NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

Phase 2 Preliminary Environmental Studies

TOWN OF BLIND RIVER, CITY OF ELLIOT LAKE AND AREA, ONTARIO

APM-REP-07000-0205

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PHASE 2: PRELIMINARY ENVIRONMENTAL STUDIES

BLIND RIVER, ELLIOT LAKE AND AREA, ONTARIO
SUMMARY REPORT

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EXECUTIVE SUMMARY

The Nuclear Waste Management Organization (NWMO) is implementing Adaptive Phased Management (APM) to plan for the long-term care of used nuclear fuel. The APM plan includes a site selection process for identifying an informed and willing host for a deep geological repository. The Town of Blind River and City of Elliot Lake, located north of Lake Huron, expressed interest in participating in the site selection process.

The Phase 1 preliminary assessment provided high level descriptions of the biological and physical environment within the community and surrounding area which, along with geoscientific information, was used to evaluate the potential for a facility to be safely constructed and operated in the vicinity.

Phase 2 preliminary environmental desktop assessments advanced information and updated the environmental data compiled for the potentially suitable areas based on new information and enhanced desktop studies. The intent of the desktop assessments was to identify and map known or potential ecological features, including ecological land classification (ELC) ecosites, candidate significant wildlife habitat, stream reach classification, and species at risk. This environmental information is useful in evaluating the overall potential to safely construct and operate the APM project in the area. The information is used as an input to the integrated assessment of the suitability of the areas of study for the project and to identify possible environmental risks associated with siting activities (e.g., drilling) in order to avoid, mitigate, and/ or monitor potential impacts.

Field verification studies were undertaken as part of Phase 2 in order to determine the accuracy of data collected through the described desktop assessment. Results suggest an overall rate of 80% accuracy of ELC data collected through desktop assessments. Stream reach classification was verified through field studies focusing on waterbody permanence (permanent or temporary) and stream morphology (shape, size, stream flow, etc.).

This report serves as documentation of environmental investigations undertaken to date in Blind River, Elliot Lake and area, and includes a summary of Phase 1 and Phase 2 studies.

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1.0 INTRODUCTION

The Nuclear Waste Management Organization (NWMO) is implementing Adaptive Phased Management (APM) for the long-term care of used nuclear fuel. This includes a site selection process for identifying an informed and willing host for a deep geological repository. The Town of Blind River and City of Elliot Lake, located north of Lake Huron, expressed interest in participating in the site selection process.

The site selection process consists of a number of steps, with each step requiring increasingly detailed evaluations of the potential suitability of the area to host the APM Project. The Phase 1 preliminary assessment report (Golder 2014) provided high level descriptions of the biological and physical environment within the community and surrounding area which, along with geoscientific information, was used to evaluate the potential for a facility to be safely constructed and operated in the vicinity.

In 2016, as part of Phase 2 of the preliminary environmental studies in the area, the NWMO initiated a series of initial desktop and field studies in one of the three general potentially suitable areas identified during Phase 1 preliminary assessment (Figure 1[1]). The objective of these initial field studies was to advance understanding of the environment of the general potentially suitable area, and assess whether it is possible to identify general Potential Repository Areas (PRAs).Investigations were undertaken by Amec Foster Wheeler Environment and Infrastructure Ltd. (Amec Foster Wheeler) as part of Phase 2 preliminary environmental studies as aerial geophysical data is available for those areas. The purpose of these studies was to update the description of the environmental features and conditions within these areas, where necessary (Amec Foster Wheeler 2017).

Data pertaining to known or potential ecological features was assessed, including ecological land classification (ELC) ecosites (a scientific method to organize, classify and evaluate ecosystems for the purposes of land resource management), candidate significant wildlife habitat, stream reach classification (a method of identifying stream hierarchy to infer stream size), and potential habitat availability and use by species at risk. This environmental information is useful in evaluating the overall potential to safely construct and operate the APM project in the area. The information can be used as an input to the integrated assessment of the suitability of the areas of study for the project and to identify possible environmental risks associated with siting activities (e.g., borehole drilling) to avoid, mitigate, and/or monitor potential effects.

This report serves as documentation of environmental investigations undertaken to date in Blind River, Elliot Lake and area, and includes a summary of Phase 1 and Phase 2 studies.

2.0 PHASE 1: DESKTOP ASSESSMENT

The Phase 1 Environment Report (Golder 2014) provides a high level description of the environment in Blind River, Elliot Lake and area (an area of approximately 14,240 km^2, as shown on Figure 1 of the Phase 1 Environmental Report; Golder 2014). Geologically, the area, situated

[1] All figures are presented in Attachment A.

on the north shore of Lake Huron, is underlain by early Proterozoic rocks of the Southern Province and Archean rocks of the westernmost portion of the Abitibi Subprovince of the Superior Province of the Canadian Shield.

Infrastructure in the area includes Trans-Canada Highway 17, Highway 108, a rail corridor operated by Huron Central Railway (HCRY), 230kV and 115kV electrical transmission lines, a natural gas pipeline, five operating landfills and a water treatment plant. There are 15 provincial parks, 12 conservation reserves and four forest reserves located in the area. The Ontario Archaeological Sites Database identifies 85 known archaeological sites in the area (Golder 2014).

The Town of Blind River, City of Elliot Lake and surrounding area lies in the Great Lakes-St. Lawrence Forest Region. Overlapping Forest Management Units (FMU) include: Northshore (FMU 680) and Spanish (FMU 210). The region's forests provide habitat for wildlife including game, fur-bearing mammals and birds. Management of featured species populations (e.g., moose) and concentration and nesting areas for raptors, herons and waterfowl are managed by the Ministry of Natural Resources (MNRF; Golder 2014).

The area is contained entirely within the St. Lawrence drainage basin, which drains towards the Atlantic Ocean through the St. Lawrence River. Water wells in the area obtain water from the overburden or bedrock (Golder 2014).

3.0 PHASE 2: PRELIMINARY ENVIRONMENTAL STUDIES

Phase 2 preliminary environmental desktop assessments advanced information presented in the Phase 1 reports and updated the environmental data compiled for the potentially suitable area based on new information, enhanced desktop studies and field verification. Studies focused on a geographically large area that was determined to be potentially suitable following Phase 1 integrated studies and for which aerial geophysics data was collected during Phase 2 geoscientific studies. For this report, this area is referred to as the Mozhabong block.

3.1 Desktop Assessments

The intent of the desktop assessments was to identify and map known or potential ecological features, including ecological land classification (ELC) ecosites (a scientific method to organize, classify and evaluate ecosystems for the purposes of land resource management), candidate significant wildlife habitat, potential species at risk habitat suitability and use, and stream reach classification (a method of identifying stream hierarchy to infer stream size). The methodology of desktop studies includes the interpretation of existing and new information, mapping of polygonal (block), point and linear features of potential ecological relevance, and identification of areas with species/habitat associations (e.g. significant wildlife habitat). Prepared natural features maps use additional information available from provincial and federal agencies and other existing information sources. The natural feature maps illustrate Boreal ELC ecosites, infrequent candidate significant wildlife habitat polygons (those covering less than 10% of the areas of study), waterbodies and stream reach classifications, steep slopes (≥ 15%) based on topographical data, and the road network (Figure 2).

3.1.1 Ecological Land Classification

Ecological land classification (ELC) is a scientific method used to organize, classify and evaluate ecosystems (and complexes of ecosystems) for the purposes of land resource management. This method uses ELC codes to represent "ecosites", which are landscape areas consisting of typical and recurring associations of vegetation, soil, and moisture regimes. These ecosites are used to understand resources availability (vegetation community) as well as potential wildlife habitat suitability and use.

Ecosite polygons (blocks) are primarily derived using existing Forest Resource Inventory (FRI) vegetation species composition and primary ecosite data, with interpretation using high resolution four-band digital aerial ortho-photos (where available). For the majority of the area being studied, FRI forest stand polygon data available from the MNRF were last updated in 2008 with some small areas being updated between 2010 and 2013. Information includes vegetation classification information in the form of Great Lakes-St. Lawrence ELC codes as described by Banton et al. (2015), tree canopy species compositions, and vegetation community age class.

Based on the desktop review, 36 distinct ecosite types were identified (Tables 1 and 2[2]). Upland coniferous forests were the most commonly distributed vegetation community, followed by upland mixedwood forest communities and coniferous swamp communities. These three vegetation community types represent 94.1% of the vegetated land area within the study area. Of the remaining 5.9% vegetated land area, 2.7% is represented by open fen vegetation communities. Several community series types were very uncommon, including the bedrock shoreline, cliff, mineral barren and rock barren. Open bedrock and cliff ELC community series types are both associated with Rare Vegetation Communities, a type of significant wildlife habitat (see Section 3.1.2 for discussion of significant wildlife habitat). Overall, upland and wetland communities represented 91.5% and 8.5% of the vegetated land area, respectively. The estimated area of each vegetation community and associated ELC ecosite(s) is presented in Table 2.

3.1.2 Candidate Significant Wildlife Habitat

The *Significant Wildlife Habitat Ecoregion 5E Criterion Schedule* (*Criterion Schedule* MNRF 2015) and *Significant Wildlife Habitat Technical Guide* (MNR 2000) provides criteria for identifying significant wildlife habitat within the area of Blind River and Elliot Lake. The *Criterion Schedule* identifies 43 distinct wildlife habitats in Ecoregion 5E, which are separated into four categories: Seasonal Concentration Areas of Animals, Rare Vegetation Communities and Specialized Habitat for Wildlife, Habitat for Species of Conservation Concern, and Animal Movement Corridors. Based on cross-referencing Great Lakes-St. Lawrence ELC codes (Banton et al. 2015) within the study area and ELC communities described in the *Criterion Schedule* for each distinct wildlife habitat type, 27 potential or candidate significant wildlife habitat types were identified. It should be noted that the *Criterion Schedule* helps to identify which significant wildlife habitat types are possible, based on typical habitat associations of ELC ecosites; however, field surveys are required to ascertain that specific micro- or macro-habitat conditions actually exist and/or that select wildlife

[2] All tables are presented in Attachment B.

species are present. Such surveys were not undertaken during this phase of the study. Potential significant wildlife habitat occurring within the study area, including their estimated area, is provided in Table 3. A summary of Great Lakes-St. Lawrence ELC ecosites and their potential significant wildlife habitat associations is provided in Table 4.

The majority of candidate significant wildlife habitat types were relatively uncommon across the study area, with 16 of the 27 significant wildlife habitat types occurring within less than 10%, on average, of the area being studied (as highlighted on Figure 2). Some significant wildlife habitat types are commonly distributed throughout the study area, such as denning sites, amphibian breeding habitat (woodlands), woodland raptor nesting habitat, Bald Eagle and Osprey nesting habitat, and deer yarding areas; although, this is a result of their potential to occur across a broad range of Great Lakes-St. Lawrence ELC ecosite types (Table 4).

Rare Vegetation Community Significant Wildlife Habitat Types were scarce to absent throughout much of the study area, with each of the three potential or candidate Rare Vegetation Communities Significant Wildlife Habitat Types (Cliff and Talus Slopes, Rock Barren and Sand Barren) occurring within less that 0.3% of the area being studied.

3.1.3 Species at Risk and Regionally Rare Species

Species at risk information was obtained through MNRF's Natural Heritage Information Centre (NHIC database; used to track species at risk occurrences, rare species and habitats, as well as other natural heritage information), as provided by the NWMO. Species element and precise occurrence information was obtained to generate specific data for the Town of Blind River, City of Elliot Lake and area. Additional species element information for bird species was obtained through the online Ontario Breeding Bird Atlas (OBBA; Bird Studies Canada 2017). As species occurrence data for northern Ontario is typically scarce, other secondary sources of information, including bird, herptile, mammal and aquatic species atlases for Ontario (Bird Studies Canada 2017; Ontario Nature 2017; Dobbyn 1994, DFO 2017; respectively) and federal and provincial species at risk lists and range maps (Government of Canada 2017; MNRF 2017, respectively) were also reviewed to generate an inclusive list.

According to the review of secondary sources the following species at risk have the potential to occur within the study areas:

- Fourteen (14) bird species: Bank Swallow, Barn Swallow, Eastern Whip-poor-will, Bald Eagle, Canada Warbler, Common Nighthawk, Olive-sided Flycatcher and Rusty Blackbird; Chimney Swift, Red-headed Woodpecker, Golden-winged Warbler, Short-eared Owl, Eastern Meadowlark and Bobolink also have the potential to occur, however, it should be noted that the study area occurs at the northern boundaries of these species' ranges;
- Two (2) mammal species: Little Brown Myotis, and Northern Myotis;
- One (1) herptile species: Snapping Turtle; and
- One (1) butterfly species: Monarch.

No species at risk plants or aquatic species were identified. As this information is based primarily from species range maps and desktop information, targeted field studies would need to be undertaken to confirm habitat suitability and/or species presence.

3.1.4 Fisheries Management

Historically, the MNRF district-wide fisheries management plans were developed to manage the commercial and recreational fisheries, and to establish and regulate sustainable harvest levels. These district fisheries management plans typically used a lake-by-lake management strategy which has largely been replaced by the landscape approach management strategies developed for the more recently mapped MNRF Fisheries Management Zones as part of the Broadscale Scientific Monitoring Program in 2008 (MNRF 2016). The fisheries management zone planning and management process includes advisory councils that consult with angling groups, scientists and researchers, conservation groups and interested community members. Consultation allows the advisory councils to share stakeholder ideas and expertise with the MNRF and to help develop and implement management strategies. The study area occurs within Fisheries Management Zone 10 which has an advisory council that contributed to the Lake Trout Operational Objectives and Management Strategies (MNRF 2014) specific to the Lake Trout lakes within this zone. Lake Trout are the second most frequent sport fish species targeted by anglers within Fisheries Management Zone10, and as such Lake Trout management is a high priority for the advisory council.

Lake Superior, the North Channel and northern shores of Georgian Bay delineate the eastern and southern extents of Fisheries Management Zone 10, which includes Lake Superior Provincial Park and numerous other provincial and Waterway Parks throughout the region. This area contains recreational and tourism-based fisheries, fisheries for sportfish species including Walleye, Northern Pike, Lake Trout and Brook Trout. A fisheries management plan for Fisheries Management Zone 10 does not currently exist, as such the MNRF Land Information Ontario data, fish species occurrence records and habitat information were used for the desktop studies.

3.1.5 Stream Reach Classification

3.1.5.1 Stream Reach Order

Stream order classifies stream hierarchy from its source (headwaters) downstream and was determined through digital elevations models (from Land Information Ontario) and the application of the Strahler stream order classification. Stream order provides a measure of the relative size of streams, which relates to the amount of water moving off the watershed into the stream channel. Water volume as well as velocity influence water quality and, therefore, health of living organisms and habitats associated with the stream (USEPA 2012). The Strahler method for classification assigns each headwater perennial stream an order of 1 (Strahler 1952; Strahler 1954; Strahler 1957). The joining of two 1st-order streams assigns the downstream reach an order of 2. The joining of two 2nd-order streams results in a downstream reach of order 3, and so on (Diagram 1). Generally, a lower stream order represents a smaller stream (i.e. a stream order of 1 is smaller than a stream order of 6). Within the area being studied, a maximum of a 4th order stream was classified.

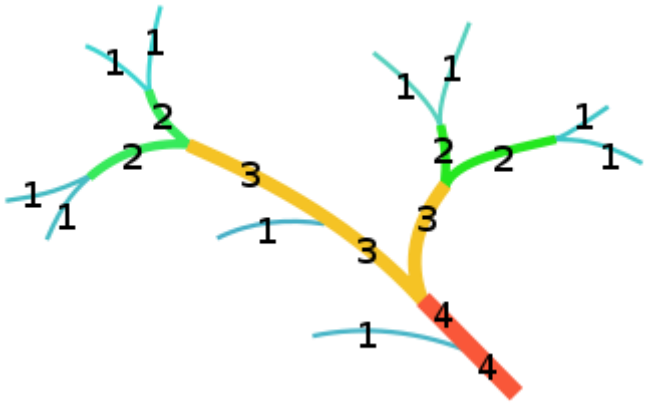


Diagram 1: Stream order based on the Strahler classification method

A general summary of stream orders with attributes commonly associated with the ranges of order classifications used in the desktop analysis is provided in Table 5 (Appendix B).

3.1.5.2 Thermal Regime

Thermal regime directly influences the aquatic environment including potential fish species present (which have specific thermal tolerances) as well as other biological elements. In this way, thermal regime can be used to provide a high-level screening of candidate areas with species of interest such as sportfish (e.g., Brook Trout, Walleye, Northern Pike). Where fish species information was available but thermal regime data was missing, the thermal regime was inferred based on Minns (2010), which describes the thermal preference of Ontario stream fish groups. Where neither fish species nor thermal regime data was available, thermal regime was inferred based on Strahler stream order, as described above. Low order streams (1st to 3rd) are typically headwaters within watersheds characterized by generally cooler, faster flowing conditions. As such, the 1st to 3rd order stream reaches that did not have associated thermal regime data were classified as cold-water environments. Stream reaches identified as 4th to 6th order streams were classified as cool-water environments in the absence of thermal regime data.

3.1.5.3 Stream Morphology

Stream morphology (form) is the shape of a river channel and how it changes in shape and direction over time. Stream morphology is a factor in stream classification systems, with initial classifications using basin characteristics such as slope (Rosgen 1996). Other factors include the shape of the channel, channel patterns, entrenchment (vertical containment of a stream and the degree to which it is cut into the surrounding land), and channel material. Most of this information is typically acquired through the interpretation of high-resolution aerial imagery and field data, with the exception of slope. As such, slope was used in the desktop screening to estimate stream morphology. Digital elevation models were used to approximate the average percent slope for each watercourse segment, and the Rosgen Stream Classification (Rosgen 1996) framework was applied to guide probable stream morphology as follows: a slope of ≤1% was classified as ‘pool’, >1-5% as ‘glide/run’, 5-12% as ‘riffle’, and >12% as ‘cascade/waterfall’. It is understood that

additional morphological data may change initial classifications; however, the use of slope provides a useful screening tool that can then be verified in the field using the Ontario Stream Assessment Protocol (OSAP; Stanfield 2013).

3.2 Field Verification Studies

Field verification studies were undertaken in order to establish the accuracy of data collected through the described desktop assessment. The field verification study areas were determined through a visual assessment of the area using ArcGIS and were chosen for:

- Optimum road accessibility;
- A diverse topography;
- The presence of a rare vegetation community;
- Diverse stream reach categories and fish communities; and/or
- Potential species at risk habit.

3.2.1 Ecological Land Classification

Terrestrial (land) field surveys were undertaken between July 22 and 25, 2017. Verification of ELC information consisted of walking the land in order to check the accuracy and classification of ecosite polygons (blocks). Ecosite communities are based on dominant plant species and soil characteristics (Banton et al. 2015). As such, plant species lists were compiled for each separate ecosite type. Determination of soil characteristics was completed through visual inspection and an estimation of organic soil (comprising mainly plant material) versus mineral soil (derived of minerals/rocks). As environmental field studies in the area are at a preliminary stage, surveys focused efforts in representative communities (based on pre-mapped ELC polygons), to the extent possible, through predetermined field survey routes. Such survey methodology is a widely used and accepted sampling protocol in ecological studies, especially when one of the main objectives is to maximize the coverage of the area of interest. Predetermined field routes were followed to the extent possible; however, minor deviations and rarely major deviations were necessary due to health and safety considerations related to accessibility and wildlife encounters. Natural features were field verified and mapped concurrently with vegetation community surveys.

A total of 195 plant species were recorded, across the study area (Table 6). Common species occurring in upland coniferous forests include Jack Pine, Balsam Fir, White Pine and White Spruce, with Bunchberry, blueberry species, and Bracken Fern in the ground layer. Mixedwood forest communities included Trembling Aspen, Red Maple and White Birch, with Mountain Maple, Beaked Hazel, Bush, Blue-bead Lily, Twinflower, and Goldthread in the ground layer. Coniferous swamp communities consisted of Black Spruce, Tamarack, and White Cedar, with Leatherleaf, Common Labrador-tea and sedge species. Other species recorded in thicket swamp, fen and marsh wetland communities include Speckled Alder, Sweet Gale, Mountain Holly and Rose Pogonia. All of these species are provincially ranked as S5 (Secure) or S4 (Apparently Secure); no rare or species at risk plant species were recorded.

A total of 134 polygons (blocks) representing 23 Boreal ELC ecosite types were surveyed in Blind River, Elliot Lake and area. Plant species lists and field notes were collected for each polygon and used to determine the accuracy of the predetermined ELC information derived from desktop assessments. Where predetermined ELC codes were not deemed accurate, a new ELC code was suggested/assigned. Large polygons, to a certain extent, are commonly composed of a mosaic of community types due to some variances in topography or hydrology. In these cases, a single "best fit" ELC code was assigned to the polygon. More accurate ELC codes were suggested for 28 of the 134 surveyed polygons, which suggests an overall rate of 80% accuracy of ELC data collected through desktop assessments.

An assessment of polygon accuracy based on Great Lakes-St. Lawrence ELC ecosite is presented in Table 7. Rationale for a revised ELC code was most often attributed to a change (most commonly an increase) in the richness of groundcover species in wetland communities (12 of the 28 suggested revisions); however, did not result in a change in community type (i.e. a fen remained a fen). Eight (8) suggested revisions were due to a change in proportion of the same canopy tree species. Two (2) meadow marsh communities were more accurately described as shore marshes, and three (3) as fen communities. Three (3) mineral barren polygons (which are associated with candidate "Sand Barren" Rare Vegetation Community Significant Wildlife Habitat) were determined to be the result of past gravel extraction (and were not associated with seasonal water erosion events). Overall, the suggested revisions do not indicate meaningful errors in the desktop assessment data.

Ecosite boundaries were determined to be fairly accurate for the majority of those polygons surveyed. Most boundary discrepancies were only up 15 m, which can be explained by ecotones (a transition zone between ecosites) which typically occur between community types. In some cases, discrepancies of up to 60 m were recorded; however, these were rather uncommon and could be attributed to inclusions of other habitat types which are too small to map separately.

3.2.2 Candidate Significant Wildlife Habitat

All three (3) potential Rare Vegetation Community Significant Wildlife Habitat Types (Sand Barren, Rock Barren, and Cliff and Talus Slopes) were visited during field surveys (see Table 7 for a list of ELC ecosites visited). Three (3) polygons representing candidate "Sand Barren" Rare Vegetation Community Significant Wildlife Habitat (G007) did not meet defining criteria. As discussed in Section 3.2.1, these polygons were determined to have originated from past gravel extraction, and were not associated with seasonal water erosion events. Six (6) polygons representing candidate "Rock Barren" (G164) and two (2) polygons representing candidate "Cliff and Talus Slopes" (G158) were confirmed as significant wildlife habitat. Field studies identified the presence of four or more characteristic plant species and, as such, confirmed the defining criteria.

Confirmation of potential significant wildlife habitat was not possible for those significant wildlife habitat types where criteria is based on the presence/absence of certain indicator wildlife species (MNRF 2015). The scope of field verification studies undertaken at this preliminary assessment stage did not include species-specific surveys.

Incidental wildlife observations were recorded broadly across all the study area. Evidence of mammals was mainly confirmed by the presence of scat and/or tracks. Mammal species documented include Black Bear, Moose, Red Squirrel, Snowshoe Hare, and Beaver (. One Bobcat was observed approximately 7 km from the study area. Herpatile species observed include Eastern Gartersnake, Spring Peeper, and Wood Frog. Incidental bird species recorded included Black-capped Chickadee, Common Loon and Spruce Grouse.

One species at risk bird, Olive-sided Flycatcher was recorded in several polygons throughout the study area.

3.2.3 Stream Reach Classification

Stream reach classification field assessments were guided by the Ontario Stream Assessment Protocol (OSAP; Stanfield 2013), the Ministry of Transportation / Ministry of Natural Resources Fisheries and Forestry Protocol, and the Ontario Stream Fishes Habitat Assessment Models as published by the Department of Fisheries and Oceans (Minns 2010). The study objective was to verify the presence of habitat, as defined by the *Fisheries Act*, as well as other characteristics that were used in the desktop studies to define individual stream reaches and their corresponding habitat type. At the stream reaches selected for field verification, physical and habitat characteristics were recorded.

Aquatic field studies were undertaken between July 22 and 25, 2017. Predetermined waypoints representing a variety of stream morphology (forms) and waterbody permanence (permanent or temporary) within the study area were visited for verification; however, minor differences between the proposed and actual waypoints were necessary due to accessibility. The aquatic field verification studies included non-invasive observations, producing a snapshot of the existing conditions documented by field notes and photographs (i.e., no aquatic biota sampling was undertaken). The field notes included general habitat observations and stream morphology measurements with an objective to verify waterbody permanence and stream morphology (shape, size, stream flow, etc.). Confirmation of other aspects such as fish community and thermal regime would require more detailed assessments such as sampling (trapping/fishing effort) and long-term temperature monitoring.

Field verification studies occurred at each waypoint to describe and verify the above-noted characteristics, with a minimum of one transect (study line across the stream) completed at accessible locations. Additional transects were positioned upstream and/or downstream of the initial waypoint, to further assess natural variability and verify classifications. A total of 15 study locations were visited, and 2 transects were completed to support the field verifications, with the summary of these locations and findings in Table 8. The stream morphology and permanence estimated through desktop assessments did not differ greatly from the actual conditions observed in the field. There were two transects with different stream morphology classifications. As noted in the observations of Table 8, one of these differences was attributable to the recent placement of a beaver dam which changed the previously existing stream characteristics. These field verification results show the estimated stream permanence and flow morphology data were largely correct.

4.0 SUMMARY

The intent of the desktop assessments was to identify and map known or potential ecological features, including ecological land classification (ELC) ecosites (a scientific method to organize, classify and evaluate ecosystems for the purposes of land resource management), candidate significant wildlife habitat, stream reach classification (a method of identifying stream hierarchy to infer stream size), and potential habitat availability and use by species at risk. This environmental information is useful in evaluating the overall potential to safely construct and operate the APM project in the area. The information can be used as an input to the integrated assessment of the suitability of the areas of study for the project and to identify possible environmental risks associated with siting activities (e.g., drilling) in order to avoid, mitigate, and/ or monitor potential impacts.

Field verification studies were undertaken in order to determine the accuracy of data collected through the described desktop assessment. Results suggest an overall rate of 80% accuracy of ELC data collected through desktop assessments. Stream reach classification was verified through field studies focusing on waterbody permanence (permanent or temporary) and stream morphology (shape, size, stream flow, etc.).

5.0 CLOSURE

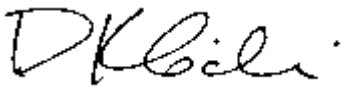
Should you require further information relative to specific field survey details, please do not hesitate to contact the undersigned.

Yours truly,
Amec Foster Wheeler Environment & Infrastructure
a Division of Amec Foster Wheeler Americas Limited

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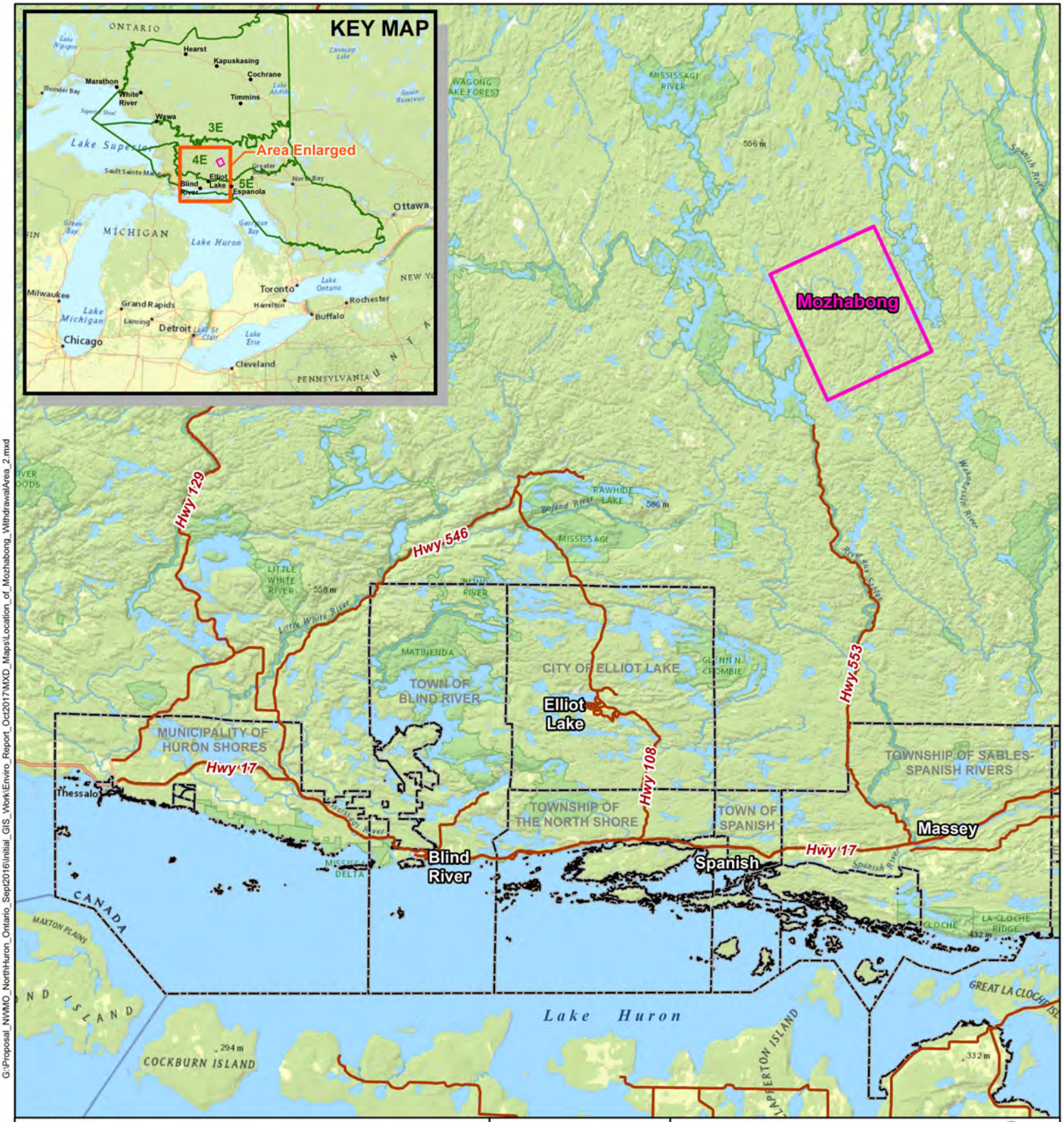
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ATTACHMENT A

FIGURES



G:\Proposal_NWMO_NorthHuron_Ontario_Sept2016\Initial_GIS_Work\Enviro_Report_Oct2017\MXD_Maps\Location_of_Mozhabong_WithdrawalArea_2.mxd

LEGEND

- Mozhabong Area withdrawn from mineral staking subject to Phase 2 Preliminary Environmental Studies
- Regional Highways
- Municipal Boundaries
- Ontario Ecoregion Boundary (labelled with ID in Key Map)

NOTES:
- Highways and municipal boundaries and Ecoregions extracted from Land Information Ontario (MNRF) Queen's printer for Ontario, 2015-2016
- Backgroup topographic map information extracted from ESRI Base Map Services

Datum: NAD83
Projection: UTM Zone 17N

0 5 10 20 30 40 50 Kilometres

N W E S

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ADAPTIVE PHASED MANAGEMENT
PHASE 2 - BLIND RIVER, ELLIOT LAKE AND AREA, ONTARIO

Location of Mozhabong Area Temporarily Withdrawn from Mineral Staking Studied

PROJECT N°: TB171007 | **FIGURE: 1**

SCALE: 1:735,000 | DATE: November 2017

400000
405000
410000
5205000
5195000
415000
420000
Centralls Creek
Labitiche Lake
Armstrong Lake
Lidstone Lake
Jackson Lake
Avis Road
Jeanne Lake
Beebe Road
Shag Lake
Fifty-five Mile Lake
Ernie Lake
West Branch Road
Supple Lake
Expanse Lake
Barn Lake
Trout Lake Road
Airport Lake
Mozhabong Road

LEGEND

- Inactive Aggregate Site
- Local Road
- Forestry Road (MNRF)
- Major Contour (50 metre interval)
- Minor Contour (10 metre interval)
- Esker
- Beaver Dam
- Research Plot
- Moose Aquatic Feeding Area
- Moose Late Wintering Area
- Flow Direction
- Dam
- Waterbody
- Wetland
- Wooded Area
- Watershed Boundary
- Aquatic Resource Area Information (Waterbody)
- Aquatic Resource Area Information (Watercourse)
- G055 Ecological Land Classification (labelled with ELC code)
- Infrequent Candidate Significant Wildlife Habitat
- Steep Slope Area (>= 15% slope)

Watercourse Reach Classification Morphology and Regime

- Cascade / Waterfall, Cold
- Glide / Run, Cold
- Glide / Run, Cool
- Pool, Cold
- Pool, Cool
- Pool, Warm
- Riffle, Cold
- Riffle, Cool

Watercourse Class

- Intermittent Watercourse
- Permanent Watercourse
- Open Water

0 0.5 1 2 3 4 5 Kilometres

NOTES:
- Base data and aquatics resource area information on this map was extracted form Land Information Ontario (MNRF), Queen's Printer for Ontario, 2015 - 2016.
- Quaternary geology features from Ontario Geological Survey, MNDM.

Datum: NAD83
Projection: UTM Zone 17N

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ADAPTIVE PHASED MANAGEMENT
PHASE 2 - BLIND RIVER, ELLIOT LAKE AND AREA, ONTARIO

Mozhabong Natural Features Map

PROJECT N°: TB171007 | **FIGURE: 2**

SCALE: 1:66,500 | DATE: November 2017

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ATTACHMENT B

TABLES

Table 1: Summary of Great Lakes-St. Lawrence Ecosites Based on Desktop Assessment

GLSL ELC Code[1]	Description[1]	Potential Tree Species[1]	Community Type
G007	Active Mineral Barren	--	Mineral Barren
G011	Very Shallow, Dry to Fresh: Red Pine - White Pine Conifer	White Pine, Red Pine, Red Maple, Red Oak, Balsam Fir, Eastern Hemlock, Black Spruce	Coniferous Forest
G012	Very Shallow, Dry to Fresh: Pine - Black Spruce Conifer	Jack Pine, Black Spruce, Balsam Fir, Paper Birch	Coniferous Forest
G016	Very Shallow, Dry to Fresh: Aspen - Birch Hardwood	Paper Birch, Trembling Aspen, Large-toothed Aspen, Sugar Maple, Balsam Fir, Red Maple	Mixedwood Forest
G034	Dry, Sandy: Jack Pine – Black Spruce Dominated	Jack Pine, Black Spruce, Paper Birch, Trembling Aspen, White Spruce	Coniferous Forest
G035	Dry, Sandy: Pine - Black Spruce Conifer	Jack Pine, Trembling Aspen, Black Spruce, Paper Birch, Balsam Fir, White Spruce, White Pine	Coniferous Forest
G037	Dry, Sandy: Spruce - Fir Conifer	White Spruce, Balsam Fir, Paper Birch, Trembling Aspen, Yellow Birch, Eastern White Cedar, Black Cherry, Red Maple, Jack Pine, White Pine, Black Spruce	Coniferous Forest
G038	Dry, Sandy: Conifer	Black Spruce, Balsam Fir, Eastern White Cedar, White Spruce, Paper Birch, Trembling Aspen, Red Maple, Sugar Maple, Yellow Birch	Coniferous Forest
G040	Dry, Sandy: Aspen – Birch Hardwood	Paper Birch, Trembling Aspen, Sugar Maple, Balsam Fir, Red Maple, White Spruce	Mixedwood Forest
G048	Dry to Fresh, Coarse: Red Pine - White Pine Conifer	White Pine, Red Pine, White Spruce, Paper Birch, Balsam Fir, Large-toothed Aspen, Red Maple, Trembling Aspen	Coniferous Forest
G049	Dry to Fresh, Coarse: Jack Pine - Black Spruce Dominated	Jack Pine, Black Spruce, Paper Birch, Red Pine, White Pine, Trembling Aspen	Coniferous Forest
G050	Dry to Fresh, Coarse: Pine - Black Spruce Conifer	Black Spruce, White Pine, Red Pine, Eastern White Cedar, Paper Birch, Balsam Fir, Red Maple	Coniferous Forest

GLSL ELC Code[1]	Description[1]	Potential Tree Species[1]	Community Type
G052	Dry to Fresh, Coarse: Spruce - Fir Conifer	Balsam Fir, White Spruce, Paper Birch, Red Maple, Trembling Aspen, Yellow Birch, Eastern White Cedar, Black Spruce	Coniferous Forest
G054	Dry to Fresh, Coarse: Red Pine - White Pine Mixedwood	White Pine, Large-toothed Aspen, Red Maple, Red Oak, Sugar Maple, Paper Birch	Mixedwood Forest
G055	Dry to Fresh, Coarse: Aspen - Birch Hardwood	Paper Birch, Trembling Aspen, Large-toothed Aspen, Sugar Maple, Balsam Fir, Red Maple	Mixedwood Forest
G058	Dry to Fresh, Coarse: Maple Hardwood	Sugar Maple, Eastern Hemlock, Yellow Birch, Basswood, American Beech, Ironwood, White Pine, Paper Birch	Mixedwood Forest
G059	Dry to Fresh, Coarse: Mixedwood	Sugar Maple, American Beech, Basswood, Red Oak, Paper Birch, Red Maple, Ironwood, Yellow Birch	Mixedwood Forest
G064	Moist, Coarse: Red Pine - White Pine Conifer	White Pine, Red Pine, Large-toothed Aspen, Paper Birch, Red Maple, White Spruce, Trembling Aspen, Balsam Fir	Coniferous Forest
G065	Moist, Coarse: Pine - Black Spruce Conifer	Black Spruce, Jack Pine, Paper Birch, Trembling Aspen, Balsam Fir, Red Maple, White Spruce	Coniferous Forest
G067	Moist, Coarse: Spruce - Fir Conifer	White Spruce, Balsam Fir, Paper Birch, Trembling Aspen, Red Maple, Black Cherry, Black Spruce, Yellow Birch, Black Ash, Sugar Maple, White Pine	Coniferous Forest
G068	Moist, Coarse: Conifer	Tamarack, White Spruce, Black Spruce, Balsam Fir, Jack Pine, Red Maple, Paper Birch, Eastern White Cedar, Trembling Aspen	Coniferous Forest
G069	Moist, Coarse: Red Pine - White Pine Mixedwood	White Pine, Trembling Aspen, Balsam Fir, Paper Birch, White Spruce, Red Maple, Yellow Birch, Large-toothed Aspen	Mixedwood Forest
G070	Moist, Coarse: Aspen - Birch Hardwood	Paper Birch, Trembling Aspen, Sugar Maple, Balsam Fir, Red Maple, White Spruce, Eastern White Cedar	Mixedwood Forest
G074	Moist, Coarse: Red Maple Hardwood	Red Maple, Trembling Aspen, Balsam Fir, Sugar Maple, White Spruce, Paper Birch, Eastern White Cedar, Black Ash, Yellow Birch	Mixedwood Forest

GLSL ELC Code[1]	Description[1]	Potential Tree Species[1]	Community Type
G127	Organic Poor Conifer Swamp	Black Spruce, Tamarack, Jack Pine	Coniferous Swamp
G128	Organic Intermediate Conifer Swamp	Black Spruce, Tamarack, Balsam Fir, White Pine, Red Maple, Paper Birch, Eastern White Cedar	Coniferous Swamp
G129	Organic Rich Conifer Swamp	Eastern Hemlock, Balsam Fir, Black Spruce, Black Ash, White Spruce, Paper Birch, Yellow Birch, Eastern White Cedar	Coniferous Swamp
G135	Organic Thicket Swamp	Black Ash, Black Spruce, Red Maple, American Elm, Eastern White Cedar, Green Ash, Tamarack	Thicket Swamp
G136	Sparse Treed Fen	Black Spruce, Tamarack	Fen
G139	Poor Fen	Black Spruce, Tamarack	Fen
G140	Open Moderately Rich Fen	Black Spruce, Tamarack	Fen
G142	Mineral Meadow Marsh	Black Spruce, Tamarack, Red Maple, Paper Birch, Green Ash, American Elm	Marsh
G146	Open Shore Fen	--	Fen
G158	Cliff	Eastern White Cedar, Red Pine, White Pine, Red Oak, Jack Pine, Large-toothed Aspen, Paper Birch	Cliff
G162	Open Bedrock Shoreline	White Pine, Red Oak	Bedrock Shoreline
G164	Rock Barren	Red Oak, White Pine, Red Pine, Paper Birch, Jack Pine, Trembling Aspen, Red Maple, Bur Oak	Rock Barren

[1] Based on GLSL ELC codes as described in Banton et al. 2015.

Table 2: Summary of Great Lakes-St. Lawrence ELC Ecosites by Community Series

Community Series	Number of Unique GLSL ELC Ecosites	GLSL Ecosite Codes[1]	Total Area (ha)	Total Area (%)
Coniferous Forest	14	G011, G012, G034, G035, G037, G038, G048, G049, G050, G052, G064, G065, G067, G068	**23,803**	**81.7**
Mixedwood/ Hardwood Forest	9	G016, G040, G054, G055, G058, G059, G069, G070, G074	**2,713**	**9.3**
Coniferous Swamp	3	G127, G128, G129	**915**	**3.1**
Fen	4	G136, G139, G140, G146	**795**	**2.7**
Thicket Swamp	1	G135	**458**	**1.6**
Marsh	1	G142	**287**	**1.0**
Cliff	1	G158	**73.5**	**0.3**
Rock Barren	1	G164	**71.2**	**0.2**
Mineral Barren	1	G007	**8.4**	**<0.1**
Bedrock Shoreline	1	G162	**0.4**	**<0.1**
Total	**36**	**--**	**132,380**	**100**

[1] Based on Great Lakes-St. Lawrence ELC codes as described in Banton et al. 2015.

Table 3: Summary of Candidate Significant Wildlife Habitats

Group[1]	Potential Significant Wildlife Habitat[1]	Mapping Code[2]	Estimated Area of Candidate Significant Wildlife Habitat (ha)[3]
Seasonal Concentration Areas for Wildlife Species	Moose Late Winter Cover	-	10,461.8
	Waterfowl Stopover and Staging Areas (Aquatic)	2	354.6
	Shorebird Migratory Stopover Area	3	0.4
	Raptor Wintering Area	-	12,362.0
	Bat Hibernacula	5	144.8
	Bat Maternity Colonies	6	349.2
	Turtle-Wintering Areas	7	1,936.1
	Reptile Hibernacula	8	496.4
	Colonially Nesting Bird Breeding Habitat (Bank/Cliff)	9	8.4
	Colonially Nesting Bird Breeding Habitat (Tree/Shrub)	a	1,897.8
	Colonially Nesting Bird Breeding Habitat (Ground)	b	295.5
Rare Vegetation Community	Cliff and Talus Slopes	d	73.5
	Rock Barren	e	71.2
	Sand Barren	f	8.4
Specialized Habitats of Wildlife	Waterfowl Nesting Area	-	13,141.8
	Bald Eagle and Osprey Nesting Habitat	-	24,798.0
	Woodland Raptor Nesting Habitat	-	27,385.7
	Turtle and Lizard Nesting Areas	k	1,034.3
	Seep or Springs	-	8,544.1
	Aquatic Feeding Habitat	-	18,730.5
	Mineral Licks	-	8,544.1
	Denning Sites	-	26,517.0
	Amphibian Breeding Habitat (Woodlands)	-	26,517.0
	Amphibian Breeding Habitat (Wetlands)	Q	829.5
	Mast Producing Areas	r	19.3
Habitat for Species of Conservation Concern	Marsh Bird Breeding Habitat	s	1,557.4
Count of Potential Significant Wildlife Habitat Types			**27**

[1] Based on the Significant Wildlife Habitat (SWH) Ecoregion 5E Criterion Schedule (MNRF, 2015)

[2] Only "infrequent" SWH types were mapped; those which cover less than 10% of the area of study

[3] As many ecosites support multiple candidate significant wildlife habitats, the sum of the hectarage is greater than the total withdrawal area.

Table 4: Great Lakes-St. Lawrence ELC Ecosite and Candidate Significant Wildlife Habitats Associations

Potential Significant Wildlife Habitat[1]	GLSL ELC Ecosite																																					
	G007	G011	G012	G016	G034	G035	G037	G038	G040	G048	G049	G050	G052	G054	G055	G058	G059	G064	G065	G067	G068	G069	G070	G074	G127	G128	G129	G135	G136	G139	G140	G142	G146	G158	G162	G164
Seasonal Concentration Areas for Wildlife Species																																						
Moose Late Winter Cover			X			X	X	X				X	X						X	X																		
Waterfowl Stopover and Staging Areas (Aquatic)																															X	X						
Shorebird Migratory Stopover Area																																			X			
Raptor Wintering Area[2]		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
Bat Hibernacula																																		X		X		
Bat Maternity Colonies[3]				X					X						X	X	X						X	X														
Turtle-Wintering Areas																										X	X	X			X	X	X					
Reptile Hibernacula																X	X						X	X														X
Colonially Nesting Bird Breeding Habitat (Bank/Cliff)	X																																					
Colonially Nesting Bird Breeding Habitat (Tree/Shrub)[4]																		X	X	X	X	X	X	X		X	X	X	X									
Colonially Nesting Bird Breeding Habitat (Ground)	X																														X							
Deer Yarding Areas			X		X	X	X	X		X	X	X	X	X				X	X	X	X	X				X	X											
Rare Vegetation Community																																						
Cliff and Talus Slopes																																		X				
Rock Barren																																				X		
Sand Barren	X																																					
Specialized Habitats of Wildlife																																						
Waterfowl Nesting Area[5]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
Bald Eagle and Osprey Nesting Habitat[6]		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
Woodland Raptor Nesting Habitat		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X											
Turtle and Lizard Nesting Areas															X	X							X	X							X	X	X					
Seep or Springs[7]		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
Aquatic Feeding Habitat[8]		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
Mineral Licks[9]		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
Denning Sites		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
Amphibian Breeding Habitat (Woodlands)		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X														
Amphibian Breeding Habitat (Wetlands)																											X	X				X	X					
Mast Producing Areas																X																						
Specialized Habitats of Wildlife																																						
Marsh Bird Breeding Habitat																											X	X	X	X	X	X	X					

[1] Based on the Significant Wildlife Habitat (SWH) Ecoregion 5E Criterion Schedule (MNRF, 2015)
[2] Polygon must be >20 ha
[3] Trees must be >80 years old
[4] Based on close proximity to water
[5] Must be adjacent to communities G129, G135, G142, and/or G146
[6] When adjacent to riparian areas
[7] Must be within headwater areas of a stream
[8] When adjacent to a waterbody
[9] Associated with upwelling, and seeps and springs

Table 5: Summary of Stream Orders with Attributes Commonly Associated with the Ranges of Order Classifications

Stream Order Attributes[1]	Upper Reaches (Headwaters) 1st to 3rd Order	Middle Reaches 3rd to 6th Order	Lower Reaches 6th Order and above
Substrate	Coarse (Boulder)	Sand/Gravel	Fines
Current	Fast ⟷		Slow
Dissolved Oxygen	Saturated ⟷		Periodic Deficits
Sunlight Exposure	Low	High	Low
Water Temperature	Fairly constant	Highly variable	Variable
Particulate Matter	Coarse ⟷		Fine
Nutrient Concentrations	Low	High	Low
Dominant Invertebrate Groups	Shredders/Collectors	Grazers (Scrapers)/Collectors	Collectors
Fish Habitat and Food Preferences	Cold-cool, invertebrates	Cool-warm, fish and invertebrates	Cool-warm, fish and invertebrates
Biological Diversity	Low	High	Low

[1] Modified from Ward 1992

Table 6: Summary of Plant Species Recorded During Field Studies

Scientific Name	Common Name	Provincial S-Rank[1]
TREES		
Abies balsamea	Balsam Fir	S5
Acer rubrum	Red Maple	S5
Betula alleghaniensis	Yellow Birch	S5
Betula papyrifera	Paper Birch	S5
Fraxinus nigra	Black Ash	S4
Larix laricina	American Larch	S5
Picea glauca	White Spruce	S5
Picea mariana	Black Spruce	S5
Pinus banksiana	Jack Pine	S5
Pinus resinosa	Red Pine	S5
Pinus strobus	Eastern White Pine	S5
Populus grandidentata	Large-tooth Aspen	S5
Populus tremuloides	Trembling Aspen	S5
Thuja occidentalis	Eastern White Cedar	S5
SHRUBS and WOODY VINES		
Acer spicatum	Mountain Maple	S5
Alnus incana	Speckled Alder	S5
Alnus viridis	Green Alder	S5
Amelanchier sp.	Serviceberry Species	-
Andromeda polifolia var. polifolia	Northern Bog Rosemary	S5
Aronia melanocarpa	Black Chokeberry	S5
Chamaedaphne calyculata	Leatherleaf	S5
Cornus alternifolia	Alternate-leaf Dogwood	S5
Cornus stolonifera	Red-osier Dogwood	S5
Corylus cornuta	Beaked Hazelnut	S5
Diervilla lonicera	Northern Bush-honeysuckle	S5
Epigaea repens	Trailing Arbutus	S5
Gaultheria hispidula	Creeping Snowberry	S5
Gaultheria procumbens	Teaberry	S5
Ilex mucronata	Mountain Holly	S5
Ilex verticillata	Black Holly	S5
Kalmia angustifolia	Sheep-laurel	S5
Kalmia polifolia	Pale Laurel	S5
Linnaea borealis	Twinflower	S5
Lonicera canadensis	American Fly-honeysuckle	S5
Myrica gale	Sweet Bayberry	S5
Prunus pensylvanica	Pin Cherry	S5
Rhododendron groenlandicum	Common Labrador Tea	S5
Ribes cynosbati	Prickly Gooseberry	S5
Ribes glandulosum	Skunk Currant	S5
Ribes hudsonianum	Northern Black Currant	S5
Ribes triste	Swamp Red Currant	S5
Rosa acicularis	Prickly Rose	S5
Rubus allegheniensis	Allegheny Blackberry	S5
Rubus idaeus ssp. strigosus	Wild Red Raspberry	S5
Rubus pubescens	Catherinettes Berry	S5
Salix pedicellaris	Bog Willow	S5
Salix sp.	Willow Species	-
Sambucus racemosa	Red Elderberry	S5
Sorbus americana	American Mountain-ash	S5
Sorbus decora	Northern Mountain-ash	S5
Spiraea alba	White Meadow-sweet	S5
Spiraea tomentosa	Steeplebush	SU
Vaccinium angustifolium	Late Lowbush Blueberry	S5
Vaccinium myrtilloides	Velvetleaf Blueberry	S5
Vaccinium oxycoccos	Small Cranberry	S5

Scientific Name	Common Name	Provincial S-Rank[1]
Gaultheria hispidula	Creeping Snowberry	S5
Gaultheria procumbens	Teaberry	S5
HERBACEOUS (Vascular and Non-Vascular)		
Achillea millefolium	Common Yarrow	SNA
Agrostis scabra	Rough Bentgrass	S5
Anaphalis margaritacea	Pearly Everlasting	S5
Apocynum androsaemifolium	Spreading Dogbane	S5
Aralia hispida	Bristly Sarsaparilla	S5
Aralia nudicaulis	Wild Sarsaparilla	S5
Athyrium filix-femina var. angustum	Lady Fern	S5
Brasenia schreberi	Watershield	S5
Calamagrostis canadensis	Canada Blue-joint	S5
Calla palustris	Wild Calla	S5
Calopogon tuberosus	Tuberous Grass-pink	S4S5
Capnoides sempervirens	Pale Corydalis	S5
Carex aquatilis	Water Sedge	S5
Carex arctata	Black Sedge	S5
Carex brunnescens	Brownish Sedge	S5
Carex cryptolepis	Northeastern Sedge	S4
Carex disperma	Softleaf Sedge	S5
Carex echinata	Little Prickly Sedge	S5
Carex gynandra	Nodding Sedge	S5
Carex houghtoniana	Houghton's Sedge	S5
Carex interior	Inland Sedge	S5
Carex lacustris	Lake-bank Sedge	S5
Carex lasiocarpa	Slender Sedge	S5
Carex leptalea	Bristly-stalk Sedge	S5
Carex magellanica	Boreal Bog Sedge	S5
Carex michauxiana	Michaux Sedge	S5?
Carex oligosperma	Few-seeded Sedge	S4

Scientific Name	Common Name	Provincial S-Rank[1]
Carex pauciflora	Few-flowered Sedge	S5
Carex stipata	Stalk-grain Sedge	S5
Carex stricta	Tussock Sedge	S5
Carex trisperma	Three-seed Sedge	S5
Carex utriculata	Bladder Sedge	S5
Chamerion angustifolium	Fireweed	S5
Chimaphila umbellata	Common Pipsissewa	S5
Cirsium palustre	Marsh Thistle	SNA
Clintonia borealis	Blue Bead-lily	S5
Comandra umbellata	Umbellate Bastard Toad-flax	S5
Comarum palustre	Marsh Cinquefoil	S5
Comptonia peregrina	Sweet Fern	S5
Coptis trifolia	Goldthread	S5
Cornus canadensis	Bunchberry	S5
Cypripedium acaule	Pink Lady's-slipper	S5
Danthonia spicata	Poverty Oat-grass	S5
Dichanthelium implicatum	Wooly Panicgrass	S5
Doellingeria umbellata var. umbellata	Flat-top White Aster	S5
Drosera rotundifolia	Roundleaf Sundew	S5
Dryopteris carthusiana	Spinulose Shield Fern	S5
Dryopteris cristata	Crested Shield Fern	S5
Dryopteris intermedia	Evergreen Woodfern	S5
Dulichium arundinaceum	Three-way Sedge	S5
Epilobium sp.	Willow-herb Species	-
Equisetum sylvaticum	Woodland Horsetail	S5
Eriocaulon aquaticum	Seven-angled Pipewort	S5
Eriophorum vaginatum	Tussock Cottongrass	S5
Eriophorum virginicum	Tawny Cottongrass	S5
Eupatorium perfoliatum	Common Boneset	S5
Eurybia macrophylla	Large-leaf Wood-aster	S5
Euthamia graminifolia	Flat-top Fragrant Goldenrod	S5

Scientific Name	Common Name	Provincial S-Rank[1]
Eutrochium maculatum var. maculatum	Spotted Joe-pye Weed	S5
Fallopia cilinodis	Fringed Black Bindweed	S5
Galium asprellum	Rough Bedstraw	S5
Gentiana andrewsii	Fringe-top Bottle Gentian	S4
Geocaulon lividum	Northern Comandra	S5
Glyceria canadensis var. canadensis	Canada Mannagrass	S4S5
Glyceria striata	Fowl Manna Grass	S5
Goodyera repens	Dwarf Rattlesnake-plantain	S5
Gymnocarpium dryopteris	Oak Fern	S5
Hieracium sp.	Hawkweed Species	-
Hypericum ellipticum	Pale St. John's-wort	S5
Hypericum perforatum	A St. John's-wort	SNA
Hypopitys monotropa	American Pinesap	S4
Iris versicolor	Blueflag	S5
Juncus articulatus	Jointed Rush	S5
Juncus effusus	Soft Rush	S5
Juncus sp.	Rush Species	-
Leucanthemum vulgare	Oxeye Daisy	SNA
Lycopus uniflorus	Northern Bugleweed	S5
Lysimachia terrestris	Swamp Loosestrife	S5
Maianthemum canadense	Wild-lily-of-the-valley	S5
Maianthemum trifolium	Three-leaf Solomon's-seal	S5
Melampyrum lineare	American Cow-wheat	S4S5
Menyanthes trifoliata	Bog Buckbean	S5
Monotropa uniflora	Indian-pipe	S5
Nuphar variegata	Yellow Cowlily	S5
Nymphaea odorata	Fragrant White Water-lily	S5?
Oclemena nemoralis	Bog Aster	S5
Oenothera biennis	Common Evening-primrose	S5

Scientific Name	Common Name	Provincial S-Rank[1]
Onoclea sensibilis	Sensitive Fern	S5
Orthilia secunda	One-sided Wintergreen	S5
Osmunda claytoniana	Interrupted Fern	S5
Osmunda regalis	Royal Fern	S5
Phegopteris connectilis	Northern Beech Fern	S5
Platanthera clavellata	Small Green Woodland Orchid	S4S5
Platanthera huronensis	Lake Huron Green Orchid	SU
Pogonia ophioglossoides	Rose Pogonia	S4S5
Polypodium virginianum	Rock Polypody	S5
Potamogeton sp.	Pondweed Species	-
Potentilla recta	Sulphur Cinquefoil	SNA
Pteridium aquilinum	Bracken Fern	S5
Pyrola americana	Round-leaved Pyrola	S4?
Ranunculus sp.	Buttercup Species	-
Rhynchospora alba	White Beakrush	S5
Sagittaria latifolia	Broadleaf Arrowhead	S5
Sarracenia purpurea	Northern Pitcher-plant	S5
Scirpus cyperinus	Cottongrass Bulrush	S5
Scutellaria galericulata	Hooded Skullcap	S5
Sibbaldia tridentata	Three-toothed Cinquefoil	S5
Solidago altissima ssp. altissima	Eastern Late Goldenrod	S5
Solidago rugosa ssp. rugosa	Northern Rough-stemmed Goldenrod	S5
Solidago uliginosa	Bog Goldenrod	S5
Sparganium americanum	American Bur-reed	S4?
Sparganium eurycarpum	Large Bur-reed	S5
Streptopus lanceolatus	Eastern Rose Twisted-stalk	S5?
Symphyotrichum ciliolatum	Lindley's Aster	S5
Symphyotrichum lanceolatum	Panicled Aster	S5

Scientific Name	Common Name	Provincial S-Rank[1]
Taraxacum officinale	Brown-seed Dandelion	SNA
Thalictrum pubescens	Tall Meadowrue	S5
Triadenum fraseri	Marsh St. John's-wort	S5
Trientalis borealis	Northern Starflower	S5
Typha latifolia	Broad-leaf Cattail	S5
Utricularia cornuta	Horned Bladderwort	S5
Utricularia intermedia	Flatleaf Bladderwort	S5
Viola adunca	Hooked Violet	S4S5
Viola sp.	Violet Species	-
Xyris montana	Northern Yellow-eyed-grass	S4
MOSSES and LICHENS (Incl. Clubmosses)		
Cladonia coccifera	A Lichen	S5
Cladonia cristatella	A Lichen	S5
Cladonia rangiferina	A Lichen	S5
Cladonia stellaris	A Lichen	S5
Cladonia stygia	A Lichen	S5
Dendrolycopodium dendroideum	Round-branched Tree-clubmoss	S5
Diphasiastrum complanatum	Northern Ground-cedar	S5
Diphasiastrum digitatum	Fan Club-moss	S5
Hylocomium splendens	Stair-step Moss	S5
Lycopodium clavatum	Running Clubmoss	S5
Pleurozium schreberi	A Moss	S5
Ptilium crista-castrensis	Knight's Plume	S5
Sphagnum sp.	Sphagnum Moss Species	-
Spinulum annotinum	Stiff Clubmoss	S5
Umbilicaria vellea	A Lichen	S4

[1] Provincial S-Rank: S4 = Apparently Secure, S5 = Secure, S? = Rank Uncertain, SU = Unranked, SNA = Not Applicable (Non-native).

Table 7: Summary of Great Lakes-St. Lawrence ELC Ecosite Accuracy Based on Field Verification Surveys

GLSL ELC Code[1]	Number of Polygons Surveyed	Number of Accurate Polygons	Overall Accuracy	Suggested ELC			Rationale			
				GLSL ELC Code	Number Revised	Percent of Inaccuracy	Change in Coniferous vs. Mixedwood	Different Proportions of Similar Canopy Species	Difference in Ground-cover Species Richness	Other
Upland Communities										
G007*	3	0	0%	G001	3	100%				Origin of barren is man-made
G012	9	8	89%	G011	1	11%		✓		
G034	4	4	100%	-	-	-				
G035	2	1	50%	G055	1	50%	✓	✓		
G048	1	1	100%	-	-	-				
G049	20	20	100%	-	-	-				
G050	15	14	93%	G052	1	7%		✓		
G052	3	3	100%	-	-	-				
G055	7	5	71%	G050	2	29%	✓	✓		
G058	2	1	50%	G055	1	50%		✓		
G065	3	2	67%	G070	1	33%	✓	✓		
G070	1	0	0%	G067	1	100%	✓	✓		
Wetland Communities										
G128	8	5	63%	G129	3	37%			✓	
G135	6	6	100%	-	-	-				
G136	5	5	100%	-	-	-				
G139	12	4	33%	G140	5	67%			✓	
G140	6	6	100%	-	-	-				
G142	14	8	57%	G139	1	7%			✓	
				G145	2	14%				Same community but on floating mat
				G146	3	22%				Fen vs. marsh
G146	5	5	100%	-	-	-				
G158*	2	2	100%	-	-	-				
G164*	6	6	100%	-	-	-				
Total	**134**	**106**	**80%**	**-**	**28**	**20%**	**-**			

[1] Based on GLSL ELC codes as described in Banton et al. 2015.

Table 8: Summary of Aquatic Field Verification Study Locations

Candidate Aquatic Study Waypoint ID	Aquatic Study Field Verification Waypoints[2]						Difference Inferred:Actual Morphology[3]	Observations
	Verification Transect[1]	Observation Date	UTM Northing	UTM Easting	Inferred Morphology	Actual Morphology		
MOZ-RS2-A	N/A	24-Jul-2017	5203364	409132	Riffle	Glide/Run	Y	Bog habitat, slow moving nearly stagnant conditions.
MOZ-RS2-B	RA, CS	22-Jul-2017	5202644	409521	Glide/Run	Glide/Run	N	Cobble substrate with fine grained sediment downstream, abundant macrophytes and low flow.
MOZ-RS2-C1	DS, RA, CS	22-Jul-2017	5203601	411330	Glide/Run	Glide/Run	N	Fine grained substrate with some wood debris and macrophytes.
MOZ-RS2-C2	US, RA	22-Jul-2017	5203576	411343	Glide/Run	Glide/Run	N	Fine grained substrate with some wood debris and macrophytes.
MOZ-RS2-D1	DS, RA, CS	24-Jul-2017	5201635	409624	Pool	Pool	N	Meandering, well-defined channel, fine grained, organic sediments with abundant macrophytes.
MOZ-RS2-D2	US, RA	24-Jul-2017	5201649	409616	Pool	Pool	N	Meandering, well-defined channel, fine grained, organic sediments with abundant macrophytes.
MOZ-RS2-E1	DS, RA	22-Jul-2017	5203940	411229	Riffle	Riffle	N	Cobble and bedrock substrate, bedrock face on right bank.
MOZ-RS2-E2	M, RA	22-Jul-2017	5203934	411224	Riffle	Riffle	N	Cobble and bedrock substrate, bedrock face on right bank.
MOZ-RS2-E3	US, RA	22-Jul-2017	5203925	411223	Riffle	Riffle	N	Cobble and bedrock substrate, bedrock face on right bank.
MOZ-RS3-A1	DS, RA	23-Jul-2017	5191813	407319	Riffle	Riffle	N	Boulders present, left bank undercut, cobble substrate.
MOZ-RS3-A2	US, RA	23-Jul-2017	5191806	407322	Riffle	Riffle	N	Boulders present, left bank undercut, cobble substrate, crayfish species observed.
MOZ-RS3-B1	DS, RA	25-Jul-2017	5191720	407522	Pool	Pool	N	Bedrock and cobble substrate
MOZ-RS3-B2	US, RA, CS	25-Jul-2017	5191716	407566	Pool	Pool	N	Bedrock and cobble substrate
MOZ-RS3-C	N/A	25-Jul-2017	5190469	406374	Pool	Pool	N	Non-wadeable conditions; very low flow characteristic of Pool or very slow moving Run.
MOZ-RS3-D	N/A	23-Jul-2017	5190805	406738	Glide/Run	Pool	Y	Beaver dam has impounded verification area, likely not included in the desktop screening data.
MOZ-RS4-A1	DS, RA	23-Jul-2017	5185895	408253	Pool	Pool	N	Gravel substrate with woody debris and abundant macrophytes.
MOZ-RS4-A2	M, RA	23-Jul-2017	5185912	408244	Pool	Pool	N	Gravel substrate with woody debris and abundant macrophytes.
MOZ-RS4-A3	US, RA, CS	23-Jul-2017	5185905	408213	Pool	Pool	N	Gravel substrate with woody debris and abundant macrophytes.
MOZ-RS4-B	N/A	25-Jul-2017	5185214	408537	Pool	Pool	N	Abundant stream cover, non-wadeable, gravel substrate near banks.
MOZ-RS4-C1	DS, RA, CS	25-Jul-2017	5184824	408861	Pool	Pool	N	Abundant macrophyte cover instream, dense riparian vegetation.
MOZ-RS4-C2	US, RA	25-Jul-2017	5184845	408836	Pool	Pool	N	Abundant macrophyte cover instream, dense riparian vegetation.
MOZ-RS4-D	RA	25-Jul-2017	5184344	408869	Glide/Run	Glide/Run	N	Fine grained substrate with some woody debris cover and macrophytes.
MOZ-RS4-E	RA	25-Jul-2017	5183535	408471	Pool	Pool	N	Fine grained substrate with some woody debris cover and macrophytes.
MOZ-RS4-F1	DS, RA	25-Jul-2017	5183653	408103	Pool	Pool	N	Fine grained substrate with some woody debris cover and macrophytes.
MOZ-RS4-F2	US, RA	25-Jul-2017	5183669	408093	Pool	Pool	N	Fine grained substrate with some woody debris cover and macrophytes.

[1] Verification transect types included; RA=Rapid Assessment and/or CS=Channel Stability, positioned DS=downstream, M=middle, US=upstream of proposed location as accessible in the field.

[2] Universal Transverse Mercator (UTM) coordinates taken in field using handheld GPS units, approximate accuracy of +/-5 metres, North American Datum 1983, Zone 17 N.

[3] Shaded cells indicate a difference between the inferred and actual morphological stream classification.

ATTACHMENT C

PHOTO APPENDIX



Photo 1: ELC Community G049 – Dry to Fresh, Coarse: Jack Pine - Black Spruce Dominated. July 22, 2017.



Photo 2: ELC Community G052 – Dry to Fresh, Coarse: Spruce - Fir Conifer. July 22, 2017.



Photo 3: ELC Community G139 – Poor Fen. July 22, 2017



Photo 4: ELC Community G001 – Excavated Bluff; exposed mineral community associated with sand or gravel extraction. July 22, 2017.



Photo 5: ELC Community G128 – Organic Intermediate Conifer Swamp. July 22, 2017.



Photo 6: ELC Community G012 – Very Shallow, Dry to Fresh: Pine - Black Spruce Conifer. July 22, 2017.



Photo 7: ELC Community G164 – Rock Barren. July 24, 2017.



Photo 8: ELC Community G136 – Sparse Treed Fen. July 24, 2017.



Photo 9: ELC Community G058 – Dry to Fresh, Coarse: Maple Hardwood. July 24, 2017



Photo 10: ELC Community G140 – Open Moderately Rich Fen. July 24, 2017.



Photo 11: ELC Community G135 – Organic Thicket Swamp. July 25, 2017.



Photo 12: ELC Community G034 – Dry, Sandy: Jack Pine – Black Spruce Dominated. July 25, 2017



Photo 13: Aquatic survey station MOZ-RS2-B, “Glide/Run” view downstream. July 22, 2017.



Photo 14: Aquatic survey station MOZ-RS2-E. “Riffle” view downstream. July 22, 2017.



Photo 15: Aquatic survey station MOZ-RS3-B. “Pool” view downstream. July 25, 2017.



Photo 16: Aquatic survey station MOZ-RS3-C. “Pool” view downstream. July 25, 2017.



Photo 17: Aquatic survey station MOZ-RS4-E. “Pool” view north. July 25, 2017.



Photo 18: Aquatic survey station MOZ-RS4-F. “Pool” view downstream. July 25, 2017.