NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Phase 2: Preliminary Environmental Studies

MEMORANDUM OF 2018 ENVIRONMENTAL FIELD INVESTIGATION METHODS AND RESULTS

TOWNSHIP OF IGNACE AND AREA, ONTARIO

APM-REP-07000-0210

OCTOBER 2019

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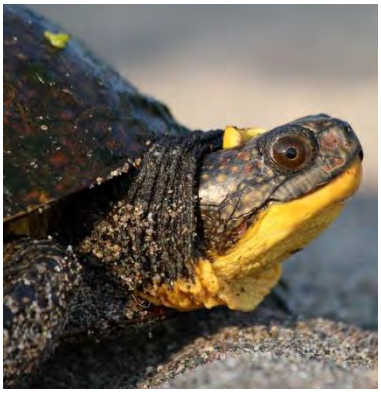
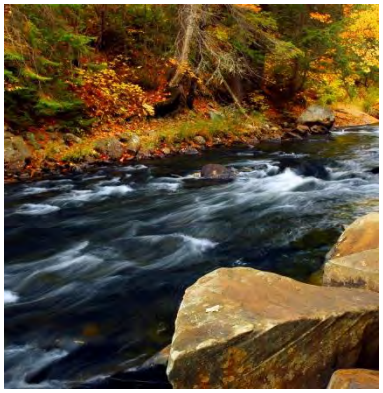
Phase 2: Preliminary Environmental Studies
Township of Ignace and Area, Ontario

Memorandum of 2018 Environmental Field Investigation Methods and Results

11 October 2019 Version 1.0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VERSION HISTORY

Version	Date	Modifications
Version 0.1 DRAFT	29-March-2019	
Version 1.0	11-October-2019	- NWMO Edits and Comments Incorporated - Borehole Site Naming Conventions Updated - Minor Edits for Clarity and Consistency

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1.0 BACKGROUND

1.1 General

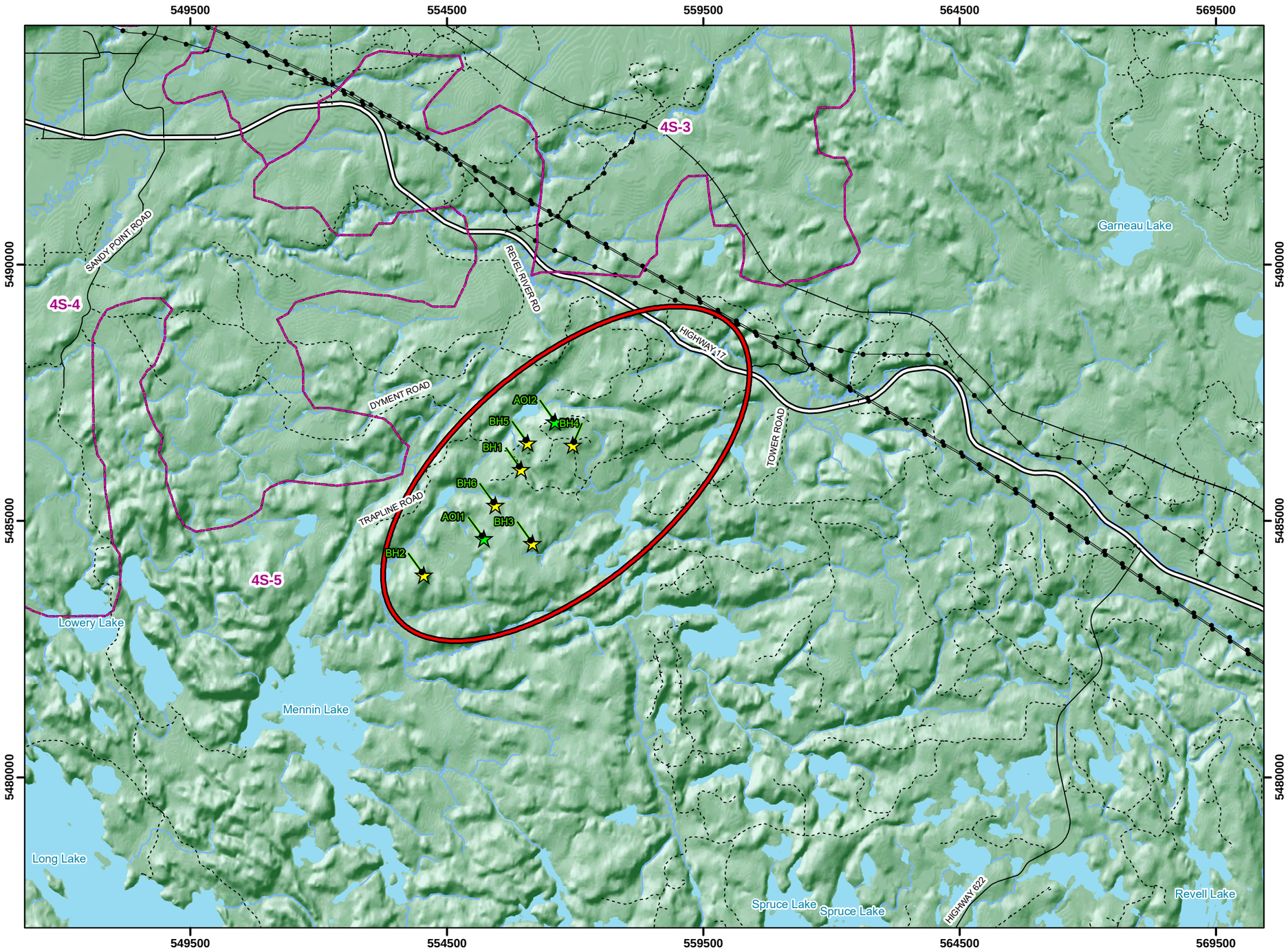
The Nuclear Waste Management Organization (NWMO) was established in 2002 in accordance with the Nuclear Fuel Waste Act to assume responsibility for long-term management of Canada's used nuclear fuel. Through national consultation, over the course of a three-year period, Canadians helped develop a technical method and management system for used nuclear fuel, called Adaptive Phased Management (APM). The APM process for the Ignace, Ontario area is currently in Phase 2 of the preliminary assessment. The purposes of the Phase 2 environmental characterization are to (1) build on previous studies to provide a detailed description of the existing environmental conditions in the Revell Batholith Study Area, (2) propose potential siting areas based on identified environmental constraints, (3) identify potential environmental impacts which may result from the siting activities and evaluate methods to avoid, manage, or mitigate those potential impacts, and (4) establish preliminary environmental baseline conditions for the purpose of evaluating any environmental impacts resulting from the siting activities. In 2016, Tulloch Engineering Inc. (Tulloch) was retained to perform the Phase 2 environmental studies in the Ignace siting area.

1.2 Context and Scope of this Report

Throughout 2018 Tulloch undertook its third year of environmental studies in the Ignace siting area. These studies included the continuation of water and soil quality monitoring as well as Natural Heritage investigations at newly identified locations around the Revell Batholith (Figure 1). This report has been prepared to provide a summary of the methods and findings of these 2018 studies. In some instances, references are provided herein to technical reports that outline 2018 study methods and results in greater detail.

NWMO Ignace APM Phase II

2018 Field Investigations
Regional Map



Kilometers
0 1 2 4 6 8

Legend

- Confirmed Borehole Location
- Possible Future Borehole Location
- Rail Line
- Utility Line
- Watercourse
- Waterbody
- Ecodistrict

FIGURE 1
PROJECT: 165010
DATE: 09/10/2019

SCALE: 1:80,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Network, Utility Line, ORWN Track, Ecodistrict, Geographic Township Improved, Municipal Boundary - Lower and Single Tier, OHN Waterbody, OHN Watercourse. Updated January 2015 through

Data Provided by Natural Resources Canada (GeoGratis):
CDEM Hillshade (Ignace Region). Retrieved July 2016.

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\4-3-3-2 Borehole Baselines for BH4, BH5 & BH6
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: Kelly Major

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2.0 STUDY AREAS

The 2018 Study Area included a collection of point (i.e. borehole site) and linear (i.e. road) features within the Revell Batholith. Some of these areas have been investigated in past years and their inclusion in this report represents a continuation of previous work. Other areas were newly identified for 2018. Collectively, these areas are referred to herein as the 2018 Study Area.

2.1 Water, Sediment and Soil Sampling

Water, sediment and soil quality monitoring around the Revell Batholith began in 2017.

Twelve surface water monitoring sites were sampled in 2018; surface water sampling sites from 2017 were re-visited, and two new sites (RE-11 and RE-12; Figure 2) were established. Submerged sediment samples were also collected at these 12 locations.

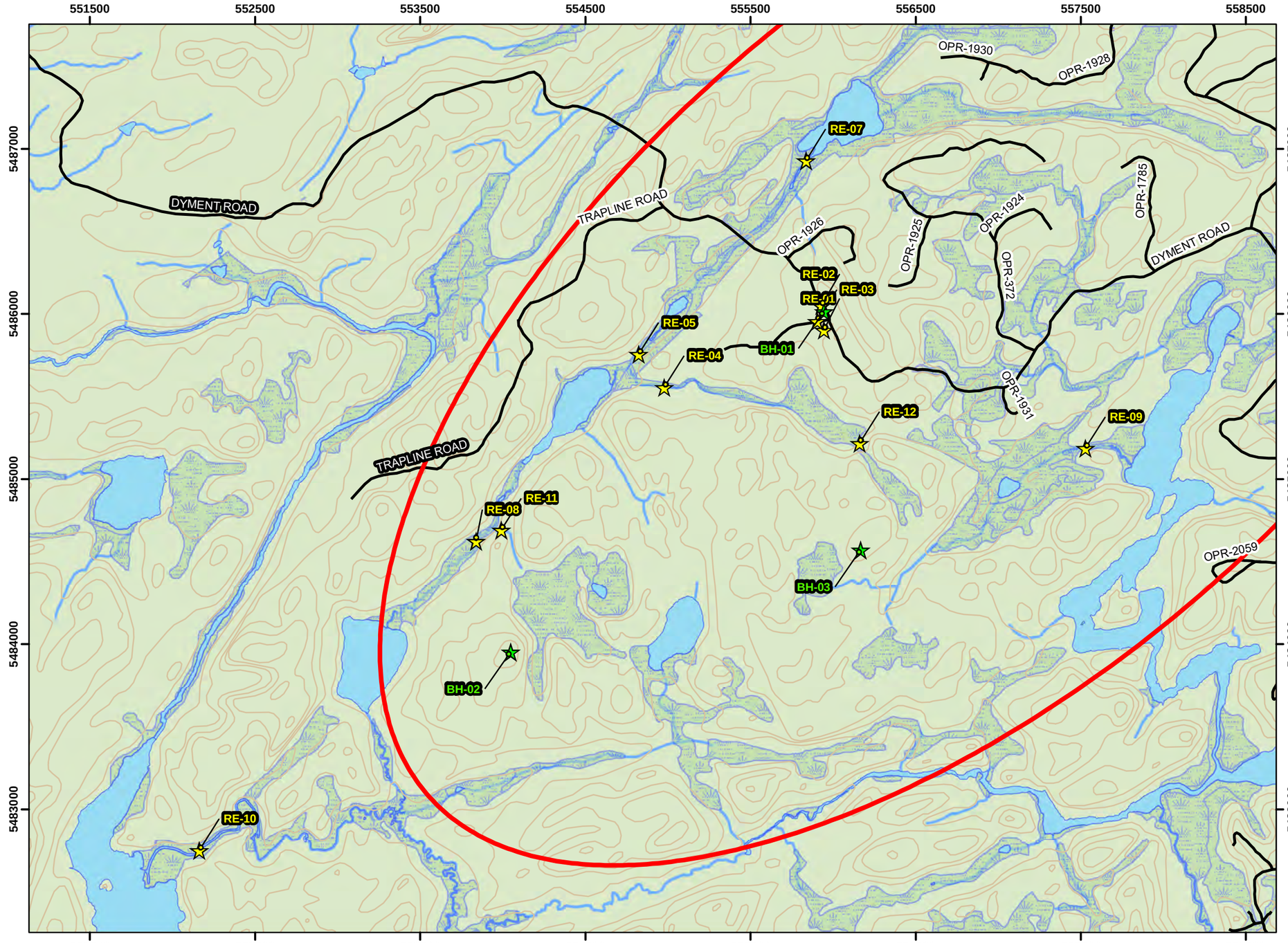
A series of soil samples were collected at three locations in 2018; Boreholes 1, 2 and 3. Samples collected at Borehole 1 are considered post-construction (operations ended in January 2018), whereas samples collected at Boreholes 2 and 3 represent baseline conditions (Figure 2).

The surface water and soil sampling programs were designed to meet these objectives:

1. To characterize baseline conditions to better monitor changes associated with siting activities
2. To distinguish background variability and temporal fluctuations (seasonal and annual) at the monitoring locations
3. To characterize the water, sediment and soil chemistry, which are relevant to the performance of organisms, habitat condition and toxicity loading
4. To identify parameters which are above provincial guidelines and background site condition values

NWMO Ignace APM Phase II

2018 Surface Water, Sediment and Soil Water Quality Sampling Program



Legend

- Surface Water & Sediment Sample Location
- Soil Sample Location
- Revell Batholith Study Area
- Other Road
- Elevation
- Watercourse
- Wetlands
- Waterbody

FIGURE 2
PROJECT: 165010
DATE: 09/10/2019

SCALE: 1:25,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Network, Utility Line, ORWN Track, OHN Waterbody, OHN Watercourse. Updated January 2015 through June 2016.

Data Provided by the Natural Resources Canada (GeoGratis):
CDEM Contours (Ignace Region). Retrieved July 2016.

J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\4-3-3 Borehole Baselines
Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: K.Major

TULLOCH ENVIRONMENTAL

2.2 Borehole Sites

Six confirmed borehole sites exist within the Revell Batholith; Boreholes 1, 2, 3, 4, 5 and 6. Borehole 1 has concluded operations. Boreholes 2 and 3 are scheduled to undergo operations sometime in 2019/2020. Environmental studies for Boreholes 1, 2 and 3 were completed in 2017 and are reported in a Technical Memorandum 3 (TM-3) report (Tulloch 2018a). Environmental studies for Boreholes 4, 5 and 6 were completed in 2018 and are included in this report. Also studied in 2018 were two locations identified as possible future borehole locations; Area of Interest 1 and 2. These two areas of interest are also included in this report. The 2018 Study Area included these five locations and areas within 120 m (Table 1, Figure 3).

Table 1 – UTM Coordinates of Boreholes 4, 5 and 6 as well as Areas of Interest 1 and 2.

Name	UTM (NAD83)
Borehole 4	15 U 556957 5486489
Borehole 5	15 U 556070 5486531
Borehole 6	15 U 555440 5485315
Area of Interest 1	15 U 555219 5484663
Area of Interest 2	15 U 556611 5486943

2.3 Borehole Access Roads

Access to borehole sites throughout the Revell Batholith, including confirmed borehole sites and areas of interest, is predominantly facilitated by existing roads / road beds in varying states of repair; ranging from active and serviceable (e.g. Dyment Road) to inactive and overgrown. In some instances, new sections of access roads may require construction. As of the 2018 field studies, the locations of some portions of new access road have been confirmed while others remain tentative. Borehole access roads are depicted in Figure 3.

Access roads servicing Boreholes 2 and 3 were studies extensively in 2017. The methods and results of those studies are provided in the Technical Memorandum 3 prepared for NWMO in 2018 (Tulloch 2018a). In 2018, the centerline of these roads was finalized. Some additional environmental field investigations were performed during this finalization process. Only this latter effort is included in this report.

Field assessments were performed along existing roads / road beds servicing Boreholes 4 and 5 as well as Area of Interest 2. Preliminary reconnaissance of possible access routes to Borehole 6 and Area of Interest 1 were completed, as these sites were not serviced by existing roads.

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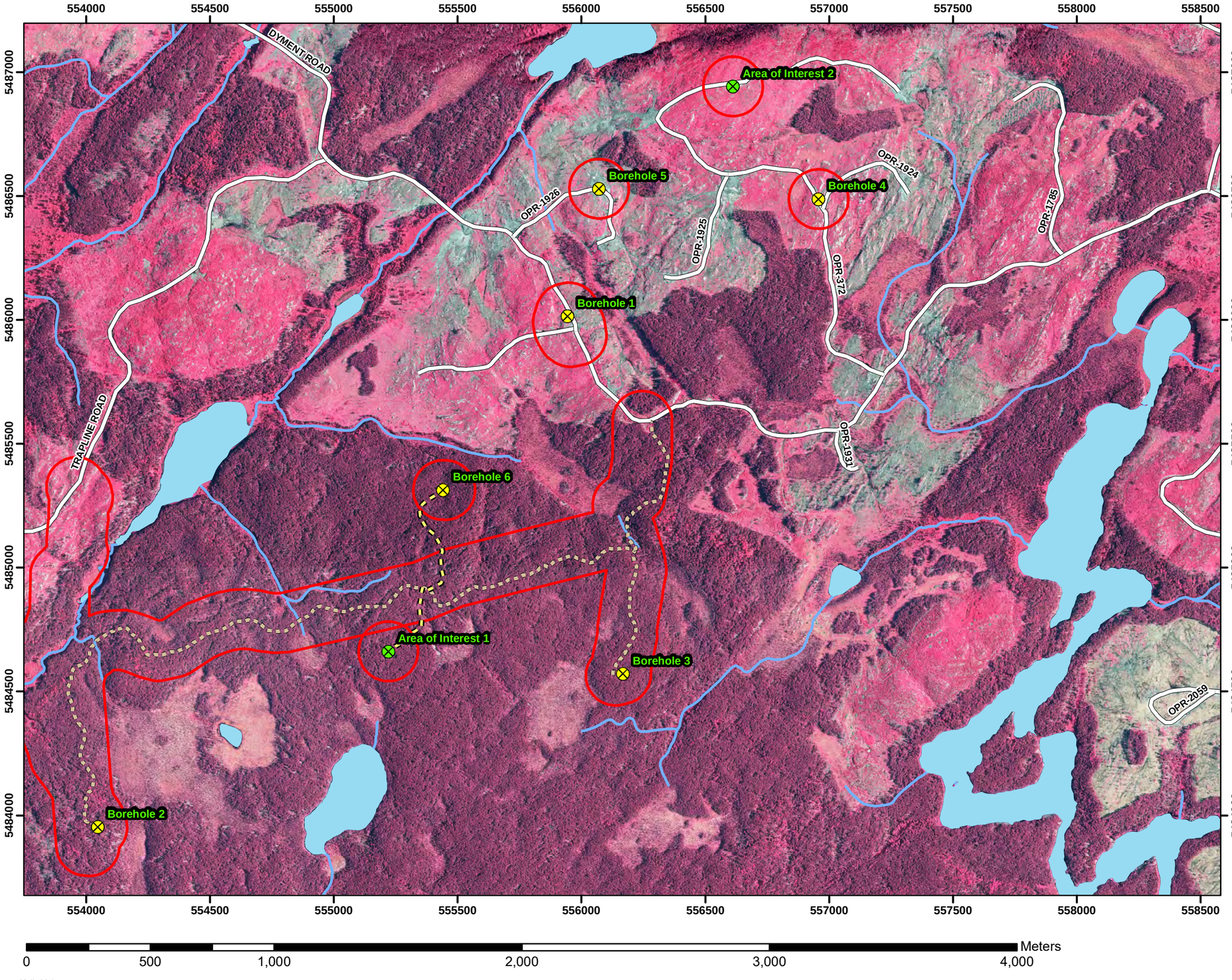
Natural Heritage Assessments
2018 Field Effort and Results

Revell Area



Legend

- 2018 Study Area
- Existing Access Roads
- Access Road to Boreholes 2 and 3
- Watercourse
- Waterbody

Borehole Locations

- Confirmed
- Possible Future
- Access Road Reconnaissance

0 500 1,000 2,000 3,000 4,000 Meters

Figure 3
PROJECT: 165010
DATE: 09/10/2019

SCALE: 1:16,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWN Track, OHN Watercourse, OHN Waterbody. Updated January 2015 through June 2016.

Data Provided by the Natural Resources Canada (GeoGratis):
None.

TULLOCH ENVIRONMENTAL

User Name: Kelly.Major
Document Path: J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\4-3-3-2 Borehole Baselines for BH4, BH5 & BH6\Figure - NWMO Locations A to F - Locations Map.mxd

3.0 REVIEW OF TECHNICAM MEMORANDUM 1 (TM-1)

3.1 Review Methods

The TM-1 report produced by Tulloch (2018b) was reviewed for Natural Heritage features associated with portions of Study Area associated with the 2018 Study Areas. Boreholes 1, 2 and 3 and associated access roads, which were established in previous years, are not reviewed in this report; see Technical Memorandum 3 (Tulloch 2018a).

Lists of Species at Risk (SAR) and rare species were carried forward from the TM-1 for consideration in this report. The Study Areas of these locations were superimposed on sensitivity maps produced during the TM-1 review to identify any known / suspected Significant Wildlife Habitat (SWH), records of past wildlife observations (e.g. raptor nesting, provincially tracked species), or potentially sensitive areas (e.g. wetlands); Figure 4.

Data from the TM-1 report was supplemented with a review of records obtained from the Atlas of the Breeding Birds of Ontario (10 x 10 km square #15WQ48, Cadman *et al* 2007). All SAR birds identified in the TM-1 were also queried for records in eBird (www.eBrid.org).

3.2 Protected Areas

Protected areas included federal, provincial and municipal parks as well as Conservation Reserves, Enhanced Management Areas, Provincially Significant Wetlands, and Areas of Natural and Scientific Interest.

A review of TM-1 data has identified no protected areas within 1000 m of the 2018 Study Area. Wetlands within the proximity of the 2018 Study Area are identified by the Ministry of Natural Resources and Forestry (MNRF) as unevaluated.

3.3 Land Use

All areas within 1000 m of the 2018 Study Area are located entirely within undeveloped crown lands.

3.4 Species at Risk (SAR)

SAR include species identified federally under the *Committee on the Status of Endangered Wildlife in Canada* (COSEWIC) and provincially under the *Committee on the Status of Species at Risk in Ontario* (COSSARO). Species and their habitat listed as endangered or threatened are regulated federally under the *Canadian Species at Risk Act* (SARA S.C. 2002 c.29) and provincially under the *Ontario Endangered Species Act* (ESA S.O. 2007 c.6). In some instances, species listed as special concern may also receive habitat protection under the *2014 Provincial Policy Statement* (MMAH 2014); see Section 3.6 *Significant Wildlife Habitat*, below.

TM-1 studies identified 31 SAR species associated with the Ignace and surrounding Kenora region (Table 2).

The *Atlas of the Breeding Birds of Ontario* (Cadman *et al* 2007) identified records of two SAR species within 10 km vicinity of the 2018 Study Area; Barn Swallow and Eastern Wood-pewee. A review of eBird records indicated observations of Bald Eagle and Eastern Wood-pewee north of the 2018 Study Area along the Highway 17 corridor and in vicinity of Borups Corners.

3.5 Locally and Provincially Rare Species

The TM-1 identified three locally rare species with historical NHIC occurrences within vicinity of Ignace; Macoun's Arctic Butterfly (*Oeneis macounii*), Vasey's Rush (*Juncus vaseyi*) and Brook Cinquefoil (*Potentilla rivalis*). These element occurrences did not overlap with the 2018 Study Area.

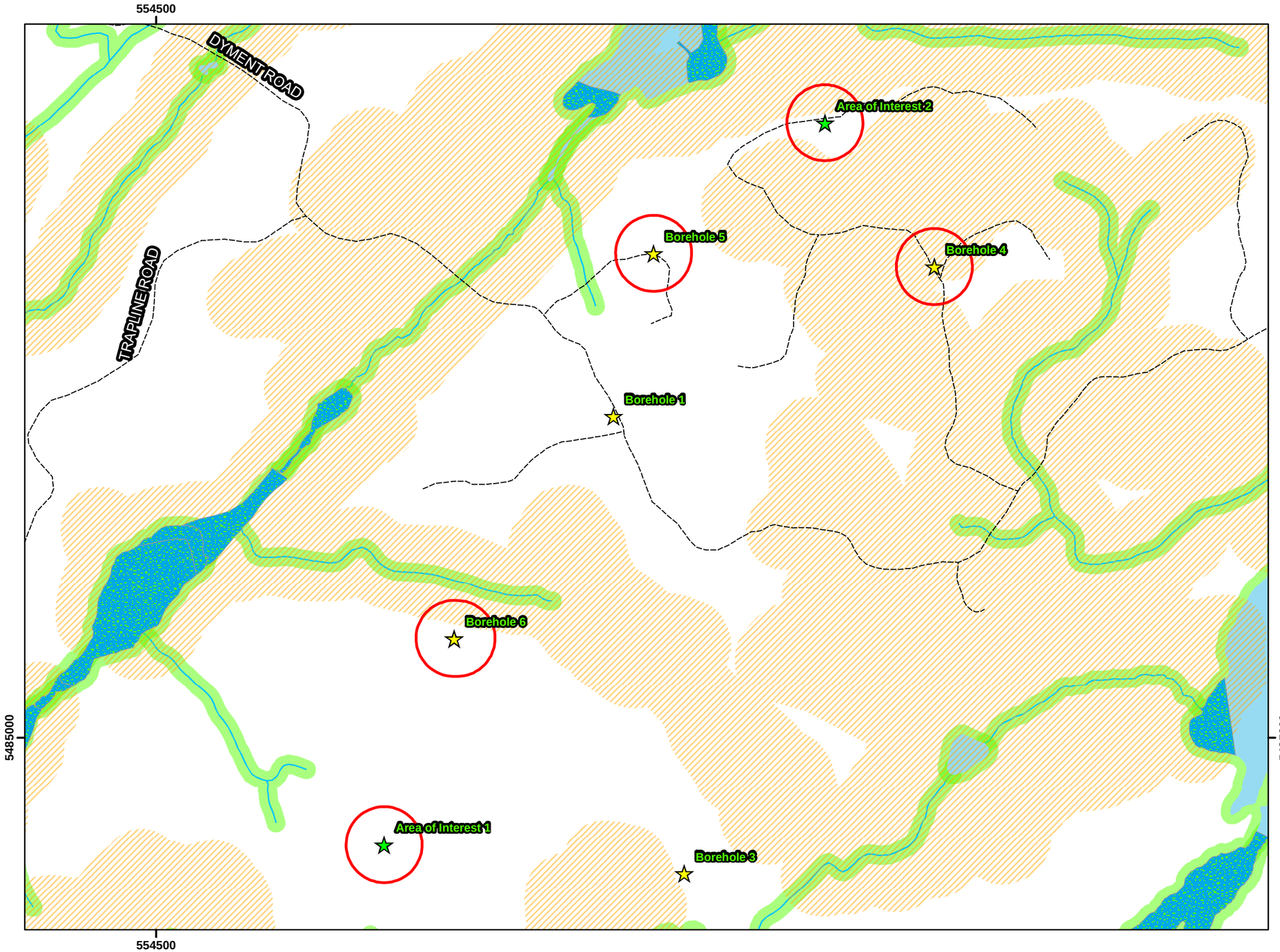
3.6 Significant Wildlife Habitat (SWH)

SWH are outlined in the *Significant Wildlife Habitat Technical Guide* (MNR 2000) as natural heritage areas that are "*ecologically important in terms of features, functions, representation and amount and contributing to the quality and diversity of an identifiable geographic area or Natural Heritage System*". The alteration and development of SWH is prohibited under the *2014 Provincial Policy Statement* (MMAH 2014). Habitat may be considered SWH according to four broad categories:

- Habitat of species identified as Special Concern provincially, and species listed as rare or historical in Ontario based on records kept by the NHIC (e.g. S1- Critically Imperiled, S2- Imperiled, S3- Vulnerable and SH - Historic ranks; these ranks are not legal designations but are assigned in a manner to set protection priorities);
- Seasonal concentration areas (e.g., winter deer yards, colonial bird nesting sites, reptile hibernacula);
- Rare vegetation communities or specialized habitat for wildlife (e.g., alvars, rare forest types, moose aquatic feeding areas, amphibian woodland breeding ponds, turtle nesting habitat); and,
- Animal movement corridors (e.g., naturally vegetated corridors or man-made features such as power transmission and pipeline corridors that provide animal movement from one habitat to another).

As per MNRF direction, the SWH Criteria Schedule implemented for these assessments is that for Ecoregion 3E (MNRF 2015a).

SWH are not known to occur within the 2018 Study Area. Non-significant moose aquatic feeding areas (Classes 1 and 2) were identified along an un-named tributary to Mennin Lake that parallels Trapline Road.



NWMO Ignace APM Phase II

TM1 Sensitivity Buffers
2018 Borehole Locations

Legend

- Confirmed Borehole Site
- Possible Future Borehole Site
- New 2018 Study Area
- Resource / Recreation Road
- Watercourse
- Waterbody
- Waterbody (30m)
- Watercourses (30m)
- Wetland >2ha (120m)
- Moose Aquatic Feeding Area (Not Significant)

Figure 4

PROJECT: 165010

DATE: 09/10/2019

SCALE: 1:13,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWM Tracks, OHN Waterbody, OHN Watercourse, Wetland (Ecoregions 3S, 4S 7 5S), Wooded Area, Nesting Site, Breeding Area, Calving and Fawning Area, Nursery Area Wildlife, Den Site, Feeding Area Wildife, Resting Area, Staging Area Wildlife, Wintering Area, Travel Corridor Wildlife, Aquatic Feeding Area, Spawning Area, Nursery Area Fish, Feeding Area Fish, Staging Area Fish, Travel Corridor Fish.

Data Provided by the MNRF:
Approximate locations of fish spawning, mineral licks, raptor nesting and colonial bird nesting.

Data Provided by Tulloch Engineering:
Data obtained from field verification exercises performed in September 2016 have been incorporated this map.

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Spatial Data Stored in: GIS Warehouse external drive pathed as W:
Author: K.Major

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Table 2 – SAR species identified by TM-1 studies for Ignace and Kenora Region.

Common Name	Scientific Name	Status in Canada	Status in Ontario	Habitat Description
Birds				
American White Pelican	*Pelecanus erythrorhynchos*	No Status	THR	Nest in groups on remote islands that are barren or sparsely treed located in lakes, reservoirs, or on large rivers.
Bald Eagle	*Haliaeetus leucocephalus*	No Status	SC	Require large continuous area of deciduous or mixed woods around large lakes, rivers; 30 to 50% canopy cover; nest in tall trees 50 to 200 m from shore; require tall, dead, partially dead trees within 400 m of nest for perching.; sensitive to toxic chemicals.
Bank Swallow	*Riparia riparia*	No Status	THR	Nest in burrows in natural and human-made settings where there are vertical faces in silt and sand deposits. Many nests are on banks of rivers and lakes, but they are also found in active sand and gravel pits or former ones where the banks remain suitable.
Barn Swallow	*Hirundo rustica*	No Status	THR	Farmlands or rural areas; cliffs, caves, rock niches; buildings or other man-made structures for nesting; open country near body of water.
Black Tern	*Chlidonias niger*	No Status	SC	Floating nests in loose colonies in shallow marshes, especially in cattails.
Bobolink	*Dolichonyx oryzivorus*	No Status	THR	Large, open expansive grasslands with dense ground cover; hayfields, meadows or fallow fields; marshes; requires tracts of grassland >50 ha.
Canada Warbler	*Wilsonia canadensis*	THR	SC	Interior forest species breeding in a wide variety of deciduous and mixed coniferous forests, usually with a moist to wet moisture regime. Forest understory must contain a well-developed shrub layer for nest concealment as this species nests near or on the ground. Ideal habitats would be >30 ha in size.

Common Name	Scientific Name	Status in Canada	Status in Ontario	Habitat Description
Common Nighthawk	*Chordeiles minor*	THR	SC	Historically, nesting habitat consisted of open areas with little to no ground cover such as burned-over areas, forest clearings and rock barrens. This species has also adapted to use cultivated fields, orchards, urban parks, mine tailings and along gravel roads and railways.
Eastern Whip-poor-will	*Antrostomus vociferus*	THR	THR	Dry, open, deciduous woodlands with small to medium trees, generally oak or beech with ample clearings and shaded leaf litter; wooded edges and forest clearings with little herbaceous growth; associated with forests >100 ha. Habitat characterization using GIS indicates that eastern whip-poor-will prefer about a 50:50 matrix of forest clearings and sparse forest as habitat.
Eastern Wood-Pewee	*Contopus virens*	No status	SC	Mid-canopy layer of forest clearings and edges of deciduous and mixed forests. It is most abundant in intermediate-age forest stands with little understory vegetation.
Golden Eagle	*Aquila chrysaetos*	No Status	END	Remote bedrock cliffs overlooking clearings such as burns, lakes or tundra.
Least Bittern	*Ixobrychus exilis*	THR	THR	Deep marshes, open bogs and marshy borders of lakes, ponds and streams, usually >5 ha. Abundant emergent vegetation such as cattails, bulrushes or sedges must be present for nesting and concealment. This species in highly intolerant of human disturbance and habitat alteration.
Olive-sided Flycatcher	*Contopus cooperi*	THR	SC	Most often found along natural forest edges and openings. It will use forests that have been logged or burned. Breeds in mixed and conifer forest, adjacent to wetlands ponds, lakes or rivers. Common nest tree species: White Spruce, Black Spruce, Jack Pine and Balsam Fir.
Peregrine Falcon	*Falco peregrinus*	SC	SC	Nests on tall, steep rock cliffs and crags, especially situated near water. This species has also adapted to use the ledges of tall buildings in urban centres.
Rusty Blackbird	*Euphagus carolinus*	SC	Not at Risk	Foraging habitat includes marshes, swamps, pond edges. Breeding habitat preference is boreal forest (wet areas), beaver ponds and bogs.

Common Name	Scientific Name	Status in Canada	Status in Ontario	Habitat Description
Short-eared Owl	*Asio flammeus*	SC	SC	Open areas such as grasslands, marshes and tundra where it nests on the ground and hunts for small mammals, especially voles.
Yellow Rail	*Coturnicops noveboracensis*	SC	SC	Marshes with little standing water. Often associated with sedges, rushes and grasses. Edges of marshes, estuaries and coastlines.
Lake Sturgeon (Great Lakes - Upper St. Lawrence population)	*Acipenser fulvescens*	No Status	THR	Found in large rivers and lakes and near the mouths of large rivers. For Great Lakes populations, lake sturgeon usually was associated with silt substrate, while infrequently associated with gravel or sand substrates.
Shortjaw Cisco	*Coregonus zenithicus*	THR	THR	Spends most of the year in deep water, usually between 55 to 180 m in depth. During the breeding season, which can be spring or fall depending on the lake, it migrates to shallower water (10 to 60 m) to mate and lay eggs.
Monarch Butterfly	*Danaus plexippus*	SC	SC	Breeding habitat is confined to where milkweed grows, since milkweed leaves are the sole food of caterpillars. Different species of milkweeds grow in a variety of environments, including meadows, along roadsides and in ditches, open wetlands, dry sandy areas, short and tall grass prairies, river banks, irrigation ditches, arid valleys and south facing hillsides.
Mammals				
American Badger (Northwestern Population)	*Taxidea taxus*	END	END	Open habitat (grasslands, meadows, golf courses, farmland, sand barrens and roadways) both man-made or natural, with friable soil to allow for burrowing.
Caribou (Boreal Population	*Rangifer tarandus*	THR	THR	Large, undisturbed tracts of boreal forest. In upland forests, Caribou prefer old, mature conifer forests. In lowland areas, preference is to jack pine or black spruce dominated forest types.

Common Name	Scientific Name	Status in Canada	Status in Ontario	Habitat Description
Cougar or Mountain Lion	*Puma concolor*	Data Deficient	END	Large, undisturbed forests or other natural areas where there is little human activity.
Little Brown Myotis	*Myotis lucifugus*	END	END	Uses caves, quarries, tunnels, and hollow trees on buildings for roosting. Winters in humid caves. Maternity sites occur in dark warm areas such as attics and barns, as well as old dead trees and snags. Feeds primarily in wetlands.
Northern Myotis	*Myotis septentrionalis*	END	END	Hibernates during the winter in mines or caves. During the summer males roost alone and females form maternity colonies of up to 60 adults. Roosts in houses and manmade structures but prefers hollow trees or under loose bark. Hunts within forests below the canopy.
Wolverine	*Gulo gulo*	No Status	THR	Large undisturbed tracts of boreal forest with individual ranges from 500-1500 km^2.
Reptiles				
Snapping Turtle	*Chelydra serpentina*	SC	SC	Variety of permanent, semi-permanent fresh waterbodies, but favours areas with abundant aquatic vegetation and soft mud or sand substrates. Ideal range size would consist of waterbodies or wetlands complexes of ~28 ha.
Plants				
Showy Goldenrod	*Solidago speciosa*	END	THR	Open habitats. Grasslands and oak savannahs with south facing slopes. Shallow soils over bedrock. Often associated with jack pine and white pine.

Common Name	Scientific Name	Status in Canada	Status in Ontario	Habitat Description
Western Silvery Aster	*Symphyotrichum sericeum*	THR	END	Fields and open areas, including undisturbed grasslands. Often found in trembling aspen/bur oak savannahs. Undisturbed grasslands. Rarely found at disturbed habitats, such as roadside ditches.

* Abbreviations: SC = Special Concern, THR = Threatened, END = Endangered

3.7 Migratory Birds

The *Migratory Birds Convention Act* (MBCA S.C. 1994, C.22) and the *Ontario Fish and Wildlife Conservation Act* (FWCA S.O. 1997, C.41) prohibits the disturbance and destruction of most birds, their nests and eggs. Environment and Climate Change Canada has developed a number of tools, including the general nesting calendars (http://www.ec.gc.ca/paom-itmb/default.asp?lang=En&n=4F39A78F-1) and avoidance guidelines (http://ec.gc.ca/paom-itmb/default.asp?lang=En&n=AB36A082-1) to support compliance with the Act.

The Atlas of the Breeding Birds of Ontario records indicate many migratory bird species are known to breed in vicinity of the 2018 Study Area.

3.8 Fisheries and Fish Management Objectives

MLT-1 (Mennin Lake Tributary 1) is an un-named watercourse that parallels Trapline Road. No fisheries information exists for this watercourse. This watercourse and its tributaries drain to Mennin Lake, approximately 2.5 km southwest of this 2018 Study Area. Mennin Lake is described by MNRF Aquatic Resource Area data as a cool water thermal regime known to support 11 fish species (Table 3).

Table 3 – Fish species known to occur within Mennin Lake. Data provided by the MNRF.

Common Name	Scientific Name	ESA Status*
White Sucker	*Catostomus commersonii*	No Status
Northern Pike	*Esox lucius*	No Status
Iowa Darter	*Etheostoma exile*	No Status
Johnny Darter / Tesselated Darter	*Etheostoma sp.*	No Status
Emerald Shiner	*Notropis atherinoides*	No Status
Blacknose Shiner	*Notropis heterolepis*	No Status
Spottail Shiner	*Notropis hudsonius*	No Status
Yellow Perch	*Perca flavescens*	No Status
Longnose Dace	*Rhinichthys cataractae*	No Status
Walleye	*Sander vitreus*	No Status
Blackchin Shiner	*Notropis heterodon*	No Status

* Abbreviations: SC = Special Concern, THR = Threatened, END = Endangered

4.0 METHODS

4.1 Water, Sediment and Soil Sampling

All surface water sampling sites were visited in 2018, as well as an additional two new sites (RE-11 and RE-12; Figure 2). These new sampling sites were established to act as additional up-steam reference sites and to provide greater resolution regarding water quality and chemistry from minor tributaries feeding into the larger Mennin Lake system.

In-situ water measurements and surface water sample collections occurred in June, August and October 2018. Sediment sampling occurred at all surface water sites in October 2018. Soils were re-samples at Borehole 1 in 2018: two sites on the footprint within 10 m of the borehole (BH1-01, -02), and three sites outside of the footprint (BH1-03, -04, -05). Additionally, nine soil samples were taken from the footprint of each Borehole 2 (BH2-01 – BH2-09) and 3 (BH3-01 – BH3-09). Sampling followed a 3 x 3 grid pattern with approximately 10 m spacing between sites

Surface water samples were analyzed for concentrations of polycyclic aromatic hydrocarbons (PAHs), petroleum hydrocarbons (PHCs), volatile organic compounds (VOCs) and general water quality. Soil and submerged sediment samples were analyzed for concentrations of PAHs, PHCs, VOCs, metals and inorganics. Samples were compared to Provincial and Federal guidelines to identify any exceedances. Further information, field sampling methods, detailed list of analytes, sampling design and quality control measures is available in the *Nuclear Waste Management Organization 2018 Surface Water, Sediment and Soil Quality Report, Ignace, ON* prepared by Tulloch (Tulloch 2019).

4.2 Natural Heritage Features Investigations; Borehole Sites

Field effort is summarized in Table 4. Each location (Figure 3) was visited a minimum of three times in May and June 2018. A series of assessments and surveys were performed throughout each location to describe existing conditions and to confirm the presence / absence of Natural Heritage features known to occur in the region. Field studies were performed by Tulloch Biologists and Technicians experienced in the identification of SAR, SWH and boreal flora / fauna.

Table 4 - Dates of 2018 field effort.

	Borehole Sites:				
Protocol	Borehole 4	Borehole 5	Borehole 6	Area of Interest 1	Area of Interest 2
General Reconnaissance 1	30-May-18	30-May-18	30-May-18	31-May-18	30-May-18
General Reconnaissance 2	23-Jun-18	22-Jun-18	23-Jun-18	23-Jun-18	24-Jun-18
Ecological Land Classification	30-May-18	30-May-18	30-May-18	31-May-18	30-May-18
Wildlife Cameras Deployed	30-May-18	30-May-18	30-May-18	31-May-18	30-May-18
Wildlife Cameras Retrieved	23-Jun-18	22-Jun-18	23-Jun-18	23-Jun-18	24-Jun-18
Songmeters Deployed	30-May-18	30-May-18	08-Jun-18	08-Jun-18	30-May-18
Songmeters Retrieved	07-Jun-18	07-Jun-18	23-Jun-18	23-Jun-18	07-Jun-18
Nightjar Acoustic Survey 1	28-May-18	28-May-18	N/A	N/A	28-May-18
Nightjar Acoustic Survey 2	24-Jun-18	24-Jun-18	N/A	N/A	24-Jun-18
Nightjar Acoustic Survey 3	26-Jun-18	26-Jun-18	N/A	N/A	26-Jun-18
Rare Plant Search	23-Jun-18	22-Jun-18	23-Jun-18	23-Jun-18	24-Jun-18

4.2.1 *General Reconnaissance*

General site reconnaissance was performed across each location in May and again in June 2018. This was a general encounter survey in which locations were walked in search of species or habitat types that could qualify as Natural Heritage features. Emphasis was placed on the identification of habitat that could support Threatened or Endangered SAR, candidate SWH, and / or fish habitat. Wildlife species encountered on site were documents as incidental observations.

4.2.2 *Ecological Land Classification (ELC)*

Plant communities and soil substrates across each location were described and classified according to Ontario's Ecological Land Classification (ELC) system. Soils were sampled with the use of an Engleman combination auger to a maximum depth of 120 cm (where soils permitted). Plant communities were described according to their canopy, understory and ground layer compositions. Ecosites were classified according to the 2009 Operational Draft of *Ecosites of Ontario* (Boreal Manual) as developed by the MNRF (MNR 2009, MNR 2012, MNRF 2015b).

4.2.3 *Motion Activated Wildlife Cameras (Trailcams)*

One motion activated wildlife camera (Moultrie m40i; henceforth Trailcam) was deployed at each of the five locations throughout June 2018. Borehole 6 received two Trailcams. The purpose of the Trailcam deployment was to inventory local mid to large-sized mammals. Trail cameras were baited with peanut butter and dry dog food to encourage passing wildlife to pause within the visible field of view. Cameras were motion activated and captured photos 24 hours per day. Evening photos were illuminated with an invisible infrared light.

4.2.4 *Automated Wildlife Recordings (Songmeters)*

One automated wildlife recording device (Wildlife Acoustics SM4 Songmeter) was deployed at each of the five locations for a minimum of 7 days in June 2018. Borehole 6 received two songmeters. The purpose of the songmeter deployment was to inventory local bird and amphibian populations. Songmeters were programed to record at six intervals throughout each 24-hour period; three morning recordings (5 minutes each) and three evening recordings (3 minutes each). Recording times were linked to the solar cycle, specifically; 30 minutes before sunrise, at sunrise, 30 after sunrise, at sunset, 30 minutes after sunset and 60 minutes after sunset.

4.2.5 *Nightjar Acoustic Surveys (Eastern Whip-poor-will and Common Nighthawk)*

Acoustic surveys were performed over the course of three evenings in May and June 2018. The purpose of these surveys was to confirm the presence / absence of Eastern Whip-poor-will (provincially Threatened) and Common Nighthawk (provincially Special Concern) at each site. Surveys were performed according to MNRF draft protocols (MNR 2013, MNR 2014) and included a series of 5-minute acoustic point counts performed after sunset on clear, precipitation free nights with lunar illumination of 50% or greater. A total of 16 point counts were performed during each night of survey (48 point counts total). Each point count is considered to have an effective radius of 300m. These surveys were only performed in areas where suitable nesting habitat was documented for the target species.

4.2.6 *Rare Plants*

Searches were performed for two species of rare plant associated with the Revell Batholith; Vasey's Rush and Brook Cinquefoil. Searches were performed only in areas of suitable habitat. Staff walked a tight meandering path across suitable habitat to visually identify the target species.

4.3 Borehole Access Roads

Access roads servicing Boreholes 2 and 3 were studies extensively in 2017. The methods and results of those studies are provided in the Technical Memorandum 3 prepared for NWMO in 2018 (Tulloch 2018a). In 2018, the centerline of these roads was finalized. Some additional environmental field investigations were performed during this finalization process. Only this latter effort is included in this report.

Field assessments were performed along existing roads / road beds servicing Boreholes 4, 5 and 6 as well as Areas of Interest 1 and 2. Preliminary reconnaissance of possible access routes to Borehole 6 and Area of Interest 1 were completed, as these sites were not serviced by existing roads.

4.3.1 *General Reconnaissance*

Final centerlines for access roads servicing Boreholes 2 and 3 were delineated in-field on April 24, 25, 26 and May 11, 2018 (Figure 3). Tulloch biologists were present during the final delineations of the proposed access roads to ensure that road right-of-ways were free of natural heritage features. In particular, trees were searched for evidence of nesting by migratory birds and raptors as well as for living and dead-standing cavity tress that could be suitable for colonial bat roosting (MNR 2011). Any trees supporting nests or quality roosting habitat were marked with flagging tape. Road right-of-ways were modified to avoided nests and quality bat roosting habitat.

Existing roads / road beds servicing Boreholes 4, 5 and 6 as well as Areas of Interest 1 and 2 were walked by Tulloch terrestrial and aquatic biologists in search of Natural Heritage features that could be impacted by increased traffic / road restoration that could result from nearby borehole operations. Natural Heritage features included habitat for nesting by Migratory Bird, habitat for provincial SAR and SWH.

All suitable habitat that could support nesting by Eastern Whip-poor-will (Threatened) and Common Nighthawk (Special Concern) along the access roads was surveyed as part of the Nightjar Acoustic surveys described in Section 4.2.5, above.

4.3.2 *Water Crossings*

Aquatic biologists walked all existing access roads / road beds and all confirmed / possible new road corridors in search of existing water crossings, or indications of seasonal water crossings. Assessments at any undocumented watercourses while walking proposed access routes took place between June 6 and June 7, 2018. Assessments at water crossings on the existing road network took place between August 15 August 19, 2018. Where possible, a full habitat assessment was completed both upstream and downstream of the identified crossing. Field staff recorded notes on: stream morphology and dimensions, substrate type, in-water and riparian cover, bank conditions, aquatic vegetation and existing structures. Photos were taken at each section of the crossing in the order: upstream, downstream, left bank, right bank. Notes were made on the current state of water at the crossing, as well as the watercourse permanency and fish habitat potential.

4.3.3 *Fisheries Assessments*

Gee minnow traps were used for passive sampling of small fish. Four traps were set in nearshore areas between 0.3 m and 0.6 m deep at sites RE-AFT-01 and RE-AFT-02. Traps were baited with dry dog food (dog kibble) and set for approximately 24 hours. Calculating catch per unit effort (CPUE) of minnow trapping is done by dividing the total number of fish caught by the total number of hours the traps were set for at that location. Any incidental observations of fish were also recorded. At any point, if possible, fish were captured by dip-netting and identified to species. All fish captured by minnow trapping were identified to species by qualified fisheries biologists and measured for total length (mm) and fork length (mm). Fish handling was kept to a minimum and fish were released carefully in the same general location where they were captured.

5.0 RESULTS

5.1 Water, Sediment and Soil Sampling

All 12 sampling sites were sampled for surface water quality in June and October 2018 (Figure 2). All 12 sampling sites were also visited in August 2018, but only five could be sampled due to insufficient water availability (RE-04, RE-05, RE-07, RE-08B, RE-09). *In-situ* water quality measurements were recorded during the August and October samplings. Sample detection limits were all below the provincial guidelines. Seven parameters exceeded provincial water quality guidelines in 2018:

- **pH (<6.5):** June (all sampling sites apart from RE-02), August (RE-04 and RE-07), October (all sampling sites);
- **Dissolved Aluminum (>0.075mg/L):** June (all sampling sites), August (RE-04, RE-07, RE-08B, RE-09), October (all sampling sites);
- **Iron (>0.3mg/L):** June (all sampling sites), August (all sampling sites), October (all sampling sites);
- **Cadmium (>0.0002mg/L):** October (RE-02);
- **Total Phosphorus (>0.03mg/L):** June (RE-01), August (RE-04, RE-05, RE-08B, RE-09), October (RE-03);
- **Toluene (>0.8µg/L):** August (RE-04, RE-05, RE-09), and;
- **Cobalt (>0.0009mg/L):** August (RE-05, RE-09), October (RE-02)

Sediment was collected in October 2018. Sediment composition at every site was a combination of either sand, clay, organic material and/or mud. Sample detection limits were all below the provincial guidelines. Cyanide exceeded the 0.1 ug/g guideline at sites RE-01, RE-02, RE-06 and RE-09.

Soil samples were collected at Boreholes 1, 2 and 3 in August 2018 (Figure 2). The soils at Borehole 1 consisted of outsourced gravel and sand used to establish the laydown area. Borehole 2 soils had a high volume of organics mixed throughout them dominated by fine sand. Borehole 3 soils were primarily sand and loamy sand atop of unconsolidated bedrock. Cyanide guidelines were exceeded at Borehole 2 sites BH2-02, BH2-03, BH2-10 and BH2-09 and Borehole 3 sites BH3-02, BH-03, BH3-09 and BH3-11. Two PHC guidelines were exceeded: F3 at site BH2-02, and F4 at site BH2-02.

Further information, including all surface water, sediment and soil quality raw data, laboratory analytical results and a summary of the monitoring program is available in the *Nuclear Waste Management Organization 2018 Surface Water, Sediment and Soil Quality Report, Ignace, ON* prepared by Tulloch in 2018 (Tulloch 2019).

5.2 Borehole Sites

2018 field assessment effort and results are summarized in Figure 5. Results for the borehole sites are described below. A list of all wildlife observed at each location is provided in Table 5. Locations are individually mapped in Figures 6A through 6E.

NWMO Ignace APM Phase II

Natural Heritage Assessments
2018 Field Effort and Results

Revell Area

554000 554500 555000 555500 556000 556500 557000 557500 558000 558500

5487000 5486500 5486000 5485500 5485000 5484500 5484000

DYMENT ROAD
OPR-1926
OPR-1925
OPR-1924
OPR-3121
OPR-1785
OPR-1931
OPR-2059

Area of Interest 2
Borehole 5
Borehole 4
Borehole 1
Borehole 6
Area of Interest 1
Borehole 3
Borehole 2
Water Quality Sampling Site (Mennin Lake)

0 500 1,000 2,000 3,000 4,000 Meters

Legend

- 2018 Study Area
- Existing Access Roads
- Access Road to Boreholes 2 and 3
- Watercourse
- Waterbody

Borehole Locations

- Confirmed
- Possible Future

2018 Equipment and Protocol Locations

- Wildlife Camera (Moultrie m40i)
- Songmeter (Wildlife Acoustics SM4)
- Nightjar Acoustic Survey Locations
- Aquatic Habitat Assessment
- Fisheries Assessment (Minnow Traps)
- Water & Sediment Quality Sampling
- Soil Sampling (Baseline)
- Soil Sampling (Post-impact)
- Ecological Land Classification
- Access Road Reconnaissance

2018 Wildlife and Habitat Observations

- Common Nighthawk (SC)
- Olive-sided Flycatcher (SC)
- Mallard Nest (Active)

Figure 5
PROJECT: 165010
DATE: 09/10/2019

SCALE: 1:16,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWN Track, OHN Watercourse, OHN Waterbody. Updated January 2015 through June 2016.

Data Provided by the Natural Resources Canada (GeoGratis):
None.

TULLOCH ENVIRONMENTAL

User Name: Kelly.Major
Document Path: J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\4-3-3-2 Borehole Baselines for BH4, BH5 & BH6\Figure - NWMO 2018 Field Effort and Results - Revell Area (Feb2019).mxd

5.2.1 *Borehole 4*

Borehole 4 (Figure 6A) is centered on a cleared forest access road intersection where OPR-1924 joins OPR-372. This cleared intersection approximates 50 m x 50 m in area and is dominated mostly by tall shrubs of Speckled Alder (*Alnus incana*) that have ingrown since the installation of OPR-372 (Ecosite B046SMn; Photo 1). Areas within 120 m of Borehole 4 are dominated by a low regenerating canopy of planted Jack Pine (*Pinus banksiana*) on moderately deep soils that vary from Fresh (B049TlMn; Photo 2) to Moist (B065TlMn). Sparse treed swamp (B136TlDn) was found 50m west OPR-372 (Photo 3). A second area of swamp was identified 25m east of OPR-372, in a swale between two rocky knolls (Photo 4). This wet area was too small to map as a unique ecosite (approximately 20 x 60m). See appended mapping.

Borehole 4 supports suitable nesting habitat for Eastern Whip-poor-will and Common Nighthawk, but acoustic Nightjar searches confirmed the absence of both within the Study Area. Songmeter recordings acquired at this location included periodic calls from a distant Eastern-whip-poor-will. Eastern Whip-poor-will calls are known to be audible for 500m to 1000m depending on local topography and ambient noise conditions (MNRF 2014). Eastern-whip-poor-will is therefore known to occur outside of this Study Area but somewhere within a 1000m radius.

The site supports suitable nesting habitat for many migratory bird species. Songmeters and incidental observations documented 14 species of migratory bird on the location in 2018 (Table 5). Wildlife Cameras captured photographs of Snowshoe Hare (*Lepus americanus;* Photo 5), Black Bear (*Ursus americanus;* Photo 6), and Canada Lynx (*Lynx canadensis*; Photo 7) on location. Songmeters indicated that Spring Peeper (*Pseudacris crucifer*) and Grey Treefrog (*Hyla versicolor*) breed in the vicinity of this location; likely in association with wetland B136TlDn and the wet area east of OPR-372. Habitat on location was suitable for Vasey's Rush and Brook Cinquefoil, but targeted searches did not find either species.

There were no watercourses or fish habitat observed within 120 m of Borehole 4.

5.2.1 *Borehole 5*

Borehole 5 (Figure 6C) is centered on a former forestry staging area on access road OPR-1926. This formerly cleared area approximates 80 m x 80 m in size and had begun to in-grow with Jack Pine (Photo 8). Borehole 5 and areas within 120 m are dominated by a low regenerating canopy of planted Jack Pine on fresh, moderately deep soils (B049TlMn; Photo 9). Some retained mature spruce forest exits at the northern extreme of the location (B049TtMn). See appended mapping.

Borehole 4 supports suitable nesting habitat for Eastern Whip-poor-will and Common Nighthawk, but acoustic Nightjar searches confirmed the absence of both within the Study Area. Songmeter recordings acquired at this location included periodic calls from a distant Eastern-whip-poor-will. Eastern Whip-poor-will calls are known to be audible for 500m to 1000m depending on local topography and ambient noise conditions (MNRF 2014). Eastern-whip-poor-will is therefore known to occur outside of this Study Area but somewhere within a 1000m radius.

Songmeters observed Common Nighthawk foraging in vicinity to the location. Common Nighthawk is not likely to be nesting on location. This conclusion is based on: (1) the infrequency of the species being

observed on / over the location (1 of 24 evening songmeter recordings and 0 of 3 Nightjar surveys), and (2) as the species was not flushed from a nest at any time during the field investigations.

Borehole 5 supports suitable nesting habitat for many migratory bird species. Songmeters and incidental observations observed 15 species of migratory bird on the location in 2018 (Table 5). Olive-sided flycatcher (Special Concern) was observed calling in May and June from a 3-ha fragment of forest 100m north of the location center. The presence of a special concern songbird species defending a territory indicates that this wooded forest fragment is a candidate SWH for *Special Concern and Rare Wildlife Species*. If this habitat is significant (i.e. if Olive-sided Flycatcher is successfully breeding), the significant habitat would be defined as the wooded forest fragment. Retention of this wooded habitat is advised in order to preserve its ecological function.

Wildlife Cameras captured photographs of Black Bear on location. No suitable amphibian breeding habitat was found on location but songmeters observed that Spring Peeper, Grey Treefrog and American Toad (*Bufo americanus*) may breed in the vicinity. Habitat on location was suitable for Vasey's Rush and Brook Cinquefoil, but targeted searches did not find either species.

There were no watercourses or fish habitat observed within 120 m of Borehole 5.

5.2.1 *Borehole 6*

Borehole 6 (Figure 6E) is located in an undeveloped and mature conifer stand. The majority of the site is Black Spruce and Jack Pine on moderately deep fresh soils (B049TtMn; Photo 10). One swale runs through the center of the location producing moister conditions (B065TtMn). See appended mapping.

Borehole 6 does not support suitable nesting habitat for Eastern Whip-poor-will or Common Nighthawk, but songmeters observed that the latter will forage above the location. Songmeter recordings also observed one instance of an Eastern-whip-poor-will calling in the distance. Eastern Whip-poor-will calls are known to be audible for 500m to 1000m depending on local topography and ambient noise conditions (MNRF 2014). The closest suitable nesting habitat for Eastern-whip-poor-will is situated 200m north of this location. Eastern-whip-poor-will is therefore known to occur somewhere between 200m and 1000m north of this location.

The site supports suitable nesting habitat for many migratory bird species. Songmeters and incidental observations observed 14 species of migratory bird on the location in 2018 (Table 5). Wildlife Cameras captured photographs of Black Bear, Snowshoe Hare and Moose (*Alces alces*; Photo 11) on location. No suitable amphibian breeding habitat was found on location but songmeters observed that Spring Peeper, Grey Treefrog and American Toad may breed in vicinity. One mature Wood Frog (*Lithobates sylvaticus*) was observed incidentally on location. Habitat on location was not suitable for Vasey's Rush and Brook Cinquefoil.

There were no watercourses or fish habitat observed within 120 m of Borehole 6.

5.2.1 *Area of Interest 1*

Area of Interest 1 (Figure 6B) is located in an undeveloped and mature conifer stand. The majority of the site is Black Spruce (*Picea mariana*) and Jack Pine, with components of Trembling Aspen (*Populus tremuloides*) and White Birch (*Betula papyrifera*), on moderately deep fresh soils (ecosite B049TtMn; Photo 12). One swale runs linearly through the northwest of the location producing moister conditions (B065TtMn). See appended mapping.

Area of Interest 1 does not support suitable nesting habitat for Eastern Whip-poor-will or Common Nighthawk, but songmeters observed that the latter will forage above the location. The site supports suitable nesting habitat for many migratory bird species. Songmeters and incidental observations observed 13 species of migratory bird on the location in 2018 (Table 5). Wildlife Cameras captured photographs of Black Bear (Photo 13) on location. No suitable amphibian breeding habitat was found on location and songmeters did not observe amphibian vocalisations near the location. Habitat on location was not suitable for Vasey's Rush and Brook Cinquefoil.

There were no watercourses or fish habitat observed within 120 m of Area of Interest 1.

5.2.2 *Area of Interest 2*

Area of Interest 2 (Figure 6D) is centered on a cleared staging area of forest access road OPR-372. This cleared area approximates 40 m x 30 m in area. The location is situated on shallow to moderately deep, fresh soil substrates. The location is dominated to the north by a mix of young Trembling Aspen and Jack Pine (ecosite B055TlMn; Photo 14) and to the south by a near pure plantation of young Jack Pine (B049TlMn; Photo 15). See appended mapping.

Area of Interest 2 supports suitable nesting habitat for Eastern Whip-poor-will and Common Nighthawk. Acoustic Nightjar searches confirmed the absence of Eastern Whip-poor-will. Common Nighthawk was incidentally observed foraging over the site on one occasion. Common Nighthawk is not likely to be nesting on location. This conclusion is based on: (1) the infrequency of the species being observed on / over the location (not observed during any of the 24 evening songmeter recordings or 3 Nightjar surveys), and (2) as the species was not flushed from a nest at any time during the field investigations. Common Nighthawk forages over broad areas each evening and is believed to be foraging over the regenerating cutover in which Area of Interest 2 is situated.

Songmeter recordings acquired at this location included periodic calls from a distant Eastern-whip-poor-will. Eastern Whip-poor-will calls are known to be audible for 500m to 1000m depending on local topography and ambient noise conditions (MNRF 2014). Eastern-whip-poor-will is therefore known to occur outside of this Study Area but somewhere within a 1000m radius.

Area of Interest 2 supports suitable nesting habitat for many migratory bird species. Songmeters and incidental observations observed 16 species of migratory bird on the location in 2018 (Table 5). Wildlife Cameras captured photographs of Snowshoe Hare (Photo 16) and Grey Wolf (*Canis lupus*; Photo 17) on location. No suitable amphibian breeding habitat was found on location but songmeters observed that Spring Peeper, Grey Treefrog and American Toad may breed in the vicinity. Habitat on location was suitable for Vasey's Rush and Brook Cinquefoil, but targeted searches did not find either species.

There were no watercourses or fish habitat observed within 120 m of Area of Interest 2.

Table 5 - Species identified on / near each site. 'Near Site' is defined here as areas within perceptible limits of the Site and typically refers to a species that was heard calling from areas adjacent the Site. Audible distance varies by species and vocalization type. Species presence can indicate a variety of possible habitat usages, including: foraging, migration, breeding or transitory occupation. Species statuses according to the Canadian Migratory Birds Convention Act (MBCA), Ontario Endangered Species Act (ESA) and Canadian Species at Risk Act (SARA) are also provided.

Species Common Name	Species Scientific Name	MBCA	ESA	SARA	Observations at Each Site				
					Borehole 4	Borehole 5	Borehole 6	Area of Interest 1	Area of Interest 2
Bird Species									
Alder Flycatcher	*Empidonax alnorum*	Migratory	-	-	Songmeter On Site	Songmeter On Site	-	-	Songmeter On Site
American Bittern	*Botaurus lentiginosus*	Migratory	-	-	-	Songmeter Near Site	Songmeter Near Site	-	-
American Redstart	*Setophaga ruticilla*	Migratory	-	-	-	Incidental On Site	Songmeter On Site	-	Incidental On Site
Black-capped Chickadee	*Poecile atricapilla*	Migratory	-	-	-	-	Songmeter On Site	Songmeter On Site	Songmeter On Site
Black-throated Green Warbler	*Setophaga virens*	Migratory	-	-	-	Incidental On Site	-	-	-
Blue Jay	*Cyanocitta cristata*	-	-	-	Incidental On Site	-	-	-	Incidental On Site
Blue-headed Vireo	*Vireo solitarius*	Migratory	-	-	-	-	Songmeter On Site	Songmeter Near Site	Songmeter On Site
Brown Creeper	*Certhia americana*	Migratory	-	-	-	-	Songmeter On Site	-	-
Canada Goose	*Branta canadensis*	Migratory	-	-	Incidental Near Site	Incidental Near Site	-	-	Incidental Near Site
Cedar Waxwing	*Bombycilla cedrorum*	Migratory	-	-	Songmeter On Site	-	-	-	-
Chestnut-sided Warbler	*Dendroica pensylvanica*	Migratory	-	-	Songmeter On Site	Songmeter On Site	-	-	Songmeter On Site
Chipping Sparrow	*Spizella passerina*	Migratory	-	-	-	Songmeter On Site	Songmeter On Site	Songmeter On Site	-
Common Loon	*Gavia immer*	Migratory	-	-	-	-	Songmeter Near Site	Songmeter Near Site	-
Common Nighthawk	*Chordeiles minor*	Migratory	SC	THR	Songmeter Near Site	Songmeter Near Site	Songmeter Over Site	Songmeter Over Site	Incidental Over Site
Common Raven	*Corvus corax*	-	-	-	-	Songmeter On Site	-	Songmeter Near Site	-
Dark-eyed Junco	*Junco hyemalis*	Migratory	-	-	Incidental On Site	-	Songmeter On Site	Songmeter On Site	Songmeter On Site
Eastern Whip-poor-will	*Caprimulgus vociferus*	Migratory	THR	THR	Songmeter Near Site	Songmeter Near Site	Songmeter Near Site	-	Songmeter Near Site
Eastern Wood-pewee	*Contopus virens*	Migratory	SC	SC	-	-	-	-	Incidental Near Site

Species Common Name	Species Scientific Name	MBCA	ESA	SARA	Observations at Each Site				
					Borehole 4	Borehole 5	Borehole 6	Area of Interest 1	Area of Interest 2
Golden-crowned Kinglet	*Regulus satrapa*	Migratory	-	-	-	Incidental On Site	Songmeter On Site	Songmeter On Site	-
Gray Jay	*Perisoreus canadensis*	-	-	-	-	-	Songmeter On Site	Trailcam On Site	Songmeter Near Site
Hermit Thrush	*Catharus guttatus*	Migratory	-	-	Songmeter On Site	Songmeter On Site	Songmeter On Site	Songmeter Near Site	Songmeter On Site
Least Flycatcher	*Empidonax minimus*	Migratory	-	-	Incidental On Site	-	-	Songmeter On Site	-
Mallard Duck	*Anas platyrhynchos*	Migratory	-	-	-	-	Incidental Near Site	-	-
Mourning Warbler	*Oporornis philadelphia*	Migratory	-	-	Songmeter On Site	Songmeter On Site	-	-	Songmeter Near Site
Nashville Warbler	*Vermivora ruficapilla*	Migratory	-	-	Songmeter On Site	Songmeter On Site	Songmeter On Site	Songmeter On Site	Songmeter On Site
Northern Flicker	*Colaptes auratus*	Migratory	-	-	Songmeter Near Site	-	-	-	-
Northern Parula	*Setophaga americana*	Migratory	-	-	-	-	-	Songmeter On Site	-
Northern Waterthrush	*Seiurus noveboracensis*	Migratory	-	-	-	Songmeter Near Site	-	-	Songmeter On Site
Olive-sided Flycatcher	*Contopus cooperi*	Migratory	SC	THR	-	Songmeter On Site	Songmeter Near Site	Incidental Near Site	Songmeter Near Site
Ovenbird	*Seiurus aurocapillus*	Migratory	-	-	-	-	-	-	Songmeter On Site
Palm Warbler	*Setophaga palmarum*	Migratory	-	-	Incidental On Site	-	-	-	-
Pine Siskin	*Carduelis pinus*	Migratory	-	-	-	-	Songmeter On Site	Songmeter On Site	-
Purple Finch	*Carpodacus purpureus*	Migratory	-	-	-	-	-	-	Songmeter On Site
Red-Bellied Woodpecker	*Melanerpes carolinus*	Migratory	-	-	-	-	Songmeter Near Site	Songmeter On Site	-
Red-breasted Nuthatch	*Sitta canadensis*	Migratory	-	-	-	-	Songmeter Near Site	Incidental On Site	-
Red-eyed Vireo	*Vireo olivaceus*	Migratory	-	-	Songmeter Near Site	Incidental On Site	-	-	Songmeter On Site
Red-tailed Hawk	*Buteo jamaicensis*	-	-	-	-	Incidental Near Site	-	-	-

Species Common Name	Species Scientific Name	MBCA	ESA	SARA	Observations at Each Site				
					Borehole 4	Borehole 5	Borehole 6	Area of Interest 1	Area of Interest 2
Roughed Grouse	*Bonasa umbellus*	-	-	-	-	-	-	Incidental Near Site	-
Ruby-crowned Kinglet	*Regulus calendula*	Migratory	-	-	Songmeter On Site	Songmeter Near Site	Songmeter On Site	Songmeter On Site	Incidental On Site
Ruby-throated Hummingbird	*Archilochus colubris*	Migratory	-	-	-	Incidental On Site	-	-	-
Sandhill Crane	*Grus canadensis*	Migratory	-	-	-	Songmeter Near Site	Songmeter Near Site	Songmeter Near Site	Incidental Near Site
Veery	*Catharus fuscescens*	Migratory	-	-	-	-	-	-	Songmeter Near Site
White-throated Sparrow	*Zonotrichia albicollis*	Migratory	-	-	Songmeter On Site	Songmeter On Site	Songmeter Near Site	Songmeter Near Site	Songmeter On Site
Wilson's Snipe	*Gallinago delicata*	Migratory	-	-	Songmeter On Site	-	-	Incidental Near Site	Songmeter Near Site
Winter Wren	*Troglodytes troglodytes*	Migratory	-	-	-	Songmeter On Site	-	-	Songmeter Near Site
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Migratory	-	-	Songmeter On Site	Songmeter Near Site	Songmeter On Site	-	-
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Migratory	-	-	-	Incidental On Site	-	-	-
Yellow-rumped Warbler	*Setophaga coronata*	Migratory	-	-	Incidental On Site	-	-	-	Incidental On Site
Amphibian Species									
American Toad	*Bufo americanus*	-	-	-	Songmeter Near Site	Songmeter Near Site	Songmeter Near Site	Songmeter Near Site	Songmeter Near Site
Gray Treefrog	*Hyla versicolor*	-	-	-	Songmeter On Site	Songmeter Near Site	Songmeter Near Site	Songmeter Near Site	Songmeter Near Site
Green Frog	*Rana clamitans*	-	-	-		-	Songmeter Near Site	Songmeter Near Site	-
Spring Peeper	*Pseudacris crucifer*	-	-	-	Songmeter On Site	Songmeter Near Site	-	-	Songmeter Near Site
Wood Frog	*Lithobates sylvaticus*	-	-	-	-	-	Incidental On Site	-	-
Mammal Species									
Black Bear	*Ursus americanus*	-	-	-	Trailcam On Site	Trailcam On Site	Trailcam On Site	Trailcam On Site	-
Canada Lynx	*Lynx canadensis*	-	-	-	Trailcam On Site	-	-	-	-

Species Common Name	Species Scientific Name	MBCA	ESA	SARA	Observations at Each Site				
					Borehole 4	Borehole 5	Borehole 6	Area of Interest 1	Area of Interest 2
Gray Wolf	*Canis lupus*	-	-	-	-	-	-	-	Trailcam **On Site**
Moose	*Alces alces*	-	-	-	-	-	Trailcam **On Site**	-	-
Snowshoe Hare	*Lepus americanus*	-	-	-	Trailcam **On Site**	-	Trailcam **On Site**	-	Trailcam **On Site**

Photo 1 – Borehole 4: Ecosite B046SMn.

Photo 2 – Borehole 4: Ecosite B049TlMn.

Photo 3 – Borehole 4: Ecosite B136TlDn.

Photo 4 – Borehole 4: Swamp in wet swale.

Photo 5 – Borehole 4: Snowshoe Hare.

Photo 6 – Borehole 4: Black Bear.

Photo 7 – Borehole 4: Canada Lynx.

Photo 8 – Borehole 5: Ecosite B049TlMn, pad.

Photo 9 – Borehole 5: Ecosite B049TlMn, pad.

Photo 10 – Borehole 6: Ecosite B049TtMn

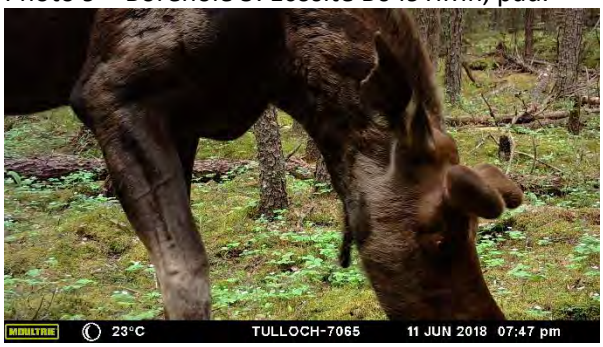


Photo 11 – Borehole 6: Moose.

Photo 12 – Area of Interest 1: Ecosite B049TtMn

Photo 13 – Area of Interest 1: Juvenile Black Bear.


Photo 14 – Area of Interest 2: Ecosite B055TlMn.

Photo 15 – Area of Interest 2: Ecosite B049TlMn

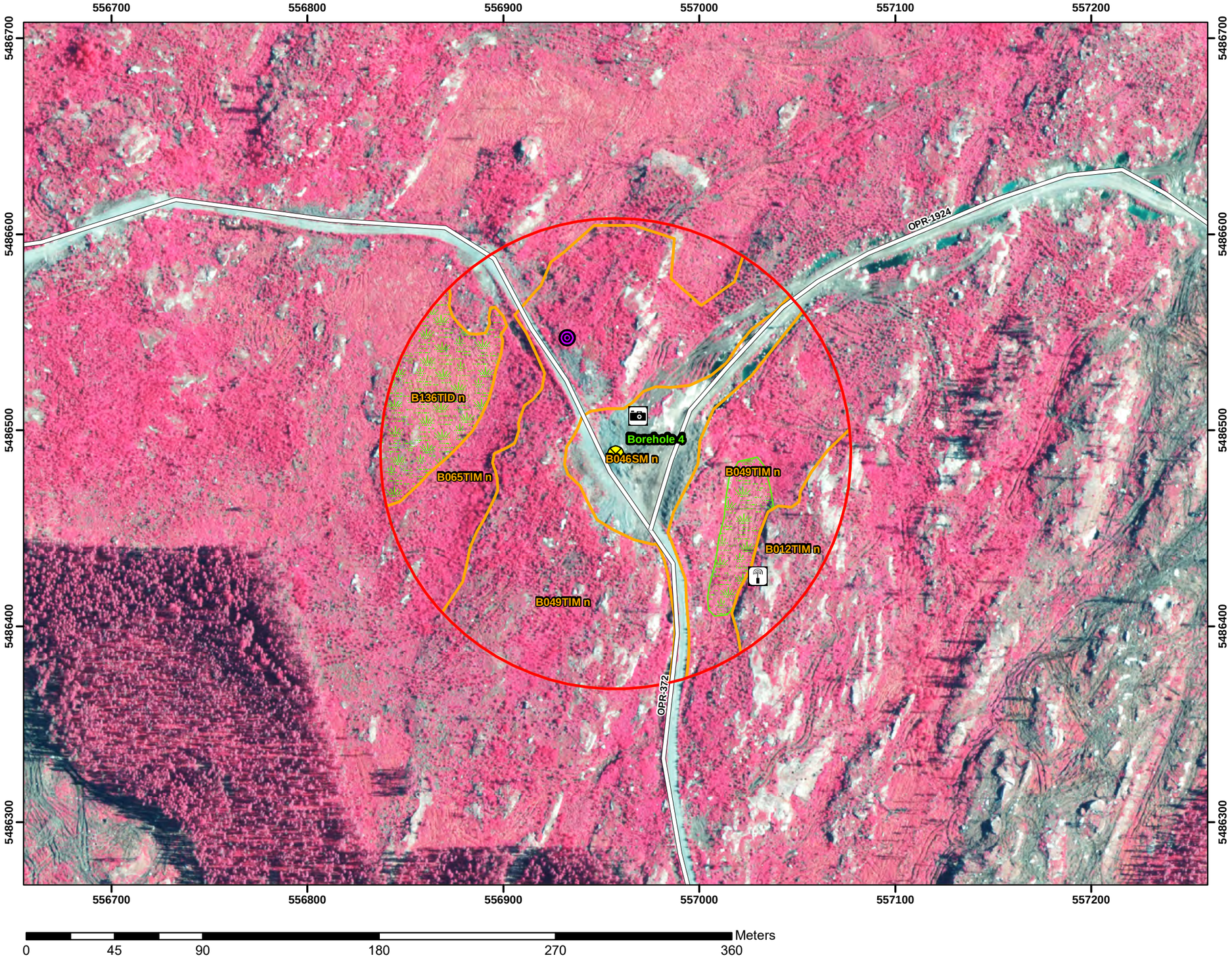
Photo 16 – Area of Interest 2: Snowshoe Hare.

Photo 17 – Area of Interest 2: Grey Wolf.

NWMO Ignace APM Phase II

Natural Heritage Assessments
2018 Field Effort and Results

Borehole 4



Legend

- 2018 Study Area
- Existing Road / Road Bed

Borehole Sites

- Confirmed

Equipment and Protocol Locations

- Wildlife Camera (Moultrie m40i)
- Songmeter (Wildlife Acoustics SM4)
- Nightjar Acoustic Survey Locations
- ELC Ecosite
- Wet Soils

Figure 6A
PROJECT: 165010
DATE: 09/10/2019

SCALE: 1:2,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, OHN Watercourse, OHN Waterbody. Updated January 2015 through June 2016.

Data Provided by the Natural Resources Canada (GeoGratis):
None.

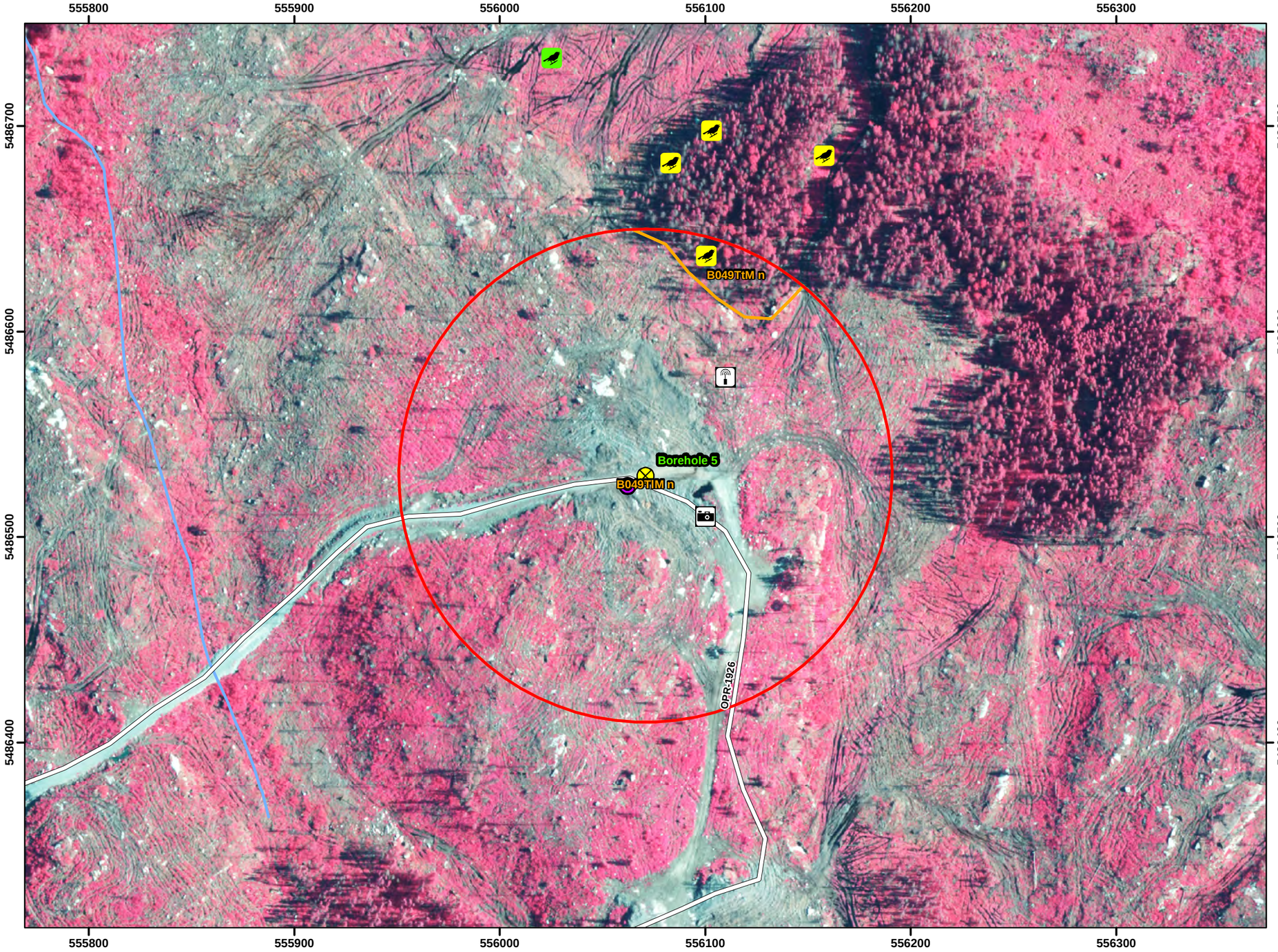
TULLOCH ENVIRONMENTAL

User Name: Kelly.Major
Document Path: J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\4-3-3-2 Borehole Baselines for BH4, BH5 & BH6\Figure - NWMO 2018 Field Effort and Results - Locations A to F (Jan2019).mxd

NWMO Ignace APM Phase II

Natural Heritage Assessments
2018 Field Effort and Results

Borehole 5



Legend

- 2018 Study Area
- Existing Road / Road Bed
- Watercourse

Borehole Sites

- Confirmed

Equipment and Protocol Locations

- Wildlife Camera (Moultrie m40i)
- Songmeter (Wildlife Acoustics SM4)
- Nightjar Acoustic Survey Locations
- ELC Ecosite

Wildlife and Habitat Observations

- Common Nighthawk (SC)
- Olive-sided Flycatcher (SC)

Figure 6B
PROJECT: 165010
DATE: 09/10/2019

SCALE: 1:2,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, OHN Watercourse, OHN Waterbody. Updated January 2015 through June 2016.

Data Provided by the Natural Resources Canada (GeoGratis):
None.

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User Name: Kelly.Major
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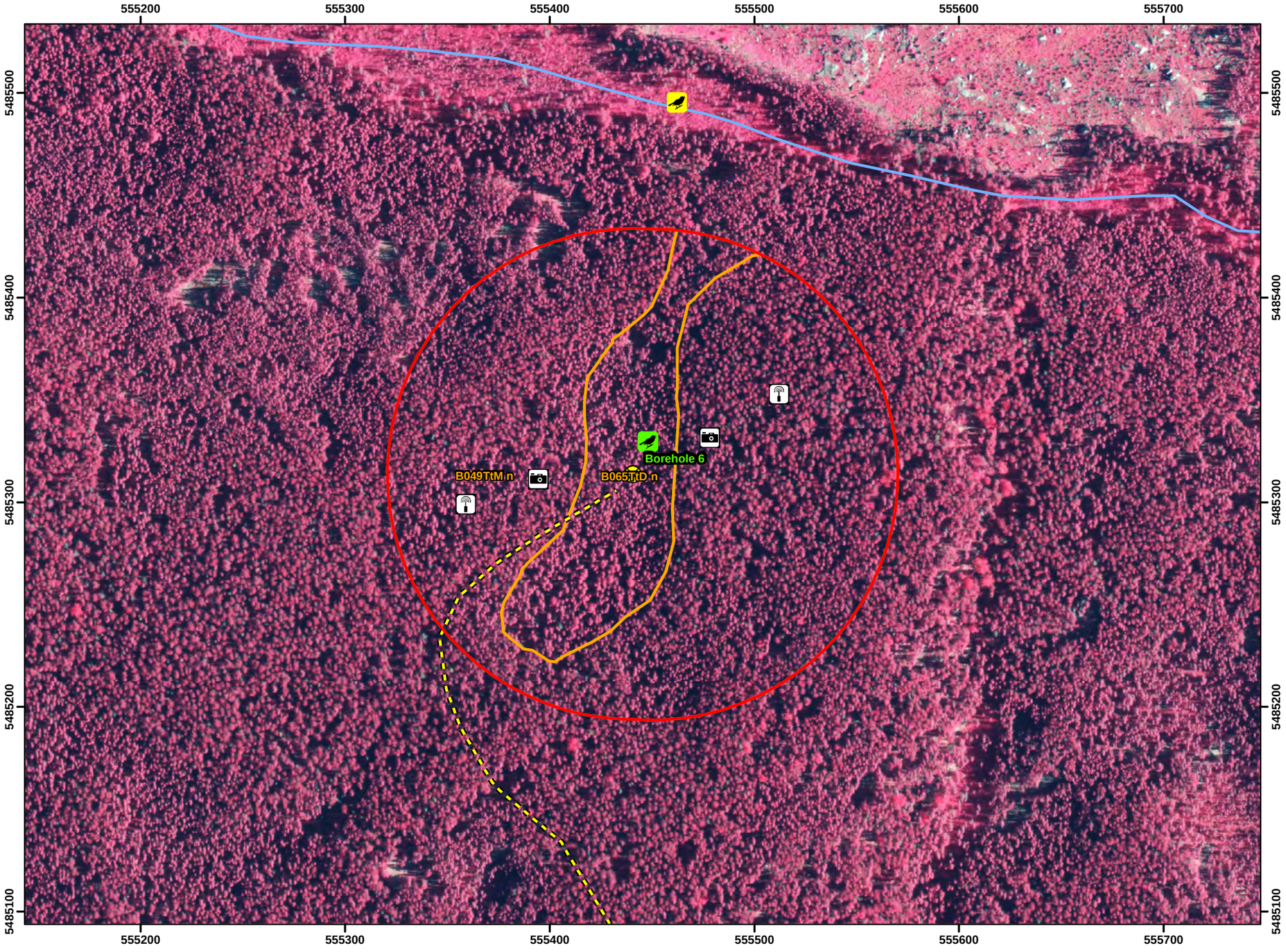
NWMO Ignace APM Phase II

Natural Heritage Assessments
2018 Field Effort and Results

Borehole 6



Legend

- 2018 Study Area
- Watercourse

Borehole Sites

- Confirmed

Equipment and Protocol Locations

- Wildlife Camera (Moultrie m40i)
- Songmeter (Wildlife Acoustics SM4)
- ELC Ecosite
- Possible Site Access

Wildlife and Habitat Observations

- Common Nighthawk (SC)
- Olive-sided Flycatcher (SC)

Figure 6C
PROJECT: 165010
DATE: 09/10/2019

SCALE: 1:2,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, OHN Watercourse, OHN Waterbody. Updated January 2015 through June 2016.

Data Provided by the Natural Resources Canada (GeoGratis):
None.

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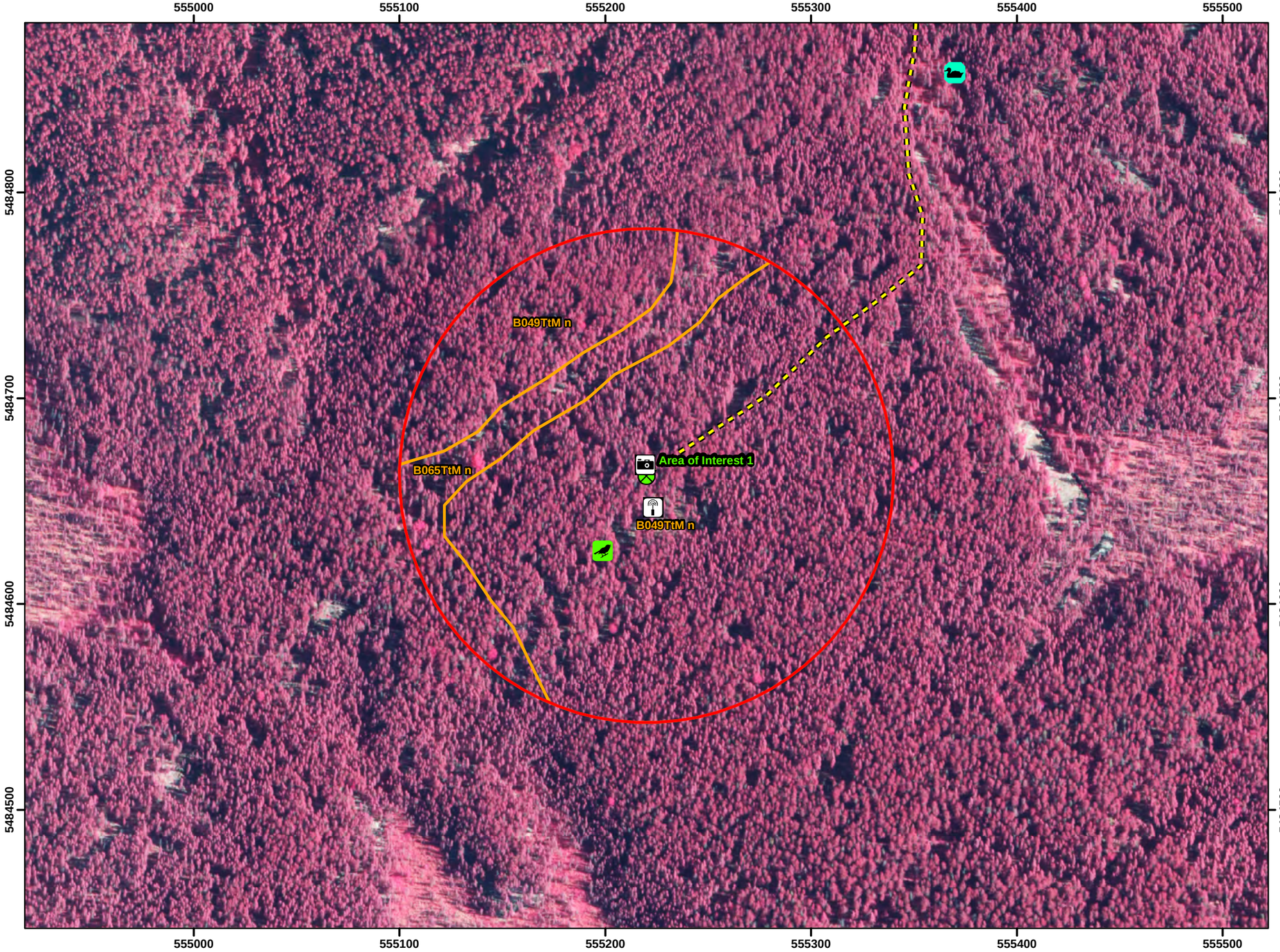
User Name: Kelly.Major
Document Path: J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\4-3-3-2 Borehole Baselines for BH4, BH5 & BH6\Figure - NWMO 2018 Field Effort and Results - Locations A to F (Jan2019).mxd



NWMO Ignace APM Phase II

Natural Heritage Assessments
2018 Field Effort and Results

Area of Interest 1

Legend

- 2018 Study Area

Borehole Sites

- Possible Future

Equipment and Protocol Locations

- Wildlife Camera (Moultrie m40i)
- Songmeter (Wildlife Acoustics SM4)
- ELC Ecosite
- Possible Site Access

Wildlife and Habitat Observations

- Common Nighthawk (SC)
- Mallard Nest (Active)

Figure 6D
PROJECT: 165010
DATE: 09/10/2019

SCALE: 1:2,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, OHN Watercourse, OHN Waterbody. Updated January 2015 through June 2016.

Data Provided by the Natural Resources Canada (GeoGratis):
None.

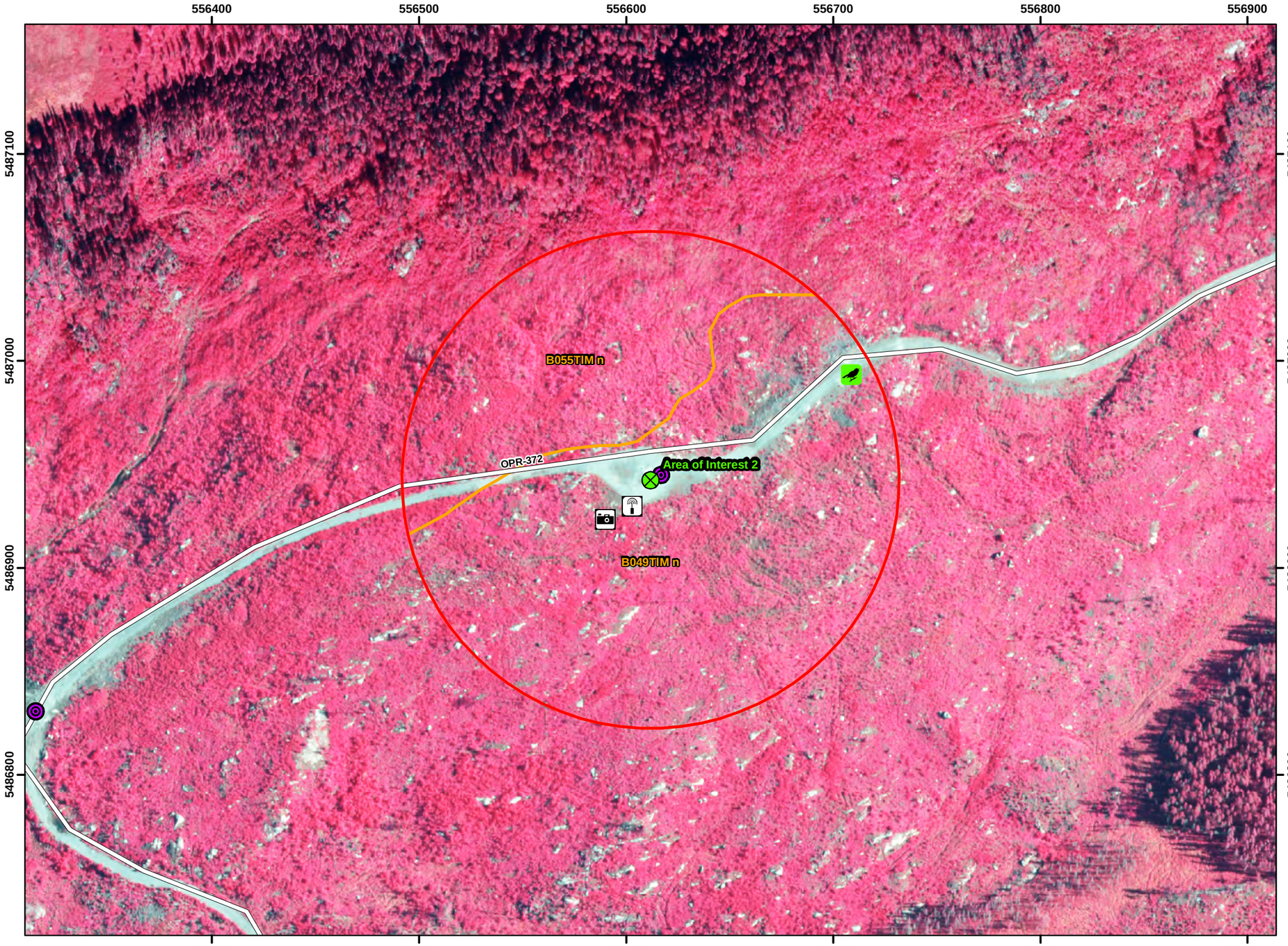
TULLOCH ENVIRONMENTAL

User Name: Kelly.Major
Document Path: J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\4-3-3-2 Borehole Baselines for BH4, BH5 & BH6\Figure - NWMO 2018 Field Effort and Results - Locations A to F (Jan2019).mxd

NWMO Ignace APM Phase II

Natural Heritage Assessments
2018 Field Effort and Results

Area of Interest 2



Legend

- 2018 Study Area
- Existing Road / Road Bed

Borehole Sites

- Possible Future

Equipment and Protocol Locations

- Wildlife Camera (Moultrie m40i)
- Songmeter (Wildlife Acoustics SM4)
- Nightjar Acoustic Survey Locations
- ELC Ecosite

Wildlife and Habitat Observations

- Common Nighthawk (SC)

Figure 6E
PROJECT: 165010
DATE: 09/10/2019

SCALE: 1:2,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, OHN Watercourse, OHN Waterbody. Updated January 2015 through June 2016.

Data Provided by the Natural Resources Canada (GeoGratis):
None.

TULLOCH ENVIRONMENTAL

User Name: Kelly.Major
Document Path: J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\4-3-3-2 Borehole Baselines for BH4, BH5 & BH6\Figure - NWMO 2018 Field Effort and Results - Locations A to F (Jan2019).mxd

5.3 Borehole Access Roads

5.3.1 *General Reconnaissance*

Final centerlines for access roads servicing Boreholes 2 and 3 were delineated in-field on April 24, 25, 26 and May 11, 2018 (Figure 3). Tulloch biologists observed no large stick nests indicative of raptor nesting along the finalized right-of-way. No evidence of nesting by migratory bird species was observed within the right-of-way, but small nest sizes produced by some species (e.g. Ruby-throated Humming Bird, Kinglet species) coupled with the evergreen conifer canopies reduces the efficacy of such searches.

No quality habitat for colonial bat roosting was observed within the road right-of-way. Trees were predominantly small (<25cm DBH) and comprise of non-preferred species (spruce and fir). Habitat throughout the right-of-way may support transient day-roosting by individual male and non-gravid female bats.

Access roads to Boreholes 4, 5 and 6 as well as Areas of Interest 1 and 2 varied from non-existent to exiting and serviceable, Table 6. Habitat and wildlife observations along these road corridors are depicted in Figure 5.

Table 6 – Access roads servicing Boreholes 4, 5 and 6 as well as Areas of Interest 1 and 2.

Location	Access Road	Condition	Features
Borehole 4	OPR-372	**Roadbed present.** Partly Overgrown with Speckled Alder	**Confirmed Present:** 2 Water Crossings **Possible:** Migratory Bird Nesting Common Nighthawk (in vicinity) **Confirmed Absent:** Eastern Whip-poor-will
Borehole 5	OPR-1926	**Roadbed present.** Overgrown with Speckled Alder	**Confirmed Present:** 1 Water Crossing **Possible:** Migratory Bird Nesting Common Nighthawk (in vicinity) **Confirmed Absent:** Eastern Whip-poor-will
Borehole 6	None.	Natural.	Road not established. Studies not performed.
Area of Interest 1	None.	Natural.	Road not established. Studies not performed.
Area of Interest 2	OPR-372	**Roadbed present.** Partly Overgrown with Speckled Alder	**Confirmed Present:** 2 Water Crossings **Possible:** Migratory Bird Nesting Common Nighthawk (in vicinity) **Confirmed Absent:** Eastern Whip-poor-will

5.3.2 *Water Crossings*

Fifteen water crossings were identified during both June 2018 and August 2018 field monitoring (RE-AHA-01 – RE-AHA-15; Figure 7). A full summary of the aquatic habitat assessments performed at the identified water crossings is provided in Table 7. All crossings had no water present, apart from RE-AHA-01 which had a small isolated mud section downstream of the culvert and a small pool upstream of it, the downstream section of RE-AHA-13, and a 10 m surface flowing section at RE-AHA-15. This suggests that most of these watercourses are maintained by seasonal flooding. Aquatic assessments were often completed using bankfull water marks. Generally, assessments of wetted depth and width, stream structure, velocity, aquatic vegetation, and water quality could not be completed. Although, the downstream section of RE-AHA-13 supporting a water depth of 0.15 m, a wetted width of 0.5 m, and was identified as 100% run with no aquatic vegetation. Additionally, the surface flow identified at RE-AHA-15 had a mean depth of 0.06 m, a wetted width of 0.40 m, and was 100% run with filamentous algae (30%) present. Assessments of in-water cover, and substrate type were attempted but should be re-assessed during high-water levels.

All water crossings identified on existing access roads had either a corrugated steel pipe (CSP) culvert or a high-density polyethylene pipe (HDSP) culvert present. Dimensions for each one can be found in Table 7. No existing structures were identified on the proposed road corridors. All water crossings assessed were classified as indirect and/or not fish habitat, apart from RE-AHA-01, which was identified as direct fish habitat. Section lengths less than 50 m occurred when watercourses extended into flat floodplains, making assessments unreliable. Bankfull width, bankfull depth, bank height and bank slope varied substantially between crossings, and between upstream and downstream sections of crossings (Table 7). No measurements of bankfull width, depth or bank height could be completed at RE-AHA-14 because flow was subsurface. Small pockets of subsurface flow were identified at sites RE-AHA-14 and RE-AHA-15, rendering upstream and downstream assessments of the identified areas uninformative. Channel slope remained relatively the same (1-4%) between, and within crossings.

Table 7 - Summary of 2018 habitat assessments performed at water crossings

Site	Location	Section Length (m)	Bankfull Width (m)	Bankfull Depth (m)	Bank Height (m)	Bank Slope (%)	Channel Slope (%)	Structure Type	Structure Dimensions (*l* x *w* x *h*)	Comments
RE-AHA-01	Upstream	50	2.0	1.20	0.15	5	1	CSP Culvert	*15* x *1.1* x *1.1*	Direct fish habitat. Small amount of water present. 3 fish captured.
	Downstream	50	2.2	0.30	0.10	30	2			
RE-AHA-02	Upstream	50	2.0	0.35	0.30	20	1	HDPE Culvert	*10* x *0.30 x* 0.30	Dry channel. Indirect / not fish habitat. Seasonal flow.
	Downstream	50	0.2	0.20	0.10	60	1			
RE-AHA-03	Upstream	50	0.8	0.25	0.08	10	1	HDPE Culvert	*15* x *0.30* x *0.30*	Dry channel. Indirect / not fish habitat. Seasonal flow.
	Downstream	40	0.5	0.60	0.05	7	2			
RE-AHA-04	Upstream	50	2.0	0.50	0.15	10	2	CSP Culvert	*20* x *1.5* x *1.6*	Dry channel. Indirect fish habitat. Seasonal flow.
	Downstream	50	1.5	0.80	0.10	10	3			
RE-AHA-05	Upstream	50	1.1	0.60	0.15	15	4	CSP Culvert	*15* x *0.73* x *0.73*	Dry channel. Indirect / not fish habitat. Seasonal flow.
	Downstream	50	1.3	0.45	0.05	15	3			
RE-AHA-06	Upstream	75	1.5	0.65	0.30	10	2	HDPE Culvert	*15 x 0.30 x 0.30*	Dry channel. Indirect / not fish habitat. Seasonal flow.
	Downstream	30	0.8	0.40	0.30	50	3			
RE-AHA-07	Upstream	50	0.8	0.40	0.20	30	4	HDPE Culvert	*15 x 0.30 x 0.30*	Dry channel. Indirect / not fish habitat. DS is a flat floodplain.
	Downstream	40	NA	NA	NA	NA	NA			
RE-AHA-08	Upstream	50	0.8	0.50	0.25	15	2	HDPE Culvert	*15 x 0.30 x 0.30*	Dry channel. Indirect / not fish habitat. Seasonal flow.
	Downstream	40	1.1	0.55	0.40	50	2			

Site	Location	Section Length (m)	Bankfull Width (m)	Bankfull Depth (m)	Bank Height (m)	Bank Slope (%)	Channel Slope (%)	Structure Type	Structure Dimensions (*l* x *w* x *h*)	Comments
RE-AHA-09	Upstream	50	1.0	0.30	0.05	5	2	HDPE Culvert	*15 x 0.30 x 0.30*	Dry. Poorly defined morphology. Indirect / not fish habitat.
	Downstream	10	2.2	0.55	0.05	90	2			
RE-AHA-10	Upstream	50	NA	0.15	0.10	15	3	HDPE Culvert	*15 x 0.30 x 0.30*	Dry. Indirect / not fish habitat. Flat flooding area.
	Downstream	15	NA	0.15	0.10	70	2			
RE-AHA-11	Upstream	50	5.0	0.75	0.23	30	2	HDPE Culvert	*15 x 0.30 x 0.30*	Dry channel. Indirect / not fish habitat. Seasonal flow.
	Downstream	40	1.4	0.40	0.05	45	2			
RE-AHA-12	Upstream	50	0.5	0.35	0.10	10	2	HDPE Culvert	*15 x 0.30 x 0.30*	Dry channel. Indirect / not fish habitat. Seasonal flow / flooding.
	Downstream	40	0.8	0.30	0.10	60	3			
RE-AHA-13	Upstream	50	2.5	0.65	1	8	3	NA	*NA*	No flow upstream. Channelized flow downstream.
	Downstream	40	0.35	0.50	0.20	NA	2			
RE-AHA-14	NA	75	NA	NA	NA	5	4	NA	*NA*	Subsurface flow. Small pocket of water.
RE-AHA-15	NA	50	0.60	0.21	0.15	45	2	NA	*NA*	Subsurface flow US and DS. 10 m of flowing water.

CSP = corrugated steel pipe
HDPE = high-density polyethylene pipe

Photo 18 - Right bank facing (North) photo of flowing water downstream of crossing RE-AHA-13.

Photo 19 – Minimal surficial flow of at proposed crossing RE-AHA-14 location.

Photo 20 - Downstream facing (North) photo of flowing water at crossing RE-AHA-15 location.

5.3.3 *Fisheries Assessments*

Fish collected locations are identified in Figure 7. Fish collection efforts in 2018 are summarized in Table 8. Four minnow traps were set at site RE-AFT-01 on August 16th, 2018 and retrieved the following day, totalling 79.1 hours of minnow trapping effort. This effort resulted in two White Sucker being captured with a mean total length of 105 mm. The CPUE totalled 0.03 fish / hour. During August 2018 sampling, water levels at site RE-AFT-01 were low, with very limited flow. However, White Sucker are highly adaptable, and able to survive and reproduce in waters with limited oxygen. Therefore, it is not notable that this species, along with no others, was captured in this location. Four minnow traps were also set at site RE-AFT-02 on August 17th, 2018 and retrieved the following day, totalling 105.6 hours of minnow trapping effort. This effort resulted in 19 Yellow Perch being caught. The CPUE totalled 0.18 fish / hour. The mean total length of the yellow perch captured was 66.7 mm. Sampling location RE-AFT-02 is directly downstream of a larger waterbody (approximately 0.5 km x 0.23 km) in a channel nearly 10 m wide. The traps were set in-shore near highly vegetated surface waters, indicative of where Yellow Perch frequent during the summer months.

Table 8 - Summary of minnow trapping efforts in 2018

Location	Trap #	Set Date (d-m-y)	Set Time	Pull Date (d-m-y)	Pull Time	Total Hours	Species	# Caught	CPUE (fish/hour)
RE-AFT-01	4	16-08-18	14:21	17-08-18	10:08	79.1	WHSC	2	0.03
RE-AFT-02	4	17-08-18	13:31	18-08-18	15:55	105.6	YLPR	19	0.18

WHSC = White Sucker
YLPR = Yellow Perch

A third fish collection event occurred in 2018 during an aquatic habitat assessment at a water crossing (RE-AHA-01). This was an incidental event, where two White Sucker and one Northern Pike were captured using a dip-net. The majority of the water crossing was dry, however a small pool upstream of the culvert extending into the first section of the culvert provided refuge for the fish caught. The fish were released after identification was confirmed.

NWMO Ignace APM Phase II

Natural Heritage Assessments
2018 Field Effort and Results

Revell Area

Legend

- Confirmed Borehole Location
- Possible Future Borehole Location
- 2018 Study Area
- Existing Access Roads
- Access Road to Boreholes 2 and 3
- Watercourse
- Waterbody
- Aquatic Habitat Assessment
- Fisheries Assessment (Minnow Traps)

Figure 7
PROJECT: 165010
DATE: 09/10/2019

SCALE: 1:19,000
Datum: NAD83
Projection: UTM Zone 15N

Data Provided by Land Information Ontario:
MNR Road Segments, Utility Line, ORWN Track, OHN Watercourse, OHN Waterbody. Updated January 2015 through June 2016.

Data Provided by the Natural Resources Canada (GeoGratis):
None.

TULLOCH ENVIRONMENTAL

User Name: Kelly.Major
Document Path: J:\2016 Projects\165010 - NWMO - Ignace\5_Maps\4-3-3-2 Borehole Baselines for BH4, BH5 & BH6\Figure - NWMO 2018 Watercrossings - Revell Area (Feb2019).mxd

6.0 CLOSING

Throughout 2018 Tulloch undertook its third year of environmental studies in the Ignace siting area. These studies included the continuation of water and soil quality monitoring as well as Natural Heritage investigations at newly identified locations around the Revell Batholith. This report has been prepared to provide a summary of the methods and findings of these 2018 studies. In some instances, references are provided herein to technical reports that outline 2018 study methods and results in greater detail.

The observations and results obtained during these investigations are representative of the conditions encountered during the 2018 site visits. Many species are migratory and may occur within the area during some years and not others. Habitat (vegetation communities) also changes over time and may become more, or less, suitable for SAR species. Tulloch Environmental has used its best professional judgment to interpret the site investigation observations along with the background information and provide accurate conclusions.

Sincerely,

TULLOCH ENGINEERING

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Environmental Department Lead

REFERENCES

Cadman, M.D., D.A. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier (eds.). 2007. *Atlas of the Breeding Birds of Ontario, 2001-2005*. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, and Ontario Nature, Toronto, xxii + 706 pp. Data available online at: http://www.birdsontario.org

Golder and Associates. 2013. *Preliminary Assessment for Siting a Deep Geological Repository for Canada's Used Nuclear Fuel: Findings from Phase One Studies*. 144 + vi pp.

Government of Canada. 2010. *Migratory Birds Convention Act* (MBCA). S.C. 1994, c. 22. Available from http://laws-lois.justice.gc.ca/eng/acts/M-7.01/

Government of Canada. 2015. *Species at Risk Act* (SARA). S.C. 2002, c 29. Available from http://laws-lois.justice.gc.ca/eng/acts/S-15.3/

Government of Ontario. 2008. *Endangered Species Act* (ESA). S.O. 2007, c. 6. Available from https://www.ontario.ca/laws/statute/07e06

Government of Ontario. 2015. *Fish and Wildlife Conservation Act*. S.0. 1997, c. 41. Available from https://www.ontario.ca/laws/statute/97f41

Harvey, M.J., J.S. Altenbach and T.L. Best. 2011. *Bats of the United States and Canada*. The John Hopkins University Press, Baltimore. xiii + 201pp.

Ontario Breeding Bird Atlas (OBBA). 2001. *Guide for Participants*. Atlas Management Board, Federation of Ontario Naturalists, Don Mills.

Ontario Ministry of Municipal Affairs and Housing (MMAH). 2014. *Provincial Policy Statement under the Planning Act*. Available from http://www.mah.gov.on.ca/AssetFactory.aspx?did=10463

Ontario Ministry of Natural Resources (MNR). 1997. *Selected Wildlife and Habitat Features: Inventory Manual*. Queen's Printer for Ontario, Toronto, Ontario..

Ontario Ministry of Natural Resources (MNR). 2000. *Significant Wildlife Habitat Technical Guide*. Queen's Printer for Ontario, Toronto, Ontario. 384 + vii pp.

Ontario Ministry of Natural Resources (MNR). 2004. *Ontario Tree Marking Guide*. Queen's Printer for Ontario, Toronto, Ontario. 251 + ix pp.

Ontario Ministry of Natural Resources (MNR). 2009. *Boreal Region - Ecosites of Ontario Operational Working Draft of Ecosites of Ontario Field Manual*. Ontario Ministry of Natural Resources. 90 + v pp.

Ontario Ministry of Natural Resources (MNR). 2011. *Bats and Bat Habitats: Guidelines for Wind Power Projects*. Ontario Ministry of Natural Resources. 24 pp.

Ontario Ministry of Natural Resources (MNR). 2012. *Boreal Ecosite Factsheets*. Ontario Ministry of Natural Resources and Forestry. 355 pp.

Ontario Ministry of Natural Resources (MNR). 2013. *General Habitat Description for Eastern Whip-poor-will (*Antrostomus vociferus). Ministry of Natural Resources and Forestry.

Ontario Ministry of Natural Resources (MNR). 2014. *Eastern Whip-poor-will Survey Protocol (Operational Draft)*. Ministry of Natural Resources and Forestry.

Ontario Ministry of Natural Resources and Forestry (MNRF). 2015a. *Significant Wildlife Habitat Criteria Schedules for Ecoregion* 3E. Ontario Ministry of Natural Resources and Forestry. 47 pp.

Ontario Ministry of Natural Resources and Forestry (MNRF). 2015b. *Field Guide to the Substrates of Ontario*. Ontario Ministry of Natural Resources and Forestry, ELC Working Group. 76 + v pp.

Tulloch Engineering (Tulloch). 2018a. *Adaptive Phased Management - Phase 2 Environmental Work: Technical Memorandum 3, Ignace, ON*

Tulloch Engineering (Tulloch). 2018b. *Adaptive Phased Management - Phase 2 Environmental Work: Technical Memorandum 1, Ignace, ON*

Tulloch Engineering (Tulloch). 2019. *Phase 2 Environmental Studies, Township of Ignace and Area, Ontario: 2018 Surface Water, Sediment and Soil Quality Monitoring Report*

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