global environmental solutions

Magino Gold Project

Terrestrial Ecology Baseline Study

Technical Support Document

November 2016

PRODIGY GOLD INCORPORATED

Terrestrial Ecology Baseline Study

Technical Support Document

Prepared for:

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TECHNICAL SUPPORT DOCUMENT
MAGINO GOLD PROJECT

This document has been prepared by SLR International Corp. The material and data in this report entitled Terrestrial Ecology Baseline Study Technical Support Document for the Magino Gold Project, Wawa, Ontario, Canada, effective as of November 2016 were prepared, reviewed and approved by the following people:

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November 2016

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Date
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Date
November 2016

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FIGURES

TABLES

APPENDICES

ACRONYMS

%	Percent
Argonaut	Argonaut Gold Incorporated
ATV	All Terrain Vehicle
CEAA	Canadian Environmental Assessment Act
Class EA	Class Environmental Assessment
cm	centimetre
EA	Environmental Assessment
EIS	Environmental Impact Statement
EIS Guidelines	Environmental Impact Statement Guidelines
ELC	Ecological Land Classification
ESA	Endangered Species Act, 2007
ESR	Environmental Study Report
ha	hectare
km	kilometres
km²	square kilometre
km/hr	kilometer per hour
LSA	Local Study Area
m	metres
MMER	Metal Mining Effluent Regulation
MNDM	Ontario Ministry of Northern Development and Mines
MNRF	Ontario Ministry of Natural Resources and Forestry
Mt	millions of tonnes
NAD	North American Datum
PPS	Provincial Policy Statement
Prodigy	Prodigy Gold Incorporated
Project	Magino Gold Project
PSA	Project Study Area
RSA	Regional Study Area
SAR	Species at Risk
SARA	Species at Risk Act
SARO	Species at Risk in Ontario
SLR	SLR Consulting (Canada) Ltd.
SOCC	Species of Conservation Concern
SWH	Significant Wildlife Habitat
TMF	Tailings Management Facility
TSD	Technical Support Document
UTM	Universal Transverse Mercator
WNS	White-nose Syndrome
WRMF	Waste Rock Management Facility

GLOSSARY

Anthropogenic	Caused by human manipulation or activities; can be either constructional (e.g. artificial levee) or destructional (quarry).
Bedrock	The solid rock that underlies loose material, such as soil, sand, clay, or gravel.
Bog	Peat-covered areas or peat-filled depressions with a high water table and a surface carpet of mosses, chiefly sphagnum. The water table is at or near the surface in the spring, and slightly below during the remainder of the year. Bogs are generally highly acidic and low in biodiversity.
Boreal	Relating to the forest areas of the Northern Temperate Zone that are dominated by coniferous trees such as spruce, fir and pine.
Brownfield	Abandoned or underused industrial and commercial facilities available for re-use.
Ecosite	Landscape areas consisting of typical, recurring associations of vegetation and substrate combinations
Fen	Carbon accumulating wetlands (either peat or marl), or wetlands on carbonate substrates, with a persistent groundwater supply and characterized by indicator plant and moss species with low tree cover.
Glaciofluvial	Glaciofluvial deposits consist of material that has been transported, sorted and deposited by melt water from a glacier or inland ice sheet.
Igneous Rock	Igneous (volcanic) rock is formed through the cooling and solidification of magma or lava. Igneous rock may form with or without crystallization, either below the surface as intrusive (plutonic) rocks or on the surface as extrusive (volcanic) rocks.
Lichen	Numerous complex plantlike organisms made up of an alga and a fungus growing together on a solid surface.
Low-grade ore	The portion of mined ore with a lower gold content.
Metamorphic	The original rock is subjected to heat (temperatures greater than 150°C to 200°C) and pressure causing profound physical and/or chemical change.
Moraine	Accumulation of rock debris of any size carried by a glacier and deposited upon melting, often in ridges.
Ore	Blasted rock up to one meter in size containing gold.
Peat	Organic soil.
Podzol	The typical soils of coniferous or boreal forests.

Polishing Pond	Polishing ponds are designed to increase the environmental compatibility and quality of effluents from preceding treatments. Their primary purpose is to improve the quality of the water before it is recharged into natural stream and lakes.
Process Plant	Facilities including buildings, grinding mills, pipes, tanks, chemical feed, and electrical and control systems used to extract the gold from the ore.
Riparian Vegetation	Plant life and the ecosystem that exists along a waterway.
Sediment	A naturally occurring material that is broken down by processes of weathering and erosion and is subsequently transported by the action of wind, water, or ice.
Substrate	A surface on which an organism grows or is attached.
Tailings	The materials left over after the extraction and separation of valuable material from non-valuable material of an ore/rock.
Trophic Level	A group of organisms that occupy the same position in a food chain.
Wetlands	A land area that is saturated with water, either permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem.

1. INTRODUCTION

1.1 BACKGROUND

Prodigy Gold Incorporated (Prodigy) proposes to develop the Magino Gold Project (the Project), which is situated on a brownfields site that contains a past-producing underground gold mine, landfill, and tailings facility. The past-producing mine is considered "temporarily suspended" under the Ontario Mining Act, Regulation 240/00 and the associated Mine Rehabilitation Code of Ontario. Prodigy has submitted notification of intent to enter a stage of redevelopment to the Ministry of Northern Development and Mines (MNDM).

The Project is located in Northern Ontario, approximately 10 kilometres (km) southeast from the Town of Dubreuilville and 40 km northeast from Wawa. The Project involves the mining of approximately 105 to 150 million tonnes (Mt) of ore and approximately 400 to 445 Mt of mine rock from an open pit in the same location as the past-producing underground mine.

This Technical Support Document (TSD) has been prepared by SLR International (SLR) as one in a series of reports intended to support the environmental assessment (EA) processes being undertaken in accordance with relevant Federal and Provincial EA legislation.

The full series of TSDs that are being prepared in support these EA processes include the following:

- Atmospheric Environment
  - Meteorology and Air Quality
  - Noise
  - Vibration
  - Light
  - Climate Change
- Physical Environment
  - Surface and Subsurface Geology
    - Terrain and Soils
    - Geotechnical and Geohydrologic Investigation
    - Geotechnical
  - Groundwater
    - Groundwater Modeling
    - Geochemical Assessment
  - Surface Water
    - Site Water Balance and Quality
    - Surface Water Hydrology
    - Surface Water and Sediment Quality
  - Visual Analysis
- Biological Environment
  - Fish and Fish Habitat
  - **Terrestrial Ecology (This TSD)**
- Social and Economic Environment
  - Social and Economic
  - Archaeology
- Aboriginal Interests
- Human Health Risk Assessment

1.2 PURPOSE AND SCOPE

The purpose of this TSD is to describe the existing or baseline environmental conditions in fulfillment of the requirements of the Canadian Environmental Assessment Act (2012) as outlined in the Environmental Impact Statement Guidelines (EIS Guidelines) (CEAA, 2013) prepared for the Project by the Canadian Environmental Assessment Agency (the Agency). It is

also intended to fulfill the requirements of the Ontario Ministry of Natural Resources and Forestry (MNRF) Class Environmental Assessment for MNR Resource Stewardship and Facility Development Projects (the Class EA) (MNRF, 2003). A summary of the information provided in this TSD will form part of the main EA document (i.e., the Environmental Impact Statement (EIS) and Environmental Study Report (ESR)) to be prepared in relation to these two EA processes.

This TSD includes a description of existing environmental conditions in the context of three study areas: the Regional, Local, and Project Study Areas, where relevant. Emphasis has been placed on one or more study areas depending on the environmental components under consideration. This TSD is based on SLR's most current studies (summarized herein) and prior studies completed by others. The primary purpose of this TSD is to provide a description of methods used for establishing existing conditions, data reporting, and overall context setting. Details of impact assessment methods, assessment results, and conclusions are provided in the Environmental Impact Statement (EIS) / Environmental Study Report (ESR) or under separate cover.

2. PROJECT OVERVIEW

2.1 PROJECT PROPONENT

The Project proponent is Prodigy Gold Inc., a wholly-owned subsidiary of Argonaut Gold Inc. (Argonaut). Argonaut is a publicly-traded Canadian gold mining company engaged in exploration, mine development, and gold production.

In addition to the Magino Gold Project, Argonaut currently operates two 100%-owned gold mines, an advanced exploration project, and multiple exploration projects in Mexico.

2.2 PROJECT LOCATION

The Project is located in Finan Township, approximately 40 km northeast of Wawa, Ontario. The Town of Dubreuilville, with a population of over 600, is the closest community. Dubreuilville is located on Highway 519, approximately 30 km east of the junction of the Trans-Canada Highway and Highway 519. Mining and ore processing are currently being carried out in the vicinity of the Project. The Island Gold Mine (operated by Richmont Mines Inc.) is 1.5 km east of the property, the former Edwards Mine (Strike Minerals) approximately 8 km to the east, and the Eagle River Mine (Wesdome Gold Mines) is 80 km to the west. The Hemlo Operation (Barrick Gold Corp) is located approximately 150 km to the northwest.

The Project is located in the geological Wawa Subprovince of the Canadian Shield. It is centered at Universal Transverse Mercator (UTM) 689049E 5351422N (North American Datum [NAD] 83 Zone 16U). The Project location is shown on Figure 2-1.

2.3 PROJECT DESCRIPTION

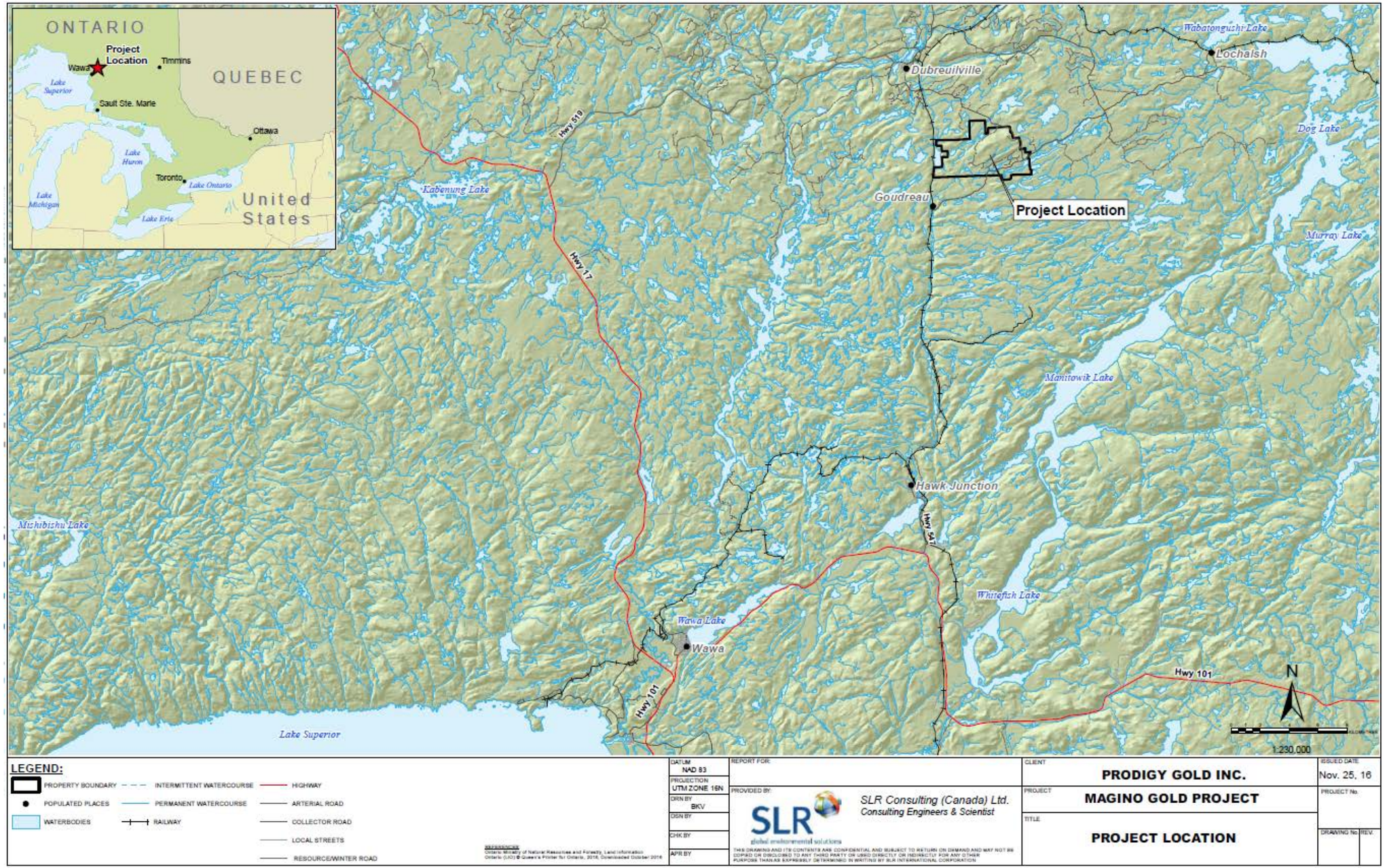
The Project will involve:

- Open pit mining;
- Construction, operation, and decommissioning (as appropriate) and/or closure of a rock crushing and ore process plant, various plant area facilities; crushed rock and low-grade ore stockpiles; overburden stockpiles, chemical, fuel and hazardous materials management and storage facilities; an explosives magazine; non-mining waste management facilities;
- Construction, operation, and closure of mine waste management area components, including a Tailings Management Facility (TMF) and Mine Rock Management Facility (MRMF);
- Construction, operation and decommissioning (as appropriate) of the enabling infrastructure for the Project, including: camp accommodation for workers, a landfill, Project roads (including a public by-pass road), electrical transmission lines and a substation, power generation equipment, potable water supply system, sewage treatment system, and site security features; and

- Construction, operation and decommissioning (as appropriate) of environmental management infrastructure on-site, including: a variety of surface water and ground water controls designed to minimize the effects on the environment to the maximum extent practicable.

While most of the old mine infrastructure has been removed, a number of additional closure measures are required. These additional measures include closure of the existing tailings facilities and other activities that deal with the industrial sewage works, the landfill, power lines, refuse, and some buildings. It is anticipated that the closure objectives for the existing infrastructure will be met concurrently with the development of the Project.

Figure 2-1: Regional Map



LEGEND:

- PROPERTY BOUNDARY
- POPULATED PLACES
- WATERBODIES
- INTERMITTENT WATERCOURSE
- PERMANENT WATERCOURSE
- RAILWAY
- HIGHWAY
- ARTERIAL ROAD
- COLLECTOR ROAD
- LOCAL STREETS
- RESOURCE/WINTER ROAD

REFERENCES
Ontario Ministry of Natural Resources and Forestry, Land Information Ontario (LIO) © Queen's Printer for Ontario, 2016, Downloaded October 2016

DATUM	NAD 83
PROJECTION	UTM ZONE 16N
DRN BY	BKV
DSN BY	
CHK BY	
APR BY	

REPORT FOR:

PROVIDED BY: SLR Consulting (Canada) Ltd. Consulting Engineers & Scientist

SLR global environmental solutions

CLIENT	PRODIGY GOLD INC.
PROJECT	MAGINO GOLD PROJECT
TITLE	PROJECT LOCATION
ISSUED DATE	Nov. 25, 16
PROJECT No.	
DRAWING No. / REV.	

2.4 PROJECT PHASES

The Project development schedule has been classified into five (5) distinct phases:

- Phase 1: Environmental Assessment and Permitting (Current Phase)
- Phase 2: Site Preparation;
- Phase 3: Construction;
- Phase 4: Operations - Mining and Processing; and
- Phase 5: Closure and Rehabilitation.

Following the completion of Phase 1 (i.e., the receipt of the applicable EA approval and other authorizations and permits), the Project is expected to extend over an approximately 18-year period.

Together, the Site Preparation (Phase 2) and Construction Phase (Phase 3) are expected to be approximately 3 years in duration. Site preparation will involve site clearing, grubbing and pre-stripping. During the site preparation phase, a number of items with potentially lengthy lead times will be procured, detailed engineering plans will be finalized, and sourcing of personnel will begin. Construction activities will involve the following works and activities:

- Closure of existing mine facilities;
- Topsoil and overburden stripping and stockpiling;
- Stream diversions, draining, and backfilling of on-site waterbodies;
- Construction of:
    - Enabling infrastructure (i.e., camp accommodations, landfill, public by-pass road, mine haul roads and service roads, electrical transmission lines and substation, potable and process water infrastructure, sewage treatment system and non-mining waste management facilities);
    - Plant area components;
    - Chemical, fuel and hazardous materials management facilities;
    - Mining waste management area components (i.e., Mine Rock Management; Facility, Tailings Management Facility); and
    - Environmental Management Infrastructure.

Full operations will commence immediately following the construction phase. Activities will include active mining from the open pit, ore stockpiling, processing of the ore, removal and placement of overburden and mine rock, equipment and facilities maintenance, various administrative activities and environmental monitoring. Mining is expected to be completed during the first 10 years of the operational phase. During this period approximately 105 to 150 Mt of ore and 400 to 445 Mt of mine rock will be mined. Approximately 45 Mt of the ore will be stockpiled for possible processing during the second half of the 12-year period of ore milling and processing.

Progressive rehabilitation will be undertaken throughout the life of the mine and will start as soon as feasible. It is assumed to begin during the final year of construction and continue through to the end of the operations phase. The Closure and Rehabilitation Phase (Phase 5) is expected to be approximately 3 years in duration. Upon cessation of mining, which will occur after approximately 10 years of operations, the pit will be allowed to fill with water to form a lake.

2.5 SPATIAL BOUNDARIES

Spatial boundaries define the geographical extents within which potential environmental changes may occur. Three scales are identified for the purposes of describing baseline conditions and assessing effects on the project environment: a Regional Study Area (RSA), a Local Study Area (LSA) and a Project Study Area (PSA) described in further detail below (Figure 2-1).

2.5.1 REGIONAL STUDY AREA

The RSA is defined by the subwatershed boundaries of the upper portion of the Dreany subwatershed, McVeigh Creek and drainage associated with the Herman-Otto Lakes basin, and a subwatershed of the Webb-Goudreau basin. This study area is approximately 11,120 ha (i.e., 110 km^2) in size and extends both upstream and beyond the potential downstream influence of mine operations. The RSA is set within Ecoregion 3E, Lake Abitibi, and Site District 3E-5 Foleyet. It falls within Wildlife Management Unit 32, includes portions of Bear Management Units WA-32-044, WA-32-010 and WA-32-002, and Baitfish Harvest Area WA00071.

The RSA includes representative diversity of lake size and depth and connecting watercourses supporting fish species preferring cold, cool, and warm water temperatures, multiple trophic levels, and feeding guilds. The RSA also represents the landscape context into which the Project is placed, and includes diverse elements and large scale factors such as extensive ranges for big game mammals. This study area exhibits diversity both in terms of natural features and functions and socio-economic features (e.g., hunt camps, former and existing mines, and forestry operations), for the assessment of cumulative effects.

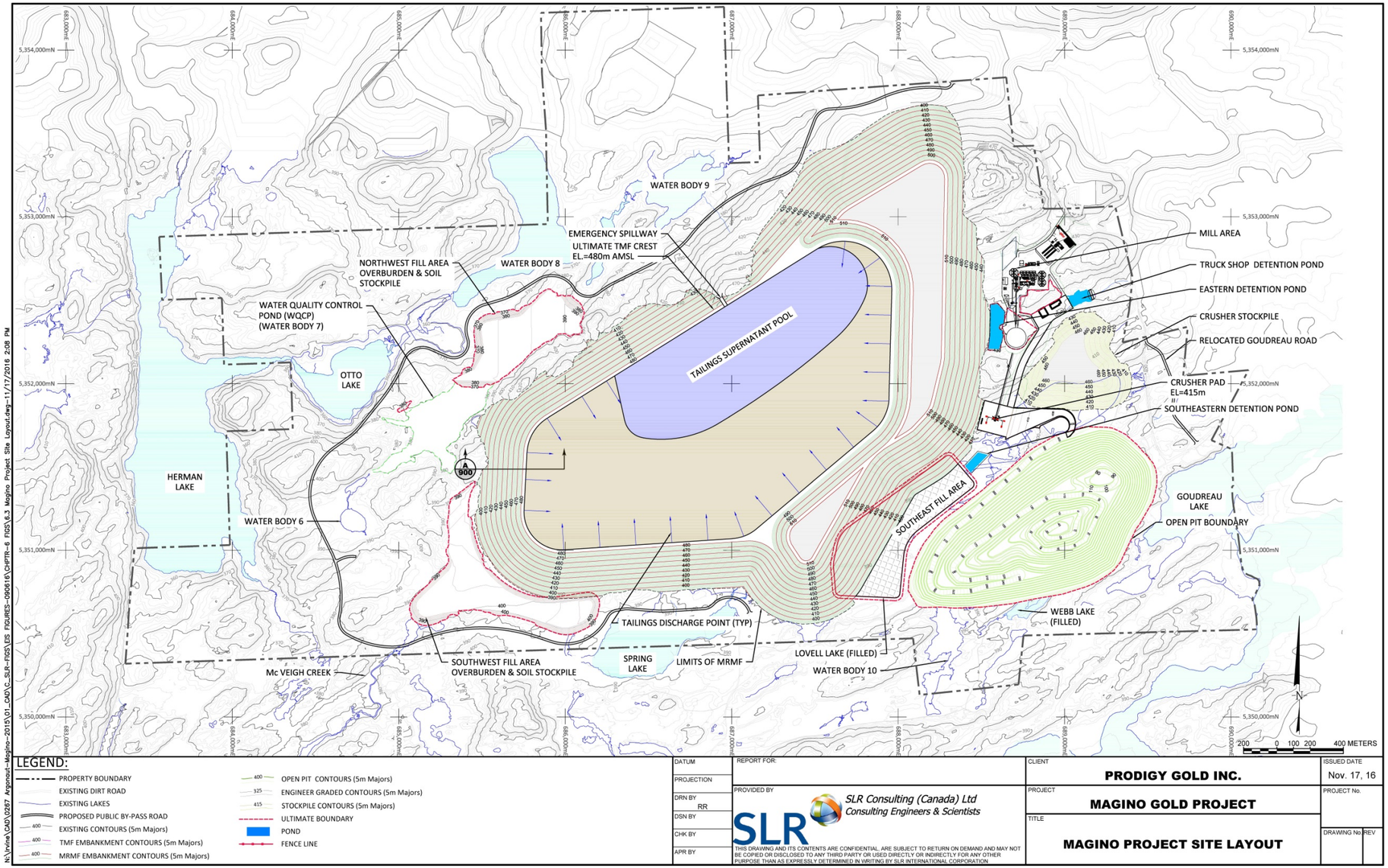
2.5.2 LOCAL STUDY AREA

The LSA is nested within the RSA, and is focused on the area in which direct and indirect effects of mine construction and operation may be expressed. This study area includes portions of the subwatersheds associated with the Herman-Otto, Spring-Lovell, and Webb-Goudreau, drainage. The LSA is approximately 3,623 ha (i.e., 36 km^2) in size and includes representative vegetation communities and wildlife habitat also present in the RSA. The northeast to southwest alignment of landforms defines the drainage basins and associated wetlands, and aligns vegetation, wildlife habitat, and natural linkages. The size of the LSA is intended to capture potential effects of the drainage from the mine project and terrestrial effects that may extend beyond the active mining operation such as blasting impacts, noise and vibration, light, odours, and changes in traffic and their transportation corridors. Most of the long term MMER monitoring will occur within the LSA to document the effectiveness of techniques and measures designed to mitigate the effects of mining construction, operations, and closure phases.

2.5.3 PROJECT STUDY AREA

The PSA for this assessment is approximately 1,802 ha (i.e., 18 km^2) in size and includes the pit area, the tailings area, and the mine rock management facility area.

Figure 2-2: Magino Project Site Layout



3. REGULATORY CONTEXT AND METHODS

3.1 REGULATORY CONTEXT

The key pieces of legislation relevant to the terrestrial environment are:

- *Provincial Endangered Species Act, 2007 (ESA, 2007) and the federal Species at Risk Act, 2002 (SARA) (Environment Canada);*
- *The Migratory Birds Convention Act, 1994;*
- *Fish and Wildlife Conservation Act,* 1997 (Ontario); and
- Provincial Policy Statement (2014), under the *Planning Act*, 1990 with respect to Significant Wildlife Habitat.

3.2 METHODS

Study types and methods were developed to describe the terrestrial environment in the Project area based on legislative requirements and scoped through consultation with Ministry of Natural Resources (MNRF) (Lebel, 2013). One of the primary outcomes of site investigations is to determine the presence/absence of species listed under the *Endangered Species Act, 2007 (Ontario)* and *the Species at Risk Act, 2002 (Environment Canada)* and to delineate habitat in the context of the Acts. Table 3-1 describes the surveys undertaken to comply with the relevant legislation.

Table 3-1: Surveys Conducted in Support of the Magino Gold Project

Legislation	Surveys
Endangered Species Act, 2007 (Ontario) and the Species at Risk Act, 2002 (Environment Canada)	Diurnal and nocturnal breeding bird surveys focused on specific identified species using MNRF survey protocols; floristic surveys focused on habitat for potential threatened and endangered species; acoustic bat monitoring, visual emergence surveys and searches for evidence of bat occupation and summer roosts.,
The Migratory Birds Convention Act	Diurnal and nocturnal breeding bird surveys, waterfowl surveys, and marsh bird surveys and casual encounter observations
Fish and Wildlife Conservation Act, 1997 (Ontario)	Incidental wildlife observations, as well as aerial raptor and raptor nest surveys; moose surveys and winter tracking surveys; mapping of beaver lodges and recording of track and scat evidence on trails.

Legislation	Surveys
Provincial Policy Statement (PPS), 2014, under the Planning Act, 1990 with respect to Significant Wildlife Habitat	Ecological Land Classification of all vegetation (including field cross referencing with guideline criteria), floristic inventory, diurnal and nocturnal breeding bird surveys, surveys targeted at Significant Wildlife Habitat as identified in Criteria for Ecoregion 3E including marsh bird surveys, waterfowl staging area surveys, amphibian surveys, mammal surveys, bat hibernacula and maternity roost surveys, and incidental wildlife observations.

Based on consultation with Ministry of Natural Resources and Forestry (MNRF) (S. Lebel, MNRF Species at Risk Biologist, Wawa), the key features to be assessed with targeted methodology are the Species at Risk (SAR) listed as Threatened or Endangered on Schedule 1 under SARA or listed on the Species at Risk in Ontario under ESA, 2007 as well as those species that fall within the categories of Special Concern and/or Species of Conservation Concern (SOCC). The habitat of the species of Special Concern triggers the designation of Significant Wildlife Habitat in the context of the Provincial Policy Statement. MNRF provides guidelines for designation of SWH that includes other habitat types. The refined list of SWH for Ecoregion 3E includes the following:

<u>Seasonal Concentration Areas of Animals</u>

- Moose Late Winter Cover;
- Waterfowl Stopover and Staging Areas (Terrestrial);
- Waterfowl Stopover and Staging Areas (Aquatic);
- Shorebird Migratory Stopover Area;
- Bat Hibernacula;
- Bat Maternity Colonies;
- Bat Migratory Stopover Area;
- Turtle Wintering Areas;
- Reptile Hibernacula;
- Colonially - Nesting Bird Breeding Habitat (Bank and Cliff) ;
- Colonially - Nesting Bird Breeding Habitat Breeding Habitat (Tree/Shrubs); and
- Colonially - Nesting Bird Breeding Habitat (Ground).

<u>Rare Vegetation Communities or Specialized Habitat for Wildlife</u>

Specialized Habitat for Wildlife

- Rare Vegetation Communities;
- Waterfowl Nesting Area;
- Bald Eagle and Osprey Nesting, Foraging and Perching Habitat;
- Woodland Raptor Nesting Habitat;
- Turtle Nesting Areas;
- Seeps and Springs;
- Moose Aquatic Feeding Habitat;
- Mineral Lick;
- Denning Sites for Mink, Otter, Marten Fisher and Eastern Wolf;
- Wolf Rendezvous Sites;

- Amphibian Breeding Habitat (Woodland);
- Amphibian Breeding Habitat (Wetlands);
- Mast Producing Areas; and
- Sharp-tailed Grouse Leks.

Habitat for Species of Conservation Concern (Not including Endangered or Threatened Species)

- Marsh Bird Breeding Habitat;
- Open Country Bird Breeding Habitat;
- Shrub/Early Successional Bird Breeding Habitat; and
- Special Concern and Rare Wildlife Species.

Animal Movement Corridors

- Amphibian Movement Corridors;
- Cervid Movement Corridors; and
- Furbearer Movement Corridor.

Surveys were conducted in appropriate seasons and weather conditions over a three year time frame (2012-2014) (Table 3-2) in order to document SAR and SWH. In the spring of 2012 surveys focused on Ecological Land Classification (ELC) of vegetation communities, aerial and ground based raptor and raptor nest surveys, diurnal and nocturnal breeding bird surveys, marsh bird surveys, waterfowl and waterbird surveys, incidental amphibian surveys an aerial moose survey. Two additional aerial moose surveys (for a total of three aerial moose surveys) were conducted in fall (October 15, 2012) and winter (February 2013). Two winter track surveys focused on Marten (*Martes americana*) occurred in February 2013.

Four surveys were conducted during the spring – summer of 2013 focused on documenting SAR and identification of input to closure planning. Surveys one and two primarily focused on diurnal and nocturnal breeding birds, marsh birds, and amphibians. Survey three focused on nocturnal breeding birds, amphibians, vegetation classification and rare vegetation communities and plants. Survey four focused on wetlands, rare vegetation and MNRF consultation regarding SAR. In August 2013, bat detectors were deployed by MNRF to survey for use of potential bat hibernacula at the historical mine adit and one raised vent.

Three surveys were conducted during the spring-summer of 2014. Different survey types were conducted during these three sampling events focused on SAR and input to closure planning. Survey one, conducted from May 16 – May 19, 2014, focused on Waterfowl Staging Area surveys and nocturnal bird surveys following MNRF protocol for Whip-poor-will (*Caprimulgus vociferous*). Survey two, conducted from June 8-June 12, 2014, focused on nocturnal bird surveys, bat exit surveys, bat and Chimney Swift (*Chaetura pelagica*) infrastructure surveys, and bat roosting surveys. Survey three, conducted from June 12 – June 17, 2014, focused on nocturnal birds and bat exit surveys. During all surveys, incidental wildlife observations were noted.

Table 3-2 Summary of Survey Types and Dates (indicated by grey areas)

Feature / Survey Type / Criteria	May 30 – Jun 10, 2012	Oct 15, 2012 - Feb 20, 2013	May 27 – Jun 1, 2013	Jun 17 – 21, 2013	Jul 8-13, 2013	Aug 27 – 29, 2013	May 16 – 19, 2014	Jun 8 – 12, 2014	Jun 12 – 17, 2014	Jun 18-22, 2016
Ecological Land Classification										
Rare Vegetation										
Breeding Birds										
Nocturnal Breeding Birds/Species at Risk										EASTERN WHIP-POOR-WILL
Waterfowl/ Marsh Birds							WATER-FOWL STAGING			
Raptor and Raptor Nest										
Moose		2 SURVEYS								
Marten										
Bat Hibernacula / Maternity Colonies						MNRF MONITORING (2 DAYS)			ON-GOING MONITORING APRIL-OTOBER 2014 AND MARCH-JUNE 2015	
Amphibians										
Incidental Wildlife	ALLSPECIES INCLUDING REPTILES									

3.2.1 VEGETATION COMMUNITIES

Plant communities provide an array of ecosystem services that include regulation of water and air quality, erosion control, and provide habitat for plant and wildlife species and populations and economic benefits. Vegetation patterns were classified in spring of 2012 based on 59 ground inspection points plus 196 aerial inspection points. Classification is based on MNRF ecological land classification (ELC) for Boreal Ecosites (Banton, 2012). Due to the heterogenerity of the vegetation patterns, polygons routinely were classified by the primary vegetation association with an inclusion of another. The label provides the code for both Ecosites with an estimate of percent inclusion. These classifications were verified in 2013 at random locations during other surveys, and targeted where the potential for rare elements was higher. These locations were selected to confirm mapping and to ensure that this approach provided sufficient information to undertake impact assessment. Particular attention was paid to wetlands and their soils, upland soils, and to determining whether the level of complexing of polygons was sufficient. The classification was visually confirmed (*i.e*., no data were collected, but general observations were matched to data) at the diurnal, nocturnal, and marsh bird survey locations. The ELC Field Collection Form is included in Appendix A.

3.2.2 FLORISTICS AND RARE VEGETATION SPECIES

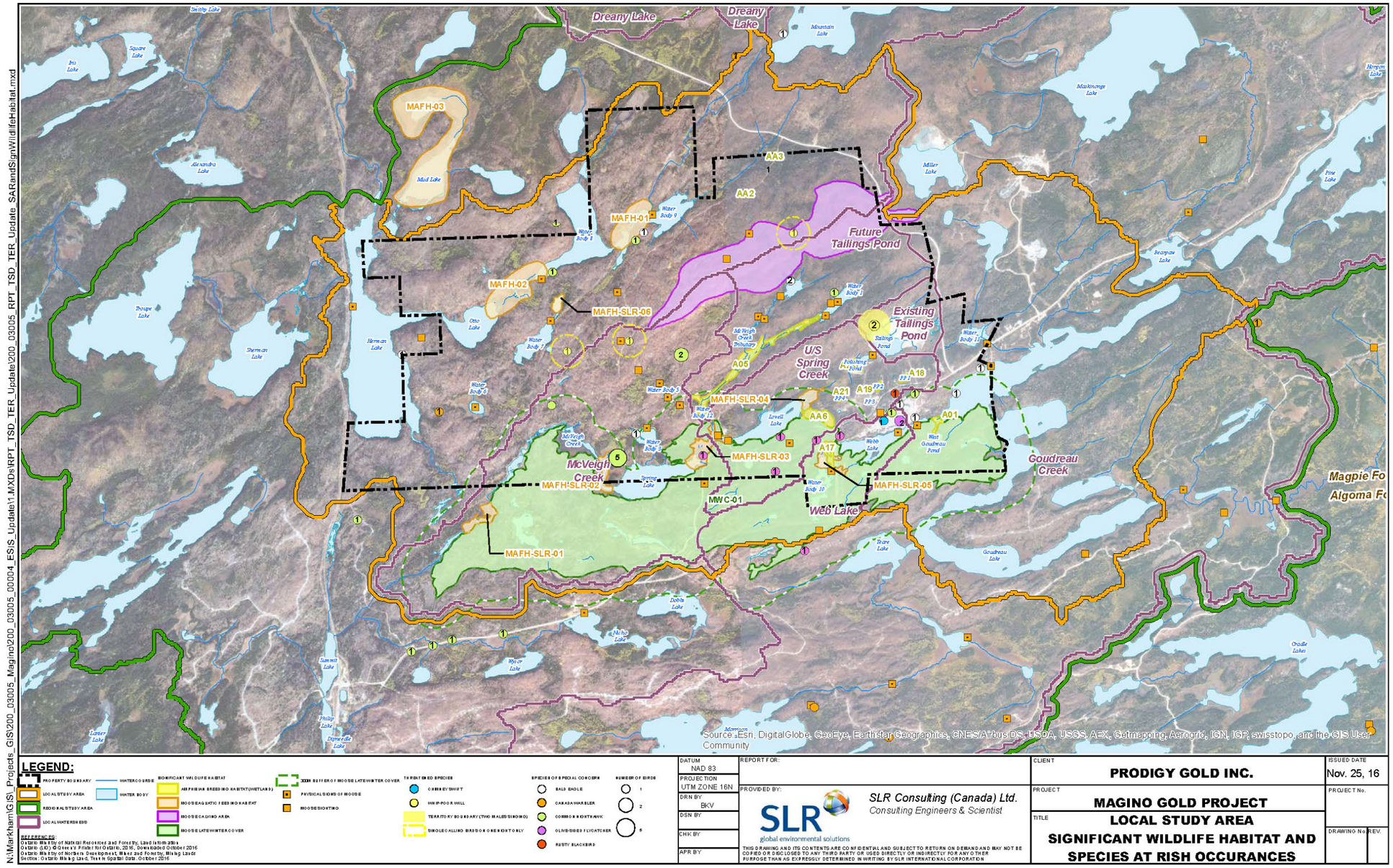
Plant species are indicative of ecological conditions and may be rare, threatened or endangered. Vegetation was sampled during field investigations in spring of 2012 and spring and summer of 2013. A list of potential rare plant species was developed and specific habitats were targeted to record presence/absence and abundance of species if present. MNRF (Lebel, 2013) was consulted with respect to a local list however there has not been one prepared. A list was derived from rare plants listed in Algoma District (Oldham, 2009) and is included in Appendix C. The final plant list was reviewed by Michael Oldham, Botanist, Natural Heritage Information Centre, Ontario Ministry of Natural Resources and Forestry. In 2013 vegetation classification was confirmed in the vicinity of diurnal, nocturnal, and marsh bird survey locations with emphasis on habitats that could include species on the rare plants list.

3.2.3 BREEDING BIRD SURVEYS

Breeding birds play an important ecological role, are indicative of ecological conditions, and many species are protected by legislation (ESA, 2007; SARA; PPS and Migratory Birds Convention Act). Point count surveys were conducted at 56 locations in the breeding season of 2012. Point count surveys were conducted at 83 locations during breeding season of 2013 during May and June surveys (Figure 3-1). A total of 139 survey locations between 2012 and 2013 were visited at least once.

Survey point locations were established in a grid pattern 300 to 500 m apart conforming to MNRF protocols (Konze, 1997). These locations were also used as nocturnal breeding bird survey locations. Listening time at each point was 5 minutes. The field collection form is included as Appendix A: Diurnal Breeding Bird Survey Form.

Figure 3-1: Survey Design



LEGEND:

PROPERTY BOUNDARY
LOCAL STUDY AREA
REGIONAL STUDY AREA
LOCAL WATERSHEDS
WATERCOURSE
WATER BODY

SIGNIFICANT WILDLIFE HABITAT
AMPHIBIAN BREEDING HABITAT(WETLAND)
MOOSE AQUATIC FEEDING HABITAT
MOOSE CALVING AREA
MOOSE LATE WINTER COVER

2KM BUFFER OF MOOSE LATE WINTER COVER
PHYSICAL SIGNS OF MOOSE
MOOSE SIGHTING

TERRESTRIAL SPECIES
CHIMNEY SWIFT
WHIP-POOR WILL
TERRITORY BOUNDARY (TWO MALES SHOWN)
SINGLE CALLING BREEDING ONE NIGHT ONLY

SPECIES OF SPECIAL CONCERN
BALD EAGLE
CANADA WARBLER
COMMON NIGHTHAWK
OLIVE-SIDED FLYCATCHER
RUSTY BLACKBIRD

NUMBER OF BIRDS
1
2
5

REFERENCES:
Ontario Ministry of Natural Resources and Forestry, Land Information Ontario
Ontario (LIO) © Crown Copyright for Ontario, 2016, Downloaded October 2016
Ontario Ministry of Northern Development, Mines and Forestry, Mining Lands Section: Ontario Mining Land, Tenure Spatial Data, October 2016

DATUM	NAD 83
PROJECTION	UTM ZONE 16N
DRN BY	BKV
DSN BY	
CHK BY	
APR BY	

REPORT FOR:

PROVIDED BY: SLR Consulting (Canada) Ltd. Consulting Engineers & Scientist

CLIENT: **PRODIGY GOLD INC.**

PROJECT: **MAGINO GOLD PROJECT**

TITLE: **LOCAL STUDY AREA SIGNIFICANT WILDLIFE HABITAT AND SPECIES AT RISH OCCURANCES**

ISSUED DATE: Nov. 25, 16

PROJECT No.

DRAWING No. | REV.

N:\Markham\GIS_Projects_GIS\200_03005_Magino\200_03005_00004_ESIS_Update\1.MXDs\RPT_TSD_TER_Update\200_03005_RPT_TSD_TER_Update_SARandSignWildlifeHabitat.mxd

3.2.4 NOCTURNAL BREEDING BIRDS: EASTERN WHIP-POOR-WILL AND COMMON NIGHTHAWK

Point count surveys (nocturnal) for Eastern Whip-poor-will and Common Nighthawk, SAR listed under the ESA, 2007 and SARA, were conducted at 26 stations along existing roads and trails in spring of 2012. Point count surveys were conducted during seven sampling events in spring-summer of 2012, 2013, and 2014 (one in 2012, three in 2013, and three in 2014). A total of 105 survey locations were visited at least once between 2012 and 2014. Sampling methods conformed to the draft protocol provided by MNRF (Lebel, 2013) in Ontario Ministry of Natural Resource and Forestry's (OMNRF) draft *Eastern Whip-poor-will Survey Protocol* (Appendix B). Surveys occurred during weeks that were one week either side of a full moon, when the moon phase was > 50%, and when the moon was above the horizon. Although surveys were conducted on most nights during the survey period, an effort was made to conduct the majority of surveys on nights where there was little to no cloud cover, wind was minimal (less than 3 on the Beaufort scale) and there was no precipitation. On survey nights, surveys started 15 minutes after sunset and continued for an average of three to four hours.

Survey point locations were established in a grid pattern, 300 to 500 m apart, along existing trails, or slightly off trails in some locations. These locations were also used as morning breeding bird survey locations, when pictures and habitat notes were also recorded. Listening time at each point was five minutes. When either species was heard, a compass bearing and estimated distance was recorded.

Nocturnal surveys were conducted in 2016 for Eastern Whip-poor-will. Five-minute acoustic survey stations were spaced approximately 300-500 m apart at the Project site along trails where access permitted (Appendix E).

The first survey was on June 18-19, 2016 with sunset at 21:41 EST. The second survey was conducted on the night of June 21-22, with sunset at 21:47. Surveys commenced 15 minutes after sunset.

3.2.5 MARSH BIRDS

Call back point count surveys were conducted at seven locations during the breeding season of 2012 and at 19 locations during breeding season of 2013 during May and June surveys (Figure 3-1). A total of 28 survey locations were visited at least once during 2012-2013. High quality habitat and locations where individuals were noted were visited on three occasions, during each of the sampling rounds. Survey protocols followed the Marsh Bird Monitoring Program (Konze, 1997), including habitat descriptions. Species calls were broadcast using standard protocol for the following species: Yellow Rail, Virginia Rail, American Bittern, American Coot, and Pied-Billed Grebe. Inventory occurred in the evening in suitable weather. The Marsh Bird field collection form included as Appendix A: Marsh Bird Field Collection Form.

3.2.6 WATERFOWL

Waterfowl are a group of species with a unique ecological niche and are managed under the Fish and Wildlife Conservation Act, Migratory Birds Convention Act and the PPS. Waterfowl are managed under the Migratory Birds Convention Act and staging areas may qualify as Significant Wildlife Habitat. Waterfowl surveys were conducted in June 2012 at 15 waterbodies. Surveys were conducted by 15 minute observation periods at waterbodies as well as zodiac surveys at waterbodies with boat access. Waterfowl species were observed as incidental wildlife during 2013 surveys.

Waterfowl Stopover and Staging Areas are potential Significant Wildlife Habitat under the PPS. Waterfowl require areas to rest and eat during migration. Waterfowl staging surveys methodology is not prescribed by MNRF, therefore SLR developed a methodology to determine whether waterbodies may be classified as Significant Wildlife Habitat. Significant Wildlife Habitat as described by the Ecoregion 3E Criterion Schedule is defined as aggregations of 100 or more individuals of listed species for seven days, resulting in >700 waterfowl use days. The criterion schedule references the "Bird and Bird Habitats: Guidelines for Wind Power Projects (MNRF)" for evaluation methods. The provided methodology is not very specific, but it clarifies that: "The objective of the survey should be to estimate the total number of individuals of each species in the area on a particular visit". Konze (1997) also provides some guidance. The survey methodology adapted by SLR described below meets this intent.

Surveys were completed during daylight hours between May 16 – May 19, 2014. Lake ice melted from waterbodies less than a week prior to these surveys, presenting ideal survey conditions. Ecologists conducted surveys from two locations: from a distance and from shore. Waterfowl are easily flushed, therefore it was important to approach survey areas quietly. SLR ecologists stopped All Terrain Vehicles (ATVs) at a distance then quietly approached a vantage point from which they could see the waterbody to be surveyed, then used scopes and binoculars to survey the waterbody. Ecologists then quietly approached the shoreline to establish a shoreline observation point. From this location, a slow methodical visual survey was employed, covering the waterbody and shore in sections. The entirety of waterbodies was observed from shore by going to multiple observation points if required.

Surveys focused on waterbodies for which direct impacts are anticipated by mine activities: Wetlands 1, 2, 4, 5, 6, 10, and the following waterbodies: Spring Lake, Lovell Lake, Webb Lake, Goudreau Lake, Tailings Pond, and Polishing Pond (Figure 3-1).

3.2.7 RAPTOR AND RAPTOR NESTS

Raptors are an integral part of the food chain and influence local ecology and include some SAR. Raptor nests were surveyed via helicopter during aerial surveys conducted on June 22, 2012. Fourteen transects were arranged in a north-south pattern spaced one km apart. They were flown at an altitude of approximately 45-90 m and approximately 65-80 km/hr. Raptors were recorded during the breeding bird surveys, and recorded when encountered during all biological surveys in 2013.

3.2.8 REPTILES AND AMPHIBIANS

Amphibians play an important role in ecosystem function and are therefore considered in the assessment of significant wildlife habitat, as guided by the PPS. Amphibians were observed incidentally during June 2012 surveys and through three formal surveys in spring-summer of 2013. Sampling methods conformed to the Marsh Bird Monitoring Protocol (Konze, 1997). Survey locations were determined by locating wetlands and open water on aerial photography and identification of further suitable habitat during field surveys. A total of 31 survey locations were visited at least once. Locations where high quality habitat was noted were visited on more than one occasion, whereas one visit to a poor quality location was sufficient to determine a very low likelihood of significance and that no further sampling was required. The survey data collection form is included as Appendix A.

No formal surveys were undertaken for reptiles, but they were recorded when observed through incidental wildlife observation from biologists as well as other staff members conducting various studies.

3.2.9 MAMMALS

Aerial surveys focused on Moose (*Alces americanus*) and wolves, but also recorded occurrences of beaver lodges and dams. Winter track surveys were conducted for Marten. The majority of mammal data were collected through incidental wildlife observations and reports from staff members performing other work in the Study Areas. Observations of tracks and scat were recorded.

3.2.9.1 Moose

Moose is a charismatic species and are important to residents of the local area. Moose are considered game animals under the Ontario Fish and Wildlife Conservation Act. Three aerial surveys for moose were conducted, one on each of June 22, 2012, October 15, 2012 and February 2013. Fourteen transects were spaced one km apart, were arranged in a north-south pattern, and were flown at an altitude of approximately 45-90 m and approximately 65-80 km/hr. Encounters of moose and moose sign were recorded as incidental wildlife.

3.2.9.2 Marten

Marten is a Provincially Featured Species and their habitats are managed on Crown Lands. Winter track surveys were conducted on February 20 and 21, 2013 to randomly sample two representative stands identified by Dubreuil Forest Products Limited as patches of suitable habitat for Marten. Marten tracks were recorded using an intercept method over approximately 400 m of transect.

3.2.9.3 Bats

Bats are ecologically important as they are seed dispersers, pollinators, and insect eaters. Some bat populations are declining in Ontario and four species are SAR due to White-nose

Syndrome (WNS). Bat hibernacula and maternity colonies are potential Significant Wildlife Habitat for species not listed by SARA or ESA, 2007. Table 3-3 provides a summary of survey effort that is described in further detail below.

Table 3-3: Summary of Bat Survey Effort

DATE	EQUIPMENT	LOCATION
August 27-28, 2013	ecoObs Batcorders, V. 2.0 (2 units)	Outside the adit door, and outside the mine door
August 28-29, 2013	ecoObs Batcorder, V. 2.0	raised mine vent north of adit
August 28, 2013	Visual assessment	Second mine vent
April 9, 2014 – October 2014	SM3BAT+ Acoustic Monitor (Wildlife Acoustics)	Inside adit at the junction with the portal and 2.5 m outside the “man door”
June 9, 12 and 14, 2014	Exit Surveys	Mine adit and Building 9 – historical cyanide treatment area
June 11, 2014	Bat Roost Surveys; snag density surveys in adjacent forest	All Buildings and infrastructure associated with historical mining and forest stands within 500m
March 2015 – June 2015	SM2 bat detector (Wildlife Acoustics)	As above

Bat Hibernacula Investigation

On August 27, 2013 the Ministry of Natural Resources met with SLR at the mine adit to evaluate the potential access/egress for bats. The orientation of the openings, reports of the shallow cave chamber due to flooding and lack of evidence of bat activity (*e.g.*, droppings) suggested that the mine was being used (H. Riddell, MNRF Biologist).

Two ecoObs Batcorders, V. 2.0 were placed outside the adit door, and outside the mine door (UTM 16U 0689067 5351023). The bat detectors were set to record bats during the night to confirm absence or detect bat activity. The detectors were retrieved on August 28, 2013.

The mine vents were examined for potential bat usage. The vent north of the east-west access road between Webb Lake and the Polishing Pond appeared to have potential, although it is reported to be flooded 10m below surface. A bat detector was placed outside of the raised vent (UTM 16U 0688686 5351144) on August 28, 2013 and retrieved on August 29, 2013. The second vent was deemed to be unsuitable (i.e., the vent at which the pump test is scheduled to occur in 2014).

Both bat detectors were returned to MNRF where the recordings were downloaded and analyzed. These recordings were provided to SLR.

On April 9, 2014, the SLR biologist with expertise in bat ecology met MNRF at the adit to install a SM3BAT+ Acoustic Monitor with two microphones mounted internal and external to the adit. Please refer to Appendix G: Bat Survey Results 2014-2015 for details. Monitoring continued until October 2014.

SM2 bat detector (Wildlife Acoustics) with internal and external microphones was placed in the same positions in March 2015. However in contrast to the SM3 it should be noted that both SM2 microphones were omnidirectional; the internal microphone was not fitted with a horn attachment which increased the potential for the internal microphone to detect calls from outside the adit. This SM2 unit was run continuously from 19 March to 20 June 2015.

Bat Exit Surveys (Bat Maternity Colonies)

Visual exit surveys occurred outside the mine adit and adjacent to the historical cyanide treatment area (Figure 3-1). Surveys occurred on June 9, June 12, and June 14, 2014 at sunset (between 10:00 pm – 11:00 pm) and after nocturnal bird surveys (between 1:30 am – 2:30 am) on each survey night with the exception of June 14, when only a sunset survey was completed. The moon was up and visible during the 1:30 AM -2:30 AM surveys. Surveyors observed the mine adit and historical cyanide treatment areas for 45 minutes during each survey (Hundt, 2012).

Bat Roost Surveys (Bat Maternity Colonies)

Buildings and old mine infrastructure provide potential habitat for bat roosting. On June 11, 2014, buildings and infrastructure were investigated for bats between 1:00 pm and 5:00 pm. Buildings 1-9 ("Building 5" is an historical cyanide treatment machine and associated timber frame rock pile) were investigated (Figure 3-1). All openings and crevices in buildings were visually inspected by naked eye and using binoculars for droppings or other evidence of occupation.

Mature deciduous or mixed forest stands with large wildlife trees (standing dead trees known as snags) provide potential maternity colony habitat. The Significant Wildlife Habitat Ecoregion 3E criteria (MNRF 2012) suggest that a density of >10 snags/ha with diameters >25 cm are required to constitute significant roost habitat. SLR ecologists walked transects through four mixed wood forest stands within 500 m from the old mine adit to document snag density (Figure 3-1).

3.2.9.4 Other Mammals

Incidental encounters with mammals (*e.g*., Lynx (*Lynx canadensis*), American Black Bear (*Ursus americanus*), Red Fox (*Vulpes vulpes*)) and other wildlife, as well as wildlife evidence (*e.g*., tracks, spoor) were documented during the focused surveys described above. A standardized form for collection of these data (Appendix A was distributed to all field staff associated with the project, including terrestrial and aquatic ecologists, hydrogeologists and technicians, including mine staff. The aquatic biologists recorded and mapped all beaver lodges encountered. Beaver (*Castor canadensis*). Beaver are furbearers under the Ontario Fish and Wildlife Conservation Act, economically important to some residents of the local area, and a charismatic species that greatly influences local watershed functions.

3.2.10 SIGNIFICANT WILDLIFE HABITAT

Significant Wildlife Habitat (SWH) is defined as an area "*where species concentrate at a vulnerable point in their annual or life cycle; and areas which are important to migratory or non-migratory species*" (OMNRF, 2000). Significant Wildlife Habitat is protected under section 2.1.4 of the PPS that directs that site alteration shall not occur "unless it has been demonstrated that there will be no *negative impacts* on the natural features or their *ecological functions*". MNRF provides specific criteria for identification of SWH in Ecoregion 3E (MNRF 2012). The surveys described above provide data inputs to determine significance of defined habitats. Fine scale attributes of habitat defined in the criterion schedule require specific observation at potentially significant sites. A list of ecological attributes that define significant wildlife habitat was used during field surveys to identify key attributes (Appendix A). Some of the criteria rely on vegetation types as an indication that there may be associated significant wildlife habitat due to the implied habitat composition and structure. The listed candidate vegetation units were compared to the vegetation mapping to identify SWH in the context of Ecoregion 3E.

3.3 QUALITY ASSURANCE

All studies were undertaken using standard industry protocols that are appropriate to the Ontario context and tailored to the flora and fauna expected to occur within the study area.

Vegetation communities were classified according to the *Operational Draft of Ecosites of Ontario, 2009,* by the Ecological Land Classification Working Group (Erin Banton, John Johnson, Harold Lee, Gerry Racey, Peter Uhlig and Monique Wester). Some concepts were incorporated into the inventory from *Vegetation Resources Inventory Ground Sampling, VRI Ground Sampling Procedures. Version 4.9.1*. 2012 (Resource Information Committee, B.C.) and *Standard for Terrestrial Ecosystem Mapping in British Columbia*, 1998 (Resource Inventory Committee, B.C.) Steve Lebel, SAR Biologist, Ministry of Natural Resources, Wawa, Ontario was consulted with respect to characteristic vegetation and/or rarities in Algoma District. The list of potential species that are rare in the study area was derived from *Rare Vascular Plants of Ontario, 2009* (M. Oldham, Natural Heritage Information Centre, Ministry of Natural Resources, Peterborough) and Michael Oldham kindly reviewed the species list and provided comments.

Faunal surveys are based on *Wildlife Monitoring Programs and Inventory Techniques for Ontario, 1997*, by Karl Konze for the Ontario Ministry of Natural Resources. Northeast Science and Technology. Additional advice was derived from the following:

- Bird Studies Canada, Environment Canada, and the U.S. Environmental Protection Agency, 2009. Marsh Monitoring Program Participant's Handbook for Surveying Marsh Birds. Bird Studies Canada;
- Bird Studies Canada, Marsh Monitoring Program, 2000. The Marsh Monitoring Program Quality Assurance Project Plan. Prepared for the U.S. Environmental Protection Agency, Great Lakes National Program Office, Chicago, Illinois;
- Canadian Wildlife Service, 2007. Standardized Protocol for the Survey of Yellow Rails (*Coturnicops noveboracensis*) in Prairie and Northern Region. (Bazin, R. and F.B. Baldwin);

- Canadian Wildlife Service, 2011. Forest Bird Monitoring Program Survey Instructions & Codes;
- Conway, C. J., 2009. Standardized North American Marsh Bird Monitoring Protocol; OMNRMNRF, 2000. Significant Wildlife Habitat: Technical Guide. Ontario Government, Ministry of Natural Resources as well as the 2012 Ecoregion 3E SWH Criterion; and
- Hundt, L., 2012. Bat Surveys: Good Practice Guidelines, 2nd Edition. Bat Conservation Trust;
- OMNRMNRF, 2011. Bats and Bat Habitats: Guidelines for Wind Power Projects;
- OMNRMNRF, 2011. Bird and Bird Habitat: Guidelines for Wind Power Projects;
- Oswald, K., 1997. Moose Aerial Observation Manual. Ontario Ministry of Natural Resources, Northeast Science & Technology.

Methods with respect to survey of aerial feeders were derived originally from Inventory Methods for Nighthawk and Poorwill. Standards for Components of British Columbia's Biodiversity, No. 9. 1998 (British Columbia Ministry of Environment, Lands and Parks) and Ontario Whip-poor-will Roadside Survey, 2012 (Bird Studies Canada). After detection of Whip-poor-will in 2013, the draft protocol for investigation of Whip-poor-will Habitat in the context of the Endangered Species Act, 2007 was provided by Steve Lebel (MNRF, *pers. comm*.).

Bat survey methods are derived from Hundt, L., 2012. Bat Surveys: Good Practice Guidelines, 2nd Edition, Bat Conservation Trust, as modified through consultation with MNRF (Lesley Hale, Pers. Comm., MNRF Peterborough, 2013).

4. DESCRIPTION OF EXISTING CONDITIONS

This section describes baseline terrestrial environmental conditions from field studies conducted in 2012 and 2013. The purpose of this section is to provide an inventory of the existing features and functions of vegetation and wildlife communities within the subject lands, and the landscape context. This is the baseline against which the effects of the mining operation will be compared in order to identify impacts and ultimately identify a mitigation plan to be implemented progressively and in concordance with the Closure Plan.

This description is organized by starting with the Regional Study Area, followed by the Local Study Area. The LSA has been broken into the portions of the three subwatersheds that define the area.

4.1 REGIONAL STUDY AREA

The Precambrian Shield underlies the RSA, a landform that extends from the Hudson Bay Lowlands in the north to the Kawartha Lakes in the South, sweeping across the continent in an arc. The thin soils over metamorphic and igneous rock, the declining average temperatures and shorter days shifts vegetation from deciduous and mixed forests to predominantly coniferous under natural conditions.

The RSA is located within Ecoregion 3E: Lake Abitibi and is generally characterized as boreal forest underlain generally by granitic or gneissic bedrock, although the surficial geology can be diverse in this Ecoregion (Crins *et al*., 2009). Soil in this western portion of the Ecoregion is generally poorly developed. Over the entire Ecoregion, mixed forest and coniferous forest comprise approximately 30% of the land area each, while sparse forest comprises 11% and deciduous forest comprises seven percent. Eight percent of the Ecoregion has been cut over, and seven percent is comprised of lakes and watercourses (Crins *et al.,* 2009). The boreal forest as a whole is subject to fire as the dominant disturbance regime. Fires are stand-replacing, with varied cycles, and are logically shorter for upland forest than for lowland forest (Crins *et al.,* 2009). The forest is dominated by typical boreal forest species: Black Spruce (*Picea mariana*), White Spruce (*Picea glauca*), Jack Pine (*Pinus banksiana*), Balsam Fir (*Abies balsamea*), White Birch *(Betula papyrifera),* Tamarack (*Larix laricina*), and Balsam Poplar (*Populus balsamifera*). There are small, isolated pockets of species typical of the Great Lakes – St. Lawrence Forest Region but they do not occur within the RSA (Crins *et al.,* 2009).

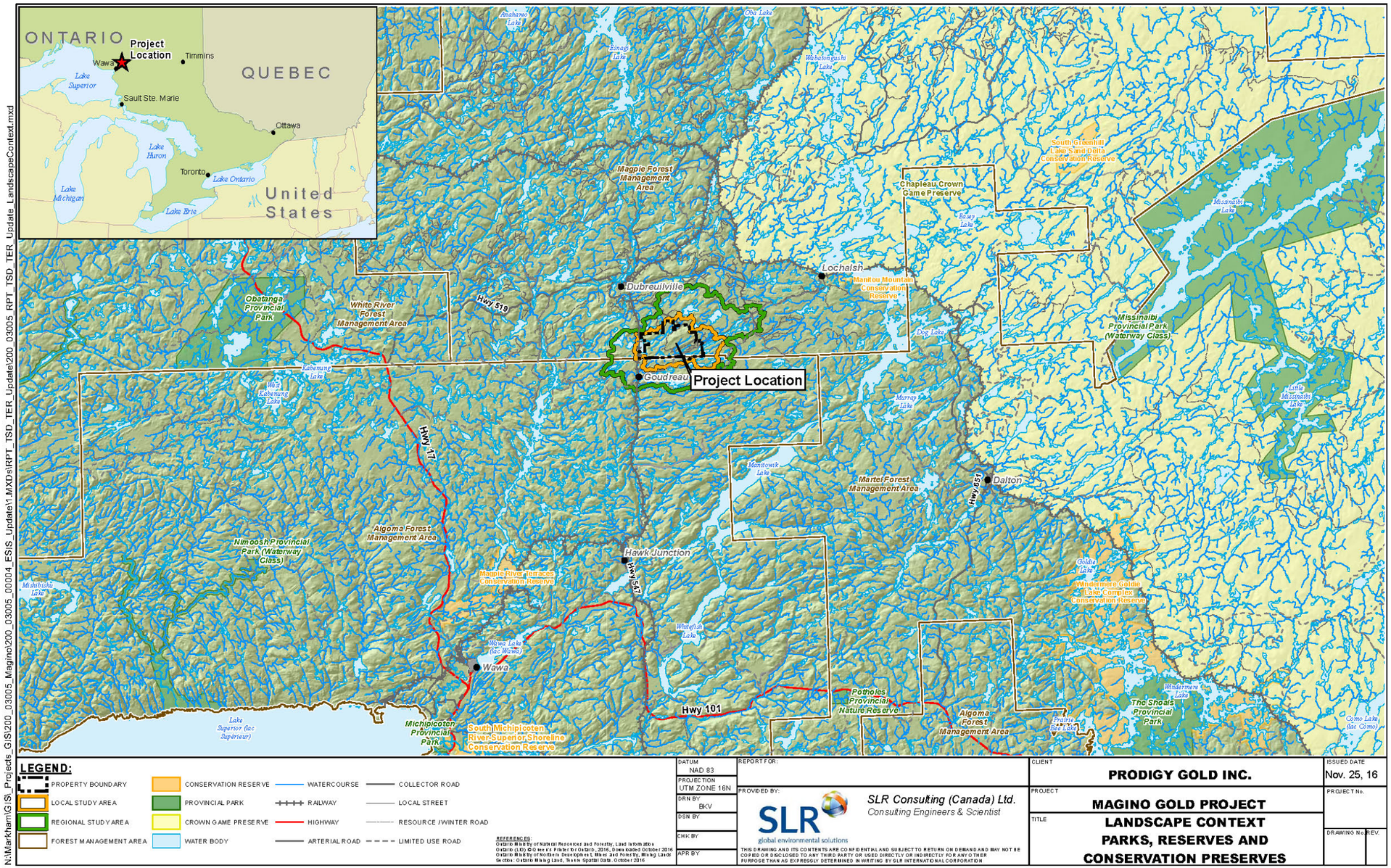
Within Ecoregion 3E, the RSA is located within the Foleyet Ecodistrict (3E-5). Soils within this Ecodistrict are classified as morainal (Crins *et al*., 2009). They are largely Humo-Ferric Podzol soils, formed over coarse-textured material. Over half of the Ecodistrict is comprised of mixed forest, dominated by Trembling Aspen (*Populus tremuloides*), White Birch, Balsam Fir, Black Spruce, and White Spruce. This is true of the RSA, where deciduous species are often in the canopy with coniferous species in the understory. Coniferous stands of Jack Pine and Black Spruce are often located on glaciofluvial terraces and on shallow substrates, which is generally true of the RSA. Trembling Aspen stands are found on mid-slopes in the Foleyet Ecodistrict, which dominate the RSA.

As described in Table 4-1, there are ten provincial parks, game preserves/reserves or nature reserves present within 50 km of the Project site, each with unique features. There no other recognized ecological areas of interest in or adjacent to the RSA (Figure 4-1).

Table 4-1: Ecological Areas within a 50 km Radius of the RSA

AREA OF INTEREST	PURPOSE AND FEATURES
Chapleau Crown Game Preserve	• Wildlife protection • High winter moose population
Obatanga Provincial Park	• Landscape representation
Windermere Goldie Lake Complex Conservation Reserve	• Landscape representation • Medium to old aged forest protection
South Michipicoten River-Superior Shoreline Conservation Reserve	• Link between Michipicoten and Lake Superior Provincial Parks • Shoreline and adjacent upland protection
Michipicoten Provincial Park	• Historic class park: protects a former fur trade post and canoe travel route. • Protects rare and locally significant plant species
South Greenhill Lake Sand Delta Conservation Reserve	• Sand plain ecosystem protection
Missinaibi Provincial Park	• Waterway class park: protects the Missinaibi River and supporting ecosystems
Manitou Mountain Conservation Reserve	• Geological representation: moraine with kettles, kames, and morainal ridges
Potholes Provincial Nature Reserve	• Geological representation: glacial potholes and troughs
Magpie River Terraces Conservation Reserve	• Geological representation: unique lake and river terraces

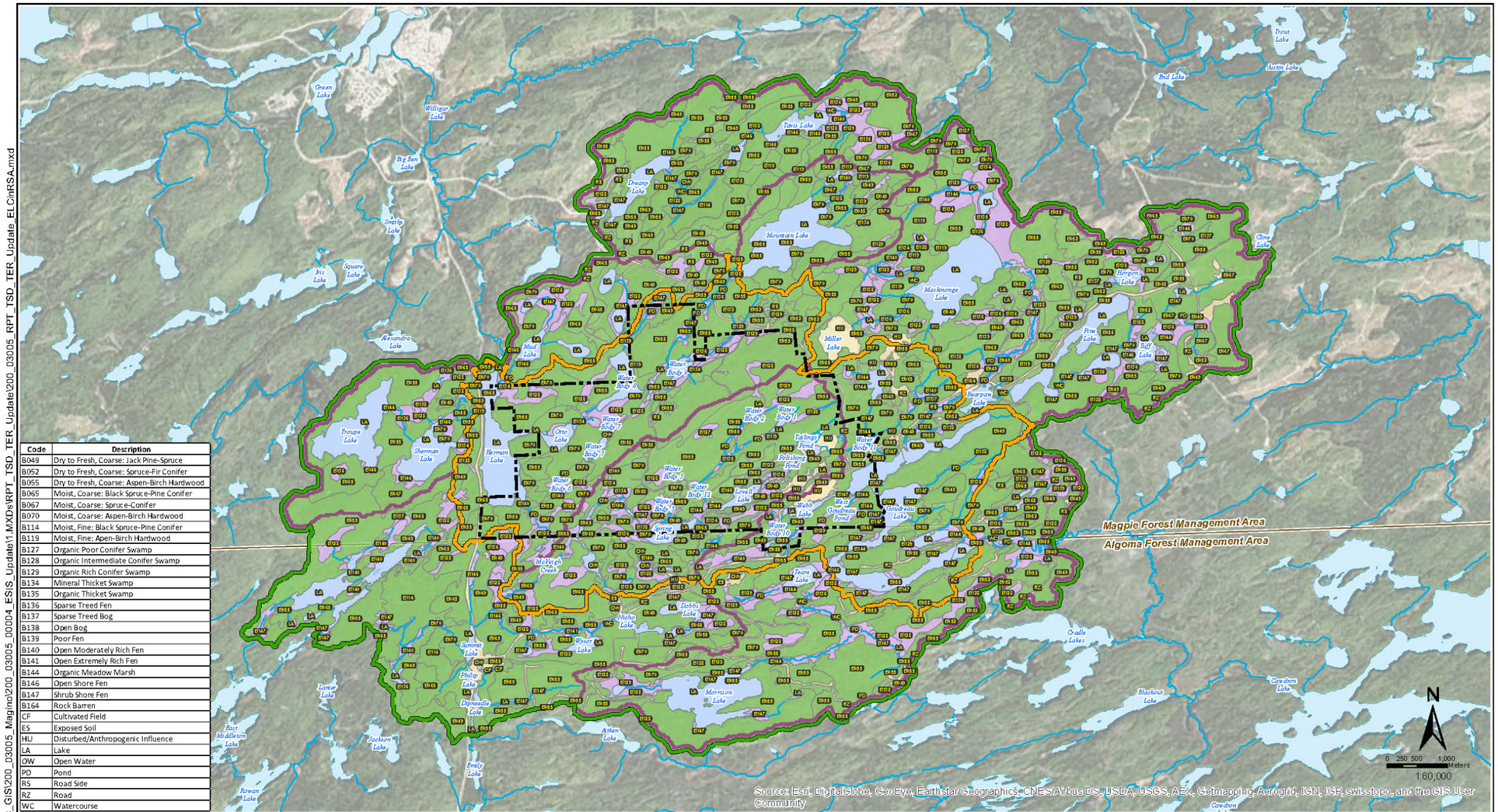
Figure 4-1: Landscape Context - Parks Reserves and Conservation Preserves



The RSA straddles two Sustainable Forest Licenses: the Magpie Forest, managed by Dubreuil Forest Products Limited (Sustainable Forest License 542003) and the Algoma Forest, managed by Clergue Forest Management Incorporated (Sustainable Forest License 542257). The RSA is at the southern limit of the Magpie and the northern limit of the Algoma. Landscape level age class distributions for the large area encompassing the Magpie forest are more representative of the RSA. Of the productive forests available, Dubreuil Forest Products Limited (2008) reports a significant imbalance in the forest age class structure, dominated by young and mature and over-mature stands. It is significantly lacking in forest stands aging 31 to 70 years old. In addition, most of the Magpie Forest is fragmented by recent disturbances, and as a result, the 1 to 20 years old age class is common throughout the area (Dubreuil Forest Products Limited, 2008).

The most abundant forest types in the RSA are early successional White Birch and Trembling Aspen stands with variable moisture regimes (Table 4-2) (Figure 4-2). These deciduous stands compose two/thirds of the upland forest within the RSA. Conifer stands are comprised of variable percentages of Black or White Spruce and Jack Pine, depending on moisture regimes. Large lakes are present throughout the RSA (12% of the cover) and are often fringed with organic fen. Coniferous swamps with organic substrates compose almost 15% of the vegetation and are aligned in roughly a north east to south west direction in the hollows between sculptured bedrock hills with thin soil cover. Lichen-covered rock barrens are exposed infrequently (less than one percent cover) and without the influence of recent logging operations that have opened up the canopy to mimic a more open forest, the canopy would be largely closed. As a result, this condition has created novel niches for wildlife, documented in the sections to follow.

Figure 4-2: Regional Study Area - Ecological Land Classification



Code	Description
B049	Dry to Fresh, Coarse: Jack Pine-Spruce
B052	Dry to Fresh, Coarse: Spruce-Fir Conifer
B055	Dry to Fresh, Coarse: Aspen-Birch Hardwood
B065	Moist, Coarse: Black Spruce-Pine Conifer
B067	Moist, Coarse: Spruce-Conifer
B070	Moist, Coarse: Aspen-Birch Hardwood
B114	Moist, Fine: Black Spruce-Pine Conifer
B119	Moist, Fine: Apen-Birch Hardwood
B127	Organic Poor Conifer Swamp
B128	Organic Intermediate Conifer Swamp
B129	Organic Rich Conifer Swamp
B134	Mineral Thicket Swamp
B135	Organic Thicket Swamp
B136	Sparse Treed Fen
B137	Sparse Treed Bog
B138	Open Bog
B139	Poor Fen
B140	Open Moderately Rich Fen
B141	Open Extremely Rich Fen
B144	Organic Meadow Marsh
B146	Open Shore Fen
B147	Shrub Shore Fen
B164	Rock Barren
CF	Cultivated Field
ES	Exposed Soil
HU	Disturbed/Anthropogenic Influence
LA	Lake
OW	Open Water
PD	Pond
RS	Road Side
RZ	Road
WC	Watercourse

LEGEND:

- PROPERTY BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- LOCAL WATERSHED
- UPLAND FOREST
- WETLAND
- BARE GROUND/DISTURBED
- AQUATIC
- FOREST MANAGEMENT AREAS
- WATER BODY
- WATERCOURSE

NOTES:
Ecological Land Classification Codes - refer to table 4.12

REFERENCES:
Ontario Ministry of Natural Resources and Forestry, Land Information Ontario (LIO) © Queen's Printer for Ontario, 2016. Downloaded October 2016
Ontario Ministry of Northern Development, Mines and Forestry, Mining Lands Section: Ontario Mining Land, Tenure Spatial Data, October 2016

DATUM	NAD 83
PROJECTION	UTM ZONE 16N
DRN BY	BKV
DSN BY	
CHK BY	
APR BY	

REPORT FOR:

PROVIDED BY: SLR Consulting (Canada) Ltd. Consulting Engineers & Scientist

CLIENT	PRODIGY GOLD INC.
PROJECT	MAGINO GOLD PROJECT
TITLE	REGIONAL STUDY AREA ECOLOGICAL LAND CLASSIFICATION
ISSUED DATE	Nov. 25, 16
PROJECT No.	
DRAWING No.	REV.

N:\Markham\GIS_Projects_GIS\200_03005_Magino\200_03005_00004_ESIS_Update\1.MXDs\RPT_TSD_TER_Update_ELCInRSA.mxd

Table 4-2: Regional Study Area - Vegetation[1]

ECOSITE CODE	NAME	AREA (ha)	AREA % OF TOTAL	AREA % OF SUBCATEGORY
Upland Forest				
B049	Dry to Fresh, Coarse: Jack Pine, Black Spruce	840	8	11
B052	Dry to Fresh, Coarse: Spruce, Balsam	373	3	5
B055	Dry to Fresh, Coarse: Trembling Aspen, Birch	3651	33	47
B065	Moist, Coarse: Jack Pine, Black Spruce	990	9	13
B067	Moist, Coarse: Spruce Conifer	256	2	3
B070	Moist, Coarse: Aspen Birch Hardwood	1296	12	17
B114	Moist, Fine: Black Spruce – Pine Conifer	185	2	2
B119	Moist, Fine: Aspen – Birch Hardwood	209	2	3
	Total	7800	70	100
Wetland				
B127	Organic Poor Conifer Swamp	6	0	0
B128	Organic Intermediate Conifer Swamp	553	5	36
B129	Organic Rich Conifer Swamp	89	1	6
B134	Mineral Thicket Swamp	70	1	5
B135	Organic Thicket Swamp	15	0	1
B136	Sparse Treed Fen	187	2	12
B137	Sparse Treed Bog	10	0	1
B138	Open Bog	49	0	3
B139	Poor Fen	22	0	1
B140	Open Moderately Rich Fen	86	1	6
B141	Open Extremely Rich Fen	13	0	1
B144	Organic Meadow Marsh	110	1	7
B146	Open Shore Fen	45	0	3
B147	Shrub Shore Fen	285	3	18
	Total	1542	14	100
Aquatic (Lakes, Rivers, Streams, and Ponds)				
LA	Lake	1295	12	96
OW	Open Water	21	0	2

[1] Detailed Descriptions of the Ecosites are in Appendix D.

ECOSITE CODE	NAME	AREA (ha)	AREA % OF TOTAL	AREA % OF SUBCATEGORY
PD	Pond	30	0	2
WC	Watercourse	6	0	0
	Total	1353	12	100
Bare Ground / Disturbed				
B164	Rock Barren	9	0	2
ES	Exposed Soil	8	0	2
RS	Road Side	88	1	21
RZ	Road	212	2	50
CF	Cultivated Field	2	0	0
HU	Disturbed/Anthropogenic Influence	107	1	25
	Total	426	4	100
	AREA TOTAL	**11,119**	**100**	

Wildlife species typical of boreal forest ecosystems include migratory birds such as Red-eyed Vireo (*Vireo olivaceus*), Chestnut Sided Warbler (*Dendroica pensylvanica*), Ovenbird (*Seiurus aurocapillus*), Hermit Thrush (*Catharus guttatus),* Veery (*Catharus fuscescens*) and hawks, as well as resident species such as Black-capped Chickadee (*Poecile atricapillus*) and Downy Woodpecker (*Picoides pubescens*). Whip-Poor-Will and Common Nighthawk, both SAR, are at the edge of their distribution in Ontario. The open water provides important habitat for migrating waterfowl. In the RSA the forest has been disturbed by past logging and mining operations have opened the canopy and exposed areas of bare soil and rock, providing a variety of niches that occur only with disturbance regimes.

The RSA is heavily influence by American Beaver activity; almost all watercourses and waterbodies have evidence of their presence. Moose and American Black Bear use these water features as well as the large network of roads and trails throughout the RSA. Local hunters and trappers anecdotally report a high population of Moose and American Black Bear (Smedts, 2014). The Ontario's Fur Managers Association report at least 12 traplines in the RSA (locations confidential) and estimated the most harvested species is Marten (Table 4-3) (EBA, 2013). However, local trappers contacted in the winter of 2014 indicate that there was virtually no Marten being harvested during the 2012-2013 season (Smedts, 2014; Hudson, 2014). The length of traplines in the RSA vary, but are on average approximately 15 km long. Local trappers estimate the harvest per trapline for the 2013-2014 season shown in Table 4-3 (Smedts, 2014; Hudson, 2014). There are no known denning sites (Smedts, 2014) in the RSA.

Table 4-3: Regional Study Area – Furbearer Harvest Estimates

COMMON NAME	SCIENTIFIC NAME	APPROXIMATE ANNUAL HARVEST IN REGION[2]	APPROXIMATE ANNUAL HARVEST PER TRAPLINE (2013-2014 SEASON)[3]
Marten	*Martes americana*	400	0-15
American Beaver	*Castor canadensis*	300	30-40
Mink	*Neovison vison*	50	5-10
Muskrat	*Ondatra zibethicus*	40	Unknown
Otter	*Lutra canadensis*	35	5-10
Fisher	*Martes pennanti*	20	2-6
Red Fox	*Vulpes vulpes*	20	Unknown
Lynx	*Lynx canadensis*	15	3-6
Wolf	*Canis lupus*	15	2-4

Moose Late Winter Cover and Moose Aquatic Feeding Areas are Significant Wildlife Habitat features in the RSA.

Amphibian species richness and abundance meet criteria for Significant Wildlife Habitat in many areas of the RSA. Spring Peeper (*Pseudacris crucifer*), American Toad (*Anaxyrus americanus*), and Green Frog (*Lithobates clamitans*) are the most common species and play an important role in the food chain. There are few reptiles at this latitude, but Eastern Gartersnake (*Thamnophis sirtalis)* has been observed in the RSA and Snapping Turtle *(Chelyddra serpentina)* is possible although not observed to date. The latter is listed as of Special Concern under SARA and ESA, 2007.

Recreational and economic hunting, trapping, and fishing are recognized as being important in the region for both local people and tourism operators (Clergue Forest Management Inc., 2009).

4.2 LOCAL STUDY AREA

This section describes the existing terrestrial environmental conditions in the LSA, organized by subwatershed (Figure 4-3). Subwatersheds are natural boundaries that often provide distinguishing ecological characteristics. Three subwatersheds cross the LSA:

- Herman-Otto (2,724 ha) subwatershed located in the west;
- Spring-Lovell (1,104 ha) subwatershed extending from Goudreau Road reaching southwest to south of Herman Lake); and,
- Webb-Goudreau (4,678 ha) subwatershed that frames the southeast of the LSA and includes the historical mine works.

[2] EBA, 2013
[3] Smedts, 2014; Hudson, 2014

The following sections provide a description of vegetation in each subwatershed followed by the results of the wildlife surveys. Finally, a summary of the key features and functions for each subwatershed is provided.

4.2.1 HERMAN–OTTO SUBWATERSHED

4.2.1.1 Vegetation

The Herman-Otto subwatershed is 2,724 ha in size, making up 37% of the LSA. The highest ridge in the LSA forms the subwatershed divide between Herman-Otto and Spring-Lovell to the south. The valleyland becomes a generally level area of lakes, wetlands and forest. Drainage from Mountain Lake to the northeast flows through Lakes 8 and 9 and to Otto and Herman Lake. Wetlands are typically associated with lakes in this subwatershed, but to a lesser degree to those in Spring-Lovell subwatershed (further described in the wetland section below) (Figures 4-3 and 4-4).

Upland forest comprises 72% of the subwatershed, slightly higher than elsewhere in the LSA. Wetlands comprise 15% reflecting the steep slopes and deep valleys where lakes cover 12%. Disturbed areas (roads, railway, forestry landing areas) comprise the remaining two percent of the subwatershed. Table 4-4 provides a summary of subwatershed composition and VEGETATION communities.

Figure 4-4: Herman–Otto Subwatershed - All Vegetation Distribution by Percent Area

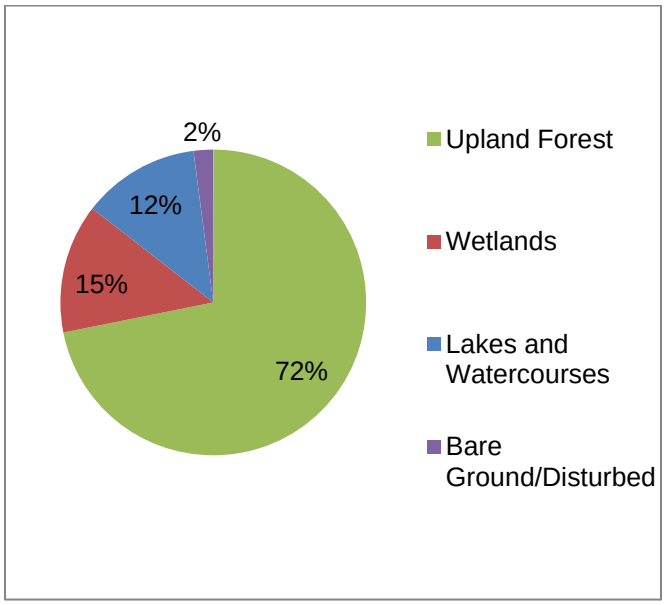
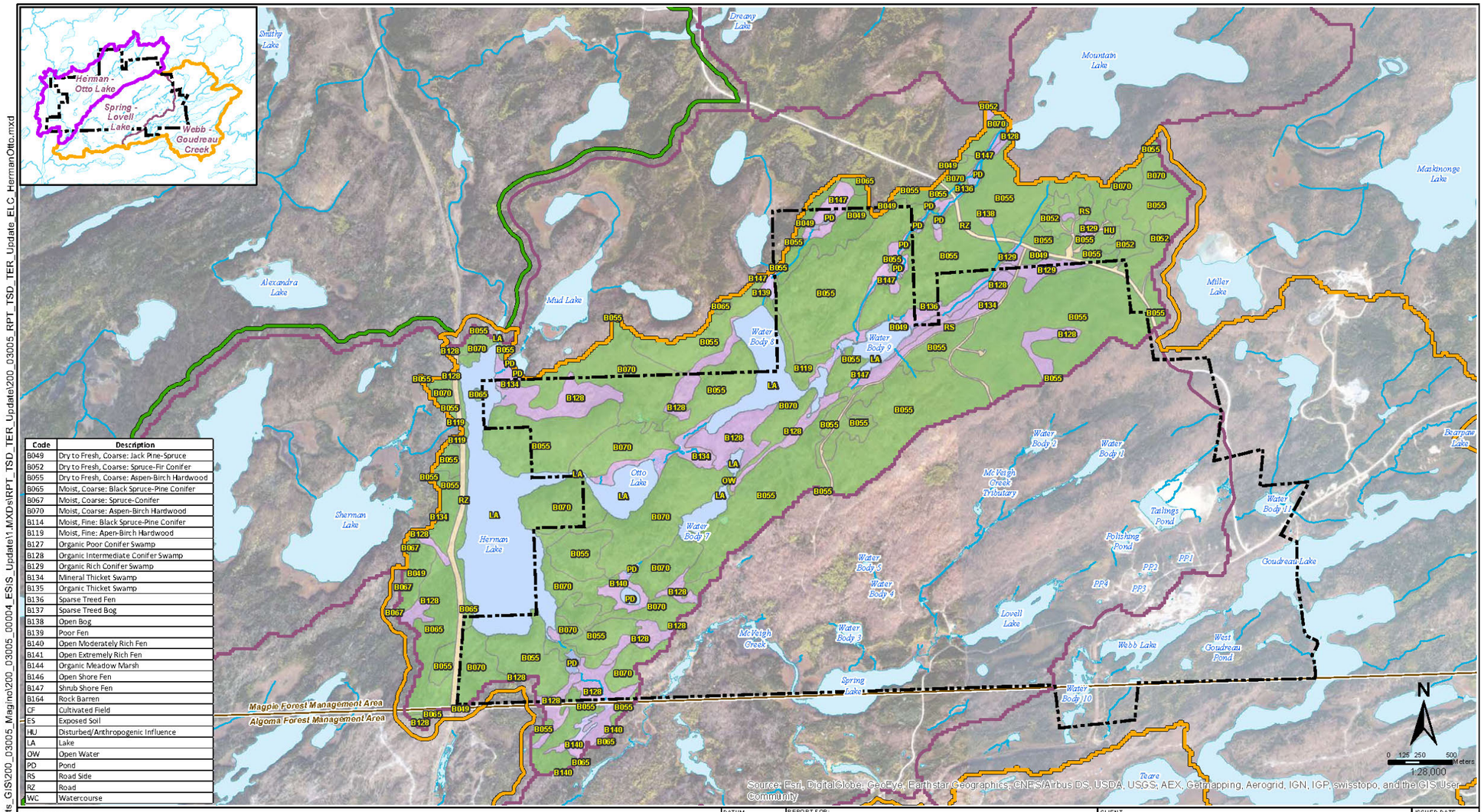


Figure 4-3: Herman-Otto Subwatershed - Ecological Land Classification



Code	Description
B049	Dry to Fresh, Coarse: Jack Pine-Spruce
B052	Dry to Fresh, Coarse: Spruce-Fir Conifer
B055	Dry to Fresh, Coarse: Aspen-Birch Hardwood
B065	Moist, Coarse: Black Spruce-Pine Conifer
B067	Moist, Coarse: Spruce-Conifer
B070	Moist, Coarse: Aspen-Birch Hardwood
B114	Moist, Fine: Black Spruce-Pine Conifer
B119	Moist, Fine: Apen-Birch Hardwood
B127	Organic Poor Conifer Swamp
B128	Organic Intermediate Conifer Swamp
B129	Organic Rich Conifer Swamp
B134	Mineral Thicket Swamp
B135	Organic Thicket Swamp
B136	Sparse Treed Fen
B137	Sparse Treed Bog
B138	Open Bog
B139	Poor Fen
B140	Open Moderately Rich Fen
B141	Open Extremely Rich Fen
B144	Organic Meadow Marsh
B146	Open Shore Fen
B147	Shrub Shore Fen
B164	Rock Barren
CF	Cultivated Field
ES	Exposed Soil
HU	Disturbed/Anthropogenic Influence
LA	Lake
OW	Open Water
PD	Pond
RS	Road Side
RZ	Road
WC	Watercourse

LEGEND:

- PROPERTY BOUNDARY
- LOCAL STUDY AREA
- REGIONAL STUDY AREA
- LOCAL WATERSHEDS
- UPLAND FOREST
- WETLAND
- BARE GROUND/DISTURBED
- AQUATIC
- FOREST MANAGEMENT AREAS
- WATER BODY
- WATERCOURSE

NOTES: Ecological Land Classification Codes - refer to table 4.12

REFERENCES: Ontario Ministry of Natural Resources and Forestry, Land Information Ontario (LIO) Open Data Catalogue, Ontario Provincial Parks, 2016, Downloaded October 2016; Ontario Ministry of Northern Development, Mines and Forestry, Mining Lands Section: Ontario Mining Land, Townships Spatial Data, October 2016

DATUM	NAD 83
PROJECTION	UTM ZONE 16N
DRN BY	BKV
DSN BY	
CHK BY	
APR BY	

REPORT FOR:

PROVIDED BY: SLR Consulting (Canada) Ltd. Consulting Engineers & Scientist

CLIENT: PRODIGY GOLD INC.

PROJECT: MAGINO GOLD PROJECT

TITLE: HERMAN-OTTO SUBWATERSHED ECOLOGICAL LAND CLASSIFICATION

ISSUED DATE: Nov. 25, 16

PROJECT No.

DRAWING No. REV.

N:\Markham\GIS_Projects_GIS\200_03005_Magino\200_03005_00004_ESIS_Update\1.MXD\sRPT_TSD_TER_Update\200_03005_RPT_TSD_TER_Update_ELC_HermanOtto.mxd

Table 4-4: Herman-Otto Ecological Land Classification

ELC CODE[4]	AREA (ha)	% OF SUBWATERSHED	DESCRIPTION
Upland Forest			
B049	36	3	Dry to Fresh, Coarse: Jack Pine - Black Spruce
B052	29	2	Dry to Fresh, Coarse: Spruce - Fir Conifer
B055	588	44	Dry to Fresh, Coarse: Aspen - Birch Hardwood
B065	40	3	Moist, Coarse: Black Spruce - Pine Conifer
B067	3	0	Moist, Coarse: Spruce Conifer
B070	251	19	Moist, Coarse: Aspen - Birch Hardwood
B119	9	1	Moist, Fine: Aspen - Birch Hardwood
Total Upland Forest	957	72	
Wetlands			
B128	102	8	Organic Intermediate Conifer Swamp
B147	19	1	Shrub Shore Fen
B136	13	1	Sparse Treed Fen
B134	24	2	Mineral Thicket Swamp
B129	10	1	Organic Rich Conifer Swamp
B140	11	1	Open Moderately
PD	7	1	Pond
B138	8.2	>0	Open Bog
B139	6	>0	Poor Fen
OW	0	0	Shallow Open Water
Total Wetland	189	15	
Aquatic (Lakes, Rivers, Streams, and Ponds)			
LA	158	12	Lakes
Total Aquatic	158	12	
Bare Ground / Disturbed[1]			
RZ	20	1	Roads
RS	7	1	Roadside
HU	1	>0	Anthropogenic
Total Disturbed	35.7	2	

[1] Although differing in classification, most sites in this category have similar ecological structure, in that they are a mixture of bare ground and sparse vegetation.

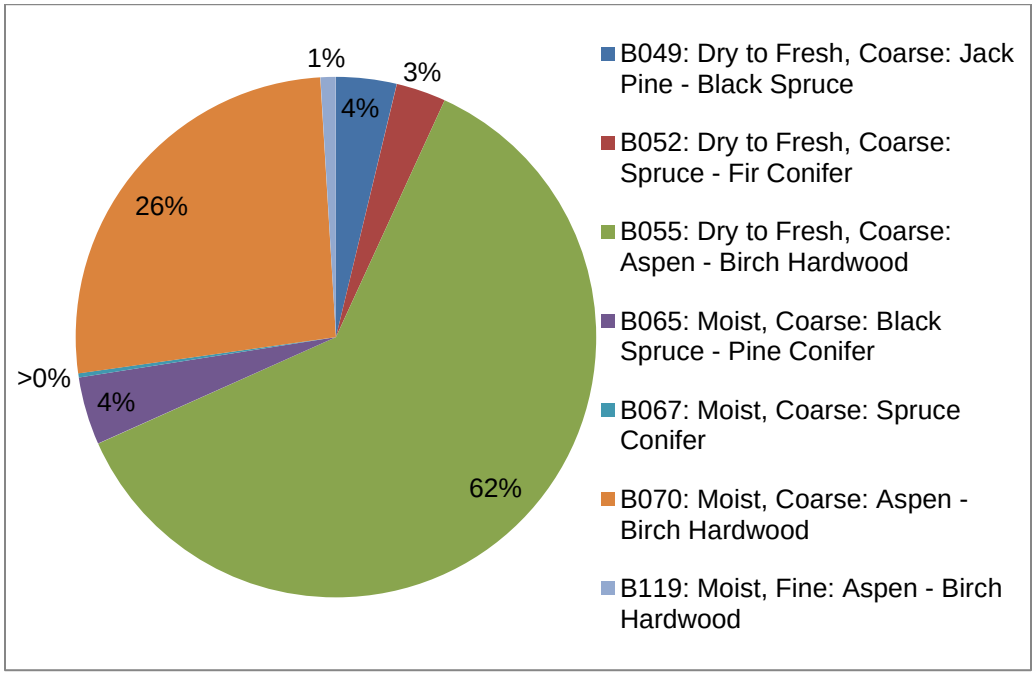
[4] Detailed Descriptions of the Ecosites are in Appendix D.

The most frequently occurring forest types are B055, Dry to Fresh, Coarse: Aspen – Birch Hardwood (588 ha, 44% of the subwatershed) and B070, Moist, Coarse: Aspen – Birch Hardwood (251 ha, 19%) differing largely in soil moisture regimes (Figure 4-5 and Table 4-4). For a complete description of all forest types, see Appendix D. This forest type heavily dominates the southern half of the subwatershed predominantly on north-facing slopes. The forest was harvested at differing times and is therefore in different stages of succession. This forest type is young to mid age with some stands being approximately 20-30 years old and others being 30-40 years old, very similar to that of Spring-Lovell subwatershed. The dominant soil type is a sandy loam. The ground layer vegetation is typical of upland boreal forest in this Ecodistrict, and is comprised of varying abundances of Bunchberry, Large-leaf Aster (*Eurybia macrophylla*), Starflower (*Trientalis borealis*), Mayflower (*Epigea repens*), Sarsaparilla (*Aralia nudicaulis*), and Goldthread (*Coptis trifolia*) with Lady Fern (*Athyrium filix-femina*) and Interrupted Fern (*Osmunda claytoniana*) being present in the moister conditions. There are several polygons of swamps interspersed in these forests. (further described in wetlands section below).

The northern portion of the subwatershed has more coniferous forest (8% of the subwatershed) than the southern portion and contains 36 ha (3%) of B049, Dry to Fresh, Coarse: Jack Pine-Black Spruce, some of it plantation. This forest type is typically more acidic than the hardwood stands and has a less diverse ground layer, often comprised of Labrador Tea and Mayflower. B065, Moist, Coarse: Black Spruce – Pine conifer comprises 40 ha (3%) and varies from B049 only in moisture regime and with a low diversity of ground cover.

Figure 4-5: Herman-Otto Subwatershed

Upland Ecological Land Classification Community Distribution by Percent Area



Wetlands

Figure 4-6 shows wetlands as a percent of total wetland. The most abundant wetland type in this subwatershed is B128, Organic Intermediate Conifer Swamp (102 ha, 8%). These organic swamps (12%) are associated with linear depressions that drain to lakes or are in the transitional area between upland forests to fen. They are dominated by Tamarack or Eastern White Cedar (*Thuja occidentalis*) with some White Birch.

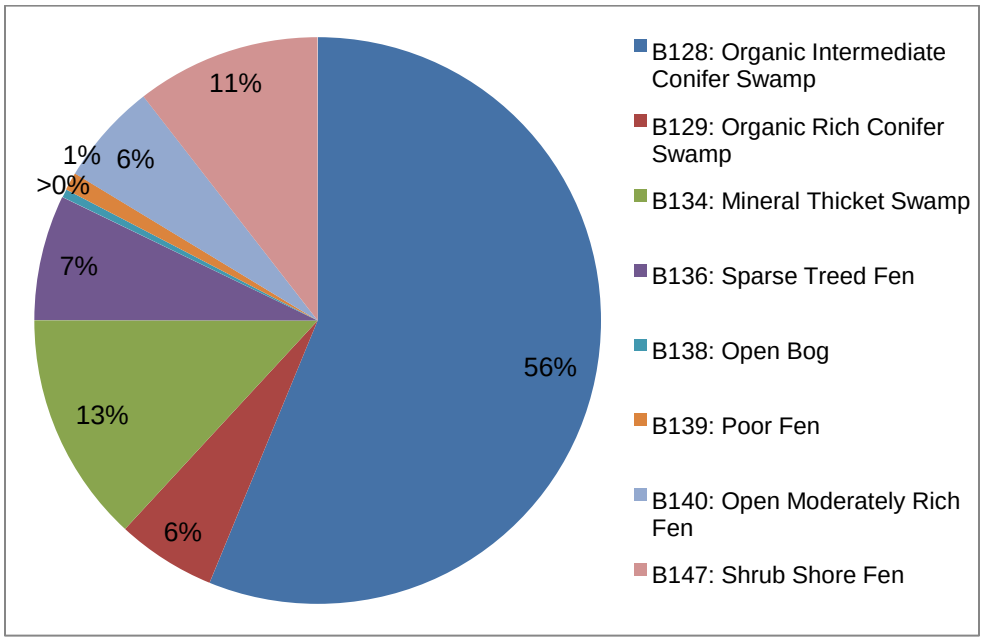
The northern, more coniferous portion of the subwatershed contains organic swamps similar those in the north, but also contains organic fens, bogs, and marshes. The fens range in character from Sparse Treed Fen to poor fens to shrubby shore fen totaling 24% of the watershed. Fens typically have a very low density of Tamarack and a ground cover of *Carex* species. They are located at the edges of lakes and watercourses.

Floristics

No rare species (S1-S3) or SAR were noted in this subwatershed. For a complete list of plant species observed in the Study Area, see Appendix C.

The species recorded are generally typical of the Algoma highlands (Oldham, M. *pers comm*. 2014). Large-leaved Goldenrod (*Solidago macrophylla*) was located north of Lakes 1 and 2 in an opening under White Birch associated with Large-leaved Aster. Large-leaved Goldenrod is ranked S4 with an unusual distribution sweeping across the Algoma District from Quebec to Lake Superior and confined to central Ontario.

Figure 4-6: Herman-Otto Wetland Type as a Percent of Total Wetland



4.2.1.2 Wildlife

Birds

Fifty eight bird species were identified in the 68 point count plots in this subwatershed. The highest concentration of birds were noted in the south: southeast of Lake 9 in young hardwood forest, in young conifer forest to the north of Lake 8, and mixedwood stands west of Goudreau Road (Figure 4-3). This area is comprised of variable cover of mixedwood and hardwood, in different seral stages, although the area in general is comprised of young forest. The species in these locations are not different than the most common birds throughout the watershed and include Red-eyed Vireo, Chestnut Sided Warbler, Ovenbird, Hermit Thrush, and Veery.

Common Loon (*Gavia immer*) was the most common bird associated with lakes. They are sensitive to water fluctuations during June and July as their inability to walk makes it necessary to nest right at the shoreline.

Common Goldeneye (*Bucephala clangula*), Ring Necked Duck (*Aythya collaris*), and Hooded Merganser (*Lophodytes cucullatus*) were the only waterfowl recorded. Waterfowl staging area surveys recorded very limited numbers of Common Goldeneye and Ring Necked Duck observed on Wetland 6.

One Northern Saw-whet Owl (*Aegolius acadicus*), one Red-tailed Hawk (*Buteo jamaicensis*), one Barred Owl (*Strix varia*), and two Bald Eagle (*Haliaeetus leucocephalus*) were observed in this subwatershed.

No marsh birds were noted on the targeted surveys. For a complete list of birds noted in this subwatershed, and their locations, see Appendix E.

Mammals

Signs of Moose are frequent and three moose individuals were observed. Two Black Bear were observed on roadsides. All waterbodies have beaver activity either in the form of lodges, dams, or direct observation. One Canada Lynx was observed southeast of Lake 9.

Amphibians

Spring Peeper were present in high numbers in 7 of the 11 wetlands sampled during the late May survey, followed by a generally equal numbers of American Toad and Boreal Chorus Frog (*Pseudacris maculata*) (Figure 4-7). In middle to late June, Spring Peepers were still the most common amphibian, followed by equal numbers of American Toad, Boreal Chorus Frog, Mink Frog (*Lithobates septentrionalis*) and Green Frog. Early to mid July surveys resulted in very low numbers of Green Frogs, the only species heard. For complete amphibian survey results, see Appendix F.

4.2.1.3 Landscape Connectivity

There are different varieties of landscape connectivity. Some species utilize corridors associated with watercourses, waterbodies, and wetlands. There are several, but no main drainage areas in this subwatershed that generally have intact riparian cover suitable for wildlife movement. Other species move in upland environments. It is likely that animal movement occurs along the edge of stands of coniferous species and along trails, although there are fewer trails in this subwatershed than in Spring-Lovell and Webb-Goudreau subwatersheds.

4.2.1.4 Significance and Sensitivities

SIGNIFICANT WILDLIFE HABITAT

According to MNRF Significant Wildlife Habitat Ecoregion 3E Criterion Schedule, the following habitats are significant in this subwatershed (Figure 4-8) and discussed below.

Amphibian Breeding Habitat (Wetlands)

To be considered significant according to the Ecoregion 3E criteria, three or more amphibian species must be present with at least 20 breeding individuals. Two wetland habitats meet the criteria for significance (Table 4-5).

Table 4-5: Herman-Otto Significant Wildlife Habitat: Amphibian Breeding

Survey Point Number (Amphibian Breeding Habitat Unique ID)	ELC Code	Habitat Description	Species (highest calling code)
AA2	B129 - Wetland: Organic Rich Conifer Swamp	Coniferous swamp with some open water areas.	Spring Peeper (3) American Toad (2) Green Frog (1)
AA3	B055 - Dry to Fresh, Coarse: Aspen – Birch Hardwood	Small depressional area of flooded Alder and Black Spruce amongst Aspen and Birch upland forest.	Spring Peeper (3) Pickerel Frog (2) Gray Tree Frog (1) American Toad (1)

Figure 4-7: Local Study Area - Amphibian Breeding Habitat

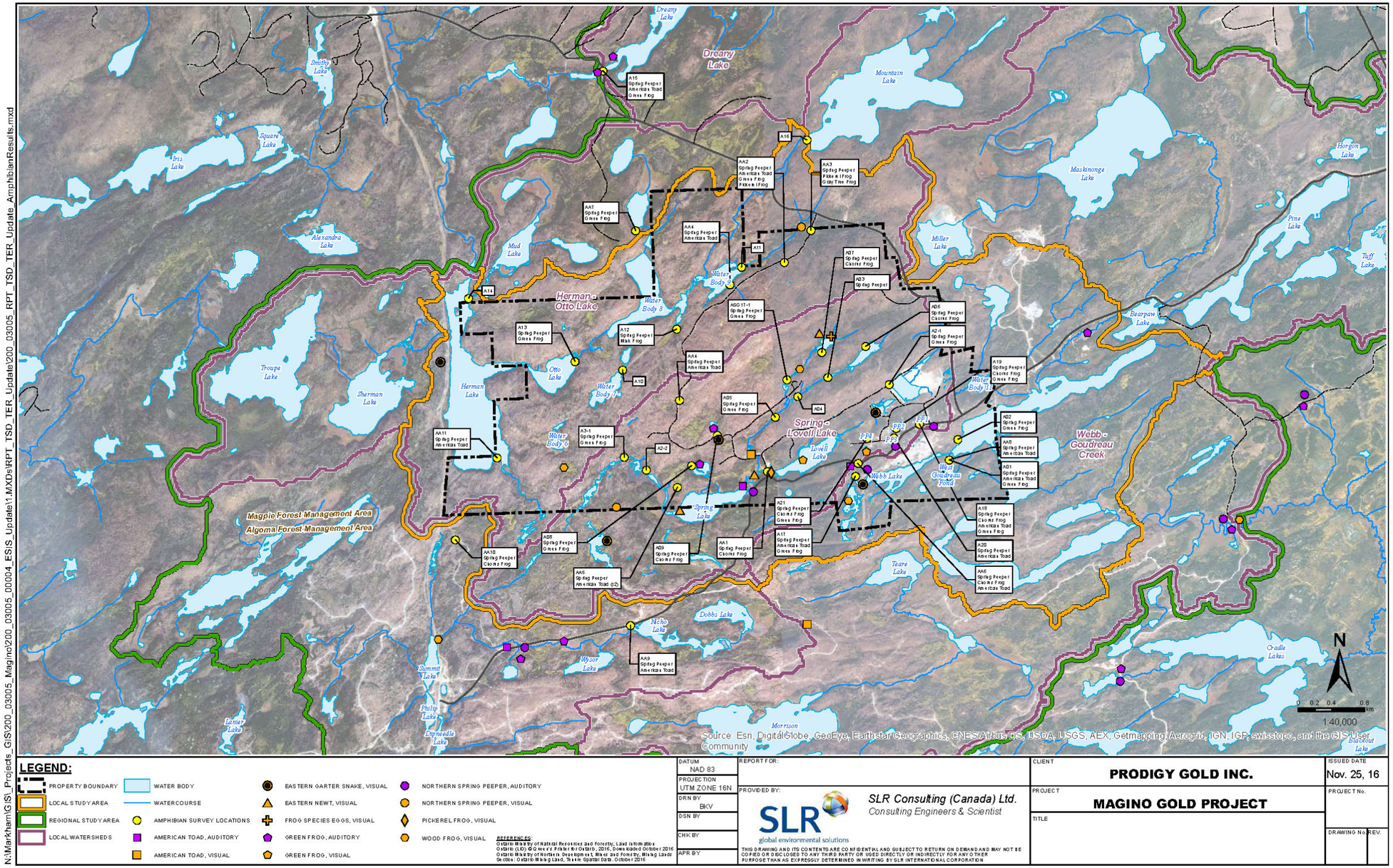
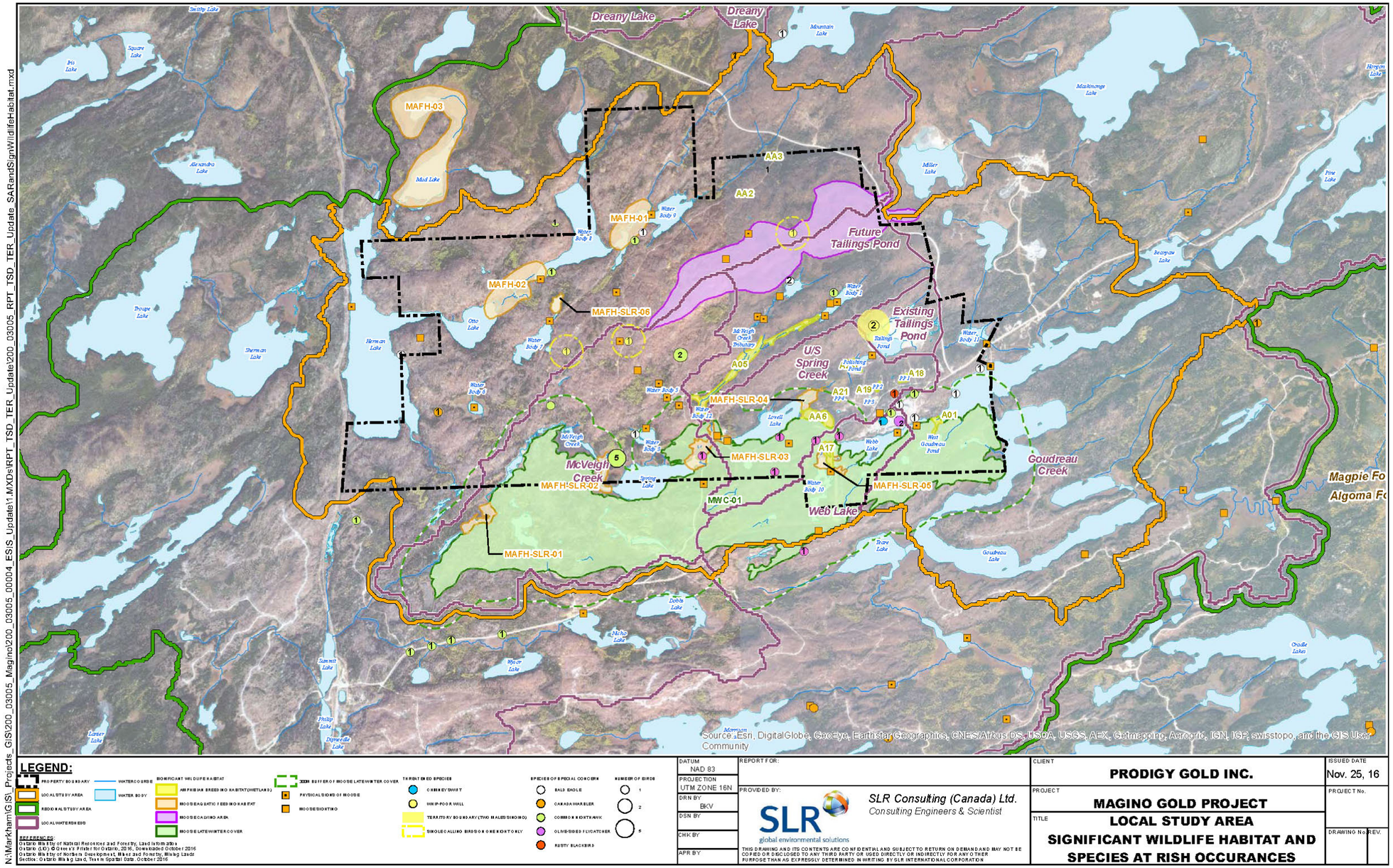


Figure 4-8: Local Study Area - Significant Wildlife Habitat and Species at Risk Occurrences



Moose Aquatic Feeding Habitat

There are two Moose Aquatic Feeding Habitats identified by MNRF and one identified by SLR in this subwatershed (Figure 4-8). One moderate quality area is located in a marsh between Lakes 8 and 9 (MAFH-01, 12.6 ha), one high quality area is located between Otto Lake and Lake 8 (MAFH-02, 17.7 ha), and a habitat identified by SLR is located in the northern portion of Lake 7 (MAFH-SLR-06, 1.6 ha).

SPECIES AT RISK

Four SAR were noted in this subwatershed: Whip-Poor-Will, Common Nighthawk, Canada Warbler (*Wilsonia canadensis)*, and Bald Eagle (Table 4-6, Figure 4-8). Two male Whip-Poor-Wills were heard calling in different locations of mixed wood forest along the southern boundary of the subwatershed.

Three Common Nighthawk were heard on the shores of Lakes 8 and 9, and one was heard adjacent to a beaver-influenced swamp in the eastern section of the subwatershed. Two Canada Warbler were heard; one south of Mountain Lake near the outflow stream and one at the southeast corner of Herman Lake in mixed wood forest. Two Bald Eagles were observed; one on the eastern shore of Herman Lake, and the other on the western shore of Mountain Lake.

Table 4-6: Herman-Otto Habitat for Species at Risk

SPECIES	CONSERVATION STATUS		NUMBER RECORDED	HABITAT
	ENDANGERED SPECIES ACT, 2007 (ON)	SPECIES AT RISK ACT (CAN)		
Whip-Poor-Will	Threatened	Threatened	2	B055: Dry-Fresh, Coarse: Aspen – Birch Hardwood
Common Nighthawk	Special Concern	Threatened	4	B055: Dry-Fresh, Coarse: Aspen – Birch Hardwood surrounding Lake 8 B128: Intermediate Conifer Swamp
Canada Warbler	Special Concern	Threatened	2	B070: Moist, Course: Aspen – Birch Hardwood B055: Dry-Fresh, Coarse: Aspen – Birch Hardwood surrounding Lake 8
Bald Eagle	Special Concern	Not listed	2	LA: Lakes, species were seen flying over lakes

4.2.1.5 Key Attributes of Herman-Otto Subwatershed

Herman-Otto Subwatershed is located in the northern portion of area planned to be influenced by project components. Key attributes of this subwatershed are provided in Table 4-7. It is well forested with the largest proportion of lakes, the least wetland cover, two types of Significant Wildlife Habitat (amphibian wetland breeding habitat and moose aquatic feeding habitat) and four species of SAR. In spite of recent logging and mining operations, it is the least disturbed of the three subwatersheds.

Table 4-7: Herman-Otto Subwatershed - Key Attributes

DOMINANT UPLAND VEGETATION COMMUNITIES	% of Subwatershed
Deciduous Aspen – Birch Hardwood Forest	63
Coniferous Jack Pine – Spruce Forest	6
DOMINANT WETLAND VEGETATION COMMUNITIES	**% of Subwatershed**
Conifer Swamp	8
Fen	2
Mineral Thicket Swamp	2
Significant Wildlife Habitat	**Number of Areas**
Amphibian Wetland Breeding Habitat	2
Moose Late Winter Cover	1
Moose Aquatic Feeding Habitat	3
SPECIES AT RISK	**Number Recorded**
Whip-Poor-Will	2
Common Nighthawk	4
Canada Warbler	2
Bald Eagle	2

4.2.2 SPRING–LOVELL SUBWATERSHED

4.2.2.1 Vegetation

Within the LSA 1,102 ha of the subwatershed includes Spring and Lovell Lakes comprising ~7% of the area (Figure 4-9). The headwaters of McVeigh Creek arise in the east (Figure 4-9). Extensive wetland surrounds the two major lakes in a wide lowland swath through the middle of the subwatershed trending northeast to southwest. Upland forest comprises 70% of the subwatershed, the largest areas associated with the high ridge on the northwest boundary. Disturbed areas (largely a result of historical mining) comprise the remaining 5% of the subwatershed (Figures 4-9 and 4-10). Table 4-8 provides a summary of areas of vegetation communities.

This historical mining disturbance in the southeast portion of the subwatershed includes tailings and polishing ponds, exposed sand and road areas, and gravel areas with excavated pits filled with water. The central portion of the subwatershed is disturbed from more recent exploratory drilling and associated trails.

The lower southwest portion of the subwatershed is recovering from past logging operations and is comprised of relatively more mixed wood stands and coniferous species.

Figure 4-10: Spring–Lovell Subwatershed - All Vegetation Cover by Percent Area

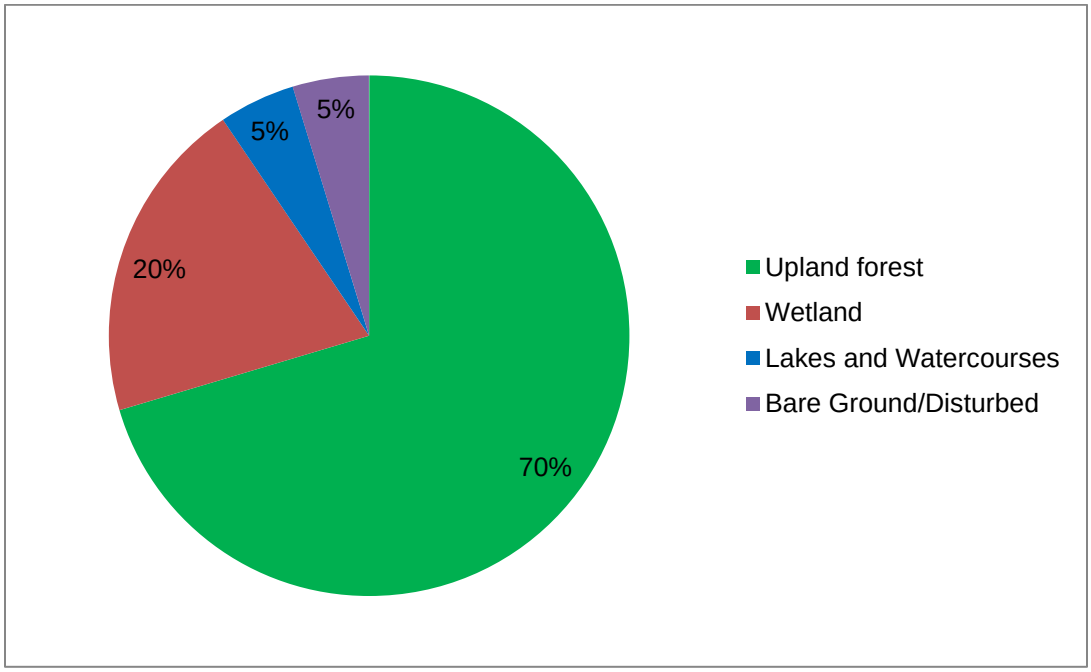
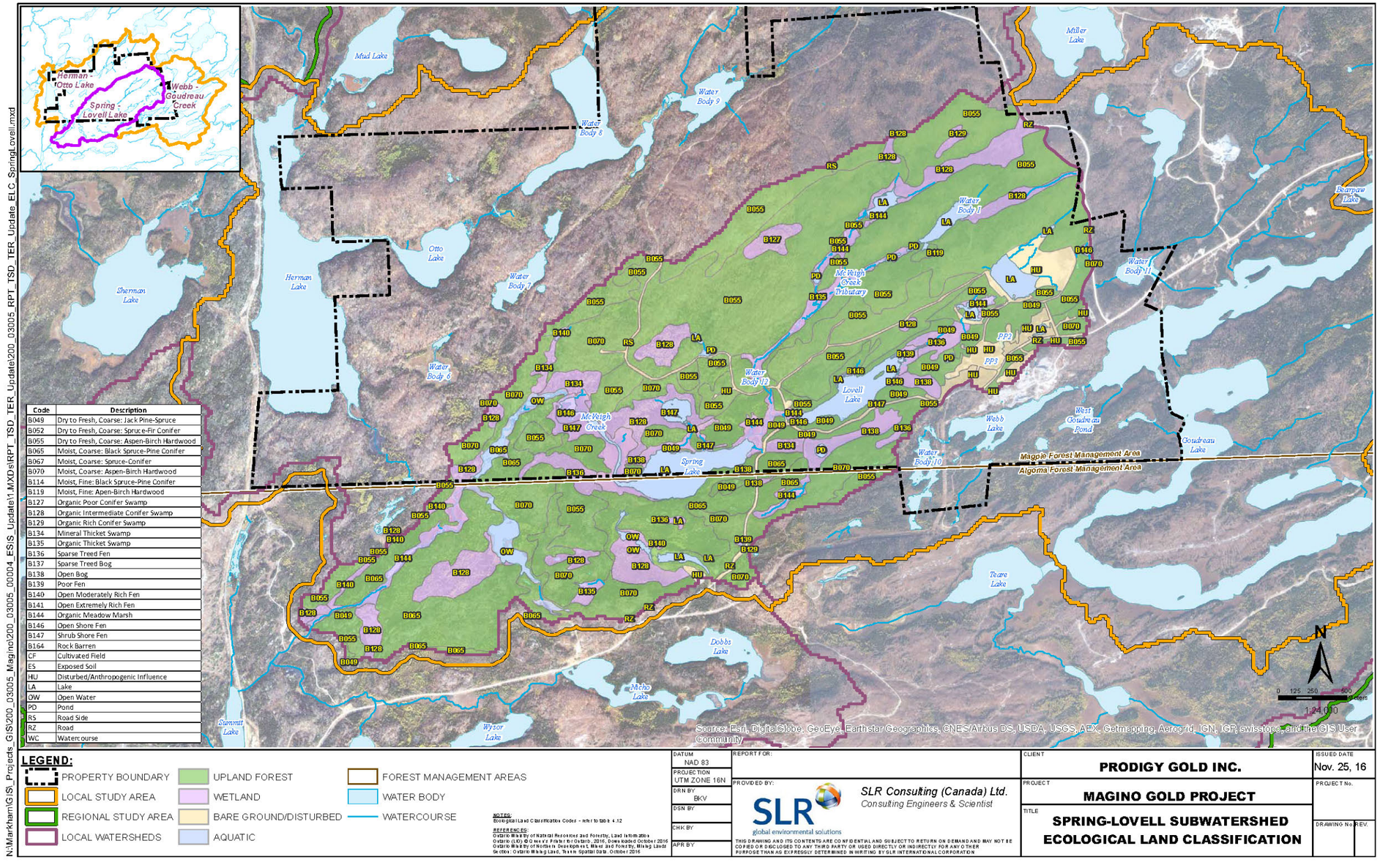


Figure 4-9: Spring-Lovell Subwatershed - Ecological Land Classification



Code	Description
B049	Dry to Fresh, Coarse: Jack Pine-Spruce
B052	Dry to Fresh, Coarse: Spruce-Fir Conifer
B055	Dry to Fresh, Coarse: Aspen-Birch Hardwood
B065	Moist, Coarse: Black Spruce-Pine Conifer
B067	Moist, Coarse: Spruce-Conifer
B070	Moist, Coarse: Aspen-Birch Hardwood
B114	Moist, Fine: Black Spruce-Pine Conifer
B119	Moist, Fine: Apen-Birch Hardwood
B127	Organic Poor Conifer Swamp
B128	Organic Intermediate Conifer Swamp
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B140	Open Moderately Rich Fen
B141	Open Extremely Rich Fen
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B146	Open Shore Fen
B147	Shrub Shore Fen
B164	Rock Barren
CF	Cultivated Field
ES	Exposed Soil
HU	Disturbed/Anthropogenic Influence
LA	Lake
OW	Open Water
PD	Pond
RS	Road Side
RZ	Road
WC	Watercourse

LEGEND:

PROPERTY BOUNDARY
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REGIONAL STUDY AREA
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BARE GROUND/DISTURBED
AQUATIC
FOREST MANAGEMENT AREAS
WATER BODY
WATERCOURSE

NOTES:
Ecological Land Classification Codes - refer to table 4.12

REFERENCES:
Ontario Ministry of Natural Resources and Forestry, Land Information Ontario (LIO) 20 Hershey Printer Ontario, 2016, Downloaded October 2016
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N:\Markham\GIS_Projects_GIS\200_03005_Magino\200_03005_00004_ESIS_Update\1.MXDs\RPT_TSD_TER_Update_ELC_SpringLovell.mxd

Table 4-8: Spring-Lovell Ecological Land Classification Communities

ELC	AREA (HA)	% OF SUBWATERSHED	DESCRIPTION
Upland Forest			
B049	52	5	Dry to Fresh, Coarse: Jack Pine - Spruce
B055	425	39	Dry to Fresh, Coarse: Aspen – Birch Hardwood
B065	138	13	Moist, Coarse: Black Spruce – Pine Conifer
B070	158	14	Moist, Coarse: Aspen – Birch Hardwood
B119	1	0	Moist, Fine: Aspen - Birch Hardwood
Total Upland Forest	**775**	**70**	
Wetlands			
B127	6	1	Organic Poor Conifer Swamp
B128	84	8	Intermediate Conifer Swamp
B129	2	0	Organic Rich Conifer Swamp
B134	12	1	Mineral Thicket Swamp
B135	12	1	Organic Thicket Swamp
B136	15	1	Sparse Treed Fen
B138	13	1	Open Bog
B139	2	0	Poor Fen
B140	5	0	Open Moderately Rich Fen
B144	25	2	Organic Meadow Marsh
B146	4	0	Open Shore Fen
B147	20	2	Shrub Shore Fen
OW	17	2	Shallow Open Water
Total Wetland	**217**	**20**	
Aquatic (Lakes, Rivers, Streams, and Ponds)			
LA	52	5	Lake
PD	5	>0	Pond
Total Aquatic	**57**	**>5**	
Bare Ground / Disturbed[1]			
HU[1]	35	3	Anthropogenic
RZ	10	1	Roads
RS	7	1	Roadsides
Total Disturbed	**52.4**	**5**	

[1] Although differing in classification, most sites in this category have similar ecological structure, in that they are a mixture of bare ground and sparse vegetation.

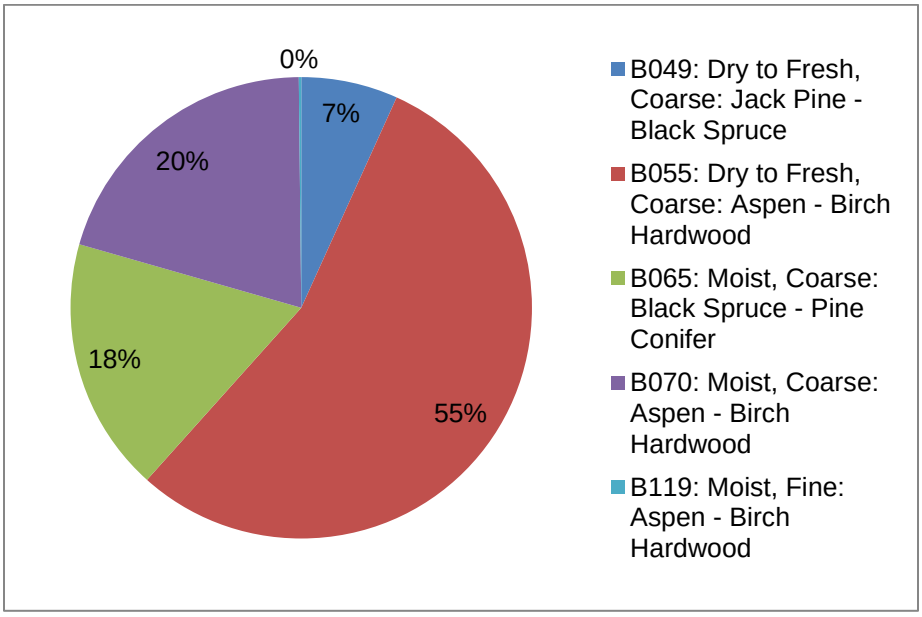
The most abundant vegetation community is B055 Dry to Fresh, Coarse: Aspen – Birch Hardwood comprising 39% of the subwatershed with a total area of 425 ha (Figure 4-11 and Table 4-8). For a complete description of all forest types, see Appendix D. As in the Herman-Otto subwatershed, B070, Moist, Coarse: Aspen – Birch Hardwood (158 ha, 14%) is closely associated being slightly more moist and with an understory more tolerant of moist conditions.

Early successional Trembling and Large-tooth Aspen and White Birch dominate the northern half of the subwatershed, which is largely on a southern aspect. The forest often has a low density of understory coniferous species such as White Spruce and Balsam Fir. Harvesting occurred at differing times creating different stages of succession. This forest type is young to mid age with distinct stands approximately 20-30 years old and others being 30-40 years old.

The dominant soil type in this forest type is a very fine sandy loam that varies over short distances. Ground layer vegetation in this forest type is typical of upland boreal forest, and is comprised of patchy distribution of Bunchberry, Large Leaf Aster, Starflower, Canada Mayflower (*Maianthemum canadense*), Sarsaparilla, and Goldthread. There are several polygons of swamps interspersed in this community (further described in wetlands section below).

The southern portion of the subwatershed is at a lower elevation giving rise to the lakes and wetlands concentrated here. Lakes are typically fringed with shore fens. The southern portion of the subwatershed also has more coniferous forest than the northern portion and contains 52 ha (5%) of B049, Dry to Fresh, Coarse: Jack Pine - Black Spruce and 138 ha (13%) of B065: Moist, Coarse: Black Spruce- Pine Conifer. The canopy of pine and spruce often has approximately 10% of White Birch as well. The trees tend to be taller on south facing slopes than those in B055, the majority of stands of this type are young to mid-age (30- 40 years old), with older age inclusions of 40-60 years. This forest has a less diverse ground layer, including Lowbush Blueberry (*Vaccinium angustifolium*), Bunchberry, and Canada Mayflower.

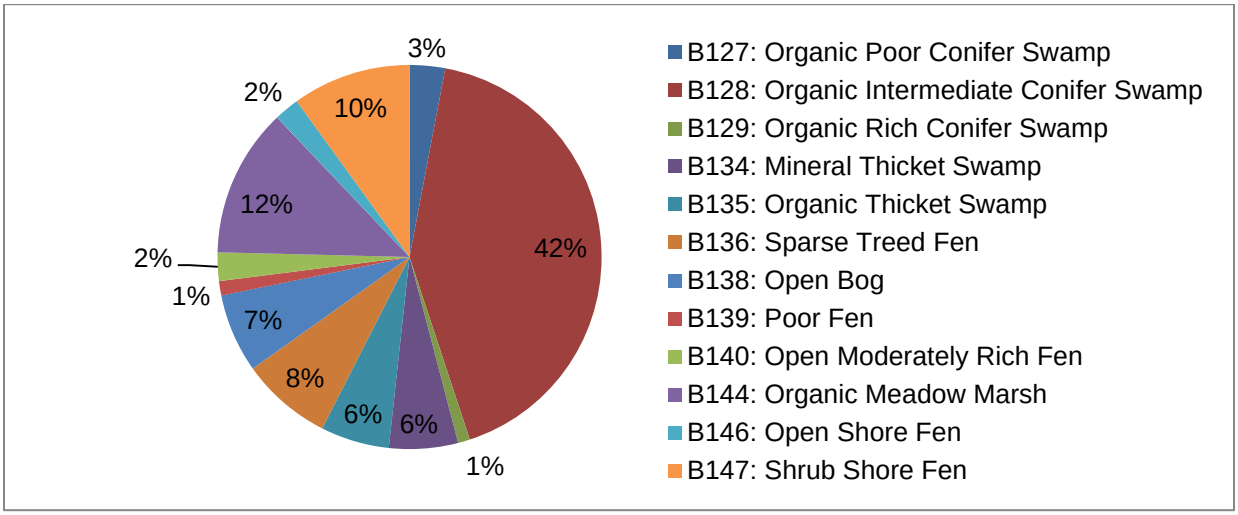
Figure 4-11: Spring–Lovell Subwatershed – Upland Ecological Land Classification Community Distribution by Percent Area



Wetlands

Two headwater areas arise in the east and flow southwest merging between Spring and Lovell Lakes. The more northerly flows from Lakes 1 and 2 through the McVeigh creek system and is associated with an organic thicket swamp (B135, comprising 1% of the subwatershed) (Figure 4-12 shows wetlands as a percent of total wetland). This wetland is dominated by Speckled Alder (*Alnus incana ssp. rugosa*) with a variable ground layer of Dwarf Raspberry (*Rubus pubescens*), Rough Bedstraw (*Galium asprellum*), and Sensitive Fern (*Onoclea sensibilis*). The southern drainage arises just upstream of the southern tailings pond flowing through the polishing pond and on through Lovell Lake. The connecting wetlands include 12 types of fens including one bog in the upper McVeigh Creek.

Figure 4-12: Spring-Lovell Subwatershed – Wetland Type as a Percent of Total Wetland within the Local Study Area



Although the northern portion of the subwatershed is dominated by upland hardwood forest, there are some low-lying areas of conifer swamp (B128, comprising 8% of the subwatershed). These organic swamps are dominated by Tamarack and to a lesser degree, Eastern White Cedar and have a component of white birch, which is often growing on hummocks in swamps. Previous logging may have raised the water table in these low lying areas.

The southern, more coniferous and moist portion of the subwatershed associated with Spring and Lovell Lakes contains organic swamps similar those in the north, but also contains organic fens, bogs, and marshes. The majority of fens are B136, Sparse Treed Fen (15.3 ha, >1 % of the subwatershed), and B147, Shrub Shore Fen (19.9 ha, 2 % of the subwatershed). Fens typically have a very low density of Tamarack and a ground layer of sedge (*Carex*) species. They are often associated with the edges of lakes and watercourses. Bogs are treed with very low densities of Black Spruce with a ground layer dominated by Leatherleaf (*Chamaedaphne calyculata*) and Labrador Tea (*Rhododendron groenlandicum*), and are by definition very low in plant species diversity. There are 25 ha (7.6%) of B144, Organic Meadow Marsh that is dominated by cattail and is associated with lakes.

Floristics

No rare plant species (S1-S3) or SAR were noted in this subwatershed. For a complete list of plant species observed in the Study Area, see Appendix C.

4.2.2.2 Wildlife

Birds

Sixty bird species were identified in the 60 point count plots in this subwatershed. The most common species throughout the subwatershed are Chestnut-sided Warbler, White - throated Sparrow (*Zonotrichia albicollis*), and Hermit Thrush. The highest species richness and abundance is located in proximity to the Tailings Pond and disturbed old mine site. Species common to the LSA and subwatershed are present in this location, but it is notable the Whip-poor-will, Sandhill Crane (*Grus canadensis*), and Canada Geese (*Branta canadensis*) are using this habitat and its surroundings. Plot locations in this area are located in a steep slope of mixed wood forest with a southern aspect, the tailings pond itself, a riparian wetland, and a bog environment. These habitats are variable, have plentiful forest edge, and have diverse horizontal and vertical structures largely due to mining and forestry activities that created and maintained openings.

Common Loon is the most common bird associated with lakes. Black Duck (*Anas rubripes*) and Mallard (*Anas platyrhynchos*) were observed in relatively equal numbers. Common Goldeneye and Ring Necked Ducks were observed in very low numbers during staging area surveys.

Two Broad-winged Hawks (*Buteo platypterus*), two Common Ravens (*Corvus corax*), one Red-tailed Hawk (*Buteo jamaicensis*), two Bald Eagles (*Haliaeetus leucocephalus*), and one Turkey Vulture (*Cathartes aura*) were observed in this subwatershed.

No marsh birds were noted in this subwatershed on the surveys and no nests were observed.

For a complete list of birds noted in this subwatershed, and their locations, please see Appendix E.

Amphibians

Spring Peeper were present in high numbers in 13 of the 20 wetlands sampled during the late May survey, followed by generally equal numbers of American Toad and Boreal Chorus Frog. In middle to late June, Spring Peepers were the most common amphibian, followed by equal numbers of American Toad, Boreal Chorus Frog, and Green Frog. Early to mid July surveys resulted in very low numbers of Green Frogs, the only species heard. For complete amphibian survey results, see Appendix F.

Mammals

American Beaver, and their lodges and dams, are the most common mammal observed in this subwatershed, followed by Moose near Spring Lake, Lovell Lake, Lake 2, and Lake 1. Black

Bear sign and direct observations occurred near Lovell Lake, Spring Lake, and in the central portion of the subwatershed.

4.2.2.3 Landscape Connectivity

The principal conduits of landscape connectivity in this watershed are those naturally occurring in the lake and wetland lowland associated with Spring Lake – Lovell Lakes connecting to McVeigh Creek. Riparian areas of the McVeigh Creek Tributary are comprised of generally intact shrub (alder) wetland vegetation, and are suitable as wildlife corridors reaching almost to Goudreau Road.

The upland forest matrix in Spring-Lovell subwatershed is a mixture of young forest and a high density of roads and trails. Forest roads and trails are major corridors in this area where tracks of Moose and Northern Gray Wolf (*Canis lupus occidentalis*), and Black Bear faeces were commonly observed. Riparian areas of McVeigh Creek are largely fen which is generally an open environment suitable for wildlife movement, especially along the edge of the fen where it meets upland forest.

4.2.2.4 Significance and Sensitivities

SIGNIFICANT WILDLIFE HABITAT

According to MNRF Significant Wildlife Habitat Ecoregion 3E Criterion schedule, the following habitats are significant in this subwatershed:

- Amphibian Breeding Habitat
- Moose Aquatic Feeding Habitat
- Moose Late Winter Cover

Amphibian Breeding Habitat

The threshold for significance is the occurrence of three or more amphibian species present with at least 20 breeding individuals. Six wetland habitats meet the criteria for significance (Table 4-9 and Figure 4-7).

Table 4-9: Spring-Lovell Significant Wildlife Habitat: Amphibian Breeding

SURVEY POINT NUMBER (AMPHIBIAN BREEDING HABITAT UNIQUE ID)	ELC CODE	HABITAT DESCRIPTION	SPECIES (HIGHEST CALLING CODE)
A05	B135 - Wetland: Organic Thicket Swamp	Pool of McVeigh Creek Tributary dominated by alder	Spring Peeper (3) Green Frog (1) Chorus Frog (1)
A18	HU – Anthropogenic (disturbed)	Excavated gravel pond filled with water. Surrounding area is very disturbed with a large amount of exposed ground.	Spring Peeper (3) Chorus Frog (2) American Toad (1)

SURVEY POINT NUMBER (AMPHIBIAN BREEDING HABITAT UNIQUE ID)	ELC CODE	HABITAT DESCRIPTION	SPECIES (HIGHEST CALLING CODE)
A19	HU – Anthropogenic (disturbed)	Excavated gravel pond filled with water. Surrounding area is very disturbed with a large amount of exposed ground.	Spring Peeper (3) Chorus Frog (1) Green Frog (1)
A21	HU – Anthropogenic (disturbed)	Excavated gravel pond filled with water. Surrounding area is very disturbed with a large amount of exposed ground.	Spring Peeper (3) Chorus Frog (1) Green Frog (1)
AA6	B138 - Wetland: Open Bog	Open bog dominated by leatherleaf; amphibians were heard calling throughout the bog.	Spring Peeper (2) Chorus Frog (1) American Toad (2)
A2-3	B136 – Wetland: Sparse Treed Fen	Adjacent to stream with alder leading to open fen; amphibians were heard calling throughout the fen and in the watercourse.	Spring Peeper (2) American Toad (2) Green Frog (2)

Moose Aquatic Feeding Habitat

SLR identified four Moose Aquatic Feeding Habitats, three of which are associated with the Spring-Lovell corridor (Figure 4-8). One habitat is in the eastern end of Lovell Lake at the inlet from the watercourse leading from the Polishing Pond (MAFH-SLR-04, 2.8 ha), another is located between Spring and Lovell Lakes in an area comprised of marsh cattails as well as fen, adjacent to upland coniferous forest (MAFH-SLR-03, 7.5 ha), and another is located where Spring Lake enters McVeigh Creek (MAFH-SLR-02, 3.4 ha). MAFH-SLR-01 (3.9 ha) is located in an area along McVeigh Creek comprised of emergent vegetation.

Moose Late Winter Cover

Significant Moose late winter cover is present in the southwest portion of this subwatershed (MWC-01) (Figure 4-8). The habitat encompasses a large area of conifer forest that varies in composition and includes some mixed wood areas and wetlands. It encompasses an area most recently logged and therefore the browse is younger and denser. Generally, the area is comprised of Jack Pine and Black and White Spruce with >60% canopy closure and trees > 6 m in height. Moose sign and direct moose observation were noted throughout this habitat. This complex of late winter cover habitat spans Spring-Lovell and Webb-Goudreau subwatersheds.

SPECIES AT RISK

Five listed species at risk were recorded (observed or heard) in this subwatershed (Table 4-10). Locations of SAR occurrences are mapped on Figure 4-8.

Table 4-10: Spring-Lovell SAR Occurrences

Species	Conservation Status		Number noted	Habitat
	Endangered Species Act, 2007 (ON)	Species At Risk Act (CAN)		
Eastern Whip-Poor-Will	Threatened	Threatened	3[1]	B055: Dry-Fresh, Coarse: Aspen – Birch Hardwood
Common Nighthawk	Special Concern	Threatened	11	B049: Dry – Fresh, Coarse: Jack Pine – Black Spruce Dominated B055: Dry-Fresh, Coarse: Aspen – Birch Hardwood (close to waterbodies, and one area slightly outside the subwatershed boundary) HU: Disturbed old mine site, gravel substrate
Olive-sided Flycatcher	Special Concern	Threatened	4	B144: Open meadow marsh B138: Open bog B070: Moist, Course: Aspen – Birch Hardwood
Bald Eagle	Special Concern	Not listed	3	LA: Lakes, species were seen flying over lakes
Rusty Blackbird	Not Listed	Special Concern	1	B055: Dry-Fresh, Coarse: Aspen – Birch Hardwood (disturbed)

[1] Two males heard on same night, constitutes a breeding territory.

Two male Eastern Whip-poor-will were heard calling on the same night in June 2013, constituting a candidate breeding territory near the tailings pond. A single call was recorded near the subwatershed boundary near the trail. A breeding territory occupies approximately 9 ha (MNRF 2014, Appendix B). However, during surveys in 2012, 2014 and 2016 no birds were recorded. Magino occurs at the northern limit of the distribution of Eastern Whip-poor-will, and the disturbed forest with canopies that are rapidly closing is not ideal habitat. The one candidate breeding territory occurs on the northern edge of the tailings pond, an artificial feature that may simulate the mix of open and forested habitat preferred by this species. The birds may not have returned due to the lower quality habitat.

Common Nighthawk, Olive-sided Flycatcher, Rusty Blackbird were observed mostly associated with the southern portion of the watershed where logging operations are most recent. Bald Eagle were observed on a small wetland north of Spring Lake. They were not nesting.

4.2.2.5 Key Attributes of Spring-Lovell Subwatershed

Upland communities comprise 70% of the subwatershed, and wetland communities comprise 18%. There are three types of Significant Wildlife Habitat: Amphibian Wetland Breeding Habitat (six sites), Moose Aquatic Feeding Habitat (four sites) and Moose Late Winter Cover (one large site). Five SAR were recorded. A summary of key attributes of Spring Lovell subwatershed is provided in Table 4-11.

Table 4-11: Spring-Lovell Subwatershed - Key Attributes

DOMINANT UPLAND VEGETATION COMMUNITIES	% of Subwatershed
Deciduous Aspen – Birch Hardwood Forest	55
Coniferous Jack Pine – Spruce Forest	13
DOMINANT WETLAND VEGETATION COMMUNITIES	**% of Subwatershed**
Conifer Swamp	8
Organic Meadow Marsh	2
Shrub Shore Fen	2
SIGNIFICANT WILDLIFE HABITAT	**Number of Areas**
Amphibian Wetland Breeding Habitat	6
Moose Late Winter Cover	1
Moose Aquatic Feeding Habitat	4
SPECIES AT RISK	**Number Recorded**
Whip-Poor-Will	3
Common Nighthawk	9
Olive-sided Flycatcher	4
Bald Eagle	3
Rusty Blackbird	1

4.2.3 WEBB-GOUDREAU SUBWATERSHED

4.2.3.1 Vegetation

This most southerly subwatershed is represented by 1,190 ha at the western edge of the watershed north of Webb and Goudreau Lakes. This portion of the subwatershed therefore receives inputs in the form of both aquatic and terrestrial functions that are unrelated to the Magino mine proposal. This western portion of the subwatershed is the site of intensive, historical mining activity by several companies, including a closed mine adit; access to the historical underground tunnels; and two mine vents. The remnants of the mine camp extend east and west along the lakeshore resulting in about 7% of the area exposed sandy areas. The large areas of lake in the Webb and Goudreau Lake basins represent 17%; higher than the Regional representation of 12% and either of the other 2 subwatersheds. Upland forest comprises 65%, slightly less than the two northern subwatersheds with less wetland coverage (11%) (Figures 4-13 and 4-14). Table 4-12 provides a summary of areas of vegetation communities.

Figure 4-14: Webb - Goudreau Subwatershed – All Vegetation Distribution by Percent Area

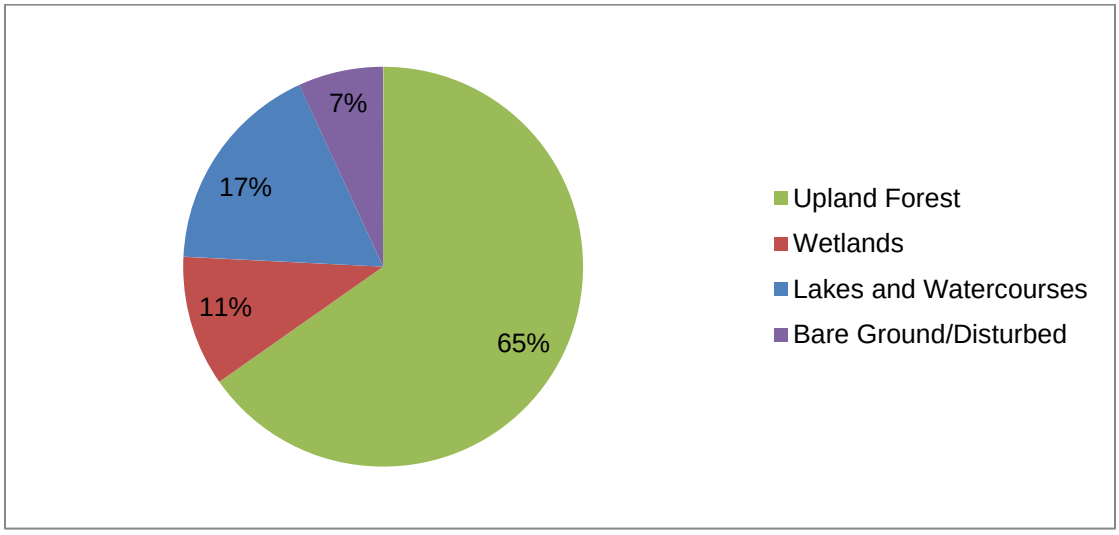
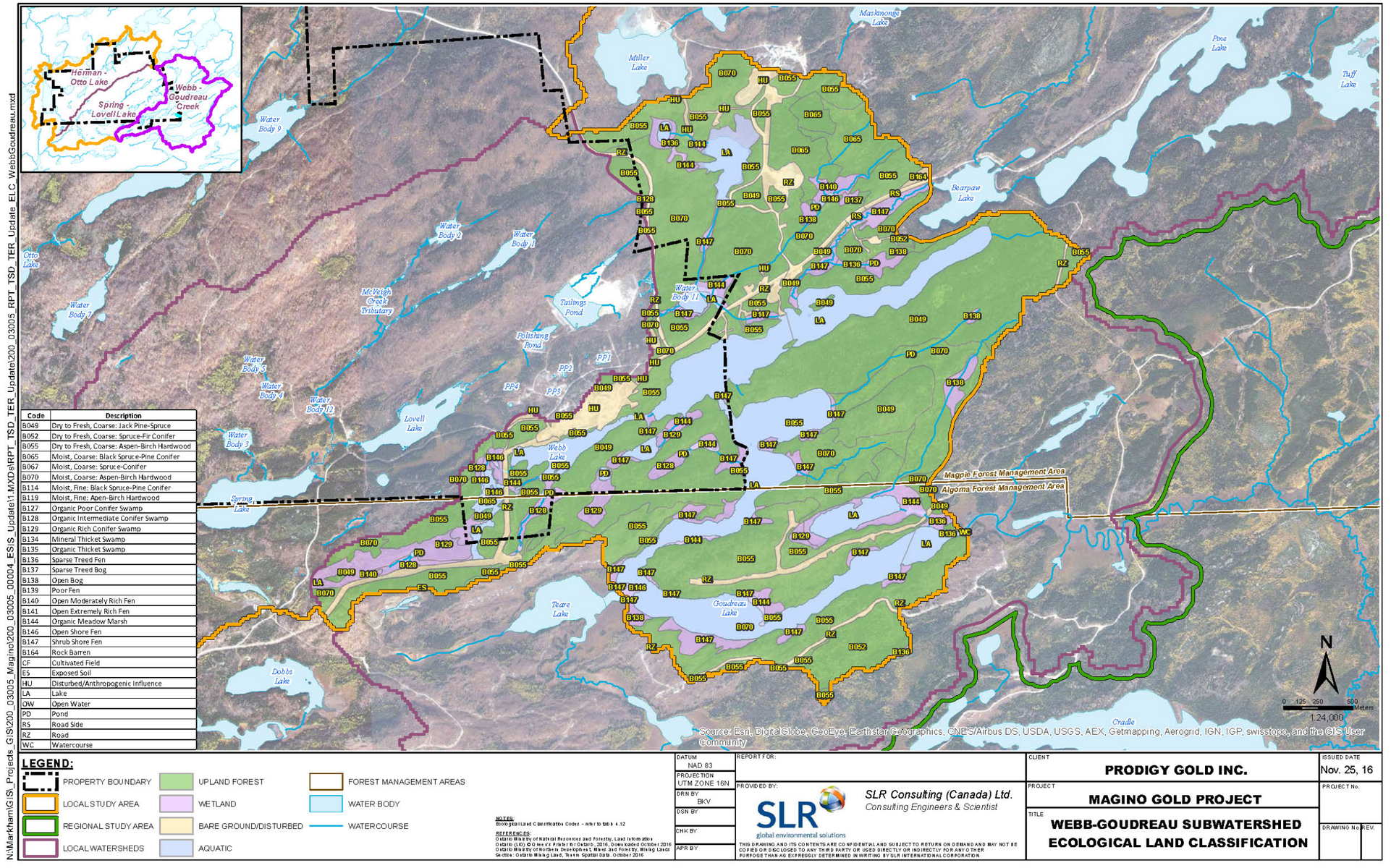


Figure 4-13: Webb-Goudreau Subwatershed – Ecological Land Classification



Code	Description
B049	Dry to Fresh, Coarse: Jack Pine-Spruce
B052	Dry to Fresh, Coarse: Spruce-Fir Conifer
B055	Dry to Fresh, Coarse: Aspen-Birch Hardwood
B065	Moist, Coarse: Black Spruce-Pine Conifer
B067	Moist, Coarse: Spruce-Conifer
B070	Moist, Coarse: Aspen-Birch Hardwood
B114	Moist, Fine: Black Spruce-Pine Conifer
B119	Moist, Fine: Aspen-Birch Hardwood
B127	Organic Poor Conifer Swamp
B128	Organic Intermediate Conifer Swamp
B129	Organic Rich Conifer Swamp
B134	Mineral Thicket Swamp
B135	Organic Thicket Swamp
B136	Sparse Treed Fen
B137	Sparse Treed Bog
B138	Open Bog
B139	Poor Fen
B140	Open Moderately Rich Fen
B141	Open Extremely Rich Fen
B144	Organic Meadow Marsh
B146	Open Shore Fen
B147	Shrub Shore Fen
B164	Rock Barren
CF	Cultivated Field
ES	Exposed Soil
HU	Disturbed/Anthropogenic Influence
LA	Lake
OW	Open Water
PD	Pond
RS	Road Side
RZ	Road
WC	Watercourse

LEGEND:

PROPERTY BOUNDARY
LOCAL STUDY AREA
REGIONAL STUDY AREA
LOCAL WATERSHEDS
UPLAND FOREST
WETLAND
BARE GROUND/DISTURBED
AQUATIC
FOREST MANAGEMENT AREAS
WATER BODY
WATERCOURSE

NOTES:
Ecological Land Classification Codes - refer to Table 4.12

REFERENCES:
Ontario Ministry of Natural Resources and Forestry, Land Information Ontario (LIO) © Queen's Printer for Ontario, 2016, Downloaded October 2016
Ontario Ministry of Northern Development, Mines and Forestry, Mining Land Sections: Ontario Mining Land, Townships, Spatial Data, October 2016

DATUM: NAD 83
PROJECTION: UTM ZONE 16N
DRN BY: BKV
DSN BY:
CHK BY:
APR BY:

REPORT FOR:

PROVIDED BY: SLR Consulting (Canada) Ltd. Consulting Engineers & Scientist
SLR global environmental solutions

CLIENT: PRODIGY GOLD INC.
PROJECT: MAGINO GOLD PROJECT
TITLE: WEBB-GOUDREAU SUBWATERSHED ECOLOGICAL LAND CLASSIFICATION

ISSUED DATE: Nov. 25, 16
PROJECT No.:
DRAWING No.: REV.:

N:\Markham\GIS_Projects_GIS\200_03005_Magino\200_03005_00004_ESIS_Update\1.MXDs\RPT_TSD_TER_Update_ELC_WebbGoudreau.mxd

Table 4-12: Webb-Goudreau Ecological Land Classification

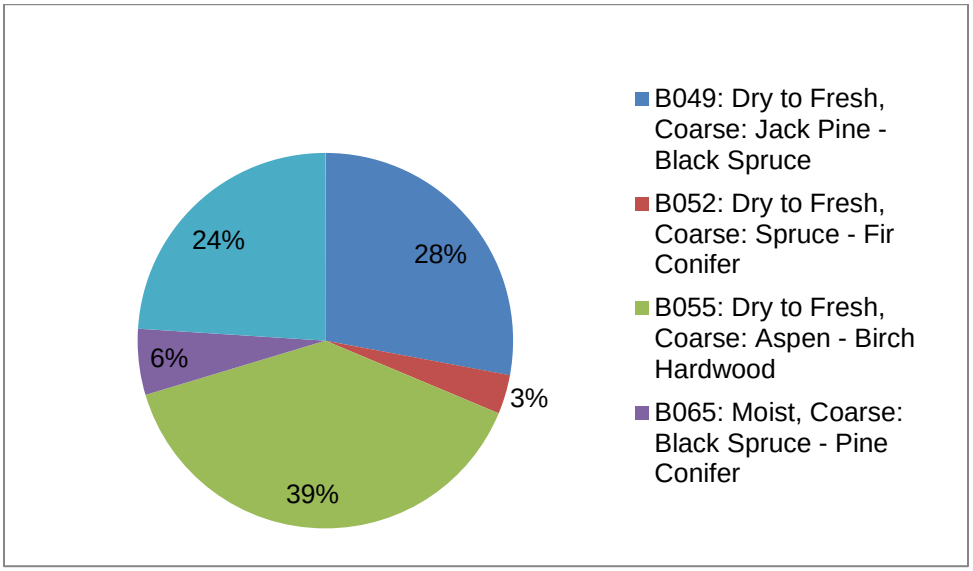
ELC	AREA (HA)	% OF SUBWATERSHED	DESCRIPTION
Upland Forest			
B049	217	18	Dry to Fresh, Coarse: Jack Pine - Spruce
B052	26	2	Dry to Fresh, Coarse: Spruce - Fir Conifer
B055	303	25	Dry to Fresh, Coarse: Aspen – Birch Hardwood
B065	44	4	Moist, Coarse: Black Spruce – Pine Conifer
B070	186	16	Moist, Coarse: Aspen – Birch Hardwood
Total Upland Forest	776	65	
Wetlands			
B128	9	1	Intermediate Conifer Swamp
B129	24	2	Organic Rich Conifer Swamp
B136	6	>0	Sparse Treed Fen
B137	1	>0	Sparse Treed Bog
B138	11	1	Open Bog
B140	7	1	Open Moderately Rich Fen
B144	23	2	Organic Meadow Marsh
B146	2	>0	Open Shore Fen
B147	41	3	Shrub Shore Fen
Total Wetlands	125	11	
Aquatic (Lakes, Rivers, Streams)			
LA	203	17	Lake
PD	3	>0	Pond
WC	>0	>0	Watercourse
Total Aquatic	206	17	
Bare Ground / Disturbed			
RZ	50	4	Roads
HU	27	2	Anthropogenic
RS	4	>0	Roadside
ES	>0	>0	Exposed Soil
Total Disturbed	82	7	
Rock Barren			
B164	1	>0	Rock Barren

The northern portion of Webb-Goudreau subwatershed is comprised of more coniferous forest than the southern portion, the early successional hardwood forest reflecting more recent logging. The historical mine site is now the site of active mine exploration activities, however the exposed sand / gravel and road areas provide ecological niches not present elsewhere.

The southern portion of the subwatershed is comprised largely of B055 Dry to Fresh, Coarse: Aspen – Birch Hardwood (303 ha, 25%) with the associated B070, Moist, Coarse: Aspen – Birch Hardwood at 186 ha, 16% (Figure 4-15 and Table 4-12). For a complete description of all forest types, see Appendix D. The forest was harvested at differing times and is therefore in different stages of succession. It is generally young (20-40 years), and often has a low density of understory coniferous species such as White Spruce. The dominant soil type in this forest type is a sandy loam. Ground layer vegetation in this forest type is typical of upland boreal forest in this Ecodistrict, and is comprised of varying abundances of Bunchberry, Large- leaf Aster, Starflower, Mayflower, Sarsasparilla, and Goldthread. There are several polygons of swamps interspersed in this community (further described in wetlands section below).

There is 287 ha (24%) of conifer forest, mostly in the north. This conifer forest is comprised of B049: Dry to Fresh, Coarse: Jack Pine – Black Spruce (18%), B065: Moist, Coarse: Black Spruce – Pine Conifer, and B052: Dry to Fresh, Coarse: Spruce – Fir Conifer. Despite differences in canopy, the soil and ground layer are similar in these conifer forests. The soil is a sandy loam and the ground layer is often comprised of Labrador Tea, blueberry, and Bunchberry. This forest is mid-age and is on average 40-60 years old.

Figure 4-15: Webb-Goudreau Subwatershed - Upland Ecological Land Classification Community Distribution by Percent Area



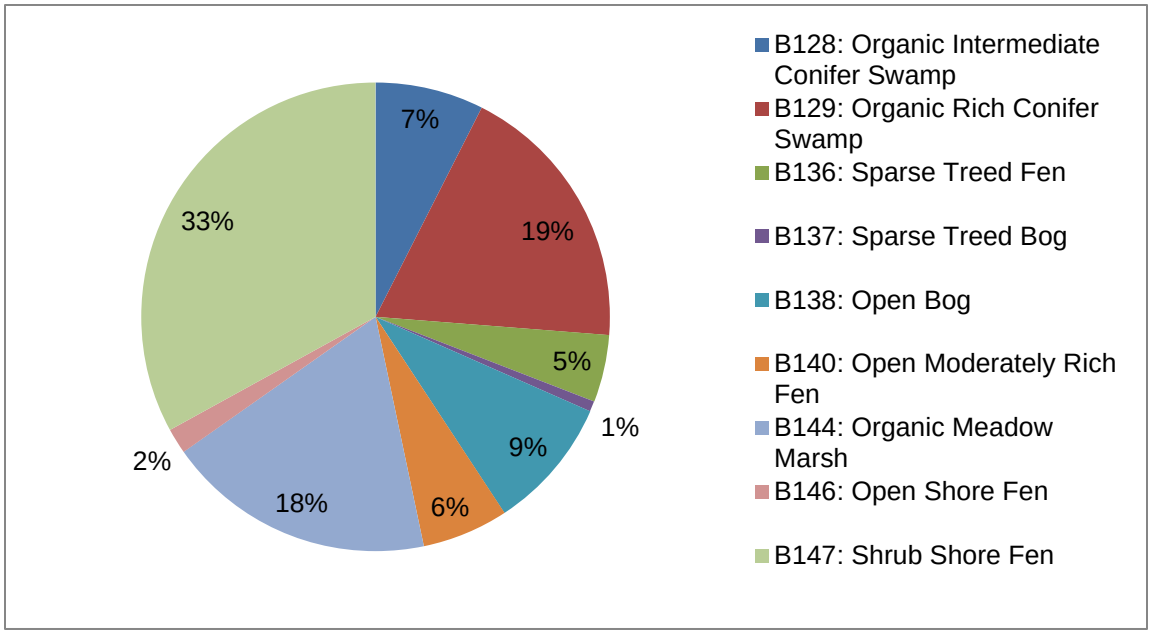
Wetlands

The most abundant wetland type in this subwatershed is B128, Organic Intermediate Conifer Swamp (9 ha, 1%) (Figure 4-16 shows wetlands as a percent of total wetland). They are largely threaded along the small watercourses that drain to major lakes. They are dominated by Larch or Eastern White Cedar with a component of White Birch.

The southern portion of the subwatershed contains organic fens, bogs, and marshes. The majority of fens are B147, Shrub Shore Fen (41 ha, 3%) and are associated with lakes and

watercourses. Fens typically have a very low density of Larch and a ground layer of sedge species.

Figure 4-16: Webb-Goudreau Subwatershed – Wetland Type as a Percent of Total Wetland



Floristics

No rare species (S1-S3) or SAR were noted in this subwatershed. For a complete list of plant species observed in the Study Area, see Appendix C.

4.2.3.2 Wildlife

Birds

Thirty nine bird species were identified in the 18 point count plots. The most common birds include Red-eyed Vireo, Chestnut Sided Warbler, White-throated Sparrow, and American Redstart (*Setophaga ruticilla*). The area south of Webb Lake and north and west of Goudreau Lake is an area of particular activity. Observations were made in deciduous forest adjacent to swamp habitats and in very young deciduous forest that was recently harvested in proximity to Lakes. Birds observed in this area include Veery and White-throated Sparrow. One Chimney Swift was heard near the historical mine site. Additional survey was undertaken in 2014 but no evidence of foraging or nesting was determined.

Common Loon, American Black Duck, Herring Gull (*Larus argentatus*), and Mallard were identified on Goudreau Lake, Webb Lake, and Lake 10. Common Loon, Northern Shoveler (*Anas clypeata*), and Ring Necked Ducks were observed on waterbodies in very low numbers during staging area surveys.

One American Kestrel (*Falco sparverius*), one Broad-winged Hawk (*Buteo platypterus*), one Merlin (*Falco columbarius*), two Common Ravens (*Corvus corax*), and two Bald Eagles were observed in this subwatershed.

No marsh birds were recorded. For a complete list of birds noted in this subwatershed, and their locations, please see Appendix E.

Amphibians

Spring Peeper were present in high numbers in three of the four wetlands sampled during the late May survey, followed by a generally equal numbers of American Toad and Green Frog. In middle to late June, Spring Peepers were still the most common amphibian although present in lower numbers than earlier in the spring, followed by equal amounts of American Toad and Green Frog. Early to mid July surveys resulted in very low numbers of Green Frogs, the only species heard.

Mammals

Moose were observed at Lake 10 and the near the southern area of Goudreau Lake. Black Bear were observed in the disturbed mine area along access roads. One Lynx (*Lynx canadensis)* was observed north of Webb Lake and another was observed south of Lake 10. There is beaver activity on Lake 10, Webb Lake, and Goudreau Lake.

Bat Observations

Efforts to document habitat used by bats at the Magino site included bat roost surveys, exit observation surveys and acoustic recording in and immediately outside the adit and mine vent. No direct observations of live bats were recorded, however six Northern Long-eared Bats were collected at entrance to the mine adit in 2014, all infected with *Pseudogymnoascus destructans* a.k.a. White-nose Syndrome

See Appendix G for Bat Acoustical Monitoring Data.

EcoObs bat data from 27-28 August was analysed by both MNR and SLR. Bat files were analysed using Analook software (Corben 2014) from April to August 2014, and subsequently with Kaleidoscope Pro (Wildlife Acoustics) using filters for the following North American bat species with known distributions in northern Ontario:

- Little brown bat *Myotis lucifugus*;
- Northern long-eared bat *Myotis septentrionalis*;
- Big brown bat *Eptesicus fuscus*;
- Silver-haired bat *Lasionycteris noctivagans*;
- Hoary bat *Lasiurus cinereus*;
- Eastern red bat *Lasiurus borealis*

It should be noted that the analysis counted the number of registrations, recorded as separate sound files. Total registrations should be interpreted as an indication of relative activity rather

than the number of individual bats. Data may be 'autocorrelated' in some periods – i.e. sound files only separated by short intervals could be the same bat.

Table 4-13 documents the results of the surveys.

Table 4-13: Results of Surveys for Bat Habitat Use

DATE	LOCATION	RESULTS
August 27-28, 2013	outside the adit door, and outside the mine door	Detected Northern Long-eared Bat, Little Brown Bat and a probable Big Brown Bat /Silver-haired Bat in a swarm.
August 28-29, 2013	raised mine vent north of adit	No evidence of use; no recordings; concluded vent not occupied
August 28, 2013	Second mine vent	No evidence of occupation; flooded with vertical opening offering poor conditions for hibernation
March 11, 2014; April 9, 2014 – October 2014	Inside adit at the junction with the portal and 2.5 m outside the "man door"	Total of six Northern Long-eared Bats were collected at entrance to the mine adit A low number of individuals of both Northern Long-eared and Little Brown were detected emerging from the adit, and occasionally returning in addition to Hoary, Big Brown, Silver-haired and Eastern Red
June 9, 12 and 14, 2014	Mine adit and Building 9 – historical cyanide treatment area	No bats were observed during visual exit surveys.
June 11, 2014	All Buildings and infrastructure associated with historical mining and forest stands within 500m	No evidence of bat use (direct observation, droppings) was observed at any of the nine (9) buildings on the historical mine (brownfield) site. Approximately 0.5 -1 snag / ha greater than 25 cm dbh were observed in each of the stands
March 2015 – June 2015	Inside adit at the junction with the portal and 2.5 m outside the "man door"	Four little brown bat files were recorded in June however may have been outside the adit along with Hoary, Big Brown, Silver-haired and Eastern Red. No Northern Long-eared were recorded.

4.2.3.3 Landscape Connectivity

Evidence of human disturbance is extensive in the southwest where historical logging and mining have left evidence in roads, logging and tailings ponds. These areas were all used by wildlife to travel through the subwatershed. The riparian/aquatic habitat connectivity exists along the major drainage patterns through Webb-Goudreau in the form of fen and other open wetlands and well-defined watercourses.

4.2.3.4 Significance and Sensitivities

SIGNIFICANT WILDLIFE HABITAT

Amphibian Breeding Habitat (Wetlands)

To be considered significant, three or more amphibian species must be present with at least 20 breeding individuals. Two wetland habitats meet the criteria for significance (Table 4-14).

Table 4-14: Webb-Goudreau Significant Wildlife Habitat: Amphibian Breeding

Survey Point Number (Amphibian Breeding Habitat Unique ID)	ELC Code	Habitat description	Species (highest calling code)
A01	B147- Wetland: Shrub Shore Fen	Fen between Webb and Goudreau lakes, open water and beaver dam in central portion.	Spring Peeper (3) American Toad (2) Green Frog (2)
A17	B128 - Wetland: Intermediate Conifer Swamp	Swamp associated with Lake 10, open water areas.	Spring Peeper (3) American Toad (2) Green Frog (2)

Moose Aquatic Feeding Habitat

There is one Aquatic Feeding Habitat of very high quality, where moose were observed several times in at Wetland 10. This habitat (MAFH-SLR-05) is 3.5 ha in size and is comprised of a high amount of dead standing trees.

SPECIES AT RISK

Six SAR were noted in this subwatershed (Figure 4-8). One Chimney Swift was observed at the disturbed old mine site. An effort was made to locate the nest in 2014, but no nest was found. Common Nighthawk, Olive-sided Flycatcher, and Bald Eagle were noted (Table 4-15). Two Common Nighthawks and two Olive-sided Flycatchers were heard at the disturbed old mine site, both on separate occasions. One Olive-sided Flycatcher was heard slightly to the west of the disturbed old mine site and another was heard south of Lake 10 in mixed wood forest.

Two Bald Eagles were observed flying over deciduous forest on the northwest shore of Goudreau Lake, two were observed flying over the disturbed old mine site, and two were observed on the southern shore of Morrison Lake. All eagles were observed as individual birds; no nests were detected.

Table 4-15: Webb Goudreau Habitat for SAR

Species	Conservation Status		Number noted	Habitat
	Endangered Species Act, 2007 (ON)	Species At Risk Act (Can)		
Chimney Swift	Threatened	Threatened	1	HU: Disturbed old mine site, gravel substrate
Common Nighthawk	Special Concern	Threatened	2	HU: Disturbed old mine site, gravel substrate
Olive-sided Flycatcher	Special Concern	Threatened	3	HU: Disturbed old mine site, gravel substrate B055: Dry-Fresh, Coarse: Aspen – Birch Hardwood
Bald Eagle	Special Concern	Not listed	4	LA: Lakes, species were seen flying over lakes HU: Disturbed old mine site, gravel substrate
Northern Long-Eared Bat	Endangered	Endangered	6 dead collected; few individuals	Overwintering in 2014/ not detected in 2015;
Little Brown Bat	Endangered	Endangered	spring activity noted – few individuals	Possible overwintering and summer roosting in 2014; unconfirmed in 2015

4.2.3.5 Key Attributes of Webb-Goudreau Subwatershed

Webb-Goudreau is the largest of the three subwatersheds but most disturbed by human activity. Like the others, Aspen-Birch Hardwood is the most abundant community (41%) of the subwatershed with wetland communities comprising 8 % but in smaller, narrower units than those in Spring-Lovell and similar to Herman-Otto. There is one type of Significant Wildlife Habitat: Amphibian Wetland Breeding Habitat (2 sites). Six SAR were observed. Key attributes are provided in Table 4-16.

Table 4-16: Webb-Goudreau Subwatershed - Key Attributes

DOMINANT UPLAND VEGETATION COMMUNITIES	% of Subwatershed
Deciduous Aspen – Birch Hardwood Forest	41
Coniferous Jack Pine – Spruce Forest	24
DOMINANT WETLAND VEGETATION COMMUNITIES	**% of Subwatershed**
Conifer Swamp	3

Treed, Shrub or Open Fen	5
Open Bog	1
Organic Meadow Marsh	2
SIGNIFICANT WILDLIFE HABITAT	**Number of Areas**
Amphibian Wetland Breeding Habitat	1
Moose Aquatic Feeding Habitat	1
SPECIES AT RISK	**Number Recorded**
Northern Long-Eared Bat	Low numbers
Little Brown Bat	Low numbers
Chimney Swift	1
Common Nighthawk	2
Olive-sided Flycatcher	4
Bald Eagle	6

4.3 PROJECT STUDY AREA

The PSA is 1802 ha, 68% of which is comprised of Spring-Lovell subwatershed, 28% is the Herman-Otto subwatershed and the remaining 4% is Webb-Goudreau subwatershed. The disturbance from past mining and logging activities is focused in the PSA resulting in more exposed ground/disturbed forest and generally younger forest that the surrounding LSA.

The majority of the PSA is comprised of upland forest in Spring-Lovell and Herman-Otto subwatersheds (Table 4-16) and includes the high north and south divide. The upland forest is typical across all subwatersheds and study areas, is dominated by dry/moist Aspen-Birch hardwood forest (B055 and B070). Wetlands comprise between 12 to 20% of the subwatersheds of which 15% falls within the PSA. Bare ground/disturbed areas comprise 4.5% of the PSA, focused in the area around the old mine site straddling the Spring–Lovell and Webb-Goudreau watersheds.

Table 4-17: Comparison of Subwatersheds within the Project Study Area

PLANT COMMUNITY (CODE = ELC)	HERMAN-OTTO		SPRING-LOVELL		WEBB-GOUDREAU	
	% PROJECT STUDY AREA	% WATERSHED AREA	% PROJECT STUDY AREA	% WATERSHED AREA	% PROJECT STUDY AREA	% WATERSHED AREA
Watershed Composition						
Upland forest	34%	66%	30%	70%	6%	57%
Wetland	7%	12%	8%	20%	1%	15%
Lakes and Watercourses	<1%	<1%	1%	<1%	<1%	<1%
Bare Ground / Disturbed	1%	1%	3%	<1%	1%	5%
Upland Forest						

PLANT COMMUNITY (CODE = ELC)	HERMAN-OTTO		SPRING-LOVELL		WEBB-GOUDREAU	
	% PROJECT STUDY AREA	% WATERSHED AREA	% PROJECT STUDY AREA	% WATERSHED AREA	% PROJECT STUDY AREA	% WATERSHED AREA
B055: Dry to Fresh, Coarse: Aspen – Birch Hardwood	23%	38%	22%	39%	2%	29%
B070: Moist, Coarse: Aspen – Birch Hardwood	10%	16%	4%	14%	1%	11%
B049: Dry to Fresh, Coarse: Jack Pine - Spruce	1%	5%	2%	5%	3%	8%
B065: Moist, Coarse: Black Spruce – Pine Conifer	<1%	6%	1%	12%	<1%	6%
B119: Moist, Fine: Aspen – Birch Hardwood	<1%	2%	<1%	<1%	-	3%
Wetland						
B127: Organic Poor Conifer Swamp	<1%	<1%	<1%	1%	-	-
B128: Intermediate Conifer Swamp	4%	5%	3%	8%	<1%	5%
B136: Sparse Treed Fen	<1%	<1%	1%	1%	-	2%
B138: Open Bog	<1%	<1%	1%	1%	-	1%
B129: Organic Rich Conifer Swamp	<1%	1%	<1%	<1%	<1%	1%
B139: Poor Fen	<1%	<1%	<1%	<1%	-	<1%
B140: Open Moderately Rich Fen	<1%	<1%	<1%	<1%	<1%	<1%
B147: Shrub Shore Fen	1%	2%	1%	2%	<1%	3%
B146: Open Shore Fen	<1%	1%	<1%	<1%	<1%	<1%
B134: Mineral Thicket Swamp	1%	1%	1%	1%	-	1%
B135: Organic Thicket Swamp	<1%	<1%	1%	1%	-	<1%
B144:Organic Meadow Marsh	<1%	<1%	1%	2%	<1%	2%

4.4 SUMMARY

This section provides a summary of the existing terrestrial environmental conditions in the study areas by different themes. First, it compares, contrasts and summarizes major ecological differences among the subwatersheds and accounts for ecological variability. Secondly, a summary of significance and sensitivities for all three subwatersheds is presented. Significance and sensitivities are limited in this concluding section to Significant Wildlife Habitat and SAR.

4.4.1 SUBWATERSHED COMPOSITION

Moving north to south, the Herman-Otto subwatershed is generally less disturbed than Spring-Lovell and Webb-Goudreau. Webb-Goudreau and Spring-Lovell have relatively lower upland forest cover and highest area of bare ground/disturbed area.

The high amount of wetland in Spring-Lovell is largely a function of topography. It is the headwater to a tributary to McVeigh Creek, it has the highest representation of wetland types and most of the wetlands are associated with watercourses.

The presence of bare ground/disturbed areas in Webb-Goudreau and Spring-Lovell and open canopy forest is largely due to past mining activities, forestry roads, and exploratory roads and trails for mining. These temporary niches may have enhanced opportunities for Whip-poor-will and Common Nighthawk breeding and foraging habitat that are less likely to occur in the closed forest, and also provide suitable forage for moose.

4.4.2 UPLAND FOREST

Generally, conifer dominated stands as hardwood stands when logged and this appears to have happened extensively in the PSA. These past forestry practices have had the greatest influence on upland forest composition, creating a relatively early aspen-birch successional forest. They are focused in areas adjacent to forest road networks. Herman-Otto has the highest percentage of this upland forest but relatively little Jack Pine/Black Spruce forest and little Spruce/Balsam Fir forest. It is the most diverse of forest types with six Ecosites represented compared to eight in the Regional Study area however only 2 occur in the PSA.

Spring-Lovell is also dominated by the Aspen – Birch forest, but with a higher proportion of Jack Pine/Black Spruce and very little Black Spruce/Balsam Fir association. Spring-Lovell has fewer forest types (five Ecosites) all of which are represented in the PSA.

There is a very small portion of Webb Goudreau within the PSA composed almost entirely of the considerable open area associated with the historical mining activities and the surface of Webb Lake. Small areas of three forested Ecosites occur within the PSA. Very small areas of Aspen/Birch forest and Jack Pine/Black Spruce occur in the patches between the clearings.

4.4.3 WETLAND

The most common wetland type Conifer Swamp. However the forested nature of Herman-Otto is clearly evidenced in the lowest percentage of the subwatershed in wetland and with the fewest wetland types. The lakes are steep-sided with limited riparian habitat with the forests close to the wetland edge in most places. Shallow areas of the lakes were emergent marshes composed of cattail, spikerush with occasional submergent wetland species that was generally too small to map. Wetlands can also change dramatically. For example, Lovell Lake was covered in White and Yellow Water-lily in August of 2013. Additional description of vegetation in the lakes is provided in the Fisheries Technical Supporting Document.

Spring-Lovell contains small portions of vegetation types. In the northern headwater areas of the subwatershed, the organic conifer swamps are more mature and floristically more diverse. They are comprised of more cedar than the younger swamps in the south characterized by Tamarack and White Birch. Spring-Lovell and Webb-Goudreau have the highest area of Shore Fen occurring along the watercourses, in the connection between large lakes in the south of the subwatershed and bordering the lakes. This wetland type is absent from the Herman-Otto. The relatively shallow gradients of the southerly subwatersheds result in larger changes in wetland

boundaries for small changes in water depth relative to Herman Otto, and therefore a more diverse combination of hydroperiod, depth and frequency of flooding occur leading to greater wetland diversity.

All wetland types except for the swamp thicket are organic wetlands that depend on groundwater as their primary water source. In combination with the shorter growing season and cooler temperature, decomposition of leaves and woody material lags behind their accumulation. This results in saturated peat soil that can be many metres deep.

4.4.4 WILDLIFE

An overview of wildlife use of the study area is shown below in Table 4-18. For a list of all species observed during all surveys, see Appendix H.

Table 4-18: Summary of Wildlife

WILDLIFE	Summary
Raptors and Raptor Nests	Raptors are present in low numbers. No nests were observed.
Breeding Birds	Species and their abundances are typical of this Ecodistrict.
Amphibians	Significant Wildlife Habitat for amphibians is present and most extensive in the Spring-Lovell Subwatershed.
Moose	The majority of moose observed in the Study Area were found occupying open water habitats. The majority of moose sign was observed along roads and trails. Lake 10 and the willows surrounding the Polishing and Tailings ponds seemed to attract moose.
Marten	Limited habitat for Marten exists due to the relatively low age classes and lack of coniferous forested polygons.
Bat Habitat	Preliminary data indicate that bats are using the area around the mine adit, suggesting a pre-hibernation swarm and possibly pre-hibernation mating activity in addition to roosting and foraging for 6 species.
Black Bear	Suitable habitat for black bear is present in the Study Area and is not considered limiting. Black bear are using existing roads and trails as travel corridors.
Beaver	Beaver activity occurs on almost all waterbodies in the Study Area. Beaver habitat is not limiting. Dams occur between all waterbodies and along tributaries.

The key habitats identified that are either SAR or SWH are listed in Table 4-19. Although there are many wetlands identified as potential Moose Aquatic Feeding Habitat in the LSA and RSA, it is lacking in the PSA. There is late winter cover in both Herman-Otto and Webb-Goudreau associated with the conifer stands, and the high ridge between Herman-Otto and Spring-Lovell may be an important feature for moose calving.

Table 4-19: Comparison of Significant Wildlife Habitat and Habitat for SAR in the LSA

ATTRIBUTE	HERMAN-OTTO	SPRING-LOVELL	WEBB-GOUDREAU
Significant Wildlife Habitat (# of Significant Habitats)			
Moose Aquatic Feeding Habitat	3	4	1
Moose Late Winter Cover	1	1	0
Amphibian Wetland Breeding Habitat	2	6	2
SAR (# of Individuals Recorded)			
Whip-Poor-Will - Threatened[5]	2	3	0
Common Nighthawk – Special Concern	4	9	2
Olive-sided Flycatcher – Special Concern	0	4	4
Bald Eagle – Special Concern	2	3	6
Canada Warbler – Special Concern	2	0	0
Chimney Swift – Threatened	0	0	1
Rusty Blackbird - Special Concern	0	1	0
Northern Long-eared Bat – Endangered	0	0	Low numbers
Little Brown Bat – Endangered	0	0	Low numbers

Based on the diversity of wetlands, it is not surprising that Spring-Lovell provides most of the diverse amphibian breeding habitat. Much of this occurs in small, constructed shallow pits that have been created by historical mining activity.

The distribution of SAR is correlated to the diversity of habitats and species preferences. Most of the Bald Eagle were observed on Webb-Goudreau because they prefer large waterbodies, and this watershed was subject to more frequent survey due to its accessibility. The Chimney Swift may be foraging on insects attracted to lights at the mine site. They may be attracted to roosting in the old buildings but to date that has not been confirmed. Common Nighthawk and Whip-poor-will both prefer woodlands with open canopies available in the PSA.

4.4.5 LANDSCAPE CONNECTIVITY AND ANIMAL MOVEMENT CORRIDORS

There are different varieties of landscape connectivity. Some species utilize corridors associated with watercourses, waterbodies, and wetlands. The major drainage areas in the Study Area generally have intact riparian cover suitable for wildlife movement. Other species move in upland environments. It is very likely that the majority of wildlife travel occurs on the network of roads and trails in Spring-Lovell and Webb-Goudreau subwatersheds. A notable lack of forest cover is present at the disturbed old mine site between Webb Lake and Wetland 11 (Tailings Pond). It is likely that Whip-Poor-Will and Common Nighthawk are opportunistically responding to open canopies and exposed soil in some disturbed areas for opportunities to nest.

[5] 2013 data only; all other surveys failed to detect this species.

4.4.6 SIGNIFICANCE AND SENSITIVITY SUMMARY

Significance of a feature or function is evaluated in the context of the Endangered Species Act, 2007 and the Species at Risk Act, and Significant Wildlife Habitat as defined by the Provincial Policy Statement and associated guidelines. Many of these features and functions are also sensitive to the effects of the mining operation to varying degrees.

4.4.6.1 Significant Wildlife Habitat Summary

The SWH Criteria for Ecoregion 3E (MNRF, 2012) were compared to the data collected for the LSA and PSA to identify candidate sites. Table 4-20 summarizes the outcome of that analysis with rationale for inclusion in the study area.

Table 4-20: Summary of Significant Wildlife Habitat within the LSA

Habitat	Summary
Seasonal Concentration Areas of Animals	
Moose Late Winter Cover	One Moose Late Winter Cover habitat (MWC-01) spans Spring-Lovell subwatershed and Webb-Goudreau subwatershed (518 ha).
Waterfowl Stopover and Staging Areas (Terrestrial)	No suitable fields are present in the Study area.
Waterfowl Stopover and Staging Areas (Aquatic)	Very limited numbers of waterfowl were observed during staging surveys. Staging areas are not significant.
Shorebird Migratory Stopover Area	None of the listed species were documented in the study area
Bat Hibernacula Bat Maternity Colonies Bat Migratory Stopover Area	No bats were observed during exit surveys and wildlife tree surveys. Bats detected in the mine adit are SAR and are addressed in Section 4.4.6.2.
Turtle Wintering Areas	No turtles were observed during vegetation, aquatic, waterfowl, and marsh bird surveys
Reptile Hibernacula	Hibernacula were searched for during all surveys types. None were observed.
Colonially-Nesting Bird Breeding Habitat (Bank and Cliff)	No suitable habitat (banks or cliffs) were noted in the Study area and no Bank or Cliff Swallows were noted.
Colonially – Nesting Bird Breeding Habitat (Tree/Shrub)	Raptor nest surveys did not result in any nests observed in the local study area
Colonially – Nesting Bird Breeding Habitat (Ground)	Raptor nest surveys did not result in any nests observed in the local study area
Rare Vegetation Communities or Specialized Habitat for Wildlife	
Cliffs and Talus Slopes	None observed through vegetation surveys, wildlife surveys, and aerial photo interpretation
Red and White Pine Stands	
Black Ash	
Elm	
Oak	
Red and Sugar Maple	

Habitat	Summary	
Yellow Birch		
Rock Barren		
Sand Dunes (and American Dune Grass Type)		
Alpine Lakes Arctic-Alpine Shoreline		
Hardwood Swamps		
Specialized Habitat for Wildlife		
Waterfowl Nesting Area	Waterfowl surveys did not reach threshold for significance.	
Bald Eagle and Osprey Nesting Habitat	Raptor nest surveys did not result in any nests observed in the local study area.	
Woodland Raptor Nesting Habitat	Raptor nest surveys did not result in any nests observed in the local study area.	
Turtle Nesting Areas	No turtles were observed during vegetation, aquatic, waterfowl, and marsh bird surveys	
Seeps and Springs	No seeps and springs were observed during field surveys	
Moose Aquatic Feeding Habitat	Eight Moose Aquatic Feeding Habitats are present throughout the LSA	
	ID	Subwatershed
	MAFH-01	Herman-Otto
	MAFH-02	Herman-Otto
	MAFH-SLR-06	Herman-Otto
	MAFH-SLR-01	Spring-Lovell
	MAFH-SLR-02	Spring-Lovell
	MAFH-SLR-03	Spring-Lovell
	MAFH-SLR-04	Spring-Lovell
	MAFH-SLR-05	Webb-Goudreau
Mineral Licks	Geologic conditions are not present	
Denning Sites	No denning sites were observed during field surveys nor reported by interviewed hunters/trappers	
Rendezvous Sites	Bogs and fens are present in the Study area. No concentrations of wolf tracks or sightings were recorded in the local study area.	
Amphibian Breeding Habitat (Wetlands)	Ten significant Amphibian Breeding Habitats are present in the LSA.	
	ID	**Subwatershed**
	A05	Spring-Lovell
	A18	Spring-Lovell
	A19	Spring-Lovell
	A21	Spring-Lovell
	AA6	Spring-Lovell

Habitat	Summary	
	A2-3	Spring-Lovell
	AA2	Herman - Otto
	AA3	Herman - Otto
	A01	Webb-Goudreau
	A17	Webb-Goudreau
Amphibian Breeding Habitat (Woodland)	Amphibian breeding surveys did not result in the population levels required to be significant.	
Mast Producing Areas	The tree and shrub species identified as mast producing are found in varying densities throughout the Study area, but are not concentrated in locations at >50% ground cover.	
Sharp-tailed Grouse Leks	No leks were observed during field surveys	
Marsh Bird Breeding Habitat	Marsh Breeding Bird Surveys were conducted throughout the Study area. Population thresholds were not met for any of the listed species.	
Open Country Bird Breeding Habitat	No suitable habitat is present in the Study area.	
Shrub/Early Successional Bird Breeding Habitat	Shrub ecosites are present, in which breeding bird surveys were conducted. None of the listed species are present in populations required for significance.	
Special Concern and Rare Wildlife Species	No S1-S3 species were observed during field investigations.	
Animal Movement Corridors		
Amphibian Movement Corridors	Amphibian breeding habitat surveys resulted in the identification of 10 significant breeding habitats. None of the habitats are isolated or are restricted by fragmentation with greater dimensions than those listed. Therefore, no movement corridor identification is required as movement is not restricted.	
Cervid Movement Corridors	There are three Moose Aquatic Feeding Areas and no Mineral Lick habitats in the Study area. None of the habitats are isolated or are restricted by fragmentation. Therefore, no movement corridor identification is required as movement is not restricted.	
Furbearer Movement Corridors	No denning sites for Mink, Otter, Marten, Fisher, and Eastern Wolf were identified. Therefore, no movement corridors are identified.	

Significant Wildlife Habitat that is present includes: One Moose Later Winter Cover habitats, eight (8) Moose Aquatic Feeding Areas, and ten (10) Wetland Amphibian Breeding Habitats. Locations of Significant Wildlife Habitats are shown on Figure 4-8.

A notable difference in habitat is present in amphibian habitats in Spring-Lovell subwatershed. Three of the six habitats are in constructed ponds; essentially excavations in gravel from past mine activities in the highly disturbed southern portion of the subwatershed. There are four such ponds; three of which provide significant Amphibian Wetland Breeding Habitat. The upland habitat surrounding these excavations is comprised of road, barren gravel ground, disturbed forest and cultural meadows, and small patches of mixed forest.

4.4.6.2 Species at Risk Summary

Nine (9) SAR were noted (observed, heard or recorded) in the LSA (Table 4-21). Locations of species are shown on Figure 4.8.

Table 4-21: Summary of SAR within the LSA

Species	Conservation Status		Number noted (subwatershed)	Habitat
	ENDANGERED SPECIES ACT, 2007 (ON)	SPECIES AT RISK ACT (CAN)		
Whip-Poor-Will	Threatened	Threatened	3 (Spring Lovell) 2 (Herman–Otto)	B055: Dry-Fresh, Coarse: Aspen – Birch Hardwood
Common Nighthawk	Special Concern	Threatened	9 (Spring Lovell) 4 (Herman-Otto) 2 (Webb-Goudreau)	B049: Dry – Fresh, Coarse: Jack Pine – Black Spruce Dominated B055: Dry-Fresh, Coarse: Aspen – Birch Hardwood HU: Disturbed old mine site, gravel substrate
Olive-sided Flycatcher	Special Concern	Threatened	4 (Spring-Lovell) 3 (Webb-Goudreau)	B144: Open meadow marsh B138: Open bog B070: Moist, Course: Aspen – Birch Hardwood HU: Disturbed old mine site, gravel substrate B055: Dry-Fresh, Coarse: Aspen – Birch Hardwood
Bald Eagle	Special Concern	Not listed	3 (Spring–Lovell) 2 (Herman–Otto) 4 (Webb-Goudreau)	LA: Lakes, species were seen flying over lakes HU: Disturbed old mine site, gravel substrate
Canada Warbler	Special Concern	Threatened	2 (Herman–Otto)	B070: Moist, Course: Aspen – Birch Hardwood B055: Dry-Fresh, Coarse: Aspen – Birch Hardwood surrounding Lake 8
Chimney Swift	Threatened	Threatened	1 (Webb-Goudreau)	HU: Disturbed old mine site, gravel substrate
Rusty Blackbird	Not Listed	Special Concern	1 (Spring Lovell)	B055: Dry-Fresh, Coarse: Aspen – Birch Hardwood (disturbed)
Northern Long-Eared Bat	Endangered	Endangered	Low numbers in 2014, not recorded in 2015	Foraging
Little Brown Bat	Endangered	Endangered	Low numbers in 2014, 4 registrations in 2015, possibly outside adit	Foraging

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APPENDIX A

INVENTORY DATA FORMS

Amphibian Call Survey

* Beaufort Scale	0 – Calm (0 km/hr) 1 – Light Air (2.5 km/hr) 2 – Light Breeze (6-12 km/hr) 3 – Gentle Breeze (13-20 km/hr) 4 - Moderate Breeze (21-30 km/hr)	Abundance Code:	1. few calling individuals, can be counted 2. overlapping calls but number can be estimated 3. large chorus, number cannot be estimated Survey should generally not be done if wind > 3

Location: ______________ Date: __________ Time: __________

Observers: ______________ Project Number: __________

Air Temp: ______ C. Beaufort Wind Speed*: __________ Cloud Cover: ______ %

Water Temp: C. Precipitation: Weather at End:

Specific Site: ______________ Time: __________

Direction: ______________ Est. Distance: ______________

Species	Code	#	Species	Code	#	Species	Code	#
American Toad			Grey Tree Frog			Green Frog		
Chorus Frog			Wood Frog					
Spring Peeper			Leopard Frog					

Habitat/Comments/UTM: ______________

Specific Site: ______________ Time: __________

Direction: ______________ Est. Distance: ______________

Species	Code	#	Species	Code	#	Species	Code	#
American Toad			Grey Tree Frog			Green Frog		
Chorus Frog			Wood Frog					
Spring Peeper			Leopard Frog					

Habitat/Comments/UTM: ______________

Specific Site: ______________ Time: __________

Direction: ______________ Est. Distance: ______________

Species	Code	#	Species	Code	#	Species	Code	#
American Toad			Grey Tree Frog			Green Frog		
Chorus Frog			Wood Frog					
Spring Peeper			Leopard Frog					

Habitat/Comments/UTM: ______________

Specific Site: ______________ Time: __________

Direction: ______________ Est. Distance: ______________

Species	Code	#	Species	Code	#	Species	Code	#
American Toad			Grey Tree Frog			Green Frog		
Chorus Frog			Wood Frog					
Spring Peeper			Leopard Frog					

Habitat/Comments/UTM: ______________

Specific Site: ______________ Time: __________

Direction: ______________ Est. Distance: ______________

Species	Code	#	Species	Code	#	Species	Code	#
American Toad			Grey Tree Frog			Green Frog		
Chorus Frog			Wood Frog					
Spring Peeper			Leopard Frog					

Habitat/Comments/UTM: ______________

SLR

Amphibian Call Survey

Location: ______________________ Date: __________ Time: __________

Observers: ______________________ Project Number: __________

Air Temp: ________ C. Beaufort Wind Speed*: __________ Cloud Cover: ________ %

Water Temp: C. Precipitation: Weather at End: ☐

Specific Site: ______________________ Time: __________

Direction:______________________ Est. Distance:______________________

Species	Code	#	Species	Code	#	Species	Code	#
American Toad			Grey Tree Frog			Green Frog		
Chorus Frog			Wood Frog					
Spring Peeper			Leopard Frog					

Habitat/Comments/UTM: ______________________

Specific Site: ______________________ Time: __________

Direction:______________________ Est. Distance:______________________

Species	Code	#	Species	Code	#	Species	Code	#
American Toad			Grey Tree Frog			Green Frog		
Chorus Frog			Wood Frog					
Spring Peeper			Leopard Frog					

Habitat/Comments/UTM: ______________________

Specific Site: ______________________ Time: __________

Direction:______________________ Est. Distance:______________________

Species	Code	#	Species	Code	#	Species	Code	#
American Toad			Grey Tree Frog			Green Frog		
Chorus Frog			Wood Frog					
Spring Peeper			Leopard Frog					

Habitat/Comments/UTM: ______________________

Specific Site: ______________________ Time: __________

Direction:______________________ Est. Distance:______________________

Species	Code	#	Species	Code	#	Species	Code	#
American Toad			Grey Tree Frog			Green Frog		
Chorus Frog			Wood Frog					
Spring Peeper			Leopard Frog					

Habitat/Comments/UTM: ______________________

Specific Site: ______________________ Time: __________

Direction:______________________ Est. Distance:______________________

Species	Code	#	Species	Code	#	Species	Code	#
American Toad			Grey Tree Frog			Green Frog		
Chorus Frog			Wood Frog					
Spring Peeper			Leopard Frog					

Habitat/Comments/UTM: ______________________

SLR

Breeding Bird Survey Form - Magino

Survey Point: _____ **UTM:** _____

Date: _____ **Time Start:** _____ **Observers:** _____

Wind: _____ **Time Stop:** _____ **Cloud:** _____

_____ **Temp:** _____ **Ppt:** _____

Species	Tally	Total
Canada Goose		
Mallard		
Red-t. Hawk		
Am. Kestrel		
Ruffed Grouse		
Killdeer		
Spotted Sand.		
Mourning Dove		
Black-b. Cuckoo		
Ruby-thr. Hum.		
Downy Woodp.		
Hairy Woodp.		
N. Flicker		
E. Wood Pewee		
Alder Flycatcher		
Willow Flycatcher		
Least Flycatcher		
E. Phoebe		
Gr. Crest Flycatcher		
E. Kingbird		
Tree Swallow		
Barn Swallow		
Blue Jay		
Am. Crow		

Species	Tally	Total
B.-c. Chickadee		
White-br. Nuthatch		
Red-br. Nuthatch		
House Wren		
Winter Wren		
Veery		
Wood Thrush		
Am. Robin		
Gray Catbird		
Br. Thrasher		
C. Waxwing		
E. Starling		
Warbling Vireo		
Red-eye Vireo		
Nashville Warbler		
Yellow Warbler		
Chestnut-side W.		
Black & White W.		
Am. Redstart		
Ovenbird		
N. Waterthrush		
Mourning Warbler		
C. Yellowthroat		
Scarlet Tanager		

Species	Tally	Total
N. Cardinal		
Rose-br. Grosbeak		
Indigo Bunting		
Chipping Sparrow		
Field Sparrow		
Vesper Sparrow		
Song Sparrow		
Swamp Sparrow		
Savannah Sparrow		
White-thr. Sp.		
Bobolink		
E. Meadowlark		
Red-w. Blackbird		
C. Grackle		
Br.-h. Cowbird		
Baltimore Oriole		
Am. Goldfinch		
House Sparrow		

Notes

_____

_____

_____

_____

_____

SLR

Marsh Bird Data Form

Plot: _____ Date: _____ Observers: _____
UTM: _____ Site #: _____ Start Time: _____
Beaufort Wind Scale: _____ Cloud Cover: _____ Temperature: _____ °C

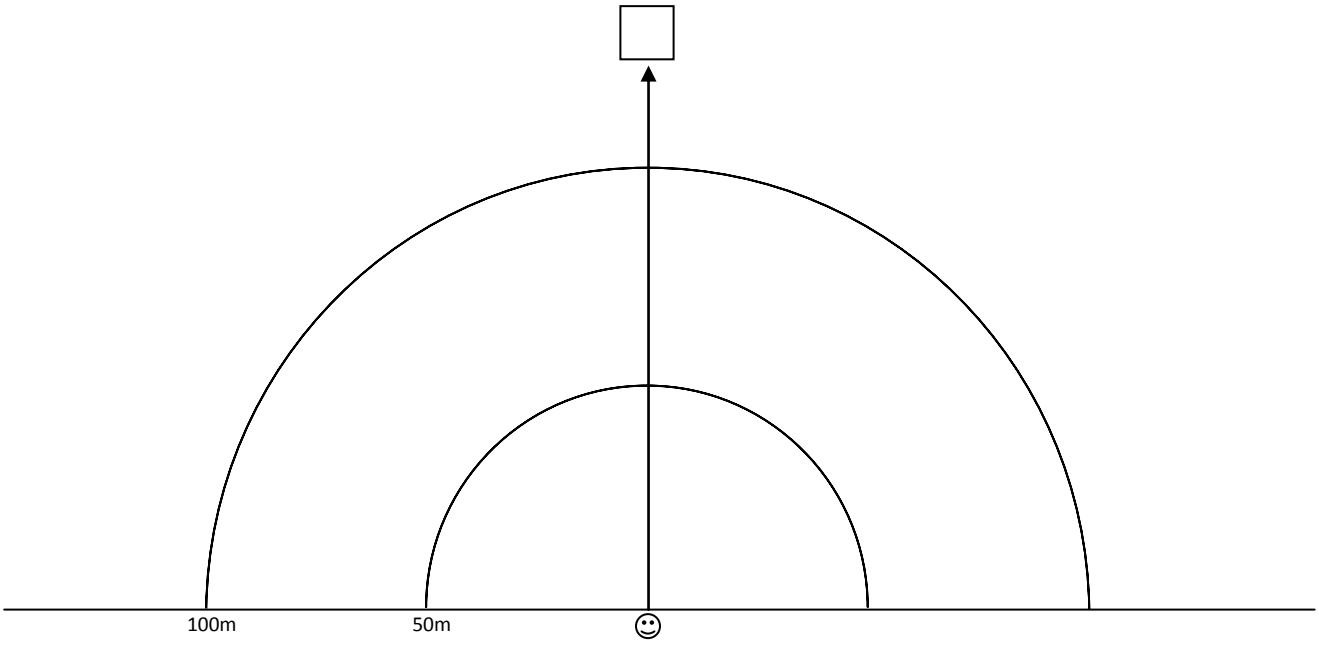
Comments: _____

Aerial Foragers		
Species	Tally	No.

Outside Flythrus

Symbols

- a — Singing/Calling bird.
- b — b — Simultaneous song/different birds of the same species.
- c — Pair together.
- d — Family group seen. Include number of accompanying adults only.
- e — Observed but not calling or singing.
- f — f — Known change in position.
- Nest.



Incidental Wildlife Form – Magino Observer name(s):	Date:
Time of observation:	Observer company:
Observer phone number and email:	

Air temperature (°C):	% Cloud cover:

Wind (select a code):

0	1	2	3	4	5	6	7
Calm. Smoke rises vertically.	Smoke drift indicates wind direction. Leaves and wind vanes are stationary.	Wind felt on exposed skin. Leaves rustle.	Leaves and small twigs constantly moving, light flags extended.	Dust and loose paper raised. Small branches begin to move.	Branches of a moderate size move. Small trees in leaf begin to sway.	Large branches in motion. Umbrella use becomes difficult. Empty plastic bins tip over.	Whole trees in motion. Effort needed to walk against the wind.

Precipitation (select a modifier): light, medium, heavy

GPS coordinates (UTM preferred):

Description of location if no GPS available (refer to feature names on map, include direction and distance to features):

Description of incidental encounter (species, sign, aural, behavior):

Description of habitat (wetland, lake, pond, forest and canopy description):

Photo numbers and description:

ELC
Community Description and Classification

Map #:		Polygon:	
Surveyor(s):	Date:	Time start:	
		finish:	
UTMZ:	UTMZ:	UTMN:	

Polygon Description

System	Substrate	Topographic Feature	Plant Form	Community
❑Terrestrial ❑Wetland ❑Aquatic	❑Organic ❑Mineral Soil ❑Parent Min. ❑Acidic Bedrk ❑Basic Bedrk ❑Carb. Bedrk	❑Lacustrine ❑Riverine ❑Bottomland ❑Terrace ❑Valley Slope ❑Tableland ❑Roll. Upland ❑Cliff ❑Talus ❑Crevice/Cave ❑Alvar ❑Rockland ❑Beach / Bar ❑Sand Dune ❑Bluff	❑Plankton ❑Submerged ❑Floating-LVD. ❑Graminoid ❑Forb ❑Lichen ❑Bryophyte ❑Deciduous ❑Coniferous ❑Mixed	❑Lake ❑Pond ❑River ❑Stream ❑Marsh ❑Swamp ❑Fen ❑Bog ❑Barren ❑Meadow ❑Prairie ❑Thicket ❑Savannah ❑Woodland ❑Forest ❑Plantation
Site ❑Open Water ❑Shallow Water ❑Surficial Dep. ❑Bedrock				
History ❑Natural ❑Cultural				
Cover ❑Open ❑Shrub ❑Treed				

Stand Description

Layer	HT	CVR	Species In Order of Decreasing Dominance (up to 4 sp) *(>> Much Greater Than; > Greater Than; = About Equal To)*
1			
2			
3			
4			

HT Codes: **7** <0.2m **6** >0.2-0.5m **5** >0.5-1m **4** >1-2m **3** >2-6m **2** >6-25m **1** >25m
CVR Codes: **0** = none **1** 0% - 10% **2** 10 - 25% **3** 25 - 60% **4** > 60%

Stand Composition:	Size Class Analysis:		<10		10-24		25-50		>50
	Standing Snags:		<10		10-24		25-50		>50
BA:	Deadfall / Logs:		<10		10-24		25-50		>50

Abundance Codes: **N** = None **R** = Rare **O** = Occasional **A** = Abundant

Com. Age:		Pioneer		Young		Mid-Age		Mature		Old Growth

Ecosite:		**Code:**	
Vegetation Type:		**Code:**	
Inclusion:		**Code:**	
Complex:		**Code:**	

Community Profile Diagram/Comments

Notes:

Tree Tally by Species

Prism Factor 2

Species	Tally 1	Tally 2	Tally 3	Tally 4	Total	Rel. Avg.
Total						100
Basal Area (BA)						
Dead						

Soils Ontario and ELC Soils Description

									Summary
Site Metrics		Pit/Auger #							
	UTM	Zone							Moisture Regime
		Easting							
		Northing							
	Slope	Position							
		Aspect							Drainage
		Percent							
		Slope Length							
Depth to…		Mottles							
		Gley							Effective Texture (indicate below)
		Water Table							
		Carbonates							
		Bedrock							
Soil Horizon Description	1	Depth from zero		% CF		% CF		% CF	% CF
		Texture							
	2	Depth from zero		% CF		% CF		% CF	% CF
		Texture							
	3	Depth from zero		% CF		% CF		% CF	% CF
		Texture							
	4	Depth from zero		% CF		% CF		% CF	% CF
		Texture							
		% Surface Stone/Rock							
		Moisture Regime							
		Drainage							

ELC
Community Description and Classification

Map #:		Polygon:	
Surveyor(s):	Date:	Time start:	
		finish:	
UTMZ:	UTMZ:	UTMN:	

Polygon Description

System	Substrate	Topographic Feature	Plant Form	Community
❑Terrestrial ❑Wetland ❑Aquatic	❑Organic ❑Mineral Soil ❑Parent Min. ❑Acidic Bedrk ❑Basic Bedrk ❑Carb. Bedrk	❑Lacustrine ❑Riverine ❑Bottomland ❑Terrace ❑Valley Slope ❑Tableland ❑Roll. Upland ❑Cliff ❑Talus ❑Crevice/Cave ❑Alvar ❑Rockland ❑Beach / Bar ❑Sand Dune ❑Bluff	❑Plankton ❑Submerged ❑Floating-LVD. ❑Graminoid ❑Forb ❑Lichen ❑Bryophyte ❑Deciduous ❑Coniferous ❑Mixed	❑Lake ❑Pond ❑River ❑Stream ❑Marsh ❑Swamp ❑Fen ❑Bog ❑Barren ❑Meadow ❑Prairie ❑Thicket ❑Savannah ❑Woodland ❑Forest ❑Plantation
Site ❑Open Water ❑Shallow Water ❑Surficial Dep. ❑Bedrock				
History ❑Natural ❑Cultural				
Cover ❑Open ❑Shrub ❑Treed				

Stand Description

Layer	HT	CVR	Species In Order of Decreasing Dominance (up to 4 sp) *(>> Much Greater Than; > Greater Than; = About Equal To)*
1			
2			
3			
4			

HT Codes: **7** <0.2m **6** >0.2-0.5m **5** >0.5-1m **4** >1-2m **3** >2-6m **2** >6-25m **1** >25m
CVR Codes: **0** = none **1** 0% - 10% **2** 10 - 25% **3** 25 - 60% **4** > 60%

Stand Composition:	Size Class Analysis:		<10		10-24		25-50		>50
	Standing Snags:		<10		10-24		25-50		>50
BA:	Deadfall / Logs:		<10		10-24		25-50		>50

Abundance Codes: **N** = None **R** = Rare **O** = Occasional **A** = Abundant

Com. Age:		Pioneer		Young		Mid-Age		Mature		Old Growth

Ecosite:		**Code:**	
Vegetation Type:		**Code:**	
Inclusion:		**Code:**	
Complex:		**Code:**	

Community Profile Diagram/Comments

Notes:

Tree Tally by Species

Prism Factor 2

Species	Tally 1	Tally 2	Tally 3	Tally 4	Total	Rel. Avg.
Total						100
Basal Area (BA)						
Dead						

Soils Ontario and ELC Soils Description

									Summary
Site Metrics		Pit/Auger #							
	UTM	Zone							Moisture Regime
		Easting							
		Northing							
	Slope	Position							
		Aspect							Drainage
		Percent							
		Slope Length							
Depth to…		Mottles							
		Gley							Effective Texture (indicate below)
		Water Table							
		Carbonates							
		Bedrock							
Soil Horizon Description	1	Depth from zero		% CF		% CF		% CF	% CF
		Texture							
	2	Depth from zero		% CF		% CF		% CF	% CF
		Texture							
	3	Depth from zero		% CF		% CF		% CF	% CF
		Texture							
	4	Depth from zero		% CF		% CF		% CF	% CF
		Texture							
		% Surface Stone/Rock							
		Moisture Regime							
		Drainage							

Significant Wildlife Habitat Field Observation Guide

Habitat Attributes	Significant Wildlife Habitat
Mature stands with >10 ha of >25 cm trees and snags, especially Aspen	Bat maternity colony
Rock piles, crevices, fissures in rock	Reptile hibernacula
Eroding banks, sandy hills, steep slopes, sand piles	Bank and cliff birds
Cliffs and talus	Cliffs and talus
>10% absolute cover or >35% relative cover of Red and white pine Black ash Elm Oak Red and Sugar Maple Yellow Birch	Rare stands
Rock barren Exposed rock with < 5 cm mineral or <10 cm organic material and < 25 cm vascular vegetation	Calcareous rock barren
Sand dunes	Sand dunes
Hardwood swamp	Hardwood swamp
Open sand and gravel areas next to water	Turtle nesting area
Seeps and springs	Seeps and springs
Vernal/seasonal pools	Amphibian habitat
Early successional areas with >50% ground cover of mast producing species: Mountain ash Pin cherry Blueberries Raspberries Beaked hazel Choke cherry	Mast producing area
Bare, grassy area possibly with sparse shrubland. Often with a knoll or slight rise in elevation	Sharp –tailed grouse lek
Field, meadow, shrub, and sparse shrub sites (>30 ha)	Open country and shrub/early successional bird breeding habitat

APPENDIX B

WHIP-POOR-WILL SURVEY PROTOCOL

Typical WHIPPO Habitat – Area to be Surveyed

The Eastern Whip-poor-will is primarily found in relatively open, coniferous, deciduous or mixed woodlands and in forest habitats, particularly along the edges of habitats where there is exposed rock, clearings, younger forest or wetlands. Typically occupied habitats may include sand barrens and forested dunes, regenerating burns, Precambrian rock barrens, limestone barrens (alvars), deciduous and mixed savannahs and woodlands, particularly those of oak and oak-pine, and coniferous woodlands. They may also occur in cutovers in early successional states. Frequently these habitats will be part of a larger forested area. OMNR district staff may have additional information on locations in a district at which WPWI may be found.

SURVEY PROTOCOL

Technique

Calling Eastern Whip-poor-will can be heard for up to 500 m under good conditions and as far as 1 km under ideal conditions. This protocol relies on observers undertaking point counts at locations they have established in advance. At each point count location, the calling male(s) are identified, and the direction and distance to each is determined and plotted on a map. The direction of a calling male is made by taking a compass bearing. Distances to calling birds are often difficult to determine and apparent distances may be influenced by such factors as topography, the proximity to waterbodies, the maturity and density of the surrounding vegetation and relative humidity (e.g. heavy mist or fog). Directions and distances may be difficult to determine if the landscape is hilly or it is windy as the sound may echo, distort or be dispersed. Caution must be used under these conditions.

Period

The dates when this survey may be used are **May 18 – June 30**. If surveys outside these dates are required, please consult with species at risk biologists at the local OMNR district office.

Conditions

Ideally, surveys should be conducted under field conditions with no precipitation, little or no wind (up to 3 on the Beaufort Scale [<12 kph]; Beaufort scale 3 = Leaves and small twigs constantly moving, light flags extended), clear skies and good visibility. Because moon phase is shown to affect calling rates, the moon should be > 50% illuminated, and above the horizon (generally one week on either side of date of full moon). The sky should have little or no cloud cover. The temperature should normally be 10°C or above. Nights when the moon is visible under these conditions have significantly higher calling rates for WPWI. Information on moon phase and position above the horizon can be obtained at websites such as: http://www.timeanddate.com/

Pre-Survey

1) Create a survey route(s) along existing roads or trails which travel within 500 m of the edge of the project area to be surveyed. If possible and depending on the size of the project area, the route should be established within 300 m of the edge. In some cases, survey points may be positioned off of existing roads or trails to ensure coverage of an area. WPWI can be heard up to 500 m under good conditions.

2) Establish points along the route at approximately 300 to 500 m intervals. On a small site, points may be 300 m apart but on a larger site they may need to be 500 m apart. Drive or walk the route during the day if unfamiliar with the area.

3) When travelling the route during the day, save waypoints for selected survey stations and note features immediately along the roadside which might be reference points at night such as bends in the road, creek crossings, large trees, forest edges or rock outcrops.

4) Two observers are preferred for the survey; one to listen and one to record. Considerations for personal safety should be taken into account and may encourage using two observers. Two observers may also be used for simultaneous recording of locations of calling birds.

Timing and Number of Surveys

Surveys should start fifteen minutes after sunset when the moon is visible above the horizon and may continue as long as the moon is visible. If conditions are favourable, surveys may extend until as late as 15 minutes before sunrise. The hours immediately following dusk and preceding dawn are the best times for a survey; calling may be less frequent at other times.

Surveys should be repeated three times during the breeding season so that sufficient data for identifying territories can be obtained. Ideally two surveys should be completed in the late May/first week of June period and a third survey in the next available moon phase period which might be the middle/end of June In some situations it may be necessary to conduct all three survey nights during one moon phase cycle although this is not recommended. If a scheduled survey must be cancelled because of rain or clouds covering the moon, one survey but not more may be done in the period when the moon is <50% illuminated because some data will be obtained. Surveys should be conducted between May 18 and June 30.

Conducting the Survey:

1) Identify a minimum of three dates for surveys based on the moon phase when the moon is more than 50% visible and above the horizon during the dusk to midnight period. Use a lunar calendar (e.g. http://www.timeanddate.com/) to establish the dates on which surveys will be conducted. Two surveys should be completed in the mid May/early June period and an additional surveys in the following moon phase cycle. If surveys are cancelled because of bad weather or no moon illumination, one survey may be done when the moon is <50% visible.

2) The surveyor should drive or walk the predetermined route and stop at the established stops (i.e. GPS determined locations) to listen for WPWI for **5 minutes** at each stop. The observer should get out of the vehicle at each stop.

3) If a WPWI is heard, take a compass bearing on the calling bird, record the time, GPS location and an estimated distance to the calling bird. Many GPS units can act as compasses, and usually one can move the cursor on the screen to the estimated location of the calling bird which can be marked as a waypoint. Estimating distances can be difficult; it may be necessary to scale them to the nearest 50 or 100 m.

4) If two or more birds are heard calling simultaneously note the directions and probable locations on a map as this is important for establishing that multiple territories may be present.

5) One option is for two observers to work simultaneously from different points. If they are able to take compass bearings for the same calling bird at the same time, their triangulation will increase the accuracy of the position of the calling location.

6) Stay at the point for five minutes to ensure all WPWI are noted. Record any changes in calling location that are noted and take new compass bearings and distances as necessary. If desired, make notes on the general conditions of the area surrounding the listening stop (e.g. small clearing, rock outcrop, etc) so the location can be found during the day (e.g. sites could be marked with flagging tape).

7) As the observer moves to the next point on the route, he or she may take additional bearings on calling bird(s) at intermediate locations if it will give better location data than at the next point. At each point, try to avoid double counting of calling birds by noting the relative location of previously calling birds. Note that birds may stop calling and may move to a new calling perch within their territory.

8) Continue to make 5 minute stops at the established points and record any calling birds as noted above until the survey is completed. Record station number, time, GPS coordinates, individuals heard calling and compass bearings as required.

APPENDIX C

POTENTIAL RARE PLANTS AND PLANT LIST

Family	Scientific Name	Common Name	Grank	Srank	COSEWIC	MNR	Notes	Habitat (Primarily from eFloras.org)
Potamogetonaceae	Potamogeton confervoides	Alga Pondweed	G4	S2			An inconspicuous Atlantic Coastal Plain pondweed with submersed filiform leaves which grows in acidic, oligotrophic ponds, bogs, lakes, and slow-moving streams. See Argus *et al* . (1982-1987), Hodgdon *et al* . (1952), Schultz (2003d), Voss (1965).	grows in acidic, oligotrophic ponds, bogs, lakes, and slow-moving streams.
Woodsiaceae	Woodsia alpina	Alpine Woodsia	G4	S2			Largely restricted to cool, moist, crevices and cliffs along Lake Superior. See Argus *et al* . (1982-1987), Catling (1975), Given & Soper (1981), Soper & Maycock (1963), Tryon (1948); APPENDIX 1.	Largely restricted to cool, moist, crevices and cliffs along Lake Superior.
Orchidaceae	Listera auriculata	Auricled Twayblade	G3G4	S3			Sandy or humic soil under alders and confiers, along streambanks and lakeshores where they survive seasonal flooding (Whiting & Catling 1986). A hybrid with *L. convallarioides* , called *L.* x *veltmanii* (Case 1964), occurs in Ontario (Catling 1976b). See Brunton & Crins (1975), Hoy (2001), Judziewicz & Nekola (1997), Platt *et al* . (1982), Whiting & Catling (1977).	Sandy or humic soil under alders and confiers, along streambanks and lakeshores where they survive seasonal flooding
Rosaceae	Amelanchier amabilis	Beautiful Serviceberry	G4?Q	S2S3			A large-flowered *Amelanchier* sometimes included in *A. sanguinea* and known from scattered southern and central Ontario sites. See McKay (1973).	Margins of woods, river ledges, shorelines, rocky slopes, crevices of open rock faces and cliffs, noncalcareous to slightly calcareous sites; 0–1000 m (NOPD)
Poaceae	Elymus glaucus	Blue Wild Rye	G5	S1			A western species disjunct in the Great Lakes area where it is rare in the vicinity of Lake Superior. Argus *et al.* (1982-1987), Dore & McNeill (1980). Ontario plants are ssp. *glaucus* (T5).	open woods and thickets
Rubiaceae	Galium kamtschaticum	Boreal Bedstraw	G5	S2			Cool moist woods and thickets in the eastern Lake Superior area. See Argus *et al* . (1982- 1987), Marquis & Voss (1981), Schultz (2003b).	Cool woods, thickets, streamsides. [Hardwood to mixed forest (forest, upland)].
Dryopteridaceae	Polystichum braunii	Braun's Holly Fern	G5	S3			Primarily in deciduous or mixed rocky woods near Lake Superior, but also at a few isolated southern Ontario sites. See Argus *et al* . (1982-1987), Brzeskiewicz & Fields (2003), Kott (1980), Taylor (1934).	Primarily in deciduous or mixed rocky woods near Lake Superior
Rosaceae	Potentilla rivalis	Brook Cinquefoil	G5	SH			Collected at three widely separated Ontario locations, with little habitat information: Ignace (no habitat data on specimen), Sault Ste. Marie (railway embankment), and Chalk River ("in the forest"; Brayshaw 1964). Some or all of these populations may have been introduced from further west. See Argus *et al.* (1982-1987).	Man-made or disturbed habitats
Juglandaceae	Juglans cinerea	Butternut	G4	S3?	END	END	The abundance and condition are both in rapid decline due to butternut canker disease, with no known remedy. Even with the canker evident and widespread, there are a large number of occurrences persisting and apparently resistant trees, though rare, are found in parts of the range. See Catling & Small (2001), COSEWIC (2003b), Furnier *et al* . (1998), Katovich & Ostry (1998), Michler *et al* . (2005), Ross-Davis *et al.* (2008), Schultz (2003c).	usually grows alone or in small groups in deciduous forests. It prefers moist, well-drained soil and is often found along streams. It is also found on well-drained gravel sites and rarely on dry rocky soil. This species does not do well in the shade, and often grows in sunny openings and near forest edges.
Cyperaceae	Trichophorum clintonii	Clinton's Clubrush	G4	S2S3			A small and inconspicuous sedge of prairies, open woods, and rocky crevices along rivers. Widespread but generally locally rare. See Argus *et al* . (1982-1987), Oldham & Darbyshire (1983), Smith (1995).	Open, dry to mesic prairies, meadows, riverbanks, rock outcrops, on lime-rich substrates; 10–900 m
Poaceae	Digitaria cognata	Fall Crab Grass	G5	S1			Apparently native in dry sandy open ground in southwestern Ontario, but also adventive along roadsides and railways. Ontario plants are ssp. *cognata* (T5) according to the revision of Wipff & Hatch (1994), though infraspecific taxa are not recognized in FNA (2003b). See Brownell *et al* . (1994).	Dry prairies, old fields, sandy open ground. also adventive along roadsides and railways.
Ophioglossaceae	Botrychium pseudopinnatum	False Northwestern Mo	G1	S1			An Ontario endemic known only from three sites near the north shore of Lake Superior. Originally described in 1990 and the only hexaploid *Botrychium* (Wagner & Wagner 1990a). See Chadde & Kudray (2003a).	Sandy soil; 300--500 m
Asteraceae	Tanacetum bipinnatum	Floccose Tansy	G5	S4			Sand beaches and dunes in the eastern Lake Superior area. Gravel riverbanks in the Hudson Bay area, where more common. Only tracked in the Great Lakes basin. See Anonymous (2002b), Given & Soper (1981), Guire & Voss (1963), Riley (2003); APPENDIX 1.	Dunes, other sandy sites, calcareous soils, coastal scrub; 0–200+ m
Lichens	Leptogium rivulare	Flooded Jellyskin			THR	THR	historic location on shore of Magpie River near Wawa (from COSEWIC report); on base (partly flooded in spring) of Fraxinus nigra; population has not been relocated so is unknown if is still present	
Poaceae	Calamovilfa longifolia var. ma	Great Lakes Sand Ree	G5T3T5	S3			A Great Lakes endemic largely restricted to sandy shores of Lake Huron. Occasionally introduced along roadsides and railways. Recently discovered in eastern Ontario by Vivian Brownell (Oldham 1999a), where it may be adventive. See Argus et al . (1982-1987), Bowles & Maun (1982), Darbyshire et al . (1984), Guire & Voss (1963), Maun (1981, 1996), Thieret (1960, 1966).	usually occurs on upland sites in mixed- and tallgrass prairies and within Great Lakes dune communities. Occasionally introduced along roadsides and railways.

Family	Scientific Name	Common Name	Grank	Srank	COSEWIC	MNR	Notes	Habitat (Primarily from eFloras.org)
Juncaceae	Juncus anthelatus	Greater Poverty Rush	G5TNR	S1			Taxonomic status and Ontario distribution uncertain (see Clemants 1990). Similar to the common and widespread *J. tenuis* . See Brooks & Whittemore (1999), Haines (2001d).	Exposed or partially shaded sites in moist or seasonally wet, sandy or clay soils
Juncaceae	Juncus greenei	Greene's Rush	G5	S3			Open sandy ground. See Argus *et al.* (1982- 1987), Sutherland (1987).	Open sandy ground.
Lycopodiaceae	Diphasiastrum sabinifolium	Ground-fir	G4	S3				
Orchidaceae	Platanthera macrophylla	Large Roundleaved Or	G4	S2			Similar to *P. orbiculata* and sometimes considered a variety of it. See Argus *et al.* (1982-1987), Reddoch & Reddoch (1993, 1997).	Shaded moist coniferous forest; rich deciduous or mixed forests
Plantaginaceae	Callitriche heterophylla	Large Waterstarwort	G5	S2?			An inconspicuous aquatic; probably overlooked. Placed in the Callitrichaceae by some authors. See Fassett (1951). Ontario plants are ssp. *heterophylla* (T5).	Lake margins and slow streams. May carpet the mud when water levels drop
Caryophyllaceae	Moehringia macrophylla	Large-leaved Sandwort	G4	S2			Cliffs, ledges, crevices, rocky woods and talus slopes near Lake Superior. See Argus *et al* . (1982-1987), Marquis & Voss (1981).	Cliffs, ledges, crevices, rocky woods and talus slopes near Lake Superior
Woodsiaceae	Cystopteris laurentiana	Laurentian Bladder Fer	G3	S3			Easily overlooked and probably more common than records indicate. Thought to have arisen through hybridization between *C. bulbifera* and *C. fragilis* . Included in Dryopteridaceae by some authors. See Anonymous (2002a), Weatherby (1926).	Cracks and ledges on cliffs, often on calcareous substrates; 0--1000 m
Woodsiaceae	Gymnocarpium robertianum	Limestone Oak Fern	G5	S2			Widespread in central Ontario usually in calcareous rocky situations (occasionally in *Thuja* swamps), though rare at most sites. Included in Dryopteridaceae by some authors. See Argus *et al* . (1982-1987), Pryer (1990, 1992), Sarvela (1978), Sarvela *et al* . (1981), Schultz (2002a), Wagner (1966).	calcareous rocky situations (occasionally in Thuja swamps); fields and open areas
Cistaceae	Helianthemum canadense	Long-branched Frostwe	G5	S3			Dry open or partly open, often sandy ground. Has apparently declined in Ontario, primarily due to loss of habitat. See Breitung (1957), Carbyn & Catling (1995), Cody (1982), Porsild (1941) .	dry; prairies, woods, inland sands
Cyperaceae	Eleocharis macrostachya	Long-headed Spike-rus	G5?	S1S3			A primarily western species similar to *E. palustris* and probably overlooked. See FNA (2002).	Fresh to slightly brackish or alkaline shores, stream beds, swales, vernal pools, pastures, ditches, artificial ponds; 10–2300 m;
Lycopodiaceae	Huperzia appressa	Mountain Firmoss	G4G5	S3?			Status poorly known in Ontario, particularly in the Hudson Bay and north shore of Lake Superior areas, due taxonomic problems, identification difficulty, and hybridization with related species. See Beitel and Mickel (1992), Haines (2003a); APPENDIX 1.	Rock crevices and ledges on the Isle Royale archipelago, especially on the Lake Superior shore.
Woodsiaceae	Woodsia scopulina	Mountain Woodsia	G5	S3			Acidic rocky ledges, cliffs, and crevices in the Lake Superior and Algonquin Park areas. See Argus *et al* . (1982-1987), I303, Reznicek (1972), Watson & Vazquez (1981), Wherry (1934). Ontario plants are ssp. *laurentiana* (TNR).	Acidic rocky ledges, cliffs, and crevices in the Lake Superior and Algonquin Park areas.
Phrymaceae	Mimulus moschatus	Muskflower	G4G5	S2?			Some or all of the Ontario populations may be non-native. Included in Scrophulariaceae by some authors. See Ewing (2001), Fernald (1935), Marquis & Voss (1981), Pennell (1935). Ontario plants are var. *moschatus* (T5).	found along watercourses and also sometimes appears in disturbed sites such as ditches and roadsides
Woodsiaceae	Gymnocarpium jessoense	Nahanni Oak Fern	G5	S3			Cool cliffs and rocky crevices, primarily in the vicinity of Lake Superior. Hybrids with *G. dryopteris* (*G. x intermedium*) also occur in Ontario and make identification difficult. Included in Dryopteridaceae by some authors. See Sarvela *et al* . (1981); APPENDIX 1. Ontario plants are ssp. *parvulum* (T4).	cool rocky outcrops
Violaceae	Viola novae-angliae	New England Violet	G4Q	S3			River shores, rocky woods and open areas. Gil-ad (1997, 1998) recognizes two subspecies, *grisea* (TNR, but a Great Lakes region endemic) and *novae-angliae* (TNR), both of which occur in Michigan. The subspecific identity of Ontario plants is not known. See Ballard (1994), Ballard & Gawler (1994), Gil-ad (1997, 1998), House (1904), McKinney (1992).	River banks, moist, grassy openings in jack pine stands.
Poaceae	Glyceria canadensis var. laxa	Northern Manna Grass	G5T5	SH				grows in swamps, bogs, and wet woods, primarily along the eastern seaboard of North America from Nova Scotia to northeastern Tennessee
Orchidaceae	Listera borealis	Northern Twayblade	G4	S1S2			Widespread but rare in northern Ontario in moist coniferous forests and shrub thickets (Whiting & Catling 1986). See Argus *et al.* (1982-1987), Case (1965).	moist coniferous forests and shrub thickets
Asteraceae	Solidago simplex var. ontario	Ontario Goldenrod	G5T3?	S3?			Rocky shores of Lakes Huron and Superior. A Great Lakes endemic. See Ringius & Semple (1987), Semple *et al.* (1999).	Rocky shores of Lakes Huron and Superior; Basaltic rocks, calcareous shorelines; ca. 200 m
Ericaceae	Vaccinium ovalifolium	Oval-leaved Bilberry	G5	S3			Mixed woods in the eastern Lake Superior region. See Argus *et al* . (1982-1987), Marquis & Voss (1981), Soper & Heimburger (1982).	Rocky, moist to well-drained soils of shady mixedwood forests, usually in coastal areas or near streams and ponds.
Ophioglossaceae	Botrychium pallidum	Pale Moonwort	G3	S1			Sporadic, mainly in open fields (FNA 1993). See Chadde & Kudray (2003c), Wagner & Wagner (1990b); APPENDIX 1.	mainly in open fields but also in shaded places; 0--2600 m
Ophioglossaceae	Botrychium acuminatum	Pointed Moonwort	G1	S1			A species of more or less open dunes and grassy areas including railroad sidings and roadside ditches, similar to *B. matricariifolium* . Globally restricted to the Lake Superior area. See Wagner & Wagner (1990a).	A species of more or less open dunes and grassy areas including railroad sidings and roadside ditches. Globally restricted to the Lake Superior area

Family	Scientific Name	Common Name	Grank	Srank	COSEWIC	MNR	Notes	Habitat (Primarily from eFloras.org)
Cyperaceae	Eleocharis nitida	Quill Spike-rush	G4	S2S3			A small and inconspicuous species of moist seepages and ditches. See Coffin & Pfannmuller (1988), Lakela (1947), Larson (1995); APPENDIX 1.	Fresh bog pools, streams, disturbed places; 30–400 m;
Asteraceae	Hieracium venosum	Rattlesnake Hawkweed	G5	S2			Dry, open, sandy woods. See Argus *et al.* (1982-1987), Sutherland (1987).	Dry, open, sandy woods.
Cyperaceae	Carex saxatilis	Russet Sedge	G5	S5			Widespread and locally common in the Hudson Bay Lowland, but known from only a single collection in the Great Lakes basin, Corbeil Point on Lake Superior where collected by T.M.C. Taylor in 1935 and not seen since. Only tracked in the Great Lakes basin. See Given & Soper (1981), Hosie (1938), Riley (2003); APPENDIX 1.	Fens, bogs, wet tundra, roadside ditches, shores of lakes, ponds, and slow moving streams, often in shallow water; 0–3700 m
Cyperaceae	Eleocharis uniglumis	Single-glumed Spike-ru	G5?	S3?			Coastal sites on James and Hudson Bays. Similar to *E. erythropoda, E. kamchatica,* and *E. palustris* . A collection from a railway yard in Sault Ste. Marie is presumably introduced. See FNA	Mostly coastal, brackish (to fresh?) shores, marshes; 0–2300 m;
Cyperaceae	Lipocarpha micrantha	Small-flowered Lipocar	G5	S2	END	THR		
Rosaceae	Potentilla pulcherrima	Soft Cinquefoil	G5	S2			Stony lakeshores, meadows, and old fields. Some or all Ontario records may be based on introductions from further west. See Argus *et al* . (1982-1987), Brayshaw (1964).	Stony lakeshores, meadows, and old fields.
Ophioglossaceae	Botrychium lanceolatum	Triangle Moonwort	G5	S3?			Widespread in southern Ontario. Small and inconspicuous and undoubtedly overlooked. See Argus *et al* . (1982-1987), Chadde & Kudray (2001b), Cody & Britton (1989), Sutherland (1987). Ontario plants are ssp./var. *angustisegmentum* (TNR).	Mainly in shaded woods; 0--1200m
Brassicaceae	Subularia aquatica	Water Awlwort	G5	S3			Widespread in central and northern Ontario. A small and easily overlooked species of lake and river shorelines. See Bowles (1993), Coffin & Pfannmuller (1988), Mulligan & Calder (1964). Ontario plants are ssp. *Americana* (T5).	occurs in shallow lake and river margins
Woodsiaceae	Athyrium filixfemina var. cycl	Western Lady Fern	G5T5	SH			Mapped from Ontario in FNA (1993) based on collections from the Lake Superior area, where disjunct from western North America. Placed in the Dryopteridaceae by some authors. See Hosie (1938).	Yellow Pine Forest, Red Fir Forest, Lodgepole Forest, Subalpine Forest, wetland-riparian; Moist woods, swamps, streambanks;
Ophioglossaceae	Botrychium hesperium	Western Moonwort	G3G4	S1				Grassy mountain slopes, snow fields, road ditches with willows, and sand dunes; 200--2800 m
Cyperaceae	Carex wiegandii	Wiegand's Sedge	G4	S1			Bogs and swamps. See Anonymous (2003a), Argus *et al* . (1982-1987), Nichols (2002), Reznicek & Ball (1980).	Bogs, openings in acidic conifer, mixed, or alder swamps, wet acidic sandy or peaty meadows; 0–1300 m
Ericaceae	Pterospora andromedea	Woodland Pinedrops	G5	S2			Mixed woods. No recent records from southwestern Ontario; very local. Placed in the Monotropaceae or Pyrolaceae by some authors. See Anonymous (2004b), Argus *et al.* (1982-1987), Bakshi (1959), Gillett (1972), Marquis & Voss (1981), Schori (2002).	Mixed woods; grows in rich conifer forests
Cistaceae	Hudsonia tomentosa	Woolly Beachheath	G5	S3			Dry, open, sandy ground. See Fortin *et al* .(2006), Nelson *et al.* (1986).	Dry, open, sandy ground

Family	Scientific Name	Common Name	S Rank	G Rank	COSEWIC	COSSARO
Adoxaceae	*Viburnum edule*	Highbush Cranberry	S5	G5	N/A	N/A
Alismataceae	*Sagittaria latifolia*	Broad-leaved Arrowhead	S5	G5	N/A	N/A
Apiaceae	*Cicuta bulbifera*	Bulbous Water-hemlock	S5	G5	N/A	N/A
Apiaceae	*Daucus carota*	Queen Anne's Lace	SNA	GNR	N/A	N/A
Apocynaceae	*Apocynum androsaemifolium*	Spreading Dogbane	S5	G5	N/A	N/A
Araliaceae	*Aralia nudicaulis*	Wild Sarsaparilla	S5	G5	N/A	N/A
Asparagaceae	*Maianthemum canadense*	Wild Lily-of-the-valley	S5	G5	N/A	N/A
Asparagaceae	*Maianthemum trifolium*	Three-leaved False Solomon's-seal	S5	G5	N/A	N/A
Asteraceae	*Achillea millefolium*	Yarrow	S5	G5	N/A	N/A
Asteraceae	*Anaphalis margaritacea*	Pearly Everlasting	S5	G5	N/A	N/A
Asteraceae	*Antennaria neglecta*	Field Pussytoes	S5	G5	N/A	N/A
Asteraceae	*Aster macrophyllus*	Large-leaved Aster	S5	G5	N/A	N/A
Asteraceae	*Centaurea stoebe ssp micranthos*	Spotted Knapweed	N/A	N/A	N/A	N/A
Asteraceae	*Conyza canadensis*	Horseweed	S5	G5	N/A	N/A
Asteraceae	*Eurybia macrophylla*	Large-leaved Aster	S5	G5	N/A	N/A
Asteraceae	*Euthamia graminifolia*	Grass-leaved Goldenrod	S5	G5	N/A	N/A
Asteraceae	*Eutrochium maculatum ssp*	Spotted Joe-Pye-Weed	S5	G5T5	N/A	N/A
Asteraceae	*Gnaphalium uliginosum*	Low Cudweed	SNA	G5	N/A	N/A
Asteraceae	*Hieracium aurantiacum*	Devil's Paintbrush	SNA	GNR	N/A	N/A
Asteraceae	*Lactuca canadensis*	Tall Lettuce	S5	G5	N/A	N/A
Asteraceae	*Leucanthemum vulgare*	Oxeye Daisy	SNA	GNR	N/A	N/A
Asteraceae	*Pilosella piloselloides*	Yellow Hawkweed	SNA	GNR	N/A	N/A
Asteraceae	*Solidago canadensis*	Canada Goldenrod	SNR	G5	N/A	N/A
Asteraceae	*Solidago macrophylla*	Large-leaved Goldenrod	S4?	G5	N/A	N/A
Asteraceae	*Solidago nemoralis*	Grey-stemmed Goldenrod	S5	G5	N/A	N/A
Asteraceae	*Sonchus arvensis*	Field Sow-thistle	SNA	GNR	N/A	N/A
Asteraceae	*Symphyotrichum lanceolatum ssp.*	White Panicled Aster	S5	G5T5	N/A	N/A
Asteraceae	*Symphyotrichum puniceum var.*	Purple-stemmed Aster	S5	G5	N/A	N/A
Asteraceae	*Symphyotrichum ciliolatum*	Lindley's Aster	S5	G5	N/A	N/A
Balsaminaceae	*Impatiens capensis*	Spotted Jewelweed	S5	G5	N/A	N/A
Betulaceae	*Alnus incana ssp incana*	Speckled Alder	N/A	N/A	N/A	N/A
Betulaceae	*Alnus viridis*	Green Alder	S5	G5	N/A	N/A
Betulaceae	*Betula papyrifera*	White Birch	S5	G5	N/A	N/A
Betulaceae	*Betula pumila*	Low Birch	S5	G5	N/A	N/A
Betulaceae	*Corylus cornuta*	Beaked Hazelnut	S5	G5	N/A	N/A
Boraginaceae	*Mertensia paniculata*	Tall Bluebells	S5	G5	N/A	N/A
Brassicaceae	*Lepidium densiflorum*	Common Peppergrass	SNA	G5	N/A	N/A
Campanulaceae	*Lobelia kalmii*	Kalm's Lobelia	S5	G5	N/A	N/A
Caprifoliaceae	*Lonicera canadensis*	Fly Honeysuckle	S5	G5	N/A	N/A
Caprifoliaceae	*Lonicera oblongifolia*	Swamp Fly Honeysuckle	S4S5	G4	N/A	N/A
Caprifoliaceae	*Symphoricarpos albus*	Common Snowberry	S5	G5	N/A	N/A
Celastraceae	*Parnassia glauca*	Grass-of-parnassus	S5	G5	N/A	N/A
Cornaceae	*Cornus canadensis*	Bunchberry	S5	G5	N/A	N/A
Cornaceae	*Cornus stolonifera*	Red-osier Dogwood	N/A	N/A	N/A	N/A
Cupressaceae	*Thuja occidentalis*	Eastern White Cedar	S5	G5	N/A	N/A
Cyperaceae	*Carex aquatilis*	Water Sedge	S5	G5	N/A	N/A
Cyperaceae	*Carex cf blanda*	Woodland Sedge	S5	G5?	N/A	N/A
Cyperaceae	*Carex disperma*	Two-seeded Sedge	S5	G5	N/A	N/A
Cyperaceae	*Carex leptalea*	Bristle-stalked Sedge	S5	G5	N/A	N/A
Cyperaceae	*Carex pauciflora*	Few-flowered Sedge	S5	G5	N/A	N/A
Cyperaceae	*Carex pellita*	Woolly Sedge	S5	G5	N/A	N/A
Cyperaceae	*Carex rossii*	Ross' Sedge	S3	G5	N/A	N/A
Cyperaceae	*Carex cf. sterilis*	Sterile Sedge	S5	S5	N/A	N/A
Cyperaceae	*Carex stricta*	Tussock Sedge	S5	G5	N/A	N/A
Cyperaceae	*Carex tribuloides*	Blunt Broom Sedge	S4S5	G5	N/A	N/A
Cyperaceae	*Carex utriculata*	Northern Beaked Sedge	S5	G5	N/A	N/A

Family	Scientific Name	Common Name	S Rank	G Rank	COSEWIC	COSSARO
Cyperaceae	*Eleocharis ovata*	Ovate Spikerush	S5	G5	N/A	N/A
Cyperaceae	*Eriophorum vaginatum*	Sheathed Cotton-grass	S5	G5	N/A	N/A
Cyperaceae	*Scirpus atrocinctus*	Black-girdled bulrush	S5	G5	N/A	N/A
Cyperaceae	*Scirpus cyperinus*	Common Woolly Bulrush	S5	G5	N/A	N/A
Dennstaedtiaceae	*Pteridium aquilinum*	Bracken Fern	S5	G5	N/A	N/A
Diervillaceae	*Diervilla lonicera*	Bush Honeysuckle	S5	G5	N/A	N/A
Droseraceae	*Drosera rotundifolia*	Round-leaved Sundew	S5	G5	N/A	N/A
Dryopteridaceae	*Dryopteris carthusiana*	Spinulose Wood Fern	S5	G5	N/A	N/A
Dryopteridaceae	*Dryopteris cristata*	Crested Wood Fern	S5	G5	N/A	N/A
Equisetaceae	*Equisetum arvense*	Field Horsetail	S5	G5	N/A	N/A
Equisetaceae	*Equisetum fluviatile*	Water Horsetail	S5	G5	N/A	N/A
Equisetaceae	*Equisetum scirpoides*	Dwarf Scouring-rush	S5	G5	N/A	N/A
Equisetaceae	*Equisetum sylvaticum*	Wood Horsetail	S5	G5	N/A	N/A
Equisetaceae	*Equisetum variegatum*	Variegated Horsetail	S5	G5	N/A	N/A
Ericaceae	*Andromeda polifolia*	Bog Rosemary	S5	G5	N/A	N/A
Ericaceae	*Chamaedaphne calyculata*	Leatherleaf	S5	G5	N/A	N/A
Ericaceae	*Epigaea repens*	Trailing Arbutus	S5	G5	N/A	N/A
Ericaceae	*Gaultheria hispidula*	Creeping Snowberry	S5	G5	N/A	N/A
Ericaceae	*Kalmia angustifolia*	Bog-laurel	S5	G5	N/A	N/A
Ericaceae	*Pyrola chlorantha*	Green Wintergreen	S4S5	G5	N/A	N/A
Ericaceae	*Rhododendron groendlandicum*	Labrador Tea	S5	G5	N/A	N/A
Ericaceae	*Vaccinium angustifolium*	Lowbush Blueberry	S5	G5	N/A	N/A
Ericaceae	*Vaccinium myrtilloides*	Velvet-leaved Blueberry	S5	G5	N/A	N/A
Ericaceae	*Vaccinium oxycoccos*	Bog Cranberry	S5	G5	N/A	N/A
Fabaceae	*Trifolium repens*	White Clover	SNA	GNR	N/A	N/A
Fabaceae	*Trifolium aureum*	Hop Clover	SNA	GNR	N/A	N/A
Fabaceae	*Trifolium hybridum*	Alsike Clover	SNA	GNR	N/A	N/A
Fabaceae	*Trifolium pratense*	Red Clover	SNA	GNR	N/A	N/A
Geraniaceae	*Geranium bicknellii*	Bicknell's Geranium	S4	G5	N/A	N/A
Grossulariaceae	*Ribes hirtellum*	Smooth Gooseberry	S5	G5	N/A	N/A
Grossulariaceae	*Ribes hudsonianum*	Northern Blackcurrant	S5	G5	N/A	N/A
Grossulariaceae	*Ribes lacustre*	Black Gooseberry	S5	G5	N/A	N/A
Grossulariaceae	*Ribes triste*	Red Swamp Currant	S5	G5	N/A	N/A
Iridaceae	*Iris versicolor*	Blue Flag Iris	S5	G5	N/A	N/A
Juncaceae	*Juncus dudleyi*	Dudley's Rush	S5	G5	N/A	N/A
Juncaceae	*Juncus nodosus*	Knotted Rush	S5	G5	N/A	N/A
Juncaceae	*Juncus sp.*	Rush	N/A	N/A	N/A	N/A
Lamiaceae	*Lycopus americanus*	American Bugleweed	S5	G5	N/A	N/A
Lamiaceae	*Mentha arvensis*	Field Mint	S5	G5	N/A	N/A
Lamiaceae	*Scutellaria galericulata*	Marsh Skullcap	S5	G5	N/A	N/A
Lentibulariaceae	*Utricularia vulgaris subsp. macrorhiza*	Greater Bladderwort	SNR	G5	N/A	N/A
Liliaceae	*Clintonia borealis*	Bluebead Lily	S5	G5	N/A	N/A
Linnaeaceae	*Linnaea borealis*	Twinflower	S5	G5	N/A	N/A
Lycopodiaceae	*Lycopodium annotinum*	Stiff Club-moss	S5	G5	N/A	N/A
Lycopodiaceae	*Lycopodium clavatum*	Running Club-moss	S5	G5	N/A	N/A
Lycopodiaceae	*Lycopodium dendroideum*	Ground Pine	S5	G5	N/A	N/A
Menyanthaceae	*Menyanthes trifoliata*	Buckbean	S5	G5	N/A	N/A
Myricaceae	*Myrica gale*	Sweet Gale	S5	G5	N/A	N/A
Nymphaeaceae	*Nuphar variegata*	Yellow Cow Lily	S5	G5T5	N/A	N/A
Nymphaeaceae	*Nymphaea odorata*	Fragrant Waterlily	S5?	G5T5	N/A	N/A
Oleaceae	*Fraxinus nigra*	Black Ash	S4	G5	N/A	N/A
Onagraceae	*Chamerion angustifolium*	Fireweed	S5	G5	N/A	N/A
Onagraceae	*Epilobium ciliatum*	Northern Willowherb	S5	G5	N/A	N/A
Onagraceae	*Oenothera biennis*	Evening Primrose	S5	G5	N/A	N/A
Ophioglossaceae	*Botrychium virginianum*	RattlesnakeFern	S5	G5	N/A	N/A
Orchidaceae	*Corallorhiza maculata*	Spotted Coralroot	N/A	N/A	N/A	N/A

Family	Scientific Name	Common Name	S Rank	G Rank	COSEWIC	COSSARO
Orchidaceae	*Platanthera hyperborea*	Northern Bog Orchid	S4S5	G5	N/A	N/A
Orobanchaceae	*Euphrasia stricta*	Stiff Eyebright	SNA	GNRQ	N/A	N/A
Osmundaceae	*Osmunda claytoniana*	Interrupted fern	S5	G5	N/A	N/A
Pinaceae	*Abies balsamea*	Balsam Fir	S5	G5	N/A	N/A
Pinaceae	*Larix laricina*	Tamarack	S5	G5	N/A	N/A
Pinaceae	*Picea glauca*	White Spruce	S5	G5	N/A	N/A
Pinaceae	*Picea mariana*	Black Spruce	S5	G5	N/A	N/A
Pinaceae	*Pinus banksiana*	Jack Pine	S5	G5	N/A	N/A
Plantaginaceae	*Plantago major*	Common Plantain	S5	G5	N/A	N/A
Poaceae	*Agrostis sp.*		N/A	N/A	N/A	N/A
Poaceae	*Bromus*		N/A	N/A	N/A	N/A
Poaceae	*Calamagrostis canadensis*	Bluejoint Reedgrass	S5	G5	N/A	N/A
Poaceae	*Danthonia spicata*	Poverty Grass	S5	G5	N/A	N/A
Poaceae	*Deschampsia caespitosa*	Wavy Hairgrass	S4S5	G5	N/A	N/A
Poaceae	*Elymus repens*	Quackgrass	SNA	GNR	N/A	N/A
Poaceae	*Glyceria canadensis*	Canada Manna Grass	S4S5	G5	N/A	N/A
Poaceae	*Glyceria grandis*	American Manna Grass	S4S5	G5	N/A	N/A
Poaceae	*Glyceria striata*	Fowl Manna Grass	S5	G5	N/A	N/A
Poaceae	*Phleum pratense*	Timothy	SNA	GNR	N/A	N/A
Poaceae	*Poa compressa*	Canada Bluegrass	SNA	GNR	N/A	N/A
Poaceae	*Poa pratensis*	Kentucky Bluegrass	S5	G5	N/A	N/A
Polygonaceae	*Polygonum amphibium*	Water Smartweed	S5	G5	N/A	N/A
Polygonaceae	*Polygonum convolvulus*	Black Bindweed	SNA	GNR	N/A	N/A
Polypodiaceae	*Polypodium virginianum*	Common Polypody	S5	G5	N/A	N/A
Potamogetonaceae	*Potamogeton natans*	Floating Pondweed	S5	G5	N/A	N/A
Primulaceae	*Trientalis borealis*	Northern Starflower	S5	G5	N/A	N/A
Ranunculaceae	*Anemone sp.*	Anemone	N/A	N/A	N/A	N/A
Ranunculaceae	*Caltha palustris*	Yellow Marsh-marigold	S5	G5	N/A	N/A
Ranunculaceae	*Coptis trifolia*	Goldthread	S5	G5	N/A	N/A
Ranunculaceae	*Thalictrum pubescens*	Tall Meadow-rue	S5	G5	N/A	N/A
Rhamnaceae	*Rhamnus alnifolia*	Alder-leaved Buckthorn	S5	G5	N/A	N/A
Rosaceae	*Amelanchier bartramiana*	Bartram's Serviceberry	S5	G5	N/A	N/A
Rosaceae	*Comarum palustre*	Marsh Cinquefoil	S5	G5	N/A	N/A
Rosaceae	*Dasiphora fruticosa*	Shrubby Cinquefoil	S5	G5	N/A	N/A
Rosaceae	*Fragaria vesca*	Woodland Strawberry	S5	G5	N/A	N/A
Rosaceae	*Fragaria virginiana*	Wild Strawberry	S5	G5	N/A	N/A
Rosaceae	*Geum macrophyllum*	Large-leaved Avens	S5	G5	N/A	N/A
Rosaceae	*Geum rivale*	Water Avens	S5	G5	N/A	N/A
Rosaceae	*Potentilla norvegica*	Rough Cinquefoil	S5	G5	N/A	N/A
Rosaceae	*Prunus pensylvanica*	Pin Cherry	S5	G5	N/A	N/A
Rosaceae	*Prunus virginianum*	Chokecherry	S5	G5	N/A	N/A
Rosaceae	*Rosa acicularis*	Prickly Rose	S5	G5	N/A	N/A
Rosaceae	*Rubus idaeus*	Red Raspberry	S5	G5	N/A	N/A
Rosaceae	*Rubus pubescens*	Dwarf Red Raspberry	S5	G5	N/A	N/A
Rosaceae	*Sorbus decora*	Showy Mountain Ash	S5	G4G5	N/A	N/A
Rosaceae	*Spiraea alba*	Narrow-leaved Meadow-sweet	S5	G5	N/A	N/A
Rubiaceae	*Galium labradoricum*	Northern Bog Bedstraw	S5	G5	N/A	N/A
Rubiaceae	*Galium trifidum*	Small Bedstraw	S5	G5	N/A	N/A
Salicaceae	*Populus balsamifera*	Balsam Poplar	S5	G5	N/A	N/A
Salicaceae	*Populus tremuloides*	Trembling Aspen	S5	G5	N/A	N/A
Salicaceae	*Salix bebbii*	Bebb's Willow	N/A	GNA	N/A	N/A
Sapindaceae	*Acer spicatum*	Mountain Maple	S5	G5	N/A	N/A
Sarraceniaceae	*Sarracenia purpurea*	Pitcher Plant	S5	G5	N/A	N/A
Saxifragaceae	*Mitella nuda*	Common Mitrewort	S5	G5	N/A	N/A
Scrophulariaceae	*Verbascum thapsus*	Common Mullein	SNA	GNR	N/A	N/A
Thelypteridaceae	*Phegopteris connectilis*	Northern Beech Fern	S5	G5	N/A	N/A

Family	Scientific Name	Common Name	S Rank	G Rank	COSEWIC	COSSARO
Typhaceae	*Typha latifolia*	Common Cattail	S5	G5	N/A	N/A
Violaceae	*Viola blanda*	Sweet White Violet	S4S5	G4G5	N/A	N/A
Woodsiaceae	*Athyrium filix-femina*	Lady Fern	S5	G5	N/A	N/A
Woodsiaceae	*Gymnocarpium dryopteris*	Oak Fern	S5	G5	N/A	N/A

APPENDIX D

VEGETATION DESCRIPTIONS

The following ecosite descriptions outline the main characteristics found in the Study Areas. The descriptions are taken from the Boreal Ecosite Factsheets, produced by the Ontario Ministry of Natural Resources (Banton and Lalonde 2012). The descriptions provided by Banton and Lalonde (2012) match conditions in the Study Areas very closely. Subtle differences due to local site conditions have been described in the results section.

Upland Forest

Ecosite B049: Dry to Fresh, Coarse: Jack Pine – Black Spruce Dominated

This ecosite has a fresh moisture regime, depending on soil texture (2 or 3 if sandy; ≤3 if coarse loamy). The nutrient regime ranges from very poor to moderate and the substrate is mostly deep and uniform (>15cm). Shallow substrates and exposed bedrock can also be present. The ecosite is often associated with deep or shallow morainal or glaciofluvial parent materials over bedrock. This ecosite is often found on crest, upper and middle slope positions but may also occur on toe slopes.

The forest canopy is dominated by conifer species, notably jack pine (*Pinus banksiana*) and/or black spruce (*Picea mariana*), which combined represent more than 90% of the total tree cover. White birch (*Betula papyrifera*) is limited to 20% or less of the overall tree cover. The understory is typically composed of regenerating tree species such as black spruce, balsam fir (*Abies balsamea*) and white birch.

This ecosite has a poorly developed shrub and herb layer which tends to improve when sites are located on base-rich bedrock or where fine-textured soils occur. Common understory vegetation includes velvet-leaf blueberry (*Vaccinium myrtilloides*), low sweet blueberry (*Vaccinium angustifolium*), creeping snowberry (*Gaultheria hispidula*), bunchberry (*Cornus canadensis*), wild lily-of-the-valley (*Maianthemum canadense*), feathermoss (*Pleurozium* spp.), and various lichen species. Xeric vegetation, such as reindeer lichen (*Cladina rangiferina*) and green alder (*Alnus viridis*), may be present and lower shrub and herb diversity may occur on exposed bedrock or very shallow (≤15 cm) substrates.

Ecosite B052: Dry to Fresh, Coarse: Spruce – Fir Conifer

This ecosite has a dry to fresh (2 or 3) moisture regime and poor to moderate nutrient regime. Sites are often associated with deep or shallow morainal or glaciofluvial parent materials over bedrock. The substrate is typically sandy to coarse loamy and mostly deeper than 15 cm. This ecosite is often located on crest, upper, or middle slope positions and may also occur on toe slopes.

This ecosite is associated with moderate tree growth and low species diversity. The conifer canopy mostly comprises balsam fir (*Abies balsamea*) and white spruce (*Picea glauca*) which make up more than 50% of the cover of conifer species. The conifers are often mixed with white birch (*Betula papyrifera*), trembling aspen (*Populus tremuloides*) and black spruce (*Picea mariana*). The canopy closure of tall trees (>10m) is variable. Sites with shorter trees (≤10m) are generally characterized by closed canopies and dense younger trees.

The understory is composed of tree species such as balsam fir, trembling aspen, white birch, and white spruce. Shrub and herb diversity is often low but may include twinflower (*Linnaea borealis*), bush honeysuckle (*Diervilla lonicera*), mountain maple (*Acer spicatum*), bunchberry (*Cornus canadensis*), wild sarsaparilla (*Aralia nudicaulis*), wild lily-of-the-valley (*Maianthemum*

canadense) and feathermosses (*Pleurozium* spp.).

Xeric vegetation, such as reindeer lichen (*Cladina rangiferina*) and green alder (*Alnus viridis*) may also be present and shrub and herb diversity may decrease on exposed bedrock or very shallow (≤15 cm) substrates. Increased species diversity and abundance may occur on base-rich bedrock or with the inclusion of fine textured materials. Speckled alder (*Alnus incana*), *Sphagnum* spp., and sedges (*Carex* spp.) may occur in moist shallow and moderately deep substrates.

Ecosite B055: Dry to Fresh, Coarse: Aspen – Birch Hardwood

The moisture regime of this ecosite is dry to fresh, depending on soil texture (2 or 3 if sandy; ≤3, if coarse loamy). The nutrient regime is very poor to moderate. The substrate is sandy to coarse loamy and mostly more than 15 cm deep. The ecosite often occurs on crest, upper, and middle slope positions but may also occur on toe slopes.

The hardwood canopy typically consists of trembling aspen (*Populus tremuloides*) and/or white birch (*Betula papyrifera*). These species may form a near pure stand but are often mixed with minor components of balsam fir (*Abies balsamea*), black spruce (*Picea mariana*), and white spruce (*Picea glauca*). The canopy closure tends to be variable irrespective of tree height. The understory tree species consist of balsam fir, trembling aspen, white birch and black spruce.

The ecosite has a well-developed shrub layer and species include bush honeysuckle (*Diervilla lonicera*), mountain maple (*Acer spicatum*), dwarf raspberry (*Rubus pubescens*), twinflower (*Linnaea borealis*), beaked hazel (*Corylus cornuta*), and low sweet blueberry (*Vaccinium angustifolium*). The herb layer diversity is typically poor but species richness tends to increase on loamy substrates.

Ecosite B065: Moist, Coarse: Black Spruce – Pine Conifer

The moisture regime for this ecosite is moist (4 or 5) and the nutrient regime is very poor to moderate. The substrate is usually sandy to coarse loamy and deep (>15cm) although depths can vary, especially where morainal deposits are present over rock. Exposed bedrock may also be present. This ecosite occurs on a wide variety of slope positions.

The conifer-dominated canopy consists of black spruce (*Picea mariana*) and/or jack pine (*Pinus banksiana*) which make up more than 50% of the conifer species present. The canopy cover includes both tall (>10m) and low (≤10 m) trees. Canopy closure can also be variable. The understory tree species consist of black spruce and balsam fir (*Abies balsamea*).

The shrub and herb layers are moderately diverse and may include creeping snowberry (*Gaultheria hispidula*), Labrador-tea (*Rhododendron groenlandicum*), velvet-leaf blueberry (*Vaccinium myrtilloides*), bunchberry (*Cornus canadensis*), wild lily-of-the-valley (*Maianthemum canadense*), goldthread (*Coptis trifolia*), feathermosses (*Pleurozium* spp.), and *Sphagnum* spp.

Increased species diversity and abundance may occur on base-rich bedrock or with the inclusion of fine- textured materials. Beaked hazel (*Corylus cornuta*), mountain maple (*Acer spicatum*), speckled alder (*Alnus incana*), large-leaved aster (*Eurybia macrophylla*), and sedges (*Carex* spp.) may occur in moist, shallow, and moderately deep substrates.

Ecosite B067: Moist, Coarse: Spruce Conifer

This ecosite was only described during development of the ecosystem map. According to

Banton and Lalonde (2012), this ecosite has a moist (4 or 5) moisture regime and very poor to moderate nutrient regime. The substrate depth is variable, especially where morainal deposits over rock are present. Substrates are typically more than 15 cm deep and sandy to coarse loamy in texture. This ecosite occurs on a wide variety of slope positions.

The conifer canopy consists of balsam fir (*Abies balsamea*), black spruce (*Picea mariana*), and white spruce (*Picea glauca*). These species are often mixed with trembling aspen (*Populus tremuloides*), white birch (*Betula papyrifera*), jack pine (*Pinus banksiana*), and balsam poplar (*Populus balsamifera*). The understory tree species consist of balsam fir, white birch, and black spruce.

The shrub and herb layer diversity is moderately poor and may include twinflower (*Linnaea borealis*), dwarf raspberry (*Rubus pubescens*), velvet-leaf blueberry (*Vaccinium myrtilloides*), bluebead-lily (*Clintonia borealis*), bunchberry (*Cornus canadensis*), wild sarsaparilla (*Aralia nudicaulis*), and feathermosses (*Pleurozium* spp.). Increased species diversity and abundance may occur on base-rich bedrock or where there are fine textured materials. Mountain maple (*Acer spicata*), speckled alder (*Alnus incana*), large- leaved aster (*Eurybia macrophylla*), *Sphagnum* spp. and sedges (*Carex* spp.) may occur in moist shallow and moderately deep substrates.

Ecosite B070: Moist, Coarse: Aspen – Birch Hardwood

This ecosite has a moist moisture regime (4 or 5) and a nutrient regime ranging from very poor to moderate. The substrate depth is variable, especially where morainal deposits over rock are present. The ecosite occurs on a wide variety of slope positions.

The hardwood canopy consists mostly of trembling aspen (*Populus tremuloides*) and/or white birch (*Betula papyrifera*). The canopy often includes balsam fir (*Abies balsamea*), white spruce (*Picea glauca*), black spruce (*Picea mariana*), and jack pine (*Pinus banksiana*). The canopy closure is variable. The understory tree species consist of balsam fir, trembling aspen, white birch, and black spruce.

Shrub and herb layer diversity is moderately rich and may include bush honeysuckle (*Diervilla lonicera*), dwarf raspberry (*Rubus pubescens*), mountain maple (*Acer spicatum*), bluebead-lily (*Clintonia borealis*), wild lily-of-the-valley (*Maianthemum canadense*), wild sarsaparilla (*Aralia nudicaulis*) and feathermosses (*Pleurozium* spp.). Increased species diversity and abundance may occur on base-rich bedrock or where there are fine-textured materials present. Speckled alder (*Alnus incana*), *Sphagnum* spp. and sedges (*Carex* spp.) may occur in moist, shallow and moderately deep substrates.

Ecosite B114: Moist, Fine: Black Spruce – Pine Conifer

This ecosite was only described during development of the ecosystem map. According to Banton and Lalonde (2012), the moisture regime is moist (4 or 5) and the nutrient regime can be rich to very rich. The substrate texture and moisture conditions are good for plant growth and are usually silty to fine, or loamy to clayey and typically uniform and deep (>15 cm).

The conifer canopy consists primarily of black spruce (*Picea mariana*) and/or jack pine (*Pinus banksiana*). Conifers are often mixed with trembling aspen (*Populous tremuloides*), balsam fir (*Abies balsamea*), and white birch (*Betula papyrifera*). The canopy closure and tree height tends to be variable. The understory tree species consist of balsam fir, black spruce, and trembling aspen.

The shrub and herb layer diversity is moderately poor and species may include velvet-leaf blueberry (*Vaccinium myrtilloides*), creeping snowberry (*Gaultheria hispidula*), twinflower (*Linnaea borealis*), bunchberry (*Cornus canadensis*), wild lily-of-the-valley (*Maianthemum canadense*), goldthread (*Coptis trifolia*), and feathermosses (*Pleurozium* spp.). Xeric vegetation, such as reindeer lichen (*Cladina rangiferina*), pincherry (*Prunus pensylvanica*), and prairie willow (*Salix humilis*), may occur on exposed bedrock or shallow substrates. Black spruce and wet organic substrates are more abundant in depressions on moderately deep substrates.

Ecosite B119: Moist, Fine: Aspen – Birch Hardwood

The moisture regime for this ecosite is moist (4 or 5) and the nutrient regime is rich to very rich. The substrate is silty to fine loamy to clayey and mostly deep (>15 cm). This ecosite often occurs on flat to gently rolling topography or at lower slope positions and in depressions.

Hardwood species usually make up more than 50% of the canopy species and consist of trembling aspen (*Populus tremuloides*) and/or birch species (*Betula* spp.), and may also include balsam poplar (*Populus balsamifera*). The canopy may be mixed with balsam fir (*Abies balsamea*), black spruce (*Picea mariana*), white birch (*Betula papyrifera*), and white spruce (*Picea glauca*).

The understory vegetation usually consists of balsam fir, trembling aspen, black spruce, balsam poplar, black ash (*Fraxinus nigra*), dwarf raspberry (*Rubus pubescens*), wild red currant (*Ribes triste*), twinflower (*Linnaea borealis*), wild lily-of-the-valley (*Maianthemum canadense*), naked mitrewort (*Mitella nuda*), wild sarsaparilla (*Aralia nudicaulis*), and feathermoss (*Pleurozium* spp.).

Xeric vegetation, such as reindeer lichen (*Cladina rangiferina*), pincherry (*Prunus pensylvanica*), and prairie willow (*Salix humilis*) may occur on exposed bedrock or shallow substrates. Black spruce and wet organic substrates are more abundant in depressions on moderately deep sites.

Wetlands

Ecosite B127: Organic Poor Conifer Swamp

The moisture regime for this ecosite is hydric (7, 8) with a poor nutrient regime and a mostly deep, organic substrate. Drainage is generally poor. The ecosite is frequently located on level ground or at middle or lower slope positions. This ecosite was described during ecosystem map development only; it was not characterized in the field.

The ecosite typically has a conifer canopy (ranging from >25% and ≤60% cover), consisting of black spruce (*Picea mariana*) with small amounts (< 10%) of other species, e.g., jack pine (*Pinus banksiana)* and tamarack (*Larix laricina).* The canopy height is often variable. Abundant ericaceous shrubs occupy and shrub layer herbs are poorly represented. The ground surface is mostly moss. Common understory vegetation includes creeping snowberry (*Gaultheria hispidula*), Labrador-tea (*Rhododendron groenlandicum*), velvet-leaf blueberry (*Vaccinium myrtilloides*), three-leaved Solomon's seal (*Maianthemum trifolium*), three-seeded sedge (*Carex trisperma*), wood horsetail (*Equisetum sylvaticum*), *Sphagnum* sp. and feathermoss (*Pleurozium* sp). Swamp indicator species, such as speckled alder (*Alnus incana*), bunchberry (*Cornus canadensis*), bristly club-moss (*Lycoposium annotinum*), Canada blue joint (*Calamagrostis canadensis*), plume moss (*Ptilium crista-castrensis*), common green peatmoss (*Sphagnum girgensohnii*), stair step moss (*Hylocomium splendens*), and

Wulf's peatmoss (*Sphagnum wulfianum*), may also be present.

Ecosite B128: Intermediate Conifer Swamp

The moisture regime is hydric (7, 8, or saturated, if soils are organic) with a moderate nutrient regime and a mostly deep organic substrate. Exposed bedrock or very shallow substrates may also occur. Drainage is poor. This ecosite can occur on level ground or at mid and lower slope positions. This ecosite was described in the field as well as during ecosystem map development.

The canopy cover and height is variable, not sparse (>25% cover). Tree species include black spruce (*Picea mariana*) with some tamarack (*Larix laricina*) and balsam fir (*Abies balsamea*). Common understory vegetation includes speckled alder (*Alnus incana*), Labrador-tea (*Rhododendron groenlandicum*), creeping snowberry (*Gaultheria hispidula*), velvet-leaf blueberry (*Vaccinium myrtilloides*), bunchberry (*Cornus canadensis*), three-leaved Solomon's seal (*Maianthemum trifolium*), goldthread (*Coptis trifolia*), *Sphagnum* sp. and feathermoss (*Pleurozium* sp). Rich and intermediate swamp indicator species, such as twinflower (*Linnaea borealis*), dwarf raspberry (*Rubus pubescens*), blue-bead-lily (*Clintonia borealis*), naked mitrewort (*Mitella nuda*), palmate-leaf sweet-coltsfoot (*Petasites frigidus*), and Wulf's peatmoss (*Sphagnum wulfianum*) are also likely to be present.

Ecosite B129: Organic Rich Conifer Swamp

The moisture regime is hydric (7, 8, or saturated if soils are organic) with a rich nutrient regime and a mostly deep organic substrate. Exposed bedrock or very shallow substrates may occur. Drainage is generally poor. The ecosite is associated with depressions in bedrock-controlled topography to relatively flat lacustrine or glaciolacustrine plains. This ecosite was described in the field as well as during ecosystem map development.

The canopy closure and height is variable and not sparse (>25% cover). Common trees species include eastern white cedar (*Thuja occidentalis*) often mixed with black spruce (*Picea mariana*), tamarack (*Larix laricina*), and balsam fir (*Abies balsamea*). Understory tree species consist of balsam fir, black spruce, and eastern white cedar. The shrub layer is sparse and herbs and non-vascular plants often include creeping snowberry (*Gaultheria hispidula*), speckled alder (*Alnus incana*), Labrador-tea (*Rhododendron groenlandicum*), bunchberry (*Cornus canadensis*), goldthread (*Coptis trifolia)*, naked mitrewort (*Mitella nuda*), various graminoids (e.g., sedges and grasses), feathermoss (*Pleurozium* sp.), and *Sphagnum* moss (*Sphagnum sp.*).

Ecosite B134: Mineral Thicket Swamp

This ecosite occurs in bedrock depressions, along the open water margins of peatlands and upland sites, or associated with large peatland systems or riparian areas such as flood plains adjacent to lakes, streams, or rivers.

The moisture regime is hydric (6) and the nutrient regime is moderate. Mineral materials are moderately deep to deep, however very shallow substrates may also occur. The ecosite generally occurs on lower or level slopes, or in depressions. It is often located adjacent to or as patches within rich swamp communities.

The tree cover is generally 10% or lower and includes white spruce (*Picea glauca*) and white birch (*Betula papyrifera*). Tree establishment is usually restricted by the extent to which soils are saturated. The ecosite varies from stands dominated by one tall shrub species to a mix of

tall and low shrubs (>25%), including speckled alder (*Alnus incana*), red-osier dogwood (*Cornus stolonifera*), willows (*Salix* spp.) and sweet gale (*Myrica gale*). Herbaceous plants may include bedstraws (*Galium* spp), Canada blue joint (*Calamagrostis canadensis*), horsetails (*Equisetum* spp.) and sedges (*Carex* spp.). *Sphagnum* spp. and *Mnium* spp. are the dominant mosses. This ecosite may originate following disturbances (i.e., logging, fire, windthrow or beaver activity) that eliminate trees in a treed swamp. Conversely, through succession, tree cover may increase over time.

Ecosite B135: Organic Thicket Swamp

Soils are largely poorly drained with a hydric (7, 8, 9 or saturated) moisture regime and poor nutrient regime. The substrate is mostly organic and deep but it can also be very shallow. This ecosite is typically located on lower or level slopes, or in depressions. This ecosite is often located adjacent to, or as patches within, forested rich swamp communities, or forms part of a complex associated with mineral thicket swamps, treed or shrub fens, or treed bogs.

Sites are generally characterized by tall deciduous shrubs or a mix of tall and low shrub species. Shrub cover is often greater than 25% and includes speckled alder (*Alnus incana*), which is often dominant, red- osier dogwood (*Cornus stolonifera*), sweet gale (*Myrica gale*) and dwarf birch (*Betula pumila*). Tree cover, if present, is low (≤10%) and canopy closure is variable. Species include black spruce (*Picea mariana*), white cedar (*Thuja occidentalis*) and tamarack (*Larix laricina*). The herb layer is moderately developed and includes Canada blue joint (*Calamagrostis canadensis*), horsetails (*Equisetum* spp.), sedges (*Carex* spp.), violets (*Viola* spp.), marsh marigold (*Caltha palustris*), dwarf raspberry (*Rubus pubescens*), marsh cinquefoil (*Comarum palustre*), and bedstraws (*Galium* spp.). Non-vascular plants are dominated by *Sphagnum* spp.

Ecosite B136: Sparse Treed Fen

The moisture regime is hydric (7, 8, 9 or saturated) and the nutrient regime is poor to moderate. The substrate is generally peaty and deep. Despite the poor drainage, the presence of hummocks and raised mounds facilitate the establishment of trees. The ecosite is typically found in association with poor conifer swamps or open fens depending on the underlying landform. This ecosite is also associated with basin fens and shores above the level of seasonal flooding, as well as along the margins of larger peatlands.

The canopy cover is sparse (>10% and ≤25%) and tree height can be variable (mostly below 10 m). In poor fens the tree species include black spruce (*Picea mariana*) and lesser amounts of tamarack (*Larix laricina*). Tamarack becomes more dominant in richer fens. The understory vegetation includes Labrador- tea (*Rhododendron groenlandicum*), creeping snowberry (*Gaultheria hispidula*), speckled alder (*Alnus incana*), three-leaved Solomon's seal (*Maianthemum trifolium*), bunchberry (*Cornus canadensis*), naked mitrewort (*Mitella nuda*), graminoids, various *Sphagnum* species, and feathermosses (*Pleurozium* spp.). Fen indicator species, such as swamp birch (*Betula alleghaniensis*), alder-leaved buckthorn (*Rhamnus alnifolia*), marsh-marigold (*Caltha palustris*), Canada blue joint (*Calamagrostis canadensis*), violets (*Viola* spp.), marsh cinquefoil (*Comarum palustre*) and three-leaved buckbean (*Menyanthes trifoliata*), may also be present.

Ecosite B137: Sparse Treed Bog

This ecosite has a hydric moisture regime (7, 8, 9 or saturated) and the nutrient regime is poor. The substrate is generally deep and organic. This ecosite is poorly drained and may be hydrologically isolated and is usually located in depressions or level

slope positions. The ecosite may be extensive and uniform but often can be found as part of a complex association of poor conifer swamps or open fens depending on the underlying landform. It may also occur adjacent to shorelines of rivers and lakes above flooding level.

The tree canopy is generally sparse to open and ranges between >10% and ≤25% cover. Trees consist largely of black spruce (*Picea mariana*) with lesser amounts of balsam fir (*Abies balsamea*) and tamarack (*Larix laricina*). Shrub species include Labrador-tea (*Rhododendron groenlandicum*), creeping snowberry (*Gaultheria hispidula*), large cranberry (*Vaccinium macrocarpon*), velvet-leaved blueberry (*Vaccinium myrtilloides*), leatherleaf (*Chamaedaphne calyculata*), and pale laurel (*Kalmia polifolia*). Herb species include three-leaved Solomon's seal (*Maianthemum trifolium*), three-seeded sedge (*Carex trisperma*), woodhorsetail (*Equisetum sylvaticum*), goldthread (*Coptis trifolia*), bunchberry (*Cornus canadensis*). Non- vascular plants include red-stem feathermoss (*Pleurozium schreberi*), and various *Sphagnum* spp.

Ecosite B138: Open Bog

The moisture regime is hydric (7, 8, or 9) and the nutrient regime and drainage is generally poor. The substrate is organic and deep. This ecosite is typically found within small, filled-in kettle lakes and depressions, on lower slopes, and areas that are hydrologically isolated. It is also associated with peatland systems (i.e., raised dome or openings in treed bogs or fens).

The ecosite typically has low tree cover (≤10% cover) with stunted black spruce (*Picea mariana*) being the main species. Low shrub species typically dominate including leatherleaf (*Chamaedaphne calyculata*), pale laurel (*Kalmia polifolia*), bog rosemary (*Andromeda polifolia*) and Labrador tea (*Rhododendron groenlandicum*). Fen indicators are usually absent. Herbaceous plants include pitcher plant (*Sarracenia purpurea*), round-leaved sundew (*Drosera rotundifolia*), dense cottongrass (*Eriophorum vaginatum*), and few-seeded sedge (*Carex microglochin*). Bryophytes include common brown peat moss (*Sphagnum fuscum*), and midway peatmoss (*Sphagnum magellanicum*).

Ecosite B139: Poor Fen

The poor fen ecosite has a hydric (6, 7, 8, 9, or saturated) moisture regime and poor nutrient regime. The substrate is either mineral or organic, and is often deep. This ecosite is located on lower slopes and level to undulating organic, morainal, glaciolacustrine and glaciofluvial deposits and is also confined to kettle or mild depressions.

This ecosite is often a mix of shrubs and herbs that often grade into bog, richer fen, or poor conifer swamp ecosites. If trees are present they are usually stunted black spruce (*Picea mariana*) and tamarack (*Larix laricina*) which cover less than 10% of the area. The trees and shrubs combined have a cover of 25% or less. Shrubs, when present, are typically ericaceous species and include leatherleaf (*Chamaedaphne calyculata*), bog rosemary (*Andromeda polifolia*), pale laurel (*Kalmia polifolia*) and small cranberry (*Vaccinium oxycoccos*). Herbaceous plants include slender sedge (*Carex lasiocarpa*), pitcher-plant (*Sarracenia purpurea*) and few-seeded sedge (*Carex oligosperma*). Non-vascular plants include midway peat moss (*Sphagnum magellanicum*) and poor-fen peat moss (*Sphagnum angustifolium*).

Ecosite B140: Open Moderately Rich Fen

This ecosite has a very moist to wet (6, 7, 8, 9, or saturated) moisture regime and moderate nutrient regime. The substrate can be organic or mineral and is primarily deep.

The ecosite is confined to groundwater fed depressions, gently sloping seepage areas, or protected riparian areas associated with lakes, rivers, and ponds. Topographically, the ecosite is generally level to undulating. The ecosite is typically non-calcareous but where calcareous conditions occur, plant diversity and vigour increases.

The ecosite is typically dominated by graminoids or low shrub communities. Commonly found shrubs include bog rosemary (*Andromeda polifolia*), leatherleaf (*Chamaedaphne calyculata*) and dwarf birch (*Betula pumila*). Herbaceous plants include white beakrush (*Rhynchospora alba*), slender sedge (*Carex lasiocarpa*) and buckbean (*Menyanthes trifoliata*). Non-vascular plants include *Sphagnum* mosses and scorpion's tail moss (*Scorpidium scorpioides*). Tree cover, if present, is low (≤10%) and usually consists of stunted black spruce (*Picea mariana*) and tamarack (*Larix laricina*).

Ecosite B141: Open Extremely Rich Fen

The moisture regime for this ecosite is hydric (6, 7 ,8, 9, or saturated), which limits the species richness. The nutrient regime is rich and the substrate is typically deep mineral or organic. Species richness and composition is influenced by drainage, with wetter areas supporting more graminoids and drier areas supporting localized communities of scattered trees and low ericaceous shrubs. This ecosite is typically found in depressions that are fed by mineral-rich groundwater, gradual seepage slopes, or protected riparian areas associated with lakes, rivers, and ponds. Substrates are typically composed of level to undulating organic, glaciolacustrine, and glaciofluvial deposits.

This ecosite often forms a complex with bog, other fen, meadow, or marsh ecosites within nutrient rich, fine textured soils. Under some circumstances, this ecosite can develop into a patterned fen with alternating raised ridges (strings) and depressions or hollows (flarks) forming perpendicular to the direction of water flow. Ridges are dominated by sedges, shrubs and stunted trees, while depressions support saturated to inundated open areas of brown mosses, sedges, and rushes.

Tree cover, if present, is low (≤10%) and usually comprises stunted black spruce (*Picea mariana*), white cedar (*Thuja occidentalis*), and tamarack (*Larix laricina*). Shrub cover (≤25%) includes dwarf birch (*Betula pumila*), shrubby cinquefoil (*Potentilla fruticosa*), and bog rosemary (*Andromeda polifolia*). Herbaceous plants include buckbean (*Menyanthes trifoliata*), flatleaf bladderwort (*Utricularia intermedia*), slender sedge (*Carex lasiocarpa*) and livid sedge (*Carex livida*). Non-vascular plants include peat mosses and scorpion's tail moss (*Scorpidium scorpioides*).

Ecosite B144: Organic Meadow Marsh

The moisture regime is hydric (7, 8, 9, or saturated). The nutrient regime is very rich and the substrate is organic and mostly deep. The ecosite generally occurs on lower or level slopes adjacent to small streams, lakeshores, beaver meadows, ditches, and occasionally in isolated basins.

This ecosite is essentially a graminoid or forb-dominated community. Trees, if present, would likely be white cedar (*Thuja occidentalis*) with a low cover (≤10%). Standing dead trees may also be present. Shrub species, generally covering ≤25%, can include willows (*Salix* sp.), speckled alder (*Alnus incana*) and sweet gale (*Myrica gale*). Herbaceous species usually cover more than 50% of the ecosite and can include Canada blue joint (*Calamagrostis canadensis*), marsh cinquefoil (*Comarum palustre*), broad-leaf cattail (*Typha latifolia*), and sedges such as *Carex rostrata, C. utriculata, C. lasiocarpa, C.*

lacustris, and C. aquatilis. Bryophytes are usually restricted to the edges of tussocks.

Ecosite B146: Open Shore Fen

This ecosite develops where substrates are permanently saturated. The moisture regime is hydric (9) and the nutrient regime is moderate. The ecosite is usually located in sheltered riparian areas along the edges of peatland or uplands, and is associated with ponds, lakes, streams, and meadow marshes. It usually forms a narrow band adjacent to open water or within a wetland complex and consists of peat held together by roots, suspended over water or loose peat that is commonly composed of sedges. This ecosite is not generally affected by fluctuating water levels.

This ecosite is dominated by a mix of water tolerant graminoids and herbs with scattered shrubs. Trees, if present, include stunted tamarack (*Larix laricina*) and black spruce (*Picea mariana*). Shrubs (>25% cover) include leatherleaf (*Chamaedaphne calyculata*), sweet gale (*Myrica gale*), speckled alder (*Alnus incana*) and dwarf birch (*Betula pumila*). Herbaceous plants may include marsh cinquefoil (*Comarum palustre*), slender sedge (*Carex lasiocarpa*), and beaked sedge (*Carex rostrata*), as well as buckbean (*Menyanthes trifoliata*) and cattail (*Typha latifolia*). Non-vascular plants are dominated by *Sphagnum* spp.

Ecosite B147: Shrub Shore Fen

This ecosite has a hydric moisture regime (9) and a moderate nutrient regime (from contact with lakes or streams). This ecosite is primarily composed of a floating mat of fibric to mesic peat, held together by roots that rises and falls according to water content.

The ecosite is generally found in sheltered riparian areas along the edges of peatlands or uplands, and is associated with ponds, lakes, streams and peatland basins affected by surface runoff. When underlying bedrock or substrate mineralogy is calcareous and the depth of the organic layer is not very deep, increased plant diversity and vigour may occur.

Trees, if present, include stunted tamarack (*Larix laricina*) and black spruce (*Picea mariana*). A low shrub community exists on a floating mat of *Sphagnum* or sedges. The shrub cover is usually greater than 25% and may be dominated by a single species or be variable in species. Shrubs include leatherleaf (*Chamaedaphne calyculata*), sweet gale (*Myrica gale*), speckled alder (*Alnus incana*), and dwarf birch *Betula pumila*). Herbaceous plants include marsh cinquefoil (*Comarum palustre*), slender sedge (*Carex lasiocarpa*), and beaked sedge (*Carex rostrata*), as well as horned bladderwort (*Utricularia cornuta*), and various cottongrass species (*Eriophorum* spp.). The non-vascular plant community is dominated by *Sphagnum* spp.

Lakes and Watercourses

Lake (LA)

A naturally occurring static body of water, greater than 2 m deep in some portion. The boundary for the lake is the natural high watermark.

Pond (PD)

A small body of water greater than 2 m deep, but not large enough to be classified as a lake (e.g., less than 50 ha).

Shallow Open Water (OW)

A wetland composed of permanent shallow open water and lacking extensive emergent plant cover. The water is less than 2m deep.

Watercourse (WC)

A river, stream, or creek that was sufficiently large to be mapped during ecosystem map development.

Bare Ground/Disturbed

Road (RZ)

An area cleared and compacted for the purpose of supporting vehicular traffic.

Roadside (RS)

Vegetated areas, usually consisting of low to moderately tall shrubby vegetation that is immediately adjacent roads.

Human Influence (HU)

Areas where evidence of human development or influence is apparent but which isn't defined by the other categories

Exposed Soil (ES)

Areas of recent disturbance or where vegetation cover is noticeably sparse but is not readily defined by other definitions.

Cultivated Field (CF)

Open, non-forested area that is or has been subject to human agricultural practices.

Ecosite B164: Rock Barren

The nutrient and moisture availability are variable and can result in a complex of very shallow and rock barren systems. This ecosite often occurs on lower, toe, or level slope positions. Higher plant diversity and abundance is likely where deeper mineral or organic materials accumulate. The ecosite is often present in openings within larger treed systems. Fire, drought, and scarce mineral and organic material help maintain this ecosite.

The ecosite is typically sparsely vegetated. The tree and/or shrub cover is often ≤10% and absolute vascular plant cover is ≤25%. Trees include jack pine (*Pinus banksiana*) and white birch (*Betula papyrifera*). Shrubs include bearberry (*Arctostaphylos uva-ursi*), low sweet blueberry (*Vaccinium angustifolium*), and common juniper (*Juniperus communis*). Herbaceous plants include three-tooth cinquefoil (*Sibbaldia tridentate*), common hair grass (*Deschampsia flexuosa*), and rusty cliff fern (*Woodsia ilvensis*). Lichens are a mix of fruticose, foliose, and crustose species. Lichen and bryophytes include reindeer lichen (*Cladina rangiferina*) and coral lichens.

APPENDIX E

BIRD INVENTORY RESULTS

Common Name	Scientific Name	Endangered Species Act, 2007 (ON)	Species At Risk Act (Can)
Birds			
Alder Flycatcher	*Empidonax alnorum*	Not at Risk	Not at Risk
American Bittern	*Botaurus lentiginosus*	Not at Risk	Not at Risk
American Black Duck	*Anas rubripes*	Not at Risk	Not at Risk
American Crow	*Corvus brachyrhynchos*	Not at Risk	Not at Risk
American Goldfinch	*Spinus tristis*	Not at Risk	Not at Risk
American Kestrel	*Falco sparverius*	Not at Risk	Not at Risk
American Redstart	*Setophaga ruticilla*	Not at Risk	Not at Risk
American Robin	*Turdus migratorius*	Not at Risk	Not at Risk
American Three-toed Woodpecker	*Picoides dorsalis*	Not at Risk	Not at Risk
American Woodcock	*Scolopax minor*	Not at Risk	Not at Risk
Bald Eagle	*Haliaeetus leucocephalus*	Not at Risk	Special Concern
Barred Owl	*Strix varia*	Not at Risk	Not at Risk
Bay-breasted Warbler	*Setophaga castanea*	Not at Risk	Not at Risk
Black and White Warbler	*Mniotilta varia*	Not at Risk	Not at Risk
Black -throated Green Warbler	*Setophaga virens*	Not at Risk	Not at Risk
Black-backed Woodpecker	*Picoides arcticus*	Not at Risk	Not at Risk
Blackburnian Warbler	*Setophaga fusca*	Not at Risk	Not at Risk
Black-capped Chickadee	*Poecile atricapillus*	Not at Risk	Not at Risk
Black-throated Blue Warbler	*Setophaga caerulescens*	Not at Risk	Not at Risk
Black-throated Green Warbler	*Setophaga virens*	Not at Risk	Not at Risk
Blue Jay	*Cyanocitta cristata*	Not at Risk	Not at Risk
Blue-headed Vireo	*Vireo solitarius*	Not at Risk	Not at Risk
Boreal Chickadee	*Poecile hudsonicus*	Not at Risk	Not at Risk
Boreal Woodpecker	*Poecile hudsonicus*	Not at Risk	Not at Risk
Broad-winged Hawk	*Buteo platypterus*	Not at Risk	Not at Risk
Brown Creeper	*Certhia americana*	Not at Risk	Not at Risk
Canada Goose	*Branta canadensis*	Not at Risk	Not at Risk
Canada Warbler	*Cardellina canadensis*	Threatened	Special Concern
Cape May Warbler	*Setophaga tigrina*	Not at Risk	Not at Risk
Cedar Waxwing	*Bombycilla cedrorum*	Not at Risk	Not at Risk
Chestnut-sided Warbler	*Setophaga pensylvanica*	Not at Risk	Not at Risk
Chimney Swift	*Chaetura pelagica*	Threatened	Threatened
Chipping Sparrow	*Spizella passerina*	Not at Risk	Not at Risk
Common Goldeneye	*Bucephala clangula*	Not at Risk	Not at Risk
Common Grackle	*Quiscalus quiscula*	Not at Risk	Not at Risk
Common Loon	*Gavia immer*	Not at Risk	Not at Risk
Common Merganser	*Mergus merganser*	Not at Risk	Not at Risk
Common Nighthawk	*Chordeiles minor*	Threatened	Special Concern
Common Raven	*Corvus corax*	Not at Risk	Not at Risk
Common Yellowthroated	*Geothlypis trichas*	Not at Risk	Not at Risk
Dark-eyed Junco	*Junco hyemalis*	Not at Risk	Not at Risk
Downy Woodpecker	*Picoides pubescens*	Not at Risk	Not at Risk
Eastern Wood Pewee	*Contopus virens*	Special Concern	Not at Risk

Common Name	Scientific Name	Endangered Species Act, 2007 (ON)	Species At Risk Act (Can)
Golden-crowned Kinglet	*Regulus satrapa*	Not at Risk	Not at Risk
Gray Catbird	*Dumetella carolinensis*	Not at Risk	Not at Risk
Gray Jay	*Perisoreus canadensis*	Not at Risk	Not at Risk
Great Blue Heron	*Ardea herodias*	Not at Risk	Not at Risk
Great Horned Owl	*Bubo virginianus*	Not at Risk	Not at Risk
Green-winged Teal	*Anas crecca*	Not at Risk	Not at Risk
Hairy Woodpecker	*Picoides villosus*	Not at Risk	Not at Risk
Hermit Thrush	*Catharus guttatus*	Not at Risk	Not at Risk
Herring Gull	*Larus argentatus*	Not at Risk	Not at Risk
Hooded Merganser	*Lophodytes cucullatus*	Not at Risk	Not at Risk
Kentucky Warbler	*Geothlypis formosa*	Not at Risk	Not at Risk
Killdeer	*Charadrius vociferus*	Not at Risk	Not at Risk
Least Flycatcher	*Empidonax minimus*	Not at Risk	Not at Risk
Lincoln's Sparrow	*Melospiza lincolnii*	Not at Risk	Not at Risk
Mallard	*Anas platyrhynchos*	Not at Risk	Not at Risk
Mangolia Warbler	*Setophaga magnolia*	Not at Risk	Not at Risk
Merlin	*Falco columbarius*	Not at Risk	Not at Risk
Mourning Warbler	*Geothlypis philadelphia*	Not at Risk	Not at Risk
Nashville Warbler	*Oreothypis ruficapila*	Not at Risk	Not at Risk
Northern Flicker	*Colaptes auratus*	Not at Risk	Not at Risk
Northern Parula	*Setophaga americana*	Not at Risk	Not at Risk
Northern Saw-whet Owl	*Aegolius acadicus*	Not at Risk	Not at Risk
Northern Shoveller	*Anas clypeata*	Not at Risk	Not at Risk
Northern Waterthrush	*Parkesia noveboracensis*	Not at Risk	Not at Risk
Olive-sided Flycatcher	*Contopus cooperi*	Threatened	Special Concern
Ovenbird	*Seiurus aurocapilla*	Not at Risk	Not at Risk
Palm Warbler	*Setophaga palmarum*	Not at Risk	Not at Risk
Philadelphia Vireo	*Vireo philadelphicus*	Not at Risk	Not at Risk
Pied-billed Grebe	*Podilymbus podiceps*	Not at Risk	Not at Risk
Pileated Woodpecker	*Dryocopus pileatus*	Not at Risk	Not at Risk
Pine Siskin	*Spinus pinus*	Not at Risk	Not at Risk
Purple Finch	*Haemorhous purpureus*	Not at Risk	Not at Risk
Red-breasted Merganser	*Mergus serrator*	Not at Risk	Not at Risk
Red-breasted Nuthatch	*Sitta canadensis*	Not at Risk	Not at Risk
Red-eyed Vireo	*Vireo olivaceus*	Not at Risk	Not at Risk
Red-tailed Hawk	*Buteo jamaicensis*	Not at Risk	Not at Risk
Red-winged Blackbird	*Agelaius phoeniceus*	Not at Risk	Not at Risk
Ring Neck Duck	*Aythya collaris*	Not at Risk	Not at Risk
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	Not at Risk	Not at Risk
Ruby-crowned Kinglet	*Regulus calendula*	Not at Risk	Not at Risk
Ruffed Grouse	*Bonasa umbellus*	Not at Risk	Not at Risk
Sandhill Crane	*Grus canadensis*	Not at Risk	Not at Risk
Scarlet Tanager	*Piranga olivacea*	Not at Risk	Not at Risk
Sharp-Shinned Hawk	*Accipiter striatus*	Not at Risk	Not at Risk

Common Name	Scientific Name	Endangered Species Act, 2007 (ON)	Species At Risk Act (Can)
Song Sparrow	*Melospiza melodia*	Not at Risk	Not at Risk
Spruce Grouse	*Falcipennis canadensis*	Not at Risk	Not at Risk
Swainson's Thrush	*Catharus ustulatus*	Not at Risk	Not at Risk
Swamp Sparrow	*Melospiza georgiana*	Not at Risk	Not at Risk
Tennesse Warbler	*Oreothypis peregrina*	Not at Risk	Not at Risk
Tree Swallow	*Tachycineta bicolor*	Not at Risk	Not at Risk
Turkey Vulture	*Cathartes aura*	Not at Risk	Not at Risk
Unidentified Hawk	-	-	-
Veery	*Catharus fuscescens*	Not at Risk	Not at Risk
Vireo Species	-	-	-
Warbler Species	-	-	-
Warbling Vireo	*Vireo gilvus*	Not at Risk	Not at Risk
Whip Poor Will	*Antrostomus vociferus*	Threatened	Threatened
White Breasted Nuthatch	*Sitta carolinensis*	Not at Risk	Not at Risk
White-throated Sparrow	*Zonotrichia albicollis*	Not at Risk	Not at Risk
White-winged Crossbill	*Loxia leucoptera*	Not at Risk	Not at Risk
Wilson's Snipe	*Gallinago delicata*	Not at Risk	Not at Risk
Winter Wren	*Troglodytes hiemalis*	Not at Risk	Not at Risk
Woodpecker species	-	-	-
Yellow Warbler	*Setophaga petechia*	Not at Risk	Not at Risk
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Not at Risk	Not at Risk
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Not at Risk	Not at Risk
Yellow-rumped Warbler	*Setophaga coronata*	Not at Risk	Not at Risk
Amphibians			
American Toad	*Anaxyrus americanus*	Not at Risk	Not at Risk
Boreal Chorus Frog	*Pseudacris maculata*	Threatened	Not at Risk
Eastern Garter Snake	*Thamnophis sirtalis*	Not at Risk	Not at Risk
Eastern Newt	*Notophthalmus viridescens*	Not at Risk	Not at Risk
Gray Tree Frog	*Hyla versicolor*	Not at Risk	Not at Risk
Green Frog	*Rana clamitans*	Not at Risk	Not at Risk
Pickerel Frog	*Rana palustris*	Not at Risk	Not at Risk
Spring Peeper	*Pseudacris crucifer*	Not at Risk	Not at Risk
Wood Frog	*Lithobates sylvaticus*	Not at Risk	Not at Risk
Mammals			
American Beaver	*Castor canadensis*	Not at Risk	Not at Risk
Black Bear	*Ursus americanus*	Not at Risk	Not at Risk
Grey Wolf	*Canis lupus*	Not at Risk	Not at Risk
Little Brown Bat	*Myotis lucifugus*	Endangered	Endangered
Lynx	*Lynx canadensis*	Not at Risk	Not at Risk
Marten	*Martes americana*	Not at Risk	Not at Risk
Moose	*Alces alces*	Not at Risk	Not at Risk
Northern Long-eared Bat	*Myotis septentrionalis*	Endangered	Endangered
Red Fox	*Vulpes vulpes*	Not at Risk	Not at Risk
Red Squirrel	*Tamiasciurus hudsonicus*	Not at Risk	Not at Risk

Common Name	Scientific Name	Endangered Species Act, 2007 (ON)	Species At Risk Act (Can)
Snowshoe Hare	*Lepus americanus*	Not at Risk	Not at Risk
Star-nosed Mole	*Condylura cristata*	Not at Risk	Not at Risk

Total bird occurences by plot in Herman-Otto watershed.

Common Name	Whip Poor Will	Common Nighthawk	Bald Eagle	American Woodcock	Wilson's Snipe	Veery	Ovenbird	American Robin	Chestnut-sided Warbler	White-throated Sparrow	Ruffed Grouse	Alder Flycatcher	Black-capped Chickadee	Common Loon	Dark-eyed Junco	Yellow-bellied Sapsucker	Bay-breasted Warbler	Cedar Waxwing	Yellow-rumped Warbler
Scientific Name	*Antrostomus vociferus*	*Chordeiles minor*	*Haliaeetus leucocephalus*	*Scolopax minor*	*Gallinago delicata*	*Catharus fuscescens*	*Seiurus aurocapilla*	*Turdus migratorius*	*Setophaga pensylvanica*	*Zonotrichia albicollis*	*Bonasa umbellus*	*Empidonax alnorum*	*Poecile atricapillus*	*Gavia immer*	*Junco hyemalis*	*Sphyrapicus varius*	*Setophaga castanea*	*Bombycilla cedrorum*	*Setophaga coronata*
Bird Plot																			
B20	0	0	0	0	0	3	1	2	2	0	0	0	1	0	0	0	0	0	2
B21	0	0	0	0	0	1	4	0	0	0	0	0	1	0	0	0	0	0	0
B22	1	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0
B23	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0
B31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B32	0	1	0	0	0	4	0	0	3	1	0	0	3	0	0	0	0	0	0
B33	0	0	0	0	0	0	3	4	3	2	1	0	0	0	0	0	0	0	4
B34	0	0	0	0	0	0	4	1	0	0	0	0	1	0	0	0	0	0	0
B35	0	0	0	0	0	1	3	1	1	3	0	0	1	0	0	0	0	0	2
B36	0	0	0	0	0	3	2	0	1	1	1	0	0	0	0	0	0	0	0
B37	0	0	0	0	0	2	1	1	2	0	0	0	1	0	1	0	0	0	1
B38	0	0	0	1	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0
B39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B40	1	0	0	0	0	1	2	0	2	1	0	0	0	0	0	0	0	0	2
B41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B43	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0
B44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B48	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
B49	0	1	1	0	0	1	1	0	1	0	0	0	1	0	0	0	0	0	0
BCA	0	0	0	0	0	1	1	1	3	2	1	0	1	1	0	0	0	0	0
BAB	0	0	0	0	0	1	1	1	2	1	0	2	3	1	1	1	1	24	0
B31-3	0	0	0	0	0	1	2	1	1	2	0	0	0	0	0	0	0	0	2
BDA	0	0	0	0	2	3	4	0	3	1	0	1	0	0	0	0	0	1	0
BDB	0	0	0	0	0	1	2	0	1	2	2	0	1	0	1	1	0	0	0
BDC	0	0	0	0	0	2	1	1	3	2	0	0	0	1	0	0	0	0	1
BDD	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0
B2-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-8	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-9	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
B2-10	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	2	0
B2-11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-12	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0
B2-13	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
B2-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-15	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0
B2-16	0	0	0	0	0	2	2	0	1	0	0	0	1	0	0	0	0	1	0
BSG19-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BSG18-02	0	1	0	0	0	1	1	0	0	0	0	0	0	2	0	0	0	0	0
BSG18-03	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BSG18-04	0	0	0	0	0	1	1	0	1	0	0	0	0	2	0	0	0	0	0
BSG18-05	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
BSG18-01	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
MBSG18-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MBSG18-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MBSG18-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2	4	2	1	2	38	49	14	38	20	5	3	15	8	3	2	1	28	14

Common Name	Black-throated Green Warbler	Nashville Warbler	Woodpecker species	Black-and-White Warbler	Blue Jay	White Breasted Nutchatch	Northern Parula	Golden-crowned Kinglet	Hermit Thrush	Red-eyed Vireo	Gray Catbird	American Redstart	Common Raven	Warbling Vireo	Ruby-crowned Kinglet	Yellow Warbler	Black-throated Blue Warbler	Downy Woodpecker	Rose-breasted Grosbeak	Hairy Woodpecker
Scientific Name	*Setophaga virens*	*Oreothlypis ruficapilla*	NA	*Mniotilta varia*	*Cyanocitta cristata*	*Sitta carolinensis*	*Setophaga americana*	*Regulus satrapa*	*Catharus guttatus*	*Vireo olivaceus*	*Dumetella carolinensis*	*Setophaga ruticilla*	*Corvus corax*	*Vireo gilvus*	*Regulus calendula*	*Setophaga petechia*	*Setophaga caerulescens*	*Picoides pubescens*	*Pheucticus ludovicianus*	*Picoides villosus*
Bird Plot																				
B20	3	0	0	1	1	0	0	0	2	1	1	2	1	0	0	0	0	0	0	0
B21	1	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	1	0	0	0
B22	3	0	0	0	0	1	0	2	0	1	0	0	0	0	0	0	0	1	1	0
B23	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
B31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B32	1	0	0	0	0	0	0	4	4	0	0	3	0	1	0	0	0	0	0	0
B33	0	0	0	3	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0
B34	2	0	0	0	0	1	0	1	1	2	0	0	0	0	1	0	3	0	0	0
B35	1	0	0	1	0	0	0	2	0	2	0	2	0	1	0	1	0	0	0	0
B36	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	1	1	0	0	1
B37	0	0	1	2	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0
B38	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
B39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B40	0	0	1	2	1	2	1	1	0	1	0	0	0	0	0	0	0	0	0	0
B41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B43	0	0	0	0	0	1	0	0	3	0	0	0	1	0	1	0	0	0	0	0
B44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B48	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B49	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
BCA	0	0	0	1	0	1	0	0	1	1	0	0	0	0	1	0	0	1	0	0
BAB	1	0	0	0	0	1	0	0	0	1	0	1	1	0	1	2	0	1	0	0
B31-3	0	1	0	0	0	4	2	0	3	3	0	1	1	0	0	0	2	0	0	0
BDA	0	0	0	0	0	1	0	0	2	2	0	1	1	0	0	0	0	0	0	0
BDB	1	1	0	0	1	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0
BDC	1	2	0	0	0	0	2	1	1	0	0	1	0	1	0	0	0	0	0	0
BDD	0	1	0	0	0	0	0	2	1	1	0	1	0	0	0	0	1	0	0	0
B2-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-8	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0
B2-9	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-10	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
B2-11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-13	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
B2-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-15	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-16	0	1	0	0	0	2	0	0	0	1	0	0	4	0	1	0	1	0	0	0
BSG19-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BSG18-02	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
BSG18-03	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0
BSG18-04	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BSG18-05	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
BSG18-01	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MBSG18-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MBSG18-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MBSG18-03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	15	9	2	14	4	18	9	15	25	26	1	14	10	3	5	6	11	3	2	1

Common Name	Least Flycatcher	Tennesse Warbler	Pileated Woodpecker	Northern Flicker	American Crow	Swainson's Thrush	Kentucky Warbler	Winter Wren	Scarlet Tanager	Song Sparrow	American Goldfinch	Magnolia Warbler	Philadelphia Vireo	Common Grackle	Red-winged Blackbird	Eastern Wood Pewee	Herring Gull	
Scientific Name	*Empidonax minimus*	*Oreothlypis peregrina*	*Dryocopus pileatus*	*Colaptes auratus*	*Corvus brachyrhynchos*	*Catharus ustulatus*	*Geothlypis formosa*	*Troglodytes hiemalis*	*Piranga olivacea*	*Melospiza melodia*	*Spinus tristis*	*Setophaga magnolia*	*Vireo philadelphicus*	*Quiscalus quiscula*	*Agelaius phoeniceus*	*Contopus virens*	*Larus argentatus*	TOTAL
Bird Plot																		
B20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24
B21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
B22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
B23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
B31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B32	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	30
B33	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	31
B34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17
B35	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	27
B36	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
B37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
B38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
B39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19
B41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B43	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13
B44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B48	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3
B49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
BCA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
BAB	1	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	63
B31-3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	1	0	34
BDA	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BDB	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	21
BDC	2	2	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	28
BDD	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	11
B2-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-8	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	5
B2-9	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	5
B2-10	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
B2-11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
B2-13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
B2-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-15	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	6
B2-16	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	18
BSG19-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BSG18-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
BSG18-03	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4
BSG18-04	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	8
BSG18-05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
BSG18-01	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4
MBSG18-02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
MBSG18-01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
MBSG18-03	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2
TOTAL	7	3	2	1	1	3	2	1	1	2	1	6	1	3	3	1	1	

Total bird occurences by plot in Webb-Goudreau watershed.

Common Name	Scientific Name	B02	BAA	BC	B30-2	B30-3	B31-1	B2-3	B2-6	TOTAL
Common Nighthawk	*Chordeiles minor*	1	0	0	0	0	0	0	0	1
Olive-sided Flycatcher	*Contopus cooperi*	1	0	0	0	0	0	0	0	1
Chimney Swift	*Chaetura pelagica*	1	0	0	0	0	0	0	0	1
Bald Eagle	*Haliaeetus leucocephalus*	1	0	0	0	0	0	0	0	1
Veery	*Catharus fuscescens*	2	1	0	5	0	1	0	0	9
Ovenbird	*Seiurus aurocapilla*	0	2	0	1	0	0	0	2	5
American Robin	*Turdus migratorius*	2	1	0	1	2	0	0	0	6
Chestnut-sided Warbler	*Setophaga pensylvanica*	3	0	2	3	3	0	0	0	11
White-throated Sparrow	*Zonotrichia albicollis*	1	2	1	4	4	4	0	3	19
Ruffed Grouse	*Bonasa umbellus*	0	0	0	1	1	0	0	0	2
Alder Flycatcher	*Empidonax alnorum*	0	0	0	2	0	0	0	0	2
Black-capped Chickadee	*Poecile atricapillus*	0	0	0	0	0	1	0	0	1
Common Loon	*Gavia immer*	0	0	2	0	0	0	0	1	3
Dark-eyed Junco	*Junco hyemalis*	1	0	0	0	0	0	0	0	1
Cedar Waxwing	*Bombycilla cedrorum*	3	0	1	0	0	0	0	0	4
Yellow-rumped Warbler	*Setophaga coronata*	0	1	0	0	2	2	0	1	6
Black-throated Green Warbler	*Setophaga virens*	1	2	0	0	0	0	0	0	3
Nashville Warbler	*Oreothlypis ruficapilla*	0	1	0	0	0	4	0	0	5

Common Name	Scientific Name	B02	BAA	BC	B30-2	B30-3	B31-1	B2-3	B2-6	TOTAL
Black-and-White Warbler	*Mniotilta varia*	0	0	2	2	1	1	0	0	6
Blue Jay	*Cyanocitta cristata*	0	0	0	0	1	0	0	0	1
White Breasted Nutchatch	*Sitta carolinensis*	0	1	0	0	0	0	0	0	1
Northern Parula	*Setophaga americana*	0	1	0	0	0	0	0	0	1
Golden-crowned Kinglet	*Regulus satrapa*	0	0	0	0	0	1	0	0	1
Hermit Thrush	*Catharus guttatus*	0	0	0	1	2	2	0	0	5
Red-eyed Vireo	*Vireo olivaceus*	0	3	1	1	1	2	0	2	10
Black-and-White Warbler	*Mniotilta varia*	0	0	0	1	1	0	0	0	2
American Redstart	*Setophaga ruticilla*	0	1	2	0	4	1	0	3	11
Common Raven	*Corvus corax*	0	0	0	0	0	1	0	0	1
Ruby-crowned Kinglet	*Regulus calendula*	0	0	0	0	2	1	0	1	4
Yellow Warbler	*Setophaga petechia*	0	0	0	1	0	0	0	0	1
Least Flycatcher	*Empidonax minimus*	0	0	0	0	0	2	0	0	2
Pileated Woodpecker	*Dryocopus pileatus*	1	0	0	0	0	0	0	0	1
Northern Flicker	*Colaptes auratus*	0	0	0	1	0	0	0	0	1
Mallard	*Anas platyrhynchos*	0	0	0	0	0	0	0	1	1
American Crow	*Corvus brachyrhynchos*	0	0	0	1	0	0	0	0	1
Common Yellowthroat	*Geothlypis trichas*	0	0	0	0	0	1	0	0	1
Kentucky Warbler	*Geothlypis formosa*	0	0	0	0	0	1	0	0	1
Common Grackle	*Quiscalus quiscula*	0	0	0	0	0	1	0	0	1
TOTAL		20	16	11	27	30	29	0	15	19

Total bird occurences by plot in Spring-Lovell watershed.

Common Name	Whip Poor Will	Common Nighthawk	American Woodcock	Wilson's Snipe	Veery	Ovenbird	American Robin	Chestnut-sided Warbler	White-throated Sparrow	Ruffed Grouse	Alder Flycatcher	Black-capped Chickadee	Common Loon	Dark-eyed Junco	Yellow-bellied Sapsucker
Scientific Name	*Antrostomus vociferus*	*Chordeiles minor*	*Scolopax minor*	*Gallinago delicata*	*Catharus fuscescens*	*Seiurus aurocapilla*	*Turdus migratorius*	*Setophaga pensylvanica*	*Zonotrichia albicollis*	*Bonasa umbellus*	*Empidonax alnorum*	*Poecile atricapillus*	*Gavia immer*	*Junco hyemalis*	*Sphyrapicus varius*
Bird Plot															
B01	0	0	1	0	1	0	0	1	3	0	0	1	0	0	0
B03	0	0	0	0	0	0	0	1	2	0	0	0	0	1	0
B04	0	1	0	0	0	1	1	3	1	0	2	0	0	0	0
B05	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
B06	0	0	0	1	0	0	2	0	5	0	0	2	0	1	0
B07	0	0	0	0	0	0	0	2	3	0	1	1	0	0	0
B08	0	0	0	0	3	3	1	1	0	0	0	0	1	0	0
B09	2	0	0	0	0	0	2	3	2	1	0	0	0	0	0
B10	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1
B11	0	0	1	1	0	0	0	0	1	0	0	0	1	0	0
B12	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0
B13	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0
B14	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0
B15	0	0	0	0	0	2	1	0	2	0	0	0	0	0	0
B16	0	0	0	0	0	2	0	0	0	0	0	1	0	0	1
B17	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0
B18	0	0	0	0	1	0	0	5	2	1	0	0	0	0	0
B19	0	1	0	0	2	4	0	3	0	1	0	0	0	0	1
B24	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
B25	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0
B26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B27	1	0	0	0	2	1	0	4	2	0	0	1	0	0	0
B28	0	0	0	1	1	0	0	3	1	0	0	1	0	0	0
B29	0	0	0	2	0	1	0	1	0	0	0	0	1	0	0
B30	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
B57	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1
B58	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
B58 (north)	0	0	1	2	0	1	0	4	5	0	2	0	0	0	0
BD	0	5	0	2	0	1	0	1	1	0	0	0	0	0	0
BCB	0	0	0	0	0	1	0	1	2	0	0	0	0	0	0
BB	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
B30-1	0	0	0	0	0	6	0	1	2	0	0	1	0	0	0
B2-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BSG17-1	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0
MBSG17-3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
MBSG17-1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
MBSG17-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B31-4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3	9	4	10	11	28	8	42	41	5	6	9	5	2	4

Common Name	Cedar Waxwing	Yellow-rumped Warbler	Black-throated Green Warbler	Nashville Warbler	Black-and-White Warbler	Blue Jay	White Breasted Nutchatch	Northern Parula	Golden-crowned Kinglet	Hermit Thrush	Red-eyed Vireo	American Redstart	Common Raven	Warbling Vireo	Ruby-crowned Kinglet	Black-throated Blue Warbler
Scientific Name	*Bombycilla cedrorum*	*Setophaga coronata*	*Setophaga virens*	*Oreothlypis ruficapilla*	*Mniotilta varia*	*Cyanocitta cristata*	*Sitta carolinensis*	*Setophaga americana*	*Regulus satrapa*	*Catharus guttatus*	*Vireo olivaceus*	*Setophaga ruticilla*	*Corvus corax*	*Vireo gilvus*	*Regulus calendula*	*Setophaga caerulescens*
Bird Plot																
B01	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
B03	0	0	0	0	0	0	0	0	1	0	2	1	0	0	0	0
B04	6	0	0	0	1	0	1	0	0	2	1	2	0	0	0	0
B05	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0	0
B06	0	0	0	0	1	0	0	0	0	0	1	0	0	1	2	0
B07	0	3	0	0	0	0	0	0	0	1	1	2	1	0	0	0
B08	0	0	2	0	0	1	1	1	1	2	2	2	0	0	0	1
B09	0	0	0	0	1	0	1	0	0	0	3	2	1	0	0	0
B10	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
B11	0	1	0	0	0	1	0	2	0	1	0	0	0	0	0	0
B12	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
B13	0	1	0	0	0	0	0	0	0	0	1	2	0	1	0	0
B14	0	0	4	0	1	1	0	1	0	2	1	0	0	0	0	5
B15	0	0	3	0	0	0	0	0	2	0	3	0	0	0	0	4
B16	0	0	1	0	1	0	0	1	0	0	2	0	0	0	0	0
B17	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0	0
B18	0	0	0	1	1	0	0	0	1	1	0	2	0	0	0	0
B19	0	1	3	0	0	0	2	0	0	0	2	0	0	0	0	0
B24	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
B25	0	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0
B26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B27	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0
B28	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0
B29	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
B30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B57	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0
B58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
B58 (north)	0	3	1	1	0	0	0	0	0	1	1	1	0	0	0	0
BD	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
BCB	0	1	1	0	2	0	1	0	0	1	0	0	0	0	0	0
BB	0	0	1	0	0	0	0	1	0	0	1	1	0	0	0	0
B30-1	0	2	0	2	0	0	0	0	3	0	1	1	2	0	2	0
B2-2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
B2-4	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BSG17-1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
MBSG17-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MBSG17-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MBSG17-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B31-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	16	14	21	4	9	4	8	7	8	16	28	20	6	4	5	10

Common Name	Downy Woodpecker	Least Flycatcher	Tennesse Warbler	Boreal Chickadee	Pileated Woodpecker	American Three-toed Woodpecker	Blue-headed Vireo	Canada Goose	Northern Flicker	Brown Creeper	White-crowned Sparrow	Sandhill Crane	American Black Duck	Mallard
Scientific Name	*Picoides pubescens*	*Empidonax minimus*	*Oreothlypis peregrina*	*Poecile hudsonicus*	*Dryocopus pileatus*	*Picoides dorsalis*	*Vireo solitarius*	*Branta canadensis*	*Colaptes auratus*	*Certhia americana*	*Zonotrichia leucophrys*	*Grus canadensis*	*Anas rubripes*	*Anas platyrhynchos*
Bird Plot														
B01	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B03	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B04	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B06	0	0	0	2	1	0	0	1	1	1	1	0	0	0
B07	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B08	0	0	1	0	0	0	0	0	0	0	0	0	0	0
B09	0	0	0	0	0	0	0	32	0	0	0	5	2	1
B10	1	0	0	0	1	0	0	0	0	0	0	0	0	0
B11	0	0	0	0	0	1	0	0	1	0	0	0	0	0
B12	0	0	0	0	0	0	1	0	0	0	0	0	0	0
B13	0	1	1	0	0	0	0	0	0	0	0	0	0	0
B14	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B16	0	1	1	0	0	0	0	0	0	0	0	0	0	0
B17	0	0	0	1	0	0	0	0	0	0	0	0	0	0
B18	0	2	0	0	1	0	0	0	0	0	0	0	0	0
B19	0	2	0	0	0	0	0	0	0	0	0	0	0	0
B24	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B26	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B27	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B28	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B29	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B57	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B58	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B58 (north)	0	1	0	0	0	0	0	0	0	0	0	0	0	0
BD	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BCB	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BB	0	0	1	0	0	0	0	0	0	0	0	0	0	0
B30-1	0	0	0	0	0	2	0	0	0	0	0	0	0	0
B2-2	0	0	0	0	0	0	0	0	0	0	0	0	4	0
B2-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B2-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BSG17-1	0	0	1	0	1	0	0	0	0	0	0	0	0	0
MBSG17-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MBSG17-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MBSG17-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B31-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1	7	5	3	4	3	1	33	2	1	1	5	6	1

Common Name	American Crow	Killdeer	Swainson's Thrush	Kentucky Warbler	Winter Wren	Song Sparrow	Magnolia Warbler	Philadelphia Vireo	Chipping Sparrow	Swamp Sparrow	Red-winged Blackbird	Red-breasted Nuthatch	Common Goldeneye	
Scientific Name	*Corvus brachyrhynchos*	*Charadrius vociferus*	*Catharus ustulatus*	*Geothlypis formosa*	*Troglodytes hiemalis*	*Melospiza melodia*	*Setophaga magnolia*	*Vireo philadelphicus*	*Spizella passerina*	*Melospiza georgiana*	*Agelaius phoeniceus*	*Sitta canadensis*	*Bucephala clangula*	TOTAL
Bird Plot														
B01	2	0	0	0	0	0	0	0	0	0	0	0	0	14
B03	0	0	0	0	0	0	0	0	0	0	0	0	0	8
B04	0	1	0	0	0	0	0	0	2	1	1	0	0	31
B05	0	0	0	0	0	0	0	0	0	0	0	0	0	6
B06	0	0	0	0	0	0	0	0	2	0	0	0	0	27
B07	0	0	0	0	0	0	0	0	0	0	0	0	0	16
B08	0	0	0	0	0	0	0	0	0	0	0	0	0	26
B09	1	1	0	0	0	0	0	0	0	0	0	0	0	67
B10	0	0	0	0	0	0	0	0	0	0	0	0	0	8
B11	0	0	0	0	0	0	0	0	0	0	0	1	0	13
B12	0	0	0	0	0	0	0	0	0	0	0	0	0	7
B13	0	0	0	0	0	0	0	0	0	0	0	0	0	10
B14	0	0	0	0	1	0	0	0	0	0	0	0	0	22
B15	0	0	0	0	0	0	1	0	0	0	0	0	0	23
B16	0	0	0	0	0	0	0	0	0	0	0	0	0	12
B17	0	0	0	0	0	0	0	0	0	0	0	0	0	12
B18	0	0	0	0	0	0	0	0	0	0	0	0	0	20
B19	0	0	0	0	0	0	0	0	0	0	0	0	0	22
B24	0	0	0	0	0	0	0	1	0	0	0	0	0	10
B25	0	0	0	0	0	0	0	0	0	0	0	0	0	12
B26	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B27	0	0	0	0	0	0	0	0	0	0	0	0	0	17
B28	0	0	0	0	0	0	0	0	0	0	0	0	0	13
B29	0	0	0	0	0	0	0	0	0	0	0	0	0	6
B30	0	0	0	0	0	0	0	0	0	0	0	0	0	3
B57	0	0	0	0	0	0	0	0	0	0	0	0	0	11
B58	0	0	0	0	0	2	0	0	0	0	0	0	0	4
B58 (north)	0	0	0	0	0	1	0	0	0	0	0	0	0	29
BD	0	0	0	0	0	0	0	0	0	0	0	0	0	12
BCB	0	0	0	0	0	0	0	0	0	0	0	0	0	10
BB	0	0	0	0	0	0	0	0	0	0	0	0	0	7
B30-1	0	0	0	1	0	0	0	0	0	0	0	0	0	26
B2-2	0	0	0	0	0	0	0	0	0	0	0	0	1	6
B2-4	0	0	0	0	0	0	0	0	0	0	0	0	0	9
B2-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BSG17-1	0	0	0	0	0	0	0	0	0	0	0	0	0	10
MBSG17-3	0	0	0	0	0	0	0	0	0	0	0	0	0	3
MBSG17-1	0	0	0	0	0	0	0	0	0	0	0	0	0	2
MBSG17-2	0	0	1	0	0	0	0	0	0	0	0	0	0	1
B31-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	3	2	1	1	1	3	1	1	4	1	1	1	1	

Waterfowl staging area survey results for all watersheds.

Subwatershed	Waterbody	Date of Survey 1	Date of Survey 2	Species	M or F	Number
Webb-Goudreau	Webb Lake	16-May-14		Common Loon	N/A	2
			17-May-14	Common Loon	N/A	1
Spring-Lovell	Lovell Lake	16-May-14		Common Loon	N/A	2
			17-May-14	Common Loon	N/a	1
Spring-Lovell	Tailings Pond	16-May-14		Common Goldeneye	M	2
					F	1
			17-May-14	Common Loon	N/A	2
				Common Goldeneye	M	1
					F	1
				Black Duck	?	2
				Sandhill Crane	?	3
Spring - Lovell	Polishing Pond	16-May-14		Ring Neck	M	10
					F	10
				Mallard	M	2
					F	2
				Sandhill Crane	?	1
			18-May-14	Hooded Merganser	M	1
Webb-Goudreau	Goudreau Lake	16-May-14		Common Loon	N/A	2
			18-May-14	Common Loon	N/A	1
Spring-Lovell	Pit Pond 1	17-May-14		Ring Neck	M	3
					F	3
			18-May-14	0		
Spring-Lovell	Pit Pond 2	17-May-14		Common Goldeney	M	1
					F	1
			18-May-14	0		
Spring-Lovell	Pit Pond 3	17-May-14		0		
			18-May-14	0		
Spring-Lovell	Pit Pond 4	18-May-14		0		
			19-May-14	0		
Spring-Lovell	Wetland 4	17-May-14		0		
			19-May-14	0		
Spring-Lovell	Wetland 5	17-May-14		Mallard	M	1

Subwatershed	Waterbody	Date of Survey 1	Date of Survey 2	Species	M or F	Number
			19-May-14	0		
Spring-Lovell	Spring Lake	17-May-14		Common Loon	N/A	2
			19-May-14	0		
Spring-Lovell	Wetland 3	17-May-14		Common Goldeneye	M	1
				Ring Neck Duck	M	1
				Hooded Merganser	F	1
			19-May-14	Ring Neck	M	2
					F	1
Herman-Otto	Wetland 6	17-May-14		Common Goldeney	M	1
				Ring Neck	M	1
					F	1
Herman-Otto	Wetland 10	17-May-14		Ring Neck	M	1
					F	1
			18-May-14	Northern Shoveller	M	2
Spring-Lovell	Wetland 2	18-May-14		0		
			19-May-14	0		
Spring-Lovell	Wetland 1	18-May-14		Common Loon	N/A	2
			19-May-14	Common Loon		2

APPENDIX F

AMPHIBIAN INVENTORY RESULTS

Survey #	Amphibian Plot	Spring Peeper	Boreal Chorus Frog	American Toad	Green Frog	Pickerel Frog	Gray Tree Frog
		Abundance Code					
1	A10						
	A13						
	A12	3					
	A11						
	A14						
	A15	3		1			
	AA2	3		2		1	
	AA3	3				2	
	AA4	3		1			
	AA7	3					
	AA11	3		2			
2	A10						
	A13	1			1		
	A12	3					
	A11						
	A14						
	A15				1		
	AA2	2		1	1		
	AA3	2					1
	AA4	3		1			
	AA7				1		
	AA11			1			
3	A10						
	A11						
	A12						
	A13						
	A14						
	A16						
	AA2						
	AA3						
	AA4						
	AA7						
	AA11						

Survey #	Amphibian Plot	Spring Peeper	Boreal Chorus Frog	American Toad	Green Frog
		Abundance Code			
1	A03	3			
	A04				
	A05	3			
	A06	3	1		
	A07	3	1		
	A08				
	A09	3	2		
	A18	3	2	1	
	A19	3	1		
	A20	2		3	
	A21	3	1		
	AA1	3	1		
	AA4	3			
	AA5	3		1	
	AA6	2	1	2	
	A2-1				
	A2-3				
	A2-2				
	A3-1				
	ASG17-1				
2	A03	3			
	A04				
	A05	3			
	A06	1			
	A07	3	1		
	A08	2			1
	A09	1			
	A18	1			
	A19	1			1
	A20				
	A21				
	AA1	3	1		
	AA4				
	AA5	3		1	
	AA6	1		2	
	A2-1	2			1
	A2-3	2		2	2
	A2-2				
	A3-1	1			1
	ASG17-1	1			
	A03				
	A04				
	A05				1

Survey #	Amphibian Plot	Spring Peeper	Boreal Chorus Frog	American Toad	Green Frog
		Abundance Code			
3	A06				
	A07				
	A08				1
	A09				
	A18				1
	A19				1
	A20				
	A21				1
	AA1				
	AA4				
	AA5				
	AA6				
	A2-1				
	A2-3				1
	A2-2				
	A3-1				1
	ASG17-1				1

Survey #	Amphibian Plot	Spring Peeper	Boreal Chorus Frog	American Toad	Green Frog
		Abundance Code			
1	A01	3		2	2
	A02				
	A17	3		1	
	AA8	3		2	
2	A01				2
	A02	1			
	A17	1		2	2
	AA8				
3	A01				
	A02				1
	A17				1
	AA8				

APPENDIX G

BAT ACOUSTICAL MONITORING RESULTS

Bat Acoustical Monitoring Results, 2014

Date	**24 Hour Time** (inc. seconds)	**Species**	**Microphone** (0=internal, 1=external, 0+1 = both microphones)
5/18/2014	2:05:00	LBB/NLE	0+1
5/18/2014	2:23:51	NLE	0
5/18/2014	2:26:09	NLE	0+1
5/18/2014	2:26:39	NLE	0+1
5/18/2014	2:26:57	NLE	0
6/2/2014	0:37:03	LBB	0+1
6/2/2014	0:37:29	LBB	0+1
6/2/2014	1:04:00	LBB	0+1
6/2/2014	1:04:29	NLE	0+1
6/2/2014	1:34:11	LBB	0+1
6/2/2014	1:58:49	LBB	0+1
6/2/2014	2:10:38	LBB	0
6/2/2014	2:10:55	LBB	0
6/2/2014	2:11:15	LBB	0+1
6/2/2014	2:27:55	LBB	0+1
6/2/2014	3:06:16	LBB	0+1
6/2/2014	4:27:53	LBB	0+1
6/2/2014	4:28:09	LBB	0+1
6/2/2014	4:54:51	LBB	0
6/2/2014	4:55:12	LBB	0+1
6/2/2014	4:55:35	LBB	0
6/2/2014	4:55:56	LBB	0
6/2/2014	4:56:07	LBB	0+1
6/3/2014	0:02:36	NLE	0+1
6/3/2014	1:08:44	LBB/NLE	0
6/3/2014	1:09:05	NLE	0+1
6/3/2014	4:24:26	NLE	0+1
6/3/2014	4:24:48	NLE	0
6/3/2014	4:55:20	LBB	0+1
6/3/2014	4:55:41	NLE	0+1
6/4/2012	00:09:26	LBB	0+1
6/4/2012	01:06:25	NLE	0
6/4/2012	01:55:28	LBB	0+1
6/4/2012	01:57:53	LBB	0+1
6/4/2012	01:58:16	LBB	0+1
6/4/2012	01:58:34	LBB	0+1
6/4/2012	01:59:36	LBB/NLE	0+1
6/4/2012	02:11:24	LBB	0+1
6/4/2012	02:12:07	LBB	0+1
6/4/2012	02:22:27	LBB	0+1
6/4/2012	02:22:50	LBB	0+1
6/4/2012	04:32:40	LBB	0+1
6/5/2012	00:45:30	LBB	0+1
6/5/2012	02:35:05	LBB/NLE	0
6/5/2012	02:35:19	LBB	0+1

Date	**24 Hour Time** (inc. seconds)	**Species**	**Microphone** (0=internal, 1=external, 0+1 = both microphones)
6/5/2012	03:32:51	LBB	0+1
6/5/2012	03:33:09	LBB	0+1
6/5/2012	03:52:42	LBB	0+1
6/5/2012	04:11:31	LBB	0+1
6/5/2012	04:19:04	LBB	0
6/5/2012	22:37:34	NLE	0+1
6/5/2012	22:49:05	LBB	0+1
6/5/2012	23:07:18	LBB	0+1
6/5/2012	23:19:29	LBB/NLE	0+1
6/6/2012	00:15:55	LBB/NLE	0
6/6/2012	00:24:35	NLE	0
6/6/2012	01:06:35	LBB/NLE	0
6/6/2012	01:12:23	LBB	0+1
6/6/2012	01:12:36	LBB	0+1
6/6/2012	1:49:21	LBB	0+1
6/6/2012	1:59:42	NLE	0+1
6/6/2012	2:40:34	LBB/NLE	0+1
6/6/2012	02:40:46	NLE	0
6/6/2012	02:41:26	LBB/NLE	0+1
6/6/2012	03:13:29	LBB	0+1
6/6/2012	04:22:55	NLE	0+1

APPENDIX G

BAT ACOUSTICAL MONITORING RESULTS

Magino Gold Mine, Ontario, Canada

Bat survey results 2014- 2015

SLR USA/Argonaut Gold

SLR Ref: 4US.01184.00029
Version No:0
July 2015

CONTENTS

TABLES

FIGURES

1.0 INTRODUCTION

1.1 Background

SLR Consulting UK was commissioned by SLR Canada and SLR USA on behalf of Argonaut Gold to undertake bat monitoring of an adit of Magino Gold Mine, Ontario, Canada. Part of the application site is planned for blasting, but it contained a known hibernation roost for little brown bat *Myotis lucifugus* and/or northern long-eared bat *M. septentrionalis.*

1.2 Scope of Works

SLR Consulting UK was commissioned to advise on assessment of the affected mine section, and to suggest appropriate mitigation and enhancement measures if the current hibernation roost is lost. Under the Endangered Species Act 2007[1] the Magino Mine project will be required to demonstrate a net benefit to the resident bat species.

The objectives of the study were to:

1) Assess bat roost potential within the mine for local bat species, and count any bats or field signs seen;
2) Monitor bat activity within the vicinity of the mine adit from April to October 2014 and March to June 2015;
3) Identify bats flying into and out of the mine adit by using a two microphone set-up on a remote bat detector (see 2.2); and
4) Use this data to determine any patterns of use and roost types by bat species (including potential hibernation and summer roosting behaviour).

1.3 Site Description

The mine is located at Latitude 48.28082 N, Longitude -84.46341 W on the north shore of Webb Lake, Ontario. The south-facing adit is largely sealed at present by two large double-doors, and a further man-door (see Figure 1-1). There is an open peephole of *c.* 6 x 4", and a narrow crack between the doors. The interior has a dead-end tunnel sloping downward for *c.* 20m which is flooded at its base.

[1] www.ontario.ca/laws/statute/07e06

Figure 1-1
External doors to the Magino mine entrance.

2.0 METHODOLOGY

2.1 Mine inspection

The mine was inspected on 9 April 2014 by an experienced bat ecologist, accompanied by two ecologists from the Ministry of Natural Resources (MNR). Due to health and safety concerns relating to entry of a confined space the adit was only expected to within 2m of the adit doors and a gas meter was used in case any dangerous gas levels were present.

The area within 2 m of the adit doors was inspected for field evidence of roosting bats including droppings, urine staining, feeding remains, potential roosting/access points and individual bats. Where necessary, an endoscope was used to facilitate the inspection of crevices. Night vision binoculars were used to scan the walls and ceiling deeper in the mine adit for any visible bats or field signs.

Due to the biosecurity risk of transmitting white nose syndrome, all clothing and equipment was sprayed with detergent upon exiting the mine (MNR staff reported that this mine adit was already infected, evidenced by three infected northern long-eared carcases in March 2014).

2.2 Bat monitoring using remote detectors

The adit was initially monitored by MNR from 27 to 28 August with two EcoObs Batcorder bat recorders either side of the adit entrance (exact positions unknown).

On the 9 April SLR installed an SM3 remote bat detector (Wildlife Acoustics) at the adit entrance with two microphones: the first *c.* 3m inside the adit doors with a horn attachment to make reception uni-directional, directed down the tunnel (to target bats flying inside the adit; see Figure 2-1); the second an omnidirectional microphone on a lead *c.* 10m outside the entrance (to detect bats flying outside).

This SM3 unit was run continuously from 9 April to 24 October 2014.

In 2015 the SM3 was removed and mine staff replaced it with an SM2 bat detector (Wildlife Acoustics) with internal and external microphones in the same positions. However in contrast to the SM3 it should be noted that both SM2 microphones were omnidirectional; the internal microphone was not fitted with a horn attachment. This SM2 unit was run continuously from 19 March to 20 June 2015.

Figure 2-1
Unidirectional microphone inside adit door.

2.3 Analysis

EcoObs bat data from 27-28 August was analysed by both MNR and SLR. Bat files were analysed using Analook software (Corben 2014) from April to August 2014, and subsequently with Kaleidoscope Pro (Wildlife Acoustics) using filters for the following North American bat species with known distributions in northern Ontario:

- Little brown bat *Myotis lucifugus*;
- Northern long-eared bat *Myotis septentrionalis;*
- Big brown bat *Eptesicus fuscus*;
- Silver-haired bat *Lasionycteris noctivagans;*
- Hoary bat *Lasiurus cinereus;*
- Eastern red bat *Lasiurus borealis*

It should be noted that the analysis counted the number of registrations, recorded as separate sound files. Total registrations should be interpreted as an indication of relative activity rather than the number of individual bats. Data may be 'autocorrelated' in some periods – i.e. sound files only separated by short intervals could be the same bat.

Little brown and northern long-eared bat sonograms can be difficult to distinguish in some cases. Sonograms were classified as little brown bat where calls ranged from 40 – 85 kHz, and northern long-eared where frequency-modulated calls extended to an end frequency of 85 - 126 kHz. Where there was any doubt in manual identification between little brown and northern long-eared bat, the file was instead labelled to the genus *Myotis*. The distinctive higher frequency range of northern long-eared may attenuate at long distances from the microphone, and therefore it is possible that northern long-eared bat activity was slightly under-recorded and little brown bat correspondingly over-recorded for faint, distant calls. There were also a few low frequency calls which closely matched larger bat species such as big brown or silver long-haired bat, although some of these may also have been social calls by little brown or northern long-eared.

2.4 Limitations

The mine adit was assessed as a confined space, and therefore surveyors were only permitted to access the entrance within 3m of the doorway. All staff were trained in Confined Spaces Awareness and a gas meter was used throughout the survey.

3.0 RESULTS

Results are provided below in chronological order for the different work phases.

3.1 EcoObs monitoring 27-28 August 2013

Total call registrations are provided in Table 2-1. Initial analysis of the night of 27-28 August 2013 revealed bat activity by both little brown and northern long-eared bat (over 200 registrations of each species). It should be noted that many bats would have been recorded simultaneously on both recorders.

Table 3-1
Bat registrations by species recorded at Magino mine, Ontario, 27-28 August 2013 (n= 897)

Batcorder	Little Brown Bat	Northern Long-eared Bat	Big Brown/Silver-haired Bat
1	226	288	18
2	200	138	27

3.2 Mine inspection

The mine was *c.* 5 - 6m wide, and 2.5 - 3.5m high. The double portal doors opened to about 1.5m. Air quality was good. The floor was very wet, and included ice around the door and over a dozen ice stalagmites *c.* 2-15m into the adit where water had dripped in from the housing above (see Figure 3-1). Some of these were large, to *c.* 70cm in height. There was a lot of water seeping out of the rock and humidity was 100%. Flooding was observed about 20m from the adit door. The decline was inspected using intensifier/infra-red binoculars but no groups of little brown bats could be seen. There were a number of deep rock cracks and crevices within 4m of the doors however, which offered suitable crevices for northern long-eared bats.

Two adult northern long-eared bat carcases were found on the floor near the entrance to the mine, immediately underneath the walls (Figure 3-2). Both were encased in ice when found. Once freed, some white discolouration suggested infection with White Nose Syndrome (WNS) *Pseudogymnoascus destructans*. These were taken by MNR, and later laboratory post-mortems confirmed WNS infection.

Figure 3-1
View from adit door into mine shaft

Figure 3-2
Two northern long-eared bat carcases found inside the adit entrance

3.3 Bat monitoring in 2014 and 2015

The numbers of bat sound files recorded in 2014 and 2015 are provided in Tables 3-2 and 3-3.

Neither little brown, nor northern long-eared bat were recorded in April 2014, but as snow began to melt four northern long eared registrations were recorded on 18 May, the first of which was only recorded on the internal microphone indicating that one individual at least had awoken after hibernation.

The activity of northern long-eared and little brown bats increased from the summer to autumn in 2014, but remained low and often clustered. Activity was recorded on most nights in 2014, but on some nights only single or very few calls were recorded, and on a few nights no activity at all was recorded.

It is considered likely that the recordings probably represent only a few individuals of these species. On many nights either the first or last call was recorded on the internal microphone only, which indicates that one or a very few little brown bats, and one northern long-eared used the adit as an occasional summer roost. Many of the calls were also clustered around 2200-2300 hrs and 0400-0500 hrs, which would correlate with dusk emergence and dawn re-entry at a roost.

In September and October 2014 little brown bat activity declined, but a small peak of northern long-eared bat was observed, including bats recorded on the internal microphone only. However in 2015 neither northern long-eared or little brown bat were recorded in March, April or May. Only four little brown bat files were recorded in June on the internal microphone; however due to the omnidirectional microphone used inside the mine and its long range for *Myotis* bats, these recordings may possibly indicate bats flying outside and not entering. Nothing was recorded on the external microphone from March to June 2015, which may indicate a fault (low numbers of big bat species – hoary, big brown, silver-haired and eastern red – were all recorded on the internal microphone only, but would almost certainly have been flying past outside).

Table 3-2
Bat registrations recorded at Magino Mine on internal (I) and external (E) microphones in 2014 (9th April to 24th October).

Species	April		May		June		July		August		September		October		Total
	I	E	I	E	I	E	I	E	I	E	I	E	I	E	
Little brown bat	0	0	0	0	47	73	44	68	10	50	4	29	6	2	**333**
Northern long-eared	0	0	2	2	7	27	3	10	10	32	5	17	10	30	**155**
Myotis spp.	0	0	0	1	11	28	12	49	21	69	0	0	0	0	**191**
Big brown	0	0	0	0	0	0	0	0	1	2	2	1	0	0	**6**
Hoary	0	0	0	0	0	0	0	0	0	8	0	8	0	2	**18**
Silver-haired	0	0	0	0	0	0	0	0	0	4	1	11	0	0	**16**
Eastern red	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Big brown/silver-haired	0	0	0	0	0	0	0	0	0	2	0	0	0	0	**2**

Table 3-3
Bat registrations recorded at Magino Mine on internal (I) and external (E) microphones in 2015 (March 19th to June 20th)

Species	March		April		May		June		Total
	I	E	I	E	I	E	I	E	
Little brown bat	0	0	0	0	0	0	4	0	**4**
Northern long-eared	0	0	0	0	0	0	0	0	**0**
Myotis spp.	0	0	0	0	0	0	0	0	**0**
Big brown	1	0	0	0	0	0	0	0	**1**
Hoary	1	0	1	0	0	0	9	0	**11**
Silver-haired	2	0	0	0	9	0	6	0	**17**
Eastern red	8	0	0	0	0	0	0	0	**8**
Big brown/silver-haired	0	0	0	0	0	0	0	0	**0**

4.0 DISCUSSION

4.1 Overview

The evidence collected between the autumn 2013 to the summer 2015 revealed a marked decline in northern long-eared and little brown bat activity. One night in August 2013 provided almost as many recordings as a whole year in 2014, although the night of 27-28 August 2013 probably recorded a major swarming event prior to mating and hibernation at the site or nearby, with up to 226 registrations of little brown bat and 288 of northern long-eared. However, monitoring in the whole of August 2014 returned no more than 60 and 42 sound file registrations for little brown and northern long-eared bat respectively. Monitoring up to 20 June 2015 only recorded four little brown bat registrations, and northern long-eared were absent.

Although different bat detectors were used in 2014 and 2015, both the SM2 and SM3 have a highly sensitive omnidirectional microphone (unless converted to unidirectional, as for the internal microphone in 2014), which can record *Myotis* activity over a range of c. 25m. The EcoObs Batcorder also has an omnidirectional microphone but it can be set to different sensitivity settings, and the range selected on 27-28 August 2013 is not known. However it is understood that the two units were set at either side of the adit, so it's unlikely that each unit would have had a range anywhere near 25m.

The different bat detectors used in monitoring from 2013 to 2015 are not considered responsible for the sharp declines in little brown and northern long-eared bat activity. Indeed the SM2 and SM3 are likely to have had more sensitive microphones, in which case the real decline could be even sharper from 2013 to 2014. However some doubt exists over the 2015 data from the external microphone, which has failed to record anything to date; this probably indicates a technical fault.

Five adult northern long-eared carcases were found in the adit from March to April 2014, and post mortems indicated White Nose Syndrome (WNS) to be the cause of death during hibernation. Therefore WNS is likely to be the cause for the declines in activity of northern long-eared and little brown bats recorded at the mine. Although no physical evidence has yet been discovered of little brown bat roosting in the mine, this species would have been deeper in the mine tunnel than northern long-eared due to their habit of clinging to rock walls, rather than entering crevices (surveyors were not permitted to enter beyond 3m due to health and safety concerns over the confined space).

Lack of any northern long-eared and little brown bat registrations in 2015 indicate that no bats successfully hibernated there this year.

Internal microphone records indicate that at least one individual little brown bat was using the adit as a summer roost in 2014; on some nights the first and last little brown bat recorded was on the internal microphone, and the times of these recordings were close to dusk and dawn. However few files were recorded each night, and on some none were recorded – indicating an occasional summer roost used by one or very few individual little brown bats. However the occasional use of the adit as a summer roost, and recordings from August to October around the adit entrance in 2013 and 2014 make it possible that the species may also have hibernated here in the past. On at least two occasions the first and/or last file recorded was a northern long-eared bat on the internal microphone, which may also indicate a very low level of summer roost activity by a single northern long-eared bat.

In contrast, activity levels of larger bat species (big brown, hoary, silver-haired and eastern red) have remained broadly similar, probably because these bats were largely flying past outside and would migrate south to hibernate.

There remains a small chance that very low numbers of surviving little brown bat will continue to use this adit as a summer roost. However while all four sound files of little brown bat in June 2015 were recorded on the internal microphone, this does not necessarily indicate bat activity inside the mine; the internal microphone was omnidirectional in 2015 and could therefore have recorded little brown bat for at least 22m outside the adit entrance.

There also remains a small chance of northern long-eared or little brown bat returning to the adit in future winters. Bats can live for many years, and northern long-eared in particular do not always return to the same hibernation roost every year (Caceres & Barclay 2000).

Therefore MNR should be consulted on the following options for future mitigation and licensing:

1) **Unmitigated destruction of the mine**, due to the apparent lack of any surviving bats from hibernation this year, and risk of infection to any further bats returning in future; and
2) **Provision of a replacement roost**; if MNR considers the mine still may have value for any surviving bats, licensed mitigation may be required due to their protection under the Endangered Species Act 2007. This could involve modification of other existing mine tunnels elsewhere, or construction of an artificial roost. It is likely that a new roost enhancement beyond 'like-for-like' replacement would be required before the existing adit can be mined again.

These mitigation options are discussed in more detail below, should they be necessary. Retention of the hibernation roost is impossible as the ore to be mined lies directly beneath the adit. It should be noted that little is currently known as to how WNS could be controlled, but mitigation in an artificial roost may have additional value to MNR if they test some current theories for combatting the disease.

4.2 Modification of existing mine tunnels or caves

Existing plans of the Magino mine or nearby mines could be examined, and if necessary further inspection of mine systems conducted to reveal any other, currently unoccupied tunnels with potential for enhancement into hibernation and summer roosts. It should be noted that any further inspection of mine systems would need further risk assessment for Health and Safety purposes, and a team trained and equipped to enter confined spaces may be necessary.

Where such tunnels are found, consideration must be given to why the tunnel is not already occupied by hibernating bats. Modifications should then be made to address the limiting factors and to replicate the internal physical characteristics and environmental conditions of the original hibernation roost as far as possible.

Air currents are a particularly important factor in cave hibernation roosts, and may be manipulated to improve other tunnels. For example other tunnels may be identified with potential in terms of similar aspect, tunnel size, depth below ground level and angle of descent/ascent etc., but which are currently inaccessible for bats due to a sealed adit, or too exposed due to a wide open adit. If such a tunnel is not partly flooded like the current hibernation roost site, a downward sloping tunnel may also be desirable to create a 'cold sump' – such sites are stable in terms of temperature and humidity, conditions which are favored by hibernating bats.

If suitable tunnel/s can be found, data-loggers and detectors should be placed just inside the entrance and at the far end of the tunnel(s) to provide information on gradients in temperature, humidity, light levels and air movement during the winter hibernation period. The data should be used to experiment with different openings at the adit entrance, until internal locations replicate as much as possible the conditions recorded at the original hibernation roost. As a starting point any adits should be fitted with a suitable door (or similar) leaving gaps of similar dimensions to those at the existing roost entrance.

4.3 Construction of an artificial hibernation roost

If further survey of neighboring mine tunnels is impossible, or fails to reveal any tunnels with sufficient potential for enhancement, at least one artificial hibernation roost would need to be constructed. According to the Endangered Species Act 2007, if a roost is present the scheme must seek to enhance the site for bats beyond 'like for like' mitigation. If MNR still consider the mine to be a roost (although no bats appear to have survived hibernation in 2015, some may return in future years), creation of an alternative hibernation and summer roost would be necessary.

A similar 'cold sump' hibernation roost could be created by burying a length of concrete pipe underground. The pipe should be at least 1.5m in diameter, and have an aspect, opening size, depth and angle of descent similar to the original roost. The location for such an artificial roost would need to be chosen carefully; partial flooding of the lower end would be desirable to provide the humidity and cold temperatures favored by bats, but most of the interior should remain unflooded to provide adequate space for bats, and a gradient in parameters such as humidity, temperature, light and air movement which bats can select from.

4.4 Roost enhancements for bats

Whether an existing mine tunnel, or new artificial roost is chosen, some walls should be rough to enable bats to land, and little brown bat to hold while roosting. This would be especially important if an artificial roost is created using a pipe. Crevices should also be created to provide roosting opportunities for northern long-eared bat. These features could be created by:

1. Attaching untreated wooden battens to walls. These should not be positioned flush to the wall, to create gaps of 20-50mm between the wood and stone walls for northern long-eared bat to enter;

2. Specially designed bat hibernation bricks (e.g. the Norfolk bat brick: http://www.nhbs.com/norfolk_bat_brick_tefno_187603.html, see Figure 4-1) built into walls. These bricks have holes which species such as northern long-eared bat can crawl into. The Norfolk bat brick has been successfully used for many years in the UK to attract and protect many crevice-hibernating species They have been deployed in thousands of locations across the UK with great success, commonly attracting 1 to 3 bats per brick.

Figure 4-1
Norfolk bat brick

Further, experimental enhancement should also be considered to combat the spread of WNS – possible measures suggested by recent research are discussed further in section 5.

4.5 Monitoring

If provision of a new roost is necessary, it would need to be monitored over successive winters to ensure that internal conditions remain suitable. Replacement roosts can take years to be colonized, and therefore any new roosts should be monitored every winter for at least five years after creation. The responsibility and program for these visits should be decided as part of any licensed development at the mine.

5.0 RESEARCH TO COMBAT WNS

One possible way to further enhance a new hibernation roost would be to conduct research on new roost features (such as those discussed below) which may reduce mortality rates of bats affected by WNS. WNS is currently a serious threat to the survival of little brown and northern long-eared bat populations, and frequently causes mortality rates of 75-80% within hibernation roosts of these species (Boyles & Willis 2010). Any research which may help combat this disease would be of value to the overall conservation effort for these and other endangered bats in North America. Creating new hibernation roosts may present unique opportunities to experiment with roost characteristics and conditions.

While this research may discover significant benefits for bats it may also cause some disturbance (particularly where handling is necessary), and therefore some activities below may also need to be licensed by MNR.

5.1 Thermal refugia

A recent modeling study has predicted that the introduction of small thermal refuges to a hibernation roost may dramatically decrease the mortality rate of bats infected with WNS (Boyles & Willis 2010). Providing localized warm-temperature refugia within affected caves

while ensuring that overall cave temperature remains cold could dramatically increase survival by reducing the energy expenditure costs of WNS infection. This theory has not yet been tested in the field to our knowledge, perhaps because it would be risky to implement in an existing roost. However if one or more alternative tunnels are offered to bats as replacements to the original hibernation roost, which the bats are free to select from, this may offer a unique opportunity to test this theory.

We would propose installing a heat pad within 100m of the hibernation point to allow bats to warm themselves quickly during bouts of awakening from hibernation. Modelling by Boyles & Willis predicted that mean bat mortality could drop to 63% in hibernacula with thermal refugia of 12℃, 43.6% in hibernacula with refugia of 20℃ and 25.2% in hibernacula with refugia of 28℃. Experimentation with various temperatures in this range would be desirable to determine any preferences by bats.

Thermal units have previously been constructed by SLR as part of maternity roost boxes, but these were either battery powered or ran off mains electricity. At a remote mine it may be possible to power a thermal pad using a solar panel outside the adit. If a solar panel is used, it would need to be secured to an external wall and at angle where it would not be dislodged or covered by snow. Alternatively, if mine staff will regularly visit the area, they could routinely replace a battery.

It would be essential that the warmer, thermal area does not raise the temperature of the nearby hibernation area, and therefore some experimentation in positioning may be necessary. As a starting point it would be advisable to locate the thermal pad in a raised ceiling section up to 100 m from the hibernation area and nearer the adit, so that warm air exits the tunnel without heating the hibernation area.

5.2 Fungicide

Another option would be to treat new hibernation roosts with fungicide; either directly to bats or indirectly to cave surfaces. Fungicide has been suggested as a possible solution before, but has in the past been considered an extreme option due to disturbance to bats from handling (in the case of direct application), and possible toxicity, not just to bats, but other species within cave ecosystems (Aley 2010). However if a fungicide can be found which is safe for bats, the use of man-made mine tunnels currently unoccupied by hibernating bats or other notable cave species could provide a good opportunity for experimentation. Handling vulnerable bats infected with WNS may cause stress, with repercussions for health and survival however, if these could be outweighed by the benefits of fungicide treatment, it may be a management option worthy of consideration. Treatment of any crevices, hibernation bricks, wooden cladding boards or other particular wall areas with ideal conditions could also be used to reduce infection of healthy bats, but may not succeed in fully treating infected bats.

5.3 Probiotics

Recent research has demonstrated that naturally occurring bacteria in the *Pseudomonas* genus can inhibit the growth of *P. destructans* on living bats (the fungus which causes WNS) (Hoyt *et al.* 2015). However the natural occurrence of these bacteria on skin varies greatly between bat species. This may explain why big brown bat – the bat species which had the highest antifungal colonies of Pseudomonas naturally occurring on its skin – is also the species with the lowest mortality rates yet recorded for WNS in North America.

Therefore Hoyt *et al*. suggested that further research should test one or more strains of *Pseudomonas fluorescens in vivo* on live hibernating bats, using a bat species which suffers high mortality from WNS such as little brown bat or northern long-eared bat. If these species

continue to hibernate at the Magino Mine site, future contribution to this research should be considered valuable mitigation in any licence application to MNR.

6.0 REFERENCES

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7.0 CLOSURE

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