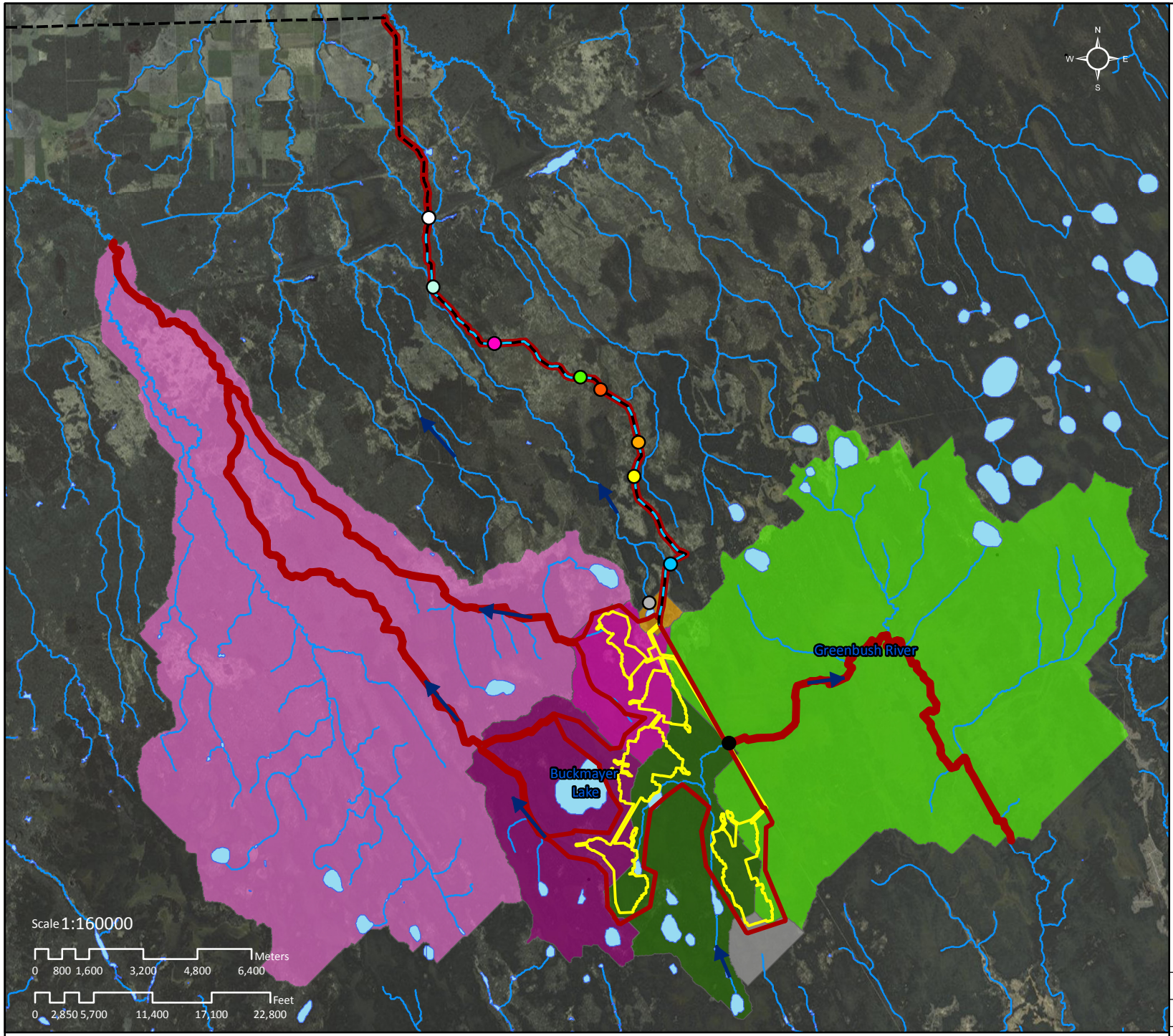
4.3 Methods

4.3.1 Compiling Precipitation and Evapotranspiration Records

The climate station closest to the Project is in Hudson Bay, Saskatchewan (Environment and Climate Change Canada [ECCC] 2017a) approximately 50 km southeast of the Project (Station No. 4083324). Canadian climate normal data for the period 1981 to 2010 are not available for the Hudson Bay climate station. However, daily and hourly meteorological data from this station including temperature, precipitation, wind speed, and wind direction are available from Environment and Climate Change Canada for the period from 1994 to 2016 (ECCC 2017a). The elevation at the climate station is 422 metres above sea level (m ASL), while elevations at the Project range from about 600 m ASL in the Pasquia Hills near the lease area to 380 m at the north end of the access road. Methods used to compile the 23 year meteorological record for this assessment are described in Section 2.0 Climate and Air Quality.

Corrected (adjusted) precipitation data for this station are also available from ECCC for the years 1943 to 2013 and these data are considered to be more accurate than the raw data (Vincent 2017 pers. comm.). Climate data were obtained from ECCC (2017a). Methods used to adjust precipitation data are outlined in Mekis and Vincent (2011).

Evaporation is the change in state of water from liquid to vapour that occurs from water, soil or other surfaces. Actual evapotranspiration (AET) comprises the evaporation from water surfaces and soil, and transpiration losses from plants. Potential evapotranspiration (PET) is the amount of evapotranspiration that would occur if water was unlimited on the surface. AET and PET results shown for the Hudson Bay climate station are based on the Morton monthly calculation method.



Site Boundaries
- Project Footprint
- Hydrology Baseline Study Area

Hydrology
- Waterbody
- Watercourse
- Flow Direction

Hydrologic Station
- Crossing 1 (Above Beaver Dam)
- Crossing 2 (Creek 2 Below Beaver Dam)
- Crossing 3 (Creek 3)
- Crossing 4 (Quad Bridge)
- Crossing 5 (Beaver Dam)
- Crossing 6 (West Flow)
- Crossing 7
- Crossing 8 (Culvert near Parking Lot)
- Greenbush River at Hydrology Station
- North Pond Outflow

Watershed

Greenbush River Watershed
- Greenbush River at Hydrology Station
- Greenbush River Below the Baseline Study Area

Papikwan River Watershed
- Upper Papikwan River below Lease Area
- Papikwan River Downstream of the Baseline Study Area
- Tributary of Papikwan

Other Watershed
- North Pond Outflow below Lease Area
- South Basin below Lease Area

Infrastructures
- Gravel Road (Exisiting)
- Access Road (Exisiting Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/25
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 4.2-1 : Hydrology Baseline Study Area |

Prairie River Bog

Published gross evaporation (lake evaporation) estimates were calculated using the modified-Meyer method (Prairie Farm Rehabilitation Administration [PFRA] 2002; Bell pers. comm. 2009). Monthly and annual total gross evaporation data were available for the Hudson Bay climate station for the years 1951 to 1990. Monthly values were calculated for 2015 and 2016 using data from the Hudson Bay station and available water temperature data collected in 2016.

Published values of AET were available over a period of four years (2003 to 2006) for a research site in central Saskatchewan for the months of May to October (Sonnentag et al. 2010), and AET data were corrected with a closed water balance for two years from 2006 to 2007 (Barr et al. 2012). The research site had a flux tower and is located in a minerotrophic fen about 200 km east of the Project. These results were compared to AET calculated using climate data from the Hudson Bay climate station.

4.3.2 Timing of Field Visits

Three field visits were completed for the hydrology program in 2016. The initial field visit was combined with the aquatics program and involved installing a logger in the Greenbush River on June 1, 2016 and measuring discharge on June 2, 2016. A subsequent field visit was completed on July 20, 2016 and involved reconnaissance and flow measurements at the streamflow crossings along the proposed access road; setup of a hydrometric station on the Greenbush River at the logger location; and flow measurements within the hydrology BSA along the north edge of the lease area. A fall field visit was completed on September 24, 2016; the hydrometric station was removed at that time.

4.3.3 Watershed Boundaries

Using Green Kenue software (National Research Council of Canada [NRC] 2012), watershed boundaries for streamflow stations were delineated using available topographic data. A digital elevation model (DEM) was compiled using orthoDEM data for the hydrology BSA (ISC SGIC 2016) and supplemented with Canadian Digital Elevation Data in surrounding areas. Watershed boundaries for the hydrology BSA were delineated using the DEM, while channel paths were delineated using national hydrological network shapefiles and checked against Google Earth aerial imagery dated May 23, 2015.

The orthoDEM data in the hydrology BSA have a vertical accuracy of about 1 to 2 m; however, this can vary with location. The watershed boundaries for the streamflow stations and local flow pathways are shown in Figure 4.2-1.

4.3.4 Water Level Surveys and Monitoring

A hydrometric station was initially set up on the Greenbush River on June 1, 2016 at an accessible location along an existing right-of-way (Figure 4.2-1) to measure outflows from the largest watershed overlapping the proposed lease area. Water level surveys were completed during two field visit using an optical level at the logger location. Surveys were conducted relative to a benchmark assigned an arbitrary elevation of 100 m.

Water level loggers measure the total pressure (i.e., atmospheric plus water pressure). Water levels and water temperatures were recorded hourly. Water pressure data were corrected for the relatively large fluctuations in barometric pressure over time using a barometric pressure sensor. The accuracy of the water level sensors is published as 0.05% of full scale range, and water levels are reported to the nearest 0.001 m.

4.3.5 Discharge Measurement

Manual discharge measurements were completed during all three field visits using the standard mid-section method (Terzi 1981), in which the stream cross-section was divided into numerous sub-sections and the average velocity and total water depth measurements were used to calculate discharge for each sub-section. Discharge is defined as the rate of volume of water passing through a cross-sectional area of a stream (perpendicular to the channel). Hence, total discharge through a specific stream cross section was calculated as the sum of the discharge calculated for all sub-sections.

For this Project, discharge was measured using a Sontek FlowTracker Acoustic Doppler Velocimeter (ADV). Water depths were measured to the nearest 0.01 m with a wading rod. Flow velocity was measured using the ADV attached to a wading rod at 60% of the flow depth when the water level depth was less than 0.75 m, and at 20% and 80% depth when water depths exceeded 0.75 m.

4.3.6 Establishing a Local Streamflow Record

The logger that was initially installed on the bed of the Greenbush River could not be retrieved due to flooding during subsequent field visits. Therefore a second logger was installed at the same location on July 20, 2016 and provided data until September 24, 2016. Surveyed water levels were within a few millimetres of the hourly logger records at the start and end of the record, and therefore no water level corrections to the datalogger measurements were necessary. The logger location on the Greenbush River was backwatered during the final field visit, therefore discharge records were corrected using measured discharge using a drift correction in the Aquarius™ software, and the timing of the correction was determined by reviewing concurrent Hudson Bay (Station No. 4083324 precipitation records and streamflow records for the Prairie River (Station No 05LB010) located about 38 km away.

A preliminary rating curve was established from measured discharge and water level data, and a preliminary discharge record was generated for the Greenbush River. The measured discharge captures a relatively wide range of flows experienced in 2016 but did not capture the peak flows that occurred in mid-July. As extrapolations beyond the measured stage and discharge values are subject to greater uncertainty, the discharge estimated from the extrapolated upper end of the curve was checked against regional flows for a river with similar flow patterns for the period of record. The three discharge measurements for the Greenbush River in 2016 were converted to unit runoff (i.e. discharge divided by watershed area) and checked against the unit runoff for the Prairie River on the same dates. The calculated unit runoff of the Greenbush River (based on the extrapolated rating curve) was approximately double that of the Prairie River for all three measurements. Based on this, the upper end of the rating curve for the Greenbush River was modified and a revised discharge record is provided.

4.3.7 Regional Streamflow Station Evaluation

Regional streamflow station data from the Water Survey of Canada (WSC) were evaluated to find a suitable reference station to calculate a long-term flow record, and to be included in a regional flood frequency analysis for the hydrology BSA. Regional stations within about 100 km from the Project were evaluated considering their relative distance from the Project, location in the boreal or agricultural region, watershed area and flow characteristics (Table 4.3-1). The Prairie River (Station No. 05LB010) was identified as the best station to derive long-term records for the Greenbush River as its watershed also originates in the Pasquia Hills, is mainly located in the boreal forest, had similar flow patterns during the period of coincident record in 2016, and is closest to the Project.

Table 4.3-1: Description of Regional Hydrometric Stations used to Characterize Hydrology

Station Name	Station Number	Years of Record[a]	Distance to Project (km)[b]	Effective Drainage Area (km^2)[c]	Gross Drainage Area (km^2)[c]	Mean Open-Water Season Flow (m^3/s)[d]
Prairie River near Prairie River	05LB010	1975-2016	38	339	355	1.28
Loiselle Creek near Hudson Bay	05LB004	1964-2016	49	82	181	0.152
Burntout Brook near Arborfield	05KB005	1965-2016	53	292	305	0.703
Overflowing River near Hudson Bay	05LD003	1975-2016	39	350	350	1.84
Fir River near Hudson Bay	05LD007	1971-2016	44	500	511	2.79
Etomami River near Reserve	05LB001	1955-1965	71	975	1,100	2.91

[a] Period of record includes years when data were available from March to October, additional sporatic records exist for these stations in earlier years.

[b] Measured at the Greenbush River hydrology station.

[c] Sources: Effective Drainage Areas from PFRA 2013, and Watershed Areas from WSC 2017.

[d] Calculated for the period March 1 to October 31 for the years 1975 to 2016 except for Etomami River, which has a short period of record.

km = kilometre; km^2 = square kilometres; m^3/s = cubic metres per second.

4.3.8 Establishing Long-term Records for the Study Area

As discussed above, the Prairie River is considered the best reference station in the region for the Greenbush and Papikwan rivers. Streamflow data are available for the Prairie River Station (Station No. 05LB010) from 1959 to 2016. The record is incomplete before 1975, but from 1975 onward complete seasonal records are available for March through October (WSC 2017). Seasonal streamflow records for the Prairie River were used to generate long-term flows for the Greenbush River at the hydrology station.

Long-term flows were derived for the Greenbush River hydrology station and other locations in the hydrology BSA based on the unit runoff at the Prairie River multiplied by a factor of 2.4. Measured unit runoff at the Greenbush River station was on average of 2.4 times higher than the unit runoff of the Prairie River on the three days when discharge measurements were completed by Golder.

4.3.9 Flood and Low Flow Calculations

A regional flow analysis was completed to determine the magnitude of flood events for the area surrounding the Project. Regional flood frequency results were provided by the Water Security Agency (WSA) to McElhanney (2014). The periods of record used in the calculations are not known. Results for the Etomami River south of Hudson Bay rely on the published values from SaskWater (1993). Flood magnitudes were estimated for the Greenbush River and for other selected locations downstream of the lease area or hydrology BSA using the regional curves of effective drainage area versus flood magnitude for floods with return periods of 2 to 100 years.

The daily mean flow records derived for the hydrology BSA were used to calculate the minimum annual and 7-day low flow based on data from March to October for the years 1975 to 2016. In most years the annual minimum and 7-day low flow was zero or near zero at the Prairie River reference station. A detailed low flow frequency analysis was therefore not completed.

4.4 Precipitation and Evapotranspiration Results

4.4.1 Precipitation

Precipitation is the main control on peatland water levels and its outflows. Precipitation includes snowfall accumulation over the winter season, which increases water storage in the peatland during snowmelt, and contributes to runoff from the peatland during the spring freshet.

Total precipitation in each month in 2016 was compared to long-term adjusted and non-adjusted precipitation records at the Hudson Bay station (Figure 4.4-1). Mean annual non-adjusted precipitation at the Hudson Bay station totals 440 mm. Mean annual adjusted precipitation at the Hudson Bay station is 520 mm (i.e., adjusted for gauge under-catch and other conditions; Environment Canada 2017a). Ten months in 2016 have recorded precipitation that is above-average.

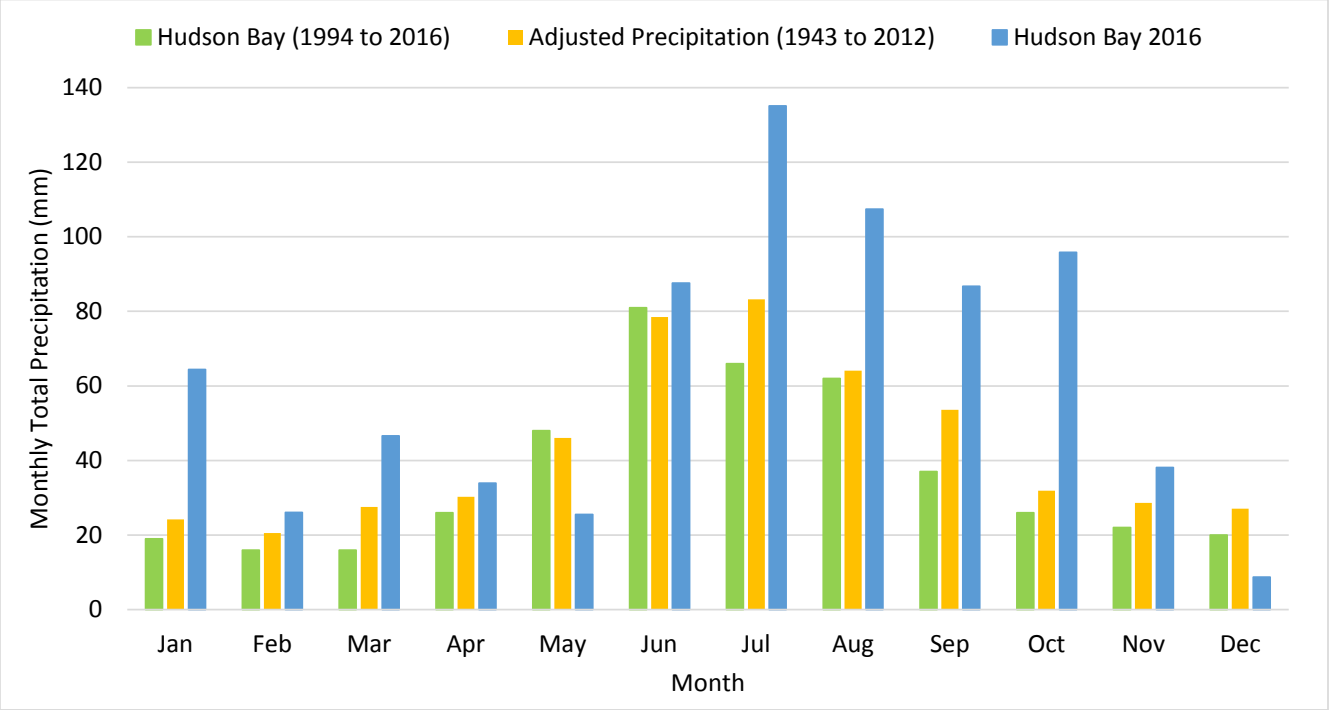


Figure 4.4-1: Monthly Precipitation for 2016 compared to Average Precipitation (Adjusted and Not-adjusted) at Hudson Bay, Saskatchewan

The hydrological year usually starts in November (once snowfall begins to accumulate) and ends in October the following year. Precipitation from a hydrological year provides a better correlation with runoff during the spring freshet and summer/fall. Conditions near Hudson Bay were much wetter than average starting in fall 2015. Precipitation in the hydrological year from November 2015 to October 2016 is more than 250 mm above the average annual adjusted precipitation at the Hudson Bay station (Figure 4.4-2). In comparison, the November 2014 to October 2015 hydrological year was close to the average value at the Hudson Bay station.

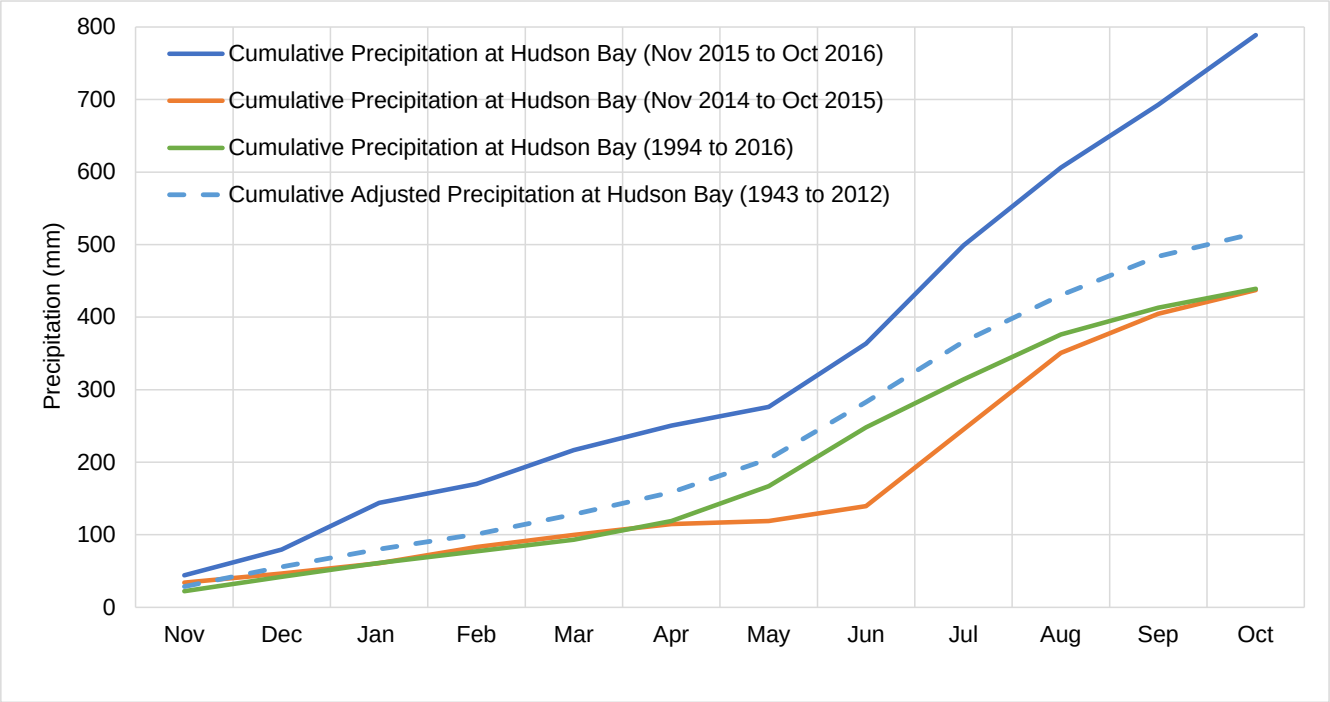


Figure 4.4-2: Monthly Precipitation for the Past Two Hydrological Years Compared to Long-Term Records

4.4.2 Lake Evaporation and Evapotranspiration

Monthly lake evaporation, based on weather data from the Hudson Bay station, is shown on Figure 4.4-3. Annual total lake evaporation (based on calculations for April to October) between 1951 and 1990 ranged from 600 mm to 759 mm, and averaged 671 mm. Lake evaporation calculated using the same method was 650 mm in 2015 and 544 mm in 2016. Results were calculated using air temperature, relative humidity and wind speed data from the Hudson Bay station. These lake evaporation estimates may provide reasonable estimates for large ponds and lakes, but should be adjusted upward by as much as 20% for small shallow ponds such as a sedimentation pond if water temperature data are not monitored (PFRA 2002). Evaporation from small ponds is higher than lakes, as water temperatures in ponds have less heat storage and evaporation increases from advection from relatively dry surrounding terrain.

Actual evapotranspiration for a peatland surface is expected to be much less than lake evaporation values. Evaporation from peatlands is affected daily by heat storage effects that are different than open water (Granger 2010). At a research site 140 km northwest of the Project that has an eddy covariance flux tower in a shrubby fen area, AET was about 470 mm in 2006 and 2007 (Barr et al. 2012). Variation in AET from 2003 to 2006 was very small and was mostly (i.e., 66%) explained by radiation differences, with water table depth having a smaller effect (Sonnentag et al. 2010). Barr et al. (2012) also found that evapotranspiration from the shrub fen was similar each year regardless of water table depth. Monthly AET values for the peatland are provided along with lake evaporation at Hudson Bay on Figure 4.4-3.

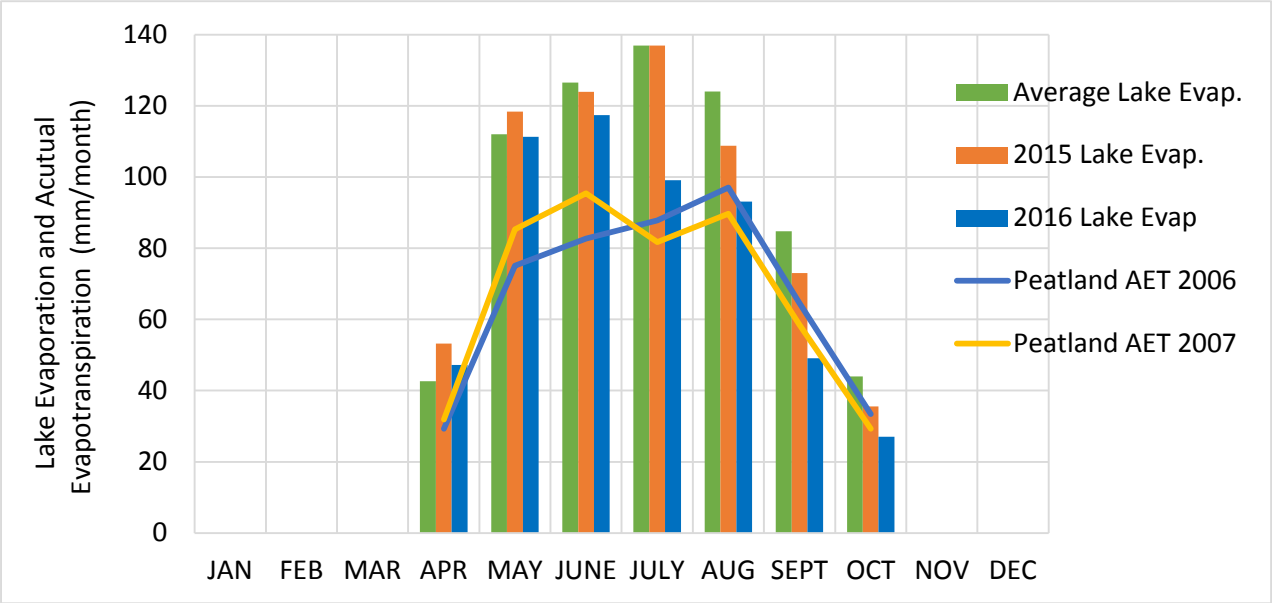


Figure 4.4-3: Monthly Lake Evaporation at Hudson Bay, Saskatchewan compared with Actual Evapotranspiration Monitored with a Flux Tower in a Fen Peatland in Central Saskatchewan (2006 to 2007)

4.5 Hydrology Results

The 2016 baseline program provides site-specific data on flows and water levels at the Project. Site-specific data provide a baseline flow record that can be correlated with flows from regional streamflow stations. These data represent existing conditions prior to development of the site; however, do not necessarily represent natural conditions, as road construction and previous land use in the watersheds (e.g., forestry) is expected to have had an effect on water levels and flows.

4.5.1 Field Measurements

Hydrology field measurements were completed in 2016 at locations provided in Table 4.5-1. Water level measurements at the Greenbush River are relative to an arbitrary benchmark elevation of 100 m (i.e., not a geodetic elevation). Manual discharge and basic geomorphological features were measured during the July 20, 2016 field visit at the stream and culvert crossings observed along the proposed access road route north of the Project.

Table 4.5-1: 2016 Field Measurements in the Hydrology Baseline Study Area

Station	Watershed Area (km²)	Location (UTM Zone 13U NAD83)	Date	Water Level (m)	Discharge (m³/s)	Bankfull width (m)	Bankfull depth (m)
Greenbush River at Hydrology Station	23.4	642,973E, 5,883,624N	June 2, 2016	99.229	0.754	5.0	1.0
			July 20, 2016	99.429	0.149		
			September 24, 2016	99.48	0.265		
North Pond Outflow	1.02	640708 E 5887795 N	July 20, 2016	N/A	0.0077	0.5	0.5
Crossing 1 (AboveBeaver Dam)	2.04	641326 E 5888945 N		N/A	0.015	0.5	0.65
Crossing 2 (Creek 2 Below Beaver Dam)	< 0.5	640273 E 5891521 N		N/A	0.003	0.25	0.1
Crossing 3 (Creek 3)	< 0.5	640374 E 5892525 N		N/A	<1L/s	Not measured	Not measured
Crossing 4 (Quad Bridge)	1.76	639273 E 5894091 N		N/A	0.0165	3.0	0.3
Crossing 5 (Beaver Dam)	<0.5	638667 E 5894448 N		N/A	Not measured	Not measured	Not measured
Crossing 6 (West Flow)	<0.5	636130 E 5895463 N		N/A	No flow	1.0	1.0
Crossing 7	<0.5	634321 E 5897125 N		N/A	Not measured	Not measured	Not measured
Crossing 8 (Culvert near Parking Lot)	6.12	634190 E 5899174 N		N/A	No flow, culvert blocked	Not measured	Not measured

km² = square kilometre; UTM = Universal Transverse Mercator; NAD = North American Datum; m = metre; m³/s = cubic metres per second; E = easting; N = northing; N/A = not applicable as only discharge was measured; < = less than; L/s = litres per second.

4.5.2 Greenbush River Hydrometric Station

The Greenbush River watershed covers almost 60% of the proposed Project lease area, and was therefore the main focus of hydrological monitoring in 2016. The remaining 40% of the lease area is within the headwaters of a few smaller watersheds that drain to the west and north.

In 2016, water levels were monitored in the Greenbush River at an accessible location along the existing access right-of-way, which is about 1.2 km downstream of the proposed lease boundary. Water levels monitored using a logger agreed very well with measured water levels that were surveyed relative to a local benchmark installed for the hydrology station (Figure 4.5-1). The discharge record for 2016 is shown in Figure 4.5-2.

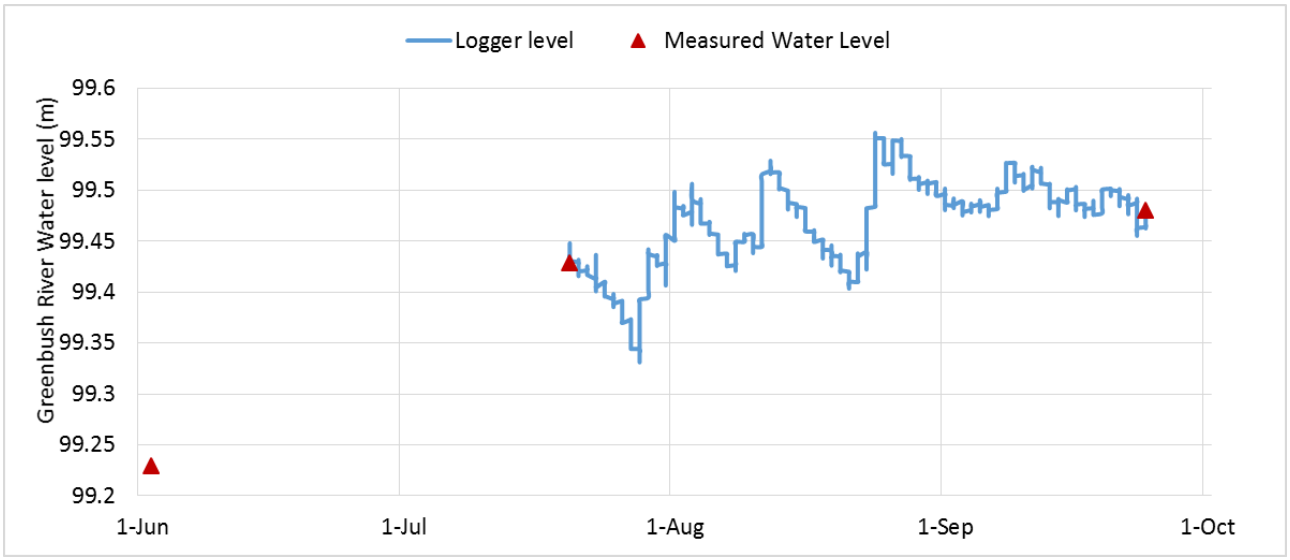


Figure 4.5-1: Water Levels at the Greenbush River Hydrology Station in 2016

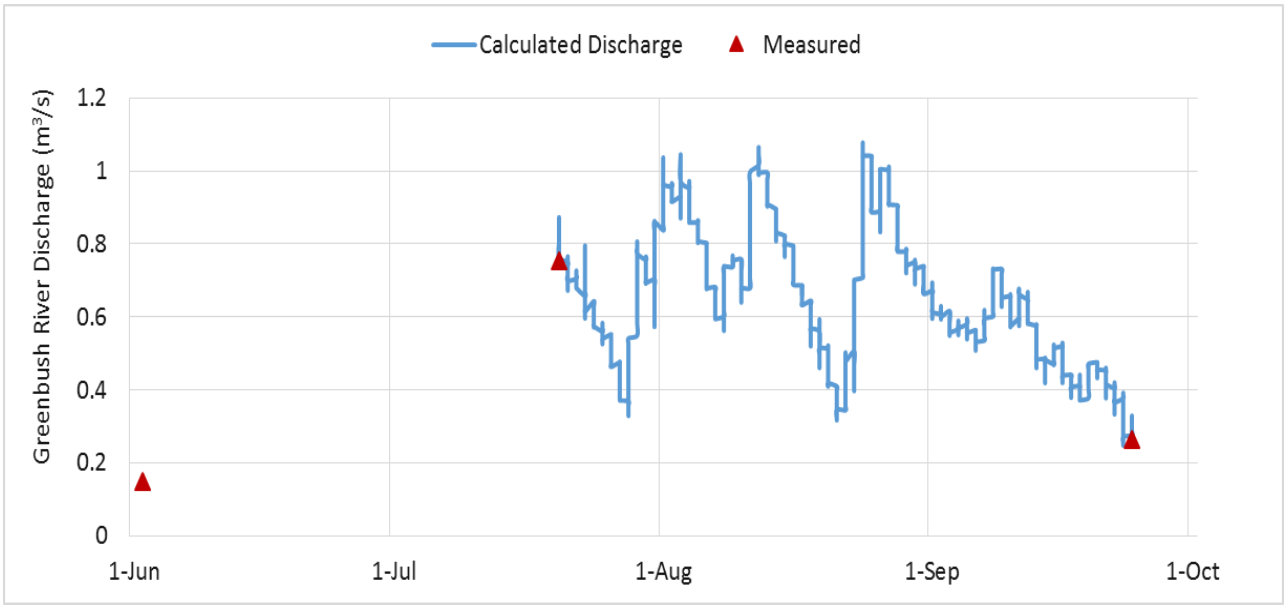


Figure 4.5-2: Discharge at the Greenbush River Hydrology Station in 2016

4.5.3 Regional Flow Characteristics

The average open-water period (i.e., March to October inclusive) discharge for the Prairie River at Prairie River (05LB010) for the 42 year period from 1975 to 2016 is shown in Figure 4.5-3. The average open-water discharge is 1.28 cubic metres per second (m^3/s), and the average open-water discharge in 2016 was 3.2 m^3/s. As shown in Figure 4.5-3, 2016 was the third-highest flow year in the 42 year record, after 2005 and 2010.

Based on the derived flow record for Greenbush River, its average open-water period discharge is 0.20 m^3/s, with an average open water discharge in 2016 of 0.55 m^3/s.

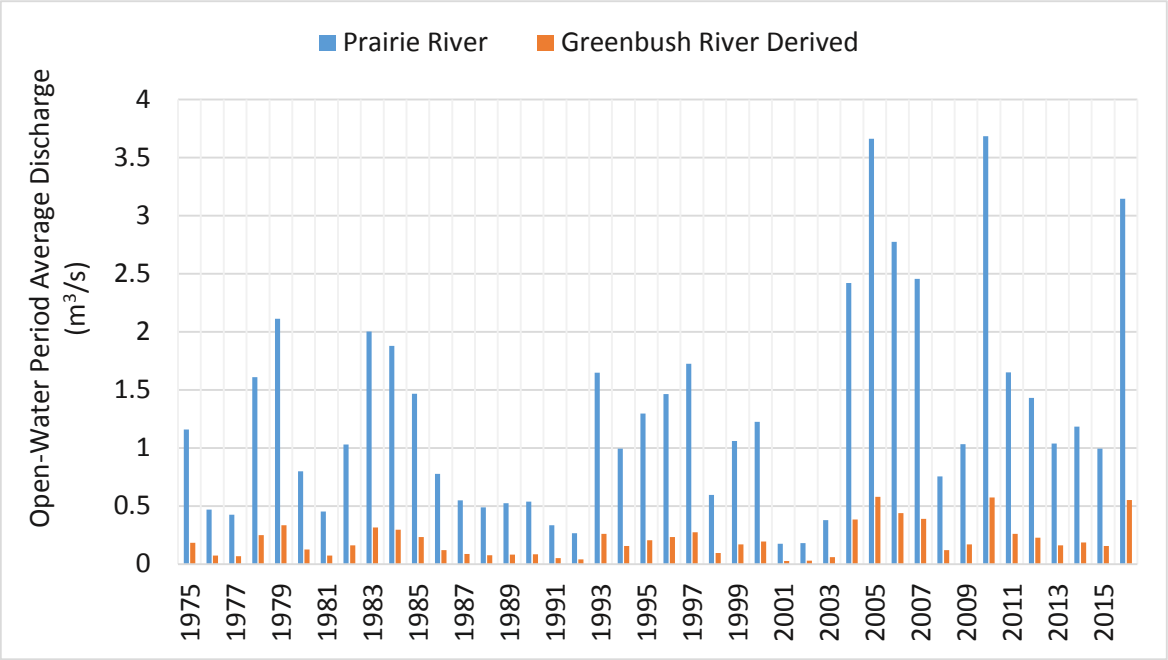


Figure 4.5-3: Average Open-Water Period Discharge at Prairie River (05LB010) from 1975 to 2016

Average, 25th percentile, and 75th percentile monthly flows for Prairie River are shown in Figure 4.5-4, and are compared with monthly mean flows in 2016. The highest monthly flows tend to occur in May due to spring snowmelt and taper off the remainder of the year. In 2016, flows exceeded the 75th percentile of monthly flows most of the season. Results are similar for the Greenbush River based on its derived flows (Figure 4.5-5).

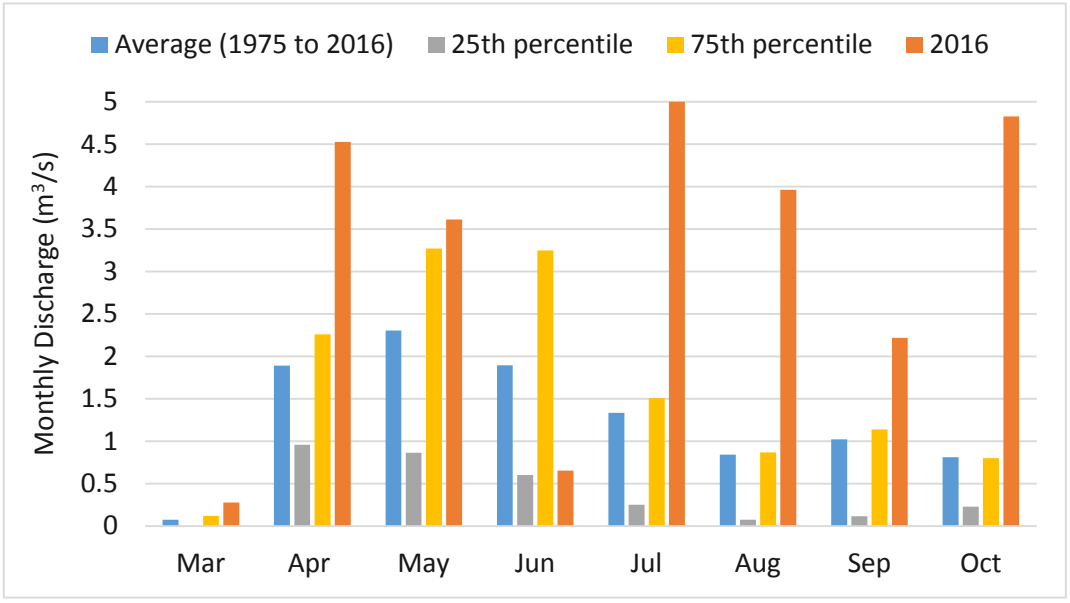


Figure 4.5-4: Monthly Flow Statistics at Prairie River (05LB010) from 1975 to 2016 compared with Monthly Mean Flow in 2016

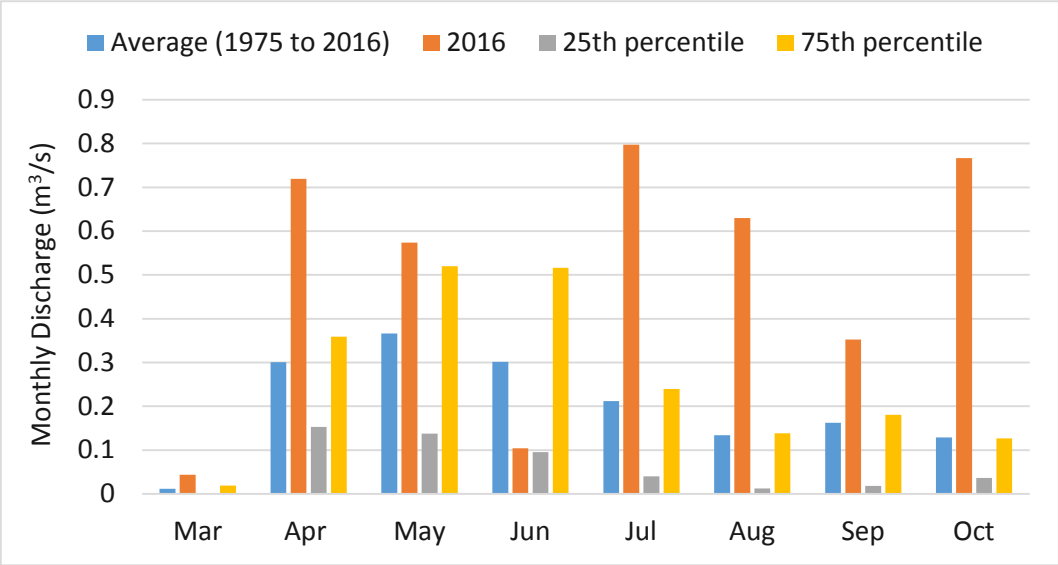


Figure 4.5-5: Monthly Derived Flow Statistics for the Greenbush River from 1975 to 2016 compared with Monthly Mean Measured and Derived Flow in 2016

A summary of open water season mean monthly flow statistics for the Prairie River Station and Greenbush River described above are provided in Table 4.5-2.

Table 4.5-2: Mean Monthly Flow Statistics for Selected Locations in the Hydrology Baseline Study Area (Open-Water Period of 1975 to 2016)

Streamflow Station	Watershed Area (km^2)	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Open-water Period
		Discharge (m^3/s)								
Prairie River at Prairie River	340.0[(a)]	0.074	1.892	2.306	1.896	1.335	0.844	1.023	0.812	1.273
Greenbush River at Hydrology Station	23.5	0.012	0.301	0.366	0.301	0.212	0.134	0.163	0.129	0.204
Greenbush River downstream of the Hydrology BSA	152.6	0.077	1.957	2.386	1.962	1.381	0.873	1.059	0.840	1.328
Upper Papikwan River downstream of the Hydrology BSA	192.0	0.097	2.446	2.994	2.462	1.733	1.100	1.328	1.054	1.667
Upper Papikwan River below the Lease Area	10.3	0.005	0.131	0.160	0.131	0.093	0.058	0.071	0.056	0.089
Tributary of Papikwan River below the Lease Area	25.9	0.013	0.332	0.404	0.332	0.234	0.148	0.179	0.142	0.225
South Basin below Lease Area	2.8	0.0014	0.036	0.0440	0.036	0.026	0.016	0.020	0.016	0.025
North Pond Outflow below Lease Area	1.0	0.001	0.013	0.016	0.013	0.009	0.006	0.007	0.006	0.009
Road Crossings (unit area)	1.0	0.001	0.013	0.016	0.013	0.009	0.006	0.007	0.006	0.009

km^2 = square kilometre; m^3/s = cubic metres per second; BSA = baseline study area.
[(a)] This is the effective drainage area for this station.

Streamflow in 2016 for several regional streamflow stations is shown in Figure 4.5-6. Daily precipitation observed at Hudson Bay Station 4083324 is also shown in Figure 4.5-6. Unit runoff based on the watershed area for each station is shown in in Figure 4.5-7.

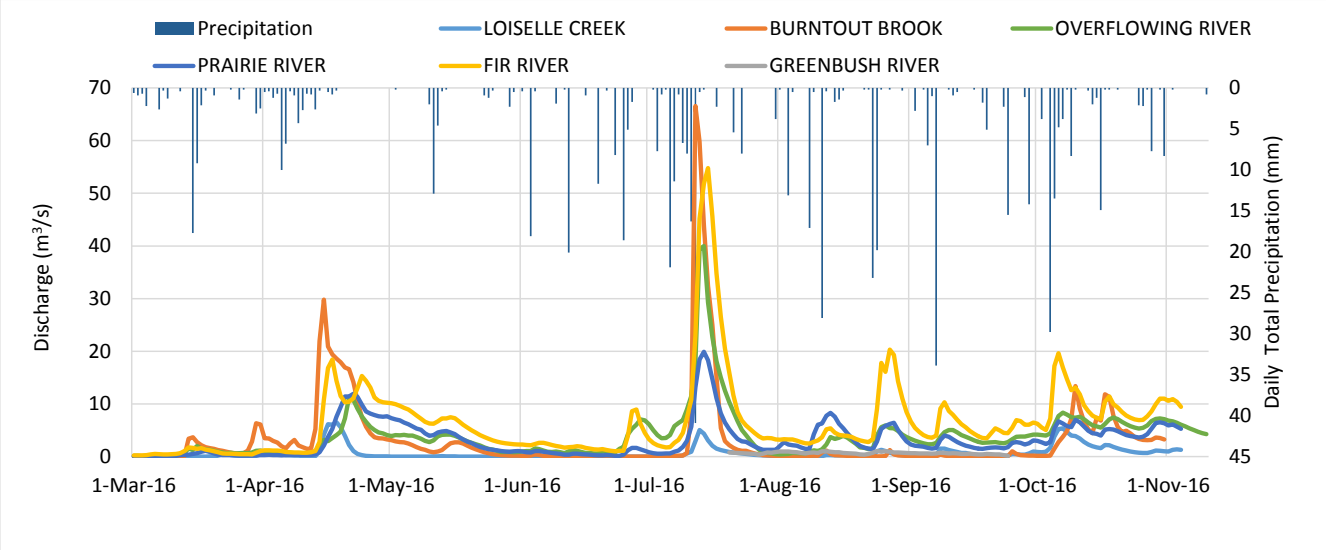


Figure 4.5-6: Daily Precipitation and Daily Mean Discharge at Regional Streamflow Stations near the Project in 2016

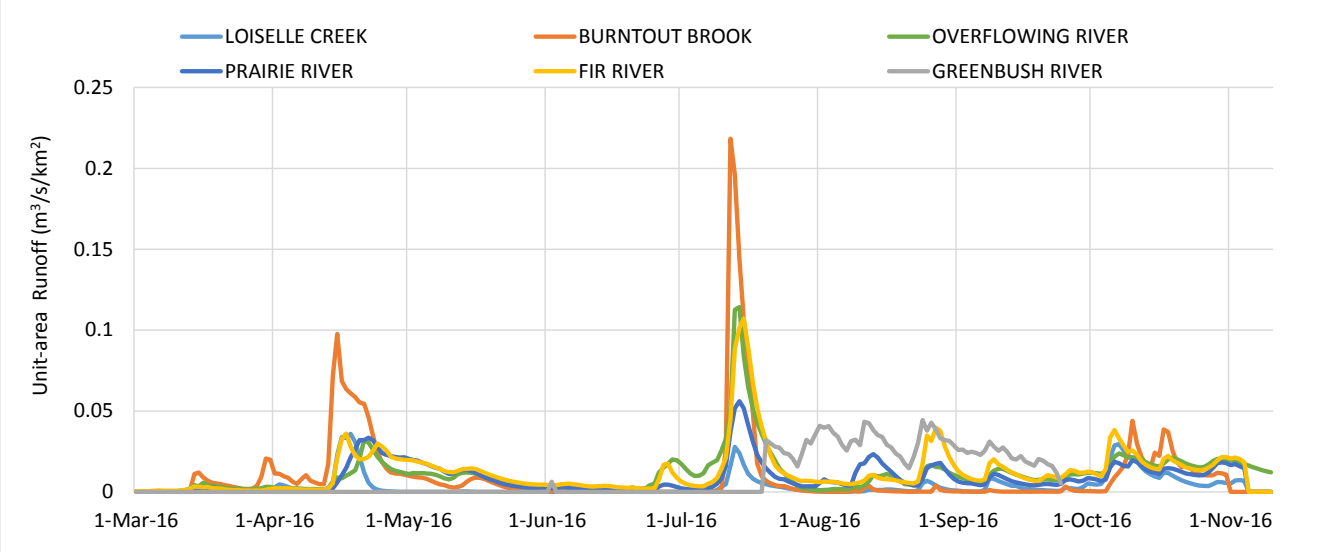
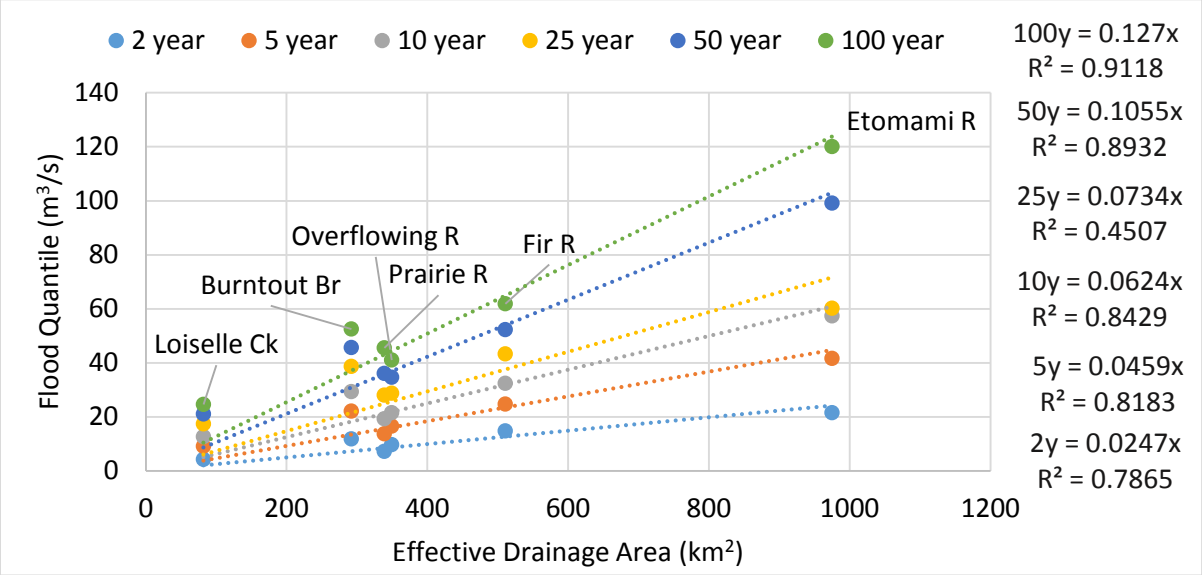


Figure 4.5-7: Unit Runoff at Regional Streamflow Stations near the Project in 2016

4.5.4 Flood Frequency Analysis

Flood magnitudes for 2 to 100 year return periods at five regional streamflow stations within 70 km of the Project and with effective drainage areas less than 1,000 km^2 are provided in Figure 4.5-8. Results are based on flood frequency analyses provided by the Water Security Agency for these stations (McElhanney 2014), with the exception of the Etomami River, which relies on results from SaskWater (1993) and has a shorter record length.



y= flood quantile (m^3/s); x = effective drainage area (km^2); and R^2 = coefficient of determination.

Figure 4.5-8: Regional Flood Frequency Analysis

Using the regional flood frequency analysis results and the drainage areas of hydrology stations at BSA outflow locations, flood frequency results were calculated (Table 4.5-3). The flood with an average return period of 2 years is expected to occur once every 2 years. On July 20, 2016, the discharge measured at the Greenbush River exceeded the estimated 2-year flood value. The highest peak of 2016 of 19.9 m^3/s occurred at the Prairie River station on July 14, 2017, which exceeded the 10-year flood statistic; however, flows receded to 5.1 m^3/s by July 20, 2016, which was somewhat less than the 2-year flood value.

Table 4.5-3: Daily Flood Magnitude and Frequency Estimates for the Prairie River Harvest Area Outflows based on Regional Flood Frequency Analysis

Streamflow Station	Watershed Area (km^2)	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
		Flood Magnitude (m^3/s)					
Prairie River at Prairie River	340.0[(a)]	7.20	13.7	19.3	28.0	36.0	45.5
Greenbush River at Hydrology Station	23.5	0.58	1.1	1.5	1.7	2.5	3.0
Greenbush River downstream of the Hydrology BSA	152.6	3.77	7.0	9.5	11.2	16.1	19.4
Upper Papikwan River below the Hydrology BSA	192.0	4.74	8.8	12.0	14.1	20.3	24.4
Upper Papikwan River below the Lease Area	10.3	0.25	0.5	0.6	0.0.8	1.1	1.3
Tributary of Papikwan River below the Lease Area	25.9	0.64	1.2	1.6	1.9	2.7	3.3

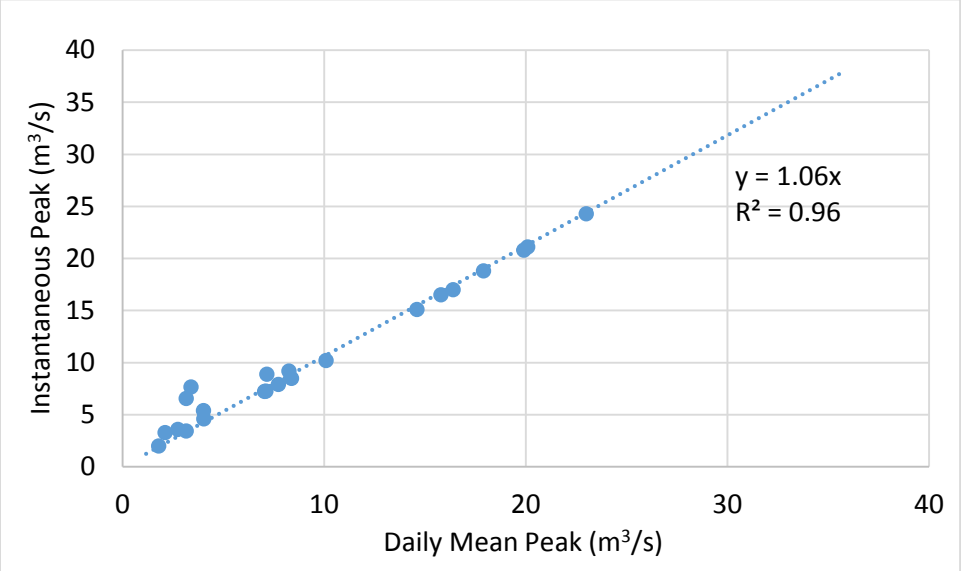
Table 4.5-3: Daily Flood Magnitude and Frequency Estimates for the Prairie River Harvest Area Outflows based on Regional Flood Frequency Analysis

Streamflow Station	Watershed Area (km^2)	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
		Flood Magnitude (m^3/s)					
South Basin below Lease Area	2.82	0.07	0.1	0.2	0.2	0.3	0.4
North Pond Outflow below Lease Area	1.02	0.03	0.1	0.1	0.1	0.1	0.1
Road Crossings	1.0	Unit Runoff Flood ($m^3/s/km^2$)					
		0.03	0.1	0.1	0.1	0.1	0.1

(a) This is the effective drainage area for this station.
km^2 = square kilometre; m^3/s = cubic metres per second; BSA = baseline study area; $m^3/s/km^2$ = cubic metres per second per square kilometre.

Flood frequency results and channel width data may be used to size culverts at the access road crossings. However, there is uncertainty in the exact watershed area for the smaller stream crossings and the orthoDEM is not reliable enough to provide this information; therefore, additional field surveys may be required prior to determining the appropriate size culverts for the access road. Additionally, the instantaneous flood peaks have not been calculated due to the lack of site-specific hydrology data even for the Greenbush River during a flood event (the July 20, 2016 field visit missed the 10 year flood by about a week). Unit runoff flood values based on a watershed size of 1 km^2 are provided in Table 4.5-4, and these are based on daily mean flood peaks from regional streamflow stations. It is assumed that the unit runoff flood values would be valid for both small (<0.5 km^2) and larger watersheds at the road crossings.

To obtain an instantaneous flood peak from a daily mean flood quantile, the peak factor (i.e., the instantaneous to daily mean peak flow) at a nearby streamflow station such as Prairie River may be used. Although the peak factor varies with different flood events, and seems to be higher during events that occur when ice is still a factor in spring, generally the instantaneous flood peaks are about 6% higher than daily mean flood peaks for the same flood events (Figure 4.5-9).



y = instantaneous peak (m^3/s); x = daily mean peak (m^3/s); and R^2 = coefficient of determination.

Figure 4.5-9: Instantaneous versus Daily Mean Flood Peaks for the Prairie River

4.5.5 Annual Low Flow Statistics

The seasonal flow records were analysed for Prairie River from March through October for the years 1975 to 2016 to estimate low flow statistics. In 60% of the years from 1975 to 2016, the annual minimum daily mean flow was zero at the Prairie River station. Zero flow or low flow was recorded either by late fall or late winter in most years. The average annual minimum flow was 0.007 m^3/s for Prairie River, and 0.001 m^3/s for the derived Greenbush River flow record. The 7-day annual low flows were also calculated; results are provided in Table 4.5-4.

Table 4.5-4: Annual Low Flow Statistics for selected locations in the Hydrology BSA

Streamflow Station	Watershed Area (km^2)	Average Annual Minimum	1 Day Minimum 2 Year	Average 7-Day Flow	7-Day Minimum 2 Year
		Discharge (m^3/s)			
Prairie River at Prairie River	340.0[(a)]	0.0071	<0.001	0.0086	<0.001
Greenbush River at Hydrology Station	23.5	0.0011	<0.001	0.0014	<0.001
Greenbush River downstream of the Hydrology BSA	152.6	0.0074	<0.001	0.0089	<0.001
Upper Papikwan River below the Hydrology BSA	192.0	0.0092	<0.001	0.0111	<0.001

km^2 = square kilometre; m^3/s = cubic metre per second; BSA = baseline study area; < = less than.
(a) This is the effective drainage area for this station.

4.6 Summary

The range of flows and water levels monitored in 2016 provide a baseline for future changes that may occur from the Project or other developments. Hydrological conditions in 2016 were above normal in the Project area due to above normal snow accumulation in the winter of 2015 to 2016, above-normal rainfall most of the year, and above-normal rainfall in October.

Discharge of the Prairie River showed similar patterns as the Greenbush River in 2016. Both watersheds drain south from the Pasquia Hills and are located about 38 km apart. Therefore Prairie River station was used to estimate a long-term record for the Greenbush River and the other watersheds in the hydrology BSA.

Overall the flow conditions in 2016 were well above the long-term average, and were the third-highest since 1975 for the Prairie River watershed which is an adjacent watershed to the Greenbush and Papikwan watersheds that overlap the Project area.

Peak flow measured at the Greenbush River hydrology station in 2016 was somewhat higher than its estimated 2-year flood value, although this measurement missed a 10-year flood peak due to data loss.

The derived flow records for the Greenbush and Papikwan rivers in the hydrology BSA (as well as the smaller watersheds) indicate that most years the annual minimum and 7-day low flows are near zero. This is based on the seasonal (March to October) flow records at Prairie River, and it is expected that if this station was measured year-round its low flows would be near zero even more frequently.

5.0 SURFACE WATER QUALITY

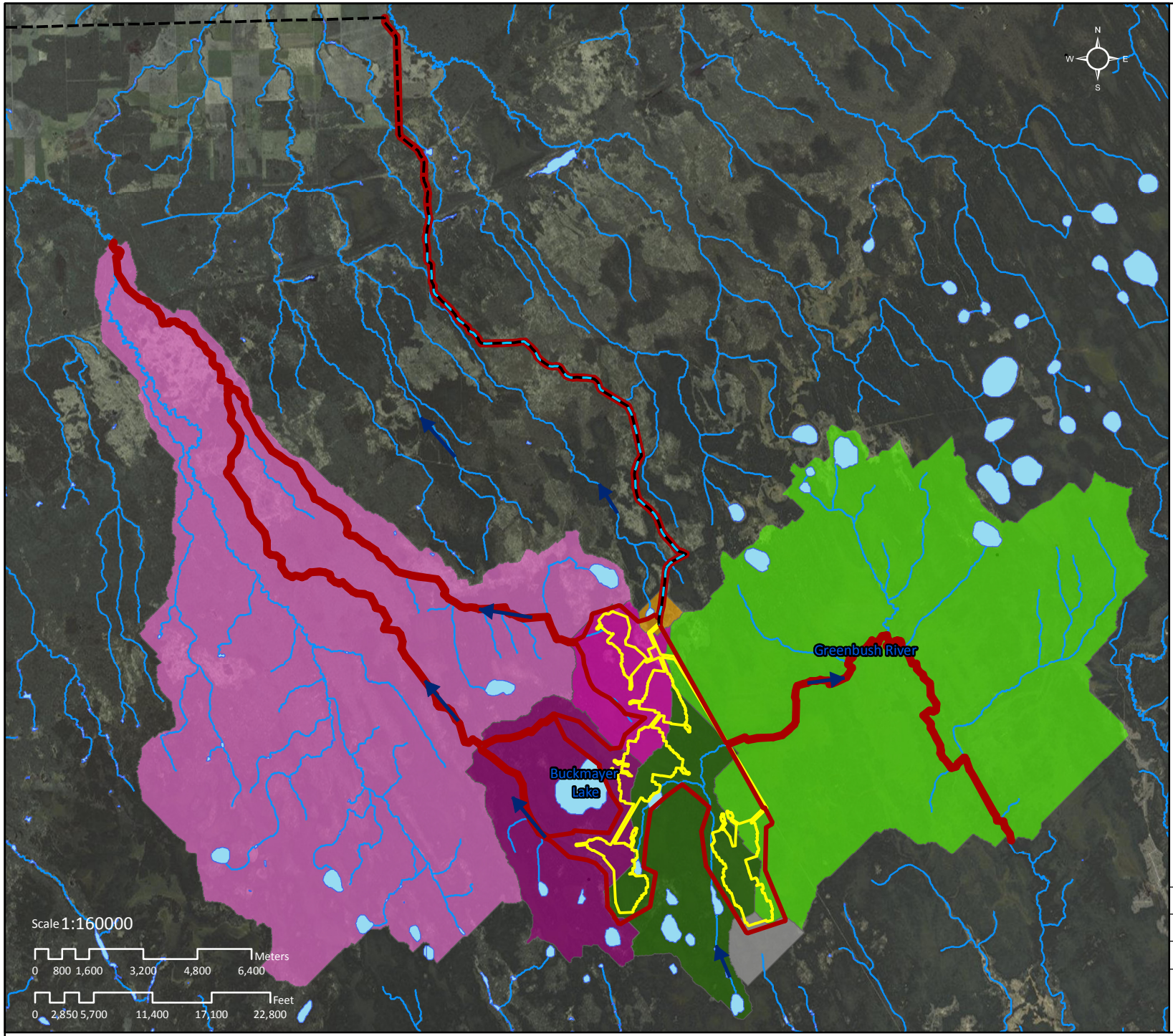
5.1 Introduction

Surface water quality is influenced by factors such as precipitation and precipitation chemistry, groundwater quality, hydrology, and sediment and soil quality. Land use activities (e.g., forestry and mining) also influence surface water quality through emissions and altered drainage patterns and soil chemistry. In turn, changes to surface water quality can affect aquatic and terrestrial organisms, human health and recreation, and traditional and non-traditional land use activities (e.g., fishing, trapping, and hunting).

A surface water quality baseline study was completed to document existing conditions in the surface water baseline study area (BSA) associated with the Prairie River Peat Harvest Project (the Project) lease boundary, this information can be used to support the assessment of effects from the Project to surface water quality. The specific objectives of the surface water quality baseline study were to characterize water quality in the BSA, to the extent possible, and compare the measured water quality data to regulatory guidelines for the protection of aquatic life, wildlife, and human health. These following sections describe the existing surface water quality in the BSA prior to development of the Project.

5.2 Baseline Study Area

The BSA for surface water quality is the same as that defined for hydrology and fish and fish habitat (Figure 5.2-1). The BSA covers 37.3 square kilometres (km^2) and includes the lease area plus the areas in the Greenbush and Papikwan River watersheds that are immediately downstream of the proposed Project outlet ditches for the five phases of development. This includes an outflow stream approximately 4 kilometres (km) north of the lease area. The proposed access route for the lease area is expected to interact with this outflow stream.



Site Boundaries
- Project Footprint
- Surface Water Quality Baseline Study Area

Hydrology
- Waterbody
- Watercourse
- Flow Direction

Watershed

Greenbush River Watershed
- Greenbush River at Hydrology Station
- Greenbush River Below the Baseline Study Area

Papikwan River Watershed
- Upper Papikwan River below Lease Area
- Papikwan River Downstream of the Baseline Study Area
- Tributary of Papikwan

Other Watershed
- North Pond Outflow below Lease Area
- South Basin below Lease Area

Infrastructures
- Gravel Road (Exisiting)
- Access Road (Exisiting Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/22
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 5.2-1 : Surface Water Quality Baseline Study Area | Prairie River Bog

5.3 Methods

5.3.1 Study Design and Sampling Methods

5.3.1.1 Sampling Dates and Locations

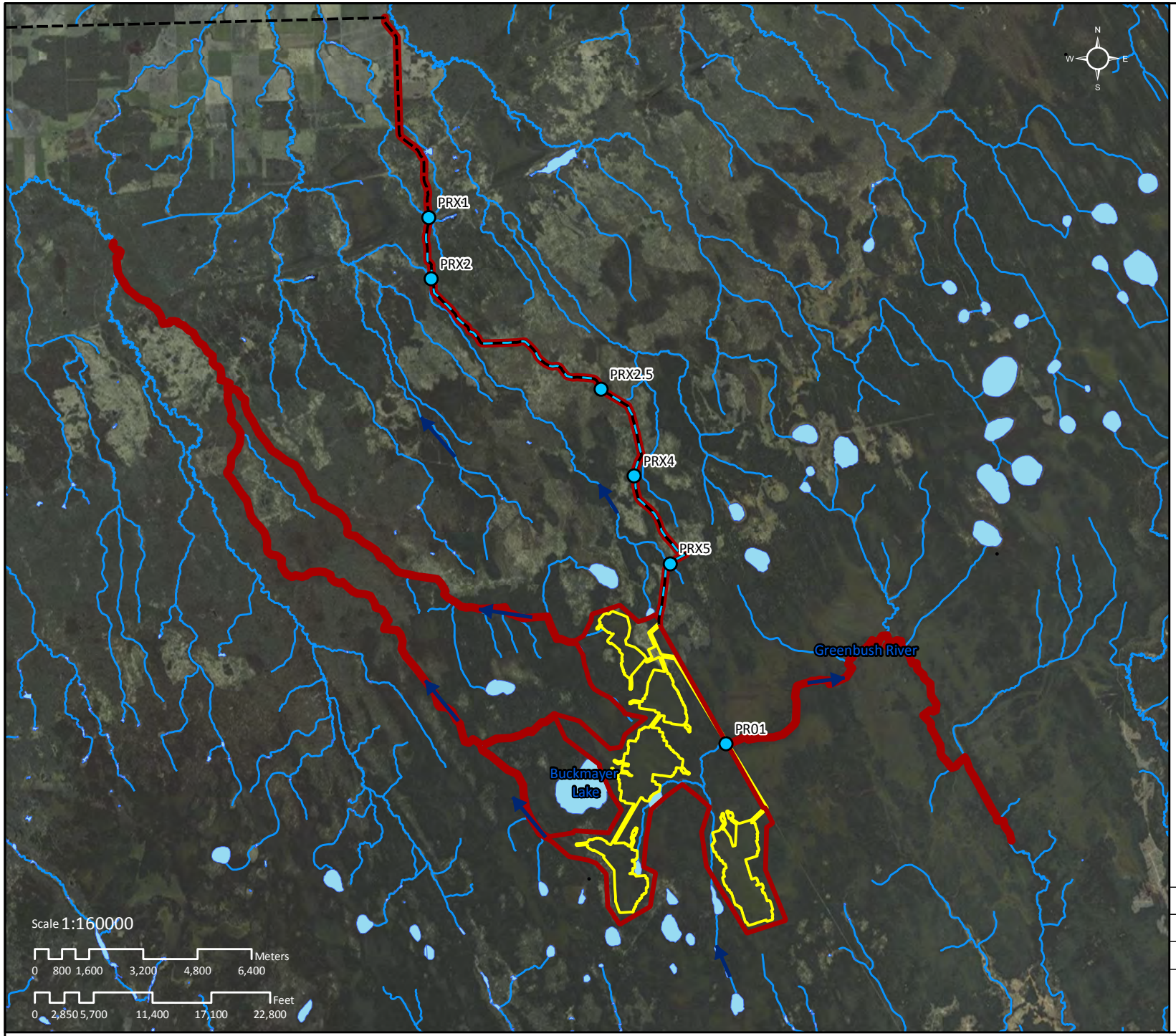
Water quality sampling in the BSA was completed on June 1 and 2, 2016. Sampling locations were selected to represent the harvest area and locations where the access road and road usage have the potential to affect surface water quality. The size of the stream or waterbody, whether water was flowing in stream channels, and accessibility were also considerations.

Station PR01 is located on the Greenbush River within the Greenbush River watershed (Figure 5.3-1), and is expected to represent conditions immediately downstream of the harvest areas. In situ measurements of physico-chemical parameters and water chemistry samples were collected during a single sampling event on June 2, 2016 (Table 5.3-1). Stations PRX1 through PRX5 are located at stream crossings along the proposed access road, which is located primarily in the Cracking River watershed to the north of the lease area (Figure 5.3-1). Baseline sampling activities at these stations were completed on June 1, 2016 and were restricted to one set of physico-chemical measurements per station (Table 5.3-1).

Table 5.3–1: Surface Water Quality Sampling Dates and Stations

Stream or Waterbody	Station	Station Type	Sample Date	Easting	Northing	Field Physico-chemical Parameters[(a)]	Water Chemistry
Greenbush River	PR01	Drainage path (harvest area)	June 2, 2016	642972	5883623	✓	✓
Unnamed stream	PRX1	Stream crossing (main access road)	June 1, 2016	634184	5899173	✓	X
Unnamed stream	PRX2		June 1, 2016	634254	5897361	✓	X
Unnamed stream	PRX2.5		June 1, 2016	639275	5894097	✓	X
Unnamed stream	PRX4		June 1, 2016	640254	5891537	✓	X
Unnamed stream	PRX5		June 1, 2016	641299	5888967	✓	X

(a) In situ measurements of pH, specific conductivity, dissolved oxygen, and water temperature.



Site Boundaries

- Project Footprint
- Surface Water Quality Baseline Study Area

Survey

- Water Quality Sampling Stations

Hydrology

- Waterbody
- Watercourse
- Flow Direction

Infrastructures

- Gravel Road (Exisiting)
- Access Road (Exisiting Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/07
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 5.3-1 : Water Quality Sampling Stations | Prairie River Bog

5.3.1.2 Physico-chemical Data and Sample Collection

A YSI 600 QS-O-M multi-parameter sonde was used to collect in situ measurements of physico-chemical parameters (e.g., pH, specific conductivity, dissolved oxygen, and water temperature) from approximately 20 cm below the water surface at each station. Water chemistry samples collected from PR01 were also taken from approximately 20 cm below the water surface. Water was transferred to the appropriate sample bottles supplied by the analytical laboratory. Water samples were filtered and preserved on site, as required, according to the analytical laboratory's protocols, which complied with standard methods (e.g., American Public Health Association [APHA] 2012). Quality control (QC) samples were also included as part of the baseline sampling program (Section 5.3.1.4). Water samples were kept in coolers with frozen ice packs during storage and transport back to the analytical laboratory.

5.3.1.3 Sample Analysis

Water samples were submitted to ALS Laboratory Group (ALS), which is accredited by the Canadian Association for Laboratory Accreditation Inc. (CALA), for analysis of the following parameters:

- conventional parameters (pH, specific conductivity, total alkalinity, total hardness, total dissolved solids, total suspended solids [TSS], and true colour);
- major ions (bicarbonate, calcium, carbonate, chloride, hydroxide, magnesium, potassium, sodium, and sulphate);
- nutrients (total ammonia, nitrate, nitrite, total nitrogen, total Kjeldahl nitrogen, total organic carbon [TOC], dissolved organic carbon [DOC], total phosphorus, and biochemical oxygen demand);
- total metals, metalloids, and non-metals[1] (aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, cesium, chromium, cobalt, copper, iron, lead, lithium, manganese, molybdenum, nickel, rubidium, selenium, silicon, silver, strontium, tellurium, thallium, thorium, tin, titanium, tungsten, uranium, vanadium, zinc, and zirconium); and
- total and dissolved mercury.

With the exception of dissolved mercury, no dissolved metals analyses were performed. Samples were not analyzed for hydrocarbons.

5.3.1.4 Quality Assurance/Quality Control

Quality assurance/quality control (QA/QC) programs are sampling and analytical procedures that are followed to limit the introduction of error into analytical data. Quality assurance (QA) procedures included appropriate training of sampling personnel, use of standard operating procedures during sample collection, handling, storage and submission to an accredited analytical laboratory as well as use of data management systems. Quality control (QC) procedures are designed to assess data quality, including potential laboratory and field contamination, through the use of blanks.

One trip blank and one field blank were collected to support the assessment of data quality. The trip blank was a sample prepared by ALS using distilled water and carried in the field (unopened) during the field program. The purpose of the trip blank is to help identify any contamination that may result from the sample containers,

[1] Henceforth, metals, metalloids (e.g., arsenic, selenium), and non-metals (e.g., boron) will be referred to as metals.

preservatives, and transport and storage conditions. The field blank was a sample prepared while in the field using distilled water provided by ALS and was treated the same way as field-collected samples. The purpose of the field blank is to help identify potential contamination associated with environmental conditions in the field and/or laboratory (e.g., contamination from handling of the sample containers).

As part of routine field operations, the multi-parameter sonde was calibrated regularly, as required. Samples were collected by experienced personnel and were prepared, labelled, preserved, and shipped according to the analytical laboratory's protocols. Chain-of-custody forms accompanied all samples from the field to the analytical laboratory. Colour and pH were the only parameters that exceeded laboratory hold times; hold time exceedances did not appear to affect the analytical results.

5.3.2 Data Analysis

5.3.2.1 Characterizing Each Sampling Station

A characterization of the water body type, and water quality condition at each sampling site was completed using the definitions in Table 5.3-2, as applicable.

Table 5.3–2: Definitions of Waterbody Characteristics

Parameter	Definition and Notes with Applicable Reference
Waterbody Type	Description of waterbody: • Type – Lake, Slough, Creek, River • Size – area (m^2, km^2) or average flow (L/s, m^3/s) • Permanence – temporary (<4 months; spring only), semi-permanent (>4 months but can dry out); permanent (water year-round but may dry up under continuous drought conditions) • Vegetation (cover) type – emergent, submerged, none • Bottom Substrate – organic, mud, sand, gravel-cobble, boulder, bedrock. (simplified from Cowardin et al. 1979)
Dissolved Oxygen (mg/L)	Guidelines/objectives for the lowest acceptable dissolved oxygen concentrations in warm water is 6.0 mg/L for early life stages and 5.5 mg/L for other life stages (CCME 1999, with updates to 2015).
pH (pH units)	• Acidic – pH <5.5 • Circumneutral – pH 5.5 to 7.4 • Alkaline – pH >7.4 (Cowardin et al. 1979)
Specific Conductivity (µS/cm)	• Hypersaline – >60,000 • Eusaline – 45,000 to 60,000 • Polysaline – 30,000 to 45,000 • Mesosaline – 8,000 to 30,000 • Oligosaline – 800 to 8,000 • Fresh – <800 (Cowardin et al. 1979)
Total Alkalinity (mg/L as $CaCO_3$)	Alkalinity is the capacity of water for neutralizing an acid solution and as such can be used as a measure of a lakes' sensitivity to acid inputs such as acid rain. • High sensitivity to acid deposition – <10 mg/L total alkalinity have high sensitivity • Moderate sensitivity – 11-20 mg/L • Low sensitivity – 21-40 mg/L • Least or minimal sensitivity – >40 mg/L (Saffran and Trew 1996).

Table 5.3–2: Definitions of Waterbody Characteristics

Parameter	Definition and Notes with Applicable Reference
Total Hardness (mg/L as $CaCO_3$)	• Soft – 0 to 60 • Moderately Hard – 60 to 120 • Hard – 120 to 180 • Very Hard – >180 (Briggs and Ficke 1977).
Nutrients and Trophic Status	Nutrients include phosphorus and other compounds that are required in small quantities for plant growth. Total phosphorus concentrations can be used to classify the trophic status of streams and waterbodies (CCME 1999, with updates to 2015). • Ultra-oligotrophic – <0.004 mg-P/L • Oligotrophic – 0.004 to 0.010 mg-P/L • Mesotrophic – 0.010 to 0.020 mg-P/L • Meso-eutrophic – 0.020 to 0.035 mg-P/L • Eutrophic – 0.035 to 0.100 mg-P/L • Hyper-eutrophic – >0.100 mg-P/L

Sources as indicated in the table.
m^2 = square metre; km^2 = square kilometre; L/s = litres per second; m^3/s = cubic metres per second; < = less than; > = greater than; mg/L = milligrams per litre; CCME = Canadian Council of Ministers of the Environment; µS/cm = microSiemens per centimetre; $CaCO_3$ = calcium carbonate; mg-P/L = milligrams phosphorus per litre.

5.3.2.2 Comparison to Environmental Quality Guidelines

Water quality data were evaluated by screening concentrations of individual parameters against the following guidelines:

- water quality guidelines for the protection of freshwater aquatic life (Canadian Council of Ministers of the Environment [CCME] 1999, with updates to 2015; Government of Saskatchewan 2015a);
- water quality standards and guidelines for the protection of human health (Health Canada 2014; United States Environmental Protection Agency [US EPA] 2002);
- water quality guidelines for the protection of wildlife health – livestock watering (CCME 1999, with updates to 2015; Government of Saskatchewan 2015a); and
- water quality guidelines for irrigation (Government of Saskatchewan 2015a).

The most conservative guideline for each protection type was used in the screening. For example, the most conservative (i.e., lowest) guideline for the protection of aquatic life was selected from the acute and chronic guidelines from the CCME (1999, with updates to 2015) and Government of Saskatchewan (2015a). The guidelines for each protection type that were used in the assessment and are listed in Table 5.3-3.

Table 5.3–3: Water Quality Guidelines for the Protection of Aquatic Life, Human Health, Wildlife Health, and Irrigation

Parameter	Unit	Guidelines for the Protection of:				
		Aquatic Life		Human Health	Wildlife/Livestock Health	Irrigation
		Acute	Chronic			
Field-measured Parameters						
Temperature	°C	-	-	-	-	-
pH	-	-	6.5 to 9.0	5.0 to 9.0	-	-
Specific conductivity	µS/cm	-	-	-	-	-
Dissolved oxygen	mg/L	6.0	6.0	-	-	-

Table 5.3–3: Water Quality Guidelines for the Protection of Aquatic Life, Human Health, Wildlife Health, and Irrigation

Parameter	Unit	Guidelines for the Protection of:				
		Aquatic Life		Human Health	Wildlife/Livestock Health	Irrigation
		Acute	Chronic			
Conventional Parameters						
Alkalinity, total as $CaCO_3$	mg/L	-	-	-	-	-
Hardness, total as $CaCO_3$	mg/L	-	-	-	-	-
Total dissolved solids	mg/L	-	-	-	3,000	500
Total dissolved solids (calculated)	mg/L	-	-	-	-	-
Total suspended solids	mg/L	-	-	-	-	-
Colour	TCU	-	-	-	-	-
Ions						
Bicarbonate	mg/L	-	-	-	-	-
Calcium	mg/L	-	-	-	-	-
Carbonate	mg/L	-	-	-	-	-
Chloride	mg/L	640	120	-	-	100
Hydroxide	mg/L	-	-	-	-	-
Magnesium	mg/L	-	-	-	-	-
Potassium	mg/L	-	-	-	-	-
Sodium	mg/L	-	-	-	-	-
Cation - anion balance	%	-	-	-	-	-
Sulphate	mg/L	-	309	-	1,000	1,000
Nutrients and Biological Indicators						
Ammonia, total	mg-N/L	-	7.1[(a)]	-	-	-
Nitrate	mg-N/L	124	2.9	10	-	-
Nitrite	mg-N/L	-	0.020[(b)]	1.0	10	-
Nitrate + nitrite	mg-N/L	-	-	-	100	-
Nitrogen, total (calculated)	mg-N/L	-	-	-	-	-
Nitrogen, total Kjeldahl	mg-N/L	-	-	-	-	-
Organic carbon, total	mg/L	-	-	-	-	-
Organic carbon, dissolved	mg/L	-	-	-	-	-
Phosphorus, total	mg-P/L	-	-	-	-	-
Biochemical oxygen demand	mg/L	-	-	-	-	-
Total Metals						
Aluminum	µg/L	-	100[(c)]	100	5,000	5,000
Antimony	µg/L	-	-	5.6	-	-
Arsenic	µg/L	-	5.0	10	25	100
Barium	µg/L	-	-	1,000	-	-
Beryllium	µg/L	-	-	4.0	-	-
Bismuth	µg/L	-	-	-	-	-
Boron	µg/L	29,000	1,500	5,000	5,000	500
Cadmium	µg/L	0.85	0.08[(d)]	5.0	80	5.1

Table 5.3–3: Water Quality Guidelines for the Protection of Aquatic Life, Human Health, Wildlife Health, and Irrigation

Parameter	Unit	Guidelines for the Protection of:				
		Aquatic Life		Human Health	Wildlife/Livestock Health	Irrigation
		Acute	Chronic			
Cesium	µg/L	-	-	-	-	-
Chromium[e]	µg/L	-	1.0	50	50	4.9
Cobalt	µg/L	-	-	-	1,000	50
Copper	µg/L	-	2.0[d]	1,300	500	200
Iron	µg/L	-	300	-	-	5,000
Lead	µg/L	-	1.0[d]	10	100	200
Lithium	µg/L	-	-	-	-	2,500
Manganese	µg/L	-	-	-	-	200
Mercury	µg/L	-	0.026	1.0	3.0	-
Molybdenum	µg/L	-	73	-	500	73
Nickel	µg/L	-	25[d]	607	1,000	200
Rubidium	µg/L	-	-	-	-	-
Selenium	µg/L	-	1.0	50	50	200
Silicon	µg/L	-	-	-	-	-
Silver	µg/L	-	0.25	-	50	200
Strontium	µg/L	-	-	-	-	-
Tellurium	µg/L	-	-	-	-	-
Thallium	µg/L	-	0.80	0.24	-	-
Thorium	µg/L	-	-	-	-	-
Tin	µg/L	-	-	-	-	-
Titanium	µg/L	-	-	-	-	-
Tungsten	µg/L	-	-	-	-	-
Uranium	µg/L	33	15	20	200	10
Vanadium	µg/L	-	-	-	100	100
Zinc	µg/L	-	30	7,440	50,000	1,000
Zirconium	µg/L	-	-		-	-
Dissolved Metals						
Mercury	µg/L	-	-	-	-	-

[a] The ammonia guideline is pH and temperature dependent. The guideline in the table was calculated based on the pH (6.83) and water temperature (12.83°C) measured in the field at the time of sample collection.
[b] The guideline is chloride dependent and was determined based on the chloride concentration in the sample.
[c] The guideline is pH dependent, and is equal to 5 µg/L at pH <6.5 or 100 µg/L at pH ≥6.5. Based on the field pH (i.e., pH = 6.83), the guideline is 100 µg/L.
[d] The guideline is hardness dependent and is calculated based on the hardness value (i.e., 41 mg/L as $CaCO_3$) measured in the corresponding water sample.
[e] The guidelines for chromium VI were used.

°C = degrees Celsius; - = no guideline or no data; µS/cm = microSiemens per centimetre; $CaCO_3$ = calcium carbonate; mg/L = milligrams per litre; TCU = true color units; µg/L =micrograms per litre; % = percentage; mg-N/L = milligrams nitrogen per litre; mg-P/L = milligrams phosphorus per litre.

Although these guidelines are adopted by regulators as benchmarks for the protection of aquatic life, wildlife, and human health, they might not be applicable in certain cases. This is because the guidelines are based on experiments conducted in laboratory conditions that might not replicate natural conditions and on species that might not be present in the study area. Furthermore, in areas where certain compounds occur naturally in relatively high concentrations, the native species might have adapted to tolerate higher levels of these compounds.

5.4 Results

5.4.1 PR01

Water quality results for the measurements and samples collected at PR01 on the Greenbush River during the June 2016 sampling program are presented in Table 5.4-1. The data indicate a highly coloured soft, circumneutral water, having low specific conductivity (i.e., relatively low total dissolved solids [TDS]) but an alkalinity minimally sensitive to acid inputs (however, still potentially sensitive to acid inputs), and possessing low concentrations of major ions, nutrients, and metals.

Table 5.4–1: Water Quality Results for the Greenbush River, June 2016

Location			**Greenbush River**
Station			**PR01**
Sample Date			**June 2, 2016**
Parameter	**Unit**	**Detection Limit**	
Field-measured Parameters			
Temperature	°C	-	12.83
pH	-	-	6.83
Specific Conductivity	µS/cm	-	76
Dissolved Oxygen	mg/L	-	**5.75**
	% saturation	-	**54**
Conventional Parameters			
pH	-	0.10	7.0
Specific conductivity	µS/cm	10	64
Alkalinity, total as $CaCO_3$	mg/L	20	44
Hardness, total as $CaCO_3$	mg/L	-	41
Total dissolved solids	mg/L	27	56
Total dissolved solids (calculated)	mg/L	-	44
Total suspended solids	mg/L	5.0	<5.0
Colour	TCU	5.0	157
Ions			
Bicarbonate	mg/L	20	54
Calcium	mg/L	1.0	10.6
Carbonate	mg/L	10	<10
Chloride	mg/L	1.0	1.5
Hydroxide	mg/L	10	<10
Magnesium	mg/L	1.0	3.6

Table 5.4–1: Water Quality Results for the Greenbush River, June 2016

Location			Greenbush River
Station			PR01
Sample Date			June 2, 2016
Parameter	**Unit**	**Detection Limit**	
Potassium	mg/L	1.0	<1.0
Sodium	mg/L	2.0	2.3
Sulphate	mg/L	3.0	<3.0
Cation - anion balance	%	-	-
Nutrients and Biological Indicators			
Ammonia, total	mg-N/L	0.050	<0.050
Nitrate	mg-N/L	0.50	<0.50
Nitrite	mg-N/L	0.050	<0.050[(a)]
Nitrate + nitrite	mg-N/L	0.50	<0.50
Nitrogen, total (calculated)	mg-N/L	-	0.22
Nitrogen, total Kjeldahl	mg-N/L	0.20	0.22
Organic carbon, total	mg/L	1.0	29
Organic carbon, dissolved	mg/L	1.0	31
Phosphorus, total	mg-P/L	0.2	<0.2
Biochemical oxygen demand	mg/L	2	<2
Total Metals			
Aluminum	µg/L	3.0	42
Antimony	µg/L	0.10	<0.1
Arsenic	µg/L	0.10	1.2
Barium	µg/L	0.10	12
Beryllium	µg/L	0.10	<0.1
Bismuth	µg/L	0.050	<0.05
Boron	µg/L	10	<10
Cadmium	µg/L	0.005	0.015
Cesium	µg/L	0.010	<0.01
Chromium	µg/L	0.10	0.16
Cobalt	µg/L	0.10	<0.1
Copper	µg/L	0.50	<0.5
Iron	µg/L	10	**418**
Lead	µg/L	0.050	<0.05
Lithium	µg/L	1.0	2.7
Manganese	µg/L	0.10	31
Mercury	µg/L	0.0050	0.0052
Molybdenum	µg/L	0.050	0.11
Nickel	µg/L	0.50	<0.5
Rubidium	µg/L	0.20	0.48

Table 5.4–1: Water Quality Results for the Greenbush River, June 2016

Location			Greenbush River
Station			PR01
Sample Date			June 2, 2016
Parameter	**Unit**	**Detection Limit**	
Selenium	µg/L	0.050	0.090
Silicon	µg/L	50	1,870
Silver	µg/L	0.010	<0.01
Strontium	µg/L	0.20	27
Tellurium	µg/L	0.20	<0.2
Thallium	µg/L	0.010	<0.01
Thorium	µg/L	0.10	<0.1
Tin	µg/L	0.10	<0.1
Titanium	µg/L	0.30	0.73
Tungsten	µg/L	0.10	<0.1
Uranium	µg/L	0.010	0.017
Vanadium	µg/L	0.50	<0.5
Zinc	µg/L	3.0	<3.0
Zirconium	µg/L	0.30	<0.3
Dissolved Metals			
Mercury	µg/L	0.005	<0.005

[a] The detection limit for nitrite (i.e., 0.050 mg-N/L) is higher than the most conservative guideline (i.e., 0.020 mg-N/L).
Note: **Bolded** values are not within acceptable ranges for pH and dissolved oxygen concentrations, or are above the most conservative guideline from Table 5.3-3.
°C = degrees Celsius; - = no data/not applicable; µS/cm = microSiemens per centimetre; mg/L = milligrams per litre; % = percent; < = less than; TCU = true color units; mg-N/L = milligrams nitrogen per litre; mg-P/L = milligrams phosphorus per litre; µg/L = micrograms per litre.

Parameters measured outside of acceptable objectives and guidelines included dissolved oxygen (DO) and iron. The DO concentrations was below the CCME (1999, with updates to 2015) guideline for the protection of early stages of warm water biota (i.e., 6.0 mg/L), but above the CCME guideline for the protection of other life stages (i.e., 5.5 mg/L). The lower DO in the Greenbush River, downstream of the proposed harvest area, is not unexpected, given values reported for other, nearby peat bog environments (e.g., Premier Tech Horticulture 2012) and that flow rates are low (Section 4.5) and oxygen demands could be high. The iron concentration reported for PR01 was measured above the Government of Saskatchewan (2015a) guideline for the protection of aquatic life (i.e., 300 micrograms per litre [µg/L]) (Table 5.3-3).

Other notable water quality observations include the following:

- The ionic composition of the water was dominated by bicarbonate and calcium.
- The water had a relatively low nitrogen (0.22 mg-N/L) concentration, but a high organic carbon concentration (approximately 30 mg/L).
- Total metal concentrations were low, with greater than 50 percent (%) of the metals measured below detection.

These observations are consistent with water quality data reported in support of other, nearby peat harvesting projects (Golder Associates Ltd. [Golder] 2016a, 2017; Premier Tech Horticulture 2012).

5.4.2 PRX1 to PRX5

A summary of the situ physico-chemical measurements collected from the stream crossings during the June 2016 sampling program are provided in Table 5.4-2. Data collected at stations PRX1 through PRX5 along the proposed access corridor indicated variability in physico-chemical conditions. There was a discernible increase in specific conductivity (i.e., 172 to 575 µS/cm) with increasing distance downstream in the Cracking River watershed. The pH range was circumneutral to slightly alkaline, DO was above 6.5 mg/L but represented under saturated to saturated conditions, and the temperature varied from 11°C to 20°C. All pH measurements and DO concentrations were within the corresponding range of guidelines (Table 5.3-3).

Table 5.4–2: Surface Water Quality Sampling Dates and Stations

Stream or Waterbody	Station	Sample Date	Temperature (°C)	pH	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	
						mg/L	% saturation
Unnamed stream	PRX1	June 1, 2016	15.63	7.73	575	6.64	66.9
	PRX2	June 1, 2016	20.09	8.17	321	10.23	112.9
	PRX2.5	June 1, 2016	19.32	7.89	249	8.06	87.4
	PRX4	June 1, 2016	11.85	7.59	201	6.93	64
	PRX5	June 1, 2016	10.79	7.64	172	8.72	78.4

Note: **Bolded** values are not within acceptable ranges for pH and dissolved oxygen concentrations, based on the guidelines in Table 5.3-3.
°C = degrees Celsius; µS/cm = microSiemens per centimetre; mg/L = milligrams per litre; % = percent.

5.4.3 Quality Assurance/Quality Control

Results for QC samples are presented in Table 5.4-3.

Parameter concentrations in the trip and field blanks were below detection limits for all parameters with the exception of DOC. The measured DOC concentration was consistent between the field and trip blank (i.e., 1.8 mg/L), within five times the detection limit, and also well below the concentration measured in the field sample, indicating that it had little influence on the interpretation of the sample results.

Total parameter concentrations were generally above their corresponding dissolved parameter concentrations. In cases where the dissolved parameter concentration was above the total parameter concentration (e.g., DOC/TOC), the relative difference was well below the acceptability threshold used in the program (30%), and/or the results were well within five times the detection limits.

The QC sample data therefore indicate that the quality of the surface water quality data presented in this report is high and therefore adequate to meet the study objectives of the program.

Table 5.4–3: Water Quality Results for Quality Control Samples, June 2016

Sample Type			Field Blank	Trip Blank
Sample Date			June 3, 2016	June 3, 2016
Parameter	**Unit**	**Detection Limit**		
Conventional Parameters				
pH	-	0.10	5.57	5.54
Specific conductivity	µS/cm	10	<10	<10
Hardness, total as $CaCO_3$	mg/L	-	<1.0	<1.0
Alkalinity, total as $CaCO_3$	mg/L	20	<20	<20
Total dissolved solids	mg/L	20	<20	<20
Total dissolved solids (calculated)	mg/L	-	<1.0	<1.0
Total suspended solids	mg/L	5.0	<5.0	<5.0
Colour	TCU	5.0	<5.0	<5.0
Ions				
Bicarbonate	mg/L	20	<20	<20
Calcium	mg/L	1.0	<1.0	<1.0
Carbonate	mg/L	10	<10	<10
Chloride	mg/L	1.0	<1.0	<1.0
Hydroxide	mg/L	10	<10	<10
Magnesium	mg/L	1.0	<1.0	<1.0
Potassium	mg/L	1.0	<1.0	<1.0
Sodium	mg/L	2.0	<2.0	<2.0
Sulphate	mg/L	3.0	<3.0	<3.0
Cation - anion balance	%	-	Low TDS	Low TDS
Nutrients and Biological Indicators				
Ammonia, total	mg-N/L	0.050	<0.050	<0.050
Nitrate	mg-N/L	0.50	<0.50	<0.50
Nitrite	mg-N/L	0.050	<0.050	<0.050
Nitrate + nitrite	mg-N/L	0.50	<0.50	<0.50
Nitrogen, total Kjeldahl	mg-N/L	0.20	<0.20	<0.20
Organic carbon, total	mg/L	1.0	<1.0	<1.0
Organic carbon, dissolved	mg/L	1.0	1.8	1.8
Phosphorus, total	mg-P/L	0.2	<0.2	<0.2
Biochemical oxygen demand	mg/L	2	<2	<2
Total Metals				
Aluminum	µg/L	3.0	<3.0	<3.0
Antimony	µg/L	0.10	<0.10	<0.10
Arsenic	µg/L	0.10	<0.10	<0.10
Barium	µg/L	0.10	<0.10	<0.10
Beryllium	µg/L	0.10	<0.10	<0.10
Bismuth	µg/L	0.050	<0.050	<0.050

Table 5.4–3: Water Quality Results for Quality Control Samples, June 2016

Sample Type			Field Blank	Trip Blank
Sample Date			June 3, 2016	June 3, 2016
Parameter	Unit	Detection Limit		
Boron	µg/L	10	<10	<10
Cadmium	µg/L	0.005	<0.0050	<0.0050
Cesium	µg/L	0.010	<0.010	<0.010
Chromium	µg/L	0.10	<0.10	<0.10
Cobalt	µg/L	0.10	<0.10	<0.10
Copper	µg/L	0.50	<0.50	<0.50
Iron	µg/L	10	<010	<010
Lead	µg/L	0.050	<0.050	<0.050
Lithium	µg/L	1.0	<1.0	<1.0
Manganese	µg/L	0.10	<0.10	<0.10
Mercury	µg/L	0.0050	<0.0050	<0.0050
Molybdenum	µg/L	0.050	<0.050	<0.050
Nickel	µg/L	0.50	<0.50	<0.50
Rubidium	µg/L	0.20	<0.20	<0.20
Selenium	µg/L	0.050	<0.050	<0.050
Silicon	µg/L	50	<50	<50
Silver	µg/L	0.010	<0.010	<0.010
Strontium	µg/L	0.20	<0.20	<0.20
Tellurium	µg/L	0.20	<0.20	<0.20
Thallium	µg/L	0.010	<0.010	<0.010
Thorium	µg/L	0.10	<0.10	<0.10
Tin	µg/L	0.10	<0.10	<0.10
Titanium	µg/L	0.30	<0.30	<0.30
Tungsten	µg/L	0.10	<0.10	<0.10
Uranium	µg/L	0.010	<0.010	<0.010
Vanadium	µg/L	0.50	<0.50	<0.50
Zinc	µg/L	3.0	<3.0	<3.0
Zirconium	µg/L	0.30	<0.30	<0.30
Dissolved Metals				
Mercury	µg/L	0.0050	<0.0050	0.0053

- = no data/not applicable; µS/cm = microSiemens per centimetre; < = less than; mg/L = milligrams per litre; TCU = true color units; % = percent; mg-N/L = milligrams nitrogen per litre; mg-P/L = milligrams phosphorus per litre; µg/L = micrograms per litre.

5.5 Summary

Baseline characterization of water quality conditions in the BSA was limited to a single site visit in summer. One station was selected in the Greenbush River (PR01), and five stations were selected at stream crossings along the access road. Water quality surveys were limited to physico-chemical field data collection, with physico-chemical field data collection and water sample collection for chemical analyses undertaken at the development station.

Surface water quality data collected from PR01 in the Greenbush River in June 2016 indicate a highly coloured soft, circumneutral water, with a low specific conductivity and minimal sensitivity to acid inputs. The dissolved concentration measured at PR01 was below the minimum guideline for the protection of early life stages of warm water biota. Concentrations of major ions were generally low; ionic composition was dominated by bicarbonate and calcium. Nutrient and metal concentrations were also low, with the exception of total iron. The total iron concentration exceeded its corresponding guideline for the protection of aquatic life. Water quality conditions observed at PR01 are consistent with those reported for other, nearby peat bog environments.

Physico-chemical conditions varied among stations PRX1 through PRX5 along the proposed access corridor. Specific conductivity appeared to increase with increasing distance downstream in the Cracking River watershed. The pH range was circumneutral to slightly alkaline and DO concentrations represented under saturated to saturated conditions. All pH measurements and DO concentrations were within corresponding ranges of water quality objectives and guidelines.

6.0 FISH AND FISH HABITAT

6.1 Introduction

Determining the fish species present within the fish and fish habitat baseline study area (BSA) is an important step in assessing the potential effects of the Prairie River Peat Harvest Project (the Project). Understanding the species present and their associated life histories requirements allows for the integration of life history requirements and species specific habitat use into the assessment of Project-related impacts. The objectives of the fish and fish habitat baseline study are to determine fish species presence in watercourses in and near the BSA as well as along the proposed access road, and fish habitat conditions in watercourse where the presence of fish is confirmed.

6.2 Baseline Study Area

The BSA for fish and fish habitat is the same as that identified for surface water quality and hydrology (Figure 6.2-1). The BSA covers 37.3 square kilometres (km^2) and includes the lease boundary plus the areas in the Greenbush and Papikwan River watersheds that are immediately downstream of the proposed Project outlet ditches for the five phases of development. This includes an outflow stream approximately 4 kilometres (km) north of the lease area, and stream crossings along the proposed access road.

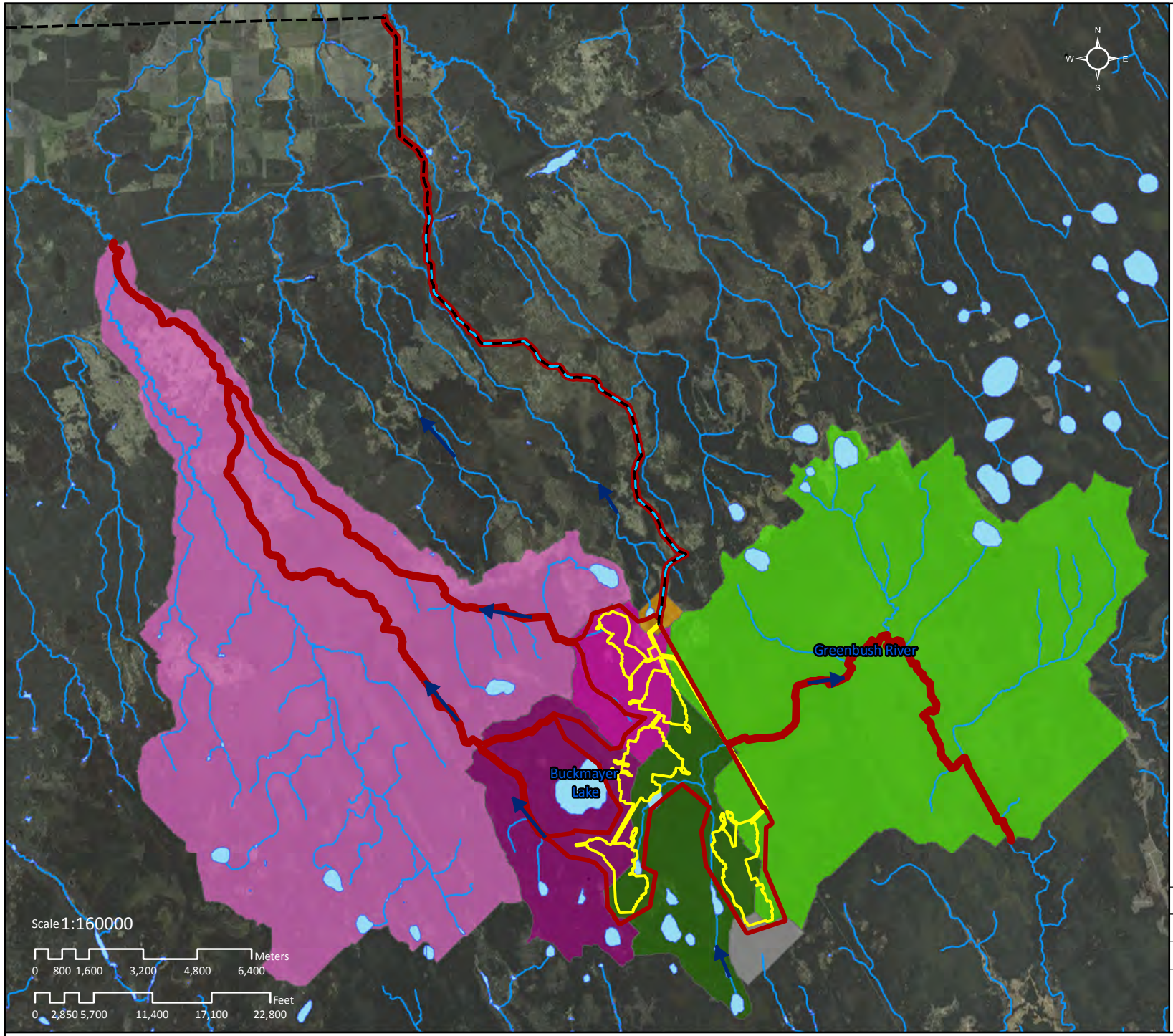
6.3 Methods

6.3.1 Fish Habitat Assessment

Fish habitat assessments were completed at five unnamed watercourses along the proposed access road and at the Greenbush River within the BSA (Figure 6.3-1). Sample sites were identified using satellite imagery and chosen based on their size and accessibility. Information was documented using a Geographic Information Systems (GIS) geodatabase and tablet pre-loaded with the Collector for ArcGIS software application. Geo-referenced habitat data were recorded digitally, in real-time. The start and end of the fish habitat assessment area, channel unit type and breaks and unique fish habitat features (e.g., large root wads, braided channel sections) were among the recorded parameters. A GIS platform was used to edit the geo-referenced habitat data and facilitate development of aquatic habitat maps. Spatial accuracy of the geo-referenced digital data capture was generally within 3 to 5 m, with a maximum allowable limit of 10 m (i.e., data were not recorded until the recorder's position could be triangulated with an accuracy of 10 m or better).

The following site related data was collected for each fish habitat assessments:

- water depth;
- shoreline characteristics (slope, substrate type and size, vegetation and cover);
- high water mark;
- channel width and depth;
- flow characteristics;
- presence of channel blockages and fish passage constraints; and
- land use adjacent to the streams.



Site Boundaries
- Project Footprint
- Fish and Fish Habitat Baseline Study Area

Hydrology
- Waterbody
- Watercourse
- Flow Direction

Watershed

Greenbush River Watershed
- Greenbush River at Hydrology Station
- Greenbush River Below the Baseline Study Area

Papikwan River Watershed
- Upper Papikwan River below Lease Area
- Papikwan River Downstream of the Baseline Study Area
- Tributary of Papikwan

Other Watershed
- North Pond Outflow below Lease Area
- South Basin below Lease Area

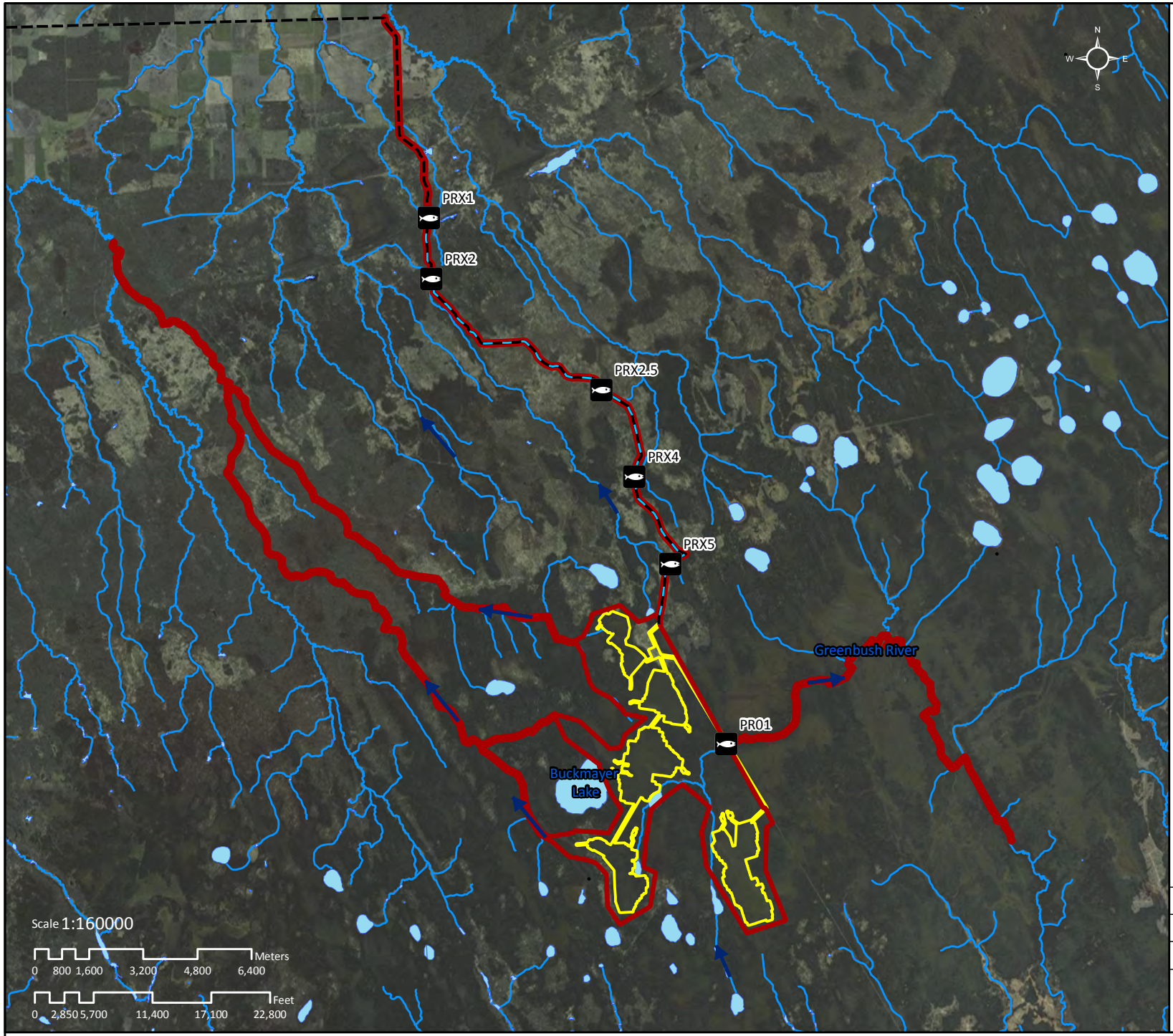
Infrastructures
- Gravel Road (Exisiting)
- Access Road (Exisiting Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/23
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 6.2-1 : Fish and Fish Habitat Baseline Study Area | Prairie River Bog



Site Boundaries

- Project Footprint
- Fish and Fish Habitat Baseline Study Area

Survey

- Fish and Fish Habitat Sampling Stations

Hydrology

- Waterbody
- Watercourse
- Flow Direction

Infrastructures

- Gravel Road (Exisiting)
- Access Road (Exisiting Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/07
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 6.3-1 : Fish and Fish Habitat Sampling Stations | Prairie River Bog

To further understand the types of fish habitat present, supporting limnology data (i.e., specific conductivity, dissolved oxygen, water temperature, and pH) was collected at each sampling location with a YSI 600 QS-O-M multimeter. Other data recorded included sampling date and time, weather, Universal Transverse Mercator (UTM) coordinates, and photographs.

6.3.1.1 Data Entry and Analysis

As described above, fish habitat assessments were completed using a GIS geodatabase and tablet pre-loaded with the Collector for ArcGIS software application. Geo-referenced habitat data were recorded digitally, in real-time. The start and end of the fish habitat assessment area, changes in channel unit type, and unique habitat features (e.g., large root wads, braided channel sections) were among the recorded parameters. A GIS platform was used to edit the geo-referenced habitat data and facilitate development of aquatic habitat maps.

6.3.1.2 Quality Assurance/Quality Control

Detailed work instructions outlining each field task were provided to field personnel prior to starting the field program as part of quality assurance (QA) for the surveys. Detailed field notes were recorded in waterproof field notebooks and on pre-printed waterproof field data sheets. The data collected during the field sessions underwent a variety of individual quality assurance and quality control (QA/QC) checks.

6.3.2 Fish Inventory

Fish inventories were completed in the BSA on five unnamed watercourses along the access route and the Greenbush River (PR01). Fish sampling was conducted at each site using non-lethal methods. Non-lethal methods of capture included:

- unbaited minnow traps at several locations within the Greenbush River and unnamed watercourses,
- backpack electrofishing efforts at several locations within the unnamed watercourses; and
- gill nets in the Greenbush River.

Both minnow trapping and electrofishing efforts focused on areas likely to attract and support fish. Minnow traps were placed near in-water structure such as woody debris and overhanging vegetation. Backpack electrofishing efforts covered a larger area while targeting habitats the crew noted to have the highest likelihood of supporting fish due to the available habitat. Gill nets were focused on large bodied fish capture and were placed in deep areas likely to support large bodied fish species. The following information was recorded for each fishing effort:

- sampling date and time (start and end times);
- UTM coordinates;
- a general habitat description for the site; and
- number of fish caught and observed.

Captured fish were held in a holding tub and processed for:

- species;
- fork length (mm); and
- external health assessment.

Captured fish were temporarily held in holding containers which were filled with water from the watercourse from which they were captured. Up to ten fish of each species captured at each sampling location had their length measured to the nearest mm. Each measured fish had a cursory external health examination conducted before being released back into the watercourse from which they were captured. Remaining fish were identified to the species level, enumerated, and released.

6.3.2.1 Data Entry and Analysis

Fishing data were entered in an excel spreadsheet and catch-per-unit-effort (CPUE) was calculated for all waterbodies sampled in the BSA. The CPUE calculation provides an estimate of the relative abundance of fish among sampling areas by standardizing the catch data according to the actual catch and fishing effort.

6.3.2.2 Quality Assurance/Quality Control

Detailed work instructions outlining each field task were provided to field personnel prior to starting the field program as part of QA for the surveys. Detailed field notes were recorded in waterproof field notebooks and on pre-printed waterproof field data sheets. The data collected during the field sessions underwent a variety of individual QA/QC checks. For example, field data sheets were checked for completeness and accuracy.

The data entered in the excel spreadsheet underwent a 100% transcription check by a second person that was not involved in the initial data entry process. In addition, all the datasets and summary tables generated by the database underwent an additional QA/QC screening. As part of routine field operations, applicable equipment was frequently calibrated and inspected. The field program was completed by experienced personnel.

6.4 Results

6.4.1 Fish Habitat Assessment

6.4.1.1 PRX1

Sampling Station PRX1 is located on a small unnamed stream located to the south of the gravel access road, approximately 13 km north of the lease (Figure 6.4-1). The watercourse is located 100 m south of where the gravel access road ends and is crossed by a maintained all-terrain vehicle (ATV) trail. The stream flows from east to west through a culvert in the ATV trail.

The stream is made up of an impoundment, flat and a run section created as water passes through the culvert. The stream ranges from 0.7 m deep and 3 m wide in the run section (Photograph 6.4-1) to 2 m deep and 40 m wide in the impoundment downstream of the culvert. The stream-bottom was predominantly organics, silt and clay with a small amount of gravel in the run section near the culvert. Potential fish cover for small and large bodied fish species was present throughout the stream with the most common cover being submergent vegetation, emergent vegetation, inundated vegetation as well as small and large woody debris. Depth and turbulence cover was also documented. At the time of baseline surveys, fish passage was possible throughout the surveyed section of the stream. Fish are anticipated to live within the stream throughout the open water seasons and the beaver impoundment should provide the depth required for fish species to overwinter near the crossing.

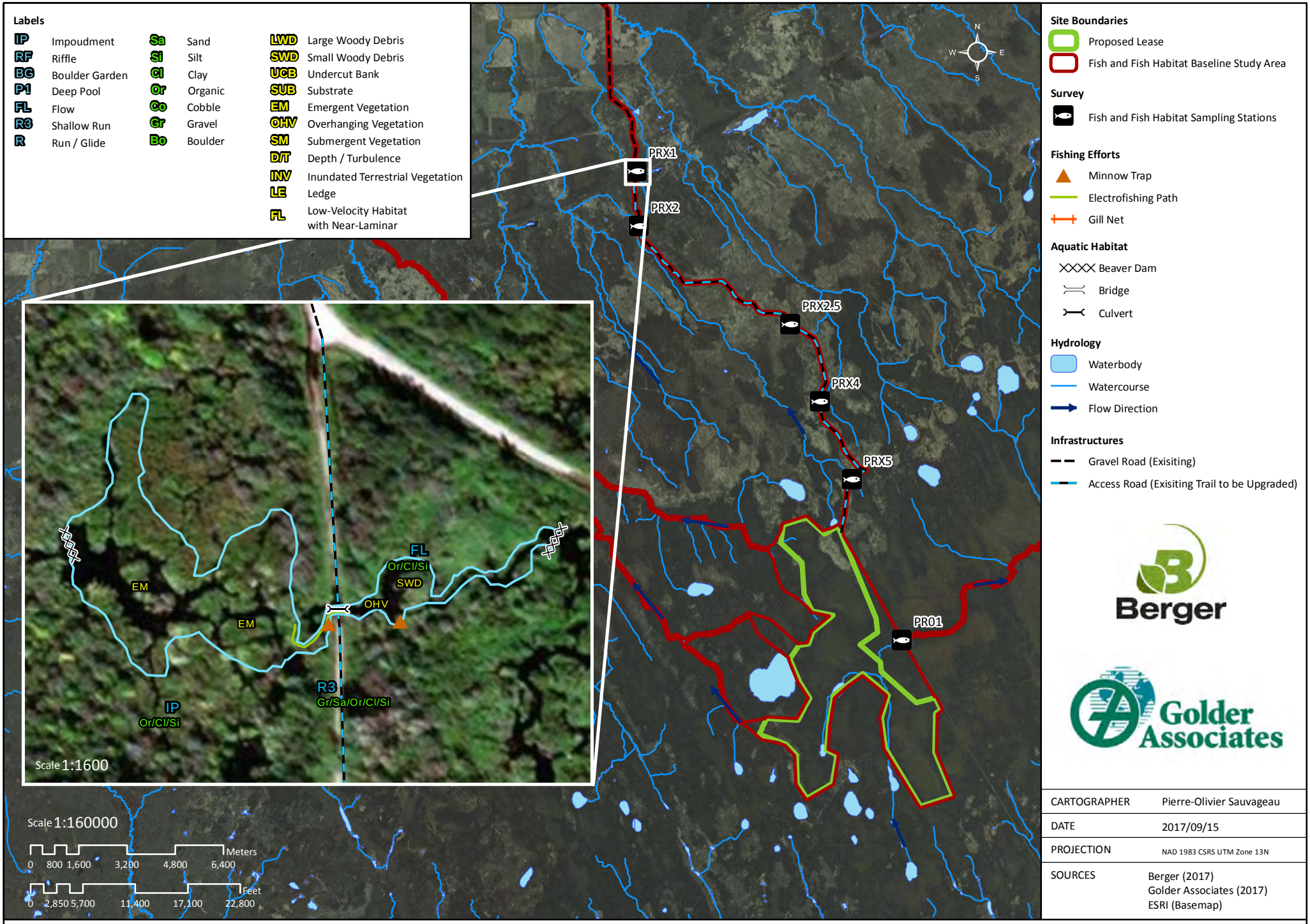


Figure 6.4-1 : Fish Habitat Map for Sampling Station PRX1 | Prairie River Bog



Photograph 6.4-1: Representative habitat for Sampling Station PRX1

6.4.1.2 PRX2

Sampling Station PRX2 is located on an impounded stream located adjacent to the proposed access route, approximately 11 km north of the lease (Figure 6.4-2). The waterbody is made up of a beaver impounded stream adjacent to the west of the existing ATV trail. The beaver impoundment extends to the north and south of the location and is approximately 30 m wide at its closest point to the proposed access road. The impoundment is greater than 1.5 m deep with an organic/submergent vegetation bottom. The shoreline of the impoundment is comprised of inundated trees and vegetation. Instream cover for fish was abundant within the waterbody and included emergent vegetation, overhanging woody vegetation and grasses and small/large woody debris (Photograph 6.4-2). Based on water depth and the abundance of instream cover it is likely that the waterbody could support both large and small bodied fish populations throughout the year.

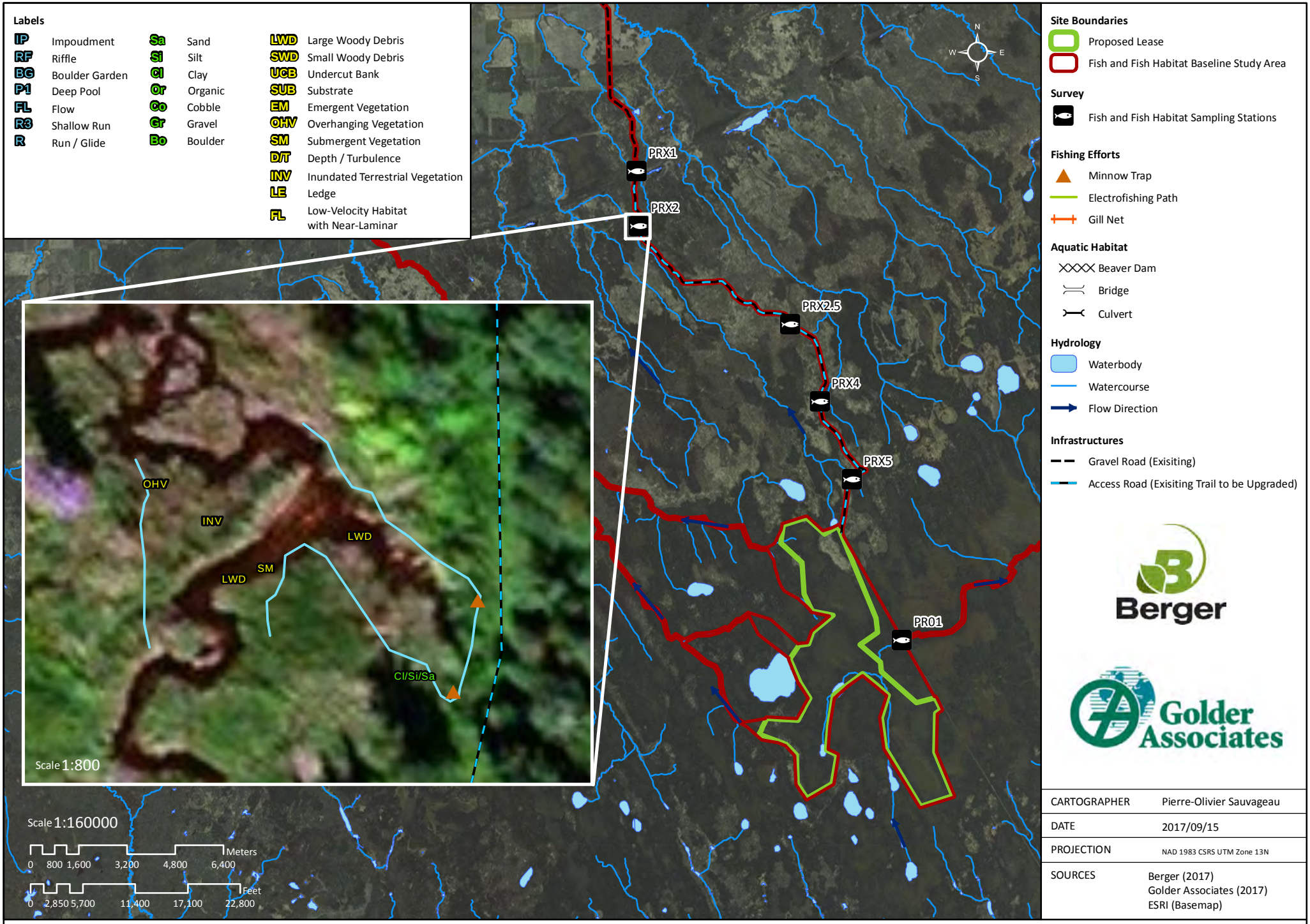


Figure 6.4-2 : Fish Habitat Map for Sampling Station PRX2 | Prairie River Bog



Photograph 6.4-2: Representative Habitat for Sampling Station PRX2

6.4.1.3 PRX2.5

Sampling Station PRX2.5 is located on a small unnamed stream located approximately 6 km north of the lease (Figure 6.4-3). The stream flows from west to east across the proposed access road.

The PRX2.5 stream is made up of shallow riffle which is approximately 1 m wide and 0.5 m deep (Photograph 6.4-3). The stream bottom was predominantly organics, silt and clay with a small amount of gravel. Potential fish cover included inundated vegetation, overhanging vegetation and small and large woody debris providing the majority of the limited cover for small bodied fish. At the time of baseline surveys, water depth was shallow (0.5 m depth), however fish passage was possible throughout the surveyed section of the stream. Watercourse PRX2.5 it is likely an ephemeral stream and provides limited seasonal fish habitat for small bodied fish. The presence of washed out culverts downstream of the culvert suggests during heavy rainfall events or spring freshet a large amount of water may pass the crossing during high runoff events.

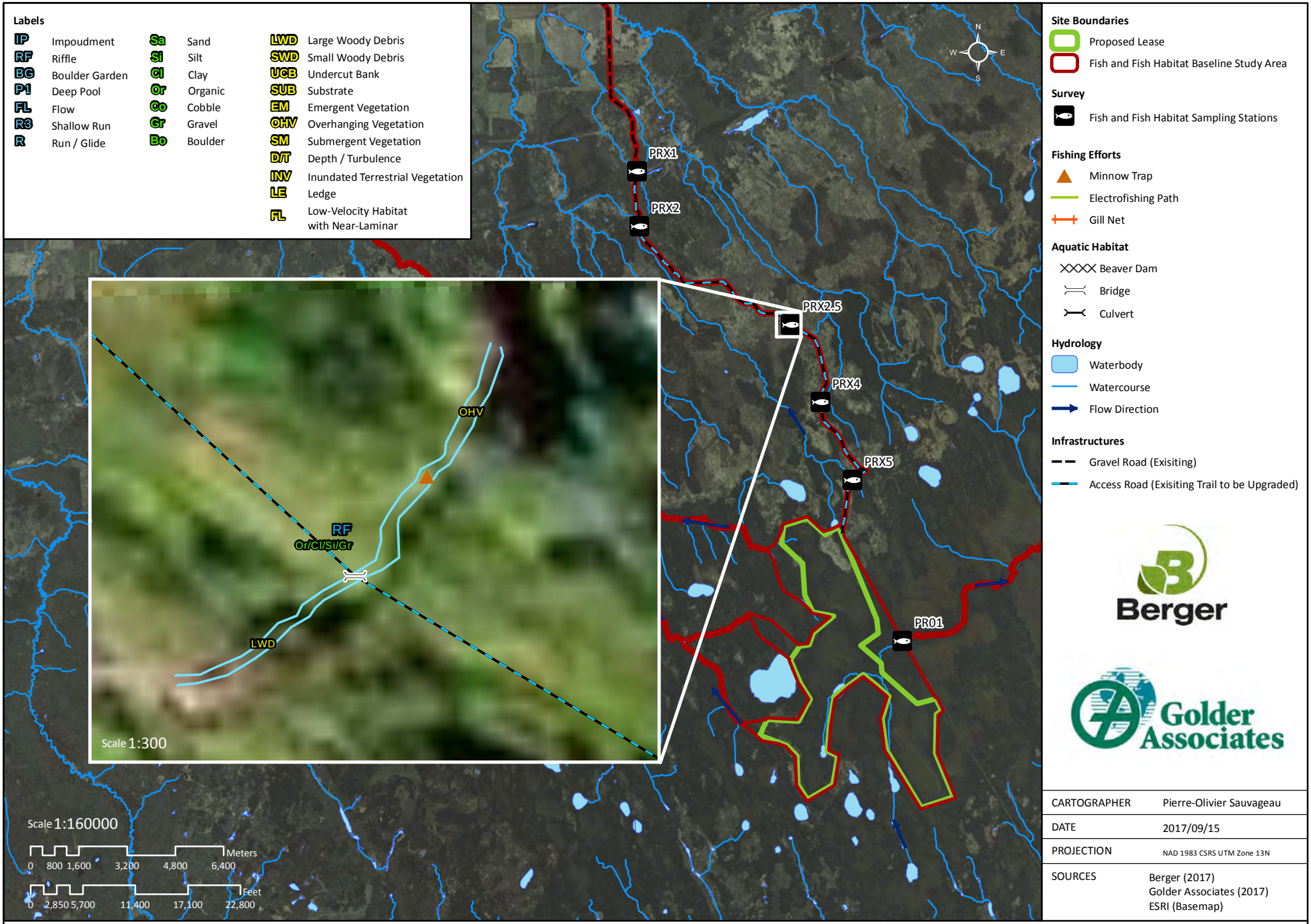


Figure 6.4-3 : Fish Habitat Map for Sampling Station PRX2.5 | Prairie River Bog



Photograph 6.4-3: Representative Habitat for Sampling Station PRX2.5

6.4.1.4 PRX4

Sampling Station PRX4 is located on a small unnamed stream located approximately 3.5 km north of the lease (Figure 6.4-4). The stream flows from west to east across the proposed access route.

The watercourse is comprised of a section of shallow stream, 0.3 m wide and 0.1 m deep, flowing into a large pool adjacent to the ATV trail (Photograph 6.4-4). The pool is approximately 20 m long by 10 m wide with a maximum depth of 1.0 m. The stream then flows east across the ATV trail. The stream-bottom was predominantly organics, silt and clay. Potential fish cover for small bodied fish species is primarily limited to the pool area, with limited cover throughout the stream section. Instream cover within the pool and stream includes overhanging vegetation and grasses, submergent vegetation and small and large woody debris. At the time of baseline surveys, fish passage was not possible from the shallow stream into and out of the pool. The stream is likely to be ephemeral, only flowing during freshet and heavy rainfall events. Based on the small size of the stream and the relatively shallow pool depth there is only limited seasonal habitat available for small bodied fish.

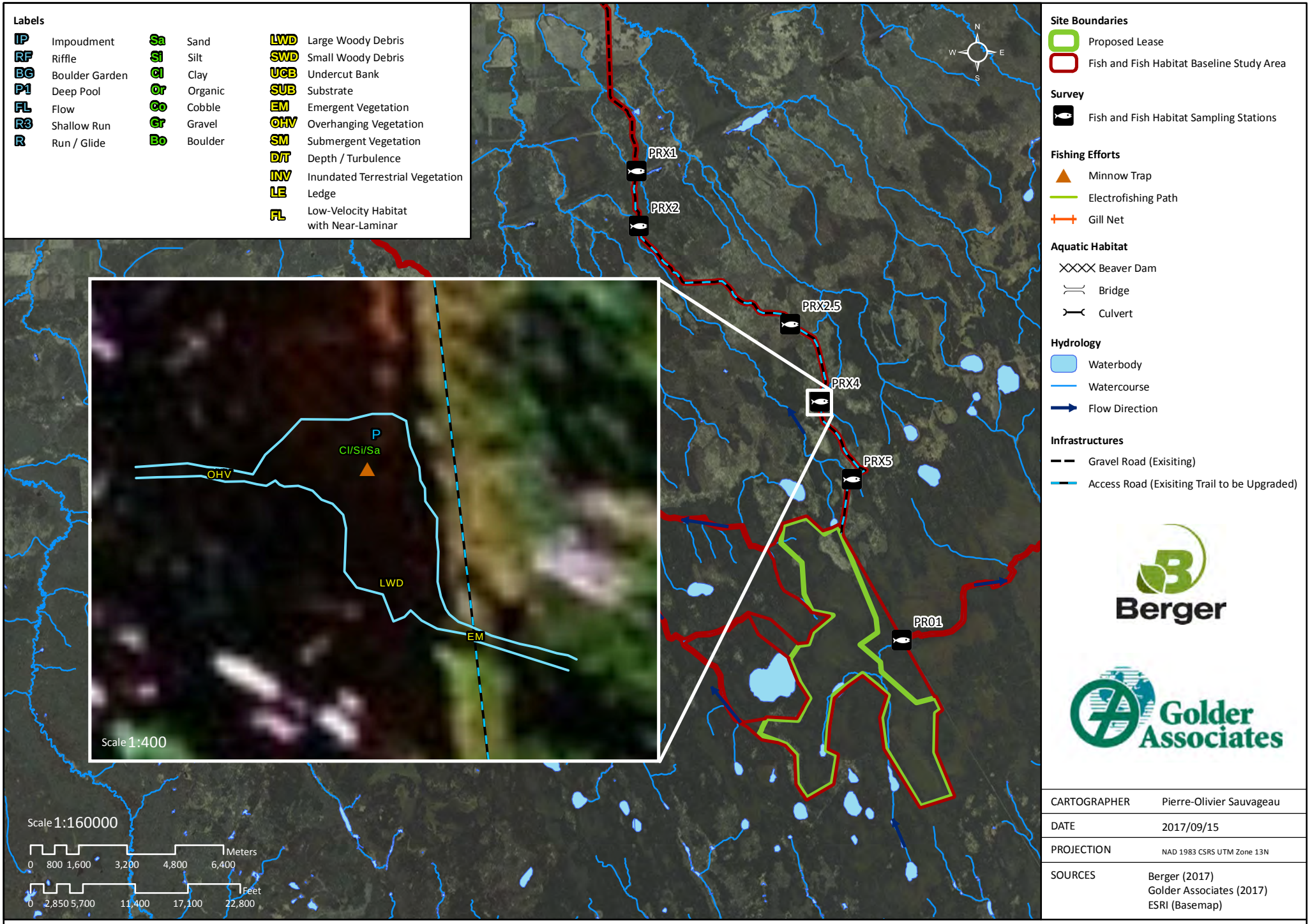


Figure 6.4-4 : Fish Habitat Map for Sampling Station PRX4 | Prairie River Bog



Photograph 6.4-4: Representative Habitat for Sampling Station PRX4

6.4.1.5 PRX5

Sampling Station PRX5 is located at an unnamed stream located approximately 3.5 km east of the lease (Figure 6.4-5). The stream flows from south to north across the proposed access route. Currently floating logs are laid across the stream to serve as a temporary ATV crossing. Fish movement is not impacted by the crossing as there are several large gaps within the crossing to allow fish passage through the area.

The stream is made up of a run (Photograph 6.4-5) upstream of the crossing, and larger braided flat downstream of the crossing (Photograph 6.4-6). The run is 0.7 m wide and 1.0 m deep while the flat is wider, 10 m, and deeper 1.6 m. The stream-bottom was predominantly organics, silt and clay with a small amount of sand. Potential fish cover for small bodied fish species was abundant through both sections with undercut banks, inundated vegetation, overhanging vegetation, submergent vegetation, emergent vegetation and small and large woody debris providing the majority of cover. At the time of baseline surveys, fish passage was possible throughout the surveyed section of the stream. Based on the water depth and presence of abundant small bodied fish species cover, the surveyed section area is likely to support small bodied species throughout the year.

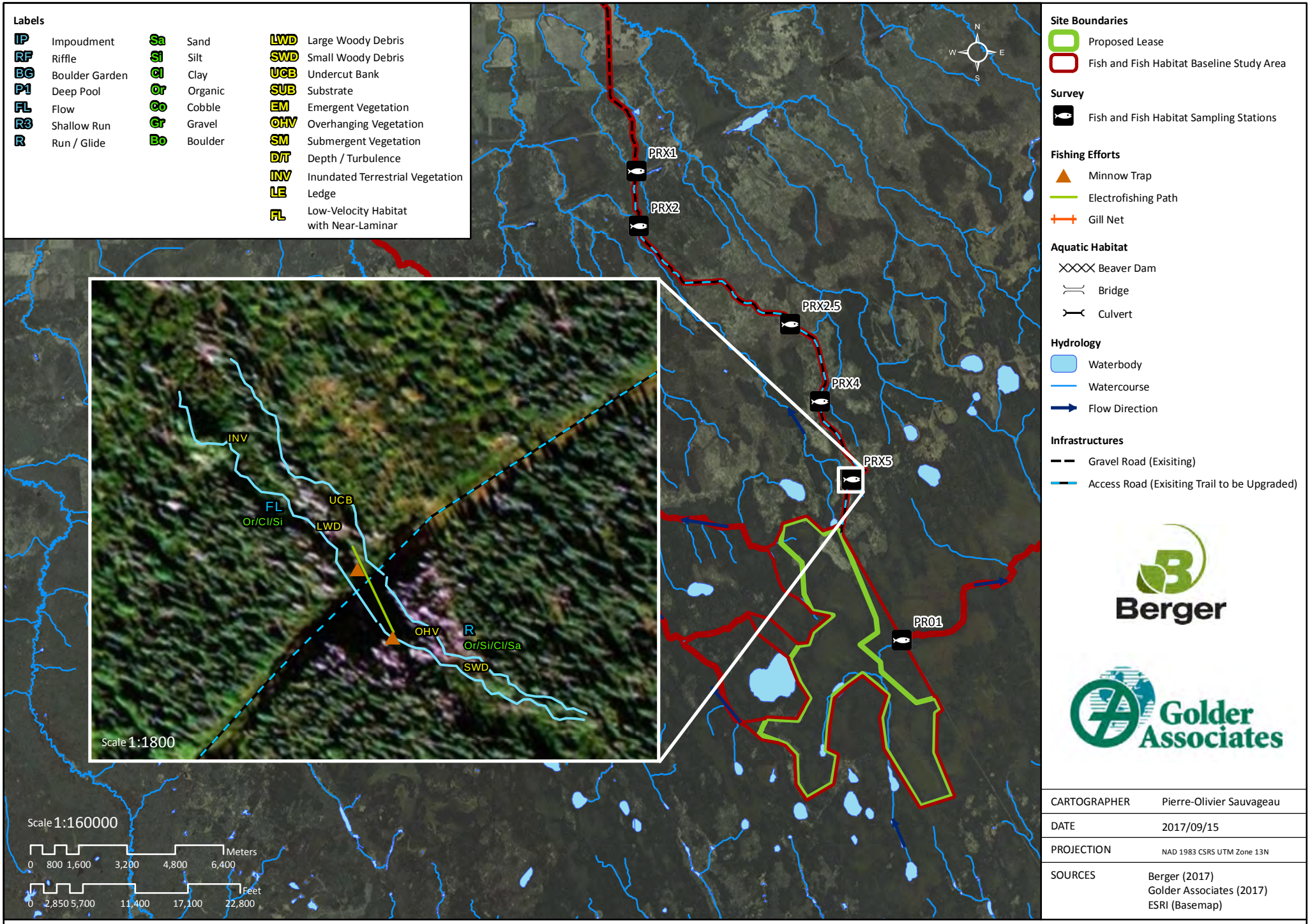


Figure 6.4-5 : Fish Habitat Map for Sampling Station PRX5 | Prairie River Bog



Photograph 6.4-5: Representative Run Habitat Upstream of Sampling Station PRX5



Photograph 6.4-6: Representative Flat Habitat Downstream of Sampling Station PRX5

6.4.1.6 PR01

Sampling Station PR01 is a crossing on the Greenbush River which flows through the proposed lease (Figure 6.4-6). The river flows from west to east from the approximate center of the lease area. The existing trail at this location may be used as a service road in the future to access the proposed harvest areas to the south. Due to access issues, surveys were completed 300 m to the east of the eastern lease boundary (at the existing trail crossing).

At Sampling Station PR01 the channel section of the Greenbush River is comprised of a deep slow moving run approximately 9 m wide and up to 2.2 m deep (Photograph 6.4-7). There are several inactive beaver dams along the surveyed section. However, they were not noted to prevent fish passage and movement. Substrate at this section of the river bottom was predominantly comprised of organics with some silt and clay. Potential fish cover and habitat for small and large bodied fish species was present throughout the area. The main types of cover were overhanging grass, willows, and alders, small and large woody debris, as well as submergent and emergent vegetation. Based on the depth and habitat availability it is likely the Greenbush River supports large and small bodied fish species at the survey location year round.



Photograph 6.4-7: Representative Habitat for Sampling Station PR01

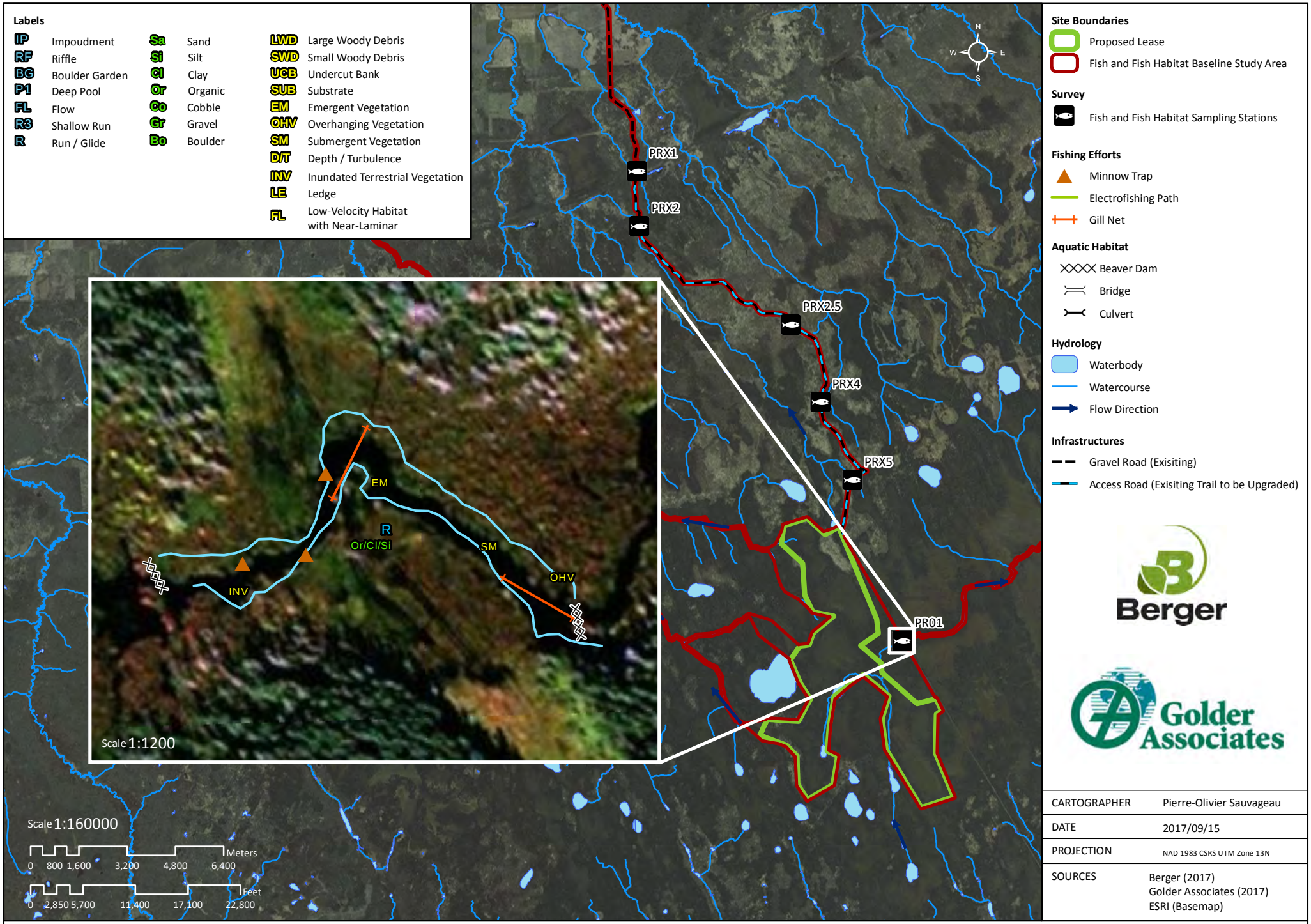


Figure 6.4-6 : Fish Habitat Map for Sampling Station PR01 | Prairie River Bog

6.4.2 Fish Inventory

Initial satellite imagery reconnaissance suggested that the streams crossing the proposed access road and adjacent to the BSA could potentially be fish bearing based on their proximity to larger rivers and streams. Saskatchewan Parks and Renewable Resources (SPRR 1991) identifies Pearl Dace (*Margariscus margarita*) and Northern Pike (*Esox Lucius*) as known species within the Greenbush River. The Ministry of Environment (MOE) fish stocking records also indicate that Brook Trout (*Salvelinus fontinalis*) have been stocked within the Greenbush River 20 km west of the Town of Hudson Bay as recently as 2015 (MOE 2015a).

Fish sampling was completed in the spring of 2016 to determine fish presence and abundance within the BSA and along streams crossing the proposed access road. Five unnamed watercourses along the proposed access road and the Greenbush River were sampled for fish presence. The watercourses were identified using satellite imagery and ground truthed once field work began. Additional waterbodies were selected for sampling within the proposed lease; however, due to access issues no sampling was completed on the proposed lease. Fishing efforts are presented in Table 6.4-1.

Small bodied fish species were captured at all locations except at the PRX4 location. A table detailing fish species captured and catch-per-unit effort is presented in Table 6.4-2. Captured fish were temporarily held in holding containers which were filled with water from the watercourse from which they were captured. Up to ten fish of each species captured at each sampling location had their length measured to the nearest millimetre. Each measured fish had a cursory external health examination conducted before release back into the capture watercourse. Remaining fish were identified to the species level, enumerated, and released. Detailed fish capture data is located in Appendix A, Table A-1.

6.4.2.1 PRX1

Sampling Station PRX1 is located on a small unnamed stream located to the south of the gravel access road, approximately 13 km north of the lease (Figure 6.4-1). The stream flows from east to west through a culvert in the ATV trail and is made up of an impoundment, flat and a run section created as water passes through the culvert. The stream was sampled using minnow traps and backpack electrofishing in June 2016 (Tables 6.4-2 and 6.4-3). Minnow trapping yielded 283 Brook Stickleback (*Culaea inconstans*), 11 Fathead Minnows (*Pimephales promelas*) and two Northern Redbelly Dace (*Phoxinus eos*) in 118.27 hours of sampling effort. CPUE was 2.39 fish/hour for Brook Stickleback, 0.09 fish/hour for Fathead Minnow and 0.02 fish/hour for Northern Redbelly Dace. Backpack electrofishing was also completed within the watercourse. Electrofishing yielded one Brook Stickleback in 320 seconds of sampling effort; CPUE was 0.31 fish per 100 seconds of sampling (fish/100 sec). Brook Stickleback total length ranged from 38 to 63 mm, Fathead Minnow lengths ranged from 48 to 64 mm, and Northern Redbelly Dace fork length ranged from 51 to 59 mm (Appendix A, Table A-1).

Table 6.4-1: Fishing Locations

Watercourse	Depth (metres)	Station	Start Date	Method	Effort[a]	Coordinates[b]	
						Easting	Northing
PRX1	2.0	PRX1-MT01/02	1-June-2016	Minnow Trap	59.17	634208	5899166
		PRX1-MT03/04			59.10	634184	5899168
		PRX1-BPEF01		Backpack Electrofisher	320	634200	5899177
PRX2	1.5	PRX2-MT01/02	1-June-2016	Minnow Trap	51.17	634255	5897361
		PRX2-MT03/04			51.00	634246	5897352
PRX2.5	0.5	PRX2.5-MT01/02	1-June-2016	Minnow Trap	46.67	639275	5894097
PRX4	1.0	PRX4-MT01/02	1-June-2016		44.00	640255	5891537
PRX5	1.0	PRX5-MT01/02	1-June-2016	Minnow Trap	41.40	641314	5888938
		PRX5-MT03/04			41.33	641299	5888976
		PRX5-BPEF01		Backpack Electrofisher	223	641293	5888981
PR01 (Greenbush River)	2.2	PR01-MT01/02	1-June-2016	Minnow Trap	30.17	642970	5883616
		PR01-MT03/04	1-June-2016		29.5	642975	5883643
		PR01-MT05	1-June-2016		24.17	642955	5883612
		PR01-GN01	1-June-2016	Gill Net	15.83	642976	5883638
		PR01-GN02	1-June-2016		15.82	643035	5883602

(a) All minnow trap and gill net efforts are in hours and all backpack electrofishing efforts are in seconds.
(b) All location coordinates are in Universal Transverse Mercator projection NAD 83, Zone 13.

Table 6.4-2: Minnow Trap Catch-Per-Unit-Effort by Species and Station

Watercourse	Station	Duration (Hours)	Fish Species	Number Captured	CPUE (Number fish/hour)
PRX1	PRX1-MT01/02	59.17	BRST	160	2.70
			FTMN	2	0.03
			NRDC	1	0.02
	PRX1-MT03/04	59.10	BRST	123	2.08
			FTMN	9	0.15
			NRDC	1	0.02
PRX2	PRX2-MT01/02	51.17	BRST	15	0.29
			FTMN	25	0.49
			NRDC	150	2.93
	PRX2-MT03/04	51.00	BRST	5	0.10
			FTMN	19	0.37
			NRDC	84	1.65
PRX2.5	PRX2.5-MT01/02	46.67	BRST	10	0.21
			FTMN	2	0.04
PRX4	PRX4-MT01/02	44.00	No Fish Caught	0	-
PRX5	PRX5-MT01/02	41.40	BRST	20	0.50
	PRX5-MT03/04	41.33	BRST	25	0.60
			FTMN	1	0.02
PR01 (Greenbush River)	PR01-MT01/02	30.17	BLDC	2	0.07
			BRST	11	0.36
			CRCH	54	1.79
			FTMN	13	0.43
			NRDC	1	0.03
	PR01-MT03/04	29.5	BRST	13	0.44
			CRCH	27	0.92
	PR01-MT05	24.17	BLDC	6	0.25
			BRST	1	0.04
			CRCH	5	0.21
			NRDC	2	0.08

CPUE = catch-per-unit-effort; BLDC = Blacknose Dace; BRST = Brook Stickleback; CRCH = Creek Chub; FTMN = Fathead Minnow; NRDC = Northern Redbelly Dace.

Table 6.4-3: Backpack Electrofishing Catch-Per-Unit-Effort by Species and Station

Watercourse	Station	Duration (seconds)	Fish Species	Number Captured	CPUE (Number fish/100 sec)
PRX1	PRX1-BPEF01	320	BRST	1	0.31
PRX5	PRX5-BPEF01	223	No Fish Caught	0	-

CPUE = catch-per-unit-effort; sec = seconds; BRST = Brook Stickleback; - = no data.

6.4.2.2 PRX2

Sampling Station PRX2 is located on an impounded stream located adjacent to the proposed access route, approximately 11 km north of the lease (Figure 6.4-2). The waterbody is made up of a beaver impounded stream adjacent to the west of the existing ATV road. The beaver impoundment extends to the north and south of the location and is approximately 30 m wide at its closest point to the access road. The stream was sampled using minnow traps (Tables 6.4-2). Minnow trapping yielded 20 Brook Stickleback, 44 Fathead Minnows and 234 Northern Redbelly Dace in 102.17 hours of sampling effort. CPUE was 0.20 fish/hour for Brook Stickleback, 0.43 fish/hour for Fathead Minnow and 2.29 fish/hour for Northern Redbelly Dace. Brook Stickleback total length ranged from 45 to 64 mm, Fathead Minnow lengths ranged from 50 to 72 mm, and Northern Redbelly Dace fork length ranged from 55 to 89 mm (Appendix A, Table A-1).

6.4.2.3 PRX2.5

Sampling Station PRX2.5 is located on a small unnamed stream located approximately 6 km north of the lease (Figure 6.4-3). The stream flows from west to east across the proposed access road. The stream is made up of shallow riffle which is approximately 1 m wide and 0.5 m deep. The stream was sampled using minnow traps (Table 6.4-2). Minnow trapping yielded ten Brook Stickleback and two Fathead Minnows in 46.67 hours of sampling effort, CPUE was 0.21 fish/hour for Brook Stickleback and 0.04 fish/hour for Fathead Minnow. Brook Stickleback total length ranged from 45 to 67 mm while Fathead Minnow lengths ranged from 39 to 47 mm (Appendix A, Table A-1).

6.4.2.4 PRX4

Sampling Station PRX4 is located on a small unnamed stream located approximately 3.5 km north of the lease (Figure 6.4-4). The stream flows from west to east across the proposed access route. The stream is made up of shallow stream, 0.3 m wide and 0.1 m deep, flowing into a large pool adjacent to the proposed access road. The stream was sampled using minnow traps (Table 6.4-2). Minnow trapping resulted in no fish being captured in 44.0 hours of effort. No fish were observed in the watercourse during surveys.

6.4.2.5 PRX5

Sampling Station PRX5 is located on an unnamed stream located approximately 3.5 km east of the lease (Figure 6.4-5). The stream flows from south to north across the proposed access route. The stream is made up of a run upstream of the crossing and larger braided flat downstream of the crossing. The stream was sampled using minnow traps (Table 6.4-2). Minnow trapping yielded 45 Brook Stickleback and one Fathead Minnow in 82.73 hours of sampling effort, CPUE was 0.54 fish/hour for Brook Stickleback and 0.02 fish/hour for Fathead Minnow. Brook Stickleback total length ranged from 40 to 65 mm while the Fathead Minnow was 67 mm in length (Appendix A, Table A-1).

6.4.2.6 PR01

Sampling Station PR01 is located at a trail crossing on the Greenbush River which flows through the proposed lease. (Figure 6.4-6). The river flows from west to east from the approximate center of the lease area. The river was sampled using minnow traps and gill nets in June 2016 (Tables 6.4-2 and 6.4-4). Minnow trapping yielded 8 Western Blacknose Dace (*Rhinichthys obtusus*), 25 Brook Stickleback, 86 Creek Chub (*Semotilus atromaculatus*), 13 Fathead Minnows and 3 Northern Redbelly Dace in 83.84 hours of sampling effort. CPUE was 0.10 fish/hour for Western Blacknose Dace, 0.30 fish/hour for Brook Stickleback, 1.03 fish/hour for Creek Chub, 0.16 fish/hour for Fathead Minnow and 0.04 fish/hour for Northern Redbelly Dace. Two gill nets were also deployed within the Greenbush River. One net (deployed at station PR01-GN01) was 15 m long with 3.81 cm stretched mesh while the second net (deployed at station PR01-GN02) measured 30 m long with 7.62 cm stretched mesh to target larger fish. The smaller mesh 15 m long gill net captured five Creek Chub in 15.83 hours of effort resulting in a CPUE of 3.32 fish/hour. The second larger mesh 30 m gill net did not catch any fish in 15.82 hours of effort. Western Blacknose Dace length ranged from 56 to117 mm, Brook Stickleback total length ranged from 42 to 59 mm, Creek Chub lengths ranged between 92 to 135 mm in the minnow traps and 134 to 150 mm in the gill nets. Fathead Minnow lengths ranged from 32 to 67 mm, and Northern Redbelly Dace ranged from 79 to 86 mm long (Appendix A, Table A-1).

Table 6.4-4: Gill Netting Catch-Per-Unit-Effort by Species and Station

Watercourse	Station	Duration (hours)	Fish Species	Number Captured	CPUE (Number fish/hour)
PR01 (Greenbush River)	PR01-GN01	15.83	CRCH	5	0.32
	PR01-GN02	15.82	No Fish Caught	0	-

CPUE = catch-per-unit-effort; CRCH = Creek Chub; - = no data.

6.5 Summary

Fish habitat surveys found abundant habitat for small-bodied fish species within watercourses along the proposed access route and within the BSA. Four of the six watercourses surveyed are deep enough and have enough cover to likely support small-bodied species throughout the year while the other two are more ephemeral in nature and are likely only able to provide fish habitat during certain times of the year. Based on their depths and in stream cover two of the watercourses PRX2, and PR01 are likely capable of supporting large and small bodied species throughout the year.

Fish sampling was completed in June 2016 on watercourses along the proposed access route and within the BSA to determine fish presence and abundance. Fish were found at Sampling Stations:

- PRX1;
- PRX2;
- PRX2.5;
- PRX5; and
- PR01.

Only Sampling Station PRX4 did not have fish present at the time of the June 2016 survey.

Five species of small bodied fish were found through the BSA, including:

- Brook Stickleback;
- Creek Chub;
- Fathead Minnow;
- Northern Redbelly Dace; and
- Western Blacknose Dace.

No large bodied fish species were captured during baseline studies. However, the Greenbush River is also known to support Pearl Dace, Northern Pike and Brook Trout.

7.0 VEGETATION

7.1 Introduction

The purpose of this section is to establish an understanding of the existing vegetation conditions in the Prairie River Peat Harvest Project (the Project) lease boundary (2,144 ha; 5,299 acres; 21.4 km^2), along the proposed access road and in the baseline study area (BSA). The BSA was surveyed to capture the local variation in plant species and communities and to ground-truth an Ecological Land Classification (ELC).

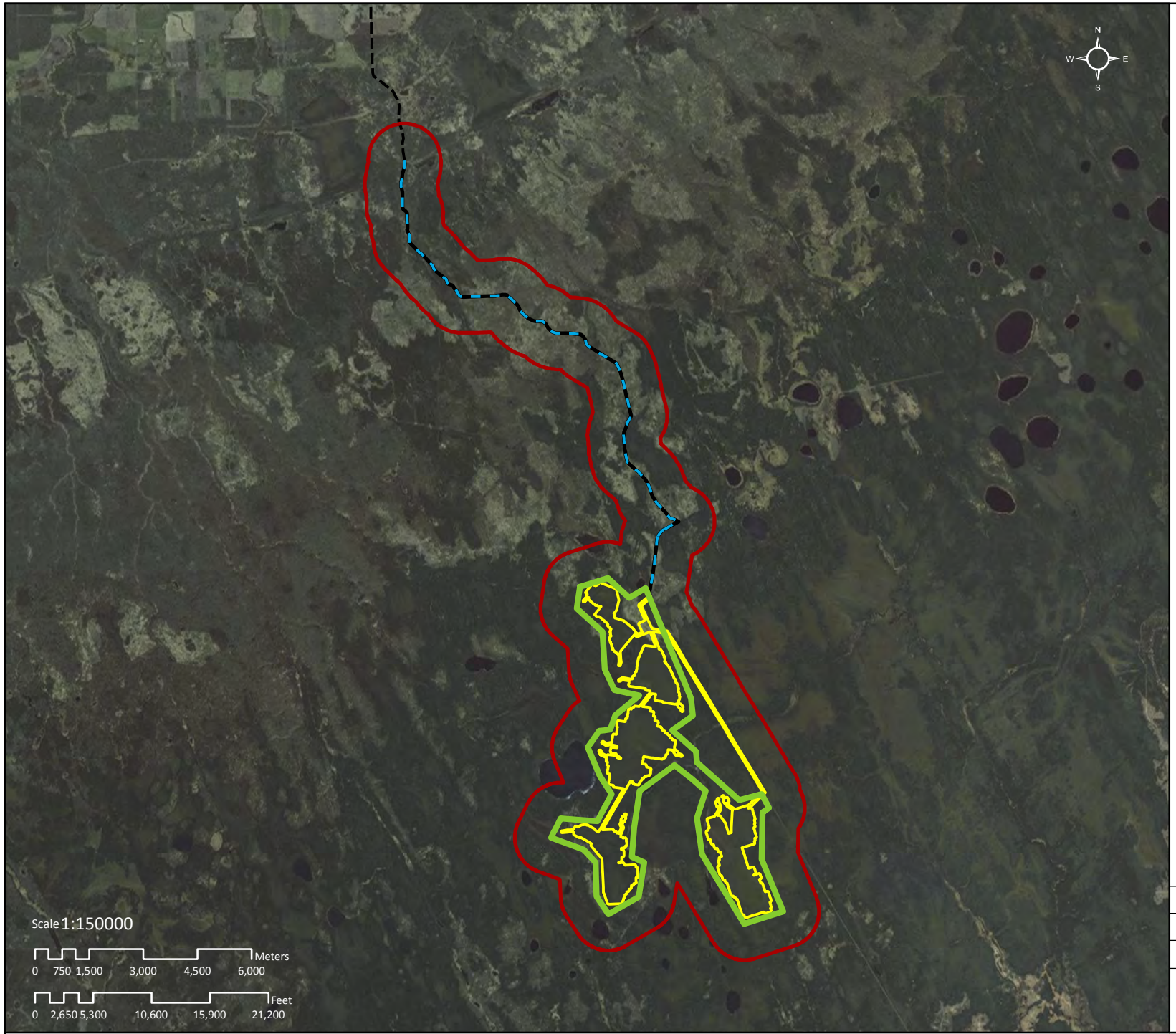
The vegetation baseline describes the composition and distribution of plant communities within the expected harvest areas, lease boundary and access road, and presents the data collected during the 2016 field programs. The data will be used to assess potential Project-specific and cumulative effects on vegetation, which include rare (i.e. provincially tracked or federally listed) and traditional use plant species.

The key objectives of the baseline vegetation section are:

- to define and map vegetation within the BSA using the ELC and field observations;
- to provide information on the characteristics of vegetation associated with the mapped ecosite types;
- to provide an inventory of the plant species present;
- to document the potential and observed occurrences of rare plants (provincial and federal) in the BSA;
- to document invasive plant (weed) species and their extent; and
- to document traditional use plants within the BSA.

7.2 Baseline Study Area

The spatial boundaries used in the description of the environmental setting and to support the assessment of potential Project effects on vegetation include the Project lease boundary, access road and the BSA (Figure 7.2-1). The Project Footprint (1,059 ha, 2,619 acres) is within the lease boundary, which is approximately 2,144 ha (5,299 acres) or 21.4 km^2. The BSA is defined by a 1-km buffer around the lease boundary area and occupies 9,571 ha (95.7 km^2) (Figure 7.2-1). The BSA was selected to provide a conservative buffer of the Project lease and Project Footprint, which includes sufficient area to accommodate all setbacks identified in the Activity Restriction Guidelines for Sensitive Species (Ministry of Environment [MOE] 2017).



Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/17
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 7.2-1 : Vegetation Baseline Study Area | Prairie River Bog

7.3 Methods

Vegetation surveys were completed on June 14 to 15 and July 25 to 26, 2016. Surveys were conducted with the assistance of an Argo for access, focusing on the lease boundary, harvest areas, and access road. Additional effort was expended on areas that were considered to have high potential to support rare species or had unique microsite conditions. The survey was completed using the Boreal Plant Species Survey Protocol submitted to the MOE and approved under the Research Permit Species Detection Permit Number 16FW094.

7.3.1 Detailed Vegetation Inventory Surveys

Detailed vegetation inventory (DVI) plots were completed to obtain site-specific and descriptive information on the characteristics of the plant communities within each ecosite type encountered (classified as per the Field Guide to the Ecosites of Saskatchewan's Provincial Forests; McLaughlan et al. 2010). Data on species presence, percent cover, and vegetation layer were documented. In addition, site information (e.g., terrain, moisture regime, nutrient regime, substrate, and slope) were recorded to provide additional background information.

Plots were established in representative locations within each ecosite type and a 10 m by 10 m plot was used to assess vegetation layers (i.e., trees, shrubs, forbs, graminoids, bryophytes, lichens, and epiphytes). Where trees were present, the main canopy height was recorded when greater than or equal to 5 m. The tall shrub layer includes all trees and/or shrubs between 2 and 4.9 m in height. The low shrub layer includes shrubs that are less than 2 m in height. The forb layer includes all herbaceous flowering plants and ferns, fern allies, and club mosses. The graminoid layer includes grasses, sedges, and rushes. At the ground layer, bryophytes (e.g., mosses), ground-dwelling (terrestrial) lichens, and epiphytes were recorded if they were observed. The plots were placed and oriented so they did not straddle more than one type of plant community. For example, plot shape in riparian areas was adjusted (e.g., 5 m by 20 m) to contain sampling to a single ecosite along the edge of water.

7.3.2 Ecological Land Classification

An ELC map was developed to provide information on the abundance and distribution of ecosite types within the BSA using the MOE forest ecosystem classification system (10 m by 10 m pixel; v2.0_rf_f, April 26, 2016). The ELC provides a broad-level inventory of ecosites within the BSA. The ELC also provides a basis for interpreting rare plant habitat potential and wildlife habitat suitability. Ecosite information collected at each DVI plot along with incidental ecosite information collected were used to ground-truth this dataset. A portion of the access road falls outside of the MOE forest ecosystem classification system coverage; therefore the Saskatchewan Digital Land Cover was used as a supplement to complete the ELC map (Saskatchewan Research Council [SRC] 1994).

7.3.3 Rare Plant Species Survey

Provincial and federal agencies maintain lists of plant species of conservation concern, which include rare species as well as other species that may not necessarily be rare, but are of conservation concern due to declining populations or other sensitivities. For the purpose of the baseline, rare species are:

- any plant species tracked by the Saskatchewan Conservation Data Centre ([SKCDC] 2017a,b);
- any plant species protected by *The Wildlife Act* (1998);
- any plant species recommended by the Committee on the Status of Endangered Wildlife in Canada ([COSEWIC] 2016) to be protected under the *Species at Risk Act* ([*SARA]* 2016); and
- any plant species listed under *SARA* (i.e., Schedule 1).

Prior to field programs, an inventory of rare species that are known to occur or have potential to occur within the BSA was compiled using federal and provincial status documents, provincial tracking lists, references, literature, and known distributions using a 20-km buffer around the BSA. The habitat requirements described by Harms et al. (1992), Harms and Leighton (2011a,b), Leighton and Harms (2014), Argus et al. (2016), and Flora of North America (1993+) of these rare plant species were reviewed and compared to availability of suitable habitat types in the BSA to focus on high potential habitat types to survey in the field.

The rare plant species survey was completed through the use of the use of plot locations and meandering pedestrian survey. Sampling effort was concentrated in habitats and microsites identified as having a greater potential to support rare plant species. However, rare species surveys were not limited to areas with highest habitat potential, as suitable microhabitats exist across all ecosite types. Therefore, plot locations were also selected to provide coverage across ecosite types. Rare plant species found during these searches were documented by taking photographs of the site and plants, and recording the global positioning system (GPS) coordinates, microhabitat, number of individuals present, and patch size.

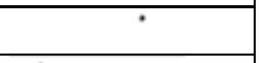
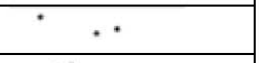
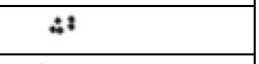
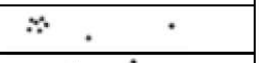
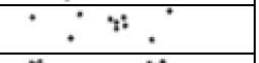
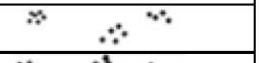
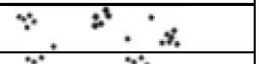
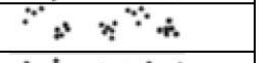
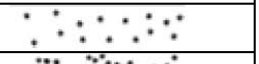
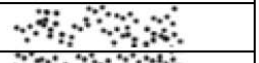
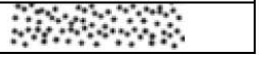
Any plant species that could not be identified in the field were collected for identification. Samples were collected only in cases where the collection removed less than 5% of the individuals observed. Species were identified using standard plant identification keys.

7.3.4 Weed Species

For this report, the definition of a “prohibited weed”, “noxious weed”, or “nuisance weed” refers to those plants designated in *The Weed Control Act* (2010). Weeds were documented during all vegetation surveys completed within the BSA as they were encountered (Section 7.4.4). No formal plot boundary was established to survey weeds, as the primary objectives were to document the weed species present, extent, and the related habitats.

As weed species were observed, the species and a weed infestation rank were recorded (Table 7.3-1). For example, if only one individual of a noxious weed species was observed at a site (i.e., rare), it would be assigned a rank of 1 for that site. If there were several patches of a noxious weed species with a few individual plants within the patches, the species would be assigned a rank of 8. The weed infestation ranking system provides a measure of how widespread a weed is and its distribution pattern, with a larger number indicating a more widespread occurrence.

Table 7.3-1: Density Distribution Guide for Ranking Weed Infestation

Density Distribution		
Rank	**Description of Abundance in Polygon**	**Distribution**
0	None	
1	Rare	
2	A few sporadically occurring individual plants	
3	A single patch	
4	A single patch plus a few sporadically occurring plants	
5	Several sporadically occurring plants	
6	A single patch plus several sporadically occurring plants	
7	A few patches	
8	A few patches plus several sporadically occurring plants	
9	Several well spaced patches	
10	Continuous uniform occurrences of well spaced plants	
11	A continuous occurrence of plants with a few gaps in the distribution	
12	Continuous dense occurrence of plants	

Note: Adapted from Adams et al. (2009).

7.3.5 Traditional Use Plants

A traditional use plant species is one that is currently used, or was historically used, by Aboriginal peoples. Many of these plant species have medicinal, ceremonial, and spiritual uses. Traditional uses of forest plant species are numerous. Most traditional plants were used for food, medicine, and tools. Gathered goods such as berries, herbs, mushrooms, and medicinal plants are used for local trade, sale and/or gifts.

A general list of traditional use plants applicable to the BSA was compiled based on plant species identified through literature reviews of ethnobotanical studies completed near the BSA (Clavelle 1997; Leighton 1983; Leighton 1985; Leighton 1996; Marles et al. 2012). Observations of traditional use plants during the field surveys were documented within DVI plots and included information on species, location, habitat, and abundance.

The following First Nations and Métis communities are currently being engaged for knowledge of traditional plant use in the BSA:

- Coté First Nation;
- Fishing Lake First Nation;
- The Key First Nation;
- Keeseekoose First Nation;
- Kinistin Saulteaux First Nation;
- Shoal Lake First Nation;
- Red Earth First Nation;
- Bjorkdale Métis Local #99;
- Carrot River Métis Local #137;
- Hudson Bay Métis Local #114;
- Chelan Porcupine Plain Métis Local #111;
- Nipawin Métis Local #134;
- Tisdale Métis Local #222; and
- Sturgis Métis Local #138.

7.4 Results

7.4.1 Detailed Vegetation Inventory

Detailed vegetation inventory plots were completed at 19 locations within the BSA (Figure 7.4-1). Locations of DVI plots were selected to obtain representative information on all ecosite types in the BSA. In total, 125 plant species were identified during the 2016 field program, which includes 26 woody (tree and shrub) species, 53 forbs, 28 graminoids, and 18 non-vascular species (Appendix B; Table B-1).

7.4.2 Ecological Land Classifications

Twenty-eight ecosite types were classified within the BSA from MOE data and observed during the 2016 field programs (Table 7.4-1). Wetlands ecosites comprise 53% (5,086 ha) of the BSA; the most dominant ecosite within the BSA area is *BP18 – Black spruce – tamarack treed swamp: Wet humic organic*, which accounts for approximately 46% (4,432.5 ha) of the BSA (Table 7.4-1; Figure 7.4-2). The second most abundant wetlands ecosite is the *BP19 - Black spruce treed bog: Moderately wet fibric organic* ecosite covering 3% (317.2 ha) of the BSA. Open water was classified separately from wetland ecosites and covers 3% (299.6 ha) of the BSA.

Upland ecosites accounted for 43% (4,147.4 ha) of the BSA. Individual upland ecosites were found in relatively small quantities with *BP14 – Trembling aspen – white spruce/ feathermoss: Fresh silty loam*, *BP8 - Trembling aspen - white birch/mountain maple: Fresh sandy clay loam*, *BP16 – Balsam poplar – trembling aspen/prickly rose: Fresh clay loam* being the three most abundant upland ecosites occupying 12% (1,162.0 ha), 12% (1,134.5 ha), and 6% (551.0 ha) of the BSA, respectively. Several of the upland ecosites were observed to have experienced natural disturbance through fire or disturbances related to current land use (i.e., logging). Early seral or modified sites (i.e. planting) were classified to the most appropriate ecosite based on the vegetation, site characteristics, and the ecological interpretations provided in McLaughlin et al. (2010).

Roads, trails, and any other existing anthropenic infrastructure (i.e., gravel pit) within the BSA were classified as anthropogenic area. Characteristic species observed within each ecosite are described below.

Table 7.4-1: Total Area and Percent Cover of Ecosite Types within the Vegetation Baseline Study Area

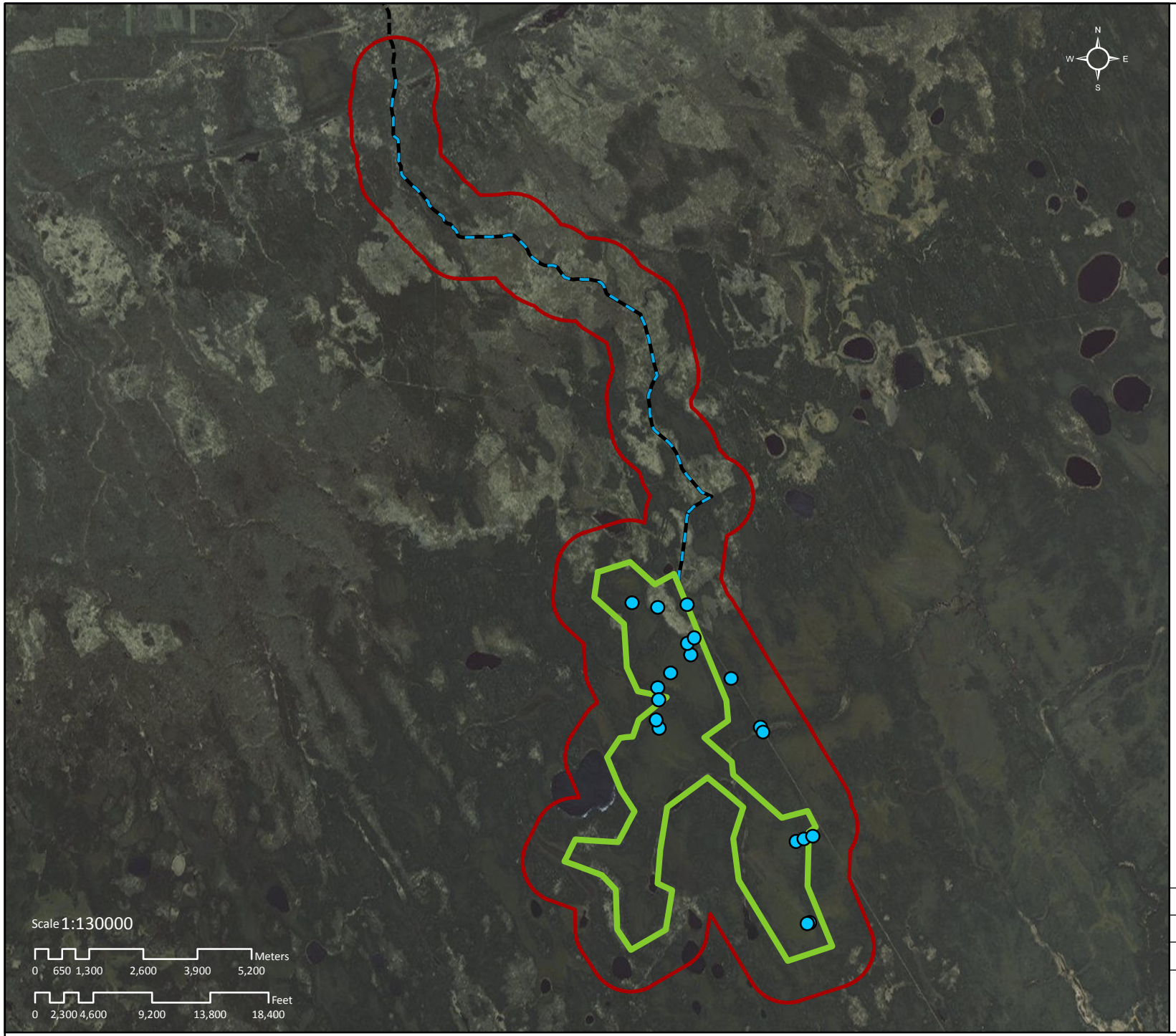
Ecosite Classification	Area (ha)	Proportion of BSA (%)
Upland Ecosites	**4,147.4**	**43**
BP1 - June grass - mountain goldenrod grassland: Moderately fresh loamy sand	2.0	<1
BP4 – Jack pine – trembling aspen/feathermoss: Moderately fresh sand	6.8	<1
BP6 – Trembling aspen/beaked hazel/sarsaparilla: Fresh loamy sand	96.9	1
BP7 – Trembling aspen – white birch/sarsaparilla: Fresh loamy sand	30.1	<1
BP8 - Trembling aspen - white birch/mountain maple: Fresh sandy clay loam	1,134.5	12
BP9 – White spruce – trembling aspen/feathermoss: Fresh sand	124.2	1
BP10 – Trembling aspen – white spruce – balsam fir: Fresh silty loam	41.4	<1
BP11 – White birch – white spruce – balsam fir: Fresh sandy clay loam	238.8	3
BP12 – Jack pine – spruce/feathermoss: Fresh loamy sand	2.5	<1
BP13 – White spruce – balsam fir/feathermoss: Fresh sandy clay loam	429.2	4
BP14 – Trembling aspen – white spruce/ feathermoss: Fresh silty loam	1,162.0	12

Table 7.4-1: Total Area and Percent Cover of Ecosite Types within the Vegetation Baseline Study Area

Ecosite Classification	Area (ha)	Proportion of BSA (%)
BP15 – Balsam poplar – white spruce/feathermoss: Very moisty silty loam	24.3	<1
BP16 – Balsam poplar – trembling aspen/prickly rose: Fresh clay loam	551.0	6
BP17 - Manitoba maple - balsam poplar/ostrich fern: Moist silty clay loam	303.6	3
Hardwood (Open Canopy)	0.2	<1
Hardwoods (Closed Canopy)	<0.1	<1
Wetland Ecosites	**5,085.7**	**53**
BP18 – Black spruce – tamarack treed swamp: Wet humic organic	4,432.5	46
BP19 – Black spruce treed bog: Moderately wet fibric organic	317.2	3
BP22 – Open bog: Wet humic organic	1.0	<1
BP23 – Tamarack treed fen: Wet fibric organic	205.0	2
BP24 – Leatherleaf shrubby poor fen: Wet humic organic	6.1	<1
BP25 – Willow shrubby rich fen: Wet humic organic	89.2	1
BP26 – Graminoid fen: Wet humic organic	16.5	<1
BP28 – Seaside arrow-grass marsh: Very moist humic organic	17.9	<1
Shrub Fen (Treed Swamp)	0.2	<1
Treed Bog	<0.1	<1
Open Water	299.6	3
Anthropogenic Area	**38.6**	**<1**
Total	**9,571.4**	**100**

Note: Numbers are rounded for presentation purposes. Therefore, it may appear that the totals do not equal the sum of the individual values.

BSA = baseline study area; ha = hectare; % = percent; < = less than.

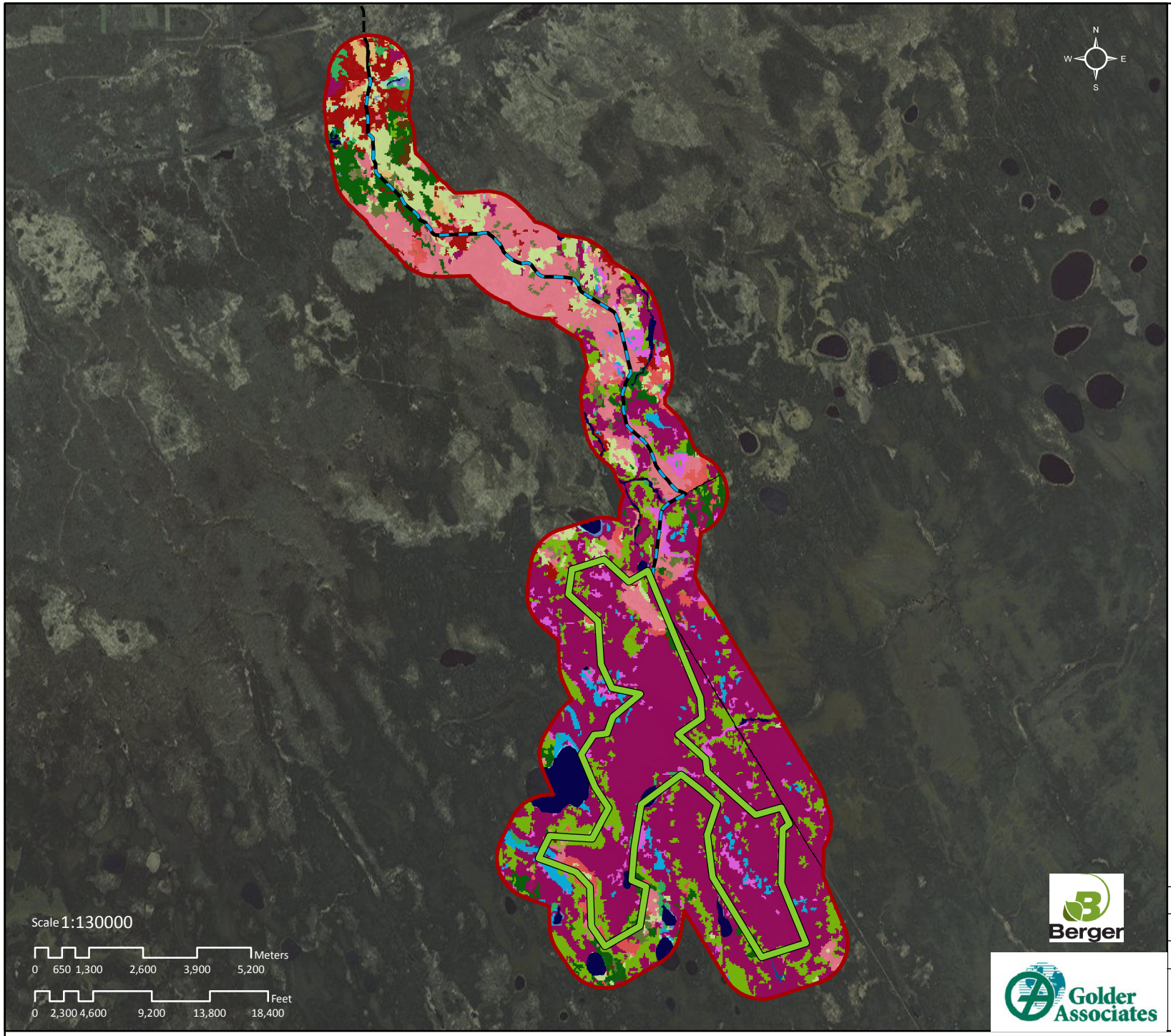


Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/28
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 7.4-1 : Vegetation Survey Locations within the Vegetation Baseline Study Area | Prairie River Bog



Site Boundaries

- Proposed Lease
- Vegetation Baseline Study Area

Infrastructures

- Gravel Road (Existing)
- Access Road (Existing Trail to be Upgraded)

Ecosystem

Upland Ecosystems

- BP01: June Grass-mountain goldenrod drassland
- BP04 : Jack Pine-trembling aspen/Feathermoss
- BP06 : Trembling aspen/Beaked hazel/Sarsaparilla
- BP07 : Trembling aspen- white birch/Sarsaparilla
- BP08: Trembling aspen- white birch/feathermoss
- BP09 : White spruce-trembling aspen/feathermoss
- BP10 : Trembling aspen-white spruce/feathermoss
- BP11 : White birch- white spruce- balsam fir
- BP12 : Jack Pine- spruce/Feathermoss
- BP13 : White spruce- balsam fir/Feathermoss
- BP14 : Black spruce/Labrador tea/feathermoss
- BP15 : Balsam poplar- white spruce/Feathermoss
- BP16 : Balsam poplar- trembling aspen/Prickly rose
- BP17: Manitoba maple - balsam poplar/Ostrich fern

Wetland Ecosystems

- BP18 : Black spruce-tamarack treed swamp
- BP19 : Black spruce treed bog
- BP22 : Open Bog
- BP23 : Tamarack treed fen
- BP24 : Leatherleaf shrubby poor fen
- BP25 : Willow shrubby rich fen
- BP26 : Graminoid fen
- BP28 : Seaside arrow-grass marsh

Other Ecosystems

- No data
- Waterbody
- Anthropic Area

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/28
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Berger

Golder Associates

Figure 7.4-2 : Ecological Land Classification of the Vegetation Baseline Study Area |

Prairie River Bog

June grass – mountain goldenrod grassland: Moderately fresh loamy sand (BP1)

June grass – mountain goldenrod grassland: Moderately fresh loamy sand (BP1) ecosites consist of a variety of graminoid species including June grass (*Koeleria macrantha*), hay sedge (*Carex siccata*), purple oat grass (*Schizachne purpurascens*), and Kentucky bluegrass (*Poa pratensis*). The BP1 ecosite was identified very infrequently and represents only 2.0 ha (<1%) of the BSA.

Jack pine – trembling aspen/feathermoss: Moderately fresh sand (BP4)

The *Jack pine-trembling aspen/feathermoss: Moderately fresh sand (BP4)* ecosite usually occurs as pine-dominated mixedwood communities. A diverse shrub understory can be present with ericaceous shrubs, prickly rose (*Rosa acicularis*), green alder (*Alnus viridis*), and willows (*Salix* sp.). Ground cover usually consists of feathermosses and leaf and needle litter. BP4 ecosites occupy 6.8 ha (<1%) of the BSA.

Trembling aspen/beaked hazel/sarsaparilla: Fresh loamy sand (BP6)

The Trembling aspen/beaked hazel/sarsaparilla: Fresh loamy sand (BP6) ecosite occupied 96.9 ha (1%) of the BSA. The BP6 ecosite is found on level to slightly sloping terrain with a submesic moisture regime and is usually found on well-drained sites. The BP6 ecosite provides a suitable comparison for the additional 0.2 ha of hardwood ecosites identified under the Saskatchewan Digital Land Cover.

Common observed tree and shrub species in BP6 ecosites include trembling aspen (*Populus tremuloides*), pin cherry (*Prunus pensylvanica*), prickly rose, green alder, and low bush-cranberry (*Viburnum edule*). The understory usually supports higher proportions of wild sarsaparilla (*Aralia nudicaulis*), low bush-cranberry, and beaked hazel (*Corylus cornuta*). Other common species can include palmate-leaved colt's-foot (*Petasites frigidus* var. *palmatus*), kidney-leaved violet (*Viola renifolia*) and American vetch (*Vicia americana*).

Trembling aspen – white birch/sarsaparilla: Fresh loamy sand (BP7)

Trembling aspen – white birch / sarsaparilla: Fresh loamy sand (BP7) occupied 30.1 ha (<1%) of the BSA. The BP7 ecosite is found on level terrain with a submesic moisture regime and is usually found on well-drained sites.

These ecosites are highly diverse and can occur as either mixedwood or hardwood stands. Shrub cover tends to be limited; however, a variety of herbaceous species are present. Commonly observed species in BP7 ecosites include trembling aspen, prickly rose, low-bush cranberry, pin cherry, saskatoon (*Amelanchier alnifolia*), twinflower (*Linnaea borealis*), wild sarsaparilla, bunchberry (*Cornus canadensis)*, and northern bedstraw (*Galium boreale*).

White spruce – trembling aspen/feathermoss: Fresh sand (BP9)

The *White spruce – trembling aspen/feathermoss: Fresh sand (BP9)* ecosite was present in limited quantities and represents only 124.2 ha (1%) of the BSA. The BP9 ecosites are dominated by white spruce (*Picea glauca*) but can be present as mixedwood stands. They are usually found on level terrain with a submesic moisture regime and on well-drained sites. Besides white spruce, common species include prickly rose, beaked hazel, low-bush cranberry, bunchberry, wild sarsaparilla, tall lungwort (*Mertensia paniculata*), and twinflower.

Trembling aspen – white spruce/feathermoss: Fresh silty loam (BP10)

The *Trembling aspen – white spruce/feathermoss: Fresh silty loam (BP10)* ecosite was observed very infrequently and represents only 41.4 ha (<1%) of the BSA. The BP10 ecosite is a mixedwood ecosite with abundant trembling aspen and lesser quantities of white spruce. Shrub diversity is low in this ecosite; however, an abundance of forb species are usually present and can include bunchberry, twinflower, palmate-leaved coltsfoot, dwarf red raspberry

(*Rubus pubescens*), two-leaved Solomon's-seal (*Maianthemum canadense*), maystar (*Trientalis borealis*), tall lungwort, one-sided wintergreen (*Orthilia secunda*), and bishop's cap (*Mitella nuda*). Stair-step moss (*Hylocomium splendens*), big red stem (*Pleurozium schreberi*), and knight's plume (*Ptilium crista-castrensis*) are frequently observed in the understory.

White birch – white spruce – balsam fir: Fresh sandy clay loam (BP11)

White birch (*Betula papyrifera var. papyrifera*) is usually the dominant canopy species within the *White birch - white spruce – balsam fir: Fresh sandy clay loam (BP11)* ecosite. Both the shrub understory and herbaceous layers are relatively diverse with sarsaparilla and bunchberry commonly observed. Leaf litter at BP11 ecosites tends to be high and there is limited presence of moss and lichen species. The BP11 ecosite is present in 238.8 ha (3%) of the BSA.

Jack pine – spruce/feathermoss: Fresh loamy sand (BP12)

Jack pine – spruce/feathermoss: Fresh loamy sand (BP12) ecosites typically have jack pine dominated canopies with scattered amounts of black and/or white spruce. Feathermosses usually provide a continuous ground cover, while the understory consists mostly of ericaceous shrubs and small amounts of green alder, prickly rose, and willow. The BP12 ecosite is present in 2.5 ha (<1%) of the BSA.

White spruce – balsam fir/feathermoss: Fresh sandy clay loam (BP13)

The *White spruce-balsam fir/feathermoss: Fresh sandy clay loam (BP13)* ecosite is usually dominated by white spruce or balsam fir (*Abies balsamea*); however, they may be present as mixedwood stands with trembling aspen and white birch. The BP13 occupies 429.2 ha (4%) of the BSA.

Black spruce/Labrador tea/ feathermoss: Very moist sandy clay loam (BP14)

The *Black spruce/Labrador tea/feathermoss: Very moist sandy clay loam (BP14)* ecosite was observed on 1,162.0 ha (12%) of the BSA. The BP14 ecosite is very moist and was observed as small patches or islands associated with treed bogs (BP19). This ecosite typically has a black spruce dominant tree canopy. A high diversity of understory species can be found in the BP14 ecosite; however, only a few are observed with any frequency and can include Labrador tea (*Rhododendron groenlandicum*), blueberry (*Vaccinium myrtilloides*), lingonberry (*Vaccinium vitis-ideas* ssp. *minus*), bunchberry, and swamp horsetail (*Equisetum fluviatile*). A continuous carpet of feathermoss species such as big red stem and stair-step moss are frequently observed.

Balsam poplar – white spruce/feathermoss: Very moist silty loam (BP15)

The *Balsam poplar – white spruce / feathermoss: Very moist silty loam (BP15)* ecosite is present in very limited quantities within the BSA occupying 24.3 ha (<1%). While balsam poplar (*Populus balsamifera ssp. balsamifera*) is usually the leading species among the canopy layer, white spruce, white birch, and trembling aspen, may also be present. Tall shrubs such as low bush-cranberry, saskatoon, prickly rose, beaked hazel, and red currant (*Ribes triste*) are commonly present. Forbs species are abundant in the understory and can include bunchberry, palmate-leaved coltsfoot, wild sarsaparilla, tall lungwort, maystar, and wild strawberry (*Fragaria virginiania*). Substantial ground cover is provided by feathermoss species and *Dicranum* mosses.

Balsam poplar – trembling aspen/prickly rose: Fresh clay loam (BP16)

The *Balsam poplar – trembling aspen/prickly rose: Fresh clay loam (BP16)* ecosite was observed in 551.0 ha (6%) of the BSA. While balsam poplar is present in the canopy layer these ecosites are usually drier than expected, but

support a high diversity of species. Balsam poplar and trembling aspen are the most common tree species. Prickly rose, willows, raspberry (*Rubus idaeus*), beaked hazel, and red-osier dogwood (*Cornus sericea*) are all common shrub species. Small bedstraw (*Galium trifidum ssp. trifidum*), wild sarsaparilla, and common horsetail (*Equisetum arvense*) are frequently observed in the understory along with sedge species (*Carex spp.*) and two-leaved Solomon's-seal.

Manitoba maple - balsam poplar/ostrich fern: Moist silty clay loam (BP17)

The *Manitoba maple - balsam poplar/ostrich fern: Moist silty clay loam (BP17)* ecosite was observed in 303.6 ha (3%) of the BSA. While Manitoba maple is always present in the canopy of the BP17 ecosite, balsam poplar, white elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica* var. *subintegerrima*), and trembling aspen may also be present. A high diversity of understory species can be found in the shrub and herbaceous layers, but ostrich fern (*Matteuccia struthiopteris*) is the most common to be found in any substantial quantities.

Hardwoods (Open Canopy)

The *Hardwoods (Open Canopy)* land class is described as a site with greater than 75% hardwoods by area, including trembling aspen, white birch, and balsam poplar, and 10 - 55% crown closure. This land class is associated with treed or forested habitats observed outside of the Provincial Forest and were classified with the Saskatchewan Digital Land Cover (SRC 1994).

Hardwoods (Closed Canopy)

The Hardwoods (Closed Canopy) land class is described as a site with greater than 75% hardwoods by area, including trembling aspen, white birch, and balsam poplar but with greater than 55% crown closure. This land class is associated with treed or forested habitats observed outside of the Provincial Forest and were classified with the Saskatchewan Digital Land Cover (SRC 1994).

Black spruce – tamarack treed swamp: Wet humic organic (BP18)

The *Black spruce – tamarack treed swamp: Wet humic organic (BP18)* ecosite occupies 4,432.5 ha (46%) and is the most prevalent in the BSA. The BP18 ecosite can be considered an intermediate step between upland and wetland conditions and usually supports a high diversity of species. The presence of water in these ecosites is often ephemeral and flow may be apparent.

Trees species present in BP18 ecosites can include black spruce, white spruce, or tamarack (*Larix laricina*). A high species diversity is usually present in the forb layer and can include marsh cinquefoil (*Comarum palustre*), swamp horsetail, three-leaf Soloman's-seal (*Maianthemum trifolium*), and arrow-leaved colt's-foot (*Petasites frigidus var. sagittatus*). Feathermoss species such as big red stem and stair-step moss are usually found more abundantly than sphagnum mosses.

Black spruce treed bog: Moderately wet fibric organic (BP19)

The *Black spruce treed bog: Moderately wet fibric organic (BP19)* ecosite occupies 317.2 ha (3%) of the BSA. The BP19 ecosite is found on level terrain with a wet moisture regime and very poor drainage. The BP19 ecosite provides a suitable comparison for the additional <0.1 ha of Treed Bog ecosite identified under the Saskatchewan Digital Land Cover.

Common tree and shrub species can include black spruce, common Labrador tea, lingonberry, small bog cranberry (*Vaccinium oxycoccos*) and northern bog-laurel (*Kalmia polifolia*). The understory consisted of a variety of forbs,

sedges and mosses. Forbs most frequently observed include three-leaf Solomon's-seal, and cloudberry (*Rubus chamaemorus*). Common moss species include midway peat moss (*Sphagnum magellanicum*), rusty peat moss (*Sphagnum fuscum*), squarrose peat moss (*Spagnum squarrosum*) and big red stem.

Open bog: Wet humic organic (BP22)

The *Open bog: Wet humic organic (BP22)* ecosite covers 1.0 ha (<1%) of the BSA. The BP22 ecosite is typically dominated by *sphagnum* moss species, but can have a low percentage of tree (<10%), shrub (<20%), and herbaceous (<20%) cover. The BP22 site is characterized by having level terrain, a wet moisture regime and very poor drainage.

Species in the shrub layer include common Labrador tea, leatherleaf (*Chamaedaphne calyculata*), black spruce, and northern bog-laurel. The understory consists of a variety of forbs and mosses, and a single graminoid. The most abundant forb species are cloudberry and the one graminoid species that may be present is sheathed cotton-grass (*Eriophorum vaginatum* var. *vaginatum*). Common moss species observed included midway peat moss and poor fen peat moss (*Spagnum angustifolium*).

Tamarack treed fen: Wet fibric organic (BP23)

The *Tamarack treed fen: Wet fibric organic (BP23)* ecosite covers 205.0 ha (2%) of the BSA. The BP23 tends to resemble ribbons in the landscape along drainage ways. Tamarack is the predominant tree species; however, black spruce may also be present. Shrub and forb species are those commonly associated with wet habitats as the water table is usually present at or near the surface. Common species include tamarack, dwarf birch (*Betula pumila*), small bog cranberry, lingonberry, and three-leaf Solomon's-seal. Sphagnum mosses provide abundant ground cover; however, open water may be present at BP23 ecosites.

Leatherleaf shrubby poor fen: Wet fibric organic (BP24)

The *Leatherleaf shrubby poor fen: Wet fibric organic (BP24)* ecosite was observed very infrequently and represents only 6.1 ha (<1%) of the BSA. The BP24 ecosite is typically characterized by having organic soils with the water table at or near the surface and species are similar to bogs but can tolerate wetter conditions. Sites usually have level slopes, very poor drainage and a wet moisture regime. The BP24 ecosite provides a suitable comparison for the additional 0.2 ha of Shrub fen (Treed Swamp) ecosite identified under the Saskatchewan Digital Land Cover.

Species in the shrub layer include leatherleaf, common Labrador tea, black spruce, dwarf birch, and bog rosemary. The understory consists of a variety of forbs and graminoids including three-leaved false Solomon's-seal, swamp horsetail (*Equisetum fluviatile*), rye-grass sedge (*Carex loliacea*), few-flowered sedge (*Carex pauciflora*), hoary sedge (*Carex canescens* ssp. *canescens*), water sedge (*Carex aquatilis* var. *aquatilis*), and tussock cotton-grass. Common moss species include midway peat moss, rusty peat moss and poor fen peat moss.

Willow shrubby rich fen: Wet humic organic (BP25)

The *Willow shrubby rich fen: Wet humic organic (BP25)* ecosite covers approximately 89.2 ha (1%). The BP25 ecosite is typically characterized by a high cover of willows and usually has more open water than shrubby poor fens (BP24). These sites usually occur on level ground with organic soils, a wet moisture regime and very poor drainage.

The shrub layer consists, primarily, of willows. The understory typically consists of a variety of forb and sedge species; the most abundant forbs being marsh cinquefoil and small bedstraw.

Graminoid fen: Wet humic organic (BP26)

The *Graminoid fen: Wet humic organic (BP26)* ecosite was observed in very limited amounts occupying 16.5 ha (<1%) of the BSA. The BP26 ecosite typically lacks a tree and shrub layers. They usually have water at or near the surface with organic soils, but can also have mineral substrates. These sites are normally found on level terrain with a very moist to very wet moisture regime and very poor drainage.

These ecosites consist of a variety of forbs including: marsh cinquefoil, swamp horsetail, small bedstraw, and marsh skullcap (*Scutellaria galericulata*). Graminoid species in the BP26 ecosite consist of a variety of sedges and grasses.

Seaside arrow-grass marsh: Very moist humic organic (BP28)

Seaside arrow-grass marsh: Very moist humic organic (BP28) ecosites commonly contain a variety of graminoid and small herbaceous species. It was observed in very limited quantity and covers 17.9 ha (<1%) of the BSA. These ecosites occur frequently around the margins of small ponds affected by fluctuating water levels. Associated species include northern reed grass (*Calamagrostis stricta*), seaside arrow-grass (*Triglochin maritima*), wild mint (*Mentha arvensis*), and water sedge.

Shrub Fen (Treed Swamp)

The *Shrub Fen (Treed Swamp)* land class is described as a wetland area consisting of decomposing peat supporting low shrubs, forbs, grass, moss, and a sparse tree cover. This land class is associated wetland habitats observed outside of the Provincial Forest and were classified with the Saskatchewan Digital Land Cover (SRC 1994). The *Shrub Fen (Treed Swamp)* would be analogous to the BP24 ecosite.

Treed Bog

The Treed Bog land class is described as a wetland area consisting of decomposing peat moss, lichen, and shrubs, with 10% or more canopy by trees (i.e., primarily black spruce and tamarack). This land class is associated with wetland habitats observed outside of the Provincial Forest and were classified with the Saskatchewan Digital Land Cover (SRC 1994). The Treed Bog land class would be analogous to the BP19 ecosite.

Open Water

Open water was observed within the BSA covering 299.6 ha (3%). The majority of the vegetation included submerged aquatic species.

Anthropogenic Area

Existing road and trail infrastructure is present within the BSA. The majority of these disturbances are related to logging and/or hunting and recreational activities within the BSA and accounts for a minimal amount of area (38.6 ha [<1%]). The trails present within the BSA supported a variety of early seral species such as white clover (*Trifolium repens*), graceful Canada goldenrod (*Solidago lepida* var. *salebrosa*), red indian paintbrush (*Castilleja miniata ssp. miniata*), narrow-leaf fireweed (*Chamerion angustifolium ssp. angustifolium*), prickly rose and willow species.

7.4.3 Rare Plant Species Survey

7.4.3.1 Historical Plant Species Occurrences

Twenty-three provincially tracked species have been previously documented by the SKCDC within 20 km of the BSA (Table 7.4-2; HABISask 2017). None of the historical observations of plant occurrences were documented within the BSA.

Table 7.4-2: Historical Provincially Tracked Plant Species Occurrences within 20 km of the Vegetation Baseline Study Area

Scientific Name	Common Name	Provincial Rank[a]	Year of Observation	Preferred Habitat[b]
Adoxa moschatellina	Musk-root	S3	1983, 2009, 2014	Wet woods[c]
Andromeda polifolia var. latifolia	Glaucous-leaved Bog-rosemary	S2	1983	Open, wet sites, bogs, fens, margins of pools, along boggy shores
Arctous rubra	Red Alpine Bearberry	S3	1983	Rocky and gravelly, arctic or alpine tundra, often in calcareous soils, coastal limestone heaths, swampy woods
Athyrium filix-femina var. angustum	Northern Lady-fern	S3	1983	Moist woods and stream banks[d]
Bistorta vivipara	Alpine Bistort	S1	1986	Moist to wet spruce or mixed woods along shorelines, moist subalpine woods and meadows, alpine meadows, heaths, nutrient-rich sites
Calypso bulbosa var. americana	Fairy Slipper	S3	1983	Mesic to wet, mossy coniferous and mixedwood forests, and bogs[e]
Campanula aparinoides	Marsh Bellflower	S3	1983	Wet meadows and marshes[f]
Cardamine pratensis var. pratensis	Meadow Bittercress	S2	2013, 2014	Moist grounds, stream sides, limestone shores, sedge and grass meadows, marshy pond margins, mossy areas, wet hollows, boggy areas, turfy shores, damp creek banks, swamps, brooks and ditches, moist ravines, springy swales
Carex hystericina	Porcupine Sedge	S3	1972	Wet woods, meadows and shores, including mucky springs and brook margins[g]
Chimaphila umbellata ssp. occidentalis	Western Prince's-pine	S2	1956	Dry, coniferous forests
Cypripedium parviflorum var. pubescens	Large Yellow Lady's-slipper	S2	1981	Mesic to moist forests, shrub thickets, meadows, fens & bog borders; mesic forest borders, clearings, shores, & wet ditches[e]
Diervilla lonicera	Northern Bush-honeysuckle	S3	1983, 2009	Dry pine woods[c]
Eleocharis nitida	Neat Spike-rush	S3	1983	Fresh bog pools, streams, disturbed places
Euphrasia subarctica	Arctic Eyebright	S1	2013	Moist crevices and muskegs[c]

Table 7.4-2: Historical Provincially Tracked Plant Species Occurrences within 20 km of the Vegetation Baseline Study Area

Scientific Name	Common Name	Provincial Rank[a]	Year of Observation	Preferred Habitat[b]
Listera cordata var. cordata	Heart-leaved Twayblade	S2	2014	Mountainous regions in mossy, damp, coniferous or mixed coniferous-hardwood forests, sphagnum bogs and evergreen swamps, and subacid humus in moist woodlands
Luzula acuminata var. acuminata	Hairy Wood-rush	S1	1973, 2014	Open woods, meadows, and hillsides
Malaxis monophyllos var. brachypoda	White Bog Adder's-mouth Orchid	S1	1982	Wet, cool, shaded, mossy, spruce woods fens, bogs, marshy shores, swampy swales and wet meadows, these often more or less calcareous[e]
Micranthes pensylvanica	Swamp Saxifrage	S1	2013	Marshy meadows, mucky seepages in woods, swamp forests, montane bogs and seeps
Pedicularis macrodonta	Purple Lousewort	S2	1983	Shore fens[c]
Polygala paucifolia	Pink Fringed Milkwort	S3	1983	Dry open woods, fens and marl bogs[c]
Trillium cernuum	Nodding Trillium	S2	1982	Rich, mostly deciduous forest southward, mixed deciduous-coniferous forests, swamps, moist coniferous forests northward
Viola macloskeyi ssp. pallens	Northern White Violet	S1	2009, 2014	Bogs, wet meadows, seeps, lake margins, stream banks, floodplains, swampy woods, mesic roadside depressions, often among mosses
Viola selkirkii	Great-spurred Violet	S3	1983	Wet to moist places, thickets, mixed or coniferous woods

Sources:

[a] Saskatchewan Conservation Data Centre Tracked Species for Vascular Plants (SKCDC 2017a), and Tracked Species for Non-Vascular Plants (SKCDC 2017b), where;
S1 = Critically Imperiled— At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors;
S2 = imperiled - at high risk of extinction or elimination due to very restricted range, very few populations, steep declines, or other factors;
S3 = vulnerable - at moderate risk of extinction or elimination due to a restricted range, relatively few populations, recent and widespread declines, or other factors (NatureServe 2012)

[b] Flora of North America (1993+)

[c] Maher et al. (1979)

[d] Harms and Leighton (2011a)

[e] Harms and Leighton (2011b)

[f] Budd et al. (1979)

[g] Leighton (2012)

7.4.3.2 Rare Plant Species Observations

Nine provincially tracked plant species were documented during the 2016 field programs (Table 7.4-3; Figure 7.4-3). Species observed included marsh bellflower (*Campanula aparinoides*), prostrate sedge (*Carex chordorrhiza*), three-fruited sedge (*Carex trisperma var. trisperma*), striped coralroot (*Corallorhiza striata var. striata*), Macoun's gentian (*Gentianopsis virgata ssp. macounii*), heart-leaved twayblade (*Listera cordata var. cordata*), purple lousewort (*Pedicularis macrodonta*), scentbottle (*Platanthera dilatata var. dilatata*), and yellow rattle (*Rhinanthus minor ssp. minor*). Occurrences of purple lousewort and yellow rattle were commonly observed

along existing access trails and previously disturbed areas. Occurrences of prostrate sedge were observed at four DVI plot locations. A single occurrence of striped coral-root was observed at the north end of the access trail approximately 10 m off trail. Observations within the proposed lease boundary include three occurrences of purple lousewort, and single occurrences of heart-leaved twayblade, prostrate sedge, and scentbottle. Additionally, occurrences of purple lousewort, yellow rattle, and Macoun's gentian were also observed outside of the BSA. Three species (purple lousewort, heart-leaved twayblade, and marsh bellflower) are included in the SKCDC list of historical observations.

Table 7.4-3: Provincially Tracked Vascular Plant Species Observed During the 2016 Field Surveys

Scientific Name	Common Name	Provincial Rank[(a)]	Number of Individuals	Ecosite	UTM Coordinates 13U	
					Easting	Northing
Campanula aparinoides	Marsh Bellflower	S3	5	BP18	640501	5884353
			50	BP14/Anthropogenic	643016	5883580
Carex chordorrhiza	Prostrate Sedge	S3	15	BP19	641191	5886633
			20	BP19	639864	5886684
			50	BP21/Anthropogenic	642248	5884867
			50	BP23	641200	5885714
Carex trisperma var. trisperma	Three-fruited Sedge	S3	500	BP18	640485	5884649
			100	BP18	640501	5884353
Corallorhiza striata var. striata	Striped Coral-root	S3	1	BP17	634148	5898823
Gentianopsis virgata ssp. macounii	Macoun's Gentian	S3	20	BP26/Anthropogenic (observed outside of the BSA)	650273	5871198
Listera cordata var. cordata	Heart-leaved Twayblade	S2	1	BP18	640442	5884133
			2	BP18	640501	5884353
Pedicularis macrodonta	Purple Lousewort	S2	500	Anthropogenic (observed outside of BSA)	648213	5874974
			>100	BP18	644960	5880375
			>100	Anthropogenic	644514	5881118
			>100	Anthropogenic	644037	5881907
			>100	Anthropogenic	643472	5882843
			>100	Anthropogenic	642604	5884277
			>100	Anthropogenic	642019	5885252
			>100	BP18	639861	5886694
			>100	BP18	641241	5885674
			10	BP21/Anthropogenic	644398	5881296
			30	BP19	641191	5886633
			40	BP14/Anthropogenic	642942	5883711
			100	BP21	642248	5884867

Table 7.4-3: Provincially Tracked Vascular Plant Species Observed During the 2016 Field Surveys

Scientific Name	Common Name	Provincial Rank[(a)]	Number of Individuals	Ecosite	UTM Coordinates 13U	
					Easting	Northing
			40	BP23	641200	5885714
Platanthera dilatata var. dilatata	Scentbottle	S3	11	BP23	641200	5885714
Rhinanthus minor ssp. minor	Yellow-rattle	S2	20	BP14 (observed outside of the BSA)	643016	5883580
			100	BP14/Anthropogenic	649617	5872255
			>100	Anthropogenic	642451	5884533
			>100	Anthropogenic	642365	5884673
			>100	Anthropogenic	642183	5884971
			>100	Anthropogenic	641776	5885641
			>100	BP08	641205	5886029
			>100	BP08	641075	5886004
			>100	BP18	640971	5887270
			>100	BP14	640512	5888115
			>100	BP09	638998	5889248
			>100	BP25	640741	5887773

SARA = *Species at Risk Act*; COSEWIC = Committee on the Status of Endangered Wildlife in Canada; UTM = Universal Transverse Mercator; m = metre; BSA = baseline study area; > = greater than.

[(a)] askatchewan Conservation Data Centre Tracked Species for Vascular Plants (SKCDC 2017a), and Tracked Species for Non-Vascular Plants (SKCDC 2017b), where;
S1 = Critically Imperiled— At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors;
S2 = imperiled - at high risk of extinction or elimination due to very restricted range, very few populations, steep declines, or other factors;
S3 = vulnerable - at moderate risk of extinction or elimination due to a restricted range, relatively few populations, recent and widespread declines, or other factors (NatureServe 2012);

No species listed under COSEWIC, *SARA (2002)*, or *The Wildlife Act* (1998) were observed within the BSA during the 2016 field survey. However, not detecting a rare species does not preclude the potential for rare species to occur within the BSA. Rare plant occurrences at a survey location can be missed due to timing of plant surveys because plant species presence can vary annually and locally. Climatic fluctuations (e.g., abnormal temperatures or precipitation) might not allow adequate time for plants to mature and produce flowers, making them more difficult to spot and identify. Available microhabitats within larger habitat types can vary over time and space. Therefore, a rare plant survey cannot confirm the absence of rare plants or rare plant communities; it can only confirm their presence.

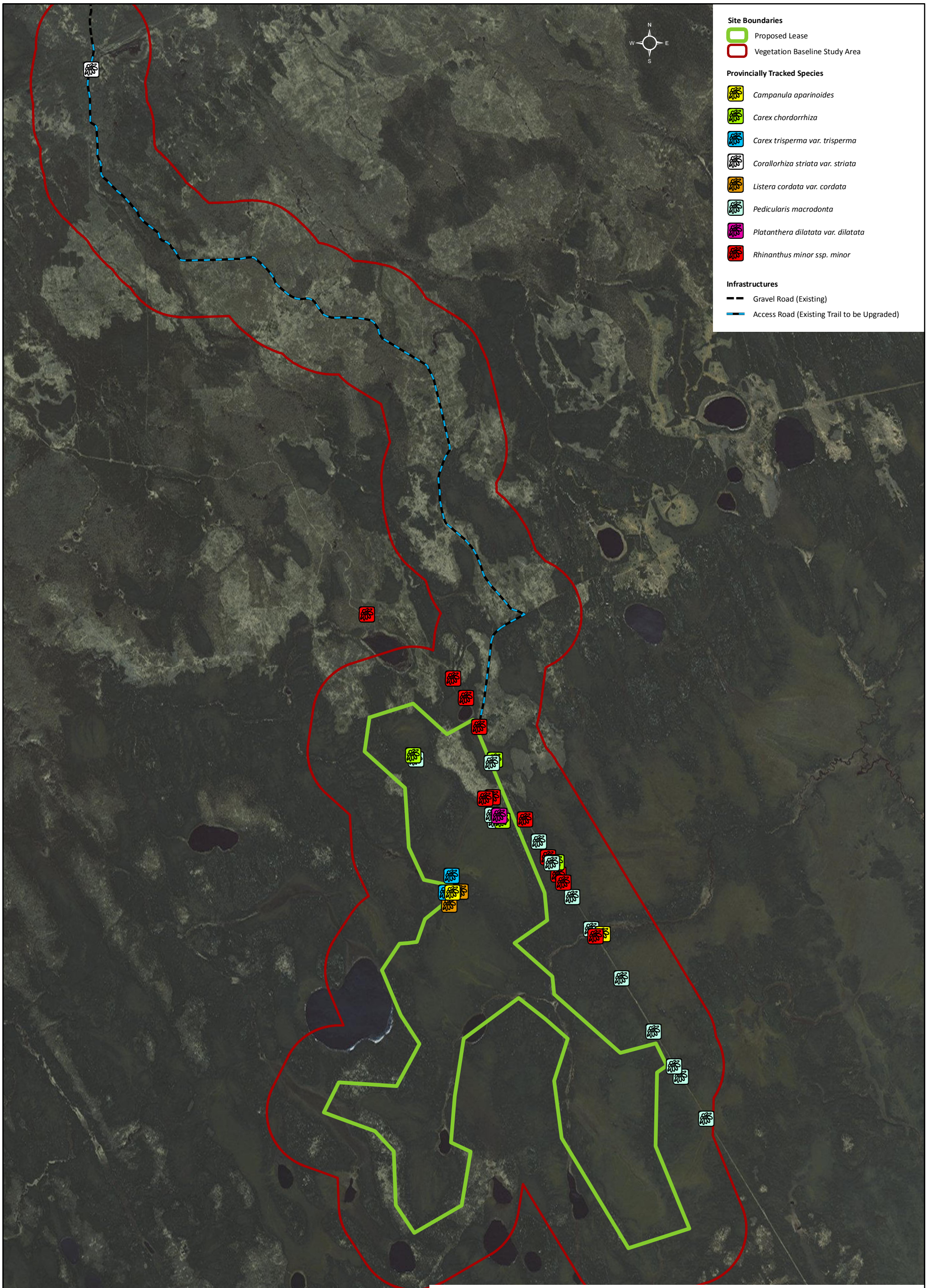


Figure 7.4-3 : Provincially Tracked Plant Species Observed during the 2016 Field Surveys |

Prairie River Bog

7.4.4 Weed Species

Three weed species designated under *The Weed Control Act* (2010) were identified during the field survey within the BSA (Table 7.4-4). Canada thistle (*Cirsium arvense*), dandelion (*Taraxacum officinale ssp. officinale*), and tansy (*Tanacetum vulgare*) were associated with existing access trails. Two occurrences of Canada thistle and one occurrence of common dandelion were recorded within DVI plot locations. Infestation rankings were observed to be low and consisted of a few sporadically occurring individuals to a single patch plus a few sporadically occurring individuals.

Introduced species such as white clover and early seral species such as fireweed, common yarrow, aster species (*Aster* sp.), horsetail species (*Equisetum* sp.), red indian paintbrush, and graceful Canada goldenrod were all commonly observed along access trails, adjacent to roadways, and other disturbed sites.

A review of the iMapInvasives (2017) database does not indicate any previous observations of designated weed species within the BSA.

Table 7.4-4: Provincially Designated Weed Species Observed during the 2016 Field Surveys

Scientific Name	Common Name	Weed Control Act Designation
Cirsium arvense	Canada Thistle	Noxious
Taraxacum officinale ssp. officinale	Common Dandelion	Nuisance
Tanacetum vulgare	Tansy	Noxious

7.4.5 Traditional Use Plants

Forty-seven traditional use plant species were identified through literature reviews (Table 7.4-5). These include medicinal plants such as prickly rose, sweet flag (*Acorus americanus*), and seneca snakeroot (*Polygala senega*). Historically, plant gathering accounted for 100% of medicines that came from traditional use plants. Plants used for food included blueberries, cranberries, raspberries, and saskatoon berries. Other plants used included cattail (*Typha latifolia*), beaked hazel, rose hips, wild mint, and wild onions (*Allium spp.)*.

Table 7.4-5: Summary of Traditional Use Plants in the Vegetation Baseline Study Area

Common Name	Scientific Name	Uses	Common Name	Scientific Name	Uses
Balsam Fir[(a)]	*Abies balsamea*	M, T	Seneca Snakeroot	*Polygala senega*	T, M
Manitoba Maple	*Acer negundo var. interius*	F	Trembling Aspen[(a)]	*Populus tremuloides*	T
Siberian Yarrow[(a)]	*Achillea alpina*	M	Chokecherry	*Prunus virginiana var. virginiana*	F
Common Yarrow	*Achillea millefolium*	M	Common Labrador Tea[(a)]	*Rhododendron groenlandicum*	F, M, S
Sweet Flag	*Acorus americanus*	M, S	Prickly Rose[(a)]	*Rosa acicularis ssp. sayi*	M
Giant Hyssop	*Agastache foeniculum*	F, M	American Red Raspberry[(a)]	*Rubus idaeus ssp. strigosus*	F
Wild onions	*Allium spp.*	F	Arum-leaved Arrowhead	*Sagittaria cuneata*	F, M

Table 7.4-5: Summary of Traditional Use Plants in the Vegetation Baseline Study Area

Common Name	Scientific Name	Uses	Common Name	Scientific Name	Uses
Saskatoon	*Amelanchier alnifolia var. alnifolia*	F	Red Samphire	*Salicornia rubra*	F
Wild Sarsaparilla[(a)]	*Aralia nudicaulis*	M	Willow species[(a)]	*Salix sp.*	F, M, T, S
Bearberry	*Actostaphylos uva-ursi*	F, T	Pitcherplant[(a)]	*Sarracenia purpurea ssp. gibbosa*	M
White Birch[(a)]	*Betula papyrifera var. papyrifera*	F, M, T	Canada buffalo-berry	*Shepherdia canadensis*	F, M
Red-osier Dogwood	*Cornus sericea ssp. Sericea*	T, M	Water Parsnip	*Sium suave*	F, M
Beaked Hazelnut[(a)]	*Corylus cornuta var. cornuta*	F	American Mountain-ash	*Sorbus americana*	F, M
Horsetail species[(a)]	*Equisetum spp.*	M, T	Peat moss[(a)]	*Sphagnum spp.*	M, T
Common Sneezeweed	*Helenium autumnale*	M	Western Snowberry	*Symphoricarpos occidentalis*	M
Cow Parsnip	*Heracleum maximum*	F, M	Northern white-cedar	*Thuja occidentalis*	M
Wild Honeysuckle	*Lonicera dioica*	M	Common Cattail	*Typha latifolia*	F
Alfalfa	*Medicago sativa ssp. Sativa*	M	Rock tripe	*Umbilicaria muehlenbergii*	F
White Sweet-clover	*Melilotus albus*	M, S	Stinging Nettle[(a)]	*Urtica dioica ssp. gracilis*	F, M, T
Wild Mint	*Mentha arvensis*	M	Blueberry[(a)]	*Vaccinium myrtilloides*	F
Wild Bergamot	*Monarda fistulosa var. menthifolia*	M	Lingonberry[(a)]	*Vaccinium vitis-idaea ssp. minus*	F
Yellow Cowlily	*Nuphar variegata*	F, M	Marsh Valerian	*Valeriana dioica var. sylvatica*	M, S
White Spruce[(a)]	*Picea glauca*	F, M, T	High Bush-cranberry	*Viburnum opulus var. americanum*	F
Common Plantain	*Plantago major*	F, M, T			

[(a)] Recorded during baseline field programs.
F = Food; M = Medicinal; S = Spiritual; T = Technical and Trade.

During the 2016 field programs 17 traditional use plant species were identified in the BSA. Traditional use plant species were found in varying abundance throughout the BSA depending on the specific habitat requirements of each plant species. Peat moss was observed in abundance throughout the BSA in both bog and fen wetland ecosites. Common Labrador tea and lingonberry were widely observed in black spruce treed bogs (BP19) and Labrador tea shrubby bogs (BP20). Traditional use plant species such as wild sarsaparilla, white birch, white spruce, and prickly rose were all observed in the upland habitats of the BSA surrounding the expected harvest area. The presence of traditional use plant species observed at each DVI plot location is included in Appendix B (Table B-2).

7.5 Summary

Field surveys were completed June 14 to 15 and July 25 to 26, 2016. Data collected during the field programs were used to capture the local variation in plant species and communities, to describe the characteristics of the

plant communities within each ecosite, and to search for rare plants, weed species, and traditional use plant species.

Detailed vegetation inventory plots were completed at 19 locations within the BSA. In total, 125 plant species were identified during the 2016 field program, which includes 26 tree and shrub species, 53 forbs, 28 graminoids, and 18 non-vascular species. An ELC map was developed to provide information on the abundance and distribution of ecosites within the BSA. A total of 28 ecosites were classified in the BSA.

Black spruce – tamarack treed swamp: Wet humic organic (BP18) was the most widespread ecosite and occupied 46% of the BSA. This ecosite is considered an intermediate step between upland and wetland conditions and usually supports a high diversity of species. The presence of water in these ecosites is often ephemeral and flow may be apparent.

Black spruce treed bog: Moderately wet fibric organic (BP19) was the second most abundant wetland ecosite accounting for 3% of the BSA. The BP19 ecosite is found on level terrain with a wet moisture regime and very poor drainage. Common species included black spruce, common Labrador tea, lingonberry, three-leaf Solomon's-seal, and a variety of sphagnum mosses.

Upland ecosites accounted for 43% of the BSA. Individual upland ecosites were found in relatively small quantities with *Trembling aspen – white spruce/ feathermoss: Fresh silty loam (BP14)*, *Trembling aspen - white birch/mountain maple: Fresh sandy clay loam (BP8)*, and *Balsam poplar – trembling aspen/prickly rose: Fresh clay loam (BP16)* being the three most abundant upland ecosites occupying 12%, 12%, and 6% of the BSA, respectively. Evidence of past and present logging activities was observed in several upland locations (i.e., recent cutblocks, planted trees).

Nine provincially tracked plant species were documented during the 2016 field programs. Species observed included marsh bellflower (*Campanula aparinoides*), prostrate sedge (*Carex chordorrhiza*), three-fruited sedge (*Carex trisperma var. trisperma*), striped coralroot (*Corallorhiza striata var. striata*), Macoun's gentian (*Gentianopsis virgata ssp. macounii*), heart-leaved twayblade (*Listera cordata var. cordata*), purple lousewort (*Pedicularis macrodonta*), scentbottle (*Platanthera dilatata var. dilatata*), and yellow rattle (*Rhinanthus minor ssp. minor*). Six observations were associated with the proposed lease boundary. Remaining species occurrences were associated with existing access trails and previously disturbed areas. Purple lousewort and yellow-rattle were commonly observed and were recorded inside and outside of the proposed lease boundary. No COSEWIC, SARA (2002), or *The Wildlife Act* (1998) species were observed within the BSA during the 2016 field survey.

Two noxious and one nuisance weed species designated under *The Weed Control Act* (2010) were documented during the 2016 field surveys. These include Canada thistle (*Cirsium arvense*), tansy (*Tanacetum vulgare*), and common dandelion (*Taraxacum officinale ssp. officinale*). All species observations were associated with existing trails and previously disturbed locations within the BSA.

Traditional use plants are plant species that were historically or are currently used for food, medicinal, spiritual, or technical and trade (i.e., tools or products for use or trade) purposes by First Nations and Métis people. Forty-seven traditional use plant species were identified through a literature review. During the 2016 field programs, 17 traditional use plant species were observed. Percent composition of traditional use plant species depended on the ecosite and growth conditions; however, Labrador tea, lingonberry, wild sarsaparilla, horsetail, willow, blueberry, white birch, and pitcherplant were among the most frequently observed.

8.0 WILDLIFE

8.1 Introduction

Components of the landscape (i.e., climate, soils, topography, hydrological features, and vegetation) that surround the Prairie River Peat Harvest Project (the Project) and land use combine to create wildlife habitats and affect the diversity and abundance of wildlife species present in the baseline study area (BSA). Changes to any of these components can potentially affect wildlife and wildlife habitat. Habitat types, relative abundance, and diversity of wildlife species present in the BSA were determined by a series of wildlife surveys. The wildlife baseline section includes information from applicable scientific literature and wildlife surveys completed in spring and summer 2016.

The key objectives of the wildlife baseline section are:

- to determine wildlife species occurrence, abundance, and distribution within the BSA;
- to document the potential and observed occurrences of tracked and protected wildlife (provincial and federal) in the BSA; and
- to identify important habitat features and describe the use of habitats by wildlife in the BSA.

The specific surveys required to support the assessment of effects from the Project were identified using available habitat and wildlife information within the BSA and were selected to maximize efficiency in data collection without sacrificing scientific merit. Wildlife data from the former Saskatchewan Conservation Data Centre (SKCDC) database (now Hunting, Angling, and Biodiversity Information of Saskatchewan [HABISask]; SKCDC 2017c) and known species ranges informed the listed species surveys that were considered to be required. Based on a review of available information, wildlife studies were conducted in the BSA from April through July 2016 (Table 8.1-1).

Table 8.1-1: 2016 Wildlife Studies Conducted for the Prairie River Peat Harvest Project

Wildlife Study	Recommended Survey Timing[(a)]	Details (2016)
Amphibian Survey	Three survey rounds from April 15 to May 25	Round 1: April 29 (8 plot visits) and May 14 (6 plot visits) Round 2: May 14 (8 plot visits), May 22 (5 plot visits), and May 31 (1 plot visit) Round 3[(b)]: May 31 (12 plot visits) and June 14 (1 plot visit)
Yellow Rail Survey	Three survey rounds from May 26 to July 7[(c)]	Round 1: June 1 (8 plot visits) Round 2: June 14 and 16 (6 plot visits) Round 3: June 27 and 29 (6 plot visits)
Breeding Bird Survey	Three survey rounds from June 1 to July 7	Round 1: June 1 (18 plot visits), June 15 (2 plot visits) and June 29 (2 plot visits) Round 2: June 14 to 16 (18 plot visits) Round 3: June 29 (16 plot visits) and July 2 (1 plot visit)
Common Nighthawk Survey	Two survey rounds from June 15 to July 31	Round 1: June 14 to 15 (15 plot visits) Round 2: June 26 and 28 (14 plot visits)

(a) Survey timing as outlined in the applicable Saskatchewan Species Detection Survey Protocols (MOE 2014a,b,c; MOE 2015c).
(b) Surveys were completed outside of the recommended survey timing window in an effort to meet the minimum air temperature requirements. One plot was completed on June 14 in an effort to complete three survey rounds not previously completed.
(c) Given that a survey timing window is not clearly outlined for yellow rail in the Species Detection Survey Protocols, Yellow Rail (MOE 2014c) a combination of suggested timing was considered including survey standards outlined in the Alberta *Sensitive Species Inventory Guidelines* (ESRD 2013).

Species-specific surveys for boreal raptors were not completed during 2016 field surveys. One federally listed raptor species, short-eared owl (*Asio flammeus*) is considered to have potential to occur in the BSA. Species-specific surveys for short-eared owl were not conducted given that habitat for the species is limited in the BSA. The protocol for boreal raptors is designed to identify and protect the essential habitat features (e.g., large balsam poplards adjacent to spruce stands) required for raptors that nest in the boreal forest (Alberta Environment and Sustainable Resource Development [ESRD] 2013). Surveys for owl species are useful for long-term monitoring; however, there are no mitigation applications if an owl is heard during a call playback survey (ESRD 2013). Alternatively, during raptor nest searches, which are able to identify essential habitat features, mitigation applications apply. However, nest searches have a very low probability of success in the boreal forest (ESRD 2013). Given that vegetation surveys were conducted that describe the composition and distribution of plant communities within the expected harvest area, lease boundary and access road whose data can be used to inform mitigation for effects to raptor nesting habitat and that incidental observations were recorded during wildlife surveys throughout the BSA where access was available, boreal raptor surveys were not considered beneficial for an understanding of available raptor habitat.

Aerial imagery, field reconnaissance, and knowledge of the field biologist conducting the surveys were used to identify habitat and features that attract wildlife (e.g., wetlands) and this information was used during sample plot selection. Selected survey methods are used widely in the area of wildlife conservation, are nonintrusive to wildlife and habitat, can be performed in an expedient manner with limited field personnel, and follow the applicable Saskatchewan Species Detection Survey Protocols (Ministry of Environment [MOE] 2014a,b,c; MOE 2015c). The survey methods and results are described in the following sections.

8.2 Baseline Study Area

The spatial boundaries used in the description of the environmental setting and to support the assessment of potential Project effects on wildlife included the Project lease boundary, access road and the BSA (Figure 8.2-1). The Project Footprint (1,059 ha; 10.6 km^2) is within the lease boundary, which is approximately 2,144 ha or 21.4 km^2. Baseline studies were completed within the BSA, which is 9,571 ha (95.7 km^2) and defined by a 1 km buffer around the lease boundary and access road (Figure 8.2-1).

8.3 Methods

8.3.1 Protected Species, Protected Areas, and Wildlife Habitat

8.3.1.1 Protected Species

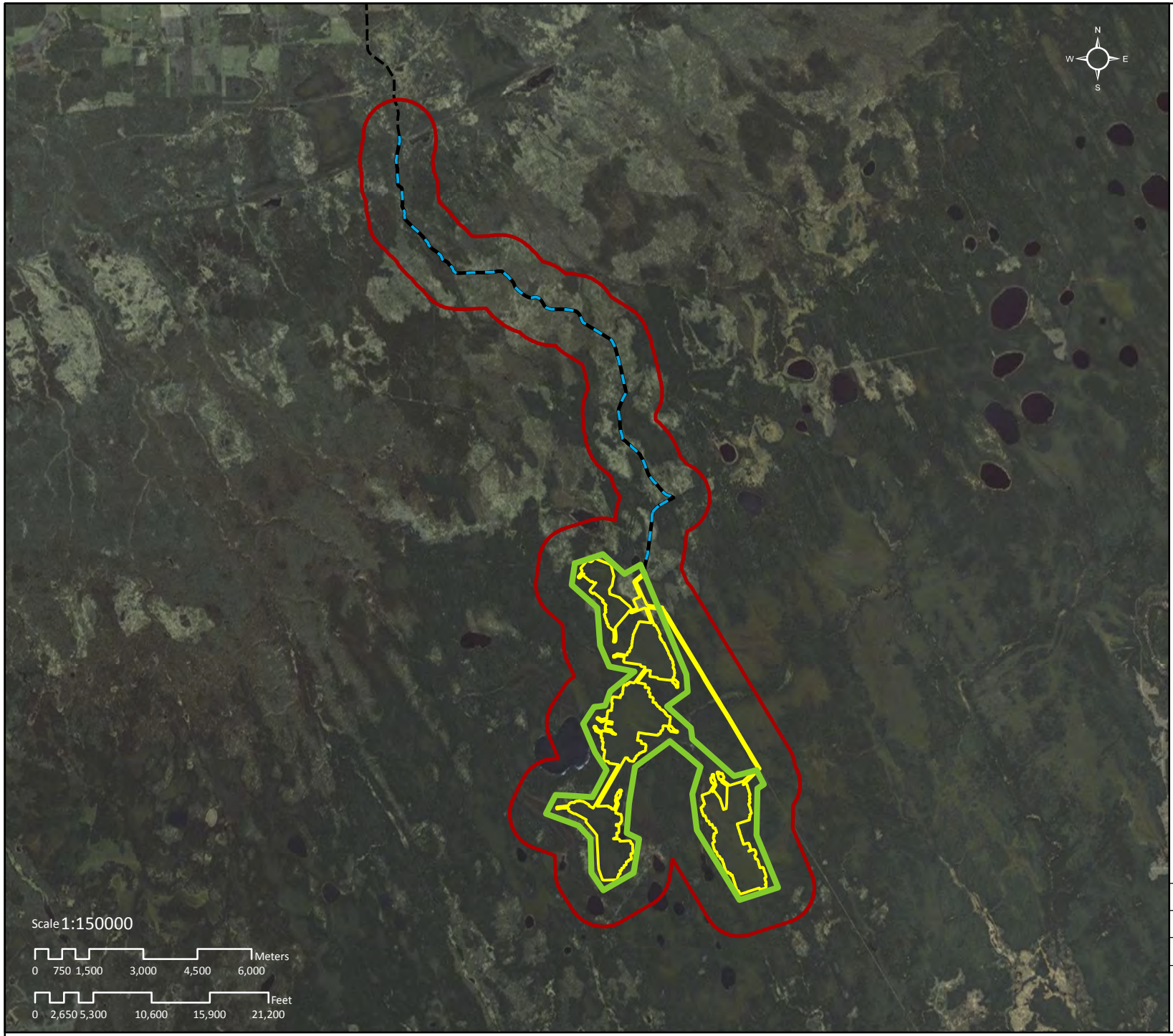
For the purposes of this report, listed wildlife species are defined as follows:

- species recommended by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to be protected under Canada's *Species at Risk Act* ([*SARA]* Government of Canada 2017; *SARA* 2002);
- species currently protected under the *SARA* (Government of Canada 2017);
- species that are provincially tracked by the SKCDC (2017d,e); and
- species listed under *The Wildlife Act* (1998).

Incidental observations of protected wildlife species within the BSA were recorded during all terrestrial surveys. Prior to beginning surveys in the BSA, a list of protected species was generated from reviewing federal and

provincial wildlife and conservation legislation documents. The list of potential species is not exhaustive, but highlights species that might occasionally occur within the Project Footprint, based on breeding ranges or migratory distribution.

Federal status documents that were reviewed include the assessments and updated status reports on wildlife species created by the COSEWIC and the *SARA* Public Registry (Government of Canada 2017). The COSEWIC is an independent body of experts that identifies and assesses which wildlife species are considered to be at risk. The COSEWIC reports its results to the Canadian government and the public. The Canadian government takes a COSEWIC designation into consideration when determining those species that should be protected under the *SARA*. Species protected under the *SARA* are separated into three different schedules. Schedule 1 is the official list of wildlife species at risk, and classifies species as being extirpated, endangered, threatened, or of special concern. Actions to protect and recover a listed species are implemented once a species is listed on Schedule 1. Schedule 2 and Schedule 3 listed species are those that were designated as species at risk by COSEWIC prior to October 1999. These species must be reassessed using revised criteria before they can be added to Schedule 1 of *SARA* (Government of Canada 2017).



Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/24
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 8.2-1 : Wildlife Baseline Study Area | Prairie River Bog

Provincially, status determination of wildlife species was based on a review of the SKCDC vertebrate and invertebrate tracking lists (SKCDC 2017d,e) and the *Wild Species at Risk Regulations* (Government of Saskatchewan 1999). The SKCDC vertebrate and invertebrate tracking lists provide standardized information on the ecological status of wildlife species and communities within the province. The SKCDC identifies a species' risk of extirpation from the province by assigning S-ranks, which does not necessarily reflect its management policy. For example, some species may be rare within Saskatchewan but are considered common within North America. S-ranks are arranged from S1 (critically imperiled/extremely rare in Saskatchewan) to S5 (secure/common in Saskatchewan) and are used to identify species that are rare in the province but may not be rare across Canada or North America (SKCDC 2017f). Species tracked by the SKCDC were identified prior to conducting terrestrial wildlife surveys. The potential presence of these species in the BSA was determined by identifying habitat requirements for breeding and foraging activities. The *Wild Species at Risk Regulations* (Government of Saskatchewan 1999) lists wildlife species protected under *The Wildlife Act* (1998) in Saskatchewan.

Species-specific surveys were completed for two federal protected species at risk: yellow rail (*Coturnicops noveboracensis*) and common nighthawk (*Chordeiles minor*). Field reconnaissance was conducted for federal protected species little brown myotis (*Myotis lucifugus*) and northern myotis (*Myotis septentrionalis*) to identify potential maternity roost habitat and/or hibernacula. Surveys for other federally listed and provincially tracked species were completed in conjunction with other wildlife surveys (e.g., breeding bird, amphibian). Surveys for woodland caribou (*Rangifer tarandus caribou*) were not completed in discussion with Tim Trottier and Rob Tether (Trottier and Tether, 2016 pers. comm.) who indicated that the MOE had sufficient data for woodland caribou in the BSA that was available. Specific surveys for moose and furbearers were not completed given that it is expected that species with ranges that overlap the BSA occur in the BSA and that habitat is available surrounding the BSA. Incidental observations of moose and furbearers were recorded during all terrestrial surveys.

Yellow Rail

Yellow rail are listed federally as 'Special Concern' under Schedule 1 of *SARA* (Government of Canada 2017) and are a provincially tracked (SKCDC 2017e) species whose range overlaps the BSA (COSEWIC 2009; Leston and Bookhout 2015). Wetlands with suitable habitat conditions for yellow rail as described in COSEWIC (2009) and Goldade et al. (2002), were selected as yellow rail survey plot locations during amphibian calling surveys.

Yellow rail surveys incorporated the use of acoustic recording units (ARUs) to passively record yellow rail calls. Acoustic recording units have been used successfully to survey for yellow rail in Saskatchewan and other areas of North America (Drake, 2013 pers. comm.; EMCLA 2014; Sidie-Slettedahl 2013). Song Meter 2 (Wildlife Acoustics Inc.) and Song Meter 4 (Wildlife Acoustics Inc.) Acoustic recording units were used to increase the efficiency and accuracy of the nocturnal wetland survey. The use of ARUs in wildlife surveys has increased over the last ten years, especially for elusive species (e.g., secretive marshbirds) (Brandes 2008; Fristrup and Clark 2009).

The benefits of using ARUs include:

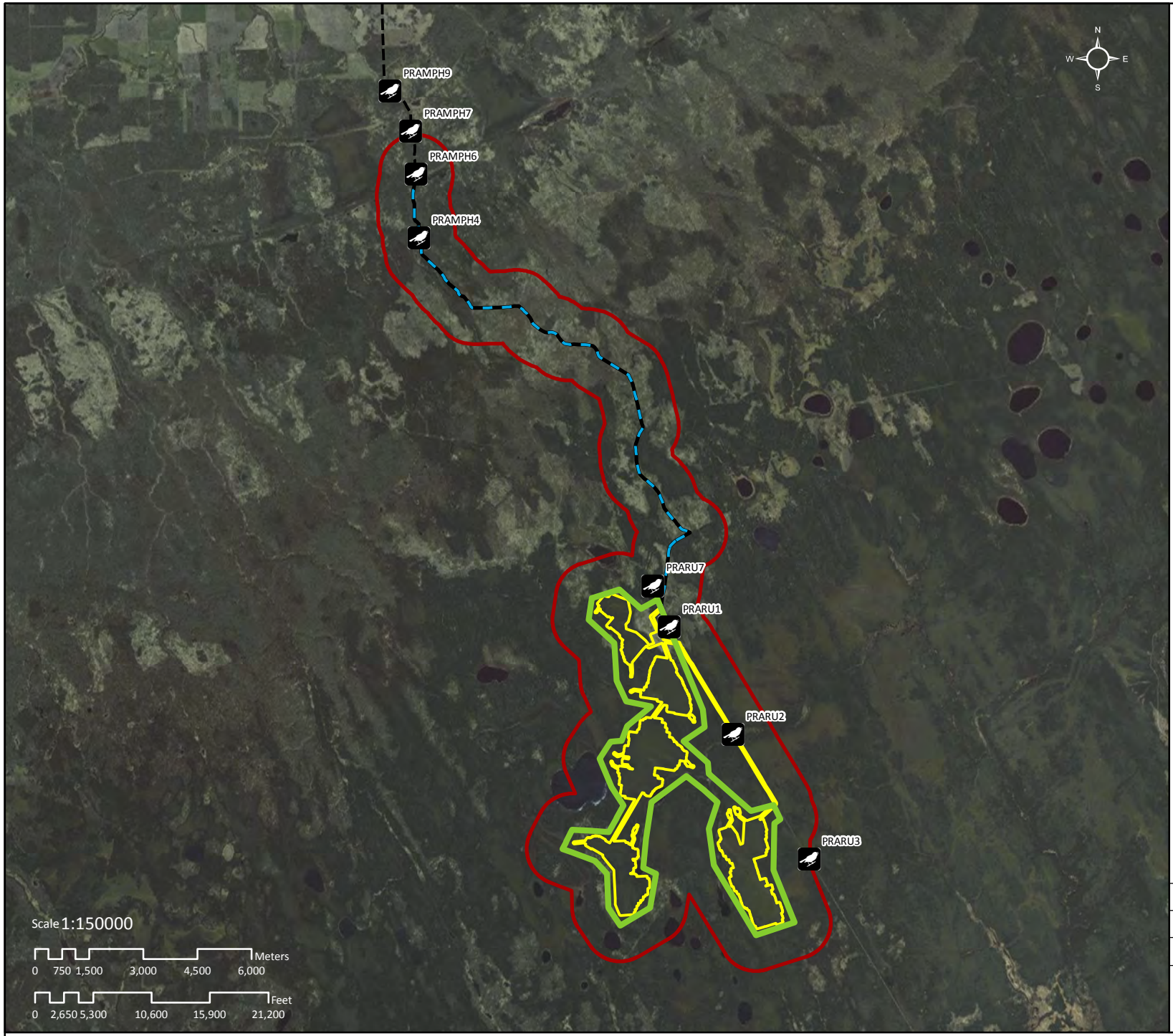
- reduced stress to wildlife species from human disturbance;
- increased sampling effort in areas that are difficult to access; and
- survey data can be stored for quality assurance and for further reference.

Field surveys for yellow rail were completed using methods described in the Species Detection Survey Protocols, Yellow Rail Surveys (MOE 2014c). Surveys were completed on June 1, June 14, June 16, June 27 and June 29, 2016. Survey plots were established at eight locations (Figure 8.3-1). No plots were established in the west portion of the BSA, given the difficulty of access to potential habitat. Six plots were surveyed during all three sampling periods and two plots were surveyed during one sampling period on June 1, 2016. Weather conditions during the survey consisted of temperatures ranging from 5 degrees Celsius (°C) to 18°C and winds ranging from 2 kilometres per hour (km/h) to 9 km/h (Environment and Climate Change Canada [ECCC] 2016). Yellow rail surveys incorporated the use of ARUs set to passively record calls once per hour for a duration of five or ten minutes, beginning at 23:00 and ending at 03:00. This resulted in 25 or 50 minutes of recordings per wetland each night. The use of ARUs increased the number of sampling intervals per night; however, a total of ten minutes was analyzed for each plot location per survey round for a total of 200 minutes of recordings analyzed. All survey data (i.e., five recordings per night) were stored.

Common Nighthawk

Common nighthawk are listed federally as 'Threatened' under Schedule 1 of *SARA* (Government of Canada 2017) and are a provincially tracked (SKCDC 2017e) species that have been recorded as a possible breeder in the mapsheet containing the BSA (Smith 1996). Surveys for common nighthawk were conducted on June 14 to 15, June 26 and June 28, 2016. Survey locations were selected to maximize coverage across the BSA and were located a minimum of 500 metres (m) apart. Weather conditions during the survey consisted of temperatures ranging from 15°C to 21°C and winds from 4 km/h to 20 km/h (ECCC 2016). Surveys incorporated the use of ARUs set to passively record common nighthawk calls on the hour from one hour before sunset to 30 minutes after sunset for a duration of five or ten minutes. Fifteen survey plots were established and two sampling periods were completed at 14 plots, with one sampling period completed at one plot (Figure 8.3-2). Surveys were conducted following standards (i.e., environmental conditions, time of year, time of day) outlined in the Species Detection Survey Protocols, Common Nighthawk Surveys (MOE 2015c). Five (14 plot visits) or ten (15 plot visits) minutes of recordings were analyzed for each plot location for two survey rounds each for a total of 220 minutes of recordings analyzed.

The use of ARUs is not included in the survey methods outlined in the Species Detection Survey Protocols, Common Nighthawk Surveys (MOE 2015c); however, ARUs have been used successfully to survey for common nighthawk in Alberta (Monk and Kohler 2014). In discussion with MOE, surveys using ARUs were approved given that ARUs often provide equal or better information on the presence of common nighthawk in an area compared to call-playback surveys (Fisher, pers. comm. 2016). Acoustic recording units Song Meter 2 (Wildlife Acoustics Inc.) and Song Meter 4 (Wildlife Acoustics Inc.) were used. All survey data were stored for further reference.



Site Boundaries

- Proposed Lease
- Project Footprint
- Wildlife Baseline Study Area

Survey

- Yellow Rail Survey Locations

Infrastructures

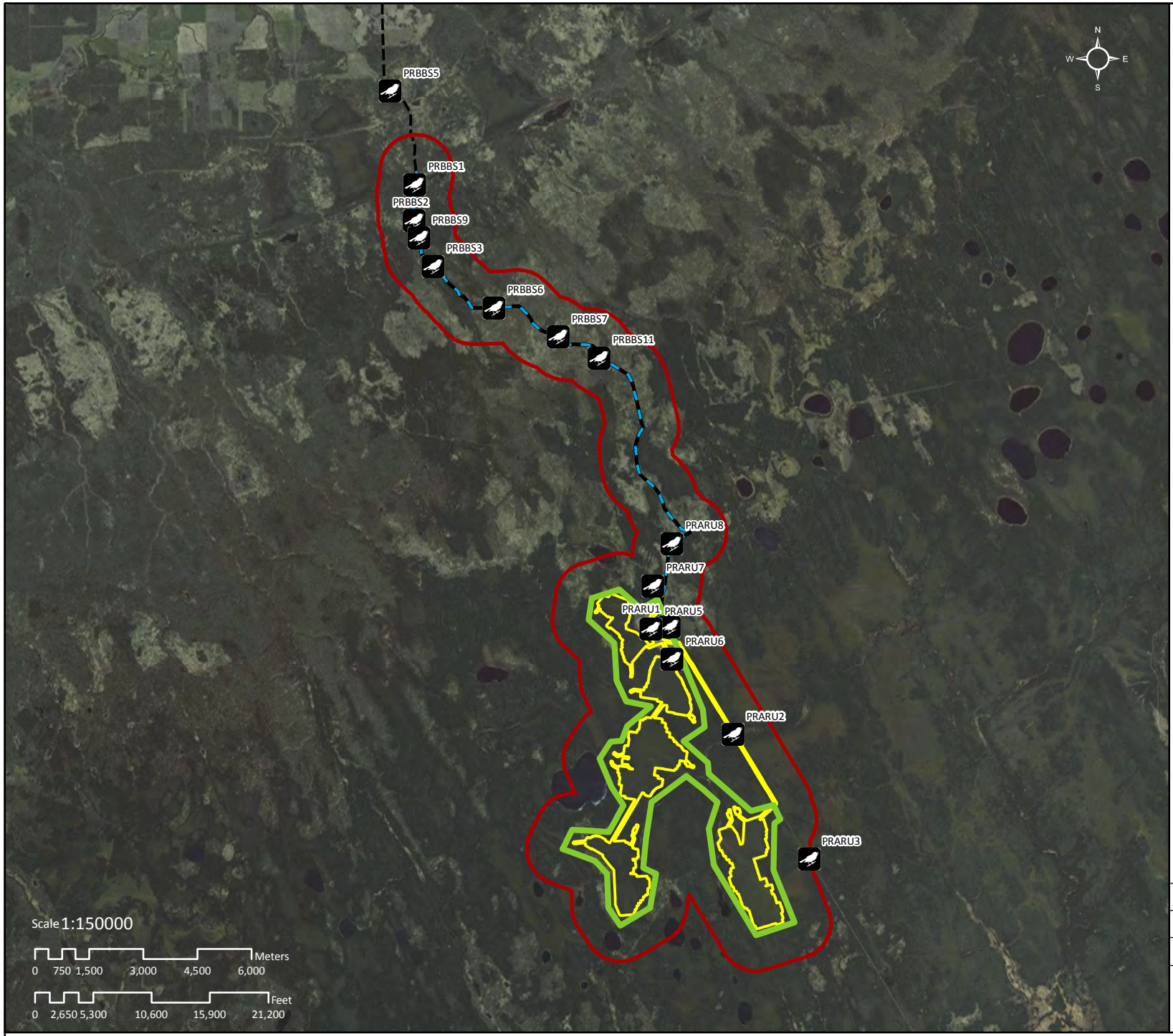
- Gravel Road (Existing)
- Access Road (Existing Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/24
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 8.3-1 : Locations of Yellow Rail Surveys, 2016 | Prairie River Bog



Site Boundaries

- Proposed Lease
- Project Footprint
- Wildlife Baseline Study Area

Survey

- Common Nighthawk Survey Locations

Infrastructures

- Gravel Road (Existing)
- Access Road (Existing Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/24
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 8.3-2 : Locations of Common Nighthawk Surveys, 2016 | Prairie River Bog

Little Brown Myotis and Northern Myotis

Two bat species are federally listed as 'Endangered' under Schedule 1 of the *SARA* (Government of Canada 2017) and provincially tracked (SKCDC 2017e) including little brown myotis (*Myotis lucifugus*) and northern myotis (*Myotis septentrionalis*). Reconnaissance surveys for little brown myotis and northern myotis were conducted during other wildlife field programs to identify potential maternity roost habitat and/or hibernacula. Maternity roost habitat was considered to be areas of larger mature forest stands with detectable snags.

A relatively higher density of large (greater than 25 centimetre [cm] diameter at breast height [DBH]; Ontario Ministry of Natural Resources and Forestry [MNRF] 2015) snags was observed in a historical cutblock located in the north portion of the lease boundary. A 1.1 km triangular transect (approximately 300 m sides) was searched by two observers on July 25, 2016 for cavity trees within 10 m of the transect (Figure 8.3-3). Information was collected on candidate roosts for the area searched. Information collected included:

- location of snag along the transect;
- distance to the snag from the transect center;
- tree species, DBH and height of snag;
- snag class (i.e., recently dead, dead several years but has lost some branches and bark, dead more than several years and lack branches and bark; Watt and Caceres 1999); and
- cavity class (i.e., no cavities, new cavity, old cavity, other wildlife use).

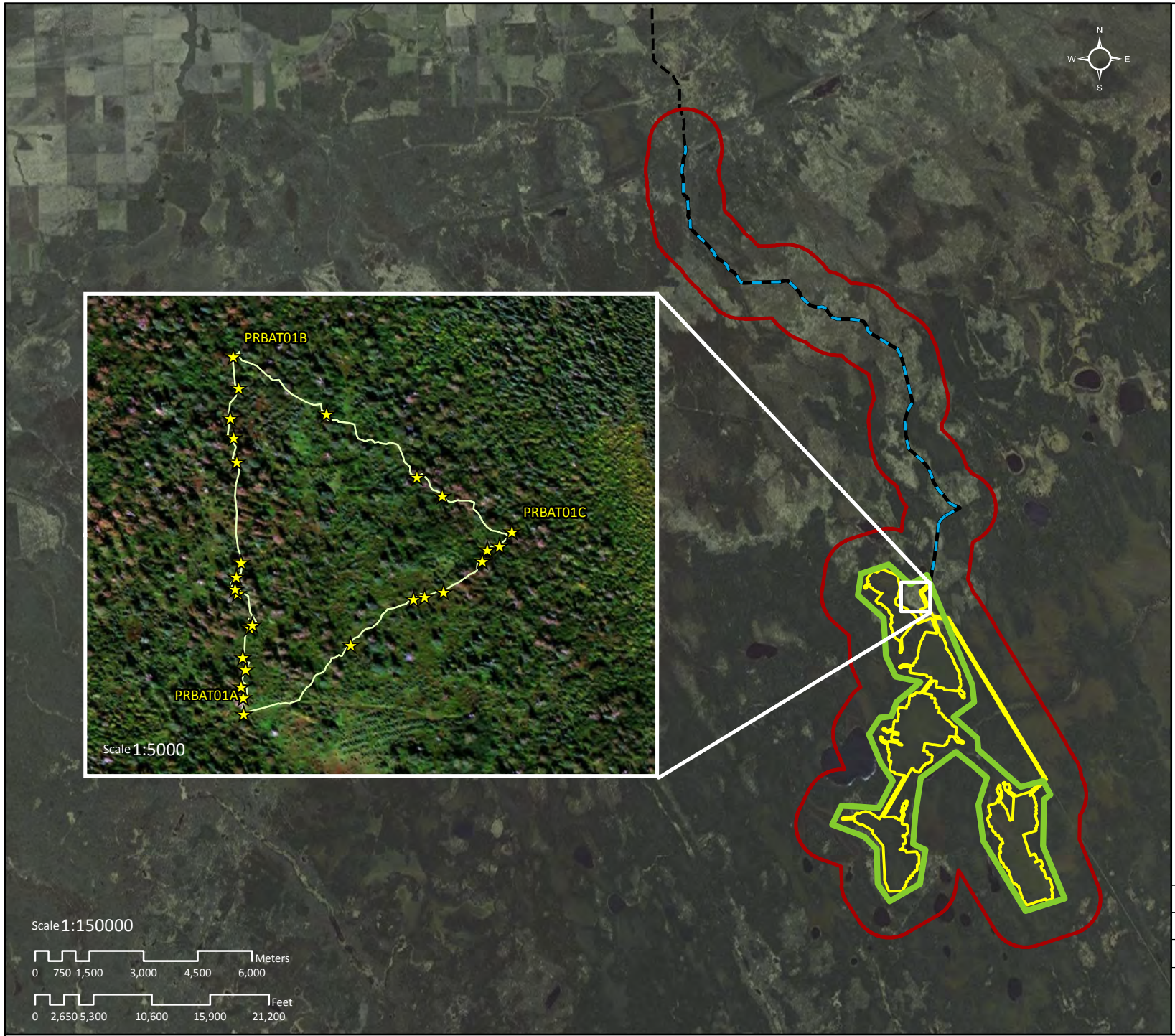
Both bat species use the same type of hibernacula (i.e., hibernation sites), which are typically abandoned mines, rock outcrops and caves or crevices where the open and accessible space extends below the frost line, and above zero temperatures and high humidity are relatively constant throughout the winter. However, habitat characteristics of hibernacula in western Canada are not well understood (Environment Canada 2015). A specific hibernacula survey was not conducted due to the lack of potential habitat in the BSA.

8.3.1.2 Protected Areas

Protected areas included provincial and regional parks, lands designated under *The Wildlife Habitat Protection Act* ([*WHPA*] 2010), MOE Crown Resource Lands, Canadian Important Bird Areas (IBAs), and lands designated by the Fish and Wildlife Development Fund and Saskatchewan Wildlife Federation. A list of protected areas occurring within the BSA was compiled using public databases.

8.3.1.3 Wildlife Habitat

Habitat types that occur within the BSA were identified by the Ecological Land Classification (ELC) (Section 7.4.2). The ELC provides a broad-level inventory of ecosites in the lease boundary. Habitat types were recorded in the field at each species-specific survey location and where listed species were encountered incidentally. Upland breeding bird analyses were completed using habitat groupings. All wetland habitats were partitioned into graminoid, shrubby, or treed wetland habitats based on field calls. All upland habitats were partitioned into deciduous forest or mixedwood forest habitats.



Site Boundaries

- Proposed Lease
- Project Footprint
- Wildlife Baseline Study Area

Survey

- Maternity Roost Survey Location
- Maternity Roost Survey Tracks

Infrastructures

- Gravel Road (Existing)
- Access Road (Existing Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/24
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 8.3-3 : Locations of Maternity Roost Habitat Survey, 2016 | Prairie River Bog

8.3.2 Amphibians

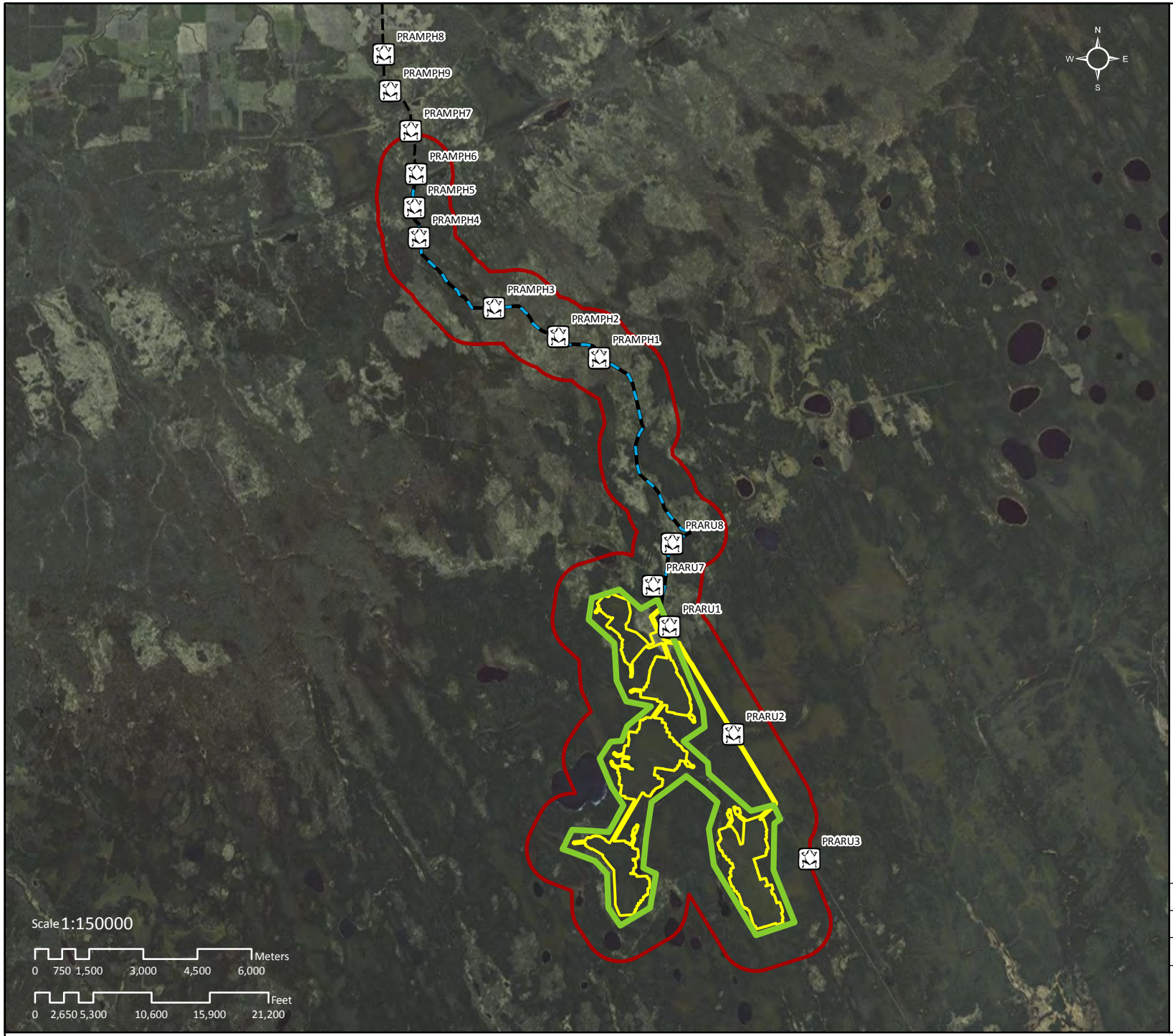
Amphibian call surveys were completed to determine the occurrence and relative abundance of northern leopard frogs (*Lithobates pipiens*) and other amphibian species in the BSA. Northern leopard frog is a federally listed (Government of Canada 2017) and provincially tracked (SKCDC 2017e) species whose range overlaps the BSA (COSEWIC 2000). Northern leopard frog requires a mosaic of habitat including open, scattered, permanent small water bodies for breeding and permanent wet areas adjacent to breeding sites in the summer and rarely occur in densely forested areas (Alberta Environment and Parks [AEP] 2013; Alberta Sustainable Resource Development 2003). Amphibian call survey locations were selected to maximize coverage across the BSA.

Surveys at 14 wetlands were completed in the BSA on April 29, May 14, May 22, May 31, and June 14, 2016 using a combination of field auditory surveys and ARUs (Figure 8.3-4). Thirteen wetlands were surveyed three times while one wetland was surveyed twice. During auditory surveys, observers listened for amphibian calls for three minutes following a one minute waiting period at each survey location between one half-hour after sunset and 1:00 am. At locations where ARUs were used, ARUs were placed in wetland habitats to passively record amphibian auditory signals once per hour for a duration of five or ten minutes, beginning at 21:00 pm and ending at 1:00 am. This resulted in 25 or 50 minutes of surveying per wetland each night. While the use of ARUs increased the number of sampling intervals per night, a total of five minutes was selected based on suitable ambient conditions and even temporal spread across the optimal survey period and was analyzed for each plot location per survey round. However, all survey data (i.e., five recordings per night) were stored for further reference. Amphibian call surveys followed Saskatchewan's Species Detection Survey Protocols, Amphibian Auditory Surveys (MOE 2014a); however, minimum air temperature recommendations (i.e., 6 °C for Round 1, 10°C for Round 2 and 13°C for Round 3; MOE 2014a) were not met for Round 1 surveys on May 14, 2016 (one plot), Round 2 surveys on May 14, 2016 (eight plots) and May 31, 2016 (one plot) and Round 3 surveys on May 31, 2016 (12 plots).

Sound recordings were reviewed to determine amphibian richness and abundance at each of the 14 wetlands surveyed. Amphibian species were assigned a calling index value based on the estimated number of calls because the actual number of calling males is difficult to estimate. Calling index values were defined as follows:

- Calling Index 1 – Individuals counted (e.g., 1-3 animals);
- Calling Index 2 – Individual calls can be distinguished but there is some call overlap (e.g., 4-7 animals); and
- Calling Index 3 – Full chorus, calls are overlapping (e.g., 8 or more animals).

Waterbody characteristics were recorded at each survey location, including waterbody type, the distance across the waterbody, water flow, and weather conditions during the survey period.



Site Boundaries

- Proposed Lease
- Project Footprint
- Wildlife Baseline Study Area

Survey

- Amphibian Calling Survey Locations

Infrastructures

- Gravel Road (Existing)
- Access Road (Existing Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/24
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 8.3-4 : Locations of Amphibian Calling Surveys, 2016 | Prairie River Bog

8.3.3 Upland Breeding Birds

Upland breeding birds include woodpeckers, corvids (e.g., jays, crows, and ravens), hummingbirds, marshbirds, shorebirds, raptors, and owls (except for yellow-bellied sapsucker). Upland breeding birds are commonly studied in baseline programs to determine the importance of habitats used by migratory upland birds for breeding and foraging activities, and to detect listed species. Most migratory bird species are protected under the *Migratory Birds Convention Act* (*MBCA* 1994). The objective of upland breeding bird surveys was to estimate the occurrence of songbirds and other upland breeding bird species in the study area.

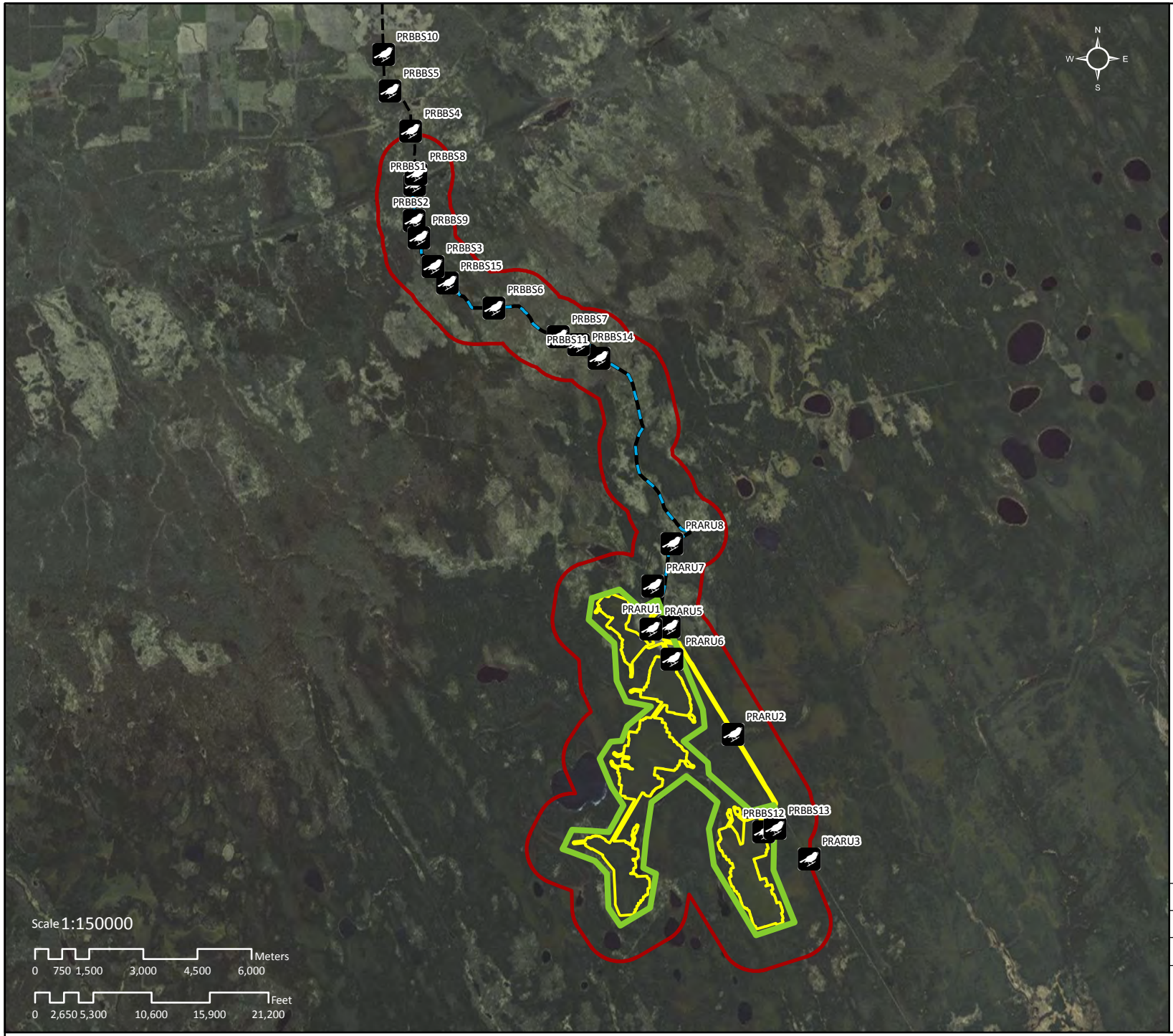
Upland breeding bird surveys (BBS) were completed using point count methods described in the Species Detection Survey Protocols, Forest Birds Surveys (MOE 2014b). Surveys were conducted during three sampling periods per plot on June 1, June 14 to 16, June 29 and July 2, 2016 to coincide with peak breeding season (when males are establishing territories and signing to attract males). Surveys were conducted using either ARUs or an observer to increase survey efficiency. Surveys conducted by an observer consisted of a 50 m radius circular plot with an additional 50 m radius buffer. Species heard outside of 100 m were also recorded as incidental observations. All species heard were recorded during surveys conducted using ARUs, and no distance data were obtained. Survey locations were selected by biologists in the field to sample a range of habitat types that occur in the BSA, to maximize coverage across the BSA, and to focus surveys on habitat in which a higher likelihood of species at risk may occur.

Plot centres were established with a minimum separation distance of 250 m. Breeding bird surveys began approximately 30 minutes before sunrise and ended approximately four hours after sunrise. At each point count station, observers waited for two minutes to allow the birds to adjust to their presence. Five (24 plot visits) or ten (33 plot visits) minutes of surveys were conducted or recordings analyzed for each plot location for three rounds each for a total of 450 minutes of survey time. All species heard or observed were recorded. The movements of individuals were carefully monitored to minimize the probability of double-counting birds.

A total of 17 point count locations were surveyed three times, while one point count location was surveyed twice and four point count locations were added for additional coverage of the BSA and surveyed once. The 22 point count locations were completed across eight different habitats (Figure 8.3-5). Weather conditions during the survey consisted of temperatures ranging from 1°C to 17°C and winds from 0 km/h to 12 km/h (field observations and ECCC 2016).

The following data were collected at each survey location:

- Universal Transverse Mercator (UTM) coordinates of plot location;
- date and time of survey;
- species observed;
- number of individuals;
- habitat type; and
- behavioural activity (e.g., territorial songs or displays, flyover) for plots completed by an observer.



Site Boundaries

- Proposed Lease
- Project Footprint
- Wildlife Baseline Study Area

Survey

- Upland Breeding Birds Survey Locations

Infrastructures

- Gravel Road (Existing)
- Access Road (Existing Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/24
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 8.3-5 : Locations of Upland Breeding Bird Point Count Surveys, 2016 | Prairie River Bog

Bird community composition was described for each survey plot by calculating abundance (i.e., the maximum number of individuals from all sampling periods of each bird species found) and count of species richness across habitats. All breeding birds detected within 100 m of the observer and all birds detected by the ARU were included in analysis. Including all birds detected by the ARU may result in an over representation of species with louder song volumes. This approach was used due to the inability to determine distances when using ARU data. Birds not considered upland breeding birds as described above, or observed outside of 100 m were reported as incidental observations.

8.3.4 Incidental Observations

Incidental wildlife observations and wildlife sign (e.g., tracks, scat, calls, nests), including mammals, amphibians, birds, and species of concern observed while traveling in the BSA were recorded opportunistically.

8.4 Results

8.4.1 Protected Species, Protected Areas, and Wildlife Habitat

8.4.1.1 Protected Species

There are 49 federally listed and provincially tracked species with the potential to occur in the BSA, including 1 amphibian species, 39 bird species, 5 mammals, and 4 invertebrate species (Table 8.4-1; Government of Canada 2017, SKCDC 2017d,e). Thirteen species that have the potential to occur in the BSA are listed under Schedule 1 of *SARA* (Table 8.4-1; Government of Canada 2017). Five of these are listed as species of 'Special Concern', six are listed as 'Threatened', and two are listed as 'Endangered'. Seven species that have the potential to occur in the BSA are recommended by COSEWIC for protection under *SARA* (Government of Canada 2017); however, they are not currently listed (Table 8.4-1; Government of Canada 2017). Four of these COSEWIC recommended species are recommended to be listed as species of 'Special Concern', two are recommended for listing as 'Threatened' and one is recommended for listing as 'Endangered'. No species having potential to occur in the BSA are protected under *The Wildlife Act* (1998) in Saskatchewan. An additional 29 species are tracked by the province of Saskatchewan (SKCDC 2017d,e) but are not protected by *SARA* or recommended to be listed under *SARA* by COSEWIC (Government of Canada 2017) and are not protected under *The Wildlife Act* (1998). The list of potential species is not exhaustive, but highlights species that might occasionally occur within the BSA.

A total of 12 species that are tracked by the SKCDC (2017d,e), protected by *SARA,* or recommended to be listed by COSEWIC (Government of Canada 2017) were identified during baseline surveys in 2016 (Figure 8.4-1; Table 8.4-1; Appendix C; Table C-1). Two species listed as 'Threatened' under Schedule 1 of *SARA* were observed during baseline surveys including common nighthawk and Canada warbler (*Cardellina canadensis*) (Table 8.4-1). One species recommended by COSEWIC for listing under *SARA* as 'Special Concern', evening grosbeak (*Coccothraustes vespertinus*), was observed during baseline surveys. An additional nine provincially tracked species were observed during baseline surveys (Table 8.4-1). Specific locations of protected species observations are found in Appendix C; Table C-1.

Table 8.4-1: Federally Listed and Provincially Tracked Species with the Potential to Occur in the Wildlife Baseline Study Area, 2016

Common Name	Scientific Name	COSEWIC[a]	*SARA*[a]	Provincial Status[b]	Potential for Occurrence in the Baseline Study Area	Species Observed During Baseline Surveys
Amphibians						
Northern leopard frog	*Lithobates pipiens*	Special Concern	Special Concern – Schedule 1	S3	Low – Inhabit scattered, permanent, small water bodies with emergent vegetation in the spring for breeding, and moves out to the permanent wet areas adjacent to the breeding sites in summer; rarely occurs in forested areas (AEP 2013; Alberta Sustainable Resource Development 2003).	No
Birds						
American wigeon	*Anas americana*	-	-	S5B S5M S2N	Low – The BSA is located within the northern portion of the species' breeding range (Smith 1996). The species breeds near wetlands, sloughs, ponds, small lakes, marshes, and rivers (Mini et al. 2014).	No
Bank swallow	*Riparia riparia*	Threatened	No Status	S5B S5M	Low – Exposed vertical banks in riparian areas and gravel pits, which are not found in the BSA, are preferred nesting habitats for this colonial species (Garrison 1999).	No
Barn swallow	*Hirundo rustica*	Threatened	No Status	S5B S5M	Moderate – Species is a confirmed breeder in the mapsheet containing the BSA. Nesting sites include buildings, bridges, and mobile structures such as ferries and farm equipment (Smith 1996).	No
Barred owl	*Strix varia*	-	-	S3	Low – Species is a probable breeder in the mapsheet adjacent the BSA and prefers old growth forest habitat (Smith 1996).	No
Black-throated blue warbler	*Setophaga caerulescens*	-	-	S2B S2M	Low – Species is a possible breeder in the mapsheet adjacent to the BSA. Breeding habitat includes second-growth deciduous woodlands or the understory of mature forests (Smith 1996).	No
Boreal owl	*Aegolius funereus*	Not at Risk	-	S3	Moderate – Species is a possible breeder in the BSA but is an uncommon resident in the boreal forest of Saskatchewan (Smith 1996). Nests in forests within the boreal region (Hayward and Hayward 1993).	Yes
Broad-winged hawk	*Buteo platypterus*	-	-	S4B S3M	Moderate – Species is a possible breeder in the mapsheet containing the BSA. Breeds in mature mixedwood or deciduous forests near water (Smith 1996).	No
Bufflehead	*Bucephala albeola*	-	-	S5B S3M S1N	Moderate – Species is a confirmed breeder in the mapsheet adjacent to the BSA (Smith 1996). The species is a cavity nester that requires the presence of poplar (*Populus balsamifera*) or aspen (*Populus tremuloides*) near permanent freshwater ponds (Gauthier 2014).	No
Canada goose	*Branta canadensis*	-	-	S5B S5M S2N	High – Species is a confirmed breeder in mapsheets adjacent to the BSA and is common throughout many regions in Saskatchewan (Smith 1996).	Yes
Canada warbler	*Cardellina canadensis*	Threatened	Threatened – Schedule 1	S4B S3M	Moderate to High – Breeds in the boreal mixed-wood forest with nesting habitat consisting of riparian willow and alder shrubbery (Reitsma et al. 2010; Smith 1996). Species is a possible breeder in the mapsheet containing the BSA (Smith 1996).	Yes
Canvasback	*Aythya valisineria*	-	-	S5B S5M S2N	Low – The BSA is at the northern range of the species' breeding range. The species prefers deep-water marshes, permanent sloughs and sheltered bays (Smith 1996).	No
Chimney swift	*Chaetura pelagica*	Threatened	Threatened – Schedule 1	S2B S2M	Moderate - Species is a probable breeder in the mapsheet adjacent to the BSA and where artificial sites (i.e., house chimneys) are not available, requires hollow trees for nesting (Smith 1996).	No
Common goldeneye	*Bucephala clangula*	-	-	S5B S3M S3N	Moderate – Species is a confirmed breeder in the mapsheet adjacent to the BSA and a common summer resident of the lakes of the boreal forests of Saskatchewan. The species is a cavity nester and requires large hollow trees for nesting (Smith 1996).	No
Common nighthawk	*Chordeiles minor*	Threatened	Threatened – Schedule 1	S4B S4M	High – Species is a possible breeder in the mapsheet containing the BSA (Smith 1996). Prefers forest clearings, rocky outcrops, prairies and pastures for breeding (Brigham et al. 2011).	Yes
Connecticut warbler	*Oporomis agilis*	-	-	S2B S2M	High – Species is a possible breeder in the mapsheet containing the BSA (Smith 1996). Breeding habitat preferences are variable, but include mature aspen stands and open areas in the prairie provinces (Pitoccheli et al. 2012).	Yes
Cooper's hawk	*Accipiter cooperii*	Not at Risk	-	S4B S2M S2N	High – Species is a confirmed breeder in the mapsheet south of that containing the BSA (Smith 1996). Species prefer forested areas near edges and rivers for nesting (Curtis et al. 2006).	Yes
Eastern whip-poor-will	*Antrostomus vociferus*	Threatened	Threatened – Schedule 1	S1B S1M	Moderate – Species is a possible breeder in the mapsheet containing the BSA (Smith 1996). The species breeds in dry deciduous or mixedwood forests with a limited understory cover (Cink et al. 2017).	No

Table 8.4-1: Federally Listed and Provincially Tracked Species with the Potential to Occur in the Wildlife Baseline Study Area, 2016

Common Name	Scientific Name	COSEWIC[a]	*SARA*[a]	Provincial Status[b]	Potential for Occurrence in the Baseline Study Area	Species Observed During Baseline Surveys
Evening grosbeak	*Coccothraustes vespertinus*	Special Concern	No Status	S4	High – Species is a confirmed and probable breeder in mapsheets adjacent to the BSA and breeds in both mixedwood and coniferous forests (Smith 1996).	Yes
Fox sparrow	*Passerella iliaca*	-	-	S5B SUM	Low to Moderate – Species is a possible breeder and spring and fall transient in the mapsheets adjacent to the BSA. Predominantly observed in Saskatchewan in mixedwood forest habitat (Smith 1996).	No
Gadwall	*Anas strepera*	-	-	S5B S5M S2N	Low – The BSA is located at the northern extent of the species breeding range and is uncommon in the boreal forest region of Saskatchewan where it breeds near wetland habitat (Smith 1996; Leschack et al. 1997).	No
Golden eagle	*Aquila chrysaetos*	Not at Risk	-	S3B S4M S3N	Low – Species is an uncommon winter resident in the southern boreal region (Smith 1996). Prefer nesting on cliffs and sheer escarpment slopes (usually along major river valleys), but occasionally will establish a nest tree (Kochert et al. 2002).	No
Great blue heron	*Ardea herodias*	-	-	S5B	High – The BSA is located within the breeding range for the species (Smith 1996). Prefers wetlands, waterbodies, and watercourses, but can be found foraging in cultivated fields and grassland habitats (Vennesland and Butler 2011).	No
Great gray owl	*Strix nebulosi*	Not at Risk	-	S3	Moderate – Species is a possible breeder in the mapsheet containing the BSA (Smith 1996). Breeds in taiga interspersed with sphagnum bogs, muskegs and open spaces (Bull and Duncan 1993).	Yes
Green-winged teal	*Anas crecca*	-	-	S5B S5M S2N	Moderate to High – Species breeds in wooded ponds of deciduous parklands typically with heavy vegetation and muddy bottoms and is a probable breeder in the mapsheet containing the BSA (Johnson 1995; Smith 1996).	No
Harris' sparrow	*Zonotrichia querula*	Special Concern	No Status	SUB S5M	Low – Species is a spring transient in the mapsheet containing the BSA (Smith 1996). The species' breeds in coniferous forests dominated by spruce or tamarack and with a shrubby understory (Norment et al. 2016).	No
Hooded merganser	*Lophodytes cucullatus*	-	-	S4B S3M	Moderate to High – Species is a probable breeder in the mapsheet adjacent the BSA (Smith 1996). Breeding habitat for the species is in forested wetlands (Dugger et al. 2009).	Yes
Lesser scaup	*Aythya affinis*	-	-	S5B S5M S3N	Moderate – Species is a confirmed breeder adjacent to the mapsheet containing the BSA. Nests along the shores of deep-water ponds, in emergent marshes or on islands in lakes (Smith 1996).	No
Northern hawk owl	*Surnia ulula*	Not at Risk	-	S3B S5N	Low – Species is a winter resident adjacent the mapsheet containing the BSA (Smith 1996). Breeding habitat is typically coniferous or mixed forests bordering marshes or open areas (Duncan and Duncan 2014).	No
Olive-sided flycatcher	*Contopus cooperi*	Threatened	Threatened – Schedule 1	S4B S4M	Moderate – Within coniferous forest habitats the species is associated with forest openings and edges (Altman and Sallabanks 2012). The species is a possible breeder in the mapsheet containing the BSA (Smith 1996).	No
Pileated woodpecker	*Dryocopus pileatus*	-	-	S3	Moderate to High – Species is a confirmed breeder in the mapsheet adjacent to the BSA and is common in the southern boreal region of Saskatchewan in mature deciduous and mixedwood forests (Smith 1996).	Yes
Pine grosbeak	*Pincicola enucleator*	-	-	S2B S4N	Moderate – Species' winter range overlaps the BSA (Smith 1996). The species breeds in open coniferous forest characterized by white or black spruce (Adkisson 1999).	No
Redhead	*Aythya americana*	-	-	S5B S5M S2N	Low – The BSA is at the northern extent of the species' breeding range. The species nests in permanent sloughs with emergent vegetation, deep-water marshes, and sheltered bays on large lakes (Smith 1996).	No
Rusty blackbird	*Euphagnus carolinus*	Special Concern	Special Concern – Schedule 1	S3B S4M SUN	Moderate – Species is a possible breeder in and a confirmed breeder adjacent to the mapsheet containing the BSA (Smith 1996). Species nests in the boreal forest near wetlands and swamps while wintering in damp woodlands and cultivated fields (Avery 2013).	No
Scarlet tanager	*Piranga olivacea*	-	-	SNA	Low – Species is a possible breeder in the mapsheet adjacent to the BSA and is a rare and irregular resident in the southern eastern portion of the southern boreal region (Smith 1996).	No
Sharp-tailed grouse	*Tympanuchus phasianellus*	-	-	S5	Low to Moderate – Species is a winter resident in mapsheets adjacent to the BSA. The species may inhabit grazed and ungrazed pastures, cultivated fields, recent burns, or dry bogs (Smith 1996).	No
Short-eared owl	*Asio flammeus*	Special Concern	Special Concern – Schedule 1	S3B S2N S3M	Low – The BSA is located at the northern extent of the species' breeding range (Smith 1996). Species prefers open areas such as grasslands, marshes, and agricultural areas for breeding (Wiggins et al. 2006).	No
Trumpeter swan	*Cygnus buccinator*	Not at Risk	-	S3B	Low – though the species was observed during 2016 wildlife surveys, it is considered a rare transient or summer visitant in the Project area, with confirmed breeding records in the Greenwater Lake area (Smith 1996).	Yes

Table 8.4-1: Federally Listed and Provincially Tracked Species with the Potential to Occur in the Wildlife Baseline Study Area, 2016

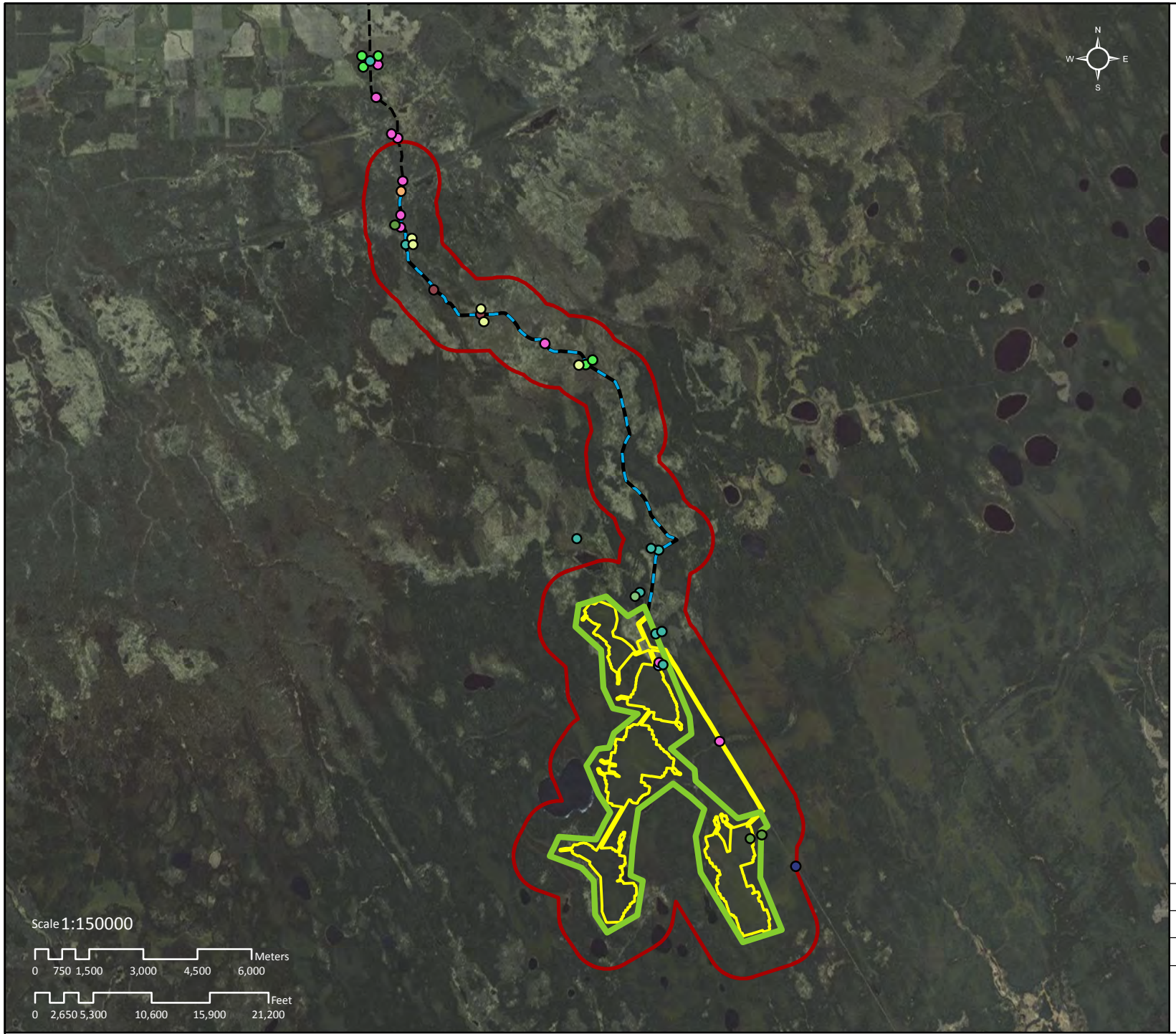
Common Name	Scientific Name	COSEWIC[a]	*SARA*[a]	Provincial Status[b]	Potential for Occurrence in the Baseline Study Area	Species Observed During Baseline Surveys
Wilson's warbler	*Cardellina pusilla*	-	-	S5B SUB	High – Species is a possible breeder in the mapsheet containing the BSA. The species prefers willow, alder and birch thickets bordering muskeg and watercourses (Smith 1996).	Yes
Yellow rail	*Coturnicops noveboracensis*	Special Concern	Special Concern – Schedule 1	S3B S3M	Low – The BSA is at the northern extent of the breeding records recorded by Smith (1996). Typically found nesting in marshes dominated by sedges, grasses, and rushes where there is little or no standing water (generally 0.0 cm to 12.0 cm water depth) and where the substrate remains saturated throughout the summer (COSEWIC 2009).	No
Mammals						
Little brown myotis	*Myotis lucifugus*	Endangered	Endangered – Schedule 1	S4	Low to Moderate – Species range includes all of Saskatchewan where it roosts/hibernates in hollow trees, buildings, and natural crevices (Fenton and Barclay 1980). Prefers to forage for aquatic insects in wetland and riparian habitats.	No
Northern myotis	*Myotis septentrionalis*	Endangered	Endangered – Schedule 1	S3	Low to Moderate – Require hibernacula (e.g., caves or buildings) for overwintering, and summer foraging areas with structures for roosting and maternal colonies (e.g., trees, rock crevices, buildings) (COSEWIC 2013).	No
River otter	*Lontra canadensis*	-	-	S3	High – Species habitat is along wooded rivers, ponds and lakes (Pattie and Fisher 1999).	No
wolverine	Gulo gulo	Special Concern	-	S3	Low – Species habitat ranges from forested areas, alpine tundra of the western mountain ranges, and arctic tundra, particularly in ecologically intact areas with an abundant variety of prey and other carnivore species (COSEWIC 2014a).	No
Woodland caribou	*Rangifer tarandus caribou*	Threatened	Threatened – Schedule 1	S3	Low to Moderate – In winter the species uses mature and old-growth coniferous forests containing large quantities of tree-inhabiting lichens and generally associated with marshes, bogs, lakes, and rivers. In summer, occasionally feed in young stands after fire or logging. The species shows preference for peatlands but avoids clear cuts, shrub-rich habitat, and aspen-poplar dominated sites (Government of Canada 2016). The Project is located within the SK2 woodland caribou conservation unit (MOE 2015b).	No
Invertebrates						
Gypsy cuckoo bumble bee	*Bombus ashtoni*	Endangered	-	SH	Low – Species can be found in various habitats including old fields, mixed farmland, and open woodlands. Species is a social parasite of bumble bees in the subgenus *Bombus* including yellow-banded bumble bee (*Bombus terricola*) (COSEWIC 2014b).	No
Hoary comma	*Polygonia gracilis zephyrus*	-	-	S3	Moderate – Species is found in coniferous and mixed forests of the boreal forest (Bird et al. 1995).	No
Monarch butterfly	*Danaus plexippus*	Endangered	Special Concern – Schedule 1	S2B	Moderate – Species has been known to migrate into the central parts of Saskatchewan (Davis 2009). Species may be found where milkweed (*Asclepias speciosa*, *A. syriaca*, or *A. viridiflora*) occur (i.e., in moist or dry, sandy areas or riverbanks [Looman and Best 1987]).	No
Yellow-banded bumble bee	*Bombus terricola*	Special Concern	-	S5	Moderate to High – Species is found in the Boreal Plain Ecozone and is a habitat generalist including open coniferous, deciduous, and mixed forests and wet and dry meadows (COSEWIC 2015).	No

[a] Government of Canada (2017)
[b] Saskatchewan Conservation Data Centre (SKCDC 2017d,e).

Provincial S-Rank Definitions (SKCDC 2017f)

S1 Critically imperiled/extremely rare - at very high risk of extinction or extirpation due to extreme rarity, very steep declines, high threat level, or other factors.
S2 Imperiled/very rare - at high risk of extinction or extirpation due to a very restricted range, very few populations, steep declines, threats or other factors.
S3 Vulnerable/rare to uncommon - at moderate risk of extinction or extirpation due to a restricted range, relatively few populations, recent and widespread declines, threats, or other factors.
S4 Apparently secure - uncommon but not rare; some cause for long- term concern due to declines or other factors.
S5 Secure/common - demonstrably secure under present conditions; widespread and abundant; low threat level.
B – for a migratory species, applies to the breeding population in the province.
M – for a migratory species, applies to the transient (migrant) population in the province.
N – for a migratory species, applies to the non-breeding population in the province.
U - status is uncertain in the jurisdiction because of limited or conflicting information (unrankable).
SNR – rank is not assigned or species has not yet been assessed (not ranked).
SH – historical occurrence of the taxon, without recent verification (e.g., 20-40 years or older).

'-' = no status; BSA = baseline study area; cm = centimetre.



Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/24
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 8.4-1 : Locations of Listed Species Observed During Wildlife Surveys in the Baseline Study Area, 2016 |

Prairie River Bog

Yellow Rail

No yellow rail were recorded during species-specific surveys or incidentally observed during other wildlife surveys in 2016.

Common Nighthawk

Common nighthawk were recorded at five survey locations with a total of 10 individuals observed during species-specific surveys (Figure 8.4-1; Appendix C; Table C-2). In addition, six common nighthawk were observed incidentally during other wildlife surveys in the BSA (Figure 8.4-1; Appendix C; Table C-1). The most common observations were in trembling aspen – white spruce/feathermoss habitat (BP9; 7 individuals) followed by tamarack treed fen (BP23; 4 individuals). The majority of individuals were observed in proximity to the lease boundary within the BSA (Figure 8.4-1).

Little Brown Myotis and Northern Myotis

Critical habitats for little brown myotis and northern myotis are considered to be maternity roost habitat and hibernation sites (i.e., hibernacula; Environment Canada 2015). Maternity roost habitat includes trees or buildings; however, large, dead or partly dead (i.e., snags) are preferred and the species' show a preference for poplar (*Populus* spp.) and birch (*Betula* spp.) trees (COSEWIC 2013; Fenton and Barclay 1980). Northern myotis in Nova Scotia and British Columbia selected home ranges with higher density of snags and large diameter trees (Broders et al*.* 2006; Sasse and Pekins 1996). Abandoned buildings are also used for roosting.

Thirty-one snags were observed during the candidate maternity roost field survey (Table 8.4-2). A total of 1,119 m was surveyed for snags up to 10 m from the center of the transect on either side (22,380 m^2; 2.2 ha). The average DBH and height of snags recorded was 76.9 cm and 13.3 m, respectively. Female bats prefer snags in early stages of decay (MNRF 2015). The majority (67.7 %) of snags recorded were considered to have been dead more than several years and lacked branches and bark. No cavities were observed on 83.9% of snags. Little brown myotis and northern myotis prefer old growth forest habitat for summer home ranges as this land cover provides abundant snags for roosting and a closed canopy, which is ideal for foraging bats (COSEWIC 2013). While the habitat surveyed provided abundant snag density (14.1 snags per hectare) the habitat surveyed was a previously cleared cutblock and did not provide a closed canopy. No maternity roosts were identified during field reconnaissance surveys.

Hibernacula sites are often abandoned mines, rock outcrops, and caves/crevices. No search was completed for hibernacula sites during the 2016 field survey due to the lack of potential habitat in the BSA. Little brown myotis and northern myotis were not observed during 2016 field surveys.

Table 8.4-2: Candidate Maternity Roost Habitat Results, 2016

Transect	Zone	UTM Coordinates (NAD 83)		Tree Species	Snag Class	DBH (cm)	Height (m)	Cavity Class	Comments
		Easting	Northing						
PRBAT01A	13U	640477	5886585	balsam poplar	1	100	20	2	-
	13U	640479	5886611	balsam poplar	3	80	10	0	-
	13U	640476	5886622	balsam poplar	1	100	20	0	-
	13U	640482	5886649	balsam poplar	2	50	15	0	-
	13U	640485	5886651	balsam poplar	1	80	8	2	-
	13U	640471	5886681	balsam poplar	1	90	11	0	-
	13U	640469	5886685	balsam poplar	3	70	30	0	-
	13U	640469	5886685	white birch	3	70	8	0	-
	13U	640470	5886696	balsam poplar	3	100	8	0	cracked bark
	13U	640470	5886696	balsam poplar	2	90	25	0	-
	13U	640470	5886696	balsam poplar	3	60	18	0	-
	13U	640474	5886709	balsam poplar	3	80	15	0	-
	13U	640470	5886802	birch	2	50	10	0	-
	13U	640470	5886802	balsam poplar	1	75	20	0	-
	13U	640470	5886802	balsam poplar	3	70	6	0	-
	13U	640468	5886825	balsam poplar	3	110	25	0	-
	13U	640465	5886842	birch	3	40	10	0	-
	13U	640472	5886870	birch	1	60	12	0	cracked and peeled bark
PRBAT01B	13U	640553	5886846	birch	2	110	12	0	-
	13U	640636	5886788	balsam poplar	3	60	15	0	-
	13U	640636	5886788	balsam poplar	3	60	15	0	-
	13U	640660	5886771	birch	3	60	9	0	tree cracked down center

Table 8.4-2: Candidate Maternity Roost Habitat Results, 2016

Transect	Zone	UTM Coordinates (NAD 83)		Tree Species	Snag Class	DBH (cm)	Height (m)	Cavity Class	Comments
		Easting	Northing						
PRBAT01C	13U	640713	5886724	balsam poplar	3	100	30	0	cracked bark
	13U	640701	5886721	balsam poplar	3	100	4	0	-
	13U	640696	5886710	balsam poplar	3	90	4	0	-
	13U	640661	5886682	birch	3	60	8	0	-
	13U	640661	5886682	birch	3	50	9	0	-
	13U	640644	5886678	birch	3	70	6	0	cracked bark
	13U	640633	5886676	birch	3	100	6	2	hollow tree, cracked bark
	13U	640575	5886633	balsam poplar	3	70	10	2	cracked bark
	13U	640575	5886633	balsam poplar	3	80	12	2	cracked bark

UTM = Universal Transverse Mercator; DBH = diameter at breast height; m = metre; cm = centimetre; balsam poplar (*Populus balsamifera*), birch (*Betula* sp.).

Snag Class (Watt and Caceres 1999):

1 – Snag that has recently died.
2 – Snag that has been dead several years and has lost some branches and bark.
3 – Snag that has been dead more than several years and lacks branches and bark.

Cavity Class:

0 – No cavities.
1 – New cavity (i.e., fresh wood chips on ground below hole, light colored wood around entrance, bird occupying cavity).
2 – Old cavity.
3 – Both old and new cavities.
4 – Other wildlife use.

8.4.1.2 Protected Areas

The majority of the BSA is located within the Pasquia-Porcupine Forest Management Agreement (FMA) area, excluding the north portion of the access route (SKCDC 2017c). Saskatchewan's Representative Areas Network (RAN) is a network of ecologically important land and water areas across the province in place to preserve natural and cultural features. No RANs were found overlapping with the BSA. The nearest RAN to the BSA is Greenbush River RAN located approximately 6.5 km east of the BSA. Additionally, the Fir River RAN is located approximately 10 km east of the BSA (SKCDC 2017c).

The majority of the BSA is located within Wildlife Management Zone (WMZ) 59 and Fur Block H-75, with the north portion of the access route extending into WMZ 49 (outside of Fur Block H-75). The IBA database was queried and no designated IBA's were found overlapping with, or in the vicinity of the BSA. The nearest IBA to the BSA is located approximately 24 km north of the north end of the access route (IBA 2017).

8.4.1.3 Wildlife Habitat

The ELC for the BSA identified 28 ecosites, classified as per the Field Guide to the Ecosites of Saskatchewan's Provincial Forests (McLaughlan et al. 2010) as discussed in Section 7.4.2. The most widespread ecosites in the BSA were wetland ecosites including black spruce – tamarack treed swamp (BP18) and black spruce treed bog (BP19). Cumulatively, wetland ecosites cover approximately 53% (5,085.7 ha) of the BSA. Dominant upland ecosites includes trembling aspen – white spruce/feathermoss (BP14) and trembling aspen – white birch/mountain maple (BP8). Several of the upland ecosites were observed to have experienced natural disturbance through fire or disturbances related to current land use (i.e., logging). Upland ecosites accounted for 43% (4,147.4 ha) of the BSA.

8.4.2 Amphibians

Amphibians were heard at 13 survey plot locations in 2016 across wetlands characterized by disturbed standing water (5 plots), standing water (5 plots) and creeks (3 plots; Appendix C; Table C-3). No amphibians were heard at survey plot location PRARU03 characterized by disturbed standing water and located in a tamarack treed fen (BP23). Two species were observed or heard during surveys including wood frog (*Rana sylvatica*) and boreal chorus frog (*Pseudacris maculata*). Wood frog was heard at 12 survey plot locations and was observed to be the most abundant where the dominant waterbody was characterized by disturbed standing water. Creeks surveyed in the BSA were the dominant waterbody type observed to have the lowest abundance of wood frog observations. Boreal chorus frog was observed at 12 survey plot locations and was observed to be the most abundant where the dominant waterbody was standing water. At plots where creeks were the dominant waterbody the lowest abundance of boreal chorus frogs were observed. There are seven amphibian species known to occur in Saskatchewan, and four of these may occur in the BSA. Amphibian species that have historical ranges that overlap the BSA, but were not heard or observed during the 2016 baseline surveys include Canadian toad (*Bufo hemiophrys*) and northern leopard frog.

8.4.3 Upland Breeding Birds

A total of 463, observations among 50 species were recorded (Table 8.4-3). White-throated sparrow (*Zonotrichia albicollis*) and red-eyed vireo (*Vireo olivaceus*) were the most commonly occurring species with observations at 86.4% and 81.8% of the survey plots corresponding to 39 and 29 individuals recorded, respectively. Other commonly occurring species included common yellowthroat (*Geothlypis trichas*), alder flycatcher (*Empidonax alnorum*) and mourning warbler (*Geothlypis philadelphia*), which occurred at 59.1% of the survey plots corresponding to 18, 18, and 15 individuals recorded, respectively (Table 8.4-3).

One provincially tracked (SKCDC 2017e) and federally listed (Government of Canada 2017) species, Canada warbler was observed during BBS (9.1% occurrence rate; 2 individuals; Table 8.4-3) with observations occurring at survey plot locations PRBBS10 and PRBBS11 in deciduous (BP6 – trembling aspen/beaked hazel/sarsaparilla) and mixedwood forest (BP15 – balsam poplar – white spruce/feathermoss), respectively (Figure 8.3-5). Canada warbler is federally listed under Schedule 1 of the SARA as 'Threatened'. Canada warbler breeds in the boreal mixed-wood forest with nesting habitat consisting of riparian willow and alder shrubbery (Reitsma et al. 2010; Smith 1996). Canada warbler was observed in the BSA along the northernmost and the south-central portions of the access route within the BSA.

Table 8.4-3: Upland Breeding Bird Species Detected During Breeding Bird Surveys 2016

Common Name[a]	Scientific Name	Number of Individuals Observed per Habitat Category[b]						Total Number of Individuals Observed[b]	Percentage of Total Observations	Number of Plots with Detections	Percentage of Plots with Detections
		Deciduous Forest (n=5)	Deciduous/Mixedwood Forest (n=1)	Mixedwood Forest (n=10)	Shrubby Wetland (n=2)	Treed Wetland (n=3)	Graminoid Wetland (n=1)				
alder flycatcher	*Empidonax alnorum*	3	2	8	3	1	1	18	3.9	13	59.1
American goldfinch	*Carduelis Tristis*	2	0	0	2	0	0	4	0.9	3	13.6
American redstart	*Setophaga ruticilla*	10	1	11	1	0	1	24	5.2	12	54.5
American robin	*Turdus migratorius*	6	1	4	1	0	1	13	2.8	10	45.5
black-and-white warbler	*Mniotilta varia*	3	0	6	1	0	2	12	2.6	9	40.9
blackburnian warbler	*Setophaga fusca*	0	1	1	1	0	1	4	0.9	4	18.2
black-capped chickadee	*Parus atricapillus*	2	0	4	1	0	0	7	1.5	4	18.2
black-throated green warbler	*Setophaga virens*	2	0	3	0	0	2	7	1.5	5	22.7
blue-headed vireo	*Vireo solitarius*	1	1	1	0	0	0	3	0.6	3	13.6
brown creeper	*Certhia americana*	0	0	1	1	0	0	2	0.4	2	9.1
Canada warbler	*Cardellina canadensis*	1	0	1	0	0	0	2	0.4	2	9.1
cedar waxwing	*Bombycilla cedrorum*	3	2	7	1	1	0	14	3.0	9	40.9
chestnut-sided warbler	*Setophaga pensylvanica*	3	2	7	1	0	2	15	3.2	10	45.5
chipping sparrow	*Spizella passerina*	0	1	6	0	3	2	12	2.6	8	36.4
common yellowthroat	*Geothlypis trichas*	5	0	7	3	1	2	18	3.9	13	59.1
Connecticut warbler	*Oporonis agilis*	1	0	1	0	1	0	3	0.6	3	13.6
dark-eyed junco	*Junco hyemalis*	0	0	2	0	2	0	4	0.9	3	13.6
golden-crowned kinglet	*Regulus satrapa*	0	0	0	1	0	0	1	0.2	1	4.5
gray catbird	*Dumetella carolinensis*	1	0	1	1	0	0	3	0.6	3	13.6
hermit thrush	*Catharus guttatus*	0	0	6	0	3	0	9	1.9	6	27.3
least flycatcher	*Empidonax minimus*	6	0	2	3	0	0	11	2.4	6	27.3
Lincoln's sparrow	*Melospiza lincolnii*	1	0	3	1	4	0	9	1.9	7	31.8
magnolia warbler	*Setophaga magnolia*	0	2	2	0	0	0	4	0.9	3	13.6
mourning dove	*Zenaida macroura*	4	0	0	0	0	0	4	0.9	4	18.2
mourning warbler	*Geothlypis philadelphia*	4	2	6	1	1	1	15	3.2	13	59.1
Nashville warbler	*Oreothlypis ruficapilla*	0	1	9	2	0	0	12	2.6	8	36.4
northern waterthrush	*Parkesia noveboracensis*	5	0	3	1	0	0	9	1.9	7	31.8
ovenbird	*Seiurus aurocapillus*	5	0	3	0	0	3	11	2.4	7	31.8
palm warbler	*Setophaga palmarum*	0	0	1	0	3	0	4	0.9	3	13.6
Philadelphia vireo	*Vireo philadelphicus*	1	0	2	0	0	0	3	0.6	3	13.6
pine siskin	*Carduelis pinus*	1	2	9	1	2	0	15	3.2	8	36.4
red-breasted nuthatch	*Sitta canadensis*	0	0	2	0	0	1	3	0.6	3	13.6
red-eyed vireo	*Vireo olivaceus*	8	1	15	2	1	2	29	6.3	18	81.8
red-winged blackbird	*Agelaius phoeniceus*	1	0	0	2	0	0	3	0.6	2	9.1

Table 8.4-3: Upland Breeding Bird Species Detected During Breeding Bird Surveys 2016

Common Name[a]	Scientific Name	Number of Individuals Observed per Habitat Category[b]						Total Number of Individuals Observed[b]	Percentage of Total Observations	Number of Plots with Detections	Percentage of Plots with Detections
		Deciduous Forest (n=5)	Deciduous/Mixedwood Forest (n=1)	Mixedwood Forest (n=10)	Shrubby Wetland (n=2)	Treed Wetland (n=3)	Graminoid Wetland (n=1)				
rose-breasted grosbeak	*Pheucticus ludovicianus*	5	0	4	1	0	1	11	2.4	8	36.4
ruby-crowned kinglet	*Regulus calendula*	0	0	8	1	5	0	14	3.0	8	36.4
sedge wren	*Cistothorus platensis*	0	0	0	1	0	0	1	0.2	1	4.5
song sparrow	*Melospiza melodia*	4	0	0	2	0	1	7	1.5	5	22.7
Swainson's thrush	*Catharus ustulatus*	0	0	3	3	2	1	9	1.9	8	36.4
swamp sparrow	*Melospiza georgiana*	4	0	2	4	0	1	11	2.4	7	31.8
Tennessee warbler	*Oreothlypis peregrina*	4	0	6	1	1	0	12	2.6	10	45.5
veery	*Catharus fuscescens*	6	0	0	1	0	0	7	1.5	5	22.7
western wood-pewee	*Contopus sordidulus*	0	0	1	1	0	0	2	0.4	2	9.1
white-throated sparrow	*Zonotrichia albicollis*	10	3	19	1	3	3	39	8.4	19	86.4
white-winged crossbill	*Loxia leucoptera*	0	0	4	0	0	0	4	0.9	3	13.6
Wilson's warbler	*Cardellina pusilla*	0	0	0	0	1	0	1	0.2	1	4.5
winter wren	*Troglodytes hiemalis*	0	0	7	0	1	0	8	1.7	6	27.3
yellow warbler	*Setophaga petechia*	6	0	4	1	0	1	12	2.6	9	40.9
yellow-bellied sapsucker	*Sphyrapicus varius*	4	0	4	1	0	1	10	2.2	8	36.4
yellow-rumped warbler	*Setophaga coronata*	0	0	7	1	0	0	8	1.7	6	27.3
Grand Total		**122**	**22**	**203**	**50**	**36**	**30**	**463**	**100.0**	**22**	**100.00**

[a] Species Common Name in *italics* = provincially (SKCDC 2017e) listed species; Species Common Name in *italics* and **bold** = provincially (SKCDC 2017e) and federally (Government of Canada 2017) listed species.
[b] Number of individuals was calculated as a maximum count for each round at the plot level. Given that individual birds are expected to remain relatively constant at each plot during the breeding season and variability in numbers between rounds can be attributed to probability of detection, this method reduces the probability of double counting individuals.
n = number of plots surveyed

Two provincially tracked species (SKCDC 2017e) Connecticut warbler (*Oporornis agilis*) and Wilson's warbler (*Cardellina pusilla*) were observed during BBS. Three Connecticut warblers were observed at three survey plots (13.6% occurrence rate; Table 8.4-3) and the observations occurred in deciduous forest (BP16 – balsam poplar – trembling aspen/prickly rose), treed wetland (BP19 – black spruce treed bog) and mixedwood forest (BP14 – trembling aspen – white spruce/feathermoss). Connecticut warbler has variable breeding preferences but in Saskatchewan the species commonly breeds in aspen or mixedwood forest dominated by aspen often along the border of open areas or small meadows (Pitoccheli et al. 2012). Connecticut warbler was observed (2 individuals) adjacent the lease boundary in the south portion of the BSA and along the north-central portion of the access route within the BSA (1 individual; Figure 8.4-1).

One Wilson's warbler was observed at one survey plot (4.5% occurrence rate; Table 8.4-3) and the observation occurred in treed wetland (BP23 – tamarack treed fen). Wilson's warbler prefers willow, alder and birch thickets that border muskeg and watercourses (Smith 1996). Wilson's warbler was observed in the south portion of the BSA, south of the lease boundary (Figure 8.4-1).

Breeding bird survey plots were grouped into broad habitat categories according to vegetation structure and hydrology conditions (Table 8.4-3). The majority of upland plots occurred in mixedwood forest habitats (10 plots) with treed wetland the most common wetland habitat category (3 plots).

8.4.4 Incidental Observations

A total of 81 species or their sign were observed or were heard incidentally during species-specific wildlife surveys, including two amphibian, 70 bird, and nine mammal species (Table 8.4-4). Mammal species observed included two ungulates, two carnivores, four small mammals and one semi-aquatic mammal. Five raptor species were recorded including boreal owl (*Aegolius funereus*), Cooper's hawk (*Accipiter cooperii*), great gray owl (*Strix nebulosa*), northern harrier (*Circus cyaneus*), and northern saw-whet owl (*Aegolius acadicus*). Waterbirds include ducks, geese, swans, cranes, rails, American coot (*Fulica americana*), grebes, gulls, terns, and loons. Ten waterbirds and six shorebirds were incidentally recorded in the BSA. Five positively identified species belonging to the woodpecker family, two corvids, two jays, one game bird, black-billed cuckoo (*Coccyzus erythropthalmus*), brown headed cowbird (*Molothrus ater*), and rock dove (*Columba livia*) were also observed among 36 species of upland breeding birds observed incidentally.

Two provincially tracked (SKCDC 2017e) and federally listed species (Government of Canada 2017), common nighthawk and Canada warbler and seven provincially tracked wildlife species were observed incidentally in the BSA during 2016 wildlife surveys (Table 8.4-4). Details on protected species are found in Section 8.4.1.1 and Appendix C; Table C-1.

Table 8.4-4: Incidental Wildlife Species Recorded in the Baseline Study Area during 2016 Wildlife Surveys

Common Name	Scientific Name	Common Name	Scientific Name
Amphibians			
Boreal chorus frog	*Pseudacris maculata*	Wood frog	*Rana sylvatica*
Birds			
alder flycatcher	*Empidonax alnorum*	mallard	*Anas platyrhynchos*
American bittern	*Botaurus lentiginosus*	northern flicker	*Colaptes auratus*
American crow	*Corvus brachyrhynchos*	northern harrier	*Circus cyaneus*
American goldfinch	*Carduelis Tristis*	northern saw-whet owl	*Aegolius acadicus*
American robin	*Turdus migratorius*	northern waterthrush	*Parkesia noveboracensis*
black-and-white warbler	*Mniotilta varia*	ovenbird	*Seiurus aurocapillus*
black-backed woodpecker	*Picoides arcticus*	pied-billed grebe	*Podilymbus podiceps*
black-billed cuckoo	*Coccyzus erythropthalmus*	*pileated woodpecker*	*Dryocopus pileatus*
blackpoll warbler	*Setophaga striata*	pine siskin	*Spinus pinus*
blue jay	*Cyanocitta cristata*	red-breasted nuthatch	*Sitta canadensis*
boreal owl	*Aegolius funereus*	red-eyed vireo	*Vireo olivaceus*
brown-headed cowbird	*Molothrus ater*	rock dove	*Columba livia*
Canada goose	*Branta canadensis*	rose-breasted grosbeak	*Pheucticus ludovicianus*
Canada warbler	*Cardellina canadensis*	ruby-crowned kinglet	*Regulus calendula*
chestnut-sided warbler	*Setophaga pensylvanica*	ruffed grouse	*Bonasa umbellus*
common loon	*Gavia immer*	sandhill crane	*Grus canadensis*
common nighthawk	*Chordeiles minor*	solitary sandpiper	*Tringa solitaria*
common raven	*Corvus corax*	song sparrow	*Melospiza melodia*
common yellowthroat	*Geothlypis trichas*	Sora	*Porzana carolina*
Connecticut warbler	*Oporornis agilis*	Swainson's thrush	*Catharus ustulatus*
Cooper's hawk	*Accipiter cooperii*	swamp sparrow	*Melospiza georgiana*
dark-eyed junco	*Junco hyemalis*	Tennessee warbler	*Oreothlypis peregrina*
evening grosbeak	*Coccothraustes vespertinus*	tree swallow	*Tachycineta bicolor*
golden-crowned kinglet	*Regulus satrapa*	*trumpeter swan*	*Cygnus buccinator*
gray jay	*Perisoreus canadensis*	unidentified woodpecker	*woodpecker spp.*
great gray owl	*Strix nebulosa*	veery	*Catharus fuscescens*
greater yellowlegs	*Tringa melanoleuca*	Virginia rail	*Rallus limicola*
hairy woodpecker	*Picoides villosus*	warbling vireo	*Vireo gilvus*
hermit thrush	*Catharus guttatus*	white-throated sparrow	*Zonotrichia albicollis*
hooded merganser	*Lophodytes cucullatus*	white-winged crossbill	*Loxia leucoptera*
Killdeer	*Charadrius vociferus*	Wilson's snipe	*Gallinago delicata*
Le Conte's sparrow	*Ammodramus leconteii*	winter wren	*Troglodytes hiemalis*
least flycatcher	*Empidonax minimus*	yellow warbler	*Setophaga petechia*
least sandpiper	*Calidris minutilla*	yellow-bellied flycatcher	*Empidonax flaviventris*
lesser yellowlegs	*Tringa flavipes*	yellow-rumped warbler	*Setophaga coronata*

Table 8.4-4: Incidental Wildlife Species Recorded in the Baseline Study Area during 2016 Wildlife Surveys

Common Name	Scientific Name	Common Name	Scientific Name
Mammals			
American red squirrel	*Tamiasciurus hudsonicus*	moose	*Alces alces*
beaver	*Castor canadensis*	skunk	*Mephitis mephitis*
black bear	*Ursus americanus*	white-tailed deer	Odocoileus virginianus
eastern cottontail	*Sylvilagus floridanus*	woodchuck	*Marmota monax*
gray wolf	*Canis lupus*	-	-

[a] Species Common Name in **bold** = provincially (SKCDC 2017e) listed species; Species Common Name in *italics* and **bold** = provincially (SKCDC 2017e) and federally listed (Government of Canada 2017) species.

8.5 Summary

Surveys were performed to determine the presence, relative abundance, and distribution of listed species, amphibians, and upland breeding birds in the BSA. Survey methods selected are widely used in the areas of wildlife conservation, are generally nonintrusive to animals and habitat, and are recommended by the Saskatchewan MOE.

A total of 12 species that are tracked by SKCDC (2017d,e), protected by *SARA*, or recommended to be listed by COSEWIC (Government of Canada 2017) were identified during baseline surveys in 2016. Two species listed as 'Threatened' under Schedule 1 of *SARA* were observed during baseline surveys including common nighthawk and Canada warbler. One species, evening grosbeak was observed that is recommended by COSEWIC for listing under *SARA* as 'Special Concern'. An additional 9 provincially tracked species were observed during baseline wildlife surveys in 2016.

The only amphibian species recorded in the BSA during baseline surveys were wood frog and boreal chorus frog. Beaver (*Castor canadensis*), gray wolf (*Canis lupus*), black bear (*Ursus americanus*), moose (*Alces alces*), and white-tailed deer (*Odocoileus virginianus*) or their sign were commonly observed. American red squirrel (*Tamiasciurus hudsonicus*) was frequently observed. Eastern cottontail (*Sylvilagus floridanus*), woodchuck (*Marmota monax*), and skunk (*Mephitis mephitis*) were observed infrequently.

A total of 463 observations of 50 upland breeding bird species were observed during the upland breeding bird surveys. White-throated sparrow and red-eyed vireo were the most abundant species recorded. A total of 81 species were observed incidentally during baseline wildlife surveys, including two amphibian, 70 bird, and nine mammal species.

9.0 HERITAGE RESOURCES

9.1 Introduction

This section provides an overview of heritage resources in the baseline study area (BSA) which includes the Prairie River Peat Harvest Project (the Project) lease boundary and access road. In Saskatchewan, heritage resources include all archaeological and paleontological objects and sites, as well as any property deemed to be of interest for its architectural, historical, cultural, environmental, aesthetic and scientific value. Heritage resources are property of the Provincial Crown and are protected under *The Heritage Property Act* (1979-80).

9.2 Baseline Study Area

The BSA corresponds to National Topographic System (NTS) map sheet 63E/2. This area includes the Project Footprint and access road, and is the spatial boundary considered when describing the environmental setting and assessment of the potential Project effects to heritage resources (Figure 9.2-1). The BSA as identified provides a broader culture history context for the Project as well as an understanding of known heritage resources recorded in the Project region.

The Project is located within the Prairie River Bog which is located on the drainage divide of the Carrot River watershed within the Saskatchewan River Basin and the Red Deer River watershed within the Lake Winnipegosis Basin. The area is mostly forested and contains numerous wetlands and peatlands. The southern section of the bog drains into the Greenbush River, which is a tributary of the Red Deer River, while the northern section of the bog drains north to the Papikwan River, a tributary of the Carrot River.

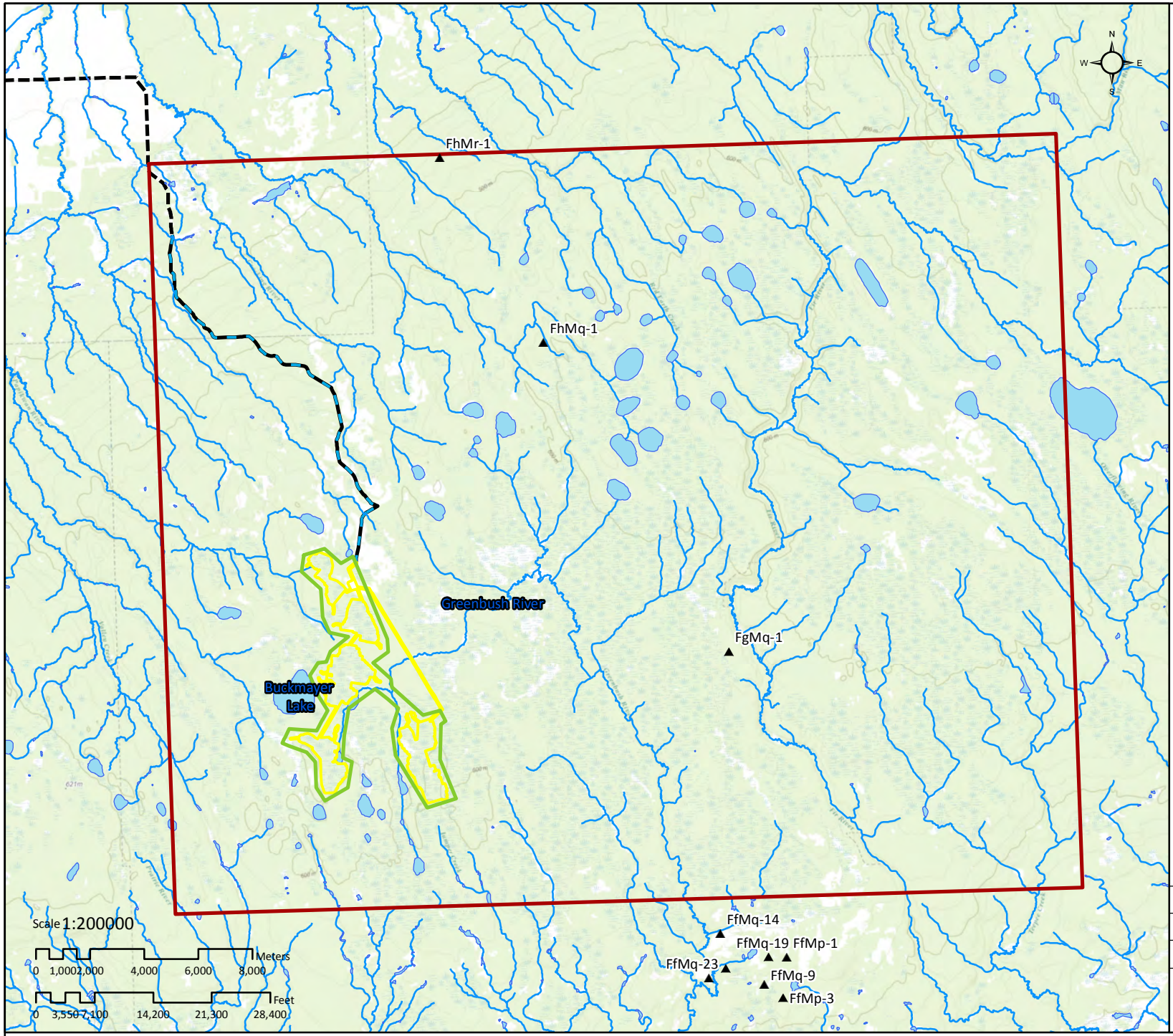
The Project Footprint represents the potential area affected by the Project including a 200 m buffer and is 1,059 ha (2,619 acres), the portion of the access road that requires construction upgrades will be 17 km long by 37 m wide (63 ha, 156 acres; Figure 9.2-1). Given the site-specific and stationary nature of heritage resources, the Project Footprint and access road is the maximum area where direct and indirect effects to heritage resources could reasonably occur. There are no expected effects to heritage resources outside the Project Footprint and access road.

9.3 Methods

9.3.1 Existing Literature and Databases

To understand the cultural setting and existing heritage resources documented in the BSA the following data sources were consulted.

- Provincial databases maintained by the Heritage Conservation Branch ([HCB] Saskatchewan Ministry of Parks, Culture, and Sport) including:
  - Survey Area Plot of previously assessed areas; and
  - Archaeological Site Inventory Database.
- Heritage Resource Impact Assessment (HRIA) reports housed at the HCB, Regina, Saskatchewan.
- Articles from various peer reviewed journals.
- Other relevant publications, online resources and government reports.



Site Boundaries

- Proposed Lease
- Project Footprint
- Heritage Resources Baseline Study Area

Heritage Resources Survey

- Known Heritage Resource

Infrastructures

- Gravel Road (Existing)
- Access Road (Existing Trail to be Upgraded)

Hydrology

- Waterbody
- Watercourse

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/22
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 9.2-1 : Heritage Resources Baseline Study Area |

Prairie River Bog

Information from these sources was used to identify previous archaeological research carried out in the region, as well as the types of heritage resources known to occur or that could potentially occur in the BSA. The data were augmented by a literature review of pertinent publications, and articles from academic journals to summarize the Precontact and Historic Culture History of the region.

9.3.2 Field Assessment

Prior to carrying out the archaeological field assessment, the proposed Project Footprint was submitted to the HCB for review to identify HRIA requirements. In a letter dated March 7, 2016 the HCB noted that there are no known archaeological sites in potential conflict with the Project. However, the Project is located within 250 m of creeks and Buckmayer Lake. As such, the heritage potential for the Project was considered to be moderate to high and a HRIA was required only for those areas within 250 m of Buckmayer Lake and unnamed creeks (HCB File No. 16-637, Appendix D).

The HRIA for Prairie River was conducted under Archaeological Resources Investigation Permit No. 16-097, issued by the HCB. The assessment included pedestrian reconnaissance and subsurface test exploration to identify heritage resources in heritage sensitive areas within the BSA. Pedestrian surface reconnaissance is the most common method used by archaeologists to identify archaeological sites (Ruppé 1966). Visual inspection of the ground is particularly effective in areas with good surface visibility, such as regions of limited soil development, sparse vegetation or other subsurface exposures (Schiffer et al. 1978). Shovel probes are used by archaeologists to locate and identify subsurface archaeological deposits, and are useful in areas of poor surface visibility (Kintigh 1988; Krakker et al. 1983; Nance and Ball 1986). Beyond a tool of discovery, shovel probes can also provide important information on the integrity, dimensions, and density of cultural materials found at archaeological sites (Kintigh 1988).

The pedestrian reconnaissance, visual inspection and subsurface testing program for the Project was carried out by one archaeologist and a field assistant. Detailed field notes and digital photographs were taken to document the Project environment, while hand-held Global Positioning System (GPS) units were used to document surveyed areas and relevant Project features. The Universal Transverse Mercator (UTM) location of each shovel probe was also recorded with the GPS units. All shovel probes measured approximately 40 cm by 40 cm and were excavated to sterile clays. Excavated soils were hand sorted with a trowel and inspected for cultural materials and wall profiles were examined for buried paleosol and occupation horizons.

9.4 Results

9.4.1 Cultural Setting

The following section provides a summary of the pre- and post-European contact periods in history relevant to the heritage BSA. Understanding the history of the region provides context to where and what type of archeological resources may be discovered within the BSA.

9.4.1.1 Precontact Period

The history of the boreal forest of Saskatchewan prior to European contact is divided into three general periods by archaeologists: Early, Middle, and Late (Figure 9.4-1). The Early Precontact Period (10,500 to 7,500 before present [BP]) coincides with the retreat of the Wisconsin continental glacier from northern Saskatchewan (Walker 1999). Current evidence suggests that the glaciers retreated to far northern Saskatchewan by 9,000 BP (Bobrowsky et al. 1990; Meyer and Russell 2007). During this period, highly nomadic hunting groups are thought to have entered the region for the first time using long throwing or thrusting spears to hunt big game animals. Stone spear points associated with occupation during this period are lanceolate in form, lack notches, and are considerably larger than during later periods (Figure 9.4-1). Occupations from this period are rare in the boreal forest of Saskatchewan and consist only of surface finds; however, when present, the diagnostic artifacts of the Early Precontact cultures are indistinguishable from those identified on the plains.

The beginning of the Middle Precontact Period (7,500 to 2,000 BP) overlaps with the peak of the Hypsithermal climatic episode. This milder and drier climatic regime resulted in the Boreal Forest/Aspen Parkland boundary shifting over 100 km north of its present location (Bobrowsky et al. 1990; Dyck 1983; Vance 1991). As much of the Project region was part of the Prairie/Parkland Ecozone through the Middle Precontact Period, the culture history is essentially that of the Northern Plains Culture Area where subsistence focused on communal bison hunting. Projectile points of this period are smaller and exhibit notches near the basal end, allowing them to be more securely bound to the shaft (Figure 9.4-1). These projectile points are associated with a type of spear thrower known as the atlatl (Frison 1978).

By the beginning of the Late Precontact Period (2,000 to 300 BP), the climate had cooled sufficiently for the boreal forest to expand southward to its current limit (Meyer and Russell 2007). In the BSA, cultures primarily adapted to the forest environment appear in the archaeological record for the first time. This period is marked by the appearance of several new technological changes to the material culture. Pottery was introduced via populations from the eastern woodlands of Manitoba and Minnesota (Figure 9.4-1; Meyer 1983). Subsistence strategies during the Woodland Period were no longer plains oriented, but based on a diverse utilization of forest food resources (e.g. deer, moose, elk, fish, plants). Changes in hunting equipment included the replacement of the atlatl by the bow and arrow. This is recognized archaeologically by a further reduction in the size of the projectile points (Figure 9.4-1). Specialized woodworking tools such as celts, adzes, and wedges were also introduced.

9.4.1.2 Protohistoric and Historic Period

The Protohistoric Period marks the interval in which European influence began influencing indigenous cultures prior to direct contact. This began shortly after the earliest fur trade posts were established on the western shore of Hudson's Bay in 1682. Some indigenous groups became successful as middlemen, exchanging furs for European goods to trade with other groups further inland (Ray 1974).

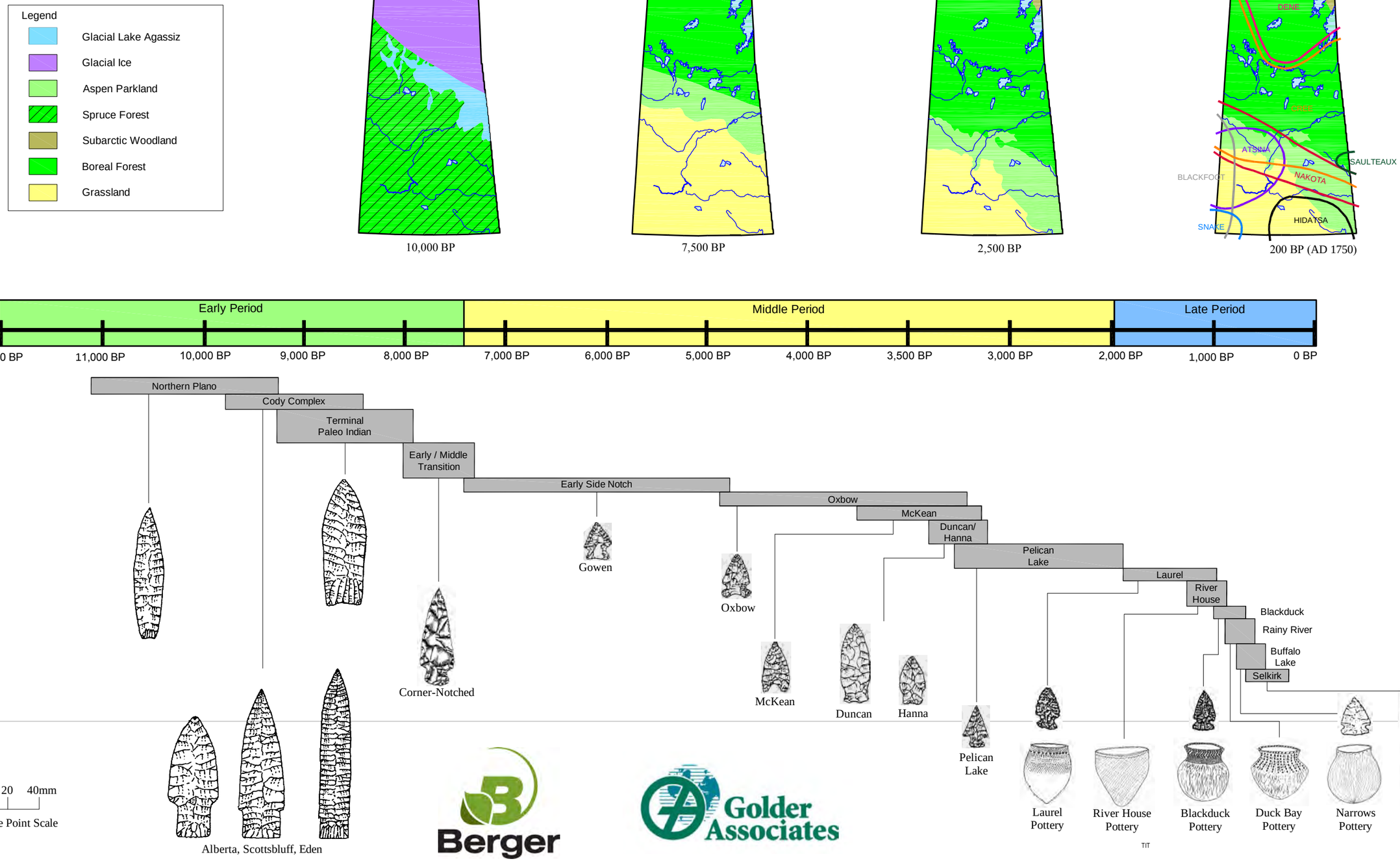


Figure 9.4-1 :Regional Chronology of the Mixedwood Boreal Forest of Northern Saskatchewan |

The fur trade continued to exert a strong influence in the boreal forest of Saskatchewan throughout the Historic Period. Fur trade posts were eventually established on major waterways of the interior, such as the Saskatchewan and Churchill Rivers throughout the 18th and 19th centuries (Russell and Meyer 1999). These waterways, and others, provided highways by which fur traders could begin to explore the Canadian interior. The Carrot and Red Deer rivers were utilized by Henry Kelsey, Anthony Henday, and Matthew Cocking, who were among the first European explorers to foray into the area now known as Saskatchewan throughout the 17th and 18th centuries. While there are no known fur trade forts within the BSA, there are at least two established nearby on the Red Deer River, one by the Northwest Company in 1797, and the other by the Hudson's Bay Company in 1817 (Russell and Meyer 1999).

In 1870, the vast fur bearing lands owned by the Hudson's Bay Company, known as Rupert's Land, were sold to the Canadian Government (Mooney 2005). With the establishment of the Dominion Lands Act in 1872, European settlement and agriculture development began within the newly created North-West Territories (Archer and Koester 1965). During this period the federal government negotiated seven treaties with the First Nations between 1871 and 1887. This included Treaty No. 5 (signed 1875), which includes lands where the BSA is located. In 1905, the federal Saskatchewan Act resulted in the creation of the province of Saskatchewan, which joined confederation that same year. The arrival of the Canadian Northern Railway resulted in increased settlement and the incorporation of the community of Etomami as a village in 1907 (McClennan 2005). The name was later changed in 1909 to Hudson Bay Junction because of its location as the starting point for the Hudson Bay Railway to Churchill, Manitoba. Logging, railway and agriculture would be the primary industries for the community and surrounding area over the subsequent decades. When the community attained town status in 1947 the word "Junction" was dropped and the current name of Hudson Bay was adopted.

9.4.2 Previous Archaeological Research

The earliest archaeological work conducted in east central Saskatchewan was initiated by the University of Saskatchewan in the 1960's as part of the Glacial Lake Agassiz studies (Pohorecky and Anderson 1968). It was not until the early 2000's that HRIA projects were carried out near the proposed Project Footprint. A summary of relevant archaeological work carried out in the BSA is summarized in Table 9.4-1. Heritage Resource Impact Assessments within the BSA have been conducted by Stantec Inc. on behalf of Weyerhaeuser, Canada (Stantec 2000, 2003, 2005a, 2005b and 2007). These HRIAs focused on the harvest blocks and access roads within Weyerhaeuser's Pasquia-Porcupine Forest Management Agreement (FMA) area.

Table 9.4-1: Previous Heritage Resource Impact Assessments in Baseline Study Area

Permit No.	Investigator	Project
2000-057	Stantec Inc.	Weyerhaeuser Canada, Hudson Bay; 2000-01 Access Roads
2003-021	Stantec Inc.	Weyerhaeuser, Hudson Bay FMA Roads and Harvest Blocks: 2003
2005-016	Stantec Inc.	Weyerhaeuser, Hudson Bay FMA Roads and Harvest Blocks: 2004
2005-104	Stantec Inc.	Weyerhaeuser, Hudson Bay FMA Roads and Harvest Blocks: 2005
2007-014	Stantec Inc.	Weyerhaeuser, Hudson Bay FMA Roads and Harvest Blocks: 2007

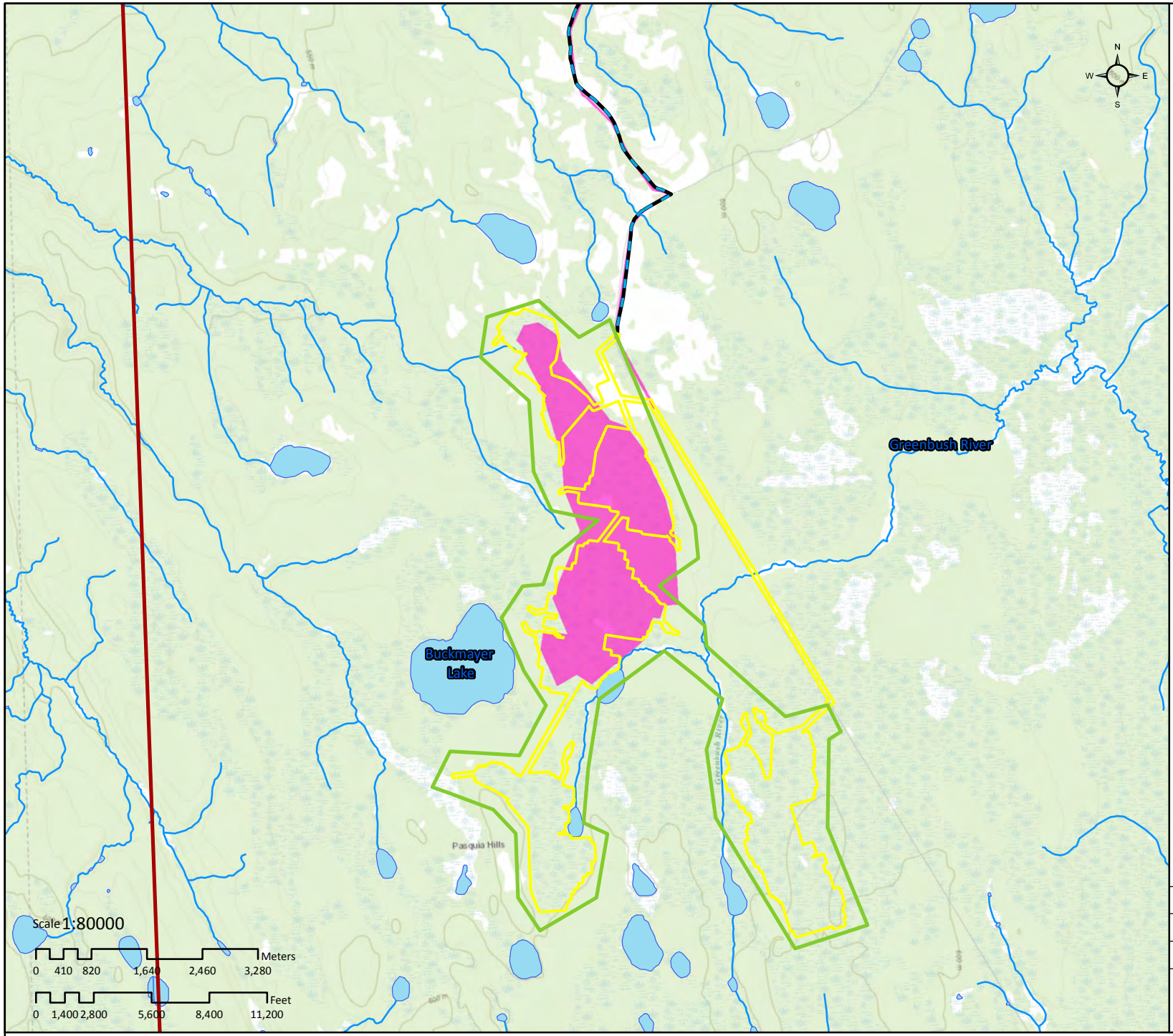
In total, three heritage resources (FgMq-1, FhMq-1 and FhMr-1) were identified within the current Project BSA. Two heritage resources (FgMq-1 and FhMq-1) were identified during the previous HRIAs conducted by Stantec. One of these sites was identified as a Precontact artifact scatter and the other site was identified as an unknown artifact/feature combination (Table 9.4-2). The remaining site, FhMr-1, was identified as a Precontact artifact scatter during the previous Glacial Lake Agassiz studies in 1963 (Table 9.4-2).

Table 9.4-2: Known Heritage Resources in the Project Baseline Study Area and NTS Mapsheet

Site Type	Definition	No. of Sites
Artifact Scatter	Archaeological sites consisting of six or more artifacts. An artifact is any object used or modified by people (e.g., projectile point, pottery sherds, lithic flakes).	2
Artifact/Feature Combination	Archaeological sites consisting of both artifacts and features. A feature is defined as a non-portable archaeological component (e.g., hearths, stone cairns, cellar depressions, cabins).	1

9.4.3 Field Assessment

The HRIA for the Project was conducted in September 2016 (Figure 9.4-2 and Figure 9.4-3). The results are detailed in the final report for Archaeological Resource Investigation Permit No. 16-097 submitted by Golder (2016b) to the HCB. The assessment confirmed that the lease area is dominated by poorly drained terrain (i.e., black spruce bog) with areas of slightly elevated terrain along the peripheries of the bog (Photographs 9.4-1 and 9.4-2). As this terrain is not conducive to human occupation, no shovel probes were excavated in these areas given their low potential for heritage resources.



Site Boundaries

- Proposed Lease
- Project Footprint
- Heritage Resources Baseline Study Area

Survey

- Assessed Area

Hydrology

- Waterbody
- Watercourse

Infrastructures

- Access Road (Existing Trail to be Upgraded)

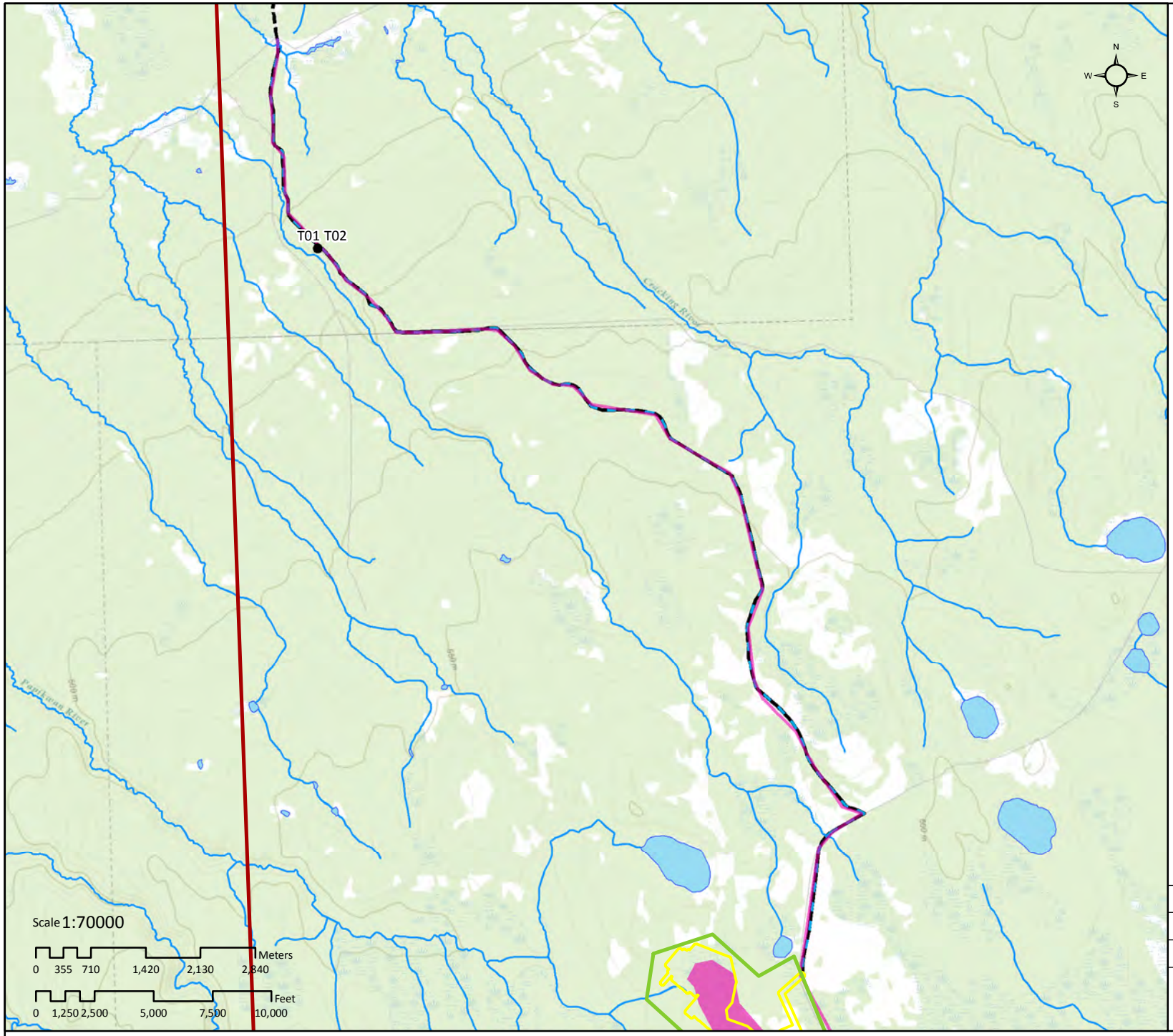
Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/22
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 9.4-2 : Prairie River Lease, Assessed Areas and Shovel Probes |

Prairie River Bog



Site Boundaries
- Proposed Lease
- Project Footprint
- Heritage Resources Baseline Study Area

Survey
- Shovel Probes
- Assessed Area

Hydrology
- Waterbody
- Watercourse

Infrastructures
- Gravel Road (Existing)
- Access Road (Existing Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/22
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) ESRI (Basemap)

Figure 9.4-3 : Prairie River Access Road, Assessed Areas and Shovel Probes |

Prairie River Bog

Additionally, the HRIA included an assessment of the northern route option where in-field assessments confirmed that the majority of the route primarily traverses poorly drained terrain not favorable for human occupation (Photographs 9.4-3, 9.4-4 and 9.4-5). Exposures along the various route were visually inspected for cultural materials and areas immediately adjacent to it were inspected for surficial features (i.e., historic cabins). One dilapidated cabin (recent hunting cabin) was noted adjacent to the route, however, it was deemed to have low historical significance (Photograph 9.4-6). A total of two shovel probes (T01 and T02) were excavated adjacent to the route on a terrace overlooking a seasonal creek (Figure 9.4-3). The stratigraphy can be summarized as follows:

- 0 to 5 cm sod;
- 5 to 14 cm black to dark brown sand;
- 14 to 21 cm light brown sandy clay; and
- 21 to 35 cm grey sandy clay.

No heritage resources were identified during the assessment.



Photograph 9.4-1: General view of northern portion of Prairie River bog, looking north



Photograph 9.4-2: General view of southern portion of Prairie River bog, looking southwest.



Photograph 9.4-3: View of northern access route traversing gentle slope descending into boggy terrain, looking south.



Photograph 9.4-4: View of clearing prior to ephemeral creek crossing along northern access route, looking southeast.



Photograph 9.4-5: View of beaver dam and associated run off along northern access route, looking northwest.



Photograph 9.4-6: View of dilapidated hunting cabin adjacent to northern access route option, looking east.

9.5 Summary

A review of existing literature and databases, as well as data collected during baseline studies were used to describe the cultural setting of the BSA. In general, the heritage potential of the Project Footprint is considered poor as the majority of it is located within low-lying bog which would not have been suitable for occupation. No heritage resources were identified within the Project Footprint and only three were identified on the same NTS mapsheet as the Project.

10.0 LAND AND RESOURCE USE

10.1 Introduction

This section provides an overview of land and resource uses that occur in the land and resource use baseline study area (BSA) that have potential to be affected by the Prairie River Peat Harvest Project (the Project). The key features of land and resource use include the following: parks, protected areas and recreational areas; hunting and fishing areas (wildlife management zones and sport fishing zones); agriculture; outfitters and lodges; fur blocks for trapping; and forest management zones. Renewable resource use includes both traditional resource use by First Nations and Métis people and non-traditional resource use of non-Aboriginal people.

10.1.1 Pasquia-Porcupine Integrated Forest Land Use Plan

The Project is located within the Pasquia-Porcupine Integrated Forest Land Use Plan (PPIFLUP) area which includes the Porcupine Hills, Pasquia Hills, and part of the Cumberland House area (PPIFLUP 1998a). The PPIFLUP also encompasses the Pasquia-Porcupine Forest Management Agreement (FMA) area that is jointly held by Weyerhaeuser Company Ltd. and Edgewood Forest Products Ltd. (Weyerhaeuser and Edgewood Forest Products 2016). The PPIFLUP is based on the principles of Integrated Resource Management, in which land use planning decisions are made on an integrated and environmentally sound basis to ensure ecological, economic, social and cultural benefits for present and future generations (PPIFLUP 1998a). The purpose of the PPIFLUP is to provide a framework for resource management and for the allocation and uses of land and resources; however, the PPIFLUP does not provide specific guidelines for how activities or developments will be conducted (PPIFLUP 1998a).

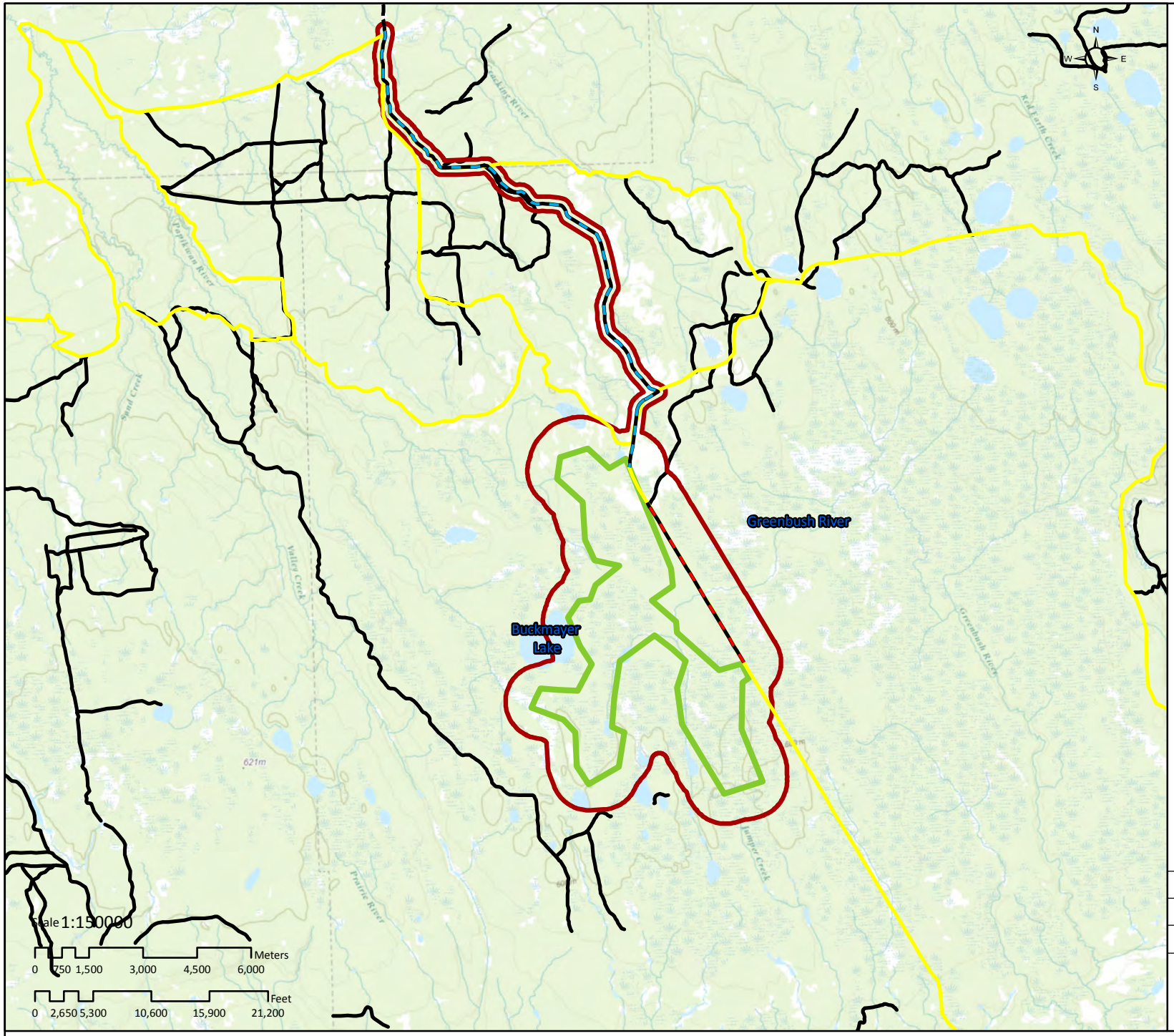
Harvesting of horticultural peat is a recognized land use activity under the mining and quarrying land use strategy. The Project is located within the Resource Management Area identified by the PPIFLUP which is managed to encourage integrated land uses and to accommodate development of renewable and non-renewable resources (subject to applicable environmental approvals and permitting; PPIFLUP 1998a).

10.2 Baseline Study Area

The spatial boundaries of the land and resource use BSA are equivalent to the BSA identified for vegetation and wildlife because effects on land and resource use are closely linked to effects on the actual resources (i.e., moose, berries). An area extending 1,000 m from the boundary of the Project Footprint and existing access road has been chosen to reflect the potential for overlap between the Project and the BSAs chosen for the resources[2] (e.g., vegetation, wildlife) used by traditional and non-traditional users. This area is also expected to encompass the area surrounding the Project used to carry out activities such as hunting, trapping, fishing, forestry, and recreation.

No parks, protected areas or agricultural areas are found within the BSA (Figure 10.2-1). The eastern portion of the BSA overlaps with local snowmobiling trails and the northeastern portion of the BSA overlaps with trails used for forest harvesting and cutlines.

[2] The area of the vegetation and wildlife BSA was determined to be 1,000 m from the Project Footprint as this distance assesses the potential direct Project effects and small-scale indirect Project effects on all terrestrial environmental components.



Site Boundaries

- Proposed Lease
- Land and Resource Use Baseline Study Area

Infrastructures

- Gravel Road (Existing)
- Access Road (Existing Trail to be Upgraded)
- Service Road (Existing Trail to be Upgraded)
- Snowmobile Trail
- Wood Trail / Cutline

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/22
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) Canvec (2015) ESRI (Basemap)

Figure 10.2-1 : Land and Resource Use Baseline Study Area | Prairie River Bog

Figure 10.2-2 presents the BSA in relation to nearby features of land and resource use. The Project and the BSA are located entirely within Wildlife Management Zone 59 (WMZ 59), Fur Blocks H-75 and H-25, and the Pasquia-Porcupine FMA area. Wildcat Hill Provincial Park is the nearest park (approximately 25 km northeast). The Town of Carrot River is the nearest town by road (approximately 61 km northwest). Red Earth Indian Reserve 29 and Carrot River Indian Reserve 29A are the closest reserve lands to the BSA (approximately 65 km northeast).

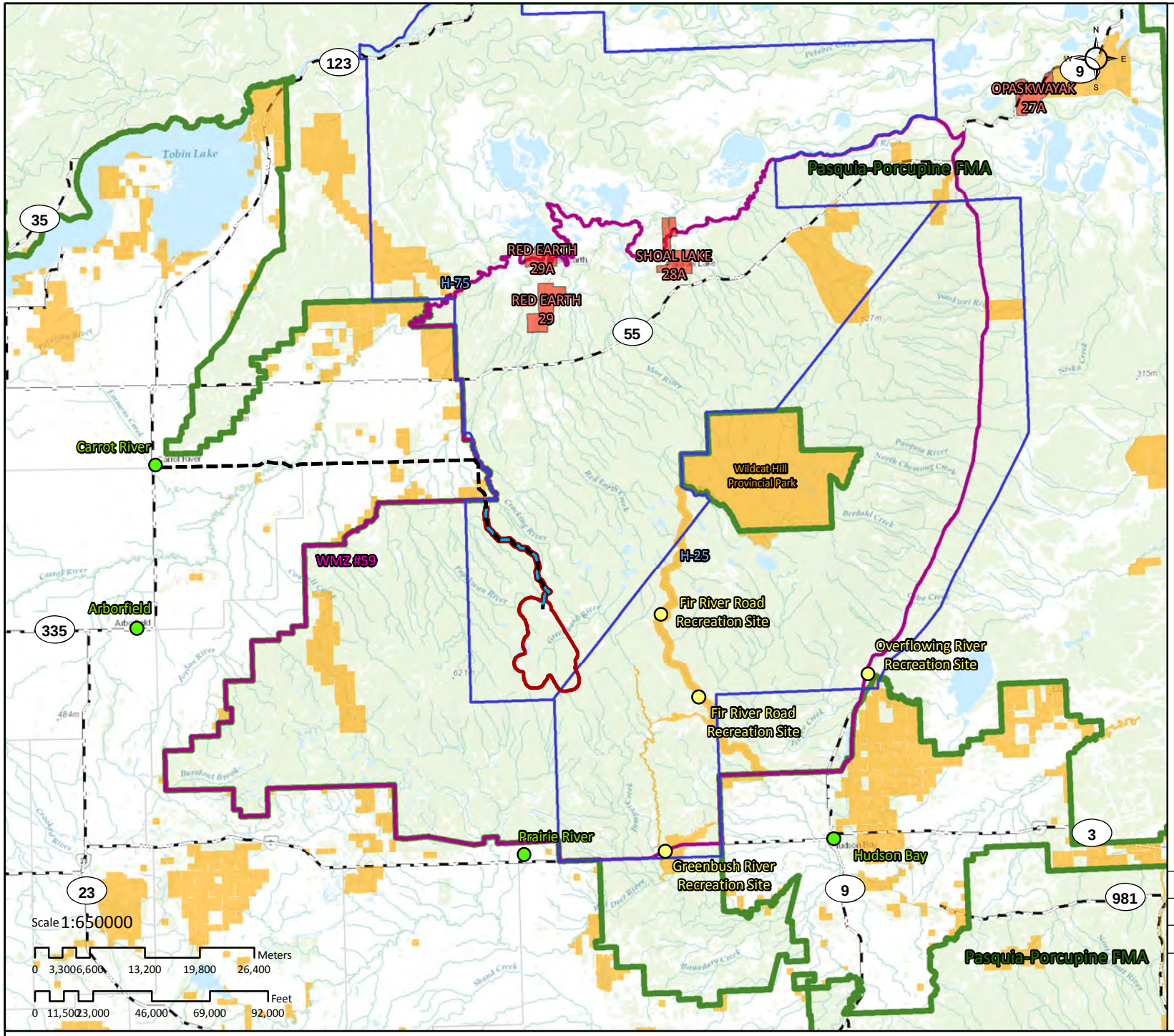
These figures present the key features of land and resource use and highlights that the BSA is located within certain zones (hunting, trapping, forestry) and notes that other features are absent within this study area (parks, protected areas, and agriculture).

10.3 Traditional Land and Resource Use

There are no First Nations reserve lands or Métis settlements in the BSA; however Berger is engaging with a number of Indigenous communities that may have traditionally used the area within the BSA and potentially have an interest in the Project.

Indigenous communities that may have an interest in the Project include:

- Coté First Nation;
- Fishing Lake First Nation;
- Keeseekoose First Nation;
- The Key First Nation;
- Kinistin Saulteaux Nation;
- Red Earth First Nation;
- Shoal Lake First Nation;
- Yellow Quill First Nation;
- Bjorkdale Métis Local #99;
- Carrot River Métis Local #137;
- Chelan/Porcupine Plain Métis Local #111;
- Hudson Bay Métis Local #114;
- Nipawin Métis Local #134;
- Sturgis Métis Local #138;
- Tisdale Métis Local #222; and
- Wynyard Métis Local #116.



Site Boundaries

- Land and Resource Use Baseline Study area

Administrative Boundaries

- First Nation Reserves
- Fur Blocks
- Wildlife Management Zone
- Forest Management Area
- Protected Areas
- Communities
- Recreation Site

Infrastructures

- Gravel Road (Existing)
- Access Road (Existing Trail to be Upgraded)

Berger

Golder Associates

CARTOGRAPHER	Pierre-Olivier Sauvageau
DATE	2017/08/30
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) Canvec (2015) ESRI (Basemap)

Figure 10.2-2 : Overall View of Land and Resource Use Baseline Study Area | Prairie River Bog

10.3.1 Methods

The baseline summary relies on a literature review of publicly available Traditional Land Use information relevant to the BSA, data collected during the 2016 field programs, and engagement with traditional land users that occurred in 2016. Engagement is ongoing and additional engagement to collect traditional land use information will occur in 2017.

The preliminary approach for engagement was to initiate contact with all Indigenous communities identified by the Ministry of Environment (MOE) Environmental Assessment and Stewardship (EAS) Branch to provide introductory information about Berger and the Project. This was conducted through face-to-face meetings, phone calls, and email correspondence with representatives from each community. Golder Associates Ltd. (Golder) representative(s) met with some communities in 2016 to collect their comments and concerns regarding the Project. Each community was sent a mail out or e-mail containing information about the Project and contact information for the community to request additional information. Following the mail out, Golder's Aboriginal Engagement Liaison conducted follow-up communication with each community by phone or email to confirm receipt of the package and to determine the level of interest in the Project from the community.

A description of each Indigenous community invited to provide feedback about the Project is provided in Table 10.3-1.

Table 10.3-1: Indigenous Communities Invited to Participate in Traditional and Current Land Use Information Gathering for the Project

Community	Description
Coté First Nation	This community includes reserve land that covers 8,088 ha and has a population of 1,821 on-reserve members (103 members on other reserves) and 1,622 off-reserve members.[(b)]
Fishing Lake First Nation	This community includes reserve lands that covers 3,652 ha and has a population of 494 on-reserve members (58 members on other reserves) and 1,244 off-reserve members.[(b)]
Keeseekoose First Nation	This community includes reserve lands that covers 16,567 ha and has a population of 692 on-reserve members (69 members on other reserves) and 1,707 off-reserve members.[(b)]
The Key First Nation	This community includes reserve lands that covers 6,405 ha and has a population of 298 on-reserve members (23 members on other reserves) and 1,025 off-reserve members.[(b)]
Kinistin Saulteaux First Nation	This community includes reserve lands that covers 3,563 ha and has a population of 317 on-reserve members (66 members on other reserves) and 652 off-reserve members.[(b)]
Red Earth First Nation	This community includes reserve lands that covers 1,455 ha and has a population of 1,514 on-reserve members (38 members on other reserves) and 262 off-reserve members. [(b)]
Shoal Lake Cree Nation	This community includes reserve land that covers 1,479 ha and has a population of 821 on-reserve members (30 members on other reserves) and 181 off-reserve members. [(b)]
Yellow Quill Nation	This community includes reserve lands that covers 6,156 ha and has a population of 906 on-reserve members (66 members on other reserves) and 2,021 off-reserve members.[(b)]

Table 10.3-1: Indigenous Communities Invited to Participate in Traditional and Current Land Use Information Gathering for the Project

Community	Description
Bjorkdale Métis Local #99; Carrot River Métis Local #137; Chelan/Porcupine Plain Métis Local #111; Hudson Bay Métis Local #114; Nipawin Métis Local #134; Sturgis Métis Local #138; Tisdale Métis Local #222; and, Wynyard Métis Local #116	The historic Métis Nation homeland includes the three prairie provinces and extends into Ontario, British Columbia, the Northwest Territories and the northern United States of America. There were 52,450 Canadians who self-identified as Métis in Saskatchewan in 2011.[a]

[a] Indigenous and Northern Affairs Canada [INAC] 2016
[b] INAC 2017a.
ha = hectare.

10.3.2 Results

The results of the traditional land use baseline are summarized in the following sections. This includes a historical summary to provide context to the traditional land uses common in the land and resource use BSA in the past as well as information on current land use by Indigenous communities.

10.3.2.1 Historical Setting of Traditional Land Use

People have resided in the boreal forest region of Saskatchewan since the retreat of the glaciers approximately 11,000 years BP (Before Present). The inhabitants of the boreal forest can be described as hunter-gatherers who primarily relied on moose, woodland caribou, beavers and fish (Meyer 1983). The seasonal migration of swans and geese also played an important role in the subsistence of these people. Numerous plants such as berries, cattails and parsnips were collected (Meyer 1983). These activities would have been carried out in the BSA. In the 1600s, the first fur traders made their way into the region to create trade relationships with the Aboriginal people (Russell and Meyer 1999). In the 1700s and 1800s, the fur traders began to establish posts along major river systems in the province.

Traditional land use activities such as hunting and trapping continued with the establishment of the fur trade; however, the introduction of European goods and European diseases are believed to have had a lasting effect on the Aboriginal people in the region (Russell and Meyer 1999). It is thought that the loss of Elders (from disease) and their medicinal, spiritual and technological knowledge led to lasting and significant cultural effects (Russell and Meyer 1999). The arrival of Europeans and the establishment of the fur trade had various effects on the Aboriginal people and led to a more sedentary lifestyle. However, it was not until the introduction of the Treaties between 1871 and 1906 that most Aboriginal people were required to settle on Reserves. Non-status Indians and Métis peoples also lived in the area. Métis and First Nations peoples shared cultural similarities while also maintaining distinctions unique to their specific cultural identities (PPIFLUP 1998b).

The Project is in the Treaty No. 6 region. Treaty No. 6 was signed in 1876 at Fort Carlton and Fort Pitt, Saskatchewan between the Queen and bands of Cree and Stoney First Nations. Adhesions to the treaty were signed at later dates well into the 20th century (Encyclopedia of Saskatchewan 2006a). Most of the communities identified for engagement are found within Treaty No. 4 (Cote First Nation, Fishing Lake First Nation, the Key First Nation, Kinistin Saulteaux First Nation, and Yellow Quill Nation). The remaining communities identified fall within Treaty No. 5 (Red Earth First Nation and Shoal Lake Cree Nation). Treaty No. 4 was signed in 1874 by the Cree and Saulteaux bands of the Ojibwa peoples and the Assiniboine (Encyclopedia of Saskatchewan 2006c). Treaty No. 5 was signed in 1875 by the Swampy Cree and Plains Cree peoples (Encyclopedia of Saskatchewan 2006b;

PPIFLUP 1998b). In the years following the signing of these treaties, First Nation communities began to settle on the Reserve lands that were allocated to them as part of Treaty No. 4, 5, and 6; however people continued to exercise their Treaty rights in their traditional lands which in some cases were located in other Treaty regions. European settlers also began arriving in Saskatchewan in the mid to late 1800s. The Treaty system, as well as the introduction of privately owned land and agricultural practices changed the landscape and greatly restricted the ability for First Nations people to practice their traditional activities.

10.3.2.2 Current Traditional Land Use

While the primary objective of meetings with First Nations and Métis communities was to provide information about the Project, information was also gathered with regards to traditional land and resource use. The findings from those discussions are summarized below, and include information about hunting, trapping, and plant gathering in the BSA.

A meeting with representatives of The Key First Nation on November 7, 2016 found that The Key First Nation does not frequent the BSA and their traditional areas are far from the Project Footprint. The representatives stated that they have no concerns regarding the area.

10.3.2.2.1 Hunting and Trapping

The BSA is located within the Northern Fur Conservation Area (FCA), specifically Fur Block H-75 and a small portion of Fur Block H-25. Subject to land provisions and safety and conservation regulations, those exercising recognized Treaty or Aboriginal rights may hunt, fish and trap for food purposes at all times of the year without a licence[3] (Government of Saskatchewan 2015b).

During a meeting with representatives of Kinistin Salteaux Nation on November 8, 2016, it was identified that their members continue to go to the Prairie River area for trapping, and areas of specific land use were identified. Concerns were raised about the Project interfering with the trapping activities, including increased human activity and barriers to movement. Members regularly trap within Fur Block H-25 and indicated that trap lines in the fur block once operated year-round but now operate only during the fall and winter.

A meeting with Elders from the Fishing Lake First Nation on October 14, 2016 confirmed that members continue to hunt and trap near the Project. A meeting on November 8, 2016 with a Councillor of Fishing Lake First Nation mapped the Fishing Lake First Nation Traditional Land Use Areas. It was identified that trappers use areas within the BSA from October to April and the Councillor stated that there is no conflict with the peat moss harvesting from May to October.

A meeting on October 25, 2016 with participants of the Tisdale, Wynyard, Chelan/Porcupine Plain Métis communities indicated that hunting and trapping still occur in the general area surrounding the Project.

10.3.2.2.2 Traditional Use Plants

A traditional use plant species is one that is currently used or was historically used by Aboriginal peoples. Many of these plant species have medicinal, ceremonial, and spiritual uses. Most traditional plants were historically used for food, medicine, and tools. Gathered goods such as berries, herbs, mushrooms, and medicinal plants are currently used for local trade, sale and/or gifts.

[3] These activities can only occur within specific areas of the province recognized by the Government of Saskatchewan and be conducted in a safe and responsible manner.

Forty-seven traditional use plant species were identified through literature reviews of ethnobotanical studies completed near the BSA (Table 10.3-2; Clavelle 1997; Leighton 1983; Leighton 1985; Leighton 1996; Marles et al. 2012).

Table 10.3-2: Summary of Traditional Use Plants in the Land and Resource Use Baseline Study Area

Common Name	Scientific Name	Uses	Common Name	Scientific Name	Uses
Balsam Fir[(a)]	*Abies balsamea*	M, T	Seneca Snakeroot	*Polygala senega*	T, M
Manitoba Maple	*Acer negundo var. interius*	F	Trembling Aspen [(a)]	*Populus tremuloides*	T
Siberian Yarrow[(a)]	*Achillea alpina*	M	Chokecherry	*Prunus virginiana var. virginiana*	F
Common Yarrow	*Achillea millefolium*	M	Common Labrador Tea [(a)]	*Rhododendron groenlandicum*	F, M, S
Sweet Flag	*Acorus americanus*	M, S	Prickly Rose[(a)]	*Rosa acicularis ssp. sayi*	M
Giant Hyssop	*Agastache foeniculum*	F, M	American Red Raspberry[(a)]	*Rubus idaeus ssp. strigosus*	F
Wild onions	*Allium spp.*	F	Arum-leaved Arrowhead	*Sagittaria cuneata*	F, M
Saskatoon	*Amelanchier alnifolia var. alnifolia*	F	Red Samphire	*Salicornia rubra*	F
Wild Sarsaparilla[(a)]	*Aralia nudicaulis*	M	Willow species [(a)]	*Salix sp.*	F, M, T, S
Bearberry	*Actostaphylos uva-ursi*	F, T	Pitcherplant[(a)]	*Sarracenia purpurea ssp. gibbosa*	M
White Birch [(a)]	*Betula papyrifera var. papyrifera*	F, M, T	Canada buffalo-berry	*Shepherdia canadensis*	F, M
Red-osier Dogwood	*Cornus sericea ssp. Sericea*	T, M	Water Parsnip	*Sium suave*	F, M
Beaked Hazelnut[(a)]	*Corylus cornuta var. cornuta*	F	American Mountain-ash	*Sorbus americana*	F, M
Horsetail species[(a)]	*Equisetum spp.*	M, T	Peat moss [(a)]	*Sphagnum spp.*	M, T
Common Sneezeweed	*Helenium autumnale*	M	Western Snowberry	*Symphoricarpos occidentalis*	M
Cow Parsnip	*Heracleum maximum*	F, M	Northern white-cedar	*Thuja occidentalis*	M
Wild Honeysuckle	*Lonicera dioica*	M	Common Cattail	*Typha latifolia*	F
Alfalfa	*Medicago sativa ssp. Sativa*	M	Rock tripe	*Umbilicaria muehlenbergii*	F
White Sweet-clover	*Melilotus albus*	M, S	Stinging Nettle [(a)]	*Urtica dioica ssp. gracilis*	F, M, T
Wild Mint	*Mentha arvensis*	M	Blueberry[(a)]	*Vaccinium myrtilloides*	F
Wild Bergamot	*Monarda fistulosa var. menthifolia*	M	Lingonberry [(a)]	*Vaccinium vitis-idaea ssp. minus*	F
Yellow Cowlily	*Nuphar variegata*	F, M	Marsh Valerian	*Valeriana dioica var. sylvatica*	M, S
White Spruce [(a)]	*Picea glauca*	F, M, T	High Bush-cranberry	*Viburnum opulus var. americanum*	F
Common Plantain	*Plantago major*	F, M, T			

[(a)] Recorded during baseline field programs.
F = Food; M = Medicinal; S = Spiritual; T = Technical and Trade.

During the 2016 field programs seventeen of the traditional use plant species from Table 10.3-2 were identified in the BSA. Traditional use plant species were found in varying abundance throughout the BSA depending on the specific habitat requirements of each plant species. Peat moss was observed in abundance throughout the BSA in both bog and fen wetland ecosites. Common Labrador tea and lingonberry were widely observed in black spruce treed bogs and Labrador tea shrubby bogs. Traditional use plant species such as wild sarsaparilla, white birch, white spruce, and prickly rose were all observed in the upland habitats of the BSA surrounding the expected harvest area.

A meeting on October 25, 2016 with participants of the Tisdale, Wynyard, Chelan Porcupine Plain Métis communities indicated that several medicinal plants are found in specific areas of bogs at specific times of the year including muskeg tea, candamo (pineapple root), horsetail, and rat root (plant names as communicated by participants).

10.4 Non-Traditional Land and Resource Use

Non-traditional land and resource use include recreational (e.g., hunting and fishing, snowmobiling) and commercial (e.g., trapping, outfitting, and forestry) use activities.

10.4.1 Methods

Data collected for the non-traditional land and resource use was acquired from public sources such as the Province of Saskatchewan's Hunting, Angling and Biodiversity Information mapping website and websites relating to hunting, fishing, and forestry (Government of Saskatchewan 2017a-c; PPIFLUP 1998b; Weyerhaeuser and Edgewood Forest Products 2016). Site visits to the BSA by Berger and Golder personnel in 2016 confirmed the current land use activities. Data from Community Information Sessions held in Hudson Bay and Carrot River provided additional information on current non-traditional land and resource uses in the BSA.

10.4.2 Results

The results of the non-traditional land use baseline are summarized in the following sections. This includes information on current recreational and commercial use activities in the BSA.

10.4.2.1 Communities and Infrastructure

No communities are located within the BSA. The Town of Hudson Bay is the closest community located approximately 51 km southeast (Figure 10.2-2).

While no highways run through the BSA, existing and previously used logging haul roads are located extensively throughout the Pasquia-Porcupine FMA. The proposed access road connecting the Project Footprint to an existing gravel road is an old logging haul road that will be upgraded for all-season access.

10.4.2.2 Parks, Protected Areas, Recreation

No parks or protected areas are located within the BSA. No recreational sites are located within the land and resource use BSA (Figure 10.2-1; Government of Saskatchewan 2017a).

The BSA overlaps with snowmobile trails used by the Hudson Bay Trail Riders Inc. (Figure 10.2-1; Saskatchewan Snowmobile Association 2016). Berger met with interested members of the public in the Town of Hudson Bay and Town of Carrot River in July 2016 and 2017 and confirmed that the BSA is used for snowmobiling, all-terrain vehicle (ATV) riding and there are several private cabin owners in the vicinity of the proposed access road. Land

users expressed concern about the potential for unrestricted access and the potential for the area to become more accessible to others. Additional concerns related to the increased number of people in the area and potential for degradation to the surrounding trails. One land user welcomed trail and road improvements in the BSA and proposed a shared development of trails with the snowmobile club.

As illustrated in Figure 10.2-2, the closest recreation site to the BSA is the Fir River Road Recreation Site, located approximately 15 km east ("as the crow flies"). The closest park to the BSA is the Wildcat Hill Provincial Park which is located approximately 25 km northeast ("as the crow flies"; Figure 10.2-2).

10.4.2.3 Hunting and Fishing

The BSA is located entirely within Wildlife Management Zone 59 (Government of Saskatchewan 2017a). Table 10.3-3 presents the open hunting seasons in Wildlife Management Zone 59. Hunting occurs in the BSA between the period of April 15 to June 30, and August 20 to December 7(Government of Saskatchewan 2017b).

Table 10.3-3: Hunting Season Dates in Wildlife Management Zone 59

Species	Draw Hunting Season Dates	Regular Hunting Season Dates
Moose	October 1 to October 14 November 1 to November 14	September 15 to September 30 October 15 to October 31 November 20 to November 30
Elk	n/a	August 20 to September 30 October 1 to October 4
White-tailed Deer	September 1 to October 31 November 1 to December 2	September 1 to December 7
Black Bear	n/a	April 15 to June 30 August 25 to October 14

n/a = not applicable.
Source: Government of Saskatchewan 2017b.

The BSA is located within the North Game Bird District which has a hunting season from September 15 to March 31. The following bird game species are found within the North Game Bird District: sharp-tailed grouse, gray partridge, ruffed grouse, spruce grouse, ptarmigan, dark geese, white geese, sandhill cranes, ducks, coots and snipe (Government of Saskatchewan 2017b).

Berger held community information sessions in the Towns of Hudson Bay and Carrot River in July 2016 and 2017. During these sessions a number of attendees confirmed that they use the BSA for hunting. Concerns related to the increased number of people in the area and hunting pressure on wildlife were raised.

The BSA is in the Southern Zone for sport fishing and is open from May 5, 2017 to March 31, 2018 (Government of Saskatchewan 2017c). There are many waterbodies and watercourses, including the Greenbush River located within the BSA that may be used as sport fishing sites. Small-bodied fish species were detected at all the fish and fish habitat sampling locations (i.e., five unnamed watercourses and the Greenbush River) except for one during baseline studies, with two watercourses likely capable of supporting large and small bodied species throughout the year (Section 6.0 Fish and Fish Habitat).

10.4.2.4 Agriculture

A search of the Saskatchewan Ministry of Agriculture's Agricultural Crown Land Map Viewer found no Agricultural Crown land parcels in the BSA (Government of Saskatchewan 2017d).

10.4.2.5 Commercial

Various commercial activities occur in the BSA, including trapping, outfitting, and forestry activities. A description of each commercial activity is provided in the sections below.

10.4.2.5.1 Trapping

The BSA is in Fur Blocks H-75 and H-25 in the Northern FCA (Figure 10.2-2; Government of Saskatchewan 2017a). Fur blocks in this conservation area are closed blocks and individuals wishing to trap in these areas must be nominated and voted onto the list of trappers for each block. Eligible fur-bearing species found in the BSA include: arctic fox, badger, beaver, bobcat, coyote, fisher, fox, lynx, marten, mink, muskrat, otter, raccoon, skunk, squirrel, weasel, and wolf (Government of Saskatchewan 2017a). In the 2015/16 trapping season, a total of 46 pelts were obtained with a total value of $1,289.95 in Fur Block H-25 and a total of 467 pelts were obtained with a total value of $16,429.49 in Fur Block H-75 (Government of Saskatchewan 2017e).

10.4.2.5.2 Outfitters and Lodges

Seven outfitters (Canadian Trophy Quest Ltd., J.D. Guiding and Outfitting Ltd., Kent Wolowski, Tim Fehr, Wade Maynard, Bonnie Choumont, and Red William Outfitting Inc.) have licences for bear and white-tailed deer in the area in and around the BSA (Ackerman, 2017 pers. comm.). There are no lodges in the BSA.

10.4.2.5.3 Forestry and Forest Products

The BSA is located within the Pasquia-Porcupine FMA area, specifically the Mid-Boreal Upland Ecoregion (Government of Saskatchewan 2017a; PPIFLUP 1998b). The Mid-Boreal Upland Ecoregion is characterized by uplands and numerous lakes populated by deciduous, coniferous and mixedwood stands. The FMA is jointly held by Weyerhaeuser Company Ltd. and Edgewood Forest Products Ltd. (Weyerhaeuser and Edgewood Forest Products 2016). The FMA holders operate according to the 20-Year Forest Management Plan (2015-2035) that addresses all aspects of forest management planning (Weyerhaeuser and Edgewood Forest Products 2016). Edgewood has the managerial rights and responsibilities for the FMA's softwood while hardwood is managed by Weyerhaeuser. The BSA falls within the administrative area managed by Edgewood Forest Products (Weyerhaeuser and Edgewood Forest Products 2016). The following types of trees are harvested in the BSA: black spruce, jack pine, lodgepole pine, pine mixedwood, and tamarack/larch (Weyerhaeuser and Edgewood Forest Products 2016).

10.4.2.5.4 Peat Harvesting

No existing peat harvesting operations are found in the BSA. However, peat harvesting does occur elsewhere within the Pasquia-Porcupine FMA.

10.5 Summary

The BSA is used for various traditional and non-traditional resources such as berry picking, hunting, fishing, and snowmobiling. In addition, the BSA is also used for commercial uses such as trapping, outfitting, forestry, and peat harvesting activities. Forestry activities in the BSA operate according to the 20-Year Forest Management Plan (2015-2035) administered by Weyerhaeuser and Edgewood Forest Products. No agricultural land, parks, protected areas and recreation areas (except for snowmobiling trails) are found in the BSA. No communities are in the BSA however there are existing and previously used logging haul roads that overlap with the BSA.

11.0 SOCIO-ECONOMIC ENVIRONMENT

11.1 Introduction

This section presents an overview of the socio-economic setting and socio-economic data that is relevant for the assessment of the effects of the Prairie River Peat Harvest Project (the Project). It describes the existing conditions against which potential changes from the Project are measured and evaluated. Data on population, the local economy, labour market conditions and relevant social and physical infrastructure (i.e., transportation routes and traffic data) have been collected.

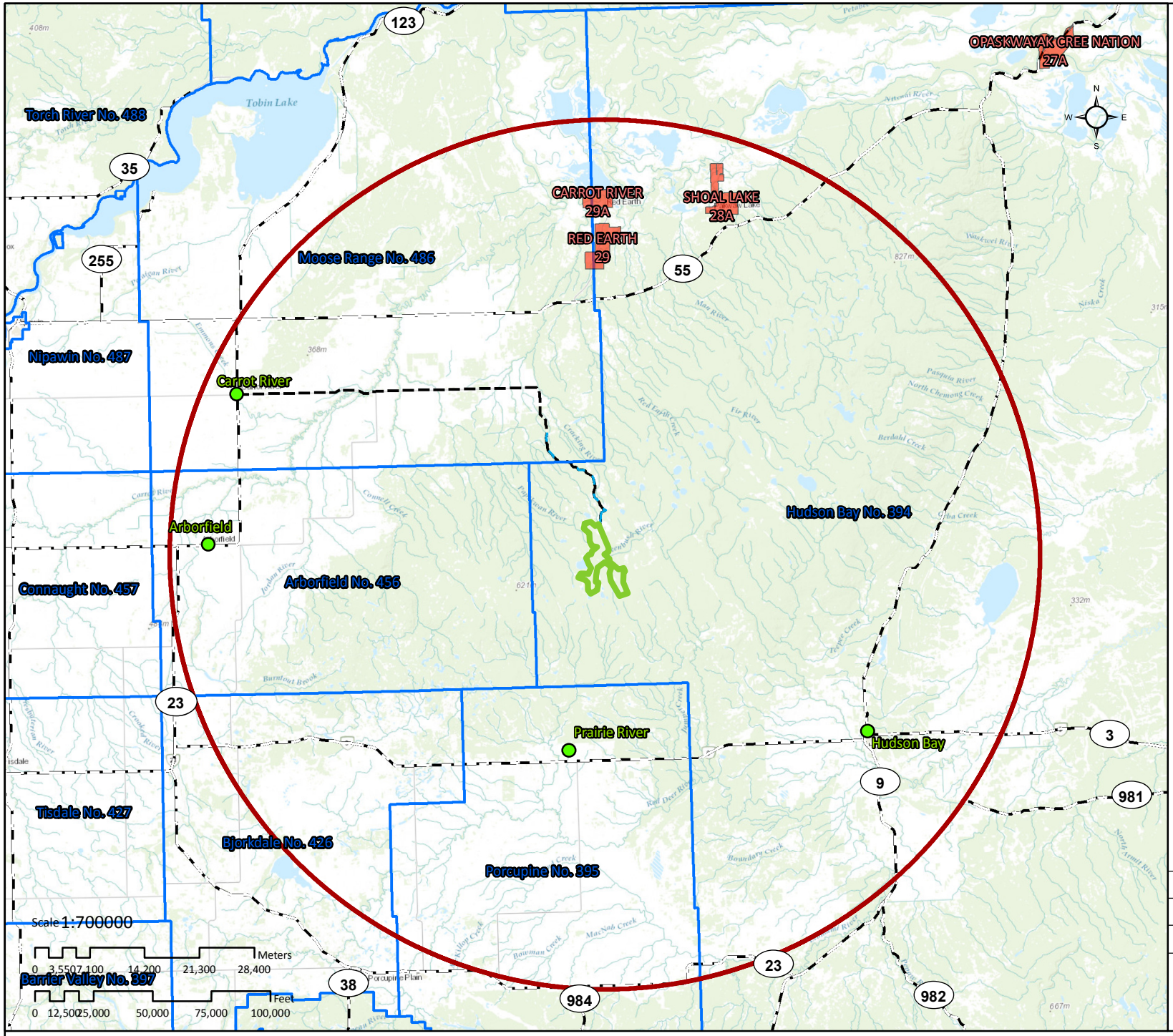
As the Project is expected to require a small workforce (22-24 seasonal employees at peak) that lives in the local area, it is unlikely that the Project will place pressure on the existing capacity of social and physical infrastructure; the exception to this may be emergency services. Therefore, information and data on housing and accommodations and local social infrastructure such as schools and hospitals are not presented. Similarly, physical infrastructure such as water and electricity will also not be discussed as the Project will not draw upon these community resources during Project phases.

11.2 Baseline Study Area

The Project Footprint is in the Rural Municipality (RM) of Hudson Bay No. 394 and the RM of Moose Range No.486 in east central Saskatchewan. The Socio-Economic baseline study area (BSA) corresponds to the area in which it can be reasonably expected that socio-economic effects may occur as a result of the Project. While Project employment will be drawn from local communities near the Project, most of these workers are expected to be sourced from the workforce available in the larger communities of the Town of Hudson Bay and Town of Carrot River. The Town of Hudson Bay, while located further away than the smaller settlements near the Project, has a larger pool of available workers and is located within a distance that is considered a reasonable commuting distance in Saskatchewan during the spring and summer months.

The largest community in the BSA is the Town of Hudson Bay (population of 1,397 in 2016) and serves as the regional service hub (Statistics Canada 2017a). Other communities in the BSA include the Hamlet of Prairie River, Town of Carrot River, Settlement of Pakwaw Lake, Red Earth Indian Reserve (IR) 29, Carrot River IR 29A, and Town of Arborfield. The Settlement of Pakwaw Lake is situated on a portion of Shoal Lake IR No. 28A[4]. The Town of Hudson Bay, Hamlet of Prairie River, Red Earth IR 29, Carrot River IR 29A and Shoal Lake IR No. 28A are located in the RM of Hudson Bay No. 394. The Town of Carrot River is in the RM of Moose Range No. 486 and the Town of Arborfield is in the RM of Arborfield No. 456 (Figure 11.2-1).

[4] No socio-economic data on Pakwaw Lake is available. Data on Shoal Lake IR No. 28A is presented instead.



Berger

Golder Associates

CARTOGRAPHE	Pierre-Olivier Sauvageau
DATE	2017/08/22
PROJECTION	NAD 1983 CSRS UTM Zone 13N
SOURCES	Berger (2017) Golder Associates (2017) Canvec (2015) ESRI (Basemap)

Figure 11.2-1 : Socio-Economic Baseline Study Area |

Prairie River Bog

11.3 Methods

Baseline information was collected from the following sources:

- Statistics Canada 2016 census and the 2011 National Household Survey[5];
- Government of Canada website;
- Strengthening Rural Canada website;
- infrastructure and services website;
- local government websites; and
- Government of Saskatchewan's Interactive Mapping website (HABISask).

This information was used to prepare a profile of the social and economic conditions in the BSA.

11.4 Results

11.4.1 Historical Setting

The Town of Hudson Bay was originally called the village of Etomami and was renamed in 1909 to Hudson Bay Junction (Town of Hudson Bay 2017a). The town grew with the presence of the Canadian Northern Railway Company and became the Town of Hudson Bay in 1947. With many sawmills and logging operations in the area, the forestry and lumber industry were major drivers of economic development in the Town. In 1979, the Town of Hudson Bay was named the 'Forest Capital of Canada' by the Canadian Forestry Association as at the time there were three large mills accounting for most of the town's industry (Town of Hudson Bay 2017b). The closure of two of the mills in just over a decade resulted in job losses and contributed to the declining population (Strengthening Rural Canada no date). Today, Hudson Bay is best known for its forestry, agriculture, wildlife, outdoor recreation and snowmobiling trails. The town is a major railway junction for the area and is located along major highways running all four directions.

The Town of Carrot River was first settled in 1911 and incorporated as a town in 1948. Settlement of the town was slow until the Canadian National Railway reached the community in 1931, bringing southern farmers seeking to settle away from drought (Town of Carrot River 2017a). Weyerhaeuser owned a sawmill in the Town of Carrot River and was once the community's largest employer (Town of Carrot River 2017b). Today the sawmill continues to operate under new ownership (Edgewood Forest Products), however agriculture has become the primary driver of the town economy, with several agricultural processing and storage facilities in operation (Town of Carrot River 2017c).

The Hamlet of Prairie River is very small and no socio-economic information is available except for population counts from 2016 (Statistics Canada 2015). The Town of Arborfield was incorporated in 1910. It is known as the gateway to Pasquia Regional Park, and has recreational attractions nearby such as snowmobiling, birdwatching, hiking, camping, and hunting (Tourism Saskatchewan no date).

Red Earth IR 29 and Carrot River IR 29A are the two reserves of Red Earth First Nation (Indigenous and Northern Affairs Canada [INAC] 2017b). Shoal Lake IR 28A is the sole IR of Shoal Lake Cree Nation and occupies 1,479 ha

[5] Employment data for 2016 from Statistics Canada was not released at the time of writing, therefore data from the 2011 National Household Survey was used.

of land (Shoal Lake Cree Nation no date). Both communities are members of Treaty 5 and are each governed by a Chief and four councillors (INAC 2017c,d).

11.4.2 Population and Demographics

11.4.2.1 Communities and Rural Municipalities in the Socio-Economic Baseline Study Area

Population and demographic data for the non-Indigenous BSA communities is provided in Table 11.4-1. In 2016, the non-indigenous BSA had a total population of 5,561. All non-Indigenous BSA communities, with the exception of the Hamlet of Prairie River, experienced population decreases between 2011 and 2016 (Statistics Canada 2012a-h; 2017a-h). The Hamlet of Prairie River increased in population by 120.0% (from 25 to 55 individuals). The RM of Arborfield No. 456 (343) had the sharpest decline in population with a 24.3% decrease (453 to 343), followed by the RM of Moose Range No. 486 (1,131 to 1,000; 11.6% decrease), and the Town of Hudson Bay (1,504 to 1,397; 7.1% decrease). The RM of Hudson Bay No. 394 had the smallest decrease in population (1,122 to 1,114; 0.7% decrease). Overall, the non-Indigenous BSA population declined by 6.6% between 2011 and 2016. As the Town of Hudson Bay is heavily dependent on the forestry industry, the cyclical nature of the industry has impacted the town's ability to maintain a stable population (Town of Hudson Bay 2013). The Government of Canada reported that employment levels in the forestry industry in Saskatchewan have remained stagnant since 2009, which has likely contributed to the population decline in forestry-dependent communities (Government of Canada 2017).

The median age of the non-indigenous BSA communities in 2016 are all notably higher than the median age for the Province of Saskatchewan (37.8), ranging from 42.6 in the RM of Moose Range No. 486 to 54.7 in the Town of Arborfield (Statistics Canada 2017a-h). The median age increased in every non-Indigenous BSA community except for the RM of Moose Range No. 486, which slightly decreased. Overall, the non-Indigenous BSA has a median age of 48.6, a slight increase from the median age of 47.1 in 2011. The higher median age in the non-Indigenous BSA communities is most likely due to the outmigration of the younger demographic who have left to seek improved employment opportunities in more urban areas (Strengthening Canada no date).

Table 11.4-1: Population and Demographic Characteristics of the Non-Indigenous Baseline Study Area Communities and Rural Municipalities (2011 and 2016)

Community or Rural Municipality	Total Population in 2011	Total Population in 2016	2011 to 2016 Population Change	Median Age of the Population (2011)	Median Age of the Population (2016)
Town of Hudson Bay	1,504	1,397	-7.1%	48.4	51.6
Hamlet of Prairie River	25	55	120.0%	n/a	n/a
Town of Carrot River	1,000	973	-2.7%	45.7	48.5
Town of Arborfield	326	312	-4.3%	51.4	54.7
RM of Hudson Bay No. 394	1,122	1,114	-0.7%	49.5	50.1
RM of Moose Range No. 486	1,131	1,000	-11.6%	44.5	42.6
RM of Arborfield No. 456	453	343	-24.3%	46.5	52.2
Total BSA	5,561	5,194	-6.6%	47.1	48.6
Saskatchewan	1,033,381	1,098,352	6.3	38.2	37.8

RM = Rural Municipality; No. = number; BSA = baseline study area; % = percent; n/a = area and data suppression was adopted to further protect the confidentiality of individual respondents' personal information.
Source: Statistics Canada 2012 a-h, 2017a-h.

11.4.2.2 First Nation and Métis Communities

Red Earth IR 29, Carrot River IR 29A and Shoal Lake IR 28A are the Indigenous communities located in the BSA. Data from Statistics Canada's 2016 census on Indigenous population was not released at the time of writing. Table 11.4-2 presents the population data for the Indigenous communities in the BSA in 2006 and 2011. More recent population data at the reserve level is not available.

Table 11.4-2: Population and Demographic Characteristics of Indigenous Communities in the Baseline Study Area (2006 and 2011)

Settlement	Total Population in 2006	Total Population in 2011	2006 to 2011 Population Change	Median Age of the Population (2006)	Median Age of the Population (2011)
Red Earth IR 29	383	385	0.5%	n/a	18.0
Carrot River IR 29A	590	815	38.1%	15.8	17.1
Shoal Lake IR 28A	540	610	13.0%	16.9	17.7
Total Indigenous BSA communities	1,513	1,810	19.6%	n/a	17.8
Saskatchewan	141,890	161,245	13.6%	21.7	22.6

IR = Indian Reserve; BSA = baseline study area; % = percent; n/a = data not available for this community.
Source: Statistics Canada 2007a-d; 2013a-d.

The total population of the Indigenous BSA communities in 2011 was 1,513, an increase of 19.6% from five years previous (Statistics Canada 2007a-d; 2013a-d). This population growth was mainly fueled by the 38.1% increase in population within the Carrot River IR 29A (590 to 815). The population increase in the Indigenous BSA (19.6%) outpaced the growth of the province's overall Indigenous population (13.6%) over the same time. In 2011, the median age of the Indigenous BSA communities was notably young, at 17.8 years (Statistics Canada; 2013a-d).

Indigenous communities located in and beyond the BSA that may have an interest in the area within and surrounding the Project Footprint and access road are:

- Coté First Nation;
- Fishing Lake First Nation;
- Keeseekoose First Nation;
- The Key First Nation;
- Kinistin Saulteaux Nation;
- Shoal Lake First Nation;
- Red Earth First Nation;
- Yellow Quill First Nation;
- Bjorkdale Métis Local #99;
- Carrot River Métis Local #137;
- Chelan/Porcupine Plain Métis Local #111;

- Hudson Bay Métis Local #114;
- Nipawin Métis Local #134;
- Sturgis Métis Local #138;
- Tisdale Métis Local #222; and
- Wynyard Métis Local #116.

These Indigenous communities may have an interest in the Project based on possible traditional land use in the area. Additional information can be found in Section 10.0 Land and Resource Use.

11.4.3 Labour Force Characteristics

Table 11.4-3 presents the labour force characteristics of the non-Indigenous BSA communities. The most current labour force data for the non-Indigenous BSA communities is from 2011. In 2011, the Town of Hudson Bay had the highest participation rate among the non-Indigenous BSA communities (57.5%), followed by the Town of Carrot River (50.9%), while the Town of Arborfield had the lowest rate (32.7%) (Table 11.4-3). Overall the non-Indigenous BSA communities had a participation rate of 52.4%, considerably lower than the provincial rate of 69.2% (Statistics Canada 2013e-h).

The Town of Carrot River had the lowest unemployment rate (6.0%) in the non-Indigenous BSA, slightly higher than the provincial unemployment rate of 5.9% (Statistics Canada 2013f,h). The lower unemployment rate in the Town of Carrot River may be attributed to the employment opportunities from the presence of agricultural industries, which have a number of processing facilities in operation in the town (Town of Carrot River 2017c). The Town of Arborfield has the largest unemployment rate with 15 unemployed persons out of a relatively small sized labour force of 85. Overall the non-Indigenous BSA had a weighted average unemployment rate of 9.3%, higher than the provincial average of 5.9%.

Table 11.4-3: Labour Force Characteristics of the Non-Indigenous Baseline Study Area Communities (2011)

Labour Force Characteristics	Town of Hudson Bay	Town of Carrot River	Town of Arborfield	Total BSA	Province of Saskatchewan
Population Aged 15 and Over	1,260	825	260	2,345	812,505
In the Labour Force	725	420	85	1,230	562,310
Employed	660	400	70	1,130	529,100
Unemployed	70	25	15	110	33,210
Participation Rate (%)	57.5	50.9	32.7	52.4	69.2
Unemployment Rate (%)	9.7	6.0	17.6	9.3	5.9

BSA = baseline study area; % = percent
Source: Statistics Canada 2013e-h.
Note: Labour force data was unavailable for the Rural Municipality (RM) of Arborfield, RM of Hudson Bay No. 394, RM of Moose Range No. 486, and Hamlet of Prairie River due to data quality or confidentiality reasons.

In 2011, most of the Town of Hudson Bay residents were employed in the Retail Trade, which employed 17.9% of the total labour force (Statistics Canada 2013e). This was followed by Transportation and Warehousing (12.9%), Educational Services (12.9%) and Agriculture, Forestry, Fishing and Hunting (12.1%). The Town of Carrot River's top industry was Agriculture, Forestry, Fishing and Hunting (18.1%), followed by Manufacturing (13.3%) and Health Care and Social Assistance (12.0%) (Statistics Canada 2013f). In the Town of Arborfield, the top industry was Agriculture, Forestry, Fishing and Hunting (35.3%), followed by health and social assistance (29.4%) (Statistics Canada 2013g). Data for the other non-Indigenous BSA communities was not available.

Table 11.4-4 presents the labour force characteristics of the Indigenous BSA communities. The most current labour force data is from 2011. In 2011, the Indigenous BSA had a weighted average participation rate (38.0%) that was considerably lower than the provincial rate (56.3%) and a weighted average unemployment rate (23.3%), that was higher the provincial rate (16.9%) (Statistics Canada 2013a-d). Of the BSA Indigenous communities, Shoal Lake IR 28A had the highest participation rate while Red Earth IR 29 had the lowest unemployment rate. A contributing factor to the lower participation rate and higher unemployment rate of the Indigenous BSA is that these IRs have relatively young populations, with an overall median age of 17.8 years. Indigenous youth are much less likely to participate in the labour market than their non-Indigenous peers, and many such as those who live in Shoal Lake IR 28A, live in communities with chronic unemployment (Expert Panel on Youth Employment 2016).

In 2011, most residents of Red Earth IR 29 were employed in educational services (36.4%) and public administration (36.4%), followed by transportation and warehousing (18.2%) and health care and social assistance (18.2%; Statistics Canada 2013c). Carrot River IR 29A residents were also employed primarily in the educational services (32.0%) and public administration (32.0%), followed by retail trade (16.0%) and health care and social assistance (12.0%) (Statistics Canada 2013d). Most residents of Shoal Lake IR 28A were employed in public administration (34.5%), followed by health care and social assistance (31.0%) and educational services (20.7%) (Statistics Canada 2013a).

Table 11.4-4: Labour Force Characteristics of the Indigenous Baseline Study Area Communities (2011)

Labour Force Characteristics	Red Earth IR 29	Carrot River IR 29A	Shoal Lake IR 28A	Total Indigenous BSA	Province of Saskatchewan
Population Aged 15 and Over	220	445	350	1,015	812,505
In the Labour Force	60	140	185	385	103,960
Employed	50	110	105	265	58,515
Unemployed	0	30	75	105	48,635
Participation Rate (%)	27.3	31.5	52.9	38.0	56.3
Unemployment Rate (%)	0.0	21.4	40.5	23.3	16.9

IR = Indian Reserve; BSA = baseline study area; % = percent.
Source: Statistics Canada 2013a-d.
Note: Census numbers were subjected to random rounding by Statistics Canada, which transforms all counts to random rounded counts. Totals may not add up due to rounding.

11.4.4 Economy

With the Project in the Pasquia-Porcupine Forestry Management Agreement (FMA) area, the forestry sector has been the main generator of employment and business opportunities for the Town of Hudson Bay (Town of Hudson Bay 2013). The Town of Hudson Bay has experienced periods of growth and decline that parallel the forestry sector. In the last few years, the forestry sector has stabilized which has resulted in the reopening of the Weyerhaeuser Oriented Strand Board (OSB) 2000 Plant in the Town of Hudson Bay, this employs a large percentage of the town's population (Town of Hudson Bay 2013).

Economic diversity has been identified as a primary goal for the Town of Hudson Bay to help insulate the community from the volatility of the forestry sector. Other industries in Hudson Bay include outdoor recreation-related tourism and peat moss harvesting and processing, which is expected to help diversify the town's economy (Town of Hudson Bay 2013). The Town of Hudson Bay is surrounded by the Porcupine Provincial Forest and the Pasquia Provincial Forest, which provides various outdoor recreation-related tourism opportunities such as wildlife viewing, snowmobiling, hiking, hunting, fishing, and camping. Snowmobiling is a notable tourism attraction with 680 km of snowmobile trails around the Town of Hudson Bay (Town of Hudson Bay 2017c).

Approximately 100 commercial businesses are in the Town of Hudson Bay, these provide retail and services to an estimated 8,000 people and businesses in the region (Town of Hudson Bay 2013). The Town of Hudson Bay is focused on maintaining the current commercial base and encouraging the growth of businesses related to and in support of outdoor recreation related tourism. There are a limited number of construction contractors in the Town of Hudson Bay (Yellow Pages 2017).

Agriculture plays a major role in the economy of the Town of Carrot River. There are approximately 400 farms in the rural municipality in which the town is situated in and they provide a variety of crops such as wheat, canola, barley, flax, and oats (Town of Carrot River 2017c). The Town of Carrot River is one of the top 10 grain delivery points in Saskatchewan and the agricultural industry has invested heavily in agricultural production facilities in the community. The town is home to two large grain handling facilities owned by Viterra and two seed processing facilities owned by AG Vision Seeds Ltd. and Clancy Seeds Ltd (Town of Carrot River 2017c). These facilities have had large expansions since their respective openings in the 1990s. The town is also home to a horticultural peat moss processing plant and packaging facility owned by Premier Horticultural Inc., which employs approximately 70 people in Carrot River (Town of Carrot River 2017d). Forestry has also played a role in the economy of Carrot River. In 2016, the Carrot River sawmill added a new production line, boosting the productivity of the facility, and increasing employment from 100 full-time employees to 150 (Nipawin Journal 2016; Prince Albert Now 2015).

The Town of Carrot River has approximately 300 small businesses and commercial businesses, with a limited number being construction contractors (Town of Carrot River 2017e). The town has branded their community as 'Saskatchewan's Outback' in an effort to increase opportunities for business, tourism, and community development. The town has invested in residential infrastructure and is currently building a 15-lot residential subdivision to support growth. The Town of Carrot River and the RM of Moose Range No.486 support a committee of business oriented volunteers and a contracted position with Carrot River Economic Development that focuses on economic development in relation to the town council. Other economic development efforts have seen the Town of Carrot River pursuing a change in property tax policy that is intended to encourage residential and commercial development (Trew 2017, pers. comm.). In the last four years, the Town of Carrot River has shifted the property

tax burden away from business and industry and further away from higher assessment (new builds) residential properties. Additional multi-year tax incentives are currently being developed (Trew 2017, pers. comm.).

Economic information on the other BSA communities is not available given the relatively small sizes of their populations.

11.4.5 Services and Physical Infrastructure

11.4.5.1 Traffic

In the BSA, the Project can be accessed via Highway 3 and Secondary Highways 23 and 55. The Average Annual Daily Traffic Count in the BSA is presented in Table 11.4-5. The average annual daily traffic count is highest entering and leaving more urban areas such as the towns of Carrot River and Arborfield, with an average of 950 vehicles per day. Closer to the Project, there is a lower volume of vehicles, ranging from 570 to 660 vehicles per day.

Table 11.4-5: Average Annual Daily Traffic Count in the Baseline Study Area (2015)

Highway Location	Short Term Count
Secondary Highway 55, west of Pakwawa Lake	430
Highway 3 west of the Town of Hudson Bay	710
Highway 3, east of Secondary Highway 23, heading towards the Project, east of Prairie River	570
Highway 3, east of Secondary Highway 23, heading toward the Project, west of Prairie River	660
Secondary Highway 23, north of Carrot River	950
Secondary Highway 23, south of Carrot River	780
Secondary Highway 23, east of Arborfield	950
Secondary Highway 23, south of Arborfield	640

Source: Government of Saskatchewan 2015c.

Traffic collision data (2015) for the BSA is provided in Table 11.4-6. The majority of accidents involved property damage (55% or 94.8%). Personal injury occurred in three (5.2%) of the collisions. The section of Highway 3 between Hudson Bay and Prairie River saw the second highest number of collisions (12) after the Town of Hudson Bay (14). The RM of Moose Range No. 486 had the highest ratio of accidents per population (Saskatchewan Government Insurance [SGI] 2016).

Table 11.4-6: 2015 Traffic Collision Data in the Socio-Economic Baseline Study Area

Community / Highway Control Section	Collisions				Accidents / 100 population	Persons	
	Property Damage	Personal Injury	Fatal	Total		Injured	Fatal
Town of Hudson Bay	13	1	0	14	0.59	1	0
Town of Carrot River	6	0	0	6	0.36	0	0
RM of Hudson Bay No. 394	7	1	0	8	1.12	1	0
RM of Moose Range No. 486	11	1	0	12	2.68	1	0
RM of Arborfield No. 456	0	0	0	0	0.00	0	0
Highway 3 (Hudson Bay – Prairie River)	12	0	0	12	n/a	0	0
Highway 3 (Prairie River – South Junction Highway 23)	6	0	0	6	n/a	0	0
TOTAL	**55**	**3**	**0**	**58**	**n/a**	**3**	**0**

RM = Rural Municipality; No. = number; n/a: not applicable.
Source: SGI 2016.
Note: Data for junctions near the communities Arborfield and Shoal Lake IR 28A were not available.

11.4.5.2 Emergency and Protective Services

The Town of Hudson Bay has a hospital, medical clinic and ambulance service. The hospital has ten acute beds and five day/night care beds and is staffed by three doctors, a primary care nurse and support staff (Town of Hudson Bay 2017d). The towns of Arborfield and Carrot River both have health centres that provide primary health services (Kelsey Trail Health Region 2017a,b). Both health centres have nurse practitioner services that can diagnose and manage day-to-day medical conditions are able to order tests, x-rays, write prescriptions and refer to other health care providers (Kelsey Trail Health Region 2017a,b, no date). The Carrot River Health Centre is open five days a week and has two physicians and two nurse practitioners (Trew 2017, pers. comm.).

The Hudson Bay Fire Department response area services the RM of Hudson Bay No. 394 and consists of 20 volunteer members (Town of Hudson Bay 2017d). Carrot River Fire and Rescue responds to fires in the Town of Carrot River and the RM of Moose Range No. 486 and consists of 20 Paid On-Call Volunteers (Town of Carrot River 2015a; Trew 2017, pers. comm.).

The Royal Canadian Mounted Police (RCMP) provides law enforcement services to the communities in the BSA with a detachment in the Town of Hudson Bay and the Town of Carrot River (RCMP 2017). The Town of Hudson Bay's detachment consists of eight members including one sergeant, five constables, one public servant and one municipal employee. The detachment's jurisdiction extends 123 km north, 75 km south, 50 km west, and 50 km east to the Manitoba border (Town of Hudson Bay 2017e). The RCMP detachment in Carrot River consists of eight members including a Sergeant in charge, a Corporal, six members, and a public servant. The Carrot River detachment policies the BSA communities of Arborfield, Carrot River, and the RM of Moose Range No. 486 (Town of Carrot River 2017f).

11.4.5.3 Physical Infrastructure

The Town of Hudson Bay operates a residential and commercial landfill that has 140,000 cubic metres (m^3) remaining capacity (as of December 2014), with a remaining life estimated to be 29 years (Town of Hudson Bay 2015). Zagrobelny Services and Sarcan Recycling provides recycling services for the Town of Hudson Bay and RM of Hudson Bay No.394 (Town of Hudson Bay 2017f). Waste disposal fees are charged for certain materials such as concrete and frame structures. The Town of Carrot River uses the landfill and recycling services in nearby Tisdale. The Tisdale landfill has a remaining capacity of 100 years as of 2017 (Town of Carrot River 2015b; Trew 2017, pers. comm.). The Town of Carrot River uses MTN Disposals for door-to-door recycling, which recycles materials such as paper, cardboard, aluminum, and plastics (Trew 2017, pers. comm.). Hazardous waste facilities are available in the RM of Moose Range No.486. Upgrades to existing infrastructure such as sewer, water, and roads are also being pursued (Trew 2017, pers. comm.).

Report Signature Page

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12.0 GLOSSARY

Term	Description
Alkalinity	A measure of water's capacity to neutralize an acid. It indicates the presence of carbonates, bicarbonates and hydroxides, and less significantly, borates, silicates, phosphates and organic substances. Alkalinity is expressed as an equivalent of calcium carbonate. Its composition is affected by pH, mineral composition, temperature and ionic strength. However, alkalinity is normally interpreted as a function of carbonates, bicarbonates and hydroxides. The sum of these three components is called total alkalinity.
Archaeology	The study of past cultures through the scientific investigation of their material remains.
Artifact	Any object used or modified by people.
Backpack Electrofishing	An active fish sampling technique used for small wadable streams. It consists of a portable electrofishing unit and a power source attached to a pack frame, with a hand held and operated anode pole and a cathode plate that trails in the water. The operator activates the anode pole in the water to temporarily stun the fish, while a second assistant dip nets the stunned fish.
Before Present (BP)	Before present. Used to refer to dates obtained by radiocarbon dating and using 1950 as the commencement date (e.g., 1,000 BP = 1,000 years before 1950 A.D. or approximately 1,000 A.D.).
Bog	A wetland condition marked by an accumulation of peat which receives its moisture almost exclusively from precipitation and is dominated by *Sphagunum* mosses and ericaceous shrubs and may be treed or treeless.
Boulder	Refers to the particle class size of substrate that is >256 mm in size.
BP	Before present. Used to refer to dates obtained by radiocarbon dating and using 1950 as the commencement date (e.g., 1,000 BP = 1,000 years before 1950 A.D. or approximately 1,000 A.D.).
Bryophyte	Non-flowering simple plants that lack vascular tissue and includes mosses, liverworts and hornworts
Catch-Per-Unit-Effort (CPUE)	A measure which related to the catch of fish, with a particular type of gear, to the sampling effort expended; it is expressed as: number of fish captured/unit of effort. It may be used to define relative fish species abundance and to compare abundances of fish between sites and seasons.
Channel	The main component of a given watercourse, it typically has flowing water, on at least a seasonal basis, and is usually defined by the area of the stream substrate.
Cobble	Refers to the particle class size of substrate that is 64 to 256 mm in size.
Creek	A branch or small tributary of a river.
Ecosite	A recurring site or stand level representation of ecosystems having a relatively homogenous combination of soil, site, and vegetation characteristics
Electrofishing	A 'live' fish capture technique in which negative (anode) and positive (cathode) electrodes are placed in the water and an electrical current is passed between the electrodes. Fish are attracted (galvano-taxis) to the anode and become stunned (galvano-narcosis) by the current, allowing fish to be collected, measured and released.
Ericaceous	Plants of the heath family (Ericaceae) that are tolerant of acidic soil conditions
Eutrophic	The nutrient-rich status (amount of nitrogen, phosphorus and potassium) of an ecosystem.

Term	Description
Fen	A wetland condition which receives its moisture from mineral-rich groundwater and precipitation and is dominated by *Sphagnum* mosses, shrubs, and graminoids; they may be treed or treeless
Fish	Fish as defined in the Fisheries Act, includes parts of fish, shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals and the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals.
Flake	A stone fragment intentionally detached from a source rock during tool manufacture. Three flake types are generally recognized: primary flakes represent early stages of reduction where the original cortex is present on the dorsal surface; secondary flakes represent later stages of reduction where no cortex is present; and tertiary flakes represent the final stages of reduction where small pressure flakes are removed to produce the cutting or scraping edge of a tool.
Forb	A herbaceous flowering plant other than a grass
Fork Length	The length of a fish measured from the most anterior portion of the head to the tip of the shortest rays in the caudal fin (i.e., to the fork in the tail).
Freshet	See *spring freshet*.
Gill net	A type of net designed to capture fish by catching the gill covers of fish species as they attempt to swim through the openings of the mesh panels in the net.
Graminoid	Grass or grass-like plants includes grasses, sedges, and rushes
Gravel	Refers to the particle class size of substrate that is 2.0 to 64 mm in size.
Heritage Resources	Any human or natural artifact or feature that is of interest for its architectural, historical, cultural, environmental, archaeological, palaeontological, aesthetic or scientific value.
Hyper-eutrophic	Trophic state classification characterized by high primary productivity and high nutrient inputs (particularly total phosphorus). Characterized by abundant plant growth, algal blooms and oxygen depletion.
Local Study Area	Defines the spatial extent directly or indirectly affected by the Project.
Mean	Centroid value of a data population when viewing its probability distribution function (or histogram) as a mass distribution.
Mesotrophic	Trophic state classification for lakes characterized by moderate productivity and nutrient inputs (particularly total phosphorus).
Minnow trap	A passive sampling technique used to sample for the presence of minnow species and small life history stages of fish (i.e. fry) of larger fish species. It consists of two pieces of a trap that are clipped together to form a small cylinder. Each end of the trap is slightly tapered with a funnel opening that allows fish to enter, but prevents them from exiting.
Organics	Chemical compounds, naturally occurring or otherwise, which contain carbon, with the exception of carbon dioxide (CO_2) and carbonates (e.g., $CaCO_3$).
pH	The degree of acidity (or alkalinity) of soil or solution. The pH scale is generally presented from 1 (most acidic) to 14 (most alkaline). A difference of one pH unit represents a ten-fold change in hydrogen ion concentration.
Projectile Point	An inclusive term for a hafted arrow, spear or dart point.
Sand	Refers to the particle class size of substrate that is 0.06 to 2.0 mm in size.

Term	Description
Sediment	Solid material that is transported by, suspended in, or deposited from water. It originates mostly from disintegrated rocks; it also includes chemical and biochemical precipitates and decomposed organic material, such as humus. The quantity, characteristics and cause of the occurrence of sediment in streams are influenced by environmental factors. Some major factors are degree of slope, length of slope soil characteristics, land usage and quantity and intensity of precipitation.
Shovel Probe	A 40 cm by 40 cm subsurface test where the excavated soils and sediments are hand trowelled for cultural materials.
Silt	Refers to the particle class size of substrate that is <0.06 mm in size.
Site	Any location with detectable evidence of past human activity (i.e., archaeological site).
Spawning	The reproductive stage of adult fish that includes fertilization and deposition of eggs.
Spring Freshet	Spring snowmelt period that occurs every year in cold climates.
Substrate	Refers to the material that comprises the bottom of the observed watercourse within the study reach (including all wetted and unwetted areas).
Total Dissolved Solids (TDS)	The total concentration of all dissolved compounds solids found in a water sample.
Total Suspended Solids (TSS)	The amount of suspended substances in a water sample. Solids, found in wastewater or in a stream, which can be removed by filtration. The origin of suspended matter may be artificial or anthropogenic wastes or natural sources such as silt.
Traditional Use Plant	A plant species that is currently used, or was historically used, by Aboriginal peoples
Trophic Status	The nutrient status (amount of nitrogen, phosphorus and potassium) of an ecosystem.
Turbidity	An indirect measure of suspended particles, such as silt, clay, organic matter, plankton and microscopic organisms, in water.
Ungulate	A hoofed animal (e.g., caribou, moose, elk, or deer).
Universal Transverse Mercator (UTM)	The UTM system applies the Transverse Mercator projection to mapping the world, using 60 pre-defined standard zones to supply parameters. UTM zones are six degrees wide. Each zone exists in a north and south variant. The northern hemisphere projections for the UTM system consist of 120 zones (60 different zones with north and south variants of each). Originally developed for military use and now widely used in civil mapping.
Upland breeding bird	Songbirds (excluding common raven), woodpeckers, pigeons, upland game birds, shorebirds, and other non-waterbird and non-raptor species that nest in upland areas.
Waterbird	A bird that requires open water or wetlands for breeding (e.g., ducks, geese, gulls, loons, grebes).
Waterbody	A general term that refers to ponds, bays, lakes, estuaries and marine areas.
Watercourse	A general term that refers to riverine systems such as creeks, brooks, streams and rivers.
Wetland	An area that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem
Wildlife	A term to describe all undomesticated animals living in the wild.

13.0 REFERENCES

Acton, D.F., G.A. Padbury, and C.T. Stushnoff. 1998. The Ecoregions of Saskatchewan. Canadian Plains Research Centre, University of Regina.

Ackerman, N. 2017. Pers. Comm. Provincial Outfitting Specialist, Ministry of Environment, Government of Saskatchewan. Outfitters. Email to Wu D, Socio-Economic Specialist, Golder Associates Ltd. August 16, 2017.

Adams BW, Ehlert G, Stone C, Lawrence D, Alexander M, Willoughby M, Hincz C, Moisey D, Burkinshaw A, Carlson J, France K. 2009. Rangeland health assessment for grassland, forest and tame pasture. Rangeland Management Branch, Lands Division, Alberta Sustainable Resource Development. Lethbridge, Pub. No. T/044 152 pp.

Adkisson, C.S. 1999. Pine grosbeak (*Pinicola enucleator*), the Birds of North America Online (A. Poole Ed.). Ithaca: Cornell Lab of Ornithology; retrieved from the Birds of North America Online: https://birdsna.org/Species-Account/bna/species/pingro. Accessed: August 16, 2017.

AEP (Alberta Environment and Parks). 2013. Northern Leopard Frog (*Rana pipiens*). Available at: http://aep.alberta.ca/fish-wildlife/wild-species/amphibians/frogs/northern-leopard-frog.aspx. Accessed: August 14, 2017.

Altman B, Sallabanks R. 2012. Olive-sided Flycatcher (*Contopus cooperi*). The Birds of North America (Rodewald PG, Ed.). Ithaca: Cornell Lab of Ornithology. Available at: https://birdsna.org/Species-Account/bna/species/olsfly. Accessed: January, 2017.

APHA (American Public Health Association). 2012. Standard Methods for the Examination of Water and Wastewater, 22nd Edition. 1496 p.

Archer J.H., Koester C.B. 1965. Footprints in time: A source book in the history of Saskatchewan. The House of Grant (Canada) Ltd.

Argus GW, Harms VL, Leighton AL, Vetter MA. 2016. Conifers and catkin-bearing trees and shurbs of Saskatchewan. Flora of Saskatchewan, Fascicle 5. Nature Saskatchewan. Regina, Saskatchewan. 272 pp.

ASRD (Alberta Sustainable Resource Development). 2003. Status of the Northern Leopard Frog (*Lithobates pipiens*) in Alberta, update 2003. Edmonton, AB: Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association. Wildlife Status Report No. 9 (Update 2003). 61 pp.

Avery ML. 2013. Rusty Blackbird (*Euphagus carolinus*). The Birds of North America Online (Poole A, Ed.). Ithaca: Cornell Lab of Ornithology. Available at: http://bna.birds.cornell.edu/bna/species/200. Accessed: September 12, 2016.

Barr, A., G. van der Kamp, T. A. Black, J.H. McCaughey, Z. Nesix. 2012. Energy Balance Closure at the BERMS Flux Towers in relation to the Water Balance of the White Gull Creek Watershed 1999-2009. Agricultural and Forest Meteorology 153: 3-13p.

Bell, G. Senior Hydrologist, Agriculture and Agri-Food Canada. Pers. Comm. Email December 11, 2009. Bird CD, Hilchie GJ, Kondla NG, Pike EM, Sperling FAH. 1995. Alberta butterflies. The Provincial Museum of Alberta. Edmonton, Alberta.

Bobrowsky P.T., Catto N.R., Brink J.W., Spurling B.E., Gibson T.H., Rutter N.W. 1990. Archaeological geology of sites in Western and Northwestern Canada. In archaeological geology of North America: centennial special volume no. 4, (Lasca NP, Donahue J, Ed.). Boulder: Geological Society of America. pp. 123-135.

Brandes S. 2008. Automated sound recording and analysis techniques for bird surveys and conservation. Bird Conservation International 18(S1). Available at: https://www.researchgate.net/publication/228776163_Automated_sound_recording_and_analysis_techniques_for_bird_surveys_and_conservation. Accessed: September 16, 2016.

Briggs JC, Ficke. 1977. Quality of rivers of the United States, 1975 Water Year – based on the National Stream Quality Accounting Network (NASQAN). USGS OFR, 78-200.

Brigham R.M, Ng J, Poulin RG, Grindal SD. 2011. Common Nighthawk (Chordeiles minor). The Birds of North America Online (Poole A, Ed.). Ithaca: Cornell Lab of Ornithology. Available at: http://bna.birds.cornell.edu/bna/species/213. Accessed: September 12, 2016.

Budd, A.C., J. Looman, K.F. Best. 1979. Budd's flora of the Canadian Prairie Provinces. Agriculture Canada. Hull, Quebec. 791 pp.

Bull EL, and Duncan JR. 1993. Great Gray Owl (Strix nebulosa), The Birds of North America (Rodewald PG, Ed.). Ithaca: Cornell Lab of Ornithology; Available at: https://birdsna.org/Species-Account/bna/species/grgowl. Accessed: September 13, 2016.

CCME (Canadian Environmental Equality Guidelines). 1999, with updates to 2015. Canadian Environmental Quality Guidelines, 1999 with updates to 2015. Canadian Council of Ministers of the Environment, Winnipeg, MB. Available at http://st-ts.ccme.ca/. Accessed 26 July 2017.

Cink, C.L., P. Pyle and M.A. Patten. 2017. Eastern Wip-poor-will (*Antrostomus vociferus*), the Birds of North America Online (A. Poole Ed.). Ithaca: Cornell Lab of Ornithology; retrieved from the Birds of North America Online: https://birdsna.org/Species-Account/bna/species/whip-p1. Accessed: August 16, 2017.

Clavelle, C.M. 1997. Ethnobotany of Two Cree Communities in the South Boreal Forest of Saskatchewan. University of Saskatchewan, Department of Anthropology and Archaeology. Saskatoon, Saskatchewan. 181 pp.

Cleary, J., N. T. Roulet and T. R. Moore, 2005. Greenhouse Gas Emissions from Canadian Peat Extraction, 1990 – 2000: A Life-cycle Analysis, Ambio, 34(6), 456-461.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2000. COSEWIC assessment and status report on the northern leopard frog (*Rana pipiens*) (Southern Mountain and Prairie populations) in Canada. Committee on the status of endangered wildlife in Canada. Ottawa. vi + 40 pp. Available at: http://www.sararegistry.gc.ca/document/default_e.cfm?documentID=250. Accessed: August 14, 2017.

COSEWIC. 2009. Assessment and status report on the Yellow Rail (*Coturnicops noveboracensis*) in Canada. Committee on the status of endangered wildlife in Canada. Ottawa. Vii +32 pp. Available at: http://www.registrelep-sararegistry.gc.ca/document/default_e.cfm?documentID=2096 Accessed: August 16, 2017.

COSEWIC. 2013. COSEWIC assessment and status report on the Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*) and Tri-colored Bat (*Perimyotis subflavus*) in Canada. Committee on the status of endangered wildlife in canada. Ottawa. xxiv + 93 pp. Available at: http://www.registrelep-sararegistry.gc.ca/document/default_e.cfm?documentID=1323. Accessed: January 2017.

COSEWIC. 2014a. Assessment and status report on the Wolverine (*Gulo gulo*) in Canada. Committee on the status of endangered wildlife in Canada. Ottawa. Xi + 76 pp. Available at: http://www.registrelep-sararegistry.gc.ca/document/default_e.cfm?documentID=207. Accessed: January 2017.

COSEWIC. 2014b. Assessment and status report on the Gypsy cuckoo bumble bee (*Bombus bohemicus*) in Canada. Committee on the status of endangered wildlife in Canada. Ottawa. Xi + 56 pp. Available at: http://www.sararegistry.gc.ca/document/default_e.cfm?documentID=1990. Accessed: September 13, 2016.

COSEWIC. 2015. Assessment and status report on the Yellow-banded bumble bee (*Bombus terricola*) in Canada. Committee on the status of endangered wildlife in Canada. Ottawa. Ix + 60 pp. Available at: http://www.sararegistry.gc.ca/document/default_e.cfm?documentID=2775. Accessed: September 13, 2016.

COSEWIC. 2016. Wildlife species search. Available at: http://www.cosewic.gc.ca/eng/sct1/index_e.cfm. .

Cowardin LM, Carter V, Golet FC, LaRoe ET. 1979. Classification of wetlands and deepwater habitats of the United States. Performed for U.S. Department of Interior, Fish and Wildlife Service, Washington, DC. http://el.erdc.usace.army.mil/emrrp/emris/emrishelp2/cowardin_report.htm, Accessed 20 August 2016.

Curtis OE., Rosenfield RN, Bielefeldt J. 2006. Cooper's Hawk (*Accipiter cooperii*). The Birds of North American Online (Poole A, Ed.). Ithaca: Cornell Lab of Ornithology. Available at: http://bna.birds.cornell.edu/bna/species/075. Accessed: August 16, 2017.

Davis D. 2009. How far north do monarchs migrate? Monarch breeding range in North America. Available at: http://www.learner.org/jnorth/tm/monarch/RangeCanada.html Accessed: August 2017.

Drake K. 2013. Pers. Comm. Ph.D., Bird Studies Canada. Saskatoon, SK.

Dugger, B.D., K.M. Dugger, and L.H. Frederickson. 2009. Hooded merganser (*Lophodytes cucullatus*). The Birds of North America (P.G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/coohaw. Accessed: August 16, 2017.

Duncan JR, Duncan PA. 2014. Northern Hawk Owl (*Surnia ulula*), The Birds of North America (Rodewald PG, Ed.). Ithaca: Cornell Lab of Ornithology; Available at: https://birdsna.org/Species-Account/bna/species/nohowl. Accessed: January 2017.

https://birdsna.org/Species-Account/bna/species/nohowl. Accessed: September 13, 2016.Dyck I. 1983. Prehistory of Southern Saskatchewan. In tracking ancient hunters (Epp HT, Dyck I.Ed.). Regina: Saskatoon Archaeological Society. pp. 63-140.

ECCC (Environment and Climate Change Canada). 2016. Historical data. Available at http://climate.weather.gc.ca/historical_data/search_historic_data_e.html. Accessed: September 2016.

ECCC. 2017a. Historical data. Available at http://climate.weather.gc.ca/historical_data/search_historic_data_e.html. Accessed on August 2017.

ECCC. 2017b. Canadian climate normals 1981-2010 calculation information. Available online at: ftp://client_climate@ftp.tor.ec.gc.ca/Pub/Documentation_Canadian_Climate_Normals/1981_2010/Canadian_Climate_Normals_1981_2010_Calculation_Information.pdf. Accessed on August 2017.

EMCLA (Ecological Monitoring Committee for the Lower Athabasca). 2014. Ecological Monitoring Committee for the Lower Athabasca 2013-14 Annual Report. Available at: ftp.public.abmi.ca/.../111_EMCLA_2014_AnnualReport2013-14_ABMI.pdf. Accessed: September 16, 2016.

Encyclopedia of Saskatchewan. 2006a. Treaty No.6. Available at: http://esask.uregina.ca/entry/treaty_6.html. Accessed August 2017.

Encyclopedia of Saskatchewan. 2006b. Treaty No.5. Available at: http://esask.uregina.ca/entry/treaty_5.html. Accessed August 2017.

Encyclopedia of Saskatchewan. 2006c. Treaty No.4. Available at: http://esask.uregina.ca/entry/treaty_4.html. Accessed August 2017.

The Environmental Assessment Act. 2013. Chapter E-10.1. Statutes of Saskatchewan 1979-80. Government of Saskatchewan.

Environment Canada. 2015. Recovery strategy for Little Brown Myotis (Myotis lucifugus), Northern Myotis (Myotis septentrionalis), and Tri-colored Bat (Perimyotis subflavus) in Canada [Proposed]. Species at Risk Act Recovery Strategy Series. Ottawa, ON: Environment Canada. ix + 110 pp.

ESRD (Alberta Environment and Sustainable Resource Development). 2013. Sensitive species inventory guidelines. April 2013. Government of Alberta, ESRD – Wildlife Management. 128 pp. Online: aep.alberta.ca/.../SensitiveSpeciesInventoryGuidelines-Apr18-2013.pdf. Accessed: August 15, 2017.

Expert Panel on Youth Employment. 2016. Understanding the Realities Youth Employment in Canada. Available at: https://www.google.ca/url?sa=t&rct=j&q=&esrc=s&source=web&cd=6&cad=rja&uact=8&ved=0ahUKEwjdgKPdqLTVAhUnjFQKHbICDJ0QFghMMAU&url=http%3A%2F%2Fwww12.esdc.gc.ca%2Fsgpe-pmps%2Fservlet%2Fsgpp-pmps-pub%3Flang%3Deng%26curjsp%3Dp.5bd.2t.1.3ls%40-eng.jsp%26curactn%3Ddwnld%26pid%3D55116%26did%3D4921&usg=AFQjCNFqSHYwAnLo2j3Z08ruaSR8fc7tPA. Accessed July 2017.

Fenton MB, Barclay RMR. 1980. Myotis lucifugus. Mammalian Species. 142:1-8.

Fisher, R. Landscape Conservation Specialist, Habitat and Lands Branch, Saskatchewan Ministry of the Environment. Personnal Communications Email, June 17, 2016.

Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 20+ vols. New York and Oxford.

Frison G. 1978. Prehistoric hunters of the high plains. San Diego: Academic Press.

Fristrup K.M., Clark C.W. 2009. Acoustic monitoring of threatened and endangered species in Inaccessible areas. Strategic Environmental Research and Development Program (SERDP). Available at: https://www.researchgate.net/publication/235094976_Acoustic_Monitoring_of_Threatened_and_Endangered_Species_in_Inaccessible_Areas. Accessed: September 16, 2016.

Gauthier G. 2014. Bufflehead (*Bucephala albeola*). 2014. The Birds of North America (Rodewald PG, Ed.). Ithaca: Cornell Lab of Ornithology. Available at: https://birdsna.org/Species-Account/bna/species/buffle. Accessed: January, 2017.

Garrison B.A. 1999. Bank Swallow (Riparia riparia). The Birds of North America Online (Poole A, Ed.). Ithaca: Cornell Lab of Ornithology. Available at: http://bna.birds.cornell.edu/bna/species/414/articles/introduction. Accessed: September 12, 2016.

GASV (Geological Atlas of Saskatchewan Viewer) © 2017, GOVERNMENT OF SASKATCHEWAN.

Goldade C.M., Dechant J.A., Johnson D.H., Zimmerman A.L., Jamison B.E., Church B.O., Euliss B.R. 2002. Effects of management practices on wetland birds: Yellow Rail. Northern Prairie Wildlife Research Center, Jamestown, ND. 21 pp.

Golder. (Golder Associates Ltd.)2016a. Saskola Peat Harvest Project Environmental Baseline Report. Prepared for: Berger Peat Moss Ltd., Saint-Modeste, QC.

Golder. 2016b. Berger Peat Moss Ltd. Prairie River and Saskola Peat Harvest Program. Permit No. 16-094. Report on file with the Heritage Conservation Branch, Regina.

Golder. 2017. Big River Peat Harvest Project Environmental Baseline Report (DRAFT). Prepared for: Berger Peat Moss Ltd., Saint-Modeste, QC.

Government of Canada. 2017. Forestry: Region of Western Canada and the Territories: 2014-2016. Available at: https://www.jobbank.gc.ca/content_pieces-eng.do?cid=10708. Accessed July 2017.

Government of Saskatchewan. 1999. Wild Species at Risk Regulations. Chapter 1-13.11 Reg 1. Government of Saskatchewan.

Government of Saskatchewan. 2015a. Saskatchewan environmental quality guidelines. Available at: https://envonline.gov.sk.ca/seqg. Accessed 12 November 2015. Regina, SK: Water Security Agency and Ministry of Environment.

Government of Saskatchewan. 2015b. Saskatchewan Guide for Treaty and Aboriginal Rights for Hunting and Fishing. Available at: http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=ee8fa9cb-45bd-4826-a94b-a90660e1eae8. Accessed August 2017.

Government of Saskatchewan. 2015c. 2015 Traffic Volume Map Average Annual Daily Traffic. Available at: http://www.highways.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=227,81,1,Documents&MediaID=9954&Filename=2015_Highway_Traffic_Volume_Maps.pdf. Accessed July 2017.

Government of Saskatchewan. 2017a. Sask. Interactive Mapping (HABISask). Available at: https://gisappl.saskatchewan.ca/Html5Ext/index.html?viewer=saskinteractive. Accessed July 2017.

Government of Saskatchewan. 2017b. Saskatchewan Hunters' and Trappers' Guide 2017. Available at: http://publications.gov.sk.ca/documents/66/93283-2017%20Hunters%20and%20Trappers%20Guide.pdf. Accessed July 2017.

Government of Saskatchewan. 2017c. Saskatchewan Anglers' Guide 2017. Available at: http://publications.gov.sk.ca/documents/66/89778-2017%20Anglers%20Guide.pdf. Accessed August 2017.

Government of Saskatchewan. 2017d. Agricultural Crown Land Map Viewer. Available at: https://gisappl.saskatchewan.ca/Html5Ext/index.html?viewer=ACLMVE. Accessed August 2017.

Government of Saskatchewan 2017e. Saskatchewan Wild Fur Harvest and Cash Values 2015-16. Available at: http://publications.gov.sk.ca/documents/66/76576-Saskatchewan%20Wild%20Fur%20Harvest%20Cash%20Values.pdf. Accessed August 2017.

Granger R. 2010. Estimating evaporation: Principles, Assumptions, and Myths. National Water Research Institute, Environment Canada, Saskatoon, Saskatchewan, October 2010.

HABISask. 2017. HABISask Hunting, Angling and Biodiversity Information. Available at: https://gisappl.saskatchewan.ca/Html5Ext/index.html?viewer=habisask#. Accessed: August 2017.

Harms VL, Ryan PA, Haraldson JA. 1992. The rare and endangered native vascular plants of Saskatchewan. Prepared for the Saskatchewan Natural History Society. University of Saskatchewan. Saskatoon, Saskatchewan.

Harms VL, Leighton AL. 2011a. Ferns & fern allies of Saskatchewan. Flora of Saskatchewan, Fascicle 1. Nature Saskatchewan. Regina, Saskatchewan. 192 pp.

Harms VL, Leighton AL. 2011b. Lilies, irises & orchids of Saskatchewan. Flora of Saskatchewan, Fascicle 2. Nature Saskatchewan. Regina, Saskatchewan. 184 pp.

Hayward GD, Hayward PH. 1993. Boreal Owl (Aegolius funereus), The Birds of North America (Rodewald PG, Ed.). Ithaca: Cornell Lab of Ornithology; Available at: https://birdsna.org/Species-Account/bna/species/borowl. Accessed: September 13, 2016.

Health Canada. 2014. Guidelines for Canadian drinking water quality—summary table. Water and Air Quality Bureau, Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, ON. Available at: http://www.hc-sc.gc.ca/ewh-semt/alt_formats/pdf/pubs/water-eau/sum_guide-res_recom/sum_guide-res_recom_2014-10_eng.pdf. Accessed 20 August 2016.

The Heritage Property Act. 1979-80. SS cH-2.2 Available at: http://canlii.ca/t/52367. Accessed on: March 15, 2016.

IBA (Important Bird Areas). 2017. IBA Canada Important Bird Areas. Bird Studies Canada. Available at: http://www.ibacanada.com/explore_how.jsp?lang=en. Accessed: August 16, 2017.

iMapInvasives. 2017. An online data system supporting strategic invasive species management, NatureServe (iMapInvasives). 2017. Available at http://www.imapinvasives.org. Date accessed: August 16, 2017.

INAC. 2016. Aboriginal Peoples: Fact Sheet for Saskatchewan. Available at: http://www.statcan.gc.ca/pub/89-656-x/89-656-x2016009-eng.htm. Accessed August 2017.

INAC. 2017a. Search by First Nation. Available at: http://fnp-ppn.aandc-aadnc.gc.ca/fnp/Main/Search/SearchFN.aspx?lang=eng. Accessed August 2017.

INAC. 2017b. Red earth First Nation. Available at: http://fnp-ppn.aandc-aadnc.gc.ca/fnp/Main/Search/FNReserves.aspx?BAND_NUMBER=356&lang=eng. Accessed August 2017.

INAC. 2017c. Red Earth Governance. Available at: http://fnp-ppn.aadnc-aandc.gc.ca/fnp/Main/Search/FNGovernance.aspx?BAND_NUMBER=356&lang=eng. Accessed July 2017.

INAC. 2017d. Shoal Lake Cree Nation Governance. Available at: http://fnp-ppn.aadnc-aandc.gc.ca/fnp/Main/Search/FNGovernance.aspx?BAND_NUMBER=357&lang=eng. Accessed July 2017.

IPCC 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

ISC SGIC (Information Services Corporation – Saskatchewan Geospatial Imagery Collaborative). 2016. SGIC Ortho Imagery Dataset data. Digital file received from ISC on August 26, 2016.

Johnson K. 1995. Green-winged Teal (*Anas crecca*). The Birds of North America (P.G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology. Available at: https://birdsna.org/Species-Account/bna/species/gnwtea. Accessed: January, 2017.

Kelsey Trail Health Region. No date. Guide to Health Services Carrot River, Arborfield & Zenon Park. Available at: http://www.kelseytrailhealth.ca/Facilities/CarrotRiver/Pages/default.aspx. Accessed August 2017.

Kelsey Trail Health Region. 2017a. Arborfield. Available at: http://www.kelseytrailhealth.ca/Facilities/Arborfield/Pages/default.aspx. Accessed July 2017.

Kelsey Trail Health Region. 2017b. Carrot River. Available at: http://www.kelseytrailhealth.ca/Facilities/CarrotRiver/Pages/default.aspx. Accessed July 2017.

Kintigh, K.W. 1988. The Effectiveness of Subsurface Testing: A Simulation Approach. American Antiquity 53:686-707.

Kochert MN, Steenhof K, Mcintyre CL, Craig EH. 2002. Golden Eagle (*Aquila chrysaetos*). The Birds of North America Online (Poole A, Ed.). Ithaca: Cornell Lab of Ornithology. Available at: http://bna.birds.cornell.edu/bna/species/684. Accessed: September 12, 2016.

Krakker, J.J., M.J. Shott, and P.D. Welch. 1983. Design and Evaluation of Shovel-Test Sampling in Regional Archaeological Survey. Journal of Field Archaeology 10:469-480.

Leighton AL. 1983, revised 1985. A Guide to 20 Plants and Their Use by the Cree. La Ronge, Saskatchewan: Lac La Ronge Indian Band.

Leighton AL. 1985. Wild plant use by the Woods Cree (Nihithawak) of East-Central Saskatchewan. Canadaian Ethnology Service Paper No. 101. National Museum of man Mercury Series. 136 pp.

Leighton AL. 1996. Plant pse by Aboriginal peoples in the Dore/Smoothstone Lakes Area. In: Thijs Kuiken et al, eds., The Dore/Smoothstone Area, An Accessible Wilderness. Saskatoon: Dore/Smoothstone Lakes Wilderness Protection Association.

Leighton AL. 2012. Sedges (Carex) of Saskatchewan. Flora of Saskatchewan, Fascicle 3. Nature Saskatchewan. Regina, Saskatchewan. 280 pp.

Leighton, A.L. and V.L. Harms. 2014. Grasses of Saskatchewan. Flora of Saskatchewan, Fascicle 4. Nature Saskatchewan. Regina, Saskatchewan. 536 pp.

Leschack C.R., McKnight S.K., Hepp G.R. 1997. Gadwall (*Anas stepera*). The Birds of North America (P.G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology. Available at: https://birdsna.org/Species-Account/bna/species/gadwal. Accessed: January, 2017.

Leston L, Bookhout TA. 2015. Yellow Rail (*Coturnicops noveboracensis*), The Birds of North America (Rodewald PG, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/yelrai. Accessed: December 21, 2016.

Looman J, Best KF. 1987. Budd's flora of the Canadian provinces. Research Branch Agriculture Canada, Publication 1662. 863pp.

Maher, R.V., G.W. Argus, V.L. Harms, and J.H. Hudson. 1979. The rare vascular plants of Saskatchewan. Syllogeus Series No. 20. National Museum of Natural Sciences. Ottawa, Ontario. 45pp.

Marles RJ, Clavelle C, Monteleone L, Tays N, Burns D. 2012, Aboriginal plant use in Canada's Northwest Boreal Forest. Natural Resources Canada, Canada Forest Service, Northern Forestry Centre. Edmonton, Alberta. 368 pp.

MBCA (Migratory Birds Convention Act). 1994. Government of Canada.

McClennan David. 2005. Big River. In The Encyclopedia of Saskatchewan. Canadian Plains Research Center, Regina.

McElhanney Consultant Ltd. 2014. Report to Saskatchewan Water Security Agency. 2014 Flood Event Assessment-Southeast Saskatchewan, 14 November 2014.

McLaughlan, M.S., R.A. Wright, and R.D. Jiricka. 2010. Field Guide to the Ecosites of Saskatchewan's Provincial Forests. Saskatchewan Ministry of Environment, Forest Service. Prince Albert, Saskatchewan. 338 pp.

McNeil, D.H. and Caldwell, W.G.E. 1981. Cretaceous Rocks and Their Formanifera in the Manitoba Escarpment. Geological Association of Canada, Special Paper 21,437pp.

Mekis, É. and L.A. Vincent. 2011. An overview of the second generation adjusted daily precipitation dataset for trend analysis in Canada. Atmosphere-Ocean, 49 (2), 163-177 pp.

Meyer David. 1983. Prehistory of Northern Saskatchewan. In Tracking Ancient Hunters, edited by H.T. Epp and I. Dyck, pp. 141-168. Saskatchewan Archaeological Society, Saskatoon.

Meyer D, Russell D. 2007. Aboriginal Peoples from the Ice Age to 1870. In Saskatchewan: Geographic Perspectives. B.D. Thraves, M.L. Lewry, J.E. Dale and H. Schlichtmann, editors. Canadian Plains Research Centre, Regina.

Millard, M.J. 1996. Geology and Groundwater Resources of the Hudson Bay Area (63C-D), Saskatchewan. SRC Publication No. R-1510-3-E-96.

Millard, M.J. 1997. Geology and Groundwater Resources of the Pasquia Hills Area (63E-F), Saskatchewan. SRC Publication No. R-1510-2-E-97

Mini, A.E., E.R. Harrinton, E Rucker, D. Dugger and T.B. Mowbray. 2014. American wigeon (*Anas americana*). The Birds of North America (P.G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/amewig. Accessed: August 16, 2017.

MNRF (Ministry of Natural Resources and Forestry). 2015. Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E. Available at: https://dr6j45jk9xcmk.cloudfront.net/documents/4775/schedule-6e-jan-2015-access-ver-final-s.pdf. Accessed: August 17, 2017.

MOE (Ministry of Environment). 2012. Saskatchewan Air Quality Modelling Guideline. Technical Resources Branch, Air Science and Monitoring Unit, Saskatchewan Ministry of Environment. March 2012. 80 pages.

MOE. 2014a. Species Detection Survey Protocols, Amphibian Auditory Surveys. Technical Report No. 2014-1.0. Ministry of Environment, Fish and Wildlife Branch. Regina, Saskatchewan. Available at: http://www.publications.gov.sk.ca/deplist.cfm?d=66&c=4567. Accessed: May, 2016.

MOE. 2014b. Species Detection Survey Protocols, Forest Birds Surveys. Technical Report No. 2014-10.0. Ministry of Environment, Fish and Wildlife Branch. Regina, Saskatchewan. Available at: http://www.publications.gov.sk.ca/deplist.cfm?d=66&c=4567. Accessed: September 13, 2016.

MOE. 2014c. Species Detection Survey Protocols, Yellow Rail Surveys. Technical Report No. 2014-14.0. Ministry of Environment, Fish and Wildlife Branch. Regina Saskatchewan. Available at: http://www.publications.gov.sk.ca/deplist.cfm?d=66&c=4567. Accessed: September 16, 2016.

MOE. 2015a. Stocked Waters Guide 2015. Available at: http://www.environment.gov.sk.ca/Default.aspx?DN=fa370435-939d-4f71-8adf-bd11d436bb33. Accessed July 21, 2017.

MOE. 2015b. Saskatchewan woodland caribou range assessment, planning and research program update. Ministry of Environment, Fish and Wildlife Branch. Regina, Saskatchewan.

MOE. 2015c. Species Detection Survey Protocols, Common Nighthawk Surveys. Technical Report No. 2015-15.0. Ministry of Environment, Fish and Wildlife Branch. Regina, Saskatchewan. Available at: http://www.publications.gov.sk.ca/deplist.cfm?d=66&c=4567. Accessed: September 20, 2016.

MOE. 2017. Activity Restriction Guidelines for Sensitive Species. Regina, Saskatchewan. April 2017. http://publications.gov.sk.ca/documents/66/89554-Saskatchewan%20Activity%20Restriction%20Guidelines%20for%20Sensitive%20Species%20-%20April%202017.pdf

Monk L, Kohler K. 2014. Monitoring rare animals in Alberta's Boreal Forest. Alberta Biodiversity Monitoring Institute. Available at: http://www.abmi.ca/home/publications/1-50/36. Accessed: September 20, 2016.

Mooney, Elizabeth. 2005. Rupert's Land Purchase. In The Encyclopedia of Saskatchewan. Canadian Plains Research Center, Regina.

Moran, S.R. and Whitaker, S.H. 1969. Geology and Groundwater Resources of the Hudson Bay Area (63-C, D) Saskatchewan. Saskatchewan Research Council, Saskatoon, Saskatchewan. Geology Division, Map No. 8.

Nance, J.D. and B.F. Ball. 1986. No Surprises? The Reliability and Validity of Test Pit Sampling. American Antiquity 51:457-483.

NatureServe. 2012. NatureServe Conservation Status Assessments: Factors for Evaluating Species and Ecosystem Risk. 76 pp.

Nipawin Journal. 2016. Upgraded mill in Carrot River opened. Available at: http://www.nipawinjournal.com/2016/03/08/upgraded-mill-in-carrot-river-opened. Accessed July 2017.

Norment, C.J. S.A. Shackleton, D.J. Watt, P. Pyle and M.A. Patten. 2016. Harris's sparrow (*Zonotrichia querula*). The Birds of North America (P.G. Rodenwald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrived from the Birds of North America: https://birdsna.org/Species-Account/bna/species/harspa. Accessed: August 16, 2017.

NRC (National Research Council of Canada). 2012. Green Kenue Visualization and Analysis for Hydrologic Applications, Copyright 1998-2012. National Research Council Canada – Canadian Hydraulics Centre, Ottawa. Green Kenue Version 3.3.10. EnSimCore Version 3.3.25, Jul 19 2012.

Ovenden, L., 1990. Peat accumulation in northern wetlands. Quaternary Research, 33, 377-386.

Pattie, D. and C. Fisher. 1999. Mammals of Alberta. Lone Pine Field Guide. Edmonton, AB. 240 pp.

PFRA (Prairie Farm Rehabilitation Administration). 2002. Gross Evaporation for the 30-year Period 1971-2000 in the Canadian Prairies, Hydrology Report #143. Techical Service, Prairie Farm Rehabilitation Administration, Agriculture and Agri-Food Canada, 31 p.

PFRA. 2013. Current Drainage Areas for PFRA Streamflow Gauge Locations.

Pitoccheli, J., J. Jones, D. Jones, and J. Bouchie. 2012. Connecticut Warbler (Oporornis agilis).The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Available at: https://birdsna.org/Species-Account/bna/species/320/articles/introduction. Accessed: September 12, 2016.

Pohorecky, Z.S. and D.E. Anderson. 1968. Agassiz Archaeology in Saskatchewan. In *Napaao* 1(1):48-70.

PPIFLUP (Pasquia-Porcupine Integrated Forest Land Use Plan). 1998a. Management Plan. Government of Saskatchewan. 74 pages. Available at: http://www.environment.gov.sk.ca/Default.aspx?DN=f359c7be-ea4e-4e62-81c4-7995bb44ccdf. Accessed on August 19, 2017.

PPIFLUP. 1998b. Background. Government of Saskatchewan. 98 pages. Available at: http://www.environment.gov.sk.ca/Default.aspx?DN=f359c7be-ea4e-4e62-81c4-7995bb44ccdf. Accessed August 2017.

Premier Tech Horticulture. 2012. Pasquia Bog Peat Harvest Project, Premier Horticulture Ltd. Environmental Impact Assessment. June 2012.

Prince Albert. Now. 2015. Carrot River Sawmill investment to create new jobs. Available at: http://panow.com/article/508096/carrot-river-sawmill-investment-could-create-over-100-jobs. Accessed July 2017.

Ray, R.J. 1974. Indians in the Fur Trade: Their Role as Hunters, Trappers and Middlemen in the Lands Southwest of the Hudson Bay 1660-1870. University of Toronto Press, Toronto.

RCMP (Royal Canadian Mounted Police). 2017. Find a Detachment. Available at: http://www.rcmp-grc.gc.ca/detach/en/find/SK. Accessed July 2017.

Reitsma, L., M. Goodnow, M.T. Hallworth, and C.J. Conway. 2010. Canada Warbler (*Wilsonia canadensis*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Available at: http://bna.birds.cornell.edu/bna/species/421 Accessed: September 12, 2016.

Roulet, N. T., P. M. Lafleur, P. J. H. Richard, T. R. Moore, E. R. Humphreys and J. Bubier, 2007. Contemporary carbon balance and late Holocene carbon accumulation in northern peatland, Global Change Biology, 13, 397-411, doi:10.1111/j.1365-2486.2006.01292.x.

Ruppé, R.J. 1966. The Archaeological Survey: A Defense. *American Antiquity* 31:13-333.

Russell D, Meyer D. 1999 The History of the Fur Trade ca. 1682 – post 1821. Atlas of Saskatchewan, Ka-iu Fung, editor, pp. 33-35. University of Saskatchewan, Saskatoon.

Saffran KA, Trew DO. 1996. Sensitivity of Alberta Lakes to Acidifying Deposition: An Update of Maps with Emphasis on 109 Northern Lakes. Water Management Division, Alberta Environmental Protection. Edmonton, AB.

SARA (Species at Risk Act). 2002. RSS. S.C. 2002, c.29. Available at: http://laws-lois.justice.gc.ca/eng/acts/S-15.3/.

SARA. 2016. A to Z Species Index. Species at Risk Public Registry, Government of Canada. Available at: http://www.sararegistry.gc.ca/sar/index/default_e.cfm. Accessed: December 2016.

Saskatchewan Snowmobile Association. 2016. Provincial Snowmobile Trails. Available at: http://www.sasksnow.com/wp-content/uploads/2012/12/2016_prov_map.pdf. Accessed July, 2017.

SaskWater 1993. Magnitude and Frequency of Peak Flows and Flow Volumes in Saskatchewan. Hydrology Branch, Water Management Division, SaskWater, April 1993, 12p.

Sasse, D.B., and P.J. Pekins. 1996. Summer roosting ecology of northern long-eared bats (Myotis septentrionalis) in the White Mountain National Forest. Bats and forests symposium. British Columbia Ministry of Forests Working Paper 23:91-101.

Schiffer, M.B., A.P. Sullivan, and T.C. Klinger. 1978. The Design of Archaeological Surveys. In *World Archaeology* 10:1-28.

SGI (Saskatchewan Government Insurance). 2016. 2015 Traffic Accident Information System (TAIS) Annual Report. Section 11 Traffic Collision. Available at: https://www.sgi.sk.ca/about/publications/collisionstats/index.html. Accessed: July, 2017.

SGS (Saskatchewan Geological Survey). 1999. Geological Map of Saskatchewan. 1:1,000,000.

Shoal Lake Cree Nation. No date. History. Available at: http://www.sicc.sk.ca/archive/bands/bshoal.html. Accessed July 2017.

Sidie-Slettedahl AM. 2013. Evaluating the use of autonomous recording units to monitor yellow rails, Nelson's sparrows and Leconte's sparrows. M.Sc. Thesis. South Dakota State University. Available at: pubstorage.sdstate.edu/wfs/thesis/Sidie-Slettedahl-Anna-2013-MS.pdf. Accessed: September 16, 2016.

SKCDC. 2017a. Saskatchewan Vascular Plant Taxa List. Regina, Saskatchewan. Retrieved from www.biodiversity.sk.ca/SppList.htm

SKCDC. 2017b. Saskatchewan Non-Vascular Plant Taxa List. Regina, Saskatchewan. Retrieved from www.biodiversity.sk.ca/SppList.htm

SKCDC. 2017c. Saskatchewan Wildlife Application. Available at: http://www.biodiversity.sk.ca/HABISask.htm. Accessed: August 16, 2017.

SKCDC. 2017d. Tracked Taxa List: Invertebrates. Available at: http://www.biodiversity.sk.ca/SppList.htm. Accessed: September, 2016.

SKCDC. 2017e. Tracked Taxa List: Vertebrates. Available at: http://www.biodiversity.sk.ca/SppList/vertstrack.pdf. Accessed: August 14, 2017.

SKCDC. 2017f. Species Conservation Rankings. Available at: http://www.biodiversity.sk.ca/ranking.htm. Accessed: August, 2017

Smith AR. 1996. Atlas of Saskatchewan Birds. Environment Canada and Nature Saskatchewan, Regina, Saskatchewan. 456pp.

Sonnentag, O., G. VanderKamp, A.G. Barr, J.M. Chens. 2010. On the relationship between water table depth and water vapor and carbon dioxide fluxes in a minerotrophic fen. Global Change Biology, 16, 1762-1776.

SPRR (Saskatchewan Parks and Renewable Resources). 1991. Fish species distribution in Saskatchewan. Technical Report 91-7. Saskatchewan.

SRC (Saskatchewan Research Council) Geology Division. 1990. Area II, Map B, Extent and Point Thickness of the Empress Group in the Southwestern portion on the Green Lake Area (73-J).

SRC. 1994. Saskatchewan Digital Land Cover.

Stantec (Stantec Inc.). 2000 Heritage Resources Impact Assessment for Weyerhauser Canada, Hudson Bay; 2000-01 Access Roads. Archaeological Resources Investigation Permit No. 00-057. Report on file at the Heritage Conservation Branch, Regina.

Stantec. 2003 Heritage Resources Impact Assessment for Weyerhauser Canada, Hudson Bay; Mistatim and Cracking River V-Shear. Archaeological Resources Investigation Permit No. 03-021. Report on file at the Heritage Conservation Branch, Regina.

Stantec. 2005a Heritage Resources Impact Assessment for Weyerhauser Canada, Hudson Bay, 2005-2006. Archaeological Resources Investigation Permit No. 05-016. Report on file at the Heritage Conservation Branch, Regina.

Stantec. 2005b Heritage Resources Impact Assessment for Weyerhauser Canada, Hudson Bay, 2005-2006. Archaeological Resources Investigation Permit No. 05-104. Report on file at the Heritage Conservation Branch, Regina.

Stantec. 2007 Heritage Resources Impact Assessment for Weyerhauser Canada, Hudson Bay. Archaeological Resources Investigations Permit No. 07-014. Report on file at the Heritage Conservation Branch, Regina.

Statistics Canada. 2007a. *Shoal Lake 28A, Saskatchewan (Code4714839)* (table). *Aboriginal Population Profile*. 2006 Census. Statistics Canada Catalogue no. 92-594-XWE. Ottawa. Released January 15, 2008. http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-594/index.cfm?Lang=E. Accessed July 27, 2017.

Statistics Canada. 2007b. *Saskatchewan (Code47)* (table). *Aboriginal Population Profile*. 2006 Census. Statistics Canada Catalogue no. 92-594-XWE. Ottawa. Released January 15, 2008. http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-594/index.cfm?Lang=E. Accessed July 27, 2017.

Statistics Canada. 2007c. *Red Earth 29, Saskatchewan (Code4714840)* (table). *Aboriginal Population Profile*. 2006 Census. Statistics Canada Catalogue no. 92-594-XWE. Ottawa. Released January 15, 2008. http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-594/index.cfm?Lang=E. Accessed July 31, 2017.

Statistics Canada. 2007d. *Carrot River 29A, Saskatchewan (Code4714845)* (table). *Aboriginal Population Profile*. 2006 Census. Statistics Canada Catalogue no. 92-594-XWE. Ottawa. Released January 15, 2008.

http://www12.statcan.ca/census-recensement/2006/dp-pd/prof/92-594/index.cfm?Lang=E. Accessed August 9, 2017.

Statistics Canada. 2012a. *Arborfield, Saskatchewan (Code 4714062) and Canada (Code 01)* (table). *Census Profile*. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E . Accessed July 25, 2017.

Statistics Canada. 2012b. *Carrot River, Saskatchewan (Code 4714069) and Canada (Code 01)* (table). *Census Profile*. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E. Accessed July 27, 2017.

Statistics Canada. 2012c. *Hudson Bay, Saskatchewan (Code 4714004) and Canada (Code 01)* (table). *Census Profile*. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E. Accessed July 27, 2017.

Statistics Canada. 2012d. *Hudson Bay No. 394, Saskatchewan (Code 4714001) and Canada (Code 01)* (table). *Census Profile*. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E. Accessed July 27, 2017.

Statistics Canada. 2012e. *Moose Range No. 486, Saskatchewan (Code 4714067) and Canada (Code 01)* (table). *Census Profile*. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E. Accessed July 27, 2017.

Statistics Canada. 2012f. *Prairie River, Saskatchewan (Code 470110) and Canada (Code 01)* (table). *Census Profile*. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E. Accessed July 27, 2017.

Statistics Canada. 2012g. *Arborfield No. 456, Saskatchewan (Code 4714059) and Canada (Code 01)* (table). *Census Profile*. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E. Accessed July 27, 2017.

Statistics Canada. 2012h. *Saskatchewan (Code 47) and Canada (Code 01)* (table). *Census Profile*. 2011 Census. Statistics Canada Catalogue no. 98-316-XWE. Ottawa. Released October 24, 2012. http://www12.statcan.gc.ca/census-recensement/2011/dp-pd/prof/index.cfm?Lang=E. Accessed July 27, 2017.

Statistics Canada. 2013a. Shoal Lake 28A, IRI, Saskatchewan (Code 4714839) (table). National Household Survey (NHS) Aboriginal Population Profile. 2011 National Household Survey. Statistics Canada Catalogue no. 99-011-X2011007. Ottawa. Released November 13, 2013. http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/aprof/index.cfm?Lang=E. Accessed July 27, 2017.

Statistics Canada. 2013b. Saskatchewan (Code 47) (table). National Household Survey (NHS) Aboriginal Population Profile. 2011 National Household Survey. Statistics Canada Catalogue no. 99-011-X2011007. Ottawa. Released November 13, 2013. http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/aprof/index.cfm?Lang=E. Accessed July 27, 2017.

Statistics Canada. 2013c. Red Earth 29, IRI, Saskatchewan (Code 4714840) (table). National Household Survey (NHS) Aboriginal Population Profile. 2011 National Household Survey. Statistics Canada Catalogue no. 99-011-X2011007. Ottawa. Released November 13, 2013. http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/aprof/index.cfm?Lang=E. Accessed July 31, 2017.

Statistics Canada. 2013d. Carrot River 29A, IRI, Saskatchewan (Code 4714845) (table). National Household Survey (NHS) Aboriginal Population Profile. 2011 National Household Survey. Statistics Canada Catalogue no. 99-011-X2011007. Ottawa. Released November 13, 2013. http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/aprof/index.cfm?Lang=E. Accessed August 9, 2017.

Statistics Canada. 2013e. *Hudson Bay, T, Saskatchewan (Code 4714004)* (table). *National Household Survey (NHS) Profile*. 2011 National Household Survey. Statistics Canada Catalogue no. 99-004-XWE. Ottawa. Released September 11, 2013. http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CSD&Code1=4714004&Data=Count&SearchText=hudson%20bay&SearchType=Begins&SearchPR=01&A1=All&B1=All&Custom=&TABID=1 Accessed July 26, 2017.

Statistics Canada. 2013f. *Carrot River, T, Saskatchewan (Code 4714069)* (table). *National Household Survey (NHS) Profile*. 2011 National Household Survey. Statistics Canada Catalogue no. 99-004-XWE. Ottawa. Released September 11, 2013. http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CSD&Code1=4714069&Data=Count&SearchText=carrot&SearchType=Begins&SearchPR=01&A1=All&B1=All&Custom=&TABID=1. Accessed July 26, 2017.

Statistics Canada. 2013g. *Arborfield, T, Saskatchewan (Code 4714062)* (table). *National Household Survey (NHS) Profile*. 2011 National Household Survey. Statistics Canada Catalogue no. 99-004-XWE. Ottawa. Released September 11, 2013. http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CSD&Code1=4714062&Data=Count&SearchText=arborfield&SearchType=Begins&SearchPR=01&A1=All&B1=All&Custom=&TABID=1. Accessed July 26, 2017.

Statistics Canada. 2013h. *Saskatchewan (Code 47)* (table). *National Household Survey (NHS) Profile*. 2011 National Household Survey. Statistics Canada Catalogue no. 99-004-XWE. Ottawa. Released September 11, 2013. http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/prof/index.cfm?Lang=E. Accessed July 26, 2017.

Statistics Canada. 2015. National Household Survey Profile – Prairie River. Available at: http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/prof/search-recherche/frm_res.cfm?Lang=E&TABID=1&Geo1=PR&Code1=01&SearchText=prairie+river&SearchType=Begins&PR=01. Accessed August 2017.

Statistics Canada. 2017a. *Hudson Bay, T [Census subdivision], Saskatchewan and Division No. 14, CDR [Census division], Saskatchewan* (table). *Census Profile*. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released May 3, 2017. http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E. Accessed July 25, 2017.

Statistics Canada. 2017b. *Arborfield, T [Census subdivision], Saskatchewan and Division No. 14, CDR [Census division], Saskatchewan* (table). *Census Profile*. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released May 3, 2017. http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E. Accessed July 25, 2017.

Statistics Canada. 2017c. *Carrot River, T [Census subdivision], Saskatchewan and Division No. 14, CDR [Census division], Saskatchewan* (table). *Census Profile*. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released May 3, 2017. http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E. Accessed July 25, 2017.

Statistics Canada. 2017d. *Hudson Bay No. 394, RM [Census subdivision], Saskatchewan and Division No. 14, CDR[Census division], Saskatchewan* (table). *Census Profile*. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released May 3, 2017. http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E. Accessed July 25, 2017.

Statistics Canada. 2017e. *Moose Range No. 486, RM [Census subdivision], Saskatchewan and Division No. 14, CDR[Census division], Saskatchewan* (table). *Census Profile*. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released May 3, 2017. http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E. Accessed July 25, 2017.

Statistics Canada. 2017f. *Prairie River, OHM [Designated place], Saskatchewan and Saskatchewan [Province]* (table). *Census Profile*. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released May 3, 2017. http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E. Accessed July 27, 2017.

Statistics Canada. 2017g. *Arborfield No. 456, RM [Census subdivision], Saskatchewan and Division No. 14, CDR[Census division], Saskatchewan* (table). *Census Profile*. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released August 2, 2017. http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E. Accessed July 27, 2017.

Statistics Canada. 2017h. *Saskatchewan [Province] and Canada [Country]* (table). *Census Profile*. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released May 3, 2017. http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E. Aaccessed July 27, 2017.

Strack, M, J. Cagampan, G. Hassanpour Fard, A.M. Keith, K. Nugent, T. Rankin, C. Robinson, I.B. Strachan, J.M. Waddington and B. Xu. 2016. Controls on plot-scale growing season CO_2 and CH_4 fluxes in restored peatlands: Do they differ from unrestored and natural sites? Mires and Peat 17:1-18.

Strengthening Rural Canada. No date. Hudson Bay. Available at: http://strengtheningruralcanada.ca/communities/saskatchewan/hudson-bay/. Accessed July 25, 2017.

Terzi, R.A. 1981. Hydrometric Field Manual – Measurement of Streamflow, Environment Canada, Inland Waters Directorate, Water Resources Branch.

Tourism Saskatchewan. No date. Arborfield. Available at: http://www.tourismsaskatchewan.com/places-to-go/cities-and-communities/103859/arborfield?. Accessed July 2017.

Town of Carrot River. 2015a. Guiding Principles. Available at: http://www.carrotriver.ca/uploads/Bylaws/Bylaw%202015-02%20Appendix%20A.pdf. Accessed July 2017.

Town of Carrot River. 2015b. Minutes from the Regular Meeting of the Council of the Town of Carrot River held on the 18th day of November, 2015 in the Town of Carrot River Council Chamber. Available at: http://www.carrotriver.ca/uploads/2015%20Council%20Minutes/Minutes%20November%2018,%202015.pdf. Accessed July 2017.

Town of Carrot River. 2017a. About the Town. http://outback.carrotriver.ca/. Accessed July 2017.

Town of Carrot River. 2017b. History. Available at: http://www.carrotriver.ca/history/brief/. Accessed July 2017.

Town of Carrot River. 2017c. Agriculture. Available at: http://live.carrotriver.ca/agriculture/. Accessed July 2017.

Town of Carrot River. 2017d. Industry. Available at: http://www.carrotriver.ca/industry/. Accessed July 2017.

Town of Carrot River. 2017e. Business Listing. Available at: http://live.carrotriver.ca/businesses.php. Accessed August 2017.

Town of Carrot River. 2017f. Emergency Services. Available at: http://www.carrotriver.ca/emergencyservices/. Accessed July 2017.

Town of Hudson Bay. 2013. Official Community Plan. Available at: http://www.townofhudsonbay.com/files/OCP_issued_final_2013.pdf. Accessed July 26, 2017.

Town of Hudson Bay. 2015. Financial Statements Year Ended December 31, 2014. Available at: http://www.townofhudsonbay.com/assets/files/Financial2014.pdf. Accessed July 2017.

Town of Hudson Bay. 2017a. Experience Guide 2017-2018. Available at: http://www.townofhudsonbay.com/assets/files/TOHB_VisitorGuide%20(17_18).pdf. Accessed July 2017/

Town of Hudson Bay. 2017b. Local History. Available at: http://www.townofhudsonbay.com/default.aspx?page=21. Accessed July 25, 2017.

Town of Hudson Bay. 2017c. Snowmobiling. Available at: http://www.townofhudsonbay.com/default.aspx?page=63. Accessed July 2017.

Town of Hudson Bay. 2017d. Health Services. Available at: http://www.townofhudsonbay.com/default.aspx?page=35. Accessed July 2017.

Town of Hudson Bay. 2017e. Protection. http://www.townofhudsonbay.com/default.aspx?page=25. Accessed July 2017.

Town of Hudson Bay. 2017f. Waste Management. Available at: http://www.townofhudsonbay.com/default.aspx?page=28. Accessed August 2017.

Trew, K. 2017. Pers. Comm. Administrator, Town of Carrot River. Infrastructure, Services and Economic Development. Email to Wu, D, Socio-Economic Specialist, Golder Associates Ltd. August 16, 2017.

Trottier T, Tether R. 2016. Pers. Comm. Area wildlife ecologists. Fish, Wildlife and Lands Branch, Ministry of Environment. La Ronge and Meadow Lake, Saskatchewan.

US EPA (United States Environmental Protection Agency). 2002. National recommended water quality criteria. Office of Water U.S. EPA 822-R-02-047. Washington, D.C.

Vance, Robert. 1991. Paleobotanical study of holocene drought frequency in Southern Alberta. Unpublished Ph.D. Dissertation. Department of Biological Sciences, Simon Fraser University.

Vennesland R.G., Butler R.W. 2011. Great Blue Heron (*Ardea herodias*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Available from: http://bna.birds.cornell.edu/bna/species/025. Accessed: September 12, 2016.

Vincent Lucie, 2017. Research climatologist, environment and climate change Canada. Daily Adjusted Precipitation Data. Email January 13, 2017.

Vitt, D. H., L. A. Halsey, I. E. Bauer and C. Campbell, 2000. Spatial and temporal trends in carbon storage of peatlands of continental western Canada through the Holocene, Canadian Journal of Earth Sciences, 37(5), 683-693, doi: 10.1139/e99-097.

Walker Ernest G. 1999. Precontact archaeology of Southern Saskatchewan. In Atlas of Saskatchewan, Ka-iu Fung, editor. University of Saskatchewan, Saskatoon.

Watt, R.W. and M.C. Caceres. 1999. Managing for Snags in the Boreal Forests of Northeastern Ontario. OMNR. Northeast Science and Technology. Technical Note- 016. 20p.

Weyerhaeuser and Edgewood Forest Products. 2016. Volume II Strategic Direction for the Pasquia-Porcupine Forest Management Area 2015 to 2035 Twenty Year Forest Management Plan. Available at: http://publications.gov.sk.ca/documents/66/93269-Volume%20II%20%20Pasquia%20Porcupine%202015%20-%202035%20FMP%20w%20Feb%202017%20Errata%20and%20Appendices.pdf. Accessed August 2017.

WHPA (Wildlife Habitat Protection Act). 2010. Chapter W-13.2. Statutes of Saskatchewan, Queen's Printer, Government of Saskatchewan.

Wiggins, D.A., D.W. Holt, and S.M. Leasure. 2006. Short-eared Owl (*Asio flammeus*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology. Available at: https://birdsna.org/Species-Account/bna/species/sheowl. Accessed: September 12, 2016.

The Weed Control Act. 2010. Chapter W-11.1 of the Statutes of Saskatchewan. Regina, Saskatchewan. 26pp.

The Wildlife Act. 1998. RSS cW-13.12. Available at: www.qp.gov.sk.ca/documents/English/Statutes/Statutes/W13-12.pdf.

WMO (World Meteorological Organization). 1989. Calculation of monthly and annual 30-year standard normals. WCDP-No. 10, WMO-TD/No. 341.

WSA (Water Security Agency) 2017. Water Well Database. https://gis.wsask.ca/Html5Viewer/index.html?viewer=WaterWells.WellsViewer, August 21, 2017.

WSC (Water Survey of Canada). 2017. Internet site accessed July, 2017, Available at: http://wateroffice.ec.gc.ca/index_e.html.

Yellow Pages. 2017. Saskatchewan Business Directory: Construction & Renovation. Available at: http://www.yellowpages.ca/locations/Saskatchewan/Hudson+Bay/80017000.html. Accessed July 2017.

APPENDIX A

Fish Capture Data

Table A-1: Individual Fish Data for the Proposed Prairie River Peat Harvest Project

Watercourse	Effort	Species	Length (mm)	Life Stage	Maturity
PRX1	PRX1-BPEF01	BRST	38	Unknown	Unknown
	PRX1-MT01/02	FTMN	64	Unknown	Unknown
	PRX1-MT01/02	NRDC	51	Unknown	Unknown
	PRX1-MT04/05	BRST	59	Unknown	Unknown
	PRX1-MT04/05	BRST	52	Unknown	Unknown
	PRX1-MT04/05	FTMN	50	Unknown	Unknown
	PRX1-MT04/05	FTMN	50	Unknown	Unknown
	PRX1-MT04/05	FTMN	55	Unknown	Unknown
	PRX1-MT04/05	BRST	53	Unknown	Unknown
	PRX1-MT04/05	BRST	53	Unknown	Unknown
	PRX1-MT04/05	BRST	50	Unknown	Unknown
	PRX1-MT04/05	FTMN	56	Unknown	Unknown
	PRX1-MT04/05	BRST	52	Unknown	Unknown
	PRX1-MT04/05	BRST	50	Unknown	Unknown
	PRX1-MT04/05	BRST	55	Unknown	Unknown
	PRX1-MT04/05	BRST	63	Unknown	Unknown
	PRX1-MT04/05	BRST	46	Unknown	Unknown
	PRX1-MT04/05	BRST	47	Unknown	Unknown
	PRX1-MT04/05	FTMN	54	Unknown	Unknown
	PRX1-MT04/05	FTMN	57	Unknown	Unknown
	PRX1-MT04/05	FTMN	50	Unknown	Unknown
	PRX1-MT04/05	FTMN	55	Unknown	Unknown
	PRX1-MT04/05	FTMN	48	Unknown	Unknown
	PRX1-MT04/05	NRDC	59	Unknown	Unknown
PRX2	PRX2-MT01/02	FTMN	64	Unknown	Unknown
	PRX2-MT01/02	FTMN	57	Unknown	Unknown
	PRX2-MT01/02	NRDC	84	Unknown	Unknown
	PRX2-MT01/02	NRDC	79	Unknown	Unknown
	PRX2-MT01/02	NRDC	55	Unknown	Unknown
	PRX2-MT01/02	NRDC	60	Unknown	Unknown
	PRX2-MT01/02	NRDC	89	Unknown	Unknown
	PRX2-MT01/02	NRDC	89	Unknown	Unknown
	PRX2-MT01/02	BRST	64	Unknown	Unknown
	PRX2-MT01/02	NRDC	68	Unknown	Unknown
	PRX2-MT01/02	NRDC	81	Unknown	Unknown
	PRX2-MT01/02	NRDC	71	Unknown	Unknown
	PRX2-MT01/02	NRDC	61	Unknown	Unknown
	PRX2-MT01/02	NRDC	82	Unknown	Unknown
	PRX2-MT01/02	BRST	45	Unknown	Unknown
	PRX2-MT01/02	FTMN	64	Unknown	Unknown
	PRX2-MT01/02	BRST	46	Unknown	Unknown
	PRX2-MT01/02	BRST	54	Unknown	Unknown

Table A-1: Individual Fish Data for the Proposed Prairie River Peat Harvest Project

Watercourse	Effort	Species	Length (mm)	Life Stage	Maturity
	PRX2-MT01/02	FTMN	63	Unknown	Unknown
	PRX2-MT01/02	FTMN	69	Unknown	Unknown
	PRX2-MT01/02	BRST	52	Unknown	Unknown
	PRX2-MT01/02	FTMN	57	Unknown	Unknown
	PRX2-MT01/02	FTMN	55	Unknown	Unknown
	PRX2-MT01/02	FTMN	61	Unknown	Unknown
	PRX2-MT01/02	FTMN	50	Unknown	Unknown
	PRX2-MT01/02	BRST	52	Unknown	Unknown
	PRX2-MT01/02	FTMN	72	Unknown	Unknown
	PRX2-MT01/02	BRST	50	Unknown	Unknown
	PRX2-MT01/02	BRST	52	Unknown	Unknown
	PRX2-MT01/02	BRST	47	Unknown	Unknown
	PRX2-MT01/02	BRST	54	Unknown	Unknown
PRX2.5	PRX2.5-MT01/02	BRST	55	Adult	Unknown
	PRX2.5-MT01/02	BRST	59	Adult	Unknown
	PRX2.5-MT01/02	BRST	67	Adult	Unknown
	PRX2.5-MT01/02	BRST	53	Adult	Unknown
	PRX2.5-MT01/02	BRST	45	Adult	Unknown
	PRX2.5-MT01/02	BRST	60	Adult	Unknown
	PRX2.5-MT01/02	BRST	56	Adult	Unknown
	PRX2.5-MT01/02	BRST	66	Adult	Unknown
	PRX2.5-MT01/02	BRST	52	Adult	Unknown
	PRX2.5-MT01/02	BRST	56	Adult	Unknown
	PRX2.5-MT01/02	FTMN	47	Adult	Unknown
	PRX2.5-MT01/02	FTMN	39	Adult	Unknown
PRX5	PRX5-MT01/02	BRST	62	Adult	Unknown
	PRX5-MT01/02	BRST	57	Adult	Unknown
	PRX5-MT01/02	BRST	42	Adult	Unknown
	PRX5-MT01/02	BRST	59	Adult	Unknown
	PRX5-MT01/02	BRST	46	Adult	Unknown
	PRX5-MT01/02	BRST	40	Adult	Unknown
	PRX5-MT01/02	BRST	51	Adult	Unknown
	PRX5-MT01/02	BRST	43	Adult	Unknown
	PRX5-MT01/02	BRST	65	Adult	Unknown
	PRX5-MT01/02	BRST	42	Adult	Unknown
	PRX5-MT03/04	FTMN	67	Adult	Unknown
PR01	PR01-MT01/02	BLDC	75	Adult	Unknown
	PR01-MT01/02	NRDC	83	Adult	Unknown
	PR01-MT01/02	FTMN	67	Adult	Unknown
	PR01-MT01/02	FTMN	55	Adult	Unknown
	PR01-MT01/02	FTMN	61	Adult	Unknown
	PR01-MT01/02	FTMN	42	Adult	Unknown

Table A-1: Individual Fish Data for the Proposed Prairie River Peat Harvest Project

Watercourse	Effort	Species	Length (mm)	Life Stage	Maturity
	PR01-MT01/02	BLDC	56	Adult	Unknown
	PR01-MT01/02	FTMN	32	Adult	Unknown
	PR01-MT01/02	FTMN	59	Adult	Unknown
	PR01-MT01/02	FTMN	43	Adult	Unknown
	PR01-MT01/02	FTMN	42	Adult	Unknown
	PR01-MT01/02	FTMN	46	Adult	Unknown
	PR01-MT01/02	FTMN	45	Adult	Unknown
	PR01-MT03/04	CRCH	113	Adult	Unknown
	PR01-MT03/04	CRCH	130	Adult	Unknown
	PR01-MT03/04	CRCH	116	Adult	Unknown
	PR01-MT03/04	CRCH	114	Adult	Unknown
	PR01-MT03/04	CRCH	92	Adult	Unknown
	PR01-MT03/04	BRST	47	Adult	Unknown
	PR01-MT03/04	BRST	48	Adult	Unknown
	PR01-MT03/04	BRST	59	Adult	Unknown
	PR01-MT03/04	BRST	44	Adult	Unknown
	PR01-MT03/04	BRST	46	Adult	Unknown
	PR01-MT03/04	BRST	51	Adult	Unknown
	PR01-MT03/04	BRST	45	Adult	Unknown
	PR01-MT03/04	BRST	59	Adult	Unknown
	PR01-MT03/04	BRST	50	Adult	Unknown
	PR01-MT05	CRCH	133	Adult	Unknown
	PR01-MT05	CRCH	117	Adult	Unknown
	PR01-MT05	CRCH	135	Adult	Unknown
	PR01-MT05	BLDC	117	Adult	Unknown
	PR01-MT05	CRCH	105	Adult	Unknown
	PR01-MT05	CRCH	103	Adult	Unknown
	PR01-MT05	NRDC	86	Adult	Unknown
	PR01-MT05	BRST	42	Adult	Unknown
	PR01-MT05	NRDC	79	Adult	Unknown
	PR01-MT05	BLDC	77	Adult	Unknown
	PR01-MT05	BLDC	84	Adult	Unknown
	PR01-MT05	BLDC	65	Adult	Unknown
	PR01-MT05	BLDC	70	Adult	Unknown
	PR01-MT05	BLDC	69	Adult	Unknown
	PR01-GN01	CRCH	147	Adult	Unknown
	PR01-GN01	CRCH	150	Adult	Unknown
	PR01-GN01	CRCH	134	Adult	Unknown
	PR01-GN01	CRCH	143	Adult	Unknown
	PR01-GN01	CRCH	141	Adult	Unknown

mm = millimetre; BLDC = Blacknose Dace; BRST = Brook Stickleback; CRCH = Creek Chub; FTMN = Fathead Minnow; NRDC = Northern Redbelly Dace.

APPENDIX B

Vegetation Data

Table B-4: Vegetation Species Observed During the 2016 Field Programs

Scientific Name	Common Name	Scientific Name	Common Name
Trees and Shrubs			
Abies balsamea	Balsam Fir	*Populus balsamifera ssp. balsamifera*	Balsam Poplar
Alnus incana ssp. rugosa	Speckled Alder	*Populus tremuloides*	Trembling Aspen
Alnus viridis ssp. crispa	Green Alder	*Rhododendron groenlandicum*	Common Labrador Tea
Andromeda polifolia var. polifolia	Bog-rosemary	*Rosa acicularis ssp. sayi*	Prickly Rose
Betula papyrifera	Paper Birch	*Rubus idaeus ssp. strigosus*	American Red Raspberry
Betula pumila	Swamp Birch	*Salix alba*	White Willow
Chamaedaphne calyculata	Leatherleaf	*Salix arbusculoides*	Little-tree Willow
Corylus cornuta var. cornuta	Beaked Hazelnut	*Salix myrtillifolia*	Myrtle-leaf Willow
Dasiphora fruticosa	Shrubby Cinquefoil	*Salix pedicellaris*	Bog Willow
Larix laricina	Tamarack	*Vaccinium myrtilloides*	Blueberryf
Myrica gale	Sweet Gale	*Vaccinium oxycoccos*	Small Cranberry
Picea glauca	White Spruce	*Vaccinium vitis-idaea ssp. minus*	Mountain Cranberry
Picea mariana	Black Spruce	*Viburnum edule*	Low Bush-cranberry
Forbs			
Achillea alpina	Siberian Yarrow	*Parnassia palustris var. tenuis*	Marsh Grass-of-parnassus
Aralia nudicaulis	Wild Sarsaparilla	*Pedicularis macrodonta*	Purple Lousewort
Athyrium filix-femina var. cyclosorum	Northern Lady-fern	*Petasites frigidus var. palmatus*	Palmate-leaved Colt's-foot
Calla palustris	Water Calla	*Petasites frigidus var. sagittatus*	Arrow-leaved Colt's-foot
Campanula aparinoides	Marsh Bellflower	*Platanthera aquilonis*	Northern Green Orchid
Chamerion angustifolium ssp. angustifolium	Narrow-leaf Fireweed	*Platanthera dilatata var. dilatata*	Scentbottle
Cirsium arvense	Canada Thistle	*Prosartes trachycarpa*	Fairybells
Comarum palustre	Marsh Cinquefoil	*Rhinanthus minor ssp. minor*	Yellow-rattle
Corallorhiza trifida	Early Coralroot	*Rubus arcticus ssp. acaulis*	Nagoon Berry
Cornus canadensis	Bunchberry	*Rubus chamaemorus*	Cloudberry
Drosera rotundifolia	Round-leaved Sundew	*Rubus pubescens*	Dewberry
Epilobium ciliatum ssp. ciliatum	Hairy Willow-herb	*Sanicula marilandica*	Black Snakeroot
Epilobium palustre	Marsh Willowherb	*Sarracenia purpurea ssp. gibbosa*	Pitcherplant
Equisetum arvense	Common Horsetail	*Senecio integerrimus var. integerrimus*	Lamb-tongue Ragwort

Table B-4: Vegetation Species Observed During the 2016 Field Programs

Scientific Name	Common Name	Scientific Name	Common Name
Equisetum fluviatile	Swamp Horsetail	*Senecio vulgaris*	Common Groundsel
Equisetum hyemale var. affine	Common Scouring-rush	*Solidago lepida var. salebrosa*	Graceful Canada Goldenrod
Equisetum scirpoides	Dwarf Scouring-rush	*Sonchus arvensis ssp. arvensis*	Field Sow-thistle
Fragaria virginiana ssp. glauca	Smooth Wild Strawberry	*Spiranthes romanzoffiana*	Hooded Lady's-tresses
Galium trifidum ssp. trifidum	Small Bedstraw	*Symphyotrichum puniceum var. puniceum*	Swamp Aster
Geum aleppicum	Yellow Avens	*Taraxacum officinale ssp. officinale*	Common Dandelion
Linnaea borealis ssp. americana	American Twinflower	*Triantha glutinosa*	Sticky Asphodel
Listera cordata var. cordata	Heart-leaved Twayblade	*Trifolium repens*	White Clover
Lycopus uniflorus var. uniflorus	Northern Water-horehound	*Triglochin maritima*	Seaside Arrow-grass
Maianthemum trifolium	Three-leaf Solomon's-seal	*Urtica dioica ssp. gracilis*	Stinging Nettle
Menyanthes trifoliata	Bog Buckbean	*Viola canadensis var. rugulosa*	Western Canada Violet
Mitella nuda	Bishop's-cap	*Viola nephrophylla*	Northern Bog Violet
Osmorhiza depauperata	Blunt-fruited Sweet-cicely		
Graminoids			
Agrostis scabra var. scabra	Hair Grass	*Carex prairea*	Prairie Sedge
Calamagrostis stricta	Northern Reed Grass	*Carex sprengelii*	Sprengel's Sedge
Carex aquatilis var. aquatilis	Water Sedge	*Carex tenera*	Slender Sedge
Carex aurea	Golden Sedge	*Carex trisperma var. trisperma*	Three-fruited Sedge
Carex brunnescens ssp. sphaerostachya	Brownish Sedge	*Deschampsia cespitosa ssp. cespitosa*	Tufted Hair Grass
Carex canescens ssp. canescens	Hoary Sedge	*Eleocharis acicularis*	Needle Spike-rush
Carex chordorrhiza	Prostrate Sedge	*Eriophorum angustifolium ssp. angustifolium*	Tall Cottongrass
Carex disperma	Two-seeded Sedge	*Eriophorum brachyantherum var. brachyantherum*	Close-sheathed Cotton-grass
Carex interior	Inland Sedge	*Eriophorum gracile*	Slender Cotton-grass
Carex lasiocarpa var. americana	Slender Sedge	*Eriophorum vaginatum var. vaginatum*	Tussock Cotton-grass
Carex limosa	Mud Sedge	*Juncus balticus*	Baltic Rush
Carex magellanica ssp. irrigua	Boreal-bog Sedge	*Luzula parviflora ssp. parviflora*	Smallflowered Woodrush
Carex pauciflora	Few-flowered Sedge	*Poa palustris*	Fowl Blue Grass

Table B-4: Vegetation Species Observed During the 2016 Field Programs

Scientific Name	Common Name	Scientific Name	Common Name
Carex praegracilis	Graceful Sedge	*Trichophorum alpinum*	Alpine Cotton-grass
Bryophytes			
Ceratophyllum demersum	Hornwort	*Sphagnum fuscum*	Rusty Peat Moss
Diphasiastrum complanatum	Trailing Club-moss	*Sphagnum magellanicum*	Midway Peat Moss
Hylocomium splendens	Stair-step Moss	*Sphagnum riparium*	Shore-growing Peat Moss
Pleurozium schreberi	Big Red Stem Feathermoss	*Sphagnum sp.*	Peat moss
Polytrichum strictum	Bog Hair Cap	*Sphagnum squarrosum*	Squarrose Peat Moss
Ptilium crista-castrensis	Knight's Plume	*Sphagnum fuscum*	Rusty Peat Moss
Sphagnum angustifolium	Poor Fen Peat Moss		
Lichens			
Bryoria sp.	Horsehair lichen	*Cladonia fimbriata*	Trumpet lichen
Cladina mitis	Green reindeer lichen	*Evernia sp.*	Evernia species
Cladina rangiferina	Gray reindeer lichen	*Unsea sp.*	Beard lichen

Table B-2: Traditional Use Plant Species Percent Cover Observed at Detailed Vegetation Inventory Plot Locations

Scientific Name	Common Name	PVA1	PVA2	PVA3	PVA4	PVA5	PVA6	PVA7	PVB1	PVB2	PVB3	PVB4	PVB5	PVB6	PVB7	PVB8	PVB9	PVB10	PVB11	PVB12
Abies balsamea	Balsam Fir																X			
Acer negundo var. interius	Manitoba Maple																			
Achillea alpina	Siberian Yarrow																	X		
Achillea millefolium	Common Yarrow																			
Acorus americanus	Sweet Flag																			
Agastache foeniculum	Giant Hyssop																			
Allium spp.	Wild onions																			
Amelanchier alnifolia var. alnifolia	Saskatoon																			
Aralia nudicaulis	Wild Sarsaparilla								X								X			
Actostaphylos uva-ursi	Bearberry																			
Betula papyrifera var. papyrifera	White Birch								X			X					X			
Cornus sericea ssp. sericea	Red-osier Dogwood																			
Corylus cornuta var. cornuta	Beaked Hazelnut								X											
Equisetum spp.	Horsetail species	X	X	X		X	X	X	X				X			X	X	X	X	
Helenium autumnale	Common Sneezeweed																			
Heracleum maximum	Cow Parsnip																			
Lonicera dioica	Wild Honeysuckle																			
Medicago sativa ssp. sativa	Alfalfa																			
Melilotus albus	White Sweet-clover																			
Mentha arvensis	Wild Mint																			
Monarda fistulosa var. menthifolia	Wild Bergamot																			
Nuphar variegata	Yellow Cowlily																			
Picea glauca	White Spruce								X											
Plantago major	Common Plantain																			
Polygala senega	Seneca Snakeroot																			
Populus tremuloides	Trembling Aspen																	X		
Prunus virginiana var. virginiana	Chokecherry																			
Rhododendron groenlandicum	Common Labrador Tea	X	X	X	X	X	X	X		X	X	X	X	X	X	X				X
Rosa acicularis ssp. sayi	Prickly Rose																X			
Rubus idaeus ssp. strigosus	American Red Raspberry								X											
Sagittaria cuneata	Arum-leaved Arrowhead																			
Salicornia rubra	Red Samphire																			
Salix sp.	Willow species		X			X		X										X	X	
Sarracenia purpurea ssp. gibbosa	Pitcherplant	X													X	X				
Shepherdia canadensis	Canada buffalo-berry																			
Sium suave	Water Parsnip																			
Sorbus americana	American Mountain-ash																			

Table B-2: Traditional Use Plant Species Percent Cover Observed at Detailed Vegetation Inventory Plot Locations

Scientific Name	Common Name	PVA1	PVA2	PVA3	PVA4	PVA5	PVA6	PVA7	PVB1	PVB2	PVB3	PVB4	PVB5	PVB6	PVB7	PVB8	PVB9	PVB10	PVB11	PVB12
Sphagnum spp.	Peat moss	X	X	X	X	X				X	X	X	X	X	X	X			X	X
Symphoricarpos occidentalis	Western Snowberry																			
Thuja occidentalis	northern white-cedar																			
Typha latifolia	Common cattail																			
Umbilicaria muehlenbergii	Rock tripe																			
Urtica dioica ssp. gracilis	Stinging Nettle								X											
Vaccinium myrtilloides	Blueberry									X	X	X				X				
Vaccinium vitis-idaea ssp. minus	Lingonberry		X	X	X	X	X				X	X	X	X	X					X
Valeriana dioica var. sylvatica	Marsh Valerian																			
Viburnum opulus var. americanum	High Bush-cranberry																			

Note:X denotes species presence during detailed vegetation inventory plot for the Prairie River Peat Harvest Project.

APPENDIX C

Wildlife Data

Table C-1: Federally Listed and Provincially Tracked Species Observations, 2016

Sampling Date (2016)	UTM Coordinates (NAD 83)			Common Name	Scientific Name	Habitat Type[(a)]	Number of Individuals	Comments
	Zone	Easting (m)	Northing (m)					
01-Jun	13	641274	5885741	boreal owl	*Aegolius funereus*	BP14	1	-
01-Jun	13	634132	5897889	Canada goose	*Branta canadensis*	BP16	21	-
01-Jun	13	633460	5901474	Canada goose	*Branta canadensis*	BP6	1	-
14-Jun	13	634036	5900355	Canada goose	*Branta canadensis*	BP16	42	-
15-Jun	13	641274	5885741	Canada goose	*Branta canadensis*	BP14	1	-
13-May	13	642958	5883648	Canada goose	*Branta canadensis*	BP25	nc	-
14-May	13	634036	5900355	Canada goose	*Branta canadensis*	BP16	nc	-
14-May	13	633443	5901481	Canada goose	*Branta canadensis*	BP6	nc	-
14-May	13	633282	5902494	Canada goose	*Branta canadensis*	BP6	nc	-
14-May	13	634186	5899170	Canada goose	*Branta canadensis*	BP25	nc	-
14-May	13	634133	5898232	Canada goose	*Branta canadensis*	BP10	nc	-
14-May	13	638117	5894665	Canada goose	*Branta canadensis*	BP15	nc	-
01-Jun	13	633282	5902494	Canada warbler	*Cardellina canadensis*	BP6	1	-
01-Jun	13	639252	5894083	Canada warbler	*Cardellina canadensis*	BP15	1	-
15-Jun	13	639252	5894083	Canada warbler	*Cardellina canadensis*	BP15	1	-
29-Jun	13	633282	5902494	Canada warbler	*Cardellina canadensis*	BP6	1	-
29-Jun	13	633282	5902494	Canada warbler	*Cardellina canadensis*	BP6	1	-
31-May	13	641194	5886628	common nighthawk	*Chordeiles minor*	BP23	2	-
31-May	13	633282	5902494	common nighthawk	*Chordeiles minor*	BP6	1	-
14-Jun	13	641270	5888936	common nighthawk	*Chordeiles minor*	BP14	2	-
26-Jun	13	641270	5888936	common nighthawk	*Chordeiles minor*	BP14	2	-

Table C-1: Federally Listed and Provincially Tracked Species Observations, 2016

Sampling Date (2016)	UTM Coordinates (NAD 83)			Common Name	Scientific Name	Habitat Type[(a)]	Number of Individuals	Comments
	Zone	Easting (m)	Northing (m)					
26-Jun	13	641194	5886628	common nighthawk	*Chordeiles minor*	BP23	2	2+ individuals heard on ARU recording
26-Jun	13	641274	5885741	common nighthawk	*Chordeiles minor*	BP14	2	2+ individuals heard on ARU recording
28-Jun	13	634264	5897407	common nighthawk	*Chordeiles minor*	BP28	1	-
28-Jun	13	640743	5887774	common nighthawk	*Chordeiles minor*	BP14	1	1+ individuals heard on ARU recording
25-Jul	13	639005	5889254	common nighthawk	*Chordeiles minor*	nc	3	-
01-Jun	13	634132	5897889	Connecticut warbler	*Oporonis agilis*	BP16	1	-
15-Jun	13	643814	5880959	Connecticut warbler	*Oporonis agilis*	BP19	1	-
15-Jun	13	644126	5881053	Connecticut warbler	*Oporonis agilis*	BP14	1	-
nc	nc	nc	nc	Cooper's hawk	*Accipiter cooperii*	nc	nc	nc
29-Jun	13	636338	5895469	evening grosbeak	*Coccothraustes vespertinus*	BP15	1	-
29-Jun	13	635046	5896163	evening grosbeak	*Coccothraustes vespertinus*	BP6	3	-
28-Jun	nc	nc	nc	hooded merganser	*Lophodytes cucullatus*	nc	nc	-
01-Jun	13	636338	5895469	pileated woodpecker	*Dryocopus pileatus*	BP15	1	-
01-Jun	13	634264	5897407	pileated woodpecker	*Dryocopus pileatus*	BP28	1	-
29-Jun	13	639252	5894083	pileated woodpecker	*Dryocopus pileatus*	BP15	1	-
29-Jun	13	636338	5895469	pileated woodpecker	*Dryocopus pileatus*	BP15	1	-
29-Jun	13	634264	5897407	pileated woodpecker	*Dryocopus pileatus*	BP28	1	-
01-Jun	13	634146	5898886	trumpeter swan	*Cygnus buccinator*	BP10	1	-
15-Jun	13	645064	5880197	Wilson's warbler	*Cardellina pusilla*	BP23	1	-

[(a)] Ecosites as described in Field Guide to the Ecosites of Saskatchewan's Provincial Forests (McLaughlan et al. 2010)

m = metre; NAD = North American Datum; UTM = Universal Transverse Mercator; '-' = not applicable; ARU = Acoustic recording unit; nc = not

Table C-2: Common Nighthawk (*Chordeiles minor*) Observations During Field Surveys, 2016

Sampling Date (2016)	UTM Coordinates (NAD 83)			Habitat Type[(a)]	Number Observed	Comments
	Zone	Easting (m)	Northing (m)			
14-Jun	13	641270	5888936	BP14	2	-
26-Jun	13	641270	5888936	BP14	2	-
26-Jun	13	641194	5886628	BP23	2	2+ individuals heard on ARU recording
26-Jun	13	641274	5885741	BP14	2	2+ individuals heard on ARU recording
28-Jun	13	634264	5897407	BP28	1	-
28-Jun	13	640743	5887774	BP14	1	1+ individuals heard on ARU recording

[(a)] Ecosites as described in Field Guide to the Ecosites of Saskatchewan's Provincial Forests (McLaughlan et al. 2010)
m = metre; NAD = North American Datum; UTM = Universal Transverse Mercator; '-' = not applicable; ARU = acoustic recording unit.

Table C-3: Amphibian Observations During Amphibian Calling Surveys, 2016

Plot Identifier	Sampling Date (2016)	UTM Coordinates (NAD 83)			Habitat Type[a]	Common Name	Scientific Name	Calling Index[b]
		Zone	Easting (m)	Northing (m)				
PRAMPH1	29-Apr	13	639252	5894083	BP15	boreal chorus frog	*Pseudacris maculata*	1
PRAMPH1	29-Apr	13	639252	5894083	BP15	wood frog	*Rana sylvatica*	2
PRAMPH1	14-May	13	639252	5894083	BP15	boreal chorus frog	*Pseudacris maculata*	2
PRAMPH1	31-May	13	639252	5894083	BP15	boreal chorus frog	*Pseudacris maculata*	1
PRAMPH2	29-Apr	13	638117	5894665	BP15	boreal chorus frog	*Pseudacris maculata*	3
PRAMPH2	29-Apr	13	638117	5894665	BP15	wood frog	*Rana sylvatica*	3
PRAMPH2	14-May	13	638117	5894665	BP15	boreal chorus frog	*Pseudacris maculata*	2
PRAMPH2	14-May	13	638117	5894665	BP15	wood frog	*Rana sylvatica*	1
PRAMPH2	31-May	13	638117	5894665	BP15	boreal chorus frog	*Pseudacris maculata*	2
PRAMPH3	29-Apr	13	636338	5895469	BP15	boreal chorus frog	*Pseudacris maculata*	3
PRAMPH3	29-Apr	13	636338	5895469	BP15	wood frog	*Rana sylvatica*	3
PRAMPH3	14-May	13	636338	5895469	BP15	boreal chorus frog	*Pseudacris maculata*	3
PRAMPH3	31-May	13	636338	5895469	BP15	boreal chorus frog	*Pseudacris maculata*	3
PRAMPH4	29-Apr	13	634264	5897407	BP28	wood frog	*Rana sylvatica*	3
PRAMPH4	14-May	13	634264	5897407	BP28	boreal chorus frog	*Pseudacris maculata*	3
PRAMPH4	14-May	13	634264	5897407	BP28	wood frog	*Rana sylvatica*	2
PRAMPH5	29-Apr	13	634133	5898232	BP10	boreal chorus frog	*Pseudacris maculata*	3
PRAMPH5	29-Apr	13	634133	5898232	BP10	wood frog	*Rana sylvatica*	2
PRAMPH5	14-May	13	634133	5898232	BP10	boreal chorus frog	*Pseudacris maculata*	3
PRAMPH6	29-Apr	13	634186	5899170	BP25	boreal chorus frog	*Pseudacris maculata*	3
PRAMPH6	29-Apr	13	634186	5899170	BP25	wood frog	*Rana sylvatica*	2
PRAMPH6	14-May	13	634186	5899170	BP25	boreal chorus frog	*Pseudacris maculata*	3
PRAMPH6	31-May	13	634186	5899170	BP25	boreal chorus frog	*Pseudacris maculata*	1
PRAMPH7	29-Apr	13	634036	5900355	BP16	boreal chorus frog	*Pseudacris maculata*	3
PRAMPH7	29-Apr	13	634036	5900355	BP16	wood frog	*Rana sylvatica*	3
PRAMPH7	14-May	13	634036	5900355	BP16	boreal chorus frog	*Pseudacris maculata*	3
PRAMPH7	14-May	13	634036	5900355	BP16	wood frog	*Rana sylvatica*	1

Table C-3: Amphibian Observations During Amphibian Calling Surveys, 2016

Plot Identifier	Sampling Date (2016)	UTM Coordinates (NAD 83)			Habitat Type[a]	Common Name	Scientific Name	Calling Index[b]
		Zone	Easting (m)	Northing (m)				
PRAMPH7	31-May	13	634036	5900355	BP16	boreal chorus frog	*Pseudacris maculata*	2
PRAMPH8	29-Apr	13	633282	5902494	BP6	boreal chorus frog	*Pseudacris maculata*	3
PRAMPH8	29-Apr	13	633282	5902494	BP6	wood frog	*Rana sylvatica*	2
PRAMPH8	14-May	13	633282	5902494	BP6	boreal chorus frog	*Pseudacris maculata*	3
PRAMPH8	14-May	13	633282	5902494	BP6	wood frog	*Rana sylvatica*	1
PRAMPH9	14-May	13	633460	5901474	BP6	boreal chorus frog	*Pseudacris maculata*	3
PRAMPH9	14-Jun	13	633460	5901474	BP6	wood frog	*Rana sylvatica*	1
PRARU1	22-May	13	641194	5886628	BP23	boreal chorus frog	*Pseudacris maculata*	1
PRARU2	14-May	13	642958	5883648	BP25	wood frog	*Rana sylvatica*	1
PRARU2	22-May	13	642958	5883648	BP25	wood frog	*Rana sylvatica*	1
PRARU7	14-May	13	640743	5887774	BP14	boreal chorus frog	*Pseudacris maculata*	2
PRARU7	14-May	13	640743	5887774	BP14	wood frog	*Rana sylvatica*	1
PRARU7	22-May	13	640743	5887774	BP14	boreal chorus frog	*Pseudacris maculata*	3
PRARU7	31-May	13	640743	5887774	BP14	boreal chorus frog	*Pseudacris maculata*	3
PRARU7	31-May	13	640743	5887774	BP14	wood frog	*Rana sylvatica*	1
PRARU8	17-May	13	641270	5888936	BP14	boreal chorus frog	*Pseudacris maculata*	2
PRARU8	17-May	13	641270	5888936	BP14	wood frog	*Rana sylvatica*	2
PRARU8	22-May	13	641270	5888936	BP14	boreal chorus frog	*Pseudacris maculata*	3
PRARU8	31-May	13	641270	5888936	BP14	boreal chorus frog	*Pseudacris maculata*	2
PRAMPH1	29-Apr	13	639252	5894083	BP15	boreal chorus frog	*Pseudacris maculata*	1
PRAMPH1	29-Apr	13	639252	5894083	BP15	wood frog	*Rana sylvatica*	2

[a] Ecosites as described in Field Guide to the Ecosites of Saskatchewan's Provincial Forests (McLaughlan et al. 2010)

[b] Calling Index 1 = Individuals can be counted (e.g., 1-3 animals); Calling Index 2 = Individual calls can be distinguished but there is some call overlap (e.g., 4-7 animals); Calling Index 3 = Full chorus, calls are overlapping (e.g., 8 or more animals).

NAD = North American Datum; UTM= U niversal Transverse Mercator; m = metre.

APPENDIX D

Heritage Requirement Letter
Heritage Clearance Letter

Ministry of Parks, Culture and Sport

Heritage Conservation Branch
2nd Floor, 3211 Albert Street
Regina, Saskatchewan
S4S 5W6

(306) 787-5774
nathan.friesen@gov.sk.ca

March 7, 2016

Our File: 16-637

Mr. Patrick Young
Golder Associates Ltd.
1721 8th Street East
SASKATOON SK S7H 0T4

Dear Mr. Young:

RE: Berger Peat Moss Ltd. Peat Harvesting Areas:
Big River, Prairie River and Saskola;
HERITAGE RESOURCE REVIEW

Thank you for referring this development proposal to our office for heritage resource review.

In determining the need for, and scope of, heritage resource impact assessment (HRIA) pursuant to S. 63 of *The Heritage Property Act*, the following factors were considered: the presence of previously recorded heritage sites, the area's overall heritage resource potential, the extent of previous land disturbance, and the scope of new proposed land development.

No HRIA Required - Big River Harvesting Area
There are no known archaeological sites located in potential conflict with this proposed development. The harvesting area is not located within 250 m of major water sources. As such, the heritage potential for this project is considered to be low. Accordingly, an HRIA is not required for this development.

HRIA Required - Prairie River Harvesting Area
There are no known archaeological sites located in potential conflict with this proposed development. However, this harvesting area is located within 250 m of unnamed creeks and Buckmayer Lake. As such, the heritage potential for this project is considered to be moderate to high. Accordingly, an HRIA is required only for the portions of this development that are located within 250 m of Buckmayer Lake and the unnamed creeks.

HRIA Required - Saskola Harvesting Area
There is one known archaeological site located in conflict with this proposed development, namely site FcMp-7. However, this site consists of a single artifact find and has low heritage significance. This harvesting area is located within 250 m of

Acid-free Paper

unnamed creeks. As such, the heritage potential for this project is considered to be moderate to high. Accordingly, an HRIA is required only for the portions of this development that are located within 250 m of the unnamed creeks.

The HRIA study, including systematic pedestrian survey and sub-surface test exploration, is a proponent responsibility. The study will first establish the presence of heritage sites within the project area, as well as where suitable site avoidance measures (including the right-of-way relocation) may be implemented. The study will also establish the content, structure, and importance of those heritage sites located in unavoidable conflict with development. On that basis, both the need for and scope of any mitigation follow-up (including archaeological salvage excavation or other preservation action) will be determined. The HRIA must be carried out by qualified personnel under an approved investigation permit issued through this office. Normally, two days are required to process a heritage contractor's permit application.

Assuming weather conditions and surface visibility are favourable, a conventional HRIA, including routine pedestrian reconnaissance and subsurface testing, is required prior to construction. However, if field conditions are limiting (e.g. by snow cover and ground frost), a conventional HRIA may not be possible. Under these conditions, a qualified consulting archaeologist should be on-site to carefully monitor snow and topsoil stripping in all sensitive areas. Monitoring will ensure that if heritage resources are uncovered during construction, they can be immediately assessed, and, if deemed significant, any further destruction can perhaps be averted. The need for any follow-up investigation next spring (e.g. post-impact assessment, compensatory salvage, or other conservation action) will also be determined at this time.

If you have any questions regarding these projects, please do not hesitate to contact me or Jennifer Thompson at the above address or by calling 787-2848.

Sincerely,

Nathan Friesen
Senior Archaeologist
Archaeological Resource Management

Government of Saskatchewan

Ministry of Parks Culture and Sport
Heritage Conservation Branch
2nd Floor, 3211 Albert Street
Regina, Saskatchewan
S4S 5W6

(306) 787-5774
nathan.friesen@gov.sk.ca

December 19, 2016

Our File: 16-637

Mr. Patrick Young
Golder Associates Ltd.
1721 8th Street East
SASKATOON SK S7H 0T4

Dear Mr. Young:

RE: Berger Peat Moss Ltd. Peat Harvesting Areas:
Prairie River and Saskola;
HERITAGE RESOURCE IMPACT ASSESSMENT RESULTS

Please be advised we received (December 16, 2016) the final report from Golder Associates Ltd. on the heritage resource impact assessment (HRIA) of these projects completed under Investigation Permit #16-094.

No new or previously recorded heritage sites were observed in the course of pedestrian survey construction monitoring, and subsurface testing of the development, despite the high potential of the area. Therefore, this office has no further concerns with these projects proceeding as planned.

On behalf of the Heritage Conservation Branch, please convey our appreciation to the developer for having commissioned this investigation, and for their continuing assistance and support in preserving Saskatchewan's archaeological heritage.

Sincerely,

Nathan Friesen
Senior Archaeologist
Archaeological Resource Management

As a global, employee-owned organisation with over 50 years of experience, Golder Associates is driven by our purpose to engineer earth's development while preserving earth's integrity. We deliver solutions that help our clients achieve their sustainable development goals by providing a wide range of independent consulting, design and construction services in our specialist areas of earth, environment and energy.

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