

Appendix F:
Wetlands Assessment



**WETLANDS ASSESSMENT
GAETZ BROOK COMMUNITY WIND FARM**

October 11, 2012



Taking Charge™



October 11, 2012

Mr. Andy MacCallum
Natural Forces Technologies Inc.
#1030 - 1791 Barrington Street
Halifax, NS B3J 3L1

Dear Mr. MacCallum,

Re: Wetlands Assessment
Gaetz Brook Community Wind Farm

Attached is the Wetlands Assessment report prepared for the Gaetz Brook Community Wind Farm.

This report documents our observations, findings, and recommendations.

We trust this report to be satisfactory at this time. Once you have had an opportunity to review this correspondence, please contact us to address any questions you may have.

Thank you,

A handwritten signature in blue ink, appearing to read "Andy Walter", with a long horizontal flourish extending to the right.

Andy Walter, BSc.
Environmental Specialist
awalter@strum.com

A handwritten signature in purple ink, appearing to read "Carys Burgess", with a long horizontal flourish extending to the right.

Carys Burgess, MMM
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1.0 INTRODUCTION

Strum Environmental completed a Desktop Review and Field Survey for the Gaetz Brook Community Wind Farm (the Project), on behalf of Natural Forces Technologies Inc. The objective of this study was to determine the location and extent of wetland habitat and watercourses in order to support Natural Forces Technologies Inc. in the planning stages of the wind farm development.

2.0 SITE DETAILS

Natural Forces Technologies Inc. has proposed the development of a single turbine, 2 MW wind farm at Gaetz Brook, located in Halifax County, Nova Scotia (Drawing 1, Appendix A). The Project site borders Highway 107 approximately 1.3 km south of the community of Gaetz Brook and consists of one parcel of land identified by Property Identification Number (PID) 00614167. The Project site encompasses approximately 100 acres of privately owned, vacant land incorporating multiple woods roads. The preliminary design consists of one wind turbine generator located in a cleared area in the eastern half of the site, as well as three potential access road options (Drawing 2, Appendix A).

3.0 METHODOLOGY

Preliminary identification of location and extent of potential wetlands across the Project site was completed by reviewing information from the following sources:

- aerial photography;
- Nova Scotia Wet Areas Mapping database (WAM);
- Nova Scotia Geomatics Centre;
- NS Significant Species and Habitats database; and
- topographical maps.

The information was then analyzed, using the following four criteria, to identify areas with a high potential for wetland habitat:

1. Wetlands identified on topographical maps and the NS Significant Species and Habitats Database.
2. Areas identified by WAM to have a depth to groundwater of less than 0.5 m.
3. Areas identified by WAM to have a depth to groundwater of between 0.5 m-2.0 m and located adjacent to "mapped" wetlands.
4. Areas of relatively flat land existing between areas identified by the WAM to have a depth to groundwater of less than 0.5 m, or between NSDNR mapped wetlands.

All high potential areas were incorporated into the development of a site plan that was then used to develop a field survey strategy.

The field survey was completed in August 2012, and was designed to focus on land associated with the proposed turbine location and access road options provided by Natural Forces Inc. (Drawing 2, Appendix A). The survey area included a 30 m wide easement along proposed road locations, and approximately 2 Ha for the proposed turbine location. Field observations and desktop information were used in combination to establish conservative wetland boundaries.

The following three criteria were used by the field team to determine wetland habitat:

1. Presence of hydrophytic (water loving) vegetation.
2. Presence of hydrologic conditions that result in periods of flooding, ponding, or saturation during the growing season.
3. Presence of hydric soils (anaerobic conditions in upper part)¹ (US Corps of Engineers, 1987).

Wetland boundaries were defined within the survey area by completing frequent soil pits to confirm the presence/absence of wetland hydrology and hydric soils. In addition, a general vegetation survey was completed to confirm the presence/absence of hydrophytic vegetation.

Waypoints were typically recorded in intervals ranging between 5-10 m apart along wetland boundaries. Detailed wetland delineation identification methodologies are attached as Appendix B.

Results of the desktop review were used in combination with observations from the field survey to identify approximate wetland boundaries.

Watercourses observed within the assessment area were identified and locations were recorded using a GPS. General characterization of the watercourse, including depth, width, and substrate, was also completed.

4.0 RESULTS

4.1 Desktop Review

The majority of areas with high potential for wetland habitat were found to exist via a combination of mapped wetlands and the WAM database. In eastern portions of the site, west of the proposed turbine location, high potential for wetland habitat was identified in the same location as a NS Geomatics identified swamp and where the WAM indicated a depth to groundwater of less than 0.5 m (Drawing 3, Appendix A). Similarly, in western portions of the site, high potential for wetlands were identified in areas where the WAM indicated a depth to groundwater of less than 0.5 m. This area connects to two mapped wetlands north of the Project site (identified by the NS Significant Species and Habitats database and NS

¹ Environmental Laboratory. (1987). "Corps of Engineers wetlands delineation manual," Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. NTIS No. AD A176 912 (Note: Appendix C information is out dated and must be obtained from regional Wetlands offices)

Geomatics Centre) (Drawing 3, Appendix A). In addition, WAM indicates that these wet areas likely connect to the Chezzetcook River located to the west of the Project site (Drawing 3, Appendix A).

4.2 Field Survey

The results of the field survey, including identification of defined wetland boundaries and watercourse locations², are presented in Drawing 4 (Appendix A). In addition, areas in close proximity to proposed roads and the proposed turbine pad, and that are expected to have a high likelihood of wetland habitat, based on a review of background material and field observations, have also been identified.

Wetland habitat within the survey area is interspersed throughout the site and consists of treed and shrub swamps (Drawing 4). Three of the five identified wetlands have been defined as 'throughflow' type features and as such, are associated with a watercourse identified during the survey. Wetlands 2 and 5 have been characterized as "outflow" type features which likely drain water to the north and supply water to portions of Wetland 1 and Chezzetcook River (Wetland 5) and an off-site waterbody or additional wetland habitat (Wetland 2). Wetland conditions are typically dominated by saturated surfaces, although areas of intermittent standing water were observed within wetlands 1 and 4. Table 1 provides a summary of characteristics for each wetland. A glossary of Commonly Used Terms is provided in Appendix C.

² Setback buffers have not been applied to watercourses or wetland habitat.

Table 1: Field Identified Wetland Characteristics

Wetland ID	Wetland Type	Landscape Position / Water Flow Path	Landform	Soil Type	Hydrologic Indicators	Dominant Vegetation			Watercourse / Water Body Present
						Herbs	Shrubs	Trees	
WL1	Treed Swamp	Lotic stream (confined) throughflow	Basin	Organic above depleted mineral	1) Intermittent standing water 2) Saturated at surface	– cinnamon fern (<i>Osmunda cinnamomea</i>) – three seeded sedge (<i>Carex trisperma</i>)	– speckled alder (<i>Alnus incana</i>) – red maple (<i>Acer rubrum</i>)	– black spruce (<i>Picea mariana</i>) – red maple – balsam fir (<i>Abies balsamea</i>)	Yes- Watercourse 1 enters from beyond the southern wetland boundary
WL2	Shrub Swamp	Terrene outflow (inferred)	Basin	Organic above depleted mineral	1) Saturated at surface 2) Drainage patterns	– cottongrass (<i>Eriophorum spp</i>) – woolgrass (<i>Scirpus cyperinus</i>) – cinnamon fern	– black spruce – red maple	none	Drainage from woods road provides source of water
WL3	Treed Swamp	Lotic stream (confined) throughflow (inferred)	Basin	Organic (A1 Histosol)	1) Saturated at surface	– cinnamon fern	– Canada holly – (<i>Ilex verticillata</i>) – black spruce – red maple	– red maple – black spruce	None observed but likely sourced by an area of open water to the north and/or connected to a Watercourse

Wetland ID	Wetland Type	Landscape Position / Water Flow Path	Landform	Soil Type	Hydrologic Indicators	Dominant Vegetation			Watercourse / Water Body Present
						Herbs	Shrubs	Trees	
WL4	Shrub Swamp	Lotic stream (confined) throughflow (inferred)	Basin	Organic (A1 Histosol)	<ul style="list-style-type: none"> – Saturated at surface – Intermittent standing water 	<ul style="list-style-type: none"> – three seeded sedge – cinnamon fern – woolgrass – Soft Rush (<i>Juncus effuses</i>) 	<ul style="list-style-type: none"> – eastern larch (<i>Larix laricina</i>) – balsam fir 	– red maple	None observed but likely drains into Watercourse 1 to the north
WL5	Shrub Swamp	Terrene outflow (inferred)	Basin	Organic (A1 Histosol)	<ul style="list-style-type: none"> – Saturated surface 	<ul style="list-style-type: none"> – cinnamon fern 	<ul style="list-style-type: none"> – Canada holly wild raisin (<i>Viburnum nudum</i>) – red maple 	– red maple	None observed but input provided via a drainage channel south of Project site boundary

The field survey also identified one watercourse in the survey area flowing in a southeast to northwest direction (Drawing 4). This watercourse is well defined, and small (>1 m wide) with depths between 10-20 cm and a silty substrate. Drainage occurs through a culvert to an active pit.

Based on the proposed road and turbine location, it is not expected that any of the identified wetlands or the watercourse will be impacted by the proposed turbine location. All three access road options (if used) however, would impact wetland habitat, within the Project site, and will require permitting. In terms of overall footprint, access road option 3 would likely incur the smallest impact to wetland habitat, whereas access road option 1 would incur the largest. Whichever road option is used, minimal adverse effects to wetland function and hydrology are expected, providing hydrologic connectivity structures and best management practices are employed during the design process. One watercourse crossing (and associated permitting) would be required if access road option 3 was utilized. There are no watercourse crossings existing in relation to access road options 1 and 2.

5.0 RECOMMENDATIONS

Recommendations for the proposed Gaetz Brook wind farm are as follows:

1. Once finalized, a detailed assessment for wetland habitat and watercourses should be completed for the chosen access road option and turbine pad footprint. Wetland delineation and functional assessment of wetland boundaries, within these locations, should be completed in the growing season (June 1 - September 30).
2. To comply with development regulations set out by the Municipality of Halifax Regional Municipality, a 20 m setback buffer is required for all watercourses and/or wetlands which are hydrologically connected to watercourses.

It should also be noted that development or infilling of wetland habitat associated with wind turbine locations, and/or construction of access roads, and any alteration of watercourses, will require provincial permitting approvals.

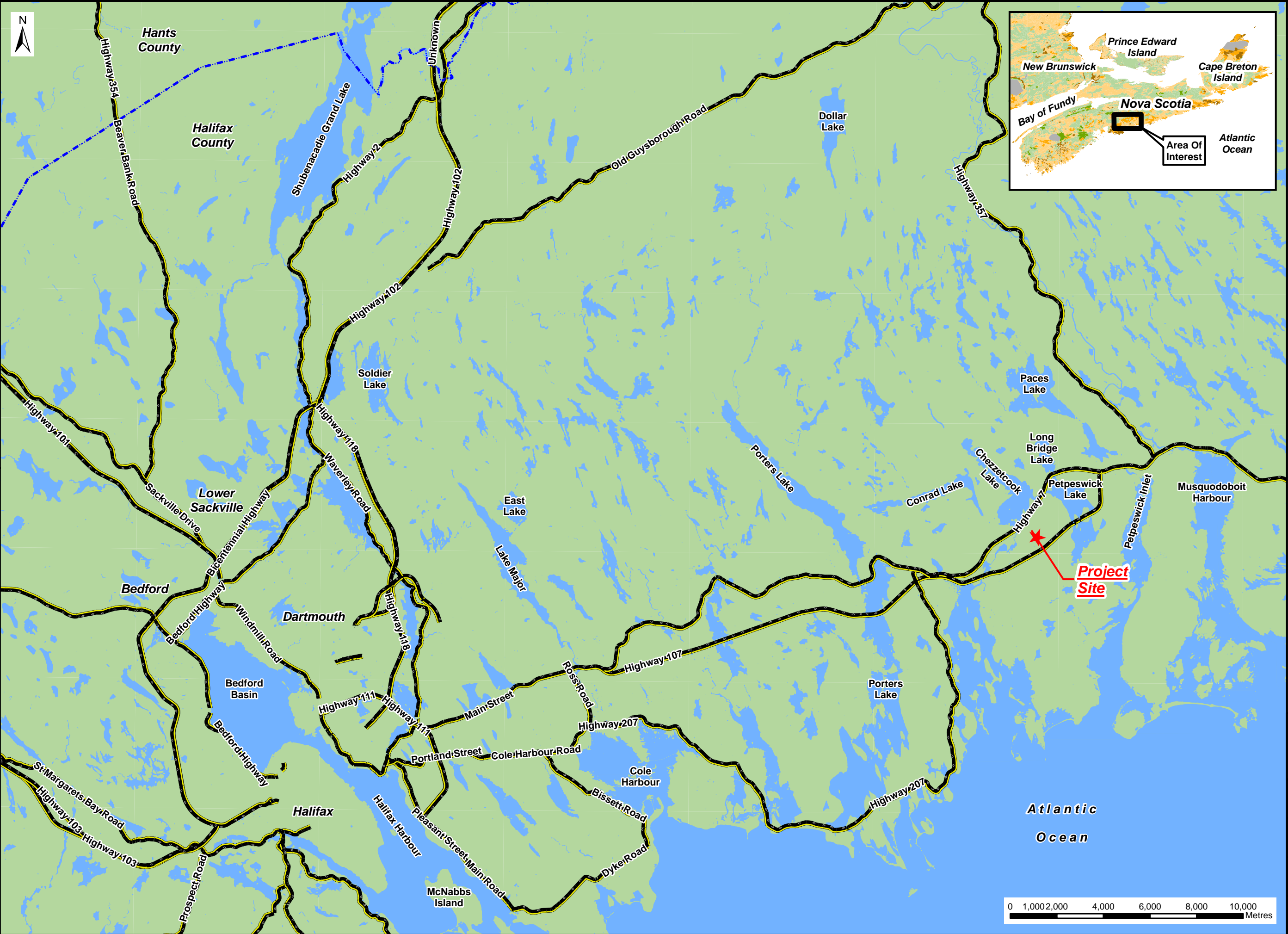
6.0 CLOSURE

This report has been completed for the sole benefit of Natural Forces Technologies Inc. Any other person or entity may not rely on this report without the express written consent of Strum Environmental and Natural Forces Technologies Inc.

The conclusions presented in this report represent the best judgement of the assessor based on the current environmental standards. The assessor is unable to certify against undiscovered environmental liabilities due to the nature of the investigation and the limited data available.

APPENDIX A

DRAWINGS



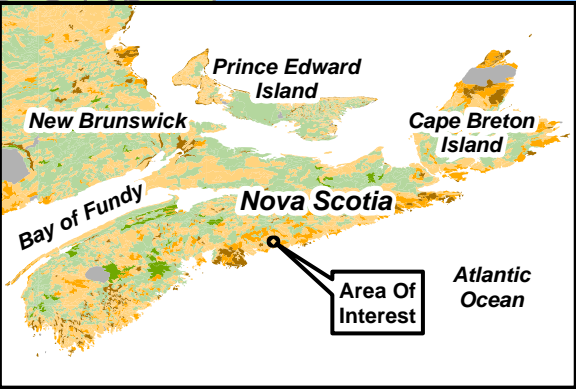
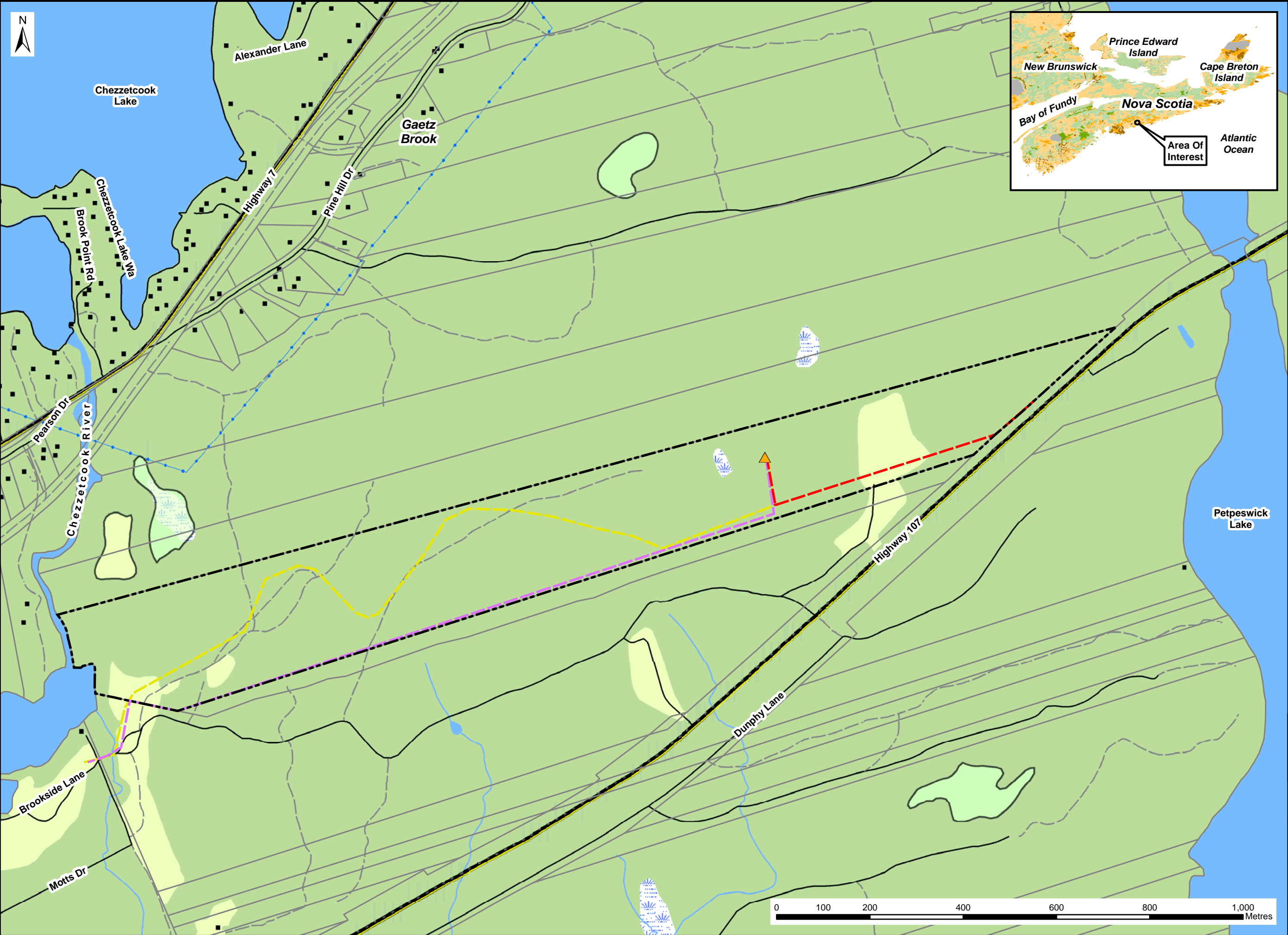
- Notes:**
1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre.
 2. Projection: NAD83(CSRS), UTM Zone 20 North.

- Legend:**
- County Boundary
 - Major Roads and Highways
 - Water Bodies

Gaetz Brook Site Location



Date: October 2012	Project #: 12-4428
Scale: 1:150,000	Drawing #: 1
Drawn By: H. Serhan	
Checked By: A. Walter	



- Notes:**
- Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre. Wetland Inventory By Nova Scotia Department Of Natural Resources (NS DNR).
 - Projection: NAD83(CSRS), UTM Zone 20 North.

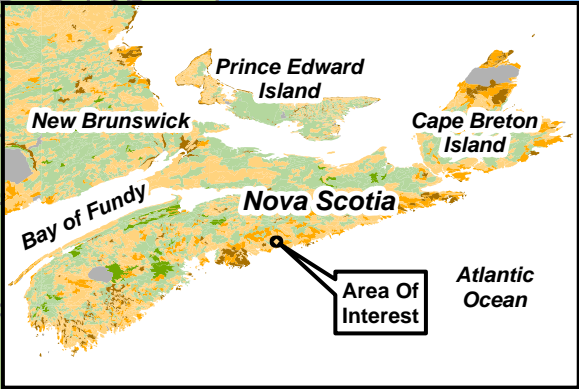
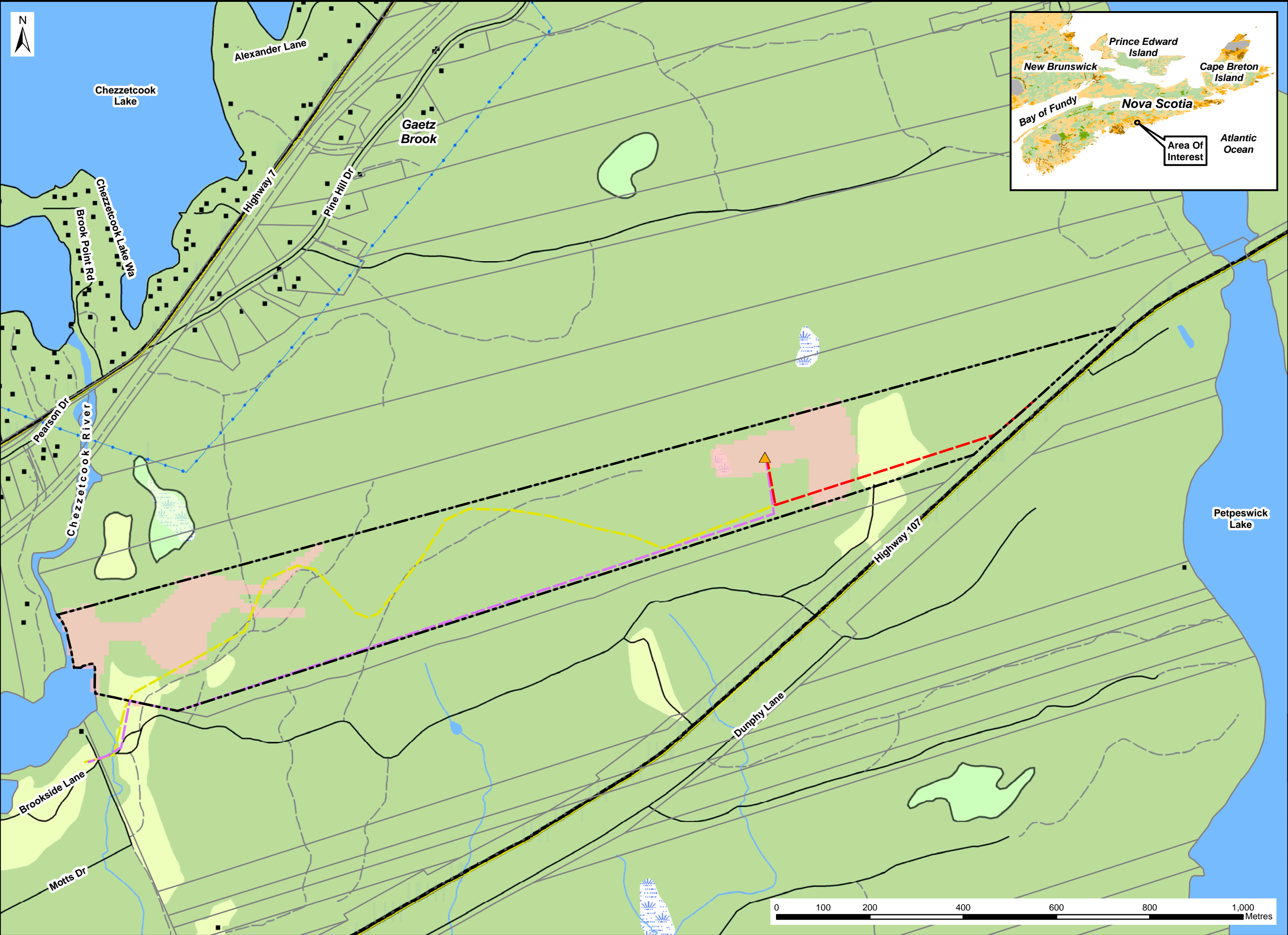
- Legend:**
- Proposed Turbine
 - Building
 - Access Option 1
 - Access Option 2
 - Access Option 3
 - Project Site Boundary
 - Major Roads and Highways
 - Roads
 - Access Roads / Trails
 - Existing Transmission Lines
 - Mapped Stream
 - Indefinite Stream
 - Water Bodies
 - Mapped Wet Area
 - Cleared Area
- NS DNR Wetland Inventory**
- Wetland Type**
- Bog or Fen
 - Fen
 - Marsh
 - Salt Marsh
 - Swamp
 - Water

**Gaetz Brook
Preliminary
Project Design**



Date: October 2012	Project #: 12-4428
Scale: 1:7500	Drawing #: 2
Drawn By: H. Serhan	
Checked By: A. Walter	





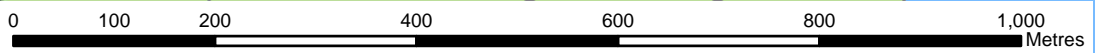
- Notes:**
- Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre. Wetland Inventory By Nova Scotia Department Of Natural Resources (NS DNR).
 - Projection: NAD83(CSRS), UTM Zone 20 North.

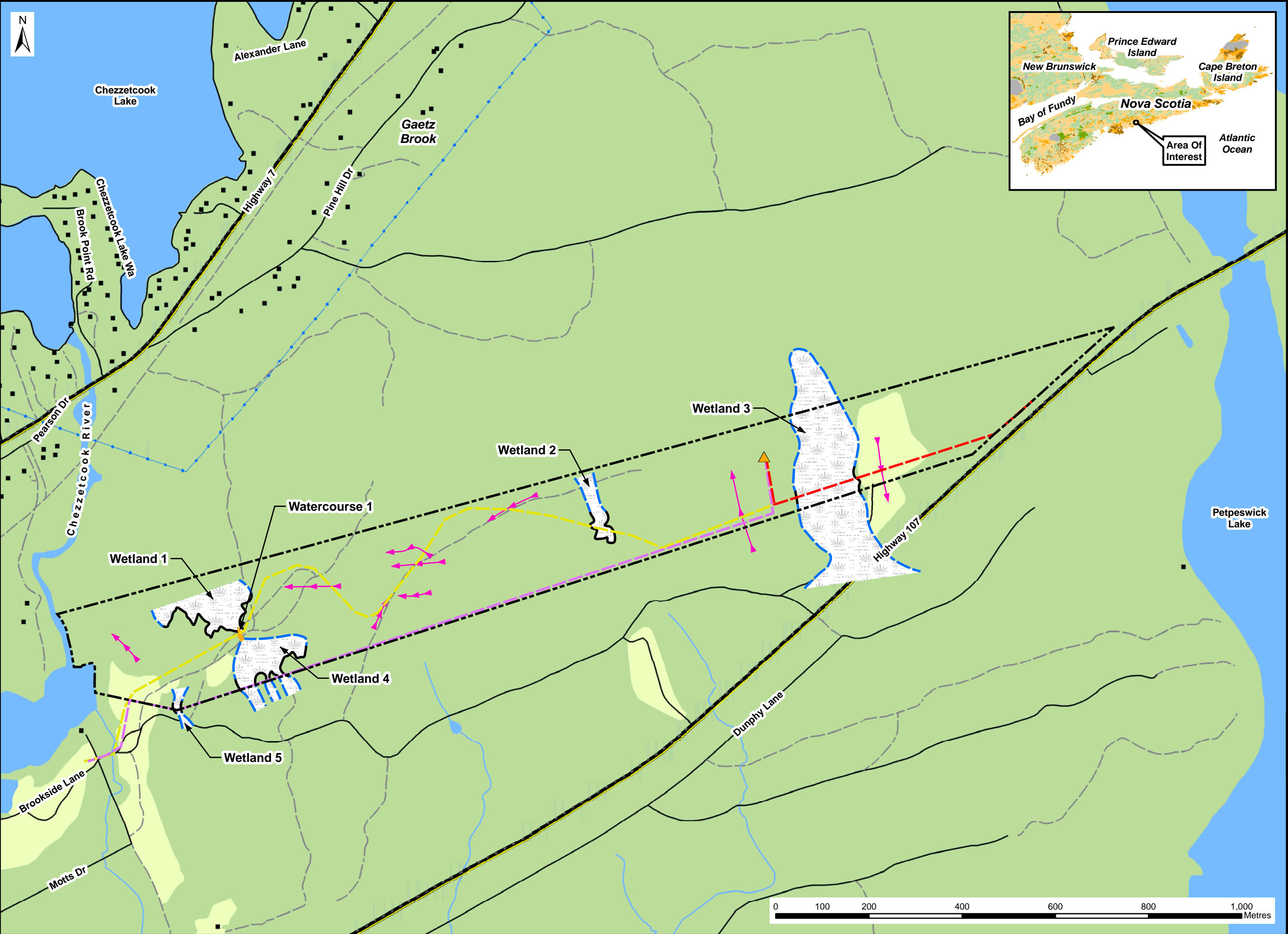
- Legend:**
- Proposed Turbine
 - Building
 - Access Option 1
 - Access Option 2
 - Access Option 3
 - High Potential Wetland Areas
 - Project Site Boundary
 - Major Roads and Highways
 - Roads
 - Access Roads / Trails
 - Existing Transmission Lines
 - Mapped Stream
 - Indefinite Stream
 - Water Bodies
 - Mapped Wet Area
 - Cleared Area
- NS DNR Wetland Inventory**
- Wetland Type**
- Bog or Fen
 - Fen
 - Marsh
 - Salt Marsh
 - Swamp
 - Water

**Gaetz Brook
High Potential
Wetland Areas**



Date: October 2012	Project #: 12-4428
Scale: 1:7500	Drawing #: 3
Drawn By: H. Serhan	
Checked By: A. Walter	





- Notes:**
1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre.
 2. Projection: NAD83(CSRS), UTM Zone 20 North.
 3. GPS Points Taken are Typically to +/-5m Accuracy.

- Legend:**
- Proposed Turbine
 - Buildings
 - Access Option 1
 - Access Option 2
 - Access Option 3
 - Project Site Boundary
 - Field Identified Watercourse
 - Field Identified Drainage
- Wetland Boundaries**
- Type
- Confirmed
 - Approximate
 - Field Identified Wetlands
 - Major Roads and Highways
 - Roads
 - Access Roads / Trails
 - Existing Transmission Lines
 - Mapped Stream
 - Indefinite Stream
 - Water Bodies
 - Cleared Area

**Gaetz Brook
Wetland
Assessment:
Survey Results**



Date: October 2012	Project #: 12-4428
Scale: 1:7500	Drawing #: 4
Drawn By: H. Serhan	
Checked By: A. Walter	



APPENDIX B
WETLAND IDENTIFICATION METHODOLOGIES

Wetlands and Watercourses in Nova Scotia

Wetlands in Nova Scotia are regulated by NSE under Section 105 of the *Environment Act*. Under the Act, wetlands are:

Land referred to as a marsh, swamp, fen, or bog that either periodically or permanently has water table at, near, or above the land surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation, and biological activities adapted to wet conditions.

Watercourses are defined in the *Environment Act* as:

Any creek, brook, stream, river, lake, pond, spring, lagoon, or any other natural body of water, and includes all the water in it, and also the bed and the shore (whether there is actually any water in it or not). It also includes all groundwater.

Watercourses are defined in Halifax Regional Municipality (HRM) land use by-laws as:

A lake, river, stream, ocean, or other natural body of water.

Delineation Methodology

In order for a wetland determination to be made, the following three criteria were assessed the field:

- Presence of hydrophytic (water loving) vegetation;
- Presence of hydrologic conditions that result in periods of flooding, ponding, or saturation during the growing season; and
- Presence of hydric soils (anaerobic conditions in upper part).

Although detailed data point analysis was not completed within the study areas, soil pits were completed frequently to confirm the presence/absence of wetland hydrology and hydric soils, as per the methodology below. A general vegetation survey was also completed within the wetlands to confirm hydrophytic vegetation.

Identification of Hydrophytic Vegetation

Hydrophytic vegetation is defined as the sum total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanent or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present (Environmental Laboratory 1987). Hydrophytic vegetation should be the dominant plant type in wetland habitat (Environmental Laboratory 1987).

WETLAND DELINEATION IDENTIFICATION METHODOLOGY

Dominant plant species observed in each wetland were classified according to indicator status (probability of occurrence in wetlands), in accordance with the U.S. Fish and Wildlife Service (USFWS) National List of Vascular Plant Species that Occur in Wetlands: NE Region (Region 1) (Reed 1988). Please refer to Table 1 (below) for these classifications. These indicators are used as this region most closely resembles the flora of Nova Scotia and climate regime. Further relevant information was reviewed in Flora of Nova Scotia (Zinck, 1998).

Table 1: Classification of Wetland-Associated Plant Species¹

Plant Species Classification	Abbreviation ²	Probability of Occurring in Wetland
Obligate	OBL	>99%
Facultative Wetland	FACW	66-99%
Facultative	FAC	33-66%
Facultative Upland	FACU	1-33%
Upland	UPL	<1%
No indicator status	NI	Insufficient information to determine status
Plants That Are Not Listed (assumed upland species)	NL	Does not occur in wetlands in any region.

¹ Source: Reed 1988

² A '+' or '-' symbol can be added to the classification to indicate greater or lesser probability, respectively, of occurrence in a wetland.

If the majority (greater than 50%) of the dominant vegetation at a data point is classified as obligate (OBL), facultative wetland (FACW), or facultative (FAC), then the location of the data point is considered to be dominated by hydrophytic vegetation.

Identification of Hydric Soils

A hydric soil is a soil that has formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (USDA-NRCS 2010). Indicators of the presence of a hydric soil include soil colour (gleyed soils and soils with bright mottles and/or low matrix chroma), aquic or preaquic moisture regime, reducing soil conditions, sulfidic material (odour), soils listed on the hydric soils list, iron and manganese concretions, organic soils (histosols), histic epipedon, high organic content in surface layer in sandy soils, and organic streaking in sandy soils.

Soil pits were excavated to a maximum depth of 40 cm or refusal. The soil in each was then examined for hydric soil indicators. The matrix colour and mottle colour (if present) of the soil were determined using the Munsell Soil Colour Charts.

Determination of Wetland Hydrology

Wetland habitat, by definition, either periodically or permanently, has a water table at, near, or above the land surface or that is saturated with water. To be classified as a wetland, a site should have at least one primary indicator or two secondary indicators of wetland hydrology, as shown in Table 2.

WETLAND DELINEATION IDENTIFICATION METHODOLOGY

Table 2: Indicators of Wetland Hydrology

Examples of Primary Indicators	Examples of Secondary Indicators
Water marks	Oxidized Root Channels in the Upper 30 cm
Drift Lines	Local Soil Survey Data
Sediment Deposition	Dry season Water Table
Drainage Patterns	Stunted or Stressed Plants
Water-stained leaves	
Visual Observation of Saturated Soils	
Visual Observation of Inundation	

Wetland habitat is assessed for signs of hydrology, via visual observations across the area and through assessment of soil pits.

References

Environmental Laboratory (1987), Corps of Engineers Wetlands Delineation Manual, US Army Corp of Engineers, 1987.

Reed. 1988. National List of Plant Species that Occur in Wetlands: NE Region (Region 1) U.S. Fish and Wildlife Service, Washington, DC.

USDA-NRCS. (United States Department of Agriculture- Natural Resources Conservation Service). 2010. *Field Indicators of Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils*. Version 7.0. 53 pp.

Zinck, M. 1998. *Rolands Flora of Nova Scotia*. Nimbus Publishing, Nova Scotia.

Environmental Laboratory. (1987). "Corps of Engineers wetlands delineation manual," [Technical Report Y-87-1](#), U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. NTIS No. AD A176 912 (Note: Appendix C information is outdated and must be obtained from regional Wetlands offices)

APPENDIX C
GLOSSARY OF COMMONLY USED TERMS

Anaerobic – A situation in which molecular oxygen is absent (or effectively so) from the environment.

Artificial Wetland – A created wetland requiring constant maintenance to remain a wetland.

Aerobic – A situation in which molecular oxygen is part of the environment.

Aquic moisture regime – A mostly reducing soil moisture regime nearly free of dissolved oxygen due to saturation by ground water or its capillary fringe and occurring at periods when the soil temperature at 19.7 in. is greater than 5 °C.

Baseline Study – An inventory of an existing community or environment that may provide information for planning or establishing goals for success criteria.

Basin – a depression.

Bidirectional-non-tidal – water levels subject to rise and fall due to fluctuations in lake levels; only applied to lentic wetlands (excluding those with a stream bisecting them = throughflow).

Bidirectional tidal – water levels subject to ebb and flood by tides.

Bog – acidic, nutrient-poor peatland characterized by woody plants (shrub bogs by ericaceous shrubs or treed bogs by black spruce, for example) and nearly permanently saturated soils.

Braided – Where streams or rivers divide into a network of smaller channels which are divided by often temporary islands.

Buffer – An area of land bordering a waterbody and/or wetland habitat which has been designated as a no activity zone, in order to protect the marine or freshwater resource.

Chroma – The relative purity or saturation of a colour; intensity of distinctive hue as related to grayness; one of the three variables of colour.

Concretion – A local concentration of chemical compounds (e.g. calcium carbonate, iron oxide) in the form of a grain or nodule of varying size, shape, hardness, and colour. Concretions of significance in hydric soils are usually iron and/or manganese oxides occurring at or near the soil surface, which develop under conditions of prolonged soil saturation.

Conservation – Ensuring that loss or degradation of wetland ecosystem functions does not occur and that previously lost or damaged functions are recovered.

Contiguous – Whereby two or more areas of wetland habitat are hydrologically connected via a watercourse and/or drainage channel.

Contour – An imaginary line of constant elevation. The corresponding line on a map is called a contour line.

Created Wetland – The conversion of a persistent upland vegetation community or ephemeral shallow water area into a permanent wetland where no previous wetland existed.

Diked – wetland surrounded by berms (dykes), may be flooded or not

Farmed – area still wet enough to be considered wetland but subject to tillage or cultivation or wet-dependent plants (e.g., cranberries).

Disturbed Wetland – A wetland that is directly or indirectly altered by external human or natural forces.

Dominance – A descriptor of vegetation that is related to the standing crop of a species in an area, usually measured by height, areal cover or basal area (for trees).

Dominant Species – A plant species that exerts a controlling influence on or defines the character of a community.

Drained – A condition in which the level or volume of groundwater or surface water has been reduced or eliminated from an area by artificial means.

Emergent Plant – A rooted plant that has parts extending above the water surface, at least during portions of the year but does not tolerate prolonged inundation.

Enhanced Wetland – An existing wetland where some planned activity by humans addresses stresses or limitations that result in an increase of one or more functions or values.

Entrenched – wetland along a stream that has undergone significant erosion, creating a deep channel.

Estuarine-Embayment – located along the shores of an open bay or similar embayment in salt-brackish tidal waters.

Estuarine-Channel – located along the shores of a tidal river in the salt-brackish zone.

Eutrophic – Refers to a water body with more nutrients than its aquatic plant community can use, occasionally resulting in algal blooms.

Excavated – material removed from the wetland creating a depression.

Exotic – Not indigenous to a region; intentionally or accidentally introduced.

Fen – a mineral-rich peatland that can be dominated by a variety of plants both herbaceous and woody including calcium-loving plants (calciphiles); examples are graminoid fen, shrub fen, and treed fen

Fill Material – Any material placed in an area to increase surface elevation.

Flat – a nearly level area with no detectable slope.

Flooded – A condition in which the soil surface is temporarily covered in flowing water from any source, such as streams overflowing their bank, runoff from adjacent or surrounding slopes, inflow from high tides, or any combination of these sources.

Floodplain – a plain subject to river overflow and characterized by alluvial (water-deposited) soils; basin – depressions on the floodplain; flat – nearly level land

Flora – A list of all plant species that occur in an area.

Fringe – bordering a water body and in tidal areas, any salt marsh or other wetland that is flooded by typical high tides and in non-tidal areas, usually a marsh in standing water (typically flooded all year in most years) and no-vegetated wetlands within the stream or river banks (in the ordinary high water mark zone).

Float mat – wetland that is not rooted to the underlying substrate; may float around in a lake, for example.

Function – The physical, chemical and biological processes, attributes and linkages related to a particular wetland.

Gleyed – A soil condition resulting from prolonged soil saturation, which is manifested by the presence of bluish or greenish colours through the soil mass or in mottles spots or streaks) among other colours. Gleying occurs under reducing soil conditions resulting from soil saturation, by which iron is reduced predominantly to the ferrous state.

Grazed – wetland actively used as pasture.

Growing Season – The portion of the year when soil temperatures at 19.7 in. below the soil surface are higher than biologic zero (5°) (U.S. Department of Agriculture-soil Conservation Service 1985). For ease of determination this period can be approximated by the number of frost free days (U.S Department of the Interior 1970). The growing season in Nova Scotia is June 01 – September 30.

Habitat – The environment occupied by individuals of a particular species, population or community, including everything required during the life cycle such as food, shelter and breeding places.

Headwaters – The origins of streams and rivers.

Herb – A non-woody individual of a macrophytic species.

Herbaceous Layer – Any vegetative stratum of a plant community that is composed predominantly of herbs.

Histic epipedon – A 20-40cm soil layer at or near the surface that is saturated for 30 consecutive days or more during the growing season in most years and contains a minimum of 20 percent organic matter when no clay is present or a minimum of 30 percent organic matter when 60 percent or greater clay is present.

Histosol – An order in soil taxonomy composed of organic soils that have organic soil materials in more than half of the upper 8 cm or that are of any thickness if directly over bedrock.

Hue – A characteristic of colour that denotes a colour in relation to red, yellow, blue, etc; one of the three variables of colour. Each colour chart in the Munsell Colour Book (Munsell Colour 1975) consists of a specific hue.

Hydric Soil – Soil characterized by abundance of moisture and much reduced oxygen levels, to the extent that the soil tolerates water-tolerant vegetation.

Hydrologic Regime – The distribution and circulation of water in an area during a given period including its fluctuations periodicity.

Hydrology – The science dealing with the properties, distribution and circulation of water both on and under the surface.

Hydrophytic Vegetation (plants) – Vegetation adapted to growing in water or in hydric soil.

Indicator – An event, entity or condition that typically characterizes a prescribed environment or situation; indicators determine or aid in determining whether or not certain stated circumstances exist.

Indicator status – One of the categories (e.g. OBL) that describes the estimated probability of a plant species occurring in wetlands.

Indigenous – Species which are native to a region.

Inflow – water flows into the subject wetland from an upstream channel

Inundation – A condition in which water from any source temporarily or permanently floods land surface.

Irregularly flooded-tidal – inundated less than daily by the tides

Isolated – water flow comes from high groundwater levels or from surface or subsurface runoff; no channeled flow in or out of the wetland; may be subject to overflow during extreme precipitation or snowmelt events; wetland is “geographically isolated” – surrounded completely by upland (non-hydric soils).

Logged – forested wetland where timber has been recently harvested

Lotic River-Unconfined – Located along a river (width ≥ 20 m) with a distinct floodplain

Lotic River-Confined – Located along a river (width ≥ 20 m) with little or no floodplain

Lotic Stream-Unconfined – Located along a stream (width < 20 m) with a distinct floodplain

Lotic Stream-Confined – Located along a stream (width < 20 m) with little or no floodplain

Lotic Pond – Located along an in-stream pond.

Lentic Lake – Located along the shores of a lake.

Lentic Reservoir – Located along the shores of a reservoir.

Macrophyte – Any plant species that can be readily observed without the aid of optical magnification including all vascular plant species and mosses, as well as some attached and filamentous algae.

Marsh – Freshwater wetland usually flooded for the entire growing season and dominated by herbaceous vegetation.

Mesophytic – Any plant species growing where soil moisture and aeration conditions lie between extremes. These species are typically found in habitats with average moisture conditions, neither very dry nor very wet.

Mineral soil – A soil consisting predominantly of, and having its properties determined predominantly by, mineral matter (sand, silt, clay) usually containing less than 20 percent organic matter.

Minerotrophic – Referring to waters rich in dissolved minerals, and to plant species and communities which grow well in these conditions.

Mitigation – The prevention, modification, or alleviation of impacts on the natural environment including any action with the intent to enhance beneficial effects.

Monitoring – Periodic evaluation of a site to determine success in achieving goals.

Mottles/Mottling – Spots or blotches of different colour or shades of colour interspersed within the dominant colour in a soil layer, usually resulting from the presence of periodic reducing soil conditions.

Muck – Highly decomposed organic material in which the original plant parts are not recognizable.

Natural Wetland – Dominated by native biota and occurring within a biophysical system which has developed through processes devoid of human intervention. Formed by natural processes (e.g. deglaciation, Aeolian processes, tectonic forces, or karst)

Nuisance Species – Species that detract from or interfere with wetland functions and/or values.

Ombrotrophic – Referring to waters poor in nutrients, where nutrients are obtained mostly from precipitation, and to plant species and communities which grow well in these conditions.

Organic soil – A soil is classified as an organic soil when it is 1) saturated for prolonged periods (unless artificially drained) and has more than 30 percent of organic matter if the mineral fraction is more than 50 percent clay, or more than 20 percent organic matter if the mineral fraction has no clay; or 2) never saturated with water for more than a few days and having more than 34 percent organic matter.

Outflow – Water flows out of the wetland, downslope from this source; no channeled surface water inflow.

Overbank flooding – Any situation in which inundation occurs as a result of the water level of a stream rising above bank level.

Paludified – Water levels or saturation affected by paludification processes, i.e., peat mosses wicking up water from a depression, spring, or seep and thereby allowing the wetland to creep uphill, smothering upland vegetation and converting these sites to wetland

Partly drained – Ditched or tile-drained but still wet enough to be considered wetland

Peat – An accumulation of partially decayed vegetation matter or histosol formed in areas where full decomposition is inhibited by acidic and anaerobic conditions.

Periodically – Detectable regular or irregular saturated soil conditions or inundation, resulting in ponding of groundwater, precipitation, overland flow, stream flooding or tidal influences that occur(s) with hours, days, weeks, months or even years between events.

Permanently flooded – Inundated year-round in all years.

Permanently saturated – High water tables virtually year-round, conditions favor development of peat.

Plant Community – All of the plant populations occurring in a shared habitat or environment.

Ponded – A condition in which water stands in a closed depression. Water may be removed only by percolation, evaporation and/or transpiration.

Poorly Drained – Soils that commonly are wet at or near the surface during a sufficient part of the year that field crops cannot be grown under natural conditions. Poorly drained conditions are caused by a saturated zone, a layer with low hydraulic conductivity, seepage, or a combination of these conditions.

Positive Wetland Indicator – Any evidence of the presence of hydrophytic vegetation, hydric soil and/or wetland hydrology in an area.

Preliminary Wetland Determination – The process or procedure by which an area is adjudged a wetland or non-wetland outside of the accepted growing season (May 1 – September 30).

Reduced soil – A soil in which oxygen has been removed and chemical reduction of ions has taken place.

Redox Features – A distinct soil morphological characteristic most readily observable by a change in soil colour. Redox features are formed by the reduction of iron and manganese oxides in the soil when in an anaerobic state i.e. soil is saturated and there is an absence of oxygen.

Regularly flooded-tidal – Inundated by the tides at least once daily.

Rehabilitation – Improving the function and values of a degraded wetland.

Relief – The elevation of a land surface between two points; including the configuration of features such as hills and valleys.

Restoration – Changing existing function and structure of wetland habitat so that it is similar to historical conditions.

Restored – Former wetland that was destroyed (e.g., effectively drained, filled, or excavated) that has regained its wetland functions by human intervention, or existing wetland with impaired functions whose functions have been completely or partially improved by human action where the goal is to restore natural functions

Rhizosphere – The zone of soil in which interactions between living plant roots and microorganisms occur.

Riparian – Inhabiting, or situated on the bank of a river, stream or watercourse.

Root Zone – The portion of a soil profile in which plant roots occur.

Salt Marsh – Tidal wetland flooded by salt water and characterized by halophytic plants

Sapling/shrub – A layer of vegetation composed of woody plants <0.8 m in diameter at breast height but greater than 1 m in height, exclusive of woody vines.

Saturated soil – A condition where all easily drained voids (pores) between soil particles in the root zone are temporarily or permanently filled with water to the soil surface at pressures greater than the atmosphere.

Seasonally flooded – Inundated for extended periods usually early in the growing season, typically flooded for more than a week

Seasonally saturated – High water tables for extended periods during the year, usually from late fall into spring, conditions favor development of mineral hydric soils

Semi-permanently flooded – Inundated year-round in most years, except extended dry periods (including droughts).

Soil matrix – The portion of a given soil having the dominant colour. In most cases, the matrix will be the portion of the soil having more than 50 percent of the same colour.

Soil texture – The relative proportions of the various sizes of particles in a soil.

Stunted – The inhibition of growth and development of trees and shrubs attributed to an excess of soil moisture (hydrology) and/or shallow rooting zones i.e. shallow bedrock.

Substrate – The base on which an attached species is growing.

Succession – Replacement of one vegetation community by another. Succession may be human induced or natural due to forces such as climate, hydrology or species competition.

Swamp – Freshwater wetland dominated by woody plants (shrub swamp or forested/treed swamp), often growing on mineral soils or mucks, and subject to seasonally flooded for extended periods.

Terrene – Located at the uppermost area in a subbasin (i.e., the source of a stream), or located along a river or stream but at an elevation not subject to overbank flooding, or located in an isolated basin, on an isolated flat, or on an isolated slope

Terrene Pond – Located along the shores of an isolated pond (no outlet)

Temporarily flooded – Inundated for brief periods usually at the beginning of the growing season, typically flooded for a week or less

Throughflow – Water flows in and out of wetland, typically as overbank flow, but also includes wetlands along lakes (lentic wetlands) that have a stream coursing through them from locations outside the lake

Topography – The pattern of the soil surface, including its relief and the position of its natural and manmade features.

Transect – A line on the ground along which observations are made at some interval.

Transition Zone – The area in which a change from one vegetation community to another, or from wetland to non-wetland habitat occurs.

Tree – A woody plant > 0.8 m in diameter at breast height, regardless of height (exclusive of woody vines).

Upland – Any area that does not qualify as a wetland because the associated hydrologic regime is not sufficiently wet to elicit development of vegetation, soils and/or hydrologic characteristics associated with wetlands. Such areas occurring within floodplains are more appropriately termed non-wetlands.

Value (soil colour) – The relative lightness or intensity of a colour.

Vegetation layer – A subunit of a plant community in which all component species exhibit the same growth form (e.g. trees, saplings/shrubs, herbs).

Watercourse (as defined under Section 105 of the *Environment Act*) – Any creek, brook, stream, river, lake, pond, spring, lagoon, or any other natural body of water, and includes all the water in it, and also the bed and the shore (whether there is actually in it or not). It also includes groundwater.

Watercourse – (as defined in the Halifax Regional Municipality [HRM] land use by-laws) – A lake, river, stream, ocean or other natural body of water.

Watershed – An area of land where water from rain and melting snow or ice drains downhill into a body of water, such as a river, lake reservoir, estuary etc. The watershed includes the streams and rivers that convey the water as well as wetlands and other natural heritage features and land surfaces from which water drains. The principle of 'everything is connected' is clearly evident in a watershed, as it involves water and any other feature or function that affects or is affected by water.

Water Table (groundwater) – The surface below which the soil is saturated with water.

Wetland – Lands that are seasonally or permanently covered by shallow water, including lands where the water table is at or very close to the surface. In either case, the presence of abundant water has caused the formation of hydric soils and has favoured the dominance of either hydrophytic or water-tolerant plants.

Wetland boundary – The point on the ground at which a shift from wetlands to nonwetlands or aquatic habitats occurs.

Wetland determination – The process or procedure by which an area is adjudged a wetland or non wetland.



April 22, 2013

Mr. Kelly Browne
Natural Forces Technologies Inc.
#1030 - 1791 Barrington Street
Halifax, NS B3J 3L1

Dear Mr. Browne,

Re: Wetland and Watercourse Assessment: Gaetz Brook Community Wind Farm
PIDs 00614107, 40018541 and 00613083

INTRODUCTION

Strum Consulting was retained by Natural Forces Technologies Inc. to conduct a preliminary wetland survey on three properties (PIDs 00614107, 40018541 and 00613083) in Gaetz Brook, NS. The objective of the study was to identify areas of wetland habitat and watercourses in support of planning the location of access roads associated with the Gaetz Brook Community Wind Project.

The scope of the study involved completion of a field survey to identify preliminary wetland boundaries and watercourse locations within the footprint of the planned access road, in order to determine potential impacts to wetlands and/or watercourse crossings.

BACKGROUND

In summer of 2012 Strum Consulting completed a wetland and watercourse assessment at three potential access road routes, as well as at the location of a proposed wind turbine. Results of the assessment indicated that no areas of wetland habitat were identified at the turbine location, however multiple areas of wetland habitat were observed along the potential access road locations, (Drawing 1). Subsequent modifications to the Project footprint have determined an alternate access road location which extends to the north of the previously assessed area.

METHODOLOGY

Field surveys were conducted on April 2nd, 2013 along a 30 m easement centred along the proposed road (the Study Area). Wetlands were delineated based on the methodology set out by the US Corps

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of Engineers Wetland Delineation Manual (1987). Preliminary wetland boundaries were walked and flagged using pink flagging tape marked 'wetland delineation' and the boundaries were documented by recording the position of each flag using a GPS unit capable of sub-5 m accuracy.

Where wetland habitat was observed to extend beyond the Study Area, 'approximate' wetland boundaries were identified. Where wetlands were observed to be contiguous with a watercourse (i.e., joined to a watercourse), a 20 m Halifax Regional Municipality (HRM) setback buffer was applied to the wetland boundaries.

Detailed delineation methodologies are attached.

RESULTS

Wetlands

A total of seven areas of wetland habitat were identified within the 2013 Study Area (Drawing 2). This includes four new wetlands (Wetlands 6 - 9) and three wetlands that were identified during the 2012 assessment (Wetlands 1, 2, and 4).

Based on contiguity with watercourses, a 20 meter HRM buffer has been applied to the boundaries of Wetlands 1, 4 and 6.

Information regarding the characteristics of wetlands within the Study Area is provided in Table 1. Representative photos are attached.

Table 1: Wetland Information

Wetland ID	Wetland Type	Comments	Photo
Wetland 1	Treed swamp	The southern edge of this wetland would be impacted by road construction. Watercourse 1 flows through this wetland via a culvert from south to north.	1
Wetland 2	Treed swamp	The southern edge of this wetland would be impacted by road construction.	2
Wetland 4	Shrub swamp	The northern edge of this wetland would be impacted by road construction. This wetland sources watercourse 1.	3
Wetland 6	Shrub swamp	The northern edge of this wetland would be impacted by road construction. Watercourses 2 and 2a flow through this wetland.	N/A
Wetland 7	Treed swamp	The eastern edge of this wetland would be impacted by road construction.	4
Wetland 8	Treed swamp	This wetland would not be impacted by the Project footprint.	5
Wetland 9	Bog	This wetland would not be impacted by the Project footprint.	N/A

Drainage Features

Multiple narrow drainage features were observed throughout the Study Area. The majority of drainage features have been formed by rutting associated with historical logging activities, and exhibit areas of pooling and draining water (Photo 6). One un-disturbed drainage feature was observed to drain ephemerally out of Wetland 2 to the south. An additional drainage feature was identified in western portions of the Study Area and exists as an artificial ditch running alongside an existing road. This ditch contributes a significant hydrological input of water into Wetland 1 (Photo 7).

Watercourses

A total of three watercourses were identified within the Study Area including two new watercourses (Watercourses 2 and 2a), and one watercourse (Watercourse 1) that was identified during the 2012 assessment. Details regarding the watercourse characteristics are outlined in Table 2. Representative photos are attached.

Table 2: Watercourse Characteristics

Watercourse ID	Drainage Direction	Bankfull Width (m)	Bankfull Depth (cm)	Comments	Photo
Watercourse 1	south to north	1.65	45	Drains Wetland 4 beneath an existing road via culvert, and then flows through Wetland 1.	1
Watercourse 2	south to north	2.45	25	Flows through Wetland 6, merges with Watercourse 2a, and then passes beneath Brookside Road via a culvert.	8
Watercourse 2a	west to east	1.45	55	Flows beneath Motts Drive through culvert into Wetland 6, and then merges with Watercourse 2.	

PROVINCIAL AND MUNICIPAL REGULATIONS

Provincial

The Nova Scotia Wetland Alteration Approval process determines the following activities as a wetland alteration:

- filling;
- draining;
- flooding; and
- excavating.

Certain exemptions for wetland alteration approval are possible under the Nova Scotia Environment Wetland Conservation Policy. Approvals are not required for linear developments that are less than 10m wide and less than 600 square meters in total area (such as forest access roads, secondary roads and driveways) through shrub or wooded swamps that are not classified as "Wetlands of Special Significance".

Municipal

For the basis of this assessment, the water features on the property have been classified according to the HRM watercourse definition. Accordingly, appropriate 20 m buffer requirements have been applied to wetland boundaries and watercourses (Drawing 2). However, as detailed in the HRM Regional Municipal Planning Strategy (2006¹), provisions shall be made to permit the development of “driveway crossings” within a buffer. In addition, if the Project footprint requires provincial wetland approval, a provision will be made to permit the planned development within the municipal buffer, at the wetland alteration location.

CONCLUSION

Based on the current development footprint, five wetlands (Wetlands 1, 2, 4, 6 and 7) and three watercourses (Watercourse1, 2 and 2a) will be impacted by the construction of the access road. No wetlands or watercourses will be impacted by the turbine lay-down pad.

RECOMMENDATIONS

Based on the impacts that the on-site wetlands and watercourses are likely to incur, the following recommendations are provided:

1. Alteration of wetland habitat is subject to provincial permitting requirements. If required, approvals for wetland alteration should be obtained in advance.
2. Alteration of watercourses identified on the property will require provincial permitting and should be obtained in advance.
3. If development is planned within, or in close proximity to identified wetlands, confirmation of wetland boundaries should be completed during the growing season (June 1-September 30).
4. Although permitting is not required to alter the drainage features, it is advisable that hydrological connectivity with wetland habitat is maintained.

CLOSURE

This report has been completed for the sole benefit of Natural Forces Technologies Inc. Any other person or entity may not rely on this report without the express written consent of Strum Consulting and Natural Forces Technologies Inc.

The conclusions presented in this report represent the best judgement of the assessor based on the current environmental standards. The assessor is unable to certify against undiscovered environmental liabilities due to the nature of the investigation and the limited data available.

This report was prepared from information collected during site visits undertaken on April 2nd, 2013. The results in this report rely only on the conditions identified at this time.

Should additional information become available, Strum requests that this information be brought to our attention immediately so that we can re-assess the conclusions presented in this report. This report

¹ Regional Municipal Planning Strategy. 164 pp.

was prepared by Scott Dickey, Environmental Specialist and reviewed by Carys Burgess, Senior Environmental Specialist.

If you have any questions, please contact us.

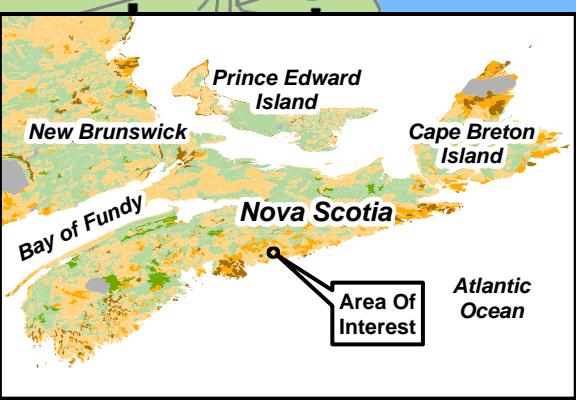
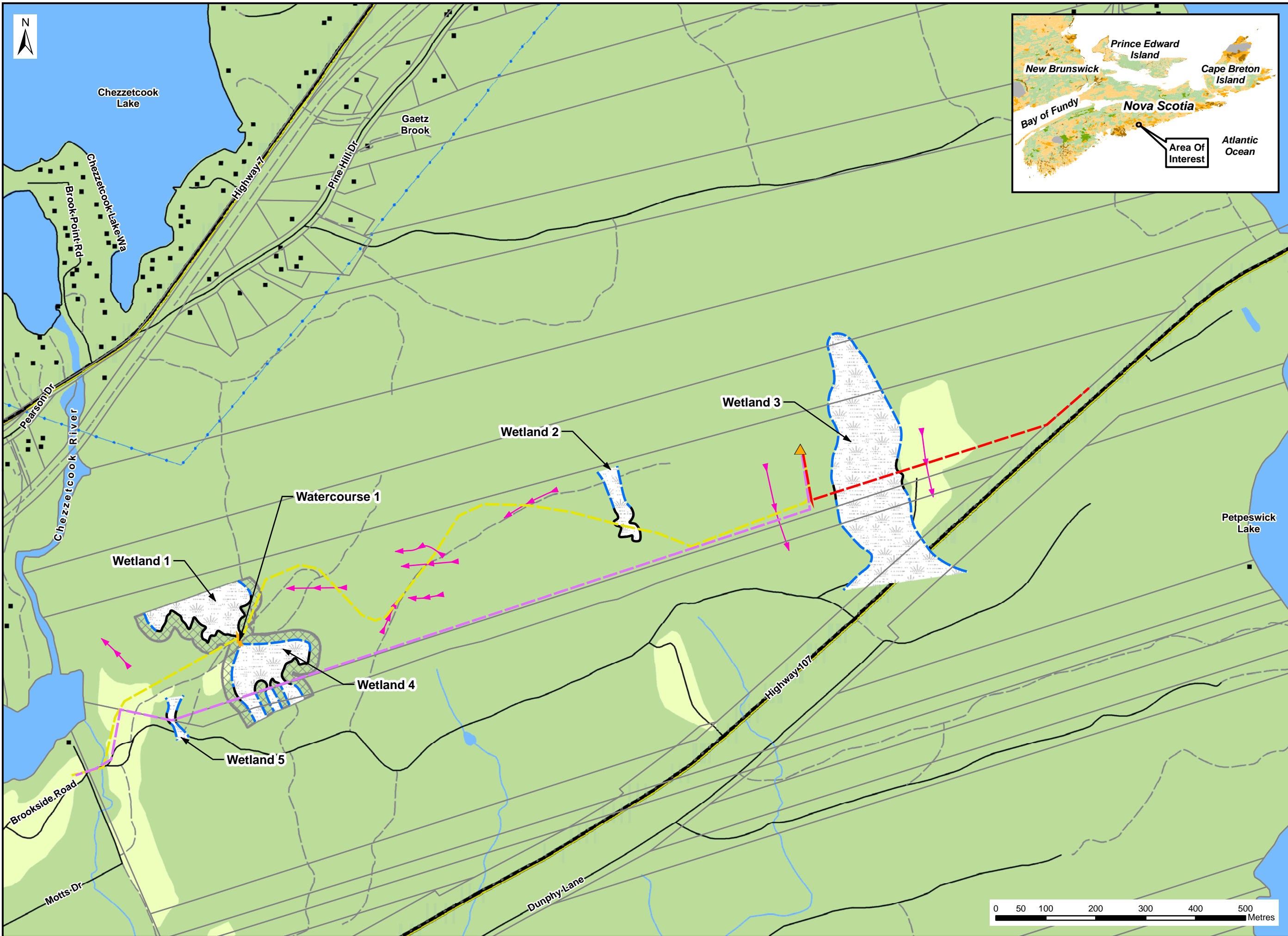
Thank you,



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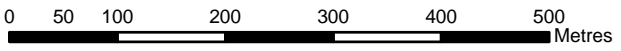
- Notes:**
1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre.
 2. Projection: NAD83(CSRS), UTM Zone 20 North.
 3. GPS Points Taken are Typically to +/-5m Accuracy.

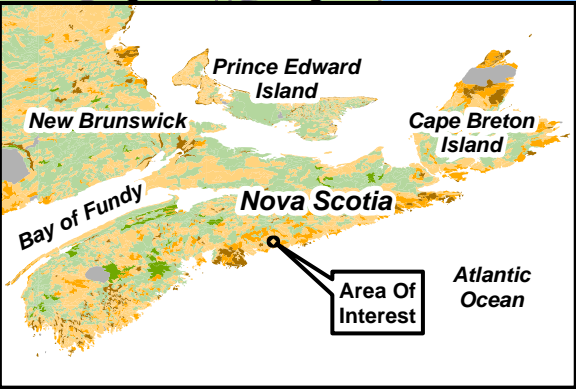
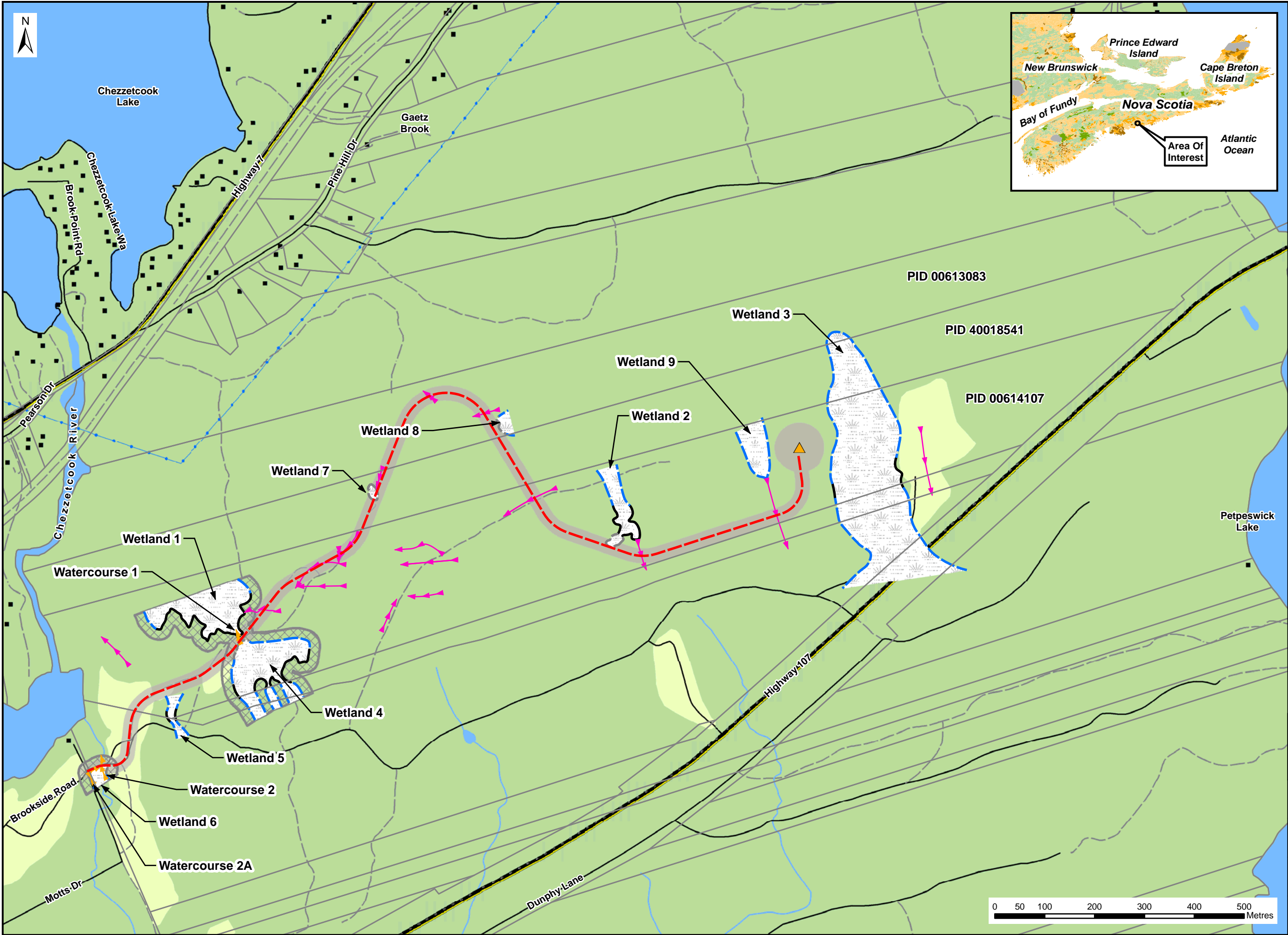
- Legend:**
- Proposed Turbine
 - Access Option 1
 - Access Option 2
 - Access Option 3
 - Field Identified Watercourse
 - Field Identified Drainage
 - Confirmed Wetland Boundary
 - Approximate Wetland Boundary
 - Field Identified Wetlands
 - 20 m HRM Buffer
 - Buildings
 - Major Roads and Highways
 - Roads
 - Access Roads / Trails
 - Existing Transmission Lines
 - Mapped Stream
 - Indefinite Stream
 - Water Bodies
 - Cleared Area

**Gaetz Brook
Summer 2012
Wetland
Assessment:
Survey Results**



Date: April 2013	Project #: 12-4428
Scale: 1:7000	Drawing #: 1
Drawn By: H. Serhan	
Checked By: A. Walter	





- Notes:**
1. Reference: Digital Topographic Mapping By Nova Scotia Geomatics Centre.
 2. Projection: NAD83(CSRS), UTM Zone 20 North.
 3. GPS Points Taken are Typically to +/-5m Accuracy.

- Legend:**
- Proposed Turbine
 - Proposed Access
 - Property Boundary
 - Field Identified Watercourse
 - Field Identified Drainage
 - Confirmed Wetland Boundary
 - Preliminary Wetland Boundary
 - Approximate Wetland Boundary
 - Field Identified Wetland
 - 20 m HRM Buffer
 - Study Area
 - Buildings
 - Major Roads and Highways
 - Roads
 - Access Roads / Trails
 - Existing Transmission Lines
 - Mapped Stream
 - Indefinite Stream
 - Water Bodies
 - Cleared Area

**Gaetz Brook
Wetland
Assessment
Results**



Date: April 2013	Project #: 12-4428
Scale: 1:7000	Drawing #: 2
Drawn By: H. Serhan	
Checked By: A. Walter	



Wetlands and Watercourses in Nova Scotia

Wetlands in Nova Scotia are regulated by NSE under Section 105 of the *Environment Act*. Under the Act, wetlands are:

Land referred to as a marsh, swamp, fen, or bog that either periodically or permanently has water table at, near, or above the land surface or that is saturated with water, and sustains aquatic processes as indicated by the presence of poorly drained soils, hydrophytic vegetation, and biological activities adapted to wet conditions.

Watercourses are defined in the *Environment Act* as:

Any creek, brook, stream, river, lake, pond, spring, lagoon, or any other natural body of water, and includes all the water in it, and also the bed and the shore (whether there is actually any water in it or not). It also includes all groundwater.

Watercourses are defined in Halifax Regional Municipality (HRM) land use by-laws as:

A lake, river, stream, ocean, or other natural body of water.

Delineation Methodology

In order for a wetland determination to be made, the following three criteria were assessed the field:

- Presence of hydrophytic (water loving) vegetation;
- Presence of hydrologic conditions that result in periods of flooding, ponding, or saturation during the growing season; and
- Presence of hydric soils (anaerobic conditions in upper part).

Soil pits were completed frequently to confirm the presence/absence of wetland hydrology and hydric soils, as per the methodology below. A general vegetation survey was also completed within the wetlands to confirm hydrophytic vegetation.

Identification of Hydrophytic Vegetation

Hydrophytic vegetation is defined as the sum total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanent or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present (Environmental Laboratory 1987). Hydrophytic vegetation should be the dominant plant type in wetland habitat (Environmental Laboratory 1987).

WETLAND DELINEATION IDENTIFICATION METHODOLOGY

Dominant plant species observed in each wetland were classified according to indicator status (probability of occurrence in wetlands), in accordance with the U.S. Fish and Wildlife Service (USFWS) National List of Vascular Plant Species that Occur in Wetlands: NE Region (Region 1) (Reed 1988). Please refer to Table 1 (below) for these classifications. These indicators are used as this region most closely resembles the flora of Nova Scotia and climate regime. Further relevant information was reviewed in Flora of Nova Scotia (Zinck, 1998).

Table 1: Classification of Wetland-Associated Plant Species¹

Plant Species Classification	Abbreviation ²	Probability of Occurring in Wetland
Obligate	OBL	>99%
Facultative Wetland	FACW	66-99%
Facultative	FAC	33-66%
Facultative Upland	FACU	1-33%
Upland	UPL	<1%
No indicator status	NI	Insufficient information to determine status
Plants That Are Not Listed (assumed upland species)	NL	Does not occur in wetlands in any region.

¹ Source: Reed 1988

² A '+' or '-' symbol can be added to the classification to indicate greater or lesser probability, respectively, of occurrence in a wetland.

If the majority (greater than 50%) of the dominant vegetation at a data point is classified as obligate (OBL), facultative wetland (FACW), or facultative (FAC), then the location of the data point is considered to be dominated by hydrophytic vegetation.

Identification of Hydric Soils

A hydric soil is a soil that has formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (USDA-NRCS 2010). Indicators of the presence of a hydric soil include soil colour (gleyed soils and soils with bright mottles and/or low matrix chroma), aquic or preaquic moisture regime, reducing soil conditions, sulfidic material (odour), soils listed on the hydric soils list, iron and manganese concretions, organic soils (histosols), histic epipedon, high organic content in surface layer in sandy soils, and organic streaking in sandy soils.

Soil pits were excavated to a maximum depth of 40 cm or refusal. The soil in each was then examined for hydric soil indicators. The matrix colour and mottle colour (if present) of the soil were determined using the Munsell Soil Colour Charts.

Determination of Wetland Hydrology

Wetland habitat, by definition, either periodically or permanently, has a water table at, near, or above the land surface or that is saturated with water. To be classified as a wetland, a site should have at least one primary indicator or two secondary indicators of wetland hydrology, as shown in Table 2.

WETLAND DELINEATION IDENTIFICATION METHODOLOGY

Table 2: Indicators of Wetland Hydrology

Examples of Primary Indicators	Examples of Secondary Indicators
Water marks	Oxidized Root Channels in the Upper 30 cm
Drift Lines	Local Soil Survey Data
Sediment Deposition	Dry season Water Table
Drainage Patterns	Stunted or Stressed Plants
Water-stained leaves	
Visual Observation of Saturated Soils	
Visual Observation of Inundation	

Wetland habitat is assessed for signs of hydrology, via visual observations across the area and through assessment of soil pits.

References

Environmental Laboratory (1987), Corps of Engineers Wetlands Delineation Manual, US Army Corp of Engineers, 1987.

Reed. 1988. National List of Plant Species that Occur in Wetlands: NE Region (Region 1) U.S. Fish and Wildlife Service, Washington, DC.

USDA-NRCS. (United States Department of Agriculture- Natural Resources Conservation Service). 2010. *Field Indicators of Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils*. Version 7.0. 53 pp.

Zinck, M. 1998. *Rolands Flora of Nova Scotia*. Nimbus Publishing, Nova Scotia.

Environmental Laboratory. (1987). "Corps of Engineers wetlands delineation manual," Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. NTIS No. AD A176 912 (Note: Appendix C information is outdated and must be obtained from regional Wetlands offices)



Photo 1: The southern extent of Wetland 1 showing Watercourse 1 draining north.



Photo 2: Wetland 2.



Photo 3: Wetland 4, south of the existing road.



Photo 4: Eastern portions of Wetland 7.



Photo 5: The Northern Portion of Wetland 8.



Photo 6: A drainage feature within tire ruts left by historic logging activities.



Photo 7: Artificial ditch in western portions of the study area.



Photo 8: Watercourse 2, draining from the south after it merged with Watercourse 2a.