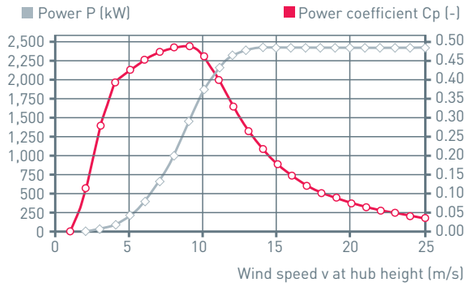
Appendix

Appendix A:

Wind Turbine Generator Specifications

Calculated power curve



Wind (m/s)	Power P (kW)	Power-coefficient Cp (-)
1	0.0	0.00
2	3.6	0.11
3	29.9	0.27
4	98.2	0.38
5	208.3	0.41
6	384.3	0.44
7	637.0	0.46
8	975.8	0.47
9	1,403.6	0.47
10	1,817.8	0.45
11	2,088.7	0.39
12	2,237.0	0.32
13	2,300.0	0.26
14	2,350.0	0.21
15	2,350.0	0.17
16	2,350.0	0.14
17	2,350.0	0.12
18	2,350.0	0.10
19	2,350.0	0.08
20	2,350.0	0.07
21	2,350.0	0.06
22	2,350.0	0.05
23	2,350.0	0.05
24	2,350.0	0.04
25	2,350.0	0.04

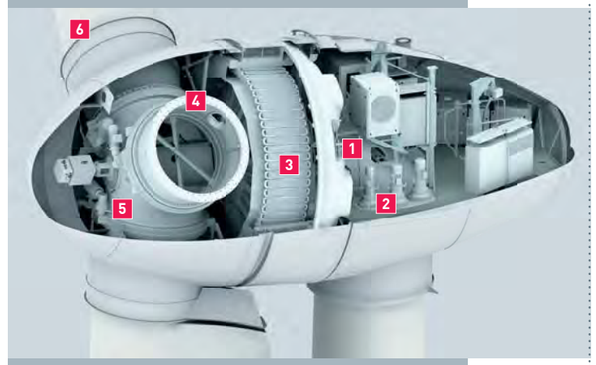
p = 1.225 kg/m³

Technical specifications E-92

Rated power:	**2,350 kW**
Rotor diameter:	**92 m**
Hub height in meter:	**84 / 85 / 98 / 104 / 108 / 138**
Wind zone (DIBt):	**WZ III**
Wind class (IEC):	**IEC/EN IIA**
WEC concept:	Gearless, variable speed, single blade adjustment
Rotor	
Type:	Upwind rotor with active pitch control
Rotational direction:	Clockwise
No. of blades:	3
Swept area:	6,648 m²
Blade material:	GRP (epoxy resin); Built-in lightning protection
Rotational speed:	Variable, 5 - 16 rpm
Pitch control:	ENERCON single blade pitch system; one independent pitch system per rotor blade with allocated emergency supply
Drive train with generator	
Main bearing:	Double row tapered/cylindrical roller bearings
Generator:	ENERCON direct-drive annular generator
Grid feed:	ENERCON inverter
Brake systems:	– 3 independent pitch control systems with emergency power supply – Rotor brake – Rotor lock
Yaw system:	Active via yaw gear, load-dependent damping
Cut-out wind speed:	28 - 34 m/s (with ENERCON storm control*)
Remote monitoring:	ENERCON SCADA

* For more information on the ENERCON storm control feature, please see the last page.

E-92
2,350 kW



1 Main carrier
2 Yaw drive
3 Annular generator
4 Blade adapter
5 Rotor hub
6 Rotor blade

Appendix B:

Avian Study

PRE-CONSTRUCTION AVIAN SURVEYS FOR PROPOSED WIND FARM AT BARRACHOIS CAPE BRETON COUNTY, NOVA SCOTIA

Submitted to:

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October 2013

Project No.: TV121034

Executive Summary

This report summarizes pre-construction baseline avian surveys at the proposed Barrachois wind farm between September 2012 and October 2013. Surveys were completed during breeding season. Winter bird surveys with a focus on raptors were also conducted, as well as spring migration surveys. Preliminary fall migration surveys were conducted in 2012 at the edge of the site property. Breeding birds were surveyed using point counts distributed around the proposed turbine locations, while migration and winter surveys were conducted along a walked transect route along the access road and passing through the site.

A total of 48 species were observed during the surveys, of which 29 are confirmed or evidently breeding on or near the project site. All of the species observed during the migration surveys are known to breed in the region; it was not evident that the area serves as a significant migration stopover. Breeding status was inferred from observed behavior during the June and July breeding bird surveys and incidental observations. Three species were confirmed to be breeding in the area by presence of fledged young and observations of adults carrying food, and a further 8 species are considered "probable" breeders based on territorial behaviour (observed in suitable habitat on two or more occasions over the breeding season), agitated behaviour of adults, and/or presence of a breeding pair in suitable habitat. Another 18 species, which are considered "possible" breeders, were heard or observed only once in a particular location in suitable breeding habitat. One federally listed species at risk, the Olive-sided Flycatcher, was observed during the summer breeding surveys. Five additional species considered regionally rare by ACCDC were observed: Gray Jay, Great Cormorant, Northern Goshawk, Yellow-bellied Flycatcher and Boreal Chickadee.

Based on observed species use of the site to date, there appears to be relatively little risk of bird mortality due to collisions with the wind turbines at the Project Area, since the site does not appear to be part of a major migration corridor. Species that engage in aerial displays which would put them at greater risk of collision were not observed at the site. Only two raptor species were observed during the field surveys, the Red-tailed Hawk and Northern Goshawk. Disturbance through displacement and habitat loss are considered to be of minor concern at this site; the habitat types found in the Project Area are not unique to the region, and the proposed wind farm consists of just two turbines.

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LIST OF APPENDICES

1.0 INTRODUCTION

Natural Forces Inc. is proposing to develop a two turbine wind farm in Barrachois, Nova Scotia, and has engaged the services of AMEC Environment & Infrastructure, a Division of AMEC Americas Limited (AMEC), to provide an assessment of the potential effects of the proposed project on local bird populations. In order to provide a complete assessment, AMEC has conducted a desktop data review for bird species in the region, and has designed and implemented a survey plan for pre-construction baseline avian surveys. This report summarizes the results of the data review and surveys conducted to date at the proposed wind farm site.

The objectives of this study were to determine: 1) what species make use of the habitat at the proposed wind farm site at different times of year; 2) of the species present at the site, which may be most susceptible to collision with turbines based on flight height and behaviour; 3) the peak spring and fall migration periods at the site, based on bird abundance and species diversity; and 4) whether any species at risk or species of conservation concern make use of the proposed site during migration or for breeding. All avian surveys were conducted by AMEC biologist Maureen Cameron-MacMillan.

2.0 METHODS

2.1 DESKTOP REVIEW

Prior to conducting field surveys, aerial photographs of the site were reviewed to determine appropriate survey sites that would ensure all representative habitat types within the proposed project footprint were surveyed. The Important Bird Area (IBA) database was consulted to determine whether known areas with significant attributes for birds exist near the project site. As well, a list of bird species known or suspected to be breeding in the area was obtained through the Maritimes Breeding Bird Atlas (MBBA), and the Christmas Bird Count (CBC) database was consulted to obtain records of wintering bird species in the region.

2.2 FIELD SURVEYS

2.2.1 Survey Methodology

For the breeding bird surveys, a “point count” survey consisting of ten minutes of silent listening was conducted at the proposed turbine locations, as well as one “control” location more than 500 m from the turbines along the site access road. The point count surveys were conducted on two occasions during the breeding season. All visual and auditory (songs and calls) observations of birds within 100 m of the observer were recorded, along with the number of individuals and breeding evidence using Bird Studies Canada and MBBA criteria. Surveys were conducted in the early morning, and only during suitable weather conditions (i.e., not during sustained precipitation or on windy days) to maximize probability of detection.

For migration surveys and winter resident surveys conducted in 2013, a 1 km transect route, selected to be representative of the habitat on the site, was established along the site access road. Transect surveys took place in the morning or early afternoon. The route was traversed on foot with frequent listening stops, and all birds seen or heard were recorded. Weather

conditions, bird species and numbers, and behaviour (in particular, the height of birds in flight around the proposed turbine locations) were noted. Surveys for winter resident species incorporated a particular focus on raptors. During the spring migration surveys, a nighttime survey for nocturnal species including owls and nighthawks was conducted; this survey employed playback of target species to increase the probability of detection.

In fall of 2012, prior to construction of the site access road, preliminary fall migration surveys were conducted at the property boundary approximately 400 m west of the proposed Turbine 1 location, in a cleared area around a cellular tower.

2.2.2 Survey Timing

Winter bird surveys were conducted on January 29th and February 21st, 2013. Spring migration surveys were conducted on May 16th, May 31st and June 8th. At each of the point count locations, two 10-minute surveys for breeding birds were conducted during the breeding season, the first on June 20th and the second on July 5th. Fall 2013 surveys were conducted on August 24th, September 5th, September 21st, September 24th and October 1st. Preliminary surveys were completed during the 2012 fall migration period on the following dates: September 7th, September 19th, October 3rd and October 12th.

3.0 RESULTS

3.1 DESKTOP REVIEW

A search of the IBA database revealed that the nearest IBA, Central Cape Breton Highlands (NS061) is situated approximately 12 km northwest of the Site (IBA 2013). This IBA is home to a globally significant number of Bicknell's Thrush (*NSESA*: Vulnerable; *SARA* and COSEWIC: Threatened). The Bicknell's Thrush favours dense coniferous forest, and so is unlikely to occur on the project site, which is dominated by mixed forest.

Results of the 2nd MBBA were accessed to provide information on breeding birds in the general project area. Results were obtained for square 20QS01, the 10 km by 10 km atlas square in which the site is located; because the site is located near the western edge of this square, results were also obtained for the adjacent square 20PR91. A total of 88 species were recorded for the square (MBBA 2013); these are listed in Table A.1 (Appendix A). Of these species, 22 were confirmed to be breeding in one or both squares based on observed breeding evidence, and a further 43 were considered probable breeders.

Count results were obtained for all 28 CBCs conducted between 1966 and 2012 in the Sydneys count area, a 24 km diameter circle which is centered near North Sydney and encompasses the project location (CBC 2013). Over the 28 CBCs, a total of 135 species have been observed wintering in the Sydneys count area (Table A.2 in Appendix A).

3.2 FIELD SURVEYS

A list of species observed during the field surveys is provided in Table 1 and in Appendix A, and the results of all surveys conducted to date are discussed below. Representative photographs of habitats on the site are provided in Appendix B.

Table 1. Species Observed during Field Surveys of the Barrachois Site.

Common Name	Latin Name	Special Status				Breeding Evidence
		ACCDC	General Status	*NS ESA*	*SARA*	
Alder Flycatcher	*Empidonax alnorum*					Y
American Crow	*Corvus brachyrhynchos*					
American Goldfinch	*Spinus tristis*					
American Robin	*Turdus migratorius*					
Belted Kingfisher	*Megaceryle alcyon*					
Black-and-white Warbler	*Mniotilta varia*					Y
Blackburnian Warbler	*Setophaga fusca*					
Black-capped Chickadee	*Poecile atricapillus*					Y
Black-throated Green Warbler	*Setophaga virens*					Y
Blue Jay	*Cyanocitta cristata*					Y
Blue-headed Vireo	*Vireo solitarius*					Y
Boreal Chickadee	*Poecile hudsonicus*	S3	Sensitive			
Brown Creeper	*Certhia americana*					
Cedar Waxwing	*Bombycilla cedrorum*					
Chestnut-sided Warbler	*Setophaga pensylvanica*					Y
Chipping Sparrow	*Spizella passerina*					Y
Common Grackle	*Quiscalus quiscula*					
Common Raven	*Corvus corax*					
Common Yellowthroat	*Geothlypis trichas*					Y
Dark-eyed Junco	*Junco hyemalis*					Y
Downy Woodpecker	*Picoides pubescens*					
Golden-crowned Kinglet	*Regulus satrapa*		Sensitive			Y
Gray Jay	*Perisoreus canadensis*	S3S4	Sensitive			
Great Cormorant	*Phalacrocorax carbo*	S3	Sensitive			
Hairy Woodpecker	*Picoides villosus*					Y
Hermit Thrush	*Catharus guttatus*					Y
Magnolia Warbler	*Setophaga magnolia*					Y
Mourning Warbler	*Geothlypis philadelphia*					Y
Nashville Warbler	*Oreothlypis ruficapilla*					

Common Name	Latin Name	Special Status				Breeding
Northern Flicker	*Colaptes auratus*	**ACCDC**	**General Status**	***NS ESA***	***SARA***	
Northern Goshawk	*Accipiter gentilis*	S3S4				Y
Northern Parula	*Setophaga americana*					Y
Olive-sided Flycatcher	*Contopus cooperi*	S3B	At Risk	Threatened	Threatened (Schedule 1)	Y
Ovenbird	*Seiurus aurocapilla*					Y
Palm Warbler	*Setophaga palmarum*					Y
Purple Finch	*Carpodacus purpureus*					
Red-breasted Nuthatch	*Sitta canadensis*					Y
Red-eyed Vireo	*Vireo olivaceus*					Y
Red-tailed Hawk	*Buteo jamaicensis*					Y
Ruby-crowned Kinglet	*Regulus calendula*		Sensitive			Y
Ruffed Grouse	*Bonasa umbellus*					Y
Song Sparrow	*Melospiza melodia*					
Swainson's Thrush	*Catharus ustulatus*					Y
White-throated Sparrow	*Zonotrichia albicollis*					Y
Winter Wren	*Troglodytes hiemalis*					
Yellow Warbler	*Setophaga petechia*					Y
Yellow-bellied Flycatcher	*Empidonax flaviventris*	S3S4B	Sensitive			Y
Yellow-rumped Warbler	*Setophaga coronata*					

3.2.1 Winter Resident Surveys

During winter resident surveys, conducted on January 29th and February 21st, 16 individuals representing seven species were detected (Table A.3 in Appendix A). Black-capped Chickadee, Golden-crowned Kinglet, and Hairy Woodpecker were the most commonly observed species.

3.2.2 Spring Migration Surveys

Spring migration surveys were conducted on May 16th and 31st, and June 8th. A total of 156 bird observations were recorded, with 30 species detected during the spring migration surveys (Table A.4 in Appendix A). Black-throated Green Warbler, Ovenbird, Black-and-White Warbler, American Robin and Hermit Thrush were the most commonly observed species at the site. Overall, species abundance and diversity was not particularly high, and all of the species observed are known to breed in the region, with no northern migrant species detected; therefore, it is unlikely that the area serves as a significant spring migration stopover.

3.2.3 Summer Breeding Surveys

Breeding bird surveys were conducted on June 20th and July 5th. Over the two breeding bird surveys, breeding evidence was recorded for 28 species (Table A.5 in Appendix A), including 8

probable breeders, 18 possible breeders and two confirmed breeders according to the categories used by the MBBA. One additional species, the Northern Goshawk, was confirmed to be nesting at the site during a late July visit to the site. At this time, an agitated adult bird was observed near the edge of the met tower clearing, and at least one juvenile could be heard in the forest nearby.

The most commonly detected species during breeding bird surveys at the site were Black-capped Chickadee, Hermit Thrush and Ovenbird. Red-eyed Vireo, Black-and-white Warbler and Black-throated Green Warbler were also frequently observed.

3.2.4 Fall Migration Surveys

Fall 2013 migration surveys were conducted on August 24th, September 5th, September 21st, September 24th and October 1st. A total of 42 bird observations were recorded, with 13 species detected (Table A.6 in Appendix A). Blue Jay, Black-capped Chickadee and Golden-crowned Kinglet were the most commonly observed species at the site in the fall.

Just 16 individuals representing 11 species were detected during the preliminary fall migration surveys conducted in 2012 at the property edge (Table A.7 in Appendix A). Species abundance and diversity were quite low at the site, and all of the species observed are known to breed in the region, with no northern migrant species detected. Therefore, it is unlikely that the area serves as a significant migration stopover.

3.3 OBSERVED HEIGHT OF BIRDS

Most of the birds observed during the surveys were detected by sound or were seen perched in vegetation on the site. For birds that were seen in flight, the approximate height at which birds were observed was recorded. Of the recorded observations of birds in flight, all but three were 20 m or lower; a pair of Great Cormorants was observed at approximately 100 m above ground surface, and Common Ravens were observed flying at 30 and 50 m above ground.

3.4 AVIAN SPECIES AT RISK AND SPECIES OF CONSERVATION CONCERN

One federally and provincially listed species at risk was observed during the field surveys, the Olive-sided Flycatcher (*SARA* and *NSESA*: Threatened). Six species considered to be of conservation concern by ACCDC were observed: Gray Jay (S3S4), Great Cormorant (S3), Northern Goshawk (S3S4B), Yellow-bellied Flycatcher (S3S4B), Boreal Chickadee (S3) and Olive-sided Flycatcher (S3B). A number of additional species at risk and species of conservation concern may occur in the project area, based on information obtained from the MBBA and CBC (Appendix A). Of those, the following are considered to have potential to occur on the site based on the available habitat:

- Common Nighthawk (*SARA* and *NSESA*: Threatened; ACCDC: S3B)
- Eastern Wood-pewee (*NSESA*: Vulnerable; ACCDC: S3S4B)
- Wilson's Snipe (ACCDC: S3S4B)
- Pine Grosbeak (ACCDC: S3?B,S5N)

- Pine Siskin (ACCDC: S3S4B,S5N)

Certain species, including raptors and the aforementioned Wilson's Snipe, are considered to be at potentially greater risk of negative interactions with wind turbines due to aerial behavior such as hunting and mating displays (Kingsley and Whittam 2007). Because of this concern, presence of raptors is of particular interest. The following raptor species have been observed at various times of year during the field surveys:

- Northern Goshawk, observed during the summer breeding season. Breeding near site, as one agitated adult bird and at least one immature were observed near the edge of the met tower clearing.
- Red-tailed Hawk, a single individual observed during summer and fall surveys.

In addition to the above species, Bald Eagle, Sharp-shinned Hawk, Broad-winged Hawk, American Kestrel and Merlin were all observed during the breeding season within approximately 10 km of the site (MBBA 2012).

3.5 OTHER FAUNA

Incidental observations of non-avian fauna noted during the surveys included white-tailed deer (*Odocoileus virginianus*), red squirrel (*Tamiasciurus hudsonicus*), coyote (*Canis latrans*), snowshoe hare (*Lepus americanus*), mink frog (*Rana septentrionalis*), and white admiral (*Limenitis arthemis*).

4.0 DISCUSSION

A total of 48 species were observed during the surveys, of which 29 are confirmed or believed to be breeding on or near the project site. All of the species observed during the migration surveys are known to breed in the region; it is not evident that the area serves as a significant migration stopover.

Breeding status was inferred based on observed behavior the June and July breeding bird surveys and incidental observations. Three species were confirmed to be breeding in the area based on presence of fledged young or on observations of adults carrying food, and a further 8 species are considered "probable" breeders based on territorial behaviour (observed in suitable habitat on two or more occasions over the breeding season), agitated behaviour of adults, and/or presence of a breeding pair in suitable habitat. Another 18 species were considered "possible" breeders, heard or observed only once in a particular location in suitable breeding habitat. One federally listed species at risk, the Olive-sided Flycatcher, was observed during the summer breeding surveys. Additionally, six regionally rare species according to ACCDC were observed: Gray Jay, Great Cormorant, Northern Goshawk, Yellow-bellied Flycatcher, Boreal Chickadee and Olive-sided Flycatcher.

The potential negative effects of wind farms on birds can be classified into four main categories: collision, displacement due to disturbance, barrier effects and habitat loss (Drewitt and Langston 2006).

Collision

Rate of collision with turbines can be affected by a number of factors. For example, certain species, due to size or behaviour, are at greater risk of collision with turbines (for example, large-bodied birds such as geese are less maneuverable, and species such as raptors and snipe engage in aerial hunting or displays (Kingsley and Whittam 2007; Environment Canada 2006). Nocturnal migrants (including many passerines) tend to fly well above turbine heights; however, they may be at risk of collision near stopover locations at dawn and dusk. In adverse weather conditions, poor visibility and impaired flight due to strong headwinds can increase collision risk.

Turbine size, rotor speed and lighting can also influence collision risk; for example, intermittent flashing white lights of the lowest effective intensity will be less disorienting to birds than a constant bright point source (Drewitt and Langston 2006).

Collision risk can be mitigated by proper siting and alignment of turbines, avoiding areas of large concentrations of sensitive species, as well as migration corridors and important nesting areas. Results of surveys to date indicate that the Barrachois site does not appear to support a large number of migrants (although fall migration surveys are ongoing). Furthermore, the site is situated more than 10 km from the nearest IBA.

Displacement Due to Disturbance

Displacement of birds can occur during both the construction and operations phases of wind farms, through visual, noise and vibration impacts. Displacement may also occur as a result of repeated movements of maintenance vehicles (Drewitt and Langston 2006). The pattern and scale of disturbance depends on the species, life cycle stage, availability of alternate habitats, and siting of the wind turbines with respect to important habitat areas. Little is known about the effects of displacement on breeding birds, particularly short-lived passerines, and in long-term recruitment rates of longer-lived species around wind turbines; however, for wintering waterfowl, reduced density and abundance has been reliably recorded as far as 600 m from wind turbines.

It is difficult to determine the potential scale of disturbance caused by a wind farm, as effects can only reliably be determined following turbine installation through comparison of abundances before and after. Therefore, post-construction follow-up monitoring of the site will be required to assess displacement effects.

Barrier Effect

In addition to the habitat displacement described above, birds may also alter their migration flyways and/or local flight paths to avoid wind turbines (Drewitt and Langston 2006; Environment Canada 2006). This may lead to birds having to fly further, resulting in a negative impact on individual energy expenditure. Construction may also disrupt routes between feeding, roosting, moulting and/or breeding areas far from the wind farm. These barrier effects are more

pronounced with larger wind farms, or those that are sited close to other wind farms creating a cumulative barrier effect. The Barrachois project is considered a small wind farm, with three turbines proposed, and is situated approximately 10 km from the nearest wind farm site, which is anticipated to be under construction at Hillside Boularderie in late 2013.

Habitat Loss

Actual habitat loss resulting from wind farm construction is quite small on a per-turbine basis, generally amounting to no more than 5% of the total development area (Drewitt and Langston 2006). The proposed wind farm consists of two turbines, and the habitat types found in the project footprint are common for the area; therefore, habitat loss is not expected to have an significant impact on species in the Project Area.

5.0 REFERENCES

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Appendix B:

Avian Study

Table A.1: List of Bird Species Observed in Square 20QS01 and/or 20PR91 During the 2nd Maritimes Breeding Bird Atlas (2006 - 2010)

Common Name	Scientific Name	Maximum Breeding Evidence[1]	Breeding Status	Special Status
Canada Goose	*Branta canadensis*	V	Probable	
American Wigeon	*Anas americana*	P	Probable	
American Black Duck	*Anas rubripes*	FY	Confirmed	
Mallard	*Anas platyrhynchos*	P	Probable	
Mallard x Am. Black Duck Hybrid		H	Possible	
Green-winged Teal	*Anas crecca*	P	Probable	
Ring-necked Duck	*Aythya collaris*	P	Probable	
Common Merganser	*Mergus merganser*	H	Possible	
Red-breasted Merganser	*Mergus serrator*	FY	Confirmed	
Ruffed Grouse	*Bonasa umbellus*	S	Possible	
Common Loon	*Gavia immer*	NE	Confirmed	ACCDC: S3B,S4N
Double-crested Cormorant	*Phalacrocorax auritus*	H	Possible	
Great Blue Heron	*Ardea herodias*	H	Possible	
Bald Eagle	*Haliaeetus leucocephalus*	NY	Confirmed	
Sharp-shinned Hawk	*Accipiter striatus*	H	Possible	
Broad-winged Hawk	*Buteo platypterus*	H	Possible	
Red-tailed Hawk	*Buteo jamaicensis*	P	Probable	
American Kestrel	*Falco sparverius*	P	Probable	
Merlin	*Falco columbarius*	H	Possible	
Killdeer	*Charadrius vociferus*	DD	Confirmed	ACCDC: S3S4B
Spotted Sandpiper	*Actitis macularius*	P	Probable	
Wilson's Snipe	*Gallinago delicata*	S	Possible	ACCDC: S3S4B
American Woodcock	*Scolopax minor*	FY	Confirmed	
Herring Gull	*Larus argentatus*	H	Possible	
Great Black-backed Gull	*Larus marinus*	H	Possible	
Common Tern	*Sterna hirundo*	H	Possible	ACCDC: S3B
Rock Pigeon	*Columba livia*	NE	Confirmed	
Mourning Dove	*Zenaida macroura*	T	Probable	
Barred Owl	*Strix varia*	D	Probable	
Northern Saw-whet Owl	*Aegolius acadicus*	S	Possible	
Ruby-throated Hummingbird	*Archilochus colubris*	T	Probable	
Belted Kingfisher	*Megaceryle alcyon*	V	Probable	
Yellow-bellied Sapsucker	*Sphyrapicus varius*	T	Probable	
Downy Woodpecker	*Picoides pubescens*	FY	Confirmed	
Hairy Woodpecker	*Picoides villosus*	P	Probable	
Northern Flicker	*Colaptes auratus*	T	Probable	
Pileated Woodpecker	*Dryocopus pileatus*	H	Possible	
Olive-sided Flycatcher	*Contopus cooperi*	CF	Confirmed	*SARA*: Threatened; *NSESA*: Threatened; ACCDC: S3B
Eastern Wood-Pewee	*Contopus virens*	S	Possible	COSEWIC: Special Concern; *NSESA*: Vulnerable; ACCDC: S3S4B
Yellow-bellied Flycatcher	*Empidonax flaviventris*	S	Possible	ACCDC: S3S4B
Alder Flycatcher	*Empidonax alnorum*	T	Probable	
Least Flycatcher	*Empidonax minimus*	S	Possible	
Blue-headed Vireo	*Vireo solitarius*	A	Probable	
Red-eyed Vireo	*Vireo olivaceus*	A	Probable	
Blue Jay	*Cyanocitta cristata*	FY	Confirmed	
American Crow	*Corvus brachyrhynchos*	FY	Confirmed	
Common Raven	*Corvus corax*	FY	Confirmed	
Tree Swallow	*Tachycineta bicolor*	NY	Confirmed	
Cliff Swallow	*Petrochelidon pyrrhonota*	P	Probable	
Barn Swallow	*Hirundo rustica*	P	Probable	COSEWIC: Threatened; *NSESA*: Endangered; ACCDC: S3B

Common Name	Scientific Name	Maximum Breeding Evidence[1]	Breeding Status	Special Status
Black-capped Chickadee	*Poecile atricapillus*	CF	Confirmed	
Boreal Chickadee	*Poecile hudsonicus*	H	Possible	ACCDC: S3
Red-breasted Nuthatch	*Sitta canadensis*	A	Probable	
Golden-crowned Kinglet	*Regulus satrapa*	H	Possible	
Ruby-crowned Kinglet	*Regulus calendula*	T	Probable	
Hermit Thrush	*Catharus guttatus*	T	Probable	
American Robin	*Turdus migratorius*	CF	Confirmed	
Gray Catbird	*Dumetella carolinensis*	P	Probable	
European Starling	*Sturnus vulgaris*	FY	Confirmed	
Cedar Waxwing	*Bombycilla cedrorum*	P	Probable	
Northern Parula	*Parula americana*	A	Probable	
Yellow Warbler	*Setophaga petechia*	P	Probable	
Magnolia Warbler	*Setophaga magnolia*	CF	Confirmed	
Yellow-rumped Warbler	*Setophaga coronata*	T	Probable	
Black-throated Green Warbler	*Setophaga virens*	T	Probable	
Canada Warbler	*Cardellina canadensis*	S	Possible	*SARA*: Threatened; *NSESA*: Endangered; ACCDC: S3B
Blackburnian Warbler	*Dendroica fusca*	A	Probable	
Black-and-white Warbler	*Mniotilta varia*	A	Probable	
American Redstart	*Setophaga ruticilla*	A	Probable	
Ovenbird	*Seiurus aurocapilla*	A	Probable	
Northern Waterthrush	*Parkesia noveboracensis*	S	Possible	
Mourning Warbler	*Geothlypis philadelphia*	T	Probable	
Common Yellowthroat	*Geothlypis trichas*	T	Probable	
Savannah Sparrow	*Passerculus sandwichensis*	A	Probable	
Song Sparrow	*Melospiza melodia*	DD	Confirmed	
Lincoln's Sparrow	*Melospiza lincolnii*	A	Probable	
Swamp Sparrow	*Melospiza georgiana*	S	Possible	
White-throated Sparrow	*Zonotrichia albicollis*	T	Probable	
Dark-eyed Junco	*Junco hyemalis*	CF	Confirmed	
Bobolink	*Dolichonyx oryzivorus*	CF	Confirmed	*SARA*: Threatened; *NSESA*: Vulnerable; ACCDC: S3S4B
Red-winged Blackbird	*Agelaius phoeniceus*	P	Probable	
Common Grackle	*Quiscalus quiscula*	FY	Confirmed	
Pine Grosbeak	*Pinicola enucleator*	P	Probable	ACCDC: S3?B,S5N
Purple Finch	*Carpodacus purpureus*	P	Probable	
Pine Siskin	*Spinus pinus*	P	Probable	ACCDC: S3S4B,S5N
American Goldfinch	*Spinus tristis*	P	Probable	
Evening Grosbeak	*Coccothraustes vespertinus*	H	Possible	
House Sparrow	*Passer domesticus*	CF	Confirmed	

Notes:

1. Maximum breeding evidence observed. Breeding evidence codes are as follows:

X No breeding evidence; species observed outside of potential breeding habitat.
S Singing; heard on one occasion only.
H Species observed in suitable breeding habitat during the breeding season.
P Pair observed in suitable breeding habitat.
A Agitated behaviour of an adult in breeding habitat.
V Visiting a probable nest site
T Territorial behaviour; adult heard singing twice at the same location, a week or more apart.
CF Adult carrying food.
FY Fledged young.
NB Nest building behaviour.
AE Adult entering a nest cavity.
NY Nest with young.

Table A.2: List of Bird Species Observed in Sydneys Christmas Bird Counts (1966 - 2012)

Common Name	Scientific Name	Number of Counts In Which Species Was Observed [1]	Number of Individuals Observed			Special Status
			Average	Min	Max	
Canada Goose	*Branta canadensis*	8	70	1	247	
Gadwall	*Anas strepera*	2	1	1	1	ACCDC: S2B
Eurasian Wigeon	*Anas penelope*	3	1	1	2	
American Wigeon	*Anas americana*	8	11	1	26	
American Black Duck	*Anas rubripes*	26	599	1	1927	
Mallard	*Anas platyrhynchos*	19	247	1	523	
American Black Duck X Mallard (hybrid)	*Anas platyrhynchos X rubripes*	11	39	10	80	
Northern Pintail	*Anas acuta*	9	2	1	2	ACCDC: S2B
Green-winged Teal	*Anas crecca*	7	1	1	3	
Ring-necked Duck	*Aythya collaris*	5	1	1	2	
Greater Scaup	*Aythya marila*	19	124	1	432	
Lesser Scaup	*Aythya affinis*	9	8	1	42	
Common Eider	*Somateria mollissima*	15	21	1	257	
Harlequin Duck	*Histrionicus histrionicus* pop. 1	2	2	2	2	
Surf Scoter	*Melanitta perspicillata*	10	7	1	25	
White-winged Scoter	*Melanitta fusca*	25	221	3	1591	
Black Scoter	*Melanitta nigra*	9	28	4	69	
Long-tailed Duck	*Clangula hyemalis*	28	96	6	303	
Bufflehead	*Bucephala albeola*	15	32	1	66	
Common Goldeneye	*Bucephala clangula*	28	196	3	469	ACCDC: S2B,S5N
Barrow's Goldeneye	*Bucephala islandica*	15	9	1	22	ACCDC: S1N; SARA: Special Concern
Hooded Merganser	*Lophodytes cucullatus*	3	2	1	3	
Common Merganser	*Mergus merganser*	19	32	3	176	
Red-breasted Merganser	*Mergus serrator*	25	78	2	434	ACCDC: S3B,S5N
Ring-necked Pheasant	*Phasianus colchicus*	14	9	1	21	
Ruffed Grouse	*Bonasa umbellus*	10	4	1	10	
Red-throated Loon	*Gavia stellata*	8	2	1	8	
Common Loon	*Gavia immer*	16	3	1	9	ACCDC: S3B,S4N
Pied-billed Grebe	*Podilymbus podiceps*	2	1	1	1	ACCDC: S3B
Horned Grebe	*Podiceps auritus*	3	1	1	1	
Red-necked Grebe	*Podiceps grisegena*	4	2	1	3	
Northern Gannet	*Morus bassanus*	8	2	1	4	ACCDC: SHB,S5M
Double-crested Cormorant	*Phalacrocorax auritus*	6	3	1	9	
Great Cormorant	*Phalacrocorax carbo*	24	31	1	107	ACCDC: S3
Great Blue Heron	*Ardea herodias*	2	1	1	1	
Bald Eagle	*Haliaeetus leucocephalus*	28	11	1	43	
Northern Harrier	*Circus cyaneus*	9	2	1	4	
Sharp-shinned Hawk	*Accipiter striatus*	13	2	1	6	
Northern Goshawk	*Accipiter gentilis*	2	1	1	1	ACCDC: S3S4
Red-tailed Hawk	*Buteo jamaicensis*	11	2	1	4	
American Kestrel	*Falco sparverius*	1	1	1	1	
Merlin	*Falco columbarius*	5	1	1	1	
Peregrine Falcon	*Falco peregrinus* pop. 1	1	1	1	1	ACCDC: S1B NSESA: Vulnerable SARA: Special Concern
American Coot	*Fulica americana*	4	3	2	4	
Black-bellied Plover	*Pluvialis squatarola*	1	1	1	1	
Killdeer	*Charadrius vociferus*	1	1	1	1	ACCDC: S3S4B
Ruddy Turnstone	*Arenaria interpres*	1	1	1	1	
Sanderling	*Calidris alba*	2	2	1	2	
Purple Sandpiper	*Calidris maritima*	9	10	2	30	ACCDC: S3N
Wilson's Snipe	*Gallinago delicata*	1	2	2	2	ACCDC: S3S4B
Black-headed Gull	*Chroicocephalus ridibundus*	18	17	1	100	
Bonaparte's Gull	*Chroicocephalus philadelphia*	10	17	1	67	
Ring-billed Gull	*Larus delawarensis*	14	19	1	100	ACCDC: S1?B,S5N
Herring Gull	*Larus argentatus*	28	1487	494	3200	
Iceland Gull	*Larus glaucoides*	27	316	5	848	
Glaucous Gull	*Larus hyperboreus*	21	7	1	20	
Lesser Black-backed Gull	*Larus fuscus*	1 (CW)	---	---	---	
Great Black-backed Gull	*Larus marinus*	28	652	196	2000	

Common Name	Scientific Name	Number of Counts In Which Species	Number of Individuals Observed			Special Status
Black-legged Kittiwake	*Rissa tridactyla*	2	3	1	5	ACCDC: S2B,S4S5N
Ivory Gull	*Pagophila eburnea*	2	1	1	1	
Common Tern	*Sterna hirundo*	1 (CW)	---	---	---	ACCDC: S3B
Forster's Tern	*Sterna forsteri*	1	1	1	1	
Dovekie	*Alle alle*	6	4	1	14	
Thick-billed Murre	*Uria lomvia*	3	3	1	6	
Black Guillemot	*Cepphus grylle*	11	8	1	31	ACCDC: S3S4
Rock Pigeon	*Columba livia*	22	322	12	1054	
Mourning Dove	*Zenaida macroura*	13	140	6	250	
Great Horned Owl	*Bubo virginianus*	1	1	1	1	
Snowy Owl	*Bubo scandiacus*	1	1	1	1	
Barred Owl	*Strix varia*	1	1	1	1	
Belted Kingfisher	*Megaceryle alcyon*	16	2	1	3	
Red-headed Woodpecker	*Melanerpes erythrocephalus*	1 (CW)	---	---	---	
Red-bellied Woodpecker	*Melanerpes carolinus*	3	2	1	4	
Yellow-bellied Sapsucker	*Sphyrapicus varius*	1	1	1	1	
Downy Woodpecker	*Picoides pubescens*	26	13	1	47	
Hairy Woodpecker	*Picoides villosus*	18	11	1	27	
Northern Flicker	*Colaptes auratus*	11	5	1	9	
Pileated Woodpecker	*Dryocopus pileatus*	8	2	1	7	
Gray Jay	*Perisoreus canadensis*	11	3	1	7	ACCDC: S3S4
Blue Jay	*Cyanocitta cristata*	28	98	6	297	
American Crow	*Corvus brachyrhynchos*	28	1425	60	7500	
Common Raven	*Corvus corax*	28	64	2	175	
Horned Lark	*Eremophila alpestris*	1 (CW)	---	---	---	ACCDC: S1S2B,S4N
Black-capped Chickadee	*Poecile atricapillus*	28	219	5	734	
Boreal Chickadee	*Poecile hudsonicus*	18	8	1	18	ACCDC: S3
Red-breasted Nuthatch	*Sitta canadensis*	12	17	4	47	
White-breasted Nuthatch	*Sitta carolinensis*	5	4	1	11	
Brown Creeper	*Certhia americana*	13	2	1	6	
Golden-crowned Kinglet	*Regulus satrapa*	23	19	1	128	
Ruby-crowned Kinglet	*Regulus calendula*	1	1	1	1	
Swainson's Thrush	*Catharus ustulatus*	1 (CW)	---	---	---	
Hermit Thrush	*Catharus guttatus*	1	1	1	1	
American Robin	*Turdus migratorius*	18	12	1	110	
Gray Catbird	*Dumetella carolinensis*	1	1	1	1	ACCDC: S3B
Northern Mockingbird	*Mimus polyglottos*	2	1	1	1	ACCDC: S3B
Brown Thrasher	*Toxostoma rufum*	1 (CW)	---	---	---	
European Starling	*Sturnus vulgaris*	28	1887	180	10000	
American Pipit	*Anthus rubescens*	1	1	1	1	
Bohemian Waxwing	*Bombycilla garrulus*	11	247	7	743	
Cedar Waxwing	*Bombycilla cedrorum*	5	37	3	85	
Orange-crowned Warbler	*Vermivora celata*	1	1	1	1	
Yellow-rumped Warbler	*Setophaga coronata*	8	4	8	1	
Pine Warbler	*Dendroica pinus*	5	1	1	2	
Palm Warbler	*Dendroica palmarum*	2	1	1	1	
Black-and-white Warbler	*Mniotilta varia*	1	1	1	1	
Common Yellowthroat	*Geothlypis trichas*	1	1	1	1	
Yellow-breasted Chat	*Icteria virens*	7	1	1	2	
Eastern Towhee	*Pipilo erythrophthalmus*	1	1	1	1	
American Tree Sparrow	*Spizella arborea*	22	8	1	48	
Chipping Sparrow	*Spizella passerina*	2	1	1	1	
Savannah Sparrow	*Passerculus sandwichensis*	11	3	1	12	
Song Sparrow	*Melospiza melodia*	22	15	1	55	
Lincoln's Sparrow	*Melospiza lincolnii*	1	1	1	1	
Swamp Sparrow	*Melospiza georgiana*	3	1	1	2	
White-throated Sparrow	*Zonotrichia albicollis*	5	2	1	4	
White-crowned Sparrow	*Zonotrichia leucophrys*	1	2	2	2	
Dark-eyed Junco	*Junco hyemalis*	27	35	2	119	
Lapland Longspur	*Calcarius lapponicus*	6	2	1	5	
Snow Bunting	*Plectrophenax nivalis*	13	33	1	210	
Dickcissel	*Spiza americana*	4	1	1	1	
Red-winged Blackbird	*Agelaius phoeniceus*	5	2	1	3	

Common Name	Scientific Name	Number of Counts In Which Species [1]	Number of Individuals Observed			Special Status
Rusty Blackbird	*Euphagus carolinus*	4	3	1	8	ACCDC: S2S3B; SARA: Special Concern
Common Grackle	*Quiscalus quiscula*	14	8	1	30	
Brown-headed Cowbird	*Molothrus ater*	10	5	1	28	ACCDC: S2S3B
Baltimore Oriole	*Icterus galbula*	16	2	1	6	
Pine Grosbeak	*Pinicola enucleator*	13	20	1	124	ACCDC: S3?B,S5N
Purple Finch	*Carpodacus purpureus*	15	40	2	337	
Red Crossbill	*Loxia curvirostra*	2	34	11	56	
White-winged Crossbill	*Loxia leucoptera*	9	36	1	171	
Common Redpoll	*Acanthis flammea*	15	64	1	319	
Hoary Redpoll	*Acanthis hornemanni*	1	1	1	1	
Pine Siskin	*Spinus pinus*	15	48	1	313	ACCDC: S3S4B,S5N
American Goldfinch	*Spinus tristis*	25	208	4	1090	
Evening Grosbeak	*Coccothraustes vespertinus*	27	70	2	270	
House Sparrow	*Passer domesticus*	28	313	70	690	

Note: 1. Out of a total of 28 CBCs conducted in the area since 1966. "CW" denotes that a species was observed during the week of the count, but not on the count day itself. Number of individuals is not recorded for Count Week species.

Table A.3: Results of winter resident surveys conducted at the Barrachois Proposed Wind Farm site.

Species	Survey Date		Total
	29-Jan	21-Feb	
American Crow		1	1
Black-capped Chickadee	4	2	6
Brown Creeper	1		1
Common Raven	1		1
Downy Woodpecker		1	1
Golden-crowned Kinglet	3		3
Hairy Woodpecker	3		3
Total (All Species)	12	4	16
Number of Species	5	3	7

Table A.4: Results Spring 2013 Migration Counts at the Barrachois Proposed Wind Farm Site

Common Name	Survey Date			Total
	16-May	31-May	08-Jun	
American Goldfinch		1		1
American Robin	1	9	2	12
Black-and-white Warbler	3	10	1	14
Black-capped Chickadee	2	2	4	8
Black-throated Green Warbler	6	8	8	22
Blackburnian Warbler		1	1	2
Blue-headed Vireo	2	3	2	7
Cedar Waxwing			1	1
Chestnut-sided Warbler		1	1	2
Common Grackle		1		1
Common Raven	1			1
Common Yellowthroat		1	1	2
Dark-eyed Junco		3	5	8
Downy Woodpecker	1			1
Gray Jay		1		1
Hairy Woodpecker			2	2
Hermit Thrush	1	5	5	11
Magnolia Warbler			3	3
Nashville Warbler			1	1
Northern Flicker	2	1	1	4
Northern Parula		1	3	4
Ovenbird	1	9	8	18
Purple Finch		2		2
Red-eyed Vireo			5	5
Ruby-crowned Kinglet	4	2	3	9
Ruffed Grouse			1	1
White-throated Sparrow	2	4	2	8
Winter Wren		2		2
Yellow-bellied Flycatcher			2	2
Yellow-rumped Warbler	1			1
Total (All Species)	27	67	62	156
Number of Species	13	20	22	30

Table A.5: Results of breeding bird surveys conducted at the Bararchois Proposed Wind Farm site.

Species	Survey Date		Total	Breeding Status
	20-Jun	05-Jul		
Alder Flycatcher	1	0	1	Possible
Black-and-white Warbler	2	2	4	Probable
Black-capped Chickadee	0	5	5	Confirmed
Black-throated Green Warbler	1	3	4	Probable
Blue Jay	0	1	1	Possible
Blue-headed Vireo	1	2	3	Possible
Chestnut-sided Warbler	0	2	2	Possible
Chipping Sparrow	0	1	1	Possible
Common Yellowthroat	1	1	2	Probable
Dark-eyed Junco	1	1	2	Possible
Golden-crowned Kinglet	2	0	2	Possible
Hairy Woodpecker	0	3	3	Probable
Hermit Thrush	1	4	5	Probable
Magnolia Warbler	1	0	1	Possible
Mourning Warbler	1	1	2	Possible
Northern Parula	0	1	1	Possible
Olive-sided Flycatcher	1	1	2	Probable
Ovenbird	2	3	5	Possible
Palm Warbler	1	0	1	Possible
Red-breasted Nuthatch	1	0	1	Possible
Red-eyed Vireo	2	2	4	Probable
Red-tailed Hawk	1	0	1	Possible
Ruby-crowned Kinglet	1	0	1	Possible
Ruffed Grouse	2	0	2	Confirmed
Swainson's Thrush	0	2	2	Possible
White-throated Sparrow	0	1	1	Probable
Yellow Warbler	0	1	1	Possible
Yellow-bellied Flycatcher	0	1	1	Possible
Total (All Species)	23	38	61	--
Number of Species	28	28	28	--

Appendix C:

Bat Impact Assessment

BARRACHOIS WIND TURBINE ACOUSTIC BAT MONITORING REPORT

Prepared for
Natural Forces Wind Inc.
1801 Hollis St. Suite 1205
Halifax NS
Canada B3J 3N4

Prepared by:

AMEC Environment & Infrastructure
a Division of AMEC Americas Ltd.
50 Troop Avenue, Unit 300
Dartmouth, NS B3B 1Z1

October 2013

Project No.: TV0134005.100

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1. INTRODUCTION

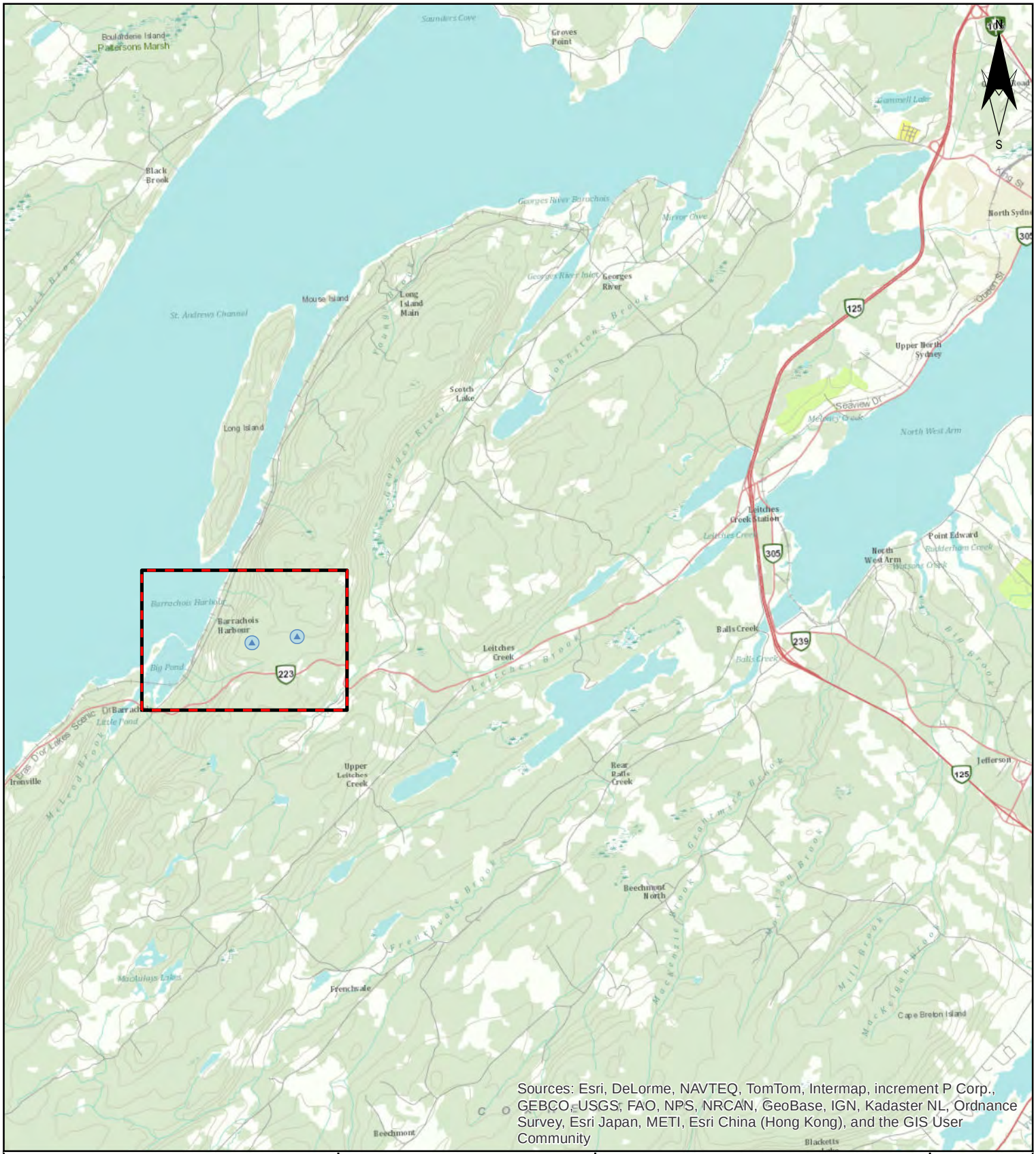
Natural Forces Wind Inc. is proposing to install a pair of wind turbines in Barrachois, Nova Scotia, and has engaged the services of AMEC Environment & Infrastructure, a Division of AMEC Americas Limited (AMEC), to provide an assessment of the potential effects of the proposed project on local and migratory bat populations. In order to provide a complete assessment, AMEC has compiled relevant information on bats in the region, reviewed existing monitoring protocols, and employed a monitoring protocol previously developed to meet the specific needs of Natural Forces Wind Inc. Finally, AMEC has collected and analyzed data on the occurrence of bats in the project area in accordance with the protocol.

The location of the site is depicted in Figure 1.1.

1.1 Legislation/Regulatory Environment

An environmental assessment (EA) is an assessment of the possible positive or negative impact that a proposed project may have on the environment, together consisting of the environmental, social and economic aspects. This is a planning tool that provides managers and decision makers with information on whether a proposed project may undermine sustainable development. There are two levels of environmental assessment legislation that govern the environmental assessment process. At the provincial level, the Nova Scotia Environment Act and the ensuing regulations provide the mandate to the NS Department of Environment to review and assess environmental assessment documents prior to the approval of projects that meets certain “trigger” conditions. Similarly, the *Canadian Environmental Protection Act* (CEPA) and the *Canadian Environmental Assessment Act* (CEAA) perform a similar function at the federal level, providing the mandates and authorities to various government departments including the Canadian Environmental Assessment Agency, Environment Canada, and the Department of Fisheries and Oceans Canada. Depending upon the location of the wind farm (private land, federal or provincial crown land), the source of funding (e.g., private investment vs. federal government) and the size of the wind farm, an environmental assessment will need to be completed for review and approval by either the NS Department of Environment, or the relevant federal department or agency.

One area of concern addressed in an EA is the potential effect that a project may have on local wildlife, and the habitats upon which these species depend. As a result, the federal *Species at Risk Act* (SARA) and the *Nova Scotia Endangered Species Act* (NSESA) must be considered in the EA process. Under the terms of the Acts, no project can have or potentially have a negative effect on a species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered, threatened or of concern, under a list within the NS General Status of Wild Species as species of conservation concern.



CLIENT: Natural Forces Wind Inc. 1791 Barrington Street Suite 1030 Halifax, Nova Scotia Canada B3J 3L1	SCALE: 1 0.5 0 1 2 Kilometers	PROJECT: Barrachois Wind Farm	DWN BY: DS CHK'D BY: BC DATE: October 2013 REV. NO: . FIGURE NO: 1.1
AMEC Environment and Infrastructure A Division of AMEC Americas Ltd. 50 Troop Avenue, Unit 300 Dartmouth, N.S., B3B 1Z1 (P) 902-468-2848 (F) 902-468-1314 www.amec.com	DATUM: NAD83 CSRS PROJECTION: UTM Zone 20 North PROJECT NO: TV134005	TITLE: General Site Location	

Path: P:\5300 PROJECTS\2013\TV134005 - Hillside Boularderie Wind Farm Spring Bird Survey\Cad\TV134005-1.1.mxd User: derrick.schulz Date: 10/11/2013

Several federal and provincial government departments and agencies have legislative and regulatory responsibility of wildlife species and habitats in Nova Scotia, including bats. Bats are a matter of special interest in the EA process; since little is known about most species, there is a lack of understanding of the long term effects that past developments have had upon their wellbeing. In 2012, emergence of a devastating fungal infection affecting bat populations in eastern North America (see Section 2.0) led COSEWIC to designate three bat species, all known residents of Nova Scotia, as “Endangered” (COSEWIC 2012).

Federally, the Canadian Wildlife Service of Environment Canada is responsible for all migratory birds and for all wildlife on federally owned land. Within the Provincial government, the Wildlife Division of the Department of Natural Resources is responsible for all wildlife, other than that managed by federal government. Furthermore, several other government Departments and Agencies have an interest in wildlife resources, and while they do not have regulatory responsibility, they may provide useful and important information on bats suitable for inclusion in an EA. Examples include the Wildlife Division of the Nova Scotia Department of Natural Resources and the Heritage Division of Nova Scotia Tourism, Culture & Heritage. Local universities and non-profit organizations such as the Atlantic Canada Conservation Data Centre and local naturalist groups can also provide valuable information.

Since wind energy development activities have commenced in Nova Scotia, the Nova Scotia Department of Environment has regularly issued consistent approval conditions for environmental assessments of wind farm projects in the province, namely:

a. The Proponent must develop and implement a program to monitor for birds and bats to the standards as defined by the Nova Scotia Department of Natural Resources (NSDNR) and Canadian Wildlife Service (CWS). Based on the results of monitoring programs, the Proponent must make necessary modifications to mitigation plans and/or wind farm operations to prevent any unacceptable environmental effects to the satisfaction of NSE, based on consultation with NSDNR and CWS.

b. The Proponent must document accidental mortalities of bats and birds and submit an annual report to the Director of Wildlife, NSDNR, and CWS. The report shall be submitted in January of each operating year unless otherwise approved by NSE.

2.0 INTRODUCTION TO BATS

Bats are one of the most abundant groups of mammals on Earth, with over 1100 known species (Tudge 2000). Members of the Order Chiroptera, bat species are divided into two main families, the Microchiroptera (insectivorous bats) and the Megachiroptera (fruit bats). They are also among the most misunderstood mammals, with general dislike and irrational fear common worldwide. Worldwide, bats play vital roles in insect control and the life cycles of fruiting plants. Despite their important ecological roles and diversity, bats in general remain poorly understood and are often unfairly reviled by the public.

The only mammals which truly fly, all bats species have wings consisting of webbing stretched between their elongated fingers. The Microchiroptera (insectivorous bats) typically have small eyes, sharp pointed teeth, and distinctly-shaped ears. This group is also unique in that it utilizes ultrasonic noise, inaudible to humans, to navigate by echolocation. Echolocating bats produce high-pitched calls which bounce off objects in their path. The bat then uses its highly sensitive ears to detect the resulting echo, and interprets it to provide information on size, shape and direction of travel of objects in its path. These calls are usually fairly species-specific, and scientists can use the characteristics of these calls to identify bat species in an area. This ability to navigate by sound results in bats being able to fly and hunt in complete darkness, and in fact most bat species are primarily nocturnal. Megabats do not echolocate, and tend to be larger. They feed mostly on fruit and are found in tropical regions.

In temperate climates such as Nova Scotia, bat species deal with the inhospitable conditions of winter by either hibernating or migrating to warmer areas until spring. Larger, fast-flying species tend to migrate, while smaller species, which tend to be weaker fliers, usually hibernate. Some bat species may fly up to several hundred kilometers to a suitable hibernating site, known as a hibernaculum. Many species begin gathering at their chosen hibernaculum several weeks before hibernation actually begins, and many species mate at this time.

The colonial hibernation behavior of many species results in a high level of vulnerability during the winter months. While bats may arouse naturally and move around within their hibernaculum (Tuttle 1991), unintentional arousals during hibernation (such as being disturbed by humans entering their hibernaculum) can cause bats to rapidly deplete their stored fat reserves, eventually leading to starvation (Thomas, 1995). A small number of visits to a winter hibernaculum of colonial species can have serious effects on the bat population utilizing that hibernaculum. Another dramatic example of this winter vulnerability is the current white-nose syndrome (WNS) situation in the American Northeast. Named for a distinctive fungal growth around the muzzles and on the wings of affected bats, WNS causes bats to wake more frequently during hibernation and deplete their fuel and/or water stores (Reeder *et al*., 2012, Cryan *et al.*, 2010). First identified in a cave in New York, USA, in February 2006 (Blehert *et al.* 2008), WNS has since spread to five provinces (Ontario, Quebec, NS, NB, and PEI) and 21 states as of March 25, 2013.

The fungus responsible has been identified as a European species, *Geomyces destructans,* a cold-loving fungus that grows at temperatures below 20 °C (68 °F) and grows on the bats when they are hibernating in caves and mines during winter (Blehert *et al.* 2008). The fungus appears to disrupt the normal patterns of hibernation, causing bats to arouse too frequently from torpor and starve to death. The symptoms associated with WNS include loss of body fat, unusual winter behavior (including flying outside), and death. The mortality rate from white nose syndrome in some caves has exceeded 90% (Frick *et al.* 2010). WNS has contributed to the deaths of over 5.5 million bats in the northeastern US (US Fish & Wildlife Service, 2012). To date, seven hibernating bat species have been confirmed with infection of *Geomyces destructans* in the Northeast USA, and several of these species have suffered major mortality (Frick *et al*., 2010). Some of these species, like the Indiana bat (*Myotis sodalis*), were already

considered endangered. The U.S Fish and Wildlife Service maintains a website documenting the current status of the WNS situation (http://www.fws.gov/whitenosesyndrome).

All of the species known to occur in NS have reported to exhibit white nose syndrome in other parts of their ranges. In the northeastern United States, the once common little brown bat (*Myotis lucifugus*), has suffered a major population collapse and may be at risk of rapid extirpation in the Northeast within 20 years, due to mortality associated with WNS (Frick *et al*. 2010). Dzal *et al.* (2001) reported a 78 per cent decline in the summer activity of the little brown bat in an area affected by WNS, as evidenced by echolocation surveys. WNS has already seriously decreased populations in NB (Canadian Broadcasting Company (CBC) News, 2012) and NS (CBC News, 2013). The long-term impact of the reduction in bat populations may be an increase in insect populations as they become subject to decreased bat predation, possibly leading to crop damage or increased pesticide requirements.

3.0 BAT SURVEY METHODOLOGY

3.1 Review of Available Data

The baseline bat monitoring survey began with a detailed desktop review of existing data. As the Nova Scotia Department of Environment (NSE) regards wind farm sites within 25 km of a known bat hibernaculum as having 'very high' site sensitivity (NSE 2009), it is imperative to determine whether the bat hibernacula are known to occur within this radius.

A review of geological mapping of the area was conducted to determine the likelihood of possible bat hibernacula, in the form of natural caves. NSDNR's Abandoned Mine Openings database was also consulted to determine if there are abandoned mines in the area which could also serve as hibernacula. As many parts of Nova Scotia have historically supported various types of mining activities, a review of the geology and mining history of the site can be beneficial in determining the likely presence of natural caves and/ or abandoned mines.

Bat species occurring in the general Sydney area were discussed with NSDNR's Regional Biologist for Cape Breton. Local naturalists were also consulted.

3.2 Acoustic Surveys

Electronic detection of bats has advanced considerably in recent years, enabling researchers to detect and monitor bats without capturing bats with mist nets. The Anabat SD2 detector, manufactured by Titley Scientific, is a well known monitoring system used throughout North America to identify and survey bats by detecting and analyzing their echolocation calls (Photo 3.1). The Anabat system is a passive detection system that monitors bat activity without human presence and intervention. It consists of a bat detector, a ZCAIM (Zero-Crossings Analysis Interface Module) and software. The Anabat detector unit contains an ultrasonic microphone, an electronic amplifier, and a digital signal divider. The bat detector will, if desired, produce an output audible to humans from the inaudible ultrasonic echolocation signals produced by the bats. The ZCAIM is an interface that is used to read the Anabat recorded data on a computer, and the software is used to present the data in a useable format. In the Anabat SD2 system

used in the present study, the ZCAIM records data directly onto a compact flash card, which is then used to transfer data to a computer.

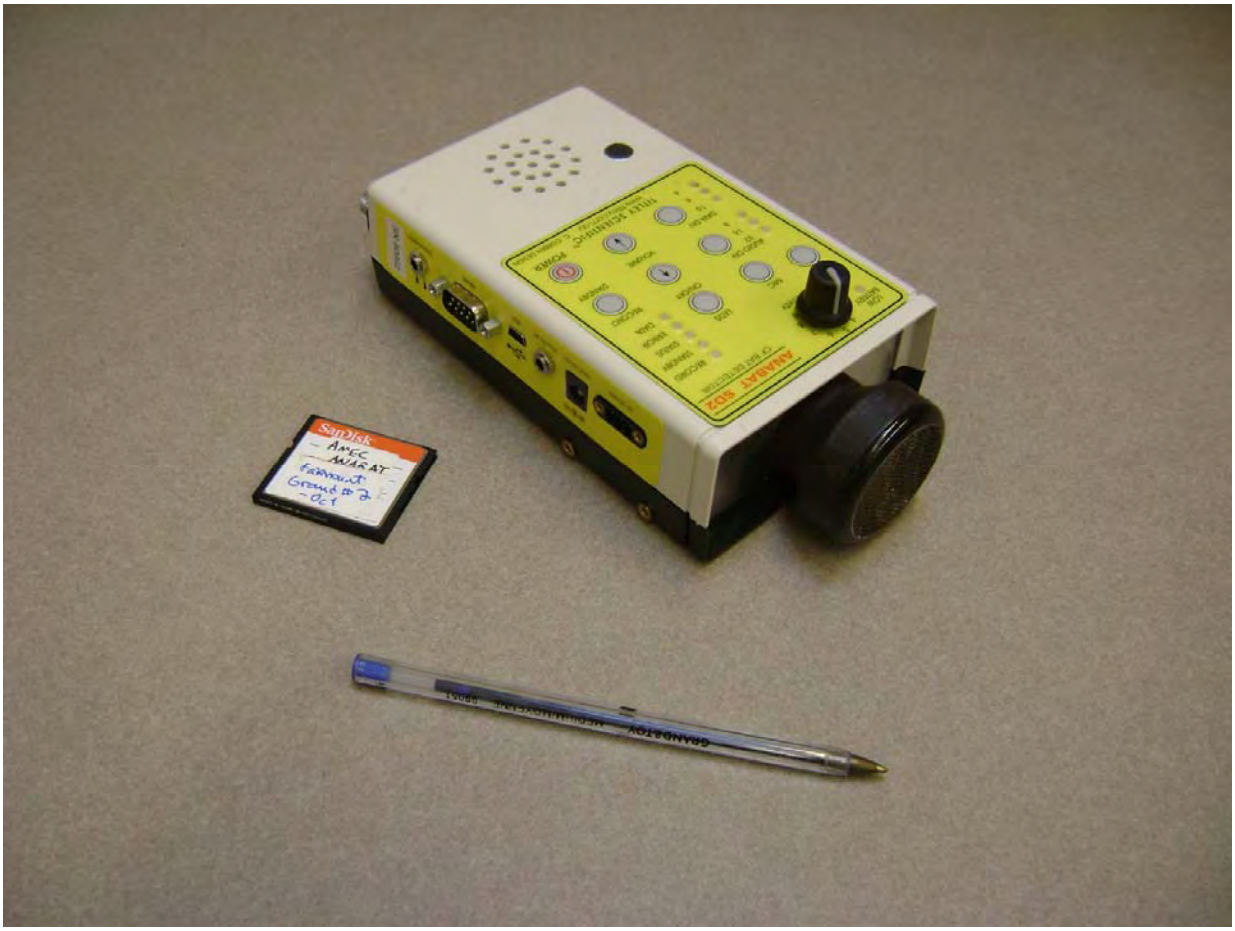


Photo 3.1 An Anabat SD2 acoustic bat detector and compact flash card.

Weller (2002) noted that there is a considerable variability in signals recorded by Anabat detectors depending upon their orientation. Based on Weller's research it was determined that multiple bat detectors should be deployed. While two detectors may record the same individuals, the redundancy will enable continued detection in the event one system fails due to battery depletion, weather events, or animal disturbance. Efforts must be made to ensure continuous detection for a complete picture of potential bat activity.

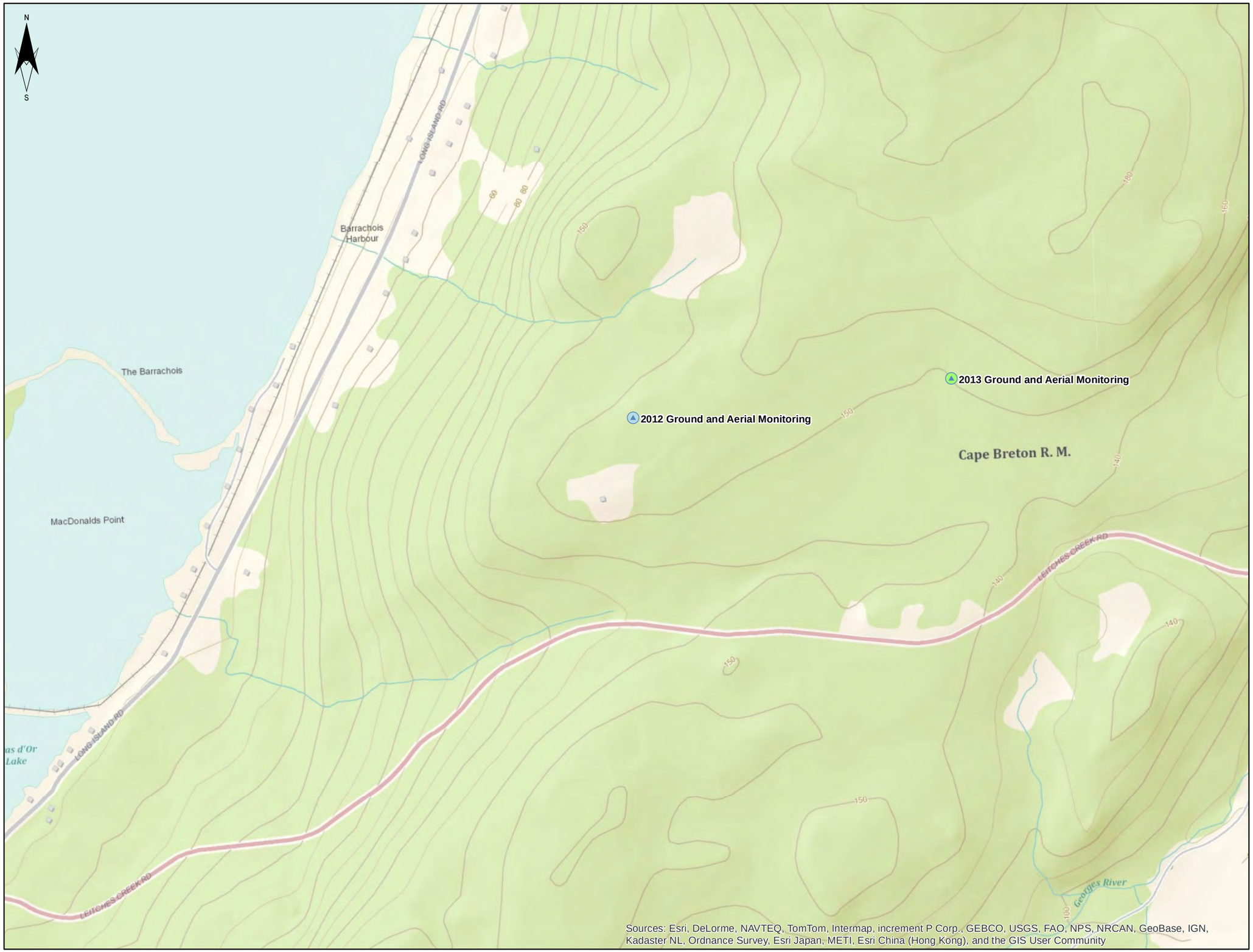
Based on previous acoustic bat surveys and literature reviews conducted by AMEC, it was decided that an aerial detector elevated 10 m above ground surface would be set to detect bats along the tree line at the edge of the cleared site, to permit detection of bats foraging near the tree canopy at the edge of the clearing and detect bats that may be migrating above the canopy. A second ground-based system was set to detect bats that forage on low flying insects in cleared areas. Use of the dual acoustic systems with a combination of ground and aerial orientation would provide effective cross coverage and ensure redundancy in the event one system failed due to battery failure or disturbance.

3.2.1 Aerial Systems

2012 Deployment

In 2012 the subject property was accessed on foot via a cleared area adjacent to a cellular tower located 600 m west of the Turbine 1 location. The southwestern edge of the property was approximately 130 m from the cellular tower access road. Because of the difficulty in accessing the property, a pole-mounted unit was not erected in 2012; instead, a high-sensitivity Anabat microphone was mounted in a waterproof cover on an extension cable and affixed to the trunk of a tree at the forest edge, approximately 2.5 m above ground level (Photo 3.2). The microphone was oriented parallel to the treeline and faced downward, with the lip of the waterproof cover angled at approximately 22.5° from horizontal to reflect incoming sounds into the microphone. A microphone extension cable ran down the pole to the main body of the detector, which was placed in a waterproof housing at the base of the pole, along with the power supply. The waterproof housing was covered in a green bag plastic to minimize visibility and potential vandalism. Coordinates were 20 T 699754E, 5114038N (UTM NAD 83) (Figure 3.1). This system remained in operation from 7 September to 11 October 2012.

Photo 3.2 Depiction of Tree-mounted and Ground Anabat units deployed on Barrachois Project Site in 2012.



TITLE:

Figure 3.1
Anabat Locations

PROJECT:

Barrachois
Wind Farm

CLIENT:

Natural Forces Wind Inc.
1791 Barrington Street Suite 1030
Halifax, Nova Scotia
Canada B3J 3L1

LOCATION:

Barrachois
Cape Breton County
Nova Scotia

DATE:

October 2013

DATUM:

North_American_1983_CSRS

PROJECTION:

Zone 20

AMEC PROJECT NO:

TV134005

LEGEND:

- 2012 Ground and Aerial Monitoring
- 2013 Ground and Aerial Monitoring

50 25 0 50 100 150 200 250 300 350

Meters

1:8,000

AMEC Environment & Infrastructure
A Division of AMEC Americas Ltd.

50 Troop Avenue, Unit 300
Dartmouth, N.S., B3B 1Z1
(P) 902-468-2848 (F) 902-468-1314

Path: \\nfx1-fs1\project$\5300 PROJECTS\2013\TV134005 - Hillside Boulardarie Wind Farm Spring Bird Survey\Cad\TV134005-3.1.mxd User: derrick.schulz, Date: 10/11/2013

In 2013, with improved road access, a tower was erected on the site on July 30th, but due to logistical difficulties could only be erected to a height of 6.6 m until September 6th. Coordinates were 20T 700455E 5114125N (UTM NAD 83). The microphone assembly pointed to the southwest, and parallel to the tree line to allow sampling of the forest edge. A high-sensitivity Anabat microphone was mounted on an extension cable and placed within a tubular waterproof plastic housing which was sealed around the cable at the base. This housing was secured to a length of 1.25 inch diameter galvanized steel pipe. The microphone faced downwards within the housing, and a plate angled at 45° from horizontal reflected incoming sounds into the waterproof housing. This allowed sampling of a horizontal section of the sky at treetop height. The tower was constructed with a cantilevered base, allowing it to be raised and lowered as needed. A microphone extension cable ran down the pole to the main body of the detector, which was placed in a waterproof housing at the base of the pole, along with the power supply. The waterproof housing was covered in green plastic to minimize visibility and potential vandalism.

This system remained in operation until Sept 6, 2013, when the tower was extended to 10 m in height and the microphone casing was raised to the top of the tower. This system was frequently checked (approximately biweekly or less) to download data, check batteries, and verify that the system was intact and functioning properly. It was left operational until Sept 30, 2013.

Both detectors were programmed to record all ultrasonic sounds between 7 pm and 7 am. Each system was frequently checked (approximately biweekly or less) to download data, refresh batteries, and verify that the system was intact and functioning properly.

Photo 3.3 Pole erected on site for aerial Anabat system in 2013, showing detail of cleared area and forest edge. Ground unit is visible at base of pole.

3.2.2 Ground Systems

2012 Deployment

In 2012 an Anabat SD2 acoustic bat detector was deployed at the Barrachois site from 6 September 2012 to 11 October 2012. Coordinates were 699754E, 5114038N (UTM NAD 83) and the location is depicted on Figure 5.1 (2012 Survey Location). The detector was deployed, along with its power supply, on the ground in a waterproof housing fitted with a microphone tube, which allowed sampling of a section of the sky approximately 45 degrees from horizontal. The detector was programmed to record all ultrasonic sounds between 7 pm and 7 am. This setup was placed within 5m of the tree line on the site, with the microphone tube pointing parallel to the tree line (northeast) to allow sampling of the forest edge (Photo 3.3). The waterproof housing was covered in brush to minimize visibility and potential vandalism.

2013 Deployment

In 2013 an Anabat SD2 acoustic bat detector was deployed at the Barrachois site from 29 July to Sept 30. Deployment was identical to the 2012 deployment, except that the unit was placed at the base of the aerial tower (Photo 3.3).

3.2.3 ANABAT Data Format and Analysis

While deployed at the site, the ANABAT detectors recorded all ultrasonic frequencies detected onto a compact flash card. This data was then interpreted via AnalookW software (version 3.8s) using zero-crossing analysis. All ultrasonic frequencies recorded were then displayed graphically as sonograms, and bat echolocation sequences were identified based on the minimum, maximum, and characteristic frequencies, in addition to the slope of the calls (O'Farrell *et al.* 1999). Sequences were identified to species using the Analook W software and published information on the calls of bat species native to eastern North America (Barclay 1989, Barclay *et al.* 1999, Betts 1998, Broders *et al.* 2001, Fenton and Bell 1981, Fenton *et al.* 1983, MacDonald *et al.* 1994). It should be noted that bats of the genus *Myotis* present within Nova Scotia (little brown bat and northern long-eared bat) generally cannot be distinguished reliably using these acoustic survey methods.

4.0 SURVEY RESULTS

4.1 Review of Available Data

Within 25 km of the Project site, there are almost 500 known mine openings according to the Nova Scotia Abandoned Mine Openings (AMO) Database (NSDNR, 2013). None of these mine openings correspond to caves known to support bats in Nova Scotia, as summarized by Moseley (2007a and 2007b). Total measured depths of most of the mine openings are not provided; however, two of the openings have a measured depth of ten metres or more. The original depths of some of these openings were much greater, but according to the records, the majority have been filled or sealed for public safety (NSDNR, 2013).

Discussions with Dr. Hugh Broders and NSDNR Regional Biologist Terry Power indicate that there are no known bat hibernacula in the immediate area of Barrachois. According to Terry Power, there is a small hibernaculum in an abandoned mine located approximately 8 km south of the project site; in a winter 2012 survey, fewer than 20 *Myotis* individuals were counted. Dr. Broders states that observations of significant swarming activity suggest a possible hibernaculum near Donkin, approximately 35 km east of the project site, and there have been reports of at least two other minor hibernacula (10 - 100 bats) in Cape Breton: the one in Coxheath described above, and another near Louisbourg, more than 40 km to the southeast of the project site.

4.2 ANABAT Data

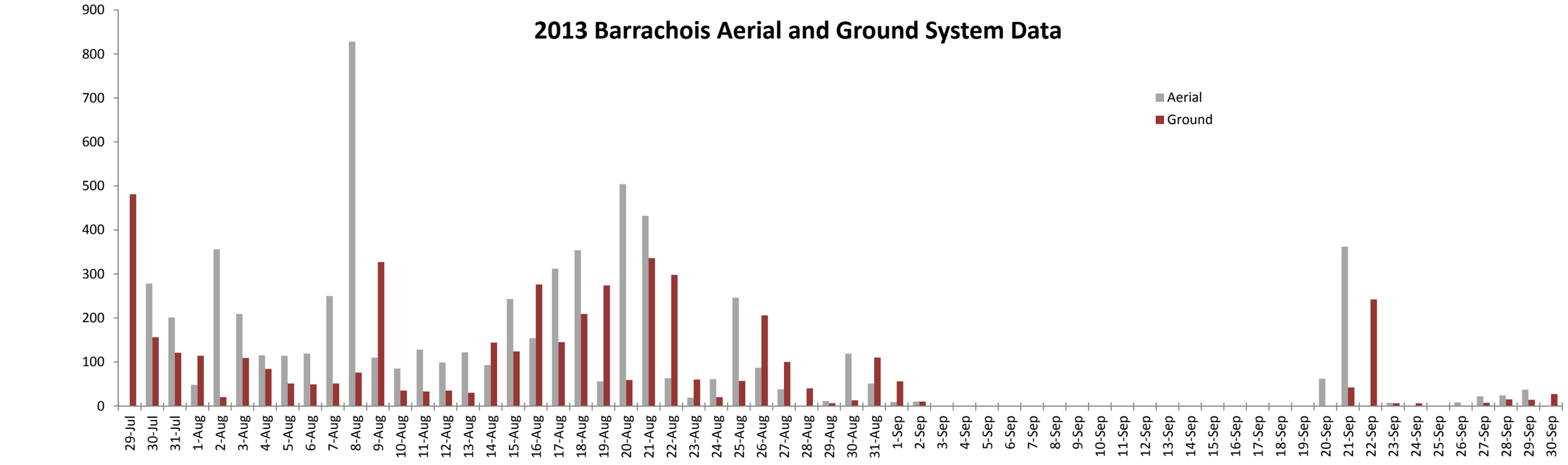
4.2.1 Aerial System

The 2012 tree-mounted system, which was deployed from Sept 6 to Oct 11 2012, recorded bat activity during 17 of the 19 deployment nights. The average was 11.05 calls per night (minimum 2, maximum 57). The majority of the bat calls were *Myotis* species, though a few were questionable. While it is difficult to confidently assign *Myotis* echolocation sequences to a particular species, the calls recorded show characteristics of both *M. lucifugus* and *M. septentrionalis*, and it is assumed that both species are present on the site.

The 2013 aerial system, which was deployed from July 30 to Sept 30 2013, recorded bats on 44 of the 54 nights on which the unit appeared to be functioning properly. During the period between 7 Sept and 16 Sept 2013 no data was recorded, possibly due to an unexpected compact flash card formatting error, however for four days prior to and after this event, the units each set up folders to record data (indicating they were functioning properly, but did not record any data).

Figure 4.1 and Table 4.2.1 depict the number of bat echolocation sequences recorded by the aerial Anabat unit at Barrachois in 2013, as well as the temperature and precipitation data for the Sydney Airport (the closest weather station with sufficient data).

All units recorded a significant number of bat calls. All appear to belong to *Myotis* species. The aerial system in particular recorded a maximum of 828 bat echolocation calls on one night, Aug 8 2013. It is of note that the majority of the aerial data recorded at Barrachois in 2013 is very “clean”, *i.e.*, there are virtually no noise files recorded. In addition, the vast majority of the aerial files appear to be simple echolocation calls, with no evidence of “feeding buzzes”, indicating that bats recorded by the aerial system are not feeding. The specific nature and reasons for this event are subject to various interpretations: migration, movement from local hibernaculum due to disturbance, etc. However, the reasons for the increased numbers does not diminish the important observation that the bats have been detected in the area.



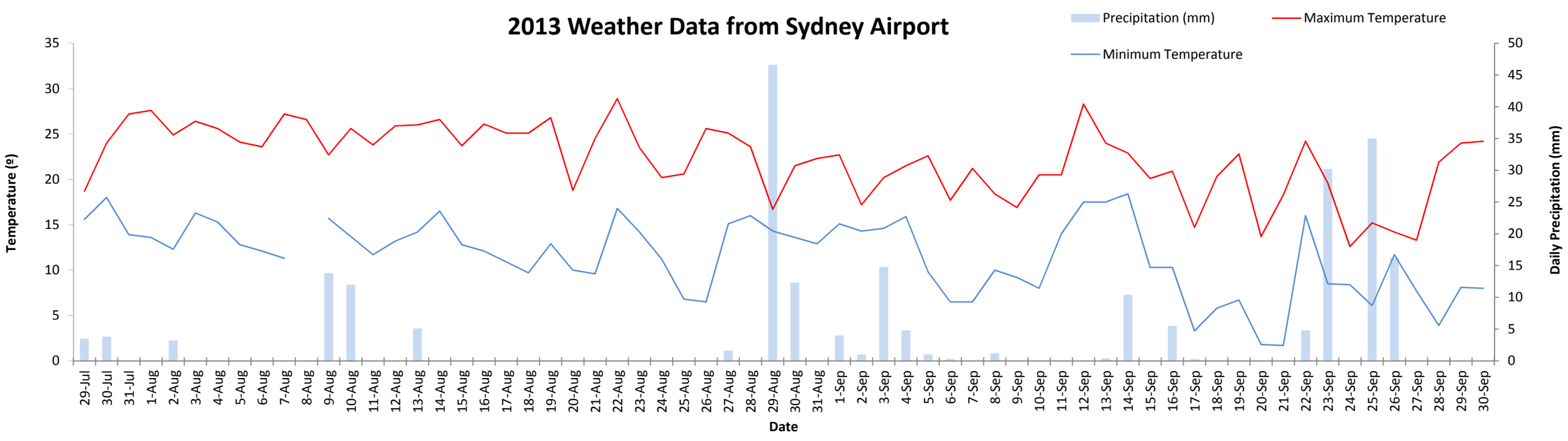


Figure 4.1 2013 Barrachois Aerial and Ground System Data and 2013 Weather Data (Sydney Airport, Environment Canada data).

Table 4.2.1: Number of bat echolocation sequences detected per night by aerial Anabat SD2 systems at proposed Natural Forces wind turbine site in Barrachois, Cape Breton Co. in 2012 and 2013

Night	Total # of Ultrasonic Events Recorded	*Myotis* spp. Calls	Indeterminate Sequences*	Non-bat Sound Events ("Noise")
2012				
7-Sep-12	40	30		10
8-Sep-12	32	18	1	13
9-Sep-12	39	3	2	34
10-Sep-12	581	57		524
11-Sep-12	6	6		
12-Sep-12	24	24		
13-Sep-12	5	5		0
14-Sep-12	11	11		
15-Sep-12	42	10		32
16-Sep-12	2	2		
17-Sep-12	4	4		
18-Sep-12	2	2		
19-Sep-12	30			30
20-Sep-12	5	3		2
21-Sep-12	9	2		7
22-Sep-12	129			129
23-Sep-12	346	3		343
24-Sep-12	22	6		16
29-Sep-12	2	2		
2013				
30-Jul-13	0			
31-Jul-13	279	278		1
1-Aug-13	201	201		
2-Aug-13	48	48		
3-Aug-13	356	356		
4-Aug-13	210	209		1
5-Aug-13	115	115		
6-Aug-13	114	114		
7-Aug-13	119	119		
8-Aug-13	251	250		
9-Aug-13	828	828		

Night	Total # of Ultrasonic Events Recorded	*Myotis* spp. Calls	Indeterminate Sequences*	Non-bat Sound Events ("Noise")
10-Aug-13	110	110		
11-Aug-13	85	85		
12-Aug-13	128	128		
13-Aug-13	99	99		
14-Aug-13	122	122		
15-Aug-13	93	93		
16-Aug-13	243	243		
17-Aug-13	154	154		
18-Aug-13	312	312		
19-Aug-13	354	354		
20-Aug-13	56	56		
21-Aug-13	504	504		
22-Aug-13	432	432		
23-Aug-13	63	63		
24-Aug-13	19	19		
25-Aug-13	61	61		
26-Aug-13	246	246		
27-Aug-13	87	87		
28-Aug-13	44	38		
29-Aug-13	232			232
30-Aug-13	11	11		
31-Aug-13	119	119		
1-Sep-13	51	51		
2-Sep-13	10	9	1	
3-Sep-13	10	10		
4-Sep-13	0			
5-Sep-13	0			
6-Sep-13	0			
7-Sep-13	ND	ND		
8-Sep-13	ND	ND		
9-Sep-13	ND	ND		
10-Sep-13	ND	ND		
11-Sep-13	ND	ND		
12-Sep-13	ND	ND		
13-Sep-13	ND	ND		
14-Sep-13	ND	ND		
15-Sep-13	0			
16-Sep-13	0			

Night	Total # of Ultrasonic Events Recorded	*Myotis* spp. Calls	Indeterminate Sequences*	Non-bat Sound Events ("Noise")
17-Sep-13	0			
18-Sep-13	0			
19-Sep-13	0			
20-Sep-13	0			
21-Sep-13	63	62	1	
22-Sep-13	362	362		
23-Sep-13	1	1		
24-Sep-13	7	7		
25-Sep-13	18		18	
26-Sep-13	0			
27-Sep-13	8	8		
28-Sep-13	22	22		
29-Sep-13	24	24		
30-Sep-13	37	37		

*May require further research.
ND= No Data

4.2.2 Ground System

The 2012 ground system, which was deployed from Sept 6 to Oct 11 2012, recorded bat activity during 20 of the 36 deployment nights. The average was 13.35 calls per night (minimum 1, maximum 62). The majority of the bat calls appear to *Myotis* species. While it is difficult to confidently assign *Myotis* echolocation sequences to a particular species, the calls recorded show characteristics of both species, and it is assumed that both species are present on the site.

The 2013 ground system, which was deployed from July 29 to Sept 30 2013, recorded bats on 44 of the 46 nights on which the detector was functioning properly. (An unexpected compact flash card formatting issue led to the units not recording data from 7 Sept to 16 Sept 2013). The data recorded by the ground system shows a very high percentage of feeding buzzes, indicating the bats are foraging in the area, but apparently below 10 m height.

Figure 4.1 and Table 4.2.2 depict the number of bat echolocation sequences recorded by the ground-based Anabat unit at Barrachois in 2013, as well as the temperature and precipitation data for the Sydney Airport (the closest weather station with sufficient data).

Table 4.2.2: Number of bat echolocation sequences detected per night by ground-based Anabat SD2 systems at proposed Natural Forces wind turbine site in Barrachois, Cape Breton Co., in 2012 and 2013.

Night	Total # of Ultrasonic Events Recorded	*Myotis* spp. Calls	Indeterminate Sequences*	Non-bat Sound Events ("Noise")
2012				
6-Sep-12	85	62	7	16
7-Sep-12	29	29		
8-Sep-12	60	20		40
9-Sep-12	294	1	1	292
10-Sep-12	1872	61		1811
11-Sep-12	28	9		19
12-Sep-12	22	21		1
13-Sep-12	7	4	2	1
14-Sep-12	11	10		1
15-Sep-12	16	2		14
16-Sep-12	70	1		69
17-Sep-12	29	2		27
18-Sep-12	4	3		1
19-Sep-12	266	1		265
20-Sep-12	23	9	3	11
21-Sep-12	34	3	1	30
22-Sep-12	14		2	12
23-Sep-12	392	8		384
24-Sep-12	11	8		3
25-Sep-12	1			1
26-Sep-12	2	1		1
27-Sep-12	10			10
28-Sep-12	5			5
29-Sep-12	1			1
30-Sep-12	41			41
1-Oct-12	72			72
2-Oct-12	36			36
3-Oct-12	2			2
5-Oct-12	2			2
7-Oct-12	12	12		
11-Oct-12	4			4
2013				
29-Jul	481	481		
30-Jul	156	156		
31-Jul	121	121		
1-Aug	114	114		
2-Aug	23	20		
3-Aug	109	109		
4-Aug	84	84		
5-Aug	52	51	1	

Night	Total # of Ultrasonic Events Recorded	*Myotis* spp. Calls	Indeterminate Sequences*	Non-bat Sound Events ("Noise")
6-Aug	49	49		
7-Aug	51	51		
8-Aug	76	76		
9-Aug	417	327		
10-Aug	36	35		
11-Aug	33	33		
12-Aug	35	35		
13-Aug	65	30		35
14-Aug	144	144		
15-Aug	124	124		
16-Aug	276	276		
17-Aug	145	145		
18-Aug	212	209		3
19-Aug	274	274		
20-Aug	59	59		
21-Aug	336	336		
22-Aug	300	298		2
23-Aug	60	60		
24-Aug	20	20		
25-Aug	57	57		
26-Aug	207	206		1
27-Aug	100	100		
28-Aug	50	40		10
29-Aug	254	6		248
30-Aug	16	13		3
31-Aug	112	110		2
1-Sep	56	56		
2-Sep	10	10		
3-Sep	0			
4-Sep	0			
5-Sep	0			
6-Sep	2			2
7-Sep	ND	ND		
8-Sep	ND	ND		
9-Sep	ND	ND		
10-Sep	ND	ND		
11-Sep	ND	ND		
12-Sep	ND	ND		
13-Sep	ND	ND		
14-Sep	ND	ND		
15-Sep	ND	ND		
16-Sep	ND	ND		

Night	Total # of Ultrasonic Events Recorded	*Myotis* spp. Calls	Indeterminate Sequences*	Non-bat Sound Events ("Noise")
17-Sep	0			
18-Sep	0			
19-Sep	0			
20-Sep	0			
21-Sep	49	42		7
22-Sep	269	242		27
23-Sep	180	6		174
24-Sep	6	6		
25-Sep	16			16
26-Sep	13			13
27-Sep	7	7		
28-Sep	16	15		1
29-Sep	15	14		1
30-Sep	31	27		4

*May require further research.
ND= No Data

5.0 DISCUSSION AND CONCLUSIONS

While it is difficult to confidently assign *Myotis* echolocation sequences to a particular species, the calls recorded by both the aerial and ground units in both 2012 and 2103 show characteristics of both *M. lucifugus* and *M. septentrionalis*, and it is therefore assumed that both species are present on the site.

The decrease in bat echolocation sequences as the fall season progresses in both 2012 and 2013 matches the seasonal behaviour of *Myotis* species in NS. Occasional nights earlier in the season during which few bat calls were recorded may be due to inclement weather conditions, such as heavy rain, discouraging foraging by bats. This is likely the case for the night of 9 Sept 2012, during which the units recorded numerous noise files but only a single recognizable bat sequence, while there were high numbers of bat calls recorded on the previous and subsequent nights.

The resurgence in bat activity on Sept 21 and 22 2013 appears to correspond to a rise in nighttime temperatures after two cold (maximum 2ºC) nights), suggesting that bats were perhaps making up for lost foraging and/or transit time. It is also possible that the resurgence in bat activity levels from Sept 20-23 could be due to different *Myotis* species behaviours or behaviours of populations from different hibernacula.

Overall, the review of the data from the monitoring program in 2012 and 2013 suggests a significant level of bat activity on the Barrachois site. Based on the high levels of bat activity detected by the aerial system (828 sequences in one night), it appears there may be significant numbers of bats present in or transiting through this area on a seasonal basis. Further research,

outside the scope of this program, is required to determine the reason for the significant bat presence in this area. As this site is approximately 8 km from a known small *Myotis* hibernaculum, resulting in Barrachois having 'very high' site sensitivity according to NSE (2009), further research is highly recommended.

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Appendix D:

Archaeology Resource Impact Assessment

BARRACHOIS WIND FARM:
ARCHAEOLOGICAL RESOURCE IMPACT ASSESSMENT

Heritage Research Permit A2013NS031

June 2013

BARRACHOIS WIND FARM:
ARCHAEOLOGICAL RESOURCE IMPACT ASSESSMENT

Heritage Research Permit A2013NS031
Category C

Davis MacIntyre & Associates Limited
Project No.: 13-018.1NFO

Principal Investigator: Stephen A. Davis
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Cover: Looking northwest from the access road to the Meteorological tower and clear cut area.

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EXECUTIVE SUMMARY

In April 2013, Davis MacIntyre & Associates (DM&A) Ltd. was contracted by Natural Force Wind Inc. to conduct an archaeological resource impact assessment of the proposed Barrachois Wind Farm. The purpose of the assessment was to determine the potential for historic and precontact period archaeological resources within the development zone (turbine candidate sites and access roads) and to provide any recommendations for further mitigation, if deemed necessary. The assessment consisted of a desk-based assessment and field reconnaissance of the study area.

The field reconnaissance was conducted on 31 May 2013. The only cultural activity identified during the field survey was indications of modern logging activity. No areas of heightened archaeological potential were noted.

In the unlikely event that any archaeological material is encountered during ground disturbance activities, all activity should cease and the Coordinate of Special Places (902-424-6475) should be contacted immediately to determine a suitable method of mitigation.

1.0 INTRODUCTION

In April 2013, Davis MacIntyre & Associates (DM&A) Ltd. was contracted by Natural Force Wind Inc. to conduct an archaeological resource impact assessment of the proposed Barrachois Wind Farm.

The purpose of the assessment was to determine the potential for archaeological resources within the development zone (turbine candidate sites and access roads) and to provide recommendations for further mitigation, if deemed necessary. The assessment consisted of a desk-based assessment conducted by consulting historical maps and manuscripts and published literature as well as a field reconnaissance of the study area.

The impact assessment was completed under Category C Heritage Research Permit A2013NS031 issued by the Nova Scotia Heritage Division. This report conforms to the standards required by the Heritage Division under the Special Places program.

2.0 STUDY AREA

The proposed Barrachois wind farm is located approximately 2 kilometers to the northeast of Barrachois between the Long Island Road and the Grand Narrows Highway. The development will consist of a meteorological tower, which has already been installed, and two turbines within the study area (Figure 2.0-1).

The study area is located in the Boisdale Hills sub-Unit of the North Bras d'Or Uplands (Natural Theme Region #313c) (Figure 2.0-2). This region is characterized by a series of elongated fault blocks oriented northeast-southwest and were once islands in the Carboniferous Sea. The soil is predominately a well-drained, stony, sandy loam, however Mira soils (poorer draining sandy loam) have developed where relief has impeded drainage. Soil depths are typically shallow, particularly on ridges and steep slopes. Characteristic arboreal species include the Sugar Maple, Yellow Birch, American Beech and shade intolerant hardwoods are found at higher altitudes. The upland flats and ravine slopes are characterized by Balsam Fir, White Spruce and Black Spruce. However, mixed-wood forests are prevalent in lower elevations in the Boisdale Hills sub-unit. Stream ravines in this sub-Unit are home to a large number of eagle nests and deer are typically found on the side slopes in the winter. There are few to no moose in the area. Freshwater species within the district include Brook Trout, Golden Shiner, White Sucker, White Perch, sticklebacks and Branded killfish.[1]

[1] Davis and Browne, 1996:33-35.

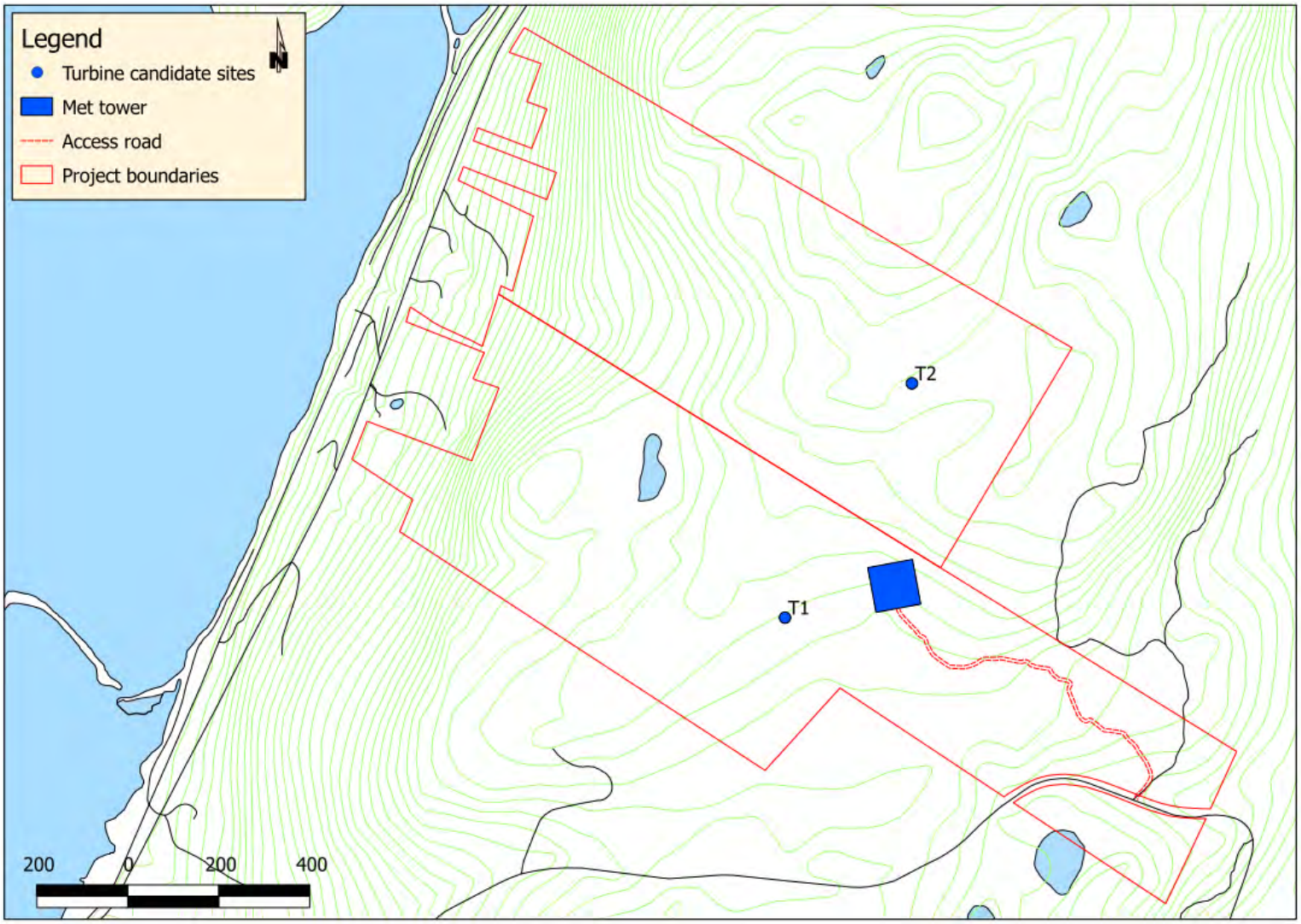

Figure 2.0- 1: A topographic map of the project boundary, access road, turbine candidate sites and meteorological tower.

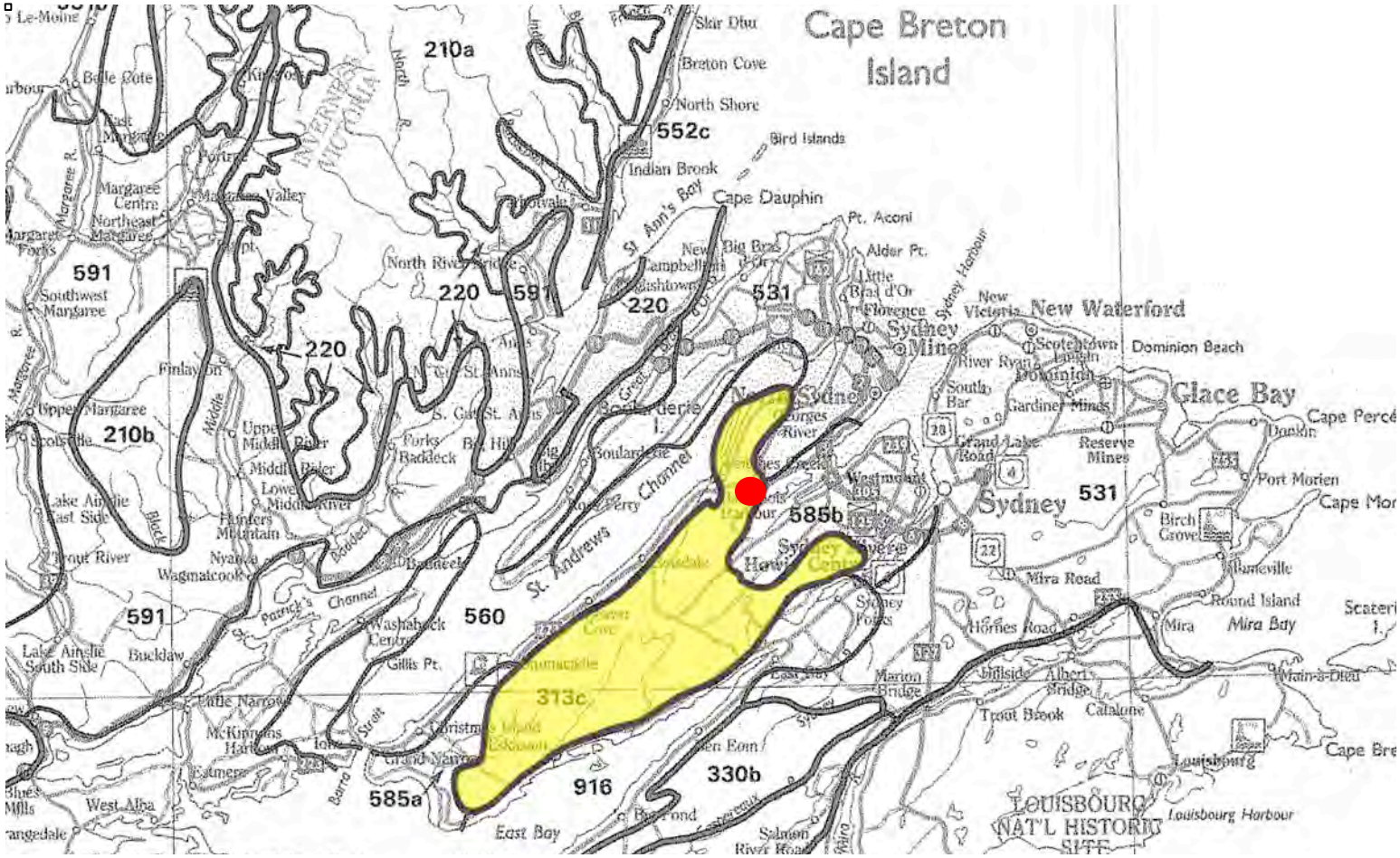

Figure 2.0- 2: Map of Natural Theme Region #313c with the Barrachois Wind Farm study area marked in red.[2]

[2] [2] Davis and Browne, 1996:33-35.

3.0 METHODOLOGY

A historic background study was conducted by Davis MacIntyre & Associates Limited in April and May 2013. Historical maps and manuscripts and published literature were consulted. The Maritime Archaeological Resource Inventory, held at the Nova Scotia Museum's Culture and Heritage Development Division, was searched to understand prior archaeological research and known archaeological resources neighbouring the study area.

A field reconnaissance of the impact area was supervised by Stephen A. Davis on 31 May 2013. The meteorological ("Met") tower location, the two turbine candidate sites and the existing access road to the Met tower were visited.

3.1 Maritime Archaeological Resource Inventory

The Maritime Archaeological Resource Inventory (MARI), a Provincial database of known archaeological sites and finds, was searched in 4 June 2013 in an effort to understand prior archaeological research and known resources within the study area. No archaeological sites have been reported within a 5 kilometer radius of the study area.

However, two archaeological sites are known within a 15 km radius. Approximately 14 kilometers south of the study area, stone flakes relating to First Nations occupation were noted on the beach of the Bras d'Or Lake in 1975 (CaCc-01). The second site is the remains of two houses representing nineteenth century Scottish occupation on the "Little" Peter MacIntyre property in Rear Boisdale (CaCc-02). This site is approximately 11 kilometers south-southwest of the study area.

The absence of recorded archaeological resources within 5 kilometers or immediately adjacent to the study area is likely an indication of a lack of detailed archaeological surveys being completed in the region, rather than a lack of archaeological resources.

3.2 Historical Background

3.2.1 The Precontact Period

The history of human occupation in Nova Scotia has been traced back approximately 11, 000 years ago, to the Palaeo-Indian period or *Saqiwe'k L'nu'k* (11,000 – 9,000 years BP). The only significant evidence of Palaeo-Indian settlement in the province exists at Debert/Belmont in Colchester County.

The *Saqiwe'k Lnu'k* was followed by the *Mu Awsami Kejihaw'k L'nu'k* (Archaic period) (9,000 – 2,500 years BP), which included several traditions of subsistence

strategy. The Maritime Archaic people exploited mainly marine resources while the Shield Archaic concentrated on interior resources such as caribou and salmon. The Laurentian Archaic is generally considered to be a more diverse hunting and gathering population.

The Archaic period was succeeded by the Woodland/Ceramic period of *Kejihawek L'nu'k* (2,500 – 500 years BP). Much of the Archaic way of subsistence remained although it was during this period that the first exploitation of marine molluscs is seen in the archaeological record. It was also during this time that ceramic technology was first introduced.

The Woodland period ended with the arrival of Europeans and the beginning of recorded history. The initial phase of contact between First Nations people and Europeans, known as the Protohistoric period, was met with various alliances particularly between the Mi'kmaq and the French.

The Mi'kmaq inhabited the territory known as Mi'kma'ki or Megumaage, which included all of Nova Scotia including Cape Breton, Prince Edward Island, New Brunswick (north of the Saint John River), the Gaspé region of Quebec, part of the Maine and southwestern Newfoundland. The Mi'kmaq name for Cape Breton was Unama'kik aq Ktaqmkuk meaning "Foggy lands and Land Across the water" (Figure 3.2-1). The Mi'kmaq name for Barrachois was Apji'jkemuejue'katik.[3]

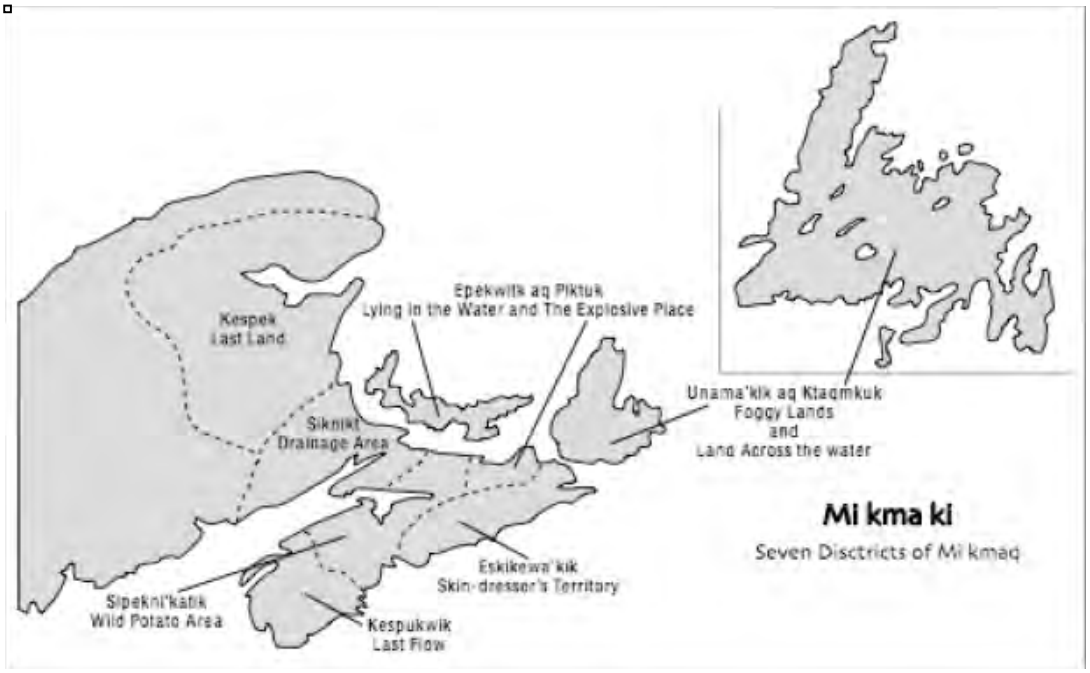

Figure 3.2- 1: Map of the Mi'kmaq districts.[4]

[3] Sylliboy <url>
[4] Confederation of Mainland Mi'kmaq, 2007:11.

3.2.2 European Settlement

The earliest documented historic activity around Cape Breton Island began in the early sixteenth century with visits by fishermen to the fishing banks off the island. Prior to the founding of Louisbourg, the harbour there was known as English Harbour, indicating the presence of English fisherman in the region[5] and Sydney Harbour was known to the French as the *baie des Espagnols* (Spanish Bay).[6] Early French fishermen tended to congregate at St. Anne's Bay. Fur traders and fisherman continued to visit Cape Breton throughout the sixteenth century.[7]

In 1629, a fort was built in Cape Breton, at *Port aux Balienes* by the Scottish James Stuart. This site was captured in the same year by the French under the control of Captain Daniel of Dieppe who used the labour offered by these prisoners to build a new fort at St. Ann's Bay (known to the French as Grand Cibou). This was the first permanent French settlement on the island and was called Saint Anne or Port Dauphin.[8]

Although the possession of mainland Nova Scotia fluctuated between the French and the English, Cape Breton remained under French control. In 1713, the Treaty of Utrecht formally gave mainland Nova Scotia to the British while Prince Edward Island and Cape Breton continued to remain under control of the French.[9]

The French response to this treaty was to consolidate control in their territories and plans were made to construct a main fortification in Cape Breton. Cape Breton was renamed *Île Royale* and the French began a period of fortification and colonization. A 1717 French map depicts the island with the three major ports – Louisbourg, Dauphin and Toulouse. Although Barrachois itself is not labeled on the map, Boularderie Island is marked as *Isle Verderonne*, indicating that the area was known to the French (Figure 3.2-2). The map also shows that Port Dauphin is somewhat close to the Barrachois area adding to the possibility of a French presence within the study area.

In 1721, Louis-Simon Boularderie received as a grant of land, *Isle Verderonne*, which became known as Boularderie. His settlement would be built approximately 26 kilometers away from Barrachois Harbour. Boularderie set up a settlement with houses and gardens, a church and eventually a mill and ship yard. When Louis-Simon Boularderie died in 1738 at Louisbourg, his son Antoine Le Poupet de La Boularderie took over the family estate and became a chief military officer at Louisbourg. Antoine described owning at Boularderie settlement a "very handsome

[5] Fergusson, 1967:373-378.
[6] Murdoch, 1865:217.
[7] Landry <url>
[8] Murdoch, 1865:72-87, 125.
[9] Murdoch, 1865:132, 333.

house, barn, stable, dairy, dovecot, oven, wind and water-mills . . .” and it is also known that he was growing wheat on the island by 1740.[10]

A map of the Boularderie settlement, dated to 1742, shows in detail the layout of the settlement, farms and gardens (Figure 3.2-3). It notes Boularderie’s house (A), stables (B), an area of fertile land (C), coal mines, an area of fishermen’s houses (N), a place where six First Nation families are living (0), and several wharfs and gardens. This detailed map depicts a fairly large settlement at the mouth of St. Andrew’s Channel some 26 kilometers away from Barrachois Harbour. It is not implausible that the Barrachois area was known to the people of Boularderie particularly since the place name is derived from *Barachoir* or *Barre a cheoir* meaning a pond or lagoon separated from a river or ocean by a neck of land or sand bar. In addition, the noted First Nations encampment on the 1742 map is evidence of, at minimum, a historical Mi'kmaq presence in the area.

A 1752 French map of *Île Royale* shows the Boularderie settlement as quite expansive, although no cultural activity is depicted in the study area (Figure 3.2-4). In addition, the map does not appear to be particularly accurate in depicting the shoreline of Isle Boularderie or the course of St. Andrew’s Channel and therefore the Boularderie settlement may have been similarly inaccurately depicted.

A map of Cape Breton, dating to 1773, is the oldest map to accurately depict Long Island, located close to the study area (Figure 3.2-5) indicating that by 1773, Europeans had probably been down the St. Andrew’s Channel. The Barrachois Harbour area is depicted in more detail in an 1831 map (Figure 3.2-6). No activity is depicted in the study area, although a “French village” is noted further up the St. Andrew’s Channel. It is unclear if this refers to an Acadian or French village which was occupied at the time of the map’s creation or if it refers to remains of an older settlement noted by the map maker.

In 1840 and 1841 land grants were given to Scottish immigrants in the Barrachois Harbour area. In the specific study area, the land grants are listed as “Certificates” (Figure 3.2-7). These certificate numbers refer to parcels of ungranted crown land in which the crown released their interest in the 1980s and 1990s.[11]

The A.F. Church map for Victoria County is dated to 1886 and depicts two properties and houses within the study boundaries (3.2-8). These properties belong to J. Nicholson and J. McNeil and appear to be located at the northwest end of the study area, well outside the impact zones of the turbines and Met tower. Aside from these two houses, no other buildings or infrastructure is depicted within the study area, although Barrachois Harbour does appear to be well-populated at this time.

[10] Landry, <url>
[11] Department of Lands and Forests:1989 to 1995.

The Geological Survey of Canada map for the Barrachois area is dated 1899 and shows very little activity within the study area (3.2-9). The Intercolonial Railway is now depicted along the northwestern edge of the study area and the Barrachois Railway station is located outside of the study area to the southwest. A mill is located to the east and the Barrachois Road passes through the southeastern part of the study area.

Figure 3.2- 2: 1717 French map of Isle Royale (Cape Breton) depicting the major settlements at this time: Louisbourg, Port Toulouse and Port Dauphin. In addition, Mira Bay has been depicted and labeled as "Miray."[12]

[12] Anon., 1717.

Figure 3.2- 3: Excerpt of 1742 map of the Boularderie settlement located approximately 26 kilometers up the St. Andrew's Channel from the study area, showing buildings, gardens, fields and wharves. Note Boularderie's house (A), cultivated fields (C), fisherman's houses (N) and the location of six Mi'kmaq families (O). [13]

[13] Boucher et La Boularderie, 1742.

Figure 3.2- 4: Excerpt of a 1752 map of Île Royale, showing Port Dauphin (today St. Ann's) Baye des Espagnols (today Sydney) and the Boularderie settlement, noted by the blue arrow. The study area (approximately shown in red) has no cultural activity noted. [14]

[14] Anon., 1752.

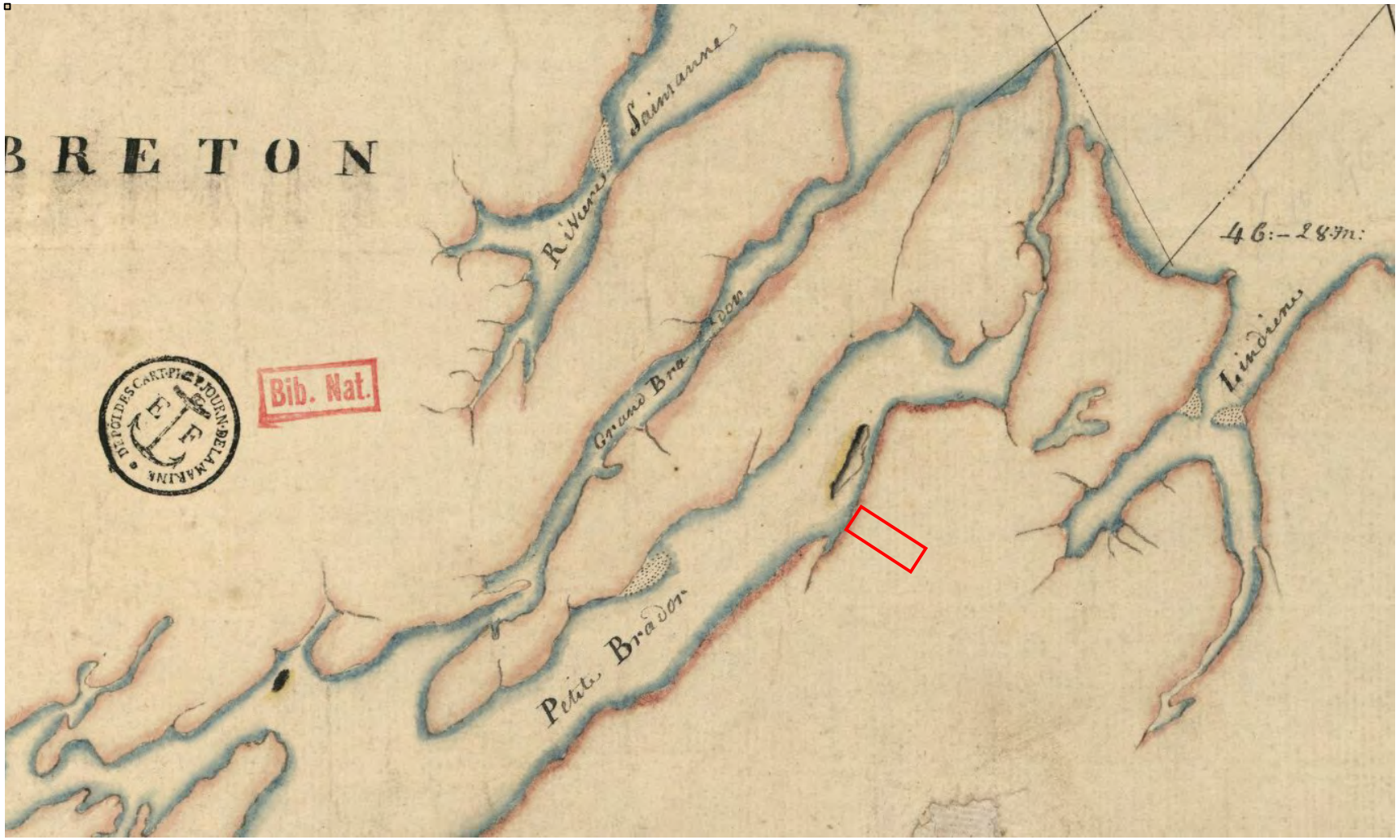

Figure 3.2- 5: Excerpt of 1773 map of Cape Breton, the first map to accurate depict Long Island (blue arrow). The approximate study area is noted in red. .[15]

[15] Lange, 1773.

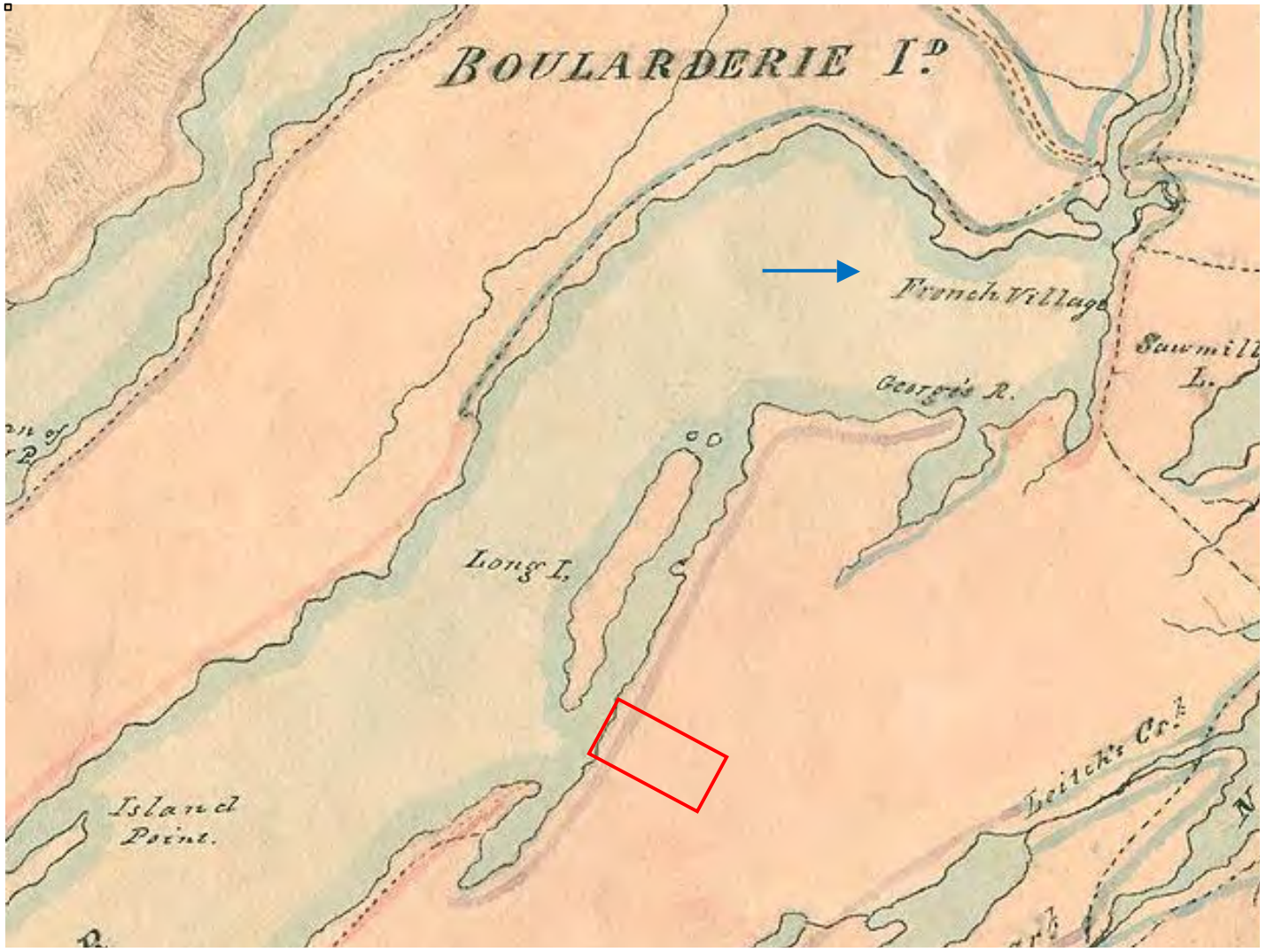

Figure 3.2- 6: Excerpt of 1831 map of Cape Breton showing the Barrachois Harbour area with the approximate study area outlined in red. Note the French Village (blue arrow).[16]

[16] Johnston, 1831.

Figure 3.2- 7: Excerpt of the Crown Land Grants map showing the land granted since 1763. The approximately study area is shown in red.[17]

[17] Nova Scotia Department of Lands and Forests, 1948.

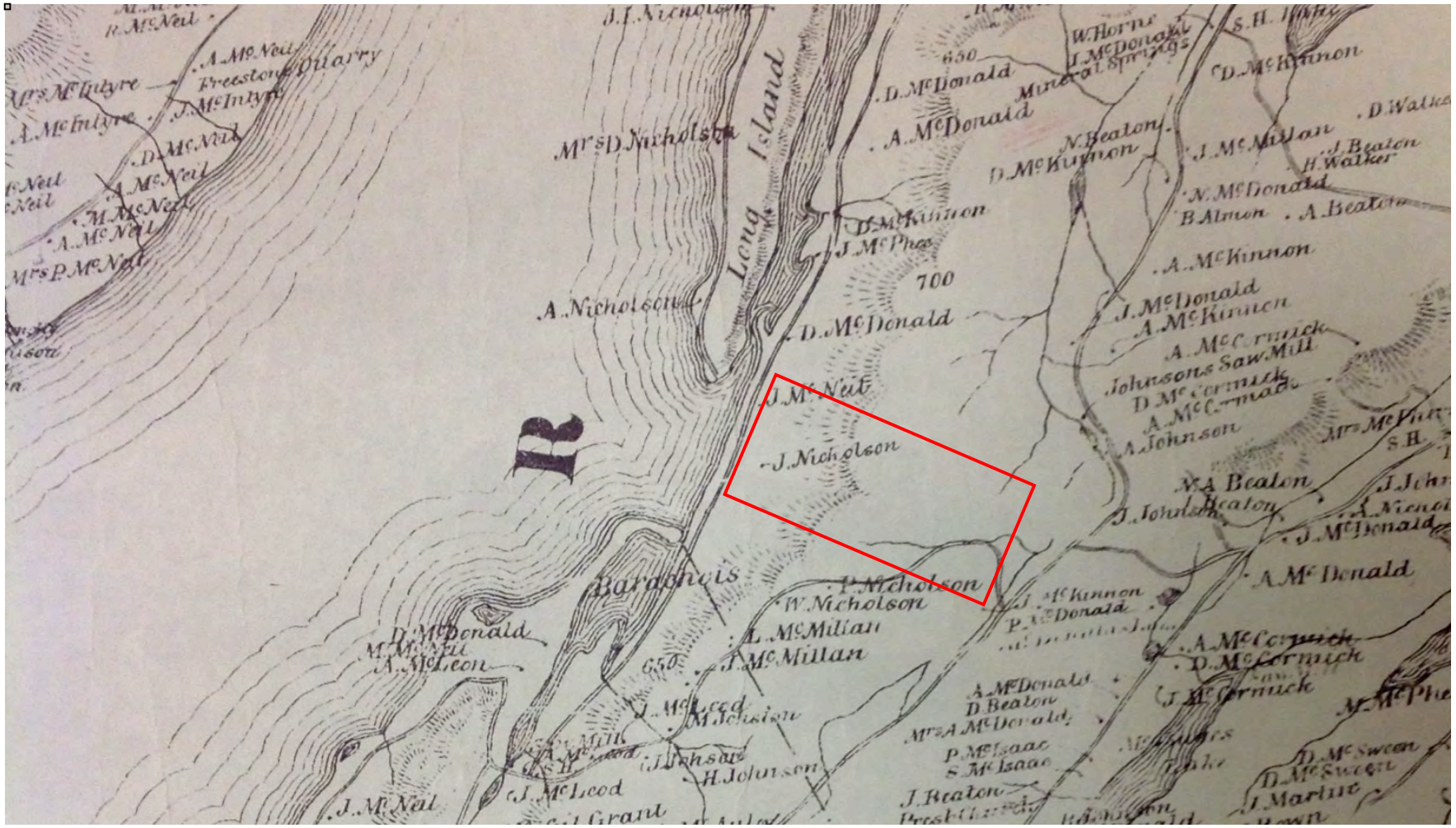

Figure 3.2- 8: Excerpt from A. F. Church's 1886 map of Victoria County. The approximate study area is shown in red.[18]

[18] Church, 1886.

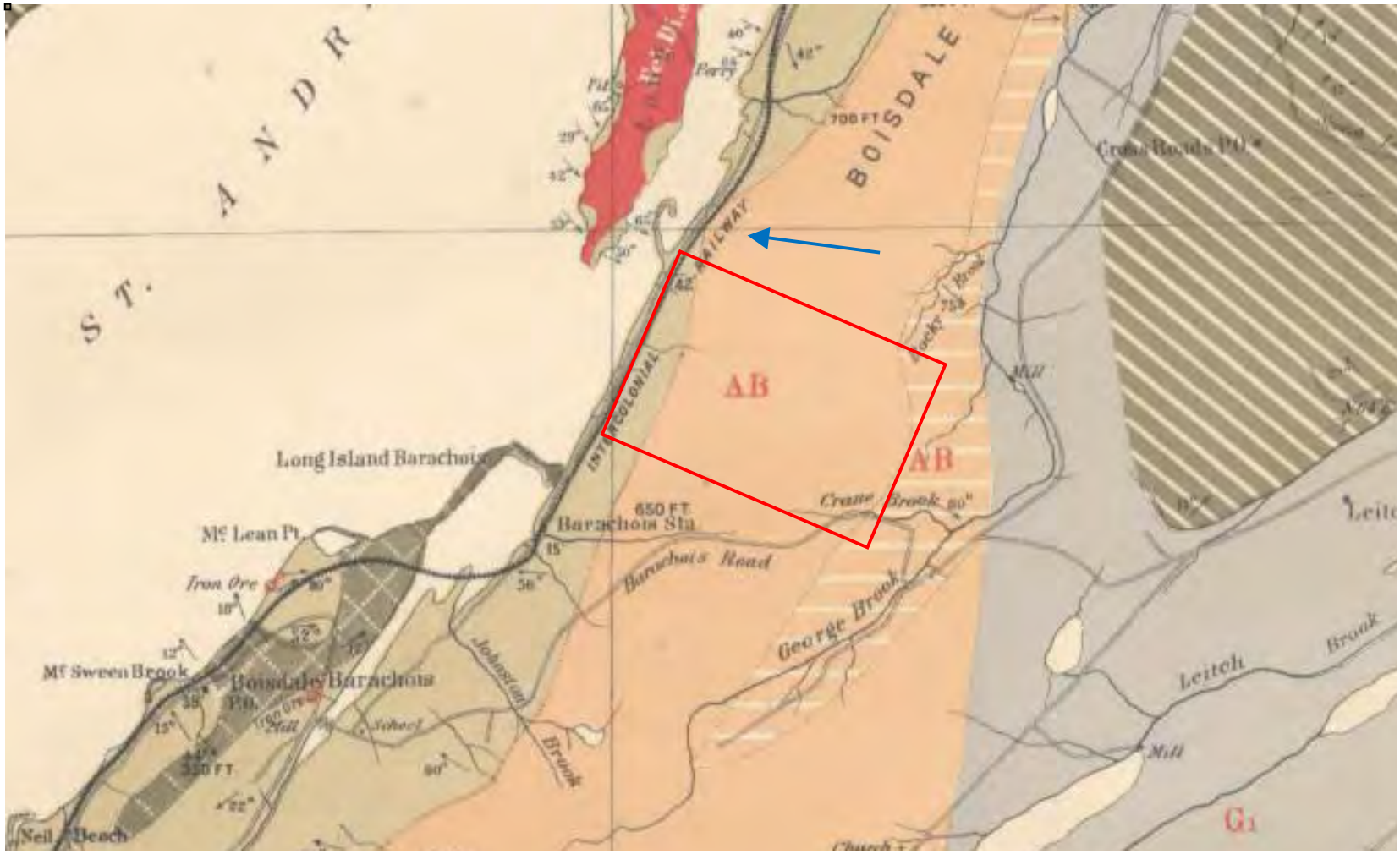

Figure 3.2- 9: Excerpt from 1899 Geological Survey of Canada map. Note the Intercolonial Railway (blue arrow). The approximate study area is shown in red.[19]

[19] Faribault, 1899.

3.3 Field Reconnaissance

The study area was situated within a mixed wood forest of predominately birch and spruce. Evidence of clear cutting and logging within the past 10 to 100 years was noted throughout the study area. A brook located along the access road close to the Grand Narrows Highway was noted but was too shallow to be navigable even under high water conditions. Overall, no evidence of historic cultural activity was noted.

Field reconnaissance was undertaken on 31 May 2013. Access to the study area was provided by an access road off on the Grand Narrows Highway. The access road was present from the Grand Narrows Highway to the meteorological tower, which had been installed and where the surrounding area had been clear cut. The crew did not have the exact location information for the access roads from the Met tower to the turbine candidate sites. Therefore, the field crew walked in an approximate straight line from the edge of the Met tower clear cut to the turbine candidate sites.

The access road led from the Grand Narrows Highway at the south end of the study area. The access road crossed a brook approximately 0.30 to 0.40 meters deep and 1 to 2 meters wide (Plate 1). The watercourse was not navigable and it is highly unlikely that it would be navigable even under extremely high water conditions.

The access road was composed of 2 inches of gravel which transitioned into an earth cut road (Plate 2). The road was sloped upwards by 20°. The bottom and sides of the road were visually examined. No cultural features or archaeological resource were found, although a piece of natural low grade quartz was found in the road bed. A culvert was noted along the road to manage runoff and no natural watercourse was found at this location.

The forest in the south end of the study area was a mainly birch forest with some spruce. The growth was fairly young (10 to 30 years old) and moss covered stumps were also identified, indicating modern logging had occurred. No signs of agriculture were noted (Plate 3).

As the elevation of the road continued to increase, quarried glacial erratics from the construction of the road were observed along the sides of the road (Plate 4) and a high stone ridge was noted to the north of the road.

The road ended in a large clear cut area where the Met tower had been erected (Plate 5). Based on the ground disturbance, the area was characterized by a thin A horizon, followed by brown and then grey grit subsoil. This would not be conducive to agriculture, particularly since there were a large number of glacial erratics located close to the surface (Plate 6).

The candidate site for Turbine 1 was located to the west of the Met tower through a mixed wood forest (Plate 7). This forest showed indications of logging activity in the

form of stumps and young tree growth. Most of the trees were 30 years old; however some of them were 70 to 100 years old. The understory was mainly composed of moss.

The candidate site for Turbine 2 was located to the northeast of the Met tower through a mixed mature forest (Plate 8). The majority of the trees were at least 30 years old with some trees being 70 to 100 years old. The understory was composed of moss. The forest was open enough to allow a visibility of 30 meters on each side (Plate 9). At the turbine candidate site itself there was no evidence of logging.

4.0 RESOURCE INVENTORY

During the field reconnaissance, no areas of heightened archaeological potential were noted and no cultural features, aside from modern logging activities, were noted.

5.0 RESOURCE EVALUATION

The brook was fairly shallow, rendering it not navigable. No areas suitable for First Nations habitation were noted based on the terrain and proximity to navigable water and other resources. No evidence of historic habitation was observed.

6.0 RESULTS AND DISCUSSION

The results of the field reconnaissance indicate that the proposed impact area has experienced little habitation by European or First Nations people. This is supported by the lack of navigable watercourses and the thin A horizon with shallow glacial erratics in the higher study area. In addition, while the background research of the study area identified historic activity in the general area, none was specifically documented within the study area.

7.0 RECOMMENDATIONS AND CONCLUSIONS

Research and field reconnaissance in the study area has revealed the presence of no areas of elevated archaeological potential or archaeological features.

In the unlikely event that any archaeological material is encountered during ground disturbance activities, all activity should cease and the Coordinator of Special Places (902-424-6475) should be contacted immediately to determine a suitable method of mitigation

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PLATES

Plate 1: Looking west from the gravel access road to the brook.

Plate 2: The access road transition from gravel surface to dirt surface. Looking northeast.

Plate 3: Looking south at typical forest surrounding access road.

Plate 4: Looking west up the access road. Note the glacial erratics on the right side of the road.

Plate 5: Looking northwest over the clear cut area to the Met tower.

Plate 6: Glacial erratics at the clear cut area. Looking northwest.

Plate 7: Candidate site for turbine 1. Looking southeast.

Plate 8: Turbine 2 candidate site looking south.

Plate 9: Looking northeast through mature forest surrounding turbine two. Note the high level of visibility.

APPENDIX A: HERITAGE RESEARCH PERMIT

NOVA SCOTIA

Heritage Research Permit (Archaeology)

Special Places Protection Act 1989

(Original becomes Permit when approved by Communities, Culture and Heritage)

Office Use Only
Permit Number:
A2013NS031

Greyed out fields will be made publically available. Please choose your project name accordingly

Surname Davis	First Name Stephen
Project Name Barrachois Harbour Wind Farm	
Name of Organization Davis MacIntyre & Associates Ltd	
Representing (if applicable) Natural Forces	
Permit Start Date 13 May 2013 (Rev. 22 May)	Permit End Date 31 July 2013
General Location: Barrachois Harbour, Cape Breton County	

Specific Location: *(cite Borden numbers and UTM designations where appropriate and as described separately in accordance with the attached Project Description. Please refer to the appropriate Archaeological Heritage Research Permit Guidelines for the appropriate Project Description format)*

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Permit Category:
Please choose one

- ☐ Category A – Archaeological Reconnaissance
- ☐ Category B – Archaeological Research
- ☑ Category C – Archaeological Resource Impact Assessment
- ☑ I certify that I am familiar with the provisions of the *Special Places Protection Act* of Nova Scotia and that I have read, understand and will abide by the terms and conditions listed in the Heritage Research Permit Guidelines for the above noted category.

Signature of applicant Stephen Davis	Date 22 May 2013
Approved by Executive Director	Date June 7, 2013

Appendix E:

Mi’kmaq Ecological Knowledge Study

A MI'KMAQ
HISTORICAL AND ECOLOGICAL KNOWLEDGE REVIEW
OF THE
BARRACHOIS PROPERTY

Submitted to:

Nova Scotia Department of Natural Resources
Halifax, Nova Scotia

Submitted by:

AMEC Environment & Infrastructure

a division of AMEC Americas Ltd.
Dartmouth, Nova Scotia

March 2013

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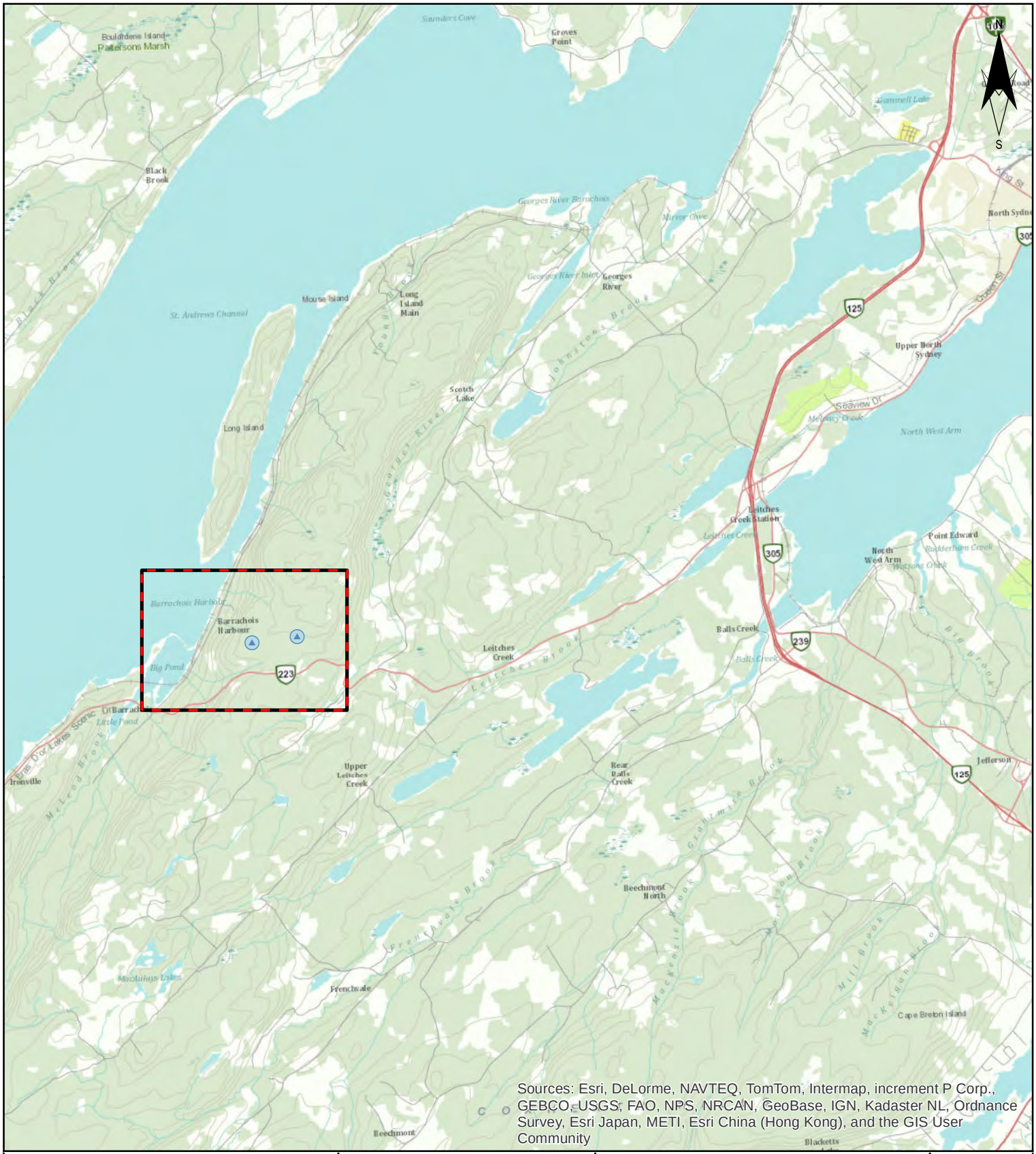
1.1. Project Background

Natural Forces Wind Inc. is proposing to develop a two turbine wind farm in Barrachois, Nova Scotia, and has engaged the services of AMEC Environment & Infrastructure, a Division of AMEC Americas Limited (AMEC), to conduct a Mi'kmaq Ecological Knowledge study of the Project Site.

1.2. Indigenous Knowledge and Knowledge Systems

Early in the 1990's governments and international development agencies became aware that Traditional Ecological Knowledge and associated Traditional Management Systems could be useful in improving development planning in areas populated by indigenous peoples (Johannes 1993). Traditional Ecological Knowledge, or as it is now more commonly known as, Indigenous Traditional Knowledge (ITK), is the accumulated knowledge of natural ecosystems, based on spiritual health, culture and language of the people that is passed between successive generations through stories, song and dance and myths to ensure their survival and the integrity of their socio-cultural and socio-economic systems. Indigenous knowledge is dynamic, based upon an intimate understanding of the components of non-living (abiotic) and living (biotic) environments. In most instances the management systems aspects of indigenous peoples knowledge systems has been segregated from the endeavour of compiling information for decision-making and the ITK aspects have been the focus of study. In Nova Scotia, ITK is referred to as Mi'kmaq Ecological Knowledge (MEK).



CLIENT: Natural Forces Wind Inc. 1791 Barrington Street Suite 1030 Halifax, Nova Scotia Canada B3J 3L1	SCALE: 1 0.5 0 1 2 Kilometers	PROJECT: Barrachois Wind Farm	DWN BY: DS CHK'D BY: BC DATE: October 2013 REV. NO: . FIGURE NO: 1.1
AMEC Environment and Infrastructure A Division of AMEC Americas Ltd. 50 Troop Avenue, Unit 300 Dartmouth, N.S., B3B 1Z1 (P) 902-468-2848 (F) 902-468-1314 www.amec.com	DATUM: NAD83 CSRS PROJECTION: UTM Zone 20 North PROJECT NO: TV134005	TITLE: General Site Location	

Path: P:\5300 PROJECTS\2013\TV134005 - Hillside Boularderie Wind Farm Spring Bird Survey\Cad\TV134005-1.1.mxd User: derrick.schulz Date: 10/11/2013

Indigenous Traditional Knowledge has become the focus of considerable international discourse on intellectual property rights (Ritchie *et al.* 1996). Indigenous communities worldwide have felt that their knowledge has been used to advance commercialization and over exploitation of local renewable resources and as a result, have become vocal about the protection of their knowledge and its use. The value of indigenous knowledge is becoming increasingly recognized by scientists, managers, and policy makers and is an evolving subject of both domestic and international law (Anaya 1996). Indigenous people are aware that there is a value to their knowledge and that it can be used for exploitative purposes. In some cases this risk has been offset by the fact knowledge holders often provided access to their knowledge and knowledge systems for a cost (fee), however, it is freely and openly shared, subject to intellectual property rights agreements, when it is used for protection of biodiversity and environmental condition.

Acquisition of knowledge on complex ecological systems is an ongoing and dynamic learning process. As such, indigenous knowledge often provides an informational foundation for, and is used by indigenous people's institutions and organizations. Indigenous knowledge is seen to be a component of the cultural elements of a society, and the processes of acquiring knowledge involve institutional frameworks and social networks nested across social and geographic scales (Folke 2004). This requires multiple tools for data and information gathering and multiple approaches to information analysis.

Recent ITK studies have focused on the collection of information from elderly members of indigenous communities. In some instances, depending on the purpose of the study, present day hunters/trappers/fishers are interviewed to collect information on the specific location of plants and animals considered important as biologically important to the local ecosystem. This approach is a science-based research approach for data acquisition, and neglects some of the social, economic, cultural and spiritual elements.

It is now widely understood that Traditional Knowledge is greater than the sum of individual experiences, and that traditional knowledge is a significant component of the culture and identity of indigenous peoples (Orcherton 2012). Traditional Knowledge is founded in the collective experiences of a community and is transmitted between individuals and generation in accordance with traditional institutions and practices. It is also understood that a society's culture can evolve as a result changing resource abundance, environmental condition, technological changes and interaction with other cultural groups.

Studies that focus on individual's harvesting experience are founded upon a false assumption that individual resources users can provide a meaningful understanding of the relationship between a "People" and a "Place". Evidence suggests that this is an incomplete approach and that the gathered information will not enhance understanding of the relationship between the Indigenous community and the traditional territory, and does not resolve the issues regarding acceptability of new project development on local indigenous populations. To this end, the United Nations Permanent Forum on Indigenous Issues has hosted several workshops that have examined the process of indigenous input on project development (Mauro and Hardison 2000, Persoon and Minter 2011). Results of these efforts

have substantiated the use of historical and archival research, information gathering through group workshops and discussions with political/traditional leadership.

In Nova Scotia MEK Studies have predominantly dealt with the collection of historical data from archival sources and data on the historical (living memory) and current use of resources. The focus of the knowledge studies has been the geographical region in or near the site of a proposed project. While this process is an effective means to meet the letter of the Mi'kmaq Ecological Knowledge Study (MEKS) protocol which has been adopted by the Assembly of NS Chiefs, it does not meet the intent of the protocol in areas where there may be limited activity or recoverable information on historical activity in a particular area. The principle of the MEKS is to understand the relationship between the Mi'kmaq and the region in which a new project is intended.

2.0 Barrachois MEKS Methodology

The methodology for the MEK study for the Barrachois site consisted of two main exercises. A desktop review of existing data was performed to gather information specific to the site, while consultations with local First Nations groups and individuals enabled the collection of local site-specific knowledge of historical and current Mi'kmaq use of natural resources in the area. Field surveys then confirmed and updated the available knowledge. Each of these exercises is described in further detail in the following subsections.

2.1 Gathering of Local Knowledge of Project Site

2.1.1 Review of Available Data

A noted deficiency in many ecological knowledge surveys has been the absence of any effort to determine the validity of information collected. An informant who is knowledgeable about historical activity or environmental matters is just as concerned about the accuracy of information as any researcher. However, there can be a temptation to embellish the facts to influence the outcome of any development initiative so that the final decisions favour the informant's community (Johannes 1993). Furthermore, since many ecological knowledge studies require payment of an honorarium or fees to the informant, some informants may feel obligated to enhance information to justify earnings for information. Finally, some individuals (who have been referred to as "glory seekers") may wish to gain recognition from outside communities by providing embellished information to researchers from outside the indigenous community (Poulette, Personal Communication, Marshall, Personal Communication). Informants may not intend to compromise the reliability of information compiled in an indigenous knowledge study, but nonetheless, create a need to verify information collected through ground-truthing.

In many regions, indigenous organizations and researchers alike have adopted a process for traditional ecological knowledge data collection that moves away from individual informant interview and brings small groups of community members together in a workshop format. This system enables researchers an opportunity to observe and collect information from a variety of sources (such as youth, elders, women, hunters, community leaders, etc.) during focus group sessions (Persoon and Minter 2011). This process provides a number of benefits:

- Group dynamic provides an opportunity to dampen embellishment of information
- Groups can provide multiple perspectives on past community experience and stories passed down in the community
- Conversation amongst members of the group can trigger old memories
- Groups can provide greater understanding on the "systems" used in the community to pass information between community members and between generations
- Groups can provide insight into resource management decision-making processes in the community.
- Group sessions are more cost and time effective means to conduct surveys.

This workshop format has been widely adopted for ongoing indigenous knowledge studies. The process is used in northern indigenous knowledge study initiatives, such as the Inuit Qaujimajatuquangit (Inuit traditional knowledge) studies being undertaken by the Qikiqtani Inuit Association. Workshop formats for indigenous knowledge research has been recently promoted in UN workshops on Indigenous Knowledge and Intellectual Property Rights, and has been discussed with KMKNO consultants involved with the review of the MEKS Protocol (Francis, Personal Communication).

The approach adapted to the MEKS involving engagement of Mi'kmaq knowledge holders at a community level was through workshops that built upon active social engagement strategies. The focus of this process was the Eskasoni Council. This was due to a number of conditions specific to the project and the community:

- Engagement activities with First Nations should be vetted by the Band Council as a matter of protocol and respect;
- For a relatively small community the Band Council can be an effective representation of a cross section of the community interests;
- The specific project is of general concern to some members of the Band;

2.1.2 Interviews and Meetings with Local Residents

AMEC conducted roundtable discussions in Membertou October 25, November 28 and 29th and March 20th. Meetings were held in Eskasoni on October 24th and April 8th. Follow-up telephone conversations with some participants were undertaken in August, 2013 to verify notes.

Invitations were sent to key informants selected by the local organizers (Band contact). AMEC provided an introduction to the meeting explaining that the purpose of the roundtable session was to discuss Mi'kmaq knowledge and interest (current and historical use) of the project area. It was specifically noted that the MEKS is about the *location*, and not about the *project* proposed for the site.

Maps of the project site and surrounding area were laid out on tables to provide participants with the location and context. All workshops included a meal so that participants could share a meal while discussions about the study area took place. The shared meal facilitated open relaxed discussion.

Participants were not paid an honorarium, since the payment of fees for interviews could be considered as a form of coercion under the principles of free, prior and informed consent, as described by the United Nations Permanent Forum on Indigenous Issues.

The Meetings had limited attendance, in part due to the lack of local concern for the project, and other ongoing, previously unscheduled community events. As a result, AMEC provided opportunity for broader community participation by arranging additional roundtable sessions. Each session was conducted in the same manner.

2.2 Field Survey for General Habitats and Plant Species with Mi'kmaq Cultural Significance

2.2.1 Review of Available Data

The Natural History of Nova Scotia was consulted to provide some background as to the vegetation communities typical of the region encompassing the Hillside- Boularderie Project Site.

2.2.2 Field Survey

A site visit was undertaken to identify and locate potential medicinal plants and other related resources that may be of importance today.

Vegetation surveys were conducted on October 12th, 2012 by AMEC Biologist, Scott Burley and Mi'kmaq Specialist, Norma Brown within the Barrachois Wind Turbine Study Area depicted in Figure 3. Prior to conducting field surveys, the various habitats located within the Study Area were assessed and classified using information gathered during a desktop study (e.g. aerial photography and Nova Scotia Forest inventory database, etc.). Habitat modeling was conducted to identify the potential presence of plant species of significance to Mi'kmaq based on available habitat.

Vegetation surveys focused on plant species identified during the desk top review and consisted of optically controlled meanders through habitat polygons identified to potentially contain plants of significance to Mi'kmaq. General locations of significant plants identified in the field were recorded using a GPS and photographs of the habitats were recorded with a digital camera

2.3 Wildlife Habitat Modeling Exercise

While surveys specifically targeting wildlife species were beyond the scope of this study, a review of the historical use of wildlife and fish resources by Mi'kmaq, combined with known wildlife habitat preferences and the results of the habitat surveys, allowed a determination of wildlife species potentially using the project site. The results of the desktop reviews, field surveys and the public consultation exercises were compiled and a habitat modeling exercise conducted. This exercise consisted to comparing habitat preferences of NS wildlife species with the habitats known to occur on the site, in order to determine the likelihood of each species' presence on the Barrachois Site.

3.0 Project Site Background

3.1 Environmental Context

The Barrachois site lies within the Sydney Coalfields subregion of the Carboniferous Lowlands region of Nova Scotia (Davis and Browne 1996). Terrestrial habitats in this region are by coniferous forests. The topography in this Unit is fairly level. Soils are thin and well-drained throughout much of this region. The bedrock closely approaches the surface and can often be observed as slabby sandstone outcrops. Imperfectly drained silt clay loams occur nearby (across the Little Bras d'Or bay) on Boularderie Island, and some gypsum is present. There is a range of coastal and marine habitats, such as rocky shores, sandy beaches, dune systems, mud flats, salt marshes, and islands, which in turn provide breeding and feeding areas for a range of resident and migratory birds. The marine habitats provide habitat for a wide variety of marine fauna. Human occupation has also led to extensive clear-cutting for forestry and for transmission-line development.

3.2 Historical Context

3.2.1 Traditional Land Use

The Mi'kmaq[1] are the pre-contact inhabitants of the region comprised of Nova Scotia, New Brunswick, Prince Edward Island, the Gaspe region of Quebec, northern Maine and southern Newfoundland. While there are a wide range of estimates of the Mi'kmaq population before initial arrival of Europeans in North America, it is likely that the population at the time of contact was roughly 35,000 (Miller 1976).

The Mi'kmaw territory was divided into seven traditional "districts". Each district had its own independent government and boundaries. The independent governments had a district chief (Keptinaq or Saqmaw) and a council. The council members were band (family groupings or "clans") chiefs, elders, and other worthy community leaders. The district council was charged with performing all the duties of any independent and free government by enacting laws, justice, apportioning fishing and hunting grounds, making war, suing for peace, etc. The seven Mi'kmaq Districts are Kespukwitk, Sikepnékatik, Eskíkekik, Unamákik, Piktuk aqq Epekwitk, Sikniktewaq, and Kespékewaq (see Figure 3-1).

[1] Lnu (plural: Lnu'k) is the self-recognized term for the Míkmaq of New Brunswick, Newfoundland, Nova Scotia, Quebec and Maine, which translated to "human being" or "the people". (http://museum.gov.ns.ca/MiKmaq/)

Figure 3-1: Traditional Mi'kmaq Districts (from http://www.danielnpaul.com/Map-Mi'kmaqTerritory.html)

In addition to the district councils, there was also a Grand Council or Santé Mawiómi. The Grand Council was composed of "keptinaq". There were also Elders, the Putús (Wampum belt readers and historians, who also dealt with the treaties with the non-natives and other Native tribes), the women council, and the Grand Chief (kji'saqmaw). The Grand Chief was a title given to one of the district chiefs.

The local Mi'kmaq communities seasonally moved throughout the region to occupy areas of abundant food and shelter. Much of this travel was along waterways which facilitated transportation and food harvesting. It is therefore likely that the coastal rivers and streams were used during coastal travel as they provided opportunity for harvesting and for inland excursion in search of suitable encampments.

Ancient First Nations people using this area would have lived a migratory life, travelling throughout the Unama'kik district, as noted above. This migratory cycle involved seasonal movement between areas where shelter and food resources were most abundant.

While it is difficult to fully comprehend the undisturbed forests and riverine habitats that existed before colonial influences, it is possible to understand the relationship between landscape and human use activities.

Barrachois site falls within the Unama'kik district which in English means "the Land of Fog". The District is today home to the Mi'kmaq communities of Eskasoni, Potlotek, Waycobah, Wagmatcook and Membertou. Eskasoni is the largest Mi'kmaq community, and is approximately 37 km from the proposed wind farm. Many of residents of Eskasoni were relocated from the territory and placed in the community as part of Canada's "centralization" policies for First Nation members. Wagmatcook, Waycobah and Membertou are also in the same district as the proposed Barrachois project site.

There are other Reserves, such as Malagawatch Island on the lake, with no permanent residency but which are used for traditional seasonal hunting and fishing.

Both archaeology and oral history add to the knowledge of how these ancestors lived in pre-contact times. Dates and time periods were not important to the Mi'kmaq in understanding their history, and many hold the belief that they have occupied the region since it was possible to sustain life. Historically, Mi'kmaq stories, which were passed down through generations from one storyteller to another, describe how the earth came into being and how the animals and the People came to inhabit the region (Lockerby 2004).

Mi'kmaq way of life changed after contact with the French, the first European settlers to this area. Colonial conflicts between France and England during the seventeenth and eighteenth centuries shaped the cultural development of the indigenous population (Thorp 1996), and eventual permanent European settlement would further challenge the survival of Mi'kmaq culture and Mi'kmaq as a people.

On June 24 1610, Grand Chief Membertou (who was from Kespukwitk) converted to Catholicism and was baptized. This relationship with the Europeans changed with the conclusion of European wars and the transfer of Acadia to British control through Treaty. The first treaty of a series of treaties (referred to as the Covenant Chain of Treaties) between the British Crown and the Micmac Nation was signed in 1725. All were treaties were reaffirmed in 1752, and culminated in the Treaty and Royal Proclamation of 1763. The treaties were an exchange of Micmac loyalty for a guarantee that "Micmacs" would be able to continue hunting and fishing in their territory. These treaties have been recognized by the Supreme Court of Canada as legal and binding

Even after the adoption of western religious beliefs, the Mi'kmaq continued to harvest food and resources in accordance with long held spiritual understanding of the relationship between living things referred to as "Netukulimk". While some have argued that the eventual dominance of British colonial rule eroded traditional Mi'kmaq worldviews, there is strong evidence that Mi'kmaq harvests are still governed by Netukulimk principles (Prosper *et al.* 2011).

3.2.2 Traditional Food Resources

Historically, the Mi'kmaq occupying the traditional district of Unama'kik annually migrated between hunting and fishing grounds throughout the district (Chute 1999). These seasonal migrations were heavily dependent upon riverine and coastal transportation. As a result, food resources were heavily biased toward fish and seafood.

In late winter, the Mi'kmaw in Nova Scotia generally moved closer to the marine coast and the river mouths. Such positions allowed them to take advantage of the numerous shallow water coastal fish and shellfish exposed by the melting ice (such as winter flounder and clams) as well as the spring fish run in the rivers. In early spring, smelts and alewife were abundant in the rivers, followed by salmon and sturgeon. Brook trout and striped bass began swimming upstream, followed by white perch and "elvers" or young eels. American plaice appeared off the coast, as did cod, various skate species, whitling or silver hake, and mackerel. Freshwater and marine fish and shellfish species historically utilized by Mi'kmaq in Nova Scotia are listed in Table 3-1.

Table 3-1. Freshwater and Marine Fish and Shellfish Species Traditionally Harvested by Nova Scotia Mi'kmaw.

Common Name	Mi'kmaq Name	Habitat[6]	Uses	Source
American lobster	Wŏlŭmkwĕch'[4]; Chŭgĕch'[4]	Marine, subtidal rocky	Food and	Common

Common Name	Mi'kmaq Name	Habitat[6]	Uses	Source
		areas	commerce	
American Plaice		Marine, subtidal sandy areas		Hoffman 1955
Brook Trout	ADAGWAASOO[2]	Freshwater streams, marine		Hoffman 1955
Clam	Āās[4]; Ā'sŭk[4]; Ŭpkwāāsk[4]; Sebooāās[4]; Boogoonŭmowāās[4], e's [3]	Marine, sand flats	Food and commerce	Common, Hoffman 1955
Cod	Pějoo[1], PEJOO[2]	Marine subtidal	Food	Common, Hoffman 1955
Common Squid[5]	SEDAASOO[2] seta'su[3]	Pelagic	Food	Hoffman 1955
Eel, Elvers	Kat[1], KATEL[2]	Marine, freshwater	Food	Common, Hoffman 1955
Gaspereau	Segoonŭměkw'[4]	Marine, ascends streams to breed in freshwater	Food and bait	Common
Haddock	Poodomkŭněch'[1]	Marine subtidal	Food	Common
Mackerel	Amlaměkw'[4]	Marine pelagic	Food and bait	Common, Hoffman 1955
Northern Crab [5]	NUMJINEGECH[2]	Marine subtidal	Food	Hoffman 1955
Oysters	NUMTUMOO[2] mntmu[3]		Food	Common, Hoffman 1955
Quahog Or Hard Clam	UPKWAASK[2] or BOOGOONUMOWAAS[2]	Marine, subtidal sandy areas	Food and commerce, Utensils	Common
Salmon	Pălămoo[1], PULAMOO[2]	Marine, ascends streams to breed in freshwater	Food, commerce and ceremony	Common, Hoffman 1955
Scallops	SAKSKALAAS[2,] sasqale's[3]	Marine subtidal	Food	Hoffman 1955
Shad	msamu[3]	Marine, ascends streams to breed in freshwater	Food	
Skate (Various Species)	KEGUNALOOECH[2]	Marine subtidal	Food	Hoffman 1955
Smelt	Kákpāsow'[1], KAKPASOW[2] gaqpesaw[3]	Marine, ascends streams to breed in freshwater	Food	Common, Hoffman 1955
Soft Clam	A'SUK [2],	Marine, sand flats	Food	Hoffman 1955
Striped Bass	Chegaoo [1]	Marine, ascends streams to breed in freshwater	Food and commerce	Common, Hoffman 1955
Sturgeon	KOMKUDAMOO[2]	Marine, ascends streams to breed in freshwater	Food	Hoffman 1955
Trout	Adagwaasoo[1] , atoqwa'su[3]	Freshwater, marine	Food	Common, Hoffman 1955
Whelks		Marine subtidal	Food	Hoffman 1955
White Perch		Marine, ascends streams to breed in freshwater	Food	Hoffman 1955
Whitling/ Silver Hake	NAGABETULOW[2]	Marine subtidal	Food	Hoffman 1955

Common Name	Mi'kmaq Name	Habitat[6]	Uses	Source
Winter Flounder	ANAGWAACH[2], anagwe'j[1]	Marine subtidal	Food	Hoffman 1955

[1] Accepted Current Smith-Francis Othography
[2] Phonetic spelling from reference document (Hoffman 1955) (also capitalized)
[3] Listuguj spelling
[4] Marshall spelling
[5] Unclear what species this refers to. See discussion in text.
[6] Habitat reference for fishes are from Scott and Scott (1988), while marine invertebrate references are from Peterson and Gosner (1999).

In later spring and summer, as the ice retreated and the water warmed, Mi'kmaq in coastal NS could also harvest whelks, scallops, quahogs or hard clams, soft clams, "common "squid, American lobster, and "northern crab (Note that it is unclear which species are intended when Hoffman refers to 'Common Squid' and 'Northern Crab', as these are not accepted common names of any species in Nova Scotia today. The squid is presumably the Northern Shortfin Squid (*Illex illecebrosus*), while the crab may be Jonah or Rock Crab (*Cancer borealis or C. irroratus*), or Snow Crab (*Chionoecetes opilio).* "

Mi'kmaq residing around the Bras d'Or Lakes and southern shore of Gulf of St. Lawrence could also harvest oysters, a species which, in the Maritimes, occurs only in these relatively warm waters (Peterson and Gosner 1999).

In addition to this abundance of fish, spring was also a time when migratory birds returned and began nesting, providing plenty of fresh meat and eggs. Hoffman (1955) provided a list of bird species traditionally harvested by Mi'kmaw in Nova Scotia (Table 3-2).

Table 3-2. Bird Species Reported as Traditionally Harvested by Nova Scotia Mi'kmaq (Hoffman 1955) with Habitat Information

Mi'kmaq Name	Common Name	Species Name	Habitat (Tufts 1986)	Season
	Pied-billed Grebe	*Podilymbus podiceps*	Shallow freshwater ponds	Fall migrant
	Semipalmated Plover	*Charadrius semipalmatus*	Marine coastal flats, shores	Fall migrant
	Black-bellied Plover	*Pluvialis squatarola*	Marine coastal flats, shores	Fall migrant
	American Golden Plover	*Pluvialis dominica*	Marine coastal flats	Fall migrant
	Hudsonian Whimbrel /Hudsonian Curlew	*Numenius phaeopus hudsonicus*	Marine coastal flats, wetlands	Fall migrant
	Eskimo Curlew	*Numenius borealis*	Marine coastal flats, wetlands	Fall migrant
	Willet	*Catoptrophorus semipalmatus*	Marine coast, wetlands, shores	Fall migrant
	Lesser Yellowlegs	*Tringa flavipes*	Marine coastal flats, wetlands, shores	Fall migrant
	Red Knot	*Calidrus canutus*	Marine coastal flats, shores	Fall migrant
	Long-billed Dowitcher	*Limnodromus scolopaceus*	Marine coast, wetlands	Fall migrant
	Passenger Pigeon	*Ectopistos migratorius*	Forested habitats	Fall migrant
	Yellow Rail	*Coturnicops noveboracensis*	Freshwater wetlands	Fall migrant

Mi'kmaq Name	Common Name	Species Name	Habitat (Tufts 1986)	Season
	Black-crowned Night Heron	*Nycticorax nycticorax*	Coastal marshes	Fall migrant
	Canada Goose[1]	*Branta canadensis*	Freshwater lakes	Fall migrant
Apchechk	Mallard	*Anas platyrhnchos*	Freshwater lakes	Fall migrant
	American Wigeon (Baldpate)	*Anas americana*	Marine coast, freshwater lakes	Fall migrant
Apchechk	Common Goldeneye	*Bucephala islandica*	Shallow coastal bays and inlets	Fall migrant
	Green-winged Teal	*Anas crecca*	Freshwater lakes	Fall migrant
	Bufflehead	*Bucephala albeola*	Marine coast, freshwater lakes	Fall migrant
	Mourning Dove	*Zenaidura macroura*	Fields, forests	Fall migrant
	Lesser Scaup	*Aythya affinis*	Marine coast	Fall migrant
	Northern Gannet	*Morus bassana*	Marine coast	Spring & Fall migrant[1]
	American Black Duck	*Anas rubripes*	Marine coast, freshwater lakes	Resident
	Red-Breasted Merganser	*Mergus serrator*	Marine coast, freshwater lakes	Resident
Nabaoo	Ruffed Grouse	*Bonasa umbellus*	Forests	Resident
Nabaoo	Spruce Grouse	*Dendragapus canadensis*	Forests	Resident
	Great Black-backed Gull	*Larus marinus*	Marine coast	Resident
	Herring Gull	*Larus argentatus*	Marine coast	Resident
	Common Murre	*Uria aalge*	Marine coast	Resident
	Atlantic Puffin	*Fractercula arctica*	Marine coast	Resident
	Great Horned Owl	*Buba virginianus*	Forests	Resident
	Barred Owl	*Strix varia*	Forests	Resident
	Common Loon	*Gavia immer*	Marine coast in winter, freshwater lakes in summer	Spring migrant
	Great Blue Heron	*Ardea herodias*	Edges of shallow water bodies, generally nest in trees	Spring migrant
	American Bittern	*Botaurus lentiginosus*	Freshwater wetlands	Spring migrant
Senŭmkw'	Canada Goose[4] (eggs also important in spring)	*Branta canadensis*	Freshwater ponds and lakes	Spring migrant
	Brant	*Branta bernicla*	Freshwater ponds and lakes	Spring migrant
	White-winged Scoter	*Melanitta fusca*	Marine coast	Spring migrant
	Black Scoter ("American Scoter")	*Melanitta americana*	Marine coast	Winter resident[3]
	Osprey	*Pandion haliaetus*	Forested areas close to water bodies	Spring migrant
	American Woodcock	*Philohela minor*	Wooded swamps, forests,	Spring migrant

Mi'kmaq Name	Common Name	Species Name	Habitat (Tufts 1986)	Season
			fields	
	Wilson's Snipe	*Gallinago delicata*	Fields, freshwater wetlands	Spring migrant
	Razorbill (" Razor Billed Auk")	*Alca torda*	Marine coast	Spring migrant
	Black Guillemot	*Uria lomvia*	Marine coast	Winter resident[2]

[1] Note Hoffman listed this as a Resident species

[2] Note Hoffman listed this as a Fall migrant

[3]Note Hoffman listed this as a Spring migrant

[4] The Canada Goose is the "bustard" often mentioned by European writers in old literature as being an important food species for the Mi'kmaq in NS. (True bustards are large Old World game birds).

A more recent report by Benoit (2007) summarized waterfowl species recently hunted by Mi'kmaq in mainland NS. While the Benoit report does not provide data on waterfowl species hunted on Cape Breton Island, it is likely that a similar suite of species are targeted by First Nation hunters on Cape Breton Island, as the species assemblage present on the Island there does not differ significantly from that occurring in mainland Nova Scotia.

Species mentioned by Benoit (2007) are listed in Table 3-3 and are presumably all species traditionally hunted by Mi'kmaq people. Most of these species utilize both freshwater and marine habitats throughout the year, while others, such as eider and scoter species occur primarily in marine coastal areas. Snipe and pin-tailed ducks occur primarily in freshwater environments, while woodcock are found in forested areas, often treed wetlands. All of these species, with the exception of the Barrow's Goldeneye, are relatively common in suitable habitats throughout NS during the appropriate season. Barrow's Goldeneye in NS belongs to the eastern population, which is currently listed as SARA special concern and are quite rare in NS. It is unlikely to occur in the vicinity of the Barrachois site.

Table 3-3: Waterfowl[1] Species Harvested by First Nations Hunters in NS in 2003 and 2004 (Benoit 2007), along with general habitats and seasons of occurrence.

Species	Season of Occurrence
Barrow's Goldeneye	Winter
Common Goldeneye	Winter
Red-Breasted Merganser	Summer
Common Merganser	Summer
Hooded Merganser	Summer
Greater Scaup	Winter
Lesser Scaup	Winter
Black Scoter	Winter
White Winged Scoter	Winter
Surf Scoter	Winter
Common Eider	Year round (mainland NS)
King Eider	Winter
Canada Goose	Year round
Long-Tailed Duck	Winter
Northern Pintail	Summer
Wilson's Snipe	Summer
Mallard	Year round
American Woodcock	Summer
Black Duck	Year round
Blue-winged Teal	Summer

[1]While Wilsons' Snipe and American Woodcock are not strictly waterfowl, they were treated as such in the Benoit (2007) report

Waterfowl species not mentioned specifically by Benoit which are likely also hunted by First Nations in NS included Blue-winged Teal and Ring-Necked Duck.

Other, non-waterfowl species are hunted in NS by First Nations hunters. Grouse (both Ruffed and Spruce) have traditionally been targeted species, and are presumably still hunted by First Nations hunters in the areas encompassing the Project Site. Ring-necked pheasant, an introduced species which now occurs through most if not all of NS, may also currently be targeted by First Nation hunters. Other bird species not typically hunted today may have been used as a traditional food source, especially in lean times.

In addition to fish, invertebrate, and bird species, the marine coast in summer also provided the Mi'kmaq with various marine mammal species which provided meat, oil, and hides. Throughout Nova Scotia, Mi'kmaq people harvested dolphins, belugas ("white whales"), long-finned pilot whales ("common blackfish"), Atlantic walrus, and harbour seals (Table 3-4).

Table 3-4. Mammal Species Traditionally Harvested by Mi'kmaq in Nova Scotia (Sources: Hoffman 1955, Wallis and Wallis 1955, Speck 1917)

Common Name	Mi'kmaq Name	Habitat [1]	Uses
Moose	Team' , tia'm	Forested areas, wetlands	Food
Deer	Lŭntook', lentug	Edges of forested areas, thickets	Food
Black Bear	Mooin	Forested areas	Food, spiritual
Hare	Able'gŭmocch	Forested areas	Food
Porcupine	Năbegŏk, matues	Forested areas	Food, cultural industry
Beaver	Kobet, gopit	Water bodies and wetlands adjacent to forested areas	Food and pelts
Groundhog/Woodchuck	mulumgwej	Fields, open areas adjacent to forests	Food and pelts
Caribou			Food and pelts
Mink	jiagewj	Coasts	Pelts
Otter	giwnig	Rivers and lakes, coasts	Food and pelts
Whale	Năbeák'	Oceans	Food and oil
Dolphins		Oceans	Food and oil
Porpoise	Năbeák'	Oceans	Food and oil
Beluga /White Whale		Oceans	Food and oil
Pilot Whale/ Common Blackfish		Oceans	Food and oil
Atlantic walrus		Oceans	Food
Harbor Seal		Oceans	Food and oil, skins
Muskrat		Freshwater ponds, wetlands	Skins
Squirrel		Forested areas	Food

The arrival of spring also meant that new plant growth, such as fiddleheads and other greens, was increasingly available to harvest. As the growing season progressed, wild fruits and other edible plant parts became available. Many foods were eaten fresh, while others which were more plentiful, such as blueberries, were dried and preserved for the leaner winter months. Edible wild plants traditionally consumed by Mi'kmaq people in Nova Scotia are listed in Table 3-5.

In the late summer and fall, the southward migrations brought many more bird species to Nova Scotia which could be harvested (**Table 3-2**). Around the middle of September, Mi'kmaq withdrew from the coast, moving inland where they began to harvest the eels now migrating downstream. In October and

November , they began hunting moose and beavers, as well as bear, otter, muskrat, and caribou (Table 3-4). They fished the salmon which were now returning downstream after spawning. In December, they fished tomcod, which spawn under the ice at that time. In January, seals were hunted as they came ashore on certain islands or areas of the coast to give birth. In February and March, the hunt for beavers, otters, moose, bears, and caribou continued. As the winter waned, the people moved closer to the coast again and the annual cycle was renewed.

Table 3-5. Native Plant Species Traditionally Consumed by Nova Scotia Mi'kmaq.

Mi'kmaq Name	Common Name	Scientific Name	Habitat[1, 2]	Mi'kmaq Traditional Use	Source
Stoqn	Balsam Fir	*Abies balsamea*	Various	Bark used for beverage and medicine	Speck and Dexter 1951, Lacey 1977
Mimkutaqo'q	Striped maple/ moosewood	*Acer pensylvanicum*	Rocky woods, rich deciduous forests, wooded slopes and along streams	Bark used for tea	Speck and Dexter 1951, 1952, Lacey 1977, Wallis and Wallis 1955
Snawey	Sugar maple	*Acer saccharum*	Well-drained soils	Sap boiled into syrup, and a beverage tea was made from the bark and twigs, Used as cooking broth	Speck and Dexter 1951, Stoddard 1962
kiw'eswa'skul	Sweetflag[3]	*Acorus americana*	Wet places and the borders of quiet streams. marshes, the edges of ponds and wet meadows. Coastal marshes just above high tides.	Rootstocks used to make a beverage and medicinal tea. Tubers eaten raw, or more commonly boiled or roasted	Yanovsky 1936, Speck and Dexter 1951, Wallis and Wallis 1955, Lacey 1977
	Wild leek	*Allium tricoccum*	Rich deciduous forests and intervales	Bulbs, fresh and dried	Speck and Dexter 1952 Stoddard 1962
	Groundnut	*Apios americana*	Thickets and along rivers in alluvial soils	Groundnuts used	Speck and Dexter 1951
Wopapa'kjukal	Wild Sarsaparilla	*Aralia nudicaulis*	Dry woodlands and old forests	Used to make a beverage.	Speck and Dexter 1951
Kinnickick	Bearberry	*Arctostaphylos uva-ursi*	Sandy or gravelly soils	Berries eaten	Speck and Dexter 1951, 1952
	Common Milkweed	*Asclepias syriaca*	Light soils	The young shoots, stems, flower buds, immature fruits, and even the roots were boiled and eaten as a vegetable The Mi'kmaq cooked the young pods and flowers with meat	Stoddard 1962
Nimnoqn	Yellow Birch	*Betula alleghaniensis*	Various	Drank sap, rendered it into syrup and sugar, made tea from the twigs	Waugh 1916, Stoddard 1962, Lacey 1977.
	Lambsquarters, Pigweed or Goosefoot	*Chenopodium album* and closely related species	A weed of cultivated and waste ground	Leaves and plants eaten as green, edible greens and seeds. The young plants were cooked as a	Speck and Dexter 1951, 1952

Mi'kmaq Name	Common Name	Scientific Name	Habitat[1, 2]	Mi'kmaq Traditional Use	Source
				potherb	
Wjkulje'manaqsi	Red Osier Dogwood/ Red Willow	*Cornus sericea ssp. sericea*	The edges of intervales, brook sides, wet meadows, and ditches along roadsides. Most common in rich, alkaline soils	Mi'kmaq people made a tea from the bark of dogwood probably this species.	Wallis and Wallis 1955
Malipqwanj	Beaked Hazelnut	*Corylus cornuta*	Dry and open woods. Sometimes ine climax forests, scattered along roadside thickets, along edges of fields and along margins of woods.	Nuts used	Speck and Dexter 1951, 1952, Stoddard 1962
KAWIKSA'QOAQSI	thornapple, hawthorn	*Crataegus spp.*	Various, depending on species	Fruit used fresh and to make beverage	Rousseau 1945, Speck and Dexter 1951, 1952, Black 1980, Speck and Dexter 1951, 1952, Adney 1944
	Trout lily/ Dogtooth violet	*Erythronium americanum* (presumably)	Upland woods of beech and maple, and along the edges of intervales	Bulbs eaten raw, boiled, or baked in the hot ashes of a fire	Stoddard 1962
	American Beech	*Fagus grandifolia*	Fertile uplands, rarely in swamps	Nuts used	Speck and Dexter 1951, 1952
Atuomkminaqsi	Virginia and Woodland Strawberries	*Fragaria virginiana , F. vesca*	Old fields and road sides	Berries used fresh or preserved, or made into beverage	Speck and Dexter 1951, 1952, Adney 1944, Rousseau 1945
	Red Ash	*Fraxinus pennsylvanica*	Near lakes or ponds, or in other low-lying areas	Sap of ash was added to maple and yellow birch sap	Stoddard 1962
Ka'qaju'mannaqsi	Wintergreen, Teaberry, or Checkerberry	*Gaultheria procumbens*	Woods, barrens, pastures	Berries eaten , Mi'kmaq were said to make juice from the berries	Stoddard 1962, Speck and Dexter 1952, Lacey 1977
	Huckleberry	*Gaylussacia sp.*	Barrens and bogs	Berries eaten	Waugh 1916, Speck and Dexter 1951, 1952
	Witch-hazel	*Hamamelis virginiana*	Rocky woods or near cliffs where there is underground water	A decoction of this plant, sweetened with maple sugar, was used as a tea. Also ate the "nuts". Twigs used for beverage	Waugh 1916, Stoddard 1962, Lacey 1977
	Jerusalem Artichoke	*Helianthus tuberosus*	Waste ground, intervales, rich soils	Tubers eaten.	Speck and Dexter 1951
	Butternut	*Juglans cinerea*	NOT IN NS	Nuts used	Speck and Dexter 1951
Kini'skweji'jik	Low Bush (Common	*Juniperus communis*	Sandy areas, old pastures, heaths and bogs	Boughs, with or without the fruits, were used to	Wallis and Wallis 1955,

Mi'kmaq Name	Common Name	Scientific Name	Habitat[1, 2]	Mi'kmaq Traditional Use	Source
	Juniper)			make a beverage tea	Lacey 1977
Alawey	Beach pea	*Lathyrus maritimus*	Coastal, along the strand line, mostly in beach gravel. Occasionally a considerable distance from shore	Pea used	Speck and Dexter 1951, 1952
Ma'susi'l	Ostrich Fern	*Matteuccia struthiopteris*	Rich, moist soils, often on floodplains. Occasionally in low-lying areas and swamp borders. Often in pure stands	The young vegetative shoots, or "fiddleheads," and sometimes the entire crown, were traditionally eaten, boiled or roasted, as a spring vegetable	
	Partridge Berry	*Mitchella repens*	Moist places, forest ground cover	Berries were eaten fresh or preserved. Used the plant for a beverage tea	Speck 1917, Speck and Dexter 1951, 1952,
Kawatkw	White Spruce (Cat Spruce)	*Picea glauca*	Old fields and along the coast	Bark used for beverage and medicine	Speck and Dexter 1951, Wallis and Wallis 1955, Stoddard 1962, Lacey 1977
Kawatkw	Black Spruce (Bog Spruce)	*Picea mariana*	Bogs, swamps and poorly drained areas	The bark of black spruce was used to make a beverage or medicinal tea by the Mi'kmaq of the Maritimes	Speck and Dexter 1951, Wallis and Wallis 1955, Lacey 1977
	Eastern White Pine	*Pinus strobus*	Bogs, swamps and poorly drained areas	Bark used for beverage, Inner bark grated and eaten	Speck and Dexter 1951 , Wallis and Wallis 1955, Lacey 1977
	American plum	*Prunus americana*	Does not occur in NS, suspected to be received in trade from outside region (Leonard 1996)	Fruit and beverage	Speck and Dexter 1951,1952, Leonard 1996
	Wild cherries	*Prunus spp.*	Thickets, clearings and open woods	Boiled cherry twigs and bark for tea	Stoddard 1962, Lacey 1977, Speck and Dexter 1951, 1952, Adney 1944
	Oak	*Quercus sp.*	In light or well drained soils and granitic areas	Nuts used	Speck and Dexter 1951, 1952
	Handsome Harry/ Meadow Beauty	*Rhexia virginica*	Peaty lake margins and swales or wet thickets	Leaves were steeped to produce a sour drink	Speck 1917, Lacey 1977
Apuistekie'ji'jit	Labrador Tea	*Rhododenrdon (syn. Ledum) groenlandicum*	Bogs, wooded swamps, wet barrens, and poorly-drained clearings and pastures	The leaves, and sometimes the whole leafy twigs and flowers, of both species were used, fresh or dried, for tea	Speck 1917, Speck and Dexter 1951,1952, Wallis and Wallis 1955, Stoddard 1962,

Mi'kmaq Name	Common Name	Scientific Name	Habitat[1, 2]	Mi'kmaq Traditional Use	Source
					Lacey 1977
	Wild Black Currant	*Ribes americanum*	Fertile thickets and slopes	Berries eaten fresh or dried and preserved	Speck and Dexter 1951, 1952
	Wild gooseberry/ currant	*Ribes spp.*	Various, depending on species	Fruit	Speck and Dexter 1951, 1952
Ajioqjominaqsi	Canada blackberry	*Rubus canadensis*	Clearing, thickets, and the edges of woods.	Berries used fresh or preserved, made into beverage	Waugh 1916, Gilmore 1933, Speck and Dexter 1951, 1952, Arnason et al. 1981
Klitawmanaqsi'k	Red Raspberry	*Rubus idaeus*	Roadsides, deforested land, talus slopes, and rocky ground	Berries used fresh or dried, juice made from berries	Speck and Dexter 1951, 1952, Stoddard 1962
	Blackberry	*Rubus sp.*	Various, depending on species	Fruit & beverage	Speck and Dexter 1951, 1952
Pukulu'skwimanaqsi'l	European Elder	*Sambucus nigra*	Rich soil, open woods, around old fields and along brooks. On damp ground or wet floodplains	Berries were eaten fresh or dried for winter storage	Speck and Dexter 1951, 1952, Stoddard 1962
Pukulu'skwimanaqsi'l	Red Elderberry	*Sambucus racemosa*	Meadows, wet places, rocky hillsides and along streams. In rich soils	The juicy, tart berries were eaten fresh or dried for winter storage	Speck and Dexter 1951, 1952
	Common Dandelion	*Taraxacum officinale*	An aggressive weed in lawns, pastures, and even cultivated soil.	Young leaves eaten raw or cooked	Rousseau 1945, Speck and Dexter 1951, 1952
	Canada Yew	*Taxus canadensis*	Cool damp woods, ravines, climax coniferous forest, and wooded swamps.	Twigs made into beverage	Lacey 1977
	Eastern Hemlock	*Tsuga canadensis*	Lakesides and swamps or old pastures, northern slopes or ravines	The inner bark of was grated and eaten by the Mi'kmaq of the Maritimes, and the bark was also used as a beverage and medicinal tea	Speck and Dexter 1951, Wallis and Wallis 1955, Stoddard 1962, Lacey 1977
	Blueberries, bilberries,cranberries	*Vaccinium spp.*	Various, depending on species	Berries used fresh or dried and also the Mi'kmaq made juice from blueberries and bilberries for drinking, but did not state which species were involved.	Speck and Dexter 195 1,1952, Adney 1944, Lacey 1977
	Large -fruited Cranberry	*Vaccinum macrocarpon*	Bogs	Berries eaten fresh	Waugh 1916, , Speck and

Mi'kmaq Name	Common Name	Scientific Name	Habitat[1, 2]	Mi'kmaq Traditional Use	Source
					Dexter 1951,1952, Stoddard 1962, Black 1980
Poqomannaqsi	Foxberry (Mountain Cranberry)	*Vaccinum. vitis-idaea*	Cooler regions, such as exposed, coastal headlands and barrens	Berries	
Nipanmaqsi'l	Highbush Cranberry	*Viburnum opulus*	Swamps and along streams	Berries used fresh or in preserve	Speck and Dexter 1951, 1952

[1] Zinck 1998, Hinds 2000

[3] Many references mention Calamus or Sweetflag, *A. calamus*, which does not occur in the Maritime provinces. The species present in this region is actually *A. americana*.

3.2.3 Traditional Medicines

A use of traditional lands that continues throughout Canada, and in particular, Mi'kmaq territory, is the collection and harvest of medicinal plants. Often overlooked in these times of over-the-counter medicines, Aboriginal peoples had developed an in-depth and intimate knowledge of various local plants and how they could be used for sustenance and, in some instances, to cure ailments. This knowledge, which formed part of the spiritual understanding of the balance between people and the local environment, continues to be informally passed on from generation to generation in aboriginal communities, often as guarded family secrets that provide position within the community. It is estimated that 70-80% of people worldwide rely on traditional herbal medicines to meet their primary health care needs (WHO 2002, Farnsworth 1991).

In Canada, traditional medicines still provide an increasingly important source of income for rural and aboriginal communities (Uprety, 2012). Many Mi'kmaq elders continue to harvest and prepare traditional medicines and provide them to friends and relatives to treat common health conditions (Prosper, personal communication), however, it has been noted that harvesting areas are becoming increasing limited due to continuous development that alters the natural ecosystem (Meuse, Personal Communication).

Due in part to the long history of territorial occupation by immigrant populations, the Mi'kmaq are one of the most studied people for the use and nature of their traditional medicines (Speck 1917, Wallis and Wallis 1955), and several guide books have been published on the subject.

Table 3-6. Native Plant Species Traditionally Used for Medicinal Purposes by Nova Scotia Mi'kmaq.

Mi'kmaq Name	Common Name	Scientific Name	Habitat[1, 2]	Mi'kmaq Traditional Medicinal Use	Sources
Stoqn	Balsam Fir	*Abies balsamea*	Various	• Buds, cones and inner bark used to treat diarrhea • Gum used to make dressing to treat burns • Gum used as cold remedy • Cones used to treat colic • Gum and sap used to treat bruises, sores, and wounds • Buds used as a laxative. • Gum used to treat fractures. • Inner bark boiled and used to treat sores and swelling • Used to prevent colds and influenza. • Tea from cones and tops used to relieve colic, asthma and tuberculosis • Sap used to treat stomach ulcers • Bark used to treat gonorrhoea	Chandler *et al.* (1979) Wallis (1922) Lacey (1993)
Mimkutaqo'q	Striped maple/ moosewood	*Acer pensylvanicum*	Rocky woods, rich deciduous forests, wooded slopes and along streams	• Wood used to treat "spitting blood" • Bark used to treat colds and coughs • Wood used to treat kidney trouble. • Bark used to treat "grippe." • Unspecified plant parts used to treat "trouble with the limbs" • Wood used to treat gonorrhoea	Chandler *et al.* (1979) Wallis (1922)
	Maple	*Acer sp.*	Various, depending on species	• Bark used externally to treat cold and congestion, as well as swollen limbs.	Lacey (1993)
	Mountain Maple	*Acer spicatum*	Characteristic of high slopes, ravines, along streams in wet thickets and moist forest openings, infrequent in dense woods	• Bark used to treat sore eyes.	Chandler *et al.* (1979)
	Common Yarrow	*Achillea millefolium*	Disturbed areas, old fields, meadows, roadsides and sandy shores. Acidic soils	• Tea from plant used to treat fevers. • Plant pulverized and used externally on bruises, sprains and swellings • Dried, powdered bark or green leaves rubbed over swellings, bruises, and sprains • Herb used to treat colds. • Decoction of plant taken with milk to cause a sweat to treat colds.	Lacey (1993) Wallis (1922) Chandler *et al.* (1979)
kiw'eswa'skul	Sweetflag	*Acorus americana*	Wet places and the borders of quiet streams, marshes, the edges of ponds and wet meadows. Coastal marshes just above high tides. Always in open sunlight and often mixed with cattails	• Root used to treat colds. • Root used to treat coughs. • Root used to treat cholera, smallpox and other epidemics. • Plant (root and herb) used as a panacea. • Root used to treat lung ailments, pneumonia and pleurisy. • Root was placed in water and steamed in the house to prevent illness. • Root was chewed to relieve indigestion and stomach cramps. • Roots chewed to treat 'medicinal use'	Speck (1917) Chandler *et al.* (1979) Lacey (1993) Speck and Dexter (1951)
	Northern Maidenhair Fern	*Adiantum pedatum*	In fertile or quite alkaline soils. Under oak-birch-sugar maples-elm trees , on intervales	• Herb used to treat fits and taken as an "agreeable decoction."	Chandler *et al.* (1979)
	Witch Grass	*Agrostis hyemalis*	Disturbed areas, along roadsides, lakeshores, and headlands	• Used as a general tonic to tune-up the body	Lacey (1993)
Tupsi	Speckled Alder	*Alnus incana*	Low ground in alluvial soils	• Bark used to treat ulcerated mouth.	Chandler *et al.* (1979)

Mi'kmaq Name	Common Name	Scientific Name	Habitat[1, 2]	Mi'kmaq Traditional Medicinal Use	Sources
Tupsi	Alder	*Alnus sp*	Low ground in alluvial soils	• Bark used to treat bleeding • Bark used to treat hemorrhage of lungs • Bark used to treat fever • Bark used to treat dislocations and fractures • Bark used to treat diphtheria • Bark used as painkiller to treat cramps • Bark used to treat retching. • Bark used to treat rheumatism. • Bark used as a physic. • Bark used to treat wounds. • Bark and leaves used to treat fevers and festers. • Tea from bark used to treat neuralgic pain. • Bark and leaves used externally to treat festering wounds	Chandler *et al.* (1979) Lacey (1993)
	Woodland Angelica	*Angelica sylvestris*	Spreading out along roadsides and in fields, An aggressive weed where found- an introduced species	• Infusion of roots and spikenard roots used to treat head colds. • Infusion of roots and spikenard roots used to treat coughs. • Infusion of roots and spikenard roots used to treat sore throats.	Mechling (1959) Chandler *et al.* (1979)
	Everlasting	*Antennaria sp or Anaphalis sp*	Pastures, old fields, roadsides, borders of woods	• Smoked, used spiritually	Lacey (1993)
	Indian Hemp	*Apocynum cannabinum*	Open ground, thickets and borders of woods	• Tea was used to kill and expel worms	Lacey (1993) Chandler *et al.* (1979)
Wopapa'kjukal	Wild Sarsaparilla	*Aralia nudicaulis*	Dry woodlands and old forests	• Used externally to treat wounds. • Root can be used to treat colds, coughs, and flu.	Lacey (1993) Chandler *et al.* (1979)
	American Spikenard	*Aralia racemos*	Rich or calcareous wooded slopes and deciduous forests. Usually as solitary plants	• Root used to treat headaches and female pains. • Root used to treat spitting blood. • Infusion of roots and angelica roots used to treat head colds. • Roots used to treat wounds • Infusion of roots and angelica roots used to treat coughs. • Roots used to treat sore eyes • Root used to treat kidney troubles. • Root used to treat fatigue. • Root used to treat consumption Tuberculosis. • Root used to treat gonorrhoea.	Chandler *et al.* (1979) Lacey (1977) Wallis (1922) Mechling (1959)
	Lesser Burrdock	*Arctium minus*	Disturbed soils	• Tea from roots were used to treat and purify blood • Roots used to treat boils and abscesses.	Lacey (1993) Chandler *et al.* (1979)
Kinnickick	Bearberry	*Arctostaphylos uva-ursi*	Sandy or gravelly soils	• Tea from leaves and berries used as a general tonic, with antiseptic effects on the urinary passage	Lacey (1993)
	Indian turnip, Jack-in-the Pulpit	*Arisaema triphyllum*	Common in wet woods, mucky areas and in alluvial soils	• Slices of the dried bulb were taken internally to treat tuberculosis and other chest complaints • Dried bulb used to treat general stomach problems • Parts of plant used to treat boils and abscesses. • Parts of plant used as a liniment used to treat external use.	Lacey (1993) Lacey (1977) Chandler *et al.* (1979)
	Horse Radish	*Armoracia rusticana*	Old gardens	• Tea of root used as a stomach medicine and to promote an appetite	Lacey (1993)
	Common Milkweed	*Asclepias syriaca*	Light soils	• White juice from this plant used to ease the rash caused from poison ivy	Lacey (1993)
	Common Barberry	*Berberis vulgaris*	Thickets, pastures and fencerows	• Bark and root used to treat ulcerated gums. • Bark and root used to treat sore throat.	Chandler *et al.* (1979)
Nimnoqn	Yellow Birch	*Betula alleghaniensis*	Various	• Wood used as a hot-water bottle. • Bark used to treat rheumatism • Bark is also chewed for nourishment • Tea from bark used to relieve indigestion , treat stomach cramps and diarrhoea	Chandler *et al.* (1979) Lacey (1993) Lacey (1977)
	Gray Birch	*Betula populifolia*	On light soils, in pastures, burnt-over land, and barrens	• Inner bark used to treat infected cuts. • Inner bark used as an emetic.	Chandler *et al.* (1979)

Mi'kmaq Name	Common Name	Scientific Name	Habitat[1, 2]	Mi'kmaq Traditional Medicinal Use	Sources
Kaju	Crinkleroot/ toothwort	*Cardamine diphylla*	Moist, rich soil along brooks and in low-lying , wet, or rocky woods, both mixed and deciduous	• Root used as a sedative. • Root used to clear the throat and to treat hoarseness. • Root used as a tonic.	Chandler *et al.* (1979)
	White Turtlehead	*Chelone glabra*	Swamps, wet roadsides, meadows, along rocky streams and estuarine rivers above the influence of salt water	• Herb used to prevent pregnancy.	Chandler *et al.* (1979)
	Pipsissewa/ prince's pine	*Chimaphila umbellata*	Dry soils sometimes in spruce or fir woods	• Used to treat consumption/ tuberculosis • Used as stomach medicine • Herb used to treat rheumatism. • Herb used as a blood purifier. • Herb used to treat blisters. • Herb used to treat stomach trouble. • Herb used to treat kidney trouble and pains • Herb used to treat smallpox. • Infusion of roots, hemlock, parsley and curled dock used to treat "colds in the bladder".	Lacey (1977) Rousseau (1948) Chandler *et al.* (1979) Mechling (1959) Lacey (1993)
	Yellow Clintonia/Bride's Bonnet	*Clintonia borealis*	Deciduous to mixed woods	• Root juice taken with water to treat "gravel" (kidney stones)	Speck (1917)
	Sweetfern	*Comptonia peregrina*	Open, sandy or barren soils	• Used to treat rheumatism and external sores • Root used to treat headache and inflammation. • Leaves used to treat sprains, swellings, poison ivy, and inflammation. • Leaves used to treat catarrh • Berries, bark and leaves used as an "exhilarant" and beverage.	Lacey (1993) Chandler *et al.* (1979)
	Chinese Hemlock parsley	*Conioselinum chinense*	Swamps, mossy coniferous woods or swales and seepy slopes near the coast	• Infusion of roots, hemlock, prince's pine, and curled dock used to treat colds in the bladder.	Mechling (1959)
Wisawtaqji'jkl	Goldthread	*Coptis trifolia*	Coniferous forests, swamps, hummocks on bogs, and roadside banks	• Herb used to treat sore or chapped lips and mouth ulcers. • Roots used to treat sore eyes, • Roots used to treat stomach medicine • Roots chewed to treat unspecified medicinal use. • Used to promote an appetite	Chandler *et al.* (1979) Lacey (1977) Speck and Dexter (1951) Lacey (1993)
Wso'qmanaqsi'l	Bunchberry/ Dwarf Dogwood	*Cornus canadensis*	Various	• Leaf tea used to treat bed wetting and kidney ailments • Berries, roots and leaves used to treat seizures • Used to treat kidney ailments. • Used to treat stomach problems • Leaves were applied to wounds to stop bleeding and promote healing	Lacey (1977) Chandler *et al.* (1979) Lacey (1993)
Wjkulje'manaqsi	Red Osier Dogwood/ Red Willow	*Cornus sericea ssp. sericea*	The edges of intervales, brook sides, wet meadows, and ditches along roadsides. Most common in rich, alkaline soils	• Herb used to treat headache. • Herb used to treat sore eyes. • Herb used to treat catarrh. • Herb used to treat sore throat.	Chandler *et al.* (1979)
	Dogwood	*Cornus sp.*	Various	• Smoke used spiritually with parts of other plants such as willows	Lacey (1993)
	Pink Lady's Slipper	*Cypripedium acaule*	Acid soil in dry or wet woods; open areas	• Tea of roots used to treat nervousness. • Tea of roots used treat tuberculosis	Chandler *et al.* (1979) Lacey (1993)
	Queen Anne's Lace, Wild Carrot	*Daucus carota*	Hayfields and along roadsides	• Leaves used as a purgative.	Chandler *et al.* (1979) Wallis (1922)
	Moosewood, Leatherwood	*Dirca palusiris*	Rich deciduous or mixed woods	• Colds, coughs, influenza , bark tea	Wallis (1922)
	Common Boneset	*Eupatorium perfoliatum*	Wet shores, meadows, the edge of swamps and bogs, along ditches and streams	• Used to treat stomach ulcers, • Used to treat colds • Used to treat arthritic pain • Used to treat kidney trouble. • Used to treat spitting blood • Used to treat gonorrhoea.	Lacey (1993) Chandler *et al.* (1979)
	American Beech	*Fagus grandifolia*	Fertile uplands, rarely in swamps Dry forest ridges and hilltops, scattered elsewhere	• Leaves used to treat chancre. • Tea from leaves used to treat tuberculosis and other chest ailments. • Leaves used to sooth nerves and stomach.	Chandler *et al.* (1979) Lacey (1993)

Mi'kmaq Name	Common Name	Scientific Name	Habitat[1, 2]	Mi'kmaq Traditional Medicinal Use	Sources
Atuomkminaqsi	Virginia and Woodland Strawberries	*Fragaria virginiana , F. vesca*	Old fields and road sides	• Parts of plant used to treat irregular menstruation. • Tea from plant used as a good general tonic • Tea from plant used to treat dysentery, • Tea from plant used to treat weakness of the intestines • Tea from plant used to treat infections of the urinary organs. • Leaves used to treat stomach cramps.	Chandler *et al.* (1979) Lacey (1993)
	White Ash	*Fraxinus americana*	Intevale forests, low grounds and open woods	• Leaves used to treat cleansing after childbirth.	Chandler *et al.* (1979)
	Cleavers/ Sticky Willy	*Galium aparine*	Ballast heaps and waste places	• Parts of plant used to treat persons spitting blood • Parts of plant used to treat gonorrhoea. • Parts of plant used to treat kidney trouble. • Parts of plant used to treat gonorrhoea.	Chandler *et al.* (1979)
Kna'ji'jk	Creeping Snowberry	*Gaultheria hispidula*	Mossy woodland knolls, barrens, and mature bogs, usually in partial shade	• Decoction of leaves or whole plant taken to treat unspecified purpose.	Speck (1917)
Ka'qaju'mannaqsi	Wintergreen, Teaberry, or Checkerberry	*Gaultheria procumbens*	Woods, barrens, pastures	• Used to prevent and treat heart attack. • Tea from plant thins and regulates the blood to prevent blood clots.	Lacey (1993)
	Yellow Avens	*Geum aleppicum*	Along roadsides, riverbanks, waste places and occasionally around outbuildings	• Roots used to treat coughs and croup.	Chandler *et al.* (1979)
	Chocolate root, purple avens	*Geum rivale*	Swamps, wet fields, and meadows	• Root used to treat diarrhoea • Root decoction used to treat Dysentery, • Root decoction used to treat coughs and colds in children,	Chandler *et al.* (1979) Speck (1917)
	Witch Hazel	*Hamamelis virginiana*	Shade tolerant, in rocky woods or near cliffs	• Leaves steeped and used as an aphrodisiac • Leaves steeped and used to treat headache	Lacey (1993)
Pako'si	Cow Parsnip / masterwort	*Heracleum lanatum*	Wet meadows and brook sides in alluvial soils	• Root tea used as General preventative medicine, • Used to treat cold and influenza as well as tuberculosis.	Lacey (1977) Lacey (1993)
	Rough cow parsnip/ Eltrot	*Heracleum sphondylium*	Along roadsides and in vacant lots	• Green and light color plant used as gynaecological medicine to treat women. • Dark and ripe plant used as urinary medicine to treat men.	Wallis (1922) Chandler *et al.* (1979)
Kjimskiku	Sweet Grass	*Hierochloe odorata*	Moist heavy soils, generally in the upper reaches of tidal marshes	• Important ceremonial and spiritual use	Lacey (1993)
	Live to treatever/ Witch's Moneybags	*Hylotelephium telephium ssp. telephium*	Shaded areas with rich soil	• Dermatological Aid; Leaves used to treat boils and carbuncles.	Chandler *et al.* (1979)
	English Holly	*Ilex aquifolium*	Cultivated non-native species	• Root used to treat cough. • Part of plant used to treat fevers • Root used to treat consumption. • Root used to treat gravel.	Chandler *et al.* (1979)
	Jewelweed	*Impatiens capensis*	Moist open places, wet ground, along brooks and ditches, and in wet thickets. Prefers alluvial ground where organic matter and nutrient content are high	• Herbs used to treat jaundice.	Chandler *et al.* (1979)
	Elecampane	*Inula helenium*	Damp roadsides and neighbouring fields, as an escape	• Root used to treat headaches. • Root used to treat colds. • Root used to treat heart trouble.	Chandler *et al.* (1979)
	Blue Flag Iris	*Iris versicolor*	Meadows, swamps, along streams and grazed pastures	• Used as an emetic to rid the stomach of poison • Root used to treat wounds • Herb used to treat sore throat. • Root used to treat cholera and the prevention of disease. • Root used as a "basic medical cure" • Herbs used to treat sore throat and root used to treat wounds.	Lacey (1993) Chandler *et al.* (1979)

Mi'kmaq Name	Common Name	Scientific Name	Habitat[1, 2]	Mi'kmaq Traditional Medicinal Use	Sources
Kini'skweji'jik	Low Bush (Common Juniper)	*Juniperus communis*	Sandy areas, old pastures, heaths and bogs	• Bark used to treat tuberculosis • Stems used in hair wash • Cones used to treat ulcers. • Gum used to heal cuts, sores, burns and sprains • Inner bark used to treat stomach ulcers. Roots used to treat rheumatism. • Used to treat kidney ailments and as a urinary tract medicine	Lacey (1993) Chandler *et al.* (1979) Wallis (1922)
	Sheep Laurel/ lambkill	*Kalmia angustifolia*	Open ground	• Roasted leaves used to treat colds • Herb used to treat pain, swellings and sprains. • Poultice of crushed leaves bound to head to treat headache. • Herb used to treat swellings, pain and sprains. • Infusion of leaves considered valuable as a "non-specific remedy." • Plant is boiled and used as bathing solution to reduce swelling, ease pain of rheumatism and treat sore legs and feet • Plant considered very poisonous.	Black 1980 Wallis (1922) Chandler *et al.* (1979) Speck (1917) Lacey (1993)
Apu'tam'kie'jit	Eastern Larch (Tamarack)	*Larix laricina*	Bogs and wet depressions in forests	• Bark used to treat colds. • Boughs brewed into tea and used to treat Sores and swelling, and as a diuretic • Bark used to treat physical weakness. • Tea from bark and twigs used to treat colds and influenza. • Bark was used externally to treat festering wounds • Bark used to treat consumption. • Bark used to treat gonorrhoea.	Speck (1917) Chandler *et al.* (1979) Lacey (1993)
	Common Motherwort	*Leonurus cardiaca*	Scattered around old houses and gardens, not often a weed in cultivated land	• Part of plant used to treat obstetric cases.	Chandler *et al.* (1979)
	Canada Lily	*Lilium canadense*	Local, in meadows and on stream banks	• Parts of plant used to treat irregular menstruation.	Chandler *et al.* (1979)
	Carolina Sealavender	*Limonium carolinianum*	Characteristic of salt marshes and seashores	• Roots pounded, ground, added to boiling water and used to treat consumption with haemorrhage.	Mechling (1959)
	Indian Tobacco	*Lobelia inflata*	Dry pastures, run-out fields, roadsides, barrens, and similar locations	• Smoke from this plant used to treat earache • Smoke from this plant used to treat asthma • Smoke used spiritually	Lacey (1977) Lacey (1993)
	Clubmoss	*Lycopodium sp.*	Various species, mostly found in wooded areas	• Herb used to treat fever.	Chandler *et al.* (1979)
	Feather or False Solomon's Seal	*Maianthemum (syn. Smilacina) racemosum ssp. racemosum*	Scattered in open deciduous woods, along edges of thickets and clearings	• Leaves and stems used to treat rashes and itch.	Chandler *et al.* (1979)
Plamwipkl	Mint (Field Mint)	*Mentha arvensis*	Rich, damp soil	• Herb used to treat children with an upset stomach. • Herb used to treat croup.	Chandler *et al.* (1979)
	Common Buckbean	*Menyanthes trifoliata*	Stagnant pools and bogs	• Strong decoction of root taken to treat unspecified purpose	Speck (1917)
	Partridge Berry	*Mitchella repens*	Moist places, forest ground cover	• Used in the late stages of pregnancy to ease the pain of childbirth	Lacey (1993)
Kljimanaqsi	Northern Bayberry	*Morella (syn. Myrica) pensylvanica*	Coastal, on headlands and beaches. Occasionally in bogs and on heavier soils	• Tea, berries, bark, leaves used as exhilarant , • Plant used to treat headache • Root poultice used to treat inflammation, • Powdered root used to treat arthritic and rheumatic pain. • Tea from dried roots and leaves used to treat mouth infections • Roots pounded, soaked in hot water to treat inflammation	Wallis (1922) Lacey (1993)
Mujila'pij	Cow Lily (Yellow Pond Lily)	*Nuphar variegata*	Lakes, ponds, quite streams and stillwaters	• Root brewed into tea or worn around neck as a general preventive • Used externally to treat swollen limbs	Lacey (1977) Lacey (1993)

Mi'kmaq Name	Common Name	Scientific Name	Habitat[1, 2]	Mi'kmaq Traditional Medicinal Use	Sources
Mujila'pij	Sweet-scented Water Lily, American White Waterlily	*Nymphaea odorata*	Lakes, slow moving rivers and mucky ponds	• Leaves used to treat colds. • Juice of root taken to treat coughs. • Root decoction used to treat Coughs, swellings • Poultice of boiled root applied to swellings. • Roots used to treat suppurating glands • Leaves used to treat colds. • Leaves used to treat grippe. • Leaves used to treat limb swellings and colds.	Chandler *et al.* (1979) Speck (1917) CLacey (1993)
Kawatkw	White Spruce (Cat Spruce)	*Picea glauca*	Old fields and along the coast	• Bark used to treat a variety of purposes	Lacey (1993)
Kawatkw	Black Spruce (Bog Spruce)	*Picea mariana*	Bogs, swamps and poorly drained areas	• Bark used as a cough remedy. • Bark used to prepare a salve to treat cuts and wounds. • Gum used to treat scabs and sores. • Parts of plant used to treat stomach trouble. • Bark, leaves and stems used to treat scurvy. • Bark is chewed to treat laryngitis.	Chandler *et al.* (1979) Lacey (1993) Wallis (1922)
	Eastern White Pine	*Pinus strobus*	Bogs, swamps and poorly drained areas	• Tea from bark, needles and twigs used to treat colds and coughs • Tea from bark, needles and twigs used to treat kidney problems • Bark used to treat wounds • Sap used to treat haemorrhaging. • Boiled inner bark used to treat sores and swellings. • Plant parts used to treat kidney trouble. • Bark, leaves and stems used to treat grippe. • Inner bark, bark and leaves used to treat scurvy.	Lacey (1993) Chandler *et al.* (1979) Speck (1917)
Wijikanipkl	Common Plantain	*Plantago major*	Disturbed areas	• Used to draw out poison from wounds and sores. • Used to treat stomach ulcers	Lacey (1993)
	Tall Northern White Bog Orchid	*Platanthera (*syn. *Habenaria) dilatata* var. *dilatata*	A wide variety of habitats , preferring sunny and wet situations such as bogs, marshes and riverbanks	• Root decoction used to treat kidney stones, • Root juice taken with water to treat kidney stones	Speck (1917) Lacey (1977)
	Rock Polypody	*Polypodium virginianum*	Damp cliffs, on top of large boulders, preferring a rocky substrate with a covering of leaf mould	• Infusion of plant used to treat urine retention. • Roots used to treat pleurisy.	Rousseau (1948) Chandler *et al.* (1979)
	Christmas Fern	*Polystichum acrostichoides*	Moist woods, cool ravines, wooded banks and thickets	• Roots used to treat hoarseness.	Chandler *et al.* (1979)
	Pickerelweed	*Pontederia cordata*	Growing in large pure colonies around the mucky margins of ponds and lakes, and in slow-moving streams	• Herbs used to prevent pregnancy.	Chandler *et al.* (1979)
A'maqansuti	Balsam Poplar	*Populus balsamifera*	Common along streams and open intervales	• Buds and other parts of plant used as salve to treat sores. • Buds and other parts of plant used as salve to treat chancre.	Chandler *et al.* (1979)
	Poplar	*Populus* sp.	Various	• Tea from bark used to treat colds and influenza • Tea from bark used to treat worms	Lacey (1993) Lacey (1977)
Miti	Trembling Aspen (Poplar)	*Populus tremuloides*	Damp soils	• Bark used to treat colds. • Bark used to stimulate the appetite.	Chandler *et al.* (1979)
Maskwe'smanaqsi	Pin Cherry	*Prunus pensylvanica*	Clearings, thickets, and the edges of fields on light soils	• Wood used to treat chafed skin and prickly heat. • Bark used to treat erysipelas.	Chandler *et al.* (1979)
	Black Cherry	*Prunus serotina*	Thickets and open wood	• Bark used to treat colds. • Bark used to treat coughs. • Bark used to treat smallpox. • Fruit used as a tonic. • Bark used to treat consumption.	Chandler *et al.* (1979) Wallis (1922)
	Red cherry (species unspecified)	*Prunus sp.*	Thickets, clearings and open woods	• Tea of the bark from 'red cherry' used to treat high blood pressure.	Lacey (1993)
	Wild Black Cherry	*Prunus serotina*	Thickets, clearings and open woods	• Black cherry used to treat coughs and colds	Lacey (1993)
Luimanaqsi	Common Chokecherry	*Prunus virginiana*	Roadsides, fencerows, edges of intervales, and the edges of woods	• Bark used to treat diarrhoea.	Chandler *et al.* (1979) Lacey (1993)

Mi'kmaq Name	Common Name	Scientific Name	Habitat[1, 2]	Mi'kmaq Traditional Medicinal Use	Sources
	Bracken	*Pteridium aquilinum*	Pastures, old fields, roadsides, borders of woods	• Fronds of plant used as stimulant to treat weak babies and old people.	Chandler *et al.* (1979)
	Liverleaf Wintergreen	*Pyrola asarifolia* ssp. *asarifolia*	Rich, mainly calcareous, woods and thickets	• Parts of plant used to treat spitting blood. • Parts of plant used to treat kidney trouble. • Parts of plant used to treat gonorrhoea.	Chandler *et al.* (1979)
	Northern Red Oak	*Quercus rubra*	In light or well-drained soils and granitic areas	• Bark and roots used to treat diarrhoea.	Chandler *et al.* (1979)
	Oak	*Quercus* sp.	In light or well drained soils and granitic areas	• Used to treat haemorrhaging and intermittent fever	Lacey (1993)
	Tall Buttercup	*Ranunculus acris*	Fields , meadows, and roadsides, mainly in heavy or moist soil,	• Herbs used to treat headache. • Leaves used to treat headaches.	Chandler *et al.* (1979)
	Buttercup	*Ranunculus* sp.	Various	• Scent or juice from leaves applied to nostrils said to cure headache • Used to treat cancer	Lacey (1993)
	Handsome Harry/ Meadow Beauty	*Rhexia virginica*	Peaty lake margins and swales or wet thickets	• Tea from plant used as a wash to clean and clear the throat.	Lacey (1993) Chandler *et al.* (1979)
	Yellow Rattle	*Rhinanthus crista-galli*	Old fields, roadsides and waste places	• Tea of plant used to treat epilepsy	Lacey (1993)
Apuistekie'ji'jit	Labrador Tea	*Rhododenrdon (syn. Ledum) groenlandicum*	Bogs, wooded swamps, wet barrens, and poorly-drained clearings and pastures	• Leaves used to treat the common cold. • Tea brewed from leaves used as dieretic • Leaves used to treat scurvy • Leaves used to treat asthma. • Tea from leaves used as a tonic to treat variety of kidney ailments • Infusion of leaves taken to treat a "beneficial effect on the system."	Chandler *et al.* (1979) Speck (1917) Lacey (1993)
Ketaqnimusi	Starhorn Sumac	*Rhus typhina*	The edges of woods in dry or rocky soils, along roadsides and other open areas and hillsides	• Used to treat coughs, sore throats, and earaches	Lacey (1993) Chandler *et al.* (1979) Wallis (1922)
Ajioqjominaqsi	Common Blackberry	*Rubus alleghaniensis*	Sandy ground, old fields, open woodlands, and clearings	• Berry used to treat diarrhoea. • Tea from runners used to as stomach medicine. • Tea from leaves and berries used to treat sores in mouth and throat.	Lacey (1993)
Mkuo'qminaqsi'k	Cloudberry (Bakeapple)	*Rubus chamaemorus*	Sphagnous bogs, heathlands, and meadows near the coast	• Roots used to treat cough. • Roots used to treat fever. • Roots used to treat consumption/Tuberculosis	Chandler *et al.* (1979)
	Bristly Dewberry/ Swamp Dewberry	*Rubus hispidus*	Peat bogs, but often on roadsides, damp hollows and barrens	• Roots used to treat cough. • Roots used to treat fever. • Roots used to treat consumption/Tuberculosis	Chandler *et al.* (1979)
Klitawmanaqsi'k	Red Raspberry	*Rubus idaeus*	Roadsides, deforested land, talus slopes, and rocky ground	• Leaves and roots used to treat rheumatism. • Berries are a good general tonic	Lacey (1993)
	Dwarf Red Blackberry/ Dwarf Raspberry	*Rubus pubescens var. pubescens*	Low-lying boggy land, talus slopes, and often growing luxuriantly under bushes in open woods	• Parts of plant used to treat irregular menstruation.	Chandler *et al.* (1979)
	Blackberry, Raspberry	*Rubus sp.*	Various, depending on species	• Tea from runners used to treat stomach issues	Lacey (1977)
	Curly Dock	*Rumex crispus*	Waste places, cultivated ground, roadsides and around dwellings	• Infusion of roots used as a purgative. • Roots used as a purgative. • Infusion of roots, hemlock, parsley and Prince's pine used to treat "cold in bladder."	Mechling (1959) Chandler *et al.* (1979)
Lmu'ji'jmnaqsi	Pussy Willow	*Salix discolor*	On low ground, in wet pastures, in damp, open woods, and along the edges of swamps	• Bark used externally to treat bruises, and skin cancer. • Tea from bark also used to treat colds and kidney ailments	Lacey (1993)
	Heartleaf Willow	*Salix eriocephala*	Riverbanks and out on gravel bars. Bottomlands	• Bark used to treat colds • Bark used to stimulate the appetite. • Bark used to treat blisters.	Chandler *et al.* (1979)
	Shining Willow	*Salix lucida*	Along large streams and lakes, on sand bars, and occasionally in wet ground or ditches	• Bark used to treat bleeding. • Bark used to treat asthma.	Wallis (1922) Chandler *et al.* (1979)
Pukulu'skwimanaqsi'l	European Elder	*Sambucus nigra*	Rich soil, open woods, around old fields and along brooks. On damp ground or wet floodplains	• Berries, bark and flower used as a purgative • Bark used as a physic. • Bark used as an emetic. • Berries, bark and flower used as a soporific	Chandler *et al.* (1979)

Mi'kmaq Name	Common Name	Scientific Name	Habitat[1, 2]	Mi'kmaq Traditional Medicinal Use	Sources
Pukulu'skwimanaqsi'l	Red Elderberry	*Sambucus racemosa*	Meadows, wet places, rocky hillsides and along streams. In rich soils	• Barked used to treat emetic and cathartic purposes	Lacey (1993) Chandler *et al.* (1979)
Malteweknejkl	Bloodroot	*Sanguinaria canadensis*	Low ground in intervales along streams, in the shade	• Tea of root used to treat tuberculosis. • Leaves used to treat rheumatism • Roots used to treat irregular menstruation. • Infusion of roots used to treat colds. • Roots used to treat infected cuts. • Roots used to treat haemorrhages and to prevent bleeding. • Used as an aphrodisiac. • Infusion of roots used to treat sore throats. • Roots used to treat consumption/tuberculosis with haemorrhage.	Lacey (1993) Rousseau (1948) Chandler *et al.* (1979) Rousseau (1948)
	Maryland Sanicle/ Black snakeroot	*Sanicula marilandica*	Rich woods and intervale soils, usually where the soil is quite damp and humus content good	• Roots used to treat irregular menstruation. • Roots used to treat rheumatism. • Roots used to treat menstrual pain and slow parturition. • Roots used to treat kidney trouble. • Roots used as a snakebite remedy*** and to treat rheumatism.	Chandler *et al.* (1979)
Mkoqewik	Northern Pitcher Plant	*Sarracenia purpurea*	Bogs	• Herbs used to treat spitting blood. • Strong decoction of root taken to treat "spitting blood" and pulmonary complaints. • Herbs used to treat kidney trouble and consumption. • Roots used to treat smallpox and herbs used to treat consumption. • Tea from root used to treat tuberculosis, kidney ailments and relieve indigestion • Infusion of root taken to treat sore throat. • Herbs used to treat consumption.	Lacey (1993) Speck (1917) Chandler *et al.* (1979)
	Panicled Bulrush	*Scirpus microcarpus*	Swamps, meadows, and along ditches and streams, especially where there is freshwater seepage	• Roots used to treat abscesses. • Herbs used to treat sore throats.	Chandler *et al.* (1979)
	White Mustard	*Sinapis alba*	Cultivated, occasionally escaping	• Parts of plant used to treat tuberculosis of lungs.	Chandler *et al.* (1979)
	Climbing Nightshade/Bittersweet	*Solanum dulcamara*	Thickets, intervales, roadsides and dumps. Along fences and around buildings	• Roots used to treat nausea.	Chandler *et al.* (1979)
E'psemusi	American Mountainash	*Sorbus americana*	Open woods and along hedgerows	• Tea from the bark used to treat stomach pains • Bark used to treat "mother pains." • Bark used to treat boils. • Parts of plant used as an emetic. • Infusion of root taken to treat colic. • Infusion of bark taken to treat unspecified purpose.	Lacey (1993) Speck (1917) Chandler *et al.* (1979)
	Claspleaf Twistedstalk	*Streptopus amplexifolius*	Scattered in moist deciduous or mixed woods, ravines, and wooded intervales	• Parts of plant used to treat spitting blood • Parts of plant used to treat kidney trouble	Chandler *et al.* (1979)
	Waxberry	*Symphorcarpus albus*	Around buildings and in gardens	• Parts of plant used to treat gonorrhoea. • Scent of plant used to treat headache	Chandler *et al.* (1979) Lacey (1993)
	Skunk Cabbage	*Symplocarpus foetidus*	Springy swales, bogs, sphagnum woods and wet thickets	• Tea from root used to treat diabetes. • Tea from root used to cure toothache	Lacey (1993)
	Common Tansy	*Tanacetum vulgare*	In patches along roadsides, becoming a weed infields	• Herbs used to prevent pregnancy. • Leaves used to treat kidney trouble.	Chandler *et al.* (1979) Chandler *et al.* (1979)
	Canada Yew	*Taxus canadensis*	Cool damp woods, ravines, climax coniferous, and wooded swamps.	• Bark used to treat bowel and internal troubles • Parts of plant used to treat afterbirth pain and clots. • Leaves used to treat fever. • Parts of plant used to treat scurvy.	Wallis (1922) Chandler *et al.* (1979) Lacey (1977)

Mi'kmaq Name	Common Name	Scientific Name	Habitat[1, 2]	Mi'kmaq Traditional Medicinal Use	Sources
	Eastern White Cedar	*Thuja occidentalis*	Lakesides and swamps or old pastures	• Used externally to treat swollen hands and feet • Stems used to treat headaches. • Inner bark, bark and stems used to treat burns. • Inner bark, bark and stems used to treat cough. • Leaves used to treat swollen feet and hands and stems used to treat headaches. • Gum used to treat toothache. • Inner bark, bark and stems used to treat consumption.	Lacey (1993) Chandler *et al.* (1979)
	Heartleaf Foamflower	*Tiarella cordifolia*	Deciduous forests and intervales. Gravelly roadsides	• Roots used to treat diarrhoea.	Chandler *et al.* (1979)
	Clover	*Trifolium pratense*	Fields and roadsides	• Tea from plant used to treat fevers	Lacey (1993)
	Eastern Hemlock	*Tsuga canadensis*	Northern slopes or ravines	• Tea from bark and stems used to treat colds, coughs, "grippe" and influenza • Inner bark used to treat diarrhoea. • Inner bark used to treat chapped skin. • Parts of plant used to treat bowel, stomach and internal troubles. • Roots and stems used to treat "cold in kidney." And "cold in bladder." • Bark used to treat grippe • Inner bark used to treat scurvy.	Lacey (1993) Chandler *et al.* (1979) Wallis (1922)
	Narrow-leaved Cattail	*Typha angustifolia*	Brackish swales near the coast, inland swamps, ditches, along streams	• Roots used to treat gravel.	Chandler *et al.* (1979)
	Broadleaf Cattail	*Typha latifolia*	Swamps, ponds, and ditches in estuaries above the salt water, occasionally in floating bogs.	• Leaves used to treat sores.	Chandler *et al.* (1979)
	Slippery Elm	*Ulmus rubra*	Ornamental, planted about towns and villages.	• Bark used to treat suppurating wounds.	Chandler *et al.* (1979)
Pkumanaqsi	Low Bush Blueberry	*Vaccinium angustifolium*	Headlands, peaty barrens, fields, dry soils, sandy areas	• Leaves and roots used to treat rheumatism. • Berries a good general tonic	Lacey (1993)
	Large -fruited Cranberry	*Vaccinum macrocarpon*	Bogs	• Stewed berries used as a general tonic	Lacey (1993)
Wo'jekunmusi	Common Mullein	*Verbascum thapsus*	Light soils, roadsides, hillsides, gravel plains, and pastures. A common weed on rough land	• Leaves smoked or steeped (fumes inhaled) to treat asthma • Parts of plant used to treat sores and cuts. • Parts of plant used to treat catarrh	Lacey (1993) Chandler *et al.* (1979)
Nipanmaqsi'l	Highbush Cranberry	*Viburnum opulus*	Swamps and along streams	• Bark used to treat swollen glands and mumps.	Chandler *et al.* (1979) Lacey (1993)
	Field Pansy	*Viola arvensis*	Fields and roadsides	• Used to treat sore eyes	Lacey (1993)

3.2.4 Traditional Materials and Other Useful Plants

Aside from food and medicines, Mi'kmaw people utilized various natural resources for a wide range of other purposes. Animal, bird and fish skins were tanned using animal materials or smoked, and then used to make clothing, footwear, and baby blankets. Pelts were used to make fur robes. Sinew from animal carcasses served as thread (Nova Scotia Museum factsheet, ND).

A variety of wood types were used in shelter construction. Spruce poles, birch bark sheets, and flexible moosewood (striped maple) saplings were used in the construction of conical dwellings known as *"wikuom"* or wigwams. Various woods were also used in the construction of devices to aid in transportation, and to create fish traps and weirs (NS Museum factsheet, ND). Other woods were used to make storage containers and vessels. Tools such as axes, adzes and gouges were made from reworking suitable stone and wood materials. Stones such as chalcedony were used to make hunting, cooking, carving, and hide-preparing tools, Spears were made of bone and wood, while bone was also used to make needles, awls and painting tools. Copper, which was likely traded for from natives from outside the region, was used to make fish hooks and needles. Teeth from beavers were used for fine carving, while walrus tusks were used for ivory. Bags and mats were made from woven reeds, grasses, cattails, cedar, and basswood bark. Baskets may have been woven from thin branches (Nova Scotia Museum factsheet, ND). Species-specific uses of many plant species are outlined in Table 3-7.

Dwellings and clothing were often decoratively painted using red and yellow ochre, charcoal, and ground eggshell, mixed with fish roe or egg yolks as a binder. Clothing was also decorated with animal bones, teeth, and claws and quills, and sometimes feathers. Bird wings were sometime worn by men. Pipes were made from stone, bone, bark, wood, and lobster claws. After 1600, Mi'kmaq women made decorative porcupine quillwork and shell beadwork for sale to Europeans. Dyes for quills and mats came from a variety of roots, bark, leaves, and flowers (Nova Scotia Museum factsheet, ND).

Table 3-7. Other Useful Native Plant Species Traditionally Used by Nova Scotia Mi'kmaq.

Mi'kmaq Name[1,]	Common Name	Scientific Name	Habitat[,3,2]	Mi'kmaq Traditional Use	Source
Stoqn	Balsam Fir	*Abies balsamea*	Various	• Wood used for kindling and fuel. • Boughs used to make beds.	Speck and Dexter (1951), Unama'ki Institute of Natural Resources, 2012
Mimkutaqo'q	Moosewood (striped maple)	*Acer pensylvanicum*	Rocky woods, rich deciduous forests, wooded slopes and along streams	• Thin saplings used in wigwam construction	Nova Scotia Museum factsheet, ND
	Red Maple	*Acer rubrum*	Swamps, alluvial soils, and moist uplands	• Used to make basketware.	Speck and Dexter (1951)
Snawey	Sugar Maple	*Acer saccharum*	Well-drained soils	• Used to make bows and arrows.	Speck and Dexter (1951)
	Maple	*Acer sp.*	Various	• Pins for securing clothing	Wallis and Wallis 1964
Tupsi	Alder	*Alnus sp.*	Low ground in alluvial soils	• Bark used to make a dye.	Speck and Dexter (1951)
Maskwi	White/Paper Birch	*Betula papyrifera*	Forests, especially on slopes	• Bark used to make baskets. • Bark used to make boxes, coffins and other containers. • Bark used to make canoes. • Bark used to make dishes and cooking utensils. • Bark used to make house coverings.	Speck and Dexter (1951) Speck and Dexter (1951) Rousseau (1948) Speck and Dexter (1951) Speck and Dexter (1951)
	Yellow birch	*Betula alleghaniensis*		Branches used as straps and thongs.	Wallis and Wallis 1960
	Birch	*Betula sp.*	Various depending on species	• Bark used to make torches for night fishing. • Bark used to make trumpets for calling game. • Bark used to construct containers, boxes, and cups • Bark sheets used in wigwam construction	Speck and Dexter (1951) Speck and Dexter (1951) Wallis and Wallis 1955 Nova Scotia Museum factsheet, ND.
	Hazel root	*Corylus cornuta*		• Basketry	Wallis and Wallis 1955
	American Beech	*Fagus grandifolia*	Fertile uplands, rarely in swamps	• Used to make snowshoe frames.	Speck and Dexter (1951)
	White Ash	*Fraxinus americana*	Intervale forests, low ground, and open woods	• Used to make axe and knife handles.	Speck and Dexter (1951)
Wiskoq	Black Ash	*Fraxinus nigra*	Low ground, damp woods and swamps	• Used to make basketware.	Speck and Dexter (1951)
	Stiff Marsh Bedstraw/ Small Bedstraw	*Galium tinctorium*	Low-lying areas, brooks, marshes, and bogs	• Roots used to make a red dye for porcupine quills.	Speck and Dexter (1951)
Kjimskiku	Sweetgrass	*Hierochloe odorata*	Moist heavy soils, generally in the upper reaches of tidal marshes	• Used to make baskets. • Used to make mats.	Speck and Dexter (1951) Speck and Dexter (1951)
	Red Cedar	*Juniperus sp.*	Various, depending on species	• Wood used for kindling and fuel.	Speck and Dexter (1951)
Apu'tam'kie'jit	Eastern Larch/ Tamarack	*Larix laricina*	Bogs and wet depressions in forests	• Wood used for kindling and fuel.	Speck and Dexter (1951)
Kawatkw	White Spruce (Cat Spruce)	*Picea glauca*	Old fields and along the coast	• Boughs used to make beds. • Wood used for kindling and fuel.	Speck and Dexter (1951) Speck and Dexter (1951)
Kawatkw	Black Spruce (Bog Spruce)	*Picea mariana*	Bogs, swamps and poorly drained areas	• Boughs used to make beds. • Roots used as sewing material for canoe birch bark products. • Wood used for kindling and fuel.	Speck and Dexter (1951) Speck and Dexter (1951) Speck and Dexter (1951)
	Eastern White Pine	*Pinus strobus*	Bogs, swamps and poorly drained areas	• Wood used for kindling and fuel.	Speck and Dexter (1951)
	Spruce	*Picea spp.*	See White and/or Black Spruce	• Poles for wigwam construction • Root used as twine, for sewing	Nova Scotia Museum factsheet, ND Wallis and Wallis (1955)
	Willow	*Salix sp.*	Various, depending on species	• Leaves used as tobacco.	Speck and Dexter (1951)
	Canada Yew	*Taxus canadensis*	Cool damp woods, ravines, climax coniferous, and wooded swamps.	• Leaves used to make a green dye.	Speck (1917)

Mi'kmaq Name[1,]	Common Name	Scientific Name	Habitat[,3,2]	Mi'kmaq Traditional Use	Source
	Eastern White Cedar	*Thuja occidentalis*	Lakesides and swamps or old pastures	• Used to make arrow shafts. • Used to make canoe slats. • Wood used for kindling and fuel. • Woven into bags and mats • Inner bark used as twine, for sewing	Speck and Dexter (1951) Speck and Dexter (1951) Speck and Dexter (1951) Nova Scotia Museum factsheet, ND Wallis and Wallis 1955
	Basswood[2]	*Tilia* spp.[2]	not native to NS	• Bark woven into bags and mats	Nova Scotia Museum factsheet, ND
	Eastern Hemlock	*Tsuga canadensis*	Northern slopes or ravines	• Bark used to make a dye. • Wood used for kindling and fuel.	Speck and Dexter (1951) Speck and Dexter (1951)
	Cattails	*Typha* spp.	Marshes, wet depressions	• Woven into bags and mats	Nova Scotia Museum factsheet, ND

1 Unama'ki Institute of Natural Resources, 2012

2 There may be confusion over this common name, as basswood (*Tilia* species, or Linden) is not native to NS or NB.

4.0 RESULTS

4.1 Results of Local Knowledge Survey

4.1.1 Results of Review of Available Data

Discussions were held with researchers from the Gorsebrook Institute, and the TAAR Center. It was noted that research is still ongoing and as a result, information is not available for public release through an MEKS at this time.

The research project is still ongoing and it is likely that a considerable effort will need to be made to collect information on all areas of the province. AMEC was informed that the rich history associated with Mi'kmaq place names strongly indicate that there was a Mi'kmaq presence throughout the province. Researchers also indicated that all place name data resulting from the research will be made available to the general public via a web site in the near future (Sable, Personal communication).

4.1.2 Results of Interviews and Meetings with Local Community Members

Sessions in Eskasoni and Membertou were consistent in findings for all informants. Respondents were familiar with the area, but participants at the roundtable were not aware of any direct interaction with the area in many years. The most commonly cited reasons were:

- The area was used by non-aboriginal population so people would not feel comfortable hunting in the area
- Better hunting areas in the Highlands (moose is a priority target for hunting)
- Too close to Sydney for good hunting
- Fewer hunters today compared to years ago (it was noted that only 60 persons were over the age of 65 in the community).

One respondent indicated that elders would use the area for picnicking in the past but was unable to assign any specific details as to the location. It was known that one elder had considerable experience in trapping fur-bearing animals in the general vicinity.

The participants in the Membertou discussions were also familiar with some activities in the project area. They indicated to following uses in the area on or near the Barrachois wind farm site:

- The water's edge has been used by Band members for swimming (possibly the same location implied by Eskasoni residents as to picnicking areas).
- Gathering (fruit).
- Deer hunting along Leitches Creek (near Barrachois)
- Fishing in Roach lake (in the general area of the project site)
- Salmon and smelt fishing in Balls Creek (<15 km from the project site)
- Lobster fishing in the Bras d'Or Lake in the waters near the property.

It was stated by one Band member that while people do not extensively hunt in this area because better hunting in the highlands and in areas closer to the reserve, it is possible that people may want to hunt in

the area in the future as game abundance changes in existing hunting areas frequented by Band members.

4.2 Results of General Habitat and Culturally Significant Plant Species Survey

4.2.1 Field Survey Results

During the plant surveys, a total of five dominant habitat types were. The major habitat types occurring within the Study Area include:

- Mixed Forest;
- Coniferous Forest;
- Riparian (Stream);
- Clear cut; and
- Shrub Swamp.

The following provides a summary of the various habitats encountered during the survey.

Mixed Forest

Mixed Forest was found to cover the majority of the Study Area. This habitat type contained a mix of coniferous and deciduous trees in the canopy including Red Maple, Yellow Birch, Balsam Fir, along with the occasional White Pine and Hemlock. Ground cover in this habitat was found to be dominated with Feather Moss and Goldthread.

Photo 4-1. Mixed Forest

Coniferous Forest

Patches of coniferous forest were also encountered within the Study Area. These areas consisted primarily of Balsam Fir and spruce trees in the canopy with Wild Sarsaparilla and Gold Thread present in

the ground layer. The understorey in these areas is relatively sparse with ground cover consisting primarily of Feathermoss.

Photo 4-2. Coniferous Forest

Shrub Swamp

An alder dominated shrub swamp was noted in the Study Area near one of the proposed turbine locations. This area follows a portion of the unnamed stream that runs through the Study Area. Vegetation in this area is dominated by Alder, Labrador Tea and Mountain Holly. Sphagnum moss dominates the ground layer.

Photo 4-3. Shrub Swamp

Riparian (River and Lake)

A small stream was noted within the Study Area. Bank flow width of the stream was estimated to range from approximately 0.5 to 1 meter with a depth of approximately 10-15 cm. Substrate within the stream is rock with organics. Vegetation along the stream banks was very similar to the surrounding forest which consisted of Yellow Birch, Red Maple, White Birch and Balsam Fir.

Photo 4-4. Riparian/Stream Habitat

Clear Cut

A large section of the Study Area consists of a clear cut where recent logging activities have left large sections of land in an early regenerating stage. Vegetation in this area is dominated by Raspberry, Black Berry, Alder, Balsam Fir, Pin Cherry, and Birch.

Photo 4-5. Clear Cut

Culturally Significant Plant species

A total of 24 plant species of edible, medical, or other significance to the Mi'kmaq were recorded during the 2012 survey of the Study Area. An additional two species considered useful for other purposes were also recorded. Table 4-1 provides a list of all 24 culturally significant plant species encountered in the Study Area, along with their tradition use category and the habitat in which they were recorded on the Barrachois site. See Table 3-5, Table 3-6, and Table 3-7 for habitat preferences of these plant species.

Table 4-1: Culturally Significant Plant Species Recorded in the Study Area, with Associated Habitats

Mi'kmaq Name	Common Name	Scientific Name	Category	Barrachois Habitat Type				
				Mixed Forest	Coniferous Forest	Stream	Clear Cut	Shrub Swamp
Tupsi	Alder	*Alnus* sp.	Useful species Medicinal				X	X
	American Beech	*Fagus grandifolia*	Food	X				
Stoqn	Balsam Fir	*Abies balsamea*	Useful species Medicinal Food	X	X	X	X	X
	Black Spruce	*Picea mariana*	Useful species Medicinal Food					X
	Common Blackberry	*Rubus alleghaniensis*	Medicinal, Food				X	
Wso'qmanaqsi'l	Bunchberry/ Dwarf Dogwood	*Cornus canadensis*	Medicinal	X		X	X	X
	Buttercup	*Ranunculus* sp.	Medicinal			X		
	Wild cherries	*Prunus* sp	Food Medicinal				X	
	Large -fruited Cranberry	*Vaccinum macrocarpon*	Food Medicinal					X
	Eastern Hemlock	*Tsuga canadensis*	Useful species Medicinal Food	x				
	Everlasting	*Antennaria* sp or *Anaphalis* sp	Medicinal				X	
Wisawtaqji'jkl	Goldthread	*Coptis trifolia*	Medicinal	x	X	X		X
	Labrador Tea	*Rhododendron groenlandicum*	Medicinal, Food					X
	Sheep Laurel/ lambkill	*Kalmia angustifolia*	Medicinal					X
	Maple	*Acer* sp.	Food	x		X	X	X
	Mountain Ash	*Sorbus americana*	Food				X	
	Partridge Berry	*Mitchella repens*	Food, Medicinal				x	
	Pussy Willow	*Salix discolor*	Medicinal				x	

Mi'kmaq Name	Common Name	Scientific Name	Category	Barrachois Habitat Type				
				Mixed Forest	Coniferous Forest	Stream	Clear Cut	Shrub Swamp
Klitawmanaqsi'k	Red Raspberry	*Rubus idaeus*	Food, Medicinal				x	
Atuomkminaqsi	Virginia Strawberry	*Fragaria virginiana*	Food, Medicinal				x	
	White Pine	*Pinus strobus*	Useful species Medicinal Food	x				
	White Spruce (Cat Spruce)	*Picea glauca*	Food	x			x	
Wopapa'kjukal	Wild Sarsaparilla	*Aralia nudicaulis*	Food	x		x		
Nimnoqn	Yellow Birch	*Betula alleghaniensis*	Food, Medicinal	x		x	x	

It should be noted that many species potentially occurring in the Study Area may have been missed given the time of year in which the surveys were conducted. Other species could not be identified to species level at this time of year.

4.3 Results of Wildlife Habitat Modeling Exercise

A review of the historical use of wildlife and fish resources by Mi'kmaq, combined with known wildlife habitat preferences and the results of the habitat surveys, allowed a determination of wildlife species potentially using the project site. These are outlined in Table 4-2.

Table 4-2: Traditional Mi'kmaq Wildlife Resources Potentially Utilizing the Barrachois Site.

Species		Barrachois Habitat Type				
		Mixed Forest	Coniferous Forest	Stream	Clear Cut	Shrub Swamp
MAMMALS						
Black Bear	*Ursus americanus*	X	X			
Bobcat	*Felis rufus*	X	X			
Eastern Coyote	*Canis latrans*	X	X			
Red Squirrel	*Tamiasciurus hudsonicus*	X	X		X	

Species		Barrachois Habitat Type				
		Mixed Forest	Coniferous Forest	Stream	Clear Cut	Shrub Swamp
Red Fox	*Vulpes vulpes*	X	X			
Raccoon	*Procyon lotor*	X	X			
Short-Tailed Weasel	*Mustela erminea*	X	X			
White-Tailed Deer	*Odocoileus virginianus*	x			X	
BIRDS						
Ruffed Grouse	*Bonasa umbellus*	X	X			
Great Horned Owl	*Buba virginianus*	X				
Barred Owl	*Strix varia*	X				

While suitable habitat may exist for them, Striped Skunks and Eastern Porcupines are not predicted to occur on the Barrachois site, as these species are currently absent from Cape Breton Island. Note that as the site does not support any freshwater or marine habitat (aside from a very small stream which does not appear to provide fish habitat), there is no habitat for edible marine or coastal fish, mammal, invertebrate or bird species which rely on these habitats.

5.0 Conclusion

The purpose of the Barrachois Mi'kmaq ecological study was to identify the interests of Mi'kmaq communities on the lands and resources in and near the proposed project. This study was conducted, in part, in conjunction with a previous study for the proposed Hillside-Boularderie Wind Farm as there is likely a shared interest in most sites in the general area due to their close proximity to present day Mi'kmaq communities.

The interests in the Barrachois site include local and traditional knowledge of the places potentially affected by a project. Information on current use of the area, combined with historical research on Mi'kmaq presence in the area, and knowledge of the impacts of government policies and programs on Mi'kmaq land use can provide a modest understanding of the interests of the Mi'kmaq on a particular place and project. The MEKS does not constitute consultation and the information is collected without prejudice to the rights and interests of the Mi'kmaq nation

This MEKS demonstrates that there has been a long-standing relationship with, and a considerable attachment to the region in and around Barrachois, Nova Scotia. This region is the source of

considerable cultural significance and the source of pride for many residents of Eskasoni. Mi'kmaq have historically used the region for hunting, and some small game trapping still occurs in the general area. Ancestors of the present residents had demonstrated local hunting, trapping and gathering practices to newcomers, thus fostering a lasting relationship of peace and friendship with the French and eventually other European inhabitants of the area.

This intimate relationship with the region is demonstrated with the extensive awareness of flora and fauna resources in the project area despite the interruption in use of the area due to development and Government of Canada aboriginal policies. The existence of multiple culturally important plants in the study area suggests that the general project area was likely used by the ancestors of local Mi'kmaq.

While it was noted that there was limited involvement of Band members in the project site, it was clearly evident that the area had been used in the past (within living memory) for trapping, food gathering and recreation. The decision to continue to use this area has been affected by a number of socio-political factors (most significantly centralization policies to move Mi'kmaq families to reserves) and demographic factors. In particular, a rapidly growing youth population that is pursuing education and alternative training has resulted in a general move away from hunting within the rapidly growing communities (it is likely that firearms legislation and hunter training requirements may be a factor in the decline in hunting amongst Mi'kmaq youth). This has been mirrored by a change in diet and change in general health condition in First Nation communities.

It is also clear from the research that, traditionally, decisions related to hunting and fishing has been based on opportunistic access to food resources that are most abundant. As a result, there may be future interest in fishing, hunting and gathering in the project area as land-use changes, urbanization and other developments impact areas currently used by Mi'kmaq hunters and fishers. In keeping with traditional decision-making practices, an important attribute of the ecological knowledge system, areas such as the project site would logically be considered for harvesting activities due to the close proximity to the reserves.

In keeping with the principles and statements of the United Nations Declaration on the Rights of Indigenous Peoples, future planning and development of the Barrachois Wind Farm should involve the application of Mi'kmaq Ecological Knowledge. Natural Forces Wind Inc. should, as a result, maintain communication with the local Mi'kmaq communities.

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