Annex III

Natural Heritage Assessments

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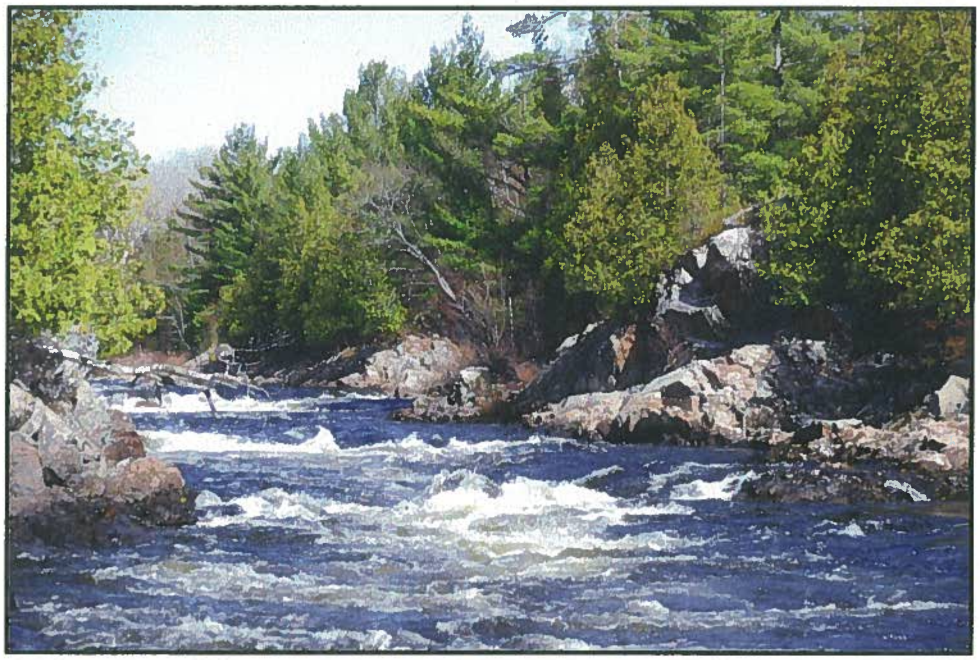
Wabageshik Rapids Hydroelectric Generating Station Project

Natural Environment Characterization and Impact Assessment Report



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Wabageshik Rapids Hydroelectric Generating Station Project

Natural Environment Characterization and Impact Assessment Report

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1.0 Introduction

Xeneca Power Development Inc. (Xeneca) is currently undertaking a provincial Class Environmental Assessment (EA) for Waterpower Projects (OWA 2008) for the development of a hydroelectric facility. This Class EA was initiated in accordance with Section 8 of the Electricity Project Regulation (Ont. Reg. 116/01) under the provincial *Environmental Assessment Act*. The proposed facility is a 3.4 Megawatt (MW) modified run-of-the-river hydroelectric Generating Station (GS) to be located at Wabageshik Rapids on the Vermilion River (Figure 1).

In support of the Class EA, Natural Resource Solutions Inc. was retained by Xeneca to characterize the existing natural environment within the Wabageshik Rapids GS study area (Figure 1) and to identify potential impacts on these features as a result of the proposed development. This report provides a description of existing ecological features, an analysis of their significance and sensitivity, and an assessment of the ecological impacts of the GS.

This report should be read in conjunction with the main EA document (Xeneca 2013a) to which this report is appended. The design information is provided in Annexes 1 and 2 of the main EA document.

1.1 Study Area

The study area is generally defined as the 'zone of influence' (ZOI) plus a 120m perimeter (Figure 1). For Wabageshik Rapids, the ZOI includes the inundation area, Wabageshik Lake, and the downstream 'ecological zone of influence'. The inundation area is the area upstream of the GS that will be inundated as a result of the construction and operation of the proposed Wabageshik Rapids GS. It includes 0.8km of the Vermilion River upstream of the proposed GS site to the outlet of Wabagishik Lake, effectively encompassing the upstream portion of Wabageshik Rapids.

The study area also includes Wabagishik Lake itself. While the lake will not be newly inundated, the dam will exert influence on the lake levels. Minor fluctuations in lake level will occur on a daily basis in conjunction with dam operations, and some ability to control lake levels during drought conditions may also be realized. The project is therefore considered a lake-coupled project, and the study area includes Wabagishik Lake.

The downstream ecological zone of influence is the reach downstream of the proposed GS site that is anticipated to experience variable flows as a result of GS operations that in turn may have potential impacts on aquatic and terrestrial biota and their habitats. A preliminary extent of the downstream variable flow reach was identified in 2010, which included only the Wabageshik Rapids feature. As an outcome of discussions with the Sudbury District Ontario Ministry of Natural Resources (OMNR) in 2011, the downstream study area extent was extended to include Graveyard Rapids to ensure this feature was appropriately studied as part of the baseline surveys. The result is considered the downstream ecological zone of influence, shown on Figure 1. Immediately beyond this downstream limit is the confluence with the Spanish River and the headpond of the Domtar dam in Espanola.

Field work conducted by NRSI in 2010 was based on the preliminary downstream variable flow reach extent. Field work conducted in 2011 was carried out based on the revised ecological zone of influence that extends downstream through Graveyard Rapids (Figure 1).

1.2 Study Scope

The scope of the natural environment studies conducted in 2010 and the level of effort for these studies were based on the project understanding as of the spring of 2010. Further consultation on the scope of field studies occurred with the OMNR on May 26, 2011 during a formal biological scoping meeting held in Sault Ste. Marie, ON. Discussions at this meeting contributed to the refinement of the 2011 field surveys.

A list of the field studies completed as part of this EA is provided in Table 1 below. Details on the scope of the desktop and field studies are provided in Sections 2.0, 3.0, and 4.0.

Table 1. Summary of Ecological Field Studies Completed to Date

	Ecological Study	2010	2011
Aquatic	Fish Community Surveys	√	√
	Walleye Spawning Surveys	√	
	Lake Sturgeon Surveys		√
	Northern Pike Spawning Survey		√
	Benthic Macroinvertebrate Sampling		√
	Mercury Fish Tissue Sampling and Analysis		√
	General Aquatic Habitat Characterization	√	
	Detailed Aquatic Habitat Characterization		√
Terrestrial	Vegetation Community Assessments	√	
	Breeding Bird Surveys	√	
	Deer Passage Study		√
	Incidental Wildlife Surveys	√	√

This report deals only with the study area that was developed for the proposed dam site, inundation area, Wabagishik Lake and downstream ecological zone of influence. It does not address distribution lines and access roads. KBM Forestry Consultants Ltd. conducted work to refine the distribution line and access road alignments to minimize overlap with identified significant natural features. They also considered construction feasibility, land ownership, and crown licenses held by forest management companies. Northern Bioscience conducted biological surveys of the distribution line and access road alignments, the results of which are included with the main EA document (Xeneca 2013a).

In addition, surface water quality, as it relates to the proposed undertaking, is also discussed under a separate cover in a study completed by Hutchinson Environmental Services Inc.

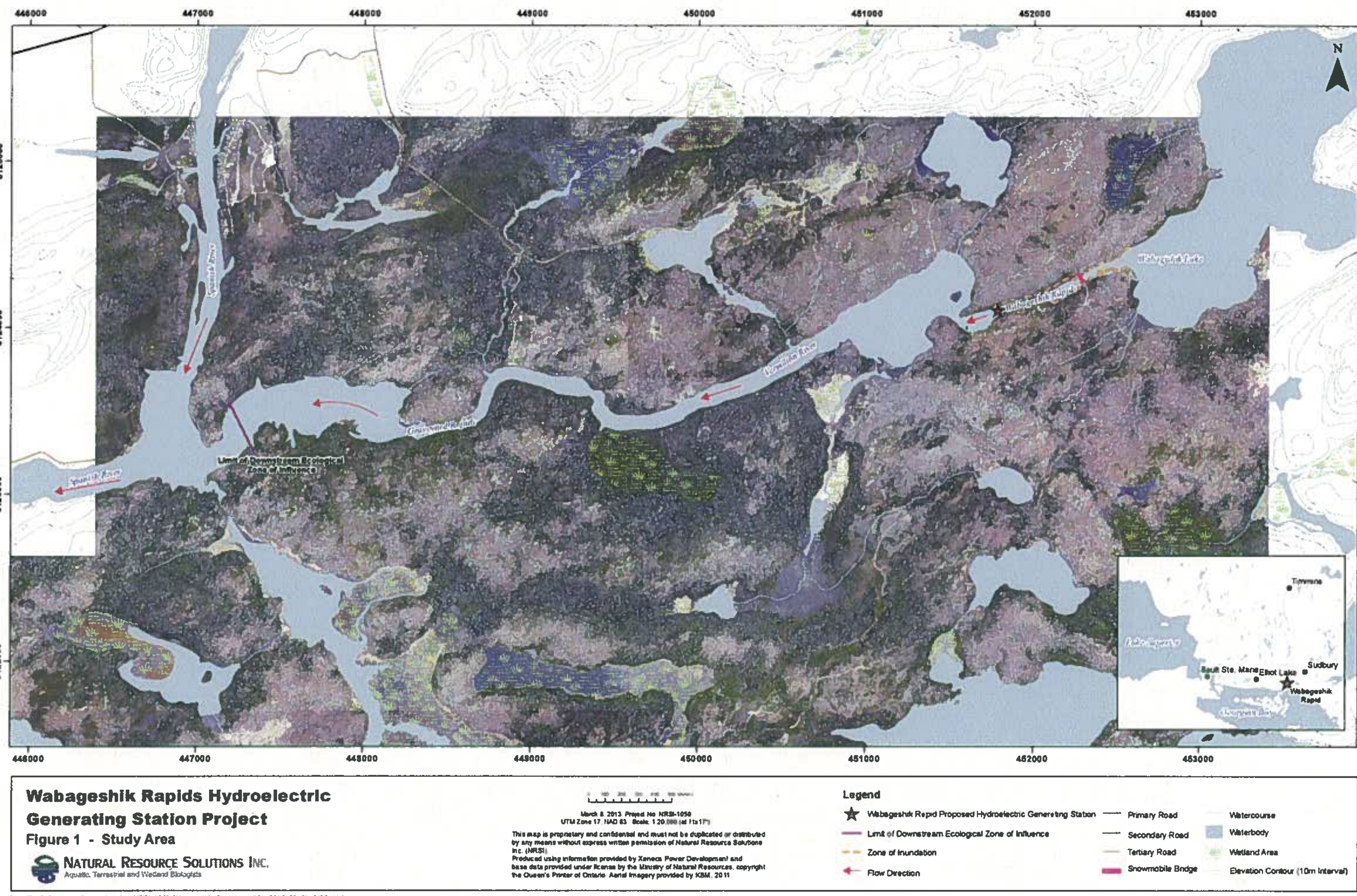

Figure 1 - Study Area

2.0 Background Secondary Source Records Review

2.1 Methods

A review of background secondary source records was conducted for the Wabageshik Rapids GS study area as known in 2010 (Figure 1). The review did not include the associated distribution lines and access road corridors. The background review targeted the identification of designated natural areas, significant vegetation communities and habitats, and significant species present within the GS study area.

The local Sudbury District OMNR office was contacted to provide background information on the natural heritage features known to be in the vicinity of the proposed corridors. In response, a Site Information Package (SIP) summarizing available habitat and species information was provided by the OMNR for the study area (OMNR Undated, found in the main EA document, Xeneca 2013a). As part of the SIP, the OMNR provided a Values Map indicating natural resource values known to occur in the vicinity of the GS study area. An additional meeting with OMNR staff was also held on September 17, 2010 to discuss potential presence of Species at Risk (SAR) within the study area.

In addition, various other resources including existing reports, mapping, and occurrence records were reviewed in order to obtain pertinent information to the study area's natural features. Below is a list of secondary sources utilized in the review:

a) OMNR Natural Heritage Information Centre (NHIC) Biodiversity Explorer (NHIC 2010);
b) Ontario Breeding Bird Atlas (OBBA, Bird Studies Canada et al. 2006);
c) Ontario Herpetofaunal Summary Atlas (Oldham and Weller 2000);
d) Ontario Reptile and Amphibian Atlas (Ontario Nature 2010);
e) Atlas of the Mammals of Ontario (Dobbyn 1994);
f) Air Photos; and
g) Land Information Ontario (LIO)

In searching the NHIC database and the OBBA, the study area was located in square 17MM52, of the 10 x 10km grid system. The results of the records review are provided below in Section 2.2.

The review also included other available online and published species information sources and information provided by the Ontario Waterpower Association (OWA 2010).

2.2 Results

The following sections provide an overview of natural areas, significant vegetation communities and habitats, as well as significant species identified through the background records review. The information is discussed further in Sections 3.0 and 4.0.

Note that while the SIP provides OBBA data, inconsistencies were noted between the OBBA data reported in the SIP and the OBBA data retrieved from the OBBA website (Bird Studies Canada et al. 2006). NRSI has used the OBBA data from Bird Studies Canada et al. throughout this report.

2.2.1 Designated Natural Areas

The records review confirmed that there are no designated natural areas overlapping the study area (NHIC 2010). This records review was conducted for a variety of natural area types, such as Areas of Natural and Scientific Interest (ANSI), Provincially Significant Wetlands (PSW), Conservation Reserves, Migratory Bird Sanctuaries, and Provincial Parks.

2.2.2 Significant Vegetation Communities and Habitats

Biodiversity Explorer (NHIC 2010) indicates that there are no known significant vegetation communities or significant habitats present within the study area.

2.2.3 Significant Species

NRSI biologists conducted a records review of significant species that may be present within the study area. This review included correspondence with the OMNR and the OWA, as well as other available online and published species information sources.

A letter dated July 13, 2010 from Collin Hoag, Policy Advisor for the Ontario Waterpower Association (OWA 2010) indicated the following with respect to the proposed Wabageshik GS on the Vermilion River:

> *The Vermilion River hydroelectric GS(s) "...does not represent any initial potential intersections with species at risk."*

Subsequent data provided to NRSI from OMNR as part of the SIP as well as additional sources indicated the potential presence of numerous SAR species within the study area. A summary of SAR and species of Special Concern identified through the background review is provided in Table 2.

Table 2. Species at Risk and Special Concern Species Identified Through Secondary Source Records Review as Possibly Present in Study Area

Scientific Name	Common Name	S-Rank[1]	COSEWIC and SARA (National Status)[2]	COSSARO and ESA (Provincial Status)[3]	Secondary Source
Bird Species					
Hirundo rustica	Barn Swallow	S4B	THR	THR	OBBA (Bird Studies Canada et al. 2006)
Caprimulgus vociferus	Whip-poor-will	S4B	THR	THR	OMNR 2011; OBBA (Bird Studies Canada et al. 2006)
Chaetura pelagica	Chimney Swift	S4B, S4N	THR	THR	OBBA (Bird Studies Canada et al. 2006)
Chordeiles minor	Common Nighthawk	S4B	THR	SC	OBBA (Bird Studies Canada et al. 2006)
Contopus virens	Eastern Wood-pewee	S4B	SC		OBBA (Bird Studies Canada et al. 2006)
Vermivora chrysoptera	Golden-winged Warbler	S4B	THR (Schedule 1)	SC	OBBA (Bird Studies Canada et al. 2006)

Scientific Name	Common Name	S-Rank[1]	COSEWIC and SARA (National Status)[2]	COSSARO and ESA (Provincial Status)[3]	Secondary Source
Wilsonia canadensis	Canada Warbler	S4B	THR (Schedule 1)	SC	OBBA (Bird Studies Canada et al. 2006)
Dolichonyx oryzivorus	Bobolink	S4B	THR (No Schedule)	THR	OBBA (Bird Studies Canada et al. 2006)
Herpetofauna Species					
Chelydra vermilionina vermilionina	Common Snapping Turtle	S3	SC	SC	Ontario Herpetofaunal Atlases (Oldham and Weller 2000, Ontario Nature 2010)
Emydoidea blandingii	Blanding's Turtle	S3	THR (Schedule 1)	THR	Ontario Herpetofaunal Atlases
Sistrurus catenatus catenatus	Eastern Massasauga Rattlesnake	S3	THR (Schedule 1)	THR	(Oldham and Weller 2000, Ontario Nature 2010)
Lampropeltis t. triangulum	Eastern Milksnake	S3	SC	SC	Ontario Herpetofaunal Atlases
Mammal Species					
Myotis lucifugus	Brown Myotis	S5	END (No Schedule)	END	Ontario Mammal Atlas (1994)
Myotis septentrionalis	Northern Long-eared Bat	S3?	END (No Schedule)	END	Ontario Mammal Atlas (1994)
Fish Species					
Acipenser fulvescens	Lake Sturgeon (Great Lakes – Upper St. Lawrence population)	S2	THR (No Schedule)	THR	OMNR (2011b), Kilgour & Associates (2012)

[1]NHIC 2013, [2]Government of Canada 2013, [3]OMNR 2013.

LEGEND:
S-Rank (Provincial Rank)
S2 - Imperiled
S3 - Vulnerable
S4 - Apparently Secure
S5 - Secure

COSEWIC, SARA – Schedule 1, and COSSARO/ESA
SC – Special Concern
THR – Threatened
END – Endangered

2.2.4 Other Species and Habitat Information

The OMNR Values Map indicates that one trap line (EP043), as well as two Bear Management Areas (SU-42-006 and EP-42-005), overlap the Wabageshik study area. The locations of the trap line and bear management areas are provided on the Values Map found in Appendix A of the main EA document (Xeneca 2011a).

In addition, the OMNR Values Map identifies Moose Aquatic Feeding Areas upstream of the study area, occurring in three locations along the southern shores of Wabagishik Lake. An unspecified Sensitive Value is also identified to be present at the proposed dam location on the Vermilion River. This value is not specified because of its sensitivity. The OMNR would prefer that the public not be made aware of the nature of these values. The locations of the Moose Aquatic Feeding Areas and the Sensitive Value are shown on the OMNR Values Map provided in Appendix A of the main EA document (Xeneca 2011a).

Finally, the OMNR Values Map indicates that there are no deer yards within the immediate vicinity of the project. However, there are several located to the northwest (greater than 3km from the study area) and one over 9km to the southwest. NRSI was informed by a member of the public that there may be significant movement of white-tailed deer (*Odocoileus viginianus*) across Wabageshik Rapids, in particular near the location of the proposed dam. During the winter of 2012 and 2013, OMNR biologists made observations of deer yarding to the south, in much closer proximity to the proposed dam than the locations indicated on the OMNR Values Map. The highest concentration was along the north shore of Elizabeth Lake, 2km due south of the proposed dam. The nearest part of the yarding activity was 500m due south of the proposed dam. The deer in this area yard in open south-facing slopes in addition to areas sheltered by conifer trees (W. Selinger pers. comm. 2013).

No fish occurrence records were made available by OMNR for the Vermilion River. However, the OMNR Espanola Area Office provided fisheries management objectives that indicated that walleye (*Sander vitreus*), northern pike (*Esox Lucius*), smallmouth bass (*Micropteris dolomieu*) and lake sturgeon (*Acipenser fulvescens*) are species of particular management interest along with generally preserving the existing aquatic species diversity (OMNR 2011b).

Information on walleye and lake sturgeon was provided by Vale, a stakeholder and owner of numerous structures on the Vermillion and Spanish Rivers. Kilgour & Associates conducted fish sampling on behalf of Vale in 2011 and 2012, and this information has provided insight into walleye and lake sturgeon populations in and around the study area (Kilgour & Associates 2012). The information is discussed in greater detail along with the results of NRSI's sampling in sections 3.2.3 and 3.2.4.

3.0 Aquatic Environment Characterization

3.1 Aquatic Field Methods

Aquatic resource information was collected over several field surveys during the 2010 and 2011 field seasons. These investigations included aquatic habitat characterization, general fish community sampling, spawning surveys for walleye, northern pike and lake sturgeon, and benthic invertebrate sampling. The methods used for these studies are described below.

3.1.1 Aquatic Habitat Characterization

Preliminary visual surveys to characterize aquatic habitat within the Wabageshik Rapids GS study area on the Vermilion River were conducted in 2010. Surveys included documenting habitats associated with specific life stages (i.e. spawning, nursery), substrate composition, aquatic vegetation and incidental fish usage of the area. General habitat mapping and photographic documentation was also conducted.

Additional focused aquatic habitat assessments were carried out in August 2011 to quantify the various channel units in the study area, with a focus on the habitats within Wagabishik Rapids. The channel units included chutes, pools, rapids, riffles and runs. The lengths and widths of these units were measured, and their areas were calculated based on these measurements in conjunction with aerial photography. Key habitats were also identified to better describe the substrate and vegetation within the channel. Substrates were characterized in a quantitative manner at representative and accessible locations using a Frequency of Size Classes method described by Bain and Stevenson (1999).

To sample the substrate quantitatively, a 1m chain painted in 10cm increments was placed on the bottom of the watercourse along the transect line. The dominant substrate touching each 10cm increment was recorded using a modified Wentworth classification, which assigns a number code to each substrate type. This provided a total of 10 observations at each sampling location. Sampling locations were positioned 1 or 2m apart on transects spaced 10m to 20m apart along accessible portions of Wabageshik

Rapids. In locations where the entire transect was not wadeable due to depth or velocity, substrate sampling was conducted within all wadeable portions of the transect.

Results of the 2010 and 2011 aquatic habitat characterization are included in Section 3.2.1.

3.1.2 Fish Community Sampling

Fish community sampling was conducted within the study area on August 4, 2010 and between August 10 and August 14, 2011. Sampling in 2010 and 2011 included gill netting, electrofishing, minnow trapping, and trotlines.

<u>Backpack Electrofishing</u>

In 2010, electrofishing surveys occurred at a total of four stations within Wabageshik Rapids (EMS-001 to EMS-004) on August 4, 2010. Total sampling duration of these surveys was 2,000 shocking seconds (33min.). A Halltech backpack electrofisher was used for the 2010 surveys and was set to a pulse frequency of 60Hz and an electric potential of 500V.

In 2011, electrofishing surveys occurred at a total of ten stations (EMS-005 to EMS-014) on August 14, 2011. This sampling was conducted in Wabageshik Rapids, as well as 3 locations at tributary outlets within the expanded study downstream of the proposed Wabageshik Rapids GS. Sampling took place in the main river stem as well as three tributaries. Total sampling duration of these surveys was 3784 seconds (63min.). A Smith-Root LR-20B backpack electrofishing unit was used for the 2011 surveys and was set to a pulse frequency of 60Hz and electric potential of 300V.

Captured fish were identified, enumerated and released live. Refer to Aquatic Assessment Mapping (Appendix I) for electrofishing station locations, and Appendix II for electrofishing sampling results by station.

<u>Gill Netting</u>

Gill nets of varying mesh size and length were used to capture a range of fish species and sizes. These nets were constructed according to the Riverine Index Netting protocol

(Jones and Yunker 2010). A description of their construction is provided below in Tables 3 and 4, respectively.

Table 3. Small Gill Nets Construction Parameters

Parameter	Panel Construction				
Stretch measure (in)	0.5	0.75	1	1.25	1.5
Stretch measure (mm)	13	19	25	32	38
Mono diameter (mm)	0.1	0.13	0.13	0.15	0.15
Series Order	4	2	5	1	3
Panel length (m)	2.5	2.5	2.5	2.5	2.5
Panel height (m)	0.9	0.9	0.9	0.9	0.9
Monofilament	Clear, double knotted except 13-25 mm are single knot				
Float line	10 mm (3/8 in)				
Lead line	no. 30 (15lbs/300ft)				
Mesh labels	yes (mm)				

Table 4. Large Gill Net Construction Parameters

Parameter	Panel Construction							
Stretch measure (in)	1.5	2	2.5	3	3.5	4	4.5	5
Stretch measure (mm)	38	51	64	76	89	102	114	127
Mono diameter (mm)	0.28	0.28	0.28	0.33	0.33	0.33	0.4	0.4
Series Order	5	3	7	1	4	8	2	6
Panel length (m)	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Panel height (m)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Monofilament	Clear, double knotted							
Float line	13 mm (1/2 in)							
Lead line	no. 27 (27lbs/300ft)							
Mesh labels	yes (mm)							

In 2010, gill netting was conducted at three stations (GND-001 to GND-003) on August 4, 2010. The sampling objective was to document the diversity of the fish community. As such, the sampling locations were selected in the field using a non-random targeted sampling approach. A small net was used at GND-002 to capture smaller fish, young-of-the-year and juveniles. Large nets, targeting large-bodied fish, were used at the two other gill net stations. Each net was set for between 6:20 and 7:00 hours.

In 2011, gill netting was conducted at 15 stations (GND-037 to GND-051) between August 10 and August 12, 2011. The sampling objectives were to provide a second year of data and to sample systematically within the expanded study area downstream of the proposed Wabageshik Rapids GS. Large RIN nets were set every 250m in the Vermillion River between Wabageshik Rapids and the confluence with the Spanish

River. For effective sampling, net locations were in slower sections of the river. Each net was set for between 17:20 and 19:20 hours with an average set time of 18:35 hours. Following the completion of the systematic sampling, an additional five nets (GND-052 to GND-056) were set within the study area targeting high density sport fish locations to collect mercury samples. Fork lengths, total lengths, and weights were measured on each individual fish captured. Refer to Aquatic Assessment Mapping (Appendix I) for gill net station locations and Appendix II for sampling results by station.

Minnow Trapping

Individual minnow traps were set at a total of 15 stations (MNT-001 to MNT-015) on August 12 and 13, 2011. Traps were baited with cat food and set for durations ranging from 28:00 to 54:30. Captured fish were identified, enumerated and released live. Refer to Aquatic Assessment Mapping (Appendix I) for minnow trap station locations and Appendix II for sampling results by station.

3.1.3 Walleye Spawning Surveys

Walleye spawning surveys were conducted within the Wabageshik study area between April 18 and 20, 2010. Sampling methods to determine the presence or absence of spawning walleye consisted of egg mats and angling and are discussed in further detail below. Spawning surveys took place throughout Wabageshik Rapids, with egg matting carried out only in the upper and middle sections of potential spawning habitat (Figure 1).

Egg Mats

Egg mats were used as a qualitative method for confirming walleye spawning activities within the study area. Egg mat setting was not used to determine the relative significance of a given spawning habitat, nor did it allow delineation of the specific boundaries of spawning areas, rather, the results of the egg mats were used to generally confirm spawning in the vicinity. While egg mats cannot be used to generate reliable quantitative data, the presence of one or more walleye eggs in the retrieved mats was considered to be confirmation of spawning.

The egg mats were constructed using a 38cm x 25cm x 0.06cm piece of steel plating wrapped in furnace filter material and fastened to the plate by four metal clips. The coarse nature of the furnace filter fabric allowed the entrapment of eggs within the fibers. Each mat weighed approximately 7kg. A length of rope was attached to a D-ring on the plate and buoyed by a small piece of foam.

Upon retrieval, the filter fabric was visually scanned for the presence of trapped eggs, with approximately 10 minutes spent searching on each mat. To positively identify the collected eggs, NRSI used egg identification information for walleye, northern pike, white sucker (*Catostomus commersonii*) and yellow perch (*Perca flavescens*) from Auer (1982). Representative photographs were also taken of each sampled egg to facilitate confirmation of the identification.

Ten egg mats (EMD-001 to EMD-010) were set on April 20, 2010, and left in place between 00:36 and 48:30 hours. Refer to Aquatic Assessment Mapping (Appendix I) for egg mat station locations and Appendix II for station sampling details.

<u>Angling</u>

Angling was used to determine presence, sexual maturity (green, ripe, spent), and general location of spawning. Angling was conducted using conventional rods and reels using a variety of lures. Angling efforts concentrated on potential walleye spawning habitats to confirm the presence of staging/spawning walleye. All angled walleye were measured for weight and total length, sexed using external observations, and the spawning condition (green, ripe, or spent) was visually assessed. Spawning condition (sexual maturity) was assessed by running a finger and thumb along the belly of the fish. If no eggs or milt were secreted and the belly felt firm, the fish was considered green and not actively spawning. If eggs or milt were secreted, the fish was considered ripe and active spawning was already starting or imminent. If the belly felt flaccid and no eggs or milt were secreted, the fish was considered spent and had completed spawning.

Any angled walleye were marked with a fin clip on the secondary dorsal fin and the caudal fin for the identification of any recaptures. Once walleye were confirmed within the vicinity of a potential spawning location and stage of the spawn was determined, angling efforts were re-focused to find other potential spawning/staging locations. Incidental catches of non-target species were also recorded.

Angling took place at eight stations (ANG-001 to ANG-008) between April 18 and April 20, 2010, with a total angling effort of 2:45 hours. Refer to Appendix I for angling station locations and Appendix II for results by station.

3.1.4 Lake Sturgeon Surveys

Lake sturgeon surveys were carried out to confirm presence/absence of the species as well as identify whether spawning was occurring within the study area reach of the Vermillion River.

Studies occurred between May 22 and June 5, 2011. All spawning surveys were conducted when water temperatures were between 14°C to 17°C, which are within the temperature range for lake sturgeon spawning (8.5°C to 18°C) (Scott and Crossman 1973, Harkness 1923, and Nichols et al 2003). Sampling methods used to determine the presence/absence of lake sturgeon as well as spawning consisted of fish capture (trot lines and gill nets) and egg capture methods. These methods are discussed further below.

Trotlines

Trotlines, also known as baited lead lines, were set strategically throughout the study area as a means of capturing lake sturgeon to assess sexual maturity, spawning condition, and general spawning area. Each trotline measured 40m in length and had 12 to 13 1m-long snoods (short lengths of line with hooks) attached to the main horizontal line. Snoods were fashioned out of 100lb-test, 0.46mm diameter braided fishing line attached to the lead line at 3m intervals. Size 3-5 hooks were used in a variety of styles and baited with either worms, minnows, or fish flesh. Lead lines were secured at each end to anchors marked with buoys. In total, 13 trotlines (STL-001 to STL-013) were set with water temperatures of 14 and 17°C and between the dates of May 22 and June 5, 2011. Trot lines STL-009, 011, and 013 were set at the rapids located 3.5 km downstream of the project site. All others were set close to the proposed dam location. Refer to Aquatic Assessments Mapping (Appendix I) for trotline station locations and Appendix II for station sampling details.

Gill Nets

Multifilament gill nets were used specifically to target lake sturgeon within the study area. Nets used were 24m long by 2m high with a float line along the top and a lead line along the bottom. They were constructed using one uniform dark green multifilament mesh size across the entire net. Three different mesh sizes were used which included 8in, 10in and 12in stretched mesh.

Gill netting was conducted at 33 stations (GND-004 to GND-036) between May 22 and June 6, 2011 when water temperatures were in the range of 14 to 17°C. The sampling objective was to confirm whether lake sturgeon use this section of the river during spawning. As such, the sampling locations were selected in the field using a non-random targeted sampling approach. The various sizes of multifilament nets were set for durations ranging between 6:25 hours and 20:50 hours with an average set time of 16:15 hours. The study area was surveyed prior to setting nets to identify areas most likely to provide staging and/or holding habitat. These areas were generally across the main channel in the deepest locations possible, as well as any additional deep troughs and pools identified within the river.

Egg Mats

Egg mats were used as a qualitative method for confirming the presence of lake sturgeon spawning activities within the study area. These mats were not used to determine the relative significance of a spawning habitat nor did they allow for the delineation of the specific boundaries of spawning areas. Rather, the presence of one or more lake sturgeon eggs found on an egg mat was used as confirmation of spawning. Refer to Section 3.1.3 for details of the egg mat construction.

Egg mats were placed within or downstream of potential spawning locations. Potential spawning locations include areas with cobble or boulder substrates and rapid moving water with depths between 0.3 and 0.6m as recommended by the Ontario Waterpower Association's Lake Sturgeon Best Management Practices Guide for Waterpower Projects (OWA 2008).

Forty-four egg mats (EMD-011 to EMD-050) were set between May 26 and June 5, 2011, and left in place between 21:50 hours and 71:35 hours. Sixteen egg mats were placed above the proposed dam site and below Wabagishik Lake. Fifteen egg mats were placed within 700m downstream of the proposed dam. The remaining nine egg mats were placed at the Graveyard Rapids, 3.5km downstream of the project site. Refer to Aquatic Assessment Mapping (Appendix I) for egg mat station locations.

Upon retrieval, the filter fabric was visually scanned for the presence of trapped eggs, with approximately 10 minutes spent searching on each mat. To positively identify the collected eggs, NRSI used egg identification information from Auer's (1982) Identification of Larval Fishes of the Great Lakes Basin Emphasis on the Lake Michigan Drainage. Information was also provided by the OMNR Sudbury District to assist in the identification and preservation of lake sturgeon eggs as required by the License to Collect Fish for Scientific Purposes issued by the OMNR Sudbury District. Any eggs were photographed and then preserved in sample container with a solution of 95% ethanol. Each sample container was labeled with the date, time, study reach, station number, and collector's name for transfer to the Sudbury District office.

Refer to Aquatic Assessment Mapping in Appendix I for egg mat station locations. Sampling results by station are provided in Appendix II.

3.1.5 Aerial Northern Pike Spawning Surveys

During the spring of 2011 (April 19), the Vermilion River was flown by helicopter to visually assess and identify potential northern pike spawning habitat. Flooded tributaries, back bays and flooded riparian areas, where northern pike have potential to spawn, were the focus of these surveys and were visually assessed and mapped on aerial photographs. During subsequent site visits in the spring of 2011, the identified potential spawning locations were observed in the field to gather additional information on the suitability of specific habitats for northern pike spawning.

3.1.6 Fish Tissue Mercury Sampling

Fish tissue samples were obtained for analysis of total mercury. This analysis was conducted to compare existing mercury levels of targeted sport fish species within the study area to current provincial sport fish consumption guidelines.

Sampling was focused on the most abundantly present sport fish species within the study area, smallmouth bass. A total of 20 fish specimens were collected, from the Vermilion River downstream of the proposed dam location at Wabageshik Rapids. Sampling occurred between August 11 and August 14, 2011 by means of angling and gill netting. Angling and gill netting efforts were used at locations GND-052 to GND-056 and ANG-012 to ANG-014, as shown in Appendix I. Sampling efforts targeted smallmouth bass greater than 200mm.

Each smallmouth bass that was collected had its fork length measured to ensure it met the 200mm length criteria, then weighed. Mortalities associated with gill netting protocol were the primary source of fish for the tissue samples. Live caught specimens from gill netting and angling were euthanized by implementing a blunt force to the head. The fish was then dissected with a sterilized fillet knife to extract a 20g (wet weight) sample of tissue from above the lateral line immediately posterior to the gills. Sampling was conducted in accordance to "Protocol for the Collection of Sport Fish Samples for Inorganic and Organic Contaminant Analyses " as developed by the Ontario Ministry of the Environment (MOE), to ensure the tissue sample showed a representative mercury level and was not influenced by the high fat content below the lateral line. Tissue samples were then descaled and rinsed in river water before being individually wrapped in a water proof re-sealable plastic bag and marked with a unique identifying number tag.

Upon completion of sampling, samples were packed on dry ice and shipped to Flett Research Ltd. in Winnipeg, an accredited laboratory located in Manitoba for analysis of total mercury. Analysis was performed using a modified version of the EPA's Method 7473 "Mercury in Solids and Solutions by Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry." Modifications to this standard protocol were made based on equipment manufacturer's recommendations and staff of Flett Research

Ltd.'s experience. This modified protocol allows for detection of total mercury as low as 0.0013 μg/g.

3.1.7 Benthic Invertebrate Surveys

Benthic invertebrate surveys were conducted in order to provide baseline invertebrate data representative of the fast-water habitats within the main stem of the Vermillion River. The baseline data will enable characterization of the benthic invertebrate community at the site, and long-term monitoring downstream of the Wabageshik Rapids GS. To achieve these objectives, quantitative benthic sampling was conducted using Hester-Dendy (H-D) artificial substrate samplers installed from August 30, 2011 to October 13, 2011. The total duration of installation was 45 days. One H-D sampler was installed at each of 20 locations. Five H-D samplers were installed upstream of the proposed Wabageshik Rapids GS (ASB-011 to ASB-015). Another 5 H-D samplers were installed at Graveyard Rapids located 4km downstream of Wabageshik Rapids (ASB-016 to ASB-020).

Stratified sampling was used immediately below the proposed Wabageshik Rapids GS location. Here, a total of 10 samplers were installed with 5 located in (or close to) the middle of the channel (ASB-006 to ASB-010), and 5 located closer to the edge (ASB-001 to ASB-005). The stratified sampling was carried out for the purpose of future monitoring when the wetted width of the channel may vary as part of the dam operation. Flows may vary to different degrees at the edge of the channel versus the middle of the channel, and this study design is intended to facilitate comparison of response in these two areas during monitoring. Refer to Aquatic Assessment Mapping (Appendix I) for specific locations.

In addition to collecting benthic invertebrate data, habitat characteristics and water quality measurements were recorded at each location. The parameters measured included water temperature, dissolved oxygen, pH, dominant substrate, water depth, and hydraulic head.

Each individual H-D Sampler was constructed in accordance with Environmental Protection Agency (EPA) specifications, using 3mm (1/8") thick tempered masonite, with nylon spacers and stainless steel hardware. Fourteen round plates were attached together at variable spacing with a bolt through the center. Of the 13 spaces on the H-D sampler, 8 spaces were 3.5mm thick, 1 space was 6.5mm thick, 2 spaces were 10mm thick and 2 spaces were 13mm thick. Altogether the H-D samplers provided a total surface area of 0.16m^2. These plates are intended to act as an artificial substrate on which benthic invertebrates can colonize.

The H-D samplers were installed in the fast-water habitats, either within or beside the main current. Specific locations were chosen on site in order to effectively cover the habitat area and represent a variety of habitat types. The H-D samplers were attached to large pieces of cobble/boulder using plastic zip ties and placed into the river, ensuring that they would not move or become dewatered over the course of sampling. To ensure that the entire surface of the H-D sampler was available for colonization by invertebrates, care was taken to ensure that the H-D samplers were not embedded in gravel, sand or finer substrates.

During retrieval a 500 micron mesh D-net was held downstream of the plate to catch any invertebrates leaving the sampler as it was pulled out of the water. The entire H-D sampler and any material collected in the D-net were placed into a 55 oz. Whirlpak bag. A 70% ethanol solution was added to the bag, making sure the entire plate was covered. An internal label was placed into this bag along with the H-D sampler that included information on the sampling location, personnel involved, preservative used, date, and time. This bag was then sealed and placed into a second 55 oz. Whirlpak bag. This second Whirlpak was externally labelled.

Samples were then processed by Richard Bland Associates, a professional taxonomist in London, Ontario. All organisms in each sample were identified to the lowest practical level. Richard Bland Associates entered the results electronically into an Excel spreadsheet, and provided the Excel file to NRSI. After processing, Richard Bland Associates archived the specimens.

Upon receiving the raw data, a variety of indices were calculated to describe the benthic community in the study area. These indices can also be used as endpoints for comparison of this baseline data to sampling conducted in the future as part of long-term monitoring within the variable flow reach. In this regard, the study design treats each of the 20 stations as a sample of riffle habitat, for a total sample size of n = 20. The following is a list of the indices that were calculated for the current report:

- Organism density (number per square metre)
- Taxonomic richness (number of taxa)
- Simpson's Diversity Index
- Proportion of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). This index is also known as %EPT.
- Dominant taxon
- Relative abundance of families
- Relative abundance of functional feeding groups

Organism density was determined based on the sampling area of the H-D samplers ($0.16m^2$).

Taxonomic richness was calculated by tallying all taxa (either species or lowest level of identification) present in a given sample. Generally, a higher number of taxa present in a sample reflect a more diverse habitat and/or better water quality.

The Simpson's diversity index takes into account both the abundance patterns and taxonomic richness of a community. It is calculated using the equation:

$$\mathbf{D} = \mathbf{1} - \sum_{i=1}^{S} (p_i)^2$$

where D = Simpson's index of diversity, S = the total number of taxa at the station, and p_i = the proportion of the i^{th} taxon at the station.

The proportion of EPT is the percentage of Ephemeroptera (mayfly), Plecoptera (stonefly), and Trichoptera (caddisfly) taxa within a sample expressed as a proportion of the entire sample. This index is based on the premise that EPT taxa are generally sensitive and intolerant of pollution and habitat degradation (Barbour *et al.* 1999; Weber 1973). Therefore, a higher EPT richness value suggests better water quality and/or habitat conditions while a low EPT richness indicates poor or degraded habitat conditions.

Other proportion-based indices include the dominant taxon, which is the taxonomic group that is most abundant in the sampling areas, relative abundance of taxonomic groups, and relative abundance of functional feeding groups. Relative abundance was calculated for 14 taxonomic groups and 5 functional feeding groups.

Some of these indices can also be used as endpoints for comparison of this baseline data to sampling conducted in the future as part of long-term monitoring within the variable flow reach. Candidate indices include organism density, taxa richness, Simpson's Diversity Index, and % EPT. In this regard, the study design treats each of the 3 sampling areas as separate units: two areas with 5 replicates, and one area with 10 replicates.

3.2 Results and Discussion of the Aquatic Environment

3.2.1 Aquatic Habitat

The Vermilion River originates northeast of Vermilion Lake and flows through numerous large lakes including Vermilion Lake, McCharles Lake, Rat Lake, Grassy Lake, and Wabagishik Lake. The river is also characterized by incoming tributaries, mid-channel islands, marshes and swamps along shorelines, and sections of meandering channel with wooded shorelines. The Vermillion River ends where it flows into the Spanish River. The Wabageshik Rapids GS is proposed to be located on the Vermillion River, 5km upstream of the outlet to the Spanish River. The GS study area is located within the Sudbury – North Bay Forest Section (L4e) of the Great Lakes – St. Lawrence Forest Region (Rowe 1972). The general topography of the area is characterized as relatively flat upland and lowland areas with the occasional bedrock outcroppings (Rowe 1972).

<u>Upstream of Proposed Dam site</u>

The outlet of Wabagishik Lake is located approximately 800m upstream of the proposed dam site. Wabagishik Lake is a large on-line lake approximately 10km in length. The outlet is located at the southwest end of the lake, with the inlet located on the northeast side of the lake. The Vermilion River flows from the outlet of Wabagishik Lake through a bedrock valley (Wabageshik Rapids) for a length of approximately 1.2km. Numerous cobble-boulder riffles are present throughout Wabageshik Rapids (Appendix I, Aquatic Habitat Map 1).

A large riffle, along approximately 150m of channel length, is located at the upstream end of the rapids. This riffle feature is approximately 1690m^2 during low flow conditions and 5510m^2 during bank full conditions. Substrates within this riffle comprise 50% boulder along with bedrock and cobble. Wetted width within the channel varies significantly with flow conditions. During low flows that often occur in the summer, the wetted width ranges from 8 to 15m, and most of the cobble substrates are exposed, with the thalweg (path of main flow) meandering through bedrock points along the southern edge of the channel. During high flow conditions, wetted width ranges from 20 to 55m, and more of the cobble substrates are submerged providing habitat that can be used by spawning fish such as walleye and sucker species. Several small pools occur within the riffle, creating some refuge and velocity breaks for fish. The habitat is suitable for spawning fish such as walleye, lake sturgeon and sucker species. This is further evidenced by the capture of walleye and white sucker eggs in this riffle in the spring of 2010.

A pool approximately 40m by 40m (1600m^2) occurs downstream of the riffle and upstream of a snowmobile bridge that crosses the river. Substrates in the pool consist of gravel, cobble, and bedrock, with isolated boulder and sand. This pool provides refuge habitat as well as potential spawning habitat for Smallmouth Bass. During the summer 2011 surveys both adult and young-of-the-year Smallmouth Bass were observed at this location.

A bedrock chute exists where the channel narrows under the snowmobile bridge. The substrate is almost exclusively bedrock. While the channel width is 15m, the wetted width is approximately 7m wide during low flow conditions, with high gradient and fast flows present. Water depths are generally greater than those observed upstream of the bridge.

Immediately downstream of the snowmobile bridge and bedrock chute, there is a large pool with a wetted width of approximately 75m. This pool has an area of approximately $3380m^2$ (bankfull) or $2270m^2$ (low flow). The substrate within the pool varies and includes mostly bedrock, along with boulder, cobble, and isolated areas of pebble substrate. In addition, boulder and cobble substrates are present within the transition of habitat from pool to riffle. The predominant bedrock substrate observed within the pool area is unsuitable spawning habitat for walleye, lake sturgeon and suckers, however isolated deposits of cobble and pebble may provide potential spawning habitat for smallmouth bass, a species known to spawn in slowly flowing water on course substrates. The pool can also serve as refuge habitat for species that spawn in fast water.

Between the large pool and another channel constriction, a riffle is present with a channel width ranging from 10 to 75m. The riffle is approximately 175m in length, encompassing approximately $9280m^2$ during bank full conditions and $4490m^2$ during low flow conditions when flow is restricted to the south side of the river. Wetted width and water depth within the channel varies considerably with flow conditions. Wetted widths ranging from 10 to 40m during low flow conditions and 35 to 75m during bank full conditions were observed. Water depth ranges from 0.75m during low flow to 2.5m during high flow conditions. A large floodplain on the northern shore of the river within this reach accounts for a significant increase of wetted width during high water conditions, however this area is dry during low flow conditions. Within the riffle, substrates are cobble (80%) and boulder (20%) which has potential to provide spawning habitat for walleye, sucker species, and lake sturgeon should they access this part of the river.

Approximately 80m upstream of the Wabageshik Rapids GS, there is a set of rapids that extends a further 100m upstream. The river is confined within a bedrock trench with steep bedrock shorelines creating rapids through this section during periods of high water. This area is a series of fast water-turbulent (Armantrout 1998) rapids over a bedrock substrate. Wetted widths and water depths within these trenched rapids vary depending on flow conditions and seasonal influences. The downstream portion of the rapids ranges in wetted width from 7m in low flow conditions, to 18m during high flow conditions. Water depth in the lower portion is also seasonally variable and may range from 1.0m during low flow up to 3.0m during high water conditions. Wetted width is greater in the upstream portion of the rapids. The wetted width at the upstream end of the rapids ranges from 10m during low flow conditions to 40.m during high flow conditions. Water depth within the upper section of the rapids ranges from 0.75m during low flow conditions to 2.75m during high water conditions. Substrates are dominated by bedrock with isolated broken bedrock present in current breaks. Due to the high water velocities within the rapids during the spring freshet and substrates dominated by bedrock, spawning habitat is not present. The total rapid habitat area during high water or bank full conditions is approximately 2600m^2 while during low flow conditions, as observed during the summer of 2011, the total rapid habitat area is approximately 920m^2.

Isolated boulder and broken bedrock are present within the riffle/run immediately downstream of the rapids.

Proposed Dam Site

The Wabageshik Rapids GS site is located in the downstream portion of Wabageshik Rapids (Appendix I, Aquatic Habitat Map 1). The spillway, powerhouse, and headrace will be built primarily in a run that can be defined as a fast water-non turbulent feature according to Armantrout (1998). This run has little to no surface agitation or turbulence during low flow conditions. During high water, the surface water may appear turbulent or agitated at this location as a result of the rapids located immediately upstream, and water velocity through this section can be substantial. In spite of surface agitation during high water, the substrate within this feature is predominantly bedrock with limited cobble and boulder substrates. The bankfull width is approximately 40m at this location and shorelines are made up steep bedrock. There is minimal change in the wetted width of the river throughout the year due to the steep bedrock shorelines. During low flow conditions, the wetted width is 35m. Water depth varies substantially with flow conditions and can range from 2.0m during low flow conditions to 4.0m during high flow conditions. The total run habitat at the proposed GS site is approximately 1200m^2.

Part of the Wabageshik Rapids GS spillway will be constructed in a large pool that occurs downstream of the run discussed above. The channel transitions from the run to the pool where it widens. The channel width of the pool is 85m at the widest point.

Wetted width, water depth and length of the pool vary based on flow conditions. During low flow conditions, the pool is approximately 80m in length, with an average wetted width of 35m and encompasses 3360m^2. Water depth within the pool ranges from 1.5 to 2.5m during low flow conditions. During high water levels, the pool measures 100m in length with an average wetted width of approximately 55m (6600m^2 total area) and water depths ranging from 2.0m to 4.0m. Based on measurements of particle size, the substrate composition of the pool is cobble, pebble and gravel. It is anticipated that this pool acts as refuge habitat for fish. During the spring 2011 field study, large groups of redhorse spp. (*Moxostoma* spp.) were observed staging in this area in a manner that is indicative of the onset of spawning behavior that would be completed within riffle habitats adjacent to the pool (Kwak and Skelly 1992). The OMNR (2012b) confirmed that the pool provides a staging area for spawning walleye, redhorse suckers and potentially lake sturgeon. In addition, the pool is known to hold large numbers of pike during certain seasons when they are most likely feeding on young-of-the-year (YOY) suckers and other drift (OMNR 2012b).

Downstream of Proposed Dam Site

Immediately downstream of the pool habitat is a large, wide riffle section. The bankfull width through this riffle is 100m, with water depths ranging from approximately 0.25m in much of the riffle area, to 2.5m in the thalweg along the south bank. In high flow conditions, a number of small vegetated islands surrounded by cobble riffles are present. The north portion of this riffle has numerous small back water eddies over cobble-dominated substrates. The total riffle habitat, during bankfull conditions, is approximately 7900m^2. During low flow conditions, the wetted area is limited to the deeper part of the channel along the south shoreline with wetted widths ranging from 15 to 25m (2380m^2 total area). The remaining cobble substrate becomes exposed at low flows. Based on the substrate analysis, the dominant substrates are pebble and cobble along with smaller areas of gravel and bedrock.

A small run, approximately 50m in length, extends from the downstream side of the riffle. The average width of this run is 20m during low flow conditions and 28m during bankfull conditions. Substrates are dominated by pebble and cobble with isolated boulders and gravels. The total area of the run varies with water levels and encompasses 970m^2 during low flow and 1420m^2 during bankfull conditions.

Immediately downstream of the run, an additional small riffle section, approximately 25m in length, is present. Wetted widths vary with water levels and average 18m during low flow (940m^2 total area) to 27m during bankfull conditions (1370m^2 total area). Substrates within the riffle are consistent with that observed within the adjacent runs, dominated by cobble, with isolated boulder or gravel.

At the downstream limit of Wabageshik Rapids, a run, approximately 75m in length, extends into a large bay. Substrates throughout this run are mostly pebble and cobble with smaller amounts of gravel. Along the margins of the run within the bay area, substrates are considerably smaller consisting of fine material such as sands and silts as a result of deposition outside the main flow. During low flow periods, the run is approximately 1500m^2 while during bankfull conditions the run encompasses 2290m^2.

This riffle-run sequenced section of river observed downstream of the proposed GS provides suitable spawning habitat for walleye, sucker sp. and lake sturgeon, which are known to spawn in fast water over cobble substrates (Scott and Crossman 1973). Isolated back water and slack water areas within this stretch of fast water provide potential staging and resting areas for small cyprinid (minnow) species and other small fish species that use the adjacent riffles and fast water habitat (Lobb and Orth 1991). Approximately half of the fish species known from the study area are minnows or similarly small-bodied fish.

The main flow from Wabageshik Rapids is directed to the northeast into a large bay. The flow continues northeast until it reaches the northern shore of the bay where it turns to flow west. A cobble and gravel point bar is located along the north side of the main flow extending west into the basin. A back eddy effect associated with the point bar occurs along the north side of the main flow downstream of the riffle. A small vegetated island is located within this back eddy.

The bay is approximately 800m x 400m (320,000m^2) with an average depth of 2.5m. Most of the area of the bay is outside of the main flow extending from Wabageshik Rapids, comprising areas of current eddies and large backwater areas. Substrates vary from gravel and fine material in the eddies to entirely silt and clay in the backwaters.

Several cobble and gravel shoals are also present. These vegetated cobble and gravel shoals experience seasonal flooding during periods of high water levels. There is an abundance of aquatic vegetation in the backwater areas including common waterweed, floating arrowhead (*Sagittaria cuneata*), tape grass (*Vallisnernia americana*), floating leaved pondweed (*Potamogetonnatans*), white water lily (*Nymphaea odorata*), yellow pond lily (*Nuphar Variegatum*), , richardson's pondweed (*Potamogeton richardsonii*), and coontail (*Ceratophyll umdemersum*). These large beds of aquatic vegetation provide potential northern pike spawning habitat, as well as nursery refuge for the wide variety of fish that inhabit the river (Table 6, section 3.2.2). The cobble and gravel shoals provide potential spawning habitat for smallmouth bass (Scott and Crossman 1973), and the bay provides potential refuge and staging area for species that spawn within Wabageshik Rapids. In addition, the bay provides feeding opportunities for fish of all trophic classes (Table 7, section 3.2.2).

Downstream from the bay, the Vermilion River flows east as a section of slow water with an average bankfull width of approximately 100m and average water depths of 3.5m (252,038m^2 total area). During low flow the average wetted width is approximately 80m (215,313m^2 total area). Substrates are dominated by fine material such as sands, silts and detritus. Woody debris, logs, and aquatic vegetation provide instream habitat throughout this low gradient section of river. These features provide potential habitat for adult walleye and smallmouth bass that are known to seek refuge near woody material and other structures both to avoid large predators and to take advantage of small prey sheltering there as well (Lobb and Orth 1991).

The only fast-water feature downstream of the Wabageshik Rapids GS is a run located approximately 4km downstream known as Graveyard Rapids. It can be defined as a non-turbulent fast water habitat as per Armantrout (1998). This run is 300m in length with mostly bedrock substrate and smaller amounts of boulder and cobble. During bankfull flows, the width is approximately 30m and the area of run habitat is approximately 9,450m^2. During low flow, the average wetted width during is 18m and the area is approximately 5,500m^2. Water depths range from 2.5m during high flow to 1.5m during low flow conditions. This area may provide some limited spawning potential for walleye, lake sturgeon and sucker species, however preferred substrates are limited. Under high water levels associated with spawning for these species, the number of back current breaks are reduced in conjunction with the higher water velocities. A more diverse range of flow conditions occur in this area of habitat during low flow conditions as compared to higher flows. The OMNR considers this feature to have critical feeding and spawning habitat functions for a range of species when flows are low (OMNR 2012b).

Downstream of Graveyard Rapids, the Vermilion River opens into a large basin that meets the confluence of the Spanish River. Within this basin, four back bays were surveyed for potential fish habitat. These back bays were located on the northeast, northwest, southeast, and southwest sides of the basin. Abundant aquatic vegetation was observed in the northeast and southeast bays providing potential spawning habitats for northern pike. Additionally, these areas provide feeding habitat for small baitfish as well as larger predatory fish. The bays on the northwest and southwest sides of the basin were found to be heavily shaded with abundant woody material but little aquatic vegetation.

Total lengths and areas of channel units within Wabageshik Rapids and the Vermillion River downstream of the rapids are provided in Table 5. Values are given for both bank full widths and summer low flow wetted widths as observed in 2011. In addition to the channel units in Table 5, the study area includes Wabagishik Lake, which represents 592ha of lacustrine habitat.

Table 5. Measurements of Channel Units Within Wabageshik Rapids and the Vermillion River Downstream

Location	Conditions	Rapid Habitat		Riffle Habitat		Run Habitat		Chute Habitat		Pool Habitat		Slow Water	
		Total Length (m)	Area (m^2)	Total Length (m)	Area (m^2)	Total Length (m)	Area (m^2)	Total Length (m)	Area (m^2)	Total Length (m)	Area (m^2)	Total Length (m)	Area (m^2)
Downstream Zone of Influence	Bank Full	0	0	125	8,580	425	13,200	0	0	100	6,600	3,400	572,000
	Low Flow	0	0	145	2,850	425	8,000	0	0	80	3,360	3,300	460,000
Dam Site	Bank Full	0	0	0	0	30	1,200	0	0	0	0	0	0
	Low Flow	0	0	0	0	33	1,000	0	0	0	0	0	0
Upstream Zone of Influence	Bank Full	100	2,600	325	14,800	0	0	15	225	140	5,480	0	0
	Low Flow	100	920	325	6,180	0	0	15	105	120	3,870	0	0

Tributaries

Four tributaries to the Vermillion River are present within the GS study area and are located downstream of the GS (Appendix I, Aquatic Habitat Maps 1 and 2). Tributary A flows in on the north side of a large back bay. This tributary had an average wetted width of 5m, with an average water depth of 3m during summer low flow conditions upstream of the beaver dam. On the downstream side of the beaver dam, the tributary had a wetted width of 1-1.5m and an average depth of 0.8m. The substrate is primarily clay with smaller areas of muck. Downstream of the beaver dam is a small bed of aquatic vegetation along the shore of the Vermilion River consisting of floating arrowhead, broad leaved arrowhead (Sagittaria cuneata), marsh spikerush (Eleocharis palustris), floating pondweed, tapegrass, and white waterlily. A large beaver dam (2m in height on the river side) exists that may impede fish movement. Upstream of the beaver dam, the tributary has no visible flow and has a moderate canopy cover providing shade for approximately 50% of the main channel. During summer 2011 surveying, young-of-the-year brown bullhead (*Ameiurus nebulosus*) were captured during by minnow trap indicating that this tributary functions as nursery habitat.

Tributary B flows into the Vermillion River to the southwestern side of the large back bay area. The tributary originates from numerous beaver ponds and meanders in a northerly direction to the Vermillion River. It had an average wetted width of 0.8m and average depth of 0.2m during summer low flow conditions. The substrate within this tributary is primarily clay with deposits of muck and detritus, at the outlet of the tributary muck and organic material becomes the dominant substrate. No riffle or pool habitats occur between the Vermilion River and the first wetland area, which is approximately 100m upstream of the Vermillion River. High watermarks on bankside trees and undercutting of banks suggest that this tributary undergoes substantial seasonal flooding. At the outlet of this tributary is a large bed of aquatic vegetation consisting of white water lily, yellow pond lily, floating leaved pondweed, Richardsons pondweed, and Coontail. Tributary B provides nursery habitat for young northern pike and other species that spawn within the aquatic vegetation at the outlet to the river. Two young-of-the-year northern pike were captured during electrofishing in August 2011 along with young-of-the year brown bullhead, yellow perch and smallmouth bass, and numerous central mudminnows (*Umbra limi*) of varying sizes.

Tributary C is well shaded and outlets to the main river approximately 250m downstream of the large basin below the proposed GS. During summer low flows observed in 2011, the average wetted width of the tributary was 2.0m and average water depth was 0.5m. Substrates within the tributary are mostly clay with smaller portions of muck and detritus. There are no observed riffles or pools within the 100m of tributary surveyed. This tributary provides habitat for a variety of cyprinids and darters that were captured by electrofishing in 2011, and possibly the young of larger fish species. A small bed of aquatic vegetation is found at the tributary outlet made up of white water lily, variable leaf pondweed (Potamogeton diversifolius), coontail, common waterweed (*Elodea canadensis*), flatstemmed pondweed (*Potamogeton zosteriformis*), Richardson's pondweed, tapegrass, submerged water starwort (*Callitriche Hermaphroditica)*, marsh spikerush, broad leaved arrowhead, and ribbon leaf pond weed (*Potamogeton epihydrus*). Electrofishing in Tributary C in August 2011 resulted in the capture of young-of-the-year brook stickleback (*Culaea inconstans*), northern redbelly cace (*Phoxinus eos*), johnny darter (*Etheostoma nigrum*), fathead minnow (*Pimephales promelas*), central mudminnow, and a small, unidentifiable sunfish (*Lepomis* sp.). The tributary functions primarily as nursery habitat.

Tributary D is located approximately 2.3km downstream of the large basin below the proposed GS. It had an average wetted width of 1.7m with an average water depth of 0.4m during summer low flows. Minimal flow was observed within the tributary during the 2011 field investigations, and no riffles were observed. Substrates within the tributary are dominated by silt, clay and muck, with the underlying substrate being composed of compressed clay under thin layers of muck and silt. High watermarks on bankside trees and undercutting of banks suggest that this tributary undergoes substantial seasonal flooding. Aquatic vegetation in the tributary includes common waterweed, floating arrowhead, tapegrass, and floating leaved pondweed. This tributary has good refuge potential for forage fish and could serve as a potential nursery habitat based on the presence of woody material and aquatic vegetation.

These habitats are further described in section 4.2.1.

3.2.2 Fish Community

During the 2010 fish community sampling, a total of 72 fish from 8 species were collected. In 2011, an additional 13 species were collected and 1 species was documented within the Wabageshik GS study area by Kilgour & Associates (2012) on behalf of Vale. Detailed results from the fish community sampling are provided in Appendix II.

For the study area as a whole, the documented fish community to date includes 22 fish species representing 11 families. The families are Acipenseridae (sturgeon), Centrarchidae (sunfishes and basses), Esocidae (pikes), Ictaluridae (North American catfishes), Catostomidae (suckers), Gadidae (cods), Cyprinidae (minnows), Percidae (perches), Umbridae (mudminnows), Gasterosteidae (sticklebacks) and Salmonidae (trouts and salmons). All species known to occur in the study area are considered to be common and widely distributed throughout Ontario. Table 6 lists the species along with their conservation and legal status.

The presence of 22 species is indicative of a diverse fish community, as evidenced by the species' varied life history requirements and trophic statuses. The species composition utilizes a range of feeding environments present within the study area (benthic, benthopelagic and pelagic). The species composition also represents multiple trophic classes (herbivore, detritivore, planktivore, invertivore, insectivore and carnivore). In addition to demonstrating diversity, this varied species composition demonstrates that a complete range of trophic levels and ecological niches are currently being filled, allowing the existing fish community to integrate with a self-sustaining ecosystem. The habitat and feeding characteristics are summarized in Table 7.

Table 6. Fish Species Observed in Study Area in 2010 and 2011

Scientific Name	Common Name	S-Rank[1]	COSEWIC Designation[2]	SARA Schedule 1 (Federal Status)[2]	ESA (Provincial Status)[3]
Acipenser fulvescens	Lake Sturgeon	S2	THR	none	THR
Sander vitreus	Walleye	S5	none	none	none
Esox lucius	Northern Pike	S5	none	none	none
Catostomus commersoni	White Sucker	S5	none	none	none
Ameiurus nebulosus	Brown Bullhead	S5	none	none	none
Lota lota	Burbot	S5	none	none	none
Moxostoma macrolepidotum	ShortheadRedhorse	S5	none	none	none
Moxostoma erythrurum	Silver Redhorse	S4	none	none	none
Micropterus dolomieu	Smallmouth Bass	S5	none	none	none
Ambloplites rupestris	Rock Bass	S5	none	none	none
Percina caprodes	Logperch	S5	none	none	none
Rhinichthys cataractae	Longnose Dace	S5	none	none	none
Phoxinus eos	Northern Redbelly Dace	S5	none	none	none
Etheostoma nigrum	Johnny Darter	S5	none	none	none
Perca flavescens	Yellow Perch	S5	none	none	none
Lepomis gibbosus	Pumpkinseed	S5	none	none	none
Umbra limi	Central Mudminnow	S5	none	none	none
Pimephales notatus	Bluntnose Minnow	S5	none	none	none
Pimephales promelas	Fathead Minnow	S5	none	none	none
Notropis atherinoides	Emerald Shiner	S5	none	none	none
Culaea inconstans	Brook Stickleback	S5	none	none	none
Coregonus artedi	Cisco (Lake Herring)	S5	none	none	none

[1]NHIC 2013, [2]Government of Canada 2013, [3]OMNR 2013.

LEGEND:
S-Rank (Provincial Rank)
S2 - Imperiled
S3 - Vulnerable
S4 - Apparently Secure
S5 - Secure

COSEWIC and COSSARO/ESA
THR – Threatened

Table 7. Habitats and Feeding Characteristics of Observed Fish Species within the Study Area

Scientific Name	Common Name	Adult Size Range - Total Length (mm)	Environment	Trophic Class	Thermal Regime
Acipenser fulvescens	Lake Sturgeon	762 – 1,425	Benthic	Invertivore/Herbivore	Coolwater
Sander vitreus	Walleye	305 – 762	Benthopelagic	Invertivore/Carnivore	Coolwater
Esox Lucius	Northern Pike	457 – 1002	Benthopelagic	Carnivore	Coolwater
Catostomus commersoni	White Sucker	254 – 508	Benthic	Invertivore/Detritivore	Coolwater
Ameiurus nebulosus	Brown Bullhead	193 – 356	Benthic	Invertivore/Herbivore/ Carnivore	Warmwater
Lota lota	Burbot	381 – 838	Benthic	Invertivore/Carnivore	Coldwater
Moxostoma macrolepidotum	Shorthead Redhorse	356 – 527	Benthic	Invertivore	Warmwater
Moxostoma erythrurum	Silver Redhorse	279 – 559	Benthic	Invertivore	Coolwater
Micropterus dolomieu	Smallmouth Bass	254 – 457	Benthopelagic	Invertivore/Carnivore	Warmwater
Ambloplites rupestris	Rock Bass	152 – 267	Benthopelagic	Insectivore/Carnivore	Coolwater
Perca flavescens	Logperch	76 – 147	Benthic	Invertivore	Warmwater
Rhinichthys cataractae	Longnose Dace	64 – 114	Benthic	Invertivore	Coolwater
Phoxinus eos	Northern Redbelly Dace	31 – 68	Benthopelagic	Invertivore/Planktavore	Coolwater
Etheostoma nigrum	Johnny Darter	41 – 69	Benthic	Invertivore	Coolwater
Perca caprodes	Yellow Perch	114 – 305	Benthopelagic	Invertivore/Carnivore	Coolwater
Lepomis gibbosus	Pumpkinseed	127 – 229	Benthopelagic	Invertivore/Carnivore	Waemwater
Umbra limi	Central Mudminnow	51 – 102	Benthic	Invertivore	Coolwater
Pimephales notatus	Bluntnose Minnow	54 – 85	Benthopelagic	Detritivore	Warmwater
Pimephales promelas	Fathead Minnow	45 – 71	Benthopelagic	Detritivore/ Invertivore	Warmwater
Notropis atherinoides	Emerald Shiner	64 – 102	Benthopelagic	Planktavore	Coolwater
Culaea inconstans	Brook Stickleback	38 – 69	Benthopelagic	Planktavore/Invertivore	Coolwater
Coregonus sp.	Cisco sp.	N/A	Pelagic	Planktavore	Coldwater

3.2.3 Lake Sturgeon

Lake sturgeon are known to occur in the Spanish River as an isolated population between Nairn Centre and Espanola, and were suspected, but not confirmed, to occur in the Vermillion River downstream of Wabageshik Rapids (OMNR 2011b). On this basis, NRSI attempted to capture lake sturgeon adults and eggs in late May and early June 2011 and to capture evidence of spawning in the Vermillion River. On behalf of Vale, the owner of numerous dams and other infrastructure on the Spanish and Vermillion Rivers, Kilgour and Associates conducted gill netting in the spring of 2011 and the spring of 2012. Their findings confirmed the presence of lake sturgeon in the section of the Vermillion River downstream of Wabageshik Rapids.

<u>Lake Sturgeon Spawning Survey Results</u>

Lake sturgeon surveys were conducted from May 22 to June 6, 2011. Sampling methods included use of trotlines, egg mats, and extra-large mesh multifilament gill nets during the period. No lake sturgeon were captured during this sampling. However, 17 fish comprising six non-target fish species were captured which included northern pike, smallmouth bass, shorthead redhorse (*Moxostoma macrolepidotum*), white sucker, rock bass (*Ambloplites rupestris*), and burbot (*Lota lota*). Egg mats set on May 22, 24, 26, 27, and June 3, 2011 were left for between 7 hours and 12 minutes and 71 hours and 35 minutes. They captured a total of 97 eggs from 2 or more species. Twenty-three eggs were identified as walleye eggs and were found at Stations EMD-017, EMD-026, and EMD-041 (Appendix I). The remaining 74 eggs were determined to belong to one or more sucker species and were retrieved at Stations EMD-002, EMD-027, EMD028, EMD-030, EMD-035, EMD-039, EMD-040, and EMD-042 (Appendix I). The habitats from which these eggs were retrieved varied from the edge of the main channel flow to the centre, directly in fast water. Substrates in these areas are predominantly gravel, cobble, and boulder. No lake sturgeon eggs were observed during these spawning surveys. Detailed results from the lake sturgeon spawning surveys are provided in Appendix II.

Extra-large mesh multifilament gill nets were set at 33 locations in the Vermilion River downstream of the Wabageshik Rapids. Nets were set through the deepest sections of river at water temperatures between 14 and 17°C. No lake sturgeon were captured over the course of sampling and in total only three individuals of one non-target species, northern pike, were captured. Detailed results from the lake sturgeon gill netting surveys are provided in Appendix II.

Based on the water temperatures and discussions with OMNR biologists, it is possible that these surveys were conducted after any spawning and related migration had concluded for the spring of 2011. While the water temperature range of 14 to 17°C is considered to be appropriate spawning temperatures by some sources (Harkness and Dymond 1961, Scott and Crossman 1973, Auer 1982), it has been observed by others that lake sturgeon spawning in the Vermillion River may occur at relatively lower temperatures (W. Selinger pers. comm. 2012).

3.2.4 Walleye

Based on the fisheries management objectives provided by the OMNR Sudbury District Office, walleye are known to inhabit Wabagishik Lake and the lower Vermillion River. For both locations, the management objectives are to maintain or increase the productive capacity and abundance of walleye, and maintain sustainable angling opportunities for walleye among other species (OMNR 2011b).

Suitable walleye spawning habitat occurs in Wabageshik Rapids upstream and downstream of the proposed Wabageshik Rapids GS, in small areas of Graveyard Rapids downstream of the proposed GS, and in 3 locations in Wabagishik Lake upstream of the proposed GS. A report prepared for the OMNR by Great Lakes Environmental Services (GLES 2010) assessed walleye spawning habitat at Lorne Falls (upstream of Wabagishik Lake), the lower portion of Wabageshik Rapids (downstream of the proposed GS) and at Graveyard Rapids. They studied the habitat by conducting modeling at cross sections. They determined the suitability of the habitat for walleye spawning based on the water levels and velocities, and the amount of suitable spawning substrate available along the cross sections. The report determined that suitable spawning habitat existed at 4 of the 5 cross sections at Wabageshik Rapids, describing the suitable habitat as 'substantial' or 'abundant' at 3 of the cross sections. Based on this information, it is clear that the habitat is suitable for walleye spawning.

While a large area of suitable habitat for walleye spawning is known to exist at Wabageshik Rapids, only small areas of suitable habitat is found at Graveyard Rapids.

The lack of habitat at Graveyard Rapids is attributable to lack of suitable substrate and water velocities that are too low. In the Lorne Falls tailwater, which flows into Wabagishik Lake at the upstream/eastern end, suitable walleye spawning habitat does not exist at the 4 cross sections studied by GLES due to water velocities that are too low (GLES 2010). Nevertheless, Kilgour & Associates (2012), while conducting walleye spawning surveys on behalf of Vale, observed numerous walleye at the base of Lorne Falls during the walleye spawning period. This indicates that suitable habitat exists at the base of Lorne Falls, a location that was not included in the cross sections studied by GLES. Finally, the OMNR Sudbury District Office provided a map of Wabagishik Lake that identifies 3 locations of walleye spawning habitat. The locations are at the base of Lorne Falls (coinciding with the observations of Kilgour & Associates), at the mouth of Blake Creek that enters the north shore of Wabagishik Lake, and at the constriction in the middle of Wabagishik Lake where the lake is approximately 140m wide (OMNR 2011c).

Walleye Spawning Survey Results

During the spring of 2010, walleye spawning surveys were conducted using angling and egg mat methods. Angling surveys resulted in the capture of one ripe male walleye on within Wabagehsik Rapids, downstream of the proposed GS (AGL-002, Appendix I).

Egg mats were set on April 20, 2010 and were left for between 0:36 and 23:10 hours. Over the course of the study, six eggs were found. Three eggs located at EMD-001 were identified as walleye eggs while the remaining three eggs retrieved from EMD-002 were identified as white sucker. Additional walleye eggs were captured in egg mats during lake sturgeon spawning surveys in the spring of 2011 (see Section 3.2.3) confirming walleye spawning within the study site over two consecutive years. Detailed results from the walleye spawning surveys are provided in Appendix II.

3.2.5 Northern Pike

Based on the fisheries management objectives provided by the OMNR Espanola Area Office, northern pike are known to inhabit Wabagishik Lake and the lower Vermillion River. For both locations, the management objectives are to maintain or increase the productive capacity and abundance of northern pike, and maintain sustainable angling opportunities for northern pike among other species (OMNR 2011b).

Northern Pike Spawning Survey Results

During the spring of 2011, the proposed GS study area on the Vermilion River was flown with the use of helicopter. A visual assessment of the study area was completed from the upstream extent at Wabagishik Lake to approximately downstream of the study area. The purpose of this flight was to assess the potential of additional spawning locations. This flight, coupled with recent aerial photography (KBM 2011) and ground truthing allowed for the identification of potential spawning habitat locations for northern pike. The majority of these identified locations occur within 1.0km of the proposed GS location along the south and east shoreline of the large bay directly downstream from the Wabageshik Rapids (Appendix I). Based on ground truthing and visual observations during spring and summer surveys, abundant aquatic vegetation is present up to approximately 1.5m in depth along these shorelines during the growing season. During high flows in the spring, much of this aquatic vegetation is in the early stages of growth but nevertheless provides adequate habitat for spawning northern pike. At the southwest edge of the bay below Wabageshik Rapids, a large tributary occurs. Approximately 200m upstream of the mouth of this tributary it flows through a large open area of land. Aerial surveys of this area indicate that little to no water is present within this opening, apart from a small channel flowing through the center. If water levels were to rise, this area could potentially provide a substantial amount of habitat that could be utilized for pike spawning. Overall, northern pike spawning habitat is present within the study area in the bay immediately downstream of Wabageshik Rapids (Appendix I). The remaining Vermilion River does have areas of northern pike habitat, although it is much more limited.

Angling surveys were conducted between April 18 and 20, 2010 as well as May 23 and 25, 2011 at several locations within the study area. On April 18, 2010, one female northern pike was captured where Wabageshik Rapids enters a large bay (AGL-001, Appendix I). This fish was determined to be spent. Additionally, between May 23 and 25, 2011, a total of twelve northern pike were caught. Of these, six fish were considered to be still green (not yet ready to spawn) while the remaining six were determined to be spent (having already spawned), further indicating the presence of pike spawning habitat within the study area.

3.2.6 Fish Tissue Mercury Specimens

Sampling efforts resulted in the capture of 17 smallmouth bass specimens from the Vermilion River downstream of Wabageshik Rapids. This did not meet the target of 20 specimens from downstream of the proposed GS site. The high water temperatures and low water levels observed during the sampling period resulted in a reduction in fish schooling behavior and low fish activity in general. However, Hutchinson Environmental Sciences Ltd. (HESL) captured an additional 3 northern pike for analysis, as well as 6 composite samples of forage fish. Refer to the report by HESL (2013) for analysis and discussion of the mercury concentrations in adult and forage fish specimens.

3.2.7 Benthic Invertebrate Community

Knowledge of the benthic invertebrate community in the Vermillion River within the study area is limited to the results of the current study. The results describe the benthic macroinvertebrate community found in the shallow riffle and run habitats both upstream of the proposed Wabageshik Rapids GS, and in the variable flow reach downstream of Wabageshik Rapids. The results were grouped into three distinct areas to allow for comparisons of indices across different habitats. The three areas were directly above the proposed dam location (5 H-D samplers), directly below the proposed dam location (10 stratified H-D samplers), and at Graveyard rapids (5 H-D samplers). All H-D samplers were successfully retrieved from the Vermilion River on October 13, 2011. All 20 samplers were observed to be in good condition, and benthic invertebrates had effectively colonized each sampler. Some swelling of the Masonite plates was observed among the samplers, however this was minimal and did not appear to affect the colonization of organisms.

The habitat characteristics and sampling conditions for each of the 20 benthic invertebrate sampling stations are presented in Appendix II and are discussed below. All parameters reflect summer river conditions at the time H-D samplers were installed on August 30, 2011. No woody material, detritus, aquatic macrophytes or algae were observed at the sampling stations in the vicinity of the sample locations. Water temperature, dissolved oxygen, and pH measurements are not available for five locations (ASB-006 to ASB-010).

The habitat parameters presented below were found to be relatively consistent at all 20 benthic stations with water depths and hydraulic head being the exceptions. Water temperatures ranged from 22.1 to 22.5°C, dissolved oxygen between 10.2 and 10.38ppm, and pH was slightly alkaline measuring at 8.4. Channel substrates were dominated by cobble at the majority of sites while the remainder were pebble, boulder, cobble/pebble, or cobble/boulder. Water depths and hydraulic head varied slightly due to the locations of subsamples across the channel but ranged from 0.17m to 0.70m and 0mm to 110mm, respectively. These substrate and water characteristics are typical of shallow riffle and run habitat. The lack of woody material, detritus, aquatic macrophytes and algae was typical of all the benthic stations.

A total of 6 indices were calculated from the benthic invertebrate data. Results of these calculations are provided in Appendix II and discussed below.

Altogether, 35 families representing 13 orders of benthic macroinvertebrates were identified. The number of organisms collected averaged 361 per H-D sampler across all stations. Per sampling area, the number of organisms averaged 548 above the proposed dam location, 388 directly below the dam location, and 120 at Graveyard Rapids.

Results for organism density were variable between H-D samplers with values ranging from 481 organisms/m^2 at ASB-019 to 5,875 organisms/m^2 at ASB-015. Higher average densities were observed at Wabageshik Rapids compared to Graveyard rapids. Above and below the proposed dam site densities averaged 3425 and 2427 organisms/m^2, respectively, while densities at Graveyard Rapids were much lower, averaging 749 organisms/m^2.

Taxonomic richness values were similar for all twenty benthic stations, ranging from 15 species to 24 species. These values indicate a moderately diverse habitat within the Vermilion River. The lowest average level of taxonomic richness was observed upstream of the proposed dam location (richness = 16), while the highest occurred at Graveyard Rapids (richness = 21). At the base of Wabageshik Rapids, directly below the proposed dam location, taxonomic richness was found to be 18.

For the Simpson's Diversity Index, a value of 1 represents infinite diversity and 0 represents no diversity. A community dominated by one or two species is calculated to be less diverse than one in which several different species have a similar abundance. Calculated values for the 20 H-D samplers ranged from 0.340 to 0.909, indicating a broad range in diversities throughout the Vermilion River. Average diversities were calculated for each of the three distinct sampling areas. The lowest average diversity was observed upstream of the proposed dam location (Diversity = 0.55), while the highest occurred at Graveyard Rapids (Diversity = 0.83). Below the proposed dam location, at the base of Wabageshik Rapids, diversity was 0.75. The predominance of several species of caddisfly (Trichoptera) within the Wabageshik Rapids had a downward influence on this index.

Percent EPT ranged from 6.4% (ASB-017) to 91.3% (ASB-013) across all stations. At 13 of the 20 stations, EPT taxa comprised the majority of the sample. Within these, caddisfly species contributed the majority of individual organisms (47.1% - 89.7%). There was a decline in %EPT moving from above the proposed dam location (74.3%) to below (64.2%), and finally to Graveyard Rapids (30.0%) (Refer to Figures 2, 3, and 4). A similar decline in the proportion of caddisfly species was also found (71.4% above, 63.2% below, and 20.6% 4.0km downstream).

Caddisflies are one of the largest groups of aquatic organisms and occupy a wide range of habitats including both lotic and lentic environments. The large majority are aquatic during their immature stages (nymph and pupa), and then hatch and complete their life cycle as adults out of water. They are widely considered to be an important component of benthic communities and provide an excellent source of food for fish throughout all of their life stages. This is especially true during the phase from pupa to adult since this occurs at the water surface, making them highly susceptible to predation (Merritt *et al.* 2008, McCafferty 1998). Common netspinners (Hydropsychidae) were observed at every sampling location and were the dominant family collected at 12 of the 20 stations. This family is widespread throughout North America and is found almost exclusively in warmer lotic environments which provide shallow-water riffles. Common netspinners are associated with fixed retreats, nets that are anchored to the substrate (cobble, pebble, woody debris etc.). These nets act to filter and collect particles including algae, detritus, and microorganisms, which the caddisflies feed on, while also providing a retreat and cover from predators (Merritt *et al.* 2008, McCafferty 1998).

Four additional group-specific proportions were calculated and incorporated into relative abundance. These included % Odonata (dragonflies and damselflies), % Chironomidae (non-biting midges), % other Dipterans (true flies), % Oligochaeta (aquatic earthworms), % Turbellaria (flatworms), and % other. Although Chironomidae is a family within the Order Diptera, it has been calculated separately due to the high proportion of Chironomidae species found within the samples. Subsequently, this has resulted in all additional Dipteran species being grouped as 'Other Dipterans'. All five categories of benthic invertebrates are generally found throughout depositional habitats that offer silty, sandy and/or detritus substrates in relatively slow-moving water, however some non-biting midge species may occasionally inhabit erosional habitats with course sediments including boulder, cobble, and pebble (Merritt *et al.* 2008). The category 'Other' includes the families; Hirudinea, Amphipoda, Hemiptera, Megaloptera, Gastropoda, and Nemertea, all of which typically occur throughout depositional habitats. Oligochaeta, Chironomidae, and Turbellaria species are considered to be herbivore-detritivores or strictly herbivores while the majority of Odonata species are predatory. Oligochaeta and non-biting midges are also tolerant of oxygen-poor environments (Weber 1973).

The percentages of Odonata and Oligochaeta were overall relatively low, ranging from 0.0 – 6.8% and 0.0 – 16.9%, respectively. Odonata were only found at the site furthest downstream (refer to Figure 4). Similarly, Oligochaeta were not found at stations above the proposed dam location, however they did increase in abundance moving downstream with the highest abundance observed at Graveyard Rapids (refer to Figure 2). Chironomidae comprised the majority of the sample at six stations (ASB-001, ASB-008, ASB-016, ASB-017, ASB-019, and ASB-020). ASB-001 and ASB-008 are located in, or in close proximity to, fast water habitat within 1km of the proposed dam location while the remaining four stations, which were 4.0km downstream of the proposed dam site, were in a slow moving section of the river. This family was found to increase in abundance from above the proposed dam location to 4.0km downstream (refer to

Figures 2, 3 and 4). Turbellaria were present in low percentages at the majority of sites, contributing from 0.0% to 15.8% of the samples. At one station, ASB-011, Turbellaria made up the majority of the sample with 39.9%. However, diversity and distribution of species was fairly high at this specific site (EPT taxa– 36.7%, and non-biting midges – 22.9%). The abundance and distribution of these organisms found within the samples are a direct result of their habitat preferences.

The category 'Other' includes the following families; Hirudinea, Amphipoda, Hemiptera, Megaloptera, Gastropoda, and Nemertea..

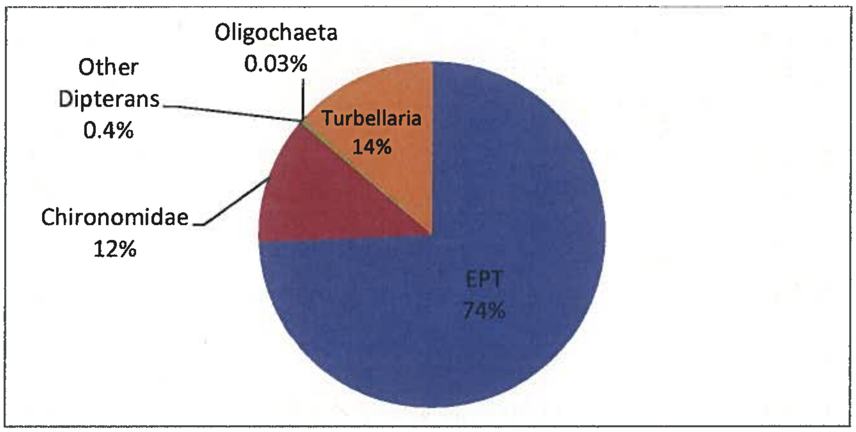

Figure 2. Average Relative Abundance – Upstream Location

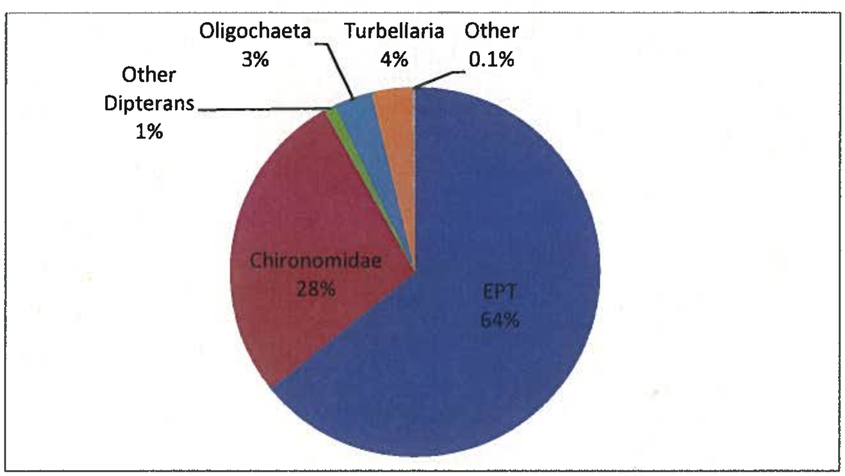

Figure 3. Average Relative Abundance – Downstream Location

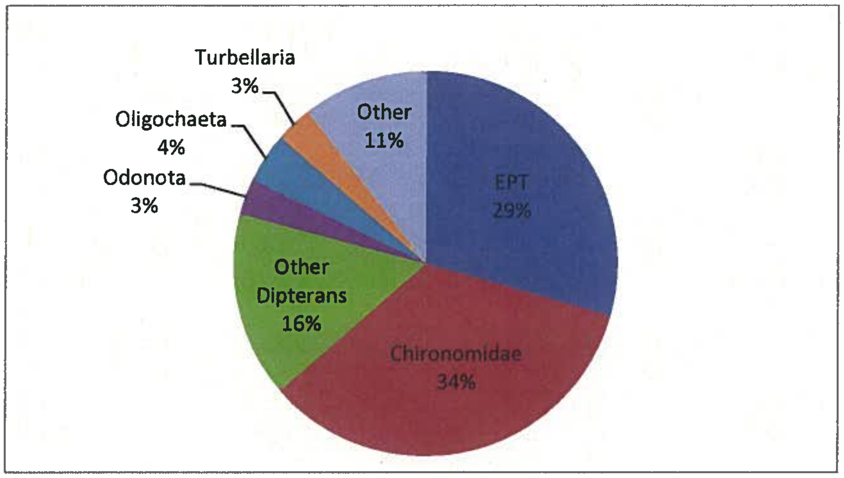

Figure 4. Average Relative Abundance - 4.0km Downstream

Finally, relative abundance of the benthic invertebrate functional feeding groups was calculated for each site to determine the major food sources available for the benthic community. Five distinct groups were identified:

- scrapers which are herbivores and feed on periphyton;
- shredders which are herbivores/detritivores and feed on living or decomposing (coarse particulate organic matter - CPOM) plant tissue;
- collectors which are detritivores and feed on decomposing fine particulate organic matter (FPOM); piercers which are carnivores and feed on living animal tissue; and
- engulfers which are also carnivores and feed on living animal tissue (Merritt *et al.* 2008).

In addition to these five groups several macroinvertebrate orders were groups as 'Other'. These included; Hirudinea, Oligochaeta, Gastrapoda, Turbellaria, and Nemertea. None of these groups fit cleanly into any of the above mentioned functional feeding groups. Generally, the species comprising these groups are considered to be herbivores or detritivores as they feed on algae and/or decaying organic matter. The dominant feeding group at 19 of the 20 stations was determined to be collectors indicating that of all the food sources available, FPOM is the most highly utilized and likely the most readily available. At one station, ASB-011, the dominant feeding group belonged to 'others'. This was a result of the high number of Turbellaria species at this location. When comparing average percentages for the three areas, no clear trends were observed. There was a decline in the abundance of collectors from Wabageshik Rapids to Graveyard Rapids which is likely a result of the lower numbers of caddisfly species (predominantly collectors). This trend, however, was not linear since the abundance of collectors was the highest directly below the proposed dam location. The remaining functional feeding groups were not observed in high numbers and remained relatively consistent throughout all three areas.

There is variability in the composition of the benthic invertebrate communities among the three sampling areas (upstream, downstream at Graveyard rapids). This is especially true when comparing communities in the immediate vicinity of the proposed GS to those at Graveyard Rapids. The different available habitats provide a logical explanation for this variability. Immediately upstream and downstream of the proposed GS, much of the habitat exhibits the characteristics typical of riffle/run sequences, with substrates dominated by cobble and hydraulic head measurements up to 110mm. Alternatively, the Graveyard Rapids sampling stations were located in relatively slow moving runs and glides with substrates dominated by boulders and hydraulic head measurements from 0 to 2mm. The benthic invertebrates located at these sites occur due to their specific habitat and feeding requirements.

In comparision, the benthic communities existing near the proposed GS are dominated by EPT species (specifically trichopterans) and exhibit considerably higher organism densities on average (2,760 organisms/m^2 compared to 749 organisms/m^2 at Graveyard Rapids). Due to their affinity for high quality environments (Weber 1973), the presence of trichopteran species indicate good water quality and suitable benthic habitat. Higher densities throughout the upstream riffle habitat may be a function of several things including resource availability (higher influx of food), habitat availability (cobble/pebble substrate versus boulder/cobble), or higher rate of invertebrate drift (higher water velocities carrying invertebrates downstream). The community at Graveyard Rapids is dominated by non-biting midge species; however the species diversity and richness values are both higher than values seen upstream at the proposed dam site. Higher diversity and richness values may indicate a more diverse habitat as there are a variety of conditions and habitat niches filled by a number of different specialized organisms.

In addition to serving as an indicator of habitat characteristics and water quality, benthic macroinvertebrates are an integral part of the aquatic ecosystem and provide an important food source for both adult and juvenile riverine species including walleye, smallmouth bass, rock bass, sucker species and a variety of Cyprinid species (minnows), all of which were observed throughout the Vermilion River. These species are considered to be benthic or benthopelagic (Eakins 2011), and will actively feed on immature invertebrates along the bottom or as emergers and adults within the water column and at the water's surface. Due to the high benthic production observed throughout the fast water habitats in the vicinity of the proposed GS, it is clear that these areas provide important foraging opportunities for many fish species.

4.0 Terrestrial Environment Characterization

Comprehensive site investigations to document the existing terrestrial and wetland characteristics of the study area were undertaken in 2010. Additional deer crossing studies were carried out in 2011. These site-specific field investigations focused on vegetation community mapping and wildlife usage. A summary of the field investigation methods is provided as follows.

4.1 Terrestrial Field Methods

Information on terrestrial and wetland habitats and biota was collected on three occasions during the 2010 field season, on May 30, June 12, and June 27, 2010. Investigations included vegetation community mapping and wildlife surveys targeting a variety of wildlife groups (i.e. mammals, reptiles, birds, etc.) and SAR. White-tailed deer monitoring was conducted in 2011, with site visits made on April 8, 2011 and February 10, 2012.

All incidental wildlife observation and any evidence of wildlife, including tracks, scat, dens, etc. were also documented during all fieldwork programs including aquatic surveys.

4.1.1 Vegetation Community Mapping

Vegetation community mapping was completed using a combination of aerial photograph interpretation at a scale of 1:5,000 (KBM 2011) and site-specific field investigations. All communities were described to the ecosite level, using the Ecological Land Classification (ELC) Field Manual (OMNR 2009), and associated Great Lakes St. Lawrence Factsheets (Wester et al. 2010). During the site investigations, vegetation mapping was conducted on all communities within the 2010 study area, and a detailed plant list was compiled for each vegetation polygon. This information, along with background occurrence information was used to produce a detailed plant list for the study area (Appendix IV). Detailed results of the vegetation community mapping are found in Sections 4.2.1 and 4.2.2, as well as the maps in Appendix III.

4.1.2 Breeding Bird Surveys

Breeding bird surveys were conducted over two field visits, following the protocol described by the Ontario Breeding Bird Atlas (OBBA) (OBBA 2001). These surveys were conducted in the early mornings of June 12 and 27, 2010. Surveys were designed to focus on breeding bird activity within the study area. All visits were conducted starting 30 minutes before sunrise and ending by 1100hrs, with at least 10 days between visits. During each site visit, area searches were conducted throughout the study area and all bird species observed within each general habitat type were recorded. Breeding evidence for each species was recorded using standard breeding evidence codes recognized by the OBBA. In addition to these specific area searches, all bird species observed during other site visits were recorded as incidental observations and have been included in the final species list. Results from the bird surveys are included in Section 4.2.3.

4.1.3 Herpetofauna Surveys

The majority of herpetofauna surveys conducted consisted of systematic area searches during site investigations in 2010. All incidental observations during site investigations also were recorded. Snake coverboard surveys were conducted in conjunction with area searches and are described as follows in more detail.

Snake Coverboards

To characterize the snake species present in the vicinity of the study area, including the SAR species identified in the background review, five coverboards were distributed within the study area based on habitat availability (SNK-001 to SNK-005). Exposed, fissured bedrock, with loose rock piles, within the study area were targeted when setting snake coverboards. All of the snake coverboards were placed along the shoreline of the Vermilion River from the outlet of Wabagishik Lake downstream to the proposed dam location. Two coverboards were placed along the north side of the river and three along the south side of the river. The specific locations of the coverboards are mapped in Appendix III. Each coverboard was made of spruce plywood, and measured approximately two feet by four feet in size with the upper surface painted with black latex paint to increase the absorption of radiant heat. Boards were placed on May 30, 2010, and were checked on June 27, 2010. Results from the snake cover board surveys and area searches are discussed in Section 4.2.4 Herpetofauna.

4.1.4 Deer Monitoring Surveys

After consultation with local Sudbury District OMNR (W. Selinger pers. comm. 2011), a study was initiated to determine if a significant deer movement corridor is found to intersect with Wabageshik Rapids. The study aimed to assess the quantity of any deer movement, the time of year at which deer move across the rapids, and whether this movement corridor is critical for deer (i.e., if this is important for movement into and out of deer yards in the context of the surrounding landscape).

In order to assess deer movement at Wabageshik Rapids, habitat assessments and track surveys were completed on April 8, 2011 to determine potential locations for deer crossing. Observations of tracks, combined with topography, location of the rapids, and depth/velocity of water informed the placement of a series of cameras which were used to capture images of deer and their activities at these locations. The cameras used were Moultrie D55-IR infra-red capable stealth cameras, which are triggered by a motion sensor as well as an infra-red sensor at night. Photos and videos taken by these cameras also record the date, time, and air temperature when the image was collected. Cameras were powered by six 'C' batteries and contained a 4GB SD memory card. Ten cameras were initially installed at various locations within the study area on April 8, 2011. An additional camera was added on May 6, 2011. Despite the fact that cameras were locked to trees, the additional camera was stolen between the beginning of June and the beginning of September, and two other cameras (CMS-006 and CMS-008) were stolen between the beginning of September and mid-November. Location CMS-007 is not mapped because none of the data was recovered due to flooding of the location in the spring. The remaining cameras monitored continuously from deployment on April 8, 2011 until February 10, 2012 to assess movement during these time periods. The locations of all cameras placed on site are shown in Appendix III. The results of the deer movement surveys are discussed in Section 4.2.6.

4.1.5 Other Wildlife

Incidental observations of all other wildlife, including mammals, herpetofauna, butterflies, and dragonflies, were documented during all field visits. These observations included direct observations of individuals, as well as signs of animal presence (tracks, scat, etc.).

Other wildlife observed is presented in Sections 4.2.5 and 4.2.7.

4.2 Results and Discussion of the Terrestrial Environment

4.2.1 Vegetation Communities

Seven ecosite types were identified within 120m of the proposed dam site and inundation area and can be seen in Appendix III. These ecosites represent seven different forest communities characteristic of the surrounding landscape. One wetland ecosite was also identified within the downstream extent of the proposed dam. Dominant species, species associations, and other habitat characteristics were recorded for all habitats, and are discussed in more detail below.

G040Tt – Dry, Sandy: Aspen – Birch - Hardwood

This forest community is located on the north side of the proposed dam and inundation area. This community extends from the north side of Wabagishik Lake west along the north side of the Vermilion River and large open water area section of the Vermilion River located west of the proposed dam location. This community is dominated by trembling aspen (*Populus tremuloides)* with red oak (*Quercus rubra*), balsam fir (*Abies balsamea*), white spruce (*Picea glauca*), white pine (*Pinus Strobus*), and open rock outcrops. The understorey includes mountain maple (*Acer spicatum*), and the herb layer includes starflower (*Trientalis borealis ssp. borealis*), wild sarsaparilla (*Aralia nudicaulis*), bracken fern (*Pteridium aquilinum*) and bunchberry (*Cornus canadensis*).

This forest community is also located on the south-east side of the Vermillion River adjacent to Wabagishik Lake. This deciduous-dominated community consists of trembling aspen and white birch (*Betula papyrifera*). White pine is also present within the community in small numbers. Species found within the understorey of this include: bluebead lily (*Clintonia borealis*), bracken fern and wild sarsaparilla. Exposed bedrock can also present throughout the community.

G023Tt – Very Shallow, Humid: Red Pine – White Pine Conifer

This forest community is located on the north side of the proposed dam and inundation area adjacent to the river shoreline. This community extends along Wabageshik Rapids from the snowmobile bridge downstream to the proposed dam location. This community is dominated by white pine, red pine (*Pinus resinosa*) and white cedar (*Thuja occidentalis*). Trembling aspen and white birch are also present within the community. Understorey vegetation found within the community also includes low sweet blueberry (*Vaccinium angustifolium*), wintergreen (*Gaultheria procumbens*), Canada mayflower (*Maianthemum canadense*) and sensitive fern (*Onoclea sensibilis*). Bedrock outcropping is present along the edge of the Vermillion River.

G069Tt – Moist, Coarse: Red Pine – White Pine: Mixedwood

This forest community is also located on the north side of the Vermillion River within 120m of the proposed dam and inundation area. The community extends westward from the proposed dam location to the large open area of the Vermillion River, including a peninsula at the outlet of the rapids and the base of a steep slope to the northeast. It is dominated by white pine, trembling aspen and white cedar. The understorey consists of sensitive fern, wild sarsaparilla, bluebead lily and Canada mayflower.

G025Tt – Very Shallow, Humid: Hemlock – Cedar Conifer

This community is located along the Vermillion River adjacent to the south side of Wabageshik Rapids, and is within 120m of the proposed dam and inundation area. This forest community is dominated by white cedar and contains some white pine and white birch. The understorey of this community consists of mountain maple, wild sarsaparilla and mayflower. Exposed bedrock outcrops are also present within this forest community.

G023Tl – Very Shallow, Humid: Red Pine – White Pine Conifer

This forest community is located on the south side of the Vermillion River within 120m of the proposed dam and inundation area. This community is dominated by white pine and exposed bedrock. Limited understorey includes bracken fern, low sweet blueberry and Canada mayflower.

G067Tt – Moist, Coarse: Spruce – Fir Conifer

This forest community occurs in several areas on the south side of the Vermillion River within 120m of the proposed dam and inundation area. Dominant tree species found within this forest community include balsam fir, white spruce, white birch, red maple (*Acer rubrum*) and red oak. Understorey consists of mountain maple, Canada mayflower, starflower, and royal fern (*Osmunda regalis var. spectabilis*).

G070Tt – Moist, Coarse: Aspen-Birch Hardwood

This forest community is located on the south side of the proposed dam and inundation area adjacent to the large open area of the Vermillion River. This community is dominated by trembling aspen and white birch with some balsam fir and white spruce. The understorey includes mountain maple and speckled alder (*Alnus incana spp. rugosa*), and the herb layer includes starflower and wild sarsaparilla.

G148N – Mineral Shallow Marsh

Four tributary associated communities located within the downstream extent of the proposed dam and inundation area have been identified as Mineral Shallow Marsh (G148N). These tributaries are discussed in section 3.2.1 and are further described below.

Tributary A

This tributary is located on the north side of a large back bay of the Vermillion River downstream of the proposed dam. A small bed of aquatic vegetation along the shore of the Vermilion River consists of floating arrowhead, broad leaved arrowhead, marsh spikerush, floating pondweed, tapegrass, and white waterlily.

Tributary B

Tributary B flows into the Vermillion River to the southwestern side of the large back bay area. The tributary originates from numerous beaver ponds and meanders in a northerly direction to the Vermillion River. At the outlet of this tributary is a large bed of aquatic vegetation consisting of white water lily, yellow pond lily, floating leaved pondweed, Richardson's pondweed, and coontail.

Tributary C

Tributary C is well shaded and outlets to the main river approximately 250m downstream of the large basin below the proposed GS. A small bed of aquatic vegetation is found at the tributary outlet made up of white water lily, variable leaf pondweed, coontail, common waterweed, flat-stemmed pondweed, Richardson's pondweed, tapegrass, submerged water starwort, marsh spikerush, broad leaved arrowhead, and ribbon leaf pondweed.

Tributary D

Tributary D is located approximately 2.3km downstream of the large bay below the proposed Wabageshik Rapids GS. The wetland associated with the mouth of the tributary consists of aquatic vegetation including common waterweed, floating arrowhead, tapegrass and floating leaved pondweed.

4.2.2 Flora

Vegetation inventories resulted in the identification of 106 plant species. Plant species found within each ecosite community are discussed in section 4.2.1 of this report. Additional wildflower species identified within the study area include: cardinal-flower (*Lobelia cardinalis*), Canada goldenrod (*Solidago canadensis*), ox-eye daisy (*Leucanthemum vulgare*), wild geranium (*Geranium maculatum*) and blue flag iris (*Iris versicolor*). Fern species recorded within the study area include royal fern, interrupted fern (*Osmunda claytoniana*) and sweet fern (*Comptonia peregrine*). No significant vegetation species were identified through background review, information provided by the Sudbury District OMNR, or the site specific investigations conducted as part of this study. A full list of plant species observed and their significance can be found in Appendix IV.

4.2.3 Birds

A combined bird species list, comprised of 2010 observations and results from the 1st and 2nd Ontario Breeding Bird Atlas is included in Appendix V. A total of 96 bird species were reported to have the potential to regularly occur and/or breed within the vicinity of the Wabageshik Rapids study area (BSC *et al.* 2010). Although breeding bird surveys were conducted by polygon in the study area, this report summarizes the highest breeding evidence observed for each species within the entire study area.

A total of 49 bird species were observed within the study area during site investigations in 2010. A total of 39 bird species were observed during early morning breeding bird surveys. An additional 10 bird species were recorded through incidental observations.

Of the species observed during breeding bird surveys, 25 demonstrated possible breeding evidence while ten species demonstrated probably breeding evidence. Only two species, spotted sandpiper (*Actitis macularia*) and common grackle (*Quiscalus quiscula*), were confirmed breeding within the study area based on observed breeding evidence. The remaining two bird species, the ring-billed gull (*Larus delawarensis*), and herring gull (*Larus argentatus*) were observed without any breeding evidence.

The OBBA (Bird Studies Canada et al. 2006) identified 8 significant bird species from the vicinity of the study area (OBBA atlas square 17MM52): golden-winged warbler (*Vermivora chrysoptera)*, Canada warbler (*Cardellina canadensis)*, bobolink (*Dolichonyx oryzivorus)*, barn swallow (*Hirundo rustica*), chimney swift (*Chaetura pelagica*), common nighthawk (*Chordeiles minor*), whip-poor-will (*Caprimulgus vociferous*) and eastern wood-pewee (*Contopus virens*). During field surveys conducted in 2010, two significant bird species, bald eagle (*Haliaeetus leucocephalus*) and osprey (*Pandion haliaetus*), were observed within the study area. The status and preferred habitat of each of the significant species known from the area is discussed as follows.

<u>Bald Eagle</u>

Bald eagle is designation as Special Concern provincially, rendering it a species of conservation concern whose habitat is considered to be Significant Wildlife Habitat under the Provincial Policy Statement (PPS) (OMNR 2010b, OMNR 2013). This species is designated as Not at Risk nationally (Government of Canada 2012). Bald eagle requires large areas with continuous deciduous or mixed forests found on large lakes or rivers. Tall dead trees within 400m of the nest site are required for perching (OMNR 2000a, OMNR 2000b). A pair of bald eagles was observed over Wabagishik Lake, at the east end of the study area, during field investigations undertaken in spring 2010. This observation, in addition to the abundance of suitable nesting and foraging habitat, suggests that the bald eagle is likely breeding and foraging within the study area. No nests were observed at this location. Based on these observations, Wabagishik Lake is considered confirmed Significant Wildlife Habitat (SWH) for bald eagle foraging (OMNR 2012). Further details on the protection of bald eagle SWH can be found in section 5.3.

Osprey

Osprey are not designated provincially or nationally. However, osprey nesting, foraging or perching habitat is considered Specialized Habitat for Wildlife under the Significant Wildlife Habitat Ecoregion 5E Criterion Schedule (OMNR 2012). Therefore, this habitat is protected by the PPS (OMNR 2010b). Osprey are associated with lakes and rivers, often nesting in trees near the water's edge. Osprey often forage along shorelines of open water areas that produce abundant fish (OMNR 2000a). Two ospreys were observed actively foraging and carrying food over the large open water bay in the Vermilion River, which is downstream and west of Wabageshik Rapids. Two ospreys were sighted at this location during field investigations in both 2010 and 2011. No nests were observed at this location. Based on these observations, the open water pool downstream of Wabageshik Rapids is considered confirmed Significant Wildlife Habitat for Osprey Foraging. Further details on the protection of osprey SWH can be found in section 5.3.

Golden-winged Warbler

Golden-winged warbler is listed as being of Special Concern provincially and Threatened nationally (OMNR 2013, Government of Canada 2012). This species requires >10 ha of habitat and typically prefers successional habitats dominated by shrubs, such as fallow fields, woodland clearings, and wetland edges (OMNR 2000b). In Ontario, territories are typically in wetlands at the edge of tamarack bogs, alder and willow wetlands (Confer et al. 2011). These habitat types are not found within the 120m perimeter of the zone of influence. Golden-winged warbler was not observed within the study area during any of the field investigations undertaken in 2010. This species is not likely to be affected by the proposed Wabageshik Rapids GS and therefore will not be discussed in further detail in section 6.0.

Canada Warbler

Canada warbler is listed as being of Special Concern provincially and Threatened nationally (OMNR 2013, Government of Canada 2012). Canada warbler breeds in interior forest habitats with dense, well developed shrub and vegetation understory, often along riparian zones in excess of 30ha (OMNR 2000b). Interior habitat is often dense mixed coniferous or deciduous forests with closed canopy. Suitable habitat is present within the study area for Canada warbler, and it was observed in 2013 by Northern Bioscience during breeding bird surveys for the access road. Therefore, this species is discussed further in section 6.0.

Bobolink

Bobolink are listed as Threatened both provincially and federally (OMNR 2013, Government of Canada 2012). This species requires large, open expansive grasslands with dense ground cover. They are often associated with hayfields, meadows or fallow fields; marshes or requires tracts of grassland >50ha (OMNR 2000b). Bobolink was not observed within the study area and the forested nature of this site does not provide suitable breeding habitat. Therefore, there are no predicted impacts to Bobolink as a result of the Wabageshik Rapids GS and this species will not be addressed in section 6.0.

Barn Swallow

Barn swallow is listed as Threatened both provincially and nationally (Government of Canada 2012, OMNR 2013). Barn swallows nest in caves, holes, crevices and ledges in cliff faces as well as in artificial structures, including barns and other outbuildings, garages, houses, bridges and road culverts (COSEWIC 2011). This species prefer various types of open habitats for foraging, including grassy fields, pastures, various kinds of agricultural crops, lake and river shorelines, cleared rights-of-way, cottage areas and farmyards, islands, wetlands, and subarctic tundra (COSEWIC 2011). Barn swallow was not observed within the study area and the forested nature of this site does not provide suitable breeding habitat. Therefore, there are no predicted impacts to barn swallow as a result of the Wabageshik Rapids GS and this species will not be addressed further in section 6.0.

Chimney Swift

Chimney swift is listed as Threatened both provincially and nationally (OMNR 2013, Government of Canada 2012). This species along with several others, collectively known as aerial insectivores have undergone rapid population declines in a relatively short time period (Ontario SwiftWatch 2011). Prior to the arrival of European settlers in North America, chimney swifts nested mainly in the trunks of large, hollow trees, and occasionally on cave walls or in rocky crevices. However, due to the land clearing associated with colonization, hollow trees became increasingly rare, which led chimney swifts to move into house chimneys (Ontario SwiftWatch 2011). Today, the species is mainly associated with urban and rural areas where the birds can find chimneys to use as nesting and resting sites. Chimney swift was not observed within the study area and the forested nature of this site does not provide suitable breeding habitat. Therefore, there are no predicted impacts to chimney swift as a result of the Wabageshik Rapids GS. This species will not be addressed further in section 6.0.

Common Nighthawk

Common nighthawk is a provincial species of Special Concern and is considered Threatened nationally (OMNR 2013, Government of Canada 2012). This species nests on open ground; in clearings in dense forests, ploughed fields, gravel beaches or barren areas with rocky soils, in open woodlands and on flat gravel roofs (OMNR 2000b). Common Nighthawk was not observed within the study area, however suitable habitat is present within the study area. Nocturnal bird surveys were not conducted during bird surveys, therefore a precautionary approach will be taken. This species will be discussed in section 6.0.

Whip-poor-will

Whip-poor-will is listed as Threatened both provincially and federally (OMNR 2013, Government of Canada 2012). Whip-poor-will breeding habitat is generally not dependent on composition, but rather on forest structure. This species can be found within dry, open deciduous woodlands of small to medium sized trees (OMNR 2000b). Habitat is commonly comprised of oak or beech with lots of clearings and shaded leaf litter as well as wooded edges and forest clearings with little herbaceous growth (OMNR 2000b). Whip-poor-will was not observed during 2010 surveys. However, it was observed by Northern Bioscience during surveys for the access road in 2013, and suitable habitat is present within the study area. Potential impacts to this species are discussed in section 6.0.

Eastern Wood-Pewee

Eastern wood-pewee is a federal species of Special Concern (Government of Canada 2012). This species prefers open habitats, as well as deciduous, mixed, or coniferous forest predominated by oak with little understory. It also prefers forest clearings, edges, farm woodlots and parks (OMNR 2000b). Suitable habitat is present within the study area. While no eastern wood-pewees were observed during breeding bird surveys in 2010, they were observed by Northern Bioscience during breeding bird surveys for the access road. Therefore, this species is discussed further in section 6.0.

Marsh Bird Breeding and Waterfowl Nesting Areas

The presence of four Non-woody Mineral Shallow Marsh wetlands within the downstream extent provides Candidate Marsh Bird Breeding Habitat and Waterfowl Nesting Areas within the study area. Evidence of nesting marsh species listed in the 5E Ecoregion Criterion was not observed during breeding birds conducted in 2010 (OMNR 2012). One marsh breeding bird, common loon (*Gavia immer*) was observed during breeding bird surveys with no evidence of breeding. However, marsh breeding bird surveys were not conducted during site investigations and therefore Marsh Bird Breeding Habitat is considered Candidate SWH.

Additionally, six waterfowl species identified by the 5E Ecoregion Criterion for Waterfowl Nesting Areas were observed during breeding bird surveys (OMNR 2012). These species include American black duck (*Anas rubripes*), wood duck (*Aix sponsa*), hooded merganser (*Lophodytes cucullatus*), common merganser (*Mergus merganser*), mallard (*Anas platyrhynchos*) and Canada goose (*Branta canadensis*). The highest breeding evidence recorded for these species was possible breeding with individuals recorded as either calling or observed in suitable habitat during breeding season. Again, no waterfowl surveys were conducted during the breeding season, therefore Waterfowl Nesting Areas are considered Candidate SWH. Protection of these habitats are discussed in section 5.3.

4.2.4 Herpetofauna

Review of the Ontario Herpetofauna Summary Atlas (Oldham and Weller 2000) and Ontario's Reptile and Amphibian Atlas (Ontario Nature 2010) identified 22 species of herpetofauna (reptiles and amphibians) that could occur within the vicinity of the study area. A complete list of herpetofauna reported from the study area, including their current status rankings, is provided in Appendix VI.

During the 2010 spring and 2011 summer field investigations, three species of frogs, one species of toad, one species of snake and one species of turtle were observed. Amphibian species recorded include green frog (*Rana clamitans melanota*), northern leopard frog (*Rana pipiens*), wood frog (*Lithobates sylvaticus*) and American toad (*Bufo americanus*). Common snapping turtle (*Chelydra serpentina serpentine*) was the one turtle species observed during field investigations in 2010 and 2011.

During snake coverboard surveys, one snake species, northern red-bellied snake (*Storeria occipitomaculata occipitomaculata*), was observed at coverboard SNK-002. Specific snake surveys, through the use of snake coverboards, did not result in any snake Species at Risk being confirmed within the study area. It was noted on the June 27, 2010 field visit that two coverboards, SNK-003 and SNK-005, were missing.

The Ontario Herpetofauna Atlas (Oldham and Weller 2000) and Ontario's Reptile and Amphibian Atlas (Ontario Nature 2010) indicate the possible presence of three significant species, including common snapping turtle, Blanding's turtle (*Emydoidea blandingii*) and eastern milksnake (*Lampropeltis t. triangulum*).

<u>Common Snapping Turtle</u>

Common snapping turtle is a species that is listed as Special Concern both at the provincial and the federal level (OMNR 2013, Government of Canada 2012). Species of Special Concern are designated as a species of conservation concern, and their habitats are considered to be Significant Wildlife Habitat under the PPS (OMNR 2010b). This species is not afforded protection under either the federal Species at Risk Act (SARA) or the provincial Endangered Species Act (ESA). Habitat for the common snapping turtle includes permanent, semi-permanent fresh water bodies including marshes, swamps, bogs, rivers and streams with soft muddy substrates. Hibernation usually occurs in congregations and is commonly found within muddy substrates under water (Ontario Nature 2010, OMNR 2000b). The common snapping turtle was observed during June 2011 aquatic surveys. This observation was made on the north bank of the Vermillion River approximately 200m upstream of Tributary C and has also been observed the Vermillion River downstream of Graveyard Rapids (John Healy pers. comm. 2012). Targeted turtle surveys were not conducted. Protection of this species is described in more detail in section 5.3.

The presence of Mineral Shallow Marsh (G148N) as well as the bay in the Vermillion River below Wabageshik Rapids provide permanent water bodies with mud substrates that could likely provide turtle species, including the common snapping turtle, with overwintering habitat. Additionally, these locations may provide sand and gravel beaches adjacent to shallow weedy areas of water bodies that some turtle species, including the common snapping turtle, may use for nesting. These habitats are listed under the SWH ecoregion 5E criterion schedule and therefore are considered Candidate SWH. Protection of Turtle Overwintering Areas and Turtle Nesting Areas are discussed in more detail in section 5.3.

Blanding's Turtle

Blanding's turtle is listed as Threatened at the provincial level and is therefore afforded protection under the ESA (OMNR 2013, Government of Canada 2007). Blanding's turtle was recognized as a SAR that potentially occurs within the vicinity of the study area. Habitat for the Blanding's turtle consists of shallow water marshes, bogs, ponds or swamps, or coves in larger lakes with soft muddy bottoms and aquatic vegetation (Ontario Nature 2010, OMNR 2000b). Habitat within the study area is likely to occur within the confines of the tributaries and potentially the backwater areas of the bay below Wabageshik Rapids; however, the extent of their presence within the study area is currently unknown. Habitat in the surrounding area includes some of the wetlands associated with the tributaries (Tributary B in particular), and upland habitats that would be used for nesting. There were no observations made of Blanding's turtle during 2010 and 2011 field surveys. However, no specific turtle surveys were conducted. Blanding's turtle surveys will most likely be required to confirm their presence within the study area for the application process for authorizations and/or operating agreements under the ESA.

Eastern Milksnake

Eastern milksnake is listed as a species of Special Concern both nationally and provincially. Species of Special Concern are designated as species of conservation concern, and their habitats are considered to be Significant Wildlife Habitat under the PPS (OMNR 2010b). This species is therefore not afforded protection under either the federal SARA or the provincial ESA. Eastern milksnake is a habitat generalist that can be found in open woodlands, including hardwood and aspen stands (Ontario Nature 2010, OMNR 2000b). It is possible that eastern milksnake could be present within the hardwood and aspen stands that are present within the study area. As the eastern milksnake is a habitat generalist, a review of significant habitat of this species focused on critical life-cycle habitat (i.e hibernaculum). Eastern milksnakes were not observed during area searches or coverboard surveys. Although this species was not observed during field investigations, the absence of eastern milksnakes cannot be concluded. Therefore, habitat such as aspen stands and hardwood stands within the study area will be considered Candidate SWH for eastern milksnake. Consequently, potential impacts to eastern milksnake habitat will be addressed in section 6.0.

The presence of several wetland communities (G148N) and surrounding forested communities may provide habitat for breeding amphibians. Wetland sizes and distance to forest areas meet with criteria for Candidate Amphibian Breeding Habitat (Woodland). Observations of wood frog and American toad were made within study area, however numbers were not high enough to meet the criteria for confirmed SWH. Specific amphibian breeding surveys were not conducted within the Wabageshik Rapids GS study area and therefore a precautionary approach is taken during the impact assessment. Any potential amphibian movement corridors are also assessed. Further details on the protection of Candidate Amphibian Breeding Habitat (Woodland) can be found in section 5.3.

4.2.5 Mammals

A total of 26 mammal species have been identified as being potentially present within the study area (Dobbyn 1994). Evidence or direct observations of ten mammal species were recorded during field investigations. All of these species represent common species with secure populations in Ontario. Species observed include black bear (*Ursus* *americanus*), beaver (*Castor canadensis*), river otter (*Lutra canadensis*), moose (*Alces alces)*, red fox (*Vulpes vulpes*) and mink (*Mustela vison*). A complete list of mammal species observed within the study area and known from the Mammal Atlas is presented in Appendix VII of this report.

Moose Aquatic Feeding Habitats were identified by OMNR on the southern shores of Wabagishik Lake. These habitats are considered confirmed SWH. Additionally, NRSI biologists observed moose feeding in areas of aquatic vegetation on the south side of the embayment area. Sightings of moose usage within these areas meet the criteria for confirmed Aquatic Feeding Areas. Moose Aquatic Feeding Areas can be seen on mapping in Appendix III. Protection of these habitats will be discussed in more detail in section 5.3 of this report.

The study area features large areas of relatively undisturbed shoreline habitats of mixed-wood forest that lies adjacent to a source of abundant fish (the Vermilion River). These habitat features make the study area a potentially significant habitat for mink and otters. Further, the surrounding forest is large (>100ha in size) and contiguous, making it suitable habitat for martens and fishers. Mink and river otter were both observed within the study area during 2010 field investigations. River otters have also been reported using the Vermillion River by the local landowner. Extensive searches for denning sites are not recommended as they can be very difficult to locate. However, it is recommended that protection of appropriate habitat be considered and therefore this habitat is considered confirmed for otter and mink denning. Associated movement corridors will also be assessed using the precautionary approach. Protection of these habitats is described in more detail in section 5.3 of this report.

No Species at Risk mammals were observed during site investigations in 2010. A review of the Ontario Mammal Atlas has identified two SAR mammal species that may be present within the Wabageshik study area, the northern myotis (*Myotis septentrionalis*) and brown myositis (*Myotis lucifuga*). Acoustic surveys conducted by Northern Bioscience for the access road in 2013 detected *Myotis* species.

Northern Myotis

Northern myotis has been recently uplisted to Endangered on the Species at Risk in Ontario list (January 2013) providing it with species protection under the ESA. Federally, COSEWIC considers this species to be Endangered, but it is not yet included in Schedule 1 of the SARA (Government of Canada 2012). Northern myotis hibernates during winter in mines or caves. During summer months, males roost alone and females form maternity colonies of up to 60 adults in manmade structures, hollow trees or under loose bark (OMNR 2000b). Based on habitat requirements and findings by Northern Bioscience during surveys of the road corridor in 2013, it is possible that this species could be present within the study area. Targeted bat surveys were not conducted within NRSI's study area, and as this species became listed late in the EA process, no further surveys have been conducted for the EA. In addition, surveys may not be necessary for ESA permitting as the habitat will not be impacted by the project. Potential impact on this species is discussed further in section 6.0 of this report.

Brown Myotis

Brown myotis has been recently uplisted to Endangered on the Species at Risk in Ontario list (January 2013) providing it with species protection under the ESA. Federally, COSEWIC considers this species to be Endangered, but it is not yet included in Schedule 1 of the SARA (Government of Canada 2012). Brown myotis hibernates during winter in humid caves. During summer months, brown myotis use caves, quarries, tunnels, hollow trees and buildings for roosting (OMNR 2000b). Based on habitat requirements and findings by Northern Bioscience during surveys of the road corridor in 2013, it is possible that this species could be present within the study area. Targeted bat surveys were not conducted within NRSI's study area, and as this species became listed late in the EA process, no further surveys have been conducted for the EA. In addition, surveys may not be necessary for ESA permitting as the habitat will not be impacted by the project. Potential impact on this species is discussed further in section 6.0 of this report.

Along with northern myotis and brown myotis, big brown bat (*Eptesicus fuscus*) is also known to occur within the vicinity of the study area. Appropriate forested ELC ecosites that meet the criteria for candidate bat maternity roosting can be found within the study area and therefore, this habitat is considered Candidate SWH. Potential impact on this species is discussed in section 6.0 of this report.

4.2.6 Deer Monitoring

Camera Results

A total of 828 wildlife records were obtained by the cameras from early April 2011 to early February 2012. These included observations of white-tailed deer, moose (*Alces alces*), black bear, beaver, muskrat (*Ondatra zibethicus*), river otter, red fox, red squirrel (*Tamiasciurus hudsonicus*), northern flying squirrel (*Glaucomys sabrinus*), Canada goose (*Branta canadensis*), great blue heron (*Ardea herodias*), hooded merganser (*Lophodytes cucullatus*), mallard (*Anas platyrhynchos*), and wood duck (*Aix sponsa*). Of these records, 732 were of white-tailed deer. Often many photographs or videos were taken of the same individual or group, if they remained in front of the camera. Detailed analysis resulted in 349 separate deer observations over 309 days, or approximately 1.13 deer per day. Individuals residing in the area, or crossing the river multiple times on separate dates, cannot be distinguished and as a result a separate occurrence of a deer has been counted as another observation. In addition, deer also periodically congregated around the location of a camera. In this scenario, the minimum number of individuals observed in any given photo or video was recorded, unless an individual could be positively distinguished based on size or other obvious physical features. Deer were not double-counted if they were recorded at more than one camera situated in close proximity and the observations occurred within a reasonable time frame to infer it was the same individual or group.

Habitat Assessment

An assessment of the habitat reveals that in the spring, the slope on the south side of the river (a north-facing slope) retains snow longer than on the north side of the river (a south-facing slope). On April 8, 2011, it was estimated that snow depths on the south side of the river were no more than 10cm, with no accumulated snow on the north side of the river. The south side of the river contains a mixed forest with many white cedar, balsam fir and white spruce, with some red maple and sugar maple. Some evidence of browsing and scat was observed on this side of the river. On the north side of the river, the south-facing forest is drier, dominated by trembling aspen and large-tooth aspen

(*Populus grandidentata*), although the understory contains many regenerating red oak saplings, and some acorns were noted. There was much deer scat (from the previous fall) observed along the side of this slope, so it is likely that this area provides some foraging for deer in the fall.

<u>Track Survey</u>

The survey of tracks completed on April 8, 2010 revealed a general movement direction parallel to the rapids, with a few exceptions where tracks appeared to continue into the water (see Appendix III). These are the primary locations where cameras were set up, including at the upstream end of the rapids (CMS-010 and CMS-011), mid-way through the rapids (CMS-001 and CMS-005), and at the downstream end of the rapids (CMS-004 and CMS-007). It was evident that deer approach the area and travel parallel to shore along the steep slopes in search of a safe crossing location. The safest location appears to be the downstream extent of Graveyard Rapids where a run extends into a bay and where the distance is shortest (approximately 40m). Additionally, at this location there are shallow areas on both sides of the river, and there are no boulders creating rapids. Appropriately, many tracks were observed to enter the water in this location.

Trails on the south slope were more dispersed (at varying distances from shore) than those on the north slope, as a trail compacted into the soil was observed leading from the peninsula at the narrows on the north side, heading up the slope, to follow the top of the ridge. This ridge trail eventually became weaker and more dispersed until it could not be distinctly followed.

Wabageshik Rapids are situated at a narrow point in the surrounding landscape. For 5km downstream of these rapids, the Vermilion River is typically at least 90m wide, with the exception of Graveyard Rapids, where the river is less than 40m wide. The Spanish River is also very wide upstream and downstream of the Vermillion River outlet. Even immediately downstream of Wabageshik Rapids, the Vermilion River widens to a point where the shortest distance is 185m across. Upstream of Wabageshik Rapids, Wabagishik Lake is over 6km long, and narrows to only 140m at the nearest point. As a result, the narrows at Wabageshik Rapids, which are only 40-50m across in several places, provide favourable conditions for deer crossing. This is especially true at the downstream extent where the distance is narrowest, there are fewer obstacles, and water velocities are lower than the channel constrictions further upstream. A short distance to cross is especially favourable to deer in the spring because of the depleted energy stores that deer have as a result of the scarcity of high-energy food in the winter. Due to the landscape-level and site-level topography, it is therefore not surprising that track surveys have resulted in the identification of some specific crossing locations.

Analysis by Date

Activity as recorded by date can be seen in Figure 5. Known crossings represent individuals photographed displaying behavior to indicate they were crossing at the time, a crossing was imminent or a crossing had just occurred (e.g. shaking water out of fur or wet fur on a dry day). Suspected crossings represent individuals which were travelling towards the river at a steady pace (i.e. not congregating by the shoreline), or were observed on terrain which would not need to be traversed for other reasons (e.g. travelling down a steep slope which leads only to the river). Unknown crossings represent those deer which were foraging, congregating around a camera for extended periods of time, or generally not exhibiting behavior which could suggest a crossing. These observations may or may not have resulted in a crossing.

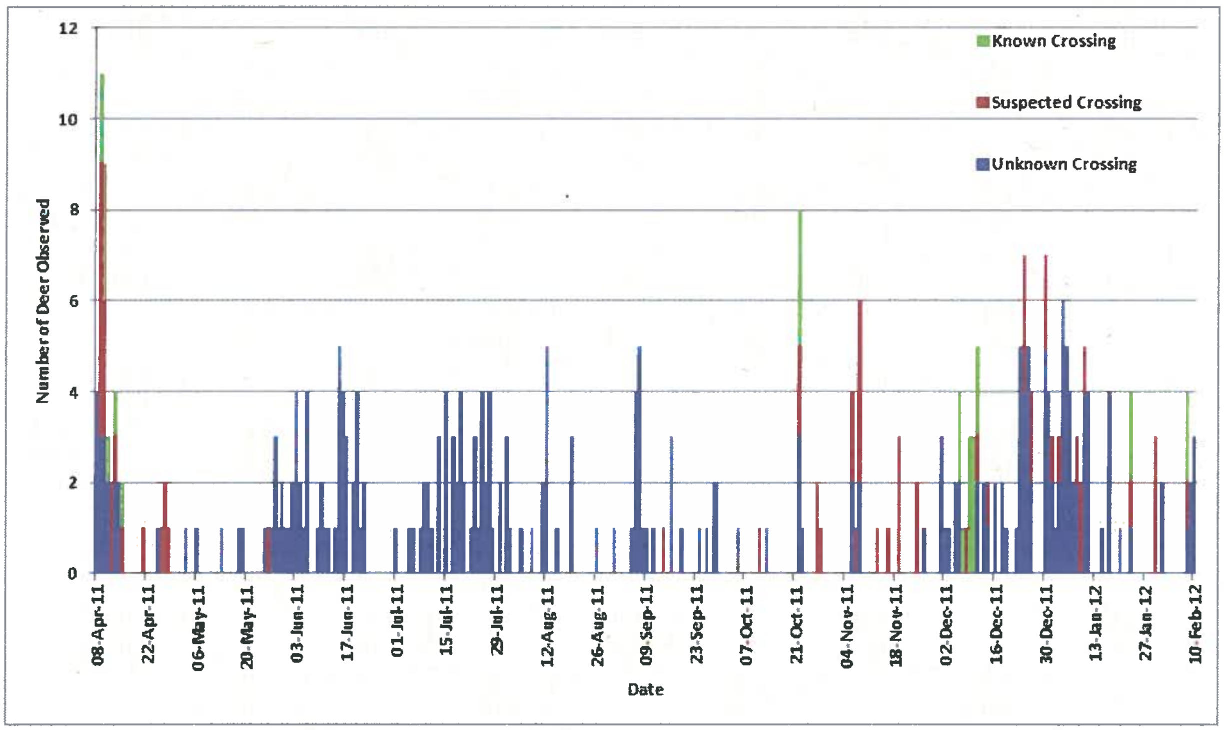

Figure 5. Deer Activity Recorded at Wabageshik Rapids by Date.

Spring Recording Period (Early April – Early June):

Recorded deer activity was highest shortly after installation in early April, and continued until mid-April. Activity was sporadic in the period from mid-April until late May, when only 11 observations were made, before activity increased again in late May until the data collection in early June. This is likely to correspond with the period of spring flooding which was initially noted from photographs on April 12, continuing to increase in depth until peaking on April 30 or May 1. Water levels remained elevated for several weeks, but had largely dropped to pre-flood levels by approximately May 20. The period in April prior to the spring flooding recorded the greatest number of known crossings (6). This is likely attributable to the lower water levels that occurred during the period from camera installation on April 8 to the water level increase that began on or around April 12, with likelihood of crossing being reduced as the water level rose. The drop in activity that occurred in late April may be a result of the high water levels and velocities, where much more water was rushing through the rapids at a high velocity, deterring deer from crossing during this period. However, it is also possible that fewer deer were recorded during the spring flooding as a result of the change in location of the camera relative to the water's edge. The distance between the cameras and the water's edge was reduced, and some cameras were on trees which themselves were partially flooded. There was also a narrower field of view due to the higher water level. In addition, CMS-004 (which recorded the greatest number of known crossings) and CMS-010 were moved further from the river on May 6 in an effort to prevent them from being flooded. As a result, the views from these cameras were altered, and some crossings may have been missed. However, a large proportion of the total observations were made during the period of April 8 to 15, where 11% of the total number of individuals was observed in only 8 days (2.6% of the time monitored). The total number of deer observed during the spring period was 1.2 deer/day; however, this value was 4.63 deer/day at the peak of movement from April 8 to 15. This movement is likely representative of spring dispersal as deer move from their wintering grounds to their summer habitat where food is more abundant.

Summer Recording Period (Early June to Early September):

During this time period a more consistent number of observations were recorded, which suggests they represented the local resident individuals. Observations recorded on a given day ranged from 0-5, with no noticeable peaks as observed in the spring. During this time period, no known or suspected crossings were recorded. This would suggest that deer movement across the river at Wabageshik Rapids was much lower during this time period, which is consistent with the day-to-day movements of deer in the area, rather than dispersal resulting from movement out of deer yards or establishment of territories. However, this time period also coincides with much lower water levels, which again changes the relative location of the camera to the shore (cameras are situated further away from shore, where deer may be beyond the camera's trigger threshold). CMS-004 and CMS-010 were also still located further from shore as mentioned above. The total number of deer observed during the summer period was 1.08 deer/day.

Fall Recording Period (Early September to Mid-November):
Similar to the spring monitoring period, the fall period had a higher number of deer observations recorded on certain days than during the summer, however, the peaks recorded are not as high as those in the spring. Additionally, it is important to note that fewer observations were made in total. This is likely related to the theft of two cameras which together had recorded approximately 60% of individuals observed during the spring and summer periods (CMS-006 and CMS-008). Increased deer movement is suggested by the peaks in number of individuals recorded, which may be associated with the rutting/hunting seasons.

Additionally, this period recorded 3 known crossings and 19 suspected crossings, which is a pattern similar to that recorded in the spring. The locations of the cameras with respect to the river's edge as a result of seasonally changing water levels were considered when reviewing the data. CMS-004, which during the spring had recorded the highest number of known crossings, was returned to its original location with a clear view of the narrowest point of the river in this area. However, this camera did not record any wildlife during the fall period. CMS-005a (located mid-way through the rapids on the north side), which had previously recorded only one individual deer, was moved on September 7 to an alternate location in an attempt to gain more valuable crossing information (CMS-005b). It was moved to the narrow point of the rapids at the downstream end, opposite from CMS-004. This was meant to fill a data gap which would have been occupied by CMS-007 had it not been flooded during the spring. However, this camera only recorded one suspected crossing and no known crossings. The most valuable crossing information came from CMS-002, the location of which was not changed during any of the monitoring. While the water level of the river did change during the year with respect to the camera, the known fall crossings were recorded when the river was at an intermediate level for the period. As a result of the data gathered from CMS-002, the increase in the number of known and suspected crossings from summer to fall is generally expected to represent an increase in the actual number of crossings that occurred in the area. The total number of deer observed during the fall monitoring period was 0.59 deer/day. This is the lowest value for the year, which can likely be attributed to the fact that some of the cameras which typically had the highest number of observations were stolen during this period and as a result the data was could not be retrieved..

Winter Recording Period (Mid-November to Mid-February):
The early winter period saw a higher number of deer observations, recording 38% of the total individuals from November 22 to February 10, which represents 26% of the monitoring days. A peak in observations occurred from approximately early December until mid-January in particular, which coincides with the anticipated period of deer movement into yards (OMNR 2000a, OMNR 2000b). Known crossings were observed from CMS-003 and CMS-004, the latter of which once again recorded some direct observations of crossing as in the spring recording period. The total number of deer observed during the early winter period was 1.63 deer/day, and was 2.48 deer/day from December 1 to January 11.

Analysis by Location

Figure 6 shows deer activity as recorded by each camera. CMS-011 did not record any deer during the spring period, and was stolen during the summer period. The data from CMS-007 was also not recovered because it was flooded during the spring, and as a result it is not included on Figure 6. Additionally, CMS-005a recorded only one deer, and as a result was moved on September 7 to gather data on the north side of the narrows (CMS-005b). CMS-006 and CMS-008 were both stolen during the fall monitoring period (the trees which they were locked to were cut down in order to remove the cameras). At this time, CMS-005b was also removed as a result of the history of theft of cameras on the north side of the river, and monitoring continued with cameras on the south side of the river.

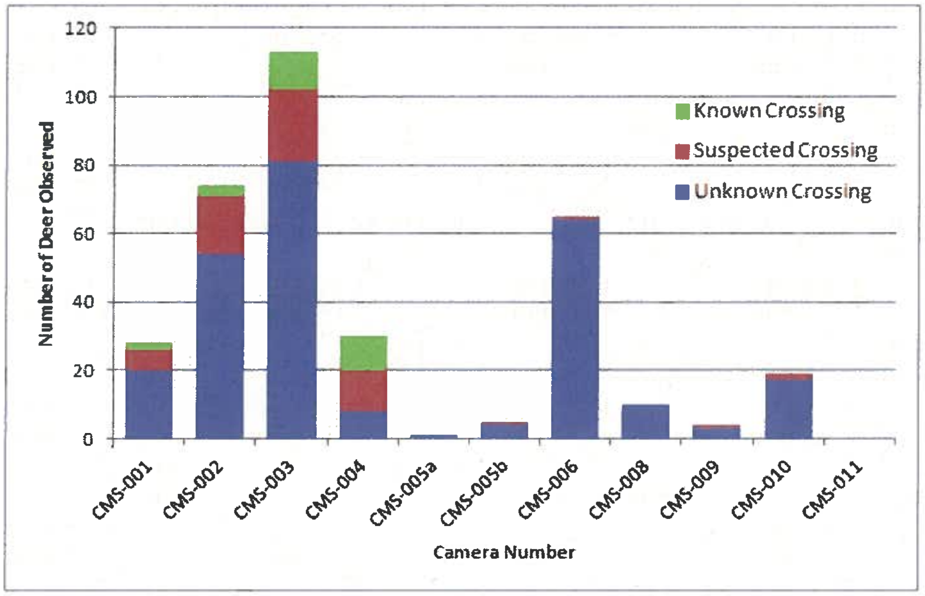

Figure 6. Deer Activity by Location at the Wabageshik Rapids.

CMS-003 recorded the greatest number of observations, with 113 individuals observed. Few of these were confirmed crossings because the camera was situated at the top of a steep bank where a deer trail runs perpendicular to the river and continues down the bank. Deer coming up the trail from the river with wet fur were recorded as confirmed crossings. Deer observed to travel down the trail were suspected of crossing the river, whereas those seen travelling westward or eastward along the top of the bank were unknown. CMS-002 and CMS-006 had moderate numbers of observations, with 74 and 65, respectively. CMS-002 is located at a bend in the riverbank towards the south end of the rapids, just downstream of a near vertical bank/rock face. This area allows some of the first access to the river after this bank if travelling from the east, and was noted to have many tracks at the water's edge when the monitoring location was chosen. CMS-006 was located along a well-used trail located on a ridge on the north side of the river. These results suggest that the majority of crossing likely occurs at the downstream end of the rapids, however it may also occur at various other locations along the length of the rapids as well, owing to moderate numbers of observations at CMS-001 and CMS-010.

Analysis by Time of Day

Figure 7 shows recorded observations of deer by the time of day. Observations were made primarily between 0800hrs and 1500hrs (72% of the total), although recordings were made throughout the day and night. Known crossings were typically observed between 0900hrs and 1800hrs, however known crossings were also observed in early morning on December 6, 2011 and January 23, 2012. This pattern corresponds to a generally higher level of activity and movement that would be expected during the day, while bedding occurs at night.

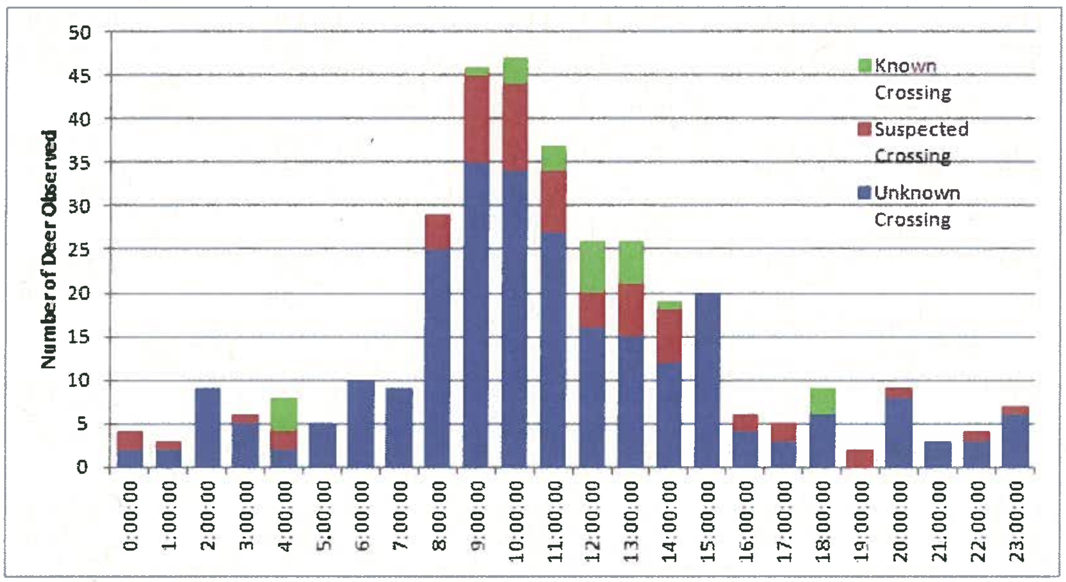

Figure 7. Deer Activity at Wabageshik Rapids by Time of Day.

Summary

The nearest known deer yards are >3km to the northwest (several smaller yards), and >9km to the southwest (one large yard). The habitats in the vicinity of these yards consist largely of treed and other naturally vegetated areas, with some small gravel roads. Lack of vegetation cover or large gaps in cover are therefore not limiting factors in the establishment of movement corridors in this area. The largest barrier to movement is likely the presence of the Vermilion River, which bisects the landscape. From a habitat perspective, the Wabageshik Rapids has the potential to represent a portion of an important movement corridor as a result of its position in the landscape, where a corridor would have to cross the river. This knowledge along with local historical knowledge of deer crossings prompted camera surveys to determine the significance of study area for deer crossing.

An estimate of 349 deer observations over 309 days were recorded by stealth cameras from April 8, 2011 to February 10, 2012. These cameras were placed at anticipated key locations for movement, as observed by track surveys conducted on April 8, 2011. These included locations where deer tracks were observed to enter the water, as well as along trails near the river. Results indicate that deer movement was highest immediately after placement of the cameras in early to mid-April and diminished considerably during the period of mid-April to mid-May, when flooding was known to occur on the river. Eleven percent of all observations were made in the initial 8 days of monitoring, or 4.63 deer/day. Movement picked up again after the flooding had receded, and data from the summer appears to represent the day-to-day activities of local, resident deer. Evidence of crossing activity appeared to pick up again in the fall and particularly early winter, corresponding with the rutting or hunting season in the fall, and the known early-winter time period for deer movement into winter yards. A particularly high volume time period in the latter part of the year occurred from the beginning of December until mid-January, where 2.48 deer/day were observed. The camera with the highest number of observations was CMS-003, located on the south side of the river at a trail which approaches from the south. CMS-002, placed by the river at the downstream end of a vertical bank/cliff, and CMS-006, placed on the north side of the river along a trail which follows from the peninsula at the downstream end of the rapids along a ridge, also had moderately high numbers of recordings. The activity patterns observed by the cameras support the prediction that the majority of deer crossings occur at the downstream end of the rapids, where the river is narrow and there are no rapids or chutes to present a challenge. However, some crossing appears to occur at other points along the rapids, including approximately mid-way (location of CMS-001) and at the upstream end (location of CMS-010). Activity was also primarily recorded between the hours of 0800hrs and 1500hrs, although some activity was recorded at all hours of the day.

The importance of a deer movement corridor relates to its ability to provide safe passage for deer into and out of a deer yard as well as the proximity of the corridor to the deer yard, as more deer will rely on it closer to the yard (OMNR 2011a). An analysis of the topography in the area suggests that the narrowed area of the Wabageshik Rapids provides some of the shortest distances in the area for crossing the Vermilion River, which may be required for deer to move into and out of deer yards located to the northwest and southwest. If deer living in the area must cross the Vermilion River to reach their winter yard, one of the narrowest points is found at these rapids, and as a result this area is likely to provide one of the safest options to cross the river.

Seasonal variations in the quantity of deer observations were made, coinciding with the expected periods of movement into and out of yards. The largest peaks in observations were made in early to mid-April, from the first day of monitoring until 8 days later (4.63 deer/day), as well as from early December to mid-January (2.48 deer/day). It is evident that greater numbers of deer cross the Vermilion River at the Wabageshik Rapids during the time periods that coincide with expected movement into and out of deer wintering areas (early December until mid-January and beginning of snow melt until approximately 15 days prior to spring flood peak in 2011). As such, this location is considered confirmed SWH for Cervid Movement Corridors as described in the Significant Wildlife Habitat Ecoregion 5E Criterion Schedule (OMNR 2012a). Protection of the habitat is described further in section 5.3 below.

4.2.7 Other Incidental Wildlife Observations

In addition to the bird, herpetofauna, and mammal species discussed above in their respective sections, two butterfly species were observed: Canada tiger swallowtail (*Papilio canadensis*) and painted lady (*Vanessa cardui*). Both species of butterfly are ranked provincially as 'S5', and are considered to be common with secure populations in Ontario. These species are unlikely to be impacted by the project and therefore will not be discussed further.

5.0 Summary of Significant and Sensitive Habitats and Species

Several of the known wildlife species and their associated habitats are significant based on conservation concerns, legal status, and/or socioeconomic value. These species and their habitats have been discussed in detail in the report thus far. They are summarized below as a means of identifying their significance and sensitivity prior to presenting the impact assessment for the proposed Wabageshik Rapids GS.

5.1 Species at Risk and Species of Conservation Concern

For the purposes of this report, species that are warranted legislative protection under the *Endangered Species Act* (ESA) are distinguished from those known to have sensitive populations. As such, the term Species at Risk will be used to identify species listed as Endangered or Threatened within Ontario and subsequently protected under the *ESA*. The term species of conservation concern will be used for species designated as Special Concern within Ontario, species that have been assigned a conservation status (S-Rank) of S1 to S3 or SH, and species that have been assigned a status of Threatened or Endangered by the Committee for the Status of Endangered Wildlife in Canada (COSEWIC) federally but not provincially by the OMNR. Habitat for Species of Conservation Concern is considered Significant Wildlife Habitat (OMNR 2000a, OMNR 2000b). Table 8 provides a summary of Species at Risk and species of conservation concern reported within the vicinity of the study area through the background review, as well as those observed during field surveys.

Table 8. Species at Risk and Species of Conservation Concern Known to Occur in the Study Area

Scientific Name	Common Name	S-Rank[1]	COSEWIC[2]	SARA Schedule 1[3]	COSSARO and ESA[4]	Preferred Habitat[5]	Suitable Habitat in Study Area?	Observed during EA Field Studies?	Discussed Further in VEC, SWH and Impact Sections
Vermivora chrysoptera	Golden-winged warbler	S4B	THR	THR	SC	early successional habitat; shrubby, grassy abandoned fields with small deciduous trees bordered by low woodland and wooded swamps; alder bogs; requires >10 ha of habitat[1]	No	No	No
Dolichonyx oryzivorus	Bobolink	S4B	THR	THR	THR	prefer large tracts of grassland or similar open habitats greater then 50ha in size	No	No	No
Wilsonia canadensis	Canada warbler	S4B	THR	THR	SC	an interior forest species; dense, mixed coniferous, deciduous forests with closed canopy, wet bottomlands of cedar or alder; shrubby undergrowth in cool moist mature woodlands; riparian habitat; usually requires at least 30ha	Yes	Yes[6]	Yes
Haliaeetus leucocephalus	Bald eagle	S4B	SC	Not at Risk	SC	requires large areas with continuous deciduous or mixed forests found on large lakes or rivers. Tall dead trees within 400m of the nest site are required for perching	Yes	Yes	Yes

Scientific Name	Common Name	S-Rank[1]	COSEWIC[2]	SARA Schedule 1[3]	COSSARO and ESA[4]	Preferred Habitat[5]	Suitable Habitat in Study Area?	Observed during EA Field Studies?	Discussed Further in VEC, SWH and Impact Sections
Hirundo rustica	Barn Swallow	S4B	THR	THR	THR	farmlands or rural areas; cliffs, caves, rock niches; buildings or other man-made structures for nesting; open country near body of water	No	No	No
Chaetura pelagica	Chimney Swift	S4B, S4N	THR	THR	THR	commonly found in urban areas near buildings; nests in hollow trees, crevices of rock cliffs, chimneys; highly gregarious; feeds over open water	No	No	No
Caprimulgus vociferus	Whip-poor-will	S4B	THR	THR	THR	dry, open, deciduous woodlands of small to medium trees; oak or beech with lots of clearings and shaded leaflitter; wooded edges, forest clearings with little herbaceous growth; pine plantations; associated with >100 ha forests; may require 500 to 1000 ha to maintain population	Yes	Yes[6]	Yes

Scientific Name	Common Name	S-Rank[1]	COSEWIC[2]	SARA Schedule 1[3]	COSSARO and ESA[4]	Preferred Habitat[5]	Suitable Habitat in Study Area?	Observed during EA Field Studies?	Discussed Further in VEC, SWH and Impact Sections
Chordeiles minor	Common Nighthawk	S4B	THR	THR	SC	open ground; clearings in dense forests; ploughed fields; gravel beaches or barren areas with rocky soils; open woodlands; flat gravel roofs	Yes	No	Yes
Contopus virens	Eastern Wood-Pewee	S4B	SC	SC		open, deciduous, mixed or coniferous forest; predominated by oak with little understory; forest clearings, edges; farm woodlots, parks	Yes	Yes[6]	Yes
Emydoidea blandingii	Blanding's Turtle	S3	THR	THR	THR	shallow water marshes, bogs, ponds or swamps, or coves in larger lakes with soft muddy bottoms and aquatic vegetation	Yes	No	Yes
Chelydra serpentine	Common Snapping Turtle	S3	SC	SC	SC	permanent, semi-permanent fresh water; marshes, swamps or bogs; rivers and streams with soft muddy banks or bottoms	Yes	Yes	Yes
Lampropeltis t. triangulum	Eastern Milksnake	S3	SC	SC	SC	farmlands, meadows, hardwood or aspen stands; pine forest with brushy or woody cover	Yes	No	Yes

Scientific Name	Common Name	S-Rank[1]	COSEWIC[2]	SARA Schedule 1[3]	COSSARO and ESA[4]	Preferred Habitat[5]	Suitable Habitat in Study Area?	Observed during EA Field Studies?	Discussed Further in VEC, SWH and Impact Sections
Sistrurusca Tenatusca tenatus	Eastern Massasauga Rattlesnake	S3	THR	THR	THR	marshes, shrub swamps, bogs, and river and stream bank edges that contain sedges or other low vegetative cover	No	No	No
Acipenser fulvescens	Lake Sturgeon (Great Lakes – Upper St. Lawrence population)	S3	THR	none	THR	bottoms of lakes and large rivers, usually 5 to 10m deep, coolwater[2]	Yes	Yes[7]	Yes
Myotis lucifugus	Brown Myotis	S4	END	none	END	uses caves, quarries, tunnels, hollow trees or buildings for roosting; winters in humid caves; maternity sites in dark warm areas such as attics and barns; feeds primarily in wetlands, forest edges[2]	Yes	Yes[6]	Yes
Myotis septentrionalis	Northern Myotis	S3?	END	none	END	roosts in houses, manmade structures but prefers hollow trees or under loose bark; hunts within forests, below canopy	Yes	Yes[6]	Yes

[1] NHIC 2013, [2] COSEWIC 2013, [3] Government of Canada 2013, [4] OMNR 2013, [5] OMNR 2000, [6] Observed by Northern Bioscience, [7] Observed by Kilgour & Associates (2012)

LEGEND:

S-Rank (Provincial Rank)
S2 - Imperiled
S3 - Vulnerable
S4 - Apparently Secure
S5 - Secure

COSEWIC, SARA Schedule 1, and COSSARO/ESA
SC – Special Concern
THR – Threatened
END – Endangered

5.2 Valued Ecosystem Components

The term Valued Ecosystem Component (VEC) is being utilized to identify species that are not considered Species at Risk (SAR) but are of importance for reasons such as recreation, subsistence or sensitivity. Within the Wabageshik GS study area, VEC's are limited to fish species. These species include northern pike and walleye. These species were identified based on their presence during field investigations.

5.2.1 Walleye

Walleye on the Vermilion River represent a VEC as they are a targeted species for recreational and subsistence fishing. Walleye were captured in the study area in the main stem of the Vermilion River downstream of the proposed dam site.

Scott and Crossman (1973) note that walleye prefer large shallow lakes or large, turbid, slow-flowing rivers. In turbid water, walleye are often more active during the day, as turbid water provides good shelter from daylight. They will also utilize shallower areas if there is a sufficient amount of aquatic vegetation, downed trees, or large boulder shoals. The habitat characteristics in which walleye prefer to reside are present throughout the study area. Walleye spawn at night in areas of fast moving water or rapids over boulder/cobble/gravel areas in water temperatures from 4 to 11°C. Walleye are active throughout the winter months and reside in the deeper pools away from fast flowing water.

Within the study area, habitat characterization has identified areas of suitable walleye spawning habitat within Wabageshik Rapids, which includes approximately 1.2km of river from the Wabagishik Lake outlet downstream to the outlet into the large basin. Specific areas within this stretch of river occur in riffle and run habitats between the proposed Wabageshik Rapids GS and the outlet into the bay, at a riffle downstream of the snowmobile bridge, and at another riffle upstream of the snowmobile bridge near the Wabagishik Lake outlet. Walleye spawning has been confirmed within Wabageshik Rapids through egg collection.

5.2.2 Northern Pike

Northern pike on the Vermilion River represent a VEC as they are a targeted species for recreational and subsistence fishing. During 2010/2011 spring aquatic assessments, northern pike were captured downstream of the proposed dam site.

Northern pike live in riverine and lacustrine habitats throughout North America. Within riverine systems, northern pike prefer clear, meandering, warm and heavily vegetated areas (Scott and Crossman 1973). Northern pike begin to spawn in the early spring following ice-out in water temperatures from 4 to 11°C. Spawning occurs over aquatic vegetation and seasonally inundated vegetation such as the wetlands found downstream of the proposed dam location. Following the spawning act eggs adhere to aquatic vegetation and are abandoned. Potential spawning habitat exists downstream of the proposed dam site along the southern and eastern shorelines of the large bay immediately downstream of Wabageshik Rapids. Spring freshet results in flooded areas along the shoreline that provide submerged vegetation required for spawning. Potential spawning habitat is also located in littoral zones of the shorelines downstream of Graveyard Rapids.

5.3 Significant Wildlife Habitat

Significant Wildlife Habitat (SWH) is designated following criteria identified in the Significant Wildlife Habitat Technical Guide (SWHTG) (OMNR 2000a, OMNR 2000b, OMNR 2012a). The SWHTG divides habitat types into four broad categories (Seasonal Concentration Areas of Animals, Rare Vegetation Communities or Specialized Habitat for Wildlife, Habitat for Species of Conservation Concern, and Animal Movement Corridors). These categories correspond with Tables 1, 2, 3, and 4 respectively in Appendix VIII.

Species listed as Special Concern under the Species at Risk in Ontario list are considered species of conservation concern. Additionally, species designated as nationally Endangered or Threatened by COSEWIC, which are not protected in regulation under the *Endangered Species Act* (2007), are considered species of conservation concern. Habitat for these species are therefore considered Significant Wildlife Habitat under the Provincial Policy Statement (2005).

A screening exercise was conducted that utilized general evaluation criteria set out in the SWHTG, Ecoregion 5E Criterion Schedule (OMNR 2012a), as well as OMNR's Decision Support System (DSS)(OMNR 2011a) to identify the presence of candidate SWH within the GS study area. The results of the site-specific vegetation mapping (ELC) and 2011 aerial photography interpretation of the study area were used for this process. Under the OMNR's Natural Heritage Assessment process (OMNR 2010b) the presence of Candidate Significant Wildlife Habitat would trigger the need for specific field surveys to confirm species presence. The outcomes of those surveys would be assessed for significance using specific tools that exist for Ecoregion 5E (OMNR 2000a, OMNR 2012a).

For SWH criteria that were determined to be present within the study area, further assessment was completed to determine the regional importance of those habitats on the surrounding landscape in relation to what was present within the study area. Following this broader level of assessment, SWH was classified as candidate, confirmed, or not present within the study area. Candidate and confirmed SWH resulting from this screening are further described below.

It is important to note that some SWH types are lacking criteria in the SWH Technical Guide for determining significance, and the relevance or importance of certain wildlife habitat types to this region of the province are not outlined. In the absence of these criteria, professional judgement was used in determining the significance or relevance of wildlife habitats for the study site. A summary of findings from the SWH screening exercise is provided in Appendix VIII in Tables 1-4, for Seasonal Concentration Areas, Specialized Wildlife Habitat, Habitat for Species of Conservation Concern and Animal Movement Corridors respectively. Confirmed SWH is also shown on the terrestrial maps provided in Appendix III.

Candidate Significant Wildlife Habitats

For all habitat identified as Candidate SWH, the precautionary approach is applied and all potential impacts assessed. This includes any recommendations for monitoring of Candidate SWH based on any perceived negative impacts to the SWH.

A SWH screening exercise has identified the potential for Marsh Bird Breeding Habitats to be present within the downstream extent of the proposed Wabgeshik Rapids GS. These habitats consist of the Shallow Mineral Marsh (G148N) which are associated with the mouths of tributaries. Only one marsh species, common loon, was observed during breeding bird surveys, however, this observation was not associated with any nesting evidence. Marsh Bird Breeding surveys were not conducted during site investigations. Consequently, the precautionary approach is taken for the purpose of this report and any potential impacts to this habitat are discussed further in section 6.5.1.

As a result of the SWH screen exercise, Waterfowl Nesting Areas were also identified as Candidate SWH. Habitat for waterfowl nesting includes four Mineral Shallow Marsh wetlands found within and surrounding the embayment area downstream of the proposed Wabageshik Rapids GS. These wetlands are greater than 0.5ha and are found within close proximity to each other. As mentioned in section 4.2.3, six waterfowl species were observed during breeding bird surveys, however, the highest breeding evidence recorded was 'possible'. Waterfowl surveys were not conducted within the study area during site investigations. However, the precautionary approach is taken for the purpose of this report and any potential impacts to this habitat are discussed further in section 6.5.1.

Turtle Wintering Areas have been identified as potentially present within the downstream ecological zone of influence of the proposed Wabageshik Rapids GS. Turtle Wintering Areas are generally found in the same area as their core habitat. They consist of water deep enough not to freeze and soft muddy substrates. These habitats are generally large wetlands, bogs and fens with Dissolved Oxygen (OMNR 2012a). Wetlands including Shallow Mineral Marsh (G148N) are present within the study area and may provide overwintering habitat for common snapping turtle which was observed within the downstream extent of the proposed GS. The embayment area found just downstream of Wabageshik Rapids may also provide suitable overwintering habitat for common snapping turtle as this area is deep enough that it is unlikely to freeze and consists of some mud substrates. As observations of common snapping turtle were not made during the spring or fall period confirmation of SWH for this habitat cannot be made at this time. However, the precautionary approach is taken for the purpose of this report and any potential impacts to this habitat are discussed further in section 6.5.1.

As a result of the SWH screening exercise, Turtle Nesting Areas were also identified as Candidate SWH. Turtle Nesting Areas generally consists of areas with sand and gravel that turtles are able to dig in and are located in sunny, dry areas (OMNR 2012a). As mentioned in section 4.2.4, these habitats can be found adjacent to shallow, weedy areas of marshes, lakes and rivers. Wetland communities include G148N are located within the downstream extent and can be found adjacent to the Vermillion River and its embayment area. Soils within Tributary C are associated with sand, sandy loam and silt loam which may provide nesting habitat for turtles such as the common snapping turtle. As common snapping turtles were observed within the downstream extent of the proposed Wabageshik Rapids GS, there is potential for this habitat to be present within the study area. There were no observations made of nesting common snapping turtle and therefore confirmation SWH cannot be made at this time. Again, the precautionary principle is applied within the report and potential impacts are detailed in section 6.5.1 of this report.

Candidate SHW is identified for otter denning both upstream and downstream of the GS. Extensive searches for denning sites is not recommended as locating them can be very difficult (OMNR 2012a). Otters are known to use abandoned dens of other animals as well as old beaver lodges (Harris et al 1997 and Gorman et al. 2006). They will also excavate dens in the river bank with entrances above or below the waterline. No den sites were confirmed during the fieldwork, however the designation of candidate SWH is based on multiple observations of otters. Denning sites likely have associated movement corridors and therefore this habitat has also been identified as Candidate SWH. A precautionary approach is taken when assessing potential impacts to otter and mink denning and movement corridors. These impacts are discussed in section 6.0.

As a result of the SWH screen exercise, Amphibian Breeding Habitat (woodland) was identified as Candidate SWH. Criteria for Amphibian Breeding Habitat include wetlands that are greater than 500m^2 and are located adjacent to forested communities. As mentioned in section 4.2.4, these habitats include the wetland communities G148N which are located within the downstream extent of the proposed Wabageshik Rapids GS. Several indicator species were observed within the study area including wood frog and American toad. As mentioned earlier, the number of observations did not meet the criteria for confirmed SWH. However, amphibian specific surveys were not conducted within the study area. As a result, the precautionary principle is applied within this report with potential impacts detailed in section 6.5.1.

The SWH screening exercise identified the potential for eastern milksnake to be found within the study area. As this species is listed as special concern provincially, it is considered a Species of Conservation Concern, and its habitat is considered to be SWH. Eastern milksnake is a habitat generalist that can be found in open woodlands, including hardwood and aspen stands (Ontario Nature 2010, OMNR 2000b). It is possible that eastern milksnake could be present within the hardwood and aspen stands that are present within the study area. Although this species was not observed during field investigations, the absence of eastern milksnakes cannot be concluded. Therefore, habitat such as aspen stands including G070Tt (Moist, Coarse – Aspen – birch Hardwood) and G040Tt (Dry, Sandy – Aspen – birch Hardwood) within the study area is considered Candidate SWH for eastern milksnake. Potential impacts to eastern milksnake habitat are addressed in sections 6.2, 6.3 and 6.5.

Habitat for the common nighthawk was identified as potentially occurring within the project area and is therefore considered Candidate SWH. This species nests on open ground; in clearings in dense forests, ploughed fields, gravel beaches or barren areas with rocky soils, in open woodlands and on flat gravel roofs (OMNR 2000b). Common Nighthawk was not observed within the study area, however suitable habitat is present within the study areas including Very Shallow, Humid - Red Pine - White Pine Conifer, Short Treed (G023Tl). Potential impacts are addressed in sections 6.8.7

Confirmed Significant Wildlife Habitats

As discussed in section 4.2.3 of this report both bald eagle and osprey were reported within the study area. A pair of bald eagles was observed over Wabagishik Lake, at the east end of the study area. This observation, in addition to the abundance of suitable nesting and foraging habitat, suggests that the bald eagle is likely breeding and foraging within the study area and therefore this location is considered confirmed SWH. Additionally, osprey were observed actively foraging and carrying food over the large open water pool of the Vermilion River, downstream of the Wabageshik Rapids, and situated in the west end of the study area. This habitat has therefore been identified as confirmed for osprey foraging. Potential impacts to these SWH are discussed in sections 6.3.1, 6.4.1 and 6.5.1.

Moose Aquatic Feeding Areas have been identified upstream of the proposed Wabageshik Rapids GS along the southern shore of Wabagishik Lake. Additional Moose Aquatic Feeding Areas were found downstream of the proposed GS along the south shore of the bay below Wabageshik Rapids. These habitats are considered SWH and therefore protected by the PPS (2005). Impacts to this habitat are discussed in section 6.4.1 below.

Habitat for species of conservation concern SWH is identified for common snapping turtle. One adult was observed basking on bedrock outcropping near the Mineral Shallow Marsh (G148N) associated with Tributary C. As such the vegetation community adjacent to which this species was documented is identified as SWH. Potential impacts to turtles are discussed in sections 6.5.1 of this report.

SWH has been identified for Cervid Movement Corridors just downstream of Wabageshik Rapids. Deer movement studies were conducted in 2011 as described in section 4.1.4 and confirmed movement across the Vermillion River at the downstream extent of the narrows. Deer crossings coincided with typical seasonal movement into and out of deer wintering areas and therefore were confirmed SWH. Potential impacts to the deer crossing are discussed in sections 6.2.1, 6.3.1 and 6.51 below.

6.0 Impact Assessment and Mitigation

The natural environment impact assessment includes potential impacts resulting from the design footprint, construction, and operation of the proposed Wabageshik Rapids GS. However, this impact assessment does not address impacts associated with the project's access roads or transmission corridors. The impacts associated with the roads can be found in the main EA report (Xeneca 2013a). Impacts are assessed using the natural environment characterization presented in this report, and the design, construction and operation information that Xeneca has developed. The design information provided by Xeneca is found in Annexes I and II of the main EA report (Xeneca 2013a). This information includes:

1) Construction management plan prepared by Canadian Projects Limited (CPL 2013)
2) Operating plan prepared by Ortech (2013)
3) Steady-state HEC-RAS model report prepared by CPL (2012a)
4) Unsteady-state HEC-RAS model report prepared by CPL (2012b)
5) Surveyed cross sections at Wabageshik Rapids prepared by Xeneca (2012a)
6) Steady Flow Additional Transects prepared by CPL (2012c)
7) Wabageshik tributary elevations prepared by Xeneca (2012b)
8) Fish passage velocity memo prepared by CPL (2012d)
9) Residence time of pool below spillway prepared by Xeneca (2013b)
10) Preliminary fish habitat compensation plan prepared by NRSI (2013a)
11) Hydraulic parameters near dam and tailrace area prepared by Xeneca (2012c)
12) Wetted surface contours in Wabageshik Rapids prepared by Xeneca (2012d)

The impact assessment is organized primarily according to the various components and processes associated with the project. For each component or process, the potential impacts are discussed according to terrestrial and aquatic aspects of the natural environment, or according to a specific mode of impact. To begin the impact assessment, Section 6.1 outlines the methods used for impact assessment. To conclude the impact assessment, Section 6.9 provides a summary of the recommended mitigation measures.

6.1 Impact Assessment Methods

6.1.1 Terrestrial Impact Assessment Methods

The assessment of impacts on existing terrestrial and wetland resources is based on the proposed extent of disturbance combined with the relative significance and sensitivity of species, habitats or designated natural areas. The extent of an impact is a combination of magnitude, spatial extent, duration and frequency. The level of terrestrial disturbance proposed to terrestrial species and habitats as part of Wabageshik Rapids GS is largely caused by the removal of existing habitat to accommodate the dam facilities, as well as the impacts that may result from the proposed upstream lake-coupled headpond area. In addition, operation of the dam causes daily variation in flows and water levels upstream and downstream, which have potential to affect shoreline vegetation and habitat. There is also potential for indirect impacts from construction processes via noise, dust and vehicular traffic. In general, avoidance and re-design are applied to the selection of the preferred design, construction and operations of the facility. Where avoidance and design modifications cannot be achieved, impacts associated with the construction of the facility, as well as operation of the proposed GS are assessed based on the predicted interactions between the design and the existing vegetation and wildlife sensitivities.

Of particular interest to this assessment is the potential for impacts to interfere with sensitive life cycle stages of SAR (Blanding's turtle, northern myotis and brown myotis) and other significant and sensitive species that have been identified. By focusing on the species with greatest value and sensitivity along with the most likely modes of impact, a clear understanding of potential terrestrial impacts can be demonstrated and an assessment of residual effects can be undertaken.

Studies have determined that there are a number of Candidate Significant Wildlife Habitats that occur in the study area. In the absence of additional field work to confirm whether critical habitats for these species exist within the study area, a precautionary approach is being taken and the habitat is treated as confirmed significant wildlife habitat.

6.1.2 Aquatic Impact Assessment Methods

The fisheries and aquatic habitat impact assessment is based primarily on the resilience of the identified habitat and the species relying on the function of that habitat, to withstand predicted disturbances caused by construction and/or operation of the project. In this manner, both the significance and sensitivity to disturbance of localized areas, both directly in the project footprint and the rest of the study area are considered. Similar to the approach outlined in DFO's Practitioners Guide to the Risk Management Framework for DFO Habitat Management Staff (Fisheries and Oceans Canada 2010), this process follows a hierarchical approach to fish habitat protection. Avoidance and re-design is applied to the selection of the preferred design, construction and operations of the facility. Where avoidance and design modifications cannot be achieved, impacts associated with the construction and operation of the GS will be assessed based on the predicted interactions between the design and the existing fish and fish habitat sensitivities.

Of particular interest to this assessment is the potential for impacts to interfere with sensitive life cycle stages of walleye and northern pike, as well as lake sturgeon (a fish SAR). By focusing on the species with greatest value and sensitivity along with the most likely modes of impact, a clear understanding of potential aquatic impacts can be demonstrated and an assessment of residual effects can be undertaken.

6.2 Facility Footprint

The proposed permanent GS structure components outlined in the construction management plan include a powerhouse, powerhouse yard, substation, spillway, and intake and tailrace structures (CPL 2013a). Details of these features are discussed below. Impacts on terrestrial, wetland and aquatic function as a result of the design footprint are discussed in Sections 6.2.1 and 6.2.2. Table 9 presents estimated design footprint areas as provided in the construction management plan (CPL 2013a). . Temporary areas required for construction are discussed in Section 6.8.

Table 9. Summary of GS Component Footprint Areas

Structure	Estimated Footprint Area in m^2
Powerhouse	400
Powerhouse Yard	500
Substation	300
Spillway	200
Intake and Tailrace	600
TOTAL AREA	**2,000**

Powerhouse, Powerhouse Yard and Substation

According to the construction management plan, aquatic and terrestrial habitats will be affected by the powerhouse, powerhouse yard and substation. In addition, cofferdams will be required for the construction of the powerhouse.

Spillway

According to the construction management plan, the construction of the proposed spillway will require the excavation of bedrock, and the spillway will be contained within the existing riverbed. According to the Construction Sequencing Plan, a cofferdam will also be required to complete spillway construction.

Headrace (Intake Channel)

As part of the proposed development, a headrace or 'intake channel', to route water from upstream reaches of the Vermilion River into the water intake structure, will be constructed. According to the construction management plan, the proposed headrace channel will primarily require the excavation of streambanks (earth and bedrock). A cofferdam will also be required for the construction of the intake and the first phase of dam construction.

Tailrace

A tailrace channel to route water downstream and away from the turbine will be constructed. Based on the construction management plan, the proposed tailrace channel will require the excavation of riverbank soils and bedrock. A cofferdam will also be required to complete the tailrace construction.

6.2.1 Terrestrial Impacts – Facility Footprint

The powerhouse, and associated powerhouse yard and substation will result in direct impacts to terrestrial habitat in the form of localized clearing and grubbing of existing riparian vegetation. The spillway and tailrace will not result in any impacts to terrestrial habitats as they are contained within the existing riverbed. The forest community that would be affected include G025TI -Very Shallow – Humid Hemlock Cedar Conifer, Tall Treed. The spatial area of 1,200m^2 for the powerhouse, powerhouse yard and substation represent a very small extent relative to the amount of available habitat in the surrounding area. The impact of these project components will be permanent, but the low relative spatial extent makes this impact minor.

Two SAR mammals, northern myotis and brown myotis, were identified to potentially occur within the vicinity of the planned powerhouse, yard and substation. The shoreline forest (G025TI) that will be cleared for these structures is unlikely to support maternity roost habitat as it does not support deciduous or mixedwoods communities. However, this community may support suitable foraging habitat for northern myotis and brown myotis. Because foraging habitat is abundant on the surrounding landscape, the overall impacts to these species are anticipated to be minor.

Three SAR birds, whip-poor-will, common nighthawk and Canada warbler, were identified to potentially occur within the vicinity of the planned powerhouse, yard and substation. The shoreline forest (G025Tt) that will be cleared for these structures is unlikely to support whip-poor-will or common nighthawk habitat as this community is tall treed and coniferous in nature. Whip-poor-will and common nighthawk habitat is likely in the surrounding communities including Very Shallow, Humid: Red Pine - White Pine Conifer, Short Treed (G023TI) however, this community will not be impacted by the facility footprint. Similarly, the habitat to be cleared for Canada warbler is not suitable for this interior-forest-dwelling species.

One bird species of conservation concern, eastern wood-pewee, was identified to potentially occur within the vicinity of the planned powerhouse, yard and substation. The shoreline forest (G025Tt) that will be cleared for these structures is most likely suitable for this species. Impacts can be mitigated by clearing vegetation outside of the migratory bird breeding period from May 9 to July 31 of any given year. Furthermore, this species is a habitat generalist, and the loss of this habitat is small relative to the surrounding landscape.

The dam, headrace, powerhouse and powerhouse yard are unlikely to affect mink or otter denning habitat given the fast-water characteristics of the shoreline habitat that would discourage denning opportunities. No such dens were observed during fieldwork in the Wabageshik Rapids area. Furthermore, given the abundant availability of this habitat on the surrounding landscape, any impact resulting from this facility footprint would be negligible.

The habitat proposed for removal (G025Tt) consists of softwood species and is unlikely to provide habitat for eastern milksnake. Preferred aspen stands are abundant within the study area and are more likely to support this species. Aspen stands are not proposed to be impacted by the footprint of the facility. Therefore, impacts to eastern milksnake habitat are predicted to be negligible.

The proposed dam structures are located in areas managed for one trap line (EP043) and two Bear Management Areas (SU-42-006 and EP-42-005), as shown in the OMNR Values Mapping. The area proposed for disturbance by the powerhouse, yard and substation is 1,200m^2, which is very small compared to the trap line and bear management areas. Therefore, it is anticipated that these areas will experience minimal habitat loss or disturbance due to the small footprint area of the proposed dam structures.

Other terrestrial wildlife species that are not of conservation concern may use habitat within the footprint of the GS structures. However, the amount of habitat lost within the context of the study area will be 1,200m^2, which is very small compared to the surrounding landscape. The overall impacts on these species on a landscape scale will likely be negligible given the abundance of appropriate habitat that exists on the surrounding landscape.

The presence of the dam structure is not anticipated to impact deer movement through the area, as the structure itself will occupy only 1,200m^2, which a very small proportion of the total area surrounding the rapids where deer are known to cross. Impact to deer movement corridors due to construction and associated disturbances is discussed in more detail in section 6.8.

6.2.2 Aquatic Impacts – Facility Footprint

The construction of the dam, intake structure and powerhouse will result in the loss of aquatic habitat due to the permanent covering and infilling of the river channel within the footprint area.

The headrace (intake channel), spillway, and tailrace will result in a restructured riverbed to form smooth concrete or bedrock channels. This alteration will result in the loss of existing natural substrates and flow conditions, reducing the function and productive capacity of habitat within these areas.

According to the construction management plan, the Wabageshik Rapids GS powerhouse, spillway, headrace and tailrace will be installed in a location that will impact aquatic habitat (CPL 2013). This will result in permanent changes to aquatic habitat. The powerhouse will have an area of 400m^2, the spillway will have an area of 200m^2, and the headrace and tailrace will have a combined area of 600m^2. Of these areas, the entire area of the powerhouse and spillway, and the area of the tailrace will affect aquatic habitat, resulting in an area of impact of approximately 400m^2 for the powerhouse, 200m^2 for the spillway, and 400m^2 for the tailrace. The headrace is not expected to impact aquatic habitat directly. Instead, this area is affected by inundation.

The Wabageshik Rapids GS powerhouse and spillway footprint area (600m^2) is located at the transition from a run to a pool. These features are described in detail in Section 3.2.1. The run has mostly bedrock substrate and does not provide fish spawning habitat or other important habitat function. The pool has more varied substrates and is therefore more productive habitat. The pool is also expected to provide holding or refuge areas for walleye, lake sturgeon and redhorse suckers that spawn in adjacent habitats, and foraging habitat for a variety of other fish species. Northern pike are known to forage in this pool for small fish and drift (OMNR 2012b). Within the 600m^2 footprint of the powerhouse and spillway structures, these habitats will be eliminated. Some of the area will cover the run, but approximately 500m^2 will cover the pool, resulting in permanent impact that will be addressed through fish habitat compensation.

Where the tailrace area must be excavated, the existing cobble substrate on the channel bottom will be replaced following excavation (CPL 2013). This will ensure that the existing substrate characteristics will be maintained. While changes in water depth and velocity must also be considered, the information is not available at this time and a specific area of impact is not being assigned. Opportunities will be sought to improve habitat characteristics in the tailrace and/or nearby habitat, using 2-dimensional modelling as a design tool (NRSI 2013a). Refer to the preliminary fish habitat compensation plan (NRSI 2013a) in Annex III of the main ER (Xeneca 2013a).

6.3 Inundation Area

The construction of the proposed Wabageshik Rapids GS will result in a backwater effect upstream of the proposed dam location, increasing water depths and inundating adjacent riparian lands for a distance of approximately 800m upstream of the dam. This affected area is known as the inundation area. The total area of the new inundation will be 4.8ha, including the area of existing aquatic habitats plus the area of existing terrestrial habitat.

In addition, the project is considered lake-coupled, such that operational effects on water levels in the inundation area will also affect Wabagishik Lake. However, the lake is not considered to be part of the inundation area because the lake will not be subject to new inundation. Specifically, there will be no change to the normal elevations of the lake. Although there will be some water level fluctuations as part of operation of the Wabageshik Rapids GS, these fluctuations will be limited to a 10cm range, or +/- 5cm compared to normal lake level (Ortech 2013). Those water level fluctuations are considered under upstream operational effects (section 6.4), and the assessment of the inundation of habitats focuses on the riverine habitat between the proposed dam location and the outlet of Wabagishik Lake 800m upstream.

6.3.1 Terrestrial Impacts – Inundation Area

The damming of the Vermilion River will require clearing of existing riparian forest within the area proposed for inundation. This will occur as part of construction prior to inundation, and will result in minor direct impacts. The area of newly inundated terrestrial habitat will be approximately 0.4ha (Ortech 2013) and includes three different ELC communities:

- G040Tt - Dry, Sandy: Aspen - Birch - Hardwood
- G023Tt - Very Shallow, Humid: Red Pine- White Pine Conifer
- G067Tt - Moist, Coarse: Spruce - Fir Conifer

Where inundation area overlaps with these communities, all vegetation will be cleared and the habitat will be converted from terrestrial to aquatic. However, the area to be converted is minimal compared to the extensive vegetation in the surrounding landscape.

Impacts to wildlife and their habitats vary in extent and magnitude depending on the species and amount of habitat loss. The following is a description of impacts to wildlife including significant species identified in section 5.0.

A pair of bald eagles was observed over Wabagishik Lake during field investigations in 2010. This observation strongly suggests that the eagles were using the lake as foraging habitat. As the area of new inundation is confined to the 800m-long section of Wabageshik Rapids, the foraging habitat function of Wabageshik Lake will not be impacted.

As mentioned in section 6.2.1, northern myotis and brown myotis are mammal SAR that were identified as potentially present in the vicinity of the inundation area. The vegetative community G040Tt - Dry, Sandy: Aspen - Birch - Hardwood, may provide maternity roosting habitat for the northern myotis and brown myotis. Additionally, this community may provide Bat Maternity Roost SWH for big brown bats. Clearing activities for the inundation area will be conducted outside of bat roosting season (mid-May to mid-July) to reduce the impacts to any roosting bat species within the area inundation area.

In addition, Three SAR birds, whip-poor-will, common nighthawk and Canada warbler, were identified to potentially occur within the vicinity of the planned inundation area. Breeding and nesting habitat for Canada warbler and common nighthawk is not present in the vegetation communities to be cleared. Dry, Sandy - Aspen - Birch - Hardwood, Tall Treed (G040Tt), and Very Shallow, Humid - Red Pine - White Pine Conifer, Tall Treed (G023Tt) may provide habitat for whip-poor-will. The removal of this vegetation will be minor in comparison to the surrounding landscape. As such, impacts to the habitat for whip-poor-will are considered to be minimal and not significant. Impacts can also be mitigated by clearing vegetation outside of the migratory bird breeding period from May 9 to July 31 of any given year.

One bird species of conservation concern, eastern wood-pewee, was identified to potentially occur within the vicinity of the planned inundation area. The shoreline forest that will be cleared prior to inundation is most likely suitable for this species. Impacts can be mitigated by clearing vegetation outside of the migratory bird breeding period from May 9 to July 31 of any given year. Furthermore, this species is a habitat generalist, and the loss of this habitat is small relative to the surrounding landscape.

The inundation area consists of relatively undisturbed shoreline dominated by mixedwoods forests, adjacent to a water body (Vermillion River, Wabagishik Lake). The Vermillion River and Wabageshik Lake both provide abundant fish production. These characteristics provide potential suitable denning habitat for mink and otters, both of which were observed in the study area. Increased water levels will result in the inundation of a small area of terrestrial shoreline habitat, thus potentially removing existing denning sites. Specifically, inundation should not occur during the winter or ice-over period as this could cause direct mortality by drowning mammals in their dens. It is anticipated that proper construction sequencing and operations planning will mitigate impacts to aquatic mammal species, such that minimal impacts are anticipated. The area of shoreline habitat expected to be lost is very minimal within the context of the study area and no such dens have been observed to date. Additionally, where land becomes permanently inundated, new shoreline areas will become established that may provide denning habitat after construction of the GS. Overall, impacts of inundation on mink and otter denning would be minimal within the study area, and negligible on a broad landscape scale given abundant habitat availability outside the study area.

The proposed inundation area occurs within areas managed for one trap line (EP043) and two Bear Management Areas (SU-42-006 and EP-42-005). It is anticipated that these areas will have minimal impacts from habitat loss or disturbance because similar habitat is available in the surrounding area. The plan includes inundation of 0.4ha of land (Ortech 2013), which is small relative to the areas of the trap line and the bear management areas. Information about the location of traplines was not available from the OMNR; however, if they are in the area of project influence, it is anticipated that they will also have minimal impacts because of similar habitat in the surrounding area.

As discussed in section 5.3, the eastern milksnake is considered a species of conservation concern and therefore its habitat is considered SWH. Although this species was not detected during snake coverboard surveys, it cannot be ruled out as present within the study area. The removal of Dry, Sandy: Aspen - Birch – Hardwood (G040Tt) may result in the loss of potential eastern milksnake habitat. However, the removal of G040Tt is proposed to account for less than 0.4ha. The overall impacts on this species on a landscape scale will most likely be negligible given the abundance of appropriate habitat that exists on the surrounding landscape.

Other terrestrial wildlife species that are not of conservation concern likely use habitat within the inundation zone of the Wabageshik Rapids GS. However, terrestrial habitat loss within the inundation zone will be minimal compared to the available habitat on the surrounding landscape. Therefore, no impacts on other terrestrial wildlife are expected.

6.3.2 Aquatic Impacts – Inundation Area

As a result of inundation, there will be an 800m section of Wabageshik Rapids upstream of the dam facility that will change from a fast-water habitat to a lacustrine channel coupled to the lake. This fast-water habitat has been demonstrated to support spawning for walleye and sucker species, and potentially lake sturgeon.

The area of walleye, lake sturgeon and sucker spawning habitat in the inundation area was calculated based on habitat mapping and measurements of channel units in the field in conjunction with aerial photography. Habitats characterized as riffles and runs were considered to be suitable spawning habitat for these fish species. At this time, the entire riffle and run areas are conservatively assumed to provide spawning habitat for both walleye and lake sturgeon. A detailed survey of the habitat parameters within these riffles will be performed during the detail design and permitting phase of the project. The areas of these habitats were estimated for moderate spring flow conditions, and are discussed as follows.

A riffle area at the upstream end of the rapids adjacent to Wabagishik Lake has an area of 2,380m^2 that is available to fish during the spring spawning season. The wetted width varies substantially with flow conditions, from 8m wide in summer low flow conditions to 55m wide during very high flows. The area of 2,380m^2 includes a large portion of the channel, but does not represent the maximum area, which occurs at very high flows. The substrates are a mixture of boulder, bedrock and cobble.

A larger riffle area occurs between the existing snowmobile bridge and proposed dam, with an area of 4,460m^2. This section of the channel has a deeper part of the channel along the south bank, such that summer low flows expose a large portion of the riffle. The area given for the riffle includes the entire area, as spring flows typically make the habitat in the entire riffle available to fish. Substrates are mostly cobble as well as some boulder.

The total area of spawning habitat is therefore approximately 6,840m^2. This habitat will be largely lost due to changes in water depths and velocities, and will be addressed through fish habitat compensation that is to occur downstream of the proposed GS location. The benthic invertebrate community in these riffles will also be impacted by the changes in hydrology, and is addressed as part of the fish habitat compensation.

Wabagishik Lake is known to have healthy populations of walleye and northern pike. The inundation will not affect any spawning habitat for northern pike, as none is present within the inundation area. In addition, it is not expected to affect recruitment of walleye to the lake, in spite of the presence of walleye spawning habitat in the inundation area. The existing recruitment from walleye spawning in Wabageshik Rapids is understood to serve the habitat downstream in the Vermillion and Spanish Rivers, because larvae will drift downstream after hatching. Therefore, populations of walleye and northern pike in Wabagishik Lake are not expected to be impacted by inundation.

Because existing recruitment of walleye, suckers and possibly lake sturgeon within Wabageshik Rapids serves the Vermillion and Spanish Rivers downstream, compensation fish habitat will be constructed downstream of the proposed Wabageshik Rapids GS. First priority will be given to the tail-water section of Wabageshik Rapids below the proposed GS. Second priority will be given to the bay immediately downstream of Wabageshik Rapids where relatively high velocities extend from the rapids, and third priority will be given to Graveyard Rapids, located 4km downstream of the proposed GS. To help ensure that the compensation habitat is effective, this plan includes a commitment to use 2-dimensional modelling to design the compensation fish habitat in the first-priority tail water section of Wabageshik Rapids downstream of the proposed dam location. Refer to the preliminary fish habitat compensation plan (NRSI 2013a) in Annex III of the main ER (Xeneca 2013a).

6.4 Upstream Operational Effects

The proposed modified run-of-river operation as described in the operating plan (Ortech 2013) will result in a fluctuation of water levels within the inundation area and Wabagishik Lake. This fluctuation will vary water levels 5cm above and 5cm below the daily average water level. This fluctuation is expected to occur up to one time each day.

6.4.1 Terrestrial Impacts – Upstream Operational

Because the Wabageshik Rapids GS project will include a lake-coupled head pond, water level fluctuation will be constrained to +/- 5cm around daily average lake levels (Ortech 2013). While there would be an increase in the frequency of water level fluctuation, relative to a natural system, it is important to note that a 10cm fluctuation in water level is less than what might be caused by wave action or seiche effect that might be realized on the lake at present, simply as a result of a shift in wind direction. Plants and other biota living within the riparian zone can generally be expected to withstand the 10cm daily fluctuation in water levels based on their adaptation to the dynamic riparian environment. While some minor changes can be expected to occur, any impacts would be considered minimal and not significant.

Wabagishik Lake has been considered confirmed SWH for Bald Eagle Foraging. However, no impacts on the lake's functional capacity to provide bald eagle foraging habitat is anticipated as a result of the 10cm daily water level fluctuation.

Moose aquatic feeding areas were identified on the OMNR Values Map along the southern shorelines of Wabagishik Lake. As the proposed water level fluctuations are unlikely to impact shoreline vegetation and emergent vegetation to a meaningful extent, any impacts as a result of the proposed GS will be minimal and not significant.

6.4.2 Aquatic Impacts – Upstream Operational

Impacts associated with water level fluctuations within the inundation area are anticipated to be limited to the shallower littoral areas of the lake, where changes in water level would be more pronounced. These littoral areas occur within the existing natural zone of fluctuation of Wabagishik Lake. As Wabagishik Lake is a very large lake its littoral zone is correspondingly very large in area. While the extent of the littoral zone varies depending on shoreline gradient, a very conservative estimate of total littoral area can be generated by assuming a 5m average width for the littoral zone and multiplying this by the shoreline perimeter of the Lake as follows:

Shoreline perimeter = 25 km (25,000 m)
Average Littoral zone width = 5m

Therefore the littoral zone area is estimated at 125,000 m^2 or 12.5ha.

Within this estimated 12.5ha of littoral zone, any impacts on biota in the littoral zone habitat are predicted to be minimal and not significant. There will be an increase in the frequency of water level fluctuation, relative to a natural system. As noted above, a 10cm fluctuation in water level is less than what might be caused by wave action or seiche effect. As a result, the plants and other biota living in the littoral zone can be expected to withstand the 10cm daily fluctuation in water levels.

6.5 Downstream Operational Effects

A modified run-of-river operation is currently proposed for the Wabageshik Rapids GS, which will result in changes to the flow regime downstream of the proposed facility. These changes result from the capacity of the operation to store water upstream of the dam during periods of low power demand, and release that water, through the turbines, during periods of higher power demand. This results in relatively rapid increases and decreases in flow, an increase in the frequency of flow changes and associated changes in the wetted widths, depths, and velocities in downstream habitat areas. These changes have the potential to affect the ecology of the river and associated natural resource values.

Terrestrial and aquatic impacts are assessed below within the downstream ecological zone of influence, which includes the 5km section of the Vermillion River between the proposed Wabageshik Rapids GS and the confluence with the Spanish River. The operating plan indicates that operations will be constrained by a compliance commitment to maintain water levels in the Spanish River at the confluence with the Vermillion River within the Domtar dam operating band (Ortech 2013). The confluence with the Spanish River is within the influence of the head pond of the Domtar dam in Espanola, which operates within a 0.3m range of water level fluctuation referred to as the operating band.

Additional compliance commitments are given in the operating plan (Ortech 2013) for the downstream ecological zone of influence. First, water levels will be maintained within +/- 15cm of the daily average level in the bay immediately below Wabageshik Rapids. This commitment was initially made to address concerns of a property owner with land adjacent to the river. However, it will also serve to mitigate the potential for natural environment impact with respect to a variety of species. Minimum flows have been established to be 5.0m^3/s in the summer through to October, 6.5m^3/s in November, February and March, and 8.0m^3/s in December and January. In addition, the operating plan includes run-of-the-river operations for walleye and lake sturgeon spawning periods, typically ending sometime in July based on the water temperature and timing criteria. Lastly, restrictions on ramping rates will be in place such that the turbine speed will be increased and decreased over a period of time within the operating range, rather than instantaneously (Ortech 2013).

6.5.1 Terrestrial Impacts – Downstream Operational

Vegetation

Downstream operational impacts consist mostly of effects on emergent and riparian vegetation along the riverbanks, and the wetlands associated with the tributary outlets. Most riparian and emergent plants will not tolerate daily water level fluctuations of more than 25cm. It is anticipated that daily operations could result in the loss of emergent and shoreline vegetation. As a worst-case scenario, much of the shoreline and nearshore areas could exist as bare substrate. At a minimum the species composition will shift to some extent. For example, some emergent or wetland species may establish along the shoreline where the substrate will be exposed for part of the day and submerged for part of the day. A compliance of +/-15cm in daily water fluctuation may limit impacts to shoreline habitats. However, as this fluctuation is greater than 25cm, impacts on the emergent and riparian vegetation may occur.

There is also aquatic vegetation within the wetland areas in the bay below Wabageshik Rapids. This vegetation is less susceptible to impacts from the proposed water level flucutations, because they are either submergent or floating and their overall moisture levels will not change. The exception would be in nearshore areas where this vegetation type becomes dewatered as a result of fluctuation in water levels. Overall, impacts to vegetation are expected to be associated with the shoreline. Post construction monitoring will be conducted to document any changes in emergent and riparian vegetation, as outlined in the preliminary biological monitoring plan (NRSI 2013b). Additional mitigation measures may be applied in response to any observed impacts.

Confirmed Deer Movement Corridor/Crossing

Deer monitoring surveys conducted in 2011 have identified a deer crossing at the downstream end of the Wabageshik Rapids. Higher numbers of deer crossings were documented at this section of river during the early winter and spring months. This section of river most likely functions as an important corridor to and from deer yards located to the northwest and south of the study area.

Impacts of river regulation on deer crossing capabilities are not well researched. Therefore, to determine potential impacts to deer crossings, a comparison of confirmed deer crossings with daily average inflows was conducted. Confirmed deer crossings at the downstream location were compared with daily average inflow data (to Wabageshik Lake) provided by Vale from the Lorne Falls Dam GS operation. Comparisons were conducted during seasons of increased crossing behaviour including the early winter and early spring months. Eleven crossings were confirmed between December 6 and 11, 2011. The average daily inflow for this time period was 57.2cms. Table 10 below summarizes the confirmed deer crossings with the daily average flow recorded at the Lorne Falls Dam. One crossing was confirmed on January 23, 2012 when the daily inflow at Lorne Falls was recorded at 27.1cms. Additionally, three confirmed crossings occurred at the lower end of Wabgeshik Rapids in April 9, 10 and 13, 2011. The average daily inflow during this time period was recorded at 69.7cms, however on April 13, 2011 an inflow rate of 100cms was found to coincide with one of the confirmed crossings. This comparison provides insight into deer crossing capabilities and shows that deer have the ability to cross at the downstream location during higher flows in the spring. Operations during the early spring movement period (April) will consist of run-of-river operations. As such, the flows during this month will fluctuate based on natural variation and will not be impacted by the proposed GS. During the early winter months (December and January), continuous operations are expected to be typical. Operations during the month of January will typically fluctuate within $5m^3/s$ of the typical inflow, as per Figure 9 in Appendix I of the operating plan (Ortech 2013). Additionally, operations in December are proposed to fluctuate approximately 18cms from typical flows, as per Figure 20 of Appendix I of the operating plan (Ortech 2013). As the proposed operations will not influence water flows beyond 64cms, impacts to deer crossing are predicted to be minimal because deer have demonstrated that they can cross at flows up to and exceeding 64cms. Controlled ramping of flows are also proposed, which will avoid sudden changes in flows that may have potential to surprise deer while crossing the river. To ensure deer crossing activity is not impacted, post-construction monitoring is recommended to compare pre- and post-construction crossing behaviours of deer within the Wabageshik Rapids GS study area. Further details on deer crossing monitoring are provided in the preliminary biological monitoring plan (NRSI 2013b).

Table 10. Deer Crossing Summary Table

Date	# Confirmed Deer Crossing	Water Flow (cms)
06-Dec-11	2	60
07-Dec-11	1	62.4
09-Dec-11	3	59.2
10-Dec-11	3	51.8
11-Dec-11	2	52.6
23-Jan-12	2	27.1
09-Apr-11	2	51
10-Apr-11	3	58
13-Apr-11	1	100

Moose Aquatic Feeding Areas

One Moose Aquatic Feeding Area was identified within the downstream extent of Wabageshik Rapids during field investigations. This habitat was identified on the south shore of the bay below Wabageshik Rapids (See Appendix III). The operation of the GS will result in changes to the flow regime downstream of the proposed facility, which may impact the Moose Aquatic Feeding Area through changes in vegetation composition. A compliance commitment of +/-15cm daily water level fluctuation will reduce impacts to the aquatic vegetation within the Moose Aquatic Feeding Areas. Moose are generally known to feed on submergent vegetation including pondweeds, water milfoil and yellow water lily (OMNR 2012a). Because these species are adapted to natural changes in water level, impacts to these species are predicted to be minimal. In addition, as fluctuations in water levels resulting from operations will be confined to the river channel, adjacent forest habitats that provide cover and shade for moose feeding will not be impacted. Monitoring of aquatic vegetation will confirm the persistence of submergent vegetation within the Moose Aquatic Feeding Area.

Osprey Foraging

Two osprey were observed actively foraging over the large open water basin located on the Vermillion River, downstream of the Wabageshik Rapids GS, during 2010 and spring

2011 surveys. This open water habitat has therefore been designated as confirmed SWH for osprey foraging. However, changes in the flow regime downstream of the GS are not expected to impact the functional capacity of this SWH to provide abundant forage fish for ospreys. An operational constraint on daily water level fluctuations to +/- 15 cm will limit the impacts to riparian and shoreline habitats. It is therefore predicted that impacts to perching opportunities will be negligible. This constraint, along with run-of-river operations during spawning season will help to limit impacts to fish communities which osprey rely on as a food source. As such, it is predicted that there will be limited impacts to osprey foraging habitat within the Wabageshik Rapid GS study area.

Otter and Mink Denning

The downstream extent of Wabageshik Rapids GS consists of relatively undisturbed shoreline dominated by mixedwoods forests adjacent to the Vermillion River that provides abundant fish production. These characteristics provide suitable denning habitat for mink and otters, both of which were observed in the study area. As otters are adapted to natural variability within the river on a seasonal basis, it is predicted that the downstream operating of the proposed Wabageshik Rapids GS will not pose a significant impact on otter denning. The primary concern is with exposure of den entrances, and their adaptation to seasonal changes in water level should help to avoid this. Operational constraints including a Q_{EA} of 6.5cms to 8.0cms during winter months will reduce the potential for den entrances to be exposed to predators. Additionally, the +/-15cm maximum daily water level fluctuation 400m downstream of the proposed GS will limit water level fluctuations within the downstream extent during modified run-of-river operations, reducing any potential impacts to otter and mink denning.

Amphibian Breeding Habitat (Woodlands)

Four wetlands within the downstream zone of influence are greater than 500m^2 and consist of Mineral Shallow Marsh (G148N). These wetlands have been identified as candidate Amphibian Breeding Habitat (Woodlands). The operation of the GS will result in changes to the flow regime downstream of the proposed facility, which may impact the wetland communities through changes in vegetation composition. In addition, water-level fluctuations may seriously affect some frog species owing to effects on floating egg masses during early summer (OMNR 2011a). The breeding season for most amphibian species begins in early May and continues until the end of June. Run-of-river operations are proposed during May when breeding generally commences. As fluctuations in water levels during this time are due to natural variability, it is anticipated that there will be no impacts to Amphibian Breeding Habitat during this month. However, a shift away from run-of-river operation is proposed to begin based on lake sturgeon life stages, typically in late June or early July based on the water temperature and timing criteria given in the operating plan (Ortech 2013). During this time, there will be restricted continuous operations during the lake sturgeon larval drift period, with no more than 20cms daily change in flow. In addition, the +/-15 cm constraint on daily water level fluctuation 400m downstream of the proposed GS will help reduce impacts to floating amphibian egg masses and the shoreline and riparian vegetation required by many amphibian species for cover and protection.

Additionally, impacts to wetlands and shoreline habitats will decrease further downstream as variability in water level fluctuations will decrease as the distance from the GS increases. It is predicted that the above operational constraints will limit impacts to adjacent forested ecosites required by breeding amphibians. It is therefore anticipated that impacts to Amphibian Breeding Habitat (Woodland) will be limited to the potential loss of riparian vegetation. Post-construction monitoring of vegetation cover and species composition can provide additional insight into the extent of impacts posed by operations.

<u>Waterfowl Nesting Areas</u>

Similar to Amphibian Breeding Habitat, Waterfowl Nesting Areas are found within the Mineral Shallow Marsh located at the mouths of the four tributaries present within the downstream zone of influence. The breeding season for waterfowl generally occurs from the end of April to the end of June. Operations during this period will typically consist of both run-of-river and continuous operations. During run-of-river operations, variations in water levels will be the result of natural variation and no impacts will result from GS operations during this period. Operations during June are proposed to be continuous and are likely to impact vegetation required for nesting waterfowl within the wetland communities. Waterfowl species often rely on grass, sedge and rushes species for cover and protection of nests. Except for northern pintail (*Anas acuta*), many waterfowl species rely on residual vegetation from previous years for nesting materials (OMNR 2011). However, the +/-15 cm daily water level fluctuation constraint may help limit impacts to ground nesting waterfowl during the month of June as it will limit impacts to shoreline vegetation composition and will limit flooding of nearby nests. Also, it is anticipated that there will be limited impacts to cavity nesting waterfowl as forested ecosystems are not predicted to be impacted by flow alteration, which is confined to the river channel. Post-construction monitoring of riparian and wetland vegetation will be conducted to determine whether there are impacts on Waterfowl Nesting Areas.

Marsh Bird Breeding Habitat

Marsh Bird Breeding Habitat has been identified as Candidate SWH within the downstream extent of the proposed Wabageshik Rapids GS. These habitats are located at the mouths of the tributaries and consist of Mineral Shallow Marsh (G148N). Breeding of marsh bird species takes place during the spring months (May and June). Changes to water level as a result of the proposed GS may affect the distribution of emergent vegetation. Abnormal water level fluctuations can stress aquatic vegetation communities and may favour the invasion of non-native species (OMNR 2011). This may result in the abandonment of nest sites when vegetation composition changes and cover becomes too dense or too sparse. Additionally, water level changes can result in flooding, or exposure of nests to predators. However, it is anticipated that the +/- 15cm daily water level fluctuation constraint will reduce the potential for flooding or exposure of nests, as well as wetland vegetation. Also, larger wetland systems available within the project vicinity, including upstream on tributaries A and B, are likely to provide more suitable habitat for waterfowl nesting. Post-construction monitoring of vegetation within the wetland communities will be conducted to determine the full extent of impacts to this SWH.

Turtle Overwintering Areas

As mentioned in section 4.2.4, overwintering habitat for turtles is present within the bay in the Vermillion River below Wabageshik Rapids, and the marsh communities within the ecological zone of influence downstream of the Wabageshik Rapids GS. One turtle species, common snapping turtle, was observed during field investigations basking on the shore several meters from Tributary C. Additionally, Blanding's turtles are known from the vicinity of the study area and a precautionary principle has been taken to assess impacts on overwintering habitat that would be used by Blanding's turtles if they are present in the zone of influence. As such, the impact analysis will focus on these two species. Based on the operating plan, there is potential for impacts to wintering areas as varying water levels from natural flows during the winter months (November to March) could interrupt turtles hibernating within the tributaries and backwater areas associated with the Vermillion River downstream of the proposed Wabageshik Rapids GS.

The four tributaries and the bay each have different characteristics, and the potential for impacts at each location is described as follows. Turtles overwintering in Tributary A are unlikely to be affected by operations and associated water level fluctuations because there is a beaver dam near the outlet that isolates the habitat upstream where the most suitable overwintering habitat occurs in the tributary. Additionally, the tributary flows will provide a natural minimum flow during the winter months should the dam cease to be maintained by beaver activity, leaving a potential concern at the interface between tributary flows and river levels. For this area, the +/- 15cm daily water level fluctuation constraint will provide mitigation of impacts by limiting the extent of the tributary affected, and by limiting water level fluctuations.

The turtle overwintering habitat in Tributary B is the most susceptible to impacts from water level fluctuation associated with operations. The outlet of this tributary is located on the south side of the Vermillion River in the bay below Wabageshik Rapids. Its location and minimal channel gradient indicates that varying water levels within the Vermillion River will result in daily water level changes within the tributary. Specifically, the operating plan shows that there will be continuous modified operations with typical flows that reach $38m^3/s$ in October, $60m^3/s$ in November and $54m^3/s$ in December (Ortech 2013). The flows in November and December will result in daytime water levels that affect Tributary B (CPL 2012c, Xeneca 2012b). For the months of January through March, flows will frequently not exceed $25m^3/s$ because the maximum flow is restricted to $25m^3/s$ for any intermittent operations that may occur during that period. In addition, when the inflows in January through March exceed the minimum turbine capacity of $19.2m^3/s$, they are typically only 22 or $23m^3/s$, resulting in outflows of 26 to $28m^3/s$ (Ortech 2013). When flows are in the range of 25 to 28 m^3/s, the water surface elevation will be very close to 198.5masl. The tributary elevations map prepared by Xeneca (2012b) shows that such water levels will not influence Tributary B. When water levels are influencing Tributary B, typically in November and December, the extent of changes to water levels in the tributary will not reach the first wetland upstream (Xeneca 2012b). However, flows in the range of 50 to 64m^3/s could inundate part of the tributary early in the daytime, and then recede again later in the daytime. A turtle could position itself in an area with an acceptable depth of water above while water levels are backwatered into the tributary, and then have the water above it recede. It would then be forced to relocate, which would place an energy demand on the turtle. This is most likely to occur in the part of Tributary B nearest the river, especially along the margins of this section of the tributary where the tributary baseflow does not keep the substrate wetted without a backwater influence from the river. The extent of this effect will be mitigated by the compliance commitment to keep water levels within +/- 15cm from daily average water level. Effects on Tributary B would occur most frequently in November and December, and hibernating Blanding's turtles would have the opportunity to relocate should they be affected.

Tributaries C and D have firm clay substrates, limiting the suitability of the overwintering habitat for some turtles species including common snapping turtle. In addition, these tributaries are situated further downstream of the proposed dam and have higher gradients than Tributary B. Based on the tributary elevations map provided by Xeneca (2012b), only a small portion of Tributary C would be impacted by varying water levels. The extent of inundation of Tributary D could not be mapped on the Wabageshik Tributary Elevations map, but topographic mapping shows that Tributary D has a similarly steep gradient. For both tributaries, the habitat is limited and small in area, and impacts are not expected to occur.

The backwater area in the bay below Wabageshik Rapids also provides suitable turtle overwintering habitat. While much of this bay is deep and not susceptible to impacts from water levels, the habitat in the shallower water at the margins of the bay will be subject to meaningful water level fluctuation as a result of operations. As with parts of Tributary B, a turtle could position itself along the margins of the bay, and then have the water above it recede, forcing it to relocate. For the bay, this could occur at any time during the overwintering period, including times when intermittent operation is used. This potential effect will be mitigated by the compliance commitment to constrain water level fluctuations in the bay to +/- 15cm from daily average water levels, the limited flow

(Q_{TL}) of 25m^3/s during intermittent operations, and by the minimum flows (Q_{EA}) of 6.5 for November, February and March, and 8.0 m^3/s for December and January.

Based on the review of the potential turtle overwintering habitats downstream, a small potential for residual impacts to turtle overwintering habitat exists in the margins of the bay below Wabageshik Rapids and the lower reach of the Tributary B. Some mitigation is currently in place in the operating plan (Ortech 2013) as described above. In particular, the compliance commitment in this location to maintaining water levels within +/- 15cm of the daily average water level will ensure that fluctuations in water levels do not create the drops in levels that can be fatal to Blanding's turtles or common snapping turtles. Opportunity for behavioural adaptation exists should a turtle have waters recede. Blanding's turtles have been reported moving up to approximately 15m to locate more suitable wintering sites (Newton & Herman 2009), and therefore are behaviourally adapted to dealing with some variation in water levels.

Finally, as the Blanding's turtle is considered Threatened under the ESA, surveys to determine species presence and habitat use are recommended and will most likely be required as part of the application process for authorizations and/or operating agreements under the ESA. If Blanding's turtles are confirmed to occur within the downstream ecological zone of influence, monitoring can be conducted to ensure no impacts will occur.

Turtle Nesting Areas

In addition to the potential for impacts to turtle overwintering habitat, there is potential to impact nesting habitat for common snapping turtle. Blanding's turtles are not likely subject to impact because they nest in habitat types located much farther (400m to 2.5km) from the nearest water source (COSEWIC 2005). However, common snapping turtle nesting habitat includes sand and gravel beaches adjacent to undisturbed shallow weedy areas of marshes, lakes, and rivers (OMNR 2000b). This habitat exists in the bay below Wabageshik Rapids, including rocky mid-channel shoals within the bay. It is possible that common snapping turtle would nest very close to the water, and have the nest flooded with water when levels increase as a result of operations. Mitigation includes the operating plan's compliance commitment to limiting daily water level fluctuation to +/-15cm in the bay below Wabageshik Rapids, including during summer months. With the existing mitigation, there may be some residual negative effect on common snapping turtle nesting habitat, although it will be low in spatial extent and is not expected to limit the local snapping turtle population. Therefore, the impact is considered to be minimal and not significant.

6.5.2 Aquatic Impacts – Downstream Operational

Wabageshik Rapids

A 400m section of fast-water habitat is located immediately downstream of the proposed location of the Wabageshik Rapids GS. The variation in flows proposed to occur with operations creates potential for a variety of impacts on this aquatic habitat and the biota that use it. Spawning by a number of fish species is occurring based on habitat characteristics, fish community information, and spawning surveys. The species include walleye; sucker species potentially including white sucker, silver redhorse (*Moxostoma erythrurum*) and shorthead redhorse (*Moxostoma macrolepidotum*)); and possibly lake sturgeon. In addition to varation in flows and as discussed in Section 6.2.2, some of this habitat will be impacted by excavation of the tailrace and Xeneca has committed to replacing the cobble substrate on the channel bottom following excavation of the tailrace (CPL 2013). The mitigiation outlined below therefore applies to both the newly placed habitat in the tailrace area as well as the natural substrates and habitat remaining outside of the tailrace excavation.

The operating plan (Ortech 2013) proposes to mitigate potential impacts on spawning by substantially restricting operations during the walleye and lake sturgeon spawning period. Mitigation focuses on these species because they are considered the most significant and sensitive fish species that use this habitat for spawning. Sucker species will also benefit from the restricted operations. The restricted operations will be triggered by water temperatures that represent the beginning and end of spawning, followed by time periods to discern the egg incubation and larval development periods. The operation parameters to avoid effects on the spawning, egg incubation and larval development and drift periods are outlined in Appendix 2 of the operating plan (Ortech 2013).

Walleye staging and spawning was determined to begin at 4°C, with active spawning beginning at 6°C. Run-of-the-river (ROTR) operations will begin at 4°C such that flows received from upstream are passed through the dam to the river downstream on a continuous basis, with no modification of flows. This is generally considered the best approach to mitigating the potential for impact on fish spawning in fast-water habitats. Walleye spawning continues through to 12°C when spawning is considered to be finished. Folllowing this, the ROTR operations will continue through 18 days of egg incubation and 15 days of early life stage development. After that time period, the walleye fry are free living, have moved out of the fast-water habitats, and are not as susceptible to changes in flows. For the purpose of walleye, the ROTR operations can cease.

A similar approach is taken with lake sturgeon as shown in Appendix 2 of the operating plan (Ortech 2013). ROTR flows will be provided from the beginning of the active spawning period, defined as 8°C, through to the end of active spawning, which is considered to be 16°C. Egg incubation, yolk sac absorption and continued larval development is considered to endure for a total of 25 days, during which ROTR operations will continue. Larval drift is an important stage during which lake sturgeon larvae disperse using the river flows. During this period, modified flows will occur, with special restrictions specific to the larval drift period. A maximum daily range in flows of 20 cms will be in place, and no intermittent operations will occur. As a result, the operations must be continuous such that the minimum turbine flow becomes the minimum flow in the river downstream, with the 20 cms range restriction acting as a further restriction on variation in flows that can occur during the continuous operation.

These operation parameters will avoid impact to walleye and lake sturgeon spawning by ensuring that the dam does not interfere with flows that influence spawning and early life stages of these fish species. The water temperatures and time periods were developed for the operating plan on the basis of the current knowledge of these species as represented in the academic literature (NRSI 2013c). Therefore impacts of operations on walleye and lake sturgeon spawning are not expected. If any occur, they are anticipated to be minimal and not significant.

The fast-water habitat immediately downstream of the Wabageshik Rapids GS also provides general productivity and habitat for benthic invertebrates. As a result of the variation in flows from operations, there will be variation in water depths and velocities over the habitat, and some of the riffle habitat that is permanently wetted will become dry when flows are reduced. The habitat that is intermittently dry will have reduced productivity and a substantial shift in community composition. The habitat that remains permanently wet will experience a shift in the taxa that form the benthic invertebrate community, favouring taxa that are tolerant of variation in water velocity. This impact will in turn affect foraging opportunities for fish as the benthic invertebrate community is reduced in density, and a portion of the habitat will only be available part of the time.

In general, daily peaking operations below hydroelectric facilities have been found to affect benthic invertebrate communities in a number of ways. Studies of the effects of flow fluctuations have repeatedly observed reductions in taxa richness and the density of the standing crop of benthic invertebrates (Troelstrup and Hergenrader 1990, Gislason 1985, Novotny 1985, Cushman 1985, Steele and Smokorowski 2000). A study by Trotzky and Gregory (1974) attributed these effects to the extremes of water velocities that result from peaking, citing specific adaptation of benthic taxa to either slow or swift currents, with high likelihood of mortality if exposed to unsuitable water velocities. In addition, the rapid changes in velocity observed in the study also appear to be responsible for low density and species diversity (Trotzky and Gregory 1974). Accordingly, certain taxonomic groups have been shown to have specific degrees of tolerance, causing a shift in the benthic community. For example, Gislason (1985) found that the Ephemeropterans *Ephemerella inermis*, *Baetis* spp., and *Rithrogena* spp. as well as the Dipteran family Chironomidae had much higher representation of numbers during a year of non-peaking flows as compared to a year with peaking flows in the Skagit River in Washington State. This was related to their feeding mechanisms, described by Merritt, Cummins and Berg (2008) as primarily collector-gatherers and scrapers. Troelstrup and Hergenrader (1990) have also observed reductions of the scraper and collector-filterer feeding groups to be associated with daily fluctuations in discharge below impoundments. The net-spinning groups of Trichopterans (caddisflies) in particular tend to be absent from locations that experience very low flows (Trotzky and Gregory 1974), which is attributable to lack of food source being provided for capture at their fixed locations. Thus it is clear that variation in water velocity can impact the benthic invertebrate community, and this effect varies for different taxa based on their adaptation and functional behaviour.

Fluctuation in water levels can also impact the benthic invertebrate community through periodic dewatering of habitat areas. Fisher and LaVoy (1972) found that periodically exposed areas of channel substrate in a regulated river had lower benthic macroinvertebrate density and diversity as compared to permanently wetted areas, with some evidence that the benthic community may tolerate brief periods of exposure. Dewatering has also been studied in intermittent headwater streams, where the extent of drying has been found to be the primary determinant of benthic macroinvertebrate production, mediated by a loss of large-bodied taxa with long generation times (Chadwick and Huryn 2007).

Changes in benthic invertebrate drift patterns have been observed, with change in flow causing an increase in drift of some taxa, and a decrease in drift of other taxa. Scullion and Sinton (1983) observed an increase in benthic invertebrate drift coinciding with a three- to four-fold increase in flows below a reservoir, followed by a rapid decrease in drift during the sustained higher flows. This suggests that invertebrates may seek shelter in response to the increased flows. Lagarrigue et al. (2002) also observed an increase in drift in response to peak flows below a hydropeaking facility, and further observed that brown trout (*Salmo trutta*) fed on the drifting invertebrates in direct response to the catastrophic drift caused by peaking. This contrasted the nocturnal periods of drift observed at an upstream reference site, and lack of feeding response by brown trout during the nocturnal drift (Lagarrigue et al. 2002). While the inducement of drift resulting from increases in flows may initially increase the feeding activity of fish, this occurrence on a daily basis has potential to deplete the standing crop of benthic invertebrates, thus reducing the long-term food supply (Cushman 1985).

The availability of benthic invertebrates as a food source also depends on the potential for impacts to the invertebrates in locations that are suitable feeding habitats for fish. Gislason (1985) observed reduced condition factor (health of the fish based on weight and length) of various Salmonid fishes as a result of daily peaking. This was attributed to impacts on invertebrates that were focused on the habitat along the river margins where the Salmonid fishes found suitable velocities in which to feed. The potential for effects on the food web connection between benthic invertebrates and fishes were confirmed in a stable isotope study of a peaking hydro facility on the Magpie River in Ontario, where peaking operations with unrestricted ramping rates resulted in a reduction in food web length between macroinvertebrates and fish by at least one trophic level (Marty et al. 2009). The shortening of a food web connection is a clear example of the potential for flow fluctuations from peaking operations to affect the aquatic ecosystem in the affected reach of the river.

These potential effects of flow variation can be mitigated but not eliminated at the proposed Wabageshik Rapids GS. Proposed mitigation measures, described in the operating plan (Ortech 2013), include minimum flow requirements (Q_{EA}) of 5.0, 6.5 or 8.0m^3/s (varies with time of year) which will ensure a permanently wetted area of invertebrate habitat, and a limited turbine operation (Q_{TL}) of 25m^3/s. , which will place a limit on the daily fluctuation in water velocities and depths within the portion of the habitat that remains fully wetted. The 25m^3/s limit on turbine operation results in a maximum ratio of 5:1 during intermittent operation when the Q_{EA} is 5.0m^3/s. The operating plan also makes the commitment to limit intermittent operations to time periods when incoming flows are less than the minimum generation requirements, which is 19.2m^3/s plus a minimum compensatory flow in the spillway area (Q_{Comp}), which ranges from 0.5 to 2.0m^3/s depending on the season. This ensures that continuous operation will be in effect whenever possible, minimizing the time when flow is reduced below 19.2m^3/s. Variation in flow will generally be less during continuous operation, which will be less stressful to the benthic invertebrates within the habitat that remains fully wetted, relative to intermittent operation.

Operational flow fluctuation affects the downstream habitat in several ways. First, there will be frequent changes in water surface elevation and wetted perimeter, resulting in more frequent and extensive wetting and drying of the channel margins compared to existing conditions. Second, there is a particular 1,000m^2 horseshoe-shaped area of habitat on the north side of the channel approximately 100m downstream of the proposed Wabageshik Rapids GS, which will be subject to this increased frequency and extent of wetting and drying. Finally, in the area of habitat that remains permanently wetted, there will be changes in water velocities that affect the aquatic biota, particularly benthic invertebrates and fish. These effects are discussed as follows.

The more frequent and extensive wetting and drying of the channel within Wabageshik Rapids will occur during both continuous and intermittent operation. Continuous operation will occur when the rate of natural inflow exceeds 19.2m^3/s plus Q_{Comp} and is less than maximum generation capacity (Q_{Tmax}) of 64m^3/s plus Q_{Comp}, and when operational restrictions for spawning and early life stages for walleye and lake sturgeon are not in effect. This will typically occur in January, March, June, July, October, November and December (Ortech 2013). In this scenario, changes in water depths and and wetted perimeters will vary based on a maximum range in flows from 19.2 to 64m^3/s plus Q_{Comp}, which is a range of 44.8m^3/s and a high-flow to low-flow ratio of approximately 3.3:1. Model output at 3 representative surveyed cross-sections was reviewed to determine changes in water level, wetted perimeter of the channel, and water velocity (Xeneca 2012c). The water surface elevation in Wabageshik Rapids would vary by up to 0.77m, and wetted perimeter would vary by as little as 4.2m (4.5% change) to as much as 36.32m (49.7% change), depending on the location in the channel. However, the variation in these parameters will typically be much less. In January and March, flows will typically vary between 20 and 26m^3/s (Ortech 2013), resulting in changes in water depths of no more than 0.2m, changes in wetted perimeter of up to no more than 12m in the worst-case location (Xeneca 2012c). In November, flows will vary between 32 and 60m^3/s, with changes in depth, wetted perimeter and velocity falling in between the previous scenarios.

Intermittent operation at the Wabageshik Rapids GS will occur when the rate of natural inflow is less than 19.2m^3/s plus Q_{Comp} and the operational restrictions for spawning and early life stages for walleye and lake sturgeon are not in effect. These conditions typically occur in February, August and September. While the proposed facility is in intermittent operation, flow rates will vary between the minimum flow (Q_{EA}) at night (5-8 m^3/s plus Q_{Comp} depending on the month) and limited turbine flow (Q_{TL}) during the day (25m^3/s as per operating plan restriction (Ortech 2013). This is a range of up to 20m^3/s and a high-flow to low-flow ratio of up to 5:1. Model output information allows comparison of 5m^3/s flows to 30m^3/s flows, representing a conservative assessment since flows will only reach 25m^3/s during intermittent operation. The water surface elevation in Wabageshik Rapids would vary by up to approximately 0.7m, and wetted perimeter would vary from as little as 3.63m (4% change) at one cross section to as much as 33.04m (67% change) at another cross section. While this is slightly overstated due to the nature of the model output, it is clear that some parts of Wabageshik Rapids will see little change in wetted perimeter while other parts will more substantial changes in wetted perimeter.

The daily variation in flow that occurs at these times will result in wetting and drying of channel substrate in a horseshoe-shaped area of habitat located at the north side of the channel approximately 100 meters downstream of the spillway. The area affected by drying has been calculated by comparing the area wetted under existing conditions during the average August flow rate of 15.5 m^3/s and the proposed minimum flow in August of 5 m3/s. The affected area is 1,000 m^2 in size (Xeneca 2012d). A loss of benthic production will result in this area during intermittent operation, and there is potential for fish stranding.

Fish habitat compensation will account for the 1,000m^2 horseshoe-shaped area of habitat that becomes more frequently dewatered due to intermittent operations. The plan commits to using 2-dimensional modeling to optimize the habitat within Wabageshik Rapids downstream of the dam. This exercise will discern the best design option for modifying the habitat, which may or may not include alteration of the mid-channel area of habitat in question. For example, lowering the habitat would facilitate a greater area of permanently wetted habitat during intermittent operations. However, this would not be the best option if the action negatively impacts function as walleye spawning habitat. Refer to the preliminary fish habitat compensation plan (NRSI 2013a) in Annex III of the main ER (Xeneca 2013a).

Regardless of the measures undertaken for fish habitat compensation, the daily variation in flows from the proposed operations will result in some residual impact due to daily dewatering of habitat. The operational mitigation measures, in particular the minimum flows and the 25m^3/s turbine limit during intermittent operations, are effective in limiting these impacts. The biological monitoring program (NRSI 2013b), which includes monitoring of benthic invertebrates and fish, will provide a means of evaluating the extent of the residual impacts.

The changes in water velocity will also affect the habitat for aquatic biota within the areas of habitat that remain permanently wetted. During continuous operation, water velocity could vary up to two-fold at the cross section closest to the dam, and will in fact be reduced with increased flow at the cross section with the most extensive change in wetted perimeter, reflecting back-eddy conditions. In reality, changes in velocity during continuous operation will typically be less than 0.1m/s during continuous operation based on typical inflows (Xeneca 2012c). During intermittent operations, water velocity will change threefold nearest the dam, and once again there is a reverse relationship to flow where the channel becomes substantially dewatered at low flow. The changes in flows will result in a shift in the benthic invertebrate community, and potentially changes in the density. While these changes will be meaningful, the overall impact from the changes in velocity is expected to be less than the changes in the areas that are dewatered more frequently than under existing conditions. The operational mitigation measures, in particular the minimum flows and the $25m^3/s$ turbine limit during intermittent operations, are effective in limiting these impacts. Monitoring of the benthic invertebrates through the biological monitoring program will provide details on the nature and extent of the change in the benthic invertebrate community resulting from variation in flows (NRSI 2013b).

In addition to the fast-water characteristics downstream of the proposed Wabageshik Rapids GS, the OMNR (2012b) indicated that the large pool located immediately below the proposed spillway provides a staging area for spawning walleye, redhorse suckers and potentially lake sturgeon. In addition, the pool is known to hold large numbers of northern pike during certain seasons when they are most likely feeding on young-of-the-year (YOY) suckers and other drift (OMNR 2012b). Because the dam will have a close-coupled powerhouse, this pool will not be completely bypassed by flows that are directed through the turbine. While the tailrace water will be directed past the pool, a hydraulic connection will remain to keep the pool wetted. In addition, the operating plan specifies minimum compensatory flows in the spillway area (Q_{Comp}) by hydrologic season. The Q_{Comp} flows will be $2m^3/s$ in the spring and $0.5m^3/s$ in the summer, fall and winter. These flows will ensure that there is turnover of the water within the pool to maintain good water quality. The residence time of the pool was verified and determined to be 8.5 hours (Xeneca 2013b). During periods when flows are greater than Q_{Tmax}, the excess flow will be directed over the spillway, exceeding the Q_{Comp} flows. A change in the ecology and fish habitat function can be expected to result from the decreased flows through the pool. While almost all of the water from upstream currently passes through the pool, most of the water will be directed through the powerhouse during flows less than 64m^3/s, bypassing the pool. The drifting food source will therefore not be available for foraging fish such as northern pike. Foraging on drift may shift to a location downstream of the powerhouse, although water velocities may be higher in those locations. Foraging on resident YOY suckers, cyprinids and invertebrates will likely continue in the pool, albeit with a shift in food source. Overall, the food sources will not be reduced, but the foraging activity that is presently concentrated in the pool will become more diffuse within the rapids and the bay below the rapids. This may require foraging fish such as northern pike to expend greater energy during feeding. As ambush predators, northern pike may shift more of their feeding activity to the bay below the rapids. This may have a negative effect on the northern pike population. However, feeding opportunities will still be available, and the impact is expected to be minimal and not significant.

Fish stranding is another potential impact that may occur in the fast-water habitat immediately downstream of the Wabageshik Rapids GS. The presence of a large, shallow riffle area adjacent to a deep section of the channel suggests that fish could become stranded as the water recedes. According to the surveyed cross sections at Wabageshik Rapids, there are areas of habitat that will be wetted and exposed by the modified peaking operations. In particular, the cross sections at RS 54.75 and 202.5 show that habitat in the middle of the channel will experience this effect (Xeneca 2012c). In addition, habitat at the edge of the channel will experience wetting and drying at all of the cross section locations. Based on this information, it is only possible to indicate that there is potential for fish stranding to occur. Operational monitoring will occur to determine whether or not fish stranding occurs. Should fish stranding be identified as an issue, possible mitigation measures include minor habitat adjustments at problem areas to provide a pathway for stranded fish to reach the flowing water, and adjustments to the operations such that flow is reduced at a slower rate to provide more time for fish to escape stranding areas. The latter measure is known as a restriction on the ramping rate, which is the rate of change of flow. Refer to the biological monitoring program (NRSI 2013b) included in Annex III of the main ER (Xeneca 2013a).

Graveyard Rapids

A second fastwater feature, known as Graveyard Rapids, occurs 4km downstream of the Wabageshik Rapids GS. Based on habitat characteristics, spawning for lake sturgeon, walleye, and sucker species may occur at this feature. However, the habitat at Graveyard Rapids is less suitable than the habitat at Wabageshik Rapids. In general, the water is deeper and slower-moving, particularly at the downstream end, and there is much less cobble substrate. The report by GLES (2010) indicated that only limited walleye spawning habitat potential occurs in 2 of the 5 cross sections studied within Graveyard Rapids. However, the OMNR considers this feature to have critical feeding and spawning habitat functions for a range of species when flows are low (OMNR 2012b).

Based on the greater water depths and generally simpler habitat characteristics, production and fish foraging opportunities are relatively less at Graveyard Rapids than at Wabageshik Rapids, and fish stranding is less likely to occur. The benthic invertebrate sampling results also show relatively greater variety but lower densities of invertebrates. Critical feeding and spawning opportunities exist for a range of species, although not for VEC or SAR species. The feature is farther from the dam and water level fluctuations are less than at Wabageshik Rapids. Based on all of these characteristics, the mitigation measures that are proposed for Wabageshik Rapids are assumed to be adequate for Graveyard Rapids. This will be confirmed through the biological monitoring program (NRSI 2013b).

Bay and Slow-Water Habitat Downstream of Wabageshik Rapids

Fluctuations in water levels within the downstream ecological zone of influence may also impact the ecological function of habitat provided by vegetated shorelines and seasonally flooded areas within the bay downstream of Wabageshik Rapids. These areas provide spawning habitat for northern pike in the spring following ice-out as they require submerged vegetation (aquatic or wetland/terrestrial) in which to spawn. Northern pike typically spawn in water temperatures of 4 to 11°C and eggs hatch in 12 to 14 days (Scott and Crossman, 1973). As fluctuations in water levels will be avoided through the implementation of run-of-river operations beginning each spring when water temperatures reach 4°C and continuing through the walleye and lake sturgeon spawning periods until 16°C (see text above), northern pike will not experience water level fluctuations beyond what might occur naturally during spawning and egg incubation.

During the majority of the year, the Wabageshik Rapids GS will be operating in either continuous or intermittent modes of operation (Ortech 2013). As a result, the river shorelines and the outlets of 4 tributaries downstream of the Wabageshik GS will be subject to water level fluctuations as a result of these operations. Aside from providing northern pike spawning habitat, these habitats function primarily as nursery and feeding habitat for a variety of fish species. It is anticipated that this variation in water levels will force some of the YOY and foraging fish to move out of some habitat areas daily as water levels decrease.

There is also potential for nearshore and riparian vegetation to be impacted by the water level fluctuations. Most riparian and emergent plants will not tolerate daily water level fluctuations of more than 25cm. It is anticipated that daily operations could result in the loss of emergent and shoreline vegetation. As a worst case scenario, much of the shoreline and nearshore areas could exist as bare substrate, or at a minimum the species composition will shift to some extent. For example, different emergent or wetland species may establish along the shoreline where the substrate will be exposed for part of the day and submerged for part of the day. This shift in vegetation will affect the characteristics of the habitat in the bay below Wabageshik Rapids. Monitoring will be conducted to document any changes in the vegetation and ensure that the fish habitat function is not impacted.

The minimum flow requirements (Q_{EA}) of 5.0, 6.5 or 8.0m^3/s (varies with time of year) and the Q_{TL} of 25m^3/s for intermittent operations will keep the range of flow fluctuation within boundaries, thus controlling water level fluctuation at the mouths of the tributaries and ensuring that the amount of available nursery habitat is largely retained. The compliance commitment to a +/-15cm range of water level fluctuation will further ensure that the fluctuation in water levels is controlled. Ramping rate restrictions will also be in effect, as shown in the typical monthly operating charts in Appendix I of the operating plan (Ortech 2013). With these mitigation measures in place, the water level fluctuations will be limited in extent and will not be instantaneous, allowing fish some ability to adapt behaviourally. The extent of this impact can be confirmed through the biological monitoring program, which includes fish and vegetation (NRSI 2013b).

<u>Tributaries</u>

There are 4 tributaries that outlet into the downstream ecological zone of influence. The tributary elevations mapping prepared by Xeneca (2012b) shows the upstream extent of potential influence by the Wabageshik Rapids GS operations. Tributaries A and C can be influenced up to 140m upstream of their outlets, although Tributary A has a beaver dam at its outlet that will limit the extent of influence as long as it is present. Tributary B can be influenced as much as 275m upstream of its outlet. Tributary D could not be mapped on the tributary elevations mapping as LiDAR elevation data was not available, but more basic contour mapping shows that it is similar to Tributaries A and C. Water levels from the river can be expected to influence water levels within these tributaries. While the water level fluctuation will be within the normal water level range, the operations have potential to cause level fluctuations to occur on a daily basis.

During intermittent operation, water levels are not expected to affect the tributaries. Intermittent operation will occur when minimum generation requirements of 19.2m^3/s plus Q_{Comp} are not met, and when operational restrictions for spawning and early life stages for walleye and lake sturgeon are not in effect. This will typically occur in February, July, August and September. In this scenario, flows will vary between the Q_{EA} of 5, 6.5 or 8m^3/s, depending on the month, and the Q_{TL} of 25m^3/s (Ortech 2013). This is a range of up to 20m^3/s and a high-flow to low-flow ratio of up to 5:1. When flows are below 25m^3/s, the modelled downstream water levels (CPL 2012c) and the tributary elevations map provided by Xeneca (2012b) show that water levels in the river will be at an elevation of less than 198.46m, which will not influence Tributaries A, B or C. River water levels are similar adjacent to the Tributary D outlet (CPL 2012c), and it is reasonable to expect the same outcome in spite of the lack of LiDAR-based mapping.

During continuous operation, water levels can have an effect on the full distance up the tributaries as described above. Continuous operation will occur when the minimum generation requirements of 19.2m^3/s plus Q_{Comp} are met, flows are less than maximum generation capacity (Q_{Tmax}) of 64m^3/s plus Q_{Comp}, and operational restrictions for spawning and early life stages for walleye and lake sturgeon are not in effect. This will typically occur in January, March, October, November and December (Ortech 2013). However, the variation in these parameters will typically be moderated compared to much less than the range of 19.2m^3/s to 64m^3/s (plus Q_{Comp}). This is based on the typical inflows combined with the mitigation measures. In January and March, outflows will typically vary between 20 and 26m^3/s (Ortech 2013). When flows are below 26m^3/s, the modelled downstream water levels (CPL 2012c) tributary elevations map provided by Xeneca (2012b) shows that water levels will be at an elevation of less than 198.46m, which will not influence Tributaries A, B or C. During the months of October, November and December, the operating plan shows that there will be continuous modified operations with typical flows that reach 38m^3/s in October, 60m^3/s in November and 54m^3/s in December (Ortech 2013). The October flows are unlikely to affect Tributaries A, B or C, but the flows in November and December will result in daytime water levels that affect those tributaries (CPL 2012c, Xeneca 2012b). River water levels are similar adjacent to the Tributary D outlet (CPL 2012c), and it is reasonable to expect the same outcome in spite of the lack of LiDAR-based mapping. In general, modified operations in November and December will typically impact all of the tributaries.

During November and December when continuous operations will typically affect water levels in the tributaries, the effects will be mitigated by the compliance commitment to restrict water level fluctuation to +/- 15cm from the daily average water level in the bay immediately downstream of Wabageshik Rapids. The monthly/seasonal minimum flows 5.0, 6.5 and 8.0m^3/s and the restricted ramping rates will provide further mitigation (Ortech 2013). The beaver dam at the outlet of Tributary A will substantially limit the extent of the influence of operations as long as it remains. There will nevertheless be some residual impact of the other tributaries' function as foraging habitat for fish in the fall of each year when continuous operations will occur at levels that affect the tributaries. The impact will be partly mediated by the benthic community, which may shift as there will be slower water velocities during times of high water, and in part by daily changes to the physical characteristics of the habitat that cause inconsistent habitat suitability for the fish species that may use the tributaries.

Lastly, the accessibility of the tributaries may vary as water levels in the river fluctuate. While such impact is expected to be minor, it will be verified as part of post-construction monitoring.

6.6 Fish Entrainment and Impingement

The potential for fish entrainment and impingement at the intake of a hydroelectric facility exists and is well studied with regards to hydroelectricity projects (New York Power Authority 2005). Entrainment occurs when fish enter into a facility through intake flows and continue passing through the turbines and other components. Similarly, impingement occurs when fish become pressed up against the trash racks by intake flows. The potential for entrainment and/or impingement are influenced by the intake velocity relative to the swimming ability of the species, the individual fish's stage of development (i.e. larval, juvenile or adult), as well as disease or presence of pre-existing injury.

Design information for the turbine(s) proposed for the Wabageshik Rapids GS was developed by Xeneca and is provided in Annex II of the main EA document. Two options for turbine installation are being explored for the Wabageshik Rapids GS. The first option involves the installation of a single, 4-blade, Kaplan turbine with a diameter of 2850mm and a rotational speed of 150 revolutions per minute (RPM). The second option involves the installation of two, 4-blade, Kaplan trubines with diameters of 2320mm and rotational speeds of 170 RPM each. For both installation options trash racks will have a 48mm gap and the entrance velocity will be 0.75m/s.

The following detailed assessment of the effects of entrainment and/or impingement of fish at the intake of the proposed Wabageshik Rapids GS takes into account walleye, northern pike and smallmouth bass, which are known to inhabit Wabagishik Lake upstream of the proposed facility. It provides information on the swimming capabilities of these fish species, assessments for risk of impingement on the trash racks, and estimates of mortality as a result of entrainment through the turbine.

6.6.1 Fish Swimming Capabilities

Swimming speed is often discussed in terms of the speed at which a fish can swim over prolonged periods. A report by Peake (2008) referred to this speed as the U Critical speed (Ucrit). If the length of time that the fish can sustain the Ucrit speed is known, this is cited as part of the speed value (e.g. $Ucrit_{10}$ is the U critical speed sustained over ten minutes). Where time is not specified values greater than 20 minutes are assumed (Peake 2008).

Further to Ucrit speeds, fish are also capable of burst swimming speeds which exceed their Ucrit values, often by a significant amount. For example, Peake (2004) demonstrated that velocity criteria based on Ucrit values underestimated, by at least 50%, the maximum velocity that could be negotiated by free swimming smallmouth bass. In general, the larger a fish gets the higher its Ucrit speed will be (Peake 2004). Using a Ucrit speed for a juvenile fish is a very conservative way of estimating a species' ability to avoid certain intake velocities at a GS, because Ucrit values are less than burst swimming capabilities and juvenile fish have lower swimming speeds. Conversely, using burst speed values for adult fish represents a much less conservative means of estimating avoidance ability for a species.

Walleye

The development of a regression equation used to accurately predict the Ucrit swimming capabilities of walleye was established by Scrunton et al. (1998), and was based on laboratory swim trials. Results of this study found that sustained Ucrit values of 0.5m/sec were observed in juvenile walleye with a fork length of 0.15m. Prior to this, Jones (1974) had determined a similar sustained swimming speed of 0.4m/sec for walleye. Scrunton et al (1998) also predicted that a juvenile walleye is capable of burst swimming speeds of 1.6m/sec and Peake et al (2000) note burst swimming speeds of 1.6m/sec to 2.6m/sec in adult walleye for short periods of time (15-20 seconds).

Northern Pike

The study completed by Peake (2008) calculated the Ucrit value for juvenile northern pike (< 35cm fork length) to be 0.15m/sec to 0.35m/sec. No burst speed capabilities were noted, but by taking the Ucrit values for juvenile northern pike (0.15 to 0.35m/sec) and applying the factor cited by Peake (2004), it is estimated that juvenile northern pike may be capable of burst speeds of between 0.2m/sec and 0.5m/sec. For larger northern pike, the Ucrit upper limit recommendation ranges from 0.38m/sec to 2.8m/sec. A second study by Harper and Blake (1990) also measured burst swimming speeds of between 1.1m/sec and 2.2m/sec for adult northern pike.

Smallmouth Bass

Smallmouth bass swimming capabilities were evaluated by Peake (2004). The objective of the study was to evaluate the validity of the assumption that fish will choose to move at a swimming speed equivalent to Ucrit during passage of a feature. The Ucrit swimming speeds ranged from 0.65 to 0.98m/sec and were positively correlated to fish length (24–44 cm). In another study Bunt, et al. (1999) examined the attraction and passage efficiency of smallmouth bass at two denil fishways. The Ucrit for smallmouth bass was determined to be between 0.5 and 1.18 m/sec. Further to these values a study by Cooke and Bunt (2001) reported that the mean Ucrit of smallmouth bass was 1.11 m/sec. In a study by Peake and Farrell (2004), maximum burst swimming speed of smallmouth bass was measured by rapidly increasing the water velocity in a swim chamber and measuring the resulting instantaneous (burst) swimming speed. The magnitude of water velocity was increased until a maximum burst swimming speed of 1.23 m/sec was recorded.

6.6.2 Impingement on the Trash Racks

The installation of trash racks will act as both a visual and physical deterrent for fish becoming entrained. However, if entrance velocities are higher than burst swimming capabilities and fish are too large to pass between the trash racks, they can become impinged. Designing the intake structure for low velocities avoids/mitigates the risk of entrainment and impingement.

Impingement is almost entirely a result of flow velocity in the area of the trash racks. Where velocities are kept low, fish benefit by being able to swim away from the intake flows, thereby avoiding impingement. Intake velocities should be lower than burst swimming capabilities of walleye, northern pike and smallmouth bass in order to avoid impingement of these species.

Based on specifications provided by Xeneca (March 2013), trash racks will be installed at each turbine entrance with a spacing of 48mm and entrance velocities are proposed to be 0.75m/s. This entrance velocity is lower than the burst swimming capabilities of VEC species such as adult northern pike, walleye and smallmouth bass which will help mitigating impingement of these species on the trash racks. Should impingement prove to be a threat to these species, there are numerous other modifications that can be made at the intake such as lighting, electrical barriers, air bubbling and sound barriers (Hogan 2008). Juveniles and small bodied fish will most likely continue to pass through the trash racks where the risk of turbine entrainment and mortality exists.

6.6.3 Entrainment Through the Turbines

The following discussions related to turbine mortality of entrained fish are primarily focused on those individuals that do not have the ability to escape (i.e. larval fish) or fish that are in a weakened state (i.e. wounded or diseased fish). In these cases, some small fish (larval fish and some juveniles) as well as adults (diseased or in weakened state) will enter the intake channel and become entrained, passing through the turbines and into the tailrace channel.

The anticipated intake velocities are used in conjunction with the information on fish swimming ability to determine the potential for fish entrainment through the turbines. Further to that analysis, the details of the turbine design, including turbine type, diameter, number of blades, operation speed (RPM) and hydraulic capacity (m^3/s) are used to estimate turbine mortality.

<u>Background</u>

Turbine injury and/or mortality of fish is a well-studied topic (Cada and Odeh 2001), the mechanisms of which have been extensively explored in the literature. One study noted that fish survival through turbines is generally more dependent on the size of the fish being entrained rather than specific species, with higher survival being documented in small fishes (New York Power Authority 2005). Furthermore, a study conducted by Amaral (2001), noted that the mechanisms by which fish are injured or killed through turbine passage can be grouped into four categories. Those being:

1. Pressure (rapid changes in pressure from intake to tailrace)
    a. Sudden pressure changes can cause physiological changes in fish (i.e. swim bladders may expand or rupture).

2. Shear and turbulence (high-velocity turbulent flow)
    a. Rapid changes in the velocity of flow within the turbine components (i.e. acceleration and deceleration) can occur resulting in shear stress to fish.

3. Cavitation
    a. Rapid changes in turbulence and cavitation as a result of gas bubble formation and collapse may result in injury to entrained fish as well as disorientation.

4. Mechanical
    a. Direct contact or strike with turbine blades or turbine components. This may also include contact with other objects being passed through the turbines at the same time.
    b. Abrasion or grinding of fish may also occur as fish are drawn into tight spacing with little clearance for passage.
    c. The effects of direct and indirect stress may result in the fish being passed through the tailrace of the facility in a weakened or disoriented state leaving them more vulnerable to disease and predation.

Assessment

With regards to pressure stress at low head hydroelectric facilities, a publication by Franke et al. (1997), observed that probable pressure-related injuries to fish are unlikely to occur at facilities with less than 18m of hydraulic head. Therefore it is not likely for pressure related injury or mortality of fish to occur at the proposed Wabageshik Rapids GS, which has a proposed head of 6m. Further to this, in regards to shear and turbulence stress, some applicable studies investigating injuries related to high-velocity jets have observed little or no injury/mortality in fish at velocities up to 18m/sec (Franke et al. 1997).

High velocity gradients have been minimized within the turbines at the Wabageshik Rapids GS (entrance velocities of 0.75m/s), therefore, injuries and mortality of fish related to shear and turbulence will likely be minimal. Impacts related to cavitation are also anticipated to be minimal because of the selection of Kaplan turbines which can operate at a high rate of generation efficiency under a wide variety of flows. As cavitation is minimized through operations running at peak efficiency, concerns regarding fish injury and mortality related to cavitation will be minimized through turbine design.

Franke et al. (1997) noted that the primary cause of fish injury and mortality during turbine passage at low head facilities is the mechanical impacts related to direct strike, abrasion, grinding and disorientation. In developing the basis for "fish friendly" design criteria, Frank et al. (1997) conducted extensive evaluations of turbine survival studies and concluded that up to 40% of the variability in turbine passage survival can be attributed to mechanical attributes of the turbines such as wicket gate openings, blade speeds and comparative fish lengths. Other publications by Headrick (1998) and Winchell et al. (2000) found that in axial flow turbines, specifications such as the number of blades, runner rotational speed and comparative fish lengths were negatively correlated to fish survival.

Further case study research related to field and laboratory studies conducted by Cada et al. (1997) listed the following criteria for minimizing the risks associated with strike related injury and fish mortality.

- Minimize the number of blades or amount of blade leading edge;
- Maximize the open space between blades and other structures;
- Use blunt leading edges instead of sharp ones;
- Minimize runner speed;
- Direct fish toward the runner hub and not the runner periphery;
- Minimize gaps between fixed and moving parts.

The influence of the proposed Wabageshik turbine designs on the survival of entrained fish has been determined following the predictive model developed by Headrick (1998) for axial flow (Kaplan) turbines.

$$\%S = 109.2 - 0.027(l) - 1.038(b) - 0.045(r)$$

where S is the estimate of turbine survival, l is fish length, b is the number of turbine blades, and r is the runner rotational speed in RPM.

This model equation was used to estimate survival rates for fish of five lengths (100 to 500mm) passing through the turbine(s) of the Wabageshik Rapids GS.

Under the circumstance where one turbine is installed at the Wabageshik Rapids GS the turbine will consists of four blades (b) with a rotational speed of 150 RPM (r). The estimated turbine survival for a 100mm fish is 95.6%, for a 200mm fish is 92.9%, for a

300mm fish is 90.2%, for a 400mm fish is 87.5% and for a 500mm fish is 84.8%. It is evident that as the size of the fish increases the percentage of survival decreases, however, it is less likely for larger fish to pass through the trash racks which minimizes the chance of turbine mortality.

Under the circumstance where two turbines are installed at the Wabageshik Rapids GS the turbines will consist of four blades (b) with a rotational speed of 170 RPM (r) each. The estimated turbine survival for a 100mm fish is 94.7%, for a 200mm fish is 92.0%, for a 300mm fish is 89.3%, for a 400mm fish is 86.6% and for a 500mm fish is 83.9%, at each turbine. Again, there is a visible trend of decreasing survival success as fish size increases. There is also a slightly lower chance of survival compared to having one turbine as the proposed rotational speed and chance of encountering a turbine are both higher with two turbines.

In conclusion, smaller and juvenile fish are more likely to be entrained through the turbine because trash rack spacing is relatively small (48mm) and their burst swimming capabilities are much lower than those of adult fish. However, their chances of survival through the turbine are relatively high. Although larger fish have a lower chance of survival compared to smaller and juvenile fish, they are likely able to escape entrainment as entrance velocities are lower than or within their range of burst swimming capabilities. At this time, entrainment does not pose a significant threat to fish as the percentages of survival for all five lengths are greater than 83%. Monitoring of fish mortality through entrainment and impingement will be conducted after dam construction in order to ensure mitigation measures are effective.

6.7 Fish Passage

The Wabageshik Rapids GS will not include any provision for upstream fish passage. This carries some risk for fisheries management, which must be evaluated by MNR and DFO. Therefore, fish passage matters will be finalized during the permit process with the OMNR and DFO. These agencies will consider the plan to not provide fish passage in conjunction with the proposed fish habitat compensation plan to ensure that the risk is acceptable and fisheries management objectives can be met without providing fish passage.

Notwithstanding the requisite agency role, this report must assess the impacts on fish passage as part of the EA documentation. The following review of fish passage and assessment of impacts provides some analysis of water velocities, and describes how fish habitat and fisheries resources can be managed without providing fish passage at the facility. While not providing fish passage may affect some fish that currently ascend Wabageshik Rapids under certain conditions, there are tools available to manage the fisheries resources without providing fish passage at the Wabageshik Rapids GS.

To develop a better understanding of the existing conditions for fish passage, water velocities were modelled in order to gain some understanding of the potential for upstream fish passage of walleye and lake sturgeon under existing conditions. The fish passage velocity memo prepared by CPL (2012d) provides results of an analysis of water velocities in Wabageshik Rapids in the spring when walleye generally move upstream to find spawning habitat. A water temperature of 4°C was assumed to represent the temperature at which walleye begin migrating for spawning. Temperature and flow data from the spring of 2011 was analyzed to determine a typical date when 4°C is reached. Historic flow data for that date was used to determine flows representing the 5th percentile, the median, and the 95th percentile. Three cross sections were selected for analysis, representing locations where velocities were expected to be greatest. This resulted in a total of 9 cross-section figures representing 9 scenarios, shown in the memo prepared by CPL (2012d). Each cross-section figure shows the cross section divided into panels that are colour coded to represent different velocities, which are defined in a legend. This analysis serves as a useful tool to gain an understanding of the potential for upstream fish passage of both walleye and lake sturgeon in the spring season under existing conditions.

Walleye swimming speeds were determined to be sufficient to permit walleye to pass upstream through Wabageshik Rapids during both the 5th percentile and median flow conditions. Their swimming speeds were discussed previously in Section 6.6.1 regarding entrainment and impingement. For upstream fish passage of walleye, swimming capabilities of adults, in particular their burst speeds, are of most interest. As noted above, Peake et al (2000) reported burst swimming speeds of 1.6m/sec to 2.6m/sec in adult walleye for short periods of time (15-20 seconds). The velocities in 8 of the 9 scenarios are well below this range of burst swimming speed for walleye. At the upstream cross section during the 95^{th} percentile flow scenario, velocities are at least 2m/sec across the entire cross section. This may not preclude the possibility that walleye pass upstream through this point, but it would be unlikely to occur in this particular scenario. Overall, the results of the velocity analysis show that walleye could potentially pass upstream through Wabageshik Rapids during their spawning period, although it would be less likely for them to reach Wabagishik Lake during years with particularly high flows.

Lake sturgeon swimming speeds are known to be very size dependent, with larger fish achieving faster swimming speeds. Larger, sexually mature lake sturgeon are of most interest for discerning the potential for fish passage, because they swim upstream to spawn and their better swimming ability makes them more likely to pass upstream through Wabageshik Rapids as compared to smaller individuals. Sexually mature lake sturgeon are generally greater than 1m in length. Peak et al (1997) developed a model that related lake sturgeon swimming velocities to fish length, water temperature, and duration of swimming. They found that a 130cm-long lake sturgeon can swim indefinitely in water velocities of 0.97m/s, and for shorter periods of up to 1.8m/s. The authors also developed a formula to determine the maximum velocity at which a lake sturgeon can pass a fishway based on swimming speed for a given size fish, length of the fishway, and the endurance of the swimming based on their model. For a 120cm-long lake sturgeon, a 4m-long fishway is passable at water velocities of up to 1.55m/s, a 10m-long fishway is passable at up to 1.42m/s, and a 100m-long fishway is passable at up to 1.1m/s.

The Fish Passage Velocity Memo prepared by CPL (2012d), while not specifically prepared for the timing of potential lake sturgeon passage, can be used to approximate flows that lake sturgeon will encounter when attempting to ascend Wabageshik Rapids in the spring season. Lake sturgeon may be compelled to swim upstream after the spring freshet when flows are lower than what is represented in the Velocity Memo, which uses flows selected based on a temperature of 4°C as recorded in the spring of 2011.

Based on the above information on lake sturgeon swimming speeds as compared to the fish passage velocity memo, it is unlikely that lake sturgeon can ascend Wabageshik Rapids during the elevated flows of a typical spring. However, it remains a possibility that lake sturgeon may pass upstream when flows have receded sufficiently or during a spring with atypically low flows. As is the case for walleye, the most difficult location for upstream passage is the uppermost cross section, at 0+801. For the 5th percentile flow rate, there is some limited area at the margins where velocities are indicated to be in the range of 0.5m/s to 1.0m/s. The remainder of the cross section has velocities of 1.5m/s or greater. For the median flow rate, the water surface elevation is higher and the wetted width is greater. Different channel margins exist and water velocities are 1m/s, while the remainder of the cross section has velocities of 2m/s or greater. For the 95th percentile flow rate, water velocities are 2m/s or greater throughout the cross section. Comparing these velocities to the swimming ability of lake sturgeon as described above, it is clear that they cannot pass this point during the 95th percentile flow rate. Upstream passage would be difficult at the median flow scenario, but it would be possible at the channel margins should a lake sturgeon choose to swim there. Therefore, it can be concluded that it is technically feasible for lake sturgeon to pass upstream through Wabageshik Rapids during the 5th percentile and median flow scenarios.

While it is technically feasible for lake sturgeon to pass upstream through Wabageshik Rapids on the basis of analysis of 3 cross sections, the overall length of Wabageshik Rapids and the behaviour of lake sturgeon are factors that have not been considered in the analysis. The fact that indefinite swimming for a 130cm-long lake sturgeon is limited to velocities of 0.97m/s (Peak et al. 1997) suggests that the upstream progress of lake sturgeon through the three locations with fastest velocities would need to be interspersed with some rest time. In addition, lake sturgeon would need to be willing to utilize the margins of the channel for upstream passage. Lake sturgeon do utilize relatively shallow habitats during the spawning period (AECOM 2009, Bruch and Binkowski 2002), so their use of the channel margins is possible. Overall, the question remains as to whether lake sturgeon will pass upstream on an overall effort and behavioural basis. To date the best indication of this lies in the fact that lake sturgeon are not known to occur in Wabagishik Lake (OMNR 2011b).

The installation of a dam that lacks provision for fish passage still allows for tools to successfully manage fisheries resources. Specifically, lake sturgeon, walleye, northern pike and smallmouth bass can be managed through the installation of spawning habitat downstream in the Vermillion River. For both Wabagishik Lake upstream and the Vermillion River downstream of Wabageshik Rapids, the fisheries management objectives include the maintenance of a diverse fish community, the maintenance or increase in the productive capacity of walleye and northern pike, and the maintenance of diverse and sustainable angling opportunities for all species currently angled including walleye, northern pike and smallmouth bass.

Management objectives for lake sturgeon exist only for the Vermillion River downstream of Wabageshik Rapids, because lake sturgeon are not known to occur in Wabagishik Lake (OMNR 2011b). The objectives are to maintain or improve lake sturgeon spawning potential including optimal incubation success, to maintain or improve other lake sturgeon habitat parameters including foraging habitats and nursery areas, and to maintain connectivity to all suitable habitats and/or compensate for habitats functionally lost to the population of concern.

Upstream passage of walleye and lake sturgeon is not essential because the required habitats for these species are available and can be enhanced where the species are known to occur. An impact of particular relevance will be the loss of access for lake sturgeon and walleye to the upper portion of Wabageshik Rapids for spawning. This habitat is also being inundated, and the compensation habitat to occur in the downstream Vermillion River will provide compensation for the loss of spawning habitat. Fish habitat compensation downstream of the proposed Wabageshik Rapids GS is the primary tool for managing the introduction of a barrier to fish passage. Refer to Section 6.3.2 and the preliminary fish habitat compensation plan (NRSI 2013a) in Annex III of the main ER document (Xeneca 2013a) for additional discussion of the proposed fish habitat compensation.

Northern pike and smallmouth bass populations are not expected to be affected by the introduction of a barrier to fish passage.

6.8 General Construction Related Impacts and Associated Best Management Practices

The following section has been prepared to identify potential construction-related impacts and associated mitigation strategies to offset these effects. Additional details regarding construction activities and associated mitigation measures are provided in the construction management plan prepared by CPL (2013).

6.8.1 Construction Details

The following provides a summary of construction details as indicated in the construction management plan (CPL 2013).

Two laydown areas, each 1000m^2, have been proposed for the south side of the river to service the primary worksites of the intake/powerhouse and the spillway. The one closer to the powerhouse will be levelled and used for construction materials, equipment storage, offices, parking, etc. The other may be required for stockpiling topsoil, excavated soil material that is unsuitable for construction use and extra blast rock material if it cannot all be incorporated into the construction. A construction camp should not be required based on the proximity of the site to Espanola. Similarly, a concrete batch plant will not be required as there are ready-mix concrete suppliers in Espanola.

In addition to the permanent access road to the site (discussed separately in a report by Northern Bioscience), a temporary vehicle access road approximately 200m in length, including a temporary bridge over the Vermillion River, will be required to provide access to the north bank for spillway construction. This bridge will be located upstream of the proposed GS dam site where the channel is relatively narrow with bedrock outcrops on each side. Further details of the construction of this bridge and temporary road will be developed as part of detailed design, including specific protection and mitigation measures.

Due to the nature of the proposed works, blasting of local bedrock can be expected in isolated locations such as with the creation of the spillway and tailrace. Blasting will result in the removal of bedrock to allow for required depth and grading necessary for the GS construction. Specifics on blasting activities were not known at the time of the completion of this report.

Earthfill and concrete will be required for construction of the dam, with amounts of each being uncertain at this stage of design. Earthfill will be sourced primarily from the abutment areas of the spillway at each shoreline, rock blasting excavations for structure foundations, and possibly from excess material from access road construction. Additional aggregate will be brought in from existing nearby licenced pits as required.

To allow for in-water work in the Vermilion River to occur in the dry, cofferdams will be temporarily installed to isolate work areas within the river. Water within the isolated work areas of the river will then require removal. It is not known at this time if groundwater pumping is required for localized draw down of the water table to allow work to occur in the dry (i.e. excavations). In general, specific details on dewatering are not known at this time and would be determined during the detail design phase of the project.
Type A cofferdams are proposed to isolate the powerhouse side of the river, followed by the spillway side to the north. They consist of cargo bags filled with clean, local granular material transported to the site by truck. They are installed by excavator and/or crane. The current area estimate of the two cofferdams is 350m^2, although uncertainty exists at this design stage as the depth to a stable substrate and the required height has not been confirmed. The water elevation will be based on a 1:20 year flood level. The final area required for the cofferdams may need to increase by up to 1.5 to 2 times, which is up to 700m^2.

6.8.2 General Effects

Temporary disturbance caused by construction may affect the use of the area as a crossing point for deer during the construction period. They may be deterred from using this area as a result of noise and activity, which may force them to cross the Vermilion River at another less desirable location. If this occurs during the spring when deer are weaker from depleted energy reserves, it could make crossing the river at a wider point more risky. Deer may choose to risk a longer crossing which would require more of the little energy they have, or they may choose to remain on one side of the river for a longer period of time, until food is more abundant and energy reserves are restored. If a sufficient number of deer remain on one side of the river, this may concentrate them and put them at a greater risk of predation. However, as discussed in section 6.5.1 an analysis of deer swimming capabilities show that deer are competent at swimming at high velocities during the spring months. In addition, deer are known to cross larger bodies of water including lakes to escape predation. As such, deer may cross the river at other locations during construction of the proposed GS. Impacts to deer crossing, although present, are predicted to be minimal and temporary.

While the deer are most sensitive to impact during the spring dispersal period, construction activities are expected to be minor at this time of year. In-water work will not be conducted at this time, given the upcoming or ongoing spring freshet flows. The land-based construction activity that may be occurring will generally be on a smaller scale, and will therefore have lower noise levels and traffic volume. This lowers the potential for impact on deer during the spring dispersal period. Any remaining impact is temporary and is therefore considered acceptable.

6.8.3 Erosion and Sedimentation Control

Overland flow paths within the construction areas have the potential to carry construction-related sediment to the watercourse or to wetlands. This may result in water quality impairment by altering primary productivity due to turbidity or nutrient inputs, affecting aquatic habitat by siltation of critical areas, or directly affecting fish by gill abrasion or covering/ smothering of eggs. Overland surface water flow may also impact terrestrial features by depositing construction-related sediments and other potential contaminants onto low-lying vegetation within flow paths. This may result in damage or death of vegetation within affected areas due to smothering, the loss of which may affect wildlife that use those species for foraging or other habitat purposes. However, the areal extent of this disturbance is anticipated to be very small relative to the available foraging areas in the vicinity. Potential impacts of siltation on vegetation and wildlife are therefore considered minimal and not significant.

Erosion control is the preferred method of erosion and sediment control mitigation. That is, preventing the soil from eroding initially. This includes phasing the construction properly to minimize exposed soils and use of geotextiles or plantings to prevent erosion. To control any eroded sediment that occurs, barriers are placed around the construction site perimeters to prevent the migration of construction related material from leaving the site or entering a watercourse.

An erosion and sediment control plan (ESCP) will be developed prior to the commencement of construction. Erosion and sediment control measures identified in this plan will be installed prior to construction and maintained diligently throughout the construction operations. The installed measures will be routinely inspected to ensure that they are maintained and functioning as designed. Erosion control devices will be left intact following construction until vegetative cover is sufficiently established.

If construction results in a cleared area to be restored, with insufficient time left in the growing season to establish vegetative cover, an overwintering treatment such as erosion control blankets, fibre matting, or equivalent will be applied to contain the site over the winter period. Planting of vegetative cover will then follow in the next growing season. Maintenance and inspection of the vegetative cover will continue until such time as the disturbed areas are sufficiently stabilized through vegetative growth to prevent overland runoff of suspended materials.

6.8.4 Blasting

The use of explosives in and near fish habitat may also result in the physical and/or chemical alteration to that habitat such as sedimentation resulting from the explosive to cover spawning areas or reduce or eliminate bottom dwelling life forms that fish use for food. Use of explosives will be controlled to minimize any such activity near fish habitats. Any such activity will need to follow the process outlined in the publication entitled "Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters" (Wright and Hopky 1998).

Given the bedrock nature of the local topography and river bottom, in-water or near shore blasting is anticipated during construction. The use of chemical explosives in or near water produces post detonation high-energy shock waves followed by a rapid decay to below ambient hydrostatic pressure. This pressure decay causes impacts on fish. The effects of sudden changes of hydrostatic pressure may result in trauma and death of fish (particularly those with swim bladders). Injuries sustained by fish include ruptured swim bladders and haemorrhaging in the colonic and pericardial cavities. Liver, kidney, spleen, or sinus venous injuries may also occur (Wright and Hopky 1998). Fish eggs and larvae may also be killed or damaged.

If in-water blasting is required, the following permits and approvals may be required:

- *Fisheries Act* Section 32 Authorization to destroy fish by means other than fishing (DFO). The blasting program should be designed with the "Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters" in mind, incorporating the mitigation measures, or others as appropriate, to prevent the destruction of fish. If, after all reasonable mitigation methods have been considered, there still exists the likelihood of killing fish; the proponent will then be required to apply for a Section 32 Authorization.
- Permit under the *Navigable Waters Protection Act* or a letter of exemption (Transport Canada)

The minimum requirements associated with DFO blasting guidelines include:

- Restriction on instantaneous pressure increases in the open water. These restrictions influence the weight of explosive and how far it needs to be buried.
- Restrictions on types of explosives (e.g. no ammonium nitrate).
- Confined explosives are generally required as opposed to unconfined.
- OMNR in-water timing window restrictions for construction for spring spawning fish species (typically April 1 to June 30). Specific timing windows should be agreed to with the local OMNR as part of the permitting process.

If blasting occurs, it is not expected to have any permanent terrestrial impacts as the blasting will occur in-water or at the near shore. Any impacts as a result of noise or dust on wildlife and vegetation are expected to be minimal, localized, and temporary. Where possible, however, blasting should occur outside of known nesting periods (i.e., May 9 – July 31) to limit disruption to those species. Refer to the report by Northern Bioscience regarding impacts of blasting associated with permanent access road construction.

Possible mitigating measures to avoid/reduce impacts include the use of bubble curtains or blast mats to block shock waves and contain debris, removal of fish prior to blasting, and the use of smaller charges and staggering of blasts.

6.8.5 Use of Cofferdams

Cofferdams are constructed to isolate any in-water work area from a water body for the purpose of enabling work under dry conditions. They are temporary structures that form an impermeable dyked enclosure which also prevent escape of debris and sediment to the exterior water body. Cofferdam material can include sandbags, sheet piling, rock fill, wood sheeting and rock filled timber cribs, depending on the size of the project and duration that the cofferdam will be in place.

Temporary disturbance to additional aquatic habitat areas is anticipated during the construction of a cofferdam required to complete the dam, intake and powerhouse and tailrace construction in the dry. Impacts to aquatic habitat and biota associated with cofferdams include the potential for excess sediment to be suspended and carried downstream by river flow during the installation and removal of the dam. Depending on the size and type of cofferdam utilized, the structure will have direct impacts on the substrates and habitat upon which it has been placed. There is also the potential to strand fish within the enclosure.

Currently, Type A cofferdams proposed to facilitate the construction of the powerhouse and spillway (CPL 2013). The cofferdams will be designed to prevent overtopping during a 1:20 year flood event (CPL 2013), and will occupy a combined area of 350 to 700m^2 (CPL 2013). It is acknowledged that the most significant potential impact during construction and removal of the cofferdam is the potential for excess sediment to be suspended and carried downstream by river flow. Due to the velocities present in this section of river, it may not possible to isolate the cofferdam construction from the channel using a silt curtain or equivalent. For these reasons the following construction Best Management Practices are recommended during construction.

- Ensure that all rock materials placed into the river have been prewashed.

- Construct and remove the cofferdam during an appropriate low flow period (generally during the summer months).
- Ensure that weather forecast does not predict significant rains during the cofferdam installation or removal time period.
- Ensure that construction takes the least possible time by having all construction materials and necessary equipment available prior to construction or removal of the cofferdam.
- Avoid construction and removal during the time typically associated with spawning and egg incubation times of spring spawning fish species (typically April 1 to June 30). Specific timing windows should be agreed to with the local OMNR as part of the permitting process.

6.8.6 Dewatering Operations

When cofferdams are first completed there is often a considerable amount of water retained inside of the cofferdam, in the area where work is to occur. Often fish can become stranded within the cofferdam with no access to the watercourse. If these fish are not removed prior to dewatering the isolated work area, the fish may not survive. In these cases, removal of the stranded fish and standing water is usually necessary before construction can proceed. A scientific collector's permit is required from the OMNR before a fish salvage can be completed.

Depending on the amount of suspended sediment in the pumped water from the dewatering activities, there is the potential to impact water quality of the receiving watercourse by increasing the suspended solids loading in the watercourse above background levels. This has the potential to result in sedimentation of critical aquatic habitat such as spawning areas. It also has the potential to interfere with native fish by causing gill abrasion or interfering with foraging activities of site feeding fish.

If dewatering is required, the following permits and approvals may be required from DFO:

- Fisheries Act Section 35 Authorization to harmfully alter, disrupt or destroy fish habitat (DFO). This requires a compensation package to address disrupted habitat.

- Fisheries Act Section 32 Authorization to destroy fish by means other than fishing (DFO).

Dewatering activities will be done in a controlled manner so as not to discharge turbid water to the receiving watercourse. Materials such as filter bags, straw bales, filter fabric, and page-wire fencing will be on site to create a dewatering corral for waste water as a contingency plan in the event that groundwater is encountered and additional filtering properties are required. Suitable containment/treatment areas will be identified by the Contract Administrator. The ultimate discharge point to the receiving watercourse will be monitored to ensure that the filtering is effective in removing excess sediment. The discharge point in the receiving watercourse will be carefully chosen as an area with low scour potential (i.e. bedrock bottom). If scour potential does exist, the contractor will use energy dissipation in the form of a splash pad or rock protection for the stream bottom.

Detailed Best Management Practices for dewatering activities can be found in Appendix B of the Best Management Practices Guide for the Mitigation of Impacts of Waterpower Facility Construction (Genivar and NRSI 2012).

6.8.7 Temporary Work Areas

Activities associated with the temporary work areas such as laydown areas and temporary road access includes clearing, grubbing and stockpiling. Impacts associated with these activities are discussed as they relate to removal of habitat of significant species, as well as general effects.

<u>Significant Species Habitat</u>

Clearing and grubbing for two temporary laydown areas, each 1,000m^2, will result in the removal of Very Shallow, Humid - Red Pine - White Pine Conifer, Short Treed (G023TI). This community potentially provides habitat for several SAR and significant species including whip-poor-will, common nighthawk, eastern wood-pewee, brown myotis, northern myotis and eastern milksnake. The shoreline forest (G023TI) that will be cleared for laydown areas is unlikely to support maternity roost habitat for brown myotis and northern myotis as it does not support deciduous or mixedwoods communities.

However, this community may support suitable foraging habitat for northern myotis and brown myotis. Given that foraging habitat is abundant on the surrounding landscape, the overall impacts to these species are anticipated to be minimal and not significant.

The habitat proposed for removal (G023Tl) consists of softwood species and is unlikely to provide habitat for eastern milksnake. Preferred aspen stands are abundant within the study area and are more likely to support this species. Aspen stands (G040Tt) are not proposed to be impacted by temporary laydown areas; however they may be impacted by temporary road access north of the Vermillion River. Areas proposed for temporary road access are small in size relative to the remaining aspen stands in the surrounding landscape. Therefore, impacts to eastern milksnake habitat are predicted to be negligible.

Very Shallow, Humid: Red Pine - White Pine Conifer, Short Treed (G023Tl) may provide foraging and breeding habitat for the common nighthawk, whip-poor-will and eastern wood-pewee. Therefore the clearing and grubbing of vegetation within this community will impact habitat for these two species resulting in the temporary loss of 2000m^2 of potential foraging and breeding habitat. Additionally, Dry, Sandy - Aspen - Birch - Hardwood, Tall Treed (G040Tt), Moist, Coarse - Red Pine - White Pine: Mixedwood, Tall Treed (G069Tt) and Very Shallow, Humid - Red Pine - White Pine Conifer, Tall Treed (G023Tt) may provide habitat for whip-poor-will and eastern wood-pewee. Small portions of these habitats will be cleared for temporary road access to the north side of the Vermillion River. The removal of vegetation within G040Tt will be minor in comparison to the surrounding landscape. As such impacts to this community are considered to be minimal and not significant. Removal of G023Tt and G069Tt will represent a substantial amount of this community available on the northern shore. However, removal of vegetation is temporary and reclamation activities including clean-up, grading and re-vegetation will be conducted post-construction to restore lost habitat. Whip-poor-will surveys will most likely be required to confirm their presence within the study area for the application process for authorizations and/or operating agreements under the ESA.

Canada warbler is also known from the vicinity of the study area. However, the habitat proposed for removal for temporary work areas is not likely to be suitable for this species, as it prefers interior-forest habitats.

<u>General Impacts</u>

The area of disturbance within the overall site boundaries will be kept to a minimum and clearing will only occur where necessitated by construction. High visibility snow fencing will be installed to restrict heavy equipment traffic to the area identified for clearing. Stockpile and staging areas will be well removed from the watercourse and be isolated with sediment and erosion control measures to prevent migration of material to the watercourse and natural areas. Lands within the construction zone reserved for laydown areas and stockpile areas will be cleared of vegetation, representing a loss of wildlife habitat within those areas. Due to the relatively small size of the areas to be cleared in relation to the large extent of similar habitat on the surrounding landscape, impacts on wildlife as a result of these habitat losses is expected to be minimal and not significant.

Wildlife trees, culturally modified trees and other significant trees will be marked for protection; marked trees will only be removed if they are safety concerns that cannot be addressed in other practical ways. Brush will be disposed of by burning or chipping. When burning is carried out, it will be under permit with the OMNR and according to the Forest Fires Prevention Act.

Travel paths, stockpile areas, and staging areas will be carefully planned and followed. Every reasonable attempt will be made to minimize the construction-related disturbance to natural features. During the bird nesting season (May 9 - July 31), construction activities involving substantial noise, such as blasting and hammering, will be conducted after sunrise and before sunset to limit impacts to nocturnal species such as whip-poor-will and common nighthawk. Night-time lighting will also be directed at construction activities, minimizing excess light in the surrounding forested habitats.

The federal *Migratory Birds Convention Act* (MBCA) is applied through *The Regulations Respecting the Protection of Migratory Birds* that states that "*no person shall disturb, destroy or take a nest, egg [...] of a migratory bird.*" This law protects all birds aside from the introduced species such as the European starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*), and rock pigeon (*Columba livia*). Bird nests that are destroyed during the course of construction and other related activities is referred to as "incidental take" and is illegal except under the authority of a permit obtained through the CWS (Canadian Wildlife Service).

Vegetation clearing has the potential to directly impact bird breeding activity through damage and destruction of nests, eggs and young, or avoidance of the area by breeding adults. Vegetation clearing is therefore recommended to occur outside the bird nesting season (May 9 - July 31) so as to limit disturbances to nesting activities of birds within the study area, and to avoid destruction of active nests. If vegetation clearing cannot be avoided during the bird breeding season, a qualified avian biologist must be retained to carry out a nest search ahead of clearing activities. Construction staff should also be educated on what significant species are known to occur in the area and what they should do if any of these species are encountered during construction. This includes contacting a qualified biologist and/or MNR immediately for proper identification and re-location to a safe area.

Excess material from in-water excavation will be removed immediately from the channel area and temporarily stockpiled in suitable locations identified by the design drawings and on-site areas approved by an environmental inspector.

The construction operations will include the repair and stabilization of any area disturbed during construction. This includes, but is not limited to, application of sod, topsoil, seed erosion control mats, or other suitable slope treatments.

Other Best Management Practices that can be employed to minimize impacts on terrestrial wildlife include the following:

- limit use of machinery in and around watercourses and sensitive terrestrial areas
- use woody debris and non-merchantable logs from corridor clearing to establish brush piles and downed logs adjacent to the cleared right-of-way to improve habitat
- allow for detour around sensitive habitat areas
- limit removal of vegetation during construction/maintenance to maintain habitat connectivity

- Schedule construction activities during day time hours, between sunrise and sunset, to avoid impacts to nocturnal species including whip-poor-will.
- schedule tree clearing to avoid migratory bird nesting periods (May 9 - July 31) and bat maternity roosting periods (mid-May to Mid-June).
- retain an avian biologist to conduct nest searches ahead of tree removal if trees must be removed during the breeding bird period
- conduct bat habitat assessments within the footprint to confirm the presence of Maternity Roosts, if trees must be removed during the maternity roost period.
- ensure construction traffic adheres to speed limits and make construction crews aware of the potential for wildlife crossings
- report any roadway mortalities of herpetofauna and reduce speed limits in specific areas to prevent additional mortalities
- keep the area of disturbance within the overall site boundaries to a minimum and only clear where necessary for construction.

6.8.8 Hazardous Material Management

Proper hazardous materials management is the first line of defense against spills occurring. In this regard, no refuelling of machinery will occur within 30m of the watercourse, and all refueling will occur on impermeable pads or pans to contain any spills. Drip pans will also be installed on equipment to capture any minor leaks. All hydraulic systems on equipment will be inspected prior to use in and around water to ensure that no spills of hydraulic oil occur into the watercourse. Any other hazardous materials, such as construction chemicals, will be stored in a designated, secure area well away from the watercourse and other sensitive environmental features. Impervious liners or dykes will be constructed around oil, fuel, or chemical storage areas to prevent leakage into surrounding aquatic or terrestrial features. All fuels, oils and lubricants will be stored in a secondary containment area. In-water work will be halted during periods of heavy precipitation.

Appropriate types and amount of sorbent materials, oil booms, etc. will be kept on site to deal with the type and amount of chemicals which may be on site at any given time. The contractor's staff should be properly trained in the use of such materials.

In the unlikely event of a spill of hazardous materials, construction will cease immediately and all effort will be directed to the containment and clean-up of the spill. Environmental incidents will be recorded, including mitigation measures taken, and any spills reported to the Ministry of Environment Spills Action Centre. An emergency preparedness and response plan will be prepared prior to construction, which will include a spill response plan (SRP).

6.9 Summary of Mitigation Measures

The following is a summary of mitigation measures that will be applied to potential or anticipated impacts on terrestrial and aquatic natural features during construction and headpond inundation. Impacted species or species groups, including SAR, are identified for each measure. Please refer to the listed report subsection for additional details about any given mitigation measure.

Table 11. Summary of Mitigation Measures

Mitigation Measure	Report Subsections
Avoid construction activities during snake hibernation period (September-March) (if snake hibernacula documented within design footprints).	6.2.1 6.3.1
Minimize shoreline habitat disturbances to the extent possible.	6.3.1
Replacement of 8,340m^2 of lake sturgeon and walleye spawning habitat, which will be lost as a result of inundation and facility footprint impacts. To be located downstream.	6.2.2 6.3.2
Maintenance of water levels in Wabagishik Lake within +/-5cm of daily average water levels.	6.4
Compliance commitment to maintain water levels in the Spanish River at the confluence with the Vermillion River within the Domtar Dam operating band.	6.5
Compliance commitment to maintain water levels in the bay immediately below Wabageshik Rapids within +/-15cm of daily average water levels.	6.5.1 6.5.2
ROTR flows during northern pike, walleye and lake sturgeon spawning and egg incubation periods, and restricted flows during larval dispersal/drift for lake sturgeon.	6.5.2
Restrict operations such that flows during intermittent operation do not exceed 25m^3/s below Wabageshik Rapids.	6.5.2
Minimum flows of 5.0 m^3/s in the summer and October, 6.5m^3/s in November, Feburary and March, and 8.0m^3/s in December and January as defined in the operating plan .	6.5.2
Proposed intake structures to be designed for low velocities to avoid/mitigate the potential risk of entrainment and impingement of fish.	6.6
If intake structures cannot be designed with low velocities potential modifications can be made to prevent entrainment and impingement including lighting, electrical barriers, air bubbling and sound barriers.	6.6

Mitigation Measure	Report Subsections
Use erosion and sediment control measures to protect aquatic and shoreline habitat.	6.8.3
Compensation fish habitat will be constructed downstream of the proposed Wabageshik Rapids GS, with first priority given to the tail-water section of Wabageshik Rapids, second priority given to the bay immediately downstream of Wabageshik Rapids where relatively high velocities extend from the rapids, and third priority given to Graveyard Rapids, located 4km downstream of the proposed Wabageshik Rapids GS.	6.2.2 6.3.2 6.5.2
Compensation fish habitat within the first-priority location in the tail-water section of the proposed Wabageshik Rapids GS will be designed using 2-dimensional modelling.	6.3.2
Clearing will comply with the requirements of all applicable permits and approvals, the Crown Forest Sustainability Act, and the Forest Operations and Silviculture Manual.	6.8.7
Wildlife trees, culturally modified trees and other significant trees will be marked for protection; marked trees will only be removed if they are safety concerns that cannot be addressed in other practical ways.	6.8.7
Clearing will have regard for the Migratory Birds Convention Act, conducting clearing of vegetation outside of the core migratory bird breeding period from May 9 to July 31 of any given year. If clearing is necessary during this time, an experienced biologist will need to visit the site to conduct a nest search.	6.2.1 6.3.1 6.8.7
Clearing will avoid bat maternity roosting periods (mid-May to Mid-July)	6.3.1
Conduct bat habitat assessments within the footprint to confirm the presence of maternity roosts, if trees must be removed during maternity roost period.	6.8.7
Brush will be disposed of by burning or chipping. When burning is carried out, it will be under permit with the OMNR and according to the Forest Fires Prevention Act.	6.8.7
Limit use of machinery in and around watercourses and sensitive terrestrial areas.	6.8.7
Use woody debris and non-merchantable logs from corridor clearing to establish brush piles and downed logs adjacent to the cleared right-of-way to improve habitat.	6.8.7
Allow for detour around sensitive habitat areas.	6.8.7
Limit removal of vegetation during construction/maintenance to maintain habitat connectivity.	6.8.7
During the bird nesting season (May 9 - July 31), construction activities involving substantial noise, such as blasting and hammering, will be conducted after sunrise and before sunset to limit impacts to nocturnal species such as whip-poor-will and common nighthawk. Night-time lighting will also be directed at construction activities, minimizing excess light in the surrounding forested habitats.	6.8.7
Ensure all construction traffic adheres to speed limits and make construction crews aware of the potential for wildlife crossings.	6.8.7
Report any roadway mortalities of herpetofauna and reduce speed limit in specific areas to prevent additional mortalities.	6.8.7
Keep the area of disturbance within the overall site boundaries to a minimum and clear only where necessary for construction.	6.8.7
Use woody debris and non-merchantable logs from corridor clearing to establish brush piles and downed logs adjacent to the cleared right-of-way to improve habitat .	6.8.7

Mitigation Measure	Report Subsections
In order to avoid/reduce impacts to fish from in or near water blasting, bubble curtains or blast mats can be used to contain shock waves, and fish removal or small staggered blasts can reduce the risk of debris to aquatic species. Blasting will also avoid critical life stages for fish, From April 1 to June 30.	6.8.4
Best management practices for cofferdam construction will reduce damage by dam construction including; prewashing rock materials, construct and remove cofferdam during low flow periods, ensure weather forecast does not predict significant rains during installation or removal, ensure the construction takes the least possible time, and avoid construction and removal during the time typically associated with spawning and egg incubation.	6.8.5

6.10 Monitoring

A preliminary biological monitoring plan (NRSI 2013b) has been prepared by NRSI and included in Annex III of the main EA document (Xeneca 2013a).

7.0 Summary and Conclusions

Natural Resource Solutions Inc. was retained by Xeneca Power Development Inc. to complete a Natural Environmental Characterization and Impact Assessment Report for the proposed Wabageshik Rapids Hydroelectric Generating Station Project on the Vermillion River.

NRSI completed field studies in 2010 and 2011 within the study area that extended from the upstream limit of Wabageshik Rapids, at the outlet of Wabagishik Lake, to the confluence with the Spanish River 5km downstream of Wabageshik Rapids.

By comparing the proposed construction, design and operation of this facility to the significance and sensitivity of aquatic, terrestrial and wetland communities within the study area, NRSI was able to predict where significant impacts might occur and then worked with Xeneca Power Inc. to develop appropriate mitigation strategies for these predicted impacts.

The following is a summary of predicted significant impacts and proposed mitigation.

<u>Facility Footprint Impacts and Proposed Mitigation</u>

The facility footprint impacts include the powerhouse, powerhouse yard, substation, spillway, intake and tailrace, with a combined total area of 2,000m^2. This will affect terrestrial habitat in the form of localized clearing and grubbing of existing riparian vegetation. Aquatic habitat will be affected by the footprint of the powerhouse and spillway, with direct impact on 500m^2 of a large pool that has important function as a holding area during spawning as well as foraging habitat for northern pike and other fish species. In addition, the 400m^2 tailrace will cause alteration to existing walleye and lake sturgeon spawning habitat.

As part of the fish habitat compensation plan, Xeneca has committed to resurfacing the tailrace area with appropriate substrates for spawning, and to improving the habitat within tailrace and in the surrounding habitats to offset the loss of spawning habitats. Run-of-river operations are proposed during the walleye and lake sturgeon spawning periods, which will ensure that flows are maintained. As part of the overall fish habitat compensation plan, which also accounts for habitat loss in the inundation area, Xeneca has also committed to carrying out 2-dimensional modelling of the 400m length of Wabageshik Rapids downstream of the proposed dam as a tool for designing spawning habitat improvements. This is outlined in the preliminary fish habitat compensation plan included with the EA documentation.

Facility footprint impacts on terrestrial habitats include no more than 1,200m^2 of area for the powerhouse, powerhouse yard and substation. Impacts are predicted to be minimal and not significant based on the relatively small size of the footprint compared to the abundance of available habitat on the surrounding landscape. Mitigation measures are focused on the construction process.

Inundation Impacts and Proposed Mitigation

The inundation area for the project is limited to an 800m section of Wabageshik Rapids upstream of the proposed dam location, with a total area of 4.8ha. While Wabagishik Lake will function as part of the headpond, it will not be newly inundated and water levels will not change substantially. Impacts will occur within the 4.8ha inundation area. The aquatic habitats will experience increases in water depths and decreases in water velocities. The most important loss will be the functional loss of approximately 8,340m^2 of walleye and lake sturgeon spawning habitat, as well as changes to the benthic invertebrate community. In addition, 0.4ha of terrestrial habitat will become aquatic habitat. This impact on terrestrial habitat is predicted to be minimal and not significant based on the relatively small size of the area compared to the abundance of available habitat on the surrounding landscape. Mitigation measures are focused on the construction process.

The loss of walleye and lake sturgeon spawning habitat are considered substantial and significant, and will be addressed through fish habitat compensation, which will occur downstream of the proposed Wabageshik Rapids GS such that the habitat continues to serve the downstream fish populations. A preliminary fish habitat compensation plan is included in the EA. As part of the fish habitat compensation plan, Xeneca has committed to carrying out 2-dimensional modeling of the 400m length of Wabageshik Rapids downstream of the proposed dam as a tool for designing spawning habitat improvements.

Upstream Operational Effects

The proposed modified run-of-river operation as described in the operating plan (Ortech 2013) will result in a fluctuation of water levels within the inundation area and Wabagishik Lake. This fluctuation will vary water levels 5cm above and 5cm below the daily average water level. This fluctuation is expected to occur up to one time each day.

This 10cm fluctuation in water level that will result from daily operations is less than what might be caused by wave action or seiche effect that might be realized on the lake at present, simply as a result of a shift in wind direction. Plants and other biota living within the riparian zone can generally be expected to withstand the 10cm daily fluctuation in water levels based on their adaptation to the dynamic riparian environment. While some minor changes can be expected to occur, any impacts would be considered minimal and not significant.

Downstream Operational Effects

A modified run-of-river operation is currently proposed for the Wabageshik Rapids GS, which will result in changes to the flow regime downstream of the proposed facility. These changes result from the capacity of the operation to store water upstream of the dam during periods of low power demand, and release that water, through the turbines, during periods of higher power demand. This results in relatively rapid increases and decreases in flow, an increase in the frequency of flow changes, and associated changes in the wetted widths, depths, and velocities in downstream habitat areas. These changes have the potential to affect the ecology of the river and associated natural resource values.

Mitigation measures include the minimum flow requirements (Q_{EA}) of 5, 6.5 or 8m^3/s (varies with time of year) and the Q_{TL} of 25m^3/s for intermittent operations, which will keep the range of flow fluctuation within boundaries. This will minimize the amount of aquatic habitat that is dewatered within Wabageshik Rapids, and will limit the extent of impacts on aquatic and riparian vegetation further downstream. There is also a compliance commitment to a +/-15cm range of water level fluctuation will further ensure that the fluctuation in water levels is controlled. Ramping rate restrictions will also be in effect, as will spillway flows of 0.5 to 2.0m^3/s. Finally, run-of-the-river operation will be used during the northern pike, walleye and lake sturgeon spawning periods, ensuring that spawning and egg incubation are not impacted. Specific operations for lake sturgeon larval drift will also ensure that drifting larvae are not impacted.

Residual downstream operational effects within Wabageshik Rapids includes an impact on the benthic invertebrate community, a 1,000m^2 area of habitat that will become dry more frequently, changes in the foraging habitat in the large pool where the spillway is proposed, and potential for fish stranding. The impacts are characterized by daily changes in water levels and velocities, and daily dewatering of some areas of habitat. Impacts on the benthic invertebrate community will be addressed in part through fish habitat compensation. The preliminary fish habitat compensation plan included with the EA documentation indicates a commitment to using 2-dimensional modeling to optimize habitat, and a plan to eliminate the area of habitat that becomes dewatered by lowering its elevation. This will reduce the area of the periodically dewatered habitat. The flow-based mitigation measures discussed above will control the extent of this impact. However, some residual impact will remain.

The large pool immediately below the proposed spillway will experience changes in hydrology as water is redirected through the powerhouse. A small amount of flow, 0.5m^3/s for most seasons, will ensure circulation remains. However, there may be a change in the composition of benthic invertebrates and small fish in the pool, which will in turn change the foraging opportunities for northern pike, redhorse suckers and other fish.

Fish stranding may occur, but is less likely with the extended ramping rates and other operational mitigation measures discussed above. If necessary, habitat modifications or changes in operations can serve as further mitigation of this potential impact.

The habitat at Graveyard Rapids, approximately 4km downstream of the proposed Wabageshik Rapids GS, will be subject to similar impacts as Wabageshik Rapids. However, Graveyard Rapids is relatively less important as fish habitat due to its lower benthic invertebrate productivity and lesser quality spawning habitat for walleye and lake sturgeon. The operational mitigation measures described above will be more than adequate to mitigate impacts at Graveyard Rapids. This will be confirmed through biological monitoring.

A deer crossing location was identified downstream of the proposed Wabagshik Rapids GS. Impacts are not expected because deer were documented crossing during flows equivalent to the planned maximum turbine capacity, and in some cases at substantially higher flows. Monitoring will be conducted to ensure there are no impacts.

Downstream operational impacts will also include effects on emergent and riparian vegetation along the riverbanks, the riverine wetland areas in the large bay below Wabageshik Rapids, and the wetlands associated with the tributary outlets. Most riparian and emergent plants will not tolerate daily water level fluctuations of more than 25cm. It is anticipated that daily operations could result in the loss of emergent and shoreline vegetation. As a worst-case scenario, much of the shoreline and nearshore areas could exist as bare substrate, or at a minimum the species composition will shift to some extent. This will in turn alter the habitat characteristics for a variety of terrestrial and aquatic wildlife. Wildlife resources that have potential to be affected include moose aquatic feeding areas, amphibian breeding habitat, waterfowl nesting areas, turtle overwintering habitat, and fish habitat. Monitoring will be conducted to ensure that the impacts are fully understood and are not significantly affecting the vegetation, wildlife or fish.

Four tributaries outlet into the Vermillion River within the downstream ecological zone of influence. These tributaries will be subjected to water level fluctuations during continuous operations, typically in November and December. This has potential to affect turtle overwintering habitat and fish habitat. The mitigation measures will substantially reduce the impact potential, and monitoring will confirm this.

Fish Entrainment and Impingement

Trash racks will be installed at each turbine entrance with a spacing of 48mm and entrance velocities are proposed to be 0.75m/s. This entrance velocity is lower than the burst swimming capabilities of VEC species such as adult northern pike, walleye and smallmouth bass which will mitigate impingement of these species on the trash racks. Should impingement prove to be a threat to these species, there are numerous other modifications that can be made at the intake. Juveniles and small bodied fish will most likely continue to pass through the trash racks where a low risk of turbine entrainment and mortality exists.

Two potential designs were considered for the assessment of turbine mortality at the Wabageshik Rapids GS: a 1-turbine design and a 2-turbine design. Survival estimates were made for fish of varying lengths. For the 1-turbine design, survival ranges from 95.6% for a 100mm fish to 84.8% for a for a 500mm fish. For the 2-turbine design, survival rates are only slightly lower, ranging from 94.7% for a 100mm fish to 83.9% for a 500mm fish.

Overall, entrainment and turbine mortality are not expected to pose a significant impact on fish in the vicinity of the powerhouse intake. Post-construction monitoring will be conducted to ensure the mitigation measures are effective and survival rates are acceptable.

Fish Passage

The Wabageshik Rapids GS will not include any provision for upstream fish passage. This carries some risk for fisheries management, which must be evaluated by MNR and DFO. Therefore, fish passage matters will be finalized during the permit process with the OMNR and DFO. These agencies will consider the plan to not provide fish passage in conjunction with the proposed fish habitat compensation plan to ensure that the risk is acceptable and fisheries management objectives can be met without providing fish passage.

Notwithstanding the requisite agency role, this report has assessed the fish community information and the available habitats upstream of the site, and outlined how the fish populations of interest can be managed. It is apparent that the walleye, northern pike, smallmouth bass and lake sturgeon populations will be able to persist and provide the natural resource and natural heritage values that they represent without the provision of fish passage. Critical life stage habitats exist both upstream and downstream for the populations that exist in those locations. The fish habitat compensation for the impacted habitat in Wabageshik Rapids will be a key management component to carry out in conjunction with the elimination of fish passage potential.

Of particular concern is the population of lake sturgeon that occurs in the downstream 5km of the Vermillion River and the Spanish River between the dams at Nairn Falls and Espanola. There are no confirmed records of Lake sturgeon in Wabagishik Lake, although there is potential that lake sturgeon can ascend Wabageshik Rapids. The dam will restrict the lake sturgeon population to its current range, which may or may not represent a change from existing conditions.

Construction

In addition to the new permanent road to the site, two laydown areas totaling 2,000m^2 will be cleared on the south side of the Vermillion River. A 200m long temporary road will also be created on the north side of the river, including a temporary bridge over the river at a location upstream of the facility that is constricted by bedrock. Cofferdams will also be installed within the channel to facilitate construction of the powerhouse and spillway. Mitigation strategies will include implementation of construction best management practices (BMPs) and specific mitigation measures to limit impacts as a result of planned general construction activities. It is anticipated that implementation of these mitigation measures will result in low levels of impacts to aquatic and terrestrial wildlife and habitats within the study area resulting from construction activities.

In conclusion, biological studies have been completed to document existing aquatic, terrestrial and wetland conditions. Potential impacts on these features have been identified based on the design, the operating plan, fish habitat compensation plan, and construction management documents. Mitigation strategies to offset these impacts have been provided. Where impacts are not fully mitigated to the satisfaction of the regulating government agencies, agreement will be sought during the permitting phase of this project to ensure that the mitigation and any residual impacts are acceptable to the review agencies.

Monitoring will also occur during and following construction to verify impact predictions, ensure compliance with permit conditions and to guide adaptive management decision making.

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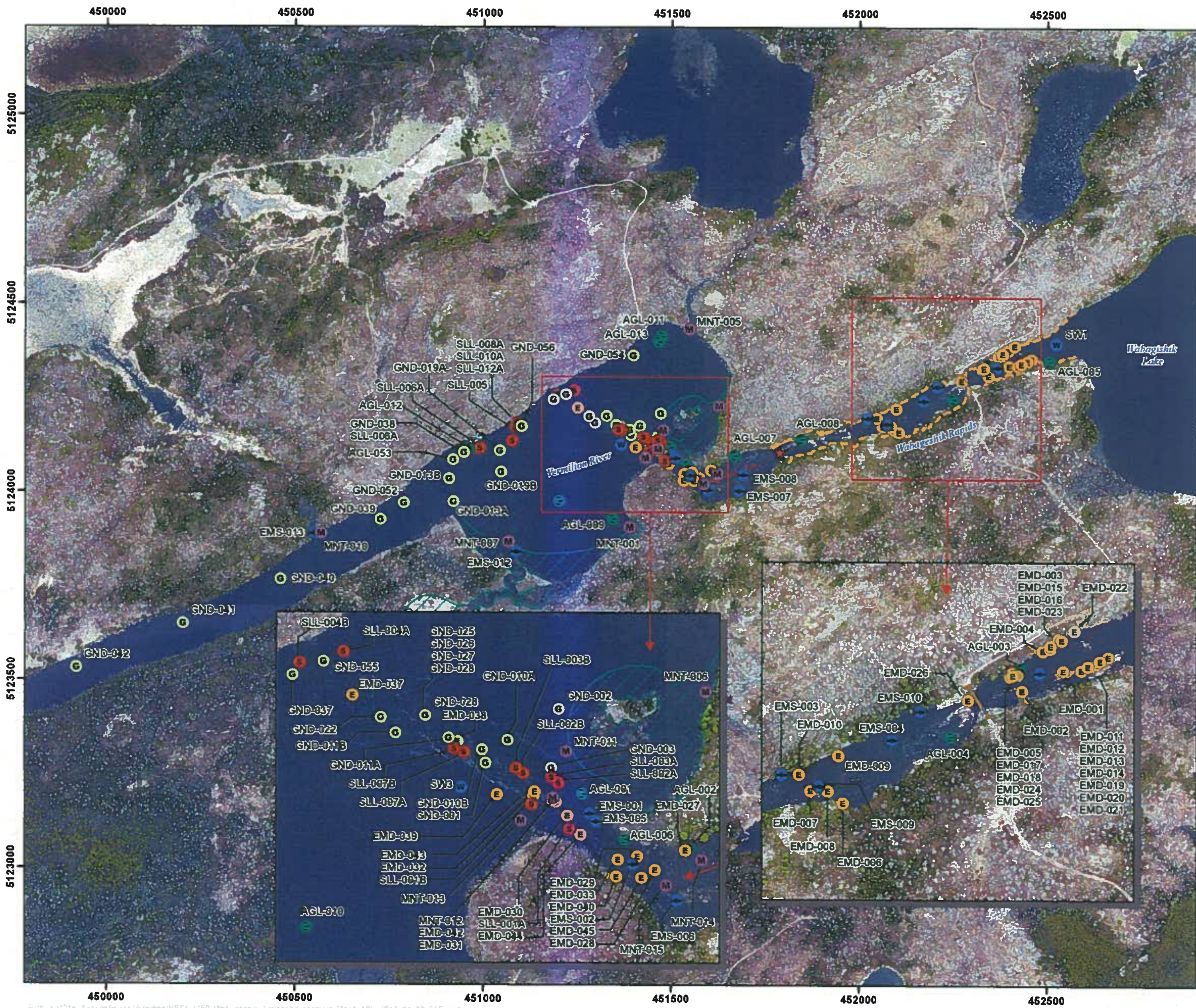
APPENDIX I

AQUATIC ASSESSMENT MAPPING

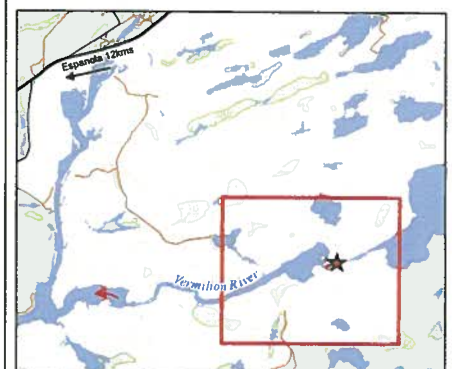


Wabageshik Rapids Hydropower Development

Aquatic Assessments - Map 1

Legend

- (MNT) Minnow Trap Station
- (AGL) Angling Effort Station
- (EMD) Egg Mat Deployment Station
- (EMS) Electroshock Monitoring
- (GND) Gill Net Deployment Station
- (SLL) Sturgeon Trot Line
- (SW) Surface Water Quality Station
- Wabageshik Rapid Proposed Hydroelectric Generating Site
- Flow Direction
- Zone of Inundation
- Potential Pike Spawning Habitat
- Snowmobile Bridge
- Elevation Contour (10m Interval)



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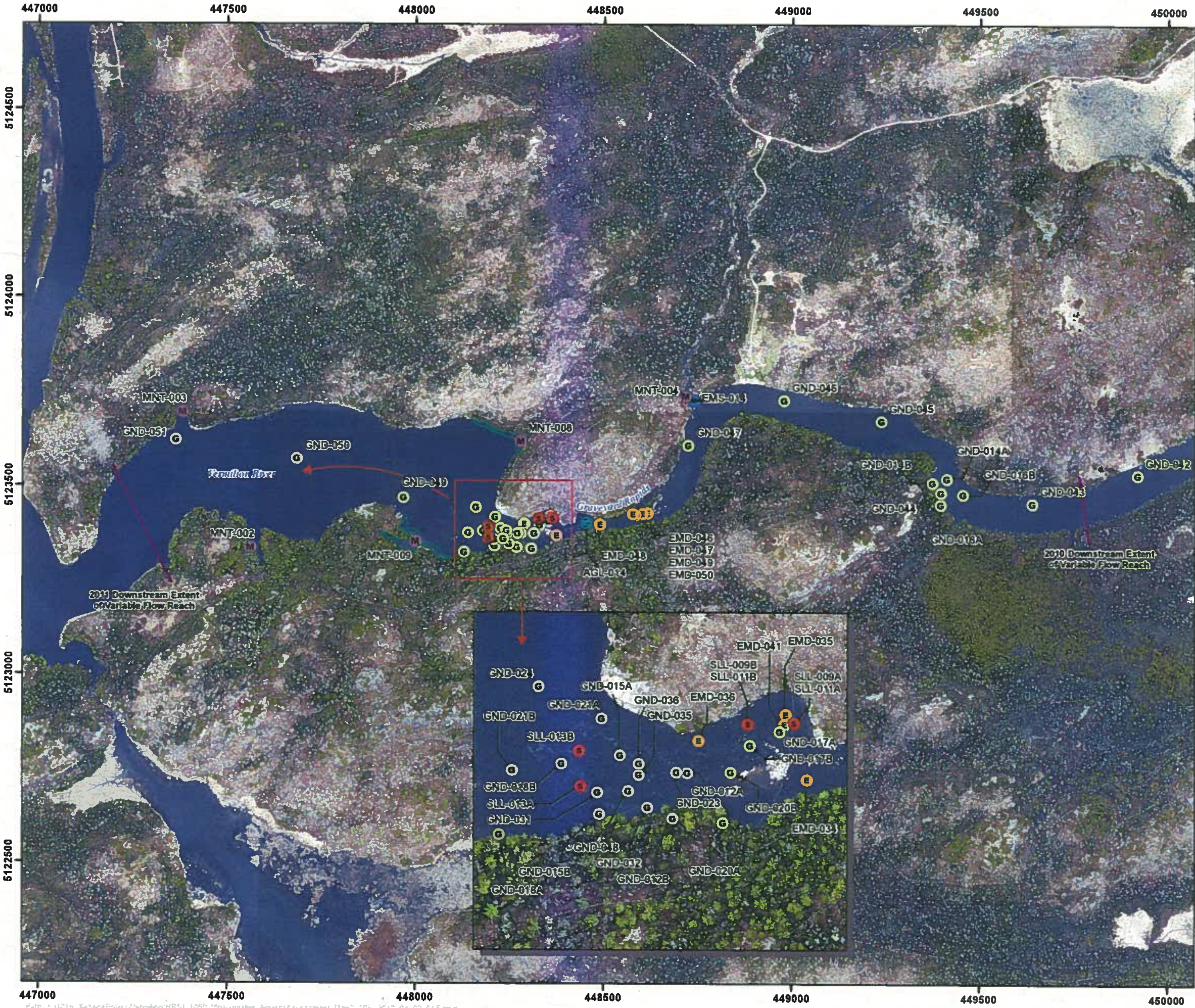
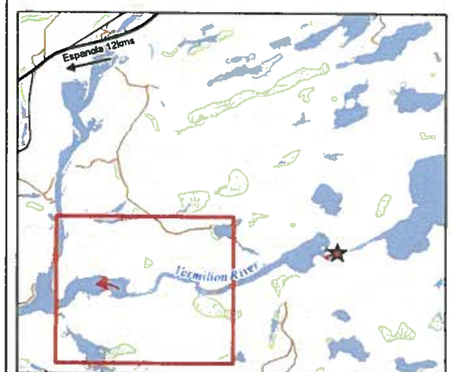


Wabageshik Rapids Hydropower Development

Aquatic Assessments - Map 2

Legend

- (MNT) Minnow Trap Station
- (AGL) Angling Effort Station
- (EMD) Egg Mat Deployment Station
- (EMS) Electroshock Monitoring
- (GND) Gill Net Deployment Station
- (SLL) Sturgeon Trot Line
- (SW) Surface Water Quality Station
- Wabageshik Rapid Proposed Hydroelectric Generating Site
- Flow Direction
- Downstream Extent of Variable Flow Reach
- Potential Pike Spawning Habitat
- Elevation Contour (10m Interval)



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Project: 1050 Date: April-02-12	NAD83 - UTM Zone 17 Size: 11x17" 1:10,000

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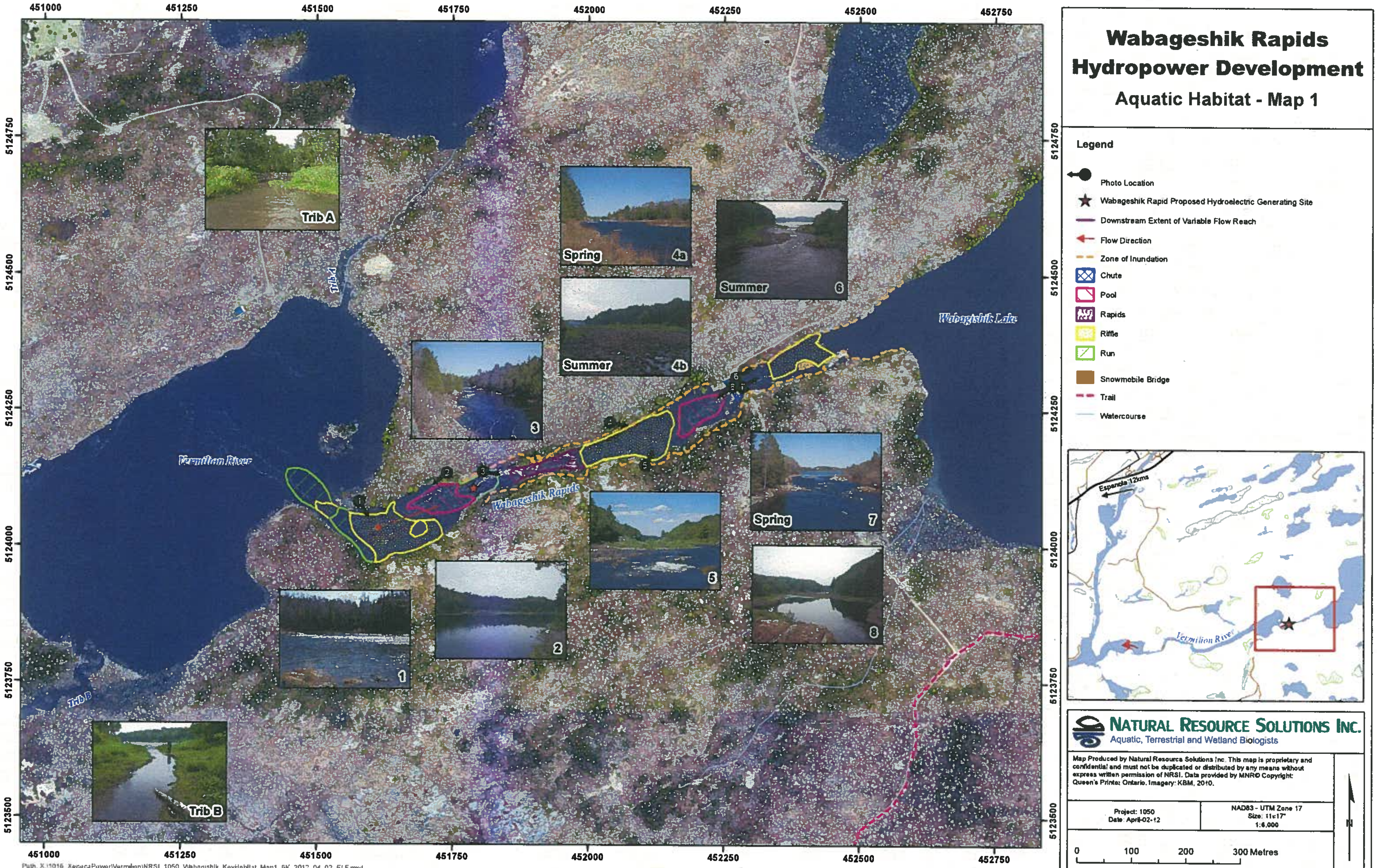
Wabageshik Rapids Hydropower Development

Aquatic Habitat - Map 1



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Project: 1050
Date: April-02-12

NAD83 - UTM Zone 17
Size: 11x17"
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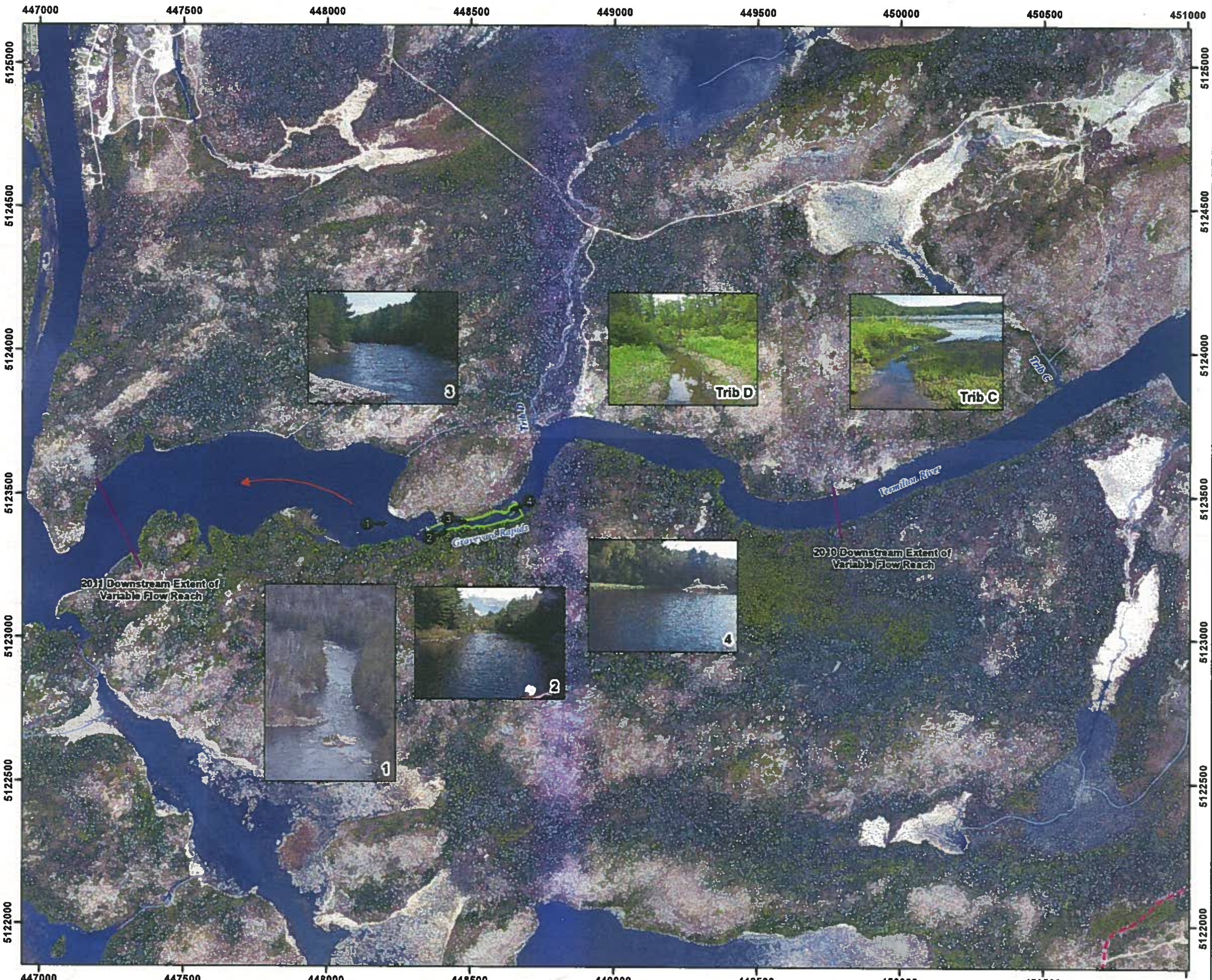
Wabageshik Rapids Hydropower Development

Aquatic Habitat - Map 2



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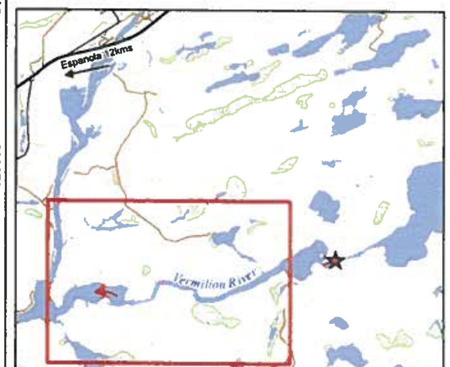
Legend

- Photo Location
- Downstream Extent of Variable Flow Reach
- Flow Direction
- Chute
- Pool
- Rapids
- Riffle
- Run
- Trail
- Watercourse



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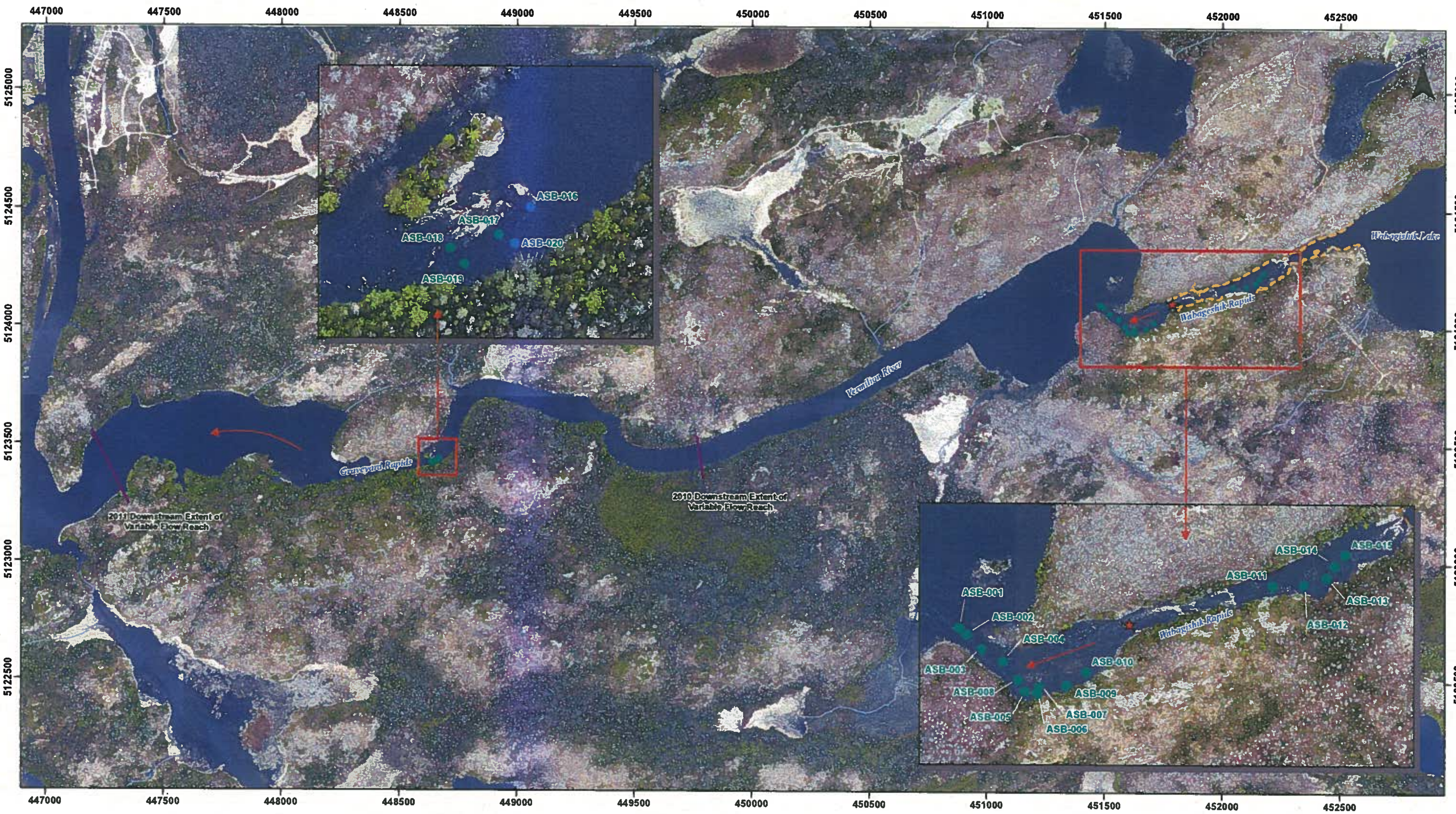

Wabageshik Rapids Hydroelectric Generating Station Project

Benthic Macroinvertebrate Sampling Locations

NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists

April 2, 2012. Project No. NRSI-1050
UTM Zone 17 NAD 83 Scale 1:15,000 (at 11x17")

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Legend

- Sampling Location
- Downstream Extent of Variable Flow Reach
- Wabageshik Rapid Proposed Hydroelectric Generating Site
- Zone of Inundation
- Flow Direction
- Primary Road
- Secondary Road
- Tertiary Road
- Watercourse
- Snowmobile Bridge

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APPENDIX II

AQUATIC ASSESSMENT RESULTS

1050 Vermilion River Wabagishik HD

Walleye Spawning Survey - 2010 Egg Mat Results

Station Label	Deployment Date	UTM Easting	UTM Northing	Number of Mats	Bottom Substrate	Water Temp When Deployed (°C)	Set Duration (hrs)	Number of Eggs	Species	Comments
EMD-001	20-Apr-10	452397	5124338	1	-	9.8	23:10	3	Walleye	Riffle
EMD-002	20-Apr-10	452343	5124312	1	-	9.8	23:10	3	White Sucker	-
EMD-003	20-Apr-10	452391	5124381	1	-	9.8	22:30	0	-	-
EMD-004	20-Apr-10	452370	5124364	1	-	9.8	0:36	0	-	-
EMD-005	20-Apr-10	452329	5124335	1	-	9.8	21:30	0	-	-
EMD-006	20-Apr-10	452104	5124161	1	-	9.8	18:04	0	-	Riffle
EMD-007	20-Apr-10	452061	5124177	1	-	9.8	-	-	-	egg mat was lost
EMD-008	20-Apr-10	452084	5124177	1	-	9.8	16:05	0	-	Riffle
EMD-009	20-Apr-10	452098	5124224	1	-	9.8	19:30	0	-	Riffle
EMD-010	20-Apr-10	452046	5124199	1	-	9.8	18:00	0	-	Riffle

*Note: (-) represents no data collected

1050 Vermilion River Wabagishik HD

Sturgeon Spawning Surveying - 2011 Egg Mat Results

Station Label	Deployment Date	UTM Easting	UTM Northing	Number of Mats	Bottom Substrate	Water Temp when Deployed (°C)	Set Duration (hrs)	Number of Eggs	Species	Comments
EMD-011	26-May-11	452453	5124353	1	Bedrock, Boulder, Cobble	14	24.30	0	-	Very Fast Flow/ Top of Rapids
EMD-012	26-May-11	452442	5124347	1	Bedrock, Boulder	14	24.50	0	-	Fast Flow
EMD-013	26-May-11	452433	5124344	1	Bedrock, Boulder	14	-	-	-	Fast line/Float line rope broke
EMD-014	26-May-11	452421	5124339	1	Bedrock, Boulder, Cobble	14	24.30	0	-	Slower Flow
EMD-015	26-May-11	452395	5124379	1	Boulder, Cobble	14	-	-	-	Very fast flow/Float line rope broke
EMD-016	26-May-11	452380	5124368	1	Boulder, Cobble	14	24.60	0	-	Very fast flow
EMD-017	26-May-11	452336	5124333	1	Boulder, Cobble	14	24.60	2	Walleye	Very fast flow
EMD-018	26-May-11	452327	5124330	1	Boulder, Cobble	14	24.80	0	-	Edge of flow
EMD-019	27-May-11	452457	5124357	1	Boulder, Cobble	14	24.50	0	-	Very fast flow
EMD-020	27-May-11	452446	5124351	1	Bedrock, Boulder	14	23.50	0	-	Fast Flow
EMD-021	27-May-11	452430	5124344	1	Bedrock, Boulder, Cobble	14	12:00	0	-	Slower Flow
EMD-022	27-May-11	452412	5124391	1	Boulder, Cobble	14	7:12	0	-	Fast Flow
EMD-023	27-May-11	452380	5124371	1	Boulder, Cobble	14	7:12	0	-	Edge of fast flow
EMD-024	27-May-11	452332	5124332	1	Boulder, Cobble	14	-	-	-	Very fast flow, Float line rope broke
EMD-025	27-May-11	452330	5124332	1	Boulder, Cobble	14	23.00	0	-	Edge of Flow
EMD-026	27-May-11	452270	5124299	1	Bedrock, Boulder	14	23.00	20	Walleye	Fast Flow
EMD-027	22-May-11	451604	5124060	1	Cobble	14	46.15	1	Sucker sp.	Fast Riffle
EMD-028	22-May-11	451572	5124039	1	-	14	46.00	1	Sucker sp.	Riffle
EMD-029	22-May-11	451553	5124054	1	Cobble	14	45.50	0	-	Fast Flow
EMD-030	22-May-11	451478	5124097	1	Cobble	14	45.15	3	Sucker sp.	Fast Flow
EMD-031	22-May-11	451466	5124112	1	Cobble	14	-	0	-	Fast Flow
EMD-032	22-May-11	451442	5124118	1	Cobble	14	-	0	-	Fast Flow
EMD-033	24-May-11	451532	5124050	1	Cobble	15	46.80	0	-	Run
EMD-034	24-May-11	448372	5123371	1	Bedrock, Boulder	15	-	0	-	Back Eddie
EMD-035	24-May-11	448355	5123422	1	-	15	71.50	16	Sucker sp.	Edge of main flow
EMD-036	24-May-11	448286	5123401	1	-	15	71.30	0	-	Slower Flow
EMD-037	26-May-11	451249	5124225	1	Gravel, Sand, Cobble	15	22.80	0	-	Edge of main flow, Shoal
EMD-038	26-May-11	451361	5124177	1	-	15	22.60	0	-	Edge of main flow
EMD-039	26-May-11	451403	5124119	1	-	15	22.50	7	Sucker sp.	Edge of main flow

1050 Vermilion River Wabagishik HD

Sturgeon Spawning Surveying - 2011 Egg Mat Results

Station Label	Deployment Date	UTM Easting	UTM Northing	Number of Mats	Bottom Substrate	Water Temp when Deployed (°C)	Set Duration (hrs)	Number of Eggs	Species	Comments
EMD-040	26-May-11	451531	5124032	1	Cobble	15	21.80	19	Sucker sp.	Run between Rapids
EMD-041	27-May-11	448354	5123414	1	-	15	24.00	1	Walleye	Edge of main flow
EMD-042	3-Jun-11	451462	5124113	1	Gravel, Cobble	17	70	12	Sucker sp.	Main Channel/Fast Flow
EMD-043	3-Jun-11	451443	5124122	1	Gravel, Cobble	17	69.5	6	Sucker sp.	-
EMD-044	3-Jun-11	451492	5124077	1	Gravel, Cobble	17	70.5	0	-	-
EMD-045	3-Jun-11	451558	5124031	1	Gravel, Cobble	17	70.5	0	-	-
EMD-046	3-Jun-11	448614	5123430	1	Gravel, Cobble	17	40.5	0	-	-
EMD-047	3-Jun-11	448599	5123428	1	Gravel, Cobble	17	40.5	0	-	-
EMD-048	3-Jun-11	448488	5123400	1	Gravel, Cobble	17	40	0	-	-
EMD-049	3-Jun-11	448581	5123426	1	Gravel, Cobble	17	40.25	0	-	-
EMD-050	5-Jun-11	448575	5123427	1	Gravel, Cobble	17	25.75	0	-	-
EMD-046	5-Jun-11	448614	5123430	1	Gravel, Cobble	17	25.5	0	-	-
EMD-047	5-Jun-11	448599	5123428	1	Gravel, Cobble	17	25.5	0	-	-
EMD-049	5-Jun-11	448581	5123426	1	Gravel, Cobble	17	25.5	0	-	-
EMD-050	5-Jun-11	448575	5123427	1	Gravel, Cobble	17	25.60	9	Sucker sp.	-

*Note: (-) represents no data collected

1050 Vermilion River Wabagishik HD

Walleye Spawning Survey - 2010 and 2011 Angling Results

Station Label	Date	UTM Easting	UTM Northing	Number of Anglers	Start Time	End Time	Elapsed Time	Species	Length (cm)	Spawning Condition			Sex		Total
										Green	Ripe	Spent	Male	Female	
ANG-001	18-Apr-10	451494	5124120	1	12:30	13:10	0:40	Northern Pike	52.6			1	NA	1	0
ANG-002	18-Apr-10	451607	5124061	1	-	-	-	Walleye	37.3		1		1	NA	1
ANG-003	18-Apr-10	452279	5124300	1	17:00	17:20	0:20	(No catch)	-				-	-	0
ANG-004	18-Apr-10	452251	5124247	1	17:15	17:30	0:15	(No catch)	-				-	-	0
ANG-005	19-Apr-10	451563	5124115	1	15:55	16:20	0:20	(No catch)	-				-	-	0
ANG-006	19-Apr-10	451539	5124072	1	17:05	17:35	0:30	(No catch)	-				-	-	0
ANG-007	19-Apr-10	451667	5124097	1	17:40	18:05	0:25	(No catch)	-				-	-	0
ANG-008	20-Apr-10	477546	5146367	1	18:45	19:00	0:15	(No catch)	-				-	-	0
ANG-009	23-May-11	451343	5123930	2	13:45	15:30	1:45	Northern Pike	45	1			Could not be sexed		6
								Northern Pike	47	1			Could not be sexed		
								Northern Pike	50	1			Could not be sexed		
								Northern Pike	55	1			Could not be sexed		
								Northern Pike	60			1	NA	1	
								Smallmouth Bass*	-		1		NA	1	
ANG-010	24-May-11	451200	5123977	2	13:30	15:45	2:15	Northern Pike	40	1			Could not be sexed		6
								Northern Pike	47	1			Could not be sexed		
								Northern Pike	50				-	-	
								Northern Pike	65			1	Could not be sexed		
								Smallmouth Bass*	-		1		NA	1	
								Smallmouth Bass*	-		1		NA	1	
ANG-011	25-May-11	451472	5124416	2	13:00	15:45	2:45	Northern Pike	42			1	Could not be sexed		4
								Northern Pike	70			1	Could not be sexed		
								Northern Pike	71			1	Could not be sexed		
								Smallmouth Bass*	-		1		1	NA	

*Note: (-) represents no data collected

(*) All Smallmouth Bass were released immediately following capture due to proximity to the spawn in order to prevent additional stress

(NA) Not Applicable

1050 Vermilion River Wabagishik HD

Angling for Mercury Analysis 2011

Station Label	Date	UTM Easting	UTM Northing	Number of Anglers	Start Time	End Time	Elapsed Time	Species	Length (cm)	Spawning Condition			Sex		Total
										Green	Ripe	Spent	Male	Female	
ANG-12	11-Aug-11	450959	5124115	2	13:30	14:30	1:00	Smallmouth Bass	338	1			1		1
ANG-13	12-Aug-11	451464	5124401	2	-	-	0:30	(No catch)	-				-	-	0
ANG-14	13-Aug-11	448453	5123403	2	-	-	1:30	(No catch)	-				-	-	0

*Note: (-) represents no data collected

(*) All Smallmouth Bass were released immediately following capture due to proximity to the spawn in order to prevent additional stress

(NA) Not Applicable

1050 Vermilion River Wabagishik HD

Summer Fish Community Sampling Gill Netting 2010

Station Label	Date Deployed	UTM Easting	UTM Northing	Time Deployed	Elapsed Time (hr)	Water Temperature (on day of set)	Mesh Size (see description below)	Net Length (m)	Net Height (m)	Water Depth (point A/point B) (m)	Net Orientation	Mesh Size (mm)	Species	Length (mm)		Weight (g)
														Fork	Total	
GND-001	4-Aug-10	451390	5124153	9:00	6:20	-	Large Rin	24.8	0.9	2.4/2.5	Against Current	64	Smallmouth Bass	310	320	240
												64	Smallmouth Bass	240	260	220
												64	Smallmouth Bass	320	345	580
												114	White Sucker	470	490	1280
												76	Smallmouth Bass	290	310	380
												76	Smallmouth Bass	315	325	480
												76	Smallmouth Bass	225	230	160
												76	Smallmouth Bass	285	300	360
GND-002	4-Aug-10	451469	5124211	10:00	7:03	-	Small Rin	12.5	0.9	3.0/4.9	Against Current	-	(no catch)	-	-	-
GIND-003	4-Aug-10	451460	5124148	10:15	7:08	-	Large Rin	24.8	0.9	2.0/2.1	Against Current	64	White Sucker	440	480	1240
												127	Shorthead Redhorse	490	560	2140
												38	Smallmouth Bass	120	140	40

*Note: (-) represents no data collected

1050 Vermilion River Wabagishik HD

Spring Sturgeon Gill Netting 2011

Station Label	Date Deployed	UTM Easting	UTM Northing	Time Deployed	Elapsed Time (hr)	Water Temperature (on day of set)	Mesh Size (see description below)	Net Length (m)	Net Height (m)	Water Depth (point A/point B) (m)	Net Orientation	Mesh Size (")	Species	Length (mm)		Weight (g)
														Fork	Total	
GND-004A/B	22-May-11	(A) 451445 (B) 451450	(A) 5124135 (B) 5124168	16:00	19:35	14	Extra Large RIN, 12"	50	2	2.7/3.9	Perpendicular	-	(no catch)	-	-	-
GND-005A/B	22-May-11	(A) 451336 (B) 451325	(A) 5124168 (B) 5124214	16:15	19:25	14	Extra Large RIN, 10"	50	2	4.0/4.6	Perpendicular	-	(no catch)	-	-	-
GND-006A/B	22-May-11	(A) 451355 (B) 451369	(A) 5124165 (B) 5124195	16:25	19:25	14	Extra Large RIN, 8"	50	2	3.0/3.8	Perpendicular	8	Northern Pike	750	770	-
GND-007A/B	23-May-11	(A) 451324 (B) 451294	(A) 5124273 (B) 5124285	15:50	19:10	15	Extra Large RIN, 10"	50	2	2.5/2.0	Perpendicular	-	(no catch)	-	-	-
GND-008A/B	23-May-11	(A) 451389 (B) 451368	(A) 5124138 (B) 5124182	16:00	19:15	15	Extra Large RIN, 8"	50	2	1.0/3.0	Perpendicular	-	(no catch)	-	-	-
GND-009A/B	23-May-11	(A) 451205 (B) 451205	(A) 5124265 (B) 5124232	16:20	18:30	15	Extra Large RIN, 12"	50	2	2.7/1.0	Perpendicular	-	(no catch)	-	-	-
GND-010A/B	24-May-11	(A) 451414 (B) 451387	(A) 5124178 (B) 5124168	16:35	19:05	15	Extra Large RIN, 12"	50	2	3.8/3.2	Perpendicular	-	(no catch)	-	-	-
GND-011A/B	24-May-11	(A) 451351 (B) 451295	(A) 5124180 (B) 5124186	16:45	19:10	15	Extra Large RIN, 10"	50	2	4.3/2.4	Perpendicular	-	(no catch)	-	-	-
GND-012A/B	24-May-11	(A) 448277 (B) 448265	(A) 5123375 (B) 5123339	17:20	17:40	15	Extra Large RIN, 8"	50	2	4.7/7.3	Perpendicular	-	(no catch)	-	-	-
GND-013A/B	25-May-11	(A) 450918 (B) 450907	(A) 5123975 (B) 5124037	17:30	20:40	16	Extra Large RIN, 10"	50	2	3.9/2.9	Perpendicular	-	(no catch)	-	-	-
GND-014A/B	25-May-11	(A) 449411 (B) 449373	(A) 5123522 (B) 5123512	17:50	20:40	16	Extra Large RIN, 12"	50	2	5.3/5.7	Perpendicular	-	(no catch)	-	-	-
GND-015A/B	25-May-11	(A) 448223 (B) 448206	(A) 5123389 (B) 5123343	18:10	18:40	16	Extra Large RIN, 8"	50	2	6.9/8.6	Perpendicular	-	(no catch)	-	-	-
GND-0016A/B	26-May-11	(A) 449395 (B) 449454	(A) 5123453 (B) 5123481	19:15	20:25	15	Extra Large RIN, 10"	50	2	3.7/6.0	Perpendicular	-	(no catch)	-	-	-
GND-017A/B	26-May-11	(A) 448350 (B) 448327	(A) 5123408 (B) 5123397	19:40	19:10	15	Extra Large RIN, 12"	50	2	6.0/4.0	Perpendicular	-	(no catch)	-	-	-
GND-018A/B	26-May-11	(A) 448127 (B) 448176	(A) 5123326 (B) 5123383	20:00	18:50	15	Extra Large RIN, 12"	50	2	9.7/10.3	Perpendicular	-	(no catch)	-	-	-
GND-019A/B	27-May-11	(A) 451040 (B) 451044	(A) 5124111 (B) 5124054	18:30	18:55	16	Extra Large RIN, 10"	50	2	3.8/3.5	Perpendicular	10	Northern Pike	790	845	3630
GND-020A/B	27-May-11	(A) 448305 (B) 448311	(A) 5123336 (B) 5123376	19:10	17:50	14	Extra Large RIN, 12"	50	2	7.0/6.5	Perpendicular	12	Northern Pike	680	735	2540
GND-021A/B	27-May-11	(A) 448208 (B) 448137	(A) 5123419 (B) 5123378	19:20	17:20	14	Extra Large RIN, 8"	50	2	8.5/9.0	Perpendicular	-	(no catch)	-	-	-
GND-022	3-Jun-11	451279	5124202	18:00	16:00	17	Extra Large RIN 10"	50	2	2.0/2.5	Perpendicular	-	(no catch)	-	-	-
GND-023	3-Jun-11	448268	5123376	19:15	16:00	17	Extra Large RIN, 10"	50	2	6.0/7.5	Perpendicular	-	(no catch)	-	-	-
GND-024	3-Jun-11	448158	5123444	19:25	16:11	17	Extra Large RIN, 10"	50	2	8.4/9.7	Against Current	-	(no catch)	-	-	-
GND-025A/B	4-Jun-11	451326	5124204	10:20	6:40	16	Extra Large RIN, 10"	50	2	5.3/3.0	Against Current	-	(no catch)	-	-	-
GND-026A/B	4-Jun-11	451326	5124204	17:00	18:00	16	Extra Large RIN, 10"	50	2	5.3/3.0	Against Current	-	(no catch)	-	-	-
GND-029A/B	4-Jun-11	448205	5123360	11:35	6:25	16	Extra Large RIN, 10"	50	2	8.1/9.0	Against Current	-	(no catch)	-	-	-
GND-030A/B	4-Jun-11	448205	5123360	18:05	15:50	16	Extra Large RIN, 10"	50	2	8.1/9.0	Against Current	-	(no catch)	-	-	-
GND-031A/B	5-Jun-11	448205	5123360	10:10	7:11	17	Extra Large RIN, 10"	50	2	8.1/9.0	Against Current	-	(no catch)	-	-	-
GND-032A/B	4-Jun-11	448245	5123348	11:50	6:25	16	Extra Large RIN, 10"	50	2	5.0/7.1	Against Current	-	(no catch)	-	-	-
GND-033A/B	4-Jun-11	448245	5123348	18:17	15:13	16	Extra Large RIN, 10"	50	2	5.0/7.1	Against Current	-	(no catch)	-	-	-
GND-034A/B	5-Jun-11	448245	5123348	9:45	7:40	17	Extra Large RIN, 10"	50	2	5.0/7.1	Against Current	-	(no catch)	-	-	-
GND-035A/B	5-Jun-11	448238	5123374	17:38	18:52	17	Extra Large RIN, 10"	50	2	6.3/8.1	Against Current	-	(no catch)	-	-	-
GND-036A/B	6-Jun-11	448238	5123383	17:45	19:05	17	Extra Large RIN, 10"	50	2	4.2/5.5	Perpendicular	-	(no catch)	-	-	-

1050 Vermilion River Wabagishik HD

Summer Fish Community Gill Netting 2011

Station Label	Date Deployed	UTM Easting	UTM Northing	Time Deployed	Elapsed Time (hr)	Water Temperature (on day of set)	Mesh Size (see description below)	Net Length (m)	Net Height (m)	Water Depth (point A/point B) (m)	Net Orientation	Mesh Size (mm)	Species	Length (mm)		Weight (g)
														Fork	Total	
GND-037	10-Aug-11	451185	5124246	16:30	17:20	24.5	Large RIN	24.8	0.9	1.7/1.6	Perpendicular	76	Smallmouth Bass	340	360	630
												76	Smallmouth Bass	267	280	290
												76	Smallmouth Bass	-	-	-
												76	White Sucker	452	490	1210
												76	Rock Bass	250	260	430
												76	Brown Bullhead	-	290	410
												51	Rock Bass	209	215	260
												51	Rock Bass	139	140	150
												51	Walleye	264	282	160
												51	Walleye	285	303	240
												51	White Sucker	439	470	1230
												89	White Sucker	402	439	1030
												51	White Sucker	338	344	272
												89	Rock Bass	226	235	280
												38	Walleye	198	210	80
												38	Smallmouth Bass	-	130	65
												38	Walleye	171	182	65
												127	Silver Redhorse	462	520	1770
												64	Northern Pike	640	685	2040
GND-038	10-Aug-11	450946	5124105	16:40	19:10	24.5	Large RIN	24.8	0.9	2.1/2.6	Perpendicular	114	Smallmouth Bass	363	382	1020
												51	Smallmouth Bass	179	187	65
												89	White Sucker	410	441	910
												64	Walleye	290	310	260
												64	Walleye	318	332	310
												102	Smallmouth Bass	365	387	790
GND-039	10-Aug-11	450725	5123927	16:45	18:31	24.5	Large RIN	24.8	0.9	2.0/3.9	Perpendicular	76	Rock Bass	224	230	290
												76	Brown Bullhead	298	305	400
												51	Smallmouth Bass	195	202	130
												51	Smallmouth Bass	292	309	400
												89	Rock Bass	202	210	210

1050 Vermilion River Wabagishik HD

Summer Fish Community Gill Netting 2011

Station Label	Date Deployed	UTM Easting	UTM Northing	Time Deployed	Elapsed Time (hr)	Water Temperature (on day of set)	Mesh Size (see description below)	Net Length (m)	Net Height (m)	Water Depth (point A/point B) (m)	Net Orientation	Mesh Size (mm)	Species	Length (mm)		Weight (g)
														Fork	Total	
GND-040	10-Aug-11	450460	5123768	16:50	18:55	24.5	Large RIN	24.8	0.9	4.0/3.5	Perpendicular	64	Rock Bass	172	179	50
												89	White Sucker	440	472	1210
												114	Silver Redhorse	495	555	1960
												76	Rock Bass	195	202	57
												76	Rock Bass	187	194	55
												76	White Sucker	337	360	540
												76	Rock Bass	180	185	55
												76	Rock Bass	206	211	63
GND-041	10-Aug-11	450201	5123650	17:00	19:15	24.5	Large RIN	24.8	0.9	3/2.6	Perpendicular	89	Rock Bass	248	238	310
												102	White Sucker	-	-	-
												102	White Sucker	510	465	1410
GND-042	10-Aug-11	449919	5123532	17:10	19:20	25	Large RIN	24.8	0.9	2.9/3.8	Perpendicular	51	Rock Bass	138	130	40
												64	Smallmouth Bass	228	215	110
GND-043	10-Aug-11	449639	5123456	17:20	19:20	24.5	Large RIN	24.8	0.9	2.8/4.5	Perpendicular	64	Northern Pike	389	361	350
												89	Smallmouth Bass	461	438	740
												89	White Sucker	478	450	1270
												89	Smallmouth Bass	482	450	1500
												89	White Sucker	482	450	1240
												89	White Sucker	428	393	920
												51	Northern Pike	400	375	320
												51	Pumpkinseed	315	310	50
GND-044	11-Aug-11	449396	5123484	16:00	18:30	25	Large RIN	24.8	0.9	2.5/6	Perpendicular	38	Rock Bass	-	105	50
												89	Rock Bass	236	230	27
												89	Smallmouth Bass	331	312	480
												51	Rock Bass	152	150	60
												51	Rock Bass	142	140	55
												76	Rock Bass	174	168	67
GND-045	11-Aug-11	449237	5123673	16:15	18:30	25	Large RIN	24.8	0.9	2.2/5.6	Perpendicular	102	White Sucker	458	430	1200
												102	Smallmouth Bass	334	314	680
												64	Rock Bass	179	171	128
												38	Walleye	206	290	74
												89	Rock Bass	247	238	300
												51	Rock Bass	130	127	55
												51	Smallmouth Bass	205	195	85

1050 Vermilion River Wabagishik HD

Summer Fish Community Gill Netting 2011

Station Label	Date Deployed	UTM Easting	UTM Northing	Time Deployed	Elapsed Time (hr)	Water Temperature (on day of set)	Mesh Size (see description below)	Net Length (m)	Net Height (m)	Water Depth (point A/point B) (m)	Net Orientation	Mesh Size (mm)	Species	Length (mm)		Weight (g)
														Fork	Total	
GND-046	11-Aug-11	448978	5123727	16:25	18:27	25	Large RIN	24.8	0.9	2.5/5	Perpendicular	76	Rock Bass	213	208	160
												114	Silver Redhorse	522	463	1730
												51	Rock Bass	140	135	-
												51	Smallmouth Bass	228	213	150
												51	Rock Bass	193	185	131
												89	Rock Bass	241	235	310
												89	Redhorse	362	320	610
												89	Rock Bass	225	219	250
												89	White Sucker	427	390	920
GND-047	11-Aug-11	448723	5123608	16:30	19:06	25	Large RIN	24.8	0.9	2.2/4.8	Perpendicular	114	Rock Bass	265	257	450
												51	Rock Bass	135	130	60
												89	White Sucker	470	446	1190
												89	Smallmouth Bass	365	348	670
												89	Smallmouth Bass	340	321	540
												38	Rock Bass	110	100	40
												64	Rock Bass	190	183	145
												102	Smallmouth Bass	373	353	720
GND-048	11-Aug-11	448230	5123360	16:50	19:10	25	Large RIN	24.8	0.9	4.5/7.9	Perpendicular	89	Brown Bullhead	327	320	430
												89	Rock Bass	259	250	430
												51	Rock Bass	138	136	60
												76	Rock Bass	217	211	230
												76	Rock Bass	390	386	170
GND-049	11-Aug-11	447966	5123469	17:00	19:20	24	Large RIN	24.8	0.9	2/2.8	Perpendicular	64	Northern Pike	408	380	380
												64	Rock Bass	173	168	147
												51	Yellow Perch	200	190	90
												51	Northern Pike	400	375	390
GND-050	11-Aug-11	447683	5123571	17:20	19:15	24	Large RIN	24.8	0.9	11/12.5	Perpendicular	64	Cisco	280	251	230
GND-051	12-Aug-11	447362	5123620	14:20	18:25	25	Large RIN	24.8	0.9	3/9.5	Perpendicular	114	White Sucker	477	440	1170

1050 Vermilion River Wabagishik HD

Mercury Sample Gill Netting 2011

Station Label	Date Deployed	UTM Easting	UTM Northing	Time Deployed	Elapsed Time (hr)	Water Temperature (on day of set)	Mesh Size (see description below)	Net Length (m)	Net Height (m)	Water Depth (point A/point B) (m)	Net Orientation	Mesh Size (mm)	Species	Length (mm)		Weight (g)
														Fork	Total	
GND-052	12-Aug-11	450787	5123971	16:00	18:20	25	Large RIN	24.8	0.9	2/3.5	Perpendicular	102	White Sucker	493	458	1420
												64	Northern Pike	450	422	620
												64	Silver Redhorse	520	455	1540
												38	Walleye	220	189	110
												76	Rock Bass	220	213	230
GND-053	12-Aug-11	450917	5124085	16:20	18:10	25	Large RIN	24.8	0.9	2.1/2.9	Perpendicular	102	White Sucker	440	415	1010
												51	Smallmouth Bass	214	201	130
												114	White Sucker	473	444	1200
GND-054	13-Aug-11	451396	5124364	16:00	17:30	25	Large RIN	24.8	0.9	3.2/3.0	Perpendicular	64	Smallmouth Bass	269	252	283
												64	Walleye	261	250	369
												64	Northern Pike	570	540	1049
												64	Smallmouth Bass	291	279	369
												38	Walleye	212	201	198
												89	Smallmouth Bass	350	328	482
												89	Rock Bass	240	230	283
												51	Rock Bass	165	158	142
												51	Rock Bass	155	150	128
												76	Rock Bass	195	190	227
GND-055	13-Aug-11	451218	5124260	16:15	17:45	25	Large RIN	24.8	0.9	2.1/2.9	Perpendicular	102	White Sucker	445	413	840
												102	Smallmouth Bass	350	336	580
												127	White Sucker	520	490	1530
												89	Rock Bass	235	225	300
												89	White Sucker	423	295	830
												51	Rock Bass	203	195	80
												114	White Sucker	-	-	-
												114	Smallmouth Bass	340	401	950
												76	White Sucker	431	320	620
												76	Rock Bass	190	185	70
												76	Rock Bass	230	228	260
												76	Walleye	360	345	440
GND-056	13-Aug-11	451098	5124174	16:30	18:30	25	Large RIN			3.2/3.5	Perpendicular	38	Rock Bass	108	106	40
												38	Rock Bass	374	367	130

*Note: (-) represents no data collected

1050 Vermilion River Wabagishik HD

Summer Fish Survey - 2011 Trot Line

Station Label	Date Deployed	UTM Northing	UTM Easting	Time Deployed	Elapsed Time (hr)	Water Temperature (°C)	Line Length (m)	Hook Interval (m)	Total Number of Hooks	Water Depth (point A/point B) (m)	Net Orientation	Species	Length (mm)		Weight (g)	Comments
													Fork	Total		
STL-001A/B	22-May-11	(A) 451481 (B) 451440	(A) 5124083 (B) 5124109	12:15	19:15	14	40	3	13	3/3	Parallel	Northern Pike	-	-	-	Escape
STL-002A/B	23-May-11	(A) 451469 (B) 451431	(A) 5124132 (B) 5124143	12:35	2:25	15	40	3	13	1.9/19	Parallel	Northern Pike	570	540	900	none
STL-003A/B	23-May-11	(A) 451461 (B) 451423	(A) 5124138 (B) 5124148	15:30	20:15	15	40	3	13	3/3	Perpendicular	(no catch)	-	-	-	-
STL-004A/B	24-May-11	(A) 451239 (B) 451193	(A) 5124272 (B) 5124260	16:00	19:55	15	40	3	13	4/4	Parallel	Shorthead Redhorse	510	460	1630	none
STL-005	25-May-11	451083.00	5124175.00	17:20	21:20	15	40	3	13	425/4.5	Parallel	Northern Pike	540	515	-	none
STL-006A/B	26-May-11	(A) 450988 (B) 450946	(A) 5124117 (B) 5124104	18:45	21:15	15	40	3	13	3.8/3.8	Parallel	Northern Pike	760	-	-	none
STL-007A/B	27-May-11	(A) 451367 (B) 451357	(A) 5124165 (B) 5124169	18:20	19:25	16	40	3	13	14/14	Parallel	(no catch)	-	-	-	-
STL-008A/B	03-Jun-11	(A) 451086 (B) 451074	(A) 5124185 (B) 5124137	17:45	16:00	17	40	3	12	2.6/5.5	angled 45°	Smallmouth Bass	330	350	397	none
												White Sucker	435	470	1106	
												Smallmouth Bass	275	285	284	
												Smallmouth Bass	390	410	879	
STL-009A/B	03-Jun-11	(A) 448362 (B) 448325	(A) 5123415 (B) 5123415	19:00	16:40	17	40	3	12	2.5/5	angled 45°	Northern Pike	500	530	-	No Scale
												Rock Bass	184	188	-	
												Burbot	-	360	-	
STL-010A/B	04-Jun-11	(A) 451086 (B) 451074	(A) 5124185 (B) 5124137	17:20	18:20	16	40	3	12	2.5/5	angled 45°	(no catch)	-	-	-	No Scale
STL-011A/B	04-Jun-11	(A) 448362 (B) 448325	(A) 5123415 (B) 5123415	18:30	15:40	16	40	3	12	2.5/5	angled 45°	(no catch)	-	-	-	No Scale
STL-012A/B	05-Jun-11	(A) 451086 (B) 451074	(A) 5124185 (B) 5124137	16:50	19:20	17	40	3	12	2.5/5	angled 45°	Rock Bass	155	160	-	No Scale
												Rock Bass	185	195	-	
												Rock Bass	195	205	-	
STL-013A/B	05-Jun-11	(A) 448192 (B) 448190	(A) 5123365 (B) 5123393	18:10	18:50	17	40	3	12	8/9	angled 45°	White Sucker	505	550	-	No Scale
												Brown Bullhead	323	330	-	

*Note: (-) represents no data collected

1050 Vermilion River Wabagishik HD

Summer Fish Survey - 2010 Electrofishing Results

Station Label	Date	UTM Easting	UTM Northing	Pulsating Frequency (Hz)	Voltage	Start Time	End Time	Shocking seconds	Species	Weight (g) - bulk if multiple collected	Number Collected
EMS-001	4-Aug-10	451502	5124099	60	450	11:20	-	537	Johnny Darter	3.8	4
									Logperch	89	10
									Longnose Dace	5.6	-
									Smallmouth Bass	9	2
EMS-002	4-Aug-10	451548	5124046	60	500	11:55	12:15	321	Smallmouth Bass	2	-
									Mudpuppy	6	-
									Logperch	21.4	24
EMS-003	4-Aug-10	452022	5124199	60	500	13:17	13:37	703	Logperch	1.3	-
									Smallmouth Bass	16.8	5
									Longnose Dace	2.1	2
									White Sucker	2.5	-
EMS-004	4-Aug-10	452169	5124246	60	500	13:58	14:24	406	Smallmouth Bass	27	6
									Logperch	19.5	8

*Note: (-) represents no data collected

1050 Vermilion River Wabagishik HD

Summer Fish Survey - 2011 Electrofishing Results

Station Label	Date	UTM Easting	UTM Northing	Pulsating Frequency (Hz)	Voltage	Start Time	End Time	Shocking Seconds	Species	Weight (g) - bulk if multiple collected	Number Collected
EMS-005	14-Aug-11	451509	5124090	60	300	11:35	11:50	337	Logperch	62.8	30
									Smallmouth Bass	12.2	2
									Longnose Dace	6.7	1
									Emerald Shiner	4.4	2
									Bluntnose Minnow	4.6	2
EMS-006	14-Aug-11	451595	5124006	60	300	12:20	12:30	509	Rock Bass	20.5	1
									Smallmouth Bass	20.5	3
									Johnny Darter	10.4	4
									Logperch	14.1	11
EMS-007	14-Aug-11	451678	5124004	60	300	13:10	13:20	519	Rock Bass	21.9	1
									Smallmouth Bass	25.3	4
									Logperch	17.4	17
									Johnny Darter	1.4	2
									Northern Pike	29.7	1
									Emerald Shiner	6.1	2
EMS-008	14-Aug-11	451689	5124046	60	300	13:45	14:00	636	Rock Bass	295	2
									Smallmouth Bass	28.8	6
									Bluntnose Minnow	1.2	1
									Emerald Shiner	1.3	1
									Logperch	447	19
									Johnny Darter	0.3	1
EMS-009	14-Aug-11	452072	5124183	60	300	14:40	14:50	325	White Sucker	7.4	2
									Smallmouth Bass	11.1	1
									Logperch	3.2	1
									Johnny Darter	1.2	1
EMS-011	14-Aug-11	452366	5124334	60	250	15:40	15:50	161	Smallmouth Bass	19.4	3
									Logperch	8.4	2

1050 Vermilion River Wabagishik HD

Summer Fish Survey - 2011 Electrofishing Results

Station Label	Date	UTM Easting	UTM Northing	Pulsating Frequency (Hz)	Voltage	Start Time	End Time	Shocking Seconds	Species	Weight (g) - bulk if multiple collected	Number Collected
EMS-012	14-Aug-11	451085	5123841	60	250	17:45	18:00	517	Northern Pike	371	2
									Brown Bullhead	7.1	1
									Yellow Perch	6.8	1
									Smallmouth Bass	7.4	1
									Central Mudminnow	200.1	76
EMS-013	14-Aug-11	450549	5123889	60	250	18:40	19:13	414	Brook Stickleback	96.9	197
									Northern Redbelly Dace	14.7	17
									Johnny Darter	2.1	5
									yoy Sunfish	0.8	1
									Fathead Minnow	2.4	2
									Central Mudminnow	43.3	17
EMS-014	14-Aug-11	448738	5123728	60	250	20:00	20:10	177	Smallmouth Bass	16.4	3
									Emerald Shiner	3.1	4

*Note: (-) represents no data collected

1050 Vermilion River Wabagishik HD

Summer Fish Survey - 2011 Minnow Trapping Results

Station Label	Date Deployed	UTM Easting	UTM Northing	Time Deployed	Elapsed Time (hr)	Bait	Species	Total Length (mm)	Fork Length (mm)	Weight (g) - Bulk if Multiple Collected	Bulk Tally	Comments
MNT-001	12-Aug-11	451388	5123907	9:00	-	Cat food	-	-	-	-	-	Stolen
MNT-002	12-Aug-11	447560	5123336	11:00	48.00	Cat food	Pumpkinseed	7.1	6.8	15.9	3	
MNT-003	12-Aug-11	447380	5123694	15:00	46	Cat food	Rock Bass	39	37	2.1	1	
							Pumpkinseed	65	57	7.3	2	
MNT-004	12-Aug-11	448716	5123738	15:45	54.5	Cat food	Smallmouth Bass	17.1	16.4	53.7	1	
MNT-005	12-Aug-11	451546	5124434	14:30	50	Cat food	Yellow Perch	103	97	11.7	1	
							Brown Bullhead	75	57	10.8	4	
MNT-006	12-Aug-11	451626	5124229	15:00	50	Cat food	Northern Pike (Head)	-	-	-	-	
MNT-007	12-Aug-11	451065	5123868	15:45	51	Cat food	Yellow Perch	67	65	2.3	1	
MNT-008	12-Aug-11	448277	5123619	9:30	47	Cat food	(no catch)	-	-	-	-	
MNT-009	12-Aug-11	447998	5123354	10:00	46.5	Cat food	(no catch)	-	-	-	-	
MNT-010	13-Aug-11	450567	5123890	11:00	29	Cat food	(no catch)	-	-	-	-	
MNT-011	13-Aug-11	451477	5124165	15:00	28	Cat food	(no catch)	-	-	-	-	
MNT-012	13-Aug-11	451463	5124115	-	-	Cat food	Smallmouth Bass	77	69	7	1	
							Logperch	94	77	90.9	18	
MNT-013	13-Aug-11	451429	5124091	-	-	Cat food	Rock Bass	75	74	6.2	1	
MNT-014	13-Aug-11	451622	5124049	-	-	Cat food	Logperch	92	88	17.6	3	
MNT-015	13-Aug-11	451584	5124022	-	-	Cat food	(no catch)	-	-	-	-	

*Note: (-) represents no data collected

1050 Vermilion River Wabagishik HD

Benthic Habitat 2011

Immediately below proposed Wabagishik Rapids GS Location: Placed on Edges of Channel

	ASB-001		ASB-002		ASB-003		ASB-004		ASB-005	
	Installation	**Retrieval**	**Installation**	**Retrieval**	**Installation**	**Retrieval**	**Installation**	**Retrieval**	**Installation**	**Retrieval**
Date	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11
Time	11:32	15:00	11:46	15:20	11:48	15:30	12:38	14:45	12:43	14:40
Water Temperature (C)	22.5	15.8	22.5	15.8	22.5	15.8	22.5	15.8	22.5	15.7
Dissolved Oxygen (ppm)	10.3	10.77	10.26	13.45	10.38	-	10.34	9.92	10.28	12.00
pH	8.4	8.2	8.4	8.2	8.4	8.2	8.4	8.2	8.4	8.2
Dominant Substrate	Cobble	Cobble	Cobble	Cobble	Cobble	Cobble	Cobble	Cobble	Pebble	Pebble
Water Depth (m)	0.41	0.45	0.36	0.38	0.42	0.38	0.46	0.48	0.39	0.39
Hydraulic Head (mm)	30	5	95	90	30	30	0	3	60	45

Immediately below proposed Wabagishik Rapids GS Location: Placed in Middle of Channel

	ASB-006		ASB-007		ASB-008		ASB-009		ASB-010	
	Installation	**Retrieval**	**Installation**	**Retrieval**	**Installation**	**Retrieval**	**Installation**	**Retrieval**	**Installation**	**Retrieval**
Date	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11
Time	12:53	14:30	13:30	14:27	13:16	14:25	13:28	14:10	13:33	13:55
Water Temperature (C)	22.5	15.8	22.5	15.8	22.5	15.8	22.5	15.8	22.5	15.8
Dissolved Oxygen (ppm)	10.38	11.93	10.22	12.14	10.2	11.40	10.31	-	10.27	-
pH	8.4	8.2	8.4	8.2	8.4	8.2	8.4	8.2	8.4	8.1
Dominant Substrate	Pebble	Pebble	Pebble	Pebble	Pebble	Pebble	Pebble	Pebble	Cobble	Cobble
Water Depth (m)	0.30	0.23	0.38	0.46	0.70	0.34	0.40	0.54	0.27	0.36
Hydraulic Head (mm)	70	60	65	50	60	15	110	90	90	100

1050 Vermilion River Wabagishik HD

Benthic Habitat 2011

Upstream of Proposed Wabageshik Rapids GS Location

	ASB-011		ASB-012		ASB-013		ASB-014		ASB-015	
	Installation	Retrieval	Installation	Retrieval	Installation	Retrieval	Installation	Retrieval	Installation	Retrieval
Date	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11
Time	15:15	13:25	15:37	13:15	15:47	13:05	15:50	12:55	15:53	12:35
Water Temperature (C)	22.1	15.8	22.1	15.8	22.1	15.8	22.1	15.7	22.1	15.7
Dissolved Oxygen (ppm)	10.26	10.75	10.32	10.34	10.23	10.22	10.34	-	10.31	-
pH	8.4	8.2	8.4	8.2	8.4	8.2	8.4	8.3	8.4	8.3
Dominant Substrate	Cobble	Cobble	Cobble	Cobble	Cobble	Cobble	Cobble	Cobble	Cobble	Cobble
Water Depth (m)	0.21	0.23	0.17	0.23	0.30	0.38	0.41	0.56	0.34	0.35
Hydraulic Head (mm)	10	0	35	5	70	80	70	110	30	10

Rapids Located 4km Downstream of Wabageshik Rapids

	ASB-016		ASB-017		ASB-018		ASB-019		ASB-020	
	Installation	Retrieval	Installation	Retrieval	Installation	Retrieval	Installation	Retrieval	Installation	Retrieval
Date	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11	30-Aug-11	13-Oct-11
Time	17:06	16:30	17:08	16:25	17:13	16:15	17:18	17:00	17:20	16:45
Water Temperature (C)	-	15.6	-	15.5	-	15.6	-	15.6	-	15.6
Dissolved Oxygen (ppm)	-	8.48	-	7.77	-	8.03	-	8.49	-	8.78
pH	-	8.2	-	8.2	-	8.1	-	8.1	-	8.1
Dominant Substrate	Boulder	Boulder	Boulder	Boulder	Boulder	Boulder	Boulder	Boulder	Cobble	Cobble
Water Depth (m)	0.37	0.07	0.24	0.29	0.42	0.60	0.36	0.36	0.45	0.52
Hydraulic Head (mm)	0	0	0	0	0	0	0	0	2	2

1050 Vermilion River Wabagishik HD

Benthic Indicies 2011

Immediately below proposed Wabagishik Rapids GS Location: Placed on Edges of Channel

	ASB-001	ASB-002	ASB-003	ASB-004	ASB-005	Average	Standard Error	95% Confidence Interval		Minimum	Maximum
								Lower	Upper		
Organism Density (no./m^2)	2744	2350	2931	2125	2631	2427	334	2092	2761	1231	3856
Taxa Richness	23	15	18	18	15	18	1	16	19	15	23
Simpson's Diversity Index	0.76	0.76	0.76	0.87	0.74	0.75	0.03	0.72	0.79	0.66	0.88
EPT Density	115	247	364	163	328	259	61	199	320	91	503
% EPT	26.20%	65.69%	77.61%	47.94%	77.91%	64.15%	8.92%	55.24%	73.07%	26.20%	83.42%
Dominant Taxon (Trichoptera)	24.83%	65.43%	76.76%	47.06%	77.20%	63.24%	8.98%	54.26%	72.22%	24.83%	82.57%
% Odonota	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
% Other Dipterans	0.91%	0.53%	0.85%	2.94%	0.95%	1.03%	0.35%	0.69%	1.38%	0.00%	2.94%
% Chironomidae	52.16%	31.38%	18.55%	39.12%	14.25%	27.68%	7.46%	20.21%	35.14%	9.40%	52.16%
% Oligochaeta	16.86%	1.06%	1.07%	6.18%	1.90%	3.31%	2.25%	1.06%	5.56%	0.51%	16.86%
% Turbellaria	3.19%	1.33%	1.92%	3.82%	4.99%	3.68%	0.94%	2.74%	4.61%	1.33%	7.56%
% Other	0.68%	0.00%	0.00%	0.00%	0.00%	0.14%	0.11%	0.03%	0.26%	0.00%	0.68%
% Scrapers	0.00%	0.00%	0.00%	0.00%	0.00%	0.05%	0.07%	-0.02%	0.12%	0.00%	0.51%
% Shredders	1.59%	8.78%	5.33%	4.12%	1.66%	4.14%	1.34%	2.80%	5.47%	1.52%	9.78%
% Collecters	75.17%	86.97%	88.06%	72.06%	85.51%	83.43%	3.08%	80.35%	86.51%	72.06%	91.88%
% Engulfers	2.28%	1.86%	2.56%	11.18%	4.04%	4.31%	1.23%	3.07%	5.54%	1.86%	11.18%
% Piercers	0.68%	0.00%	1.07%	2.65%	1.90%	0.98%	0.35%	0.63%	1.33%	0.00%	2.65%
% Other	20.27%	2.39%	2.99%	10.00%	6.89%	7.09%	2.45%	4.64%	9.55%	2.39%	20.27%

1050 Vermilion River Wabagishik HD

Benthic Indicies 2011

Immediately below proposed Wabagishik Rapids GS Location: Placed in Middle of Channel

	ASB-006	ASB-007	ASB-008	ASB-009	ASB-010	Average	Standard Error	95% Confidence Interval		Minimum	Maximum
								Lower	Upper		
Organism Density (no./m^2)	2413	3856	1231	1406	2581	2427	661	1766	3087	1231	3856
Taxa Richness	17	20	15	17	17	18	1	17	18	15	23
Simpson's Diversity Index	0.66	0.68	0.71	0.88	0.70	1	0.07	0.68	0.83	0.66	0.88
EPT Density	322	503	91	117	343	259	103	156	363	91	503
% EPT	83.42%	81.52%	46.19%	52.00%	83.05%	71.78%	8.78%	62.99%	80.56%	36.70%	91.32%
Dominant Taxon (Trichoptera)	82.12%	80.55%	45.69%	50.22%	82.57%	69.82%	9.23%	60.59%	79.05%	30.85%	89.65%
% Odonota	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
% Other Dipterans	1.55%	0.97%	0.00%	0.89%	0.73%	0.59%	0.21%	0.38%	0.80%	0.00%	1.55%
% Chironomidae	11.92%	9.40%	51.27%	37.33%	11.38%	18.09%	6.69%	11.40%	24.79%	4.51%	51.27%
% Oligochaeta	0.52%	1.62%	0.51%	2.22%	1.21%	0.62%	0.36%	0.27%	0.98%	0.00%	2.22%
% Turbellaria	2.59%	6.48%	1.52%	7.56%	3.39%	8.84%	5.23%	3.61%	14.07%	1.52%	39.89%
% Other	0.00%	0.00%	0.51%	0.00%	0.24%	0.07%	0.08%	0.00%	0.15%	0.00%	0.51%
% Scrapers	0.00%	0.00%	0.51%	0.00%	0.00%	0.10%	0.10%	0.01%	0.20%	0.00%	0.53%
% Shredders	2.85%	2.11%	1.52%	9.78%	3.63%	5.54%	2.03%	3.50%	7.57%	1.50%	15.96%
% Collecters	89.38%	85.90%	91.88%	74.67%	84.75%	80.16%	7.97%	72.19%	88.13%	32.98%	92.99%
% Engulfers	3.89%	3.57%	2.54%	4.89%	6.30%	4.24%	1.16%	3.08%	5.41%	1.67%	10.64%
% Piercers	0.78%	0.32%	1.02%	0.89%	0.48%	0.42%	0.16%	0.26%	0.58%	0.00%	1.02%
% Other	3.11%	8.10%	2.54%	9.78%	4.84%	9.54%	5.13%	4.41%	14.67%	1.83%	39.89%

1050 Vermilion River Wabagishik HD

Benthic Indicies 2011

Upstream of Proposed Wabageshik Rapids GS Location

	ASB-011	ASB-012	ASB-013	ASB-014	ASB-015	Average	Standard Error	95% Confidence Interval		Minimum	Maximum
								Lower	Upper		
Organism Density (no./m^2)	1175	2575	3744	3756	5875	3425	819	2606	4244	1175	5875
Taxa Richness	16	16	16	15	16	16	1	14	17	15	16
Simpson's Diversity Index	0.79	0.68	0.34	0.47	0.47	0.55	0.09	0.46	0.64	0.34	0.79
EPT Density	69	293	547	544	770	445	125	320	570	69	770
% EPT	36.70%	71.12%	91.32%	90.52%	81.91%	74.31%	15.23%	59.08%	89.54%	36.70%	91.32%
Dominant Taxon (Trichoptera)	30.85%	66.02%	89.65%	89.35%	81.17%	71.41%	15.66%	55.75%	87.06%	30.85%	89.65%
% Odonota	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.07%	-1.07%	1.07%	0.00%	0.00%
% Other Dipterans	0.53%	0.24%	0.50%	0.17%	0.32%	0.35%	9.86%	-9.50%	10.21%	0.17%	0.53%
% Chironomidae	22.87%	12.86%	4.51%	7.49%	11.91%	11.93%	8.35%	3.58%	20.28%	4.51%	22.87%
% Oligochaeta	0.00%	0.00%	0.00%	0.17%	0.00%	0.03%	2.31%	-2.28%	2.34%	0.00%	0.17%
% Turbellaria	39.89%	15.78%	3.67%	1.66%	5.85%	13.37%	5.42%	7.95%	18.79%	1.66%	39.89%
% Other	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.19%	-4.19%	4.19%	0.00%	0.00%
% Scrapers	0.53%	0.00%	0.00%	0.00%	0.00%	0.11%	1.77%	-1.67%	1.88%	0.00%	0.53%
% Shredders	15.96%	6.31%	1.50%	4.49%	7.23%	7.10%	3.30%	3.80%	10.40%	1.50%	15.96%
% Collecters	32.98%	74.51%	92.99%	91.01%	83.51%	75.00%	9.77%	65.24%	84.77%	32.98%	92.99%
% Engulfers	10.64%	3.16%	1.67%	2.50%	3.30%	4.25%	2.85%	1.40%	7.10%	1.67%	10.64%
% Piercers	0.00%	0.24%	0.17%	0.17%	0.11%	0.14%	0.43%	-0.29%	0.57%	0.00%	0.24%
% Other	39.89%	15.78%	3.67%	1.83%	5.85%	13.40%	5.88%	7.52%	19.28%	1.83%	39.89%

1050 Vermilion River Wabagishik HD

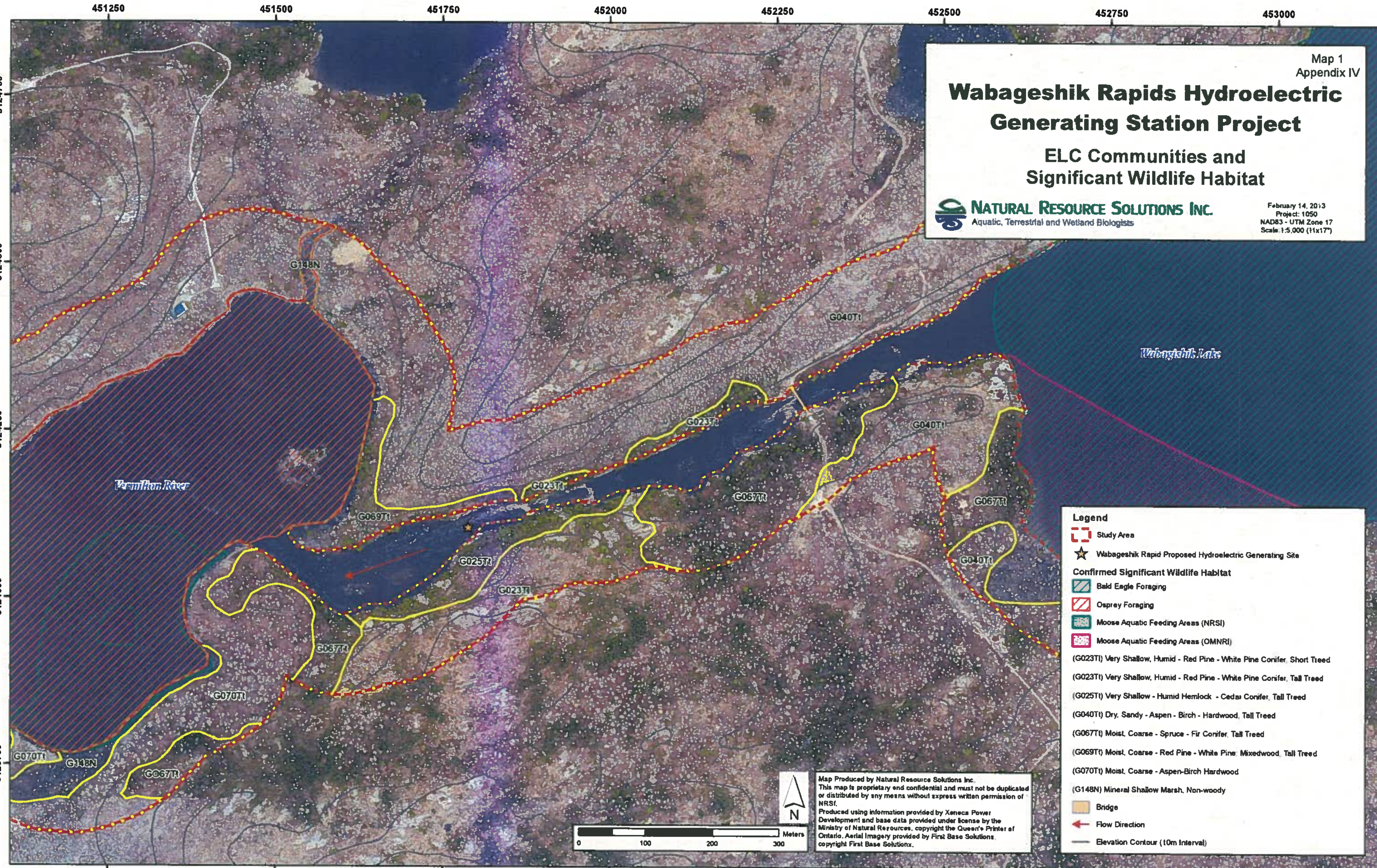
Benthic Indicies 2011

Rapids Located 4km Downstream of Wabageshik Rapids

	ASB-016	ASB-017	ASB-018	ASB-019	ASB-020	Average	Standard Error	95% Confidence Interval		Minimum	Maximum
								Lower	Upper		
Organism Density (no./m^2)	856	488	1094	481	825	749	118	631	866	481	1094
Taxa Richness	23	20	24	18	21	21	1	20	22	18	24
Simpson's Diversity Index	0.87	0.91	0.84	0.86	0.69	0.83	0.04	0.79	0.87	0.69	0.91
EPT Density	50	5	131	13	20	44	23	21	67	5	131
% EPT	36.50%	6.41%	74.86%	16.88%	9.09%	28.75%	12.67%	16.07%	41.42%	6.41%	74.86%
Dominant Taxon (Trichoptera)	35.77%	3.85%	54.86%	2.60%	6.82%	20.78%	10.48%	10.29%	31.26%	2.60%	54.86%
% Odonota	1.46%	5.13%	0.00%	6.49%	1.52%	2.92%	1.23%	1.69%	4.15%	0.00%	6.49%
% Other Dipterans	0.73%	1.28%	4.00%	0.00%	70.45%	15.29%	13.81%	1.49%	29.10%	0.00%	70.45%
% Chironomidae	51.82%	39.74%	20.00%	51.95%	3.79%	33.46%	9.43%	24.03%	42.90%	3.79%	51.95%
% Oligochaeta	0.00%	16.67%	1.14%	1.30%	1.52%	4.12%	3.15%	0.98%	7.27%	0.00%	16.67%
% Turbellaria	3.65%	8.97%	0.00%	0.00%	2.27%	2.98%	1.65%	1.33%	4.63%	0.00%	8.97%
% Other	5.84%	21.79%	0.00%	23.38%	0.76%	10.35%	5.10%	5.25%	15.45%	0.00%	23.38%
% Scrapers	0.00%	1.28%	12.00%	3.90%	6.06%	4.65%	2.12%	2.53%	6.76%	0.00%	12.00%
% Shredders	13.87%	24.36%	4.00%	10.39%	0.76%	10.67%	4.13%	6.55%	14.80%	0.76%	24.36%
% Collecters	70.07%	30.77%	80.00%	58.44%	66.67%	61.19%	8.35%	52.84%	69.54%	30.77%	80.00%
% Engulfers	8.03%	10.26%	1.71%	12.99%	21.21%	10.84%	3.19%	7.65%	14.03%	1.71%	21.21%
% Piercers	2.19%	2.56%	1.14%	1.30%	0.00%	1.44%	0.45%	0.99%	1.89%	0.00%	2.56%
% Other	5.84%	30.77%	1.14%	12.99%	5.30%	11.21%	5.25%	5.96%	16.46%	1.14%	30.77%

APPENDIX III

TERRESTRIAL ASSESSMENT MAPPING



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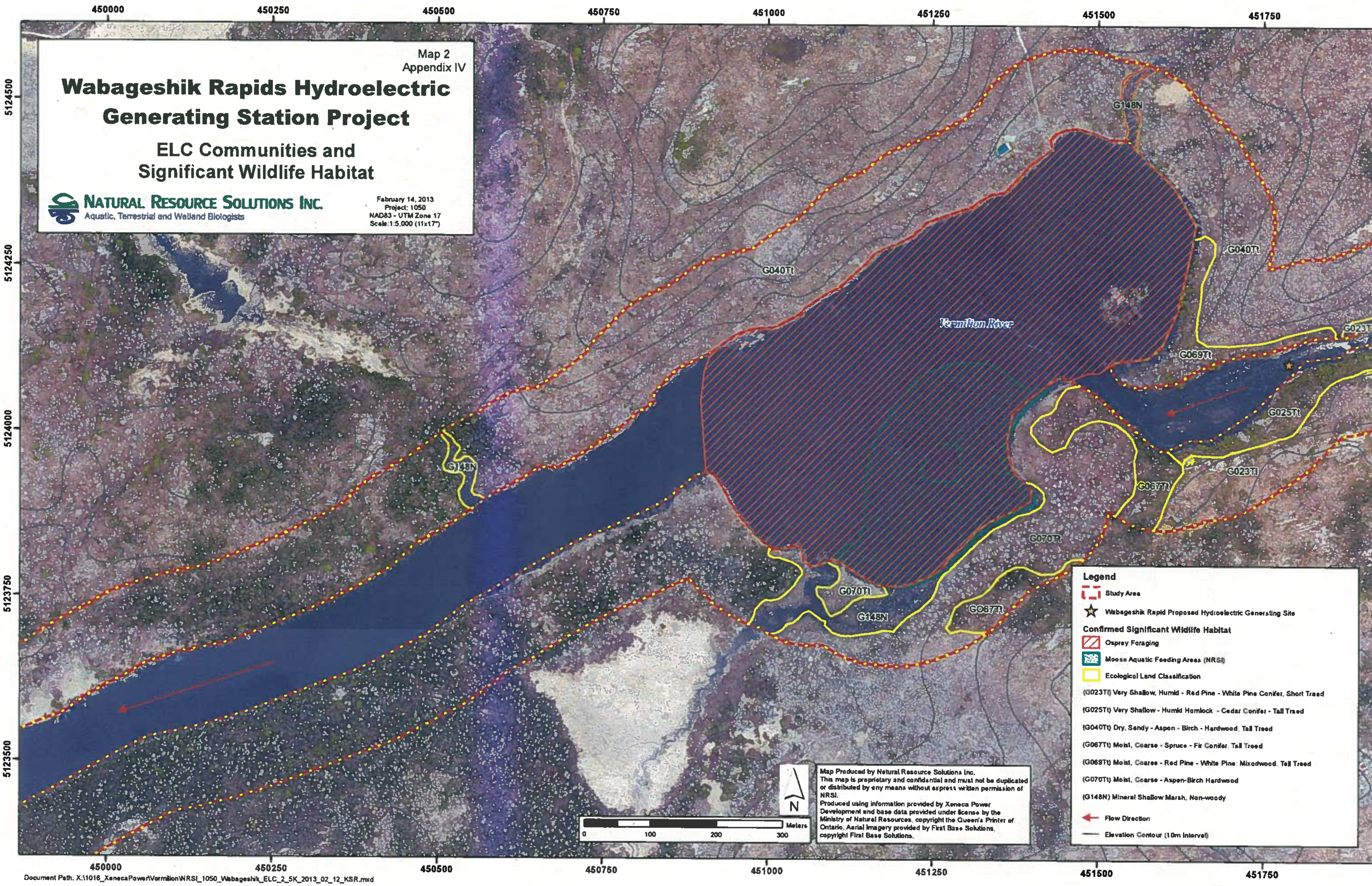
Map 2
Appendix IV
Wabageshik Rapids Hydroelectric Generating Station Project
ELC Communities and Significant Wildlife Habitat
NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists
February 14, 2013
Project: 1050
NAD83 - UTM Zone 17
Scale 1:5,000 (11x17")
Vermilion River
G040Tt
G148N
G023Tt
G069Tt
G025Tt
G067Tt
G070Tt
Legend
Study Area
Wabageshik Rapid Proposed Hydroelectric Generating Site
Confirmed Significant Wildlife Habitat
Osprey Foraging
Moose Aquatic Feeding Areas (NRSI)
Ecological Land Classification
(G023Tt) Very Shallow, Humid - Red Pine - White Pine Conifer, Short Treed
(G025Tt) Very Shallow - Humid Hemlock - Cedar Conifer - Tall Treed
(G040Tt) Dry, Sandy - Aspen - Birch - Hardwood, Tall Treed
(G067Tt) Moist, Coarse - Spruce - Fir Conifer, Tall Treed
(G069Tt) Moist, Coarse - Red Pine - White Pine: Mixedwood, Tall Treed
(G070Tt) Moist, Coarse - Aspen-Birch Hardwood
(G148N) Mineral Shallow Marsh, Non-woody
Flow Direction
Elevation Contour (10m Interval)
N
0 100 200 300 Meters
Map Produced by Natural Resource Solutions Inc.
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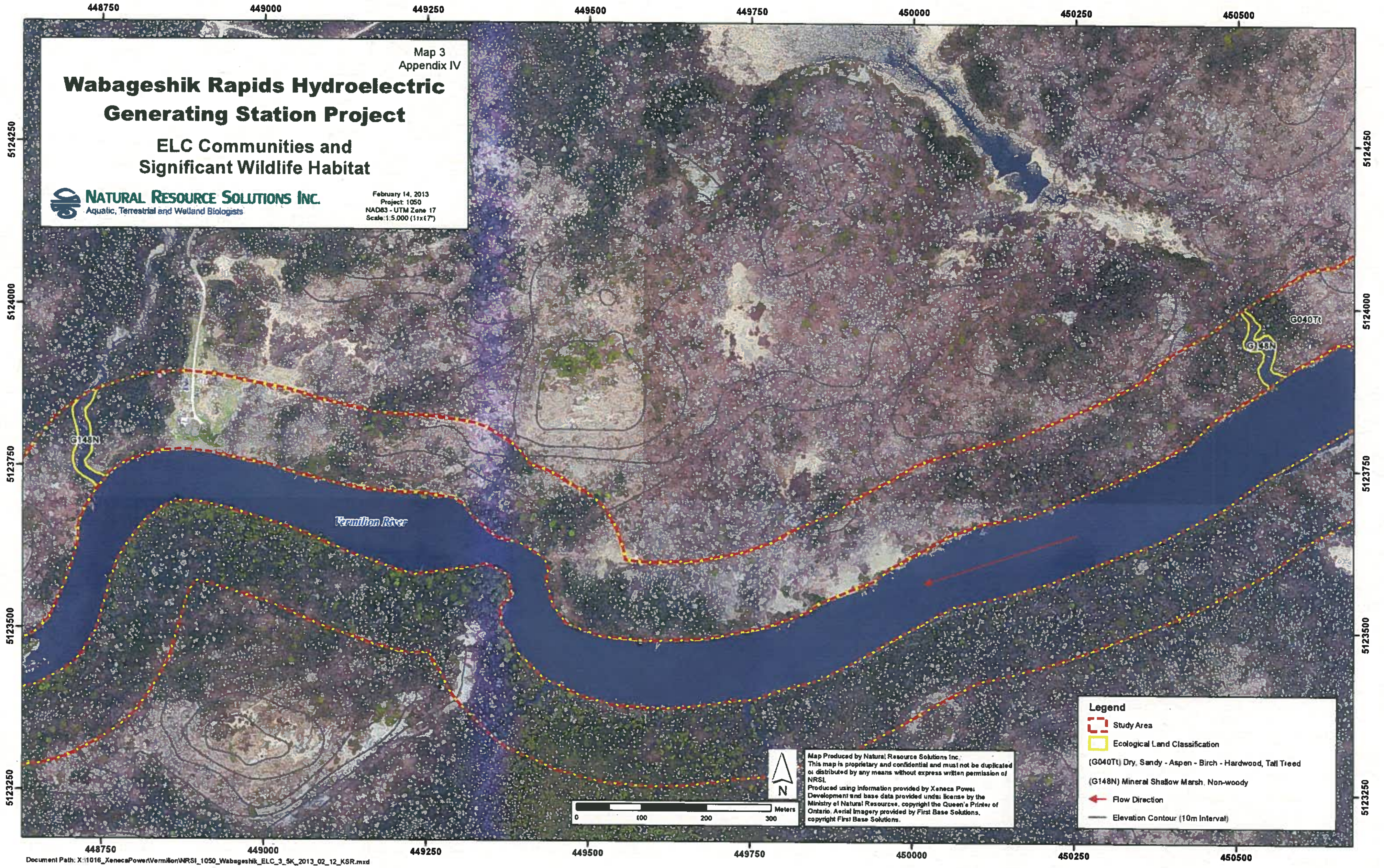
Map 3
Appendix IV
Wabageshik Rapids Hydroelectric Generating Station Project
ELC Communities and Significant Wildlife Habitat
NATURAL RESOURCE SOLUTIONS INC.
Aquatic, Terrestrial and Wetland Biologists
February 14, 2013
Project: 1050
NAD83 - UTM Zone 17
Scale 1:5,000 (11x17")
Vermilion River
G040Tt
G148N
Legend
Study Area
Ecological Land Classification
(G040Tt) Dry, Sandy - Aspen - Birch - Hardwood, Tall Treed
(G148N) Mineral Shallow Marsh, Non-woody
Flow Direction
Elevation Contour (10m Interval)
Map Produced by Natural Resource Solutions Inc.
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Produced using information provided by Xeneca Power Development and base data provided under license by the Ministry of Natural Resources, copyright the Queen's Printer of Ontario. Aerial Imagery provided by First Base Solutions, copyright First Base Solutions.
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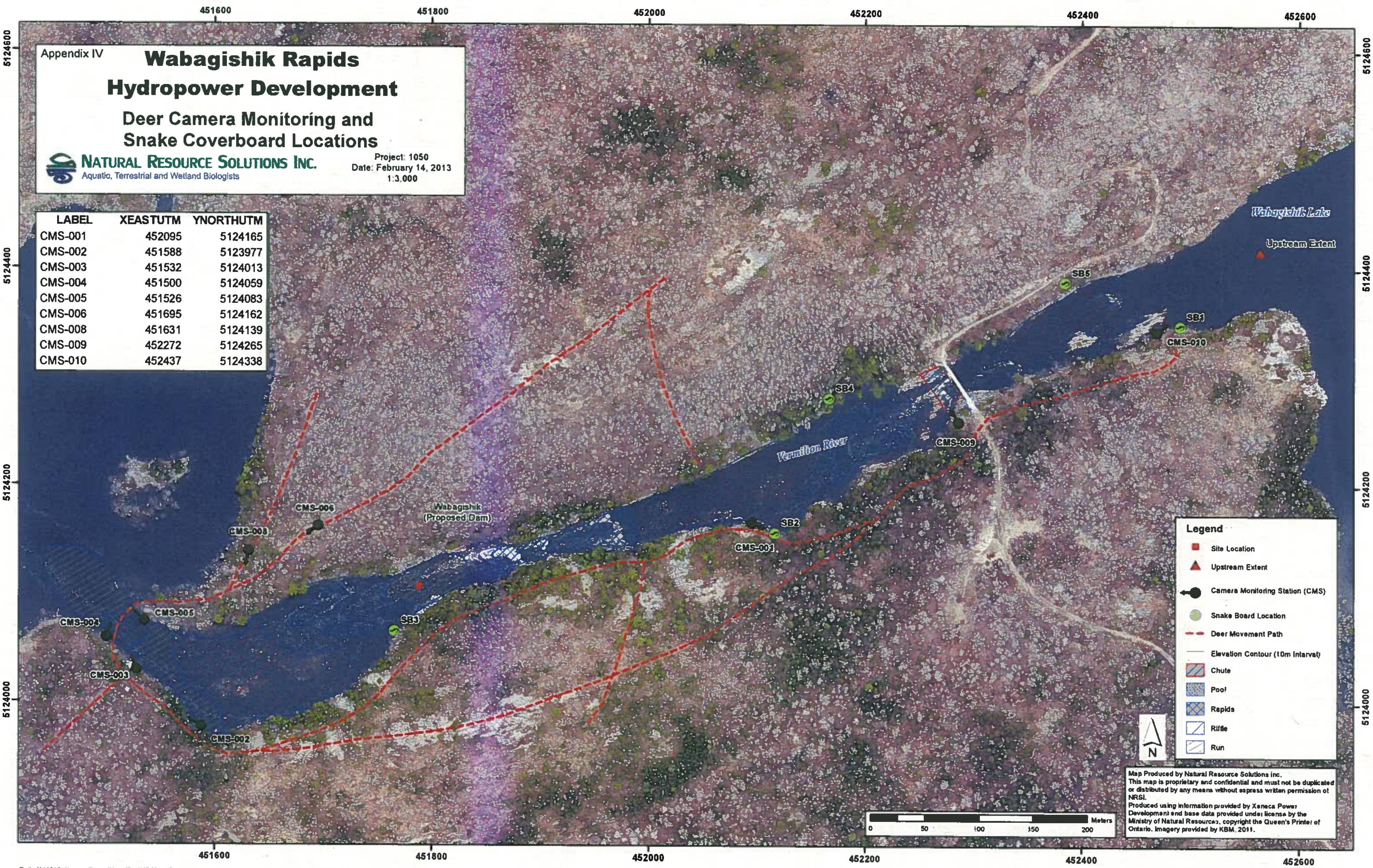

LABEL	XEASTUTM	YNORTHUTM
CMS-001	452095	5124165
CMS-002	451588	5123977
CMS-003	451532	5124013
CMS-004	451500	5124059
CMS-005	451526	5124083
CMS-006	451695	5124162
CMS-008	451631	5124139
CMS-009	452272	5124265
CMS-010	452437	5124338

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APPENDIX IV

VEGETATION INVENTORY

Appendix IV. Vegetation Reported From the Study Area

Common Name	Botanical Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	Coefficient of Conservation[4]	Wetness Index[4]	Weediness Index[4]
FERNS & ALLIES	**PTERIDOPHYTES**						
Bracken Fern Family	**Dennstaedtiaceae**						
Eastern Bracken	*Pteridium aquilinum var. latiusculum*	S5			2	3	
Wood Fern Family	**Dryopteridaceae**						
Northern Lady Fern	*Athyrium filix-femina var. angustum*	S5			4	0	
Sensitive Fern	*Onoclea sensibilis*	S5			4	-3	
Horsetail Family	**Equisetaceae**						
Water Horsetail	*Equisetum fluviatile*	S5			7	-5	
Royal Fern Family	**Osmundaceae**						
Cinnamon Fern	*Osmunda cinnamomea*	S5			7	-3	
Interrupted Fern	*Osmunda claytoniana*	S5			7	-1	
American Royal Fern	*Osmunda regalis var. spectabilis*	S5			7	-5	
CONIFERS	**GYMNOSPERMS**						
Cypress Family	**Cupressaceae**						
White Cedar	*Thuja occidentalis*	S5			4	-3	
Pine Family	**Pinaceae**						
Balsam Fir	*Abies balsamea*	S5			5	-3	
White Spruce	*Picea glauca*	S5			6	3	
Black Spruce	*Picea mariana*	S5			8	-3	
Red Pine	*Pinus resinosa*	S5			8	3	
Eastern White Pine	*Pinus strobus*	S5			4	3	
DICOTS	**DICOTYLEDONS**						
Maple Family	**Aceraceae**						
Red Maple	*Acer rubrum*	S5			4	0	
Mountain Maple	*Acer spicatum*	S5			6	3	
Freeman's Maple	*Acer X freemanii*						
Sumac or Cashew Family	**Anacardiaceae**						
Staghorn Sumac	*Rhus hirta*	S5			1	5	
Carrot or Parsley Family	**Apiaceae**						
Wild Carrot	*Daucus carota*	SE5				5	-2
Hemlock Water-parsnip	*Sium suave*	S5			4	-5	
Ginseng Family	**Araliaceae**						
Sarsaparilla	*Aralia elata*	SE1				5	-1
Milkweed Family	**Asclepiadaceae**						
Common Milkweed	*Asclepias syriaca*	S5			0	5	
Composite or Aster Family	**Asteraceae**						
Yarrow	*Achillea millefolium ssp. borealis*	SU					

Common Name	Botanical Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	Coefficient of Conservation[4]	Wetness Index[4]	Weediness Index[4]
Devil's Paintbrush	*Hieracium aurantiacum*	SE5				5	-2
Field Hawkweed	*Hieracium caespitosum ssp. caespitosum*	SE5				5	-2
Ox-eye Daisy	*Leucanthemum vulgare*	SE5				5	-1
Canada Goldenrod	*Solidago canadensis*	S5			1	3	
Rush Aster	*Symphyotrichum boreale*	S5			10	-5	
Touch-me-not Family	**Balsaminaceae**						
Spotted Touch-me-not	*Impatiens capensis*	S5			4	-3	
Birch Family	**Betulaceae**						
Speckled Alder	*Alnus incana spp. rugosa*	S5			6	-5	
White Birch	*Betula papyrifera*	S5				2	
Bellflower Family	**Campanulaceae**						
Blue Bells of Scotland	*Campanula rotundifolia*	S5			7	1	
Cardinal-flower	*Lobelia cardinalis*	S5			7	-5	
Honeysuckle Family	**Caprifoliaceae**						
High Bush Cranberry	*Viburnum trilobum*	S5			5	-3	
Pink Family	**Caryophyllaceae**						
Mouse-ear Chickweed	*Cerastium glomeratum*	SE2				5	-1
Hornwort Family	**Ceratophyllaceae**						
Common Coontail	*Ceratophyllum demersum*	S5			4	-5	
Dogwood Family	**Cornaceae**						
Bunchberry	*Cornus canadensis*	S5			7	0	
Red-osier Dogwood	*Cornus stolonifera*	S5			2	-3	
Sundew Family	**Droseraceae**						
Round-leaved Sundew	*Drosera rotundifolia*	S5			7	-5	
Heath Family	**Ericaceae**						
Wintergreen	*Gaultheria procumbens*	S5			6	3	
Low Sweet Blueberry	*Vaccinium angustifolium*	S5			6	3	
Pea Family	**Fabaceae**						
Bird's-foot Trefoil	*Lotus corniculatus*	SE5				1	-2
Tufted Vetch	*Vicia cracca*	SE5				5	-1
Beech Family	**Fagaceae**						
Red Oak	*Quercus rubra*	S5			6	3	
Geranium Family	**Geraniaceae**						
Spotted Crane's-bill	*Geranium maculatum*	S5			6	3	
St. John's-wort Family	**Guttiferae**						
Common St. John's-wort	*Hypericum perforatum*	SE5				5	-3
Swamp St. John's-wort	*Triadenum virginicum*	S4			10	-5	

Common Name	Botanical Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	Coefficient of Conservation[4]	Wetness Index[4]	Weediness Index[4]
Mint Family	**Lamiaceae**						
Northern Water-horehound	*Lycopus uniflorus*	S5			5	-5	
American Wild Mint	*Mentha arvensis ssp. borealis*	S5			3	-3	
Heal-all	*Prunella vulgaris ssp. lanceolata*	S5			5	5	
Hooded Skullcap	*Scutellaria galericulata*	S5			6	-5	
Wax-myrtle Family	**Myricaceae**						
Sweetfern	*Comptonia peregrina*	S5			7	5	
Sweet Gale	*Myrica gale*	S5			6	-5	
Water-lily Family	**Nymphaeaceae**						
Fragrant White Water-lily	*Nymphaea odorata spp. odorata*	SU					
Olive Family	**Oleaceae**						
Ash Species	*Fraxinus sp.*						
Green Ash	*Fraxinus pennsylvanica*	S5			3	-3	
Plantain Family	**Plantaginaceae**						
Ribgrass	*Plantago lanceolata*	SE5				0	-1
Milkwort Family	**Polygalaceae**						
Gay Wings	*Polygala paucifolia*	S5			6	3	
Smartweed Family	**Polygonaceae**						
Fringed Black Bindweed	*Polygonum cilinode*	S5			2	5	
Primrose Family	**Primulaceae**						
Swamp Loosestrife	*Lysimachia terrestris*	S5			6	-5	
Star-flower	*Trientalis borealis ssp. borealis*	S5			6	-1	
Buttercup Family	**Ranunculaceae**						
Buttercup Species	*Ranunculus sp.*						
Tall Meadow-rue	*Thalictrum pubescens*	S5			5	-2	
Rose Family	**Rosaceae**						
Marsh Cinquefoil	*Comarum palustre*	S5			7	-5	
Woodland Strawberry	*Fragaria vesca ssp. americana*	S5			4	4	
Wild Strawberry	*Fragaria virginiana*	S5					
Ninebark	*Physocarpus opulifolius*	S5			5	-2	
Choke Cherry	*Prunus virginiana ssp. virginiana*	S5			2	1	
Smooth Rose	*Rosa blanda*	S5			3	3	
Alleghany Blackberry	*Rubus allegheniensis*	S5			2	2	
Red Raspberry	*Rubus idaeus ssp. idaeus*	SE1					
Showy Mountain-ash	*Sorbus decora*	S5			8	3	
Barren Strawberry	*Waldsteinia fragarioides*	S5			5	5	
Madder Family	**Rubiaceae**						
Sweet-scented Bedstraw	*Galium triflorum*	S5			4	2	

Common Name	Botanical Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	Coefficient of Conservation[4]	Wetness Index[4]	Weediness Index[4]
Willow Family	**Salicaceae**						
Large-tooth Aspen	*Populus grandidentata*	S5			5	3	
Trembling Aspen	*Populus tremuloides*	S5			2	0	
Balsam Willow	*Salix pyrifolia*	S5			10	-4	
MONOCOTS	**MONOCOTYLEDONS**						
Water-plantain Family	**Alismataceae**						
Common Water-plantain	*Alisma plantago-aquatica*	S5			3	-5	
Broad-leaved Arrowhead	*Sagittaria latifolia*	S5			4	-5	
Sedge Family	**Cyperaceae**						
Fringed Sedge	*Carex crinita*	S5			6	-4	
Lake-bank Sedge	*Carex lacustris*	S5			5	-5	
Bristle-stalked Sedge	*Carex leptalea ssp. leptalea*	S5			8	-5	
Cypress-like Sedge	*Carex pseudocyperus*	S5			6	-5	
Greenish Sedge	*Carex viridula ssp. viridula*	S5			5	-5	
Small's Spike-rush	*Eleocharis smallii*	S5			6	-5	
	Scirpus caespitosus						
Wool-grass	*Scirpus cyperinus var. cyperinus*	S5			4	-5	
Small-fruited Bulrush	*Scirpus microcarpus*	S5			4	-5	
Frog's-bit Family	**Hydrocharitaceae**						
Canada Waterweed	*Elodea canadensis*	S5			4	-5	
Water-celery	*Vallisneria americana*	S5			6	-5	
Iris Family	**Iridaceae**						
Multi-coloured Blue-flag	*Iris versicolor*	S5			5	-5	
Montane Blue-eyed-grass	*Sisyrinchium montanum*	S5				-1	
Lesser Duckweed	*Lemna minor*	S5			2	-5	
Greater Duckweed	*Spirodela polyrhiza*	S5			4	-5	
Lily Family	**Liliaceae**						
Bluebead-lily	*Clintonia borealis*	S5			7	-1	
Wild Lily-of-the-valley	*Maianthemum canadense*	S5			5	0	
Nodding Trillium	*Trillium cernuum*	S5			8	0	
Grass Family	**Poaceae**						
Blue-joint Grass	*Calamagrostis canadensis*	S5			4	-5	
Tall Manna Grass	*Glyceria grandis*	S4S5			5	-5	
Fowl Meadow Grass	*Glyceria striata*	S5			3	-5	
Canada Blue Grass	*Poa compressa*	S5			0	2	
Tall Cord Grass	*Spartina pectinata*	S4			7	-4	
Pondweed Family	**Potamogetonaceae**						
Nuttall's Pondweed	*Potamogeton epihydrus*	S4S5			5	-5	
Grass-like Pondweed	*Potamogeton gramineus*	S5			4	-5	
Common Floating Pondweed	*Potamogeton natans*	S5			5	-5	
Richardson's Pondweed	*Potamogeton richardsonii*	S5			5	-5	
Flat-stemmed Pondweed	*Potamogeton zosteriformis*	S5			5	-5	

Common Name	Botanical Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	Coefficient of Conservation[4]	Wetness Index[4]	Weediness Index[4]
Bur-reed Family	**Sparganiaceae**						
Broad-fruited Bur-reed	*Sparganium eurycarpum*	S5			3	-5	
Cattail Family	**Typhaceae**						
Broad-leaved Cattail	*Typha latifolia*	S5			3	-5	

[1] NHIC 2012, [2] OMNR 2012, [3] COSEWIC 2012, [4] Oldham et al 1993

Legend
SRANK (Provincial Rank)
S4 - Apparently Secure
S5 - Secure
S4S5 - Range Rank
SU - Unrankable
SE - Exotic

APPENDIX V

BIRD SPECIES LIST

Appendix V. Birds Reported From the Study Area

Common Name	Scientific Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	OBBA[4] First Atlas	OBBA[4] Second Atlas	2010 Breeding Bird Surveys (Highest Breeding Evidence)	2010 Incidentals	2011 Incidentals
DUCKS, GEESE & SWANS									
Wood Duck	*Aix sponsa*	S5				FY			
American Black Duck	*Anas rubripes*	S4				P	H		
Mallard	*Anas platyrhynchos*	S5			SH	H	H		X
Blue-winged Teal	*Anas discors*	S4				P			
Green-winged Teal	*Anas crecca*	S4				P			
Ring-necked Duck	*Aythya collaris*	S5						X	
Canada Goose	*Branta canadensis*	S5				FY		X	X
Hooded Merganser	*Lophodytes cucullatus*	S5B, S5N			SH	FY			
Common Merganser	*Mergus merganser*	S5B, S5N			FY	H	H		X
PARTRIDGES, GROUSE & TURKEYS									
Ruffed Grouse	*Bonasa umbellus*	S4			SH	H			X
LOONS									
Common Loon	*Gavia immer*	S5B, S5N	NAR	NAR	FY	FY	H		X
GREBES									
Pied-billed Grebe	*Podilymbus podiceps*	S4B, S4N				P			
CORMORANTS									
Double-crested Cormorant	*Phalacrocorax auritus*	S5B	NAR	NAR				X	
HERONS & BITTERNS									
American Bittern	*Botaurus lentiginosus*	S4B				H			
Great Blue Heron	*Ardea herodias*	S4B					H		X
HAWKS, KITES & EAGLES									
Osprey	*Pandion haliaetus*	S5B			SH	H		X	X
Bald Eagle	*Haliaeetus leucocephalus*	S2N, S4B	SC	NAR			P		X
Northern Harrier	*Circus cyaneus*	S4B	NAR	NAR		CF		X	
Sharp-shinned Hawk	*Accipiter striatus*	S5	NAR			CF			
Broad-winged Hawk	*Buteo platypterus*	S5B			P	AE	H		X
Red-tailed Hawk	*Buteo jamaicensis*	S5	NAR	NAR		T			
CARACARAS & FALCONS									
American Kestrel	*Falco sparverius*	S4			SM	H			
Merlin	*Falco columbarius*	S5B	NAR	NAR		H	H		
RAILS, GALLINULES & COOTS									
Virginia Rail	*Rallus limicola*	S5B				T			
Sora	*Porzana carolina*	S4B				T			
CRANES									
Sandhill Crane	*Grus canadensis*	S5B							
PLOVERS									
Killdeer	*Charadrius vociferus*	S5B, S5N			SM	H			
SANDPIPERS & PHALAROPES									
Spotted Sandpiper	*Actitis macularia*	S5			SH		FY		
American Woodcock	*Scolopax minor*	S4B			SH	S			

Common Name	Scientific Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	OBBA[4] First Atlas	OBBA[4] Second Atlas	2010 Breeding Bird Surveys (Highest Breeding Evidence)	2010 Incidentals	2011 Incidentals
GULLS, TERNS & SKIMMERS									
Ring-billed Gull	*Larus delawarensis*	S5B, S4N					X		X
Herring Gull	*Larus argentatus*	S5B, S5N					X		
Common Tern	*Sterna hirundo*	S4B	NAR	NAR	SH				
PIGEONS & DOVES									
Mourning Dove	*Zenaida macroura*	S5				P			
CUCKOOS & ANIS									
Yellow-billed Cuckoo	*Coccyzus americanus*	S4B				S			
Black-billed Cuckoo	*Coccyzus erythropthalmus*	S5B			SM	S			
TYPICAL OWLS									
Barred Owl	*Strix varia*	S5			SH				
GOATSUCKERS									
Common Nighthawk	*Chordeiles minor*	S4B	SC	T	SH				
SWIFTS									
Chimney Swift	*Chaetura pelagica*	S4B, S4N	THR	T	SH				
HUMMINGBIRDS									
Ruby-throated Hummingbird	*Archilochus colubris*	S5B			P	H			
KINGFISHERS									
Belted Kingfisher	*Megaceryle alcyon*	S4B			FS	CF	H		
WOODPECKERS									
Yellow-bellied Sapsucker	*Sphyrapicus varius*	S5B			FY	AE	H		
Downy Woodpecker	*Picoides pubescens*	S5			P	H		X	
Hairy Woodpecker	*Picoides villosus*	S5			SH	H			
Northern Flicker	*Colaptes auratus*	S4B			SM	AE	H		
Pileated Woodpecker	*Dryocopus pileatus*	S5			T	S	H		
TYRANT FLYCATCHERS									
Eastern Wood-Pewee	*Contopus virens*	S4B		SC	SM				
Alder Flycatcher	*Empidonax alnorum*	S5B			SM	S			
Least Flycatcher	*Empidonax minimus*	S4B			SM	S	S		
Eastern Phoebe	*Sayornis phoebe*	S5B				H			
Great Crested Flycatcher	*Myiarchus crinitus*	S4B			SM	AE			
Eastern Kingbird	*Tyrannus tyrannus*	S4B			SM	AE			
VIREOS									
Blue-Headed Vireo	*Vireo solitarius*	S5B			SM				
Philadelphia Vireo	*Vireo philadelphicus*	S5B				T			
Red-eyed Vireo	*Vireo olivaceus*	S5B			SM	CF	A		
CROWS & JAYS									
Gray Jay	*Perisoreus canadensis*	S5			SH	H			
Blue Jay	*Cyanocitta cristata*	S5			SM	H			
American Crow	*Corvus brachyrhynchos*	S5B			SH	T		X	
Common Raven	*Corvus corax*	S5			SH	T	H		X
SWALLOWS									
Tree Swallow	*Tachycineta bicolor*	S4B			AE	AE	H		

Common Name	Scientific Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	OBBA[4] First Atlas	OBBA[4] Second Atlas	2010 Breeding Bird Surveys (Highest Breeding Evidence)	2010 Incidentals	2011 Incidentals
Cliff Swallow	*Petrochelidon pyrrhonota*	S4B			AE	AE			
Barn Swallow	*Hirundo rustica*	S4B	THR	T	NY				
CHICKADEES & TITMICE									
Black-capped Chickadee	*Poecile atricapillus*	S5			SH	H	H		
NUTHATCHES									
Red-breasted Nuthatch	*Sitta canadensis*	S5			FY	H			
CREEPERS									
Brown Creeper	*Certhia americana*	S5B			P				
WRENS									
Winter Wren	*Troglodytes hiemalis*	S5B			FY	S		X	
KINGLETS									
Golden-crowned Kinglet	*Regulus satrapa*	S5B			FY	H			
Ruby-crowned Kinglet	*Regulus calendula*	S4B			SM	S			
THRUSHES									
Veery	*Catharus fuscescens*	S4B			SM	T	S		
Swainson's Thrush	*Catharus ustulatus*	S4B			SM				
Hermit Thrush	*Catharus guttatus*	S5B			T	S	S		
American Robin	*Turdus migratorius*	S5B			AE	FY	T		
MOCKINGBIRDS & THRASHERS									
Gray Catbird	*Dumetella carolinensis*	S4B			SM	H	H		
STARLINGS									
European Starling	*Sturnus vulgaris*	SNA				H			
WAXWINGS									
Cedar Waxwing	*Bombycilla cedrorum*	S5B			N	H	H		X
WOOD-WARBLERS									
Golden-winged Warbler	*Vermivora chrysoptera*	S4B	SC	T	SM	S			
Tennessee Warbler	*Oreothlypis peregrina*	S5B					S		
Nashville Warbler	*Oreothlypis ruficapilla*	S5B			SM	CF	S		
Yellow Warbler	*Setophaga petechia*	S5B			P	P	S		
Chestnut-sided Warbler	*Setophaga pensylvanica*	S5B			SM	CF	T		
Magnolia Warbler	*Setophaga magnolia*	S5B			P	H			
Black-throated Blue Warbler	*Setophaga caerulescens*	S5B			SM	T			
Yellow-rumped Warbler	*Setophaga coronata*	S5B			FY	P	T		
Black-throated Green Warbler	*Setophaga virens*	S5B			FS	T	S		
Blackburnian Warbler	*Setophaga fusca*	S5B			FS	S			
Pine Warbler	*Setophaga pinus*	S5B				CF	S		
Black-and-white Warbler	*Mniotilta varia*	S5B			SM	H	T		
American Redstart	*Setophaga ruticilla*	S5B			SM	CF	T		
Ovenbird	*Seiurus aurocapillus*	S4B			FS	T	T		X
Mourning Warbler	*Geothlypis philadelphia*	S4B			P	CF			
Common Yellowthroat	*Geothlypis trichas*	S5B			D	P			
Canada Warbler	*Cardellina canadensis*	S4B	SC	T	SM	H			
Wilson's Warbler	*Cardellina pusilla*	S4B			SM				

Common Name	Scientific Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	OBBA[4]		2010		2011
					First Atlas	Second Atlas	Breeding Bird Surveys (Highest Breeding Evidence)	Incidentals	Incidentals
SPARROWS									
Chipping Sparrow	*Spizella passerina*	S5B			P	FY			
Vesper Sparrow	*Pooecetes gramineus*	S4B				S			
Savannah Sparrow	*Passerculus Sandwichensis*	S4B			SM	S			
Song Sparrow	*Melospiza melodia*	S5B			FS	T	T		
Swamp Sparrow	*Melospiza georgiana*	S5B			SM	T			
White-throated Sparrow	*Zonotrichia albicollis*	S5B			P	P	T		
CARDINALS & ALLIES									
Scarlet Tanager	*Piranga olivacea*	S4B			SM	H			
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	S4B			SM	P			
Indigo Bunting	*Passerina cyanea*	S4B			SM	S			
BLACKBIRDS									
Bobolink	*Dolichonyx oryzivorus*	S4B	THR	T	P	A			
Brewer's Blackbird	*Euphagus cyanocephalus*	S4B			P				
Red-winged Blackbird	*Agelaius phoeniceus*	S4			SM	CF		X	
Common Grackle	*Quiscalus quiscula*	S5B			SH	H	CF		
Brown-headed Cowbird	*Molothrus ater*	S4B			P				
Baltimore Oriole	*Icterus galbula*	S4B			SM				
FINCHES									
Purple Finch	*Carpodacus purpureus*	S4B			SM	S			
Red Crossbill	*Loxia curvirostra*	S4B							
Quiscalus quiscula	Common Grackle	S5B				CO	CO	X	X
								39	20

[1] NHIC 2012, [2] OMNR 2012, [3] COSEWIC 2012, [4] OBBA 2001

APPENDIX VI

HERPETOFAUNA SPECIES LIST

Appendix VI. Herpetofauna Reported From the Study Area

Common Name	Scientific Name	SRANK[1]	COSSARO[2]	COSEWIC[3]	Ontario Herptofauna Atlas[4]	NRSI Observations 2010	NRSI Observations 2011
TURTLES							
Common Snapping Turtle	*Chelydra serpentina serpentina*	S3	SC	SC	X		X
Midland Painted Turtle	*Chrysemys picta marginata*	S5			X		
Blanding's Turtle (*Great Lakes/St Lawrence population*)	*Emydoidea blandingii*	S3	THR	T	X		
SNAKES							
Northern Ringneck Snake	*Diadophis punctatus edwardsi*	S4			X		
Eastern Milksnake	*Lampropeltis t. triangulum*	S3	SC	SC	X		
Smooth Greensnake	*Opheodrys vernalis*	S4			X		
Northern Watersnake	*Nerodia sipedon sipedon*	S5	NAR	NAR	X		
Northern Red-bellied Snake	*Storeria occipitomaculata occipitomaculata*	S5			X	X	
Eastern Gartersnake	*Thamnophis sirtalis sirtalis*	S5			X		
SALAMANDERS							
Blue-spotted Salamander	*Ambystoma laterale*	S4			X		
Spotted Salamander	*Ambystoma maculatum*	S4			X		
Four-toed Salamander	*Hemidactylium scutatum*	S4	NAR	NAR	X		
Mudpuppy	*Necturus maculosus*	S4	NAR	NAR	X		
Red-spotted Newt	*Notophthalmus viridescens viridescens*	S5			X		
Eastern (Northern) Redback Salamander	*Plethodon cinereus*	S5			X		
TOADS &FROGS							
American Toad	*Bufo americanus*	S5			X	X	X
Tetraploid Gray Treefrog	*Hyla versicolor*	S5			X		
Northern Spring Peeper	*Pseudarcris crucifer crucifer*	S5			X		
Bullfrog	*Rana catesbeiana*	S4			X		
Green Frog	*Rana clamitans melanota*	S5			X	X	
Northern Leopard Frog	*Rana pipiens*	S5	NAR	NAR	X	X	
Wood Frog	*Rana sylvatica*	S5			X	X	

[1] NHIC 2012, [2] OMNR 2012, [3] COSEWIC 2012, [4] Ontario Nature 2012

Legend
SRANK (Provincial Rank)
S3 - Vulnerable
S4 - Apparently Secure
S5 - Secure
COSSARO
SC - Special Concern
THR - Threatened
NAR - Not At Risk
COSEWIC
SC - Special Concern
T - Threatened
NAR - Not At Risk

NOTE: Under the new ESA all species classified as END or THR automatically receive habitat protection under the Act

APPENDIX VII

MAMMAL SPECIES LIST

Appendix VII. Mammal Species Reported From the Study Area

SCIENTIFIC NAME	COMMON NAME	SRANK[1]	COSEWIC[2]	OMNR[3]	ONTARIO MAMMAL ATLAS[4]	NRSI OBSERVATIONS (2010)	NRSI OBSERVATIONS (2011)
Alces alces	Moose	S5			X	X	X
Blarina brevicauda	Northern Short-tailed Shrew	S5			X		
Canis latrans	Coyote	S5			X		
Canis lupus	Gray Wolf	S4		NAR	X		
Castor canadensis	Beaver	S5			X	X	X
Condylura cristata	Star-nosed Mole	S5			X		
Eptesicus fuscus	Big Brown Bat	S5			X		
Erethizon dorsatum	Porcupine	S5			X		
Glaucomys sabrinus	Northern Flying Squirrel	S5			X		
Lepus americanus	Snowshoe Hare	S5			X		
Lutra canadensis	River Otter	S5			X	X	X
Lynx canadensis	Lynx	S5	NAR	NAR	X		
Marmota monax	Woodchuck	S5			X		
Martes americana	Marten	S5			X		
Martes pennanti	Fisher	S5			X		
Mephitis mephitis	Striped Skunk	S5			X		
Mus musculus	House Mouse	SE			X		
Mustela vison	Mink	S5			X	X	
Myotis lucifuga	Little Brown Bat	S5	E	END	X		
Myotis septentrionalis	Northern Long-eared Bat	S3?	E	END	X		
Napeozapus insignis	Woodland Jumping Mouse	S5			X		
Odocoileus virginianus	White-tailed Deer	S5			X	X	X
Ondatra zibethicus	Muskrat	S5			X		X
Parascalops breweri	Hairy-tailed Mole	S4			X		
Peromyscus maniculatus	Deer Mouse	S5			X		
Procyon lotor	Raccoon	S5			X		X
Sciurus carolinensis	Gray Squirrel Black Morph	S5			X		
Sorex cinereus	Masked (Common) Shrew	S5			X		
Sorex fumeus	Smokey Shrew	S5			X		
Sorex palustris	Water Shrew	S5			X		
Tamias mimumus	Least Chipmunk	S5			X		
Tamias striatus	Eastern Chipmunk	S5			X		
Tamiasciurus hudsonicus	Eastern Chipmunk	S5			X		X
Ursus americanus	Black Bear	S5	NAR	NAR	X		X
Vulpes vulpes	Red Fox	S5			X		X

[1] NHIC 2012, [2] COSEWIC 2012, [3] OMNR 2012, [4]

Legend
S-Rank (Provincial Rank)
SE - Exotic
S3- Vunerable
S4- Apparently Secure
S5- Secure
COSEWIC (National Rank)
NAR- Not at Risk
E- Endangered
OMNR (Provincial Status)
NAR- Not at Risk
E- Endangered

NOTE: Under the new ESA all species classified as END or THR automatically receive habitat protection under the Act

APPENDIX VIII

SIGNIFICANT WILDLIFE HABITAT (SWH) SCREENING

Table 1. Characteristics of Seasonal Concentration Areas for Ecoregion 5E.

Wildlife Species[1]	Candidate SWH		Confirmed SWH	Wabageshik
	ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Waterfowl Stopover and Staging Areas (Terrestrial)				
American Black Duck Wood Duck Green-winged Teal Blue-winged Teal Mallard Northern Pintail Northern Shoveler American Wigeon Gadwall	These field/meadow ELC ecosites with appropriate soils and vegetation: G060-062 G077-079 G093-095 G109-111 - Plus evidence of annual spring flooding from melt water or run-off.	Fields with sheet water during Spring (mid March to May). • Fields flooding during spring melt and run-off provide important invertebrate foraging habitat for migrating waterfowl. • Agricultural fields with waste grains are commonly used by waterfowl, these are not considered SWH. Information Sources • Anecdotal information from the landowner, adjacent landowners or local naturalist clubs may be good information in determining occurrence. • EIS reports and other studies prepared by CA's • Sites documented through waterfowl planning processes (eg. EHJV implementation plan) • Naturalist Clubs • Ducks Unlimited Canada	Studies carried out and verified presence of an annual concentration of any listed species, evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • Any mixed species aggregations of 100[l] or more individuals. • The area of the flooded field ecosite habitat plus a 100-300m radius buffer dependant on local site conditions and adjacent land use is the SWH[cxlviii]. • Annual use of habitat is documented from information sources or field studies (annual use can be based on studies or determined by past surveys with species numbers and dates). • SWHDSS[cxlix] Index #7 provides development effects and mitigation measures.	Appropriate ELC ecosite are not present within study area. **Not SWH**

Wildlife Habitat: Waterfowl Stopover and Staging Areas (Aquatic)				
Canada Goose Cackling Goose Snow Goose American Black Duck Northern Pintail Northern Shoveler American Wigeon Gadwall Green-winged Teal Blue-winged Teal Hooded Merganser Common Merganser Lesser Scaup Greater Scaup Long-tailed Duck Surf Scoter White-winged Scoter Black Scoter Ring-necked duck Common Goldeneye Bufflehead Redhead Ruddy Duck Red-breasted Merganser Brant Canvasback Ruddy Duck	ELC Ecosites: G142-G152	• Ponds, marshes, lakes, bays, coastal inlets, and watercourses used during migration. Sewage treatment ponds and storm water ponds do not qualify as a SWH, however a reservoir managed as a large wetland or pond/lake does qualify. • These habitats have an abundant food supply (mostly aquatic invertebrates and vegetation in shallow water); <u>Information Sources</u> • Canadian Wildlife Service staff know the larger, most significant sites. Check website: http://wildspace.ec.gc.ca • Naturalist clubs often are aware of staging/stopover areas. • OMNR Wetland Evaluations indicate presence of locally and regionally significant waterfowl staging. • Sites documented through waterfowl planning processes (eg. EHJV implementation plan) • Ducks Unlimited projects • Element occurrence specification by Nature Serve: http://www.natureserve.org	Studies carried out and verified presence of: • Aggregations of 100[l] or more of listed species for 7 days[l], results in > 700 waterfowl use days. • Areas with annual staging of ruddy ducks, canvasbacks, and redheads are SWH [cxlix] • The combined area of the ELC ecosites and a 100m radius area is the SWH [cxlviii] • Wetland area and shorelines associated with sites identified within the SWHTG [cxlviii] Appendix K [cxlix] are significant wildlife habitat. • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • Annual Use of Habitat is Documented from Information Sources or Field Studies (Annual can be based on completed studies or determined from past surveys with species numbers and dates recorded). • SWHDSS[cxlix] Index #7 provides development effects and mitigation measures.	G148N exists at the mouths of 4 tributaries located downstream of the proposed Wabageshik GS. Bird Species observed during breeding bird surveys include: - Canada goose - American black duck - common merganser - ring-necked duck Species recorded were not observed in high enough concentrations to be considered SWH. Wetlands present not likely large enough to support >100 of the listed species. **Not SWH**

Wildlife Habitat: Shorebird Migratory Stopover Area				
Greater Yellowlegs Lesser Yellowlegs Marbled Godwit Hudsonian Godwit Black-bellied Plover American Golden-Plover Semipalmated Plover Solitary Sandpiper Spotted Sandpiper Semipalmated Sandpiper Pectoral Sandpiper White-rumped Sandpiper Baird's Sandpiper Least Sandpiper Purple Sandpiper Stilt Sandpiper Short-billed Dowitcher Red-necked Phalarope Whimbrel Ruddy Turnstone Sanderling Dunlin	ELC Ecosites: G005-G006 G160-G162 G170-G172 G176-G178 G186-G188 G204-G214	Shorelines of lakes, rivers and wetlands, including beach areas, bars and seasonally flooded, muddy and un-vegetated shoreline habitats. Great Lakes coastal shorelines, including groynes and other forms of armour rock lakeshores, are extremely important for migratory shorebirds in May to mid-June and early July to October. Storm water retention ponds and sewage lagoons are not considered SWH. Information Sources • Western hemisphere shorebird reserve network. • Canadian Wildlife Service (CWS) Ontario Shorebird Survey. • Bird Studies Canada • Ontario Nature • Local birders and naturalist clubs.	Studies confirming: • Presence of 3 or more of listed species and > 1000[l] shorebird use days during spring or fall migration period. (shorebird use days are the accumulated number of shorebirds counted per day over the course of the fall or spring migration period) • Whimbrel stop briefly (<24hrs) during spring migration, any site with >100[l] Whimbrel used for 3 years or more is significant: • The area of significant shorebird habitat includes the mapped ELC shoreline ecosites plus a 100m radius area [cxlviii] • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHDSS[cxlix] Index #8 provides development effects and mitigation measures.	Appropriate ELC ecosites are not present within study area. **Not SWH**

Wildlife Habitat: Raptor Wintering Area				
Rough-legged Hawk Long-eared Owl Boreal Owl Northern Saw-whet Owl **Special Concern:** Short-eared Owl	Combination of meadow/field and forest/woodland ecosites. Need to have a forest ELC Ecosite : G011-G019 G023-G028 G033-G043 G048-G059 G064-G076 G081-G092 G097- G108 G113-G125 or Central Ontario FEC Ecosites ES11 – ES35 And A meadow/field ELC Ecosite: G020-022 G029-032 G044-047 G060-063 G077-080 G093-096 G109-112	The habitat provides a combination of fields and woodlands that provide roosting, foraging and resting habitats for wintering raptors. Raptor wintering sites need to be > 20 ha [cxlviii, cxlix] with a combination of forest and upland.[xvi, xvii, xviii, xix, xx, xxi] Least disturbed sites, idle/fallow or lightly grazed field/meadow with adjacent woodlands [cxlix] Information Sources: • OMNR Ecologist or Biologist may be aware of locations of wintering raptors. In addition, these staff may know local naturalists that may be aware of the locations of raptor wintering habitats. • NHIC maintains winter concentration data in connection with wind power developments. • Data from Bird Studies Canada, most notably for Short-eared Owls. • EIS reports and other studies prepared by CA's.	Studies confirm the use of these habitats by: • One or more Short-eared Owls or; • At least 10 individuals and two spp.of the listed spp [l]. • To be significant a site must be used regularly (3 in 5 years) [cxlix] for a minimum of 20 days by the above number of birds[l]. • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHDSS[cxlix] Index #10 provides development effects and mitigation measures.	ELC ecosites that exist within the study area include: G023Tl – Very Shallow, Humid: Red Pine – White Pine Conifer, Short Treed. G023Tt- Very Shallow, Humid: Red Pine – White Pine Conifer, Tall Treed. G067Tt – Moist, Coarse: Spruce – Fir Conifer, Tall Treed. G070Tt – Moist, Coarse: Aspen-Birch Hardwood. No field/meadow habitats present in study area. **Not SWH**

Wildlife Habitat: Bat Wintering Hibernacula				
Big Brown Bat Little Brown Myotis Tri-coloured Bat/Eastern Pipistrelle Northern Myotis Eastern Small-footed Myotis	Bat Hibernacula may be found in association with components of cliffs and rock talus in these ELC Ecosites; G158-G159 G164 G180-G181 Calcareous bedrock is fairly rare in ecoregion 5E. Or Central Ont. FEC: ES4 ES5 (Note: buildings are not considered to be SWH)	• Hibernacula may be found in abandoned caves, horizontal mine shafts (adits), abandoned underground foundations and areas of limestone bedrock with solution channels known as Karsts. The locations and site characteristics of bat hibernacula are relatively poorly known. Information Sources • OMNR Districts for possible locations and contact for local experts • NHIC stores Bat Hibernacula data in Animal Concentration Area under Biotics. Most known historical and currently extant bat hibernacula are contained in this database. • Ministry of Northern Development and Mines for location of mine shafts and adits. • Clubs that explore caves (eg. Sierra Club) • University Biology Departments with bat experts.	• All sites with confirmed hibernating bats is SWH [l]. • The area includes 1000m radius around the entrance of the hibernaculum [cxlviii, ccvii, l] • Studies are to be conducted during the peak swarming period (Aug. – Sept.). Surveys should be conducted following methods outlined in the "Guideline for Wind Power Projects Potential Impacts to Bats and Bat Habitats"[ccv]. • If a SWH is determined for Bat Hibernacula then Movement Corridors are to be considered as outlined in Table 1.4.1 of this Schedule. • SWHDSS[cxlix] Index #1 provides development effects and mitigation measures.	No cliffs or caves present within study area. No hibernacula identified by the MNR in the vicinity. **Not SWH**

Wildlife Habitat: Bat Maternity Colonies				
Big Brown Bat Little Brown Myotis Silver-haired Bat Northern Myotis	Maternity colonies considered SWH are found in forested Ecosites. ELC Ecosites: G016-G019 G028 G040-G043 G055-G059 G070-G076 G088-G092 G103- G108 G118-G125 or: Central Ontario Forest Ecosites: ES14 ES17 ES18 ES23 ES24 ES25 ES26 ES27 ES28 ES29 ES30	Maternity colonies can be found in tree cavities, vegetation and often in buildings[xxii, xxv, xxvi, xxvii, xxxi] (buildings are not considered to be SWH). Maternity roosts are not found in caves and mines in Ontario[xxii]. • Maternity colonies located in Mature (dominant trees > 80yrs old) deciduous or mixed forest stands[ccix, ccx] with >10/ha large diameter (>25cm dbh) wildlife trees[ccvii]. • Female Bats prefer wildlife trees (snags) in early stages of decay, class 1-3 [ccxiv] or class 1 or 2 [ccxii]. • Northern Myotis prefer contiguous tracts of older forest cover for foraging and roosting in snags and trees[ccix] • Silver-haired Bats prefer older mixed or deciduous forest and form maternity colonies in tree cavities and small hollows. Older forest areas with at least 21 snags/ha are preferred[ccx] Information Sources • OMNR for possible locations and contact for local experts • University Biology Departments with bat experts.	• Maternity Colonies with confirmed use by; – >20 Northern Myotis[cxlix] – >10 Big Brown Bats[l] – >20 Little Brown Myotis[l] – >5 Adult Female Silver-haired Bats[l] • The area of the habitat includes the entire woodland or the forest stand ELC Ecosite containing the maternity colonies[l]. • Evaluation methods for maternity colonies should be conducted following methods outlined in the "Guideline for Wind Power Projects Potential Impacts to Bats and Bat Habitats"[ccv]. • SWHDSS[cxlix] Index #1 provides development effects and mitigation measures.	Appropriate ELC ecosites within the study area include: G040Tt – Dry, Sandy: Aspen – Birch Hardwood. G070Tt – Moist, Coarse: Aspen-Birch Hardwood. Old trees along river may provide suitable maternity roosts. However, this habitat type is likely abundant on the surrounding landscape. Northern myotis, brown myotis and big brown bat are known within the vicinity of the project area. Brown myotis and northern myotis have been uplisted to Endangered by COSSARO. As such, habitat for thse species are now protected by ESA and will be treated accordingly. **Candidate SWH**

Wildlife Habitat: Bat Migratory Stopover Area				
Hoary Bat Eastern Red Bat Silver-haired Bat	No specific ELC types.	Long distance migratory bats typically migrate during late summer and early fall from summer breeding habitats throughout Ontario to southern wintering areas. Their annual fall migrations concentrate these species of bats at stopover areas. The location and characteristics of stopover habitats are generally unknown. Information Sources • OMNR for possible locations and contact for local experts • University Biology Departments with bat experts.	• The confirmation criteria and habitat areas for this SWH are still being determined • SWHDSS cxlix Index #38 provides development effects and mitigation measures	Criteria unavailable to assess significance of habitat in study area.

Wildlife Habitat: Turtle Wintering Areas				
Midland Painted Turtle **<u>Special Concern:</u>** Northern Map Turtle Snapping Turtle	For Snapping and Midland Painted turtles; ELC Ecosites: G128-G135 G140-G152 For Northern Map Turtle - Open Water areas such as deeper rivers or streams and lakes with current can also be used as over-wintering habitat.	For most turtles, wintering areas are in the same general area as their core habitat. Water has to be deep enough not to freeze and have soft mud substrates. • Over-wintering sites are permanent water bodies, large wetlands, and bogs or fens with adequate Dissolved Oxygen.[cix, cx, cxi, cxviii] <u>Information Sources</u> • EIS reports and other studies prepared by CA's • Local naturalists and experts, as well as university herpetologists may also know where to find some of these sites. • OMNR ecologist or biologist may be aware of locations of wintering turtles	• Presence of 5 over-wintering turtles of Midland Painted Turtles is significant[l]. • One or more Northern Map Turtle or Snapping Turtle over-wintering within a wetland is significant[l]. • The mapped ELC ecosite area with the over wintering turtles is the SWH. If the hibernation site is within a stream or river, the deep-water pool where the turtles are over wintering is the SWH. • Over wintering areas may be identified by searching for congregations (Basking Areas) of turtles on warm, sunny days during the fall (Sept. – Oct.) or spring (Mar. – April)[cvi]. Congregation of turtles is more common where wintering areas are limited and therefore significant[cix, cx, cxi, cxii]. • SWHDSS[cxlix] Index #28 provides development effects and mitigation measures for turtle wintering habitat.	A Mineral Shallow Marsh (G148N) is present within the study area. The embayment area also provides a permanent water body with mud substrates and is likely overwintering habitat. Winter habitat for the common snapping turtle may exist within the study area. Common snapping turtle was observed within the study area in June, which is not during their emergence period. **Candidate SWH**

Wildlife Habitat: Reptile Hibernaculum				
Snakes: Eastern Gartersnake Northern Watersnake Red-bellied Snake Brownsnake Smooth Green Snake Ring-necked Snake **Special Concern:** Milksnake Eastern Ribbonsnake Lizard: **Special Concern:** Five-lined Skink	For all snakes, habitat may be found in any forested ecosite in central Ontario other than very wet ones. Talus, Rock Barren, Crevice and Cave, and Alvar sites may be directly related to these habitats. The existence of rock piles or slopes, stone fences, and crumbling foundations assist in identifing candidate SWH. For Five-lined Skink; Central Ontario Forest Ecosites: ES14.2, ES17 – ES20, ES23 – ES30 Or; ELC Ecosites: G056-G059 G070-G076 G087-G092 G103-G108 G118-G125	For snakes, hibernation takes place in sites located below frost lines in burrows, rock crevices and other natural locations. Areas of broken and fissured rock are particularly valuable since they provide access to subterranean sites below the frost line[xliv, l, li, lii, cxii]. Wetlands can also be important over-wintering habitat in conifer or shrub swamps and swales, poor fens, or depressions in bedrock terrain with sparse trees or shrubs with sphagnum moss or sedge hummock ground cover. Information Sources • In spring, local residents or landowners have observed the emergence of snakes on their property (e.g.old dug wells). • EIS reports and other studies prepared by CA's. • Local naturalists and experts, as well as university herpetologists may also know where to find some of these sites. Five-lined skink prefer mixed forests with rock outcrop openings providing cover rock overlaying granite bedrock with fissures [cciii]. Information Sources • EIS studies carried out by Conservation Authorities. • Local naturalists and experts, as well as university herpetologists may also know where to find some of these sites. • OMNR ecologist or biologist may be aware of locations of wintering skinks	Studies confirming: • Presence of snake hibernacula used by a minimum of five individuals of a snake sp. or; individuals of two or more snake spp. • Congregations of a minimum of five individuals of a snake sp. or; individuals of two or more snake spp. near potential hibernacula (eg. foundation or rocky slope) on sunny warm days in Spring (Apr/May) and Fall (Sept/Oct)[l]. • Note: If there are Special Concern Species present, then site is SWH • Note: Sites for snake hibernation possess specific habitat parameters (e.g. temperature, humidity, etc.) and consequently are used annually, often by many of the same individuals of a local population [i.e. strong hibernation site fidelity.]. Other critical life processes (e.g. mating) often take place in close proximity to hibernacula. As such, a 30 m radius centred on the hibernaculum is the SWH[l] • SWHDSS[cxlix] Index #13 provides development effects and mitigation measures for snake hibernacula. • Presence of any active hibernaculum for skink is significant. The ELC Ecosite polygon containing the skink hibernacula is the SWH[l] • SWHDSS[cxlix] Index #37 provides development effects and mitigation measures for five-lined skink wintering habitat.	Small, localized areas of exposed, fissured bedrock with loose rock present within the study area, although this habitat type is likely common in the surrounding landscape. No species of conservation concern observed. However, suitable habitat exists to support eastern milksnake within the study area. Coverboard surveys resulted in only 1 red-bellied snake which was found in the surrounding landscape greater than 120 meters from the perimeter of the project area. **Not SWH**

Wildlife Habitat: Colonially-Nesting Bird Breeding Habitat (Bank and Cliff)				
Bank Swallow Cliff Swallow Northern Rough-winged Swallow	Habitat found in the following ELC Ecosites: G001-G004 G007-G008 G020-G021 G029-G031 G044-G046 G060-G062 G077-G079 G093-G095 G109-G111 G173-G175 G201-G203 G210-G212	• Any site or areas with exposed soil banks, sandy hills, borrow pits, steep slopes, and sand piles that are undisturbed or naturally eroding that is not a licensed/permitted aggregate area. • Does not include man-made structures (bridges or buildings) or recently (2 years) disturbed soil areas, such as berms, embankments, soil or aggregate stockpiles. • Does not include a licensed/permitted Mineral Aggregate Operation. Information Sources • EIS Reports prepared by Conservation Authorities. • Ontario Breeding Bird Atlas. • Bird Studies Canada; *NatureCounts* http://www.birdscanada.org/birdmon/ • Naturalist Clubs.	Studies confirming: • Presence of 1 or more nesting sites with 8[cxlvix] or more cliff swallow pairs or 50[l] bank swallow, and rough-winged swallow pairs during the breeding season. • A colony identified as SWH will include a 50m radius habitat area from the peripheral nests[ccvii] • Field surveys to observe and count swallow nests are to be completed during the breeding season (may-July). Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHDSS[cxlix] Index #4 provides development effects and mitigation measures	Banks and cliffs not present within the study area. No target species observed. **Not SWH**

Wildlife Habitat: Colonially-Nesting Bird Breeding Habitat (Tree/Shrubs)				
Great Blue Heron Black-crowned Night Heron	ELC Ecosites: G064-G076 G081-G092 G097-G108 G113-G125 G128-G136 Central Ontario Forest Ecosites: ES11.2 ES12.2 ES13.2 ES14.2 ES15.2 ES16.2 ES17.2 ES18.2 ES19.2 ES20.2 ES21.2 ES23.2 ES24.2 ES25.2 ES26.2 ES27.2 ES28.2 ES29.2 ES30.2 ES31 ES32 ES33 ES34 ES35	• Nests in live or dead standing trees in wetlands, lakes, islands, and peninsulas. Shrubs and occasionally emergent vegetation may also be used. • Most nests in trees are 11 to 15 m from ground, near the top of the tree. Information Sources • Breeding Bird Atlas, colonial nest records. • Ontario Heronry Inventory 1991 available from Bird Studies Canada or NHIC (OMNR). • Aerial photographs can help identify large heronries. • EIS reports and other studies prepared by CA's • MNR District Offices. • Local naturalist clubs.	Studies confirming: • Presence of 10[l] or more active nests of Great Blue Heron. • Presence of 1 or more active nests of Black-crowned Night Heron[l] is significant. • The edge of the colony and a minimum 300m area of habitat or extent of the Forest Ecosite containing the colony or any island <15.0ha with a colony is the SWH [cc, ccvii] • Confirmation of active heronries must be achieved through site visits conducted during the nesting season (April to August) or by evidence such as the presence of fresh guano, dead young and/or eggshells • SWHDSS[cxlix] Index #5 provides development effects and mitigation measures.	The following suitable habitats were found: G067 Tt - Moist, Coarse: Spruce – Fir Conifer, Tall Treed. G069 Tt - Moist, Coarse: Red Pine – White Pine Mixedwood, Tall Treed G070Tt - Moist, Coarse: Aspen – Birch Hardwood, Tall Treed Great blue heron was observed within suitable nesting habitat. However, no heronry observed. **Not SWH**

Wildlife Habitat: Colonially-Nesting Bird Breeding Habitat (Ground)				
Herring Gull Great Black-backed Gull Little Gull Ring-billed Gull Common Tern Caspian Tern Brewer's Blackbird	Brewer's Blackbird habitat is in ELC Ecosites: G001-G004 G007-G008 G020-G021 G029-G031 G044-G046 G060-G062 G077-G079 G093-G095 G109-G111 G142-G145	Nesting colonies of gulls and terns are on islands or peninsulas (natural or artificial) associated with open water, marshy areas, lake or large river (two-lined on a 1;50,000 NTS map). • Brewers Blackbird colonies are found loosely on the ground in or in low bushes in close proximity to streams and irrigation ditches within farmlands. Information Sources • Breeding Bird Atlas, rare/colonial species records. • Canadian Wildlife Service • EIS reports and other studies prepared by CA's • MNR District Offices. • Local naturalist clubs.	Studies confirming: • Presence of > 25 active nests for Herring Gulls or Ring-billed Gulls, >5 active nests for Common Tern or >2 active nests for Caspian Tern[l]. • Presence of 5 or more pairs for Brewer's Blackbird[l]. • Any active nesting colony of one or more Little Gull, and Great Black-backed Gull is significant[l]. • The edge of the colony and a minimum 150m area of habitat, or the extent of the ELC ecosites containing the colony or any island <3.0ha with a colony is the SWH [cc, ccvii] • Studies would be done during May/June when actively nesting. Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHDSS[cxlix] Index #6 provides development effects and mitigation measures.	Appropriate ELC ecosites are not present within study area. **Not SWH**

Wildlife Habitat: Deer Yarding Areas				
White-tailed Deer	May be found in all Tall Treed forest and swamp ELC Ecosites; G12-G15 G23-G27 G33-G38 G48-G54 G64-G69 G81-G87 G97-G103 G113-G118 G128-G129 Central Ontario Forest Ecosites: ES11 ES14 ES16......ES18 ES20 ES21 ES22 ES27 ES28 ES30 ES31 ES32 ES33 ES34 Note: OMNR to determine this habitat.	• Deer wintering areas or winter concentration areas (yards) are areas deer move to in response to the onset of winter snow and cold. This is a behavioural response and deer will establish traditional use areas. The yard is composed of two areas referred to as Stratum I and Stratum II. Stratum II covers the entire winter yard area and is usually a mixed or deciduous forest with plenty of browse available for food. Agricultural lands can also be included in this area. Deer move to these areas in early winter and generally, when snow depths reach 20 cm, most of the deer will have moved here. If the snow is light and fluffy, deer may continue to use this area until 30 cm snow depth. In mild winters, deer may remain in the Stratum II area the entire winter. • The Core of a deer yard (Stratum I) is located within Stratum II and is critical for deer survival in areas where winters become severe. It is primarily composed of coniferous trees (pine, hemlock, cedar, spruce) with a canopy cover of more than 60%[cxciv]. • OMNR determines deer yards following methods outlined in "Selected Wildlife and Habitat Features: Inventory Manual" [cxcv] • Woodlots with high densities of deer due to artificial feeding are not significant[1].	No Studies Required: • Generally, there will be a history of traditional use of the yard by deer, although deer do move to other areas over the course of time if conditions in the yard change or due to societal impacts (i.e. artificial deer feeding). There may be circumstances where deer have recently moved to new areas. • Deer Yards are mapped by OMNR District offices. Locations of Core (Stratum 1) and Stratum 2 deer yards considered significant by OMNR will be available at local MNR offices. • Field investigations that record deer tracks in winter are done to confirm use (best done from an aircraft). Preferably, this is done over a series of winters to establish the boundary of the Stratum I and Stratum II yard in an "average" winter. MNR will complete these field investigations. [cxcv] • If a SWH is determined for Deer Wintering Area or if a proposed development is within a Stratum II yarding area then Movement Corridors are to be considered as outlined in Table 1.4.1 of this Schedule. • SWHDSS[cxlix] Index #2 provides development effects and mitigation measures.	Deer Yarding Areas within the study area are not identified by OMNR. Deer crossing was identified at the downstream end of Wabageshik. Habitat for wintering area is likely present in the project vicinity. OMNR identified 2 deer yarding areas approximately 3km and 9km away from the project site. ELC communities are large within the surrounding landscape, but is not significant within 120 meters of the project site. The following ELC habitats were found: G023Tl - Very Shallow, Humid: Red Pine – White Pine Conifer, Short Treed G025Tt - Very Shallow, Humid: Hemlock – Cedar Conifer, Tall Treed G067Tt - Moist, Coarse: Spruce – Fir Conifer, Tall Treed. G069Tt - Moist, Coarse: Red Pine – White Pine Mixedwood,Tall Treed **Not SWH**

1: Ontario Ministry of Natural Resources (OMNR). 2011. Significant Wildlife Habitat Ecoregion 5E Criterion Schedule. June 2011. 42pp.

Table 2. Characteristics of Specialized Wildlife Habitat for Ecoregion 5E

Wildlife Species[1]	Candidate SWH		Confirmed SWH	Wabageshik
	ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Waterfowl Nesting Area				
American Black Duck Northern Pintail Northern Shoveler Gadwall Blue-winged Teal Green-winged Teal Wood Duck Hooded Merganser Common Merganser Red-breasted Merganser Mallard Canada Goose American Widgeon Bufflehead Common Goldeneye	All upland habitats located adjacent to these wetland ELC Ecosites are Candidate SWH: G129-G135 G142-G152 **Note: includes adjacency to provincially Significant Wetlands**	A waterfowl nesting area extends 120 m [cxlix] from a wetland (> 0.5 ha) or a cluster of 3 or more small (<0.5 ha) wetlands within 120 m of each individual wetland where waterfowl nesting is known to occur [cxlix]. • Upland areas should be at least 120 m wide so that predators such as racoons, skunks, and foxes have difficulty finding nests. • Wood Ducks, Bufflehead, Common Goldeneye and Hooded Mergansers utilize large diameter trees (>40cm dbh) in woodlands for cavity nest sites. Information Sources • Ducks Unlimited staff may know the locations of particularly productive nesting sites. • OMNR Wetland Evaluations for indication of significant waterfowl nesting habitat. • EIS reports and other studies prepared by CA's.	Studies confirmed: • Presence of 3 or more nesting pairs for listed species excluding Mallards[l], or; • Presence of 10 or more nesting pairs for listed species including Mallards[l]. • Any active nesting site of an American Black Duck is considered significant. • Nesting studies should be completed during the spring breeding season (April - June). Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • A field study confirming waterfowl nesting habitat will determine the boundary of the waterfowl nesting habitat for the SWH, this may be greater or less than 120 m [cxlviii] from the wetland and will provide enough habitat for waterfowl to successfully nest. • SWHDSS[cxlix] Index #25 provides development effects and mitigation measures.	Wetlands found within and surrounding the embayment area downstream of the proposed Wabageshik include G148N – Non- Woody Mineral Shallow Marsh. These wetlands are greater than 0.5ha and are found within close proximity to each other. The following bird species were observed as possibly breeding during breeding bird surveys in 2010: American black duck wood duck hooded merganser common merganser mallard Canada goose Waterfowl surveys were not conducted within the study area. **Candidate SWH**

Wildlife Habitat: Bald Eagle and Osprey Nesting, Foraging and Perching Habitat				
Osprey **Special Concern** Bald Eagle	Forest communities directly adjacent to riparian areas – rivers, lakes, ponds and wetlands	Nests are associated with lakes, ponds, rivers or wetlands along forested shorelines, islands, or on structures over water. Osprey nests are usually at the top a tree whereas Bald Eagle nests are typically in super canopy trees in a notch within the tree's canopy. Nests located on man-made objects are not to be included as SWH (e.g. telephone poles and constructed nesting platforms). <u>Information Sources</u> • NHIC compiles all known nesting sites for Bald Eagles in Ontario. • MNR values information (LIO/NRVIS) will list known nesting locations • Nature Counts, Ontario Nest Records Scheme data. • OMNR Ecologist or Biologist may be aware of locations of nesting raptors. In addition, these staff may know local naturalists that may be aware of the locations of raptor nests. • Sustainable Forestry Licence (SFL) companies will identify additional nesting locations through field operations. • Check the Breeding Bird Atlas or Rare Breeding Birds in Ontario for species documented • EIS reports and other studies prepared by CA's. • Local naturalists may know of other locations. • Use maps and aerial photographs to identify forests with few roads that tend to have less human disturbance.	Studies confirm the use of these nests by: • One or more active Osprey or Bald Eagle nests in an area[cxlviii]. • Some species have more than one nest in a given area and priority is given to the primary nest with alternate nests included within the area of the SWH. • For an Osprey, the active nest and a 300 m radius around the nest or the contiguous woodland stand is the SWH [ccvii], maintaining undisturbed shorelines with large trees within this area is important [cxlviii]. • For a Bald Eagle the active nest and a 400-800 m radius around the nest is the SWH. [cvi, ccvii] Area of the habitat from 400-800m is dependant on site lines from the nest to the development and inclusion of perching and foraging habitat [cvi] • To be significant a site must be used annually. When found inactive, the site must be known to be inactive for $\geq$3 years or suspected of not being used for >5 years before being considered not significant. [ccvii] • Observational studies to determine nest site use, perching sites and foraging areas need to be done from mid March to mid August. • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHDSS[cxlix] Index #26 provides development effects and mitigation measures	Large contiguous forest adjacent to riparian areas are present within the study area. Two osprey were observed actively foraging over the Vermillion River, within the study area. A bald eagle pair was observed within study area. Due to the abundance of suitable habitat, this species is likely breeding within the study area. **Confirmed Foraging SWH**

Wildlife Habitat: Woodland Raptor Nesting Habitat				
Red-tailed Hawk Great Horned Owl: Broad-winged Hawk Sharp-shinned Hawk Merlin Barred Owl Red-shouldered Hawk Coopers Hawk Northern Goshawk	May be found in all forested ELC Ecosites in Community Class: TR May also be found in the forested swamp ELC Ecosites: G128-G133	All natural or conifer plantation woodland/forest stands [lxxxviiii, lxxxix, xc, xci, xciii, xciv, xcv,xcvi, cxxxiii]. • Stick nests found in a variety of intermediate-aged to mature conifer, deciduous or mixed forests within tops or crotches of trees. Species such as Merlin or Coopers hawk nest along forest edges sometimes on peninsulas or small off-shore islands. • Includes nest sites within tree cavities for Barred Owl and sometime Great Horned Owls and Merlin. • In disturbed sites, nests may be used again, or a new nest will be in close proximity to old nest. Information Sources • OMNR Ecologist or Biologist may be aware of locations of nesting raptors. • Sustainable Forestry Licence (SFL) companies will identify additional nesting locations through field operations. • Check the Breeding Bird Atlas or Rare Breeding Birds in Ontario for species documented. • Check data from Bird Studies Canada. • EIS reports and other studies prepared by CA's. • Use maps and aerial photographs to identify forests with few roads that tend to have less human disturbance.	Studies confirm: • Presence of 1 or more active nests from species list is considered significant[cxlviii]. • Red-shouldered Hawk and Northern Goshawk – A 400m radius around the nest or 28 ha of suitable habitat is the SWH [ccvii]. • Barred Owl – A 200m radius around the nest is the SWH [ccvii]. • Broad-winged Hawk, Coopers Hawk, Great Horned Owl, Red-tailed Hawk – A 100m radius around the nest is the SWH[ccvii]. • Merlin and Sharp-Shinned Hawk – A 50m radius around the nest is the SWH[ccvii]. • Conduct field investigations from mid-March to end of May. The use of call broadcasts can help in locating territorial (courting/nesting) raptors and facilitate the discovery of nests by narrowing down the search area. • SWHDSS [cxlix] Index #27 provides development effects and mitigation measures.	Mixedwood forest with large trees present. However, this habitat is abundant on the surrounding landscape. Broad-winged hawk was observed in suitable breeding habitat, however no active nests were found within 120m of the study area. **Not SWH**

Wildlife Habitat: Turtle and Lizard Nesting Areas				
Midland Painted Turtle <u>Special Concern Species</u> Northern Map Turtle Snapping Turtle Five-lined Skink	Turtle Nesting areas may be adjacent to these ELC Ecosites: G138 G140-149 For Five-lined Skink; Central Ontario Forest Ecosites: ES14.2, ES17 – ES20, ES23 – ES30 Or; ELC Ecosites: G056-G059 G070-G076 G087-G092 G103-G108 G118-G125	• Best nesting habitat for turtles are close to water and away from roads and sites less prone to loss of eggs by predation from skunks, raccoons or other animals. • For an area to function as a turtle-nesting area, it must provide sand and gravel that turtles are able to dig in and are located in open, sunny areas. Nesting areas on the sides of municipal or provincial road embankments and shoulders are not SWH. • Sand and gravel beaches adjacent to undisturbed shallow weedy areas of marshes, lakes, and rivers are most frequently used. <u>Information Sources</u> • Use Ontario Soil Survey reports and maps to help find suitable substrate for nesting turtles (well-drained sands and fine gravels). • Check the Ontario Herpetofaunal Summary records for uncommon turtles; location information may help to find potential nesting habitat for them. • Use aerial photographs and maps to narrow the search for prime nesting areas including shoreline beaches located near weedy areas of wetlands, lake and river shorelines, road embankments near turtle habitat, and stream crossings/culverts. • Skinks will nest under logs, in stumps or under loose rock in partially wooded areas • EIS reports and other studies prepared by CA's. • Sightings by local Naturalist groups	Studies confirm: • Presence of 5 or more nesting Midland Painted Turtles[l] • The area or collection of sites within an area of exposed mineral soils where the turtles nest, plus a radius of 30-100m around the nesting area dependant on slope, riparian vegetation and adjacent land use is the SWH.[cxlviii] • Travel routes from wetland to nesting area are to be considered within the SWH.[cxlix] • One or more Northern Map Turtle or Snapping Turtle nesting is a SWH[l]. • Any confirmed active skink nest site and a 30 m radius around it is significant[l]. • Field investigations should be conducted in prime nesting season typically late spring to early summer. • SWHDSS [cxlix] Index #28 provides development effects and mitigation measures for turtle nesting habitat and Index #37 provides information for Five-lined Skink.	Associated ELC ecocites within the downstream zone of influence includes tributary and embayment associated wetlands including G148N – Non-woody Mineral Shallow Marsh. Majority of surrounding soils consists of rockland with less than 10cm of soil material overlying bedrock. Ontario Soil Survey reports for the Sudbury district show Tributary B to have more suitable substrates consisting of sand, sandy loam and silt loam which may provide nesting habitat for turtles within the project area. Snapping turtles were observed within the downstream zone of influence near Tributary C. **Candidate SWH**

Wildlife Habitat: Seeps and Springs				
Wild Turkey Ruffed Grouse Spruce Grouse Moose White-tailed Deer Salamander spp.	Seeps/Springs are areas where ground water comes to the surface. Often they are found within headwater areas within forested habitats. Any forested Ecosite within the headwater areas of a stream could have seeps/springs.	Any forested area (with <25% meadow/field/pasture) within the headwaters of a stream or river system [cxvii, cxlix]. • Seeps and springs are important feeding and drinking areas especially in the winter will typically support a variety of plant and animal species [cxix, cxx, cxxi, cxxii, cxiii, cxiv]. Information Sources • Topographical Map. • Thermography. • Hydrological surveys conducted by CA's and MOE. • Local naturalists and landowners may know some locations. • Municipalities may have drainage maps and headwater areas mapped.	Field Studies confirm: • Presence of a site with 2 or more[l] seeps/springs should be considered SWH. • The area of a ELC forest ecosite containing the seeps/springs is the SWH. The protection of the recharge area considering the slope, vegetation, height of trees and groundwater condition need to be considered in delineation the habitat [cxlviii]. • SWHDSS [cxlix] Index #30 provides development effects and mitigation measures	Not a headwater area. **Not SWH**

Wildlife Habitat: Aquatic Feeding Habitat				
Moose White-tailed Deer	Habitat may be found in all forested ecosites adjacent to water.	MNR maps these location on Crown land and rates the site on a scale of 0 – 4, with 4 being the best. Feeding sites classed 3 or 4 are potential/candidate significant[l]. Where MAFA habitat is in low supply, class 2 MAFA habitat could also be considered potential/candidate significant[l] Wetlands and isolated embayments in rivers or lakes which provide an abundance of submerged aquatic vegetation such as pondweeds, water milfoil and yellow water lily are preferred sites. Adjacent stands of lowland conifer or mixed woods will provide cover and shade [cxlviii]. Information Sources • Local naturalists and landowners may know some locations. • MNR values information (NRVIS) may list known locations • OMNR Ecologist or Biologist may be aware of locations. • Sustainable Forestry Licence (SFL) companies may identify additional MAFA locations through field operations. • Topographical Maps together with aerial photographs will help locate potential sites. Methods for identification of Moose Aquatic Feeding Areas are outlined in OMNR's Selected Wildlife and Habitat Features: Inventory Manual [cxcv]	• Observational studies of the moose feeding habitat observing use or track studies demonstrating use of the habitat are required for any candidate site; any candidate site with observed or demonstrated moose use is significant[l]. • The area of the habitat includes the wetland area and adjacent forest stands (120m) of mixed or conifer forest, particularly those that provide thermal cover and/or travel corridors to other habitat features are considered significant [cxcvii]. • Surveys should be conducted from mid June to end of July when submergent aquatic vegetation has peaked.[cxcv] • If a SWH is determined for Aquatic Feeding Habitat then Movement Corridors are to be considered as outlined in Table 1.4.1 of this Schedule • SWHDSS [cxlix] Index #24 provides development effects and mitigation measures.	Three moose aquatic feeding areas identified upstream of the study area along the southern shore of Wabagishik Lake. MNR did not identify any feeding areas within the downstream zone of influence. Moose observed in study area. Shallow aquatic areas with appropriate aquatic vegetation including yellow pond lily and floating leaved pondweed were identified within the southern shore of the embayment area of the Vermillion River. These locations can be observed in Appendix II at AHY-011 (NRSI identified) and at AGL-005 (OMNR identified). **Confirmed SWH**

Wildlife Habitat: Mineral Licks				
Moose White-tailed Deer	Habitat may be found in all forested ecosites.	This habitat component is found in upwelling groundwater and the soil around these seepage areas. It typically occurs in areas of sedimentary and volcanic bedrock. In areas of granitic bedrock, the site is usually overlain with calcareous glacial till [cxlviii]. <u>Information Sources</u> • Local naturalists and landowners may know some locations. • MNR values information (NRVIS) may list known locations • OMNR Ecologist or Biologist may be aware of locations. • Sustainable Forestry Licence (SFL) companies may identify additional calving locations through field operations.	• Studies confirming any known site will be considered significant together with a 120 m radius around the site [cxcvii]. • The area of the habitat is the wetland, seep or spring containing the mineral lick and 100-200m of undisturbed contiguous forest around the site dependant on level of disturbance in the area [cxlviii]. • Field investigations should be conducted in early spring prior to leaf out. Since sites will be very difficult to locate, consider using a small aircraft. • SWHDSS [cxlix] Index #29 provides development effects and mitigation measures.	Not a seepage area. Mineral lick not identified. **Not SWH**

Wildlife Habitat: Denning Sites for Mink, Otter, Marten Fisher and Eastern Wolf				
Mink Otter Marten Fisher Grey Wolf **Special Concern** Eastern Wolf	Habitat may be found in all forested ecosites.	Mink prefer shorelines dominated by coniferous or mixed forests with dens usually underground. Mink will sometimes use old muskrat lodges [cxlviii]. Otters prefer undisturbed shorelines along water bodies that support productive fish populations with abundant shrubby vegetation and downed woody debris for denning. They often use old beaver lodges or log jams and crevices in rock piles [cxlviii]. Marten and fisher share the same general habitat, requiring large tracts of coniferous or mixed forests of mature or older age classes. Denning sites are often in cavities in large trees or under large downed woody debris [cxlviii]. Information Sources • Local naturalists and landowners may know some locations. • MNR values information (NRVIS) may list known locations • OMNR Ecologist or Biologist may be aware of locations. • Sustainable Forestry Licence (SFL) companies may identify additional denning sites through field operations. • Topographical Maps together with aerial photographs will help locate potential sites. • Local trappers may know the location of prime denning sites.	• Any known active denning site and a 100 m radius around it with the listed species is considered to be significant[cxlviii]. • A known Eastern or Grey Wolf den site and a 200m radius will be considerd significant[ccvii]. • Extensive searches for denning sites are not recommended as they are very difficult to locate but protection of appropriate habitat should be considered during planning. • SWHDSS [cxlix] Index #31 provides development effects and mitigation measures.	Undisturbed river shorelines heavily vegetated with large mixedwoods forest and providing a source of fish - suitable for mink, otters, marten and fisher. River otter and mink were observed within study area south of Wabageshik Rapids. River otter were also observed by land owners. A precautionary approach has been taken as dens are very difficult to locate, however protection of habitat is considered during planning. **Candidate SWH**

Wildlife Habitat: Amphibian Breeding Habitat (Woodland).				
Eastern Newt Blue-spotted Salamander Spotted Salamander Four-toed Salamander Northern Two-lined Salamander Spring Peeper Wood Frog American Toad	All forested, ELC Ecosites; The wetland breeding ponds (including vernal pools) may be permanent, seasonal, ephemeral, large or small in size and could be located within or adjacent to the woodland [lxxii].	• Presence of a wetland, lake or pond >500m² (about 25m diameter) [ccvli] within or adjacent (within 120m) to a woodland (no minimum size) [clxxxii, lxiii, lxv, lxvi, lxvii, lxviii, lxix, lxx] The wetland, lake or pond and surrounding forest, would be the Candidate SWH. Some small wetlands may not be mapped and may be important breeding pools for amphibians. • Breeding ponds within the woodland or the shortest distance from forest habitat are more significant because of reduced risk to migrating amphibians and more likely to be used. • Woodlands with permanent ponds or those containing water in most years until mid-July are more likely to be used as breeding habitat [cxlviii]. Information Sources • Refer to the Ontario Herpetofaunal Summary for historical records. • Local landowners may also provide assistance as they may hear spring-time choruses of amphibians on their property. • Contact local OMNR Ecologist or Biologist and wetland evaluations. • Local field naturalist clubs • Canadian Wildlife Service Amphibian Road Call Survey information. • Ontario Vernal Pool Association (http://www.ontariovernalpools.org/)	Studies confirm; • Presence of breeding population of 1 or more of the listed salamander species; or 2 or more of the frogs or toads with at least 100 individuals (adults, juveniles, eggs/larval masses) [lxxi] is significant. • The habitat is the wetland and woodland or adjacent woodland ELC ecosites. The amount of area protected is dependant on slope, riparian vegetation, high water mark, density and height of trees and ground/surface water condition [cxlviii]. • A study to determine this SWH will be required during the spring (May-June) when amphibians are migrating, are concentrated around suitable breeding habitat or have eggs/larval stages present within the wetland. • SWHDSS [cxlix] Index #14 provides development effects and mitigation measures.	Weltands within the downstream zone of influence are >500m² in size. These wetlands consist of Non-Woody Mineral Shallow Marsh (G148N). American toad (3), green frog (4), northern leopard frog (1) and wood frog (1) observed. Number of observations of American toad and wood frog do not meet criteria for Confirmed habitat. However, amphibian breeding surveys were no conducted within the project area. **Candidate SWH**

Wildlife Habitat: Amphibian Breeding Habitat (Wetlands)				
Eastern Newt American Toad Spotted Salamander Four-toed Salamander Blue-spotted Salamander Gray Treefrog Western Chorus Frog Northern Leopard Frog Pickerel Frog Green Frog Mink Frog Bullfrog	ELC Ecosites: G129-G135 G142-G152	• Wetlands and pools (including vernal pools) >500m² (about 25m diameter) [ccvii] isolated from woodland/forest habitat(>120m) supporting high species diversity are significant; some small or ephemeral habitats may not be identified on MNR mapping and could be important amphibian breeding habitats [clxxxiv]. Amphibians mostly breed in habitats that lack fish. • Presence of shrubs and logs increase significance of pond for some amphibian species because of available structure for calling, foraging, escape and concealment from predators. • Bullfrogs require permanent water bodies with abundant emergent vegetation. Information Sources • Ontario Herpetofaunal Summary database. • Canadian Wildlife Service Amphibian Road Surveys and Backyard Amphibian Call Count. • OMNR Ecologist or Biologist may know of populations, wetland evaluations may be a good source of information.. • Use maps or aerial photography to locate marsh habitat. • EIS reports and other studies prepared by CA's.	Studies confirm: • Presence of breeding population of 1or more of the listed salamander species; or 3 or more of the listed frog or toad species with at least 20 breeding individuals (adults, juveniles, eggs/larval masses) [lxxi, lxxiii] **or;** • Wetland with confirmed breeding Bullfrogs is significant[l]. • The ELC ecosite wetland area and the shoreline are the SWH. • Surveys to confirm breeding to be completed during spring (Apr to June) when amphibians are migrating, calling and breeding within the wetland habitats. • If a SWH is determined for Amphibian Breeding Habitat (Wetlands) then Movement Corridors are to be considered as outlined in Table 1.4.1 of this Schedule. • SWHDSS [cxlix] Index #15 provides development effects and mitigation measures.	Four G148N Wetlands identified at the mouths of tributaries downstream of the proposed GS. These wetlands are all greater than 500m².However, all of these wetlands are <120m from forested/woodland habitats within the proposed Wabageshik GS study area. **Not SWH**

Wildlife Habitat: Mast Producing Areas				
Black Bear White-tailed deer Wild Turkey Ruffed Grouse	ELC Ecosites: G015 G017 G019 G027-G028 G041-G043 G057 G059 G072 G090 G106 G108 G121 Central Ontario Forest Ecosites: ES14 ES17.1 ES23 ES24 ES25 ES26	Most important areas are mature forests >0.5 ha containing numerous large beech and red oak trees that supply the energy-rich mast that wildlife prefer [cxlviii]. Other significant tree species include hickory, basswood, black cherry, ironwood, mountain ash, pin cherry, and butternut. Significant shrub species include blueberries, wild black berry, serviceberry, raspberry, beaked hazel, choke cherry and hawthorn [cxlviii]. Sites providing long-term, relatively stable food supplies, forest openings or barrens >1 ha provide excellent sites for mast producing shrubs [cxlviii]. Sites such as clear-cuts or burns are temporary source of food and are less significant [cxlviii]. Information Sources • OMNR Ecologists, Biologists or Foresters may know of important feeding sites or areas with high composition of mast producing trees. • FRI maps to locate stands with mast producing trees. • SFL companies may know of areas through regular forest inventory work. • Local naturalists clubs or hunters may be aware of important locations.. • Aerial photography will assist in locating forest openings and bedrock outcrops.	•Any forested site with a high component (>50%)[1] of mast producing tree species >40-65cm dbh [cxlix] or; • An opening within a woodland/forested site with an abundance (50% ground cover)[1] of mast producing shrubs (e.g. wild blackberry, serviceberry, raspberry, blueberry and beaked hazel) species is considered significant [cxlix]. •Area of the early successional habitat or woodland/forest stand ELC ecosite is the SWH. •Surveys should be conducted from June to August when plants are actively growing to determine presence. •SWHDSS [cxlix] Index #3 provides development effects and mitigation measures	Appropriate ELC ecosites are not present within the study area. Forests do not contain mast-producing trees. No shrub communities present. Lack of large areas of stable food source. **Not SWH**

1: Ontario Ministry of Natural Resources (OMNR). 2011. Significant Wildlife Habitat Ecoregion 5E Criterion Schedule. June 2011. 42pp.

Table 3. Characteristics of Habitat for Species of Conservation Concern for Ecoregion 5E

Wildlife Species[1]	Candidate SWH		Confirmed SWH	Wabageshik
	ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Wildlife Habitat: Marsh Bird Breeding Habitat				
American Bittern Sora Red-necked Grebe Pie-billed Grebe Redhead Ring-necked Duck Lesser Scaup Ruddy Duck Common Moorhen American Coot Wilson's Phalarope Common Loon Sandhill Crane Green Heron Sedge Wren Marsh Wren Trumpeter Swan **Special Concern**: Yellow Rail Black Tern	ELC Ecosites: G138-G152 For Green Heron: Above Ecosites plus: G129-G136.	• Nesting occurs in wetlands. • All wetland habitat is to be considered as long as there is shallow water with emergent aquatic vegetation present [cxxiv]. • For Green Heron, habitat is at the edge of water such as sluggish streams, ponds and marshes sheltered by shrubs and trees. Less frequently, it may be found in upland shrubs or forest a considerable distance from water. Information Sources • Contact OMNR, wetland evaluations are a good source of information. • Local naturalist clubs • NHIC Records. • EIS reports and other studies prepared by CA's. • Ontario Breeding Bird Atlas [ccv].	Studies confirm: • Presence of 5 or more nesting pairs of Sedge Wren or Marsh Wren or **or** 1 pair of Sandhill Cranes; **or** breeding by any combination of 5 or more of the listed species [l]. • Note: any wetland with breeding of 1 or more Trumpeter Swans, Black Terns, Green Heron or Yellow Rail is SWH [l]. • Area of the ELC ecosite is the SWH. • Breeding surveys should be done in May/June when these species are actively nesting in wetland habitats. • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHDSS [cxlix] Index #35 provides development effects and mitigation measures	ELC ecosite code includes G148N Non-woody Mineral Shallow Marsh . No nesting of the listed species was observed during breeding bird surveys in 2010. Common loon was observed with no evidence of breeding within the study area. Marsh Breeding Bird Surveys were not conducted during site investigations. **Candidate SWH**

Wildlife Habitat: Open Country Bird Breeding Habitat				
Upland Sandpiper Grasshopper Sparrow Vesper Sparrow Northern Harrier Savannah Sparrow **Special Concern** Short-eared Owl	ELC Ecosites: G008-G009 G020-G021 G029-G031 G044-G046 G060-G062 G077-G079 G093-G095 G109-G111	Large grassland areas (includes natural and cultural fields and meadows) >30 ha [clx, clxi, clxii, clxiii, clxiv, clxv, clxvi, clxvii, clxviii, clxix] Grasslands not Class 1 or 2 agricultural lands, and not being actively used for farming (i.e. no row cropping or intensive hay or livestock pasturing in the last 5 years) [l]. Grassland sites considered significant should have a history of longevity, either abandoned fields, mature hayfields and pasturelands that are at least 5 years or older. The Indicator bird species are area sensitive requiring larger grassland areas than the common grassland species. Information Sources • Use Agricultural land classification maps with aerial photographs to determine the potential grasslands that might be candidate sites. • Ask local birders for location of grasslands that support abundant and species rich populations of area-sensitive species. • EIS reports and other studies prepared by CA's.	Field Studies confirm: • Presence of nesting or breeding of 2 or more of the listed species.[l] • A field with 1 or more breeding Short-eared Owls is to be considered SWH. • The area of SWH is the contiguous ELC ecosite field areas. • Conduct field investigations of the most likely areas in spring and early summer when birds are singing and defending their territories. • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHDSS [cxlix] Index #32 provides development effects and mitigation measures	Appropriate ELC ecosites are not present within the study area. **Not SWH**

Wildlife Habitat: Shrub/Early Successional Bird Breeding Habitat				
Willow Flycatcher Brown Thrasher Blue-winged Warbler Tennessee Warbler Prairie Warbler Eastern Towhee Clay-colored Sparrow Field Sparrow **Special Concern:** Golden-winged Warbler	ELC Ecosites: G009-G010 G021-G022 G031-G032 G046-G047 G062-G063 G079-G080 G095-G096 G111-G112 G134-G135 Patches of shrub ecosites can be complexed into a larger habitat for some bird species.	Large field areas succeeding to shrub and thicket habitats>30 ha in size. Shrub land or early successional fields, not class 1 or 2 agricultural lands, not being actively used for farming (i.e. no row-cropping, haying or live-stock pasturing in the last 5 years) [l]. Larger shrub thicket habitats (>30 ha) are most likely to support and sustain a diversity of these species [clxxiii]. Shrub and thicket habitat sites considered significant should have a history of longevity, either abandoned fields or lightly grazed pasturelands. Information Sources • Use agricultural land classification maps and recent aerial photographs to determine the amount of potential shrub and thicket habitats. • Ask local birders for location of shrub and thicket habitats that support abundant and species rich populations of area-sensitive species. • EIS reports and other studies prepared by CA's.	Field Studies confirm: • Presence of nesting or breeding of 2 or more of species listed [l]. • A field with breeding Golden-winged Warbler is to be considered as Significant Wildlife Habitat. [l] • The area of the SWH is the contiguous ELC ecosite field/thicket area. • Conduct field investigations of the most likely areas in spring and early summer when birds are singing and defending their territories • Evaluation methods to follow "Bird and Bird Habitats: Guidelines for Wind Power Projects"[ccxi] • SWHDSS [cxlix] Index #33 provides development effects and mitigation measures.	Appropriate ELC ecosites are not present within the study area. **Not SWH**
Wildlife Habitat: Common Nighthawk Habitat				
		open ground; clearings in dense forests; ploughed fields; gravel beaches or barren areas with rocky soils; open woodlands; flat gravel roofs[2]	Confirmed use of a habitat by common nighthawk for its life cycle requirements is considered Significant Wildlife Habitat	Habitat for the common nighthawk may be present within the forested ecosites adjacent to openings in G023TI. NRSI biologist did not observed common nighthawk ; however, nocturnal bird surveys were not conducted. **Candidate SWH.**

Wildlife Habitat: Eastern Milksnake Habitat				
		Open woodlands.[2]	Confirmed use of a habitat by Eastern Milksnake for its life cycle requirements is considered Significant Wildlife Habitat	Eastern milksnake is a species of Special Concern in Ontario. Consequently, confirmed habitat is considered Significant Wildlife Habitat. NRSI biologists did not observe this species within the study area during coverboard surveys, but it was identified by the OMNR as potentially occurring in the project area and suitable habitat is available within the study area. **Candidate SWH**
Wildlife Habitat: Common Snapping Turtle Habitat				
		Permanent, semi-permanent fresh water; marshes, swamps or bogs; rivers and streams with soft muddy banks or bottoms; often uses soft soil or clean dry sand on south-facing slopes for nest sites; may nest at some distance from water; often hibernate together in groups in mud under water; home range size ~28 ha.[2]	Confirmed use of a habitat by common snapping turtle is considered Significant Wildlife Habitat	Common snapping turtle is a species of Special Concern in Ontario. Consequently confirmed habitat is considered Significant Wildlife Habitat. NRSI biologist observed one common snapping turtle within the study area. **Confirmed SWH**.

1: Ontario Ministry of Natural Resources (OMNR). 2011. Significant Wildlife Habitat Ecoregion 5E Criterion Schedule. June 2011. 42pp.
2: OMNR Significant Wildlife Habitat Technical Guide and Appendices (2000)
3: Birds of North America Online (2011) (www.bna.birds.cornell.edu)

Table 4: Characteristics of Animal Movement Corridors for Ecoregion 5E.

Wildlife Species[1]	Candidate SWH		Confirmed SWH	Wabageshik
	ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
Amphibian Movement Corridor				
Eastern Newt Blue-spotted Salamander Spotted Salamander Gray Treefrog Spring Peeper Western Chorus Frog Wood Frog Northern Leopard Frog Pickerel Frog Green Frog Mink Frog Bullfrog American Toad	Corridors may be found in all ecosites associated with water. Corridors will be determined based on identifying the significant breeding habitat for these species in Table 1.1	Movement corridors between breeding habitat and summer habitat clxxiv, clxxv, clxxvi, clxxvii, clxxviii, clxxix, clxxx, clxxxi. Movement corridors must be determined when Amphibian breeding habitat is confirmed as SWH from Table 1.2.2(Amphibian Breeding Habitat – Wetland) of this Schedule Ì. Information Sources • MNR District Office. • NHIC. • EIS reports and other studies prepared by CA's • Naturalist Clubs.	Field Studies must be conducted at the time of year when species are expected to be migrating or entering breeding sites. Corridors should consist of native vegetation, roadless area, nogaps such as fields, waterways or bodies, and undeveloped areas are most significantcxlix Corridors should be at least 200m widecxlix with gaps <20mcxlix and if following riparian area with at least 15m of vegetation on both sides of waterwaycxlix . Shorter corridors are more significant than longer corridors, however amphibians must be able to get to and from their summer and breeding habitatcxlix. SWHDSS cxlix Index #40 provides development effects and mitigation measures	Candidate Amphibian Breeding Habitat (Woodland). Has been identified within 120m of the project site. Amphibian specific surveys have not been conducted. **Candidate SWH.**
Cervid Movement Corridors				
White-tailed Deer Moose	Corridors may be found in all forested ecosites.	Movement corridor must be determined when Deer Wintering Habitat is confirmed as SWH from Table 1.1 and Moose Aquatic Feeding Area and Mineral Lick Habitat from Table 1.2.2 of this schedule. Ì A deer wintering habitat identified by the OMNR as SWH in Table 1.1 of this Schedule will have corridors that the deer use during fall migration and spring dispersion clxxxii, clxxxiii, cxlix, cxciv. Corridors typically follow riparian areas, woodlots, areas of physical geography	Studies must be conducted at the time of year when deer or moose are migrating or moving to and from yard, mineral lick or feeding areas. Corridors that lead to a deer wintering yard should be unbroken by roads and residential areas. Corridors that lead moose to MAFA's, and mineral licks should remain intact. Corridors should be at least 200m	Deer movement studies were conducted in 2011. Movement across the Vermillion River was confirmed and occurred mostly at the downstream extent of the narrows. This deer crossing coincides with typically seasonal movement into and out

		(ravines, or ridges). Corridors will be multi-functional i.e. these will function for any smaller mammal species as well. Information Sources • MNR District Office. • NHIC. • EIS reports and other studies prepared by CA's. • Naturalist Clubs.	widecxlix with gaps <20mcxlix and if following riparian area with at minimum of 15m of vegetation cover on both sides of the waterwaycxlix . Shorter corridors are more significant than longer corridors, however cervids must be able to get to and from their habitatcxlix. SWHDSS cxlix Index #39 provides development effects and mitigation measures	of wintering areas. **Confirmed SWH.**

Furbearer Movement Corridor				
Mink Otter	All Forested Ecosite Codes adjacent to or within shoreline habitats.	Mink and Otter den sites are typically found within a riparian area of a lake, river, stream or wetland. The den site will potentially have a movement corridor associated with it. All Mink or Otter den sites identified using Table 1.22 of this schedule under the habitat of **Denning Sites for Mink, Otter, Marten Fisher and Eastern Wolf** are to be considered for an animal movement corridor. <u>Information Sources</u> • Local naturalists and landowners may know some locations. • MNR values information (NRVIS) may list known locations • OMNR Ecologist or Biologist may be aware of locations. • Topographical Maps together with aerial photographs will help locate potential sites. • Local trappers may know the location of prime denning sites and movement corridors.	Studies to confirm: • Studies must be conducted at the time of year when mink or otter are using the denning sites. Studies can be based on observation or from scat and track surveys • SWHDSS [cxlix] Index #31 provides development effects and mitigation measures	Otter and mink were observed within the study area. Confirmed denning sites likely have an associated movement corridor and therefore a precautionary approach was taken. **Candidate SWH.**

1: Ontario Ministry of Natural Resources (OMNR). 2011. Significant Wildlife Habitat Ecoregion 5E Criterion Schedule. June 2011. 42pp.

Table 5: Characteristics Significant Wildlife Habitat Exceptions for Ecoregion 5E.

Wildlife Species[1]	Candidate SWH		Confirmed SWH	Wabageshik
	ELC Ecosite Codes[1]	Habitat Criteria and Information Sources[1]	Defining Criteria[1]	Assessment Details
5e-11				
Rare Forest Types: Jack Pine Rationale; Uncommon to rare in southern area of Ecoregion 5E.	**Jack Pine** ELC Ecosites: G012 G023 G034-G035 G049 G065 G068 G082-G083 G098-G099 G114 Central Ont. FEC: ES13.1 ES13.2 ES15.1 ES 15.2	Jack Pine grows best on soils that are sandy, silty or a coarse loam on dry to moist sites No minimum size to stand. <u>Information Sources</u> OMNR Forester, Ecologist or Biologist may be aware of locations. Local Naturalist clubs Conservation Authorities	Any forest stand with ≥ 40% jack pine is to be considered significant [I]. The ELC Ecosites containing the jack pine woodland/forest stand is the SWH. • SWHDSS[cxlix] Index #37 provides direction for rare speices and habitats.	G023 – Very Shallow, Humid: Red Pine – White Pine Conifer, Tall Treed Found within the project site. No Jack Pine were identified within the ELCO ecosite. **Not SWH.**
5E-13				
Late Winter Moose Habitat	**The preferred ecosites are described in the Field Guide to Forest Ecosystems of Central Ontario** [ccvi]: ES 16 ES 22 ES 30 ES 33 ES 34 Corresponding ELC Ecosites: G012-G014 G024-G026	Late winter moose habitat is characterized by dense conifer cover with greater than 50% canopy closure and >10m in height. Snow depth in excess of 70cm restrict moose movement during winter, however late winter thermal refuge is important in relieving heat stress . These habitats are extensively used by moose during late spring and summer due to the shade provided [cxcv]. Conifer stands >50ha [cxcv], dominated by tall trees >10m[ccvi], on gentle to moderately rugged sites with deep soils. Areas identified as rating 3 or 4 [cxcv] for late winter moose habitat are Candidate SWH.	Field Studies will confirm the use of these areas as late winter habitat by moose during the months of March and April. Moose are very difficult to observe in late winter habitat, therefore any number of moose observed or moose tracks and trails observed in the habitat confirm this habitat as a SWH. The area of the SWH is the area of forest ecosites . SWHDSS [cxlix] Index #24 provides development effects and mitigation measures for aquatic feeding areas, similar effects and mitigation can be used for late winter habitat.	Moist, Coarse: Spruce – Fir Conifer, Tall Treed (G067) habitat was found within the project area. Ecosites do not meet size criteria within project area. No winter moose habitat was identified by MNR SIP within project area. Camera surveys did not detect moose in March or April.

	G035-G038 G050-G053 G066-G068 G083-G086 G099-G102	Information Sources • OMNR Forester, Ecologist or Biologist may be aware of locations. • The Selected Wildlife and habitat Inventory Manual (1998)[cxcv] outlines the inventory method for Late Winter Moose Habitat.		**Not SWH.**

1: Ontario Ministry of Natural Resources (OMNR). 2011. Significant Wildlife Habitat Ecoregion 5E Criterion Schedule. June 2011. 42pp.