KMTNUK WIND POWER PROJECT

Environmental Assessment Registration Document

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Environmental Assessment Registration Document

Prepared By:
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Prepared For:
Kmtnuk Wind Ltd.
c/o Wind Strength
1969 Upper Water Street, Suite 2101
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October 2023

October 25th, 2023

Ms. Helen MacPhail
Nova Scotia Department of Environment & Climate Change
Environmental Assessment Branch
#2085 - 1903 Barrington Street
PO Box 442
Halifax, NS B3J 2P8

Dear Ms. MacPhail,

Re: Environmental Assessment Registration Document
Kmtnuk Wind Power Project

Please find enclosed the Environmental Assessment Registration Document for the Kmtnuk Wind Power Project.

The undersigned approves and accepts the contents, as submitted to Nova Scotia Environment & Climate Change, Environmental Assessment Branch.

Sincerely,

Terrance J. Paul

Chief Terry Paul
Membertou First Nation

Trent Vichie
CEO, Everwind Fuels

EXECUTIVE SUMMARY

Wind Strength, a Membertou company and EverWind Fuels Company (EverWind), through a jointly-controlled subsidiary, Kmtnuk Wind Ltd. (the Proponent), is proposing to construct and operate the Kmtnuk Wind Power Project (the Project) near the communities of Earltown, McCallum Settlement, and North River, Nova Scotia. The Project is an onshore wind farm with up to 16 wind turbines, along with associated infrastructure, including access roads, substation, operations and maintenance building, and power collection systems. The Project turbines will have a nominal nameplate capacity of between 5.2 to 7.0 megawatts, which represents the range of turbine models being considered for the Project. The development of this Project will provide renewable energy required for the production of certified green hydrogen and ammonia within Nova Scotia; leading and supporting the province in becoming a national and international leader in the clean renewable energy sector.

The Project is considered a Class I Undertaking under Schedule A of the Nova Scotia Environmental Assessment Regulations, N.S. Reg. 26/95, and therefore, requires the registration of an Environmental Assessment Registration document. The Environmental Assessment Registration document has been completed according to methodologies and requirements outlined in A Proponent's Guide to Environmental Assessment and has incorporated guidance from the Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia.

Several Valued Components were identified and evaluated as part of this assessment. Based on provincial guidance, desktop analysis, and subsequent field studies. Valued Components determined for assessment were as follows:

- Atmospheric Environment
- Geophysical Environment
- Aquatic Environment
- Terrestrial Environment
- Socioeconomic Environment
- Archaeological Resources
- Human Health
- Electromagnetic Interference
- Shadow Flicker
- Visual Aesthetics
- Sound

The results of the assessment indicated that the Project, with the implementation of mitigation and monitoring measures, will not result in significant adverse residual effects. The Project will also have a positive residual effect associated with the reduction of greenhouse gas emissions (i.e., production of renewable energy) and economic prosperity within Nova Scotia.

Wind Strength is a partnership between Membertou Development Corporation and EverWind Fuels. Wind Strength has, and will continue, to engage and collaborate with local communities, the Mi'kmaq of Nova Scotia, and government representatives to ensure that any potential concerns identified in association with the Project are addressed and mitigated.

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ACCDC	Atlantic Canada Conservation Data Centre
AM	Amplitude modulation
ANSA	African Nova Scotia Affairs
AQHI	Air Quality Health Index
ARIA	Archaeological Resource Impact Assessment
ARU	Autonomic Recording Units
ATV	All-terrain Vehicle
ARD	Acid Rock Drainage

AVFN	Annapolis Valley First Nation
BOP	Balance of Plant
BMPs	Best Management Practices
°C	Degrees Celsius
CAAQS	Canadian Ambient Air Quality Standards
CanWEA	Canadian Renewable Energy Association
CCME	Canadian Council of Ministers of the Environment
CCOHS	Canadian Centre for Occupational Health and Safety
CEO	Chief Executive Officer
CEPA	Canadian Environmental Protection Act
CH_4	Methane
CLC	Community Liaison Committee
cm	Centimeters
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CRM Group	Cultural Resource Management Group
CWS	Canadian Wildlife Service
dBA	Decibels (A-weighted)
DBH	Diameter Breast Height
DEM	Digital Elevation Model
DFO	Fisheries and Oceans Canada
DND	Department of National Defence
DO	Dissolved Oxygen
DTV	Digital Television Station
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EMF	Electromagnetic Fields
EMI	Electromagnetic Interference
EPP	Environmental Protection Plan
ESA	Endangered Species Act
EverWind	EverWind Fuels
FAC	Facultative
FACU	Facultative Upland
FACW	Facultative Wetland
FEC	Forest Ecosystem Classification
FM	Frequency modulation
FWI	Fire Weather Index
GCP	Green Choice Program
GHG	Greenhouse Gase
GIS	Geographic Information System
GPS	Global Positioning System
GW	Gigawatt

GWh/year	Gigawatt hours per year
H_2S	Hydrogen Sulfide
ha	Hectare
HPAs	High Potential Areas
Hz	Hertz
IBA	Important Bird Areas
IBoF	Inner Bay of Fundy (Atlantic salmon population)
IPCC	United Nations Intergovernmental Panel on Climate Change
ISED	Innovation, Science and Economic Development Canada
kHz	Kilohertz
kg	Kilogram
kg/MW	Kilogram per megawatt
km	Kilometers
km^2	Square kilometers
km/hr	Kilometers per hour
KMK-ARD	Kwilmu'kw Maw-klusuaqn – Archaeological Research Division
KMKNO	Kwilmu'kw Maw-klusuaqn
kV	Kilovolt
kWh/year	Kilowatts per hour per year
LAA	Local Assessment Area
Lpm	Litres per minute
m	Metres
m^2	Square metres
m^2/day	Square metres per day
m^3	Cubic metres
m/s	Metres per second
MARI	Maritime Archaeological Resource Inventory
masl	Metres above sea level
MBCA	Migratory Bird Convention Act
MBBA	Maritimes Breeding Bird Atlas
MEKS	Mi'kmaq Ecological Knowledge Studies
MET Tower	Meteorological Tower
mg/L	Milligrams per litre
MLA	Member of the Legislative Assembly
mm	Millimetres
MOU	Memorednum of Understanding
M.P.	Member of Parliment
mS/cm	MilliSiemens per centimetre
MW	Megawatt
MYOT	Myotis Species
NH_3	Ammonia
NI	No Indicator Status
NL	Not Listed
NO	Nitric Oxide

NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
N_2O	Nitrous Oxide
NRCan	Natural Resources Canada
NS AAQS	Nova Scotia Ambient Air Quality Standards
NSAQR	Nova Scotia Air Quality Regulations
NSCCTH	Nova Scotia Communities, Culture, Tourism and Heritage
NSECC	Nova Scotia Environment and Climate Change
NSNRR	Nova Scotia Natural Resources and Renewables
NS Power	Nova Scotia Power
NSPW	Nova Scotia Public Works
NSSU	Nova Scotia Southern Upland (Atlantic salmon population)
NTSC	National Television Standards Committee
O_3	Ozone
O&M	Operations and Maintenance
OBL	Obligate
OEM	Original Equipment Manufacture
%	Percent
PGI	Pellet Group Inventory
PID	Property Identification
PLFN	Pictou Landing First Nation
PM	Particulate Matter
POI	Point of Interconnection
PPE	Personal Protective Equipment
Q_{20}	Long term safe yield
RAA	Regional Assessment Area
RABC	Radio Advisory Board of Canada
RBP	Rate-based Procurement
RCFNS	Rural Community Foundation of Nova Scotia
RCMP	Royal Canadian Mounted Police
RES	Renewable Energy Systems
ROW	Right of way
SANS	Snowmobilers Association of Nova Scotia
SAR	Species at Risk
SARA	Species at Risk Act
SCADA	Supervisory Control and Data Acquisition
SGEM	Silvicultural Guide for the Ecological Matrix
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
SOCI	Species of Conservation Interest
SOI	Signals of Interest
SUV	Sports Utility Vehicle
t/km/hr	Targets per kilometer per hour
tCO_2e	Tonnes of Carbon Dioxide Equivalent

tCO_2e/kg	Tonnes of Carbon Dioxide Equivalent per kilogram
tCO_2e/km	Tonnes of Carbon Dioxide Equivalent per kilometre
tCO_2e/tonne·km	Tonnes of Carbon Dioxide Equivalent per tonne-kilometre
tCO_2e/y	Tonnes of Carbon Dioxide Equivalent per year
TRS	Total Reduced Sulfur
TSP	Total Suspended Particulate
µm	Microns or micrometres
$\mu g/m^3$	micrograms per cubic metre
UPL	Upland
UTM	Universal Transverse Mercator
VC	Valued Component
VHF	Very high frequency
WAM	Wet Areas Mapping
WESP-AC	Wetland Ecosystem Services Protocol – Atlantic Canada
WHMIS	Workplace Hazardous Material Information System
WSS	Wetlands of Special Significance

LIST OF DRAWINGS

LIST OF APPENDICES

1.0 PROPONENT DESCRIPTION

Wind Strength, a Membertou company and EverWind Fuels Company (EverWind), through a joint-controlled subsidiary, Kmtnuk Wind Ltd. (the Proponent), is proposing to construct and operate the Kmtnuk Wind Wind Power Project (the Project), an onshore wind farm with up to 16 wind turbines. The Proponent is majority-owned by Wind Strength. Wind Strength is a translation of the Mi'kmaq word "Wju'snewiknaq" (Wu-jew-sin-eh-wee-ginn-ah), which embodies the strength, resiliency, and environmental stewardship of the Mi'kmaq people through green energy leadership. The Project is being developed to support the production of Certified Green hydrogen and ammonia in Nova Scotia.

The Wind Strength and EverWind team includes experienced Canadian wind farm developers, constructors and operators who have designed, financed, constructed, and operated wind and solar energy projects in Nova Scotia, Atlantic Canada, Western Canada, and across North America over the past 20 years. Wind Strength and EverWind combine Indigenous values, local knowledge, and responsible resource stewardship with industry leading experience developing, constructing, and operating renewable energy projects.

Wind Strength and EverWind retained Strum Consulting to undertake required technical studies, manage technical sub consultants, and undertake regulatory consultations which have all contributed to the preparation of the Project's Environmental Assessment (EA) Registration Document. Strum Consulting is an independent multi-disciplinary team of consultants with extensive experience undertaking EAs throughout Atlantic Canada.

Wind Strength and EverWind have retained Renewable Energy Systems (RES), the world's largest independent renewable energy company, to develop, construct, and initially operate the Project. RES has 41 years' experience in clean energy and has been active in the North American renewable energy market since 1997. RES has delivered more than 23 gigawatts (GW) and over 340 renewable energy projects globally and supports an operational asset portfolio exceeding 12 GW worldwide. RES has experience with onshore and offshore wind projects, utility-scale solar farms, energy storage solutions, transmission, and green hydrogen projects. RES has been engaged as the developer for the Project under a cooperation agreement. RES' construction branch, RES Canada Construction LP, will oversee the construction of the Project and the RES services branch is to provide the Project with Balance of Plant (BOP) operations and maintenance (O&M) and asset management services.

Contact information for the Proponent and their consultant is included in Table 1.1.

Table 1.1: Proponent and Consultant Contact Information

Proponent Information	
Project Name	Kmtnuk Wind Power Project
Proponent Name	Kmtnuk Wind Ltd.
Chief Executive Officer(s) (CEOs)/Principal(s)	Chief Terry Paul, Membertou First Nation 47 Autwen Ma'sl Awti B1S 2P5 Trent Vichie – CEO EverWind Fuels 1969 Upper Water Street, Suite 2101 Purdy's Wharf II Halifax, NS B3J 2V1
Mailing and Street Address	1969 Upper Water Street – Suite 2101 Purdy's Wharf II B3J 2V1 Halifax, NS
Proponent Contact Information for the EA Registration	Mark Savory EVP Project Delivery Phone: 902.237.7321 Email: mark.savory@everwindfuels.com
Consultant Information	
Name of Consultant	Strum Consulting
Mailing and Street Address	211 Horseshoe Lake Road, Unit #210 Halifax, NS B3S 0B9
EA Contact	Paul Koke, Senior Environmental Specialist Phone: 902.835.5560 Email: pkoke@strum.com

2.0 PROJECT INFORMATION

2.1 Project Introduction

The Proponent proposes to construct and operate an onshore wind energy project with up to 16 wind turbines near the communities of Earltown, McCallum Settlement, and North River in Colchester County, Nova Scotia (Drawing 2.1). The approximate center of the Project is located at 45.543379° N, 63.280918° W.

The Project turbines will have a nominal nameplate capacity of between 5.2 megawatts (MW) to 7.0 MW, which represents the range of turbine models being considered for the Project. For the purposes of this EA's noise and shadow flicker modelling, the Nordex N163 5.9 MW wind turbine generator was selected as it represents the general range of turbines that are being considered for the Project. The turbine locations are shown on Drawing 2.2. The Project also consists of access roads, an interconnecting transmission line, a substation, an O&M building, and a switching station connection to the Nova Scotia Power (NS Power) grid. The Project is being developed to support the production of Certified Green hydrogen and ammonia in Nova Scotia. EverWind expects to enter into a "sleeved" power purchase agreement which will enable its production facility in Point Tupper, Nova Scotia, to purchase renewable energy from the Project.

The Project lies within two primary watersheds, including the Salmon/Debert Primary Watershed (1DH) and the River John Primary Watershed (1DO). Watercourses within the Study Area primarily drain south through the Salmon/Debert Primary Watershed, eventually discharging to the Bay of Fundy. The northernmost stretches of the Study Area drain north through the River John Primary Watershed, which ultimately discharges into the Northumberland Strait. The Study Area consists primarily of Crown land, with several parcels of private land. Lands are currently utilized primarily for forestry and recreational use.

Upon approval of the EA, construction activities are proposed to begin in the spring of 2024 and once constructed, the Project is expected to be operational for a minimum of 35 years.

2.2 Purpose & Need for the Undertaking

Need for Incremental Renewable Energy

The Project will be connected to the NS Power grid and support the province of Nova Scotia to achieve its legislated requirement for 80% of electricity sales from utilities to be renewable beginning in 2030. Development of wind energy is expected to be a significant part of achieving that goal. Dependence on fossil fuels increases the vulnerability of Nova Scotia to rising and volatile international energy markets, weakens energy security, and takes money out of the province, further leading Nova Scotia towards a preference for renewable energy. Negative impacts to human health, particularly in developing countries, and the environment, mainly in the form of climate change, are among the widely cited challenges associated with fossil fuel consumption around the world.

In its assessment report, Climate Change 2022 - Impacts, Adaptation and Vulnerability, the United Nations Intergovernmental Panel on Climate Change (IPCC) provides a detailed synopsis of the impacts associated with climate change on both global and regional scales. Evidence from all continents indicates that many biological systems and habitats are currently being affected by regional climate change. Ecological changes include changes to the thermal dynamics and quality of aquatic habitats, shifts in migratory timing and ranges of fauna and flora, changes in fish abundance, and increased risk of extinction and loss of forest habitat. In North America specifically, the increase in ground, water, and atmospheric temperatures has resulted in direct mortality and redistribution of flora and fauna species. In addition, coastal flooding along with an increase in the frequency and intensity of extreme weather events will continue to impact the socioeconomic environment through displacement and / or damage to communities and economies. Impacts of climate change are, and will increasingly be felt, across environmental, social, human health, and economic sectors (IPCC, 2022).

Canadian climate experts acknowledge that the debate has largely evolved from questions about the reality and causes of climate change, to what actions can be taken to adapt to the realities of a changing climate. As the second most important and fastest growing (along with solar) renewable energy source in Canada (NRCan, 2017), wind energy is a critical component of Canada's renewable energy strategy. Wind energy is emission-free; with every megawatt hour of wind energy generated, greenhouse gas emissions are reduced in comparison to previous levels associated with coal-related production (NSNRR, u.d.). Numerous benefits can be expected from the transition to renewable energy, and may include:

- Long term stability in energy prices.
- Long term security in locally-sourced energy supply and decreased dependence on international markets.
- Creation of jobs and economic opportunities throughout the province.
- Community investment and economic return.
- Protection of human health and the environment.
- Retaining revenue within the province.
- Educational opportunities for youth and the broader community about renewable energy technology, its benefits, and the role it will play in Nova Scotia's energy future.

The Project is committed to sharing economic opportunities with the local community, throughout the development and lifespan of the Project, via the use of local skills and labour where possible, municipal tax revenue, community support programs and ongoing energy literacy/education.

Need for the Project

In addition to producing incremental renewable energy, the Project is being developed to support the production of Certified Green hydrogen and ammonia in Nova Scotia. The Project and the power, which is expected to be used to for green fuels, is needed to support provincial and federal goals, and enable global decarbonization. Nova Scotia has a vision to become a national and international leader in the clean renewable energy sector, through green hydrogen and ammonia production and export to help other countries meet their clean energy needs.

Wind Strength is investing significant private capital in the Project to build new, zero-emission generation capacity to supply green fuels production in Nova Scotia, accelerating global decarbonization and standing up a new, clean, green hydrogen industry in Atlantic Canada.

As explained by Tory Rushton, Minister of Natural Resources and Renewables, "Green hydrogen is a clean-burning fuel that can help with our transition to green, renewable energy in circumstances where fossil fuels cannot easily be replaced". EverWind is well-positioned to become Canada's first commercial Certified Green hydrogen and ammonia production facility, and the Project is needed to supply the green energy required for EverWind's production.

The Project will add an incremental 98 MW of newly constructed zero-emission generation capacity in addition to the ~350 MW of renewable energy that will be built under the Government of Nova Scotia's recent Rate Base Procurement (RBP) program and 1,100 gigawatt hours per year (GWh/year) to be procured under the Green Choice Program (CGP). Each of these are needed to reduce Nova Scotia's dependence on fossil fuels, achieve the Province's Renewable Electricity Standard of 80% by 2030, and support the goal of achieving a 53% reduction in greenhouse gas emissions by 2030 and net-zero by 2050.

The production of green energy for green hydrogen and ammonia production for export is widely supported as a means to stimulate investment from the private sector, support global energy security, and facilitate global decarbonization (Bennett Jones LLP, 2023; BMWK, 2023). The Project will also provide for the advancement of social and economic reconciliation, representing investments in Indigenous majority-owned and Indigenous-led projects.

Need for the Green Ammonia

The Project and the power are expected to be used for Certified Green hydrogen and ammonia production.

Ammonia (NH_3) is a key component in the production of agricultural fertilizers, with over 50% of the world's food crop farmers relying on it to keep their soils productive through improvement of crop nutrition, growth, and quality (Erisman et al., 2008). In 2019, the global production of ammonia was approximately 235 million tonnes (Ghavam et al., 2021).

Although ammonia-based fertilizers are necessary to produce the food crops required to feed over seven billion people worldwide, industrial ammonia production emits more CO_2 than any other chemical production process (Chemical & Engineering News, 2019). The direct emissions from ammonia production total approximately 450 metric tonnes of CO_2 per year (IEA, 2021).

The green ammonia produced with power from the Project will be supplied to support the global demand for agricultural fertilizer products while significantly reducing the carbon footprint of conventional ammonia production methods.

It is expected that the demand for green hydrogen and ammonia will also increase in Nova Scotia and Canada in the coming years, and these fuels will be made available to support local decarbonization as this market evolves.

In addition to green hydrogen production, energy produced by the Project will be made available to NS Power at times of peak electricity demand to directly supply customers in the province.

Green hydrogen and ammonia production, as a flexible power user, brings substantial benefits to the electricity grid and allows for greater renewable penetration on the grid by purchasing green energy during periods of overproduction that would otherwise result in curtailment / wasted energy.

Green hydrogen also supports Nova Scotia's 2030 Clean Power Plan. By 2030, with coal generation closed, green hydrogen will provide fast-acting, dispatchable generation for periods of time if it is not windy, to ensure power during winter peaks, or should storms/events impact transmission lines (NS Power, u.d). EverWind expects to be able to provide green hydrogen to NS Power to deliver hydrogen-capable generators.

2.3 Regulatory Framework

2.3.1 Federal

A federal impact assessment is not required for the Project as it is not located on federal lands or listed as a physical activity that constitutes a designated project as listed in the Physical Activities Regulations, S.O.R./2019-285 under the *Impact Assessment Act*. Federal approval, permit, notification, and compliance requirements for the Project are provided in Table 2.1.

Table 2.1: Federal Regulatory Requirements

Requirement	Regulatory Body	Status/Comments
Notification of Project	Royal Canadian Mounted Police (RCMP)	Will be completed following the detailed design phase.
Aeronautical obstruction clearance	Transport Canada	Will be completed following the detailed design phase.
Lighting design for navigational purposes	Transport Canada	Will be completed following the detailed design phase.
Electromagnetic interference (EMI) consultation and radio communication layout authorization	Various	EMI and radio communication stakeholders have been contacted. The EMI consultation process is described further in Section 10.2.
Fisheries Act	Fisheries and Oceans Canada (DFO)	Compliance legislation – an authorization under the *Fisheries Act* is not anticipated. If, during the detailed design phase potential effects to fish or fish habitat are identified that may require authorization under the *Fisheries Act*, the Proponent will submit a Request for Project Review to DFO.
Species at Risk Act (*SARA*)	Environment and Climate Change Canada (ECCC), and DFO	Given the confirmed presence of the Atlantic salmon Inner Bay of Fundy (IBoF) subspecies, a *SARA* permit was obtained prior to any electrofishing proceeding (*SARA* Permit No: DFO-MAR-2023-32a).

Requirement	Regulatory Body	Status/Comments
Migratory Bird Convention Act, 1994 (*MBCA*)	ECCC	Compliance legislation – the requirement to obtain a *MBCA* permit is not anticipated.

2.3.2 Provincial

The Project is subject to a Class I EA as defined by the Environmental Assessment Regulations, N.S. Reg. 26/95 under the *Environment Act*, S.N.S. 1994-95, c. 1. As such, this submission has been prepared in accordance with:

- A Proponent's Guide to Environmental Assessment (NSECC, 2017).
- Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSE, 2021).

Other provincial approval, permit, notification, and compliance requirements for the Project are provided in Table 2.2.

Table 2.2: Provincial Regulatory Requirements

Requirement	Regulatory Body	Status/Comments
Watercourse Alteration Permit Wetland Alteration Permit	Nova Scotia Environment and Climate Change (NSECC)	Alteration applications will be submitted to NSECC in accordance with the Activities Designation Regulations, N.S. Reg. 47/9 following EA approval. Locations requiring alteration are described in Sections 7.3.1 to 7.3.3
Endangered Species Act, S.N.S. 1998, c. 11 (*ESA*)	Nova Scotia Natural Resources and Renewables (NSNRR)	Compliance legislation – the requirement to obtain an *ESA* permit is not anticipated.
Use of Crown lands	NSNRR	Application is in progress.
Notification of blasting (if required)	NSECC, Nova Scotia Health and Safety	To be confirmed following the geotechnical investigations.
Overweight/Special move permit	Nova Scotia Public Works (NSPW)	Future approval.
Access permit Work within highway right of way (ROW) Use of ROW for pole lines	NSPW	Future approvals.
Elevator lift license	Nova Scotia Labour Skills and Immigration	Future approval.
Archaeology Field Research Permit	Nova Scotia Communities, Culture, Tourism and Heritage (NSCCTH)	Permit A2022NS095 and A2023NS157 obtained to complete the archaeology assessment.
Nova Scotia Temporary Workplace Traffic Control Manual	NSPW	Compliance with the Manual, for the use of provincial roads during the construction, operation, and decommissioning phases of the Project.

2.3.3 Municipal

Municipal approval, permit, notification, and compliance requirements for the Project are provided in Table 2.3.

Table 2.3: Municipal Requirements

Requirement	Regulatory Body	Status/Comments
License from a Development Officer – Colchester County	Municipality of Colchester	Application expected to be submitted in Q1 2024

2.4 Funding

The Proponent is arranging debt project financing and currently no government funding has been secured for the Project. CIBC and Citi, two leading investment banks are engaged to lead the Project financing. Commercial banks, along with additional funding sources have been approached to participate in the Project as a lender, and various financing support letters have been received for the funding. Equity funding for the Project has been secured.

2.5 Structure of the EA Registration Document

An outline of the content of each section of the EA Registration Document is provided in Table 2.4.

Table 2.4: EA Registration Document Structure

Section	Content
Section 1	Proponent Description
Section 2	Project Information
Section 3	Description of the Undertaking
Section 4	Project Scope and Assessment Methodology
Section 5	Mi'kmaq of Nova Scotia
Section 6	Government and Public Engagement
Section 7	Biophysical Environment
Section 8	Socioeconomic Environment
Section 9	Archaeological Resources
Section 10	Other Considerations
Section 11	Effects of the Undertaking on the Environment – Summary
Section 12	Effects of the Environment on the Undertaking
Section 13	Accidents and Malfunctions
Section 14	Cumulative Effects Assessment
Section 15	Closure
Section 16	Limitation of Liability
Section 17	References

3.0 DESCRIPTION OF THE UNDERTAKING

3.1 Geographical Location

The Project is located within Colchester County, near the communities of Earltown, McCallum Settlement, North River, as well as the Gully Lake Wilderness Area (Drawing 2.1). The Project is situated on Nuttby Mountain primarily on Crown lands, except for several private land parcels. The Project is centered at approximately 45° 32' 43.9764" N, 63° 35' 54.6576" W (or 45.545549° N, 63.598516° W).

A Study Area was established as a large assessment area based on land parcels (i.e., PIDs) that are included in the development area (Table 3.1, Drawing 2.2). The intent of the Study Area was to first survey a broad area at a high-level to allow flexibility in the design to move infrastructure and minimize effects to Valued Components (VCs). An Assessment Area was subsequently established for detailed field investigations, which includes the physical footprint of the Project where the direct physical disturbance is expected to occur (i.e., the Project Area), plus a buffer to allow design flexibility and assess for indirect effects beyond the direct effects within the Project Area. For this Project, the buffer included a 150 m radius area for each turbine, a minimum 50 m buffer on either side of the centreline for the road layout, and a 150 m corridor for transmission lines. The areas of the Study Area, Assessment Area, and Project Area are provided in Table 3.2.

Table 3.1: Land Parcels within the Study Area

PID	Landowner
20477394	Private
20477378	Private
20477402	Private
20477386	Private
20098984	Private
20477410	Private
20001723	Private
20099123	Crown Land
20099156	Crown Land
20419362	Crown Land
20002499	Crown Land
20099701	Crown Land
20419255	Crown Land

Table 3.2: Areas of Study

Area of Study	Area (ha)
Study Area	7306
Assessment Area	607
Project Area*	89

*Area is a conservative estimate of the permanent footprint of the Project Area. Temporary Project Area components are shown in Drawing 3.1A – 3.1E but not included in this calculation. Following the detail design, the area will be refined.

The Study Area has undergone previous development for wind energy production and has been subjected to extensive forestry activities over the years. The Project will utilize the existing system of access roads, where possible, to minimize the need for new road construction.

3.1.1 Siting Considerations

As part of the Project planning process, a constraints analysis was undertaken that considered potential effects to the environment, nearby residents, and sociocultural resources. The constraints analysis was informed by the results of Project-specific technical studies which included: desktop studies, field investigations, environmental resource/potential effects modeling, as well as information collected through engagement with the Mi'kmaq of Nova Scotia, government agencies, stakeholders, and local communities. Through this process several iterations of the Project layout were considered for development before a Project layout was finalized for the purposes of this EA.

Project and Project component siting included the following considerations:

- Site turbines at locations for efficient capture of wind energy.
- Avoid interference with telecommunication and radar systems.
- Avoid Project component interactions with lakes, or other visible open water bodies and their riparian habitats as identified in 1:50,000 provincial mapping.
- Avoid known protected areas; field identified archaeological, cultural, and heritage resources; significant habitats; and wildlife sites, provincial parks, or reserves.

The minimum setbacks and separation distances applied during the development, design, and siting of the Project are summarized in Table 3.3.

Table 3.3: Summary of Minimum Setbacks and Separation Distances

Setback Category	Distance	Relevant Regulators / Stakeholders
Watercourses	30 m from watercourses, where possible or otherwise where authorized by NSECC	NSECC
Wetlands	30 m from wetlands, where possible or otherwise where authorized by NSECC	NSECC, NSNRR
Wetlands of Special Significance (WSS)	30 m from WSS, to be determined in consultation with NSECC	NSECC, NSNRR
Protected Areas and Public Resources	To be determined in consultation with NSECC and NSNRR, as appropriate	NSECC, NSNRR
Rare Plants and Lichens	Species-specific (Section 7.4.2)	NSNRR
Residences	2,048.75 m from civic address points	Municipality of the County of Colchester
External Property Boundaries	206.5 m	Municipality of the County of Colchester

Setback Category	Distance	Relevant Regulators / Stakeholders
Public Roads	206.5 m	Municipality of the County of Colchester
Powerlines	309.75 m from non-Project-related powerlines *(1.5 x Turbine Height)*	NS Power
Shadow Flicker	As necessary to meet shadow flicker guidelines based off shadow flicker modelling	NSECC
Sound/Noise	As necessary to meet sound / noise guidance based off sound modelling	NSECC, Colchester County

The Project Area also offers considerable development opportunities that were incorporated into the Project design to minimize potential effects to surrounding land uses, local residents, and environmental features. Project development opportunities include the following:

- Use of Crown and privately owned land which has been subject to previous and ongoing disturbance from forestry activities and previous nearby wind farm development, that includes road use (including recreational traffic), new road construction, tree clearing, silviculture, and other recreational uses.
- Maximize the use of existing roads, and existing cleared areas to minimize habitat fragmentation from new road construction and clearing of mature vegetation stands.
- Minimize potential impacts to wetlands, watercourses, and their riparian buffers through the use, and rehabilitation, of existing roads, and existing road watercourse crossings, including shared use of infrastructure with the existing Nuttby Mountain Wind Farm, located immediately to the east of the Project.

3.2 Physical Components

3.2.1 Turbine Specifications

The Proponent is proposing the construction of up to 16 turbines. Each turbine will have an individual generating capacity of 5.2 MW to 7.0 MW. There are a variety of turbine makes and models being considered. For the purposes of the EA, the Proponent has selected the Nordex N163 5.9 MW wind turbine generator as it represents the general range of turbine options that are being considered for noise and shadow flicker modelling. Refer to Table 3.4 for both the range of turbine characteristics that are being considered as well as the specific characteristics of the Nordex N163 5.9 MW.

Table 3.4: Turbine Technical Specifications

Turbine Component	Range of Turbines Being Considered	Turbine Specifications for N163 5.9 MW
Rated capacity	5.2 MW to 7.0 MW	5.9 MW
Rotor diameter	145 m to 170 m	163 m
Hub height	110 m to 127.5 m	125 m

Turbine Component	Range of Turbines Being Considered	Turbine Specifications for N163 5.9 MW
Cut-out wind speed	22.0 m/s to 30.0 m/s	26.0 m/s
Number of blades	Three	Three
Swept area	16,512 m^2 to 22,698 m^2	20,867 m^2
Rotor speed (variable)	Various	6 rpm to 11.8 rpm
Generator	Various	Six-pole doubly-fed induction
Brake system	Various	Three independent pitch control systems with emergency power supply, rotor brake, rotor lock
Yaw control	Various	Electric motors incl. spring-loaded brake and four-stage planetary gear
Remote monitoring	Via Wind Farm Controller	Via Wind Farm Controller

3.2.2 Road Layout

Much of the road system that exists in the Study Area has been constructed over time to provide access roads for forestry operations in the area. In addition, there are access roads associated with the existing Nuttby Mountain Wind Farm turbines and transmission line infrastructure. New road construction will be minimized by using the existing road network, where possible. Some roads will need to be widened and/or graded to meet transportation requirements for turbine components and/or for crane access during construction.

Old Nuttby Road and Truro Road (to the west of Highway 311) are the two largest arterial roads that grant access to the majority of the Project Area. Old Tatamagouche Road may be able to provide access to the southwestern extent of the Project Area, with appropriate road upgrades completed. A network of smaller spur roads and trails suited for all-terrain vehicle (ATV) and/or snowmobile use are present throughout much of the Study Area and may require upgrades to facilitate the transportation of turbine components. Construction during the winter months will be avoided, if possible, thereby minimizing the potential impact to recreational use of trails in that season.

3.2.3 Substation and Power Collection Systems

The Project consists of a combination of new overhead and underground medium-voltage electrical cabling, and a substation to gather the produced energy. A new Point of Interconnection (POI) connecting the Project substation to the grid will be established on Nova Scotia's existing 230 kilovolt (kV) transmission line by way of a new 10 km high-voltage transmission line and a switching station at the POI. The Project turbines will generate power that will flow via the wind farm's 34.5 kV collection system to the new substation.

Drawing 3.1A - 3.1E shows the location of Project infrastructure.

3.2.4 Operations and Maintenance Building

The Project may require a new O&M building. The O&M building would mainly consist of an electrical room, workshop, supervisory control and data acquisition (SCADA) room, parts room, conference room, and office spaces. The O&M building would occupy an area of no more than one acre.

3.3 Project Phases

The Project will include three phases:

- Site preparation and construction (18 to 24 months, starting Q3 2024)
- Operations and maintenance (approximately 35 years, starting Q1 2026)
- Decommissioning (1 year duration, at Project end of life)

Activities and requirements associated with each phase are discussed in the following sections.

3.3.1 Site Preparation and Construction

Site preparation activities include:

- Land surveys for placement of roads, turbines, and associated infrastructure (Q2-2022 – Q4 2023)
- Geotechnical investigations (Q3-Q4 2023)
- Placement of erosion and sedimentation control measures (Q2-Q3 2024)
- Clearing of trees and grubbing areas for construction (Q2-Q3 2024)

General construction activities include:

- Meteorological (MET) Tower installation (~ Q2-Q3 2025)
- Existing access road upgrading and construction (Q3 2024 – Q2 2025)
- Laydown area and turbine pad construction (Q3 2024 – Q3 2025)
- Transportation of turbine components (Q2 2025-Q4 2025)
- Turbine assembly (Q2 2025-Q4 2025)
- Construction of power collection system and substation (Q3 2024 – Q4 2025)
- Transmission switching station interconnection to the NS Power 230kV transmission system (Q2-Q4 2025)
- Removal of temporary works and site restoration (Q2-Q3 2026)
- Commissioning (Q3-Q4 2025)

In general, construction will largely occur between the months of April and December with minimal construction activities taking place during the winter season.

Access Road Construction

Approximately 19 kilometers (km) of the existing road network will be re-used as part of the Project. Approximately 16 km of new road construction is required to provide direct access to the turbines. Access roads will have a 6 metre (m) to 12 m wide road surface and including ditching and grading will be 17 m to 20 m wide. Wider roads (12 m road surface) are required for the crane to crawl from turbine to turbine and narrower roads (6 m road surface) will be utilized if the crane is mobilized via a float truck.

During construction, roads will be maintained with additional gravel or periodic grading. Aggregate material for road construction will be transported from off-site quarries and stored temporarily until used. Any material removed for road construction will be stored or disposed of in accordance with regulations and best practices for road construction. Any material stored on-site will be managed with appropriate erosion and sedimentation control measures or re-used. To the extent possible, road construction will only occur during daytime hours.

The following equipment is typically used during road upgrading and construction:

- Excavators
- Dump trucks
- Bull dozers
- Rollers
- Graders
- Crusher
- Light trucks

Laydown Area and Turbine Pad Construction

Laydown and turbine pad construction may include:

- Installation of erosion and sedimentation control measures
- Removal of vegetation
- Removal of overburden and soils
- Blasting/chipping of bedrock (to be determined, based on geotechnical conditions and foundation design)
- Pouring and curing of concrete pads (complete with reinforcing steel)
- Placement of competent soils to bring area to grade
- Compaction of soils
- Excavation for electrical conduits and fibre optic communication trenches

The turbine tower foundations will be up to 30 m diameter (typical for a 5.9 MW wind turbine) and extend to a depth of 3 m to 7 m below grade. Foundations will be backfilled (underground) with the exception of the concrete pedestal which will extend up to 1 m above ground to support the wind turbine tower structure.

Each turbine pad and laydown area is expected to be approximately 100 m by 100 m. The exact arrangement of each turbine pad and crane pad will be designed to suit the specific requirements of the turbine and the surrounding topography during the detailed design process.

Temporary wind turbine laydown areas may be up to 250 m by 100 m, which includes clearing limits and any overburden. There are currently two temporary turbine laydown areas under consideration. Construction of a typical turbine pad (from clearing to final preparation for erecting of the turbine) can take between one to four months, depending on weather, soil, and construction vehicle availability/access. The following equipment may be used for the laydown areas and turbine pad construction:

- Excavators
- Dump trucks
- Bull dozers
- Rollers
- Graders
- Crusher (not required if a local quarry can supply gravel sizes)
- Concrete trucks and pumper trucks
- Light cranes
- Light trucks

Turbine Assembly
The wind turbine assembly includes tower sections, the nacelle, the hub, and three-blade rotors. All sections will be delivered by several flatbed trucks and the components will require a crane for removal at each of the prepared turbine laydown areas.

The tower sections will be erected in sequence on the turbine foundation, followed by the nacelle, hub, and blades. This assembly will occur with the use of cranes. Turbine erection will depend on weather, specifically wind and lighting conditions. Typical assembly duration per turbine is expected to be between two and five days, and between three and five turbines will be delivered and erected per week. The following equipment is expected to be used for turbine assembly:

- Main crane unit
- Assembly cranes
- Manufacturer’s support vehicles

Power Collector System, Substation, and Transmission Lines
The Project turbines will generate power that will flow via its 34.5 kV collection circuit (that primarily follows the proposed roads) to a 34.5 kV to 230 kV Project substation. Power will be transmitted via a dedicated overhead 230 kV transmission interconnection line to the NS Power transmission system to the POI where a new switching station will be constructed to interconnect the project to the grid (Drawing 3.1A - 3.1E).

The following equipment is expected to be used during the grid connection process:

- Excavators and/or back hoes
- Concrete trucks and pumper trucks
- Assembly cranes
- Bucket trucks
- Light cranes
- Light trucks

Removal of Temporary Works and Site Restoration
Once construction has been completed, all temporary works will be removed, and the site will be appropriately graded. The following equipment is expected to be used in this process:

- Excavator and/or backhoe
- Grader
- Hydroseeder
- Light trucks

Commissioning

The turbines will undergo a series of tests for mechanical, electrical, and operational controls prior to unit start-up sequence. Once the start-up sequence has been initiated, another series of performance checks for safety systems will be completed. When the turbines have cleared all tests, the commissioning of the units can begin.

Commissioning includes performance testing which will be conducted in coordination with NS Power (as the electrical grid operator), to ensure that the generated electricity meets NS Power quality criteria. These performance tests will be completed by qualified wind turbine technicians and electrical utility (i.e., NS Power) employees. Additional testing may also be required for transformers, power lines, and substation components; all of which will be performed by qualified engineers and technical personnel. Commissioning will take place through Q3 and Q4 2025.

3.3.2 Operations & Maintenance

Maintenance will conform to original equipment manufacturer (OEM) specifications, industry best management practices (BMPs), and standard operating procedures.

The life span of the Project is estimated to be 35 years. During this time, roads will be used to access the turbines by staff and maintenance personnel. The roads will be maintained with additional gravel and grading, as required. During the winter months, roads used for the Project will be plowed, sanded, and/or salted, as required for driving safety and to ensure access to all site locations in the event of an emergency.

A vegetation management plan will be initiated to ensure that access roads and turbine locations remain clear of vegetation. Timing of vegetation management will depend on site specific conditions and requirements by the Proponent and/or their operations and maintenance contractors.

Due to the potential for public access to the wind farm, signage will be affixed and maintained on all access roads to provide essential safety information such as emergency contacts and telephone numbers, speed limits, and the hazards associated with being in close proximity to the turbines (i.e., ice throw). These signs will be maintained during the life of the Project.

Scheduled maintenance work will be carried out on a periodic basis. Maintenance work may require the use of a variety of cranes for brief periods of time for replacement of blades or other turbine repairs. The most common vehicle during maintenance work will be light/medium pickup trucks.

An O&M building will be constructed on approximately one acre of land next to the Project substation (Drawing 3.1A - 3.1E). Detailed design will determine the precise size and location of the building; however, it will be contained within the Assessment Area.

3.3.3 Decommissioning

Soon after the start of operations, the municipal land use by-law requires the Proponent to post a form of security in favour of the Municipality of Colchester to ensure funds are available for decommissioning at the Project's end of life.

Prior to decommissioning, NSECC will be provided with decommissioning plans for review and compliance with the Project's EA conditions.

Generally, the decommissioning phase will follow the same steps as the construction phase:

- Dismantling and removal of the turbines from the Project Area.
- Decommissioning the turbine foundations as per the conditions of the land lease agreement.
- Removal, recycling (where possible), and disposal of power collection system, conductor, and poles with NS Power's permission/cooperation.
- Removal of all other equipment and reinstatement and stabilization of land.

Procedures for Dismantling

If the facility is to be decommissioned and the turbines are to be removed at the end of their service life or during construction, the procedures will be similar to the construction phase, but in reverse sequence. The general dismantling procedure will proceed as follows:

- The Project will first be de-energized and isolated from all external electrical lines.
- Creation of temporary staging areas. To provide sufficient area for the laydown of the disassembled wind turbine components and loading onto trucks, an area of approximately 1 ha around each wind turbine must be cleared, levelled and made accessible. After completion of the decommissioning, temporary staging areas and any associated temporary decommissioning facilities or components used throughout the decommissioning phase will be removed. The temporary staging areas would be located within the Project Area used during the construction phase of the Project.
- Installation of crane pads. It is expected that the crane pads will be approximately 30 m x 70 m (actual size to be finalized) and will be located within the temporary staging area around each wind turbine. The topsoil at the crane pad will be removed and approximately 600 mm of compacted crushed gravel will be added. Once the turbine disassembly has been completed, the gravel area around each turbine will be removed and the area will be restored to prior use using stockpiled topsoil.
- Removal of the wind turbines. The blades, hub, nacelle and tower segments will be removed using cranes. The components and associated equipment will be hauled off using trucks and heavy-loaders.
- Partial removal of the foundations. The top of the concrete foundations will be removed to approximately 1 m below the surface at that time. Excavated foundation

areas will be backfilled with clean fill and stockpiled topsoil to match the original elevations. These areas will also be graded, contoured, and restored to a land use similar to what was present prior to foundation installation to allow for prior activities to resume.

- Overhead electrical lines are expected to be removed at the end of the Project's life; however, the poles on which the collector lines will be installed that are not shared with NS Power will be cut to a depth of approximately 1 m below original grade or may be completely removed from the ground, where feasible.
- The Proponent is responsible for decommissioning the electrical connector line from the substation up to the point of common coupling, after which point the infrastructure is owned by NS Power.
- The substation and associated infrastructure will be dismantled and removed in accordance with the legal requirements at the time unless otherwise requested by NS Power. Any concrete foundations associated with these facilities will be removed to at least 1 m below the original grade. The area will be graded, contoured, and restored to land use similar to what was present prior to foundation installation in order to allow for prior activities to resume. All materials will be recycled, where possible, or disposed of offsite at an approved and appropriate facility.
- Removal of access roads will depend on the requirements and agreements in place with the individual landowner. Impacted lands will be restored to the land use in place prior to the construction of the access road, at the discretion of landowners.
- The meteorological tower will be removed unless otherwise requested by the municipality or other stakeholders (and agreed to by the Proponent and the property owner) for them to remain in place. Any concrete foundation would be removed to at least 1 m below original grade or to the depth originally installed if less than 1 m below original grade. The area will be graded, contoured, and restored to land use similar to what was present prior to foundation installation in order to allow for prior activities to resume.

Restoration of Land

All affected lands will be restored once the dismantling procedures have been completed and the turbines and other ancillary facilities have been removed.

Dismantling of the wind turbines or other Project components will not result in any impacts to surface or groundwater quality. After the dismantling process has been completed, the land will be returned to previous conditions in consultation with the landowner, local municipality and NSECC. This will be accomplished by removing the foundations (or part of foundation), granular material from roadways and culverts. The natural environment will be restored by re-vegetation. If there is insufficient material on-site, topsoil and/or subsoil will be imported from a source acceptable to the landowner, local municipality and local NSECC office, as applicable.

Strict spill prevention procedures will be in place; therefore, the potential for small spills is very low. In the unlikely event that a spill occurs during decommissioning, the soil conditions of the areas will be surveyed per standards at the time of occurrence to determine if any impacts have occurred. Should soil impacts be noted, the impacted soils will be immediately delineated, excavated and removed from the site, per applicable standards, for disposal at an approved and appropriate facility.

Waste Generated

Waste and debris generated during the decommissioning activities will be collected and disposed of at an approved facility. All reasonable efforts will be made to minimize waste generated throughout the decommissioning phase. Materials used and generated throughout decommissioning will be recycled, as practicable.

Industry best practices for spill prevention will be employed. In the unlikely event of a minor spill, it will be cleaned up immediately and any impacted soils will be removed from the site and disposed of at an appropriate facility in accordance with the applicable regulations. After decommissioning, vehicles and construction equipment will be removed from the site.

RES has successfully decommissioned renewable energy projects in Europe and the United States with the most recent example being the Jake and Elwood Battery Energy Storage Projects in Illinois. In compliance with local regulations, the projects were returned to their original state and 98% of project materials were recycled.

3.3.4 Environmental Management & Protection

An Environmental Protection Plan (EPP) will be developed following EA approval. The EPP is the primary mechanism for ensuring that mitigation is implemented, as determined through the EA process, to avoid or mitigate potential adverse environmental effects that might otherwise occur from construction activities, and as required by applicable agencies through the permitting processes.

The EPP is developed for all Project personnel, including contractors, and describes the responsibilities, expectations, and methods for environmental protection associated with Project activities. The EPP will incorporate:

- Means to comply with requirements of relevant legislation.
- Environmental protection measures identified as part of the EA.
- Environmental commitments made as part of the EA.

A suggested Table of Contents for the EPP is provided in Appendix A. The EPP will be provided to NSECC prior to the start of construction for review.

3.4 Project Schedule

Table 3.5 presents the Project schedule from EA registration to Project decommissioning.

Table 3.5: Project Schedule

Project Activity	Timeline
EA Registration	October 2023
Post-EA Environmental Monitoring Programs	Late 2023 onward (as required by the EA Approval)
Geotechnical Assessment	November-December 2023
Detailed Engineering Design	November 2023 - March 2024
Municipal Decision on Development Agreement	Q1 2024
Clearing	Late Winter 2024 / Early Spring 2024
Construction	Q3 2024 to Q4 2025
Commissioning	Summer/Fall 2025
Operation	December 2025 onward
Decommissioning	2060 or beyond

4.0 PROJECT SCOPE & ASSESSMENT METHODOLOGY

As a Class 1 EA, this Registration Document and supporting studies have been developed to meet all requirements under Section 9(1A) of the *Environment Act,* S.N.S 1994-95, c. 1. As such, this submission has been prepared in accordance with:

- A Proponent's Guide to Environmental Assessment (NSECC, 2017)
- Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSECC, 2021)

Over the past several years, Project team members have engaged with the following regulatory bodies to provide input and advice into the EA scope and planning for the proposed Project, as well as for several other similar proposed wind project developments in Nova Scotia:

- Environment and Climate Change Canada (ECCC) – Canadian Wildlife Service (CWS)
- Nova Scotia Communities, Culture, Tourism and Heritage (NSCCTH)
- NSECC
- Nova Scotia Natural Resources and Renewables (NSNRR)
- Nova Scotia Office of L'nu Affairs

4.1 Site Sensitivity

Potential wind farms are assigned a category level, according to a matrix provided in the Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSECC, 2021). This matrix considers the overall Project size and the sensitivity of the Project. The category level then outlines guidance for the collection of baseline data and post-construction monitoring requirements.

As the total turbine height is greater than 150 m, the Project is automatically considered to have a category 4 risk rating.

4.2 Assessment Scope & Approach

EA is a planning tool used to predict the environmental effects of a proposed project, identify measures to mitigate adverse environmental effects, and predict the significance of any effects after the application of mitigation measures.

The EA focuses on VCs. VCs are specific components of the biophysical and human environments that, if altered by the Project, may be of concern to the Mi'kmaq of Nova Scotia, regulators, stakeholders, and/or the public. The scope of the EA for this Project includes:

- Identify VCs with which the Project may interact (by activity and phase) within established spatial and temporal boundaries.
- Establish the existing conditions for VCs.
- Identify potential interactions between the Project and the VCs.
- Assess the potential effects that could occur from the interaction.
- Identify mitigation measures to reduce or eliminate those effects.
- Evaluate the significance of the environmental effects after the implementation of mitigation measures using VC-specific criteria.
- Identify monitoring or follow-up programs to verify predictions and/or evaluate the need to implement adaptive management.

4.3 Identification of Valued Components

The following VCs were identified based on the experience of the Project Team and through engagement with the Mi'kmaq of Nova Scotia, regulators, stakeholders, and the public:

- Biophysical environment
    - Weather, climate, air quality
    - Geology, hydrogeology/groundwater
    - Watercourses, fish and fish habitat
    - Wetlands
    - Flora, fauna (including Mainland moose), habitat
    - Bats
    - Avifauna
    - Species at risk (considered in the appropriate VC chapter, as necessary)

- Socioeconomic environment
    - Economy, land use, transportation, recreation and tourism, human health
    - Archaeological and cultural resources
    - Electromagnetic interference
    - Shadow flicker
    - Visual impacts
    - Sound

4.4 Spatial & Temporal Boundaries

4.4.1 Spatial Boundaries

Spatial boundaries are considered separately for each VC and are typically based on natural system boundaries or administrative/political boundaries, as appropriate. The following spatial boundaries have been established for the effects assessment:

- Project Area – the physical footprint of the Project, where the direct physical disturbance is expected to occur [e.g., turbine pads, transmission line right of way (ROW), the substation and other laydown areas].
- Local Assessment Area (LAA) – the area where Project-related effects can be predicted or measured for assessment. The LAA is VC-specific and defined in each VC chapter.
- Regional Assessment Area (RAA) – includes the area established for context in the determination of significance of Project-specific effects. It is also the area in which accidents and malfunctions are assessed. The RAA is VC-specific and defined in each VC chapter.

As detailed in Section 3.1, a Study Area was established as a large assessment area based on land parcels [i.e., Property Identification (PIDs)] that are included in the development area (Table 3.1, Drawing 2.2). The intent of the Study Area was to first survey a broad area at a high-level to allow flexibility in the design to move infrastructure and minimize effects to VCs. Based on the resulting Study Area analyses, an Assessment Area was established for more detailed field investigations. The Assessment Area represents the physical footprint of the Project where the direct physical disturbance is expected to occur (i.e., the Project Area), plus a buffer to allow design flexibility and assess for indirect effects beyond the direct effects within the Project Area. For this Project, the buffer included a 150 m radius area for each turbine, a minimum 50 m buffer on either side of the centreline for the road layout, and a 150 m corridor for transmission lines. Where appropriate, the Study Area and Assessment Area are identified as the LAA and RAA for specific VCs in the individual VC chapters.

4.4.2 Temporal Boundaries

The temporal boundaries in Table 4.1 apply to all VCs unless otherwise stated in the individual chapters.

Table 4.1: Temporal Boundaries

Project Phase	Temporal Boundary
Site Preparation and Construction	18 to 24 months
Operation and Maintenance	35 years
Decommissioning	+35 years

4.5 Potential Project-Valued Component Interactions

The potential interactions between the Project and the VCs, by phase, are presented in the individual VC chapters (Sections 7 to 10), following a description of existing conditions. Where an adverse effect on a VC is identified, strategies for mitigation, avoidance, or compensation are proposed. Where possible, mitigation measures are incorporated into Project design to eliminate or reduce potential adverse effects.

4.6 Effects Assessment Criteria

The significance of the effects after mitigation is determined using defined criteria. Most criteria will be the same for all VCs (Table 4.2); however, the magnitude criteria are VC-specific and are provided in the individual chapters.

Table 4.2: Effects Assessment Criteria

Rating Criteria	Rating
Magnitude The amount of change in measurable parameters or the VC relative to existing conditions	VC-specific as outlined in individual chapters.
Geographic Extent The geographic area in which an effect occurs	**Project Area –** residual effects are restricted to the Project Area **LAA –** residual effects extend into the local assessment area **RAA –** residual effects interact with those of projects in the regional assessment area
Timing Considers when the residual effect is expected to occur	**Not applicable –** seasonal aspects are unlikely to affect the VC **Applicable –** seasonal aspects may affect the VC
Duration The time required until the measurable parameter or VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived	**Short term –** residual effect restricted to no more than the duration of the construction phase **Medium term –** residual effect extends through the operation and maintenance phase **Long term –** residual effect extends beyond the decommissioning phase
Frequency Identifies how often the residual effect occurs and how often in a specific phase	**Single event –** occurs once **Intermittent –** occurs occasionally or intermittently during one or more phase of the Project **Continuous –** occurs continuously
Reversibility Describes whether a measurable parameter or the VC can return to its existing condition after the activity ceases	**Reversible –** the residual effect is likely to be reversed after the activity is completed **Irreversible –** the residual effect is unlikely to be reversed

If, based on the criteria in Table 4.2, a residual effect is identified, its significance is then evaluated based on the criteria in Table 4.3.

Table 4.3: Definition of Significant Residual Environmental Effect

Significance Level	Definition
Significant	The potential effect could threaten sustainability of a resource or result in a moderate to high change in baseline levels within the RAA. The effect is anticipated to last for a medium to long-term duration and will occur on a continuous basis. Research, monitoring, and/or recovery initiatives should be considered and may be required.
Not Significant	The potential effect may result in a negligible to low change in a resource or condition in the RAA but should return to baseline levels within the short-term and occur only once or on an intermittent basis. Research, monitoring, and/or recovery initiatives are not recommended.

4.7 Monitoring & Follow-Up

Follow-up programs and monitoring, in some cases developed in conjunction with regulators, may be recommended to verify predictions and/or assess effectiveness of mitigation measures and the need to implement adaptive management. Follow-up programs and monitoring are presented, as necessary, in individual VC chapters.

5.0 MI'KMAQ OF NOVA SCOTIA

5.1 Overview

The Project is majority-owned by Wind Strength, a Membertou company. EverWind, minority owner of the Project, has also signed Memorandum of Understandings (MOUs) with Bayside Corporate (Paqtnkek), Membertou, and Potlotek for minority equity investments. As a result of this, the success of the Project is anticipated to have a positive effect on multiple Mi'kmaq communities and will support community growth through economic development. In addition, the strong relationships Membertou, Paqtnkek, and Potlotek have with other Mi'kmaq communities in Nova Scotia support a strong commitment to meaningful engagement with the Mi'kmaq of Nova Scotia throughout the life of the Project.

To share information and identify, assess, and avoid potential impacts to the Mi'kmaq of Nova Scotia, a Mi'kmaq Ecological Knowledge Study (MEKS) and thorough community engagement was undertaken for the Project, which are discussed in the following sections.

The Project has received written support from Membertou (Appendix B).

5.2 Membertou First Nation Ownership

The Project is majority-owned (51%) by Wind Strength, a Membertou company. Wind Strength is a translation of the Mi'kmaq word "Wju'snewiknaq" (Wu-jew-sin-eh-wee-ginn-ah), which embodies the strength, resiliency, and environmental stewardship of the Mi'kmaq people through green energy leadership.

Membertou has been heavily involved in all aspects of the Project, including prior to the involvement of EverWind. In addition to regularly occurring business discussions with Membertou representatives, the Proponent continues to engage with Membertou Chief and Council, Membertou staff, along with environmental and consultation representatives to ensure they have an opportunity to review the Project with respect to their interests and treaty rights.

5.2.1 EverWind and Mi'kmaq Engagement

EverWind is in constant communication with its equity partners to provide updates on all aspects of EverWind's broader ambitions, including the Project. Various senior members of EverWind's Mi'kmaq equity partners travel with the EverWind team to attend conferences, meetings, and commercial discussions.

The wind energy from the Project will be primarily used to power EverWind's Point Tupper Green Hydrogen/Ammonia Project – Phase 1, which received EA Approval from the Minister of NSECC on February 7, 2023. As part of the EA for Point Tupper Green Hydrogen/Ammonia Project – Phase 1, fulsome community engagement was conducted, including with the Mi'kmaq of Nova Scotia about the wind portion of the Project. Engagement focused on the use of renewable energy to power green fuels production. Engagement was completed with the following Mi'kmaq communities:

- Paqtnkek Mi'kmaw Nation
- Membertou First Nation
- Potlotek First Nation
- Millbrook First Nation
- Sipekne'katik First Nation

EverWind has also engaged with Indigenous-led companies and events through the following activities:

- Engaged Indigenous Treaty Partners to undertake cultural training for the EverWind management team and staff; contributions to fund training for various Nova Scotia not-for-profits has also been provided.
- Engaged the President and Chief Executive Officer (CEO) of Indigevisor Advisory and Consulting to provide the Project Team with cultural competence training and guidance for building relationships with Indigenous communities.
- Working closely with 3D Wave – an Indigenous owned firm supplying 3D LIDAR-based flyover modelling – and supporting their climate modelling initiatives through funding.
- Collaborating with Ulnooweg on development of educational materials on green hydrogen, the Hydrogen Fuel Cell Marine Pilot Project, and funding for the Ulnooweg Summer Solstice Run and 11th Indigenous Entrepreneur Awards Show.

For detailed information regarding EverWind's completed engagement with the Mi'kmaq of NS, see EverWind's Point Tupper Green Hydrogen/Ammonia Project – Phase 1 EA, specifically Section 5.0, which is publicly available on the NSECC website (https://novascotia.ca/nse/ea/everwind-point-tupper-green-hydrogen-ammonia-project/).

5.3 MEKS

A MEKS presents a thorough and accurate understanding of the Mi'kmaq's use of the land and resources within an area. It is a report of gathered, identified, and documented ecological knowledge which is held by individual Mi'kmaq people. In addition, the MEKS report provides information on proposed Project activities that may impact the traditional land and resources of the Mi'kmaq. The MEKS for this Project is currently underway by Membertou Geomatics Solutions and is geographically scoped to include an evaluation of the Project Area along with a 5 km buffer surrounding the Project Area (referred to as the "Study Area" for the MEKS report). To date, the site assessment (i.e., site visit) has been completed by Membertou Geomatics Solutions, with community interviews ongoing; however, the finalized report is not available. Once available, a copy of the MEKS will be provided to the required reviewers under separate cover.

MEKS considers the land and water areas in which the proposed Project is located to identify what Mi'kmaq traditional use activities have occurred or are currently occurring within the "Study Area"; and what Mi'kmaq ecological knowledge presently exists with respect to the area. This process is done in accordance with the Mi'kmaq Ecological Knowledge Protocol, 2nd Edition, which was established by the Assembly of Nova Scotia Mi'kmaq Chiefs and speaks to the process, procedures, and results that are expected of a MEKS.

The MEKS consists of two major components:

- Mi'kmaq Traditional Land and Resource Use Activities
    - Considers both past and present uses of the area.
    - Uses interviews as the key source of information regarding Mi'kmaq use.

- A Mi'kmaq Significance Species Analysis
    - Identifies species in the area and considers resources that are important to Mi'kmaq use (food/sustenance resources, medicinal/ceremonial plant resources, and art/tools resources).
    - Considers resource availability/abundance in the area (along with adjacent areas or in other areas outside), their use, and their importance, with regards to the Mi'kmaq.

Interviews undertaken by the MEKS Team with Mi'kmaq knowledge holders are ongoing throughout October 2023. Interviewees are shown topographical maps the Project Area and its 5 km buffer and asked to identify where they undertake their activities and to identify where and what activities were undertaken by other Mi'kmaq, if known. These interviews are allowing the MEKS Team to develop a collection of data that reflects the most recent Mi'kmaq traditional use in this area, as well as historic accounts. The data gathered will also consider its significance to the Mi'kmaq people. Once the analysis is complete, the MEKS report and any recommendations will be reviewed by the Project Team to determine if any mitigation measures are required to support the continued traditional use of the Study Area by the Mi'kmaq of Nova Scotia.

5.4 Mi'kmaq Engagement

As an integral component of any project development activity in Nova Scotia, the Proponent prioritized early engagement with Nova Scotia Mi'kmaq communities. Engagement was led by Membertou, with emails provided containing the Project overview, location, website, open house presentation details, and maps. All 13 Mi'kmaq communities were contacted about the Project and informational meetings have already taken place with Pictou Landing, Potlotek, and the Nova Scotia Office of L'nu Affairs. Meetings are ongoing with communities and Mi'kmaq stakeholders, as detailed in Table 5.1. The feedback from these meetings has informed the overall design, sizing, and development of the Project.

Table 5.1: Engagement with the Mi'kmaq of Nova Scotia

First Nation / Organization	Role(s)/Representatives	Contact Details
Kwilmu'kw Maw-klusuaqn (KMKNO)	Twila Gaudet, Director of Consultation Janice Maloney, Executive Director	September 2023 Email outreach to organize an introductory meeting with KMKNO regarding the Project, Project Team, and work done to date. The Proponent has previously reached out to the KMKNO in 2022 regarding the Point Tupper Green Hydrogen/Ammonia Project – Phase 1, which will be powered in part by the Project.
Millbrook First Nation	Chief Gloade	September 2023 Email outreach to organize an introductory meeting with Millbrook First Nation regarding the Project, Project Team, and work done to date. The Proponent recognizes that Millbrook First Nation is not represented by KMKNO for the purposes of engagement and consultation and will direct conversations on related matters with Chief and Council.
Sipekne'katik First Nation	Chief Michelle Glasgow Brian Dorey, Director of Operations	September 2023 Email outreach to organize an introductory meeting with Sipekne'katik First Nation regarding the Project, Project Team, and work done to date. Sipekne'katik First Nation responded, and a meeting is currently being arranged. The Proponent recognizes that Sipekne'katik First Nation is not represented by KMKNO for the purposes of engagement and consultation and will direct conversations on related matters with Chief and Council.

First Nation / Organization	Role(s)/Representatives	Contact Details
Pictou Landing First Nation (PLFN)	Barry Francis, Director of Lands and Economic Development Michael Polak, Executive Director Chief Andrea Paul	September,2023 Email outreach to organize an introductory meeting with PLFN regarding the Project, Project Team, and work done to date. A meeting was held on September 21, 2023. Further Project information was provided following the meeting.
Acadia First Nation	Chief Deborah Robinson Rachel Stevenson, Economic Development Officer	September 2023 Email outreach to organize an introductory meeting with Acadia First Nation regarding the Project, Project Team, and work done to date.
Glooscap Energy Limited Partnership	Glooscap Chief Sidney Peters Robyn Crowe, Executive Assistant Michael Peters, CEO, Glooscap Energy LP	September 2023 Email outreach to organize an introductory meeting with Glooscap First Nation regarding the Project, Project Team, and work done to date.
Annapolis Valley First Nation (AVFN)	Chief Gerald Toney John McCaul, Head of Economic Development	September 2023 Email outreach to organize an introductory meeting with AVFN regarding the Project, Project Team, and work done to date.
Eskasoni First Nation	Chief Leroy D.C. Denny	September 2023 Email outreach to organize an introductory meeting with Eskasoni First Nation regarding the Project, Project Team, and work done to date.
L'sitkuk (Bear River) First Nation	Chief Carol Dee Potter	September 2023 Email outreach to organize an introductory meeting with L'sitkuk (Bear River) First Nation regarding the Project, Project Team, and work done to date.
Membertou First Nation	Chief Terrance J. Paul	Membertou is the majority owner of the Project, and the community has been engaged from the outset. Chief Terry Paul, Membertou Council and the Development Corporation support the Project, as it has the capacity to support the transition to green energy in Mi'kma'ki and beyond.

First Nation / Organization	Role(s)/Representatives	Contact Details
Paqtnkek First Nation	Chief Corey Julian	Paqtnkek First Nation is a partner in the Point Tupper Green Hydrogen/Ammonia Project – Phase 1, which will be powered in part by the Project. EverWind, minority owner of the Project, has also signed a MOU with Bayside Corporate (Paqtnekek), for a minority equity investment in the Project.
Potlotek First Nation	Chief Wilbert Marshall Tahirih Paul, Economic Development Director	September 2023 Email outreach to organize an introductory meeting with Potlotek First Nation regarding the Project, Project Team, and work done to date. A meeting was held on September 21, 2023. Further Project information was provided following the meeting. EverWind, minority owner of the Project, has also signed a MOU with Potlotek First Nation, for a minority equity investment in the Project. Potlotek First Nation is also a partner in the Point Tupper Green Hydrogen/Ammonia Project – Phase 1 which will be powered in part by the Project.
Wagmatcook First Nation	Chief Norman Bernard	September 2023 Email outreach to organize an introductory meeting with Wagmatcook First Nation regarding the Project, Project Team, and work done to date.
We'koqma'q First Nation	Chief Annie Bernard-Daisley	September 2023 Email outreach to organize an introductory meeting with We'koqma'q First Nation regarding the Project, Project Team, and work done to date. We'koqma'q First Nation responded asking to receive more information about the Project and a meeting is being organized.

5.4.1 Ongoing Engagement

The Proponent is committed to on-going, meaningful engagement with the Mi'kmaq of Nova Scotia and will continue to provide regular updates and seek feedback throughout the Project. The Proponent is also committed to minimizing footprint disturbance and impacts to the Mi'kmaq of Nova Scotia while generating positive economic and environmental benefits.

The Proponent also plans on:

- Providing tours of the Project to the Mi'kmaq of Nova Scotia during construction and operations.
- Ensuring various opportunities for Mi'kmaq participation in the Project (contracting opportunities, employment).
- Continuing engagement with the Mi'kmaq through the EA process, and the construction and operations phases of the Project.

6.0 ENGAGEMENT

The Proponent is committed to meaningful engagement with government, the public, stakeholders, and the Mi'kmaq of Nova Scotia.

The Project Team has directly engaged with members of the public, municipal leadership and staff, as well as relevant provincial and federal departments through in-person meetings, letters, emails, telephone conversations, and open houses. This section provides a summary of the activities that have been conducted by the Proponent and outlines how the Proponent will continue to engage throughout the remainder of the Project's permitting, construction, and operational life.

Associated presentations, posters, newsletters, and letters of support are provided in Appendix B.

6.1 Engagement with Government Departments, Agencies, & Regulators

The Project Team has been in contact with government entities and officials representing federal, provincial, and municipal jurisdictions (Table 6.1) to open lines of communication about the Project and ensure all regulatory requirements are met.

Table 6.1: Government Meetings and Events

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, & Comments
	Federal Government	
Canadian Coast Guard	Wind Farm Coordinator	September 2023 EMI notification letter sent. Awaiting response.
Department of National Defence (DND)	Military Air Defence and Air Traffic Control; Military Radio communication users	September 2023 EMI notification letter sent. Response received; further information provided to DND as per request.
ECCC	Public Inquiries Centre Weather Radar Coordinator	August 2023 Email outreach to organize an introductory meeting with ECCC (Public Inquiries) regarding the Project, Project Team, and work done to date. ECCC responded providing direction to other federal and provincial departments to contact for renewable energy projects. September 2023 EMI notification letter sent. Awaiting response.
Innovation, Science, and Economic Development Canada (ISED)	Nova Scotia District Office	September 2023 EMI notification letter sent. ISED confirmed receipt of Project package and stated that ISED will reach out if further information is needed.
NAV Canada	General Inquires Email Land Use Specialist	August 2023 Email outreach to organize an introductory meeting with NAV Canada (General Inquiries) regarding the Project, Project Team, and work done to date. A meeting with NAV Canada was held on August 11, 2023. Additional information was provided to NAV Canada following the Project meeting.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, & Comments
		September 2023 EMI notification letter sent. NAV Canada confirmed receipt of Project package and stated that NAV Canada will review (eight to 12 week turnaround time) and reach out if further information is needed.
RCMP	Wind Farm Coordinator	September 2023 EMI notification letter sent. Awaiting response.
Transport Canada	General Inquiries Email	August 2023 Email outreach to organize an introductory meeting with Transport Canada regarding the Project, Project Team, and work done to date. October 2023 Transport Canada responded requesting additional information which was provided.
Provincial Government		
Member of the Legislative Assembly (MLA.) for Colchester North	MLA Tom Taggart	August 2023 Email outreach to organize an introductory meeting regarding the Project, Project Team, and work done to date. A virtual meeting with MLA Tom Taggart was held August 12, 2023; during the meeting MLA Tom Taggart emphasized the importance of public consultation and developing the Project with respect to the local communities. Further information was provided following the meeting.
Members of Parliament (MP's) for Cumberland – Colchester	Stephen Ellis MP Kody Blois MP	August 2023 Email outreach to organize introductory meetings with the MP regarding the Project, Project Team, and work done to date.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, & Comments
		A virtual meeting with Kody Blois MP was held on August 17, 2023. Further information was provided following the meeting.
NSCCTH, Acadian Affairs and Francophonie Division	General Inquiries Email	August 2023 Email outreach to organize an introductory meeting regarding the Project, Project Team, and work done to date. Acadian Affairs and Francophonie Division declined to participate in engagement and suggested that the Proponent reach out to the Federation Acadienne de la Nouvelle Ecosse.
NSCCTH, African Nova Scotia Affairs (ANSA) Division	General Inquiries Email	August 2023 Email outreach to organize an introductory meeting with the ANSA regarding the Project, Project Team, and work done to date.
NS Department of Municipal Affairs and Housing	Head Office	August 2023 Email outreach to organize an introductory meeting regarding the Project, Project Team, and work done to date. October 2023 NS Department of Municipal Affairs and Housing responded and a meeting is currently planned for October 25, 2023.
NSPW	Head Office Area Manager Director, Operations Services	August 2023 Email outreach to organize an introductory meeting with NSPW regarding the Project, Project Team, and work done to date. A virtual meeting was with NSPW on August 16, 2023. Further information was provided following the meeting.
NSECC	General Inquires	August 2023 Email outreach to organize an introductory meeting with the NSECC regarding the Project, Project Team, and work done to date.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, & Comments
NSECC, EA Branch	Manager – EA Branch Business Relationship Manager	July 2023 Strum Consulting gave a presentation to the NSECC EA Branch on July 6, 2023 providing details on the Project, Project Team, completed environmental studies, engagement, and Project timeline. A copy of the presentation is provided in Appendix B.
NSECC, Protected Areas & Ecosystems Branch	Manager – Protected Areas & Ecosystems Business Relationship Manager	August 2023 Email outreach to organize an introductory meeting with the Protected Areas & Ecosystems Branch regarding the Project, Project Team, and work done to date. A virtual meeting with the Protected Areas & Ecosystems Branch was held August 14, 2023. Further Project information was provided following the meeting.
Nova Scotia Office of L'nu Affairs	CEO – Office of L'Nu Affairs	September 2023 Email outreach to organize an introductory meeting with the Office of L'Nu Affairs regarding the Project, Project Team, and work done to date. A virtual meeting was held October 4, 2023. Further Project information was provided following the meeting.
NSNRR	Tory Rushton, Minister of Natural Resources and Renewables	August 2023 Email outreach to organize an introductory meeting regarding the Project, Project Team, and work done to date. October 2023 NSNRR responded and a meeting is being organized. October 2023 In-person meeting with NSNRR held on broader EverWind developments including the Project.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, & Comments
	Municipal Government	
Municipality of Colchester	Councilors (Districts 7, 8 & 9) Mayor Christine Blair	August 2023 Email outreach to organize an introductory meeting with the Mayor and Councilors regarding the Project, Project Team, and work done to date. A meeting was held with the District 8 and 9 Councilors on August 1, 2023. Additional information was provided as a follow-up to the meeting. The Mayor was also sent an email invitation to the Open House on August 23, 2023. October 2023 The Proponent presented a Project update to Council on October 3, 2023. Topics of discussion included the results of noise and shadow flicker studies, community benefits, work done to date and next steps. Some questions required follow-up and the Proponent is currently working to set another meeting with Council. A copy of the Presentation is provided in Appendix B.
Municipality of Colchester, Community Development	Director of Community Development Development Officer	August 2023 Email outreach to organize an introductory meeting regarding the Project, Project Team, and work done to date. A meeting was held with the Director and Development Officer on August 31, 2023, to review the Project and work done to date.

6.1.1 Review of Government Concerns

Discussions with federal and provincial regulators primarily focused on Project infrastructure location and impact to federally managed lands or infrastructure (i.e., NavCan radars). Discussions with provincial regulators primarily focused on environmental impacts, provincial infrastructure that would be impacted and/or used (i.e., roads, component delivery), stakeholder engagement, Project progress and timelines, and design and infrastructure siting. All regulators emphasized the importance of sharing Project information early and in detail, to support the permitting and administrative processes.

Engagement with government officials will continue through development, construction, and operational phases of the Project.

6.2 Public & Stakeholder Engagement

The Project Team has been involved in formal engagement activities with the public and stakeholders to ensure the community was made aware of the Project and given ample opportunity to receive information, ask questions, and share local knowledge.

The Proponent directly engaged local landowners regarding the Project and expanded its engagement efforts to include additional landowners near the Project Area throughout the Project's development. The Proponent will continue to engage the public and stakeholders through various communication channels during the Project's development, construction, and operations. Table 6.2 summarizes engagement with stakeholders.

Table 6.2: Stakeholder Meetings and Events

Community/Stakeholder Organization	Engagement
Bicycle NS	August 7, 2023 Email outreach to organize an introductory meeting with Bicycle NS regarding the Project, Project Team, and work done to date.
Centre for Local Prosperity	August 7, 2023 Email outreach to organize an introductory meeting with the Centre for Local Prosperity regarding the Project, Project Team, and work done to date.
Cobequid Eco-Trails	August 7, 2023 Email outreach to organize an introductory meeting with Cobequid Eco-Trails regarding the Project, Project Team, and work done to date.
Cobequid Off-Highway Vehicle Club	August 7, 2023 Email outreach to organize an introductory meeting with Cobequid Off-Highway Vehicle Club regarding the Project, Project Team, and work done to date.
Colchester-Cumberland Wind Field	September 7, 2023 Meeting with Colchester-Cumberland Wind Field to discuss potential Community Economic Development Investment Fund programs across EverWind owned wind farms.
Ecology Action Centre	August 7, 2023 Email outreach to organize an introductory meeting with the Ecology Action Centre regarding the Project, Project Team, and work done to date.
Happy Atmosphere Environmental Society	August 7, 2023 Email outreach to organize an introductory meeting with the Happy Atmosphere Environmental Society regarding the Project, Project Team, and work done to date.
Hart Lake Property Owners Association	August 7, 2023 Email outreach to organize an introductory meeting with the Hart Lake Property Owners Association regarding the Project, Project Team, and work done to date. A meeting with the President and several members of the Hart Lake Property Owners Association was held on August 15, 2023. During the meeting, the Hart Lake Property Owners Association requested the Project include Hart Lake Road as an access point. Additional information was provided as a follow-up to the meeting and the Proponent committed to analyzing Hart Lake Road for potential use in the Project.
Healthy Forest Coalition	August 7, 2023 Email outreach to organize an introductory meeting with the Healthy Forest Coalition regarding the Project, Project Team, and work done to date.

Community/Stakeholder Organization	Engagement
Living Earth Council	August 7, 2023 Email outreach to organize an introductory meeting with the Living Earth Council regarding the Project, Project Team, and work done to date.
North River Fire Brigade	August 7, 2023 Email outreach to organize an introductory meeting with the North River Fire Brigade regarding the Project, Project Team, and work done to date.
NS Federation of Anglers and Hunters	August 7, 2023 Email outreach to organize an introductory meeting with the NS Federation of Anglers and Hunters regarding the Project, Project Team, and work done to date.
NS Nature Trust	August 7, 2023 Email outreach to organize an introductory meeting with the Nova Scotia Nature Trust regarding the Project, Project Team, and work done to date.
Rural Communities Foundation of Nova Scotia (RCFNS)	August 7, 2023 Email outreach to organize an introductory meeting with the RCFNS regarding the Project, Project Team, and work done to date.
North Shore ATV Club	August 7, 2023 Email outreach to organize an introductory meeting with the North Shore ATV Club regarding the Project, Project Team, and work done to date.
Ski Wentworth	August 7, 2023 Email outreach to organize an introductory meeting with Ski Wentworth regarding the Project, Project Team, and work done to date.
Sunrise Trails ATV Club	August 7, 2023 Email outreach to organize an introductory meeting with the Sunrise Trails ATV Club regarding the Project, Project Team, and work done to date.
Truro & Colchester Partnership for Economic Prosperity	August 7, 2023 Email outreach to organize an introductory meeting with the Partnership regarding the Project, Project Team, and work done to date.

6.2.1 Digital Communications

The Proponent has maintained a Project website since July 4, 2023 (https://kmtnukwind.com/home). This publicly accessible website continues to be updated regularly. It includes information about the Project and Proponent including:

- About the Project (i.e., ownership, developers, location, sizing, job creation)
- Project contact information (i.e., email-address)
- Project timeline
- Community benefit programs
- Open house details
- Project documents (i.e., open house materials, newsletters, presentations, benefits summaries, visual simulations, etc.)
- Environmental studies

A dedicated email inbox was set up on July 14, 2023, info@kmtnukwind.com. The email inbox is actively monitored by the Proponent multiple times a day. The Proponent has invited the public to reach out and engage with the lead contact through the Project social media channels, including LinkedIn and Facebook. The public was specifically invited to provide feedback and questions.

6.2.2 Newsletters

A newsletter was mailed by regular mail in July 2023 to a list of 60 stakeholders comprised of community groups, municipal government and Mi'kmaq communities and organizations.

An electronic newsletter was distributed in July 2023 to an email list populated by interested parties who either signed-up on the Project website or made a request via phone, email, or mail.

The newsletter included the following information:

- Overview of the Project.
- Introduction to the Proponent.
- Contact information.
- Information on upcoming open houses.
- Map of the general area of the Project.
- Community/local benefits.
- Environmental and socioeconomic assessments.
- Overview of engagement efforts.

6.2.3 Public Open House Events

Two public open house events took place prior to EA registration. Details are provided below.

Open House #1

The first Open House was held on Wednesday August 23, 2023 from 5:00 pm to 8:00 pm at the Earltown Community Centre (55527 Highway 311, Earltown). This event was advertised on the Project website, in the July newsletter, and the Colchester Wire on August 16, 2023.

In addition, the Proponent conducted a door knocking campaign on August 9, 2023, along Sullivan, Kavanaugh Mill, Kennedy Hill and Truro Roads. Where residents were not home, a fuel card and newsletter which included information about the Project and the upcoming open house were left at the door.

The objective of Open House #1 was to introduce the Project to the community, show the general Project location, and gather community feedback to inform the Project design. The Project Team presented 21 posters and provided a one-page handout, which included contact information for the Proponent and the Project's specific lead contact. The Project Team also answered questions and took feedback, both verbally and through written forms, about concerns and interest from the local community and various stakeholders. Sign-in sheets were available for participants to provide their contact information and enable follow up. A total of 45 attendees were recorded on the sign-in sheets. All materials presented at the session were also made available on the Project website.

Figure 6.1: Open House #1 held in the Earltown Community Centre, Wednesday August 23, 2023

Feedback received from Open House #1 was incorporated into the planning and development of Open House #2 and to inform the Project design process.

Open House #2

The second Open House was held on Thursday September 21, 2023 from 2:00 pm to 7:00 pm at the Earltown Community Centre (55527 Highway 311, Earltown). The Open House #2 duration was expanded from 3 hours to 5 hours to allow for more time for the community to attend. This event was advertised on the Project website, EverWind's LinkedIn Profile, and in the Colchester Wire.

The Project Team presented 21 posters and provided a one-page handout, which included contact information for the Proponent and the Project's specific lead contact, as well as relevant Project and assessment drawings (e.g. Project layout, sound and shadow flicker modelling). The Project Team also answered questions and took feedback about concerns and interest from the local community and various stakeholders. Sign-in sheets were available for participants to provide their contact information and enable follow up. A total of 15 attendees were recorded on the sign-in sheets. All materials presented at the session were also made available on the Project website.

At both open houses, community benefits programs were presented, which include an electricity subsidy fund, community vibrancy fund, and a bursary fund. The electricity subsidy fund represents an annual payment to residents within a specified distance from a turbine. The community vibrancy fund is an annual fund with oversight governed by a committee of community members, council representatives, and project representatives. The bursary fund represents at least 10 scholarships available to community members to be used for training in the renewable energy industry.

Fundy Trail Snowmobile Club Meeting

The Proponent attended a regular meeting of the Fundy Trail Snowmobile Club at their clubhouse at 7 pm on Friday, October 13, 2023. Approximately 30 club members attended the meeting. The Proponent spent approximately an hour speaking with the group, taking questions, and collecting feedback. The Proponent shared contact information and committed to providing more information to the group as needed, as well as maintaining contact with the club throughout the development process.

Other – Upcoming Colchester County Community Meeting

In consultation with the Colchester Development Officer and in accordance with the land use by-law, a meeting is being planned for late November to present to the community the development license application filed by the Proponent to the municipality.

6.2.4 Review of Concern

Issues and concerns raised by the public have been grouped into broader categories and reference to the relevant section of the EA in which the concern is addressed have been noted (Table 6.3)

Table 6.3: Comments Received from the Public

Key Issues	Proponent Response	Section of EA
Human Health		
Will wind turbines be noisy?	NSECC requires sound levels of no more than 40 A-weighted decibels (dBA) outside of a home. For context, 40 dBA is equivalent to the sound of a quiet library. Sound modelling results of the Project indicate that all residences will fall below the 40 dBA threshold. The Proponent has used a minimum setback of	Section 10.5

Key Issues	Proponent Response	Section of EA
	1000 m from all receptors to ensure that noise is mitigated.	
Socio Economic		
What kind of investments/ programs are planned for community development?	The Proponent has provided community benefit programs which include an electricity subsidy fund, community vibrancy fund, and a bursary fund.	6.2.3
Will jobs created by the Project be given to local workers?	The Proponent has engaged with local community members and service provides to identify suitable candidates and/or business to support the construction and operation of the Project. Job fairs and events may also be held in local communities closer to construction of the Project.	Section 8.1
How will the Project impact all-terrain vehicle (ATV) and snowmobile trails in the area?	The Project Team is committed to working with local ATV and snowmobile groups to ensure continued access to the area and associated trails, within the bounds of all safety considerations, particularly during construction.	Sections 8.3 8.4
Visual Impacts		
What will be the visual impacts associated with the wind turbines?	Photo renderings of what the Project could look like from specific vantage points and viewsheds have been prepared for this EA.	Section 10.4
Environmental Impacts		
How will this impact wildlife and wildlife habitat, vegetation communities, species at risk, waterbodies, and areas of scientific or natural interest?	A full desktop review and extensive field surveys have been completed to identify the presence of wildlife and wildlife habitat, vegetation communities, species at risk, waterbodies, and areas of scientific or natural interest.	Sections 7.3.2 7.4.1 7.4.2 7.4.3 7.4.4 7.4.5
What is the carbon/ greenhouse gas offset achieved from the Project?	A climate change/greenhouse gas assessment study was completed for the Project to quantify, minimize, and mitigate Project-generated greenhouse gas emissions.	Section 7.1.2
General		
Will the power produced by the Project be available to Nova Scotia residents and help contribute to the provinces 80% renewable energy target? Concerns raised regarding private/industrial power use.	The Project is expected to primarily be used to power green hydrogen and green ammonia production, which has substantial decarbonization and grid benefits.	2.2

6.2.5 Ongoing Engagement

The Project has evolved significantly to address feedback received from the public. Some examples include:

- Employment opportunities – the Proponent has committed to creating a Community Liaison Committee (CLC) and holding job fairs prior to construction to ensure that job openings are advertised locally.
- The Proponent is planning additional meetings to answer questions and provide additional information in response to requests by the public.
- Additional support for local recreation. The Proponent has committed to working with the snowmobile trail clubs to ensure that their recreational activities are minimally impacted through construction and operations.

The Proponent will continue to document questions and concerns raised by the public through telephone and e-mail correspondence, and any additional in-person contact with the public. By maintaining a database of public comments in Net Benefit, the Proponent is well positioned to design a Project that is sensitive to concerns, while also balancing these concerns with the feasibility of the Project. When possible, the Proponent will directly engage with members of the public, landowners, interested stakeholders, governmental authorities or any other authorities having jurisdiction who have expressed concerns relating to the Project. In addition, the Proponent will reach out to members of the community who have expressed an interest in supporting the Project.

6.3 Engagement Completed for Related Projects

The wind energy from the Project will be primarily used to power EverWind's Point Tupper Green Hydrogen/Ammonia Project – Phase 1 which received EA Approval from the Minister of NSECC on February 7, 2023. As part of the EA for Point Tupper Green Hydrogen/Ammonia Project – Phase 1, fulsome community engagement was conducted, including with various government departments, stakeholders, and the public about the wind portion of project. The vast majority of engagement included mentions of the renewable energy to be used to power the green fuels production. This included various email correspondences, meetings, and presentations along with four open houses:

- Open House #1 took place on September 6, 2022 from 4:00 pm to 7:00 pm in the Hawkesbury Room of the Maritime Inn Port Hawkesbury. This event was advertised on 101.5 "The Hawk" radio station as well as on the radio station's Facebook page.

- Open House #2 was held on September 22, 2022 from 5:00 pm to 8:00 pm in the Shannon Studio Room of the Port Hawkesbury Civic Centre. This event was advertised on the 101.5 "The Hawk" radio station and an ad for the event was also run in the Port Hawkesbury Reporter.

- Open House #3 was held on November 1, 2022 from 2:00 pm to 4:00 pm in St. Peter's United Church Hall in Richmond County. This event was advertised on the 101.5 "The Hawk" radio station and in the St. Peter's United Church bulletin.

- Open House #4 was also held on November 1, 2022 from 6:00 pm to 8:00 pm in the Isle Madame New Horizons Senior Citizens Club in Arichat within Richmond County. This event was advertised on the 101.5 “The Hawk” radio station.

Open House attendees had the opportunity to speak one-on-one with EverWind team members regarding any questions or concerns and were also provided with an opportunity to supply written feedback through the use of an exit survey. Attendees were also encouraged to supply their contact information to receive future updates.

For detailed information regarding completed engagement, see EverWind’s Point Tupper Green Hydrogen/Ammonia Project – Phase 1 EA, specifically sections 5.0 and 6.0, which is publicly available on the NSECC website (https://novascotia.ca/nse/ea/everwind-point-tupper-green-hydrogen-ammonia-project/).

7.0 BIOPHYSICAL ENVIRONMENT

7.1 Atmospheric Environment

7.1.1 Atmosphere and Air Quality

7.1.1.1 Overview

The assessment of the atmospheric environment included a review of weather, climate, and air quality data.

7.1.1.2 Regulatory Context

Relevant legislation includes:

- *Environment Act*, S.N.S. 1994-95, c.1
- Air Quality Regulations, N.S. Reg. 8/2020

7.1.1.3 Assessment Methodology

The assessment was completed through a review of the following resources:

- Ecological Land Classification for Nova Scotia (Neily et al., 2017)
- ECCC Weather and Climate (ECCC, 2023a)
- NSECC Ambient Air Quality Data (NSECC, 2023a)

7.1.1.4 Assessment Results

Weather and Climate

Nova Scotia's climate is quite varied and is largely governed by coastal influences and elevation (Davis & Browne, 1996). The Project is located within the Cobequid Hills Ecodistrict (340), which is part of the Nova Scotia Uplands Ecoregion (Drawing 7.1).

The hills in the Cobequid Hills Ecodistrict receive the greatest snowfall on the mainland, with over 300 centimeters (cm) in an average year. However, within the Nova Scotia Uplands Ecoregion, Cobequid Hills is the driest ecodistrict with annual precipitation of about 1,200 mm. The highest points on the mainland are found in the Cobequid Hills at Nuttby Mountain and Dalhousie Mountain, which rise to 335 masl (Neily et al., 2017).

The local temperature and precipitation data were obtained from the Debert meteorological station (Climate ID 8201390), located approximately 20 km north of the Project at 45.416667 N, 63.466667 W (Table 7.1).

Table 7.1: Climate Data from the Debert Meteorological Station (2012-2022)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Temperature (°C)													
Daily Avg	-6.2	-5.9	-2.6	3.8	9.5	14.2	18.9	18.6	14.0	8.6	2.9	-2.3	6.2
Daily Max	-0.8	-0.5	2.7	9.2	16.0	20.4	25.1	24.8	20.2	14.3	7.6	2.1	11.8
Daily Min	-11.6	-11.3	-7.9	-1.8	3.0	8.0	12.6	12.4	7.9	2.9	-1.9	-6.8	0.5
Extreme Max	16.5	15.9	19.4	21.7	27.7	30.3	32.9	32.7	28.7	24.7	22.8	16.9	32.9
Extreme Min	-29.8	-29.4	-28.2	-19.8	-5.2	-3.2	4.5	0.0	-3.1	-8.5	-13.8	-27.8	-29.8
Precipitation													
Precip (mm)	82.6	86.6	74.1	84.0	80.5	109.7	79.6	82.8	127.5	105.5	118.0	118.3	1,149.2

Source: (ECCC, 2023a)

From 2012 to 2022, the mean annual temperature was 6.2 degrees Celsius (°C), with a mean daily maximum of 11.8°C and a mean minimum of 0.5°C. January and February were the coldest months (mean daily average of -6.2°C and -5.9°C, respectively), while the warmest months were July and August (mean daily average of 18.9°C and 18.6°C, respectively). From 2012 to 2022, data was recorded in terms of precipitation (monthly average), with most occurring in September and December [127.5 millimeters (mm) and 118.3 mm, respectively] (ECCC, 2023a).

Wind speed and direction data were obtained from the Debert meteorological station (Climate ID: 8205774) located approximately 20 km southwest of the Project at 45.416667° N, 63.466667° W (Table 7.2).

Table 7.2: Wind Data from the Debert Meteorological Station (2012-2022)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum Hourly Speed (km/h)	102	101	102	91	79	65	85	63	113	85	91	93
Most Frequent Direction	NW	SW	SW	SW	SW	SW	SW	SW	SW	SW	NW	NW

Source: (ECCC, 2023a)

The maximum hourly wind speeds recorded at the Debert meteorological station between 2012 and 2022 ranged from 63 km per hour (km/h) in August to 113 km/h in September. The wind direction most observed at the meteorological station is from the southwest; however, between November and January, wind occurred primarily from the northwest. Note that wind directions may occur in all directions; however, during calm wind flows, the direction is not recorded at the meteorological station (ECCC, 2023a). A windrose plot provided for the Debert meteorological station (CZDB) demonstrates the wind directions from 2012 to 2022 (Figure 7.1).

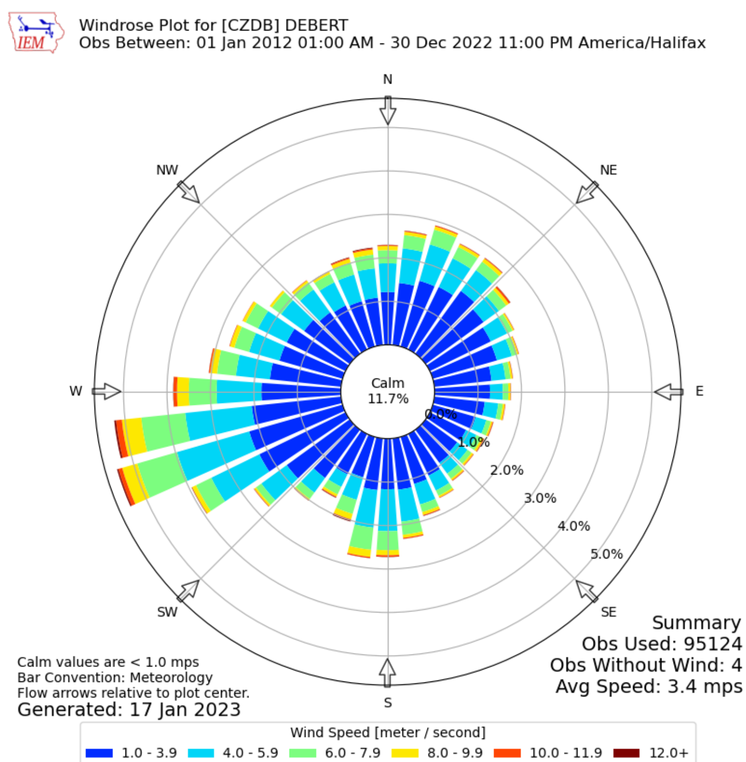

Figure 7.1: Windrose Plot for Debert Meteorological Station (CZDB) – January 1, 2012, through December 30, 2022 (Iowa State University, 2023)

Figure 7.1 demonstrates that between January 1, 2012, and December 30, 2022, wind speeds above 12 metres per second (m/s) (or 43.2 km/h) occurred the most frequently from the southwest.

Air Quality

The Canadian Council of Ministers of the Environment (CCME) has established Canadian Ambient Air Quality Standards (CAAQS) for fine particulate matter (PM) [≤2.5 micrometres (µm) ($PM_{2.5}$) or ≤10 µm (PM_{10}) in size], ozone (O_3), sulphur dioxide (SO_2), and nitrogen dioxide (NO_2) over select averaging time periods (CCME, u.d.); while the Government of Nova Scotia has legislated Air Quality Regulations, N.S. Reg. 8/2020 (NSAQR) under the *Environment Act,* S.N.S. 1994-95, c.1 (Table 7.3).

The ambient air quality standards published in the NSAQR set the maximum permissible ground-level concentration limits. Proposed changes to the current NSAQR are underway and will govern future air quality criteria once implemented (NSECC, 2022b); these proposed values have been provided below for comparative purposes (Table 7.3).

Table 7.3: Summary of Regulations Pertaining to Ambient Air Quality in Nova Scotia

Contaminant	Averaging Period	Regulatory Threshold (µg/m³)	
		Existing Provincial(1)	Proposed Provincial(2)
Carbon Monoxide (CO)	1-hour	34,600	35,000
	8-hour	12,700	10,000
Nitrogen Dioxide (NO_2)	1-hour	400	200
	24-hour	---	25
	Annual	100	10
Ozone (O_3)	1-hour	160	---(4)
$PM_{2.5}$	24-hour	---	15
	Annual	---	5
PM_{10}	24-hour	---	45
	Annual	---	15
Sulphur Dioxide (SO_2)	1-hour	900	---
	24-hour	300	40
	Annual	60	---
Total Suspended Particulate (TSP)	24-hour	120	100
	Annual	70(3)	60

(1)Current Ambient Air Quality Standards (NS AAQS) [Air Quality Regulations, NS Reg. 8/2020].
(2)Proposed Ambient Air Quality Standards (subject to change) (NSECC, 2022b).
(3)Geometric mean.
(4)Ozone is no longer an ambient air quality standard in the Proposed Ambient Air Quality Standards.

Nova Scotia monitors air quality at eight ambient air quality monitoring stations throughout the province (NSECC, 2023a). Measured parameters at these locations may include the following:

- Carbon monoxide (CO)
- O_3
- Nitrogen oxides (NO_x)
- Nitric oxide (NO)
- NO_2
- $PM_{2.5}$
- SO_2
- Total reduced sulphur (TRS)

The NO_2, O_3, and $PM_{2.5}$ values from seven of the eight air quality monitoring stations are used to calculate a score on the Air Quality Health Index (AQHI) (ECCC, 2023b; NSECC, 2023a). The AQHI is a scale from 1 to 10+, in which scores represent the following health risk categories: Low (1 to 3), Moderate (4 to 6), High (7 to 10), and Very High (10+) (ECCC, 2023b).

The air quality monitoring station closest to the Project is in Pictou, NS, approximately 42 km east of the Study Area at 45.681744° N, 62.696575° W.

Table 7.4 summarizes the current (baseline) maximum ambient air quality conditions observed at the Pictou air quality monitoring station from 2017 to 2022. The monitored parameters are compared to the current NSAQR.

Table 7.4: Current (Baseline) Maximum Ambient Air Quality Conditions in Proximity to the Project

Parameter	Averaging Period	O_3 (ppb)	SO_2 (ppb)	NO_X (ppb)	NO (ppb)	NO_2 (ppb)	$PM_{2.5}$ (ug/m^3)	TSP (ug/m^3)	CO (ppb)	H_2S (ppb)
Pictou Ambient Monitoring 2018-2022	1 hour	83.9	48	112.4	80.5	31.9	48	-	-	-
	24 hours	53.2	19.0	26.0	11.7	14.2	23.0	-	-	-
	Annual	28.2	0.3	1.2	0.2	0.9	4.8	-	-	-
NS AAQS Schedule A	1 hour	82	340	-	-	210	-	-	30,000	30
	24 hours	-	110	-	-	-	-	120	-	6
	Annual	-	20	-	-	50	-	70*	-	-
Fraction of NS AAQS Schedule A	1 hour	102%	14%	-	-	15%	-	-	-	-
	24 hours	-	17%	-	-	-	-	-	-	-
	Annual	-	2%	-	-	2%	-	-	-	-

Source: (NSECC, 2023a)
*geometric mean

As seen in Table 7.4, existing air quality conditions (i.e., baseline data) indicate that most of the measured contaminants are well below their respective NS AAQS Schedule A limits except O_3, which is 102% of the 1-hour limit. In reviewing the available data for the Pictou air quality monitoring station, the reported AQHI is typically scored 'low' at all times of the year (ECCC, 2023b).

7.1.1.5 Effects Assessment

Project-Atmospheric Interactions

Project activities will primarily interact with the atmospheric environment through fugitive dust and exhaust emissions from construction equipment (Table 7.5). While this may occur during all phases of the Project, fugitive dust and exhaust emissions would be highest during the construction phase. No air emissions are associated with the operation of the wind turbines (Section 7.1.2).

Table 7.5: Potential Project-Atmospheric Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Atmospheric Environment		X	X	X	X	X	X	X		X		X	X	X	X

Assessment Boundaries

The LAA for the atmospheric environment is the Project Area. The RAA for atmospheric environment is not applicable.

Assessment Criteria

The assessment criteria provided in Section 4.6 apply to the atmospheric environment. The VC-specific definition for magnitude is as follows:

- Negligible – no changes are expected to ambient air quality.
- Low – minimal changes are expected to ambient air quality.
- Medium – some changes are expected to ambient air quality.
- High – widespread changes are expected to ambient air quality.

Effects

Fugitive dust emissions consist of PM and may be generated from open-air activities (e.g., moving earth/disturbing soil, wind erosion, increase in traffic). Fugitive dust emissions are composed mainly of soil minerals but can also contain salt, pollen, spores, and tire particles. There are two forms of PM which pose the greatest concern for human health: PM with a diameter of 10 µm or less (PM_{10}) and PM with a diameter of 2.5 µm or less ($PM_{2.5}$). PM is measured by TSP and is defined as the mass of airborne particles having a diameter of less than 44 µm.

When fugitive dust enters the atmosphere, it may potentially affect lung and heart functions. Particulate matter has been linked to premature death (people with lung and heart disease), non-fatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, and increased respiratory symptoms such as irritation of the airways, coughing, or difficulty breathing. People with underlying lung and heart disease, children, and the elderly are the most susceptible to particulate pollution exposure (US EPA, 2023a).

Fugitive dust may also affect the environment through visibility impairment and environmental damage. Fine particles are the leading cause of reduced visibility in many cities, national parks, and wilderness areas. In addition, fugitive dust particles can be carried over long distances (via wind), deposited in other locations, and within surface water features. Some of the effects of particulate deposition may include the following (US EPA, 2023a):

- Increasing lake and stream acidity.
- Altering the nutrient balance in coastal waters and large river basins.
- Depleting the nutrients in the soil.
- Damaging sensitive forests and farm crops.
- Affecting the diversity of ecosystems.
- Contributing to acid rain effects.

Anticipated sources of fugitive dust emissions from the Project will be primarily associated with the construction of the Project and may include the following activities:

- Soil disturbance during site preparation (i.e., clearing/grubbing, grading, blasting).
- Wind erosion from soil or rock stockpiles during grading.
- Increase in traffic on roadways from travel by Project personnel (to/from the site).
- Management of on-site materials transfers (i.e., loading/unloading).

The interaction with local receptors was assessed to determine impacts on ambient air quality from fugitive dust emissions. The closest non-participating potential receptor (Drawing 7.2) is located well beyond the extent to which fugitive dust emissions are expected to travel, and, as a result, no impacts are anticipated as fugitive dust emissions are considered short-term (construction), intermittent, and within the LAA.

Construction of the Project may increase combustion residuals and/or exhaust tailpipe emissions, primarily PM, NO_x, SO_2, and CO from vehicles (i.e., travel by Project personnel, transport/delivery activities) and heavy equipment. Exhaust emissions are primarily anticipated to be associated with local roadways and roads developed for the Project within the Project Area. Exhaust emissions are not anticipated to travel beyond the extent of the Project Area, and as such, impacts to local residential receptors are not anticipated. Overall, exhaust emissions are considered short-term, intermittent, and within the LAA.

Mitigation

An Air Quality and Dust Management Plan will be developed as a component of the EPP to define measures to minimize and mitigate the creation and emission of pollutants, including fugitive dust and exhaust emissions, particularly for the construction phase of the Project.

In addition, general mitigation measures for fugitive (dust) emissions include:

- Conduct grading and site preparation in phases to minimize disturbed soil areas until just prior to construction activities.
- Stabilize exposed soil surfaces by sloping or using vegetation, stone, soil, or geotextiles to prevent dust and airborne particles.
- Compact and/or ridge disturbed soil to prevent dust formation.
- Cease dust-generating construction activities during periods of excessive wind.
- Enclose or cover soil storage and/or stockpile areas.
- Wet (with water) aggregate and soil stockpiles to control dust.
- Design storage areas and material stockpiles with prevailing wind directions in mind.
- Wet roadways and heavy traffic areas with water or dust suppressant technologies to minimize airborne emissions.
- Tie down, cover, and/or store loose site materials and/or products prior to inclement weather and wind events to prevent materials from becoming airborne.
- Wash down vehicles and equipment using hoses and water to remove accumulated mud/dirt on undercarriages, tracks, or wheel wells.
- Ensure Project personnel adhere to all safety protocols and wear appropriate personal protective equipment (PPE) in the event of significant fugitive emissions events (i.e., windstorms, dust storms).

General mitigation measures for exhaust emissions include:

- Ensure equipment meets all applicable provincial and air quality regulations and emissions standards.
- Ensure equipment is fueled using low-sulphur diesel (to reduce SO_x air emissions).
- Maintain engines and exhaust systems according to the manufacturer's specifications and the recommended maintenance schedule.
- Remove from service malfunctioning equipment and/or equipment generating excess amounts of smoke, odour, or noise, until an assessment and necessary repairs can be completed.
- Remove from service construction equipment with improperly functioning emissions control systems.
- Restrict the idling of equipment where feasible.

Monitoring
Given the low to negligible impacts, no monitoring is required.

Conclusion
Results are characterized as low to negligible magnitude, within the LAA, of short-duration, intermittent, reversible, and not significant.

7.1.2 Climate Change

The Project is being developed to support various end-use electrical requirements (i.e., the production of Certified Green hydrogen and ammonia within Nova Scotia, NS Power grid). Climate change for this Project is addressed in terms of greenhouse gas (GHG) emissions and per NSECC's Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (2021).

For the purposes of this EA, the GHG emissions only consider the emissions from wind energy. The GHG assessment for Certified Green hydrogen and ammonia was considered independently and completed as part of the EverWind Point Tupper Green Hydrogen/Ammonia Project – Phase 1 EA, which was subsequently approved by NSECC on February 7, 2023. However, since then, a carbon footprint evaluation was completed by ERM Worldwide Group Limited (2023) and an updated summary of emissions from green ammonia production from the Project-generated renewable energy is summarized in this EA (Section 7.1.2.6).

7.1.2.1 Overview

Climate change is a long-term alteration of weather patterns and conditions strongly impacted by changes in temperature and precipitation. Climate change typically involves changes in average conditions, as well as changes in variability. The main contributor to climate change is GHGs from anthropogenic sources. Since GHGs disrupt the natural heat transfer processes within the Earth's atmosphere, a build-up of these gases has enhanced the natural greenhouse effect. These human-induced enhancements are especially of concern since ongoing GHG emissions have the potential to warm the planet to levels that have yet to be experienced (Government of Canada, 2019a).

The impacts of climate change on the Project are assessed separately under Section 12.1.

7.1.2.2 Regulatory Context

The climate change assessment considered the following Acts and Regulations:

- *Canadian Environmental Protection Act*, *1999* (CEPA)
- *Environment Act*, S.N.S. 1994-95, c. 1
- *Environmental Goals and Sustainable Prosperity Act,* S.N.S. 2007, c 7
- Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations, S.O.R./2013-24
- Ozone-depleting Substances and Halocarbon Alternatives Regulations, S.O.R./2016-137
- Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations, S.O.R. 2010-201
- Regulations Respecting Greenhouse Gas Emissions, N.S. Reg. 260/2009

Regulatory guidance was used to determine the appropriate assessment methodologies, mitigation controls, best management practices, and emissions targets.

7.1.2.3 Assessment Methodology

The objectives of this assessment include the following:

- Establish the sources of GHG contributions from the Project.
- Quantify baseline and Project-generated GHG emissions.
- Mitigate and minimize GHG generation from Project-related activities.

Sources of GHG emissions were identified through a review of Project phases, components, and equipment.

Baseline GHGs were quantified using emission factors published in the NSECC Standards for Quantification, Reporting, and Verification of Greenhouse Gas Emissions (2020) and current electricity generating practices from NS Power.

Project-generated GHGs were quantified in accordance with the specifications described in the International Standard ISO 14064 (2019) and using published values found in the literature (sources provided in applicable sections that follow). GHG emissions and removal enhancements are stated in tonnes of carbon dioxide equivalent (tCO_2e).

7.1.2.4 Sources of Greenhouse Gas Emissions

The main GHGs of concern include:

- CO_2
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Halocarbons
- Water vapour

GHGs may be natural or anthropogenic in origin, except halocarbons, which are human-made (Government of Canada, 2019b). The following subsections describe the GHGs and their contributors (sources) as anticipated during each phase of the Project.

Carbon Dioxide

The primary source of atmospheric CO_2 is burning carbon-containing fossil fuels (i.e., coal, oil, and natural gas) and deforestation/land clearing activities.

Site preparation and construction for the Project will include several activities that are likely to produce CO_2; including, but not limited to, the following:

- Use of heavy equipment (excavators, dozers, cranes, etc.).
- Use of light-duty vehicles and equipment (pick-up trucks, light plants, generators, etc.).
- Land clearing, including the decay of cut foliage (which releases CO_2 slowly).

- Cement production results in the heating of limestone, which releases CO_2 (Government of Canada, 2019b).

During the operations phase, CO_2 emissions will be limited to maintenance activities (i.e., transportation and materials). Where these activities are intermittent and short-term, the GHG contributions from operations are negligible and are not considered further.

Methane

CH_4 is produced when fossil fuels are burned with insufficient oxygen to complete combustion (Government of Canada, 2019b).

The Project's construction phase requires different heavy- and light-duty equipment, contributing to methane emissions.

During the operations phase, methane emissions will be limited to maintenance activities (i.e., transportation and materials). Where these activities are intermittent and short-term, the GHG contributions from operations are negligible and are not considered further.

Nitrous Oxide

The primary sources of N_2O are related to the use of nitrogen-based synthetic fertilizers and manure. These sources have added significant amounts of reactive nitrogen to Earth's ecosystems. Other contributors include the release of N_2O into the atmosphere during the combustion of fossil fuels and biomass (e.g., trees or wood-based fuels) and from some industrial sources (Government of Canada, 2019b).

The Project's construction phase requires heavy- and light-duty equipment, which can contribute to nitrous oxide emissions. Land restoration activities (i.e., soil amendments and reclamation) following construction will also contribute nitrous oxide emissions. Overall, the production of N_2O in association with this Project is anticipated to be minimal.

During the operations phase, N_2O emissions will be limited to maintenance activities (i.e., transportation and materials). Where these activities are intermittent and short-term, the GHG contributions from operations are negligible and are not considered further.

Halocarbons

Halocarbons are a group of synthetic chemicals containing a halogen group (e.g., fluorine, chlorine, and bromine) and carbon (Government of Canada, 2019b). They are typically used in refrigerants, fire-extinguishing agents, and solvents (Government of Canada, 2020). There are various industrial sources, but the main contributor is aluminum production (US EPA, 2023b).

During the construction phase, the primary source of halocarbon emissions from the Project will be associated with coolants in air conditioning units found in vehicles, portable construction buildings (i.e., trailers), and equipment. Fire-extinguishing agents (containing halocarbons) may also be used in the event of an emergency which requires a fire-fighting response.

During the operations phase, halocarbon emissions will be limited to maintenance activities (i.e., transportation and materials). Where these activities are intermittent and short-term, the GHG contributions from operations are negligible and are not considered further.

Water Vapour

Water vapour is the most important naturally occurring GHG. Human activities do not directly influence the amount of water vapour in the atmosphere as it is a function of the atmosphere's temperature. The atmosphere can hold about 7% more water vapour for every additional degree Celsius in air temperature. When the air becomes saturated with water vapour, the water vapour condenses and falls as rain or snow, leading to climate change effects (i.e., variances in weather patterns).

As climate warming gases (i.e., CO_2, CH_4, N_2O) increase in the atmosphere, the temperature rise increases water evaporation from the Earth's surface and increases the atmospheric water vapour concentrations. This increased water vapour, in turn, amplifies the warming from the initial GHGs, causing the cycle to repeat and temperatures to keep rising (Government of Canada, 2019b).

Project activities contributing to GHG emissions are not anticipated to impact water vapour concentrations in the atmosphere.

7.1.2.5 Quantification of the GHG Baseline Conditions

The GHG baseline is a reference of sources, sinks (removing), and reservoirs (storing) occurring in the absence of the Project and is used to compare pre- and post-project conditions. That said, the baseline determines the quantity of carbon dioxide equivalent (CO_2e) emitted from current electricity production methods for the same electrical capacity of the Project.

The baseline sources are related to emissions generated from electricity currently produced in Nova Scotia from coal, oil, natural gas, and wind. There are no sinks and reservoirs attributed to the baseline scenario.

The Project consists of up to 16 turbines, each capable of generating 5.9 MW of renewable energy. Based on the wind turbine design capacity and the Proponent's preliminary capacity rating (per an energy assessment; not for public distribution), the Project will produce approximately 346,489,536 kilo Watts per hour per year (kWh/year). The lifespan of the Project is estimated at a minimum of 35 years.

Quantifying GHGs regarding tCO_2e requires using emission factors published in the NSECC Standards for Quantification, Reporting, and Verification of Greenhouse Gas Emissions (2020) and current electricity generating practices (Figure 7.2).

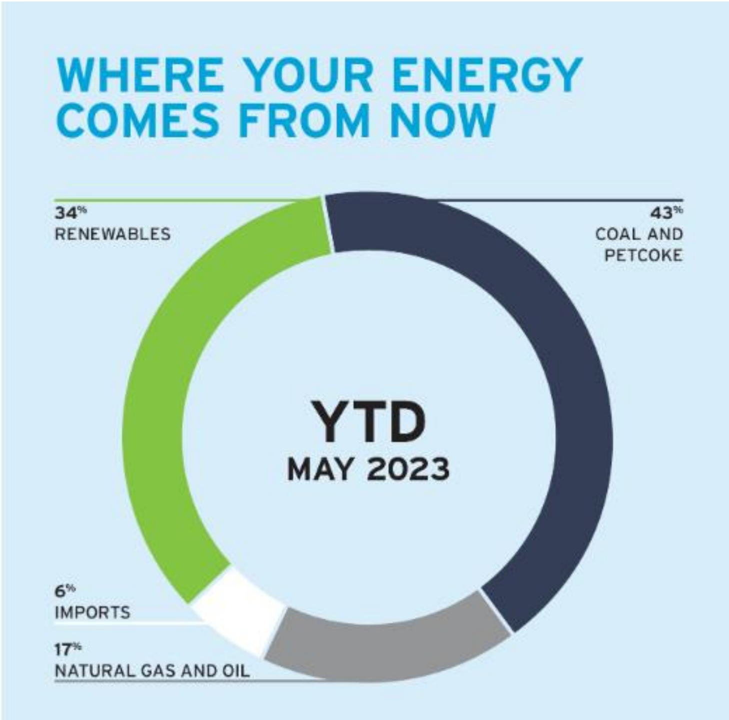

Figure 7.2: NS Power 2023 Energy Statistics

As of May 2023, electricity generated in Nova Scotia by NS Power (the leading producer) was produced from the following fuel sources (NS Power, 2023):

- Coal and Petcoke (43%)
- Renewables (34%)
- Natural Gas and Oil (17%)
- Imports (6%)

Most electricity is generated through coal, petcoke, natural gas, and oil at 60%. Renewable sources account for 34% (biomass, wind, hydro, and tidal), and the remaining 6% consists of imports. For the purpose of this assessment, the energy imports are distributed amongst coal (+2%), natural gas (+2%), and oil (+2%). Therefore, the fractions used for this assessment were coal at 45%, natural gas at 10.5%, and oil at 10.5%. As most renewable energy is generated from wind, quantification considers wind at 34%.

Table 7.6 summarizes the GHG emission factors for the different types of electricity generated in Nova Scotia.

Table 7.6: Electricity Fuel Source Emission Factors

Electricity Fuel Source	Emission Factor (tCO_2e/year)
Coal	0.001251
Natural Gas	0.00044

Electricity Fuel Source	Emission Factor (tCO_2e/year)
Oil	0.0011068
Wind	0

Source: (US EIA, 2022)

Given the current electricity generation methods and the fuel source emission factors (Table 7.6), Table 7.7 summarizes the baseline GHG emissions.

Table 7.7: Baseline Quantification Summary

Electricity Fuel Source	Electricity Generation (kWh/yr)	Emissions (tCO_2e)
Coal	155,920,291	159,836.85
Natural Gas	36,381,401	16,007.26
Oil	36,381,401	40,265.66
Wind	117,806,442	0
Total	**346,489,536**	**216,109.77**

The total annual GHG emissions generated in Nova Scotia for the same electrical capacity of the Project is **216,109.77 tCO_2e.**

Detailed CO_2e calculations are provided in Table 1 (Appendix C).

7.1.2.6 Quantification of GHG Emissions from Ammonia Production

The Project is being developed (in part) to support the production of Certified Green hydrogen and ammonia in Nova Scotia.

In normal circumstances, CO_2 emissions would result from the power generated to supply the hydrogen process [traditional methods of hydrogen production, such as Steam Methane Reforming, emit approximately 8 to 10 kg of CO_2 per kg of hydrogen produced (Siemens Energy, 2022)]; however, as the renewable energy resource from this Project supplies the hydrogen electrolyzers, no CO_2 emissions are generated (ERM, 2023).

Based on carbon footprint modelling completed by ERM Worldwide Group Limited (third-party), the primary CO_2 emissions would result from the process plant emissions. Ammonia production through electrolytic hydrogen (using renewable electricity resources) and the Haber-Bosch process results in significantly lower greenhouse gas (GHG) emissions (0.13 g of CO_2 equivalent per megajoule of energy [gCO_2e/MJ]) compared to steam reformation technologies which produce up to 99 gCO_2e/MJ (ERM, 2023; Timmerberg et al., 2020).

When considering the Projects 98 MW capacity, should the entire energy produced result in the production of ammonia via the Haber-Bosch process, approximately 162 tCO_2e would be generated annually. Conventional ammonia production processes generate up to 123,489 tCO_2e annually. These projections indicate that the Project’s renewable energy could reduce global CO_2 emission from ammonia production up to 76,228%.

7.1.2.7 Quantification of the Project-generated GHG Emissions

Construction Phase

Access Roads

Most turbines are located adjacent to existing trails and access roads; however, the construction of new roads and upgrading of existing roads will require the removal of vegetation and overburden, which will create fugitive dust and GHG emissions. However, where fugitive dust and GHG contributions for these activities are temporary, short-term, and represent a small incremental addition compared to the overall Project emissions, they were not quantified.

Fugitive dust and air emissions as they relate to the Project, are discussed in Section 7.1.1.

Laydown Areas

Laydown areas [estimated area 250 m by 100 m = 25,000 square metres (m^2) each] are intended to store the turbine pad foundation, the crane pad and other equipment temporarily. These areas will be prepped by removing the vegetation and overburden and placing competent soils. Construction activities and equipment associated with the laydown areas are anticipated to create fugitive dust and GHG emissions. However, where fugitive dust and GHG contributions for these activities are temporary, short-term, and represent a small incremental addition compared to the overall Project emissions, they were not quantified. Additionally, a vegetation management plan will be initiated to recover the lost flora and reduce dust resuspension while maintaining access and clearances to the turbine.

Concrete Foundation

A concrete tower foundation and pedestal will be required for each wind turbine. As such, the Project will require a significant quantity of concrete to be produced and delivered to each wind turbine location.

In 2017, Casey Concrete Ltd. poured approximately 1,000 cubic metres (m^3) to build the base of a 3 MW wind turbine in Amherst, Nova Scotia. Transportation of the concrete consisted of 140 truckloads (Kenter, 2017). Note that a concrete supplier has not been procured at this stage of the Project; as such, for the purpose of this assessment, the Casey Concrete Ltd. quantities will be assumed for GHG quantification. The quantification of the GHG emissions requires the following inputs:

- The vehicle size and fuel type used to transport the concrete.
- The distance travelled to and from the concrete manufacturer to the wind turbine sites.
- The freight and weight associated with each trip (to and from each turbine location).
- The quantity of concrete produced for the wind turbine bases.

Heavy-duty diesel concrete trucks will be required to transport concrete to the Project Area. For this assessment, transportation distances are based on the nearest known concrete supplier, located approximately 57 km from the Project Area. Given that the turbine locations are scattered across the Project Area, transportation distances range from 64 km to 74 km (Table 7.8).

Table 7.8: Distance from the Nearest Known Concrete Supplier to Individual Wind Turbine Locations

Wind Turbine	Approximate Distance (km)
1	65.90
2	66.60
4	64.70
5	64.70
6	65.90
7	67.00
8	67.70
10	71.10
11	71.10
12	70.90
13	70.30
14	69.80
15	73.80
16	73.46
17	72.80
20	70.50
Total	**1106.26**

Based on Table 7.8, the total distance between the wind turbines and the nearest concrete supplier is 1106.26 km. Assuming 140 truckloads per wind turbine, the total one-way distance travelled is 154,876.40 km. GHG quantification considered travel to and from the nearest concrete supplier to the wind turbine locations.

It is assumed that each concrete truck will carry approximately 17.86 tonnes[1] of concrete per delivery for a total of 2,500 tonnes of concrete per wind turbine.

Table 7.9 summarizes the GHG emission factors for the different components used for concrete-related activities.

[1] $2{,}500\,\frac{Tonnes\ of\ Concrete}{Turbine} \div 140\,\frac{Trucks}{Turbine} = 17.86\,\frac{Tonnes\ of\ Concrete}{Truck}$

Table 7.9: Concrete Manufacturing and Transportation Emission Factors

Component	Emission Factor
Concrete Production	3×10^{-4} tCO_2e/kg
Concrete Truck (Diesel) with Freight	1.35×10^{-4} tCO_2e/tonne·km
Concrete Truck (Diesel) without Freight	1.106×10^{-3} tCO_2e/km

Source: (Squared Consultants Inc., 2022)

Given the travelling distances, the quantity of concrete required for the Project, and the emission factors (Table 7.9), the CO_2e emissions are expected to be approximately **12,544.66 tCO_2e** for constructing all the tower foundations and pedestals.

Detailed CO_2e calculations are provided in Table 2, Appendix C.

Turbine

The Project will require wind turbines to be manufactured and delivered to the Project Area. The chosen turbine model is the Nordex N163 5.9 MW, which has a rotor diameter of 163 m and can generate up to 5.9 MW of power.

To quantify GHG contributions from the turbines during the construction phase, the following items were assessed:

- The turbine materials and quantity.
- The turbine transportation distances from the manufacturer to the intended wind turbine laydown.
- The vehicle size and fuel type used to transport the wind turbines.

For quantification purposes, the assessment assumed the following:

- Manufacturing Material: Steel
- Manufacturing Location: Nordex, Chennai, India
- Nearest US Shipping Port: Chennai, India
- Nearest NS Shipping Port: Dartmouth, Nova Scotia, Canada

Wind turbines are typically made up of 12 principal components (Electrical Academia, u.d.):

- Blade (three)
- Drive Train
- Gearbox
- Generator
- Hub
- Nacelle
- Rotor
- Speed Shafts (low and high)
- Tower

According to the National Renewable Energy Laboratory (2017), the total weight of manufacturing material is equivalent to approximately 120,000 kilograms per megawatt (kg/MW). Given the Project's wind turbine model capacity of 5.9 MW, the total weight of a wind turbine is assumed to be approximately 708,000 kilograms (kg).

GHG emission factor for wind turbine manufacturing is provided in Table 7.10

Table 7.10: Wind Turbine Weights

Component	Emission Factor (tCO_2e/kg)
Wind Turbine Material (Steel)*	$1.5x10^{-3}$

*Estimated from the UK's mixture of steel types, excluding stainless steel (University of Bath, 2011).

The GHG emission factor for wind turbine manufacturing is provided in Table 7.11.

Given the steel required to produce the wind turbines for the Project and the emission factor (Table 7.10), the CO_2e emissions from the manufacturing of all the wind turbines are expected to be approximately **16,992.00 tCO_2e**.

The Nordex Group has multiple manufacturing facilities within North America. Project turbines are assumed to be manufactured at the Chennai, India manufacturing facility for this assessment. The turbines will travel to the port in Chennai, India, by heavy diesel hauler (transport), where they will be shipped via diesel cargo vessel to Dartmouth, Nova Scotia. Table 7.11 summarizes the transportation distances from the manufacturer to the Project.

Table 7.11: Wind Turbine Transportation Distances

Originating Destination	Final Destination	Distance (km)
Manufacturing Facility Chennai, India	Port in Chennai, India	49 (Land)
Port of Chennai, India	Dartmouth, Nova Scotia	21,600 (Marine)
Dartmouth, Nova Scotia	Kmtnuk Wind Power Project	130 (Land)

To determine the travel distance for a wind turbine, the following assumptions were made:

- Each component will be individually transported via a single diesel heavy hauler.
    - 12 components per turbine to travel from the Manufacturing Facility in Chennai, India, to the Port in Chennai, India (total of 588 km per turbine).
    - 12 components per turbine to travel from Dartmouth, Nova Scotia to turbine location (distance will vary from one turbine location to another).
- Each wind turbine (in its entirety) will be transported via a single diesel cargo vessel.

Land transportation distances were calculated according to the assumptions in Table 7.12.

Table 7.12: Land Distance from the Manufacturer to Individual Wind Turbine Locations

Wind Turbine	Approximate Distance (km)*
1	1,856.40
2	1,864.80
4	1,842.00
5	1,842.00
6	1,842.00
7	1,856.40
8	1,869.60
10	1,878.00
11	1,932.00
12	1,918.80
13	1,918.80
14	1,916.40
15	1,909.20
16	1,903.20
17	1,951.20
20	1,950.00
Total	**30,250.80**

* Estimated distances from the Port of Dartmouth to the individual turbines one way. The number of trips and transport vehicles should be considered for a cumulative travel distance.

Based on Table 7.12, the total land transportation distance between the wind turbine manufacturer and the wind turbine laydowns (not including marine transportation) is **30,250.80 km**. The total marine transportation distance associated with getting the wind turbines from Chennai, India to Dartmouth, Nova Scotia, is **344,843 km**. The distances travelled consider travel from the manufacturer to the Project Area only; an equivalent return distance is not considered as the hauling companies would have commitments with other clients, and those GHG emissions would not be attributable to the Project.

GHG emission factors for the different components of wind turbine transportation are provided in Table 7.13.

Table 7.13: Wind Turbine Transportation Emission Factors

Component	Emission Factor (tCO_2e/tonne·km)
Heavy Duty Truck (Diesel) with freight	1.35×10^{-4}
Marine Cargo and Container Vessel (Diesel) with Freight	1.51×10^{-5}

Source: (Squared Consultants Inc., 2022)

Given the land transportation distances required to deliver the wind turbines to the Project and the emission factors (Table 7.13), the CO_2e emissions from land transportation of the wind turbines are expected to be approximately **240.95 tCO_2e**. In addition, the marine transportation distances required to deliver the wind turbines from the United States to Canada will contribute **3,686.65 tCO_2e**.

Detailed CO_2e calculations are provided in Table 3, Appendix C.

7.1.2.8 Operations Phase

Following the construction phase, the turbine will be operational, and the sinking of GHG emissions will begin. Based on the wind turbine design capacity, the Project will be capable of producing approximately **346,489,536 kWh/year**. Therefore, the renewable energy produced will replace power production from fossil fuels and more intense generation methods described under baseline conditions (Section 7.1.2.5).

According to Padey et al. (2012), maintenance activities are the only contributor to GHGs during the operations phase. The maintenance typically includes replacing approximately 15% of the nacelle components and one blade during the wind turbine's lifetime. According to GE Renewable Energy (2018) and the European Wind Energy Association (u.d.), nacelle weights range from 59,200 kg to 61,400 kg, and blade assembly weights range from approximately 28,000 kg to 35,000 kg. For the purposes of this assessment, a conservative estimation of 61,400 kg and 35,000 kg was assumed for the nacelle and blade weights, respectively. Given the replacement rates, nacelle material accounts for approximately 9,210 kg and blade replacement 11,667 kg throughout the wind turbine lifetime. The total emission from the replacement material for all the Project's wind turbines is **501.05 tCO_2e** (Table 3, Appendix C).

7.1.2.9 Effects Assessment

Project-GHG Interactions

Project activities will emit GHGs during all phases of the Project (Table 7.14).

Table 7.14: Potential Project-GHG Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
GHG		X	X	X	X	X	X	X		X		X	X	X	X

Assessment Boundaries

The LAA for GHGs is the Study Area. The RAA for GHGs is not applicable.

Assessment Criteria

The assessment criteria provided in Section 4.6 apply to Project-related GHG contributions. The VC-specific definition for magnitude is as follows:

- Positive – The Project is expected to have a positive effect on GHG emissions.
- Negative – The Project is expected to have a negative effect on GHG emissions.

Effects

The Project is intended to have a net positive effect on the GHG environment (Table 7.15).

Table 7.15: Project GHG Emission Summary

Component	Emissions (tCO_2e)
Baseline	
Electricity Generated from Coal	159,836.85
Electricity Generated from Natural Gas	16,007.26
Electricity Generated from Oil	40,265.66
Electricity Generated from Wind	0
Total	**216,109.77**
Construction Phase	
Concrete Production and Transportation	12,544.66
Wind Turbine Manufacturing	16,992.00
Wind Turbine Transportation	3,686.65
Total	**33,464.26**
Operations Phase	
Electricity Generated from Wind	0
Wind Turbine Maintenance	501.05*
Total	**501.05**

The values in this table may differ from those presented in Appendix C as a result of rounding errors; however, the rounding errors are negligible and do not change their representation.
*Project lifespan emissions (single event)

As mentioned, the current GHG emissions for the quantity of electricity required by the Project using NS Power's conventional generation methods contribute to **216,109.77 tCO_2e**.

The Project's construction phase will generate the most GHGs from the manufacturing and transportation of the wind turbine and the production and transport of the concrete for the tower foundation and pedestal. The total GHG emission contributions from the construction phase are **33,464.26 tCO_2e**.

The operations phase will generate GHGs from the wind turbines' maintenance (i.e., part replacements) as a one-time (Project lifespan) occurrence of **501.05 tCO_2e**.

Following the commissioning of the Project, the annual Project GHG emission reduction is expected to be **216,109.77 tCO_2e**. A one-time **501.05 tCO_2e** may be subtracted from any annual reduction; however, the annual reduction rate will be applied for the lifespan of the

Project (35+ years). The Project is anticipating a 0.15-year[2] payback period to offset the construction-related GHG emissions. Following this period, the Project will positively offset GHG emissions typically emitted from conventional production methods employed by NS Power. The GHG emission reduction over the Project's lifespan (35 years) could be **5,717,442.04 tCO_2e**. Annual Project emissions reduction defaults to the same value for each year the Project is in operation (0% change in baseline and project emissions). Emissions reductions are anticipated to change in any given year due to externalities such as changes to energy fuel sources, grid emissions factors, or others which may affect reductions resulting from the Project. The emission projections described in this assessment (annual and Project lifespan) do not consider the provincial commitment to removing coal from the energy grid by 2030 and for the provincial GHG emissions (including the grid) to be net-zero by 2050 (NSECC, 2023b). As such, this lifespan emissions reduction is a rough estimate of a best-case GHG reduction scenario over the lifetime of the Project.

The assumptions considered in this assessment propose a conservative estimate of GHG emissions, which may be lower if turbine and concrete manufacturer locations are closer to the Project and manufacturing materials are less than assumed. Where assumptions may change the values provided in this assessment, the results remain constant; the Project will offset GHG emissions.

Mitigation

Mitigation measures to reduce the Project's contributions to GHG emissions, thus reducing the overall impact of climate change, include:

- Use locally sourced materials, where possible, to reduce CO_2, CH_4, and NO_x emissions associated with transport.
- Incorporate the shortest construction/transport routes where possible to minimize the use of fossil fuels during construction.
- Recover and recycle construction and demolition waste, where possible.
- Recycle and compost workforce waste (i.e., food waste). Diverting this waste will reduce methane generated in landfills as it decomposes.
- Minimize deforestation during land clearing throughout project lifecycle by only clearing the area that will be needed, to maximize carbon storage on project lands.
- Plan construction activities to reduce the double handling of materials, reducing GHG emissions associated with heavy equipment operations.
- Use recycled or repurposed materials, where possible, to reduce GHG emissions associated with embodied energy (i.e., the energy associated with manufacturing a product or service).
- Ensure Project equipment meets all applicable provincial and air quality regulations and emissions standards.
- Maintain engine and exhaust systems according to the manufacturer's specifications and applicable maintenance schedule.

[2] $\frac{Construction\ Emissions}{Offset\ Emissions} = \frac{33{,}464.26\ tCO2e}{216{,}109.77\ tCO2e/year} = 0.15\ years$

- Remove from service malfunctioning equipment or equipment generating excess amounts of smoke, odour, or noise until an assessment and necessary repairs can be completed.
- Ensure construction equipment with an improperly functioning emission control system is not operated.
- Ensure regular equipment maintenance is undertaken to maintain good operations and fuel efficiency.
- Ensure equipment containing coolant (i.e., air conditioning units) undergoes preventative maintenance and inspections (i.e., leak testing).
- Train Project personnel (as appropriate) in the proper disposal of halocarbon-containing substances.
- Dispose of halocarbon-containing substances at an approved hazardous waste facility per applicable regulations and in compliance with local requirements.
- Ensure trucks removing waste from or bringing materials to the Project are filled to the maximum allowable capacity where practical (dependent on the truck size and load weight) to reduce transportation requirements and limit the number of trips.
- Implement an anti-idling policy to limit GHG emissions from vehicles and equipment and limit the use of fossil fuels.
- Incorporate energy-efficient infrastructure (i.e., solar panels) where feasible to limit GHG emissions and the use of fossil fuels resulting from standard equipment (e.g., diesel-powered generators or light stands).

Monitoring
No monitoring programs are recommended.

Conclusion
Results are characterized as a positive effect within the LAA, medium duration, continuous, irreversible, and significant (positive).

7.2 Geophysical Environment

7.2.1 Overview
The assessment of the geophysical environment included a review of topography, surficial geology, bedrock geology, and hydrogeology/groundwater.

7.2.2 Regulatory Context
Relevant legislation includes:

- Sulphide Bearing Material Disposal Regulations, N.S. Reg. 57/95
- *Environment Act,* S.N.S. 1994-95, c. 1 (protected water/watershed areas)

If blasting is required for construction, groundwater wells within 800 m must undergo an assessment in accordance with NSECC’s Procedure for Conducting a Pre-Blast Survey (1993).

7.2.3 Assessment Methodology

The assessment was completed through a review of the following resources:

- Aerial imagery and topography
- Ecological Land Classification for Nova Scotia (Neily et al., 2017)
- Nova Scotia Geoscience Atlas (NSNRR, 2021a)
- Mineral Resource Land-Use Atlas (NSNRR, 2002)
- Nova Scotia Groundwater Atlas (NSNRR, 2021b)
- Karst Risk Map (NSNRR, 2019)
- Well Logs Database (NSECC, 2022c)
- Nova Scotia Pumping Test Database (NSNRR, 2022a)
- Nova Scotia Groundwater Observation Well Network (NSECC, 2015a)
- Potential for Radon in Indoor Air (NSNRR, 2009)

7.2.4 Assessment Results

Topography

The Study Area lies within the Cobequid Hills Ecodistrict (340), which is part of the Nova Scotia Uplands Ecoregion (Drawing 7.1) (Neily, et al. 2017). This ecodistrict extends across Cumberland, Colchester, and Pictou counties from the Parrsboro area in the west to the Pictou area in the east. The Cobequid Hills spans a total area of 1,866 square kilometres (km^2), separating two lowland ecodistricts: Minas Lowlands (620) to the south and Northumberland Lowlands (530) to the north. Topography is rugged with flat to strongly rolling ridges that contain exposed rock in areas with thin layers of till. Elevations in this ecodistrict are predominately higher than other upland regions, with the Cobequid Hills containing the highest peak in mainland Nova Scotia at approximately 360 metres above sea level (masl). These hills also support one of the largest intact Acadian Forests on the mainland, consisting of shade-tolerant hardwoods such as sugar maple (*Acer saccharum*), yellow birch (*Betula alleghaniensis*), and American beech (*Fagus grandifolia*). Lastly, non-forested landscapes within this ecodistrict are dominated by grassland, shrubland, and dry sites (i.e., small cliffs, talus slopes, and bedrock outcropping) (Neily, et al. 2017) (Drawing 7.3).

Within the Study Area, elevations range between 80 masl and 355 masl (Drawing 7.3). The topography in the Study Area is dominated by imperfect coarse hummocks along with hilly knobs and knolls with concentrated areas of steep canyons and slopes (NSNRR, 2021a).

Surficial Geology

Surficial geology within the Study Area is dominated by silty till plain dating back to the Quaternary Period (NSNRR, 2021a). This plain is composed of 3 m to 30 m of compact silty material derived from distant and local sources that was deposited at the base of receding/melting ice sheets. Silty till plains provide moderate drainage due to stoniness and have calcareous bedrock components which provide good acid rain buffering capacity (Drawing 7.4). Other surficial geology units within the Study Area include:

- Exposed bedrock
- Colluvial deposits
- Kame fields and esker systems
- Stony till plain
- Organic deposits

Areas of exposed bedrock and/or bedrock overlain by a thin discontinuous layer of till were formed as a result of glacial scouring, erosion, and/or non-deposition. These features are composed of various ages and types of bedrock and result in exposed ridges of hard rock (NSNRR, 2021a).

Colluvial deposits (also known as talus slopes) are loose deposits of surficial material at the base of steep slopes that are a result of glacial deposition, weathering, and/or ice fractured rock. The thickness of these deposits range from <1 m at the top to 5 m at the bottom of the slope. Colluvial deposits can pose significant geologic hazards as these slopes are subject to sudden and rapid slides/failures (NSNRR, 2021a).

Kame fields and esker systems are steep-sided, narrow, winding ridges of stratified sediment that formed as a result of deposition from glacial meltwater streams. These surficial features can range in thickness between 3 m and 30 m and are typically composed of silt, sand, and gravel. Kame field and esker systems can pose significant geologic hazards as they are subject to faulting and collapse (NSNRR, 2021a).

Stony till plains are composed of a stony sandy material (with a thickness of 2 m to 20 m) derived from local sources that was deposited at the base of receding/melting ice sheets. These surficial features have high erodibility, rapid drainage, high water tables, and are shallow/stony which can pose limitations for construction (NSNRR, 2021a).

Organic deposits (i.e., wetlands/peatlands) develop as a result of topographic depressions collecting and/or storing surface water along with the infilling of ponds/watercourses with vegetation. Within the Study Area, the organic deposits range in depth from 1 m to 5 m (NSNRR, 2021a).

Surficial soils within the Cobequid Hills are dominated by coarse gravelly to stony loams derived from igneous and metamorphic rocks. In areas with hilly topography, soils become shallow and close to bedrock. Soils are predominantly well-drained to moderately well-drained with finer textured soils imperfectly drained (Neily et al., 2017).

Bedrock Geology

The geological history of Cobequid Hills is complex with underlying fault blocks consisting of Pre-Carboniferous metamorphic sediments, volcanic deposits, and granites dominating the landscape. The lower elevations contain more easily eroded bedrock types such as sandstones, shale, and limited deposits of limestone. There are also many fault lines expressed throughout the Cobequid Hills, with the most prominent – the Cobequid Fault – extending from Truro to Cape Chignecto (Neily et al., 2017).

Within the Study Area, bedrock geology varies significantly and overlaps with 11 bedrock zones/types which are summarized in Table 7.16 and presented on Drawing 7.5.

Table 7.16: Summary of Bedrock Geology within the Study Area

Bedrock Formation	Code	Age	Components
Diamond Brook Formation	DC_{Fd}	Devonian – Carboniferous	Basalt, siltstone, wacke, rhyolite
Byers Brook Formation	DC_{Fbb}	Devonian – Carboniferous	Felsic volcanic rocks, wacke, siltstone
Devonian–Carboniferous Granite	DC_{g}	Devonian – Carboniferous	Granite
Nuttby Formation	$D_{\text{-E}}C_{Hn}$	Devonian – Early Carboniferous	Siltstone, alluvial wacke, felsic volcanic rock, rare lacustrine limestone, fluvial argillite, conglomerate
Devonian – Carboniferous Diorite – Gabbro	DC_{dg}	Devonian – Carboniferous	Diorite, gabbro
Unnamed Unit	OS_{v}	Ordovician – Silurian	Wacke, siltstone, shale, tuff
Gamble Brook Formation	$K3_{gb}$	Cryogenian – Neoproterozoic	Quartzite, garnet-mica schist
Folly River Formation	3_{fr}	Neoproterozoic	Tholeiitic metabasalts, chert, deep marine distal turbiditic meta-argillite
Neoproterozoic Granitoid	3_{gt}	Neoproterozoic	Granitoid
Pictou Group	${}_{L}C_{P}$	Late Carboniferous	Sandstone, mudstone, siltstone, conglomerate, limestone
Mabou Group	${}_{E\text{-}L}C_{M}$	Early – Late Carboniferous	Sandstone, shale, siltstone, limestone

Source: NSNRR 2021a

According to the Mineral Resource Land-Use Atlas, there are no occurrences of sulphide-bearing slates within the Study Area (NSNRR, 2002). In addition, the Study Area is predominantly located in a “Low Risk” area for karst topography and naturally occurring sinkholes with few areas of “medium risk” along the southern extent of the Study Area (NSNRR, 2019).

General Hydrogeologic Conditions

Less than 1% of the ecodistrict is composed of freshwater lakes and streams. The Cobequid Hills encompass the watershed resulting in the rivers and streams which run north or south and leave the mountain’s ravines and gorges in a series of falls or cascades. There are 20 major river systems within Cobequid Hills, most draining into the Minas Basin and Cobequid Bay (Neily et al., 2017).

The nearest protected water area is the French River Watershed Protected Water Area (also known as the Tatamagouche Water Utility Catchment) located north of the Study Area (Province of NS, 2009). This protected water area provides water to Tatamagouche, Nova Scotia and is designated/delineated under the *Environment Act*, S.N.S. 1994-95, c. 1, specifically the French River Watershed Protected Water Area, N.S. Reg. 7/2022.

Groundwater Quality and Quantity

The northern regions of the Study Area are underlain by volcanic bedrock while the southern regions are underlain by either plutonic, metamorphic, or sedimentary bedrock (NSNRR, 2021b). Wells located in sedimentary bedrock typically have higher dissolved solids, hardness, and well water yields as groundwater can flow through the rock itself and along fractures. Wells located in volcanic, plutonic, or metamorphic rock have lower dissolved solids, hardness, and well water yields as a result of groundwater only flowing through fractures in the rock (NSECC & NSNRR, 2009). Naturally occurring trace metals such as iron, arsenic, and manganese can be found in all groundwater regions; however, they are more often associated with plutonic and metamorphic groundwater regions.

According to groundwater risk mapping, the Study Area contains a mix of “Low Risk” to “High Risk” zones for arsenic in bedrock wells; “Low Risk” zones are concentrated to the northern portion of the Study Area, while the “Medium Risk” and “High Risk” zones are concentrated to the southern extent. Similarly, the Study Area is primarily located in a “Low Risk” zone for uranium, however, there are pockets of “Medium Risk” and “High Risk” zones (NSNRR, 2021b).

Groundwater Wells

Water supplies near the Study Area are generally derived from individually drilled or dug wells. A total of 76 water wells were identified within 2 km of the Study Area using the NSECC Well Logs Database (2022c) (Appendix D). A summary of well statistics is provided in Table 7.17.

Table 7.17: Summary of Water Well Records within 2 km of the Study Area

	Drilled Date (year)	Well Depth (m)	Bedrock Depth (m)	Static (m)	Yield (Lpm)	Elevation (masl)
Minimum	1963	3.65	0.91	0.30	0.91	82
Maximum	2018	91.96	33.50	44.15	272.40	300
Average	n/a	43.17	6.20	7.52	32.02	146

Source: (NSECC, 2022c)

Based on short term driller’s estimates for the wells located within 2 km of the Study Area (Appendix D), well depth varied between 3.65 m and 91.96 m, with an average depth of approximately 43.17 m. Static water levels were found on average at 7.52 m below the surface, with well yields averaging 32.02 litres per minute (Lpm). These measurements represent very short-term yields estimated by the driller at the completion of well construction (NSECC, 2022c).

Of the 76 water wells, 21 are located in the Study Area and/or within 800 m of the Assessment Area:

- 100336
- 100337
- 101528
- 101529
- 180561
- 690380
- 710603
- 730727
- 740484
- 740497
- 740506
- 872324
- 872394
- 902016
- 930550
- 950458
- 952001
- 952665
- 972498
- 981193
- 992129

No wells were identified within the Assessment Area (Drawing 7.6).

The NSNRR Pumping Test Database (2022a) provides longer term yields for select wells throughout the province. The nearest pumping test well (ID 892655) is located approximately 7 km north of the Study Area near Highway 256, Nova Scotia. Conducted in 1989, this test indicates a long-term safe yield (Q_{20}) of 0.9 Lpm and an apparent transmissivity of 0.07 square metres per day (m^2/day).

NSECC maintains the Nova Scotia Groundwater Observation Well Network (2015a). The nearest provincial observation well to the Study Area is Tatamagouche Station (#83) located approximately 13 km north, near Tatamagouche, Nova Scotia. This well was drilled to a depth of 24.5 m through sandstone and siltstone bedrock of the Tatamagouche Formation. Monitoring at this well location began in 2009 and is on-going. In 2020, the average annual water elevation was 16.81 masl and the annual water level fluctuation was approximately 2.25 m.

7.2.5 Effects Assessment

Project-Geophysical Interactions

Project activities will primarily interact with the geophysical environment during earth moving activities (Table 7.18).

Table 7.18: Potential Project-Geophysical Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Geophysical Environment		X		X	X	X				X				X	X

Assessment Boundaries

The LAA for the geophysical environment is the Assessment Area. The RAA is the Study Area.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for the geophysical environment. The VC-specific definition for magnitude is as follows:

- Negligible – no expected changes to local topography or geology; no anticipated impacts to the quality/quantity of groundwater wells (no wells located within 2 km of the Assessment Area).
- Low – changes to local topography/geology are possible but not anticipated as no geologic hazards are present within the Study Area; impacts to the quality/quantity of groundwater wells are possible but not anticipated (wells exist between 800 m and 2 km from the Assessment Area).
- Moderate – changes to local topography/geology are possible as geologic hazards exist within proximity to the Assessment Area; impacts to the quality/quantity of groundwater wells are possible (wells are located within 800 m of the Assessment Area).
- High – changes to local topography or geology are anticipated due to the presence of geologic hazards within the Assessment Area; impacts to the quality/quantity of groundwater wells are anticipated (wells located within the Assessment Area).

Effects

The geophysical environment will be disturbed within the Assessment Area during the site preparation and construction phase, and again during infrastructure removal and site reinstatement. During these phases, potential impacts related to the geologic environment are primarily due to the presence and subsequent disturbance of geologic hazards including:

- Sulphide bearing slates (i.e., acid generating rock)
- Karst topography
- Colluvial deposits/talus slopes
- Radon
- Arsenic and/or uranium containing bedrock

In Nova Scotia, several bedrock formations are known to contain acid generating rock (sulphide minerals such as pyrite, pyrrhotite) that, when disturbed, can result in the production of acid rock drainage (ARD). ARD occurs when sulphide-bearing rocks are disrupted and exposed to air or water, producing sulphuric acid and metal oxides that are subsequently mobilized/leached through freshwater systems (NSNRR, 2021c). Based on provincial risk mapping, there are no sulfide-bearing slates or formations recorded within the Assessment Area or the larger Study Area (NSNRR, 2002). The presence/absence of sulfide bearing minerals and likelihood of ARD will be confirmed following the results of the geotechnical evaluation.

Karst topography is characterized by naturally occurring sinkholes, underground drainage systems, and caves which are formed by the dissolution of soluble bedrock (e.g., limestone). The presence of karst terrain has the potential to cause extensive damage to infrastructure and the local landscape due to the risk of sudden collapse/subsidence. The Karst Risk Map (Drawing 7.7) shows the Study Area and predominantly located within a “Low Risk” zone for karst topography with few “Medium Risk” areas. Select sections of Assessment Area are within the “Medium Risk” zone, and therefore, these areas will be assessed and confirmed for karst topography during geotechnical investigations (NSNRR, 2019). If present, these areas will be avoided.

Colluvial deposits (also known as talas slopes) were identified sporadically within the Study Area (Drawing 3.1). These geologic features can pose significant hazards as they are subject to sudden and rapid slides/failures. During design and development of the Project, regions containing colluvial deposits were highlighted as construction hazards and were subsequently avoided where possible. Few areas containing colluvial deposits overlap with the Assessment Area; therefore, these areas will be assessed further during geotechnical investigations. If determined to be present, these areas will be avoided.

Radon potential mapping (Drawing 7.8) shows the Study Area is located in a “Low-Risk” to “High Risk” area for radon in indoor air (NSNRR, 2009). There is no indoor air pathway for radon gas associated with the Project, and therefore, radon gas is not considered a risk for outdoor inhalation.

Construction activities, primarily blasting (if required), have the potential to impact the quality and quantity of surrounding groundwater supply depending on the proximity to drinking water wells and extent of disturbance caused by construction activities. Disturbance of arsenic and/or uranium containing bedrock can mobilize arsenic/uranium within groundwater, and subsequently degrade nearby groundwater well quality. Risk mapping shows the Study Area is situated in a "Low Risk" to "High Risk" zone for both uranium and arsenic containing bedrock wells (Drawings 7.8 and 7.9) (NSNRR, 2021b). In addition to water quality, groundwater quantity can also potentially be impacted if blasting activities (as required) alter local hydrogeological flow regimes, resulting in groundwater draining from or flowing towards existing wells. As a result of potential impacts to groundwater quality and quantity, wells located within 800 m of blasting activities require monitoring per NSECC's Procedure for Conducting a Pre-Blast Survey (1993). No wells were identified within the Assessment Area; however, 19 wells were identified within 800 m (Appendix D). The requirement for blasting and pre-blast surveys will be confirmed and assessed further during geotechnical investigations.

Mitigation

Avoidance of hazardous geologic features was the priority during the design and development of the Project. Colluvial slopes were the key geologic hazard identified and were subsequently avoided during Project siting (where possible). The use of existing road networks, siting in previously disturbed areas, and use of existing ROWs all contributed to minimizing the Project's impact to the geologic environment.

The following mitigation measures are also recommended to minimize impacts to the geologic environment:

- Conduct blasting, if required, in accordance with provincial legislation and subject to terms and conditions of applicable permits.
  - Conduct pre-blast surveys for wells within 800 m of blasting activities.
  - Ensure all blasts are conducted and monitored by certified professionals.
  - Ensure all protective measures outlined in the EPP are implemented in advance of blasting activities.
  - Notify landowners in advance of any blasting activities.
  - Recover and revegetate exposed soils or bedrock as required to minimize any exposure following blasting.
- Include specific mitigation for sulphide bearing materials in the EPP, if they are identified through pre-construction geotechnical surveys.
- Ensure rock removal in known areas of elevated sulphide potential will conform to the Sulphide Bearing Material Disposal Regulations, N.S. Reg. 57/95 and in consultation with relevant regulatory departments.
- Store any soil needed for backfilling, after foundations have been poured, temporarily adjacent to the excavations until needed. Any remaining excavated material will be used on-site or removed and sent to an approved facility.
- Install erosion and sedimentation control measures prior to excavation activities and inspect controls on a regular basis.
- Remove temporary erosion and sedimentation controls once backfilled material has stabilized. Attention will be paid during site reinstatement to ensure areas will promote wildlife return to the area, to the extent possible.

Monitoring

No monitoring programs are recommended at this time in relation to the geophysical environment.

If geologic hazards (e.g., ARD, colluvial slopes, etc.) are identified within the Assessment Area (and/or Project Area) during geotechnical investigations, requirements for monitoring will be further detailed as part of the Project's EPP.

If blasting activities are required to construct the Project (to be confirmed during geotechnical investigations), groundwater wells within 800 m of blasting activities will be monitored as per the Procedure for Conducting a Pre-Blast Survey (NSECC, 1993).

Conclusion

Results are characterized as high magnitude, within the LAA, short-term duration, intermittent, reversible, and not significant.

7.3 Aquatic Environment

7.3.1 Waterbodies and Watercourses

7.3.1.1 Overview

The objective of the waterbody and watercourse assessment was to inform the Project's design and collect the information necessary to assess potential impacts to waterbodies, watercourses, and fish habitat (assessed separately in Section 7.3.2) resulting from the Project. This was accomplished using the following approach:

- Identify watercourses and waterbodies within the Study Area using desktop resources (Drawings 7.10).
- Use the information collected to inform Project design (e.g., avoid/minimize impacts to waterbodies and watercourses) and develop an Assessment Area.
- Traverse the entirety of the Assessment Area to ground truth waterbodies and watercourses and provide characterization of any identified features (Drawings 7.11A to 7.11J).
- Use the information collected to inform mitigation and management practices and further refine the Project Area.

CBCL carried out detailed desktop and field waterbody and watercourse assessments in 2022 (refer to full report in Appendix E). As Project planning advanced and the Project layout evolved, Strum biologists completed supplemental assessments in 2023 to provide full coverage of the anticipated Project footprint (see Appendix F).

7.3.1.2 Regulatory Context

Under the *Environment Act,* S.N.S. 1994-95, c. 1, NSECC has the authority to promote the sustainable management of water resources in Nova Scotia. More specifically, as per section

5A of the Activities Designation Regulations, N.S. Reg. 47/95, the alteration of a watercourse or the flow of water within a watercourse is an activity that requires an approval from NSECC, or a notification to NSECC if the work will be completed in accordance with the Nova Scotia Watercourse Alterations Standards (NSECC, 2015b).

There are also federal regulations that impact the management of watercourses. DFO has a responsibility to oversee the protection of fish and fish habitat in accordance with the *Fisheries Act* and *SARA*. Furthermore, the *Canadian Navigable Waters Act* gives Transport Canada the authority to regulate interferences with the public right to navigable waters, including approving and setting the terms and conditions for works within navigable waterways.

7.3.1.3 Desktop Review

Waterbodies

A desktop review was conducted to identify mapped and potential waterbodies within the Study Area, along with any associated aquatic species at risk (SAR), using the following sources:

- CanVec Database – Hydrographic Features (NRCan, 2022a)
- Significant Species and Habitats Database (NSNRR, 2018a)

A review of the federal CanVec Database – Hydrographic Features (2022a) identified seven waterbody features within the Study Area: Black Lake, Clear Lake, Harts Lake, Silica Ponds, and four unnamed waterbody features. Within 5 km of the Study Area, 36 named and unnamed features were also identified (Table 7.20). Clear Lake is the largest open body of water within the Study Area, approximately 8 hectares (ha) in size, located in the northwestern extent of the Study Area. A complete list of named waterbodies located within 5 km of the Study Area is provided in Table 7.19.

Table 7.19: Named Waterbodies Within 5 km of Study Area

Name of Waterbody	Distance and Direction[1]
Waterbodies Within the Study Area	
Black Lake	---
Clear Lake	---
Harts Lake	---
Silica Ponds[2]	---
Waterbodies Within 5 km of Study Area	
Farm Lake	1.0 km west
Gards Pond	<0.1 km north
Johnston Lake	2.4 km west
Little Lake	2.1 km west
MacRaes Lakes	0.3 km east

Name of Waterbody	Distance and Direction(1)
North River	4.4 km south
Roodes Pond	0.1 km west
Silica Lake	<0.1 km north
Whippey Lake	<0.1 km north
Whirleywaugh Lake	3.2 km west

Source: (NRCan, 2022a)
(1)Measurement from the nearest point of the Study Area.
(2)Silica Ponds is also listed in the NSNRR Wetland Inventory (2021e) as a “swamp”. The Project has been oriented to avoid the open-water portion of this feature. As such, this feature will be treated as a wetland for the purpose of this EA. Please refer to section 7.3.3 for further details.

According to the Significant Species and Habitats Database (2018a), Harts Lake overlaps with a deer wintering area. As this record is related to the terrestrial environment, refer to Section 7.4.3 for further details.

The results of the desktop review indicated that Project infrastructure will not interact with any waterbodies. This was later confirmed by the results of the field assessments. As such, waterbodies are not discussed further in this section.

Watercourses

A desktop review was conducted to identify mapped and potential watercourses within the Study Area, along with any associated aquatic SAR, using the following sources:

- NS Topographic Database – Water Features (GeoNOVA, 2022)
- CanVec Database – Hydrographic Features (NRCan, 2022a)
- Significant Species and Habitats Database (NSNRR, 2018a)
- Wet Areas Mapping (WAM) (NSNRR, 2021d)
- NS 1:10,000 Primary Watersheds (NSECC, 2011)

A review of the NS Topographic Database – Water Features (GeoNOVA, 2022) identified 363 watercourse feature segments within the Study Area and 2,494 feature segments within 5 km of the Study Area. Several named watercourses were identified within the Study Area including:

- Barren Brook
- Cavanagh Brook
- Coal Mine Brook
- East Branch Chiganois River
- Falling Brook
- McGill Brook
- Meadow Brook
- Middle Branch North River
- North River
- West Branch North River

The largest watercourse flowing through the Study Area is the West Branch North River, which travels north-south through the central interior of the Study Area. This watercourse is a major tributary to the North River, which drains south into the Salmon River and eventually discharges into the Bay of Fundy near Truro, Nova Scotia. The West Branch North River has several smaller tributaries, including Coal Mine Brook and Meadow Brook. Coal Mine Brook drains the southern-central extent of the Study Area through a large collection of channels while Meadow Brook drains the southernmost extent of the Study Area through one primary channel.

In addition, the Middle Branch North River and McGill Brook are also tributaries to the North River. The Middle Branch North River drains the northeastern extent of the Study and has a collection of smaller tributaries including Falling Brook. McGill Brook is a smaller watercourse that flows west along the southern border of the Study Area where it eventually merges with the North River.

The East Branch Chiganois River is another large watercourse originating from Black Lake located in the northwestern extent of the Study Area. This watercourse has several smaller tributaries, including Barren Brook which drains the southwestern extern of the Study Area. The East Branch Chiganois River drains south into the Chiganois River which eventually discharges into the Bay of Fundy near Fort Belcher, NS. According to the Significant Species and Habitats Database (2018a), the Chiganois River is recorded to contain Wood turtle (*Glyptemys insculpta*); for further details regarding Wood turtle, refer to Section 7.4.3.

Watercourses within the Study Area primarily drain south through the Salmon/Debert Primary Watershed (1DH) with northernmost stretches of the Study Area draining north through the River John Primary Watershed (1DO) (Drawing 7.12) (NSECC, 2011).

The Salmon/Debert Primary Watershed drains the Study Area south through two secondary watersheds: the North River Watershed (1DH-4) and Chiganois River Watershed (1DH-3). These two watersheds both eventually discharge into the Bay of Fundy but are separated via the topographic influences. The North River Watershed drains the central-eastern portion of the Study Area into the North River while the Chiganois River Watershed drains the western portion of the Study Area into the Chiganois River.

The River John Primary Watershed drains the Study Area north through a secondary watershed known as the Waugh River Watershed (1DO-3). This watershed drains the northeastern extent of the Study Area which ultimately discharges into the Northumberland Strait, near Tatamagouche, Nova Scotia.

Throughout the Study Area, WAM data indicates that groundwater ranges from 0 m to >10 m of the surface, with the majority being within 2 m to 10 m of the surface on account of the area being well to moderately-well drained (Drawing 7.13). WAM results generally aligned with the locations of watercourses identified using topographic mapping and highlighted the potential for additional watercourses throughout the Study Area (NSNRR, 2021d).

7.3.1.4 Field Assessment Methodology

The results of the desktop review were used to inform Project design (e.g., avoid/minimize impacts to waterbodies and watercourses) and determine the Assessment Area. Given that no waterbodies are located within the Assessment Area, field assessment efforts in both 2022 and 2023 focused on potential Project-watercourse interactions.

2022 Field Assessments (CBCL Limited)

Surveys were completed by CBCL biologists in fall 2022 to identify and classify any watercourses within the Preliminary Study Area that may intersect Project components. Identified watercourses were assessed to determine permanence and/or fish-bearing potential.

Detailed assessments focused on those watercourses that were deemed to be fish-bearing, possibly fish-bearing, or permanent in nature, and generally adhered to the assessment methods presented in the BC Reconnaissance 1:20 000 Fish and Fish Habitat Inventory: Standards and Procedures (BC MoE, 2001) and the Nova Scotia Fish Habitat Suitability Assessment (NS Adopt a Stream, 2018). Detailed assessments covered a 400 m area: 100 m upstream of the proposed watercourse crossing or Project-watercourse interaction location (at intervals of 50 m) to 300 m downstream (at intervals of 100 m). The assessment locations represent areas that could be monitored throughout the construction and operations periods of the Project to provide comparisons to baseline (upstream) and impacted area (downstream) results. Refer to Appendix F for additional details regarding assessed parameters (e.g., water quality, connectivity, etc.) and feature classifications.

2023 Field Assessments (Strum Consulting)

Watercourse assessments were also completed during the summer months of 2023 by Strum biologists to survey areas not covered by the 2022 assessment due to layout changes. Desktop-identified watercourses, along with WAM and predicted flow data, were provided to field staff to guide the identification and assessment of watercourses within the Assessment Area. Any watercourses identified were delineated (until their extent reached the buffer/Assessment Area boundary end or the watercourse terminated) and assessed for general watercourse characteristics. Supplementary information on fish/fish habitat and any observations of species of conservation interest (SOCI) were also recorded during the surveys (Section 7.3.2). Information collected included:

- Weather
- Date and time
- Watercourse class
- Channel pattern
- Flow characteristics (direction, velocity, etc.)
- Physical characteristics (width, length, etc.)
- Substrate composition
- Instream cover
- Riparian habitat
- Bank stability
- Fish presence/habitat potential (Section 7.3.2)
- Photos, spatial data, etc.

This information was collected and georeferenced using Survey123, an ESRI application for creating, sharing, and analyzing data. As a result of identified environmental constraints (such as watercourses), the Project's turbine layout underwent several iterations to minimize potential interactions and limit the number of required watercourse crossings. Information collected on watercourses was also used to guide further freshwater species assessments (i.e., fish and herpetofauna).

7.3.1.5 Field Assessment Results

2022 Field Assessment Results (CBCL Limited)

In 2022, 74 watercourses were identified in the Study Area during the initial mapping review and preliminary survey. Of these, 23 watercourses were determined to be fish-bearing or likely fish-bearing and subject to a detailed assessment, while the remaining 51 were determined to be non-fish-bearing (refer to Section 7.3.2 for Fish and Fish Habitat assessment details).

Most of the watercourses within the Project Area are small intermittent or ephemeral drainage features, with little or no habitat present that would be suitable to support a population of fish. Only 18 watercourses were considered to be permanent; all of which were small permanent watercourses. Many of the watercourses observed or assessed were anthropogenically influenced by existing roads or tree harvest areas and had minimal natural fish habitat potential. No large permanent watercourses were identified within the Study Area, as the larger primary watershed level streams (e.g., Salmon/Debert River) are located downstream of the Study Area.

Refer to Appendix E for detailed results from the 2022 waterbody and watercourse field assessments completed.

2023 Field Assessment Results (Strum Consulting)

In 2023, 43 watercourses were identified within the Assessment Area (Appendix F and Drawing 7.11A to 7.11J) including small permanent (25), large permanent (five), and intermittent (13) features ranging in bankfull width from 0.53 m to 6.78 m. There were no observations of aquatic SAR identified during the watercourse assessment.

Permanent watercourses see flow for the vast majority, if not the entirety, of the year. Their continuous flow is often attributed to their direct connection to stable sources of water, including lakes and groundwater springs (US EPA, 2013). Small permanent features include streams, brooks, and creeks. These features are often first- and second-order streams fed by springs, groundwater, and run-off, and often act as tributaries to larger features, creating larger permanent features at their confluence. Large permanent features often exhibit lower flow path gradients, larger channel dimensions, and an increased flow (US EPA, 2013).

Intermittent watercourses exhibit overland flow in intervals throughout the year. They typically have well-defined stream morphology, and often have subterranean flow when overland flow is absent (US EPA, 2013). These features are heavily influenced by seasonality, often displaying characteristics similar to permanent features during periods of heavy rain, or after significant snowmelt. During drier times of the year, flow velocity within these features may reduce to pools of standing water, or eventually dry stream beds (US EPA, 2013).

Combined Field Assessment Results (Strum & CBCL)

One of the identified watercourses (WC18) had multiple segments within the Assessment Area, and thus each segment is discussed individually for the purpose of this EA. As such, field surveys completed between 2022 and 2023 by Strum and CBCL biologists identified 60 watercourses (17 by CBCL, 43 by Strum) either partially or fully within the final iteration of the Assessment Area (Drawings 7.11A to 7.11J) including small permanent (29), large permanent (six), and intermittent (25) features ranging in bankfull width from 0.2 m to 6.78 m. For coherence, Strum- and CBCL-identified watercourses/watercourse segments were merged and given a new ID based on the order of their occurrence from north to south. The original CBCL field ID's are listed in Table 7.20.

Table 7.20: Watercourse ID Guide for CBCL-Identified Watercourses

Watercourse ID	Previous ID
WC1	NR-WC-200b83
WC3	NR-WC-200b115
WC10	NR-WC-121b0001
WC12	NR-WC-121b244
WC13	NR-WC-121a204
WC14	NR-WC-122h26
WC15	NR-WC-121a131
WC16	NR-WC-122i34/39
WC17	NR-WC-122b89
WC27	NR-G3-003
WC30	NR-WC-122d101
WC31	NR-G2-001
WC33	NR-WC-122d22
WC34	NR-WC-122d94
WC36	NR-WC-122d32
WC37	NR-WC-122d35
WC39	NR-WC-122d116

A large portion (28 of 60) of the identified watercourses/watercourse segments within the Assessment Area had evidence of alteration from anthropogenic development activities (e.g., culverts and bridges). Further, forestry activities have also indirectly impacted watercourses through a decrease in evapotranspiration, a decrease in shaded areas, and an increased displacement of organic material and sediment through surface erosion and overland flow.

7.3.1.6 Effects Assessment

A geographic information system (GIS) suitability analysis was conducted to design a Project Area that would optimize the placement of Project infrastructure to avoid waterbodies and watercourses, to the greatest extent possible. The Assessment Area considered multiple options/configurations of infrastructure components such as roads, collector system, and a laydown areas. Further, the Project design utilizes as many pre-existing roads as possible. The Project's detailed design phase may see additional refinements to the Project Area and placement of infrastructure which could further reduce interactions with field-identified watercourses within the Assessment Area.

Project-Watercourse Interactions

Project activities, primarily those that involve earth moving, vegetation removal, and road construction have the potential to impact watercourses (Table 7.21). These potential impacts could include habitat loss, changes to hydrology, and/or displacement of sediment.

Table 7.21: Potential Project-Watercourse Interactions

Valued Component	**Site Preparation and Construction**											**Operations and Maintenance**		**Decommissioning**	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Watercourses			X	X	X	X			X				X		X

Assessment Boundaries

The LAA for watercourses includes the Assessment Area. The RAA for watercourses includes the Study Area (Drawing 2.2).

Assessment Criteria

Assessment criteria provided in Section 4.6 also apply to watercourses. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of aquatic habitat. No expectation for altered hydrology.
- Low – no loss of aquatic habitat, with minimal potential for altered hydrology.
- Moderate – small loss of aquatic habitat. Altered hydrology expected but can be managed with routine measures.
- High – loss of aquatic habitat. Altered hydrology expected that would be challenging to manage with routine measures.

Direct Effects

Direct effects to watercourses such as habitat loss and altered hydrology are likely to be most prominent during the construction phase. Effect-specific active management, mitigation, and monitoring are required to eliminate, mitigate, or otherwise manage the magnitude of these direct effects.

Habitat Loss

Watercourse alterations required for the Project have the potential to impact aquatic habitat. The removal of overhanging vegetation from stream banks decreases shade/cover for fish resulting in increased vulnerability to predators. Likewise, the removal of instream cover, such as coarse woody debris or edge habitat (e.g., undercut banks) can have a negative effect on both fish and aquatic invertebrate habitat (MTO, 2009). Furthermore, alterations to channel morphology including altered substrate composition and interference with sediment transport can also result in aquatic habitat degradation.

Altered Hydrology

Several of the watercourses within the Assessment Area contain pre-existing crossings that have declined in efficiency since being installed. Therefore, some areas will see improved hydrology and fish passage with the upgraded crossings.

None of the alterations are expected to result in the diversion, redistribution, or realignment of the respective watercourse. That is, each alteration will be executed as a means of retrofitting the current or natural conditions to facilitate Project developments.

A summary of the watercourses identified within the Assessment Area and how they are expected to interact with Project infrastructure is provided in Table 7.22.

Table 7.22: Watercourse Alteration Summary

ID	Watercourse Type	Existing Alteration Present?	Forecasted Alteration
WC1	Intermittent	Yes, culvert installation for road crossing	None – watercourse expected to be avoided.
WC2	Small Permanent	None observed	Crossing to be installed with road construction
WC3	Intermittent	Yes, culvert installation for road crossing	None – watercourse expected to be avoided.
WC4	Small Permanent	None observed	Crossing to be installed with road construction
WC5	Small Permanent	None observed	Crossing to be installed with road construction
WC6	Small Permanent	None observed	None – watercourse expected to be avoided.
WC7	Small Permanent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.

ID	Watercourse Type	Existing Alteration Present?	Forecasted Alteration
WC8	Large Permanent	Yes, open-bottom bridge present for road crossing	Existing crossing to be evaluated during the detail design to determine if it is suitable in its current state; if a new open-bottom bridge will be installed; or if an alternate nearby crossing location will be selected. For the purposes of the EA, the potential crossing is considered under road upgrades.
WC9	Small Permanent	None observed	None – watercourse expected to be avoided.
WC10	Intermittent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC11	Intermittent	None observed	Crossing to be installed with road construction.
WC12	Small Permanent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC13	Large Permanent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC14	Small Permanent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC15	Intermittent	Yes, anthropogenically realigned with road construction	None – watercourse expected to be avoided.
WC16	Intermittent	Yes, anthropogenically realigned with road construction	None – watercourse expected to be avoided.
WC17	Small Permanent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC18A	Large Permanent	Yes, open-bottom bridge present for road crossing	Bridge to be assessed and potentially replaced during road upgrades.
WC18B	Intermittent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC19	Small Permanent	Yes, open-bottom bridge present for road crossing	Bridge to be assessed and potentially replaced during road upgrades.
WC20	Small Permanent	None observed	Crossing to be installed with road construction.
WC21	Small Permanent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC22	Large Permanent	None observed	None – watercourse expected to be spanned by transmission line.
WC23	Small Permanent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.

ID	Watercourse Type	Existing Alteration Present?	Forecasted Alteration
WC24	Small Permanent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC25	Intermittent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC26	Intermittent	None observed	Crossing to be installed with road construction.
WC27	Intermittent	None observed	Crossing to be installed with road construction.
WC28	Large Permanent	Yes, open-bottom bridge present for road crossing	Existing crossing to be evaluated during the detail design to determine if it is suitable in its current state; if a new open-bottom bridge will be installed; or if an alternate nearby crossing location will be selected. For the purposes of the EA, the potential crossing is considered under road upgrades.
WC29	Intermittent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC30	Intermittent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC31	Intermittent	None observed	None – watercourse expected to be avoided.
WC32	Small Permanent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC33	Intermittent	None observed	None – watercourse expected to be avoided.
WC34	Intermittent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC35	Intermittent	None observed	None – watercourse expected to be spanned by transmission line.
WC36	Intermittent	None observed	Crossing to be installed with road construction.
WC37	Intermittent	None observed	None – watercourse expected to be avoided.
WC38	Large Permanent	None observed	None – watercourse expected to be spanned by transmission line.
WC39	Small Permanent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC40	Small Permanent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.
WC41	Small Permanent	None observed	Crossing to be installed with road construction.
WC42	Small Permanent	Yes, culvert installation for road crossing	Culvert to be assessed and potentially replaced during road upgrades.

ID	Watercourse Type	Existing Alteration Present?	Forecasted Alteration
WC43	Intermittent	None observed	Crossing to be installed with road construction.
WC44	Intermittent	None observed	Crossing to be installed with road construction.
WC45	Intermittent	None observed	Crossing to be installed with road construction.
WC46	Intermittent	None observed	Crossing to be installed with road construction.
WC47	Intermittent	None observed	Crossing to be installed with road construction.
WC48	Small Permanent	None observed	None – watercourse expected to be spanned by transmission line.
WC49	Small Permanent	Yes, culvert installation for road crossing	None – watercourse expected to be spanned by transmission line.
WC50	Small Permanent	None observed	None – watercourse expected to be spanned by transmission line.
WC51	Small Permanent	None observed	None – watercourse expected to be spanned by transmission line.
WC52	Intermittent	None observed	None – watercourse expected to be spanned by transmission line.
WC53	Small Permanent	Yes, culvert installation for road crossing	None – watercourse expected to be spanned by transmission line.
WC54	Small Permanent	None observed	None – watercourse expected to be spanned by transmission line.
WC55	Small Permanent	None observed	None – watercourse expected to be spanned by transmission line.
WC56	Small Permanent	None observed	None – watercourse expected to be spanned by transmission line.
WC57	Small Permanent	None observed	None – watercourse expected to be spanned by transmission line.
WC58	Small Permanent	None observed	None – watercourse expected to be spanned by transmission line.
WC59	Intermittent	None observed	None – watercourse expected to be spanned by transmission line.

Road Upgrades

If determined to be required, most of the forecasted alterations (22/36) will be upgrades to existing watercourse crossings during road upgrades. This includes 18 potential culvert upgrades and four potential clear-span bridge upgrades. However, given that the bridges provide safe crossing for logging machinery and logging trucks, it is expected that they will be sufficient for the Project as they exist in their current state. Should the bridges need to be replaced, open-bottom structures will be utilized to ensure watercourse characteristics stay as true to pre-construction conditions as possible. Project engineers will make this determination during the detailed design phase.

Road Construction

The construction of new roads will require the installation of 14 new watercourse crossings. Each of these crossings will be designed to avoid any permanent diversion, restriction, or blockage of natural flow, such that the hydrologic function of the watercourse is maintained. Specific details of each crossing will be finalized during the detailed design phase and will be included in any necessary applications for alteration or notifications to NSECC.

Transmission Line

Of the identified watercourses within the Assessment Area, 15 are either partially or fully within the proposed transmission line route. None of these crossings are anticipated to impact the respective watercourses, as the transmission lines will span the watercourse. Further, any activity related to the installation of poles or structures to string or pull the transmission lines will be confined to the area above the ordinary high-water mark and will ensure a sufficient vegetative buffer is preserved along the riparian zone.

Indirect Effects

Indirect effects such as erosion and sedimentation or changes in water quantity and quality can be farther reaching, extending outside of the LAA and into the greater RAA. These effects are often foreseeable, and research based, standardized BMPs can be implemented to mitigate the resulting outcomes, and the magnitude at which they are felt.

Erosion and Sedimentation

The mobilization of sediment within aquatic environments can cause shifts in ecological integrity, including changes to the plant species composition, the distribution of primary and secondary producers, and the habitat suitability for vulnerable species (Tilman et al., 1997). Erosion and sedimentation can occur throughout the lifecycle of the Project, including during construction efforts, routine road maintenance, and daily traffic. However, the highest potential for these effects is related to the construction and upgrading of access roads, and the installation or upgrading of crossing structures. The alteration or removal of riparian vegetation can also result in bank instability and erosion.

Changes in Surface Water Quantity

Changes to the amount of flow can alter channel morphology, increase flood potential, and disrupt habitat characteristics that support vulnerable species (MTO, 2009). These impacts could result from the alteration of bank or channel grades for road development, the compaction of soil from the heavy machinery required for turbine assembly, or the alteration of channel beds to facilitate the removal and replacement of preexisting infrastructure (e.g., rusted culverts).

Changes in Surface Water Quality

Changes in the quality of surface water can arise from alterations to the surrounding environment and can include an increase in water temperature from decreased shade, an increase in pollutants from machinery and infrastructure, and the mobilization of sediments (MTO, 2009). Given the dynamic nature of channeling water, effects upon water quality can quickly spread throughout different reaches of the respective watershed.

Mitigation

As required, all work completed under the provincial watercourse alteration notification process will be done in accordance with the Nova Scotia Watercourse Alterations Standards and will be executed by a certified Watercourse Alteration Installer/Sizer. For work requiring an approval, specific and detailed mitigation will be developed and submitted to NSECC as part of the application process.

Additional mitigation measures have been supplied below with respect to:

Habitat Loss

- Educate Project personnel on the sensitivity of aquatic habitat.
- Ensure watercourses are clearly marked and avoid impacts to the watercourse and adjacent riparian habitat to the extent possible.
- Revegetate along the watercourse edge and above the ordinary high-water mark to stabilize the area.
- Redesign existing watercourse crossings to facilitate habitat upgrades, including unblocking culverts and making waterways more conducive to fish passage.
- Locate new crossings away from potential salmonid spawning areas, such as pools with a dominant substrate of small-to-medium sized gravel (DFO, 2022).
- Conduct work between June 1 and September 30 to avoid sensitive periods in the life cycles of fish, to better control water flow, and to allow for a faster revegetation period (NSECC, 2015c).

Altered Hydrology

- Plan any activities to align with low-flow periods.
- Design any necessary alterations in a way that maintains the natural grade of the watercourse, to ensure the hydroperiod remains as it was pre-alteration.

Erosion and Sedimentation

- Develop a site-specific erosion and sedimentation plan during the detailed design phase.
    - The plan will target the disturbance to banks (as required) and adjacent land, and will address the type of control structures, proper installation techniques, grading, maintenance and inspection, timing of installation, and revegetation.
- Limit the area of exposed soil and the length of time soil is exposed without mitigation (e.g., mulching, seeding, rock cover).
- Limit the slope and gradient of disturbed areas to minimize the velocity of surface water runoff.

Changes in Surface Water Quantity

- Integrate water management systems including diversion and collection ditches, roadside drainage channels, vegetated swales, and stormwater retention ponds.
- Fit any watercourse crossings with appropriately sized infrastructure, as prescribed by a certified Watercourse Alteration Installer/Sizer.

Changes in Surface Water Quality

- Leave riparian vegetation as intact as Project developments will allow.
- Integrate outlet protection features to dissipate flow velocities and decrease erosion at the outflow.
- Ensure that if concrete is to be used, it is pre-cast and cured for at least one week prior to use at a crossing site (NSECC, 2015c).
- Utilize untreated, rot-resistant timber (e.g., hemlock, tamarack, juniper, or cedar) below the ordinary highwater mark to avoid the leaching of toxic preservatives into waterways (NSECC, 2015c).
- Utilize rock material that is clean, coarse granular, non-ore-bearing, non-watercourse-derived, and non-toxic to aquatic life (NSECC, 2015c).

Monitoring

For crossings subject to provincial notification requirements, visual monitoring will be completed during the installation process to ensure the work is conducted in accordance with the Nova Scotia Watercourse Alteration Activity Standards (2015b). Monitoring requirements for crossings requiring an approval will be determined on a crossing-specific basis during the detail design phase.

A watercourse monitoring plan, if required as part of the permitting phase, may include hydrological, sediment, and stability assessments upstream, downstream, and at the crossing of the watercourse. An example is included in Table 7.23.

Table 7.23: General Watercourse Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
Erosion and Sedimentation	Examine stability of watercourse banks both upstream and downstream of the crossing. Examine grade of slope at the crossing, taking note of any erosive channeling in substrate that would indicate the slope may be too steep.	Yes	Yes
	Inspect sediment control measures for effectiveness and look for evidence of sedimentation within the watercourse.	Yes	No
Water Quantity	Examine flow velocity, taking note of any undercutting or abrasive channeling, leftover construction debris, or obstruction to flow resulting from alteration activities.	No	Yes
	Preserve ability for fish passage by maintaining flow and adequate water levels.	No	Yes
	Examine water management systems (e.g., drainage channels) for effectiveness, taking note of any blockages, washouts, or unfavorable conditions.	Yes	No
Water Quality	Record basic water quality parameters and infer whether alteration activities have drastically disrupted natural conditions.	Yes	Yes

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
Water Quality (cont'd)	Note the physical characteristics of watercourse, including colour, odour, cloudiness, or presence of algae.	Yes	Yes
Habitat Loss	Conduct stream assessments equivalent to those completed prior to alteration. Examine substrate, taking note of any obvious sediment mobilization, residual slash, or a build-up of fines/muck.	Yes	Yes
	Examine crossing for visual observance of fish, and/or any obvious signs of deteriorated fish habitat (e.g., desiccation of riparian vegetation, channel infill, etc.) or diversified fish habitat (e.g., pools, woody debris, etc.).	Yes	No

Conclusion

As previously mentioned, there are no identified Project-waterbody interactions.
The effects to watercourses are expected to be of moderate magnitude such that there will be a small loss of aquatic habitat. Altered hydrology is expected but can be managed with routine measures. Timing and seasonality of effects is expected to be applicable, with a potential for the effects to be exasperated by high precipitation events in the spring and fall. Effects will be restricted to the LAA, a short-term single event, and reversible. Therefore, effects to watercourses will not be significant.

7.3.2 Fish and Fish Habitat

7.3.2.1 Overview

The objective of the fish and fish habitat assessment was to inform the Project's design and collect the information necessary for the assessment of fish species and associated habitat within the Study Area. This was accomplished using the following approach:

- Identify potential fish habitat (waterbodies, watercourses, and wetlands) within the Study Area using desktop resources.
- Use the information collected to inform the Project design (e.g., avoid/minimize impacts to watercourses and water bodies) and determine an Assessment Area.
- Assess the quality of fish habitat within the Assessment Area via field surveys.
- Inventory and assess abundance and diversity of fish within the Assessment Area.
- Use the information collected to inform mitigation and management practices and further refine the Project Area.

CBCL Limited completed fish and fish habitat assessments in 2022, including both desktop and field-based assessments (refer to full report in Appendix E). As Project planning advanced and the Project layout evolved and was confirmed, Strum biologists completed additional assessments in 2023 to provide greater coverage of the anticipated Project footprint and confirm fish presence in select watercourses (Appendix F).

7.3.2.2 Regulatory Context

For species designated as rare or at risk, said species and/or their dwellings are provided protection federally under *SARA* and provincially under the *Endangered Species Act*, S.N.S. 1998, c. 11 (*ESA*) and *Biodiversity Act*. Throughout this EA, SOCI are defined as follows:

- Species listed under *SARA* as "Endangered," "Threatened," or "Special Concern" (Government of Canada, 2023).
- Species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as "Endangered," "Threatened," or "Special Concern" (Government of Canada, 2023).
- Species listed under *ESA* as "Endangered," "Threatened," or "Vulnerable" (Government of NS, 2023).
- Species having a subnational (provincial) rank (S-Rank) of "S1," "S2," or "S3" (ACCDC, 2023a).

Federally, DFO is responsible for the protection of fish and fish habitat in accordance with the *Fisheries Act.* Section 34.4(1) of the *Fisheries Act* states that no person shall carry on any work, undertaking or activity, other than fishing, that results in the death of fish, and Section 35(1) of the *Fisheries Act* restricts any work, undertaking or activity that results in the harmful alteration, disruption or destruction of fish or fish habitat. The *Fisheries Act* provides additional protection to fish and fish habitat through means such as permitting, licensing, regulations, habitat restoration, marine refuge, and fish stocks.

Provincially, the potential for alterations/activities to impact fish and fish habitat is considered through the watercourse and/or wetland alteration application process, as appropriate.

7.3.2.3 Desktop Review

The desktop component included a review of the following resources and databases:

- Completed watercourse assessments (Section 7.3.1)
- Completed wetland assessments (Section 7.3.3)
- Wetlands Inventory (NSNRR, 2021e)
- WSS Database (NSNRR, 2014)
- NS Hydrographic Network (Open Data NS, 2023)
- WAM (NSNRR, 2021d)
- Aquatic Species at Risk Map (DFO, 2023)
- Significant Species and Habitats Database (NSNRR, 2018a)
- Atlantic Canada Conservation Data Centre (ACCDC) Data Report (ACCDC, 2023b)

Surface water mapping and associated information conducted for waterbodies, watercourses, and wetlands is found in Sections 7.3.1 and 7.3.3, respectively.

The Aquatic Species at Risk Map (DFO, 2023) is a federal database showing the distribution of SAR and their associated critical habitat within Canadian waters. A review of this database identified several watercourses in the Study Area that contain (or potentially contain) Atlantic salmon – Inner Bay of Fundy population (IBoF) (*Salmo salar pop. 1*). No critical habitat is located within the Study Area according to the Aquatic Species at Risk Map (DFO, 2023).

The Significant Species and Habitat Database (NSNRR, 2018a) contains 31 unique species and/or habitat records pertaining to fish and fish habitat within a 100 km radius of the Study Area. These records include:

- A total of 14 "Species of Concern" records relating to Brook floater (*Alasmidonta varicosa*) (one), Delicate lamp mussel (*Lampsilis cariosa*) (three), Triangle floater (*Alasmidonta undulata*) (seven), Creeper (*Strophitus undulatus*) (two), and an unknown mollusc (*Mollusca spp.*) (one).
- A total of 17 "Species at Risk" records relating to Triangle floater (10), Brook floater (four), and Delicate lamp mussel (three).

The ACCDC Data Report (2023b) identified 17 fish and aquatic invertebrate SOCI within 100 km of the Study Area (Table 7.24). In addition, five aquatic mammal SOCI were identified within 100 km of the Study Area; these species are not discussed further as the Study Area is contained inland and will not impact the marine environment (Appendix G). The ACCDC report includes points within the Study Area and a 5 km buffer around the Study Area. No fish or aquatic invertebrate SOCI have ACCDC-documented observations within the Study Area (ACCDC, 2023b).

Table 7.24: Fish and Aquatic Invertebrate SOCI within a 100 km Radius of the Study Area

Common Name	Scientific Name	COSEWIC Status	*SARA* Status	*ESA* Status	NS S-Rank
Fish					
Alewife	*Alosa pseudoharengus*	---	---	---	S3B
American eel	*Anguilla rostrata*	Threatened	---	---	S3N
Atlantic cod	*Gadus morhua*	Endangered Special Concern Data Deficient	---	---	SNR
Atlantic salmon	*Salmo salar*	Endangered Threatened Special Concern	---	---	S1B, S1N
Atlantic salmon – Gaspe-Southern Gulf of St. Lawrence population	*Salmo salar pop. 12*	Special Concern	---	---	S1
Atlantic salmon – Inner Bay of Fundy population (IBoF)	*Salmo salar pop. 1*	Endangered	Endangered	---	S1
Atlantic salmon – Nova Scotia southern upland population (NSSU)	*Salmo salar pop. 6*	Endangered	---	---	S1
Atlantic sturgeon	*Acipenser oxyrinchus*	Threatened	---	---	S2S3N

Common Name	Scientific Name	COSEWIC Status	*SARA* Status	*ESA* Status	NS S-Rank
Brook trout	*Salvelinus fontinalis*	---	---	---	S3
Lake trout	*Salvelinus namaycush*	---	---	---	S3
Striped bass	*Morone saxatilis*	Endangered Special Concern	---	---	S2S3B, S2S3N
Striped bass – Bay of Fundy population	*Morone saxatilis pop. 2*	Endangered	---	---	S2S3B, S2S3N
Aquatic Invertebrates					
Atlantic mud-piddock	*Barnea truncata*	Threatened	Threatened	---	S1
Brook floater	*Alasmidonta varicosa*	Special Concern	Special Concern	Threatened	S3
Eastern pearlshell	*Margaritifera margaritifera*	---	---	---	S2
Tidewater mucket	*Atlanticoncha ochracea*	---	---	---	S1
Triangle floater	*Alasmidonta undulata*	---	---	---	S2S3

Source: (ACCDC, 2023b)

Two watercourses (North River and Chiganois River) within the Study Area have documented observations of Atlantic salmon IBoF (ACCDC, 2023b). Both watercourses are located within the Salmon/Debert Primary Watershed (1DH), draining south-southeast into the Bay of Fundy (NSNRR, 2021b).

7.3.2.4 Field Assessment Methodology

Fish presence and existing habitat were documented as part of the watercourse surveys (Section 7.3.1) in 2022 and 2023. For each watercourse, notes on the visual observance of fish were recorded along with any habitat characteristics that may influence fish presence such as pool/riffle sequences, barriers to fish passage, and substrate composition. This information, along with the results of the desktop review, and proposed watercourse crossing locations, was then used to select ideal watercourses for detailed fish habitat assessments and qualitative electrofishing in 2023 (Drawing 7.14). The locations selected also considered the position of the watercourse within the watershed and attempted to utilize notable, permanent features that offered a representation of the surficial hydrology across the entire Study Area.

2022 Field Assessments (CBCL Limited)

As described in Section 7.3.1, a preliminary survey of an earlier Study Area was conducted by CBCL biologists in late summer through early fall 2022 to identify and classify watercourses that may intersect Project components. Identified watercourses were assessed to determine which of those are potential permanent and/or fish-bearing watercourses.

Detailed assessment focused on those watercourses that were deemed to be fish-bearing, possibly fish-bearing, or permanent in nature. Assessment methods generally adhered to those presented in the BC Reconnaissance 1:20 000 Fish and Fish Habitat Inventory: Standards and Procedures (BC MoE, 2001) and the Nova Scotia Fish Habitat Suitability Assessment (NSSA Adopt a Stream, 2018), and covered a 400 m area: 100 m upstream of the proposed watercourse crossing or Project interaction location (at intervals of 50 m) to 300 m downstream (at intervals of 100 m). The assessment locations represent areas that could be monitored throughout the construction and operations phases of the Project to provide comparisons to baseline (upstream) and impacted areas (downstream).

Refer to Appendix E for full details regarding the parameters (e.g., water quality, connectivity) assessed in 2022, watercourse feature classifications (e.g., substrate, potential for permanence), and habitat quality for spawning, rearing, staging/holding and overwintering in each watercourse evaluated. The potential for fish presence year-round was determined based on the results of water quality measurements, habitat quality at the time of the assessment, the quality of overwintering and spring/summer habitat, and upstream/downstream connectivity of the watercourse to other watercourses.

2023 Field Assessments (Strum Consulting)

In 2023, fish and fish habitat assessments were completed by Strum biologists in tandem with watercourse assessments. Field crews assessed areas and features of the Assessment Area that were not subject to detailed assessment in 2022, due to Project infrastructure layout changes since the 2022 field program was undertaken. The 2023 assessments included several components: a physical analysis of the watercourse including bank characteristics and substrate composition, an assessment of fish habitat potential across various life stages (i.e., spawning, rearing, and overwintering), and an analysis of in-situ water chemistry for a selection of watercourses. A description of assessment components is provided below:

- *Physical Makeup*

  Substrate Percent

  Substrate composition was evaluated based on percent cover of bedrock, boulders, rubble, cobble, gravel, sand, and fines/muck. Habitat potential was assessed based on the presence/absence of suitable areas for various fish life stages, including spawning, rearing, and overwintering.

  In-stream Habitat Types

  In-stream habitat diversity was assessed by presence of pools, riffles, runs, flat sections, rapids, or cascades. A diverse selection of in-stream habitat can cater to a diverse assemblage of species.

In-stream Cover

Watercourse was assessed for physical characteristics that provide fish refuge, including boulders, overhanging and instream vegetation, woody debris, deep pools, and undercut banks. These parameters were ranked as being present in either trace, moderate, or abundant amounts.

Bank Characteristics

Bank conditions were evaluated for stability and composition, as well as evidence of erosion and undercutting. Bank stability was ranked as either low, moderate, or high, and notes were collected based on any observed erosion. Further, left and right back undercutting depths were measured where applicable.

Barriers to Fish Passage

Watercourse was assessed for any potential barriers to fish passage. Barriers may include any physical structure or feature that hinders the ability of fish to navigate throughout the watercourse.

- *Water Chemistry*

Temperature

As most fish are considered ectotherms, water temperature is a crucial factor in habitat suitability. While the ideal temperature range is mostly species-specific, extreme temperature changes can have adverse effects on critical processes including metabolism, energy levels, behaviour, and nutrient uptake (Volkoff & Rønnestad, 2020).

Dissolved Oxygen

Dissolved oxygen (DO) fluctuates in response factors such as plant biomass, substrate, velocity, and temperature. Optimal DO concentrations should be >6.5 milligrams per liter (mg/L) to 8 mg/L, with a subsequent saturation of around 80% to 120% (DataStream Initiative, 2021).

Conductivity

Conductivity is a measure of how easily water can conduct electricity, providing an indirect estimate of salinity. Conductivity is often categorized by the following hierarchy:

  - Low conductivity [0 milliSiemens per centimeter (mS/cm) to 0.2 mS/cm] is used as an indicator of pristine conditions.
  - Medium conductivity (0.2 mS/cm to 1 mS/cm) is the typical range of most major rivers.
  - High conductivity (1 mS/cm to 10 mS/cm) indicates saline conditions (Government of Northwest Territories, 2013).

pH

pH is a measure of acidity based on a 0 to 14 scale. Waterbodies of low pH (high acidity) typically register below 6 or 6.5. Waterbodies of high pH (low acidity), typically register above 9. Aquatic species typically have an optimum pH range, and fluctuation from this range can result in reduced hatching rates, poor health, or mortality (US EPA, 2022b).

Electrofishing Surveys

Electrofishing is a standard fish capture measure used to collect juvenile and adult fish in streams, rivers, and standing bodies of water (e.g., lakes). The process involves submerging an anode and cathode in the water and passing an electrical current through the water to attract and immobilize fish for capture.

In 2023, electrofishing was conducted by certified Strum field staff. Surveys were conducted over approximately 200 m stretches along select watercourses. At each of the targeted watercourses, two passes were completed beginning approximately 100 m downstream of a crossing and ending 100 m upstream of the crossing. Six second shock intervals were administered every 2 m. All captured fish were held in a tank of aerated water until the pass was complete. Upon completion, all fish were measured, photographed, and identified to species. The time (in seconds) as well as all electrofisher settings were recorded. Field staff then travelled on shore back to the starting point to release the captured fish and begin the second pass, ensuring all captured fish had travelled downstream out of the survey corridor. A window of at least 15 minutes was maintained between the first pass ending and the second pass beginning. Photos of the upstream and downstream environment were taken at the crossing location. As part of the assessment, field staff made note of any points of concern such as potential obstructions to fish passage (e.g., elevated culverts, waterfalls, etc.).

Target watercourses were selected based on the results of the desktop review, proposed watercourse crossing locations for the Project, and consultation with DFO regarding the confirmed presence of SAR in the area. Selected locations also considered the position of the watercourse within the watershed.

7.3.2.5 Field Assessment Results

Fish Habitat Assessment (2022/2023)

Fish presence and existing habitat were documented as part of the watercourse surveys (Section 7.3.1), carried out by both CBCL (2022) and Strum (2023) biologists. Notes on the visual observance of fish were recorded along with fish habitat characteristics such as pool/riffle sequences, substrate composition, and barriers to fish passage (e.g., elevated culverts). Further, an analysis of in-situ water chemistry was completed for a selection of watercourses (Table 7.25). Detailed descriptions and characterization parameters for each watercourse are found in Appendix F.

Table 7.25: Results of the In-situ Water Chemistry Analysis Complete for a Selection of Watercourses within the Assessment Area

Watercourse ID	Water Chemistry(1)				
	pH	Temperature (°C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Conductivity (mS/cm)
WC2	7.2	15.6	8.14	81.3	0.03
WC22	6.67	13.1	9.37	88.8	0.03
WC26	4.48	15.8	5.09	50.8	0.03
WC30	6.28	15.7	6.61	70.3	0.03
WC33	7.3	15.2	7.65	72.5	0.04
WC36	6.86	18.7	6.15	59.2	0.06
WC39	7.02	17.5	6.87	71.2	0.04
WC47	5.4	19.6	8.12	80.8	0.02
WC50	7.05	16.1	8.25	83.5	0.03
WC51	6.96	15.4	8.62	83.7	0.06
WC52	6.67	18.6	8.07	87	0.04
WC53	4.74	15.9	6.10	60.9	0.03
WC54	5.33	13.8	7.51	74.5	0.03
WC55	6.32	17.3	5.66	59.2	0.03

(1)Results averaged over three data points taken along the watercourse

Electrofishing Surveys

Electrofishing was completed by Strum biologists in fall 2023. Given the confirmed presence of the Atlantic salmon IBoF subspecies, a *SARA* permit was obtained prior to the commencement of any electrofishing (*SARA* Permit No: DFO-MAR-2023-32a). Qualitative electrofishing was conducted along a tributary of Middle Branch North River, Cavanagh Brook, and West Branch North River (Drawing 7.14). A fourth location was selected for conducting electrofishing surveys along a tributary of East Branch Chiganois River; however, this location was inaccessible. Results are provided in Table 7.26.

Table 7.26: Electrofishing Survey Results

Watercourse	CPUE(1) (fish/seconds)	Common Name	Scientific Name	Count	Fork Length Range (mm)	Fork Length Average (mm)
Tributary of Middle Branch North River (Pass 1)	0.028	Brook trout	*Salvelinus fontinalis*	19	40 to 155	81
Tributary of Middle Branch North River (Pass 2)	0.031	Brook trout	*Salvelinus fontinalis*	19	40 to 149	81
Cavanagh Brook (Pass 1)	0.048	Brook trout	*Salvelinus fontinalis*	21	52 to 184	104
		Brown trout	*Salmo trutta*	9	47 to 176	102
Cavanagh Brook (Pass 2)	0.036	Brook trout	*Salvelinus fontinalis*	13	52 to 149	94
		Brown trout	*Salmo trutta*	10	43 to 118	99

Watercourse	CPUE[1] (fish/seconds)	Common Name	Scientific Name	Count	Fork Length Range (mm)	Fork Length Average (mm)
West Branch North River (Pass 1)	0.0091	Brook trout	*Salvelinus fontinalis*	6	55 to 206	105
		American eel	*Anguilla rostrata*	1	180[2]	180[2]
West Branch North River (Pass 2)	0.0041	Brook trout	*Salvelinus fontinalis*	3	58 to 84	67

[1]CPUE = Catch per unit effort
[2]Total length (mm)

The electrofishing surveys resulted in 81 Brook trout (*Salvelinus fontinalis*) being caught across the three surveyed watercourses. These results aligned with observations made during the watercourse characterizations completed by both CBCL (Appendix E) and Strum (Appendix F), demonstrating the high availability of Brook trout habitat throughout the Study Area. There were 19 Brown trout (*Salmo trutta*) caught in Cavanagh Brook. This non-native species poses a threat to the native Brook trout; however, is not considered invasive. One American eel (*Anguilla rostrata*) was caught in West Branch North River, where numerous stonefly (*Plecoptera*) larvae were observed.

Priority Species

Based on the results of the field and desktop assessments, the following fish and aquatic invertebrate species were identified as priority species and are discussed in further detail below:

- Atlantic salmon (IBoF) – “Endangered” (*SARA,* COSEWIC), “S1” (S-Rank)
- Brook trout – “S3” (S-Rank)
- American eel – “Threatened” (COSEWIC), “S3N” (S-Rank)

Atlantic Salmon

The Atlantic salmon – IBoF subspecies are a genetically distinct population of Atlantic salmon that encompass 48 rivers, including the Minas Basin and Chignecto Bay (COSEWIC, 2011). Atlantic salmon species undertake long feeding migrations to the ocean as older juveniles and adults, returning to freshwater streams to reproduce. For freshwater habitat, Atlantic salmon prefer clear, well-oxygenated waters in streams with bottoms of gravel, cobble, and boulder. This species prefers cool waters, with spawning typically observed in the 4.4° C to 10° C range, and growth typically observed in the 5° C to 19° C range (US Fish and Wildlife Service, 2023a). As temperatures rise above 23° C, habitat potential decreases, and Atlantic salmon will search for cooler waters. Riffles, rapids, and pools are also necessary components for various life stages, with the preferred depth being in the 10 cm to 40 cm range (US Fish and Wildlife Service, 2023a). Furthermore, Atlantic salmon prefer a circumneutral pH ranging from 6.5 to 7.5 (Maine Department of Environmental Protection, 2022).

Marine requirements for IBoF salmon are not as well understood, but temperature is thought to be important. IBoF salmon smolts migrate seaward from rivers during May to July and adults return to the rivers in the late fall to spawn (COSEWIC, 2011).

The closest ACCDC observation of Atlantic salmon IBoF subspecies is approximately 8.1 km from the centre of Study Area (ACCDC, 2023b). Additionally, there are two watercourses (North River and Chiganois River) which overlap the Study Area that have documented observations of Atlantic salmon IBoF (ACCDC, 2023b).

Brook Trout

Brook trout are typically found in cold, clear, and well oxygenated rivers and lakes with plenty of shade and gravel substrate (US Fish and Wildlife Service, 2023b). They prefer water temperatures that do not exceed 20° C, though adult fish can tolerate temperatures of up to 25° C for short periods of time. Furthermore, despite being able to reproduce in waters with a pH as low as 4.5, this species is most successful in a pH range of 5.0 to 7.5 (Maryland Department of Natural Resources, 2012).

Brook trout are a migratory species that migrate further inland to rivers and lakes during the fall months to spawn. Sea-run Brook trout may spend April to June in marine environments, but migration to marine habitat does not always occur year to year, with some Brook trout never entering marine environments (DFO, 1996). In Nova Scotia, Brook trout are considered the number one sportfish, with approximately 2 million trout stocked within the province on an annual basis (NS Department of Agriculture and Fisheries, 2005). Brown trout, a non-native trout species introduced to Nova Scotia decades ago, have negatively impacted Brook trout through ecosystem and lifecycle disruption.

There were 81 Brook trout recorded by field staff during electrofishing surveys. Brown trout were also found within the Study Area, in the same watercourse as Brook trout although in smaller numbers.

American Eel

American eels are a migratory species with life stages in freshwater, estuary, and marine environments (COSEWIC, 2012). Though much is still unknown about the American eel, several studies have shown a temperature preference of around 16.7° C (Blakeslee et al., 2018). Spawning and maturation occurs in the marine environment, where adults migrate inland to freshwater habitats. Within freshwater habitats, this species of eel is typically found in rivers and lakes, and will readily burrow into mud, sand, fine gravel, cobble, and woody debris. Within marine environments, American eels are commonly associated with protected shallow waters containing submerged vegetation (e.g., eelgrass) and woody debris (COSEWIC, 2012).

There was one American eel recorded by field staff during electrofishing surveys. This eel was caught in a watercourse with a recorded temperature of 11°C and pH of 7.5. The dominant substrate was a combination of cobbles and boulders, with gravel in lesser abundance, as well as areas with mud forming a thin film over the bed of the watercourse. Areas featuring deep pools, small and large woody debris, and instream vegetation were also observed.

7.3.2.6 Effects Assessment

Project-Fish and Fish Habitat Interactions

Project activities, primarily those that involve watercourse crossing, earth moving, or vegetation removal, have the potential to impact fish and fish habitat (Table 7.27). These potential impacts could include habitat removal, disruptions to hydrology, and/or displacement of sediment.

Table 7.27: Potential Project-Fish and Fish Habitat Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Fish and Fish Habitat			X	X	X	X				X			X		X

Assessment Boundaries

The LAA for fish and fish habitat includes the Assessment Area. The RAA for fish and fish habitat includes the Study Area (Drawing 2.2).

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for fish and fish habitat. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of fish habitat or impact to fish behaviour expected.
- Low – small loss of fish habitat or impact to fish behaviour.
- Moderate – moderate loss of fish habitat or impacts to fish behaviour, but these impacts will only be experienced by individuals rather than entire populations and can be managed with routine measures.
- High – high loss of fish habitat and impacts to fish behaviour that will be experienced by entire populations and cannot be managed with routine measures; the population’s life history is permanently altered.

Direct Effects

Direct effects to fish and fish habitat, such as habitat loss, are likely to be most prominent during the construction phase. Effect-specific active management, mitigation, and monitoring are required to eliminate, mitigate, or otherwise manage the magnitude of these direct effects.

Habitat Loss

The Project design has been optimized to minimize interactions between the Project and watercourses and wetlands that may support fish and fish habitat. However, in areas where watercourse/wetland interactions are unavoidable, there is a potential for habitat loss.

Watercourse alterations required for the Project have the potential to impact fish and fish habitat. The removal of overhanging vegetation from stream banks decreases shade/cover for fish resulting in increased vulnerability to predators. Likewise, the removal of instream cover, such as coarse woody debris or edge habitat (e.g., undercut banks) can have a negative effect on both fish and aquatic invertebrate habitat (MTO, 2009). Alterations to channel morphology and interference with sediment transport can also result in aquatic habitat degradation.

As detailed in Section 7.3.1, there is a potential for 36 watercourse alterations for the Project. These alterations are primarily associated with upgrades to existing roads and associated crossings (22/36), as well as the construction of 14 new crossings (Table 7.28). Several of the current watercourse crossings have flow being directed through inadequate infrastructure such as raised, collapsed, or improperly sized culverts. Furthermore, when paired with the current buildup of sediment, organic material, and both natural and artificial debris, some of the observed crossings may be seen as a barrier to fish passage in their current state. Therefore, for a number of these crossings, proposed upgrades will improve flow and aid in fish passage.

Wetland alterations required to facilitate Project developments also have the potential to impact fish and fish habitat. Wetlands that are contiguous with a watercourse or offer areas of open water may provide areas of fish feeding, spawning, and/or rearing. The dense macrophytic vegetation that often comes with these wetland environments can offer refuge to fish including shelter from predators, a substrate to which eggs can be adhered, and a source of food.

Based on the wetland assessments, it is possible that 27 of the 139 wetlands within the Assessment Area may offer some form of fish habitat based on the feature being contiguous with a mapped and assessed watercourse. In these situations, habitat loss may be attributed to either partial or total infill, thus altering wetland functionality such as water cooling, sediment stabilization, or stream flow support. However, the magnitude of potential impacts to fish habitat due to wetland habitat loss is dependent on the proximity of the alteration to the contiguous watercourse, the type of wetland being altered, and the localized benefits provided by the wetland regarding fish habitat, if any (Table 7.29). As such, potential effects to fish and fish habitat stemming from Project-wetland interactions are addressed below and will be further addressed through the watercourse notification or alteration permitting process.

The WESP-AC results for each of the 27 wetlands show that the majority (24/27) of these wetlands scored “lower” in the benefits ratings pertaining to fish and fish habitat (i.e., Anadromous Fish Habitat (FA) and Resident Fish Habitat (FR)). The three wetlands that scored above “lower” likely did so based on the relationship of the wetland with its contiguous watercourse. That is, WL57A and WL57B had evidence of localized flooding with bank definition decreasing in some areas where WC21 dissipated into the surrounding wetland. Further, WL115 was formed from the braided flow of WC46, causing an increase in the localized hydroperiod.

Table 7.28: Summary of Alterations to Features that May Support Fish and Fish Habitat

Feature ID	Feature Characterization	Existing Alteration Present?	Forecasted Alteration
Watercourses			
WC1	Intermittent	Yes, culvert installation for road crossing.	None – watercourse expected to be avoided.
WC2	Small permanent	None observed.	Crossing to be installed with road construction
WC3	Intermittent	Yes, culvert installation for road crossing.	None – watercourse expected to be avoided.
WC4	Small permanent	None observed.	Crossing to be installed with road construction
WC5	Small permanent	None observed.	Crossing to be installed with road construction
WC6	Small permanent	None observed.	None – watercourse expected to be avoided.
WC7	Small permanent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC8	Large permanent	Yes, open-bottom bridge present for road crossing.	Bridge will be replaced with new open-bottom bridge during road construction.
WC9	Small permanent	None observed.	None – watercourse expected to be avoided.
WC10	Intermittent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC11	Intermittent	None observed.	Crossing to be installed with road construction.

Feature ID	Feature Characterization	Existing Alteration Present?	Forecasted Alteration
WC12	Small permanent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC13	Large Permanent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC14	Small Permanent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC15	Intermittent	Yes, anthropogenically realigned with road construction.	None – watercourse expected to be avoided.
WC16	Intermittent	Yes, anthropogenically realigned with road construction.	None – watercourse expected to be avoided.
WC17	Small permanent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC18A	Large permanent	Yes, open-bottom bridge present for road crossing.	Bridge to be assessed and potentially replaced during road upgrades.
WC18B	Intermittent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC19	Small permanent	Yes, open-bottom bridge present for road crossing.	Bridge to be assessed and potentially replaced during road upgrades.
WC20	Small permanent	None observed.	Crossing to be installed with road construction.
WC21	Small permanent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC22	Large permanent	None observed.	None – watercourse expected to be spanned by transmission line.
WC23	Small permanent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC24	Small permanent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.

Feature ID	Feature Characterization	Existing Alteration Present?	Forecasted Alteration
WC25	Intermittent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC26	Intermittent	None observed.	Crossing to be installed with road construction.
WC27	Intermittent	None observed.	Crossing to be installed with road construction.
WC28	Large permanent	Yes, open-bottom bridge present for road crossing.	Bridge will be replaced with new open-bottom bridge during road construction.
WC29	Intermittent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC30	Intermittent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC31	Intermittent	None observed.	None – watercourse expected to be avoided.
WC32	Small permanent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC33	Intermittent	None observed.	None – watercourse expected to be avoided.
WC34	Intermittent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC35	Intermittent	None observed.	None – watercourse expected to be spanned by transmission line.
WC36	Intermittent	None observed.	Crossing to be installed with road construction.
WC37	Intermittent	None observed.	None – watercourse expected to be avoided.
WC38	Large permanent	None observed.	None – watercourse expected to be spanned by transmission line.
WC39	Small permanent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.

Feature ID	Feature Characterization	Existing Alteration Present?	Forecasted Alteration
WC40	Small permanent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC41	Small permanent	None observed.	Crossing to be installed with road construction.
WC42	Small permanent	Yes, culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC43	Intermittent	None observed.	Crossing to be installed with road construction.
WC44	Intermittent	None observed.	Crossing to be installed with road construction.
WC45	Intermittent	None observed.	Crossing to be installed with road construction.
WC46	Intermittent	None observed.	Crossing to be installed with road construction.
WC47	Intermittent	None observed.	Crossing to be installed with road construction.
WC48	Small permanent	None observed.	None – watercourse expected to be spanned by transmission line.
WC49	Small permanent	Yes, culvert installation for road crossing.	None – watercourse expected to be spanned by transmission line.
WC50	Small permanent	None observed.	None – watercourse expected to be spanned by transmission line.
WC51	Small permanent	None observed.	None – watercourse expected to be spanned by transmission line.
WC52	Intermittent	None observed.	None – watercourse expected to be spanned by transmission line.
WC53	Small permanent	Yes, culvert installation for road crossing.	None – watercourse expected to be spanned by transmission line.
WC54	Small permanent	None observed.	None – watercourse expected to be spanned by transmission line.

Feature ID	Feature Characterization	Existing Alteration Present?	Forecasted Alteration
WC55	Small permanent	None observed.	None – watercourse expected to be spanned by transmission line.
WC56	Small permanent	None observed.	None – watercourse expected to be spanned by transmission line.
WC57	Small permanent	None observed.	None – watercourse expected to be spanned by transmission line.
WC58	Small permanent	None observed.	None – watercourse expected to be spanned by transmission line.
WC59	Intermittent	None observed.	None – watercourse expected to be spanned by transmission line.
Wetlands			
WL28A	Shrub swamp	Yes, gravel road cuts through WL28A and WC12.	Partial infill for road upgrades.
WL28B	Shrub swamp	Yes, gravel road cuts through WL28B and WC12.	Partial infill for road upgrades.
WL29B	Shrub swamp	Yes, gravel road cuts through WL29B and WC14.	Partial infill for road upgrades.
WL37A	Shrub swamp	Yes, gravel road cuts through WL37A and WC17.	Partial infill for road upgrades.
WL38	Marsh / Fen	Yes, gravel road cuts through WL38 and has artificially straightened WC16.	Partial infill for road upgrades.
WL39	Fen / Shrub swamp	Yes, gravel road cuts through WL39 and WC17.	Partial infill for road upgrades.
WL45	Treed swamp / Shrub swamp	Yes, gravel road cuts through WL45 and WC18B.	Partial infill for road upgrades.
WL57A	Shrub swamp / Treed swamp	Yes, gravel road cuts through WL57A and WC21.	Partial infill for road upgrades.
WL57B	Shrub swamp / Treed swamp	Yes, gravel road cuts through WL57B and WC21.	Partial infill for road upgrades.
WL61	Shrub swamp / Bog	Yes, gravel road cuts through WL61, WC23, and WC24.	Partial infill for road upgrades.
WL65A	Shrub swamp	Yes, gravel road cuts through WL65A and WC25.	Partial infill for road upgrades.
WL65B	Shrub swamp	Yes, gravel road cuts through WL65B and WC25.	Partial infill for road upgrades.

Feature ID	Feature Characterization	Existing Alteration Present?	Forecasted Alteration
WL74	Shrub swamp / Bog	None observed in WL74 or WC26.	Partial infill for road construction.
WL77A	Shrub swamp	None observed in WL77A or WC27.	Partial infill for road construction.
WL85A	Treed swamp	Yes, gravel road cuts through WL85A, WC30, WC31, and WC32.	Partial infill for road upgrades.
WL85B	Treed swamp	Yes, gravel road cuts through WL85B and WC29.	Partial infill for road upgrades.
WL88	Treed swamp	Yes, gravel road cuts through WL88 and WC33.	Partial infill for road upgrades.
WL90	Treed swamp	Yes, gravel road cuts through WL90 and WC34.	Partial infill for road upgrades.
WL91A	Shrub swamp	Yes, gravel road cuts through WL91A, WC37, and WC39.	Partial infill for road upgrades.
WL91B	Shrub swamp	Yes, gravel road cuts through WL91B and WC39.	Partial infill for road upgrades.
WL92	Treed swamp	Yes, gravel road cuts through WL92 and WC36.	Partial infill for road construction.
WL103	Treed swamp / Shrub swamp	Yes, gravel road cuts through WL103 and WC41.	Partial infill for road construction.
WL111	Treed swamp	None observed in WL111 or WC44.	Partial infill for road construction.
WL115	Fen / Shrub Swamp	None observed in WL115 or WC46.	Partial infill for road construction.
WL117	Fen / Treed swamp	None observed in WL117 or WC48.	Wetland and watercourse expected to be avoided.
WL118	Treed swamp	None observed in WL118 or WC52.	Wetland and watercourse expected to be avoided.
WL124	Treed swamp	None observed in WL124 or WC54.	Wetland and watercourse expected to be avoided.

Table 7.29: WESP-AC Benefits Rating Scores for the Delineated Wetlands Determined to be Contiguous with Watercourses within the Assessment Area

Feature ID	Wetland Type	WESP-AC Benefits Rating	
		Anadromous Fish Habitat (AR)	Resident Fish Habitat (FR)
WL28A	Shrub swamp	Lower	Lower
WL28B	Shrub swamp	Lower	Lower
WL29B	Shrub swamp	Lower	Lower
WL37A	Shrub swamp	Lower	Lower
WL38	Marsh / Fen	Lower	Lower

Feature ID	Wetland Type	WESP-AC Benefits Rating	
		Anadromous Fish Habitat (AR)	Resident Fish Habitat (FR)
WL39	Fen / Shrub swamp	Lower	Lower
WL45	Treed swamp / Shrub swamp	Lower	Lower
WL57A	Shrub swamp / Treed swamp	Higher	Moderate
WL57B	Shrub swamp / Treed swamp	Higher	Moderate
WL61	Shrub swamp / Bog	Lower	Lower
WL65A	Shrub swamp	Lower	Lower
WL65B	Shrub swamp	Lower	Lower
WL74	Shrub swamp / Bog	Lower	Lower
WL77A	Shrub swamp	Lower	Lower
WL85A	Treed swamp	Lower	Lower
WL85B	Treed swamp	Lower	Lower
WL88	Treed swamp	Lower	Lower
WL90	Treed swamp	Lower	Lower
WL91A	Shrub swamp	Lower	Lower
WL91B	Shrub swamp	Lower	Lower
WL92	Treed swamp	Lower	Lower
WL103	Treed swamp / Shrub swamp	Lower	Lower
WL111	Treed swamp	Lower	Lower
WL115	Fen / Shrub Swamp	Lower	Moderate
WL117	Fen / Treed swamp	Lower	Lower
WL118	Treed swamp	Lower	Lower
WL124	Treed swamp	Lower	Lower

Indirect Effects

The temporal and spatial extent of indirect effects such as erosion and sedimentation and changes in water quantity and quality can be farther reaching, but are often foreseeable, and research based, standardized BMPs can be implemented to mitigate the resulting outcomes.

Erosion and Sedimentation

The mobilization of sediment within aquatic environments can cause shifts in ecological integrity, including changes to the plant species composition, the distribution of primary and secondary producers, and the habitat suitability for vulnerable species (Tilman et al., 1997). Erosion and sedimentation can occur throughout the lifecycle of the Project, including during construction efforts, routine road maintenance, and daily traffic. However, the highest potential for these effects is related to the construction and upgrading of access roads and crossing structures. The alteration or removal of riparian vegetation can also result in bank instability and erosion, further exasperating these effects (MTO, 2009).

Changes in Surface Water Quantity

Changes to the amount of flow can alter channel morphology, increase flood potential, and disrupt habitat characteristics that support vulnerable species (MTO, 2009). These impacts could result from the alteration of bank or channel grades for road development, the compaction of soil from the heavy machinery required for turbine assembly, or the alteration of channel beds to facilitate the removal and replacement of preexisting infrastructure (e.g., decaying culverts).

Changes in Surface Water Quality

Changes in the quality of surface water can arise from alterations to the surrounding environment and can include an increase in water temperature due to decreased shade, an increase in pollutants from machinery and infrastructure, and the mobilization of sediments (MTO, 2009). Given the dynamic nature of channeling water, effects upon water quality can quickly spread throughout different reaches of the respective watershed.

Mitigation

The primary mitigation measure to protect fish and fish habitat is the Project's use of existing roads, resulting in 14 new crossings.

As required, all work completed under the provincial watercourse alteration notification process will be done in accordance with the Nova Scotia Watercourse Alterations Standards (2015b) and executed by a certified Watercourse Alteration Installer/Sizer. For work requiring an approval, specific and detailed mitigation will be developed and submitted to NSECC as part of the application process.

In addition, the following mitigative measures will be implemented to avoid and mitigate any potential effects on fish and fish habitat.

Habitat Loss

- Ensure watercourses and wetlands are clearly marked and avoid impacts to the area and adjacent riparian habitat to the extent possible.
- Ensure all crossings are installed by a certified Watercourse Alteration Installer/Sizer, and designed to avoid any permanent diversion, restriction or blockage of natural flow, such that the hydrologic function of the watercourse is maintained.
- Revegetate along the watercourse edge and above the ordinary high-water mark to facilitate the stabilization of the area, and restoration of fish habitat.
- Redesign existing watercourse crossings to facilitate habitat upgrades, including unblocking culverts and making waterways more conducive to fish passage.
- Avoid impacts to wetlands to the extent possible.
    - Where unavoidable, complete wetland alterations in accordance with the NS Wetland Conservation Policy (NSECC, 2019) and the wetland alteration process during the permitting stage, which includes a requirement to compensate for lost wetland habitat and functions.
    - Design wetland crossings to occur at the narrow part of the wetland or the wetland's edges, to the extent possible.

- Conduct work between June 1 and September 30 to avoid sensitive periods in the life cycles of fish, to facilitate a better control of water flow, and to allow for a faster revegetation period (NSECC, 2015c).

Erosion and Sedimentation

- Develop a site-specific erosion and sedimentation plan during the detailed design phase.
    - The plan will target the disturbance to banks and adjacent land, and will address the type of control structures, proper installation techniques, grading, maintenance and inspection, timing of installation, and revegetation.
- Limit the area of exposed soil and the length of time soil is exposed without mitigation (e.g., mulching, seeding, rock cover).
- Limit the slope and gradient of disturbed areas to minimize the velocity of surface water runoff.
- Ensure surface run-off containing suspended materials or other harmful substances is minimized.
- Direct run-off from construction activities away from wetlands and watercourses.

Changes in Surface Water Quantity

- Leave riparian vegetation as intact as Project developments will allow.
- Integrate outlet protection features to dissipate flow velocities and decrease erosion at the outflow.
- If concrete is to be utilized, ensure it is pre-cast and cured for at least one week prior to use at a crossing site (NSECC, 2015b).
- Utilize untreated, rot-resistant timber (e.g., hemlock, tamarack, juniper, or cedar) below the ordinary highwater mark to avoid the leaching of toxic preservatives into waterways (NSECC, 2015b).
- Utilize rock material that is clean, coarse granular, non-ore-bearing, non-watercourse-derived, and non-toxic to aquatic life (NSECC, 2015b).

Changes in Surface Water Quality

- Leave riparian vegetation as intact as Project developments will allow.
- Integrate outlet protection features to dissipate flow velocities and decrease erosion at the outflow.
- Utilize vegetated swales for the phytoremediation of contaminated runoff.
- If concrete is to be utilized, ensure it is pre-cast and cured for at least one week prior to use at a crossing site (NSECC, 2015b).
- Utilize untreated, rot-resistant timber (e.g., hemlock, tamarack, juniper, or cedar) below the ordinary highwater mark to avoid the leaching of toxic preservatives into waterways (NSECC, 2015b).
- Utilize rock material that is clean, coarse granular, non-ore-bearing, non-watercourse-derived, and non-toxic to aquatic life (NSECC, 2015b).

Monitoring

A site-specific monitoring plan will be developed and executed in tandem with watercourse monitoring during the construction phase. This will consist of detailed monitoring and general spot checks. Detailed monitoring will include hydrological, sediment, and stability assessments upstream, downstream, and at the crossing of the watercourse, as well as detailed vegetative, hydrological, and soil assessments within the wetland habitat adjacent to the infill site. Spot checks will involve a general overview of vegetative, hydrological, and substrate conditions, focusing on evidence of significant hydrologic alterations, sedimentation, and degradation of fish habitat (Table 7.30).

Table 7.30: General Fish Habitat Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
Hydrology	Examine flow velocity, taking note of any undercutting or abrasive channeling, leftover construction debris, or obstruction to flow resulting from alteration activities.	No	Yes
	Assess the general hydrologic condition and hydrologic connectivity of wetland habitat, including evidence of drier/wetter conditions, impeded water drainage, and upland flooding.	Yes	Yes
Vegetation	Complete vegetation assessments along the riparian zone and within remaining wetland habitat of partially infilled wetlands. An assessment of the potential changes in composition, species, health, and presence/absence of invasive plants will be evaluated.	No	Yes
Erosion & Sedimentation	Examine stability of watercourse banks both upstream and downstream of the crossing. Examine grade of slope at the crossing, taking note of any erosive channeling in substrate that would indicate the slope may be too steep.	Yes	Yes
	Assess potential changes in soil conditions throughout the remaining wetland habitat, including evidence of sedimentation and siltation.	Yes	Yes
	Inspect sediment control measures for effectiveness and look for evidence of sedimentation within the watercourse or wetland.	Yes	No
Habitat Loss	Conduct stream assessments equivalent to those completed prior to alteration. Examine substrate, taking note of any obvious sediment mobilization, residual slash, or a build-up of fines/muck.	Yes	Yes
	Examine crossing for visual observance of fish, and/or any obvious signs of deteriorated fish habitat (e.g., desiccation of riparian vegetation, channel infill, etc.) or diversified fish habitat (e.g., pools, woody debris, etc.).	Yes	No

Conclusion

The effects to fish and fish habitat are expected to be of low magnitude. Timing and seasonality of effects is expected to be applicable, with a potential for the effects to be exasperated by high precipitation events in the spring and fall, and an expectation to complete work during the period of June 1 to September 30. Effects will be restricted to the LAA, occurring as a short-term, single event during the construction phase, and are reversible. Therefore, effects to fish and fish habitat are not significant.

7.3.3 Wetlands

7.3.3.1 Overview

Wetland assessments were conducted to identify and delineate wetland habitat so that impacts to wetland area and function could be avoided and minimized, to the extent possible. This was achieved by using the following approach:

- Identify wetland habitat in the Study Area using desktop resources.
- Use the findings of the desktop study to design the Project (e.g., avoid/minimize impacts to wetlands), and establish an Assessment Area, thus informing planning and logistics for field studies.
- Ground-truth and delineate wetland habitat within the Assessment Area.
- Complete functional assessments for delineated wetlands identified within the Assessment Area.
- Identify the potential for, and confirm the presence of, Wetlands of Special Significance (WSS) within the Assessment Area.

7.3.3.2 Regulatory Context

The Nova Scotia Wetland Conservation Policy outlines a policy goal of no loss of WSS and no net loss in area and function for other wetlands (NSECC, 2019). Wetlands are considered WSS based on the wetland having significant species or species assemblages, high levels of biodiversity, significant hydrological value, or high social or cultural importance. Under this policy, the following are considered WSS:

- All salt marshes.
- Wetlands that are within or partially within a designated Ramsar site, Provincial Wildlife Management Area (Crown and Provincial lands only), Provincial Park, Nature Reserve, Wilderness Area or lands owned or legally protected by non-government charitable conservation land trusts.
- Intact or restored wetlands that are project sites under the North American Waterfowl Management Plan and secured for conservation through the Nova Scotia Eastern Habitat Joint Venture program.
- Wetlands known to support at-risk species as designated under *SARA* or the *ESA*.
- Wetlands in designated protected water areas as described within Section 106 of the *Environment Act,* S.N.S. 1994-95, c. 1.

As per Section 5 of the *Environment Act*, S.N.S. 1994-95, c. 1 approval from NSECC is required to alter a wetland. Nova Scotia considers a wetland alteration to be any activity that may affect wetland function and habitat. Such activities include, but are not limited to, excavating, flooding, infilling, or draining (NSECC, 2019).

7.3.3.3 Desktop Review

A desktop review for the location and extent of potential wetlands across the Study Area was completed using the following information sources:

- Wetlands Inventory (NSNRR, 2021e)
- WSS Database (NSNRR, 2014)
- NS Hydrographic Network (Open Data NS, 2023)
- WAM Database (NSNRR, 2021d)
- NS Digital Elevation Model (DEM) (GeoNOVA, 2020)
- Provincial Landscape Viewer (NSNRR, 2017)
- Satellite and aerial imagery

The NSNRR Wetland Inventory (2021e) identified 75 wetlands within the Study Area, which are classified as: swamp (68), marsh (three), bog or fen (three), and fen (one). The wetlands ranged in size from <1 ha to 38 ha (Drawing 7.15).

According to the NSNRR WSS database (2014), there are no WSS located within the Study Area. Outside the Study Area, there are several WSS associated with Gully Lake Wilderness Area to the east, NS Community College grounds to the southeast, and Salmon River to the south near Truro.

The NS Hydrographic Network (Open Data NS, 2023) was used in conjunction with the WAM database (NSNRR, 2021d) and DEM layer to further assess the distribution of confirmed and potential wetland habitat within the Study Area. These sources identified potential wet areas and predicted flow based on the assumed depth-to-water generated from digital elevation data (Drawing 7.13). The depth-to-water ranged from 0 m to >10 m from the surface across the Study Area, with the majority of the Study Area being well to moderately-well drained.

The Provincial Landscape Viewer (NSNRR, 2017) was consulted to further confirm the presence of both wetlands and WSS, as well as identify areas of interest including significant habitat, special management practice zones, and protected areas. The results show that the Study Area is classified as white-tailed deer (*Odocoileus virginianus*) wintering area (terrestrial fauna discussed in Section 7.4.3).

Satellite and aerial imagery were used as a quality assurance/quality control tool when reviewing desktop resources.

The results of the desktop review assisted in scoping field studies and were ultimately used to conduct a constraints analysis thus refining turbine/road siting locations to avoid known wetland features to the extent possible.

7.3.3.4 Field Assessment Methodology

General

Wetland field assessments were completed across the entirety of the Assessment Area by qualified Strum wetland delineators in 2023, supplementing those completed by CBCL in 2022. This work included high-level assessments for hydrology, complimented by in-depth wetland delineations and functional assessments. Wetland surveys were generally done in conjunction with watercourse assessments. Field assessments aimed to minimize wetland alteration by establishing areas to be avoided during Project scoping for turbine siting, as well as the placement of access roads and other Project infrastructure. This approach resulted in several layout modifications as the Project Area was optimized to minimize Project-wetland interactions. Although extensive wetland field assessments were completed throughout the entire Study Area, wetlands situated within the current Assessment Area are the focus of discussion for this EA. Additional wetland assessment report details are presented in Appendix H.

To accompany wetland field surveys, a list of SOCI known to occur within the general area of the Project was compiled to help with identification. Throughout the wetland surveys all observations of SOCI were noted; details of these observations are captured within the EA under their respective reporting sections, as applicable to the species observed.

Field Delineations

Throughout the field-based assessments completed from 2022 to 2023, crews traversed the entirety of the Assessment Area, delineating and characterizing each wetland identified. Wetland boundaries were determined by confirming the following:

- Presence of hydrophytic (water loving) vegetation.
- Presence of hydrologic conditions which result in periods of flooding, ponding, or saturation during the growing season.
- Presence of hydric soils.

A positive indicator must typically be present for all three parameters to definitively identify any given site as a wetland (Environmental Laboratory, 1987). If the identified wetland extended significantly outside of the Assessment Area, the extent of its boundary was generally estimated using aerial imagery and other desktop resources.

Identification of Hydrophytic Vegetation

Hydrophytic vegetation is defined as the sum of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produces 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 observed in wetland habitat (Environmental Laboratory, 1987).

Dominant plant species observed in each wetland were classified according to indicator status (probability of occurrence in wetlands), in accordance with the US Fish and Wildlife Service National List of Vascular Plant Species that Occur in Wetlands: NE Region (Region 1) (Reed, 1988) (Table 7.31). These indicators are used as this region most closely resembles the flora and climate regime of Nova Scotia. Further relevant information was reviewed in Flora of Nova Scotia (Zinck, 1998).

Table 7.31: Classification of Wetland-Associated Plant Species

Plant Species Classification	Abbreviation[1]	Probability of Occurring in Wetland
Obligate	OBL	>99%
Facultative Wetland	FACW	66% to 99%
Facultative	FAC	33% to 66%
Facultative Upland	FACU	1% to33%
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

Source: (Reed, 1988)
[1]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 formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper layer (USDA-NRCS, 2010). Indicators of the presence of hydric soils include soil colour (gleyed soils and soils with bright mottles and/or low matrix chroma), aquic or preaquic moisture regimes, reducing soil conditions, sulfidic material (odour), soils listed on the hydric soils list, iron and manganese concretions, organic soils (histosols), histic epipedons, high organic content in the surface layer of sandy soils, and organic streaking in sandy soils.

During field surveys, soil pits were excavated to a maximum depth of 40 cm or until (auger) refusal. The soil in each pit was then examined for hydric soil indicators. The matrix colour and mottle colour (if present) of the soil were determined using 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. To be classified as a wetland, a site should have at least one primary indicator or two secondary indicators of wetland hydrology (Table 7.32). Wetland habitat is assessed for signs of hydrology via visual observations across the area and through the assessment of soil pits.

Table 7.32: Indicators of Wetland Hydrology

Examples of Primary Indicators	Examples of Secondary Indicators
Surface Water	Oxidized Root Channels in the Upper 30 cm
Saturation	Local Soil Survey Data
Sediment Deposition	Dry Season Water Table
Drainage Patterns	Stunted or Stressed Plants
Water-stained Leaves	Drainage Patterns
Sparsely Vegetated Concave Surfaces	Surface Soil Cracks
Hydrogen Sulfide Odor	Moss Trim Lines

Functional Assessments

Field delineated wetlands within the Assessment Area were assessed for their functionality based on their geographic locations, as well as their variety in terms of landform, type, and characteristics. Aerial imagery and mapping data were used to visualize the wetland within the Study Area, including the position of the wetland within its respective tertiary watershed, and the estimated extent of its catchment area. Consideration was also given to the general ecological conditions of the wetland as observed during field delineations. Functional assessments were completed according to the Wetland Ecosystem Services Protocol – Atlantic Canada (WESP-AC) (Adamus, 2021).

WESP-AC is a standardized rapid assessment methodology for the important natural functions of all types of non-tidal wetlands in Atlantic Canada. Users complete a desktop review comprised of multiple-choice questions about the wetland by consulting aerial imagery and specific regulatory resources. Upon visiting the wetland, a field form is completed based on field observations, as well as a stressor data form relating to the degree to which a wetland or its catchment area has been altered or exposed to risk from factors capable of reducing its function (primarily anthropogenic in origin).

WESP-AC then generates scores (0 to 10) and ratings (lower, moderate, higher) for each of the wetland's functions and benefits. In addition, scores are provided for five grouped functions based on environmental similarities. Scoring is based on logic models programmed into the calculator spreadsheet. The spreadsheet contains rationale for use of each metric or indicator in every model, often with the citation of supporting scientific literature.

The most recent version of WESP-AC is available as a separate Excel file for each of the Atlantic provinces, and each calculator has been calibrated to a series of nontidal reference wetlands within their respective province. The calibrated wetlands were selected with minimal bias through a statistical procedure intended to encompass as much variation as possible. WESP-AC scores are presented in their raw form and as a normalized score, relative to the calibrated wetlands.

7.3.3.5 Field Assessment Results

2022 Field Assessment Results (CBCL Limited)

In 2022, 90 wetlands were identified within or directly adjacent to the Study Area during field studies. Of these, one wetland was determined to be a WSS based on the presence of flora SAR (refer to Section 7.4.2 for CBCL flora assessment details). This information was taken into consideration when designing the Project Area, and infrastructure will be oriented to avoid the portion of the wetland that directly supports the identified SAR.

A second wetland was designated a WSS based on its high level of support for the hydrologic and water purification wetland function supergroups, as determined by the WESP-AC functional assessment. This wetland is situated within a heavily altered area, flanked by Truro Road to the west and forestry activity to the east. As such, any road upgrades required for Project developments will be restricted to the west of Truro Road to mitigate further impact on the wetland.

Detailed characterization results for both wetlands are found in Appendix H.

2023 Field Assessment Results (Strum Consulting)

In 2023, 78 wetlands were delineated either partially or fully within the Assessment Area (Drawing 7.11A to 7.11J). Of the wetlands identified, none were determined to be WSS. Where 2023 delineated wetlands overlapped with 2022 delineated wetlands, the features were merged, and the most up-to-date data was used. Detailed characterization results are found in Appendix I.

Combined Field Assessment Results (Strum & CBCL)

The results of the combined field efforts identified 125 wetlands either partially or fully within the final iteration of the Assessment Area. For coherence, Strum- and CBCL-identified wetlands were merged into one data set and given a new ID based on the order of their occurrence from north to south. The original CBCL field ID's are found in Table 7.33. If a wetland has been fragmented by previous developments, but fragments remained hydrologically connected, the wetland was given the same numeric ID and subdivided using letters (i.e., WL11A & WL11B). For the purposes of this EA, these fragments are discussed individually regarding Project-wetland interactions. As such, field surveys identified 139 wetlands/wetland fragments (57 by CBCL, 82 by Strum) either partially or fully within the final iteration of the Assessment Area (Drawings 7.11A to 7.11J).

Table 7.33: Wetland ID Guide for CBCL Delineated Wetlands

Wetland ID	Previous ID
WL1	NR-WL-002
WL6	NR-WL-004
WL8	NR-WL-009
WL9	NR-WL-011

Wetland ID	Previous ID
WL10	NR-WL-014
WL11A	NR-WL-015
WL11B	NR-WL-015
WL12	NR-WL-017
WL13A	NR-WL-018
WL13B	NR-WL-018
WL14	NR-WL-026
WL15	NR-WL-027
WL20A	NR-WL-042
WL20B	NR-WL-042
WL21	NR-WL-036
WL23A	NR-WL-043
WL23B	NR-WL-043
WL25	NR-WL-034
WL26	NR-WL-035
WL27	NR-WL-039
WL28A	NR-WL-041
WL28B	NR-WL-041
WL29A	NR-WL-044
WL29B	NR-WL-044
WL29C	NR-WL-044
WL30	NR-WL-045
WL31	NR-WL-048
WL32	NR-WL-049
WL33	NR-WL-050
WL34	NR-WL-060
WL36	NR-WL-058
WL37A	NR-WL-057
WL37B	NR-WL-057
WL38	NR-WL-061
WL48	NR-WL-063
WL54	NR-WL-064
WL71	NR-WL-070

Wetland ID	Previous ID
WL73	NR-WL-071
WL75	NR-WL-072
WL77A	NR-WL-075
WL77B	NR-WL-075
WL80	NR-WL-074
WL81	NR-WL-076
WL82	NR-WL-077
WL84	NR-WL-078
WL85A	NR-WL-081
WL85B	NR-WL-081
WL86	NR-WL-082
WL87	NR-WL-087
WL89	NR-WL-085
WL91A	NR-WL-086
WL91B	NR-WL-086
WL92	NR-WL-091
WL93	NR-WL-089
WL94	NR-WL-092
WL105	NR-WL-099
WL106	NR-WL-100

Of the 139 identified wetlands, the most prominent wetland type was swamp (119). The Canadian Wetland Classification System (1997) defines a swamp as a wetland characterized by the dominance of woody vegetation in which the water table is typically at or near the surface or inundates the soil for a significant portion of the growing season. Swamps are often associated with poorly drained or saturated soils, and they provide important habitat for various plant and animal species adapted to wet conditions. Swamps can be further sub-divided into treed swamps or shrub swamps, depending on their physiological makeup.

Of the identified swamps, 63 were classified as treed swamps. Treed swamps are characterized by the presence of trees as the dominant vegetation and an environment that is not as waterlogged as other wetland types, such as shrub swamps or marshes. These wetlands typically experience their highest hydroperiod during spring and fall precipitation events (Province of NS, 2018). As a result, treed swamps provide deciduous trees [e.g., red maple (*Acer rubrum*) and yellow birch (*Betula alleghaniensis*)] and coniferous trees [e.g., black spruce (*Picea mariana*) and balsam fir (*Abies balsamea*)] the opportunity to establish themselves and adapt to the inconsistent inundation periods (Province of NS, 2018). Typical species composition of the identified treed swamps consisted of northern starflower (*Lysimachia borealis*), two-seeded sedge (*Carex disperma*), bunchberry (*Cornus canadensis*), cinnamon fern (*Osmundastrum cinnamomeum*), red spruce (*Picea rubens*), and balsam fir. Surface water was typically not observed, though saturation was often present as identified through the excavation of small soil pits.

The remaining 56 identified swamps were classified as shrub swamps. Shrub swamps are dominated by shrubs and smaller woody plants with a denser understory and tend to form in permanently or seasonally flooded areas where the surface is moist from ground saturation. Trees may be present but are less dominant than in treed swamps. In many cases, shrub swamps eventually transition into treed swamps via succession (Province of NS, 2018). The typical species composition of shrub swamps identified within the Assessment Area included bristly dewberry (*Rubus hispidus*), sheep laurel (*Kalmia angustifolia*), speckled alder (*Alnus incana*), red maple, and balsam fir. Surface water was more common than within treed swamps, though the temporal extent of the surficial hydroperiod is expected to be seasonal.

A number of marshes (nine) were also observed within the Assessment Area. These wetlands often display more persistent surface water areas that tend to shrink as the growing season progresses. Furthermore, the lack of canopy cover and high water table in marshes often facilitate vigorous growth of herbaceous vegetation (Province of NS, 2018). Such was the case for the marsh observed, with evidence of herbaceous encroachment along the edges of a small open-water area. Vegetation composition included sensitive fern (*Onoclea sensibilis*), common woolly bulrush (*Scirpus cyperinus*), fringed sedge (*Carex crinita*), and balsam fir.

Fens (seven) were identified within the Assessment Area. Fens typically exhibit more open water than bogs, often with a connection to a small watercourse or abutting a lakeshore. They may also receive hydrology from neighbouring uplands. Ultimately, this inundation of water from outside sources facilitates a transfer of nutrients that allow fens to support a wider variety of flora and fauna than bogs (Province of NS, 2018). Typical species assemblages included flat-topped white aster (*Doellingeria umbellate*), common Canada bluejoint (*Calamagrostis canadensis*), white meadowsweet (*Spiraea alba*), and red maple.

Bogs (four) were also observed within the Assessment Area. These wetlands are characterized by their poor drainage, accumulation of peat, and dense coverage of either sphagnum moss or grass-like sedges (Province of NS, 2018). Bogs typically have a high water table and receive most of their water from precipitation, resulting in a nutrient-poor environment (National Wetlands Working Group, 1997). Typical species composition observed included tawny cottongrass (*Eriophorum virginicum*), bog cranberry (*Vaccinium oxycoccos*), lambkill (*Kalmia angustifolia*), speckled alder, and black spruce. Trees, when present, were often stunted and scattered throughout.

Functional Assessments

Functional assessments were completed between 2022 and 2023 by Strum and CBCL wetland specialists for each of the 139 wetlands located within the Assessment Area. Note that functional assessments completed by Strum were done using version 2.0 of the WESP-AC calculator form, while those done by CBCL were done using version 3.0. Detailed WESP-AC results are found in Appendix I (Strum) and Appendix H (CBCL), and a summary is provided in Table 7.34 and Table 7.35.

As previously mentioned, one wetland (WL34) was designated a WSS based on its high level of support for the hydrologic and water purification wetland function supergroups, as determined by the WESP-AC functional assessment. This wetland is situated within at a low point in relation to the surrounding topography and is contiguous with a portion of West Branch North River. Just north of the Assessment Area, beaver activity, forestry activity, and recreational activity have led to the lateral expansion of this wetland up to the edge of Truro Road, sometimes inundating the road during periods of high precipitation. This information was taken into consideration when designing the Project Area, and any required infrastructure upgrades will be west of Truro Road and will continue west along another pre-existing, unnamed road. This will avoid lower-lying areas to the north, maintain the remaining vegetative buffer to the east, and thus mitigate further impact on the wetland.

None of the Strum-delineated wetlands were determined to be WSS, as dictated by the Functional WSS Interpretation Results within the WESP-AC spreadsheet calculator. The results of the wetland field assessments were also cross-referenced with breeding bird survey results, vegetation survey results, and lichen survey results, specifically for SAR with wetland habitat requirements. No field delineated wetlands were found to directly support SAR within the Assessment Area, thus confirming the Functional WSS Interpretation Results.

Table 7.34: Summary of WESP-AC Assessments Using Version 2.0 for Wetlands within the Assessment Area

Wetland ID	Wetland Type(s)	WSS[1] (Yes/No)	Summary Ratings for Grouped Functions				
			Hydrologic	Water Quality Support	Aquatic Support	Aquatic Habitat	Transition Habitat
WL2	Treed swamp	No	Higher	Lower	Lower	Higher	Higher
WL3	Treed swamp	No	Higher	Moderate	Moderate	Higher	Moderate
WL4	Fen	No	Higher	Lower	Lower	Higher	Higher
WL5	Treed swamp	No	Higher	Lower	Moderate	Higher	Higher
WL7	Treed swamp	No	Higher	Lower	Lower	Higher	Higher
WL16	Bog/Treed swamp	No	Higher	Lower	Lower	Moderate	Moderate
WL17	Treed swamp	No	Higher	Lower	Lower	Higher	Moderate
WL18	Treed swamp/Bog	No	Lower	Higher	Lower	Higher	Higher

Wetland ID	Wetland Type(s)	WSS(1) (Yes/No)	Summary Ratings for Grouped Functions				
			Hydrologic	Water Quality Support	Aquatic Support	Aquatic Habitat	Transition Habitat
WL19	Bog/Treed swamp	No	Higher	Lower	Lower	Lower	Moderate
WL22	Shrub swamp/Treed swamp	No	Higher	Lower	Lower	Moderate	Moderate
WL24	Shrub swamp	No	Higher	Moderate	Higher	Higher	Moderate
WL35	Treed swamp	No	Higher	Moderate	Moderate	Higher	Higher
WL39	Fen/Shrub swamp	No	Higher	Moderate	Moderate	Higher	Moderate
WL40	Shrub swamp	No	Moderate	Moderate	Lower	Higher	Higher
WL41	Treed swamp/ Shrub swamp	No	Higher	Moderate	Moderate	Higher	Higher
WL42	Treed swamp	No	Higher	Lower	Lower	Higher	Higher
WL43	Shrub swamp/Fen	No	Higher	Moderate	Moderate	Higher	Higher
WL44	Treed swamp	No	Higher	Moderate	Moderate	Higher	Higher
WL45	Treed swamp/ Shrub swamp	No	Lower	Higher	Moderate	Higher	Higher
WL46	Treed swamp	No	Higher	Lower	Lower	Moderate	Moderate
WL47	Marsh/Shrub swamp	No	Higher	Moderate	Moderate	Higher	Higher
WL49	Treed swamp	No	Higher	Moderate	Lower	Higher	Higher
WL50	Marsh/Bog	No	Higher	Lower	Lower	Moderate	Lower
WL51	Treed swamp	No	Higher	Moderate	Moderate	Moderate	Higher
WL52	Treed swamp	No	Higher	Higher	Moderate	Higher	Higher
WL53	Marsh/Treed swamp	No	Higher	Lower	Lower	Moderate	Lower
WL55	Shrub swamp	No	Higher	Higher	Lower	Higher	Higher
WL56	Treed swamp/Shrub swamp	No	Higher	Higher	Lower	Higher	Higher
WL57A/B	Shrub swamp/ Treed swamp	No	Lower	Higher	Moderate	Higher	Higher
WL59	Treed swamp/ Shrub swamp	No	Moderate	Higher	Moderate	Higher	Higher
WL60	Shrub swamp	No	Higher	Higher	Lower	Higher	Higher
WL61	Shrub swamp/ Bog	No	Higher	Moderate	Moderate	Higher	Higher
WL62	Marsh	No	Moderate	Lower	Moderate	Higher	Higher
WL63	Treed swamp	No	Moderate	Lower	Lower	Higher	Higher
WL64	Treed swamp	No	Lower	Higher	Moderate	Higher	Higher

Wetland ID	Wetland Type(s)	WSS(1) (Yes/No)	Summary Ratings for Grouped Functions				
			Hydrologic	Water Quality Support	Aquatic Support	Aquatic Habitat	Transition Habitat
WL65A/B	Shrub swamp	No	Lower	Higher	Moderate	Moderate	Lower
WL66	Treed swamp	No	Higher	Moderate	Lower	Higher	Moderate
WL68	Treed swamp	No	Moderate	Lower	Lower	Higher	Higher
WL69	Treed swamp	No	Moderate	Lower	Lower	Higher	Higher
WL70	Bog	No	Moderate	Lower	Lower	Higher	Higher
WL72	Treed swamp	No	Higher	Moderate	Moderate	Higher	Moderate
WL74	Shrub swamp/ Bog	No	Moderate	Lower	Lower	Higher	Higher
WL76	Shrub swamp/ Fen	No	Moderate	Lower	Moderate	Higher	Higher
WL78	Treed swamp	No	Higher	Lower	Moderate	Moderate	Moderate
WL79	Treed swamp/ Fen	No	Moderate	Lower	Moderate	Higher	Higher
WL83	Treed swamp/ Shrub swamp	No	Higher	Moderate	Higher	Moderate	Moderate
WL88	Treed swamp	No	Higher	Higher	Moderate	Higher	Higher
WL90	Treed swamp	No	Moderate	Higher	Moderate	Higher	Higher
WL95A/B	Treed swamp	No	Moderate	Lower	Moderate	Higher	Higher
WL96	Treed swamp,Shrub swamp	No	Higher	Lower	Moderate	Higher	Moderate
WL97	Treed swamp/ Shrub swamp	No	Higher	Moderate	Lower	Higher	Higher
WL99	Fen / Treed swamp	No	Higher	Lower	Moderate	Higher	Higher
WL100	Treed swamp/ Shrub swamp	No	Higher	Lower	Moderate	Higher	Moderate
WL101	Treed swamp/ Shrub swamp	No	Higher	Lower	Moderate	Higher	Moderate
WL102	Treed swamp/ Fen	No	Higher	Lower	Moderate	Higher	Moderate
WL103	Treed swamp/ Shrub swamp	No	Higher	Moderate	Moderate	Higher	Higher
WL104	Fen/Treed swamp	No	Higher	Lower	Moderate	Higher	Moderate
WL107	Bog	No	Higher	Lower	Lower	Higher	Moderate
WL108	Treed swamp	No	Higher	Lower	Moderate	Higher	Higher
WL109	Marsh/Treed swamp	No	Higher	Lower	Moderate	Higher	Higher
WL110	Shrub swamp	No	Moderate	Higher	Moderate	Higher	Lower
WL111	Treed swamp	No	Higher	Higher	Moderate	Higher	Higher
WL112	Treed swamp	No	Moderate	Lower	Moderate	Higher	Moderate

Wetland ID	Wetland Type(s)	WSS(1) (Yes/No)	Summary Ratings for Grouped Functions				
			Hydrologic	Water Quality Support	Aquatic Support	Aquatic Habitat	Transition Habitat
WL113	Treed swamp	No	Moderate	Lower	Lower	Lower	Lower
WL114	Treed swamp	No	Moderate	Lower	Lower	Lower	Lower
WL115	Fen/Shrub Swamp	No	Higher	Higher	Moderate	Higher	Higher
WL116	Treed swamp	No	Lower	Lower	Moderate	Higher	Higher
WL117	Fen/Treed swamp	No	Higher	Lower	Higher	Higher	Higher
WL118	Treed swamp	No	Moderate	Higher	Lower	Higher	Higher
WL119	Shrub swamp	No	Moderate	Lower	Lower	Moderate	Higher
WL120	Fen	No	Moderate	Lower	Moderate	Higher	Higher
WL121	Treed swamp	No	Moderate	Lower	Moderate	Higher	Higher
WL122	Treed swamp	No	Moderate	Moderate	Lower	Higher	Higher
WL123	Marsh	No	Moderate	Lower	Lower	Higher	Higher
WL124	Treed swamp	No	Moderate	Higher	Moderate	Higher	Higher

(1) Wetlands of Special Significance determination as dictated by the Functional WSS Interpretation Results within the WESP-AC spreadsheet calculator

Table 7.35: Summary of WESP-AC Assessments Using Version 3.0 for Wetlands within the Assessment Area

Wetland ID	Wetland Type(s)	WSS(1) (Yes/No)	Summary Ratings for Grouped Functions				
			Hydrologic	Water Quality Support	Aquatic Support	Aquatic Habitat	Transition Habitat
WL1	Shrub swamp	No	High	Moderate	Low	Low	Low
WL6	Shrub swamp	No	High	Moderate	Low	Low	Low
WL8	Shrub swamp	No	High	Moderate	Low	Low	Low
WL9	Shrub swamp	No	High	Moderate	Low	Low	Low
WL10	Shrub swamp	No	High	Moderate	Low	Low	Low
WL11A	Shrub swamp	No	High	Low	Low	Low	Low
WL11B	Shrub swamp	No	High	Low	Low	Low	Low
WL12	Treed swamp	No	High	Low	Low	Low	Low
WL13A	Treed swamp	No	High	Moderate	Low	Low	Low
WL13B	Treed swamp	No	High	Moderate	Low	Low	Low
WL14	Shrub swamp	No	High	Moderate	Low	Low	Low
WL15	Shrub swamp	---	---	---	---	---	---
WL25	Shrub swamp	No	High	Moderate	Low	Low	Low
WL26	Shrub swamp	---	---	---	---	---	---
WL21	Shrub swamp	No	High	Low	Low	Low	Low
WL27	Shrub swamp	No	High	Moderate	Low	Low	Moderate
WL28A	Shrub swamp	No	High	Low	Low	Low	Low
WL28B	Shrub swamp	No	High	Low	Low	Low	Low
WL20A	Shrub swamp	No	High	Low	Low	Low	Low
WL20B	Shrub swamp	No	High	Low	Low	Low	Low

Wetland ID	Wetland Type(s)	WSS[1] (Yes/No)	Summary Ratings for Grouped Functions				
			Hydrologic	Water Quality Support	Aquatic Support	Aquatic Habitat	Transition Habitat
WL23A	Treed swamp	No	High	Low	Low	Low	Low
WL23B	Treed swamp	No	High	Low	Low	Low	Low
WL29A	Shrub swamp	No	High	Moderate	Low	Low	Moderate
WL29B	Shrub swamp	No	High	Moderate	Low	Low	Moderate
WL29C	Shrub swamp	No	High	Moderate	Low	Low	Moderate
WL30	Marsh	No	High	Moderate	Low	Low	Moderate
WL31	Marsh/Fen	No	High	Low	Low	Low	Low
WL32	Shrub swamp	No	High	Moderate	Low	Low	Moderate
WL33	Shrub swamp	No	High	Moderate	Low	Low	Low
WL37A	Shrub swamp	No	High	Moderate	Low	Low	Low
WL37B	Shrub swamp	No	High	Moderate	Low	Low	Low
WL36	Treed swamp	No	High	Moderate	Low	Low	Low
WL34	Shrub swamp	Yes	High	High	Moderate	Low	Moderate
WL38	Marsh/Fen	No	High	Low	Low	Low	Low
WL48	Shrub swamp	No	High	Moderate	Low	Low	Low
WL54	Shrub swamp	No	High	Moderate	Low	Low	Low
WL71	Shrub swamp	No	High	Low	Low	Low	Low
WL73	Shrub swamp	No	High	Moderate	Low	Low	Low
WL75	Treed swamp	No	High	Low	Low	Low	Low
WL80	Shrub swamp	No	High	Moderate	Low	Low	Low
WL77A	Shrub swamp	No	High	Moderate	Low	Low	Low
WL77B	Shrub swamp	No	High	Moderate	Low	Low	Low
WL81	Treed swamp	No	High	Low	Low	Low	Low
WL82	Treed swamp	No	High	Moderate	Low	Low	Low
WL84	Shrub swamp	No	High	Low	Low	Low	Low
WL85A	Treed swamp	No	High	Moderate	Low	Low	Low
WL85B	Treed swamp	No	High	Moderate	Low	Low	Low
WL86	Treed swamp	No	High	Moderate	Low	Low	Low
WL89	Treed swamp	No	High	Moderate	Low	Low	Low
WL91A	Shrub swamp	No	High	Low	Low	Low	Low
WL91B	Shrub swamp	No	High	Low	Low	Low	Low
WL87	Treed swamp	No	High	Low	Low	Low	Low
WL93	Shrub swamp	No	High	Moderate	Low	Low	Low
WL92	Treed swamp	No	High	Low	Low	Low	Moderate
WL94	Shrub swamp	No	High	Moderate	Low	Low	Low
WL105	Shrub swamp	No	High	Moderate	Low	Low	Low
WL106	Shrub swamp	No	High	Moderate	Low	Low	Low

(1) Wetlands of Special Significance determination as dictated by the Functional WSS Interpretation Results within the WESP-AC spreadsheet calculator

7.3.3.6 Effects Assessment

A GIS suitability analysis was conducted to design a Project Area that would optimize the placement of Project infrastructure to avoid and minimize loss of wetland area and function, to the greatest extent possible.

In areas where wetland alteration is unavoidable, the detailed design phase will refine the layout, wherever possible, to have wetland crossings along wetland edges or narrow portions of the wetland to further minimize the impacts to wetland habitat and function. Furthermore, all necessary wetland crossings will be designed to avoid any permanent diversion, restriction, or blockage of natural flow, such that the hydrologic function of the wetland is maintained. Specific details of each crossing will be finalized during the detailed design phase and will be included in the application for alteration.

Project-Wetland Interactions

Project activities, primarily those that involve earth moving or vegetation removal, have the potential to impact wetlands through habitat removal, disruptions to hydrology, and/or displacement of sediment (Table 7.36).

Table 7.36: Potential Project-Wetland Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Wetlands				X	X	X				X			X		X

Assessment Boundaries

The LAA for wetlands is the Assessment Area. The RAA for wetlands is the Study Area (Drawing 2.2).

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for wetlands. The VC-specific definition for magnitude is as follows:

- Negligible – no direct loss of wetland habitat or alteration to wetland functions expected.
- Low – direct loss of wetland habitat, but overall wetland functions remain intact.
- Moderate – direct loss of wetland habitat and impact to wetland functions, but wetland area loss will not impact the hydrology of the wetland's watershed and/or the impacted wetland areas do not directly support species at risk.
- High – direct loss of wetland habitat and impact to wetland functions; and wetland area loss will affect the hydrology of the wetland's watershed and/or the impacted wetland areas directly support species at risk.

Direct Effects

Direct effects on wetland habitat and functionality such as habitat loss and changes to hydrology can occur throughout the life of the Project but are likely to be most prominent during construction. Effect-specific active management, mitigation, and monitoring are required to eliminate, mitigate, or otherwise manage the magnitude of these direct effects.

Habitat Loss

Habitat loss can occur both directly (i.e., excavation or infilling) and indirectly (i.e., altered hydrology or canopy cover) from the Project (Trombulak & Frissell, 2000). Loss of habitat can fragment wildlife corridors, potentially isolating species and lowering species richness. Habitat loss can also disrupt vital habitat characteristics that support vulnerable species. Further, the removal or infilling of wetland habitat can impact the hydroperiod of neighbouring wet areas, resulting in farther reaching impacts on habitat quality (Mitsch & Gosselink, 2001).

Hydrological Effects

The hydrology of a wetland is one of the most important aspects of its overall structure and function. Project infrastructure within or near a wetland can result in changes in the timing and quantity of flow, potentially impacting species composition, water treatment capabilities, and nutrient export (Mitsch & Gosselink, 2001). Further, disruption to the hydrology of one area may hinder the hydrological connectivity to other areas, thus resulting in impacts being felt in neighbouring wet areas.

A summary of the wetlands identified within the Assessment Area and how they may be affected by the Project is provided in Table 7.37 and shown on Drawing 7.11A to 7.11J.

Table 7.37: Habitat Alteration Potential for Wetlands within the Assessment Area

ID	Wetland Type	Delineation Extent	Delineated Area (m^2)	Area Of Potential Alteration(1) (m^2)	Activity
WL1	Shrub swamp	Full	20.46	0	Road construction – wetland expected to be avoided
WL2	Treed swamp	Full	194.50	0	Turbine pad – wetland expected to be avoided
WL3	Treed swamp	Partial	9367.17	2718.26	Road construction
WL4	Fen	Full	1042.81	1042.81	Turbine pad
WL5	Treed swamp	Partial	1068.11	200.55	Road construction
WL6	Shrub swamp	Full	1931.06	0	Turbine pad – wetland expected to be avoided
WL7	Treed swamp	Full	211.40	0	Road construction – wetland expected to be avoided
WL8	Shrub swamp	Full	104.69	0	Road construction – wetland expected to be avoided
WL9	Shrub swamp	Full	615.39	129.35	Road construction
WL10	Shrub swamp	Full	163.15	0	Road construction – wetland expected to be avoided
WL11A	Shrub swamp	Partial	6252.44	2856.01	Road upgrades

ID	Wetland Type	Delineation Extent	Delineated Area (m²)	Area Of Potential Alteration(1) (m²)	Activity
WL11B	Shrub swamp	Partial	2193.18	124.28	Road upgrades
WL12	Treed swamp	Full	2101.05	0	Road upgrades – wetland expected to be avoided
WL13A	Treed swamp	Full	2173.79	720.51	Road upgrades
WL13B	Treed swamp	Full	701.67	325.22	Road upgrades
WL14	Shrub swamp	Full	2301.67	335.98	Road upgrades
WL15	Shrub swamp	Full	878.82	0	Turbine pad – wetland expected to be avoided.
WL16	Bog/Treed swamp	Partial	6951.54	3913.05	Turbine pad
WL17	Treed swamp	Full	211.13	0	Turbine pad – wetland expected to be avoided
WL18	Treed swamp/ Bog	Full	1231.49	216.53	Turbine pad
WL19	Bog/Treed swamp	Partial	1513.22	0	Turbine pad – wetland expected to be avoided
WL20A	Shrub swamp	Full	337.52	86.85	Road upgrades
WL20B	Shrub swamp	Full	2698.94	323.92	Road upgrades
WL21	Shrub swamp	Full	95.43	0	Road upgrades – wetland expected to be avoided.
WL22	Shrub swamp/ Treed swamp	Partial	2377.23	831.55	Road construction
WL23A	Treed swamp	Full	1030.67	509.11	Road upgrades
WL23B	Treed swamp	Full	598.83	99.02	Road upgrades
WL24	Shrub swamp	Partial	1569.68	708.58	Road construction
WL25	Shrub swamp	Full	1118.44	306.32	Turbine pad
WL26	Shrub swamp	Full	228.56	0	Turbine pad – wetland expected to be avoided
WL27	Shrub swamp	Full	7242.29	1230.26	Turbine pad
WL28A	Shrub swamp	Partial	848.01	151.17	Road upgrades
WL28B	Shrub swamp	Full	608.87	190.93	Road upgrades
WL29A	Shrub swamp	Partial	5616.26	689.74	Road upgrades
WL29B	Shrub swamp	Partial	6050.71	174.83	Road upgrades
WL29C	Shrub swamp	Partial	489.12	231.41	Road upgrades
WL30	Marsh	Full	1665.04	371.72	Road upgrades
WL31	Marsh/Fen	Partial	3950.14	246.77	Road upgrades
WL32	Shrub swamp	Partial	1614.89	117.26	Road upgrades
WL33	Shrub swamp	Partial	281.08	0	Road upgrades – wetland expected to be avoided
WL34	Shrub swamp	Partial	4009.31	0	Road upgrades – wetland expected to be avoided
WL35A	Treed swamp	Full		102.35	Road upgrades
WL35B	Treed swamp	Full	1727.45	1218.20	Road upgrades
WL36	Treed swamp	Full	429.57	328.98	Road upgrades

ID	Wetland Type	Delineation Extent	Delineated Area (m^2)	Area Of Potential Alteration(1) (m^2)	Activity
WL37A	Shrub swamp	Partial	5172.12	79.72	Road upgrades
WL37B	Shrub swamp	Partial	2049.69	541.53	Road upgrades
WL38	Marsh/Fen	Partial	1681.59	393.86	Road upgrades
WL39	Fen/Shrub swamp	Partial	12932.63	3797.70	Road upgrades
WL40	Shrub swamp	Full	621.56	42.44	Road upgrades
WL41	Treed swamp/ Shrub swamp	Partial	2008.45	0	Road upgrades – wetland expected to be avoided
WL42	Treed swamp	Partial	36538.36	12050.33	Road construction
WL43	Shrub swamp/ Fen	Full	204.77	0	Road upgrades – wetland expected to be avoided
WL44	Treed swamp	Partial	5497.32	2247.45	Road upgrades
WL45	Treed swamp/ Shrub swamp	Partial	5319.82	1018.60	Road upgrades
WL46	Treed swamp	Partial	6339.50	1991.32	Road construction
WL47	Marsh/Shrub swamp	Partial	5187.08	1517.71	Road upgrades
WL48	Shrub swamp	Full	26.00	0	Turbine pad – wetland expected to be avoided
WL49	Treed swamp	Partial	3817.79	775.42	Turbine pad
WL50	Marsh/Bog	Partial	3963.93	2255.41	Road upgrades
WL51	Treed swamp	Partial	230.35	0	Road upgrades – wetland expected to be avoided
WL52	Treed swamp	Full	531.66	186.11	Road upgrades
WL53	Marsh/Treed swamp	Full	370.54	313.85	Road upgrades
WL54	Shrub swamp	Partial	5167.75	0	Turbine pad – wetland expected to be avoided
WL55	Shrub swamp	Full	911.55	367.96	Road upgrades
WL56	Treed swamp/ Shrub swamp	Full	900.30	358.29	Road upgrades
WL57A	Shrub swamp/ Treed swamp	Partial	14561.08	3442.02	Road upgrades
WL57B	Shrub swamp/ Treed swamp	Partial	3452.37	837.74	Road upgrades
WL58	Shrub swamp/ Bog	Full	599.29	194.94	Road upgrades
WL59	Treed swamp/ Shrub swamp	Full	615.62	203.88	Road upgrades
WL60	Shrub swamp	Full	1719.81	396.54	Road upgrades
WL61	Shrub swamp/ Bog	Partial	13395.08	3903.17	Road construction
WL62	Marsh	Partial	1644.49	0	Transmission line – wetland expected to be avoided

ID	Wetland Type	Delineation Extent	Delineated Area (m^2)	Area Of Potential Alteration[(1)] (m^2)	Activity
WL63	Treed swamp	Full	1483.46	0	Transmission line – wetland expected to be avoided
WL64	Treed swamp	Partial	6450.05	0	Transmission line – wetland expected to be avoided
WL65A	Shrub swamp	Full	10199.02	2191.31	Road upgrades
WL65B	Shrub swamp	Full	7295.89	1384.06	Road upgrades
WL66	Treed swamp	Partial	1971.57	34.74	Road upgrades
WL67	Shrub swamp/ Bog	Full	341.01	222.31	Road construction
WL68	Treed swamp	Partial	19207.92	0	Transmission line – wetland expected to be avoided
WL69	Treed swamp	Full	837.19	837.19	Turbine pad
WL70	Bog	Partial	11848.18	0	Turbine pad – wetland expected to be avoided
WL71	Shrub swamp	Full	758.40	0	Turbine pad – wetland expected to be avoided
WL72	Treed swamp	Partial	32565.84	0	Transmission line – wetland expected to be avoided
WL73	Shrub swamp	Full	2713.30	0	Turbine pad – wetland expected to be avoided
WL74	Shrub swamp/ Bog	Partial	14553.30	3581.63	Road construction
WL75	Treed swamp	Full	1548.91	180.66	Road construction
WL76	Shrub swamp/ Fen	Full	739.92	318.03	Road construction
WL77A	Shrub swamp	Partial	1147.63	964.79	Road construction
WL77B	Shrub swamp	Partial	400.23	0	Road upgrades – wetland expected to be avoided
WL78	Treed swamp	Partial	17575.30	0	Transmission line – wetland expected to be avoided
WL79	Treed swamp/ Fen	Partial	4855.35	2809.35	Turbine pad
WL80	Shrub swamp	Full	439.21	0	Road upgrades – wetland expected to be avoided
WL81	Treed swamp	Full	1456.54	0	Road upgrades – wetland expected to be avoided
WL82	Treed swamp	Full	3277.26	0	Transmission line – wetland expected to be avoided
WL83	Treed swamp/ Shrub swamp	Partial	5113.59	2069.34	Road construction
WL84	Shrub swamp	Full	447.84	0	Road upgrades – wetland expected to be avoided
WL85A	Treed swamp	Partial	12080.37	192.22	Road upgrades
WL85B	Treed swamp	Full	635.26	20.72	Road upgrades

ID	Wetland Type	Delineation Extent	Delineated Area (m^2)	Area Of Potential Alteration(1) (m^2)	Activity
WL86	Treed swamp	Full	752.40	338.71	Turbine pad
WL87	Treed swamp	Full	273.55	0	Road construction – wetland expected to be avoided
WL88	Treed swamp	Partial	2965.00	91.19	Road upgrades
WL89	Treed swamp	Partial	7078.65	2086.62	Road construction
WL90	Treed swamp	Full	17514.88	138.95	Road upgrades
WL91A	Shrub swamp	Partial	3862.26	114.71	Road upgrades
WL91B	Shrub swamp	Partial	1665.04	204.15	Road upgrades
WL92	Treed swamp	Full	6005.65	2554.54	Road construction
WL93	Shrub swamp	Full	1271.74	0	Road upgrades – wetland expected to be avoided
WL94	Shrub swamp	Partial	7985.96	564.40	Road upgrades
WL95A	Treed swamp	Partial	2258.93	0	Transmission line – wetland expected to be avoided
WL95B	Treed swamp	Partial	480.97	0	Transmission line – wetland expected to be avoided
WL96	Treed swamp/ Shrub swamp	Partial	15658.13	0	Transmission line – wetland expected to be avoided
WL97	Treed swamp/ Shrub swamp	Partial	15701.13	3596.67	Road construction
WL98	Treed swamp/ Fen	Full	548.02	0	Turbine pad – wetland expected to be avoided
WL99	Fen/Treed swamp	Full	1590.95	0	Turbine pad
WL100	Treed swamp/ Shrub swamp	Full	237.56	0	Transmission line – wetland expected to be avoided
WL101	Treed swamp/ Shrub swamp	Full	3011.42	0	Transmission line – wetland expected to be avoided
WL102	Treed swamp/ Fen	Partial	29470.50	0	Transmission line – wetland expected to be avoided
WL103	Treed swamp/ Shrub swamp	Partial	8671.26	3119.92	Road upgrades
WL104	Fen/Treed swamp	Partial	1539.44	0	Transmission line – wetland expected to be avoided
WL105	Shrub swamp	Full	983.84	651.75	Road construction
WL106	Shrub swamp	Full	368.67	368.67	Road construction
WL107	Bog	Full	156.97	0	Transmission line – wetland expected to be avoided
WL108	Treed swamp	Partial	11775.83	3269.62	Road construction
WL109	Marsh/Treed swamp	Partial	6667.85	1752.01	Road construction
WL110	Shrub swamp	Partial	6082.65	0	Transmission line – wetland expected to be avoided
WL111	Treed swamp	Partial	11230.26	2017.53	Road construction

ID	Wetland Type	Delineation Extent	Delineated Area (m²)	Area Of Potential Alteration[1] (m²)	Activity
WL112	Treed swamp	Full	5029.37	1120.71	Turbine pad
WL113	Treed swamp	Partial	4880.86	0	Transmission line – wetland expected to be avoided
WL114	Treed swamp	Full	2697.93	0	Transmission line – wetland expected to be avoided
WL115	Fen/Shrub Swamp	Full	444.69	35.79	Road construction
WL116	Treed swamp	Partial	6367.04	0	Transmission line – wetland expected to be avoided
WL117	Fen/Treed swamp	Full	1260.92	0	Transmission line – wetland expected to be avoided
WL118	Treed swamp	Partial	36307.52	0	Transmission line – wetland expected to be avoided
WL119	Shrub swamp	Partial	20827.81	0	Transmission line – wetland expected to be avoided
WL120	Fen	Partial	2122.73	0	Transmission line – wetland expected to be avoided
WL121	Treed swamp	Partial	10054.16	0	Transmission line – wetland expected to be avoided
WL122	Treed swamp	Partial	5041.02	0	Transmission line – wetland expected to be avoided
WL123	Marsh	Partial	16154.72	0	Transmission line – wetland expected to be avoided
WL124	Treed swamp	Partial	36775.88	0	Transmission line – wetland expected to be avoided

[1]The area of potential alteration was calculated via GIS by assuming a conservative road disturbance width of 30 m and a conservative turbine pad disturbance radius of 50 m. As the detailed design is completed, the actual area of alteration required to upgrade or construct a new road or turbine pad will be used to determine the precise area of alteration, which will be smaller than the estimates presented here.

The results of the field assessments indicate that there is a potential for 86 Project-wetland interactions to facilitate Project developments for a total of 9.42 ha. Significant effort was made to maximize existing disturbed areas, with 16 km of new road being constructed, and 19 km of previously existing road being utilized. As such, 49 of the 86 potential alterations would be associated with upgrades to existing roads (if determined to be required during the detailed design phase). The remaining 37 potential alterations would stem from construction efforts, including road construction (23) and turbine pad construction (14). As the detail design phase progresses, additional opportunities for micro-siting to further minimize Project-wetland interactions will be undertaken.

Provincial wetland data (NSNRR, 2021e) was used to estimate the total amount of wetland habitat within the 7,306.21 ha Study Area. An estimated 247.62 ha of wetland habitat was identified, which equates to approximately 3.39% of the total Study Area. Field delineated wetland habitat that may be directly impacted comprises approximately 0.13% of the total area within the Study Area, approximately 3.8% of the potential wetland habitat within the Study Area, and approximately 1.55% of the total area within the 607 ha Assessment Area. The final Project Area and subsequent area of impact will be determined following the detailed design phase.

Indirect Effects

The temporal and spatial extent of indirect effects such as erosion and sedimentation, dust, invasive species, and compaction can be far reaching, but are often foreseeable, and research based, standardized BMPs can be implemented to mitigate the resulting outcomes.

Erosion and Sedimentation

Erosion and sedimentation can occur throughout the lifecycle of the Project, including during construction efforts, routine road maintenance, and daily traffic. The accumulation of sediment within wetland environments can cause shifts in ecological integrity, including the plant species composition and subsequent nutrient retention potential, hydrological storage capabilities, and habitat suitability for vulnerable species (Tilman et al., 1997).

Dust

The potential for dust deposition will likely be highest during the construction phase, though the risk will be present throughout the Project's lifecycle. Dust primarily impacts vegetative health, with particle size influencing the scale of the impact (Farmer, 2003). Smaller particulate can result in clogged pores, hindering vital biochemical processes including photosynthesis, respiration, and transpiration; and larger particulate can result in lacerations in plant tissues, thus jeopardizing the health of the plant (Farmer, 2003).

Invasive Species

The colonization of invasive species can result in detrimental impacts on wetland environments, including alterations to evapotranspiration rates, infilling from reduced decomposition rates, and ultimately a reduction in the complexity of the wetland and its subsequent species richness (Zedler & Kercher, 2004). The creation of roadways can act as a vector for invasive species, with the potential for seed dispersal increasing with both vehicular and animal traffic. Further, with many invasive species being partial to disturbed soils, routine maintenance of roadways can provide ideal conditions for their establishment (Trombulak & Frissell, 2000).

Compaction

Compaction can hinder both the vegetative and hydrological structure of a wetland, with a loss of pore space restricting root growth and groundwater infiltration (Duiker, 2005). This impacts the absorption of moisture and nutrients, thus impacting the ecological integrity of the wetland and the ecosystem services it provides. Further, compaction can decrease percolation rates, resulting in prolonged periods of saturation, and increasing the potential for flooding (Duiker, 2005).

Mitigation Measures

The following specific mitigative measures will be implemented to avoid and mitigate any potential effects on wetlands.

Habitat Loss

- Ensure wetlands are clearly marked to avoid interference with wetland habitat to the extent possible.
- Avoid impacts to wetlands to the extent possible.
  - Where unavoidable, complete wetland alterations in accordance with the NSECC Wetland Conservation Policy (2019) and the wetland alteration process during the permitting stage, which includes a requirement to compensate for lost wetland habitat and functions.
  - Design wetland crossings to occur at the narrow part of the wetland or the wetland's edges, to the extent possible.
    - For wetlands along the transmission line corridor, orient placement of lattice towers and support poles in dry areas adjacent to wetlands thus allowing transmission cables to span wetlands, to the extent possible.

Hydrology

- Require that wetland crossings will not result in permanent diversion, restriction, or blockage of natural flow, such that hydrologic function of wetlands will be maintained.

Erosion and Sedimentation

- Develop a site-specific erosion and sedimentation plan during the detail design phase.
  - The plan will address the type of control structures, proper installation techniques, grading, maintenance and inspection, timing of installation, and revegetation.
- Limit the area of exposed soil and the length of time soil is exposed without mitigation (e.g., mulching, seeding, rock cover).
- Use the existing roads and access routes to the extent feasible.
- Avoid travel through wetlands.
  - If travel through wetlands is required, use geotextile matting and time work to occur during frozen ground conditions, or travel through the drier portions of the wetland, as appropriate.
- Ensure surface run-off containing suspended materials or other harmful substances is minimized.
- Direct run-off from construction activities away from wetlands.
- Maintain existing vegetation cover, where possible.

Dust Deposition

- Use water or an approved dust suppressant to control dust on roads, as required.
- Enforce site speed limits to minimize dust generation.

Invasive Species

- Use quarried, crushed materials for road construction to reduce the introduction of invasive vascular plant species.
- Clean and inspect work vehicles prior to use to prevent the introduction of invasive/non-native species.

Compaction

- Require that wetland delineation tape is in place and visible to avoid unnecessary compaction within wetlands.
- Hold pre-construction site meetings to educate staff on the sensitivity of wetlands.
- Avoid travel through wetlands.
    - If travel through wetlands is required, use geotextile matting and time work to occur during frozen ground conditions, or travel through the drier portions of the wetland, as appropriate.

Monitoring

A site-specific post-construction wetland monitoring plan will be developed to facilitate adaptive management and contribute to the safeguarding of ecological integrity and environmental stability. The plan will be provided to NSECC as part of the permitting process and will consist of detailed monitoring and general spot checks. Detailed monitoring will include vegetative, hydrological, and soil assessments within the wetland habitat adjacent to the infill site. Spot checks will involve a general overview of vegetative, hydrological, and soil conditions, focusing on evidence of significant hydrologic alterations and sedimentation (Table 7.38).

Table 7.38: General Wetland Monitoring Parameters and Methods of Assessment

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
Hydrology	A shallow monitoring well will be installed within the remaining wetland habitat of the partially infilled wetland.	No	Yes
	Standing water depth measurements will be noted within the existing wetland (if applicable).	No	Yes
	Evidence of positive indicators of hydrology (e.g., drainage patterns, water-stained leaves, saturated surfaces, raised tree roots, development of a hydrogen sulphide odour in soils, water marks etc.) will be noted.	Yes	Yes
	An assessment of the general hydrologic condition and hydrologic connectivity will be made, including evidence of drier/wetter conditions, impeded water drainage, and upland flooding.	Yes	Yes

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
Vegetation	Vegetation assessments will be completed within plots along a vegetative transect throughout the remaining wetland habitat of the partially infilled wetlands. An assessment of the potential changes in composition, species, health, and presence/absence of invasive plants will be evaluated. Photographs will be taken of individual vegetation plots for comparison with future monitoring events.	No	Yes
	General assessment of the above variables throughout existing wetland habitat will be completed.	Yes	Yes
	Photographs will be taken of the existing wetland habitat from a fixed location for comparison with future monitoring events.	Yes	Yes
Soils	Assessment of surface soils within the remaining wetland habitat will be completed via hand digging of test pits. An assessment of potential shifts in soil characteristics will be evaluated.	Yes	Yes
	Assessment of potential changes in soil conditions throughout the remaining wetland habitat will be evaluated, including evidence of sedimentation and siltation.	Yes	Yes

Conclusion

Effects to wetland habitat and functionality are expected to be of moderate magnitude in that there may be a direct loss of wetland habitat and impact to wetland functions, but wetland area loss will not impact the hydrology of the wetland's watershed and/or the impacted wetland areas do not directly support SAR. Timing and seasonality of effects is expected to be applicable, with a potential for the effects to be exasperated by high precipitation events in the spring and fall. Effects will be restricted to the LAA, occurring as a short-term, single event during the construction phase, and are reversible. Therefore, effects to wetlands are considered not significant.

7.4 Terrestrial Environment

7.4.1 Terrestrial Habitat

7.4.1.1 Overview

The terrestrial habitat assessment focused on the identification of sensitive and important habitats through a combination of desktop review and field surveys, with the goal of designing the Project to avoid sensitive and important habitats. Wetland habitats are addressed in Section 7.3.3, and habitat assessment related to specific fish, fauna, bats, and bird species are addressed in Sections 7.3.2, and 7.4.3 to 7.4.5.

Historic and existing land use on Nuttby Mountain includes forestry operations and recreation activities which occur during all months of the year. These activities have established an expansive road and trail network that allows for access to most locations within the Assessment Area.

To assess the terrestrial habitat within the Study Area, a desktop review was conducted prior to field surveys to identify different habitats and key areas of interest. The findings informed the design of field surveys with the goal of assessing all habitat types, including habitats in both their natural state and habitat that have been subject to anthropogenic disturbance. Results of the desktop and field studies informed the siting of wind turbines, laydown areas, spur roads and other infrastructure components. This was an iterative process, with the layout being refined through ground truthing of Project component footprint impacts against sensitive and important habitats confirmed to be present through field studies. The results were also used to develop targeted mitigation and best management practices.

7.4.1.2 Regulatory Context

Applicable laws and regulations relevant to terrestrial habitat are within the *Environment Act*, S.N.S. 1994-95, c. 1 as well as the Old-Growth Forest Policy for Nova Scotia (NSNRR, 2022b) and the Nova Scotia Silvicultural Guide for the Ecological Matrix (SGEM) (McGrath et al., 2021).

The *Environment Act,* S.N.S. 1994-95, c. 1 supports and promotes the protection, enhancement, and use of the provincial environment while maintaining ecosystem integrity and sustainable development. The Old-Growth Forest Policy and SGEM regulate forestry and forest management practices on Crown land in Nova Scotia and inform best practices for management of forested areas on private lands. These policies provide requirements and/or guidance on how best to maintain ecological integrity and allow for the determination of whether old growth forests exist. These requirements include no net loss of old-growth forests on Crown land, and guidance for avoiding development within 100 m of a confirmed old-growth stand.

A small portion of the Assessment Area lies within private land; however, most of the Assessment Area is on Crown land. While no legal protection is granted to habitat on private land, the best practices described within the policies were still carefully considered.

For species designated as rare or at risk, individual species and/or their dwellings are provided protection federally, under *SARA*, and provincially, under the *ESA* and *Biodiversity Act*.

7.4.1.3 Desktop Review

To assess the terrestrial habitat, a desktop review was undertaken prior to any field activities using the following resources:

- Ecological Land Classification for Nova Scotia (Neily et al., 2017)

- Provincial Landscape Viewer (NSNRR, 2017)
- Nova Scotia Forest Inventory (Province of NS, 2021)
- Old-Growth Policy Layer (Province of NS, 2022)
- Significant Species and Habitat Database (NSNRR, 2018a)
- Nova Scotia Parks and Protected Areas Map (NSECC, 2023d)
- Project Ecological Land Classification (CBCL, 2022)

The Study Area falls within the Nova Scotia Uplands Ecoregion, which covers 19.8% of the province, and is characterized by summits and plateaus, an abundance of river and streams, and uneven-aged forests exhibiting old-growth features (Neily et al., 2017). The majority of the Assessment Area lies within the Cobequid Hills Ecodistrict (340), which is a narrow district extending east-west for 150 km between the towns of Pictou and Parrsboro. This ecodistrict makes up 17.1% of the ecoregion and represents a division between the foothills and lowlands that occur to both its north and south. The Cobequid Hills contain large intact late successional Acadian forests of shade tolerant hardwood trees, such as sugar maple, beech, yellow birch, white ash, and ironwood. Additionally, the forests of this ecodistrict are generally defined by a large abundance and diversity of ferns and club mosses in the understory. Softwood-dominant forests can also be found at higher elevations, where topographic features are plateau-like, and mixed-wood forests dominate sheltered ravines. While wind exposure can be a source of significant damage to trees at these high elevations, stand-level disturbances are rare. A notable province-wide disturbance that has impacted this ecodistrict is the beech bark canker, which has reduced beech from a dominant overstory species to primarily understory. This shift in forest dynamics is reflected in the new status of beech as a SOCI in March 2022.

The Provincial Landscape Viewer and Nova Scotia Forest Inventory layer were reviewed to identify the land cover within the Study Area (Table 7.39; Drawing 7.16). Land cover within the Study Area is varied, including built infrastructure and forested area, with softwood forest covering the largest area (48%). The majority of the Study Area is composed of untreated (i.e., not treated silviculturally) natural forest stands according to the Nova Scotia Forest Inventory Forest Groupings (76% cover) (Province of NS, 2021). The Nova Scotia Forest Inventory is based on aerial imagery from 2013, and more recent imagery shows that many of these previously natural forest stands have since been harvested. Therefore, the percentage of land cover made up of natural, untreated forest stands is much lower than reported in the Nova Scotia Forest Inventory.

Table 7.39: Land Cover Types within the Study Area and their Respected Percent Cover as Determined by the Provincial Landscape Viewer and NSNRR Forest Inventory

Land Cover Type	Percent Cover (%)
Softwood	48.04
Mixed Wood	28.39
Hardwood	18.71
Bog or Wetland	2.36
Harvests	1.02

Land Cover Type	Percent Cover (%)
Urban, Landfill, Quarry, or Transport Corridor	0.69
Agriculture	0.65
Water	0.12
Utility Corridor	0.011
Brush	0.0055

Source: (NSNRR, 2017; Province of NS, 2021)

The Old-Growth Policy layer and an Old-Growth Potential Index layer provided by NSNRR through a data sharing agreement were also reviewed (Province of NS, 2022). There are no forest stands protected under the Old-Growth Forest Policy (2022) within the Study Area. The Old-Growth Potential Index is a desktop tool, used to rank forest stands and determine where there is high potential for high-ranking old-growth forests to occur (i.e., a score of >90). Several high ranking potential old-growth stands were identified as occurring on Crown parcels within the Study Area, with numerous stands (Rank = 10) intersecting the Assessment Area or within 100 m of proposed infrastructure. These stands were selected for further investigation with field assessments, as described in Section 7.4.1.4.

A review of the NSNRR Significant Species and Habitat Database (2018a) within 100 km of the Study Area identified 40 feature records:

- 35 records classified as “Other Habitat” which relate to a brook (one), cave (one), cliffs (two), estuaries (14), islands (four), karst (four), lakes (six), a National Wildlife Area (one), and talus slopes (two).
- Two records classified as “Species at Risk” which relate to caves.
- Three records classified as “Species of Concern” which relate to a cave, an island, and karst.

None of these features are located within the Study Area.

The Nova Scotia Parks and Protected Areas Map (NSECC, 2023d) was screened to identify any protected areas in/near the Study Area (Drawing 7.17), which include:

- Gully Lake Wilderness Area and Gully Lake Wilderness Area Addition (Pending)
- Cook Conservation Lands

All protected areas noted above are located outside the Study Area and will therefore have no direct interactions with the Project.

A Project Ecological Land Classification was conducted by CBCL; methodology and results can be found in Appendix H.

7.4.1.4 Field Assessment Methodology

Terrestrial communities found within the Study Area were classified according to various categorization schemes by CBCL during 2022 field studies. To support the identification of rare or otherwise important terrestrial habitat types, specific habitats associated with watercourses, wetlands, caves/mine shafts, and other habitat types known to support rare plants, lichens, and important lifecycle functions/stages for moose, birds, and bats were investigated. Any of the above habitat types, if found within the Assessment Area, were noted during 2023 field assessments.

For areas within and adjacent to the Assessment Area that occur on Crown land, potential locations for old-growth forest were noted during field surveys. These locations, as well as those stands identified during desktop review, were assessed for old-growth conditions. Field biologists with demonstrated experience in conducting old-growth forest assessments travelled to pre-determined sample plot locations. At each plot, a rapid assessment for old-growth conditions was conducted. This rapid assessment included identification of the presence and abundance of long-lived intermediate-tolerant or late-successional tree species, evidence of previous harvest activity or other human-related disturbance, or evidence of any natural disturbances that resulted in drastically altered stand composition.

Where the rapid assessment was inconclusive or indicated potential for old-growth, Part 1 of the old-growth scoring procedure, as defined by NSNRR (2022a), was employed. At each plot, a tree core was retrieved and analyzed with a microscope to determine the average stand age. Relevant photos were also taken to accompany the surveys.

Identification of sensitive or important terrestrial habitat features through field investigations were used to further refine siting of proposed Project infrastructure components (wind turbines and roads) with the objective of avoiding or minimizing interaction with these habitat features.

7.4.1.5 Field Assessment Results

Historic and ongoing forestry operations in the Study Area have resulted in extensive modification to the natural habitat conditions. Given the extent and intensity of forestry activities in the Assessment Area, there are very few areas that have gone untouched by industrial forestry operations. Natural, undisturbed forests were found to be less abundant than indicated by publicly available desktop data and aerial imagery.

An inventory of vegetation communities was conducted by CBCL in 2022. Four upland vegetation community groups were identified within the Study Area, including three upland forest groups comprised of nine different vegetation types and one shrubland. Additionally, two wet forest groups were identified, comprised of two wet coniferous vegetation types and one wet deciduous vegetation types. Detailed results from the community classification assessment can be found in Appendix H. No additional community groups were identified during 2023 surveys by Strum personnel; however, two additional ‘Tolerant Hardwood’ vegetation types were identified during old-growth surveys. Specific terrestrial habitat found to support flora, fauna, avifauna, and bat SOCI within the Study Area are discussed in the respective sections, if applicable.

During 2023 field surveys, two stands of undisturbed, forested habitats were identified as areas for potential old-growth. These stands, in addition to the 17 stands selected based on desktop review, were targeted during old-growth field surveys. Of these stands, seven were found to either have experienced significant blowdown leaving no standing trees larger than 15 cm diameter breast height (DBH) (Mapstand IDs: E163-03955, E161-03134, E163-02978, E163-02982, E163-03435, E163-03426) or were previously harvested (Mapstand ID E161-08354). Old-growth scoring procedures were not carried out at these stands. Twelve stands were assessed using old-growth scoring procedures, including 10 stands with a Potential Old-Growth Rank of 10 and two stands with a Potential Old-Growth Rank of 9 (Table 7.40; Appendix J; photo log in Appendix J).

Three stands were determined to be old-growth. One stand confirmed as old-growth (Mapstand ID E163-02973) has a Potential Old-Growth Rank of 10; however, the majority of the stand is now composed of deadfall. Only three plots were able to be surveyed, despite a stand size of 9.7 ha, due to the extensive blowdown. Two neighbouring stands (E163-02978 and E163-02982) were also assessed and were found to be almost entirely blown down. This area has since been removed from the Assessment Area and these stands will not be impacted. The second confirmed old-growth stand (Mapstand ID E163-04929) has a Potential Old-Growth Rank of 10. This stand will be avoided in the final iteration of the Project Design. The third confirmed old-growth stand (Mapstand ID E161-08144) has a Potential Old-Growth Rank of 9 and was identified during wetland and watercourse surveys as potential old-growth. This stand and the surrounding area have been avoided in the final iteration of the Assessment Area. Furthermore, the Assessment Area includes no proposed infrastructure within 100 m of confirmed old-growth stands, as recommended in the Old-Growth Forest Policy (NSNRR, 2022b) (Drawing 7.18A to 7.18C).

Table 7.40: Old-Growth Survey Results

Stand ID	Stand Size (ha)	Potential Old Growth Rank	Plot #	Species Cored(1)	DBH(2) (cm)	Height (m)	Age (years)	Old Growth Reference Age (years)	Avg. Stand Age	Old Growth Status
E163-03453	4.0	10	1	rS	29.6	18.0	58	125	62	Not Old Growth
			2	rS	29.5	19.0	58			
			3	rS	25.8	24.5	69			
E163-04914	5.8	10	1	sM	20.6	16.5	52	140	105	Not Old Growth
			2	yB	42.3	16.0	169			
			3	yB	39.5	17.5	95			
E163-02973	9.7	10	1	rS	28.6	15.5	49	125	154	Old Growth
			2	rS	34.1	16.0	210			
			3	rS	34.2	14.5	202			

Stand ID	Stand Size (ha)	Potential Old Growth Rank	Plot #	Species Cored(1)	DBH(2) (cm)	Height (m)	Age (years)	Old Growth Reference Age (years)	Avg. Stand Age	Old Growth Status
E163-03425	2.8	10	1	rS	44.5	19.5	78	125	80	Not Old Growth
			2	rS	26.0	17.0	81			
			3	rS	42.4	21.5	81			
E163-03459	3.5	10	1	rS	27.7	18.5	66	125	82	Not Old Growth
			2	yB	37.2	17.0	120			
			3	yB	28.8	16.0	60			
E163-04883	5.8	10	1	rS	30.6	18.0	64	140	127	Not Old Growth
			2	yB	36.6	16.0	168			
			3	yB	44.1	16.0	150			
E163-04877	7.6	10	1	yB	18.3	14.0	62	100	68	Not Old Growth
			2	rS	46.6	25.0	104			
			3	yB	19.1	12.0	56			
			4	yB	25.1	16.5	67			
			5	yB	13.5	8.5	53			
E163-04929	1.5	10	1	rS	46.4	17.0	114	125	136	Old Growth
			2	yB	32.3	16.0	154			
			3	yB	43.5	17.5	140			
E161-08144	4.5	9	1	yB	41.2	16.5	124	140	140	Old Growth
			2	yB	41.4	23.0	149			
			3	yB	34.1	14.0	147			
E163-04400	13.0	10	1	yB	34.5	20.0	87	140	81	Not Old Growth
			2	yB	42.9	17.0	71			
			3	rS	31.8	19.5	62			
			4	yB	40.2	16.0	85			
			5	yB	24.5	16.5	44			
			6	yB	35.5	17.5	100			
			7	yB	40.6	15.0	119			
E163-03424	15.0	9	1	sM	43.3	23.0	86	140	105	Not Old Growth
			2	yB	42.2	14.5	116			
			3	sM	41.8	16.0	115			
			4	yB	44.5	18.5	139			
			5	sM	34.7	14.0	87			
			6	sM	28.7	16.5	73			
			7	yB	64.6	23.0	142			
			8	yB	24.1	13.5	85			
E163-04878	15.0	10	1	sM	40.1	21.0	138	140	104	Not Old Growth
			2	sM	42.5	24.0	162			
			3	yB	50.2	16.5	157			

Stand ID	Stand Size (ha)	Potential Old Growth Rank	Plot #	Species Cored(1)	DBH(2) (cm)	Height (m)	Age (years)	Old Growth Reference Age (years)	Avg. Stand Age	Old Growth Status
			4	yB	26.4	26.4	62			
			5	yB	37.1	37.1	77			
			6	yB	34.2	23.0	45			
			7	sM	33.2	33.2	100			
			8	yB	41.3	41.3	90			

(1)rS = red spruce; sM = sugar maple, yB = yellow birch, rS = red spruce
(2)DBH = Diameter Breast Height

7.4.1.6 Effects Assessment

Project-Terrestrial Habitat Interactions

Project activities, primarily those that involve earth moving or vegetation removal, have the potential to impact terrestrial habitat (Table 7.41). These activities could result in habitat removal or alteration.

Table 7.41: Potential Project-Terrestrial Habitat Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Terrestrial Habitat			X	X	X	X				X			X		X

Assessment Boundaries

The LAA for terrestrial habitat includes the Assessment Area, while the RAA includes the Study Area and all connected neighbouring habitat (Drawing 2.2).

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for terrestrial habitat. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of terrestrial habitat or alteration to habitat functions expected.
- Low – small loss of terrestrial habitat, but overall habitat functions remain intact.
- Moderate – small to moderate loss of sensitive terrestrial habitat or loss of key

habitat functions.

- High – high loss of sensitive terrestrial habitat or key habitat functions.

Effects

Habitat Loss and Fragmentation

The loss or conversion of undisturbed habitat to construct roads, transmission line corridors, and turbine pads can impact the terrestrial habitat. Habitat to consider includes habitat for flora and fauna SOCI, old-growth forest, priority habitat features, areas of special concern for conservation or protection, and unfragmented, undisturbed areas.

No terrestrial habitat for SOCI was identified within the Study Area through the NSNRR Significant Species and Habitat Database (2018a). No confirmed old-growth forest will be impacted by the Project, as the Assessment Area avoided the field-assessed confirmed old-growth found within the Study Area. No pending or designated conservation areas, wilderness areas, or otherwise protected areas are found within the Study Area.

The majority of land cover within the Study Area is softwood, mixed wood, and hardwood forests, including natural and treated stands, as determined by desktop review and confirmed through field surveys. The extent of treated and cleared areas were found to be greater than aerial imagery and Forest Inventory database designations suggested. The Project Area will consist of approximately 16 km of new roads and utilize 19 km of pre-existing roads and fourteen turbine locations are within previously disturbed area. Therefore, impacts to undisturbed and unfragmented habitat will be low and although there will be small losses to terrestrial habitat associated with the Project, habitat functionality will remain intact relative to pre-construction conditions.

Habitat Creation

The terrestrial habitat within the Assessment Area will be modified. Although the majority of the Project Area consists of existing roads, these roads may require widening and additional infrastructure added in the ROWs (ditches, transmission line). New gravel roadsides may become preferred nesting habitat for herpetofauna, and the new and widened roads may become basking habitat for snakes, wildlife corridors for terrestrial mammals, and the introduction of road salt may attract ungulates. New and widened road ROWs may become new habitat for nesting birds who prefer rocky or grassy surfaces to nest in. Roadside ditches and cleared ROWs will be revegetated through mitigation measures and naturally over time. This process may lead to the creation of different habitat types than were previously present, including wetlands and early successional forests. Although succession will be induced by anthropogenic factors, the natural process will, in time, persist, and this new habitat will be used by a variety of species. Mitigation measures will be designed to ensure the process can proceed as naturally as possible, and that any new habitat created has a low magnitude of effects on the terrestrial environment.

Mitigation Measures

To address effects to terrestrial habitat, the following mitigation measures will be implemented:

Habitat Loss

- Minimize overall area to be cleared, fragmentation of habitats, and isolation of existing habitats by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
    - Avoid disturbance to important habitat features (e.g., old-growth forests) identified during desktop and field assessments.
- Restore cleared areas where possible to reduce permanent habitat loss, primarily through revegetation of road ROWs.

Habitat Creation

- Revegetate disturbed areas, exposed soils, and cleared areas using native seed mixes.
- Minimize use of road salt to minimize attraction of ungulates to roadsides during the winter.

Monitoring

No monitoring programs specific to the terrestrial habitat are recommended.

Conclusion

Effects to terrestrial habitat associated with the Project have been assessed, including habitat loss and habitat creation. Based on this assessment and through the implementation of proposed mitigation strategies, effects to terrestrial habitat are expected occur within the LAA and be of low magnitude. Although a small loss of terrestrial habitat will occur, overall habitat functions will remain intact relative to pre-construction functionality. Residual effects may occur as a single-event and persist long-term until natural successional processes can occur. Furthermore, residual effects are expected to be reversible upon decommissioning of the Project and are not significant.

7.4.2 Terrestrial Flora

7.4.2.1 Overview

The terrestrial flora assessment included both desktop and field studies components. The objectives of the terrestrial flora assessment included the following:

- Classify habitat that supports terrestrial flora SOCI in the Study Area using available desktop resources (see Section 7.3.2.2 for definition of SOCI species).
- Identify important and sensitive habitat features that support terrestrial flora SOCI on/near the Project.
- Design field program efforts to document the diversity of terrestrial flora within the Assessment Area, and to identify locations of terrestrial flora SOCI within the

Assessment Area.

- Ground truth and collect information on terrestrial flora SOCI identified during desktop studies.
- Use the information collected through field studies to update the Project design to avoid or minimize interactions between Project infrastructure components and confirmed locations of terrestrial flora SOCI or the habitats that are known to support terrestrial flora SOCI.
- Apply mitigation, construction, and operational management practices to minimize effects to terrestrial flora (i.e., apply setbacks to lichen SOCI).

7.4.2.2 Regulatory Context

The following section describes terrestrial flora resources with the potential to occur in the Study Area, with a focus on vascular plant and lichen SOCI, that may be potentially impacted by Project activities. Plant and lichen SAR receive protection under *SARA* and/or *ESA* which prohibits their disturbance and destruction. Special management practices are required around occurrences of certain rare lichen, as prescribed in the At-Risk Lichens – Special Management Practices (NSNRR, 2018b). Additional regulations discussed in Section 7.4.1 aim to protect important habitat features, such as old-growth forests or wetlands, that support many plant and lichen SOCI in Nova Scotia.

7.4.2.3 Desktop Review

The desktop review included a review of the following databases for terrestrial flora:

- ACCDC Data Report (2023b)
- Boreal Felt Lichen Habitat Layer (NSNRR, 2012)

ACCDC records (2023b) identified 445 flora species within 100 km of the Study Area (Appendix G). Of the 445 species, 276 are vascular plants and 169 are non-vascular plants. A summary of plant and lichen SOCI identified by the ACCDC records as being known to occur within the Study Area is provided in Table 7.42 (Drawings 7.19A - 7.19D).

Table 7.42: ACCDC Plant and Lichen SOCI Identified within the Study Area*

Common Name	Scientific Name	COSEWIC	*SARA*	*ESA*	S-Rank
Plants (Vascular)					
American beech	*Fagus grandifolia*	---	---	---	S2
Black ash**	*Fraxinus nigra*	Threatened	---	Threatened	S1S2
Mountain firmoss	*Huperzia appressa*	---	---	---	S3
Small round-leaved orchid	*Platanthera orbiculata*	---	---	---	S3S4
Southern twayblade	*Neottia bifolia*	---	---	---	S3S4
Lichens (Non-vascular)					
Powdered fringe lichen	*Heterodermia speciosa*	---	---	---	S3
Shaggy fringed lichen	*Anaptychia palmulata*	---	---	---	S3S4
Tree pelt lichen	*Peltigera collina*	---	---	---	S3S4

Source: (ACCDC, 2023b)
* The ACCDC report includes points within the Project Study Area and a 5 km buffer around the Project Study Area. For the purposes of this report, only those points within the Project Study Area are included.
**Location-sensitive species, exact location unknown and may be anywhere within 5 km from the Study Area

Of these species, four SOCI were recorded within the Assessment Area. Shaggy fringed lichen (*Anaptychia palmulata)* was recorded next to a proposed road. Two records of powdered fringe lichen (*Heterodermia speciosa)* were located in turbine pads, one of which is the same turbine pad where American beech (*Fagus granfifolia)* was recorded. Southern twayblade (*Neottia bifolia*) was reported next to a proposed road. None of the abovementioned records occur next to pre-existing infrastructure (i.e., roads).

The Boreal Felt Lichen Layer (provided to Strum by NSNRR) was reviewed to identify potential habitat for boreal felt lichen within the Assessment Area. The habitat model is based on the known distribution of boreal felt lichen, which is known to grow on the trunks of balsam fir trees in peatland and in close proximity (<30 km) to the Atlantic Ocean (NSNRR, 2012). Boreal felt lichen – Atlantic population (*Erioderma pedicellatum*) is a rare species listed as “Endangered” under Schedule 1 of *SARA* and *ESA* and is also listed as “S1” by ACCDC. The Boreal Felt Lichen Layer identified no suitable habitat across the Assessment Area.

7.4.2.4 Field Assessment Methodology

2021/2022 Assessments (Strum Consulting)

In 2021, wetland and watercourse assessments were carried out by Strum within the Study Area, and lichen occurrences were initially noted concurrently with this field program. Based on data collected from the 2021 surveys, site reconnaissance to identify areas where adequate or preferred habitats might be present, and a detailed desktop review, lichen-focused surveys were completed by Strum between January 1 and November 1, 2022. Details of the lichen survey program, including field assessment methodology, are provided in Appendix K.

2022 Assessments (CBCL Limited)

In 2022, terrestrial flora surveys were completed across the Assessment Area by CBCL Limited. Vegetation surveys focused on examining habitats considered highly suitable for containing vascular plant SOCI and examining general vascular plant diversity and community composition within the Study Area. Habitats considered to be highest-priority areas for visitation generally include wetlands, floodplains, old-growth forests, and regions of calcareous geology (i.e., gypsum and limestone). The search pattern used in the field was a random meander, an accepted method for detecting presence or absence of plant species, including rare flora.

For each species sighting, the plant was identified and tabulated on an overall species inventory. Photos were taken for initial sightings where there was some doubt about identification. When necessary, specimens were collected for immediate identification (assuming the plant in question appeared abundant); voucher specimens and herbarium samples were not collected. In addition to the prior knowledge of the surveyors, the study team used keys and descriptions from various print and electronic resources.

Observations of lichen, moss, and liverwort species were also noted during the vascular plant and vegetation community surveys conducted within the Study Area in 2022. More detailed observation of moss and lichen species were recorded as part of the habitat classification task, as determination of Nova Scotia Forest Ecosystem Classification (FEC) vegetation types relies on the composition of both vascular and non-vascular communities.

Non-vascular species were identified in the field based on habitat, substrate, growth form, colour (both wet and dry) of the plant/thallus, presence, form and/or colour of reproductive structures, presence and structure of rhizines (lichens only), texture, and co-occurring species. A running inventory of all species identified was kept for each survey day. When a potential non-vascular SOCI was identified, information such as geographic coordinates and a detailed habitat description was recorded. This included information on the type of substrate the specimen(s) were growing on, size of thallus/thallus, aspect, co-occurring lichen and bryophyte species, and the approximate number of specimens present. Photographs showing details of the upper and lower thallus, including rhizines and any reproductive structures such as apothecia, as well as the general habitat were taken. If the specimen appeared common in the area, a voucher sample was sometimes also taken to aid in identification. This procedure was also followed whenever a species that could not be identified in the field was encountered. In addition to the prior knowledge of the surveyors, the study team used keys and descriptions from various print and electronic resources.

Observations of lichen, moss, and liverwort species were also recorded by CBCL ecologists during other wetland, and watercourse surveys within the Study Area in 2022.

Details of the CBCL surveys, including field assessment methodology, are provided in Appendix H.

2023 Assessments (Strum Consulting)

Observations of SOCI plant and lichen were recorded during wetland and watercourse surveys completed in summer 2023 by Strum ecologists within the Assessment Area.

7.4.2.5 Field Assessment Results

2021/2022 Assessments (Strum Consulting)

During the 2022 field program, eight lichen SOCI were observed, with 35 recorded observations within the Study Area (Table 7.43).

Table 7.43: Lichen Species Identified During 2022 Strum Field Surveys

Common Name	Scientific Name	COSEWIC Status	SARA Status	*ESA* Status	NS S-Rank	Number of Observations
Acadian jellyskin lichen	*Leptogium acadiense*	---	---	---	S3S4	16
Blue felt lichen	*Pectenia plumbea*	Special Concern	Special Concern	Vulnerable	S3	2
Eastern waterfan	*Peltigera hydrothyria*	Threatened	Threatened	Threatened	S1	2
Frosted glass-whiskers (Atlantic population)	*Sclerophora peronella (Atlantic pop.)*	Special Concern	Special Concern	---	S3S4	1
Powdered fringe lichen	*Heterodermia speciosa*	---	---	---	S3S4	2
Scaly fringe lichen	*Heterodermia squamulosa*	Threatened	---	---	S3	1
Shaggy fringed lichen	*Anaptychia palmulata*	---	---	---	S3S4	5
Wrinkled shingle lichen	*Pannaria lurida*	Threatened	Threatened	Threatened	S2S3	5

Source: Species Ranks (ACCDC, 2023a)

Frosted glass-whiskers (*Sclerophora peronella*), listed as “Special Concern” under COSEWIC and *SARA*, was observed once within the Study Area. This lichen is listed in the At-Risk Lichens – Special Management Practices (NSNRR, 2018b), where it is granted a buffer for “Rare and sensitive lichens.” This buffer restricts new construction within 100 m of the lichen. The single observation was within the Assessment Area, adjacent to a pre-existing road.

Acadian jellyskin lichen (*Leptogium acadiense*) was also found within the Assessment Area in two locations, both of which are along pre-existing roads, while powdered fringe lichen was found once within the Assessment Area in an undisturbed area. Neither of these two species are listed under *SARA*, COSEWIC, or *ESA* and therefore have no associated protective buffer.

Details of the lichen survey program and its results are provided in Appendix K.

2022 Assessments (CBCL Limited)

During the 2022 field surveys, 345 vascular plant species were encountered within the Study Area, four of which are SOCI (Table 7.44).

Table 7.44: Vascular Plant SOCI Identified During 2022 CBCL Limited Field Surveys

Common Name	Scientific Name	COSEWIC Status	SARA Status	*ESA* Status	NS S-Rank	Number of Sites
American beech	*Fagus grandifolia*	---	---	---	S3S4	Widespread
Black ash*	*Fraxinus nigra*	Threatened	---	Threatened	S1S2	2
Large purple fringed orchid	*Platanthera grandiflora*	---	---	---	S3	1
Large round-leaved orchid	*Platanthera macrophylla*	---	---	---	S2	1

Source: Species Ranks (ACCDC, 2023a)
*Location-sensitive species, not included in Drawing 7.11A to 7.11J

American beech was found widespread throughout the Study Area and Assessment Area; however, in some areas the trees were nearly defoliated despite the season (August) and were in poor health, presumably due to impacts of the invasive Beech weevil (*Orchestes fagi*). No other vascular flora SOCI were found within the Assessment Area. Two black ash (*Fraxinus nigra*) trees were found in a floodplain wetland, over 1 km from the nearest proposed infrastructure.

Many non-native vascular plant species were detected within the Study Area; however, most are considered naturalized and are not currently considered a threat to native ecosystems. One species of invasive concern, glossy buckthorn (*Frangula alnus*) was identified at four locations within the Study Area, two of which are within the Assessment Area next to pre-existing roads.

A total of 111 non-vascular plant species, comprising 70 lichens and 43 bryophytes were detected within or adjacent to the Study Area. Seven of the species found within the Study Area are SOCI (Table 7.45, Drawing 7.11A to 7.11J).

Table 7.45: Non-vascular Plant SOCI Identified During 2022 CBCL Limited Field Surveys

Common Name	Scientific Name	COSEWIC Status	SARA Status	*ESA* Status	NS S-Rank	Number of Sites	Number of Specimens
Acadian jellyskin lichen	*Leptogium acadiense*	---	---	---	S3S4	5	29
Birdnest jellyskin lichen	*Scytinium tenuissimum*	---	---	---	S2S3	1	1
Blistered tarpaper lichen	*Collema nigrescens*	---	---	---	S3	1	1
Blue felt lichen	*Pectenia plumbea*	Special Concern	Special Concern	Vulnerable	S3	2	3
Fringe lichen	*Heterodermia neglecta*	---	---	---	S3S4	1	1
Powdered fringe lichen	*Heterodermia speciosa*	---	---	---	S3S4	11	107
Shaggy fringed lichen	*Anaptychia palmulata*	---	---	---	S3S4	26	58

Source: Species Ranks (ACCDC, 2023a)

Four of these species were found within the Assessment Area, none of which are listed under *SARA*, COSEWIC, or *ESA*. Blistered tarpaper lichen (*Collema nigrescens*) was found in one location within the Assessment Area, next to a pre-existing road along the proposed transmission corridor. Shaggy fringed lichen (*Anaptychia palmulata*) was found in seven locations within the Assessment Area; two if which are along a proposed road, south of a pre-existing road, and the remaining five are within a proposed turbine pad. Powdered fringe lichen (*Heterodermia speciosa*) was found in eight locations within the Assessment Area; four of which are within one proposed turbine pad, and the remaining four are in a different proposed turbine pad. Acadian jellyskin lichen (*Leptogium acadiense*) was found in one location within the Assessment Area, in a proposed turbine pad.

Details of the CBCL Limited surveys and its results are provided in Appendix H.

2023 Assessments (Strum Consulting)

No new SOCI or non-native plants or lichen were observed during 2023 field surveys. Large purple fringed orchid was observed within the Assessment Area in one location, next to a pre-existing road (Drawing 7.11A to 7.11J).

The results of all 2021 to 2023 flora studies have been incorporated into the Project design. Protection of flora SOCI will continue to be employed throughout operation and decommissioning phases through the use of targeted mitigation and BMPs.

7.4.2.6 Effects Assessment

Project-Terrestrial Flora Interactions

Project activities, primarily those that involve earth moving or vegetation removal, have the potential to impact terrestrial flora (Table 7.46). These activities could result in changes to or loss of habitat used by SOCI, loss of plant or lichen SOCI, or introduction of non-native species that may become invasive in the environment.

Table 7.46: Potential Project-Flora Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Terrestrial Flora				X	X	X				X			X		X

Assessment Boundaries

The LAA for terrestrial flora includes the Assessment Area, while the RAA includes the Study Area and all connected neighbouring habitat (Drawing 2.2).

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for terrestrial habitat. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of terrestrial flora SOCI individuals or alteration to habitat supporting terrestrial flora SOCI expected.
- Low – small loss of habitat supporting terrestrial flora SOCI, but no terrestrial flora SOCI individuals lost.
- Moderate – small loss of terrestrial flora SOCI individuals (and associated habitat), but their populations remain largely intact.
- High – high loss of the habitat that supports terrestrial flora SOCI and/or loss of an entire population of terrestrial flora SOCI.

Effects

Loss of SOCI

Targeted surveys were conducted to identify locations of plant and lichen SOCI across the Study Area. The Project was designed to avoid areas where plant and lichen SOCI were found, and to avoid any buffered area surrounding lichen occurrences. Therefore, loss of plant and lichen SOCI is expected to be negligible to low.

Habitat Loss

Rare plants often become rare because they require specialized habitats (BCECC, 2018; CPC, 2020). Although most of the Project Area will utilize pre-existing roads (approximately 16 km of new roads will be required), road widening may be required. A targeted approach was used when conducting field assessments for terrestrial flora to survey habitat suitable for containing flora SOCI. Habitats considered to be of high priority for assessment included wetlands, floodplains, old-growth forests, and regions of calcareous geology. The Project design has avoided habitat that is known to support plant and lichen SOCI within the Study Area to the extent possible. Effects to terrestrial flora from habitat loss is therefore expected to be negligible to low.

Invasive species

Terrestrial flora, particularly rare flora, may be at risk due to threats from invasive species (BCECC, 2018). Non-native species, often introduced into a landscape accidentally by humans, can become invasive when they cause harm to the environment, economy, or human health through rapid reproduction and out-competing native species (National Geographic, 2022). Industrial projects can lead to the introduction of invasive species in two main ways:

- Revegetation of cleared land with non-native seed mixes.
- Increased access to remote areas with equipment carrying seeds, spores, or other reproductive materials from non-native species.

A number of non-native plants have already been found across the Study Area, and most areas would not be considered remote as access is already widespread. Although the magnitude of effects is expected to be negligible to low, mitigation strategies to minimize the risk of introducing and/or spreading invasive species across the Study Area are provided.

Mitigation Measures

To address effects to terrestrial flora, the following mitigation measures will be implemented:

Loss of SOCI

- Minimize overall area to be cleared by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
- Minimize loss of flora SOCI from areas with known occurrences during the design phase.

    - Desktop and field assessments identified terrestrial flora SOCI locations to be avoided during the design phase.
    - Where flora SOCI occur within the Assessment Area, the Project will utilize only the pre-existing road and the area opposite the road from the flora.
    - Where flora SOCI overlap with the Assessment Area and no pre-existing roads are present, new infrastructure will avoid known locations of these SOCI.
- Educate Project personnel about the potential for plant or lichen SOCI during construction.
    - Guidance will be provided to Project personnel to raise awareness of terrestrial flora SOCI that are known to exist within the Study Area to increase the number of trained eyes looking for these species.
- Consult with NSNRR if an unexpected flora SOCI is encountered during construction activities. Potential mitigation measures based upon recognized practices to transplant or collect seeds can be used as a contingency if flora SOCI are unexpectedly encountered during construction activities. A transplantation plan will be developed along with a monitoring protocol through consultation with NSNRR should this be required during construction.

Habitat Loss

- Minimize overall area to be cleared by utilizing pre-existing roads and previously disturbed areas (i.e., clearcuts).
- Minimize (through avoidance) the loss of important habitat which supports terrestrial flora SOCI during the detailed design phase.
- Restore as much habitat as possible through revegetation (with native seed mix) to promote continued growth of terrestrial flora across the Study Area.

Invasive Species

- Use native seed mixes when revegetating cleared areas.
- Ensure equipment is as clean as possible to prevent the introduction of non-native species into previously untouched areas.
    - Because non-native species are already present within the Study Area, including one confirmed invasive species (glossy buckthorn), care will be taken when travelling from developed areas to intact areas so that plant material is not transferred between locations.

Monitoring

Because all known locations of flora SOCI and their respective buffers have been avoided during Project design, no monitoring of terrestrial flora is recommended.

Conclusion

Effects to terrestrial flora associated with the Project have been assessed, including loss of SOCI, habitat loss, and introduction of invasive species. Based on this assessment and through the implementation of proposed mitigation and monitoring strategies, effects to terrestrial flora are expected to occur within the LAA and be of low magnitude. Although a small loss of habitat that support terrestrial flora SOCI may occur, the loss of known flora SOCI themselves will be avoided. Residual effects may occur as a single-event and persist long-term with no seasonal aspects applicable; however, effects are expected to be reversible upon decommissioning of the Project and are not significant.

7.4.3 Terrestrial Fauna

7.4.3.1 Overview

The terrestrial fauna assessment was completed using a combination of desktop and field assessments to achieve the following objectives:

- Identify significant species and habitat supporting SOCI within/near the Study Area using desktop resources.
- Determine the likelihood of SOCI species occurring in the Study Area.
- Undertake targeted surveys for different groups of terrestrial fauna to document the presence of species within the Study Area, particularly SOCI.
- Use the information collected through field studies to update the Project design to avoid or minimize interactions between Project infrastructure components and confirmed locations of terrestrial fauna SOCI or the habitats that are known to support terrestrial fauna SOCI.
- Apply mitigation, construction, and operational management practices to minimize effects to terrestrial fauna.

7.4.3.2 Regulatory Context

Applicable laws and regulations relating to the protection of fauna (i.e., mammals, herpetofauna, butterflies, and Odonates (dragonflies and damselflies)) including the following:

- *SARA*
- *ESA*
- *Canada Wildlife Act*
- *Wildlife Act,* R.S.N.S. 1989, c. 504
- *Biodiversity Act*
- *CEPA*
- *Environment Act,* S.N.S. 1994-95, c. 1

The *ESA* and *SARA* prohibit harm to listed SAR along with their habitually occupied spaces and core/critical habitat (respectively). The *Canada Wildlife Act* provides a framework for the creation of protected wildlife areas, and the Nova Scotia *Wildlife Act,* R.S.N.S. 1989, c. 504 provides policies and programs for wildlife to maintain diversity of species at levels of abundance to meet specific management objectives. The *Wildlife Act,* R.S.N.S. 1989, c. 504 includes a clause for the protection of den/habitation of a furbearer [48(3)]. The Nova Scotia *Biodiversity Act* provides a framework for the creation of Biodiversity Management Zones used for conservation and sustainable biodiversity values. Lastly, *CEPA* and the *Environment Act,* S.N.S. 1994-95, c. 1 both provide measures for the protection of the environment and pollution prevention.

7.4.3.3 Desktop Review

The desktop component included a review of the NSNRR Significant Species and Habitat Database (2018a) and ACCDC data (2023a) for mammal, herpetofauna, butterfly, and Odonates species recorded within a 100 km radius of the Study Area. The ACCDC report includes points within the Study Area and a 5 km buffer around the Study Area. For the purposes of this report, only those points within the Study Area have been included. A comparison of habitat mapping data to known habitat requirements for species expected to occur within the area, and for all SOCI, was also completed. Specifically, habitat suitability modelling for Mainland moose (*Alces alces americanus)* was conducted to identify important moose habitat within the Study Area.

Mammals

The NSNRR Significant Species and Habitat Database (2018a) contains 54 unique species and/or habitat records pertaining to terrestrial mammals within a 100 km radius of the Study Area. These records include:

- 51 records of “Deer Wintering” related to White-tailed deer (*Odocoileus virginianus*).
- Two records of “Species of Concern” relating to the Southern flying squirrel (*Glaucomys volans*) and Long-tailed shrew (*Sorex dispar*)
- One record of “Other Habitat” relating to an American black bear (*Ursus americanus*).

One large deer wintering area overlaps with the southern extent of the Study Area and the proposed transmission corridor (Drawing 7.19A to 7.19D).

The ACCDC Data Report (2023b) indicates that eight terrestrial mammal SOCI (excluding birds and bats, see Sections 7.4.4 and 7.4.5) have been recorded within a 100 km radius of the Study Area (Table 7.47). None of the identified SOCI have records within the Study Area.

Table 7.47: Mammal Species Recorded within a 100 km Radius of the Study Area

Common Name	Scientific Name	COSEWIC Status	*SARA* Status	*ESA* Status	NS S-Rank
Eastern water shrew	*Sorex albibarbis*	---	---	---	S2
Fisher	*Pekania pennanti*	---	---	---	S3S4
Long-tailed shrew	*Sorex dispar*	Not At Risk	---	Endangered	S1
Maritime shrew	*Sorex maritimensis*	---	---	---	S1
Mainland moose*	*Alces alces americana*	---	---	Endangered	S1
Moose	*Alces alces*	---	---	---	S3
Southern bog lemming	*Synaptomys cooperi*	---	---	---	S3
Southern flying squirrel	*Glaucomys volans*	Not At Risk	---	---	S3S4

Source: (ACCDC, 2023b)
*Reported by ACCDC as “Moose – *Alces americanus*” which has been changed to reflect most up to date nomenclature.

Mainland Moose Habitat Suitability Modelling

Mainland moose habitat suitability modelling was conducted by Strum using ArcGIS Pro software and the provincial Forest Inventory database (Province of NS, 2021). The data contained within this database were reclassified for the purposes of this analysis based on land cover groups (i.e., forest types and wet areas). Once different habitat types were determined, these locations were weighted according to which habitat is most preferred by moose (i.e., preferred habitats received higher weighted scores). This method was informed mainly by the Mainland Moose Recovery Plan (NSNRR, 2021f) and a variety of other sources to determine characteristics of high-quality moose habitat (NSEL, 2002; NSNRR, 2021g; NWF, u.d.).

Wetland environments were a required component in the creation of this model as Mainland moose use wetlands for thermal refuge in summer, and aquatic plants such as pondweed (*Potamogeton spp*.) and yellow pond lily (*Nuphar lutea*) provide important nutritional foraging options. Wetlands, particularly isolated areas surrounded by water, are also important calving areas as they provide protection and nutrients for calves and cows. For the purposes of the model, wetlands were defined as bog, fen, swamp, pond, or high-water table/flood prone regions based on the NSNRR Wetlands Inventory (2021e) and Forest Inventory (Province of NS, 2021)

Mixed wood forests were also a required component in this model due to the various benefits they provide to Mainland moose. Mixed wood forests provide winter cover, summer shelter, calving shelter, foraging opportunities in the forms of new growth and broad leaves, and satisfy winter diet requirements. Within the model, this habitat (i.e., mixed wood forest) was defined as a forest stand composed of 26% to 74% softwood by basal volume. Due to the wide range of species, mixed wood forests are ideal for a generalist species (such as moose) due to the diversity of ecosystems supported by both the deciduous and coniferous canopy. Common species found in the canopy of these mixed wood forests include yellow birch, paper birch (*Betula papyrifera*), sugar maple, red spruce, balsam fir, and eastern hemlock. Because of the rich nutrient regime and fresh moisture regime common in mixed wood forests, there is also a high abundance of understory vegetation which provide moose with foraging opportunities. Most mixed wood areas also met the criteria provided in the Recovery Plan for each Mainland moose habitat component (i.e., summer forage area, winter forage area, summer cover, winter cover, calving area) (NSNRR, 2021f).

Mainland moose are considered a generalist species, which indicates that they can survive in a wide variety of habitats outside of their preferred habitat types. The Mainland Moose Recovery Plan (NSNRR, 2021f) defines suitable moose habitat as areas where a maximum distance of 200 m separates a mixed wood forest from a wetland. To account for generalist behaviours, and to showcase the connectivity of the habitat identified by the model, a 500 m buffer was used around any area defined as a wet area or mixed wood stand. Shorter distances between mixed wood forests and wetlands were given a higher score in the weighting scheme to account for the greater suitability of these areas (i.e., a distance of up to 100 m between mixed wood forest and wetland receives the highest score, whereas a distance of over 400 m, but no more than 500 m, between mixed wood forest and wetland receives the lowest score). An area with a distance of over 500 m between mixed wood forest and wetland was not considered suitable moose habitat in this model.

Upon running this model with the abovementioned criteria, the analysis displays the habitat of Mainland moose ranked from suitable to high quality, based on the weighted criteria (Table 7.48), in 5 ha hexagons spanning the RAA (as defined in Section 7.4.3.6).

Table 7.48: Moose Habitat Suitability Model Weighting Scheme

Score	Distance between Wetland and Mixedwood Forest
110	Up to 100 m
90	Over 100 m but no more than 120 m
83	Over 120 m but no more than 140 m
76	Over 140 m but no more than 160 m
72	Over 160 m but no more than 180 m
66	Upper limit of 200 m specified in recovery plan (over 180 m but no more than 200 m)
59	Over 200 m but no more than 300m
50	Over 300 m but no more than 400m
11	Over 400 m but no more than 500 m (encompasses 200 – 250% of distance in recovery plan)

This model identified large areas of high-quality habitat across the Study Area. The areas surrounding the Assessment Area feature a gradient of habitat quality, indicating important areas that remain connected despite the presence of pre-existing roads. Potential impacts to this habitat and connectivity are discussed in Section 7.4.3.6.

Herpetofauna

The Nova Scotia Significant Species and Habitat Database (NSNNR, 2018a) contains 96 unique species and/or habitat records pertaining to reptiles and amphibians within a 100 km radius of the Study Area. These records include:

- 94 records of “Species at Risk” relating to Wood turtle (*Glyptemys insculpta*) (91) and Snapping turtle (*Chelydra serpentine*) (three).
- Two records of “Species of Concern” relating to Painted turtle (*Chrysemys picta*).

None of these records occur within the Study Area. The closest record is a Wood Turtle (*Glyptemys insculpta*) positioned 1.1 km from the Study Area.

Data from the ACCDC (2023b) report indicate that six herpetofauna SOCI have been recorded within a 100 km radius of the Study Area (Table 7.49). None of the identified SOCI have records within the Study Area.

Table 7.49: Herpetofauna Species Recorded by ACCDC within a 100 km Radius of the Study Area

Common Name	Scientific Name	COSEWIC Status	*SARA* Status	*ESA* Status	NS S-Rank
Eastern painted turtle	*Chrysemys picta picta*	Special Concern	Special Concern	---	S4
Four-toed salamander	*Hemidactylium scutatum*	Not At Risk	---	---	S3
Leatherback sea turtle - Atlantic population	*Dermochelys coriacea pop. 2*	Endangered	Endangered	---	S1S2N
Painted turtle	*Chrysemys picta*	Special Concern	Special Concern	---	S4
Snapping turtle	*Chelydra serpentina*	Special Concern	Special Concern	Vulnerable	S3
Wood turtle	*Glyptemys insculpta*	Threatened	Threatened	Threatened	S2

Source: (ACCDC, 2023b)

Butterflies and Odonates

The NSNRR Significant Species and Habitats (2018a) database identifies nine significant habitat features relating to butterflies and Odonates within a 100 km radius of the Study Area. These records include:

- Eight records of "Species of Concern" which relate to Jutta arctic (*Oeneis jutta*) (two), Northern bluet (*Enallagma cyathigerum*) (two), Little bluet (*Enallagma minusculum*) (one), Sphagnum sprite (*Nehalennia gracilis*) (one), Kennedy's emerald (*Somatochlora kennedyi*) (one), and Elfin skimmer (*Nannothemis bella*) (one).
- One record classified as "Species at Risk" pertaining to Ebony boghaunter (W*illiamsonia fletcheri*).

The database contains no records of butterflies or Odonates within a 40 km radius of the Study Area.

The ACCDC report (2023b) contains records of 53 unique butterfly and Odonate SOCI within a 100 km radius of the Study Area (Table 7.50). None of the identified SOCI have records within the Study Area.

Table 7.50: Unique Butterfly and Odonate Species Recorded within a 100 km Radius of the Study Area

Common Name	*Scientific Name*	COSEWIC Status	*SARA* Status	*ESA* Status	NS S-Rank
Acadian hairstreak	*Satyrium acadica*	---	---	---	S2
Aphrodite fritillary	*Argynnis aphrodite*	---	---	---	S3S4
Arctic fritillary	*Boloria chariclea*	---	---	---	S1S2
Banded hairstreak	*Satyrium calanus*	---	---	---	S3
Black meadowhawk	*Sympetrum danae*	---	---	---	S3S4
Blue dasher	*Pachydiplax longipennis*	---	---	---	S1
Bog elfin	*Callophrys lanoraieensis*	---	---	---	S3
Broad-tailed shadowdragon	*Neurocordulia michaeli*	---	---	---	S2
Brook snaketail	*Ophiogomphus aspersus*	---	---	---	S3

Common Name	*Scientific Name*	COSEWIC Status	*SARA* Status	*ESA* Status	NS S-Rank
Compton tortoiseshell	*Nymphalis l-album*	---	---	---	S2S3
Delicate emerald	*Somatochlora franklini*	---	---	---	S3S4
Early hairstreak	*Erora laeta*	---	---	---	S1
Eastern comma	*Polygonia comma*	---	---	---	S1?
Eastern red damsel	*Amphiagrion saucium*	---	---	---	S3S4
Eastern tailed blue	*Cupido comyntas*	---	---	---	S3S4
Ebony boghaunter	*Williamsonia fletcheri*	---	---	---	S2S3
Elfin skimmer	*Nannothemis bella*	---	---	---	S3S4
Forcipate emerald	*Somatochlora forcipata*	---	---	---	S3
Gray hairstreak	*Strymon melinus*	---	---	---	S3
Green comma	*Polygonia faunus*	---	---	---	S3S4
Greenish blue	*Icaricia saepiolus*	---	---	---	SH
Harlequin darner	*Gomphaeschna furcillata*	---	---	---	S3S4
Harpoon clubtail	*Phanogomphus descriptus*	---	---	---	S3
Hoary comma	*Polygonia gracilis*	---	---	---	SH
Jutta arctic	*Oeneis jutta*	---	---	---	S3S4
Kennedy's emerald	*Somatochlora kennedyi*	---	---	---	S2S3
Lance-tipped darner	*Aeshna constricta*	---	---	---	S3S4
Maine snaketail	*Ophiogomphus mainensis*	---	---	---	S3
Maritime copper	*Tharsalea dospassosi*	---	---	---	S2
Milbert's tortoise shell	*Aglais milberti milberti*	---	---	---	S2S3
Milbert's tortoiseshell	*Aglais milberti*	---	---	---	S2S3
Monarch	*Danaus plexippus*	Endangered	Special Concern	Endangered	S2?B,S3M
Monarch	*Danaus plexippus plexippus*	Endangered	Special Concern	---	S2?B,S3M
Mottled darner	*Aeshna clepsydra*	---	---	---	S3S4
Northern cloudywing	*Cecropterus pylades*	---	---	---	S3S4
Ocellated darner	*Boyeria grafiana*	---	---	---	S3S4
Pepper and salt skipper	*Amblyscirtes hegon*	---	---	---	S3S4
Prince baskettail	*Epitheca princeps*	---	---	---	S3
Quebec emerald	*Somatochlora brevicincta*	---	---	---	S1S2
Question mark	*Polygonia interrogationis*	---	---	---	S3B
Rusty snaketail	*Ophiogomphus rupinsulensis*	---	---	---	S3
Satyr comma	*Polygonia satyrus*	---	---	---	S1?
Seaside dragonlet	*Erythrodiplax berenice*	---	---	---	S3S4
Skillet clubtail	*Gomphurus ventricosus*	Special Concern	Endangered	---	SH
Southern pygmy clubtail	*Lanthus vernalis*	---	---	---	S2S3

Common Name	*Scientific Name*	COSEWIC Status	*SARA* Status	*ESA* Status	NS S-Rank
Spot-winged glider	*Pantala hymenaea*	---	---	---	S2?B
Taiga bluet	*Coenagrion resolutum*	---	---	---	S2
Two-spotted Skipper	*Euphyes bimacula*	---	---	---	S1S2
Vernal bluet	*Enallagma vernale*	---	---	---	S3
Vesper bluet	*Enallagma vesperum*	---	---	---	S3S4
Violaceous globetail	*Sphaerophoria pyrrhina*	---	---	---	SH
Williamson's emerald	*Somatochlora williamsoni*	---	---	---	S2S3
Zebra clubtail	*Stylurus scudderi*	---	---	---	S2S3

Source: (ACCDC, 2023b)

7.4.3.4 Field Assessment Methodology

Mammals

Winter tracking and pellet group inventory (PGI) surveys were conducted by two-person survey teams with Stantec Consulting Ltd. to assess the presence and distribution of mammals across the Study Area (Stantec summary report presented in Appendix L). While the surveys were designed with a particular focus on Mainland moose, the methods employed sufficiently captured evidence of other mammal species within the Study Area (Drawing 7.20 and Drawing 7.21). The goal of the surveys was to cover relevant habitat types present across the Study Area, including roadways, wetlands, various forested habitats, riparian areas along watercourses and waterbodies, and previously disturbed areas (i.e., clearcuts), to assess the potential for mammals and/or their habitats to interact with the Project.

The methods for winter track surveys were developed based on the Recovery Plan for the Moose in Mainland Nova Scotia (NSNRR, 2021f) and the Protocol for Mainland Moose Snow Tracking Survey 2022 Update (NSNRR, 2022b). The Recovery Plan for the Moose in Mainland Nova Scotia defines the parameters for various types of mainland moose core habitat in Nova Scotia, including winter cover and winter forage. Winter cover is defined as mature softwood and softwood-dominated mixed wood stands with:

- A crown closure greater than or equal to 60%.
- Height of greater than or equal to 12 m (except in areas where the depth to water table is less than or equal to 0.5 m, where height can be greater than or equal to 8 m).
- A minimum size of 5 ha.

Winter forage is defined as habitat within 200 m of winter cover that:

- Meets the criteria of winter cover, but with no minimum size.
- Is regenerating (i.e., 3 to 15 years old) hardwood, mixed wood, and conifer stands.

Provincial forest cover (NSNRR, 2021c), development spatial data (NSNRR, 2016), and depth to water table spatial data (NSNRR, 2021d) were used in a selection process completed within ArcMap to identify potential winter cover habitat for Mainland moose within 2 km of the study area available at the time of survey planning (which differed slightly from the current Study Area). Following this, winter forage habitat was selected, and then limited to a buffer of 200 m around previously selected winter cover habitat polygons. More recent aerial imagery was reviewed to identify any perceived changes to winter cover (e.g., recent clearcuts within habitat listed as mature in forest cover data).

Transects of a minimum of 1 km in length were placed where they would occur primarily within identified potential winter cover and/or winter foraging habitat, within the study area and within the adjacent 2 km buffer (typically, within the surrounding Assessment Area) (Drawing 7.20). Although the Protocol for Mainland Moose Snow Track Survey 2022 Update document indicates transect placement would be optimal if extending outward in a radial fashion from a central point, preference was given to transects that contained more than 50% identified winter cover and/or winter forage habitat and were also reasonably accessible from roads that are likely to be accessible in a standard truck during the winter. Land ownership was also considered. In total, eight transects were identified within the Study Area.

Winter wildlife tracking surveys were completed during three events between January 23 and March 10, 2022. Survey dates were within 24 to 48 hours following a snowfall and were completed on clear days with no precipitation. This timeline allowed sufficient time for animals to leave their tracks, and limited opportunities for tracks to deteriorate or disappear as a result of excessive snowfall, melting, or rain. Care was also taken to ensure surveys were not completed during rain or snow events. Recent, intact tracks in fresh snow allow for the most accurate track identification. Each transect was surveyed three times within the winter season, which was done to increase the probability of encountering moose tracks crossing the transect.

During the winter track surveys, survey teams walked or snowshoed the length of the transect and assessed the environment along the transects for evidence of wildlife. The survey teams used ArcGIS Field Maps software and Garmin Glo Bluetooth Global Positioning System (GPS) receivers to follow the planned transects and record the locations of observations. Observations of interest were photographed and georeferenced using Field Maps.

PGI methods were developed based on the Recovery Plan for the Moose in Mainland Nova Scotia (NSNRR, 2021f) and the Pellet Group Inventory Data Collection Protocol (NSNRR, 2022c). Methods, as provided by NSNRR, indicated that PGI transects should be developed similarly to winter track surveys, and that surveys are to be completed after snow melt but before herbaceous ground vegetation growth begins.

Transects of a minimum of 1 km in length were placed where they would occur primarily within potential winter cover and/or winter foraging habitat, within the Study Area (Drawing 7.20). Although the PGI Data Collection Protocol document indicates transect placement would be optimal if extending outward in a radial fashion from a central point, preference was given to transects that contained more than 50% identified winter cover and/or winter forage habitat and were also reasonably accessible from site roads. As PGI transects are not meant to resurvey winter track survey transects, an effort was made to establish PGI transects in areas of the sites that were not previously surveyed during the winter track surveys. The PGI transects therefore typically pass through less identified winter cover and/or winter forage habitat, as prime areas were previously targeted for winter track surveys. In total, fourteen transects were identified, including thirteen within the Study Area and one located outside of the Study Area in the surrounding area.

PGI surveys were completed between May 2 and 17, 2022, following the spring snow melt. Survey teams walked the length of the transects and assessed the environment along the transects for evidence of wildlife. The survey teams used ArcGIS Field Maps software and Garmin Glo Bluetooth GPS receivers to follow the planned transects and record the locations of observations. Observations of interest were photographed and georeferenced within Field Maps.

Herpetofauna

CBCL biologists evaluated the Study Area for the presence of suitable turtle habitat features within the identified watercourses intersecting the Project Area between August and December 2022. Turtle habitat assessments were conducted during the detailed watercourse assessments, and generally covered a minimum of 50 m upstream and downstream of a planned crossing. In some instances, these distances varied, depending on access and watercourse conditions.

To assess the presence and quality of turtle habitat, a number of environmental conditions and stream characteristics were recorded (Appendix E). CBCL evaluated habitat features of the watercourse and surrounding riparian area to determine habitat quality in terms of summer habitat, overwintering sites, nesting sites, and foraging potential; the study evaluated suitable habitats for target turtle species such as Wood turtle, Snapping turtle, and Eastern painted turtle (*Chrysemys picta picta*).

Additional watercourse assessment work was conducted by Strum environmental scientists and technicians between July and September 2023. Observations of herpetofauna habitat or evidence of species presence was noted throughout all surveys. Because turtle habitat surveys were completed by CBCL outside of the appropriate season to detect Wood turtles, survey methods as recommended by NSNRR will be employed in Spring 2024 to further understand the presence of turtle SOCI within the Study Area. Habitat that will be targeted for surveys will include areas 200 m upstream and downstream of any proposed upgraded infrastructure on watercourses, specifically within the watercourses determined to be potential Wood turtle habitat by CBCL.

Transect lines will be walked at a width of 10 m along both sides of a watercourse and surveyed simultaneously by two field biologists. The transect line will serve as a center point, and surveyors will scan 10 m on either side for a total search area of 20 m on both sides of the watercourse. Search efforts will focus on bank areas with high sun exposure or other adequate basking areas such as instream rocks or logs. Turtles may also be found under or near deadfall, grasses, leaf litter, or woody shrubs, particularly alder trees, and so these areas will be searched with greater intensity as they may be more inconspicuous.

Surveys will occur in late spring when the ambient air temperature is higher than the water temperature (at least 10°C) but not higher than 25°C. Any observation of one of the four native turtles to Nova Scotia, snakes, or salamanders will be recorded and georeferenced in the field.

Butterfly and Odonates

Targeted surveys for butterfly and Odonates species were not conducted; however, any observations of butterfly and Odonates SOCI during other field surveys were documented.

7.4.3.5 Field Assessment Results

Mammals

Six species were identified during field assessments conducted within the Study Area by Stantec Consulting Ltd. (Table 7.51; Appendix L for detailed results). Because of the ecological vulnerability of Mainland moose, the locations of all findings have been redacted from Appendix L. Location data for Mainland moose has been provided directly to NSNRR.

Table 7.51: Summary Results of the Mammal Field Assessments

Common Name	Scientific Name	COSEWIC Status	*SARA* Status	*ESA* Status	NS S-Rank
American black bear	*Ursus americanus*	Not at Risk	---	---	S5
American porcupine	*Erethizon dorsatum*	---	---	---	S5
Eastern coyote	*Canis latrans*	---	---	---	S5
Fisher	*Pekania pennanti*	---	---	---	S3
Mainland moose	*Alces alces americana*	---	---	Endangered	S1
White-tailed deer	*Odocoileus virginianus*	---	---	---	S5

Source: Species Ranks (ACCDC, 2023a)

Eight instances of moose evidence, including pellets, browse, and tracks, were observed by Strum staff during 2023 field surveys (photo log provided in Appendix M).

Terrestrial mammals that have been recorded within a 100 km radius of the Study Area were screened against the criteria outlined in the Guide to Addressing Wildlife Species and Habitat in an EA Registration Document (NSECC, 2009) to develop the following list of priority species:

- Mainland moose – “Endangered” (*ESA), “*S1” (S-Rank)
- Fisher (*Pekania pennanti*) – “S3” (S-Rank)

Mainland moose are a SOCI listed as “Endangered” under the *ESA* with a subnational ranking of “S1” (highest priority) (ACCDC, 2023a). In 2021, NSNRR published a recovery plan for Moose in mainland Nova Scotia, thereby assigning the common name ‘Mainland moose’. Threats to Mainland moose include habitat loss and fragmentation, particularly resulting from industrial activities; and loss of habitat connectivity due to the increased placement and density of roads (NSNRR, 2021f). The Study Area has previously been and continues to be subject to the abovementioned threats as a result of historical and current land-uses, including forestry activities and recreation. Renewable energy projects were described as a medium level threat, as the nature of wind projects usually requires the construction or expansion of road networks and loss of forested habitat.
Evidence of Mainland moose was observed by Stantec Consulting Ltd. in the Study Area during PGI surveys conducted in May 2022, as well as during another field program near access roads in April and September 2022. The signs observed included tracks and pellets. The mid-April observation of tracks appeared to be of an adult cow and one or two calves. Notably, no moose observations were made during the winter snow tracking surveys conducted between January and March 2022. Both Mainland moose tracks and pellets were observed within the Study Area on three of the transects during the PGI surveys.

Evidence of Mainland moose was also observed by Strum staff during wetland and watercourse surveys during July and August 2023, and during the MEKS site visit in September 2023. Signs observed included both old and fresh pellets, tracks, and a suspected lay and browse area featuring depressed moss in a bog and a large patch of sheared cinnamon fern.

Given the ubiquity of moose observations made, it appears that the Study Area supports a population of Mainland moose for at least part of the year. Based on results to date, moose seem to be most concentrated in the northern half of the Study Area. Mid-aged to mature forest stands in the Assessment Area may provide escape cover and relief from deep snows and hot summer temperatures, while regenerating cutovers provides suitable forage. An abundance of wetland habitat in the Study Area also provides important and suitable habitat, specifically large bogs. Moose tracks were also observed along gravel roads and overgrown logging trails, providing linear features for easy passage across the Study Area. The absence of no sign of Mainland moose within the Assessment Area in winter 2022 may indicate that moose are less likely to use the Study Area during the winter, possibly owing to the deep snow cover that accumulates during winter in this relatively high elevation area.

Fishers prefers dense, mature to old-growth forests with continuous overhead cover (Allen, 1983). Generally considered a forest-interior species (OMNR, 2000), Fishers require large tracts of well-connected habitat (Meyer, 2007). Fishers are distributed throughout mainland Nova Scotia, and trapping data suggests the population is concentrated in Cumberland, Colchester, and Pictou counties. A total of 143 Fishers have been harvested from Colchester

County since 2010, representing 10.64% of the provincial total during that time (NSNRR, 2022h). Fisher tracks were observed by Stantec Consulting Ltd. during winter tracking surveys along transect N7 (Appendix L). Based on aerial imagery and land cover designations, this transect travels through a softwood stand bisected by a large harvest patch.

Herpetofauna

Ten watercourses within the Study Area were characterized as potentially suitable for summer forage and basking habitat for Wood turtles by CBCL biologists (Appendix E). Additionally, riparian habitat associated with these watercourses were noted as potentially suitable for Wood turtle foraging. Due to small gravel sidebars, these watercourses were determined to not support nesting habitat. With the majority of these watercourses being generally quite shallow, they were also deemed to be unlikely to support hibernation. No Wood turtles were observed during field surveys.

None of the watercourses intersecting the Study Area were deemed by CBCL biologists to be suitable habitat for summer, winter hibernation, or forage for Eastern painted turtles or Snapping turtles (Appendix E). Although suitable nesting habitat for either species may occur along gravel roads or other disturbed areas within the Study Area, without suitable summer habitat to support adult turtles, it is unlikely that any turtles are utilizing this habitat.

No Snapping turtles were observed within the Study Area, and no watercourses were deemed suitable for foraging or overwintering due to their size and substrate type (Appendix E).

Based on desktop results and field surveys, the following herpetofauna species was identified as a priority species and is discussed in further detail:

- Wood turtle – “Threatened” (*SARA*, *ESA*, and COSEWIC), “S2” (ACCDC).

Wood turtles require three key habitat components: a watercourse, sandy substrate for nesting, and a forested area for thermal relief during the summer months (MacGregor & Elderkin, 2003). Ideal streams have a clear, moderate flow, a hard bottom composed of sand or gravel, and are 2 m to 30 m wide (MacGregor & Elderkin, 2003).

The species is found throughout the province but seems to be most abundant in central Nova Scotia (MacGregor & Elderkin 2003). The ACCDC Data Report (2022b) indicated that the closest observation of this species to the center of the Study Area was 12.9 ± 1.0 km. The EA conducted for the Nuttby Mountain Wind Farm, a pre-existing wind farm adjacent to the Project, indicated that no Wood turtles were identified during field surveys (CBCL Limited, 2008). During 2023 field surveys, no Wood turtles were observed within the Study Area; however, ten watercourses that may provide suitable summering habitat were identified. In-season turtle surveys will be conducted in Spring 2024 to confirm whether turtles are found within the Assessment Area. Mitigation measures are designed to protect Wood turtles, regardless of any turtles being found.

Butterflies and Odonates
There were no observances of butterfly and Odonates SOCI during the field assessments within the Study Area. Based on the results of the field and desktop assessments no priority species were identified.

7.4.3.6 Effects Assessment

Project-Terrestrial Fauna Interactions
Project activities, primarily those that involve earth moving or vegetation removal, have the potential to impact terrestrial fauna (Table 7.52). These activities could result in habitat removal, alterations to wildlife corridors, and reductions in food availability. Other Project related activities, including during construction and operation, may impact terrestrial fauna behaviours, such as increased traffic and noise.

Table 7.52: Potential Project-Terrestrial Fauna Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Terrestrial Fauna	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Assessment Boundaries
For the purposes of this assessment, the LAA for terrestrial fauna includes the Assessment Area. The RAA for terrestrial fauna includes surrounding regions that may fall within the habitat range of each species, bounded by pre-existing infrastructure and roads or other large crossing areas (Drawing 7.21).

Assessment Criteria
Assessment criteria provided in Section 4.6 apply for terrestrial fauna. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of fauna habitat or impact to fauna behaviours expected.
- Low – small loss of habitat supporting fauna, but no impacts to fauna behaviours expected.
- Moderate – moderate loss of fauna habitat or moderate impacts to fauna behaviours, but these impacts will only be experienced by individuals rather than entire

populations.
- High – high loss of fauna habitat or high impact to fauna behaviours on a population scale.

Effects

Mainland Moose

Habitat Loss

The Mainland Moose Recovery Plan identifies three localized groups of Mainland moose within the province, one of which being the Cumberland/Colchester group (NSNRR, 2021f). The Recovery Plan has defined Core Habitat of each group through habitat suitability modeling and found that the Cumberland/Colchester group requires an area of approximately 5,300 km^2 of Core Habitat to meet recovery objectives. This area overlaps with the Study Area and is approximately 170 km^2 more than the current amount of modelled Core Habitat in the Recovery Plan. Mainland moose Core Habitat is dependent on a number of biophysical parameters to satisfy different habitat requirements, including but not limited to:

- Summer foraging area composed of either regenerating forest that is within close proximity of winter or summer cover, or mature mixed or hardwood stands.
- Winter foraging area composed of either regenerating forest; mixed or hardwood forest within close proximity of winter cover; or mixed wood forest dominated by softwood trees.
- Winter cover area composed of mature softwood stands or mature mixed wood stands dominated by softwood trees.
- Summer cover area composed of mature hardwood, mixed wood, or softwood stands.
- Calving area with open water or wetlands in close proximity to both foraging and cover areas.

Road construction is defined as one of the main activities likely to result in destruction of important moose habitat (NSNRR, 2021f). Renewable energy is included as a potential threat to Mainland moose in the Recovery Plan due to potential habitat loss, conversion, and degradation caused by vegetation clearing for infrastructure associated with wind farms. Current and historical land-use in the Study Area (i.e., forestry activities and recreational off-road vehicle use) has altered the landscape within the Study Area to its current state, where road networks are abundant and forested habitat has been altered and degraded. The Project Area will utilize these pre-existing disturbed areas to the greatest extent possible to reduce habitat loss.

Habitat loss and reduced habitat quality may result in behavioural changes, including from reduced opportunities for thermoregulation, loss of overwintering areas, loss of adequate sources of food, reduced space for mating, and reduced protection for calves.

A Mainland moose habitat analysis was developed to assess the quality of Mainland moose habitat within the RAA, and the specific results of this analysis will be provided directly to NSNRR for review. Of the 11,497 ha of habitat determined to be suitable for Mainland moose within the RAA, only 417 ha lie within the Assessment Area (3.6%). Furthermore, approximately 19 km of existing roads have been incorporated into the Project design, while 16 km of new road construction will be required. The creation of wider road ROWs will increase the space for early successional vegetation, creating new foraging opportunities for moose adjacent to this built infrastructure that may eventually become suitable habitat.

The Mainland moose habitat analysis indicates that the majority of suitable habitat within the RAA is considered high quality. A total of 85.7% of Mainland moose sightings observed during field surveys occurred within habitat deemed suitable through this Mainland moose habitat analysis. This overlap indicates the relative accuracy of this model in identifying suitable habitat on site. The average habitat score within the RAA is 72, while the average score within the LAA is 71. The Project Area will therefore be located in areas of statistically average quality for moose habitat, and the Project design has maximized the use of pre-existing roads, thereby minimizing habitat loss within areas of particularly high-quality habitat. Additionally, half of the turbines are located in previously disturbed areas, thus minimizing new habitat loss. Therefore, the availability of and connectivity to alternative areas of high-quality habitat will remain high. Furthermore, following turbine construction, vegetation around the turbine laydown will be allowed to naturally regenerate to an early successional stage, while maintaining clearance from wind turbine blades.

Although some area considered to be high quality Mainland moose habitat will require alteration or removal to construct the Project, the design has maximized the use of existing infrastructure and disturbed areas such that the overall area of habitat loss is small and the direct impacts to moose habitat are expected to be low.

Habitat Fragmentation

The Recovery Plan identifies habitat fragmentation as another key threat to Mainland moose (NSNRR, 2021f). Habitat fragmentation is directly related to habitat connectivity which is a major concern for the longevity of Mainland moose in Nova Scotia, where communities are already highly localized to three areas of the province. Road placement and road density are the main drivers of reduced habitat connectivity. Wildlife corridors are often cited as a mitigation strategy for improving habitat connectivity; however, effective maintenance of these corridors requires an understanding of natural wildlife corridors and Mainland moose movement patterns on the landscape.

The majority of the Project Area will utilize pre-existing roads, thus minimizing habitat fragmentation with 16 km of new roads needing to be constructed (while the remaining 19 km of roadways will utilize existing road). The length of roads will increase in the Project Area (from 19 km to 35 km), and the Project may have a small interaction with habitat fragmentation in the RAA. Additionally, the size of habitat gaps may increase for roads requiring widening. Areas requiring upgrading to facilitate developments (e.g., the widening of a turn to accommodate a radius sufficient for turbine blade transport) are likely to see more impact, whereas areas with roadways large enough to accommodate forestry equipment will remain as true to their current state as Project developments will allow.

There is an abundance of high-quality moose habitat (i.e., habitat with a mean distance of less than 180 m between mixed wood forest and wetland) that will remain unfragmented due to the limited construction of new roads. The Mainland moose habitat analysis also identifies high quality habitat surrounding most pre-existing roads. During field surveys, Mainland moose were observed on the eastern and western sides of both pre-existing main roadways running north-south. These findings indicate that despite the presence of linear gaps in high quality habitat, connectivity between habitat patches has persisted and moose activity is taking place across the Study Area. From the results of field surveys and desktop analyses, the magnitude in which habitat fragmentation will affect Mainland moose within the LAA and RAA is low.

Disruption of Life History

Direct effects to Mainland moose from wind farms may include sensory disturbance and stress from anthropogenic light sources or human presence resulting in behavioural changes. Mitigation strategies to avoid direct impacts resulting in behavioural changes during sensitive windows and in important habitat are described below. Indirect effects may include removal of adequate calving habitat through conversion of the landscape to support new project-related infrastructure and reducing areas with enough seclusion or cover to protect calves from predators. Mainland moose breeding season takes place between September and October, with calving generally occurring in late May to early June, where one to two calves are born. Cows may require specific habitat types for calving, such as secluded islands, peninsulas, and shorelines. Seclusion is an important factor for protecting calves from predators. The cow and calf/calves remain together for one year until the calf/calves become mature enough for independence (NSNRR, 2021f).

Evidence of age diversity was noted within the Study Area by Stantec Consulting Ltd. (Appendix L). Indirect effects to moose reproduction may include removal of adequate calving habitat through conversion of the landscape to support new Project-related infrastructure and reducing areas with enough seclusion or cover to protect calves from predators. Specific habitat types required for calving, however, were not observed within the Assessment Area. An analysis of Mainland moose habitat quality within the RAA has shown that large areas of suitable habitat exist around the Assessment Area that will not be directly impacted by the Project. Furthermore, the Study Area has already become fragmented by previous human activity, mainly road construction, yet evidence of reproduction was still found within the Study Area. Mitigation measures will be implemented to minimize impacts; however, the amount of high quality habitat remaining within the RAA and the extent of pre-existing linear features across the landscape indicate that the magnitude of Project-related impacts to Mainland moose life history will be low.

Disease

Problematic native species have been identified as a pervasive threat to Mainland moose due to their potential to spread debilitating disease. Specifically, White-tailed deer are hosts for Brainworm (*Parelaphostrongylus tenuis*) and Winter tick (*Dermacentor albipictus*), both of which cause mortality in moose and are thought to be regulators of population abundance and distribution (NSNRR, 2021f). A possible concern associated with developments is their potential to cause indirect effects on Mainland moose by increasing access to the site by white-tailed deer and therefore, increasing the chances of disease spreading to Mainland moose.

Although there is a large, known deer over-wintering area directly south of the Study Area, there are already multiple roads connecting this overwintering area to the Project Area and it is unlikely that the new and upgraded roads will increase access for White-tailed deer. As such, effects to Mainland moose from disease are expected to be negligible.

Poaching

Poaching has been identified as a potential threat facing Mainland moose in the Recovery Plan (NSNRR, 2021f). Increased human access may increase the risk of poaching for rare, sought-after animals. The Project Area is already highly accessible to the public, including local hunters and recreational users. Due to the pre-existing access to the Study Area and no known issues associated with poaching to date, poaching is not expected to affect Mainland moose within the LAA or RAA as a result of this Project. Furthermore, increased presence of staff within the Project may act as a deterrent to moose poaching.

Climate Change

Climate change has been identified as a potential threat facing Mainland moose in the Recovery Plan; however, the details of how moose will be impacted by climate change are not yet well understood (NSNRR, 2021f). The development of windfarms is one of the province’s strategies to transition to renewable energy to reduce provincial emissions. It is expected that this Project will have a net positive impact on climate change (for further details see Section 7.1.2), thus this potential threat is not expected to negatively affect Mainland moose within the LAA or RAA.

Fisher

Habitat Loss

Fishers show preference for a variety of habitat types depending on location; however, they generally prefer dense, mature forests with continuous canopy cover. Generally considered to be forest interior species, Fishers require large tracts of intact forest and tend to prefer hardwood stands for their superior prey availability compared to softwood stands. Other important factors associated with Fisher habitat include the presence of slopes, low elevation, nearby water or riparian areas, and shallow snow cover. Denning habitat is often restricted to downed woody debris, tree snags, or standing living trees (Meyer, 2007).

Within the LAA, a number of steep slopes leading to brook valleys can be found, with a large amount of large woody debris suitable for denning. Deep snow atop the slopes may, however, be excluding fishers from using the extent of the Study Area. A desktop analysis places the transect on which the Fisher tracks were found in a softwood forest surrounded by pre-existing roads and bisected by a harvest patch. Nearby hardwood and mixed wood stands will remain largely unaffected by the Project, particularly old-growth forests which have been avoided completely.

Habitat Fragmentation

Fishers have large home ranges, and are capable of moving long distances; however, they may exhibit sensitivity to habitat fragmentation. When suitable habitat is bisected by a large tract (10 km to 20 km) of unsuitable habitat, Fishers may be unable to cross this distance and therefore be excluded from this neighbouring habitat. Unsuitable habitat generally refers to open or clear-cut forests which are avoided by Fishers. The degree of habitat connectivity may also influence genetic dispersal, as large distances between populations may reduce chances of dispersal (Meyer, 2007). Because the Project Area will maximize the use of pre-existing roads, and no intact areas will be bisected by large tracts of unsuitable habitat, effects of habitat fragmentation for fishers resulting from the Project are expected to be low.

General Effects to Terrestrial Mammals

Road Traffic

The Project will result in increased road traffic within the LAA. Both small and large terrestrial mammals are known to use the roadways within the Study Area, as evidenced by winter tracking/pellet survey results. An increase in road traffic will increase chances of collision and mortality to those animals using the roadways. The majority of roads within the Study Area are currently used for recreation by ATV, snowmobile, and dirt bike users; by technicians to access the Nuttby Mountain wind farm; and for forestry activities. Outside of the construction phase, the Project will only require a small number of technicians to access the site to perform regular maintenance/equipment checks. Considering the pre-existing traffic load and the minimal traffic to be associated with the Project, road traffic is expected to have a negligible to low effect on terrestrial mammals in the LAA.

Habitat Loss and Fragmentation

Other non-priority species were observed within the Study Area and make use of various habitat types across this area. The footprint of the Project, particularly the area that will impact intact habitat, is relatively small compared to other developments in the natural resource sector. Roughly 16 km of new road will be constructed within the Study Area, and upgrades to pre-existing roads will be limited to removing small areas of habitat in areas that have already been disturbed. Habitat alteration may result in the removal of refugia which may increase predation risks and disrupts the ecological balance within a community. Patterns of movement/migration across the landscape may also be disrupted by habitat alteration and fragmentation. Evidence of animals using these roads through wildlife surveys indicate that the creation of additional roads may in fact be creating usable habitat. These linear features allow for easier access across the Study Area, and terrestrial fauna will continue to use these roads post-construction. Direct habitat loss and fragmentation within the LAA will therefore be small and can be mitigated through various strategies to reduce the effects of habitat loss.

Sensory Disturbance

Reproduction and survival strategies of terrestrial mammals may be directly or indirectly impacted by sensory disturbances caused by Project construction and operation. Many species have sensitive windows for breeding and birthing, and any small disruption to these activities may reduce reproductive success in the population. Sensory disruptions may result from sound/vibration or excess light. Lovich and Ennen (2013) stress the importance of turbine siting relative to the needs of wildlife to minimize effects. The iterative Project design process has prioritized avoidance and minimization of interactions with important wildlife habitat such as wetlands and mature forest, which will minimize sensory disturbances in these areas.

Project-related noise may impact habitat use, patterns of activity, stress levels, immune response, reproductive success, risk of predation, communication with conspecifics and antipredator predator behaviours, and hearing damage (Rabin et al., 2006; Lovich & Ennen, 2013). The extent that noise associated with wind farms may impact terrestrial mammals is not well studied, and results have been inconclusive thus far (Lovich & Ennen, 2013). The Study Area is, however, already subject to noise from forestry activities and recreation vehicles (snowmobiles, ATVs) and despite the pre-existing noise, different mammal species were still observed across the Study Area so impacts from sensory disruptions caused by the Project within the LAA are anticipated to be low.

Herpetofauna

Road Traffic

Increased road traffic may affect herpetofauna within the LAA due to the potential for an increase in risk of traffic collisions with herpetofauna species. Turtles (if present), salamanders, and snakes may cross roads daily in search of food, or seasonally during migration to find nesting habitat or to escape uninhabitable climatic conditions (Wills, 2021). As stated previously, the pre-existing traffic load and the minimal traffic to be associated with the Project both indicate that road traffic is not expected to have a significant effect on terrestrial herpetofauna in the LAA.

Habitat Loss

Terrestrial habitat utilized by herpetofauna includes riparian areas along wetlands and watercourses, forested areas near watercourses, and rocky or gravelly areas such as roadsides. These different habitat types support different biological needs of species, and relate directly to life history strategies. The Project layout aims to reduce impacts to intact habitat and has been specifically designed to minimize interactions with riparian areas and intact forest. The majority of watercourses intersecting the Assessment Area were not found to support turtle habitat, and none of the assessed watercourses were found to support hibernation or nesting habitat. No new roads or turbine pads will cross any of the watercourses determined to potentially support turtle habitat. Furthermore, with 16 km of new road being constructed, a small area of new habitat may be created in the form of gravel roadsides and this new habitat may serve as a potential benefit to herpetofauna species. Because of the lack of quality turtle habitat and because no herpetofauna SOCI were identified within the Assessment Area during desktop review and field surveys, no direct impacts resulting from habitat loss within the LAA are expected.

Habitat Fragmentation

Terrestrial herpetofauna utilize the terrestrial environment to move across the landscape, particularly between wetlands and watercourses. The alteration of these habitats and conversion of intact forest to roads may result in a fragmented landscape, preventing natural patterns of movement across the landscape. Habitat fragmentation has been minimized through the Project design, which prioritized the use of pre-existing roads or otherwise disturbed habitats. Additionally, through desktop and field assessments, there were no aquatic habitats found to support hibernation or nesting herpetofauna SOCI within the Study Area. Therefore, minimal direct effects to herpetofauna related to habitat fragmentation are expected within the LAA.

Disruption of Life History

Sensitive windows for herpetofauna may relate to migration or nesting periods, and interference with these animals' activities during these windows may disrupt their natural life history. Interference may be both temporal and spatial; Project related activities occurring during sensitive windows may impact migratory or breeding behaviours, and habitat removal or fragmentation may create a physical barrier to herpetofauna species from reaching important habitat. Limited impacts to fragmentation and life history are expected due to the small Project footprint and minimized interactions with important habitat features such as wetlands and watercourses.

Sensory Disturbance

Given the pre-existing traffic load and the minimal traffic to be associated with the Project, sound and light impacts are expected to be low.

Butterflies and Odonates

Turbine Collision-Induced Mortality

Swarming and migrating insects, including butterflies and Odonates, are susceptible to mortality from collisions with wind turbines. There are a number of hypotheses as to whether, or why, these insects are attracted to wind turbines (Long et al., 2011; Rydell et al., 2010; Jansson et al., 2020). Questions remain in the literature concerning how this potential attraction affects mortality rates; whether insect fatalities at wind turbines are contributing to population declines; and how these fatalities are impacting ecological functions (Voigt, 2021). No significant effects to butterfly and Odonate SOCI are expected as a result of this Project based on current insect population and ecology research and a lack of confirmed butterfly and Odonate SOCI within the Study Area.

Mitigation Measures

To address the abovementioned effects to terrestrial fauna, the following mitigation measures will be implemented:

Habitat Loss

- Minimize overall area to be cleared by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
- Continue to review habitat modelling results, field survey results, and guidance from NSNRR through the detail design phase.
    - Conduct in-season Wood turtle surveys to further understand how/if turtles are using the Study Area.
- Revegetate roadsides and cleared areas to minimize lost habitat as much as possible.
    - Reclaim small roads leading to turbines to minimize long-lasting effects of habitat loss.

Habitat Fragmentation

- Minimize fragmentation and habitat isolation by utilizing pre-existing roads and previously altered areas during the design phase.
- Support connectivity by maintaining vegetated buffers around wetlands and watercourses, where possible.
- Revegetate as much cleared area as possible to limit the effects of fragmentation.

Road Traffic

- Design the Project footprint to minimize road density and utilize pre-existing roads to the greatest extent possible.
- Install traffic signs to alert road users of speed limits and the presence of wildlife in the area.
    - Inform all Project-related staff working on the site of dangers to wildlife and create awareness around wildlife hotspots on the site.
- Minimize Project-related traffic to reduce chances of wildlife collisions and traffic-related stress to wildlife.
- Impose restrictions to site access if deemed necessary due to a substantial increase in wildlife collisions and mortality.

Disease

- Use seed mixes that do not contain clover to avoid attracting deer (which carry ticks) to the area when revegetating road ROWs and other cleared areas requiring revegetation.

Disruption of Life History

- Avoid removal of vegetation/habitat alteration in key habitat areas during sensitive windows for priority species, where possible, including:
    - Mainland moose – late May to early June (birthing season) and September to

    - October (breeding season)
    - Fisher – March to April
    - Wood turtle – April to mid-October
- Minimize loss of important habitat required by priority species for reproduction events, including:
    - Mainland moose – wetlands and isolated islands/peninsulas
    - Fisher – large diameter snags, large woody debris, or live standing trees in mature, intact forests
    - Wood turtle – clear, meandering streams with gravel shores, gravel roadsides.
- Minimize overall area to be cleared to maintain refugia and cover for protection from predators.
- Maintain all equipment and machinery on site to reduce noise and vibration emissions associated with malfunctions. Where practical, install vehicles and machinery with noise muffling equipment to limit disturbance.
- Restrict on-site lighting, especially at night, to limit disturbance.
- Prohibit harassment and feeding of wildlife by Project personnel.

Monitoring

A site-specific post-construction Wildlife Management Plan may be developed to inform monitoring activities that will take place to ensure continued protection of known SOCI in the LAA and RAA. The Proponent will seek to collaborate with relevant stakeholders on a broader regional wildlife monitoring and management plans, including the developers of other wind-power projects, local landowners, consultants, subject-area experts, government departments (i.e., NSECC, NSNRR, ECCC, etc.) and the Mi'kmaq of Nova Scotia.

Conclusion

While effects to mammals, herpetofauna, and insects differ, the effects considered to be of greatest concern include habitat loss, habitat fragmentation, and associated disruption of the life history of populations within these groups. Based on this assessment and through the implementation of proposed mitigation and monitoring activities, effects to terrestrial fauna are expected to be of low magnitude and within the RAA. Residual effects are expected to be long-term for habitat loss but negligible for individual SOCI, continuous but differ seasonally as the needs of species change, reversible, and not significant.

7.4.4 Bats

7.4.4.1 Overview

A desktop review and field studies were undertaken to gather information on bat species and associated habitat in the Study Area. Studies were led and primarily undertaken by Stantec Consulting Ltd. Objectives were as follows:

- Assess observations, species diversity and habitat utilization of bats within the Study Area during the active bat periods (spring to fall).

- Assess nearby hibernacula for bat activity.
- Assess for summer roosting activity in the suitable areas of the Study Area (e.g., mature hardwood forests).
- Use the information collected to inform and refine the Project design (i.e., avoid impacts to SOCI and their habitats; see Section 7.3.2.2 for definition of SOCI species).
- Use the information collected to inform mitigation and management practices.

7.4.4.2 Regulatory Context

There are seven species of bats in Nova Scotia, of which three are resident species that reside in the province year-round and four migratory species that overwinter in the southern United States. Resident species include the Little brown myotis (*Myotis lucifugus*), Northern myotis (*Myotis septentrionalis*), and Tri-colored bat (*Perimyotis subflavus*). Migratory species that occur irregularly in Nova Scotia include the Eastern red bat (*Lasiurus borealis*), Hoary bat (*Lasiurus cinereus*), Silver-haired bat (*Lasionycteris noctivagans*), and Big brown bat (*Eptesicus fuscus*).

All three resident species are protected at both the federal and provincial level under *SARA* and the *ESA*. The Little brown myotis, Northern myotis, and Tri-colored bat were added to the *ESA* list as “Endangered” species on July 11, 2013, and were declared as “Endangered” under Schedule 1 of *SARA* on November 26, 2014. In Nova Scotia, a 90% population decline of resident bat species has been attributed to a disease called White-nose syndrome, caused by the fungus *Geomyces destructans*, which was first detected in Canada in 2010. White-nose syndrome is lethal and affects bat species that congregate in caves and abandoned mines during winter hibernation (COSEWIC, 2013).

7.4.4.3 Desktop Review

Databases and online resources referenced as part of this desktop review include:

- Terrestrial Habitat Mapping (Section 7.4.1)
- Locations of Known Bat Hibernacula in NS (Moseley, 2007)
- NS Geoscience Atlas - Abandoned Mine Openings (NSNRR, 2021a)
- NS Significant Species and Habitats Database (NSNRR, 2018a)
- ACCDC Data Report (ACCDC, 2023b)

Terrestrial Habitat Mapping

Terrestrial habitat mapping was used to identify locations of ideal bat foraging and over-day habitat (i.e., day roosts) within the Study Area. Ideal habitats for bat foraging and over-day habitat include lakes, wetlands, watercourses, forest edges, cliffs, rock outcrops, talus slopes, and mature hardwood forests. Identification of ideal habitats from terrestrial mapping was subsequently used to guide field surveys for bats/bat habitat.

There are three habitat features considered to be significant for bats: hibernacula for overwintering, maternity roosts for birthing and raising young, and migratory stopovers for rest periods during spring/fall migration. Hibernacula are overwintering sites that are typically located in abandoned mines or caves and can support hundreds of bats.

Maternity colonies are poorly documented in Nova Scotia, with limited desktop information regarding these sites' location and use (NSNRR, 2020). As a result, information on potential maternity roosts near the Project was supplemented through field studies. As an initial step for estimating the presence of suitable bat roosting habitat within the Assessment Area, a desktop analysis was performed using GIS. Forest inventory data from NSNRR (2021j) were mapped, and areas with mature and old or mixed-aged forest (including coniferous, deciduous and mixedwood forest) with an average diameter of at least 17 cm DBH (i.e., that contain larger trees that may provide roosting habitat) were identified. The data, received from NSNRR in 2022, are based on aerial photography from 2004 to 2012. The data were modified based on more recent satellite imagery to remove areas that have been harvested since the data were interpreted. Forest stands that represented potential bat roosting habitat were identified, and a subset of 18 forest stands were chosen for field verification.

Migration is one of the most poorly understood components of bat biology, at both a regional (<200 km) and long distance (>1,000 km) scale. Migratory stopovers utilized for short term rest or sanctuary are thought to be located on islands or shorelines of large bodies of water and along geographic features such as riparian zones or mountain ranges (McGuire et al., 2011). During terrestrial habitat mapping, riparian and shoreline habitats were identified and used to guide field studies.

Locations of Known Bat Hibernacula

Moseley (2007) provides an overview of the known and recorded bat hibernacula located within Nova Scotia. This research indicates 16 known hibernacula within a 100 km radius of the Study Area.

The review of nearby hibernacula was scoped to a 25 km buffer around the Study Area, as per recommendations outlined in the in the Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSECC, 2021). Within 25 km of the Study Area, there are two known/documented hibernaculum: the Lear Shaft and Hayes Cave.

The Lear Shaft was considered a significant hibernaculum and was suspected to support approximately 50 to 1,000 over-wintering bats (Moseley, 2007). The estimated population occupying this hibernaculum was based primarily off the large underground extent of the Londonderry mine network; this approximation was established prior to White-nose syndrome and, therefore, populations are likely significantly less than originally estimated (Moseley, 2007). Based on the proximity of this hibernaculum to the Project, supplementary information was collected through targeted field surveys (discussed further below).

Hayes Cave is the largest known hibernaculum in Nova Scotia (Moseley, 2007). Up to 6,000 bats have been recorded entering this cave in September where they reside until June (Davis & Browne, 1996). However, preliminary results from 2012 studies suggest that White-nose syndrome has reduced this hibernating population to approximately 250 individuals (M. Elderkin, personal communication, June 13, 2012).

Abandoned Mine Openings

Abandoned mine openings serve as potential roosting or over-wintering habitat for various bat species. There are two recorded abandoned mine openings located in the Study Area: a coal pit and a coal slope. In addition, there are several mine openings documented outside of the Study Area, predominately to the south and southwest (NSNRR, 2021a).

Significant Species and Habitat Records

The NSNRR Significant Species and Habitats database (2018a) indicates 32 features related to bats and/or bat habitats within a 100 km radius of the Study Area. All are classified in the database as "Species at Risk" and relate to Little brown myotis (24) and Northern myotis (six). None of these records are within 10 km of the Study Area.

ACCDC Records

A search of the ACCDC Data Report (2023b) indicated seven bat species of conservation interest recorded within 100 km of the Study Area (Table 7.53).

Table 7.53: Bat Species Recorded within a 100 km Radius of the Study Area

Common Name	Scientific Name	COSEWIC Status	*SARA* Status	*ESA* Status	NS S-Rank
Bat species	*Vespertilionidae sp.*	---	---	---	S1S2
Eastern red bat	*Lasiurus borealis*	Endangered	---	---	SUB,S1M
Hoary bat	*Lasiurus cinereus*	Endangered	---	---	SUB, S1M
Little brown myotis	*Myotis lucifugus*	Endangered	Endangered	Endangered	S1
Northern myotis	*Myotis septentrionalis*	Endangered	Endangered	Endangered	S1
Silver-haired bat	*Lasionycteris noctivagans*	Endangered	---	---	SUB,S1M
Tricolored bat	*Perimyotis subflavus*	Endangered	Endangered	Endangered	S1

Source: (ACCDC, 2023b)

Bat species that have been recorded within a 100 km radius of the Study Area were screened against the criteria outlined in the document Guide to Addressing Wildlife Species and Habitat in an EA Registration Document (NSECC, 2009) to develop a list of priority species. These priority species include:

- Little brown myotis
- Northern myotis
- Tri-colored bat

The Little brown myotis is the most common species in Nova Scotia and is likely ubiquitous in the province (Broders et al., 2003). During the day, the Little brown myotis will roost in buildings, trees, under rocks, in wood piles, and in caves. At night, they will congregate in tight spaces to roost (Fenton & Barclay, 1980). As a non-migratory species, Little brown myotis hibernates from September to early or mid-May in abandoned mines or caves (Fenton & Barclay, 1980; Mosely, 2007).

ACCDC data indicates that the closest Little brown myotis observation is 23.2 ± 0.0 km from the center of the Study Area (ACCDC, 2023b).

The Northern myotis, once considered uncommon throughout Nova Scotia (Moseley, 2007), is likely ubiquitous in the forested regions of the province (Broders et al., 2003). This species is widely distributed in the eastern United States and Canada and is commonly encountered during swarming and hibernation (Caceres & Barclay, 2000). During the day, Northern myotis show a preference for roosting in trees; however, the habitat preferences of females may vary according to their reproductive status (Garroway & Broders, 2008). Females appear to prefer shade tolerant deciduous trees over coniferous trees, whereas males roost alone in coniferous or mixed-stands in mid-decay stages (Broders & Forbes, 2004). Northern myotis are also non-migratory and are typically associated with the Little brown myotis during hibernation, being found in caves or abandoned mines also inhabited by this species (Moseley, 2007). Hibernation of the Northern myotis is thought to begin as early as September and can last until May (Caceres & Barclay, 2000).

ACCDC data indicates that the closest Northern myotis observation is 29.9 ± 0.0 km from the center of the Study Area (ACCDC, 2023b).

The Tri-colored bat (also known as the Eastern pipistrelle) only has approximately 10% of its range in Canada and is considered rare in Nova Scotia (COSEWIC, 2013). Documented observations of the Tri-colored bat predominantly occur in the southwest region of the province, especially during the summer months (Broders et al., 2003). The Tri-colored bat can be found in a variety of habitats, foraging in covered riparian areas and around open bodies of water. Hibernation for this species begins in September and extends to early or mid-May in abandoned mines or caves with high humidity and above freezing temperatures (COSEWIC, 2013).

ACCDC data indicates that the closest Tri-colored bat observation is 35.3 ± 5.0 km from the center of the Study Area (ACCDC, 2023b).

7.4.4.4 Field Assessment Methodology

Field surveys and monitoring conducted within the Study Area include the following:

- Active Bat Assessment (2022)
  - Bat Habitat Field Survey (2022)
- Passive Bat Assessment (2022-2023)
  - Spring/Summer Acoustic Survey (2022)
  - Fall Acoustic Survey (2022)
  - Spring/Summer Acoustic Survey (2023; results pending)
  - Fall Acoustic Survey (2023; results pending)

Active Bat Assessment

Bat Habitat Survey

Informed by the desktop review and terrestrial habitat mapping, as described in Section 7.4.4.3, a bat habitat survey was conducted by Stantec biologists in spring 2022. The focus of the bat habitat survey was to identify ideal day-roosting habitat, primarily large diameter (>25 cm) snags and/or downed trees along with potential significant habitat features including hibernacula, maternity roosts, and migratory stopovers within the Study Area. A subset of 18 forest stands were identified in the desktop review and were selected for field verification.

Stantec biologists visited each of the 18 selected stands to verify the habitat and to assess the potential for maternity roost sites. A 200 m transect was plotted in GIS at each of the stands. At each site, surveyors walked this transect to determine the presence of potential maternity roost trees and noted their observations on a data sheet (refer to Appendix N) to document the presence/relative abundance of snags, trees in decay classes 1 to 3 (early decay, as per Watt and Caceres, 1999), *Usnea trichodea* lichen, and trees with cracks, crevices or/or peeling banks (and distinguished between trees with a DBH of >25 cm or between 10 cm and 25 cm). Notes were taken on overall site characteristics and dominant tree species. These surveys were conducted prior to leaf out, when it is easiest to look for specific trunk characteristics (e.g., cavities and cracks). Results of the habitat surveys are presented in Section 7.4.4.5 and Appendix N.

Based on the habitat survey results, the sites with the highest potential to support maternity colonies were identified. Sites were deemed as suitable for a bat detector if they met at least one of the following selection rules:

- Two or more of the following were ranked as common or abundant, OR three or more were ranked as uncommon or above, with at least one as common or abundant:
  - Presence of snags
  - Presence of trees in decay classes 1 to 3
  - Presence of trees with DBH >25 cm containing cavities/cracks/crevices
  - Presence of trees with DBH >25 cm containing loose peeling bark
  - *Usnea* presence is common or abundant

Passive Bat Assessment

Passive acoustic monitoring was conducted at the Study Area across various representative habitats such as clear cuts, riparian river valleys, and forest edges, and with a particular emphasis on areas with mature and old or mixed-age forest (including coniferous, deciduous, and mixed wood forest. Monitoring stations were chosen based on habitat mapping and accumulated knowledge from field studies to represent various habitat types present and ideal bat habitat for foraging and maternity roost habitat for the bat species present in Nova Scotia. Location details of bat detectors are provided in Appendix N. The passive acoustic bat monitoring program was conducted using Wildlife Acoustic Song Meter

Mini Ultrasonic Recorders. The devices were programmed to monitor between 30 minutes prior to sunset until 30 minutes after sunrise, to correspond with peak bat activity between sunset and sunrise. The detector settings were chosen based on the species with potential to occur in the Study Area, and on standard settings that are typically used for bat detection in this region. Supplementary information of each monitor location and set up were recorded, including specific location details (i.e., height, tree type etc.), mapped habitat and surrounding habitat types.

During consultation with NSNRR, it was also determined that one bat detector would also be deployed near the avian radar location.

Acoustic monitoring data was processed using Wildlife Acoustics' Kaleidoscope Pro software. The data processing through Kaleidoscope Pro involves running the software's automatic identification, which screens out noise files (that were not previously screened out by the detector) and provides a suggested species for each bat call file. In some cases, species cannot reliably be identified based on the quality of the call. These calls are categorized as No ID by the software.

Calls were manually reviewed by a qualified biologist to confirm the identification. Where a call was reviewed and determined to be in the Myotis genus, but a species ID was not possible, it was categorized as Myotis species. In other instances, if a call was manually reviewed and of a high frequency [>35 kilohertz (khz)], and thus potentially representative of a SAR bat, it was categorized as 'high frequency unknown'. The category includes all SAR species (Little brown myotis, Northern myotis, and Tri-colored bat), as well as Eastern red bat. Alternatively, low frequency calls (<35 khz) that could not be identified to species were categorized as 'low frequency unknown'. These calls could represent Hoary, Silver-haired, or Big brown bats.

Spring/Summer 2022 Acoustic Survey

A spring/summer acoustic survey was carried out between June 25 and August 3, 2022, using eight Wildlife Acoustic Song Meter Mini Ultrasonic Recorders. These detectors recorded for between 31 and 39 nights, depending on battery life; see Appendix N for monitoring details, including durations and detector locations. Bat detectors were located in habitats representative of both the Study Area and surrounding environment expected to provide suitable foraging and day-roost habitat for bats.

Fall 2022 Acoustic Survey

The fall 2022 acoustic survey was conducted between August 26 and November 4, 2022. Seven bat detectors were deployed on August 26, 2022, and an eighth was deployed on September 14, 2022. Detectors were deployed at the same locations used for spring/summer 2022. Batteries and SD cards were replaced on either September 14 or 23, and again on October 21, before being picked up on November 3 and 4. These detectors recorded between 29 and 62 nights.

7.4.4.5 Field Assessment Results

Active Bat Assessment

Bat Habitat Survey

Stantec biologists visited 18 pre-selected stands to verify the habitat and assess the potential for maternity roost sites. Of the 18 sites surveyed, 12 met the criteria for having the highest potential to support maternity colonies. Based on this determination, seven bat detector locations were chosen to represent both foraging and maternity roost habitat, to provide adequate site coverage, and to be representative of habitat types identified. One bat detector was deployed near the radar location, as requested by NSNRR. Detailed results of the 2022 Bat Habitat Survey details are provided in Appendix N.

Passive Bat Assessment

A summary of the 2022 passive acoustic bat survey results is provided in Table 7.54.

Table 7.54: Summary of the Passive Acoustic Bat Survey Results

ID	Detector Habitat	Distance to AA*	Monitoring Period (2022)	# Files Recorded per Bat Species					
				Little brown myotis	Hoary bat	Silver-haired bat	Silver-haired bat or Big brown bat	Unknown *(High or Low Frequency)*	Total
N-1	Balsam fir	0.31 km	Spring/Summer	---	---	---	---	---	**---**
			Fall	---	---	---	---	---	**---**
N-2	Balsam fir, open wetland	2.17 km	Spring/Summer	29	6	---	---	6	**41**
			Fall	---	---	---	---	---	**---**
N-3	Spruce, radar site	0.44 km	Spring/Summer	---	---	---	---	1	**1**
			Fall	---	---	---	---	1	**1**
N-4	Red spruce	0.14 km	Spring/Summer	1	---	---	---	---	**1**
			Fall	---	---	---	1	---	**1**
N-5	Balsam fir	0.04 km	Spring/Summer	---	---	---	---	1	**1**
			Fall	2	---	---	---	2	**4**
N-6	Red spruce	0.12 km	Spring/Summer	---	---	---	---	---	**---**
			Fall	---	---	---	---	---	**---**
N-7	Fir wetland / watercourse	0.08 km	Spring/Summer	---	---	---	---	---	**---**
			Fall	---	---	---	---	2	**2**
N-8	Black spruce, open road	1.48 km	Spring/Summer	5	---	---	---	2	**7**
			Fall	---	---	2	---	3	**5**
Total				**37**	**6**	**2**	**1**	**18**	**64**

*AA = Assessment Area

Spring/Summer 2022 Acoustic Survey

A total of 51 bat calls were recorded during the spring/summer acoustic surveys. Two species of bats were confirmed from these recordings. Little brown myotis was the most commonly recorded species, with 35 recordings over three detectors. Most of these recordings (29) were at N-2, which is located at an open wetland with a watercourse present. Little brown myotis were recorded throughout the survey period, from June 25 to August 1, 2022. In addition, six high-frequency unknown calls were recorded over four detectors, which may represent a Myotis species, a tri-colored bat, or red bat. Six hoary bat calls were recorded at detector N-2. Four of these calls were recorded on June 22, 2022, and two were recorded on June 27, 2022. Four low frequency unknown calls were also recorded at two detectors. Detailed results of the spring/summer 2022 acoustic survey are provided in Appendix N.

Fall 2022 Acoustic Survey

The number of bats detected during the fall period was quite low, with only 13 recorded calls. Two species were confirmed during the fall surveys: Little Brown myotis and Silver-haired bat. Little brown myotis were recorded at detector N-5, which was in a softwood forest adjacent to a forested bog. The recordings occurred on September 3 and 5, 2022. Silver-haired bat was recorded at N-8, located at a 10-year-old clearcut in the southern portion of the Study Area. These recordings occurred on September 3 and 4, 2022. One other low-frequency call occurred on September 10, 2022, which was likely a Silver-haired or Big brown bat. Due to the similarity of these calls, they could not be distinguished or confirmed. Seven high-frequency calls also occurred over four detectors. All bat calls during the fall period were recorded between August 26 and September 19, 2022. Detailed results of the fall 2022 acoustic survey are provided in Appendix N.

7.4.4.6 Effects Assessment

Project-Bat Interactions

Project activities, primarily those involving vegetation removal and turbine operation, have the potential to impact bats and bat habitat (Table 7.55). These activities could result in habitat removal along with accidental injury/mortality. Other Project activities during construction and operation may impact bat behaviours such as increased noise and lighting.

Table 7.55: Potential Project-Bat Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Bats				X	X	X						X			

Assessment Boundaries

The LAA for bats includes the Assessment Area, while the RAA includes the Study Area (Drawing 2.2).

Assessment Criteria

Assessment criteria provided in Section 4.6 applies for bats. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of bat habitat or impact to bat behaviours expected.
- Low – small loss of habitat supporting bats, but loss of individuals is not expected.
- Moderate – minimal loss of individuals or impacts to bat behaviours, but these impacts will only be experienced by individuals rather than entire populations.
- High – high loss of habitat that supports bats and/or loss of individuals or impacts to bat behaviours on a population scale.

Effects

Based on the spring/summer (2022) and fall (2022) acoustic monitoring periods and consistent low number of recorded bat calls over the two seasons, bat activity within the Study Area appears to be low. Little brown myotis was the most common species during the spring/summer seasons. This species is a resident in Nova Scotia and is a SAR. The higher number of June and July records from N-2 suggest that Little brown myotis are likely breeding in that general area. However, it is important to note that the number of recording nights varied by detector, and thus the results cannot be directly compared between detectors. Fall records of Little brown myotis may be representative of individuals that are foraging or making short distance movements to swarming or hibernation sites.

Two migratory species were confirmed in the Study Area: Hoary bat and Silver-haired bat. Both species are relatively rare in Nova Scotia. The records of Hoary bats occurred during July, which is representative of the breeding season for this species. It is not known if the recorded individuals are breeding in the area. In Nova Scotia, most records of Hoary bats occur during fall migration; however, records of this species from the breeding season have previously occurred (Lucas & Hebda, 2011).

Two records of Silver-haired bat were recorded during the fall migration period, when this species is moving southwards towards wintering areas. Overall, the number of recorded Silver-haired (and other low frequency calls representing migratory bats) during the fall migratory period was low. That may indicate a low amount of migratory activity in this area. However, it is also important to note that all detectors were deployed at ground level, and thus migrants flying at height will have been missed.

The Study Area is significantly disturbed from previous and active forestry, recreation, and an existing wind farm immediately to the east, leaving relatively few intact and undisturbed mature hardwood forests which are preferred habitats for bats. Potential impacts to bat species from the Project's construction and operation include:

- Habitat fragmentation and/or removal.
- Injury/mortality from barotrauma or collision with turbine blades.
- Sensory disturbance (i.e., lighting, noise, human activity, etc.).

Habitat Fragmentation and Removal

There is limited research and knowledge on how wind farm developments impact habitat suitability and populations of bat species (Segers & Broders, 2014). Vegetation clearing required for wind turbine construction can result in the removal of ideal bat habitat (snags, wetlands, etc.) or disrupt corridors between important habitat features (foraging grounds, birthing areas, etc.) (Segers & Broders, 2014). In addition, the construction of roads can potentially impede movement, foraging, flight activity, and habitat use (Government of Canada, 2015). One study by Segers & Broders (2014) found that different species of bats respond differently to landscape alteration for wind farm development. Suitable habitat for the Little brown myotis increased after wind turbine installation, which is likely associated with the increase in open areas and forested edges as these areas are preferred foraging habitats for the species (Segers & Broders, 2014). Alternatively, suitable habitat for Northern myotis bats decreased, likely due to this species' preference to forage in forested areas and around canopy covered streams (Segers & Broders, 2014). Pregnant and lactating female bats have also been shown to be sensitive to habitat degradation as their foraging ranges are more constricted due to decreased energy and caring for young (Henry et al., 2002; Segers & Broders, 2014).

During the field surveys, it was observed that the Assessment Area is already significantly fragmented and disturbed from previous developments including an existing wind farm development immediately to the east, active and previous forestry, and recreational activity. However, it is possible that the bat habitat observed during the 2022 spring/summer survey supports maternity colonies, and the identified snags may provide adequate day-roosting habitat for a variety of bat species.

Impacts to bats as a result of habitat fragmentation and removal are anticipated to be minimal based on the widespread existing disturbance/fragmentation in the Study Area along with the Project's maximized use of existing roadways. Habitat fragmentation and removal will be associated with newly constructed roads within the Project Area (totaling approximately 16 km in length). Areas where new roads are proposed do not contain important bat habitat.

Injury/Mortality

Wind project related bat injuries/mortalities are increasingly becoming a concern as some researchers have highlighted that turbines could have a greater impact on bats than birds. Bats have a slower life cycle than birds resulting in impacts to population dynamics when mortalities occur, especially where populations are already small (Wellig et al., 2018). Bat injuries/mortalities can result either from a direct collision with a turbine blade or from barotrauma which is caused by the sudden decrease in air pressure following rotating blades (Government of Canada, 2015). Reasons for bats colliding with blades include the inability for bats to detect or avoid blades due to high speeds, which can be up to 300 km/h at the tip of the blade (Wellig et al., 2018). Research suggests that bats are attracted to wind turbines because the tall structures dominate landscapes which may attract insects or be perceived as potential mating sites or roost trees (Wellig et al., 2018). A study done by Horn et al. (2008) found that bats actively forage within turbine locations during operation. Through the investigation, researchers observed bats approaching non-rotating and rotating blades, repeatedly investigating turbine elements, following or trapped by blade-tip vortices, and bats colliding with turbine blades (Horn et al., 2008).

Long distance migrating bats including the Eastern red bat, Hoary bat, and Silver-haired bat comprise most of the reported mortalities from wind turbines due to their higher flight elevations and long migration distances (Parisé & Walker, 2017; Government of Canada, 2015). Alternatively, Myotis species of bats have lower fatality rates due to lower flight elevation and short migrating distances (Government of Canada, 2015). In the Recovery Strategy for Little Brown Myotis, Northern Myotis, and Tri-colored Bat developed by the Government of Canada (2015), collisions and barotrauma from wind turbines were listed as a high level of concern in areas impacted by white-nose syndrome (like Nova Scotia), with localized seasonal impacts in the summer, fall, and spring.

Bat activity and use of habitat within the Study Area was assessed through various passive and active acoustic monitoring, which found low levels of bat activity/use during the spring/summer and fall migratory seasons. Bat species identified during field studies include Little brown myotis, Hoary bat, and Silver-haired bat. Little brown myotis resident bats were the most frequently recorded species within the Study Area. This species is at a lower risk for turbine related injuries and mortalities due to lower flight patterns. Only six Hoary bats, which are at a higher risk due to higher flight patterns and longer migration routes, were recorded (spring/summer only) across all surveys. Individual bat injury/mortality as a result of wind turbine operation is possible; however, based on low observed bat activity and existing disturbance (forestry, recreational, etc.) within the Study Area, impacts to bat SOCI populations at a regional scale or population level are not anticipated.

Strum Consulting has completed numerous post-construction bat mortality surveys for wind turbine developments and have identified minimal/negligible levels of bat mortality across the province of Nova Scotia. These reports/results are client-confidential, but copies were submitted to, and are accessible by, NSECC in accordance with the EA Approvals of past wind turbine developments.

Sensory Disturbance

Sensory disturbance generated primarily by lighting and noise during both construction and operation phases of the Project may also impact bat behaviours and/or impede movement, foraging, flight activity, and habitat use. Based on the pre-existing traffic loads, forestry, recreational activity, and developments within the Study Area, along with the minimal traffic to be associated with the Project, effects on bat behaviours are not anticipated within the LAA.

Mitigation

To address the abovementioned effects to bat and bat habitat, the following mitigation measures will be implemented:

Habitat Fragmentation & Removal

- Minimize overall area to be cleared by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
- Complete clearing during winter months when bats are overwintering in caves (end of September to late April), where possible.
- Maintain avoidance of important bat habitat (i.e., caves and abandoned mines) to the greatest extent possible.
- Avoid/minimize the removal of large diameter (≥25 cm) snags and hollow trees (bat over-day roosting habitat) within the Project Area during the detail design phase, to the greatest extent possible. Consult NSNRR, where appropriate.
- Minimize fragmentation and habitat isolation during the design phase.
- Revegetate roadsides and cleared areas to minimize lost habitat as much as possible.

Injury/Mortality

The primary mitigation measure to prevent injury/mortality of bats is avoidance of important habitat (i.e., hibernacula, migration routes, and migratory stopovers) along with placement of turbines in an area demonstrated to contain low bat activity, which has been incorporated into the Project’s design/development.

Sensory Disturbance

- Continue to prioritize the use of existing roads to the extent possible to minimize increases in the road density.
- Restrict lighting to minimums required for safety considerations.
- Utilize noise controls (e.g., mufflers) on machinery, equipment, etc. during construction of the Project.

Monitoring

A Post Construction Bat Monitoring Plan will be developed, which may include:

- Passive acoustic monitoring.
- Post-construction bat mortality monitoring (up to two years).
- Adaptive management/contingency plan if post-construction monitoring identifies significant bat mortality, which would include consultation with NSNRR.

Conclusion

Results are characterized as moderate magnitude, within the LAA, medium duration, continuous, reversible, and not significant.

7.4.5 Avifauna

7.4.5.1 Overview

A desktop review, field program, and habitat modelling were undertaken to gather information on avian species and associated habitat in the Study Area. Objectives were as follows:

- Assess observations, species diversity, and habitat utilization of avian species within the Study Area during all seasons.
- Use the information collected to inform and refine the Project design (i.e., avoid impacts to SOCI and their habitats).
- Assess migratory bird activity and assess the risk that the Project poses to migratory birds.
- Use the information collected to inform mitigation and management practices.

7.4.5.2 Regulatory Context

Applicable laws and regulations relating to the protection of avian species include the following:

- *Migratory Bird Convention Act, 1994 (MBCA)*
- *ESA*
- *SARA*

The *MBCA* protects all migratory birds while they are present in Canadian jurisdiction, including on land, in the air, and on the water. The *ESA* and *SARA* prohibit harm to listed SAR along with their habitually occupied spaces and core/critical habitat.

7.4.5.3 Desktop Review

Desktop information was utilized to gain insight into protected avifauna habitats, species utilization of the area, and to identify SOCI potentially occurring at or within the Assessment Area using the following sources:

- Terrestrial Habitat Mapping (Section 7.4.1)
- Important Bird Areas (IBAs) (Bird Studies Canada & Nature Canada, 2023)
- Maritimes Breeding Bird Atlas (MBBA) (Bird Studies Canada, 2016)
- Species at Risk in Nova Scotia Database (NSNRR, 2021a)
- Significant Species and Habitats Database (NSNRR, 2018a)
- ACCDC Data Report (ACCDC, 2023b)

The Study Area features predominantly mixed wood stands, with hardwood dominated slopes. Much of the forested area is managed for silviculture and has been subject to clear-cutting or thinning activities within the past decade. Hurricane Fiona in September of 2022 damaged much of the forest with the Study Area, blowing down entire stands of trees, and altering habitats. The diversity of habitat types, in particular the prevalence of edge/transitional habitat, provides for the foraging, breeding, and roosting requirements of a variety of resident and migratory bird species.

The closest IBA in Nova Scotia (Bird Studies Canada & Nature Canada, 2023) is the Cobequid Bay, Bay of Fundy, approximately 14 km south of the Project (Drawing 7.22). This IBA is a long (40 km) point-shaped bay that widens from 1.5 km at its eastern end, to 15 km at its juncture with the Minas Basin. At low tide, vast areas of mud and sand flats, and salt marshes are exposed. It provides a staging ground for one to two million shorebirds in the fall before the southern migration. The availability of such a prodigious food supply attracts 50% to 95% of the world total of Semipalmated Sandpipers (*Calidris pusilla*), along with many other species of shorebirds. Due to the distance between this IBA and the Study Area, no interactions with the Project are expected.

The majority of the Assessment Area is contained within the map square 20MR74 of the MBBA. The Study Area also intersects squares 20MR84, 20MR73, and 20MR83 (Bird Studies Canada, 2016). In the most recent edition of the MBBA (2006-2010), 89 species were identified as being possible, probable, or confirmed breeders in square 20MR73, including seven SOCI:

- Barn Swallow *(Hirundo rustica)* - “Threatened” (*SARA*), “Special Concern” (COSEWIC)
- Bobolink *(Dolichonyx oryzivorus)* - “Threatened” (*SARA*), “Special Concern” (COSEWIC), “Vulnerable” (*ESA*)
- Canada Warbler *(Cardellina canadensis)* - “Threatened” (*SARA*), “Special Concern” (COSEWIC), “Endangered” (*ESA*)
- Eastern Wood-Pewee (*Contopus virens*) – “Special Concern” (*SARA* and COSEWIC), “Vulnerable” (*ESA*)
- Olive-sided Flycatcher *(Contopus cooperi)* - “Special Concern” (*SARA* and COSEWIC), “Threatened” (*ESA*)
- Rusty Blackbird *(Euphagus carolinus)* - “Special Concern” (*SARA* and COSEWIC), “Endangered” (*ESA*)
- Wood Thrush (*Hylocichla mustelina*) - “Threatened” (*SARA* and COSEWIC)

The NSNRR Significant Species and Habitats Database (2018a) contains 1462 unique records pertaining to birds and/or bird habitat within a 100 km radius of the Project. These records include but are not limited to:

- 635 records classified as "Species at Risk" most of which relate to Golden-crowned Kinglet (*Regulus satrapa*) (95), Piping Plover (*Charadrius melodus*) (76), Ruby-crowned Kinglet (*Regulus calendula*) (61), and Canada Warbler (46).
- 161 records classified as "Species of Concern" most of which relate to unclassified Tern (49), Common Loon (*Gavia immer*) (36), and Pine Siskin (*Spinus pinus*) (30).
- 163 records classified as "Migratory Bird" most of which relate to Double-crested Cormorant (*Phalacrocorax auratus*) (40), Common Eider (*Somateria mollissima*) (24) and unclassified shorebirds (23).
- 503 records classified in the database as "Other Habitat", most of which relate to Bald Eagle (*Haliaeetus leucocephalus*) (481).

The NSNRR Significant Species and Habitats Database (2018a) contains three unique records pertaining to birds and/or bird habitat within a 10 km radius of the Project. Two of these records are classified as "Other Habitat", referencing Bald Eagle and the third record is classified as "Species of Concern", referencing a Yellow-bellied Flycatcher (*Empidonax flaviventris*).

The ACCDC database therefore contains records of 120 bird species within a 100 km radius of the Study Area (Table 7.56).

Table 7.56: Bird Species Recorded within a 100 km Radius of the Study Area

Common Name	*Scientific Name*	COSEWIC Status	*SARA* Status	*ESA* Status	NS S-Rank
American Bittern	*Botaurus lentiginosus*	---	---	---	S3S4B,S4S5M
American Coot	*Fulica americana*	Not At Risk	---	---	S1B
American Eel	*Anguilla rostrata*	Threatened	---	---	S3N
American Golden-Plover	*Pluvialis dominica*	---	---	---	S2S3M
American Kestrel	*Falco sparverius*	---	---	---	S3B,S4S5M
American Marten	*Martes americana*	---	---	Endangered	S2S3
American Three-toed Woodpecker	*Picoides dorsalis*	---	---	---	S1?
Arctic Tern	*Sterna paradisaea*	---	---	---	S3B
Atlantic Puffin	*Fratercula arctica*	---	---	---	S2B
Baltimore Oriole	*Icterus galbula*	---	---	---	S2S3B,SUM
Bank Swallow	*Riparia riparia*	Threatened	Threatened	Endangered	S2B

Common Name	*Scientific Name*	COSEWIC Status	*SARA* Status	*ESA* Status	NS S-Rank
Barn Swallow	*Hirundo rustica*	Special Concern	Threatened	Endangered	S3B
Barrow's Goldeneye	*Bucephala islandica*	Special Concern	Special Concern	---	S1N,SUM
Bay-breasted Warbler	*Setophaga castanea*	---	---	---	S3S4B,S4S5M
Bicknell's Thrush	*Catharus bicknelli*	Threatened	Threatened	Endangered	S1B
Black Tern	*Chlidonias niger*	Not At Risk	---	---	S1B
Black-backed Woodpecker	*Picoides arcticus*	---	---	---	S3S4
Black-bellied Plover	*Pluvialis squatarola*	---	---	---	S3M
Black-billed Cuckoo	*Coccyzus erythropthalmus*	---	---	---	S3B
Black-crowned Night-heron	*Nycticorax nycticorax*	---	---	---	S1B
Black-headed Gull	*Chroicocephalus ridibundus*	---	---	---	S3N
Black-legged Kittiwake	*Rissa tridactyla*	---	---	---	S2S3B
Blackpoll Warbler	*Setophaga striata*	---	---	---	S3B,S5M
Blue-winged Teal	*Spatula discors*	---	---	---	S3B
Bobolink	*Dolichonyx oryzivorus*	Special Concern	Threatened	Vulnerable	S3B
Boreal Chickadee	*Poecile hudsonicus*	---	---	---	S3
Boreal Owl	*Aegolius funereus*	Not At Risk	---	---	S2?B,SUM
Brant	*Branta bernicla*	---	---	---	S3M
Brown Thrasher	*Toxostoma rufum*	---	---	---	S1B
Brown-headed Cowbird	*Molothrus ater*	---	---	---	S2B
Canada Jay	*Perisoreus canadensis*	---	---	---	S3
Canada Warbler	*Cardellina canadensis*	Special Concern	Threatened	Endangered	S3B
Cape May Warbler	*Setophaga tigrina*	---	---	---	S3B,SUM
Chimney Swift	*Chaetura pelagica*	Threatened	Threatened	Endangered	S2S3B,S1M
Cliff Swallow	*Petrochelidon pyrrhonota*	---	---	---	S2S3B
Common Eider	*Somateria mollissima*	---	---	---	S3B,S3M,S3N
Common Gallinule	*Gallinula galeata*	---	---	---	S1B
Common Goldeneye	*Bucephala clangula*	---	---	---	S2S3B,S5N,S5M
Common Murre	*Uria aalge*	---	---	---	S1?B

Common Name	*Scientific Name*	COSEWIC Status	*SARA* Status	*ESA* Status	NS S-Rank
Common Nighthawk	*Chordeiles minor*	Special Concern	Special Concern	Threatened	S3B
Common Tern	*Sterna hirundo*	Not At Risk	---	---	S3B
Cooper's Hawk	*Accipiter cooperii*	Not At Risk	---	---	S1?B,SUN,SUM
Eastern Bluebird	*Sialia sialis*	Not At Risk	---	---	S3B
Eastern Kingbird	*Tyrannus tyrannus*	---	---	---	S3B
Eastern Meadowlark	*Sturnella magna*	Threatened	Threatened	---	SHB
Eastern Whip-Poor-Will	*Antrostomus vociferus*	Special Concern	Threatened	Threatened	S1?B
Eastern Wood-Pewee	*Contopus virens*	Special Concern	Special Concern	Vulnerable	S3S4B
Evening Grosbeak	*Coccothraustes vespertinus*	Special Concern	Special Concern	Vulnerable	S3B,S3N,S3M
Fox Sparrow	*Passerella iliaca*	---	---	---	S3S4B,S5M
Gadwall	*Mareca strepera*	---	---	---	S2B,SUM
Great Cormorant	*Phalacrocorax carbo*	---	---	---	S2S3B,S2S3N
Great Crested Flycatcher	*Myiarchus crinitus*	---	---	---	S1B
Greater Yellowlegs	*Tringa melanoleuca*	---	---	---	S3B,S4M
Harlequin Duck - Eastern population	*Histrionicus histrionicus pop. 1*	Special Concern	Special Concern	Endangered	S2S3N,SUM
Horned Grebe	*Podiceps auritus*	Special Concern	Special Concern	---	S3N,SUM
Horned Lark	*Eremophila alpestris*	---	---	---	SHB,S4S5N,S5M
Hudsonian Godwit	*Limosa haemastica*	Threatened	---	---	S2S3M
Indigo Bunting	*Passerina cyanea*	---	---	---	S1?B,SUM
Ipswich Sparrow	*Passerculus sandwichensis princeps*	Special Concern	Special Concern	---	S1B
Killdeer	*Charadrius vociferus*	---	---	---	S3B
Lapland Longspur	*Calcarius lapponicus*	---	---	---	S3?N,SUM
Laughing Gull	*Leucophaeus atricilla*	---	---	---	SHB
Leach's Storm-Petrel	*Hydrobates leucorhous*	Threatened	---	---	S3B
Least Bittern	*Ixobrychus exilis*	Threatened	Threatened	---	SUB
Least Sandpiper	*Calidris minutilla*	---	---	---	S1B,S4M

Common Name	*Scientific Name*	COSEWIC Status	*SARA* Status	*ESA* Status	NS S-Rank
Lesser Yellowlegs	*Tringa flavipes*	Threatened	---	---	S3M
Long-eared Owl	*Asio otus*	---	---	---	S2S3
Long-tailed Shrew	*Sorex dispar*	Not At Risk	---	---	S2
Marsh Wren	*Cistothorus palustris*	---	---	---	S1B
Nelson's Sparrow	*Ammospiza nelsoni*	Not At Risk	---	---	S3S4B
Northern Gannet	*Morus bassanus*	---	---	---	SHB
Northern Goshawk	*Accipiter gentilis*	Not At Risk	---	---	S3S4
Northern Mockingbird	*Mimus polyglottos*	---	---	---	S1B
Northern Pintail	*Anas acuta*	---	---	---	S1B,SUM
Northern Shoveler	*Spatula clypeata*	---	---	---	S2B,SUM
Northern Shrike	*Lanius borealis*	---	---	---	S3S4N
Olive-sided Flycatcher	*Contopus cooperi*	Special Concern	Special Concern	Threatened	S3B
Pectoral Sandpiper	*Calidris melanotos*	---	---	---	S3M
Peregrine Falcon - anatum/tundrius	*Falco peregrinus pop. 1*	Not At Risk	---	Vulnerable	S1B,SUM
Philadelphia Vireo	*Vireo philadelphicus*	---	---	---	S2?B,SUM
Pine Grosbeak	*Pinicola enucleator*	---	---	---	S3B,S5N,S5M
Pine Siskin	*Spinus pinus*	---	---	---	S3
Pine Warbler	*Setophaga pinus*	---	---	---	S2S3B,S4S5M
Piping Plover melodus subspecies	*Charadrius melodus melodus*	Endangered	Endangered	Endangered	S1B
Purple Martin	*Progne subis*	---	---	---	SHB
Purple Sandpiper	*Calidris maritima*	---	---	---	S3S4N
Razorbill	*Alca torda*	---	---	---	S2B
Red Crossbill	*Loxia curvirostra*	---	---	---	S3S4
Red Knot	*Calidris canutus*	Endangered, Special Concern	Endangered, Threatened	---	S2M
Red Knot rufa subspecies	*Calidris canutus rufa*	Endangered, Special Concern	Endangered	Endangered	S2M
Red Phalarope	*Phalaropus fulicarius*	---	---	---	S2S3M
Red-breasted Merganser	*Mergus serrator*	---	---	---	S3S4B,S5M,S5N

Common Name	*Scientific Name*	COSEWIC Status	*SARA* Status	*ESA* Status	NS S-Rank
Redhead	*Aythya americana*	---	---	---	SHB
Red-necked Phalarope	*Phalaropus lobatus*	Special Concern	Special Concern	---	S2S3M
Roseate Tern	*Sterna dougallii*	Endangered	Endangered	Endangered	S1B
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	---	---	---	S3B
Rough-legged Hawk	*Buteo lagopus*	Not At Risk	---	---	S3N
Ruddy Duck	*Oxyura jamaicensis*	---	---	---	S1B
Ruddy Turnstone	*Arenaria interpres*	---	---	---	S3M
Rusty Blackbird	*Euphagus carolinus*	Special Concern	Special Concern	Endangered	S2B
Sanderling	*Calidris alba*	---	---	---	S2N,S3M
Scarlet Tanager	*Piranga olivacea*	---	---	---	S2B,SUM
Semipalmated Plover	*Charadrius semipalmatus*	---	---	---	S1B,S4M
Semipalmated Sandpiper	*Calidris pusilla*	---	---	---	S3M
Short-billed Dowitcher	*Limnodromus griseus*	---	---	---	S3M
Short-eared Owl	*Asio flammeus*	Threatened	Special Concern	---	S1B
Spotted Sandpiper	*Actitis macularius*	---	---	---	S3S4B,S5M
Tennessee Warbler	*Leiothlypis peregrina*	---	---	---	S3S4B,S5M
Turkey Vulture	*Cathartes aura*	---	---	---	S2S3B,S4S5M
Vesper Sparrow	*Pooecetes gramineus*	---	---	---	S1S2B,SUM
Virginia Rail	*Rallus limicola*	---	---	---	S2S3B
Warbling Vireo	*Vireo gilvus*	---	---	---	S1B,SUM
Whimbrel	*Numenius phaeopus*	---	---	---	S2S3M
Whimbrel	*Numenius phaeopus hudsonicus*	---	---	---	S2S3M
Willet	*Tringa semipalmata*	---	---	---	S3B
Willow Flycatcher	*Empidonax traillii*	---	---	---	S2B
Wilson's Snipe	*Gallinago delicata*	---	---	---	S3B,S5M
Wilson's Warbler	*Cardellina pusilla*	---	---	---	S3B,S5M
Wood Thrush	*Hylocichla mustelina*	Threatened	Threatened	---	SUB

Source: (ACCDC, 2023b)

7.4.5.4 Field Survey Methodology

Several types of survey methods were employed by Stantec Consulting Ltd. to assess the avian species using the Study Area throughout the year. Survey methods were based on the protocols recommended in the document Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds (CWS, 2007a), unless otherwise stated.

Point Counts

Point count surveys were used as the primary means of identifying species in the Study Area through the breeding season. Point counts were 10 minutes in duration and were completed at predetermined locations. All visual and auditory observations of birds were recorded for each point count location, along with relevant behavioral information (such as breeding evidence). Point count locations were chosen with the objective of representing the diversity of habitat within the Study Area. Survey stations were established with a minimum distance of 250 m between points, and 100 m from edges of other land cover types, where possible. The estimated distance to target, and species is recorded, while the observer remains still and silent for the duration of the survey interval. Surveys were generally completed from just before dawn until approximately 10:00 am to observe the most active time of day for passerine species. Survey opportunities were maximized for clear weather and minimal wind within the appropriate timeframe. Target species of point counts are primarily passerines, identified audibly.

Nocturnal Owl Surveys

Nocturnal owl surveys were conducted to assess the species composition and relative abundance of nocturnal owls. The survey approach applied representative sampling across the land cover types in the Study Area which were considered to have potential to provide suitable habitat for nocturnal owls. The survey method followed the Nova Scotia Nocturnal Owl Survey Guide for Volunteers (Birds Canada, 2019).

Thirteen survey stops situated in locations accessible by vehicle and spaced a minimum of 1.6 km apart, were visited once in April 2022. Surveys began approximately one-half hour after sunset under suitable environmental conditions, including light winds and little to no precipitation. The Nova Scotia Nocturnal Owl Survey broadcast recording, which lasts approximately 9 minutes and 30 seconds, was played at each survey location. Any owls or other nocturnal bird species encountered either by visual or auditory cues were recorded. Additional survey methodology details are provided in Appendix O.

Survey Transects

Survey transects were established along accessible corridors throughout a variety of habitats within the Study Area. They were situated mostly along existing forest roads and conducted through both the spring and fall migration periods. Each transect was 500 m long and as the Study Area expanded, more transects were added to reflect those changes. All visual and auditory observations of birds were recorded, along with relevant behaviour information.

Diurnal Raptor Passage Monitoring Surveys

Raptor watch count surveys targeting migrating raptors were completed at points of high elevation within the Study Area during the day. Observations on the movement of birds were recorded, including bearing from the observer, distance to the target, the direction that the target was moving, its passing height, and any other behaviour notes.

The aforementioned survey types were utilized to seasonally survey avifauna throughout the Study Area.

Breeding Bird Surveys (2022)

Breeding bird surveys were completed to inventory avian species and assess their breeding activity within the Study Area during the breeding season. In Nova Scotia, the core breeding season for migratory species runs from mid-June to late July. Breeding bird surveys were conducted using point counts. Two rounds of point count surveys were completed, and any evidence of breeding as outlined by the MBBA was recorded. A primary round of surveys was conducted in 2022 (see Appendix P), with a secondary round of surveys underway in 2023 (results for year 2 to follow post-EA)

Nightjar Surveys (2022)

Surveys targeting crepuscular species [(Common Nighthawk (*Chordeiles minor*) and Eastern Whip-poor-will (*Antrostomus vociferus*)] were completed following the CWS Canadian Nightjar Protocol (2020). Surveys were completed during the evening hours (30 minutes prior to sunset), during the full moon period in July. Survey stations were established a minimum of 1 km apart in habitat suitable for breeding and began with 6 minutes of silent listening.

Spring and Fall Stopover Migration Surveys (2021- 2022)

Stopover bird migration monitoring surveys were completed during the spring and fall seasons and involved the collection of presence and behavioural data of birds observed from accessible survey transects. Fall migration surveys were used in tandem with spring migration surveys to determine the migratory species that are moving through the Study Area. Survey protocols were developed based on information and guidance provided in ECCC's guidelines for wind turbines and birds (CWS, 2007b) and survey protocols document (CWS, 2007a), as well as previous guidance from the CWS on methodology, timing, and frequency of surveys.

Stopover migration transect surveys were completed weekly at each transect and repeated through the migration periods. The spring migratory period runs from early April through mid-June. Fall migration surveys began mid-season in 2021 which missed the early part of the season. Follow-up surveys were completed in the early fall season of 2022.

Surveys generally began near sunrise and continued until late morning. The order in which transects were completed was randomized to the extent possible, accounting for site accessibility and travel time. A variation of the standardized area search method was completed at each 500 m long transect. Birds detected either visually or through auditory cues were documented, and information on the species, number of individuals, and behaviour (including relative flight height, where applicable) was recorded for each observation.

See Appendix Q for details regarding the spring and fall migratory surveys in 2022. Results from spring and fall migratory surveys in 2023 (year 2) will follow, post-EA submission.

Winter Bird Surveys (2021/2022)

Winter bird surveys were completed to establish the species, distribution, and relative abundance of resident birds through the winter season. These surveys were conducted from mid-December through March and included line-transect survey methods to quantify overwintering species in the area based on the methods described in CWS (2007a). Transects surveyed during the fall 2021 migration monitoring program that were accessible during winter conditions were surveyed.

The subset of transects which were accessible over the winter varied from month to month due to changing snow depths. Accessible transects were visited once monthly from December through March, and all birds detected through visual or auditory cues along each 500 m long transect were recorded.

Habitat types crossed by the transects vary along the length of each transect and include a representative sample of habitats. Sampled habitat types include hardwood, softwood, and mixedwood stands of varying ages, regenerating clearcuts, and treed swamps. Birds detected either visually or through auditory cues were documented, and information on the species, number of individuals, distance from the transect, behavior, flight height, and the direction of travel were recorded.

Nine transect locations were surveyed. A complete survey of all transects took a single survey day each month except in February and March where transects were completed over the course of two survey days due to environmental conditions. In total, 28 transect surveys were completed over six survey days.

Additional survey methodology details are provided in Appendix O.

7.4.5.5 Habitat Modelling Methodology

Habitat modelling for SAR observed during the 2022 breeding bird surveys (i.e., priority species that may be breeding within the Study Area) was completed by Strum. Breeding habitat preferences for these species were incorporated into a GIS model, which was used to estimate the quality and quantity of breeding habitat for each species. The model criterion for each species is summarized below.

Canada Warbler

The land cover classification was queried based on bogs, wetlands, or brush to account for the species preferred habitat of treed conifer swamps, extensive mid-story growth (e.g., holly, alders). Forest data was queried to include the FORNON code of 39 which is an area where in part alders compose 75% or more of the Crown closure. The leading species (SP1) attribute of BF (balsam fir), and BS (black spruce) were used. Furthermore, to account for smaller scale wetland features, the NSNRR wetland data was filtered to include those classified as bog, bog or fen, fen, and swamp.

Common Nighthawk

Forestry inventory data was filtered to identify areas with bare ground, including clear cuts, ditched areas (confirmed by DEM), roadsides, laydown areas, and other corridors where vegetation has been removed or is kept cut. This habitat is primarily suitable for nesting, not breeding nor foraging.

Eastern Wood-Pewee

Using the forest inventory, the data was filtered based on 10% to 45% crown closure of the treed stands in both the first story and the second story to survey the area for any open woodland type of forest. All tree species were included due to the lack of hardwood or hardwood dominated stands in the Study Area. In addition, the land cover classification was queried based on hardwood (regardless of crown closure), with all hardwood included due to the minimal (0.8%) coverage in the Study Area.

Olive-sided Flycatcher

Using the forest inventory, forest data was queried to include the leading species (SP1) attribute of BS (black spruce), RS (red spruce), WS (white spruce), SP (scots pine), RP (red pine), JP (jack pine), and EH (eastern hemlock), if present. To account for all softwood forests, the land cover dataset was filtered based on the softwood classification (may result in an overestimation of habitat).

7.4.5.6 Remote Sensing Methodology

Avian Radar Assessment

The nocturnal radar surveys were conducted using an X-band marine surveillance radar, like that described by Cooper et al. (1991) by Stantec Consulting Ltd. The radar unit was deployed just outside of the northeastern boundary of the Study Area, near Turbine 9 at the existing Nuttby Mountain Wind Farm, at an elevation approximately 340 masl. The radar operated continuously during nighttime hours (sunset to sunrise) on survey nights, between mid-April and late May for spring migration, and between mid-August and late-October for fall migration. The radar was operated in two modes: surveillance (horizontal) mode and vertical mode, throughout each night in the spring and fall.

In surveillance mode, the antenna spins horizontally to survey the airspace around the radar and detects the number of targets and their flight direction as they pass through the radar's detection area. By analyzing the echo trail for each target, flight direction and flight speed were determined. In vertical mode, the radar unit is tilted 90° to vertically survey the airspace above the radar. In vertical mode, target echoes do not provide direction or speed data but do provide information on the altitude of targets passing through the vertical radar beam. The radar operated in both modes during each survey hour, resulting in 30 minutes each of horizontal and vertical data collection. Videos produced by the radar were recorded and archived for subsequent analysis.

Survey nights were selected based on weather forecast predictions. Because the anti-rain function of the radar must be turned down to detect small birds and bats, surveys could not be undertaken during active rainfall. Nights expected to be optimal for radar migration surveys (nights with no precipitation) were targeted for survey. Conversely, nights with intermittent precipitation, strong winds, and/or unusually high or low temperatures were sampled at a lower frequency than optimal nights.

For each hour of radar operation, six 1-minute horizontal video samples and six 1-minute vertical video samples were randomly selected for visual analysis. For those hours with less than 60 minutes sampled (due to rain, equipment failure, or less than 60 minutes of nighttime), proportionally fewer but no fewer than three samples were selected. The videos were visually reviewed to identify and select targets (migrants) and their flight paths, resulting in location, flight height, and flight direction data for each target. Data were summarized using programs and macros designed by Stantec Consulting Ltd. Horizontal video samples were used to calculate mean hourly, nightly, and seasonal passage rates, as well as nightly and seasonal mean flight direction. Vertical video samples were used to calculate mean hourly, nightly, seasonal flight heights, and percent of targets flying below the potentially minimum and maximum turbine heights that may be utilized at the Project (180 m and 200 m, respectively).

Avian Acoustic Assessment

The avian acoustic assessment was conducted by Stantec Consulting Ltd. using Autonomous Recording Units (ARUs) that recorded from approximately sunset to sunrise while spring and fall radar sampling occurred. The recorded data were saved as compressed .wav files on high-capacity SD cards inside the units. Data files were downloaded from the data cards once during each survey period and at the end of each survey period. Files recorded during the nights that the radar was operated were converted from their compressed form into full spectrum .wav files. The data were processed using Cornell Lab’s BirdNET acoustic identification program, an artificial neural network designed to identify bird vocalizations. This application provides a highly accurate characterization of the bird species present within acoustic recordings of avian activity.

Recorded call files are defined as signals of interest (SOIs), not bird vocalizations, because non-bird audio recordings (e.g., equipment noise, splashing or dropping water, etc.) may also meet the processing parameters and would be included in the initial analysis results. BirdNET provides suggested species identifications, including less commonly observed species, resulting in more accurate results. The software is programmed to include all SOIs with durations from 0.05 seconds to 3 seconds and with frequency levels between 250 Hertz (Hz) and 12,000 Hz. A Stantec biologist experienced with the analysis of acoustic avian calls reviewed the SOIs and verified each species group when possible and non-bird vocalizations when present.

Vocalizations were manually reviewed for accuracy using a combination of active listening to vocalizations and a visual comparison to the spectrograms of species that could potentially occur in the Project Boundary as defined in Appendix R. SOIs that made it through the initial identification but were not determined to be bird vocalizations through qualitative review were removed from the dataset. Spectrograms of known or likely occurring species were obtained from the Macaulay Library at the Cornell Laboratory of Ornithology.

BirdNET provides a ranking to each SOI identified during automated classification. The ranking ranges from 0.1 to 1.0, providing a measurement of how likely an SOI is to be the species that the application identifies the vocalization to be. Below a ranking of approximately 0.3, species' classifications typically become less accurate and reliable, so a lower limit mask of 0.3 was used to remove false positive identifications from the dataset.

Once the initial analysis and species identifications were completed, a second Stantec biologist conducted a quality assurance/quality control review of the analyzed dataset. This quality review included an audio and visual review of a subset of call files for each identified species in the dataset, including those call files with the highest (near 1.0) and lowest (0.3) confidence rankings attributed by BirdNET. For species with a relatively low number of calls (less than 15 call files recorded), 90% to 100% of files were reviewed. For bird species recorded relatively frequently (i.e., 30 to 150 call files, sometimes many thousands), the review included approximately 10% to 20% of call files. For bird species of special concern, all call files were reviewed.

7.4.5.7 Field Survey Results

2022 Breeding Bird Surveys

Breeding bird surveys were conducted within the Study Area in 2022 (June 19, 20, and 25). In total, 48 10-minute point counts were completed across the Study Area covering a wide range of habitat types and spatial distribution. A total of 60 bird species were observed (Appendix P). The most abundant and frequently observed species were the Black-throated Green Warbler (*Setophaga virens*; 62 individuals, 10.62% relative abundance), Ovenbird (*Seiurus aurocapilla*; 53 individuals, 9.08% relative abundance), and Hermit Thrush (*Catharus guttatus;* 40 individuals observed, 6.85% relative abundance), all of which were assessed as "possible" breeders.

SOCI observed during the 2022 breeding surveys include Canada Warbler, Eastern Wood-Pewee, Olive-sided Flycatcher, Philadelphia Vireo (*Vireo philadelphicus*), Canada Jay (*Perisoreus canadensis*), Pine Siskin, Wilson's Warbler (*Cardellina pusilla*), and Rose-breasted Grosbeak (*Pheucticus ludovicianus*).

Refer to Appendix P for full survey program details.

2022 Nightjar Surveys

Nightjar surveys were completed on July 13 and 14, 2022. Surveys were also completed at some survey stations on July 12; however, the wind conditions were strong. Although the data collected was considered incidental, surveys were repeated during the following two days. In total, 18 survey locations were established. Four Common Nighthawks were observed during the surveys on July 13 and 14, each at different survey location. Two individuals were performing wing booms. No Eastern Whip-Poor-Will were recorded during the nightjar surveys (refer to full details, including locations, Appendix P).

2022 Nocturnal Owl Survey

Nocturnal owl surveys were conducted at 13 locations between 8:21 pm on April 26, 2022, and 12:04 am on April 26, 2022. Thirteen 9.5 minute surveys were completed at 13 locations throughout the Study Area, with six individual owls representing two species, Barred Owl (*Strix varia)* and Northern Saw-whet Owl (*Aegolius acadius*), observed (Appendix O). Barred Owl was the most common species observed.

No SOCI owls were observed during the 2022 nocturnal owl surveys. Full survey details are provided in Appendix O.

2021/2022 Diurnal Raptor Passage Monitoring Surveys

Diurnal raptor passage monitoring surveys were conducted on one day during the fall 2021, and three separate days in fall 2022. Surveys were completed on November 1, 2021, and October 20, 21, and 28, 2022. These surveys were conducted within the Study Area, under suitable environmental conditions including no precipitation and good visibility. Surveys were carried out between approximately 11:00 am and 2:00 pm on each survey day, when conditions for the creation of thermals which allow thermal soaring are more prevalent and migratory raptor movements are most visible. Using binoculars and a spotting scope, the surveyor scanned for birds in flight from all visible directions.

Six raptor species, comprising 20 individual birds, were observed during the diurnal raptor passage monitoring surveys. Raptors noted during the surveys were flying at or above 10 m from the ground, with most of the species being observed flying at 60 m to 120 m from the ground (high height). Raptors were observed singly or in small (fewer than three) groups. No large kettles of raptors were observed. Additional raptor survey program details are provided in Appendix Q.

2021/2022 Fall Stopover Migration Surveys

Fall stopover migration surveys were completed from September 22 to October 19, 2021, and August 25 through September 17, 2022. Excluding individuals not identified to species level, 63 species, comprising 1,248 individual birds were observed during the fall stopover migration surveys (Table 7.57; Appendix Q). Surveys were completed across a wide range of habitats, spatially distributed throughout the Study Area.

The most abundant identified species observed during fall migration were Black-capped Chickadee (*Poecile atricapillus;* 145 individuals, 10.44% relative abundance), Dark-eyed Junco (*Junco* hyemalis; 102 individuals, 7.34% relative abundance), and Golden-crowned Kinglet (98 individuals, 7.06% relative abundance). These three species were also the most frequently detected species. Unidentified passerines made up 10.15% of birds observed. Relative abundance was calculated for each observed species; this is a measure of the proportion of each when compared with the total number of birds observed.

The majority of birds were observed individually or in small groups; however, some larger groups were observed. The largest single observation of a group of birds was of 30 American Goldfinches (*Spinus tristis*) seen flying outside of the Study Area, approximately 3 km to the east of Study Area's northeastern boundary, on October 19, 2021. The second largest observation was of 20 unidentified Warblers (possibly a mixed species migratory group), seen flying over the northeastern extent of the Study Area on September 1, 2022.

Three survey days in August 2022 produced records of 282 individuals representing 39 species. Combined 2021 and 2022 surveys (two survey days in 2021 and five survey days in 2022) completed in September produced records of 756 individuals representing 56 species. Three survey days in October of 2021 produced records of 351 individuals representing 29 species.

Table 7.57: Total Observations by Bird Group – 2020 Fall Migration Point Count Surveys

Bird Group	# Individuals*
Gamebirds	6
Landbirds	1,358
Owls	2
Raptors	6
Shorebirds	1
Waterbirds	1
Waterfowl	15
Total	**1,389**

*Includes individuals not identified to species level.

Landbirds dominated the observations, and most birds (over 86% of individual birds) were observed within 10 m of the ground, with an additional 12.5% observed between 10 m and 60 m of the ground. Out of a total of 1,389 birds observed, less than 1.1% percent were observed flying at 60 m to 120 m or above.

SOCI observed during the fall migratory point count surveys include:

- Black-billed Cuckoo (*Coccyzus erythropthalmus*)
- Turkey Vulture (*Cathartes aura*)
- American Kestrel (*Falco sparverius*)

- Canada Jay
- Boreal Chickadee (*Poecile hudsonicus*)
- Pine Siskin
- Cape May Warbler (*Setophaga tigrine*)
- Blackpoll Warbler (*Setophaga striata*)
- Wilson's Warbler
- Rose-breasted Grosbeak

Full details of the 2021/2022 fall stopover migration survey program, including results, are provided in Appendix Q.

2022 Spring Stopover Migration Surveys

Spring surveys were completed within the Study Area from March 31 through May 30, 2022. Excluding individuals not identified to species level, the surveys identified 1,049 individual birds representing 62 species (Table 7.62, Appendix Q). Surveys were completed across a wide range of habitats, spatially distributed throughout the Study Area.

The most abundant species observed during spring migration were American Robin (*Turdus migratorius*) and White-throated Sparrow (*Zonotrichia albicollis*; 98 individuals, 9.34% relative abundance) and Dark-eyed Junco (91 individuals, 8.67% relative abundance). Relative abundance was calculated for each observed species; this is a measure of the proportion of each when compared with the total number of birds observed. These three species were also the most frequently detected species.
During the survey period, most birds were observed singly or in small (i.e., fewer than 10 individuals) groups, but a small number of larger groups were observed. The largest single observation of a group of birds was of 50 Canada goose seen flying over the centre of the Study Area on May 2, 2022. The second largest observation was of 15 White-winged Crossbills (*Loxia Leucoptera*) seen flying low over the northeastern Study Area boundary on March 31, 2022.

A single survey day in March 2022 produced records of 56 birds representing 13 species. Surveys completed in April (four survey days) produced records of 315 birds representing 31 species. Surveys completed over three survey days in May produced records of 678 birds representing 57 species.

Different bird groups demonstrate differences in potential sensitivity to the presence of wind turbines (Kingsley & Whittam, 2004). The data on migration have therefore been summarized according to seven bird groups: landbirds (including most passerines), waterfowl (including ducks and geese), waterbirds (including herons, gulls, and cormorants), shorebirds (including plovers and sandpipers), raptors (including hawks, falcons, eagles, and for the purposes of this summary, vultures), owls, and gamebirds (including grouse), as indicated in Table 7.58.

Table 7.58: Total Observations by Bird Group – 2022 Spring Stopover Migration Surveys

Bird Group	# Individuals*
Gamebirds	9
Landbirds	984
Owls	3
Raptors	2
Waterfowl	53
Total	**1051**

* Includes individuals not identified to species level.

Landbirds dominated the observations, and most (over 96%) were observed foraging or flying within 10 m of the ground. Two observations of two individual raptors were made during spring migration, with one individual flying within 10 m of the ground, and the other flying between 10 m and 60 m of the ground. Most birds (96.29% of individual birds) were observed within 10 m of the ground. None of the 1,051 birds recorded during the spring surveys were observed flying above 120 m from the ground.

SOCI encountered throughout the 2022 spring stopover migration surveys included:

- Olive-sided Flycatcher
- Evening Grosbeak (*Coccothraustes vespertinus*),
- Canada Warbler
- Turkey Vulture
- Philadelphia Vireo
- Canada Jay
- Boreal Chickadee
- Pine Grosbeak (*Pinicola enucleator*)
- Cape May Warbler

Full details of the 2022 spring stopover migration survey program, including results, are provided in Appendix Q.

2021/2022 Winter Bird Surveys

Winter bird surveys were completed on December 14, 2021; January 5, 2022; February 16 and 24, 2022; and March 5 and 31, 2022. A total of 28 surveys of 500 m long transects were conducted over six survey days. In total, 89 observations of 139 individual birds, representing 20 species were made (refer to Appendix O). Observations included: 15 passerines, three woodpeckers, one gamebird, and one waterfowl species. The bird species observed during the overwintering surveys were expected for the Study Area and are typical of the habitat types in this area.

The most abundant species observed included Black-capped Chickadee (36 individuals), White-winged Crossbill (20 individuals), and Dark-eyed Junco (11 individuals). The most frequently recorded species were Black-capped Chickadee (18 observations), Common Raven (*Corvus corax*; 8 observations), and Dark-eyed Junco (8 observations).

The only SAR observed during overwintering surveys was a single Evening Grosbeak, while other SOCI observed include Boreal Chickadee and Canada Jay. Refer to Appendix O for additional 2021/2022 winter bird survey details.

Species diversity was observed to be low during the winter surveys compared to other seasons. SOCI observed are generally consistent with those observed during migration and breeding bird surveys and are not expected to be breeding during the winter months.

7.4.5.8 Habitat Modelling Results

Following a review of desktop resources and the completion of field assessments, a habitat model for SAR encountered during breeding season field surveys was constructed based on their respective breeding habitat requirements, as described above.

- Canada Warbler
- Common Nighthawk
- Eastern Wood-Pewee
- Olive-sided Flycatcher

The results of the modelling are shown in Drawings 7.32A and 7.32D. Given each SAR species' individual requirements for breeding habitat, the percentage of available modelled habitat within the Study Area to be potentially impacted within the Assessment Area is variable, as seen in Table 7.59 below.

Table 7.59: Potential Project Impacts to Modelled Habitat for SAR

Species	Percentage of modelled habitat within the Study Area that is also within the Assessment Area (%)
Canada Warbler (*Cardellina canadensis*)	7
Common Nighthawk (*Chordeiles minor*)	18
Eastern Wood-Pewee (*Contopus virens*)	8
Olive-sided Flycatcher (*Contopus cooperi*)	8

7.4.5.9 Remote Sensing Results

Avian Radar Assessment

The results of the avian radar assessment are presented in detail in Appendix R. A summary is provided below.

Spring 2022

The ARU operated for 20 nights between April 22 and May 29, 2022. A total of 10,984 targets were identified during the spring monitoring campaign. Nightly mean passage rates ranged from 5 ± 2 targets per kilometer per hour (t/km/hr) on April 24 to 989 ± 69 t/km/h on May 11. The mean nightly passage rate for the survey period was 230 ± 21 t/km/h. The seasonal mean flight height of targets during the spring season was 371 ± 4 m above the radar site. The mean nightly flight height ranged from 152 ± 13 m on April 22 to 610 ± 34 m on May 27. The percent of targets observed flying below 180 m and 200 m was 34% and 37% for the season, respectively, and varied nightly from 15% and 18% on May 11 to 78% and 80% on April 22. For the season, mean hourly flight heights were variable throughout the night but were lowest at 1 hour after sunset and 10 hours after sunset. A small portion of the targets detected (~2%) flew with an erratic enough flight pattern to possibly be considered bats. Additional details and Figures 3.1 to 3.7 in Appendix R provide further detail on the spring 2022 radar program.

Fall 2022

The ARU operated for 30 nights between August 20 and October 28, 2022. A total of 50,731 targets were identified during the fall monitoring campaign. Nightly mean passage rates ranged from 35 ± 9 targets/km/hr on October 25 to 1,508 ± 255 targets/km/hr on September 6. The mean nightly passage rate for the survey period was 591 ± 36 targets/km/hr. Individual hourly passage rates varied among nights and throughout the season, ranging from 0 targets/km/hr during hour 11 on August 29 and during hour 12 on September 16 to 3,750 targets/km/hr during hour 4 on October 14. The seasonal mean flight height of targets during the fall season was 322 ± 1 m above the radar site. The mean nightly flight height ranged from 192 ± 5 m on August 30 to 694 ± 9 m on October 23. The percent of targets observed flying below 180 m and 200 m was 41% and 44% for the season, respectively, and varied nightly from 12% and 14% on October 23 to 64% and 67% on October 14. For the season, mean hourly flight heights were lowest at 1 hour and 12 hours after sunset. A small percentage of the targets detected (~5%) flew with an erratic enough flight pattern to possibly be considered bats. Additional details and Figures 3.8 to 3.14 in Appendix R provide further detail on the fall 2022 radar program.

Further discussion of the avian radar monitoring program is presented in Appendix R.

Effect of Weather on Bird Migration

The stochastic nature of migratory bird activity is likely attributable in large part, to weather, as it is well understood that weather and atmospheric conditions influence bird migration activity (Richardson, 1990), especially wind speed and direction (Liechti & Bruderer, 1998). Conditions when tailwinds assist the migration objective are often exploited by migrating birds to travel farther with less energy (Liechti & Bruderer, 1998).

Most birds in the region migrate south in the fall from breeding grounds in northern North America, to wintering grounds in Central and South America. Likewise, in spring, most species make the reverse journey, moving northward. The Nova Scotia peninsula extends along a southwest to northeast axis, and birds in the province often migrate along this axis, following the Atlantic coast. As such, birds migrating in Nova Scotia during the spring likely also proceed in an easterly direction in addition to north. Likewise in the fall, migrating birds may move to the west and south as they head to southerly wintering grounds.

Acoustic Monitoring Results

The results of the avian acoustic assessment are presented in detail in Appendix R. A summary is provided below.

Spring 2022

In the spring, 96,857 vocalizations were identified as bird vocalizations, and 99.9% of those were identified to species, resulting in a total of 77 identified species. These included various types of birds such as waterfowl, raptors, gamebirds, shorebirds, and landbirds. Among these, 23 species are year-round residents, and the remaining 54 species are migrants. The most frequently recorded species was the American Woodcock (*Scolopax minor*), a migrant breeding species, representing 54% of recorded vocalizations. Other commonly recorded species included the migrant Hermit Thrush (8% of vocalizations) and the migrant Winter Wren (*Troglodytes troglodytes*; 8% of vocalizations). The most frequently occurring resident species was the Black-capped Chickadee (4% of vocalizations).

Six of the 77 species identified were SAR and six were SOCI. SAR included Canada Warbler, Chimney Swift (*Chaetura pelagica*), Common Nighthawk, Evening Grosbeak, Olive-sided Flycatcher, and Rusty Blackbird. All SAR individually constituted less than 1% of total recorded vocalizations except for Canada Warbler, which constituted 1% of vocalizations. A total of 99% of the 1,446 Canada Warbler vocalizations were recorded at one detector between the nights of May 19 and May 29. These recordings of Canada Warbler were at acoustic monitor N4 (Figure 1.1, Appendix R), and while the concentration of calls in one location suggests potential breeding, there was limited activity afterwards, until the end of August at this location. SOCI included Boreal Chickadee, Boreal Owl (*Aegolius funereusi*), Canada Jay, Pine Siskin, Red-breasted Nuthatch (*Sitta canadensis*), and Rose-breasted Grosbeak, all of which constituted less than 1% of total vocalizations.

The average number of vocalizations per hour was greatest during hours 6 through 9 after sunset, dropping off drastically afterwards. Most species, besides owls, showed hourly trends similar to the overall data.

Fall 2022

In the fall, 6,951 vocalizations were identified as bird vocalizations, and 96% of those were identified to species, resulting in a total of 60 identified species. These included various types of birds such as waterfowl, raptors, gamebirds, shorebirds, and landbirds. Among these, 21 species are year-round residents, and the remaining 39 species are migrants. The most frequently recorded species were resident species and included Golden-crowned Kinglet (26% of vocalizations), Great Horned Owl (*Bubo virginianus*; 12% of vocalizations), Barred Owl (10% of vocalizations), and Hairy Woodpecker (*Picoides villosus*; 9% of vocalizations). The most commonly recorded migrant species included Hermit Thrush (6% of vocalizations) and White-throated Sparrow (3% of vocalizations).

Three of the 60 species identified were SAR and eight were SOCI. SAR included Canada Warbler, Eastern Wood-Pewee, and Evening Grosbeak. Eastern Wood-Pewee and Evening

Grosbeak individually constituted less than 1% of total recorded vocalizations while Canada Warbler constituted 3% of total recorded vocalizations. A total of 99% of the 182 Canada Warbler vocalizations were recorded at a single detector between the nights of August 26 and August 30. These Canada Warbler calls were at the same location as the concentration of calls during the spring 2022 monitoring. SOCI included Boreal Chickadee, Boreal Owl, Canada Jay, Greater Yellowlegs (*Tringa melanoleuca*), Least sandpiper (*Calidris minutilla*), Pine Siskin, Red-breasted Nuthatch, and Rose-breasted Grosbeak, all of which constituted less than 1% of total vocalizations, except for the Red-breasted Nuthatch, which constituted 2% of total vocalizations.

The average number of vocalizations was greatest during hours 10 through 11 after sunset. Most species, besides owls, showed hourly trends similar to the overall data.

Further discussion of the avian acoustic monitoring program can be seen in Appendix R.

7.4.5.10 Effects Assessment

Project-Avifauna Interactions

Project activities, primarily those that involve earth moving or vegetation removal, or interactions with avifauna in the airspace have the potential to impact avifauna (Table 7.60). These activities could result in habitat removal, reductions in food availability, and direct bird-turbine interactions. Other Project related activities, including during construction and operation, may impact avifauna behaviours, such as increased traffic and noise.

Table 7.60: Potential Project-Avifauna Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Avifauna		X		X	X	X			X	X		X	X		X

Assessment Boundaries

For the purposes of this assessment, the LAA for avifauna includes the Assessment Area as well as the airspace that is directly surrounding the turbines. The RAA for avifauna includes the surrounding landscape, including the airspace above this area, up to approximately 3000 m (Drawing 7.20).

Assessment Criteria

Assessment criteria provided in Section 4.6 also apply for avifauna. The VC-specific definition for magnitude is as follows:

- Negligible – no loss of important avifauna habitat (e.g., breeding bird habitat) and no impacts to migratory avifauna are expected.
- Low – small loss of important habitat supporting avifauna and/or impacts to migratory avifauna are expected to be low.
- Moderate – moderate loss of important avifauna habitat and/or moderate impacts to migratory avifauna.
- High – high loss of important avifauna habitat and/or high impact to migratory that would be sufficient to impact species on a population scale.

Effects

Habitat Loss and Fragmentation

Across Canada, forest harvesting, and silviculture are leading causes of habitat loss for forest-dependent avian species, with mining and energy exploration also contributing to habitat loss, as well as to the disruption of individuals and their migratory and breeding behaviours (ECCC, 2016).

The footprint of the Project, particularly the area that will impact intact habitat, is relatively small compared to other developments in the natural resource sector. Only approximately 16 km of new road will be constructed within the Study Area, and upgrades to pre-existing roads will be removing small areas of habitat in an area that has already been disturbed. In addition, 14 of the 16 turbines are sited in areas that have been previously disturbed through forestry activities or otherwise, minimizing impacts to breeding habitats for birds. The Project design also prioritized the avoidance of old growth forests and has minimized loss of wetland habitat. Habitat loss and fragmentation effects to avifauna are therefore expected to be low.

Additional evaluation of habitat loss and availability was completed for SAR observed within the Study Area during field surveys.

Canada Warblers were observed throughout breeding bird studies in the field, as well as through remote sensing using acoustic monitors within the Study Area. The highest level of breeding status observed was possible, indicated by multiple instances of males singing. While it is possible that Canada Warblers could be using the Study Area for breeding and related activities, no breeding behavior was observed throughout breeding bird surveys. Given the concentration of activity recorded through acoustic monitoring, it is possible that there was breeding in 2022, though no confirmation was observed. This location of concentrated acoustic activity is along an existing trail corridor adjacent to the Assessment Area, near modelled Canada Warbler breeding habitat. Modelled habitat suggests there is some available breeding habitat within the Study Area (Drawing 7.23A), though the Project has been optimized to minimize impacts to modelled habitat.

Common Nighthawks were observed during nocturnal field surveys, primarily foraging and passing overhead. While these observations are consistent with potential breeding behaviours, no confirmed breeding evidence was observed. Modelled habitat suggests there is ample breeding habitat available for these birds, including along roads (both active and unused) throughout the Study Area (Drawing 7.23B). In addition, the construction of turbine pads and new spur roads may create additional suitable habitat for Common Nighthawks.

Eastern Wood-pewee was only observed on one occasion during the breeding bird surveys. No behaviour suggestive of breeding was observed, however habitat modelling suggests there is ample habitat suitable for breeding and associated activities within the Study Area. As the species prefers the mid-canopy of more developed deciduous or mixed forests, there is the possibility that the damage resulting from Hurricane Fiona may have impacted the breeding habitat available on site (Drawing 7.23C).

Olive-sided Flycatchers were observed on several occasions throughout the breeding bird surveys, however there was no confirmed evidence of breeding. As the species prefers coniferous or coniferous dominated mixed-wood stands near edge and transitional habitat, the hardwood dominated slopes and silviculture focused Study Area are not an idyllic example of preferred habitat. Much of the habitat modelled for Olive-sided Flycatchers is coincidental with areas that have undergone significant silvicultural and forest management work to increase the yield of softwood from those areas, as most of the less-managed forest types on within the Study Area are deciduous-dominated (Drawing 7.23D).

Road Traffic

Many species of avifauna are known to use the roadways within the Study Area, as evidenced by field survey results. An increase in road traffic will increase chances of mortality to those avifauna using the roadways, especially Roughed Grouse (*Bonasa umbellus*) and similar species, as they are known to use roadways for travel and nesting. Most roads within the Study Area are currently used for recreation by off-highway vehicle users and forestry activities. Outside of the construction phase, the Project will only require technicians to access the site to perform regular maintenance/equipment checks. Considering the pre-existing traffic load and the minimal traffic to be associated with the Project, road traffic is expected to have a negligible to low effect on avifauna in the LAA.

Bird Strikes

Bird strikes are a primary concern when considering the interactions of avifauna with the Project, as turbine blades spin at high speeds through the airspace frequented by a variety of species at all different altitudes within the rotor swept area. Bird strikes include instances when birds are struck by the rotating turbine blades, or birds collide with the turbine tower or nacelle structures, which can cause injury or mortality to birds.

Observed migration events were stochastic throughout the migration seasons, and are likely heavily influenced by weather, particularly wind direction. This is consistent with the findings of a large-scale avian radar study conducted in the continental United States, which determined that most migratory bird movements occur on just 10% of a migration season's nights (Horton et al., 2021). Although mean nightly passage heights observed across both spring and fall 2023 seasons were well above turbine heights, targets heights were also noted to be highly variable. It is anticipated that interactions with the turbine infrastructure would vary over time, with variations in migratory bird height and density. Bird strikes and avian mortalities are likely to be proportional to migratory bird activity.

Radar surveys cannot quantify the level of collision risk involving nocturnal migrants at a particular project, and statistical analysis has shown no relationship between pre-construction passage rate and post-construction level of mortality, as noted in Appendix R.

Other studies that examined interactions between wind turbines and avifauna have determined the level of avian mortality caused by wind turbines to be low (Zimmerling et al., 2013), including several post-construction avian mortality monitoring programs conducted by Strum at operating wind power projects in Nova Scotia within the past decade (i.e., >1 detectable bird mortality[3] per wind turbine per year on average).

Migration Disruption

The Project could impact bird migration indirectly (e.g., sensory disturbance or requiring excess calorie expenditure that would compromise a bird's ability to migrate).

Turbine lighting could cause sensory disturbances that disrupt migration activity, as migratory birds are attracted to sources of light at night, especially in low visibility conditions. Operating turbines can also cause sensory disturbances, causing birds to divert course, and possibly spend excess caloric energy, thus compromising migration success.

Lighting associated with the Project will be minimal, and the turbines will be un-lit at night (apart from a red navigation hazard light mounted on the turbine's nacelle). As such, lighting is not expected to impact bird migration. Other research that addresses the impacts of operating wind turbines on migratory bird movements has determined that the machines do not significantly alter migratory bird movements (d'Entremont et al., 2017), suggesting that impacts to migration as a whole would be minimal.

Mitigation Measures

Adaptive management of potential effects will be addressed through the development and implementation of an EPP which will include mitigation and monitoring for avian species. The primary mitigation for avifauna is avoidance in the siting of infrastructure, including:

[3] Detectable bird mortalities are determined during post-construction avian mortality monitoring programs by searching for bird carcasses under operating wind turbines using human searchers. This technique is subject to error from scavenger removal and searcher efficiency, so the actual bird mortality levels are likely higher than the detectable levels.

- Avoidance of topographic funnels, such as within lake or river valleys, for turbine placement to reduce the likelihood of interactions with concentrated bird movements.
- Avoidance, to the extent possible, of important bird habitats, such as wetlands, waterbodies, old growth forest, etc. to reduce the impact of habitat changes. This includes siting Project infrastructure within areas with existing disturbances, such as existing roads and cutover areas of forest.

Mitigations to reduce effects on avifauna include:

- Adhere to ECCC guidelines on clearing windows for nesting migratory birds. Vegetation clearing activities will be conducted outside of the nesting period that is generally from late March/April to September each year (ECCC, 2018). Timing of clearing activities are generally dependent on seasonal conditions.
- Establish speed limits within the Project Area for construction vehicles to mitigate the effect of vehicle-avifauna collisions.
- Incorporate a lighting plan for construction-related activities into the EPP.
- Maintain good housekeeping practices during construction to avoid indirectly feeding birds, and potentially attracting nuisance wildlife.
- Develop a spill response plan, and an emergency response plan within the EPP to mitigate the impacts of spills, hazardous substances, and other emergencies.
- Develop a fire response plan in accordance with provincial standards.
- Revegetate disturbed areas, as appropriate.
- Install avian deflectors on powerlines, including any powerline spans, or areas of line that will be identified in the EPP as requiring mitigation based on monitoring results.
- Minimize lighting, to the extent possible.
- Develop a site reclamation plan in accordance with engineering standards and in consultation with NSECC and NSNRR.

Monitoring

A site-specific Wildlife Management Plan will be developed to inform monitoring activities that will take place to ensure continued protection of known SOCI in the LAA and RAA. Some preliminary monitoring activities related to avifauna may include:

- Conduct post-construction avian mortality monitoring to assess mortality levels caused by turbine operations.
- Provide results from the second year of avian radar monitoring to CWS.
- Monitor changes to habitat within the Study Area and greater RAA that may occur as an indirect result of the Project and explore adaptive management measures to address monitoring results.
- Conduct breeding bird surveys post-construction to establish potential impacts to the breeding bird community, while also addressing changes in population dynamics, with special attention to SAR.

Conclusion
While effects to avifauna species differ, the effects considered to be of greatest concern include habitat loss, migratory disruption, and bird strikes. Based on this assessment and through the implementation of proposed mitigation and monitoring activities, effects to avifauna are expected to be of low magnitude, within the LAA, of medium duration, intermittent, reversible, and not significant.

8.0 SOCIO-ECONOMIC ENVIRONMENT

8.1 Economy

8.1.1 Overview and Assessment Methodology
The assessment of the economy included consideration of local demographics, income, and businesses, as well as the economic contributions of the Project to the local economy through a review of the following resources:

- Census of Population – Statistics Canada (2023)
- Taxation legislation
- Public mapping resources
- Economic data from the Proponent

8.1.2 Existing Environment
The Project is located in Colchester County, near the communities of Nuttby (3.3 km east), East New Annan (3.3 km north), McCallum Settlement (3.5 km south), West Earltown (5.9 km northeast), Central New Annan (7.8 km northwest), and Upper North River (6.6 km southeast). Colchester County is divided into five census subdivisions (CSDs) and the Project is located in Colchester Subdivision B.

Population statistics for the 2016 and 2021 Census of Population for the province and Colchester Subdivision B are summarized in Table 8.1.

Table 8.1: Population Characteristics from 2016-2021 for Nova Scotia and Colchester Subdivision B

Population Statistics	Nova Scotia	Colchester Subdivision B
Population in 2021	969,383	19,806
Population in 2016	923,598	19,534
Population change from 2016 to 2021	5.0%	1.4%
Total private dwellings in 2021	476,007	9,836
Land area	52,824.71 km^2	1,248.24 km^2
Population density	18.4/km^2	15.9/km^2

Source: (Statistics Canada, 2023)

The age distribution in Colchester Subdivision B reveals a median age of 48.8 years, which is slightly higher than the provincial median age of 45.6 (Statistics Canada, 2023). An overview of the age distribution in 2021 is outlined in Table 8.2.

Table 8.2: Age Distribution in 2021 in Nova Scotia and Colchester Subdivision B

Age Statistics	Nova Scotia	Colchester Subdivision B
0 to 14 years	136,710 (14.1%)	2,885 (14.6%)
15 to 64 years	617,345 (63.7%)	12,045 (60.8%)
65+ years	215,325 (22.2%)	4,875 (24.6%)
Total Population	**969,380 (100%)**	**19,805 (100%)**

Source: (Statistics Canada, 2023)

Average housing costs and average individual incomes in 2020 for Colchester Subdivision B were compared to the provincial and federal averages and are shown in Table 8.3.

Table 8.3: Housing Costs and Average Individual Income in 2020 for Colchester Subdivision B, Nova Scotia, and Canada

Jurisdictions	Average Dwelling Value in 2020	Average Total Income in 2020
Colchester Subdivision B	$227,400	$46,280
Province of Nova Scotia	$295,600	$47,480
Canada	$618,500	$54,450

Source: (Statistics Canada, 2023)

Most residents in Colchester Subdivision B speak English (>99%) (Statistics Canada, 2023). All public outreach and communication for the Project has been and will continue to be in English. There is some knowledge of other languages in the RAA, though no communication has been requested in other languages.

The nearest fire station to the Study Area is the North River and District Fire Brigade, located approximately 13 km south of the Study Area on Truro Road. The Valley Kemptown District Fire Brigade is also nearby, approximately 17 km south of the Study Area on Brookside Road.

Health and emergency services also exist in the area and are accessible to Project workers if the need should arise. The closest locations are the Urgent Treatment Centre at the Lillian Fraser Memorial Hospital, approximately 19 km north of the Study Area on Blair Avenue, and the Emergency Department at the Colchester East Hants Health Centre, approximately 22 km south of the Study Area on Abenaki Road.

Statistics for Colchester Subdivision B indicate that the unemployment rate in 2021 was 10.6%, lower than the provincial unemployment rate of 12.7% (Statistics Canada, 2023). The Colchester Subdivision B employment rate was 52.7%, slightly higher than the provincial employment rate of 51.9% (Statistics Canada, 2023).

The top five industries in the province in 2017 were compared with the top industries in Colchester Subdivision B and are provided in Table 8.4. The top two industries in Colchester Subdivision B were “retail trade” (15.8%) and “health care and social assistance” (13.7%) (Statistics Canada, 2023). Overall, the top industries in Colchester Subdivision B were similar to the top industries in the province as a whole, however, "manufacturing" was the third top industry (9.7%) in Colchester Subdivision B, compared to 6.4% in the province (Statistics Canada, 2023).

Table 8.4: Top Industries for the Employed Labour Force in 2017 in Nova Scotia Compared to Colchester Subdivision B

Industry	Nova Scotia	Colchester Subdivision B
Total employed labour force 15 years +	487,260	9,860
Health care and social assistance	70,595 (14.5%)	1,355 (13.7%)
Retail trade	58,985 (12.1%)	1,560 (15.8%)
Public administration	42,070 (8.6%)	700 (7.1%)
Educational services	38,425 (7.9%)	790 (8.0%)
Construction	35,720 (7.3%)	950 (9.6%)

Source: (Statistics Canada, 2023)

In the immediate vicinity of the Assessment Area there is recent and ongoing forestry operations, as well as the wind turbines associated with the Nuttby Mountain Wind Farm, located immediately to the east. All other uses of the Study Area could be considered recreational.

The Town of Truro is the closest economic centre, located approximately 20 km south of the Project and offering a range of business services. A review of some of the businesses located near the Project (both within and near Truro) is provided below in Table 8.5.

Table 8.5: Local Businesses and Proximity to the Project

Business	Distance and Direction to the Project*
Sullivans Family Farm	5 km east, on Sullivan Road
Dream Acres MX Park	7 km northeast, on Ferguson Brook Road
Belmont Mountain Range	12 km southwest, on Upper Belmont Road
The Store	13 km south, on Highway 311
Velocity Tire	13 km south, on Truro Road
Manley's Auto Salvage	14 km south, on Onslow Mountain Road
Patton's Plumbing and Heating	15 km south, on Gorman Road
Raging Crow Distillery	15 km south, on Highway 311
Roadside Willies Smokehouse & Bar	18 km south, on Jennifer Drive
The Hub Shopping Centre (Truro Mall)	19 km south, on Robie Street
Truro Golf & Country Club	20 km south, on Golf Street

*All distances measured from centre of the Study Area, using the most direct route.

Aside from the immediate area and associated businesses, the communities of Nuttby, East New Annan, and others are all generally dependent on the greater municipal centre of Truro for many of their regular shops and services, including indoor recreation, big-box stores, and health care facilities including emergency services and inpatient care. Many residents of the communities surrounding the Project Area would commute daily to Truro for employment purposes.

8.1.3 Effects Assessment

Project-Economy Interactions

Project activities have the potential to interact with the economy during all phases of the Project (Table 8.6).

Table 8.6: Potential Project-Economy Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Economy	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Assessment Boundaries

The LAA for economy is Colchester Subdivision B. The RAA for economy includes the entire province.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for the economy as well. The VC-specific definition for magnitude is as follows:

- Positive – Project is expected to have a positive effect on the economy.
- Negative – Project is expected to have a negative effect on the economy.

Effects

It is estimated that the Project will result in approximately 200 million dollars in investments prior to operations at the end of 2025.

The Proponent is committed to sharing economic opportunities with the local community throughout the development and lifespan of the Project via the use of local skills and labour where possible, municipal tax revenue, and on-going energy literacy/education (such as presentations about renewable energy at local schools, community meetings or for municipal councils, windfarm tours and visits, etc.). The Project Team has and will continue to engage the community, local businesses, and municipal staff and leaders to help identify Project-related opportunities and benefits for the local community.

The Proponent understands the importance of supporting local suburban and rural communities. The Project Team is committed to using as many local skills as possible. Potential work includes environmental studies, geotechnical investigation, engineering, land and snow clearing, surveying, worksite security, road construction and maintenance, turbine component transportation, turbine foundation construction, turbine installation, collector system construction, and substation construction. Specifically, elements of job creation throughout the lifespan of the Project may include:

- Project Development – During the development phase of the Project, Nova Scotian professionals have and will continue to deliver services in a variety of areas, including civil and electrical engineering, geotechnical engineering, legal, environmental and biological surveys, archaeological, land and community relations, and many others. Dozens of professionals within Nova Scotia will render their services as part of the development of the Project.

- Construction – Though the construction phase of the Project is relatively short (i.e., 18 to 24 months), it will require a large workforce that will fluctuate throughout the construction period. Much of the construction employment will come through contracting and subcontracting of Canadian, and where possible, Nova Scotian construction firms and specialized service providers related to the balance of plant and installation and commissioning of the wind turbines. It is estimated that the Project will require approximately 150 to 250 jobs for varying scope and duration throughout the approximately two-year construction period. The largest construction scopes of work are anticipated to be:
    - Civil installation, which includes land clearing, grubbing, road building, and foundation installation, which includes:
        - Excavating
        - Rebar supply and installation
        - Anchor bolt supply and installation
        - Forming
        - Concrete supply and pouring
        - Grouting
    - Electrical installation, that is, transmission line, collector line and substation infrastructure installation, and connection to the NS Power grid; includes;
        - MV underground and Overhead installation
        - MV and LV cable terminations
        - Electrical Testing
        - Instrument installation and testing
    - Turbine installation, that is, the offloading of turbine components, stacking of the wind turbine generators, and commissioning, includes,
        - Crane supply
        - Turbine offload and erection
        - Mechanical works inside turbines
        - Electrical work inside turbines

- The Proponent will look to maximize local content where appropriate. To this end, the Proponent will hold a job fair prior to the start of construction to engage with local community members and service providers and identify suitable candidates and/or businesses to support construction phase employment and service providers.

- Operations and Maintenance – Operational wind projects require long-term operations and maintenance professionals to be located either on-site or within short driving distance of the Project. It is generally anticipated that an on-site operations manager will be required to run the day-to-day operations. This individual will work closely with local service providers who will carry out high-voltage maintenance work, collection maintenance work, snow removal, road maintenance and vegetation removal. In addition, a team of one to three turbine maintenance technicians will be required to maintain the wind turbines. In all, it is anticipated that there will be six to 12 full-time and part-time jobs associated with the Project, including the maintenance technicians described above. The jobs associated with operations and maintenance are long-term, local, stable, and well-paying jobs requiring skillsets such as experience managing facilities, working on wind farm or working with high-voltage systems. These jobs include:
    - HV Technicians / Electricians
    - Wind Technicians
    - Road Maintenance Workers
    - Vegetation Management Service Providers

- In addition to operations and maintenance of the wind turbines, there will be a variety of wind farm activities that will require on-going resources such as snow removal and road surface maintenance, administrative support, inventory/materials management, shipping, scheduling, and coordination of maintenance inspections to accommodate the facility's operation (i.e., power collection system, electrical substation inspections, etc.).

- EverWind will make available a Bursary Fund prior to commercial operations for community members who want to train in the renewables industry. This will support the additional use of local labour and skills both during the construction phase and operations phase of the Project.

In addition to the direct investments that the Project would bring to Nova Scotia's economy, the Project will result in indirect and induced economic benefits that will be realized by governments, local businesses, communities, and residents. Workers that are directly involved with the development, construction and operations would contribute to the local economy by redistributing wealth to a variety of goods and services such as hotels, restaurants, and grocery stores (USDE, 2008).

As outlined in the *Wind Turbine Facilities Municipal Taxation Act*, S.N.S. 2006, c. 22, Colchester County will receive tax revenues per MW on an annual basis and as such, the royalty will annually increase as the Consumer Price Index rises. The Project is expected to enhance the community's economic development by providing tax revenues of approximately $830,000 annually to the Municipality of Colchester, escalating in each year of operation.

A renewable energy project in a community provides residents with the opportunity to gain a better understanding of wind technology and how wind power can help reduce reliance on fossil fuels. Energy literacy is an increasingly important skill in today's economy, and the Project Team is committed to promoting energy literacy initiatives in the surrounding communities and is available to answer questions and provide a better understanding of local and provincial energy issues.

Mitigation Measures
The economic impact to the LAA and RAA is positive; therefore, no mitigation is proposed.

Monitoring
A specific monitoring program for the economy is not recommended.

Conclusion
The impact to the economy is expected to be positive, extend to the RAA for a medium duration, be continuous, and irreversible.

8.2 Land Use and Value

8.2.1 Overview and Assessment Methodology

The assessment of land use and value was completed through a review of desktop resources and in consideration of feedback from public engagement to evaluate how the Project may interact with this VC. The following resources were reviewed:

- Nova Scotia property records
- Public mapping resources
- Literature review of property values and wind farms

8.2.2 Existing Environment

The Study Area primarily consists of Crown land, with several parcels of private land. Land use around the Study Area is primarily used for forestry and recreational use; however, there is a mix of residential and agricultural land uses to the east along Highway 311. Recreational land use is discussed in Section 8.4.

Several public protected lands and parks are also located in the vicinity (Drawing 7.17), including Cook Conservation Lands northwest of the Project and Gully Lakes Wilderness Area east of the Project. There are also several other points of interest near the Project including Nuttby Falls and Stone House, a century old stone home in Tatamagouche.

There are no Mi'kmaq reserve lands within 10 km of the Study Area, nor any mineral leases known to be held for the Study Area, aside from the pre-existing quarries that are on private land nearby. Further consideration of Mi'kmaq resources and the results of the MEKS are included in Section 5.0, and further consideration of the Project's geophysical environment are included in Section 7.2.

8.2.3 Effects Assessment

Project-Land Use and Value Interactions

Project activities have the potential to interact with land use and value during all phases of the Project (Table 8.7).

Table 8.7: Potential Project-Land Use and Value Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Land Use and Value	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Assessment Boundaries

The LAA for land use and value includes Colchester Subdivision B. The RAA is not applicable.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for land use and value as well. The VC-specific definition for magnitude is as follows:

- Negligible – no change in land value expected and surrounding land use can largely continue.
- Low – small change in land value expected and/or minor limitations to surrounding land use.
- Moderate – moderate change in land value and/or moderate limitations to surrounding land use.
- High – high change in land value and/or widespread limitation to surrounding land use.

Effects

Due to the nature of turbines being tall structures with small footprints, they are highly compatible with other land uses like agriculture, forestry, and ground-based recreation. The forestry activities that are ongoing in the area will not be disrupted by the Project. As existing users of the private land parcels are primarily commercial in nature, upgraded roads and infrastructure will improve access, limit weather related access disruptions, and improve the access road conditions which will reduce wear on vehicles and other industrial equipment. In addition, the Project will likely increase the value of forestry lands used for the Project as it represents a new source of revenue with land lease agreements. None of the existing and permitted users of the private land are expected to be impacted by the Project.

A recent study mentions that given the traditional energy industry's impacts on conservation in both direct and indirect ways, wind energy can be seen as a complementary land use to conservation and protected areas in a broad way, as wind energy is not a carbon emitter (Wind Europe, 2017). Given the context of Nova Scotia where the traditional energy source has primarily been coal, land use for wind energy can be seen as a positive step.

Potential effects on property value are often a concern of neighbouring residents due largely to anecdotal reports from appraisers of drastic declines in property values following the nearby installation of a wind energy facility (Gulden, 2011). Despite these concerns, many rigorous and statistically defensible studies have concluded that wind energy developments have had no significant effect on surrounding property values.

Prior to 2013, the most comprehensive study on the impact of wind farms on property values was completed by Hoen et al. (2009). This research analyzed data on nearly 7,500 sales of single-family homes situated within 10 miles (16 km) of 24 existing wind farms in the United States. Eight different hedonic pricing models failed to generate statistically significant evidence that property values for houses located within 10 miles (16 km) of wind farms are influenced by the developments. Subsequent research by the same researchers but employing additional analyses confirmed these results (Hoen et al., 2011).

Carter (2011) analyzed home transactions in a rural landscape surrounding small (one to four turbines) wind energy developments, while employing a hedonic model to statistically control for variables affecting all real estate transactions such as square footage, age of home, and school zone. This study concluded that proximity to the wind farms did not impact the average selling price of homes; in fact, in one case, homes closer to a wind farm sold for significantly higher than those elsewhere (Carter, 2011).

A study by Hinman (2010) tracked property transactions in communities located close to a 240-turbine wind farm for an eight-year period that spanned pre-development and operation stages. Hinman (2010) found that before project approval, property values in the area decreased. This was attributed to a fear of the unknown effects that the development would have; an effect known as anticipation stigma. However, once the development became operational, property values recovered. This recovery was attributed to a greater understanding of the operational effects of the development. Anticipation stigma, however, was not detected in a similar study in Colorado (Laposa & Mueller, 2010), in which it was concluded that the announcement of a large wind energy development did not significantly reduce the selling prices of homes surrounding the proposed development.

Until recently, the primary limitation of previous research on the effects of wind energy facilities on surrounding home values has been that research has been based on relatively small sample sizes (data sets) of relevant home-sale data. The inability to account for the complexity of the various factors which affect property values has also been cited as a limitation to previous studies. In particular, data had been limited for homes located within about a half mile (800 m) of turbines, where impacts would be expected to be the largest: Hinman (2010) (sample size of 11); Carter (2011) (sample size of 41). This is in part because setback requirements generally result in wind facilities being sited in areas with relatively few dwellings, limiting the number of sales transactions available to be analyzed (Hoen et al., 2013). Although these smaller data sets are adequate to examine large impacts (e.g., over 10%), they are less likely to reveal small effects with any reasonable degree of statistical significance.

A study published in August 2013 by Berkeley National Laboratory (principal authors) was conducted to address these gaps in data and included the largest home-sale data set to date. Researchers collected data from 51,276 home sales spanning 27 counties in nine states, related to 67 different wind facilities (Hoen et al., 2013). These homes were within 10 miles (16 km) of 67 different wind facilities, and 1,198 of the sales analyzed were within 1 mile (1.6 km) of a turbine, giving a much larger data set than previous studies had collected. The data span the periods well before announcement of the wind facilities to well after their construction (Hoen et al., 2013).

Two types of models were employed during Hoen et al.’s (2013) study to estimate property-value impacts: (1) an ordinary least squares model, which is standard for this type of study, and (2) a spatial-process model, which accounts for spatial variability. These models allowed the researchers to control for home values before the announcement of a wind facility (as well as the post-announcement, pre-construction period), the spatial dependence of unobserved factors effecting home values, and value changes over time. A series of robust models was also employed to add an additional level of confidence to the study results (Hoen et al., 2013).

Regardless of model specification, the results of Hoen et al.’s (2013) study revealed no statistical evidence that home values near turbines were affected in the post-construction or post-announcement/pre-construction periods. Therefore, the authors concluded that if effects do exist, either the average impacts are relatively small (within the margin of error in the models) and/or sporadic (impacting only a small subset of homes) (Hoen et al., 2013).

A study analyzing more than 7,000 home and farm sales from 2002 to 2010 in the Melancthon Township and 10 surrounding counties found that Ontario’s first and largest wind farm (133 turbines) had “no statistically significant effect” on property values. Further, the study found a lack of significant effect is similar across both rural residential properties and agricultural properties (Vyn & McCullough, 2014)

A recent review based on housing and property values within specific radii of wind farms and other energy infrastructure by Brinkley and Leach (2019) finds that while most energy infrastructure has an impact on nearby land values, renewable energy projects (including wind farms) do not have statistically significant impacts. These findings are based on seven individual studies of varying scales that all consider the value of property relative to the proximity to wind power, whether a single turbine or more (Brinkley & Leach, 2019).

A 2019 analysis of property values research in the energy sector was conducted by researchers at the University of California, Davis. The analysis found that studies on the topic of wind turbines and property values overwhelmingly find that wind turbines do not negatively impact property values at any point during their installment, including post-announcement, during construction and post-construction" (Property Values and Land-based Utility-Scale Wind Turbines, American Clean Power Association).

More recently, in March 2022, Marous & Company conducted a Market Impact Analysis for the Shenandoah Hills Wind Project in Fremont and Page counties, in the state of Iowa. The authors conducted a survey of county assessors across 10 states in which wind farms are located (41 Iowa counties, 11 Minnesota counties, 20 Illinois counties, 5 Indiana counties, 7 Michigan counties, 3 Ohio counties, 6 New York counties, 21 Kansas counties, 8 South Dakota counties, and 5 West Virginia counties). They did not find any market evidence to support a negative impact on residential property values because of the development of and the proximity to a wind farm. They also concluded that there were no reductions in assessed valuations" (Property Values and Land-based Utility-Scale Wind Turbines, American Clean Power Association)

Research has consistently demonstrated that, in a variety of spatial settings and across a wide temporal scale, sale prices for homes surrounding wind energy facilities are not significantly different from those attained for homes sited away from wind energy facilities.

Mitigation Measures

The Project has been designed to minimize potential effects to land use and value through siting considerations and engagement with neighbouring landowners. This has included the movement of specific turbines based upon stakeholder engagement and the results of desktop, field, and modelling studies to minimize visual disturbance to existing homes. Furthermore, the Project has a large spatial and topographic separation from most dwellings which will avoid other nuisance interactions such as shadow flicker and wind turbine related noise. No specific mitigation related to land use and value is recommended.

Monitoring

A specific land use and value monitoring program is not recommended.

Conclusion
The impact to land use and value is expected to be negligible and is therefore considered not significant.

8.3 Traffic and Transportation

8.3.1 Overview and Assessment Methodology
The assessment of traffic and transportation was completed using information provided by the Proponent and gathered during stakeholder engagement to understand how the Project may interact with existing traffic volume and patterns.

8.3.2 Existing Environment
The centre of the Project is located approximately 5 km west of Highway 311. The two arterial roads that grant access to the majority of the Project Area are Old Nuttby Road which begins at Highway 311 and runs northwest where it ends at the intersection of Kennedy Hill Road and Kavanaugh Mill Road, and Truro Road which also begins at Highway 311 and runs north where it ends at Maple Avenue near Highway 6. However, much of the road system that exists in the Study Area consists of existing access roads associated with the existing Nuttby Mountain Wind Farm, or forestry-related access roads.

Throughout the Study Area, the roads are accessible by truck/ sports utility vehicles (SUVs) as well as other vehicles designed for rough dirt roads and tracks. During the summer months, there are few vehicles visiting the area aside from the rare drive-through or ATV user. Due to the relatively remote location and lack of inhabitants, as well as the poor quality of the roads, there is little through traffic in the summer.

Existing traffic is primarily related to forestry activities. During the fall and winter months, the Study Area is far more frequently visited, both for hunting and other recreation activities, including snowmobiling and ATV use. Smaller roads that cover the Study Area, many of which are dead ends, are primarily used for ATVs year-round, though most see very little traffic.

The transportation route to deliver turbine components to the Project is subject to the final turbine technology provider, who will undertake a comprehensive logistics study to determine the transportation route from the receiving and unloading port. Primary access routes during the operational lifespan of the Project are expected to be Old Nuttby Road and Truro Road, potentially Old Tatamagouche Road, and the existing network of smaller access roads. Appropriate permits and engagement with NSPW will occur prior to transportation.

Air Navigation, communications, and navigation aids are addressed in Section 10.2.

8.3.3 Regulatory Context
The following permits and considerations are anticipated to be required for the transportation of turbine components:

- Work Within Highway Right of Way Permit (NSPW)
  - Required if removing access signs and guard rails.
- Overweight Special Moves Permit (Service NS and Internal Services)
  - Required to transport oversized and overweight components. In some cases, due to the size and weight of the components, some may only be transported on Sundays.
- Provincial road weight restrictions will also need to be considered, especially spring weight restrictions, for heavier equipment and materials that will be transported to the Project boundary.
- Access points will be designed with proper height and width to accommodate large trucks and will adhere to commercial stopping sight distances.

8.3.4 Effects Assessment

Project-Transportation Interactions

As on-site traffic is minimal, Project activities primarily have the potential to interact with transportation during the delivery and removal of turbine components (Table 8.8).

Table 8.8: Potential Project-Transportation Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Transportation							X							X	

Assessment Boundaries

The LAA for transportation is Colchester Subdivision B. The RAA extends from the LAA to the Port of Dartmouth. A route study is currently underway to determine the exact transportation route that turbine components will follow to reach the Project.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for transportation as well. The VC-specific definition for magnitude is as follows:

- Low – small change in traffic levels and/or minimal disruptions to traffic flow and routing.

- Moderate – moderate change in traffic levels and/or moderate disruptions to traffic flow and routing.
- High – high change in traffic levels and/or high disruptions to traffic flow and routing.

Effects

The transportation route may require road modifications, including the removal of signage and guardrails. Upgrades will also be made to roads and overhead wires, branches, and signs if conflicts arise.

During the Project's construction phase, trucks and other vehicles will be frequently visiting the area resulting in increased vehicular sound and air emissions. Most days during construction will have 20 to 40 trucks per day, with a few days potentially requiring up to 100 trucks. Outside of the construction phase, the Project will only require a small number of technicians to access the site to perform regular maintenance/equipment checks.

The Proponent has committed to not restricting public access to roads and trails in the area with the exception of active construction sites such as excavations or lift sites where restrictions are necessary due to safety considerations. In such circumstances, signs will be posted and physical barriers such as cones, candle sticks, t-posts and rope will be erected.

Mitigation Measures

- Install notices in public areas to inform residents of signage removal or road infrastructure alterations, as well as notify relevant municipal government staff of construction scheduling and safety measures.
- Replace removed signage and guardrails immediately with appropriate temporary signage to ensure the safety of travelling public.
- Complete upgrades to roads and overhead wires, branches, and signs if conflicts arise.
- Complete modifications and associated reinstatement to relevant specifications.
- Avoid, to the extent possible, transportation through urban areas (including Halifax and Truro) during high traffic times (e.g., 7 am to 9 am and 3 pm to 6 pm; Monday through Friday).
- Conduct all travel using safe work practices for transporting oversized loads.
- Utilize the minimum number of vehicles possible to minimize impacts to road-way flow and air quality due to exhaust emissions.
- Ensure vehicles only visit and work on-site during normal daytime hours of operation, where possible, and avoid high-traffic times of day to reduce local traffic congestion.

Monitoring

A specific traffic monitoring program is not recommended. However, the Project will develop a complaint response protocol, which will consider complaints related to traffic.

Conclusion

The impact to traffic and transportation is expected to be moderate, extend to the RAA for a short duration, be intermittent and reversible. Impacts related to transportation are considered not significant.

8.4 Recreation and Tourism

8.4.1 Overview and Assessment Methodology

The assessment of recreation and tourism was completed through a review of desktop resources and in consideration of feedback from public engagement to evaluate how the Project may interact with this VC. The following resources were reviewed:

- Nova Scotia Visitor Exit Survey (2019)
- Literature review of wind farm impacts on tourism and recreation
- Review of Municipality of Colchester website

8.4.2 Existing Environment

The Project is located in Colchester County, specifically Colchester Subdivision B, situated between Truro and Tatamagouche.

The communities of Kemptown and Nuttby are home to a variety of primarily outdoor recreational activities. Approximately 23 km northwest of the Study Area is the largest ski hill in the province. Ski Wentworth is a primary economic driver for local tourism and recreation sectors in the winter months. The attractions to the area for recreational property owners include proximity to skiing, as well as the other recreational activities such as hiking and sight-seeing that can be enjoyed during all seasons.

In the summer, the draws include ATV use on the various trails (that are used for snowmobiling in the winter), and the use of other outdoor facilities. Rogart Mountain Trail is located approximately 8 km east of the Project, a 6.2 km trail used for hiking and snowshoeing through a forest of white spruce, yellow birch, and sugar maples. Earltown Lake & Portage Trail is also located approximately 12 km east of the Project, a 4.5 km trail passing through fern-covered woods, beside two lakes.

Despite the lack of direct tourism destinations within the Study Area, there are many tourists who pass near the area on Highway 311 either travelling north towards Tatamagouche or south towards Truro. As the Study Area is located between these two regions, there are several restaurants and accommodations in the area and most tourist attractions in the area are less than an hour drive.

The standard deer hunting season in Nova Scotia stretches from the last Friday in October through the first Saturday in December. There is no hunting allowed on Sundays, except for the first two Sundays of the deer hunting season. Mammalian hunting or trapping may occur on the site, though no signs were observed during field surveys.

Most recreation within the Study Area is concentrated on the existing roads and trails. ATV use in the warmer months and snowmobile use in the winter account for most of the recreational use; however, other uses exist.

8.4.3 Effects Assessment

Project-Recreation and Tourism Interactions

Project activities have the potential to interact with recreation and tourism during all phases if access is changed, is temporarily limited to facilitate work, or if changes to the visual environment impact the user's experience (Table 8.9). Note that further details regarding visual impacts are addressed in Section 10.4.

Table 8.9: Potential Project-Recreation and Tourism Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Recreation and Tourism	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Assessment Boundaries

The LAA for recreation and tourism is Colchester Subdivision B. The RAA is not applicable.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for recreation and tourism as well. The VC-specific definition for magnitude is as follows:

- Negligible – no expected changes to recreation and tourism.
- Low – small change to tourism expected and/or minor limitations to recreation use.
- Moderate – moderate change to tourism and/or moderate limitations to recreation use.
- High – high change to tourism and/or widespread limitation to recreation use.

Effects

The 2019 Nova Scotia Visitor Exit survey, administered by Tourism Nova Scotia from January 1 to December 31, 2019, shows little information about attractions that could be related to the region surrounding the Project. No spatial data is available regarding the places visited within province, limiting the understanding of the impact that tourism has on the communities that surround the Project. Given that the main attractions discussed in the exit survey report are coastal scenery, the world's highest tides, lobster consumption, and the attractions in the Halifax Regional Municipality, the communities surrounding the Project do not appear to be significant tourist destinations, indicating that the Project is not likely to have a significant impact on inter-provincial tourism in the area.

There is visual evidence of the forestry operations in the Study Area. Although the Project is generally well-hidden from surrounding vantage points, some of the wind turbines proposed would be visible from several locations along Highway 311. The proposed turbines would be in addition to those that are pre-existing at Nuttby Mountain Wind Farm; the pre-existing turbines are presently visible from Highway 311 and other local roads. For further information on the view planes and landscape impacts related to the proposed turbines, see Section 10.4.

The area is also known for its recreational offerings such as hiking, camping, and biking. Enjoyment of the area and these activities are not expected to be impacted by the Project and will remain an interest for intra-provincial visitors.

It is difficult to determine with certainty how tourists will react to a wind power development. Wind farms are objects of fascination for many and thus could generate tourism for the local community, while others consider them to be an "eyesore". Some wind farms attract thousands of visitors per year and the benefits of even drawing a fraction of that number of visitors to a community can be felt by many businesses including shops, restaurants, and hotels (CanWEA, 2006a). Pincher Creek, Alberta developed a 19 MW wind farm in 1993. Since that time, tourism revenue from visitors from as far away as Russia has generated $5,000 in annual sales of clothing and souvenirs branded with the "Naturally Powerful Pincher Creek" logo (CanWEA, 2006a). The North Cape Wind Farm, a 10.56 MW wind facility located near Tignish, Prince Edward Island, has become a regional attraction, bringing in over 60,000 visitors per year. PEI's provincial government constructed a restaurant and gift shop at the site, resulting in a capital expenditure of $1.4 million. At the time of publication, the restaurant and gift shop were generating approximately $260,000 in annual revenue and employing 20 seasonal workers from mid-May to the end of October (CanWEA, 2006b). In Nova Scotia, the Pubnico Point wind farm has a positive public perception, despite being very visible from most of the surrounding communities (Municipality of Argyle, 2014).

A 2002 study by Market and Opinion Research International interviewed tourists visiting Argyll and Bute, Scotland and asked them about their attitudes towards the presence of wind farms in the area. Of those who knew about the surrounding wind farms (40% of those interviewed), 43% felt that wind farms had a positive effect on the area, 43% felt it made no difference, and 8% felt it had a negative effect (Market and Opinion Research International, 2002).

The Project Team is committed to working with local recreational groups to ensure continued access to the area and associated trails, within the bounds of all safety considerations, particularly during construction. As discussed above, the presence of turbines is highly compatible with most land-based recreation activities and is not expected to limit the usability of the area.

Mitigation Measures

- Continue to work with local recreation groups to ensure continued access to within the Study Area for recreation and hunting/trapping.
- Continue to work with nearby landowners to ensure there is a positive relationship within the community.

Monitoring

A specific tourism and recreation monitoring program is not recommended.

Conclusion

The impact to tourism and recreation is expected to be low, extend to the LAA for a medium duration, be intermittent and reversible. Impacts related to tourism and recreation are considered not significant.

8.5 Other Wind Farm Undertakings in the Area

The nearest wind development to the Study Area is the Nuttby Mountain Wind Farm, located immediately adjacent to the Project to the east. It has an installed capacity of 50.6 MW. No other wind developments were identified within 5 km of the Assessment Area.

8.6 Green Hydrogen and Ammonia Benefits

National and Global Benefits

The majority of energy produced from the Project will go towards green hydrogen and green ammonia production. EverWind expects to enter into a “sleeved” power purchase agreement which will enable its production facility in Point Tupper, Nova Scotia, to purchase renewable energy from the Project. As an emerging area, green hydrogen is expected to have an increasingly important role in a transforming energy sector by providing the zero-carbon feedstock to create ammonia in liquid form, which is then able to be easily shipped.

The production of green energy for green hydrogen and ammonia production for export is widely supported as a means to stimulate investment from the private sector, support global energy security, support the shift of fuel sources away from Russia, and facilitate global decarbonization (Bennett Jones LLP, 2023; BMWK, 2023; Federal Ministry for Economic Affairs and Climate Action, 2023; The Canadian Press Staff, 2023).

The green ammonia industry is relatively new, with diverse projects around the world in various stages of development from early planning to implementation. Countries such as Australia, Saudi Arabia, Oman, India, Russia, and China, among others, are investing substantially to gain a lead position in this industry which is projected to grow to $2.5 trillion in revenue by 2050 (Merida, 2023).

The Project also supports Canada's goals to become one of the top three hydrogen producers while adding another 350,000 jobs over the next three decades. It is estimated that the domestic hydrogen market can potentially scale to $50 billion by 2050, and the first movers will have a competitive edge over the competitors (NRCan, 2020).

> "Unlocking the potential of hydrogen is an essential part of our government's plan for a sustainable economic future — not just for the domestic opportunities for emissions reductions but also for its potential as an export opportunity: to provide clean energy to countries around the globe" (Government of Canada, 2022).
>
> The Honourable Jonathan Wilkinson
>
> Minister of Natural Resources
>
> "Green hydrogen is an important key for a climate-neutral economy. We must resolutely pursue climate change mitigation in order to secure our prosperity and freedom. This is more important and urgent than ever at this time. The Hydrogen Alliance between Canada and Germany is a significant milestone as we accelerate the international market rollout of green hydrogen and clear the way for new transatlantic cooperation. Specifically, we aim to build up a transatlantic supply chain for green hydrogen. The first shipments from Canada to Germany are to begin as early as 2025" (Government of Canada, 2022).
>
> Robert Habeck
>
> Vice-Chancellor of Germany

Grid Benefits

Green hydrogen contributes to energy resilience - hydrogen can act as an energy carrier to enable increased penetration of renewables by providing time shifting and energy storage capabilities. Hydrogen adds optionality in a future net-zero mix, complementing other energy vectors such as direct electrification and biofuels, and serving as a bridge between energy grids in an integrated energy system (NRCan, 2020).

Green hydrogen supports Nova Scotia's 2030 Clean Power Plan. Green hydrogen and ammonia production, as a flexible power user, has substantial benefits to the electricity grid and increases renewable penetration into the grid by purchasing green energy during periods of overproduction that would otherwise result in curtailment / wasted energy. By

2030, and with coal closed, green hydrogen provides fast-acting, dispatchable generation for periods of time if it is not windy, to ensure power during winter peaks, or should storms/events impact transmission lines. EverWind expects to be able to provide green hydrogen to NS Power to deliver hydrogen-capable generators.

Offshore Wind Benefits

Nova Scotia has also set a target to offer leases for five gigawatts of offshore wind energy by 2030 to support its budding green hydrogen industry, with the most promising use for offshore wind energy being generating renewable electricity to produce green hydrogen for use in the province and for export. The Project and EverWind's green hydrogen production facility enables future expansion into offshore wind, establishing Nova Scotia as a leader in clean energy.

9.0 ARCHAEOLOGICAL RESOURCES

9.1.1 Overview

The purpose of the Archaeological Resource Impact Assessment (ARIA) is to identify areas of high archaeological potential within the Assessment Area. Cultural Resource Management Group Limited (CRM Group) was contracted to conduct the ARIA, which was directed by Logan Robertson. In 2023, Boreas Heritage Consulting Inc. (Boreas Heritage), under the direction of Sara Beanlands, was contracted to supplement information in CRM Group's 2022 ARIA and provide greater geographical coverage of the area following modifications to Project layout plans within the Study Area.

9.1.2 Regulatory Context

The *Special Places Protection Act,* RSNS 1989, c 438 provides the province of Nova Scotia with a mandate to protect important archaeological, historical, and paleontological sites and remains, including those underwater. A permit is required for any archaeological or paleontological exploration or excavation in Nova Scotia. The permit system ensures that work is completed based on established standards by qualified applicants.

This ARIA was conducted in accordance with the terms of Heritage Research Permit A2022NS095, issued by the NSCCTH – Special Places Program. Boreas Heritage's 2023 ARIA is being conducted in accordance with the terms of Heritage Research Permit A2023NS157.

As archaeological work can often result in findings or information that is confidential or sensitive, a summary of the results of the ARIA are provided in the EA, with the ARIA reports provided directly to NSCCTH for review. It is understood that the findings and recommendations of the ARIA reports are considered "draft" until they are accepted by NSCCTH.

9.1.3 Assessment Methodology

The objectives of the ARIA were to:

- Evaluate archaeological potential within the Assessment Area.
- Identify, delineate, and investigate (where recommended) areas considered to exhibit high potential for encountering archaeological resources.
- Provide detailed and accurate information on the results of the survey.
- Provide comprehensive recommendations so that appropriate archaeological resource management strategies can be devised.

To achieve these objectives, both CRM Group and Boreas Heritage designed an assessment strategy consisting of a desktop component (background screening) and a field component (archaeological reconnaissance).

The desktop component examined three elements: the environmental context, the archaeological context, and the historical context of the Assessment Area. The environmental context is examined to identify past and current environmental influences or conditions that may elevate archaeological potential (e.g., topography, local resources, and potential for agriculture). The archaeological context is examined to identify how people used and occupied the surrounding landscape based on evidence from previously registered archaeological sites and past archaeological work conducted near the Project. The historical context is examined to identify how people used and occupied the local area based on evidence from published archival documents, ethno-historic records, local oral traditions, historic maps, local and/or regional histories, scholarly texts, and available property records.

In Nova Scotia, the Maritime Archaeological Resource Inventory (MARI) is maintained by the Nova Scotia Museum, on behalf of NSCCTH. Reports from past archaeological assessments and academic research conducted near the Project provide archaeological context, which informs the interpretation and evaluation of any potential archaeological resources identified during the field component of the ARIA.

Additionally, the desktop component involved a general review of topographic maps, coastal charts and aerial photographs to identify topographical and hydrological attributes that correlate with high archaeological potential (e.g., waterfalls/rapids as focal points for fishing or requiring portage, submerged marine terraces representing former coastline). These attributes were also incorporated into the archaeological potential models, developed by CRM Group and Boreas Heritage.

The field component involved an on-site visual examination (field-truthing phase) of the Assessment Area. The research team transected across the Assessment Area to visually assess archaeological potential, as ascribed by the background study and potential model. These transects assist in maintaining effective coverage. The field truthing phase assisted in the recognition of topographic and/or vegetative anomalies that may inform the extent and nature of previous disturbance factors in the Assessment Area (e.g., clear-cutting, ploughing, construction earthworks), or suggest an elevation in archaeological potential, including evidence of buried archaeological resources (e.g., small knolls, apple trees in the forest, overgrown depressions or abandoned roads).

As part of the potential model field truthing, one exploratory shovel test to assess the depth and composition of sediment stratigraphy within the area was also undertaken to help evaluate the area's surficial geology and archaeological potential.

As a follow-up to the archaeological potential modelling and field-truthing phase, fieldwork for the ARIA, conforming to the Guidelines set by NSCCTH (Special Places), consisted of archaeological reconnaissance. The goals of the archaeological field reconnaissance were to conduct a visual inspection of the proposed infrastructure area to search for and document any exposed archaeological resources and to further delineate areas of archaeological potential (low, moderate, and high). The survey was guided by the results of engagement, background research, potential model and field-truthing and took care to note any cultural landscape indicators. The researchers transected all portions of the proposed infrastructure, ensuring diligent observations within areas that may have been identified as having elevated archaeological potential as a result of the potential modelling and field-truthing.

Field geomatic data and tracklogs were recorded with handheld Garmin GPSmap 62s with +/- 5-metre accuracy. Field observations were recorded through the combination of georeferenced photographs, field sketches, and field notes.

Upon completion of field activities, analysis and interpretation, the results of the assessment were summarized in the ARIA reports (2022 ARIA submitted under separate cover, 2023 follow-up ARIA to be submitted under separate cover), including recommendations for appropriate resource management strategies. Photos, detailed plans, and GIS-based mapping of the testing area and specific find locations (if applicable) were also incorporated.

9.1.4 Assessment Results

2022

The field component of the ARIA was carried out over five days in July 2022 and resulted in the identification of three areas (HPA 1, HPA 2, and HPA-03) within the proposed Assessment Area considered to exhibit high potential for encountering archaeological or cultural heritage resources.

2023

A layout modification was made to the Project following the completion of the 2022 ARIA. As a result of this modification, an additional Heritage Research Permit was obtained to assess this area. The field component was carried out in September and October 2023 and resulted in the identification of 19 HPAs.

With the exception of the identified HPAs, all remaining portions of the Assessment Area are considered to exhibit low archaeological potential for encountering archaeological or other cultural heritage resources. As a result, CRM Group and Boreas Heritage recommend that these areas be cleared by NSCCTH of any further requirement for future archaeological assessment.

9.1.5 Effects Assessment

Project-Archaeological Resources Interactions

Project activities could interact with archaeological resources during earth moving activities in the construction phase (Table 9.1).

Table 9.1: Potential Project-Archaeological Resources Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Archaeological Resources		X		X	X	X									

Assessment Boundaries

The LAA for archaeological resources is the Assessment Area. The RAA is not applicable.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for archaeological resources. The VC-specific definition for magnitude is as follows:

- Negligible – activities have no potential for encountering archaeological resources during ground disturbance.
- Low – activities have a low potential for encountering archaeological resources during ground disturbance.
- Moderate – activities have a moderate potential for encountering archaeological resources during ground disturbance.
- High – activities have a high potential for encountering archaeological resources during ground disturbance.

Effects

There is low potential for effects to archaeology resources across most of the Assessment Area. Twenty-two HPAs were identified, which will be avoided or subject to a shovel testing program prior to ground disturbance. On April 26, 2023 NSCCTH provided a letter indicating its review and acceptance of the 2022 ARIA. The 2023 ARIA is well-advanced and will be submitted to NSCCTH for review upon completion. The Proponent is committed to following any forthcoming recommendations from the archaeologist and NSCCTH related to this work.

Mitigation

The following mitigation measures are recommended:

- Complete a systematic shovel testing program if ground impacts at HPAs cannot be avoided through Project design to further assess and delineate cultural heritage resource potential.
- Develop a chance find procedure in the EPP related to the potential unexpected discovery of archaeological items or sites, or human remains, during construction. This would include halting any work immediately upon discovery of suspected resources and contacting NSCCTH. If the resources are suspected to be of Mi’kmaq origin, the Executive Director of KMKNO would also be contacted.
- Conduct additional archaeological assessment if, during the detail design phase, it is determined that ground disturbance is required in areas not previously assessed. The EA Branch will be provided with the acceptance letter from NSCCTH prior to completion of any disturbance in newly proposed areas.

Monitoring

No monitoring programs are recommended.

Conclusion

With the implementation of the above mitigation measures, the potential for encountering archaeological resources is low to moderate. Effects would occur once, be short-term, restricted to the LAA, and be irreversible (to be confirmed based on any identified resources, as applicable). Effects are considered not significant.

10.0 OTHER CONSIDERATIONS

10.1 Human Health

The Project will be completed in the safest manner possible according to applicable health and safety related standards and requirements. Wind turbine models chosen for this Project were selected to ensure compliance with international wind class standards and incorporation of safety features to reduce the risk of lightning strikes, ice build-up, and general malfunctions. In addition, wind turbine siting considerations were incorporated into the Project’s design to reduce potential impacts on nearby receptors.

Potential human health impacts associated with air quality, shadow flicker, sound, effects from climate change, and other natural environmental hazards on the Project, and accidents and malfunctions are addressed in the following sections:

- Section 7.1.1 – Atmosphere and Air Quality
- Section 10.3 – Shadow Flicker
- Section 10.5 – Sound
- Section 12.0 - Effect of the Environment on the Undertaking
- Section 13.0 – Accidents and Malfunctions

Other potential effects to human health include electromagnetic fields (EMFs), ice throw, and electrical fires, which are discussed in the sections that follow.

10.1.1 Electromagnetic Fields

EMFs are a form of naturally occurring energy that is produced through the use of equipment or electrical appliances, not unique to wind turbines or farms. EMF fields are concentrated near the source, quickly dissipating with distance (Health Canada, 2020). Sources of low frequency EMFs may be associated with the following Project components:

- Wind turbines
- Transmission and distribution lines
- Underground cables
- Generator transformers

Several studies and reports have demonstrated that EMFs generated by wind turbines and associated infrastructure are not considered to be a concern to human health (CMOH, 2010; Knopper et al., 2014; & McCallum et al., 2014). Therefore, impacts to human health from Project emitted EMFs are negligible.

10.1.2 Ice Throw

Ice throw and ice fall (or shedding) occurs when ice builds up and releases from the turbine's rotor blades, tower, or nacelle under specific temperature and humidity conditions. Ice fragments can either be thrown from the rotor due to centrifugal and aerodynamic forces or fall to the ground during idling or shutdown periods (CREA, 2020).

Typically, ice buildup is associated with high winds or extreme weather events when the turbines are already shutdown. In addition, wind turbines have built-in ice or vibrational sensors that will shut down the turbine in the event of an ice buildup. Ice throw typically only occurs due to a malfunction of the control system or during start-up when speeds are low. The risk of injury or damage as a result of ice throw is only present within close proximity to the turbine during conditions of ice buildup. The maximum throwing distance of accumulated ice from a turbine is determined using the following equation (CREA, 2020):

$$d_t = 1.5 * (D + H)$$

Whereas:
d_t = Maximum throwing distance (m)
D = Rotor diameter (m)
H = Hub height (m)

Based on the above equation and turbine model specifications (163 m rotor diameter and 125 m hub height), the maximum throwing distance associated with the Project's turbines is 432 m. All potential receptors, both participating and non-participating, are located well beyond this distance. The public road within closest proximity to a turbine is Highway 311, which is approximately 2.9 km southeast of the nearest turbine. Therefore, there is little to no risk associated with ice throw to the public using these roads. However, there is a collection of logging roads and trails that exists throughout the Study Area, which are frequented by recreationalists for snowmobiling, hunting, and ATV use.

Mitigation measures to protect recreation users and site workers will include:

- Continue engagement and education with local recreational users (Section 8.0) regarding the safe continued use of lands within the Study Area.
- Install signage illustrating and warning of potential hazards associated with ice throw and fall around wind turbines.
- Equip staff and workers accessing the Project Area for maintenance or other purposes with necessary PPE and associated safety protocols and procedures to mitigate risk of injury and/or fatality, especially during potential icing conditions.

With the implementation of these mitigation measures, the impacts to human health from ice throw are negligible.

10.1.3 Electrical Fires

Wind turbines contain the key elements required for fire: fuel, oxygen, and a source of ignition. These elements are housed in the turbine nacelle, which is a compact and enclosed space at a height of 120 m. Fires may be ignited by lightning, an electrical malfunction, mechanical malfunction, or during maintenance. The height and remote nature of the turbines may make the early detection and effective control of fires difficult. However, these factors also reduce the direct impacts of electrical fires to human health. Evidence indicates that the occurrence of fires in wind turbines is rare. Between the years of 1995 and 2012, an average 11.7 fires were reported globally on an annual basis, resulting in four injuries and no fatalities over this time (Uadiale et al., 2014). With ~200,000 operational turbines worldwide in 2011, fires were reported in 0.006% of turbines (Uadiale et al., 2014). It is believed, however, that turbine fires are under-reported, and the proportion of fires occurring in turbines is closer to 0.05% (Uadiale et al., 2014). This percentage is still small, and wind turbine fires remain rare in comparison to fires occurring in other energy industries (Whitlock, 2015).

The wind energy industry has implemented various standards and guidelines to minimize the chances of fires occurring in turbines. This Project specifically has large setbacks from potential receptors and public roads.

Fire extinguishers will be in compliance with applicable Nova Scotia regulations and strategically located throughout the Project area in appropriately designated places such as Project vehicles, within the turbines themselves and the substation electrical building. If a fire occurs, Project personnel will attempt to extinguish it, but only if and when it is safe to do so. All Project personnel on-site during the life of the Project will be trained in fire response safety procedures. If there is any risk of personal injury, extinguishing the fire will not be attempted and the local fire department (and ambulance if necessary) will be called immediately. Project personnel will also notify the occupants at all adjacent properties immediately if the fire appears to be spreading beyond the specific Project site. Depending on the final choice of turbine model, a fire suppression system may be integrated into the operation of the wind turbine.

During operations, appropriate signage will be in place that includes instructions to call 911 and the phone number of the operator or owner representative of the Project, should an emergency arise. In the event of an emergency, Project personnel on-site will contact 911 and the Project Proponent. All incidents will be documented and kept on file. Documentation will include: date of incident, date of reporting, name of reporter, description of the incident, cause of the incident, actions taken, communications to outside groups and internal personnel, and follow-up, as required.

A fire prevention and evacuation plan will be implemented for Project personnel as part of the EPP, in addition to general safety protocol and training. Impacts to human health from electrical fires are negligible.

10.1.4 Conclusion

The impact to human health is expected to be negligible and is therefore considered not significant.

10.2 Electromagnetic Interference

10.2.1 Overview

The rotating blades and support structures of wind turbines can interfere with various types of electromagnetic signals emitted from telecommunication and radar systems (RABC & CanWEA, 2020).

EMI created by a wind turbine can be classified into two categories: obstruction and reflection. Obstruction occurs when a wind turbine is placed between a receiver and a transmitter, creating an area where the signal is weakened and/or blocked. Reflection is caused by the distortion between a raw signal and a reflection of the signal from an object. Scatter is a sub-category of reflection caused by the rotor blade movement.

The EMI assessment identified point-to-point, broadcast systems, radar, navigation, and communications systems susceptible to the effects of windfarm interference. The specific characteristics of a wind turbine will influence the type and magnitude of the interference. Other factors that influence interference include blade dimension and design, tower height, diameter of the supporting tower, as well as the material used for blade and tower construction.

10.2.2 Assessment Guidelines

The Radio Advisory Board of Canada (RABC) and CanWEA developed guidelines for assessing the EMI potential from a wind turbine development: Technical Information and Coordination between Wind Turbines and Radiocommunication and Radar Systems; hereafter referred to as the RABC Guidelines (RABC & CanWEA, 2020).

These guidelines outline a consultation-based assessment protocol that establishes areas (called “consultation zones”) around transmission systems, based on the type and function of the system.

10.2.3 Assessment Methods

Consultation is generally the best method of notification, and this process typically begins with a letter distribution to those parties affected by the development. A summary of the RABC Guidelines for determining consultation zones can be found in Table 10.1.

Table 10.1: RABC Guidelines – Recommended Consultation Zones

Systems	Consultation Zone
Point-to-Point Systems above 890 MHz	**1 km**
Broadcast Transmitters (AM, FM, and TV stations)	AM station: **5 km** for omnidirectional (single tower) antenna system **15 km** for directional (multiple towers) antenna system FM station: **2 km** TV station: **2 km**
Over-the-Air Reception (TV off-air pickup, consumer TV receivers)	Analog TV Station (NTSC): **15 km** Digital TV (DTV) station (ATSC): **10 km**
Cellular Type Networks, Land Mobile Radio Networks, and Point-to-Point Systems below 890 MHz	**1 km**
Satellite Systems (Direct to Home, Satellite Ground Stations)	**500 m**

Systems	Consultation Zone
Air Defence Radars, Vessel Traffic Radars, Air Traffic Control Radars, and Weather Radars	DND Air Defence Radar: **100 km** DND or Nav Canada Air Traffic Control Primary Surveillance Radar: **80 km** DND or Nav Can Air Traffic Control Secondary Surveillance Radar: **10 km** DND Precision Approach Radar: **40 km** Canadian Coast Guard Vessel Traffic Radar System: **60 km** Military or Civilian airfield: **10 km** Environment Canada Weather Radar: **50 km**
Very High Frequency (VHF) OmniRange	**15 km**

To conduct an EMI assessment, the following information regarding turbine design and placement is generally required to complete notifications:

- Turbine Universal Transverse Mercator (UTM) coordinates
- Number of turbines
- Ground elevation
- Tower/hub height of each turbine
- Nacelle height
- Rotor diameter
- Turbine blade sweep diameter (or length of blades)
- Turbine base diameter
- Substation/converter location coordinates and height(s) along with new transmission line(s) to connect to a grid

Response time and feedback from the various organizations varies and can take up to 12 weeks. If turbine type, layout or design changes, many organizations will need to be re-consulted prior to proceeding.

10.2.4 Assessment Results

Consultation with relevant agencies was completed and results are provided in Table 10.2. Reponses are provided in Appendix S.

Table 10.2: EMI Consultation Results

Signal Source	Operator	Consultation Results
Air defense and air control radar systems DND Radio Communications	DND	Notification letter sent September 2023. Response received; further information provided to DND as per request.
Maritime vessel traffic system radars	Canadian Coast Guard	Notification letter sent September 2023. Awaiting response.
VHF omnidirectional range Primary air traffic control surveillance radar	NAV Canada	Notification letter sent September 2023. NAV Canada confirmed receipt of Project package and stated that NAV Canada will review (eight to 12 week turnaround time) and reach out if further information is needed.
Weather radar	ECCC	Notification letter sent September 2023. Awaiting response.
Radiocommunication Systems	RCMP	Notification letter sent September 2023. Awaiting response.
Regulator	ISED	Notification letter sent September 2023. ISED confirmed receipt of Project package and stated that ISED will reach out if further information is needed.
Telecom	Bell Aliant	Notification letter sent September 2023. Awaiting response.
	Eastlink	Notification letter sent September 2023. Awaiting response.
	NCS Managed Services Inc.	Notification letter sent September 2023. Awaiting response.
	Rogers Communications	Notification letter sent September 2023. Awaiting response.
	Seaside Communications	Notification letter sent September 2023. Awaiting response.
Emergency Services	Bible Hill Fire Brigade	Notification letter sent September 2023. Awaiting response.
	Salmon River Fire Brigade	Notification letter sent September 2023. Awaiting response.
	Valley Kemptown and District Fire Brigade	Notification letter sent September 2023. Awaiting response.

Signal Source	Operator	Consultation Results
	North River Fire Brigade	Notification letter sent September 2023. Awaiting response.

10.2.5 Effects Assessment

Project-EMI Interactions

Project activities only interact with electromagnetic signals during operations (Table 10.3).

Table 10.3: Potential Project-EMI Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
EMI												X			

Assessment Boundaries

Assessment boundaries align with the consultation boundaries established by the RABC Guidelines.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for EMI. The VC-specific definition for magnitude is applied to each operator individually as follows:

- Low – letter of no objection received.
- Moderate – organization requests additional consultation.
- High – letter of objection received.

Effects

As shown in Table 10.2, 15 notifications were submitted, with no responses received to date.

Mitigation

The following general mitigation measures regarding EMI will be implemented:

- Continue consultation with operators who have not yet responded to the notification letters.

- Ensure operators are consulted on any future layout updates.

Should additional layout modifications be required, the above agencies will be provided with updated information, as appropriate.

Monitoring
No monitoring programs are recommended.

Conclusion
Results are anticipated to be low magnitude based on the responses received to date, within the consultation zones defined by RABC Guidelines, medium duration, continuous, reversible, and not significant.

10.3 Shadow Flicker

10.3.1 Overview

Shadow flicker can occur when rotating blades cast flickering shadows during times of direct sunlight. The magnitude of shadow flicker is determined by the position and height of the sun, wind speed and direction, geographical location, time of year, cloud cover, turbine hub height and rotor diameter, and proximity to the turbine.

For shadow flicker to occur, the following criteria must be met:

- The sun must be shining and not be obscured by clouds/fog.
- The source turbine must be operating.
- The wind turbine must be situated between the sun and the shadow receptor.
- The wind turbine must be facing directly towards, or away from, the sun such that the rotational plane of the blades (i.e., rotor plane) is perpendicular to the azimuth of incident sun rays. For this to occur, the wind direction would have to be parallel to the azimuth of the incident sun rays throughout the day.
- The line of sight between the turbine and the shadow receptor must be clear. Light-impermeable obstacles, such as vegetation, tall structures, etc., will prevent shadow flicker from occurring at the receptor.
- The shadow receptor has to be close enough to the turbine to be in the shadow.

10.3.2 Regulatory Context

There are no municipal, provincial, or federal guidelines related to shadow flicker, but many jurisdictions (including NSECC) have adopted the industry guideline of no more than 30 hours of shadow flicker per year, and no more than 30 minutes of shadow flicker on the worst day of the year at residential receptors.

10.3.3 Assessment Methodology

The shadow flicker assessment was completed through modelling to achieve the following objectives:

- To identify nearby receptors that may potentially experience shadow flicker from the Project's operation.
- To quantify and assess the duration and frequency of shadow flicker for nearby residents under worst-case and real-case scenarios.
- To determine if applicable guidelines are met/exceeded.
- To mitigate and minimize shadow flicker experienced by nearby residents, as necessary.

Potential receptors located within 2 km of the turbine locations were identified using GIS data from the Nova Scotia Geomatics Centre and aerial imagery. As a conservative measure, no distinction was made between habitable dwellings and barns, sheds, or outbuildings.

One operational wind turbine exists within 3 km of the Project; the single Enercon E-82/2300 wind turbine is part of the Nuttby Mountain Wind Farm and is located approximately 2.9 km from the nearest proposed Project turbine. This single turbine is not close enough to relevant receptors or the proposed Project turbines to have a cumulative effect on shadow flicker, and therefore, is not considered in the shadow flicker modelling.

Assessment Scenario A was conducted using the WindPRO version 3.5.552 software package, which assumes that all the criteria listed in Section 10.3.1 are always met.

As Assessment Scenario A uses highly conservative assumptions, resulting in modelled conditions that are not possible to occur in practice, a second scenario was developed to better represent site characteristics. Assessment Scenario B incorporated the average daily sunshine hours from the Charlottetown weather station (Table 10.4) instead of the assumption of continuous sunshine used in the Assessment Scenario A.

Assessment Scenario B is still conservative as it used the rest of the criteria listed in 10.3.1. For example, no line-of-sight obstacles (e.g., trees, vegetation, outbuildings, or other local structures) were considered and the model assumed that the turbines were always in operation and always between the sun and the receptor, which is not the case.

Table 10.4: Sunshine Data Used for the Real-Case Scenario

Month	Average Daily Sunshine (Hours)*
January	3.37
February	4.18
March	4.42
April	5.04
May	6.34
June	7.54
July	7.95
August	7.19
September	5.76

Month	Average Daily Sunshine (Hours)*
October	3.98
November	2.63
December	2.31

*Source: Charlottetown weather station (Available WindPRO Weather station closest to Project Area)

10.3.4 Assessment Results

A total of 16 potential receptors were identified within 2 km of the turbine locations. Under Assessment Scenario A conditions (meeting criteria described in Section 10.3.1 above), one potential receptor exceeds 30 hours of shadow flicker per year and/or 30 minutes of shadow flicker on the worst day (Table 10.5; Drawings 10.1A and 10.1B). Detailed results showing all receptors within 2 km of the turbine locations are provided in Appendix T. As Assessment Scenario A uses highly conservative assumptions, the modelled conditions are not possible to occur in practice.

Table 10.5: Potential Receptors Impacted by Shadow Flicker – Assessment Scenario A

Receptor ID*	Hours of Shadow Flicker per Year	Minutes of Shadow Flicker per Day (on the worst day)
P	47:52:00	36

* Receptor ID corresponds to labelling on Drawings 10.1A-10.1B.

The model was subsequently re-run using the sunshine data in Table 10.4. Under Assessment Scenario B conditions, no potential receptors exceed the recommended guidelines of 30 hours of shadow flicker per year (Table 10.6; Drawing 10.1C). Detailed results are provided in Appendix T.

Table 10.6: Potential Receptors Impacted by Shadow Flicker – Assessment Scenario B

Receptor ID*	Hours of Shadow Flicker per Year**
P	20:32:00

*Receptor ID corresponds to labelling on Drawing 10.1C.
**WindPRO cannot calculate minutes per day for a real-case scenario.

10.3.5 Effects Assessment

Project-Shadow Flicker Interactions

Project activities only interact with shadow flicker during wind turbine operations (Table 10.7).

Table 10.7: Potential Project-Shadow Flicker Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Shadow Flicker												X			

Assessment Boundaries

The LAA for shadow flicker includes a 2 km area around the Assessment Area (Drawings 10.1A to 10.1C). The RAA is not applicable for shadow flicker.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for shadow flicker. The VC-specific definition for magnitude is as follows:

- Negligible – no measurable shadow flicker predicted at receptor location(s).
- Low – measurable shadow flicker predicted at receptor locations, but results are below guidance.
- High – shadow flicker predicted to exceed guidance at receptor locations.

Effects

Assessment Scenario B predicts that all potential receptors will experience less than 30 hours of shadow flicker per year. This is still considered a conservative assessment because the scenario still assumes the following:

- Wind turbines are always in operation (i.e., rotors always spinning).
- A clear line of sight, with no screening by trees, outbuildings, or other local structures.
- The wind turbines are always situated between the sun and the potential receptor.
- The rotational plane of the blades are always perpendicular to the azimuth of the sun rays.

Mitigation

No mitigation is recommended.

The Project will develop a complaint response protocol, which will consider complaints related to shadow flicker and outline a process to investigate complaints. During all phases of the Project, including operations, contact information for the site manager will be made available and displayed publicly should the public have any questions, inquiries or complaints. The Proponent representative will respond to each communication accordingly. Each question, inquiry and complaint will be logged electronically with the following information: date of question, inquiry or complaint, name, phone number, e-mail address of the individual, response, date of response, and any follow-up, as required. Mitigation to resolve complaints, if determined to be necessary, will be completed on a case-by-case basis in consultation with the affected landowner and may include the provision of screening, the development of a turbine-specific curtailment plan, or a negotiated form of compensation.

Monitoring

No monitoring programs are recommended.

Conclusion

Results are characterized as low magnitude, within the LAA, medium duration, intermittent, reversible, and not significant.

10.4 Visual Impacts

10.4.1 Overview

The development of wind turbines has the potential to change the visual landscape and/or aesthetics of a local area. The level of change varies depending on the significance of the landscape, local topography, and the degree to which the turbines alter or modify the landscape. Locations of concern may include:

- Public viewpoints
- Protected areas
- Areas of local significance
- Recreational areas (hiking trails, biking routes, etc.)

Lighting associated with wind turbines may also result in visual impacts, especially during the nighttime.

10.4.2 Regulatory Context

There are no provincial or federal guidelines related to viewscapes. At the municipal level, visual impacts are considered during wind development licensing under the Municipality of the County of Colchester Wind Turbine Development By-law (2023).

Operational turbine lighting is regulated by NAV Canada and Transport Canada.

10.4.3 Assessment Methodology

Visual simulations were undertaken to assess the wind turbines impact on the visual landscape and local aesthetics. Locations for the visual assessment were selected based on known significant viewpoints (i.e., lookouts, hiking trails, etc.) within the area surrounding the Project and through engagement with and consideration of local stakeholders/users. During the public open houses completed for the Project, participants were asked if they recommended particular locations for additional visual simulations, which helped inform the selection of the following visual simulation locations (Drawings 10.2A to 10.2J):

- Earltown near the intersection of Highway 311 and 326 (coordinates provided in Drawing 10.2A to 10.2C)
- Highway 256/Balmoral Road near Central New Annan (coordinates provided in Drawing 10.2D)
- Highway 311 near Nuttby (coordinates provided in Drawing 10.2E and 10.2F)
- Ridge along Highway 311 (coordinates provided in Drawing 10.2G)
- Intersection of Old Nuttby Road and Wind Energy Road near the Nuttby Mountain Wind Farm (coordinates provided in Drawing 10.2H and 10.2I)
- Spiddle Hill Road (coordinates provided in Drawing 10.2J)

Photos were taken using a Canon EOS REBEL T7 camera with a 50 mm lens. Precise location, time, direction of view, and weather conditions at the time of the photo were also recorded.

The visual simulations were completed using WindPro software that incorporates elevation, turbine location, and camera/photo location information to simulate what the landscape will look like after the wind turbines have been constructed. Weather conditions (clear sky, overcast, etc.) and visibility (clear, fog, etc.) can be selected during the process to demonstrate the visual aesthetics of the Project during various environmental conditions.

The result is a series of photos showing the landscape from selected locations with the turbines in place.

10.4.4 Assessment Results

Visual simulations are provided in Drawings 10.2A to 10.2J.

Turbines will be equipped with pilot warning and obstruction avoidance lighting to ensure compliance with NAV Canada and Transport Canada safety requirements.

10.4.5 Effects Assessment

Project-Visual Aesthetics Interactions

Project activities only interact with visual aesthetics during operations (Table 10.8).

Table 10.8: Potential Project-Visual Aesthetics Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Visual Aesthetics												X			

Assessment Boundaries

The LAA for visual effects includes the observer locations. The RAA is not applicable for visual effects.

Assessment Criteria

Assessment criteria provided in Section 4.6 apply for visual effects. The VC-specific definition for magnitude is applied to each observer location individually as follows:

- Negligible – Project components cannot be seen from the observer location.
- Low – Project components may be seen from the observer location, but do not stand out or are not discernible in the view (i.e., low exposure on the horizon).
- Moderate – Project components can be seen from the observer location but are not a prominent feature in the view.
- High – Project components are a prominent feature in the view from the observer location.

It is noted that the magnitude criteria for visual effects is considered a neutral criteria as the perception of a change to the visual landscape can be adverse or positive depending on the individual observer.

Effects

Based on the simulations, portions of the turbines are visible from the following observer locations:

- Earltown
- Highway 256
- Highway 311 Ridge
- Old Nuttby Road
- Spiddle Hill Road

Wind turbines were not visible from the Highway 311 Nuttby observer location.

Operational lighting could be visible from the turbines during the night; however, potential impacts to residents are expected to be limited due to the distance between the Project turbines and nearest potential receptor. Lighting intensity and flashes will be minimized, as allowable by Transport Canada; and the exterior turbine maintenance lights will be turned off prior to maintenance staff leaving the site. In addition, the Proponent expects to install a light mitigation system. The technologies under consideration are a light dimming system whereby the turbine lights would be dimmed by up to 90% during high visibility conditions (i.e., clear skies), or an aircraft detection system where the lights would be turned off when no aircraft are detected within a certain distance of the Project. The Proponent will make a final decision once the Project design has been further advanced and a final turbine technology has been selected.

Mitigation
No mitigation is recommended related to viewscapes.

The following mitigation is recommended regarding turbine lighting:

- Limit lighting on turbine hubs and blades to minimum levels while still meeting requirements of NAV Canada and Transport Canada.
- Prohibit general lighting within the Project Area. Lighting will only be used when technicians are working on-site.

Construction activities will be limited to daytime hours when possible. It is noted that the turbine may be erected during the evening as the activity must be completed when the wind is less than 8 m/s as a safety measure. On-site lighting will be pointed downward to minimize light throw.

Monitoring
No monitoring programs are recommended.

Conclusion
Results are characterized as low to moderate magnitude, within the LAA, medium duration, continuous, reversible, and not significant.

10.5 Sound

10.5.1 Overview

The assessment of sound considered construction and operational noise generated from the Project.

During construction, heavy equipment, machinery, and light vehicles will emit sound to the surrounding environment from activities associated with the development of wind turbine pads, roads, the transmission line corridor and grid connection, along with the subsequent assembly of wind turbines. To quantify potential impacts, noise levels of equipment anticipated for the Project's construction were used to calculate noise levels at set distances from the Assessment Area considering nearby receptors. Noise generated during decommissioning activities will be similar to those presented below for construction based on the same process/activities (just in reverse).

During the Project's operational phase, wind turbines will emit sound to the surrounding environment from mechanical equipment operation and the turbines' interaction with the surrounding air (aerodynamic sound). Design and engineering of wind turbine components (e.g., anti-vibration products) have reduced, but not eliminated, mechanical and aerodynamic sound and its associated impacts. Detailed sound modelling was completed to quantify the potential impacts of turbine-generated noise on nearby receptors.

10.5.2 Regulatory Context

Changes to the acoustic environment during construction and operational activities could result in displacement, annoyance, and interference with communication, sleep, and/or working efficiency. As such, sound levels are regulated at the various government levels (Table 10.9).

Table 10.9: Summary of Sound Level Regulations and Guidelines

Regulated By	Regulation/Guidance	Sound Level (dBA)	Hours / Duration
For Residential Receptors			
NSECC	Guidelines for Environmental Noise Measurement and Assessment (NSECC, 1990)*	≤ 65	0700 to 1900
		≤ 60	1900 to 2300
		≤ 55	2300 to 0700
	Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSECC, 2021)	≤ 40	During the operation of wind turbines
Municipality of the County of Colchester	Chapter 56 - Wind Turbine Development By-law (Municipality of the County of Colchester, 2023)	Large Scale Wind Turbines must not have an Ambient Degradation Noise Standard greater than 36 dBA as measured at existing dwellings** †	During the operation of wind turbines
	Neighbourhood Nuisance By-Law ***	Defined as: "activity that by frequency or intensity unreasonably interferes with the enjoyment of the neighbourhood"	All hours

Regulated By	Regulation/Guidance	Sound Level (dBA)	Hours / Duration
For Occupational Safety			
Workplace Health and Safety Regulations & Canadian Centre for Occupational Health and Safety (CCOHS)	Noise – Occupational Exposure Limits in Canada (Workplace Health and Safety Regulations & CCOHS, 2023)	85	8-hour maximum

*NSECC is updating these guidelines (NSECC, 2022d); any changes resulting from this update will be referenced/incorporated as part of the Project's EPP.
** "Dwelling" means all structures intended for regular human occupation and living, such as a house or cottage, but not a camp or an accessory structure, such as a shed or storage area.
*** This By-Law does not apply to lawfully operating businesses and their activities.
† With permissions from landowners this can be increased to 40 dBA.

10.5.3 Assessment Methodology

Ambient Sound

Aerial imagery and field observations were used to identify nearby sources of sound and characterize the ambient sound within the Study Area.

Construction Sound

The assessment of construction sound (assumed to be consistent decommissioning phase sound) is based on desktop studies and addresses Project-related effects on human receptors. The objectives aim to achieve the following:

- Establish the construction sound levels produced by the Project.
- Identify nearby receptors that may be exposed to construction sound produced by the Project.
- Determine if the applicable guidelines are met/exceeded.
- Mitigate and minimize any impacts experienced by nearby receptors.

Receptors (including sensitive receptors such as schools, daycares, and senior residences) located within 2 km of the turbine locations were identified using GIS data from the Nova Scotia Geomatics Centre and aerial imagery.

Construction will take place within daylight hours to the extent possible and will comply with municipal by-laws regarding construction noise timings. This assessment does not include sound levels and impacts from blasting activities. If blasting is determined to be required during construction, the Proponent will notify NSECC and apply for any required permits and approvals. Any potential impacts, mitigation, and subsequent required monitoring will be described in the Project's EPP.

Operational Sound

The operational sound assessment was completed through a combination of desktop studies and modelling with the following objectives in mind:

- Identify receptors/dwellings within the vicinity of the Project.
- Identify existing operational turbines within 3 km of the Project in accordance with NSECC guidance (NSECC, 2021).
- Identify and assess any potential impacts on these receptors, including cumulative effects from neighbouring turbines, if present.
- Avoid and/or mitigate impacts of Project-generated sound on nearby receptors.

The sound assessment identified receptors within a 2 km radius of the turbine locations. The assessment was completed using the WindPRO version 3.5.552 software package. For the purposes of this model, receptors included all structures identified in GIS data from the Nova Scotia Geomatics Centre, as well as any additional identifiable structures based on aerial imagery. No attempt to distinguish sheds and outbuildings from dwellings or cottages was made.

One operational wind turbine exists within 3 km of the Project; the single Enercon E-82/2300 wind turbine is part of the Nuttby Mountain Wind Farm and is located approximately 2.9 km from the nearest proposed Project turbine. The single turbine is not close enough to relevant receptors or the proposed Project turbines to have a cumulative effect on the sound levels, and therefore, is not considered in the sound modelling.

The model followed ISO 9613-2 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method and calculations, and was based on the following input information:

- UTM coordinates for the wind turbines.
- 1/1 Octave band sound power level data, provided by the manufacturer or calculated by WindPRO, for the wind turbines.
- UTM coordinates for receptors (all structures within a 2 km radius of the turbines were evaluated).
- A wind speed of 7.0 m/s at a height of 10 m, the loudest speed up to 95% rated power (based on test data from the manufacturer).
- Ambient sound level 35.0 A-weighted decibels (dBA)
- Topographic data for the surrounding area.

The ISO 9613-2 calculation method assumes meteorological conditions ideal for noise propagation, including a ground temperature of 10°C and 70% relative atmospheric humidity. A ground factor of 1.0 was applied to the model, representing porous ground (i.e., capable of vegetative growth) interspersed with hard surfaces (e.g., water).

Modelling results were mapped and presented as a heat-map, demonstrating the sound levels each receptor will experience.

10.5.4 Sound Assessment Results

Ambient Sound

When evaluating sound levels produced by the Project, it is important to understand ambient sound existing in and around the Study Area pre-development.

The Study Area is situated in a rural area with established and ongoing agriculture, forestry, and recreational use (ATV, snowmobile, etc.). Sounds associated with the operation of light vehicles and heavy equipment (tractors, harvesters, etc.) are frequent within the Study Area, especially during months when forestry and agriculture are most active. Surrounding the Study Area are several privately owned parcels containing permanent and/or seasonal residences. Primary and secondary roadways within the Study Area include Old Tatamagouche Road, Old Nuttby Road, Truro Road, and a small portion of the Nova Scotia 311 Highway. These roadways are travelled daily by vehicular traffic emitting different sound levels, including transport trucks and motorcycles. Several developments in/near the Study Area also contribute to ambient sound levels, including:

- Nuttby Mountain Wind Farm (adjacent to the Study Area)
- Dream Acres MX Park (7 km northeast)

Based on the nearby industrial and recreational activity coupled with the high elevation and strong wind resource, baseline sound levels are likely elevated for short periods of time during the described activities and on windy days.

Construction Sound

Sound will predominantly be generated through construction equipment and heavy machinery such as cranes, backhoes, excavators, dump trucks, graders and transportation vehicles during construction activities. A summary of sources and anticipated volumes of sound produced during the Project's construction activities are provided in Table 10.10.

Table 10.10: Decibel Limits of Construction Equipment Required for the Project

Equipment	Average Noise Level Ranges (in dBA)
Road, Transmission Line, Grid Connection, Substation, and Turbine Pad Development	
Backhoe	85-104(1)
Dozer	89-103(1)
Dump Truck	84-88(1)
Excavator	97-106(3)
Concrete Truck/Pump	103-108(3)
Roller	95-108(3)
ATV	97(4)
Pickup Trucks	95(4)

Equipment	Average Noise Level Ranges (in dBA)
Harvesting Equipment (log truck, manual faller, etc.)	85-103[5]
Loaders	88[5]
Tracked Drilling Units	91-107[6]
Tracked Dump Truck/Decks	91[7]
Tracked Man Lift/Bucket Machines	85[7]
Tracked Radial Boom Derricks/Cranes	93-98[3]/[7]
Turbine Assembly	
Crane	78-103[1]
Handheld Air Tools	115[2]
Compressor (drilling, etc.)	85-104[2]

Note that measurements shown are relevant to the decibel level ranges within close proximity (i.e., less than 15 m of distance) between a receptor and the relevant piece of equipment.

Sources: [1] (WorkSafe BC, u.d.)
[2](Government of Ontario, 2022)
[3](Transport Scotland, u.d.)
[4](Government of Oregon, u.d.)
[5](WorkSafe BC, 2016)
[6](The Driller, 2005)
[7](SCE, 2016)

The range of decibels anticipated for the Project's construction activities will be between 78 dBA to 115 dBA (from a single piece of equipment within 15 m from the source). Construction activities are proposed to begin in fall 2024.

Assuming that sound attenuates at the standard rate of 6 dBA per doubling in distance from a given point source, approximate sound levels experienced at incremental distances during construction activities for the Project are provided in Table 10.11. The attenuation rate of sound presented below does not consider local landscape/topography or buildings and, therefore, is considered a "worst-case" scenario for sound levels produced by a single piece of equipment.

Table 10.11: Attenuation of Construction-Related Sounds

Case	Example Equipment Type	Sound Level @ 15 m (dBA)*	Point Source Sound Levels (dBA) at Incremental Distances					
			50 m	100 m	200 m	500 m	1,000 m	2,000 m
Minimum	Crane	78	67.5	61.5	55.5	47.5	41.5	35.5
Median	Pickup/ATV	96	85.5	79.5	73.5	65.5	59.5	53.5
Maximum	Handheld Air Tools	115	104.5	98.5	92.5	84.5	78.5	72.5

*Approximate point source sound levels, based on data collected in Table 10.10 above. Combined sound levels produced by multiple equipment operating simultaneously have not been included in the assessment.

Operational Sound

A total of 16 potential receptors were identified within 2 km of the turbine locations. Results of the sound modelling (presented as a heat map) are shown in Drawing 10.3, and detailed results are provided in Appendix U. No potential receptors exceed the recommended guideline of 40 dBA; however, potential receptors did exceed the municipal guideline of 36 dBA (as per the Municipality of the County of Colchester Wind Turbine Development By-law) The highest predicted sound level at a receptor is 36.8 dBA without modelling ambient sound and 39.0 dBA when ambient sound levels are included in the modelling.

Information from the turbine manufacturer supplied the 1/3 octave low frequency power levels at 125 m hub height. The power levels were entered into a Finland low frequency model in WindPRO software to produce the maximum dBA at each receptor. No potential receptors exceed the most critical noise demand from WindPRO's Finland low frequency model of 43 dBA; therefore, low frequency sound is not expected to be a concern. The Findland low frequency model along with a literature review of low frequency/infrasound is provided in Appendix U.

10.5.5 Effects Assessment

Project-Sound Interactions

Project activities will interact with the acoustic environment during all phases of the Project. Sound related to the decommissioning phase is not specifically addressed because sound levels are expected to be comparable to construction levels (Table 10.12).

Table 10.12: Potential Project-Sound Interactions

Valued Component	Site Preparation and Construction											Operations and Maintenance		Decommissioning	
	Land Surveys	Geotechnical Investigations	Placement of Sedimentation and Erosion Control Measures	Clearing and Grubbing	Access Road Upgrading and Construction	Laydown Area and Turbine Pad Construction	Transportation of Turbine Components	Turbine Assembly	Grid Connection	Removal of Temporary Works and Site Restoration	Commissioning	General Operation and Maintenance	Vegetation Management	Infrastructure Removal	Site Reclamation
Sound		X		X	X	X	X	X	X			X	X	X	X

Assessment Boundaries

The LAA for sound includes a 2 km area around the Assessment Area (Drawing 10.3). The RAA is not applicable for sound.

Assessment Criteria

The assessment criteria provided in Section 4.6 apply to sound. The VC-specific definition for magnitude is provided for construction and operational sound as follows:

Construction Sound

- Negligible – sound levels from Project activities are expected to be ≤55 dBA at residential and sensitive receptor locations.
- Low – sound levels from Project activities may measure between 55-65 dBA at residential and sensitive receptor locations.
- Moderate – sound levels from Project activities may exceed 65 dBA at residential and sensitive receptor locations, but only during high-impact activities (intermittently).
- High – sound levels from Project activities may exceed 65 dBA at residential and sensitive receptor locations during multiple activities.

Operational Sound

- Low – measurable sound levels predicted at receptor location(s), but results are below NSECC guidance.
- High – sound levels predicted to exceed NSECC guidance at receptor location(s).

Effects

During construction (and decommissioning) of the Project, decibel limits above 55 dBA at residential receptors can result in disruptions of sleep during nighttime hours, while sounds above 65 dBA may cause annoyance during daytime hours. Sounds produced during construction can exceed these thresholds at certain potential receptors located within close proximity to activities at some locations within the Project Area. However, construction will be kept within daylight hours and is considered a temporary source of noise generated by the Project. Based on the desktop review, a total of:

- No potential receptors are located within 0.5 km of construction activities, which may result in median/continuous sound levels above 65 dBA during daytime hours.
- No potential receptors are located within 1.0 km of construction activities, which may result in median/continuous sounds above 55 dBA to 65 dBA during daytime hours.
- 14 potential receptors are located within 2.0 km of construction activities, which may result in median/continuous sound levels above 55 dBA during daytime hours.

Sound levels within the Study Area are a collection of anthropogenic and natural sources, as described in Section 10.5.4. This location was also selected for its high wind speeds, contributing to baseline sound levels due to moving air and vegetation. Furthermore, the median sound level from construction is similar to the sound produced from an ATV or pick-up truck, which is already a common source of sound within the Study Area, as are logging trucks and harvesting equipment. Therefore, most Project-related construction sounds will be consistent with existing sound levels. Activities producing higher levels of sound, such as blasting (if required) or handheld air tools, will be less frequent and last for a very short duration.

During the operation of the turbines, all potential receptors comply with the NSECC guidelines. The Municipality of the County of Colchester guidance for operational sound underlines that the decibels produced by large-scale wind power projects must not exceed 36 dBA at any receptor. The sound modelling (Appendix U) demonstrates that decibels up to 36.0 and 39.0 dBA are possible at potential receptors. Therefore, it is recommended that the Proponent exercise section 5.7 of the Municipality of the County of Colchester Wind Turbine Development By-law, which allows the Proponent (with written landowner permission) to increase the ambient degradation noise standard to 40 dBA.

Mitigation
To minimize construction sound and the potential to disturb receptors during construction, the following general mitigation/protective measures will be implemented:

- Use noise suppressants (e.g., mufflers) on vehicles/equipment.
- Limit vehicle idling.
- Conduct construction activities within the recommended daytime hours of 7:00 am to 10:00 pm.
- Include mitigation and monitoring for blasting in the Project's EPP if geotechnical investigations determine it is required.

No mitigation is recommended for operational sound.

The Project will develop a complaint response protocol to consider complaints related to sound and outline a process to investigate complaints. Mitigation to resolve complaints, if determined to be necessary, will be completed on a case-by-case basis in consultation with the affected landowner. Pre-construction sound levels at key receptor locations will be measured as part of this process to establish baseline conditions for future reference (if needed).

Monitoring
No monitoring programs are recommended.

Conclusion
Construction phase results are characterized as high magnitude, within the LAA, short duration, intermittent, reversible, and not significant.

Results are characterized as low magnitude, within the LAA, medium duration, intermittent, reversible, and not significant.

11.0 EFFECTS OF THE UNDERTAKING ON THE ENVIRONMENT

11.1 Summary of Effects of the Undertaking on the Environment

Table 11.1 summarizes the results of the effects assessment for each VC.

Table 11.1: Effects of the Undertaking on the Environment - Summary

VC	Magnitude of Effects	Geographic Extent of Effects	Timing and Duration of Effects	Frequency of Effects	Reversibility of Effects	Significance Level	Mitigation and/or Monitoring Required?
Atmosphere and Air Quality	Low to negligible – Minimal to no changes are expected to ambient air quality	Within the Project Area	Seasonal aspects not applicable; short-term duration	Intermittent	Reversible	Not significant	Mitigation required; no monitoring required
Climate Change	Positive – A positive effect on GHG emissions is expected	Within the Study Area	Seasonal aspects not applicable; medium-term duration	Continuous	Irreversible	Significant (positive)	Mitigation required; no monitoring required
Geophysical Environment	High – Changes to local topography/geology are possible as geologic hazards exist within proximity to the Assessment Area; impacts to the quality/quantity of groundwater wells are possible (wells exist within 800 m of the Assessment Area)	Within the Assessment Area	Seasonal aspects not applicable; short-term duration	Intermittent	Reversible	Not significant	Mitigation required; monitoring may be required
Waterbodies and Watercourses	Moderate – No loss of aquatic habitat, with minimal potential for altered hydrology	Within the Assessment Area	Seasonal aspects applicable; short-term duration	Single event	Reversible	Not significant	Mitigation and monitoring required
Fish and Fish Habitat	Low – small loss of fish habitat or impact to fish behaviours	Within the Assessment Area	Seasonal aspects applicable; short-term duration	Single event	Reversible	Not significant	Mitigation and monitoring required
Wetlands	Moderate – Direct loss of wetland habitat, but overall wetland functions remain intact.	Within the Assessment Area	Seasonal aspects applicable; short-term duration	Single event	Reversible	Not significant	Mitigation and monitoring required
Terrestrial Habitat	Low – Some loss of terrestrial	Within the Assessment	Seasonal aspects	Single event	Reversible	Not	Mitigation

VC	Magnitude of Effects	Geographic Extent of Effects	Timing and Duration of Effects	Frequency of Effects	Reversibility of Effects	Significance Level	Mitigation and/or Monitoring Required?
	habitat, but overall habitat functions remain intact	Area	not applicable; long-term duration			significant	required; no monitoring required
Terrestrial Flora	Low – Small loss of habitat supporting terrestrial flora SOCI, but no terrestrial flora SOCI individuals lost	Within the Assessment Area	Seasonal aspects not applicable; long-term duration (for habitat, N/A for individual SOCI)	Single event (for habitat, N/A for individual SOCI)	Reversible	Not significant	Mitigation required; no monitoring required
Terrestrial Fauna	Low – Small loss of habitat supporting fauna, but no impacts to fauna behaviours expected	Regions surrounding the AA that may fall within the habitat range of each species, bounded by pre-existing infrastructure and roads or other large crossing areas	Seasonal aspects applicable; long-term duration (for habitat, N/A for SOCI)	Continuous	Reversible	Not significant	Mitigation and monitoring required
Bats	Moderate – Minimal loss of individuals or impacts to bat behaviours, but these impacts will only be experienced by individuals rather than entire populations.	Within the Assessment Area	Seasonal aspects not applicable; medium-term duration	Continuous	Reversible	Not significant	Mitigation and monitoring required
Avifauna	Low – Small loss of important habitat supporting avifauna and/or impacts to migratory avifauna are expected to be low	Within the Assessment Area and the airspace directly surround the turbines	Seasonal aspects not applicable; medium-term duration	Intermittent	Reversible	Not significant	Mitigation and monitoring required

VC	Magnitude of Effects	Geographic Extent of Effects	Timing and Duration of Effects	Frequency of Effects	Reversibility of Effects	Significance Level	Mitigation and/or Monitoring Required?
Economy	Positive – A positive effect on the economy is expected	Within Nova Scotia	Seasonal aspects not applicable; medium-term duration	Continuous	Irreversible	Significant (positive)	No mitigation or monitoring required
Land Use and Value	Negligible – No change in land value expected and surrounding land use can largely continue					Not significant	No mitigation or monitoring required
Traffic and Transportation	Moderate – Moderate change in traffic levels and/or moderate disruptions to traffic flow and routing	Within the area of Colchester Subdivision B extending to the Port of Dartmouth.	Seasonal aspects not applicable; short-term duration	Intermittent	Reversible	Not significant	Mitigation required; no monitoring required
Recreation and Tourism	Low – small change to tourism expected and/or minor limitations to recreation use	Within Colchester Subdivision B	Seasonal aspects not applicable; medium-term duration	Intermittent	Reversible	Not significant	Mitigation required; no monitoring required
Archaeological Resources	Low to Moderate – Activities have a moderate to low potential for encountering archaeological resources during ground disturbance	Within the Assessment Area	Seasonal aspects not applicable; short-term duration	Single event	Irreversible (to be confirmed based on any identified resources, as applicable)	Not significant	Mitigation required; no monitoring required
Human Health	Negligible – No expected impacts to human health					Not significant	Mitigation required; no monitoring required
Electromagnetic Interference	Low – Letter of no objection received	Within consultation zones as defined by RABC Guidelines	Seasonal aspects not applicable; medium-term duration	Continuous	Reversible	Not significant	Mitigation required; no monitoring required

VC	Magnitude of Effects	Geographic Extent of Effects	Timing and Duration of Effects	Frequency of Effects	Reversibility of Effects	Significance Level	Mitigation and/or Monitoring Required?
Shadow Flicker	Low – Measurable shadow flicker predicted at receptor location(s), but results are below guidance	Within 2 km buffer around Assessment Area	Seasonal aspects applicable; medium-term duration	Intermittent	Reversible	Not significant	No mitigation or monitoring required
Visual Impacts	Low to Moderate – Project components may be seen from the observer location, but do not stand out or are not discernible in the view (i.e., low exposure on the horizon)	Within observer locations	Seasonal aspects not applicable; medium-term duration	Continuous	Reversible	Not significant	Mitigation required; no monitoring required
Sound: Construction Phase	High – Sound levels from Project activities may exceed 65 dBA at residential and sensitive receptor locations, but only during high-impact activities (intermittently)	Within 2 km buffer around Assessment Area	Seasonal aspects not applicable; short-term duration	Intermittent	Reversible	Not significant	Mitigation required; no monitoring required
Sound: Operation Phase	Low – Measurable sound levels predicted at receptor location(s), but results are below NSECC guidance	Within 2 km buffer around Assessment Area	Seasonal aspects not applicable; medium-term duration	Intermittent	Reversible	Not significant	No mitigation or monitoring required

11.2 Summary of Mitigation Measures

A compiled list of mitigation measures identified throughout the EA is provided below.

Atmospheric Environment

General mitigation measures for fugitive emissions, exhaust emissions, and GHG emissions include:

- Conduct grading and site preparation in phases to minimize disturbed soil areas until just prior to construction activities.
- Stabilize exposed soil surfaces by sloping or using vegetation, stone, soil, or geotextiles to prevent dust and airborne particles.
- Compact and/or ridge disturbed soil to prevent dust formation.
- Cease dust-generating construction activities during periods of excessive wind.
- Enclose or cover soil storage and/or stockpile areas.
- Wet (with water) aggregate and soil stockpiles to control dust.
- Design storage areas and material stockpiles with prevailing wind directions in mind.
- Wet roadways and heavy traffic areas with water or dust suppressant technologies to minimize airborne emissions.
- Tie down, cover, and/or store loose site materials and/or products prior to inclement weather and wind events to prevent materials from becoming airborne.
- Wash down vehicles and equipment using hoses and water to remove accumulated mud/dirt on undercarriages, tracks, or wheel wells.
- Ensure Project personnel adhere to all safety protocols and wear appropriate PPE in the event of significant fugitive emissions events (i.e., wind storms, dust storms).
- Enforce site speed limits to minimize dust generation.
- Ensure equipment meets all applicable provincial and air quality regulations and emissions standards.
- Ensure equipment is fueled using low-sulphur diesel (to reduce SO_x air emissions).
- Maintain engines and exhaust systems according to the manufacturer's specifications and the recommended maintenance schedule.
- Remove from service malfunctioning equipment and/or equipment generating excess amounts of smoke, odour, or noise, until an assessment and necessary repairs can be completed.
- Remove from service construction equipment with improperly functioning emissions control systems.
- Use locally sourced materials, where possible, to reduce CO_2, CH_4, and NO_x emissions associated with transport.
- Incorporate the shortest construction/transport routes where possible to minimize the use of fossil fuels during construction.
- Recover and recycle construction and demolition waste, where possible.
- Recycle and compost workforce waste (i.e., food waste). Diverting this waste will reduce methane generated in landfills as it decomposes.
- Minimize deforestation during land clearing by only clearing the area that will be needed. This will reduce CH_4 and NO_x emissions associated with soil disturbance

and limit the use of equipment (lowering emissions produced during equipment operations).

- Plan construction activities to reduce the double handling of materials, reducing GHG emissions associated with heavy equipment operations.
- Use recycled or repurposed materials, where possible, to reduce GHG emissions associated with embodied energy (i.e., the energy associated with manufacturing a product or service).
- Ensure construction equipment with an improperly functioning emission control system is not operated.
- Ensure regular equipment maintenance is undertaken to maintain good operations and fuel efficiency.
- Ensure equipment containing coolant (i.e., air conditioning units) undergo preventative maintenance and inspections (i.e., leak testing).
- Train Project personnel (as appropriate) in the proper disposal of halocarbon-containing substances.
- Dispose of halocarbon-containing substances at an approved hazardous waste facility per applicable regulations and in compliance with local requirements.
- Ensure trucks removing waste from or bringing materials to the Project are filled to the maximum allowable capacity where practical (dependent on the truck size and load weight) to reduce transportation requirements and limit the number of trips, where practical.
- Implement an anti-idling policy to limit GHG/exhaust emissions from vehicles and equipment, limit the use of fossil fuels, and reduce excessive sound.
- Incorporate energy-efficient infrastructure (i.e., solar panels) where feasible to limit GHG emissions and the use of fossil fuels resulting from standard equipment (e.g., diesel-powered generators or light stands).

Geophysical Environment

General mitigation measures for avoidance of geologic hazards and groundwater resources include:

- Conduct blasting, if required, in accordance with provincial legislation and subject to terms and conditions of applicable permits.
  - Conduct a pre-blast survey for wells within 800 m of blasting activities
  - Ensure all blasts are conducted and monitored by certified professionals.
  - Ensure all protective measures outlined in the EPP are implemented in advance of blasting activities.
  - Notify landowners within 800 m of any blasting activities.
  - Recover and revegetate exposed soils or bedrock as required to minimize any exposure following blasting.
- Include specific mitigation for sulphide bearing materials in the EPP, if they are identified through pre-construction geotechnical surveys.
- Ensure rock removal in known areas of elevated sulphide potential will conform to the Sulphide Bearing Material Disposal Regulations, N.S. Reg. 57/95 and in consultation with relevant regulatory departments.

- Store any soil needed for backfilling, after foundations have been poured, temporarily adjacent to the excavations until needed. Any remaining excavated material will be used onsite or removed and sent to an approved facility.
- Install erosion and sedimentation control measures prior to excavation activities and inspect controls on a regular basis.
- Remove temporary erosion and sedimentation controls once backfilled material has stabilized. Attention will be paid during site reinstatement to ensure areas will promote wildlife return to the area, to the extent possible.

Aquatic Environment

General mitigation measures for impacts to watercourses, waterbodies, fish and fish habitat, and wetlands include:

- Educate Project personnel on the sensitivity of aquatic habitats, including wetlands and watercourses.
- Ensure wetlands and watercourses are clearly marked and avoid impacts to the watercourse/wetland and adjacent riparian habitat to the extent possible.
    - Complete in-season wetland surveys for areas subject to minor layout modifications (refer to Section 7.3.3).
- Ensure all crossings are installed by a certified Watercourse Alteration Installer/Sizer, and designed to avoid any permanent diversion, restriction or blockage of natural flow, such that the hydrologic function of the watercourse is maintained.
- Revegetate along the watercourse edge and above the ordinary high-water mark to facilitate the stabilization of the area.
- Redesign existing watercourse crossings to facilitate habitat upgrades, including unblocking culverts and making waterways more conducive to fish passage.
- Avoid impacts to wetlands to the extent possible (including alteration, compaction, or otherwise).
    - Where unavoidable, complete wetland alterations in accordance with the NS Wetland Conservation Policy (NSECC, 2019) and the wetland alteration process during the permitting stage, which includes a requirement to compensate for lost wetland habitat and functions.
    - Design wetland crossings to occur at the narrow part of the wetland or the wetland's edges, to the extent possible.
    - If travel through wetlands is required, use geotextile matting, time work to occur during frozen ground conditions, or travel through the drier portions of the wetland, as appropriate.
- Conduct work between June 1 and September 30 to avoid sensitive periods in the life cycles of fish, to facilitate a better control of water flow, and to allow for a faster revegetation period (NSECC, 2015b).
- Plan any activities to align with low-flow periods
- Develop a site-specific erosion and sedimentation plan during the detailed design phase.
    - The plan will target the disturbance to banks (as required) and adjacent land,

and will address the type of control structures, proper installation techniques, grading, maintenance and inspection, timing of installation, and revegetation.

- Limit the area of exposed soil and the length of time soil is exposed without mitigation (e.g., mulching, seeding, rock cover).
- Limit the slope and gradient of disturbed areas to minimize the velocity of surface water runoff.
- Ensure surface run-off containing suspended materials or other harmful substances is minimized.
- Direct run-off from construction activities away from wetlands.
- Leave riparian vegetation as intact as Project developments will allow.
- Integrate water management systems including diversion and collection ditches, roadside drainage channels, and stormwater retention ponds.
- Design any necessary alterations in a way that maintains the natural grade of a watercourse, to ensure the hydroperiod remains as it was pre-alteration.
- Fit any watercourse crossings with appropriately sized infrastructure, as prescribed by a certified Watercourse Alteration Installer/Sizer.
- Integrate outlet protection features to dissipate flow velocities and decrease erosion at the outflow.
- Ensure that if concrete is to be used, ensure it is pre-cast and cured for at least one week prior to use at a crossing site (NSECC, 2015b).
- Utilize untreated, rot-resistant timber (e.g., hemlock, tamarack, juniper, or cedar) below the ordinary highwater mark to avoid the leaching of toxic preservatives into waterways (NSECC, 2015b).
- Utilize vegetated swales for the phytoremediation of contaminated runoff.
- Utilize rock material that is clean, coarse granular, non-ore-bearing, non-watercourse-derived, and non-toxic to aquatic life (NSECC, 2015b).
- Use quarried, crushed materials for road construction to reduce the introduction of invasive vascular plant species.
- Ensure wetland crossings will not result in permanent diversion, restriction or blockage of natural flow, such that hydrologic function of wetlands will be maintained.
- Use the existing roads and access routes to the extent feasible.
- Maintain existing vegetation cover, where possible.
- Use water or an approved dust suppressant to control dust on roads, as required.
- Enforce site speed limits to minimize dust generation.
- Clean and inspect work vehicles prior to use to prevent the introduction of invasive/non-native species.
- Ensure wetland delineation tape is in place and visible to avoid unnecessary compaction within wetlands.
- Hold pre-construction site meetings to educate staff on the sensitivity of wetlands.

Terrestrial Environment

General mitigation measures for impacts to terrestrial habitat, flora, fauna, bats, and avifauna include the following:

- Minimize overall area to be cleared, road density, habitat fragmentation, and habitat isolation by utilizing pre-existing roads and previously altered areas (i.e., clearcuts).
  - Avoid disturbance to important habitat features (e.g., karsts, caves, wetlands, mature forest stands) identified during desktop and field assessments.
  - Avoidance of topographic funnels, such as within lake or river valleys, for turbine placement to reduce the likelihood of interactions with concentrated bird movements.
- Complete in-season rare plant and lichen surveys for areas subject to minor layout modifications (further discussed in Section 7.3.3).
- Restore cleared areas as much as possible to reduce impacts from habitat loss and promote continued growth of terrestrial flora, primarily through revegetation of road ROWs, and limit effects of fragmentation.
  - Revegetate cleared areas using native seed mixes, and particularly use seed mixes that do not contain clover to avoid attracting deer to the area.
  - Augment connectivity by creating semi-artificial pathways such as wildlife corridors, greenbelts, and vegetated buffers around wetlands and watercourses, where possible.
  - Reclaim small roads leading to turbines to minimize long-lasting effects of habitat loss.
- Complete clearing during winter months when bats are overwintering in caves (end of September to late April), where possible.
- Continue to review habitat modelling results, field survey results, and guidance from NSNRR through the detail design phase.
- Minimize use of road salt to minimize attraction of ungulates to roadsides during the winter.
- Minimize loss of flora SOCI from areas with known occurrences during the design phase.
  - Desktop and field assessments identified important habitat features with terrestrial flora SOCI locations to be avoided during the design phase.
  - Additional surveys will be conducted to determine presence (if any) of flora SOCI in the Assessment Area which have not yet been surveyed during flowering season.
- Educate Project personnel about the potential for plant or lichen SOCI during construction.
  - Guidance will be provided to Project personnel to raise awareness of terrestrial flora SOCI that are known to exist within the Study Area to increase the number of trained eyes looking for these species.
- Consult with NSNRR if an unexpected flora SOCI is encountered during construction activities. Potential mitigation measures based upon recognized practices to transplant or collect seeds can be used as a contingency if flora SOCI are unexpectedly encountered during construction activities. A transplantation plan will be developed along with a monitoring protocol through consultation with NSNRR should this be required during construction.

- Ensure equipment is as clean as possible to prevent the introduction of non-native species into previously untouched areas.
    - Because non-native species are already present within the Study Area, care will be taken when travelling from developed areas to intact areas so that plant material is not transferred between locations.
    - Install traffic signs to alert road users of speed limits and the presence of wildlife in the area.
        - Inform all Project-related staff working on the site of dangers to wildlife and create awareness around wildlife hotspots on the site.
    - Minimize Project-related traffic to reduce chances of wildlife collisions and traffic-related stress to wildlife.
    - Impose restrictions to site access if deemed necessary due to a substantial increase in wildlife collisions and mortality.
- Avoid removal of vegetation/habitat alteration in key habitat areas during sensitive windows for priority species, where possible, including:
    - Mainland moose – late May to early June (birthing season) and September to October (breeding season)
    - Fisher – March to April
    - Wood turtle – April to mid-October
    - Bats – late April to late September
    - Birds – late March to September
- Minimize loss of important habitat required by priority species (i.e., for reproduction events), including:
    - Mainland moose – wetlands and isolated islands/peninsulas
    - Fisher – large snags, large woody debris, or live, hollow standing trees in mature, intact forests
    - Wood turtle – clear, meandering streams with gravel shores, gravel roadsides
    - Bats – Abandoned mines, large diameter (≥25 cm) snags and hollow trees (over-day roosting habitat)
- Prevent injury/mortality of bats by avoiding important habitat (i.e., hibernacula, migration routes, and migratory stopovers) along with placement of turbines in an area demonstrated to contain low bat activity, which has been incorporated into the Project's design/development.
- Maintain all equipment and machinery on site so that a level of good working condition is kept to reduce noise and vibration emissions. Where practical, install vehicles and machinery with noise muffling equipment to limit disturbance.
- Restrict on-site lighting, especially at night, to limit disturbance.
- Prohibit harassment and feeding of wildlife by Project personnel.
- Incorporate a lighting plan for construction-related activities into the EPP.
- Maintain good housekeeping practices during construction to avoid indirectly feeding birds, and potentially attracting nuisance wildlife.
- Develop a spill response plan, and an emergency response plan within the EPP to mitigate the impacts of spills, hazardous substances, and other emergencies.
- Develop a fire response plan in accordance with provincial standards.

- Install avian deflectors on powerlines, including any powerline spans, or areas of line that will be identified in the EPP as requiring mitigation based on monitoring results.
- Develop a site reclamation plan in accordance with engineering standards and in consultation with NSECC and NSNRR.

Socio-Economic Environment

General mitigation measures for traffic, transportation, recreation, and tourism include:

- Install notices in public areas to inform residents of signage removal or road infrastructure alterations.
- Replace removed signage and guardrails immediately with appropriate temporary signage to ensure the safety of travelling public.
- Complete upgrades to roads and overhead wires, branches, and signs if conflicts arise.
- Complete modifications and associated reinstatement to relevant specifications.
- Avoid, to the extent possible, transportation through urban areas during high traffic times (e.g., 7am to 9 am and 3 pm to 6 pm; Monday to Friday).
- Conduct all travel using safe work practices for transporting oversized loads.
- Utilize the minimum number of vehicles possible to minimize impacts to road-way flow and air quality due to exhaust emissions.
- Ensure vehicles only visit and work on-site during normal daytime hours of operation, where possible, and avoid high-traffic times of day to reduce local traffic congestion.
- Continue to work with local recreation groups to ensure continued access to recreation sites, including development site-specific safety plans in coordination with landowners, recreational groups, and the Project operations team.
- Ensure no net loss of snowmobile trails, as a means of maintaining access to all specific points of interest.
- Create new snowmobile trails, in the event compatible use in a specific area is no longer possible.

Archaeological Resources

- Complete a systematic shovel testing program if ground impacts at HPAs cannot be avoided through Project design to further assess and delineate cultural heritage resource potential.
- Develop a chance find procedure in the EPP related to the potential unexpected discovery of archaeological items or sites, or human remains, during construction. This would include halting any work immediately upon discovery of suspected resources and contacting NSCCTH. If the resources are suspected to be of Mi’kmaq origin, the Executive Director of KMKNO would also be contacted.
- Conduct additional archaeological assessment if, during the detail design phase, it is determined that ground disturbance is required in areas not previously assessed. The EA Branch will be provided with the acceptance letter from NSCCTH prior to completion of any disturbance in newly proposed areas.

Other Considerations
General mitigation measures for impacts to human health, shadow flicker, EMI, visual impacts, and sound include the following:

- Continue engagement and education with local recreational users regarding the safe continued use of lands within the Study Area.
- Install signage illustrating and warning of potential hazards associated with ice throw and fall around wind turbines.
- Equip staff and workers accessing the Project Area for maintenance or other purposes with necessary PPE and associated safety protocols and procedures to mitigate risk of injury and/or fatality, especially during potential icing conditions.
- Implement a fire prevention and evacuation plan for Project personnel as part of the EPP, in addition to general safety protocol and training.
- Ensure signal operators are consulted on any future layout updates.
- Continue consultation with operators who have not yet responded to the notification letters and/or who expressed concerns with initial layouts presented.
- Develop a complaint response protocol, which will consider complaints related to shadow flicker and sound and outline a process to investigate complaints.
- Limit lighting on turbine hubs and blades to minimum levels while still meeting requirements of NAV Canada and Transport Canada.
- Prohibit general lighting within the Project Area. Lighting will only be used when technicians are working on-site.
- Conduct construction activities within the recommended daytime hours of 7:00 am to 10:00 pm.
- Confirm information regarding turbine tonality when the final turbine model is selected. If additional assessment related to low frequency sound is required based on turbine model selection, this will be completed and provided to NSECC and Health Canada prior to construction.
- Use noise suppressants (e.g., mufflers) on vehicles/equipment.
- Limit vehicle idling.
- Include mitigation and monitoring for blasting in the Project's EPP, if geotechnical investigations determine it is required.

12.0 EFFECTS OF THE ENVIRONMENT ON THE UNDERTAKING

The following section discusses potential effects of the natural environment, including natural hazards and weather events, on the infrastructure and operation of the Project. Potential sources of effects from the environment are described below, including mitigation and design strategies for reducing the significance of residual effects.

The primary mitigative measure employed during the construction and operation of the Project will be to educate and train site personnel. Environmental and safety orientations will be conducted prior to the start of construction and all staff will be informed of the potential effects of the environment on the Project. Staff responsible for the operation and maintenance of the Project will be trained on the design and operation of the turbine, including applicable operating procedures, safety protocols, and evacuation plans. To further mitigate damages that cannot be controlled by education and training alone, turbines will all be equipped with safety mechanisms to limit damage resulting from extreme weather events.

12.1 Climate Change

Climate change is the persistent change in the state of the climate which lasts for decades or longer (IPCC, 2018). Climate change may impact the Project through increased occurrences of extreme weather, precipitation, and subsequent flooding. In addition, increased weather extremes due to climate change may impact turbines, powerlines, and/or roadways, causing washouts and/or damage to infrastructure.

12.1.1 Temperature

One major change associated with climate change is global warming, which is defined as an increase in global mean surface temperature averaged over a 30-year period, relative to pre-industrial temperatures (IPCC, 2018). Projected rising temperatures associated with global warming may impact many phases of the Project and on-site personnel. For example, longer and more intense heat waves may increase heat-related illnesses and increase the risk of food and water-borne contamination. Hotter and drier conditions also increase the risk of droughts and wildfires during construction and operation activities (Government of Canada, 2019c). Requirements for stopping work or taking regular breaks to cool down and rehydrate will be mandated throughout the Project's lifetime to protect Project personnel. If it is unsafe to work due to severe conditions, a stop-work-authority may be issued.

Warmer temperatures can also spread forest and agricultural pests and disease vectors (i.e., ticks) to the Project location. Invasive plant species are discussed in greater detail in Section 7.4.2.

12.1.2 Sea Level Rise

The majority of the Assessment Area is between approximately 180 masl and 360 masl, and should therefore, experience negligible impacts from rising sea levels. The integrity of the roads leading to the Project Area are also of little concern as it is over 10 km from the nearest tidal waters. The Project is therefore unlikely to be impacted by rising sea water levels within the lifespan of the Project.

12.1.3 Flooding

Flooding in the Study Area may increase due to more frequent severe precipitation associated with climate change. Due to the effects of ocean warming, climate change is predicted to produce more intense precipitation, which may result in increased flood risk (US EPA, 2022c). Flooding may impact both terrestrial and aquatic habitat, damage Project infrastructure, and limit site access. The Project will mitigate the risks of flooding by concentrating the road and turbine layout in high elevation areas, maintaining regular upkeep and grading of roads to reduce formation of ruts, designing roadside ditches and water off-take infrastructure next to all roads to encourage drainage of rainwater off the roads, and revegetating roadsides to absorb excess water.

12.2 Natural Hazards

12.2.1 Severe Weather Events

Nova Scotia is subject to severe weather events, including heavy rainfall, blizzards, and hurricanes, all of which may lead to negative outcomes including power outages, health related emergencies, infrastructure damage, and road damage, and therefore may pose direct risks to wind farm infrastructure (Government of Canada, 2018). Heavy rainfall is a common, highly probable natural hazard in Nova Scotia. Short duration heavy rainfall is defined as 25 mm or more of rain within one hour, while long duration heavy rainfall can range from 25 mm of rain or more within 24 hours during winter, or 50 mm of rain or more within 24 hours during summer (ECCC, 2020). Heavy rain or snow melt has the potential to deposit high quantities of water within the Project Area in a short period of time. Project design features noted in Section 12.1.3 will also mitigate the effects of heavy rainfall and snow melt to maintain road access during severe precipitation events.

Wind and lightning, which may be associated with heavy rainfall or hurricane conditions, may increase the risk of mechanical issues or electrical fires. Restricted access to the site during severe weather events may limit the ability to shut down the system to prevent damage. To mitigate this risk, the turbines will be equipped with an automatic shut down when thresholds for wind are reached and will also be designed with a built-in grounding system for lightning strikes. In addition, the Proponent will ensure access is maintained, either by clearing the roads or providing vehicles that can traverse all conditions.

12.2.2 Turbine Icing

Turbine icing occurs when ice accumulates on the surface of turbine blades, a condition created by specific temperatures and levels of humidity or the presence of freezing rain. The chances of turbine icing increase when the blades reach 150 m above ground, where the lower clouds may contain supercooled rain (Seifert et al., 2003). Turbine icing may lead to ice throw or ice fall, and the distance and direction in which the ice is thrown/falls is dependent on factors such as wind speed and direction, rotor speed, rotor azimuth, the position of the ice on the blade, and the characteristics of the ice itself. Due to the numerous factors contributing to where these ice fragments may land when thrown/fallen, the likelihood of a human being struck is insignificant and thus the risk of injury is minute (LeBlanc, 2007). The impacts from turbine icing on human health are discussed further in Section 10.1.1. To further reduce the risk of injury from ice throw or falling ice, restricted site use may be enforced when the ideal weather conditions for turbine icing are present. Education of operators, adequate signage warning of falling ice, and the requirement to wear hardhats around operational turbines will also be implemented. Additionally, the turbines will be equipped to automatically shut down when thresholds for ice formation are detected.

12.2.3 Wildfire

The Forest Fire Protection Regulations, N.S. Reg. 135/2019 outline restrictions for burning and operating power saws during the fire season (March 15 to October 15). Burning restrictions are determined daily, depending on the Fire Weather Index (FWI). The Nova

Scotia government employs an FWI during the fire season to determine fire danger across the forested areas in Nova Scotia (NSNRR, 2021i). A higher FWI score indicates that if a fire were to start it would be of high intensity and pose greater danger than a lower FWI score. Operation of power saws and/or clearing saws in forested areas within the Project Area will only occur when and as permitted under the Forest Fire Protection Regulations, N.S. Reg. 135/2019. Any activities requiring burning during the Project lifetime will be timed according to local burning restrictions.

As a best practice, the FWI can be used to determine fire danger associated with activities that may result in burning. The FWI during the summer months across the Study Area ranges from low (0 to 5) to high (10 to 20) (NRCan, 2022b). Federal and provincial FWI data is updated daily, with the closest provincial weather stations to the Study Area being ‘Economy Lake’, ‘Onslow Mountain’, and ‘West Tatamagouche’ (NSNRR, 2021i; NRCan, 2022b). To mitigate potential risk of wildfire, safety protocols will be put into place such as implementing a fire prevention and site evacuation plan. Furthermore, the FWI will be checked regularly at nearby weather stations during summer months to determine the potential for highly dangerous wildfires. Precautions should be taken when undergoing construction or maintenance activities that could result in fires on days when FWI scores are >5, such as mechanical brushing/land clearing, using spark-producing tools, or piling of woody debris (Wildfire Regulation, B.C. Reg. 38/2005). Should the risk of fires increase throughout the lifetime of the Project, mitigation strategies to protect Project infrastructure and relevant VCs will be adapted accordingly.

12.3 Potential Residual Effects

Environmental effects associated with climate change and natural hazards have the potential to result in a significant effect on the Project. Project location siting and design measures will minimize many of the risks associated with these environmental hazards, and the mitigation measures described above will allow for both proactive and adaptive management of any remaining risks, thus limiting the likelihood of impacts on all phases of the Project. Therefore, the residual effects associated with climate change are considered not significant.

13.0 ACCIDENTS AND MALFUNCTIONS

Without proper mitigation, accidents, and malfunctions can interact with many VCs and potentially result in adverse effects. However, implementing preventative measures limits the probability of occurrence, and having appropriate response procedures in place reduces the magnitude of residual effects.

Accidents, malfunctions, and unplanned events considered for this Project include:

- Erosion and Sediment Control Failure
- Fire
- General Hazardous Material Spill

The safety of on-site personnel is a vital Project component; however, it is not specifically considered in the EA, as workplace occupational health and safety is regulated by the policies, procedures, plans, and codes of practice set in the *Occupational Health and Safety Act,* SNS 1996, c. 7.

13.1 Erosion and Sediment Control Failures

Failure of erosion and sedimentation controls may result in potential adverse effects on VCs (primarily during construction), most notably to watercourses, wetlands, and fish and fish habitat. Erosion and sedimentation controls may fail due to extreme weather conditions (e.g., flooding), improper installation, improper maintenance, and unforeseen accidents (e.g., collisions). Failure of these control measures may release sediment into the environment, impacting water quality and aquatic and terrestrial habitats.

Mitigation measures to limit the probability of an occurrence and reduce the magnitude and extent of potential effects include:

- Implement all mitigation related to erosion and sediment control provided in Sections 7.3.1, 7.3.2, and 7.3.3.
- Develop and implement an erosion and sedimentation control plan for all phases of the Project.
- Require that erosion and sediment controls are installed per the manufacturer's specifications.
- Heed ECCC’s special weather warnings to ensure proper care is given to stabilize erosion and sediment controls in advance of, and following, extreme weather events.
- Conduct regular monitoring of all the erosion and sediment controls and repair or replace them as necessary.
- Ensure erosion and sediment controls are functioning effectually, and that additional supports or controls are available on hand and able to be applied to support these efforts.
- Ensure workers are trained to properly install and repair erosion and sediment controls.

13.2 Fires

An accidental fire could potentially adversely affect the atmospheric environment (emissions), the terrestrial environment (vegetation and wildlife), and the socio-economic environment (land use and value) during all Project phases.

Mitigation measures to limit the probability of an occurrence and reduce the magnitude and extent of potential effects include:

- Prohibit the use of campfires or burning within the Project Area by staff and contractors.
- Dispose of all flammable waste regularly at an approved facility.

- Implement mitigation related to chemical and fuel storage (Section 13.3).
- Smoke in designated areas only.
- Equip heavy machinery and turbines with fire suppressant equipment and ensure response materials are available during construction and turbine operation.
- Maintain vegetation clearing at turbine pads throughout the Project's operation to act as a firebreak and remove cleared vegetation from the Project Area to reduce fuel build-up.

13.3 General Hazardous Material Spills

Hazardous spills resulting from fuel (i.e., storage, refueling, operation of combustion vehicles) and other on-site chemicals may occur during the Project's construction and operations activities. Hazardous spills can adversely impact air, soil, surface water, groundwater quality, human health, and safety. In addition, hazardous spills may risk the health of aquatic, avian, and terrestrial wildlife. The severity of the impacts will depend on the nature of the hazardous material and the quantity spilled.

Mitigation measures to limit the probability of an occurrence and reduce the magnitude and extent of potential effects include the following:

- Develop a Spill Prevention and Response Plan as part of the Project's EPP, which will set out spill prevention and response procedures.
- Require that all fuels, lubricants, and chemicals are stored in designated containers and areas.
- Provide secondary containment in storage areas (where possible).
- Require that the equipment used is inspected and free of fluid leaks.
- Require that fuel storage areas, refueling, and/or equipment lubrication are located a minimum of 30 m from any surface and groundwater feature (i.e., watercourse, well).
- Require that refueling of machinery and equipment is conducted on an impervious surface.
- Require that any equipment servicing is completed off-site. If this is not possible, ensure the work is completed on an impervious surface.
- Require that the storage of all dangerous goods comply with the Workplace Hazardous Material Information System (WHMIS).
- Require that all mobile equipment has spill kits stocked with soaker pads, oil-absorbing materials, and containment booms.
- Locate stationary spill kits or spill drums at work areas utilizing mobile equipment, hazardous fluids and/or in proximity to environmentally sensitive areas (i.e., wetlands or watercourses).
- Stock spill kits with the appropriate quantity and type of material for the anticipated product type(s) and volume(s) in use.
- Require that site workers are trained in the use of on-site spill kits.

With the implementation of the above preventative measures, the likelihood of an accident or a malfunction is low. Appropriate response plans will be put in place to ensure any interactions with VCs from an accident or malfunction are limited and the effects can be quickly contained.

14.0 CUMULATIVE EFFECTS

14.1 Overview

Cumulative effects are changes to environmental, social, and economic values caused by the combined effect of past, present, and potential future human activities and natural processes (Government of British Columbia, u.d). Concerns are often raised about long-term changes that may occur not only as a result of a single action but of the combined effects of each successive action on the environment (Hegman et al., 1999). While a single undertaking might not cause significant adverse effects, multiple undertakings may result in incremental impacts, referred to as cumulative effects. These cumulative effects may potentially result in an overall impact to a VC of interest.

14.2 Other Undertakings in the Area

The Nuttby Mountain Wind Farm is a 50.6 MW wind energy development located within the northeastern portion of the Study Area and Assessment Area. The development was commissioned in 2010 and consists of 22 Enercon E-82/2300 turbines (2.3 kW each) with 78 m hub heights and 82 m rotor diameters. The Project will utilize existing infrastructure (e.g., road networks) associated with the Nuttby Mountain Wind Farm to minimize the area of disturbance and resultant cumulative effect on the surrounding environment.

EverWind Fuels is currently developing the Windy Ridge Wind Project (340 MW) to the west of the Project. Additionally, the Higgins Mountain Wind Project (17 wind turbines) and the Westchester Wind Project (15 wind turbines), which both received EA Approval earlier in 2023, are in development further to the west, near the communities of Londonderry and Westchester Mountain, respectively.

Table 14.1 summarizes other industrial activities/developments near the Assessment Area (within approximately 5 km).

Table 14.1: Nearby Industrial Activities

Development	Development Activity	Status of Activity	Activity Location	Distance to AA*
Forestry	Harvests, thinning, plantations, & other treatments	Active	Within and Surrounding the Study Area	Within AA
Agriculture	Agricultural fields (planting, harvesting, spraying, etc.) and/or livestock	Active	Within and Surrounding the Study Area	Within AA (along Old Nuttby Road)

*Distance to nearest point of the Assessment Area

14.3 Cumulative Effects Assessment

Cumulative effects were assessed for the Project by taking into consideration the potential residual effects of significance (as identified in VC sections) in relation to the activities that have taken place in the past, those that currently exist, and those that can be reasonably expected to be developed within the area surrounding the Project (i.e., undergoing regulatory approval/under construction). Table 14.2 summarizes the potential for VCs to have cumulative impacts with other undertakings in the area.

Table 14.2: Potential for Cumulative Effects on Identified VCs

VC	Cumulative Effects Assessed	Reasoning
Atmosphere	No	Residual positive impacts regarding provincial GHG emissions from the use of renewable energy resources.
Geology	No	The Project will not impact the geologic environment outside the Project Area or interact with nearby industrial activities.
Waterbodies & Watercourses	No	The Project is maximizing the use of existing roadways, minimizing the disturbance of surface freshwater resources. Residual impacts will be mitigated, monitored, and be contained within the Assessment Area.
Fish & Fish Habitat	No	The Project is maximizing the use of existing roadways, minimizing the disturbance to fish and fish habitat. Residual impacts will be mitigated, monitored, and be contained within the Assessment Area.
Wetlands	No	The Project is maximizing the use of existing disturbed areas to minimize impacts to wetlands. In accordance with provincial permitting requirements, all impacted wetlands will be compensated for, such that there is no residual effect.
Terrestrial Habitat	No	The Project Area is located within an active forest management area, such that a large portion of tree removal would have been subject to future harvesting in the absence of the Project.
Terrestrial Flora	No	Avoidance of flora SOCI.
Terrestrial Fauna	Yes	Nearby wind developments. Potential effect for loss of habitat connectivity to act cumulatively at the regional scale.
Bats	Yes	Nearby wind developments. Potential for wind turbine related injury/mortality of bats.

VC	Cumulative Effects Assessed	Reasoning
Avifauna	Yes	Nearby wind developments. Potential for wind turbine related injury/mortality of avifauna.
Economy, Land Use, Transportation, & Recreation/Tourism	No	Residual impacts are anticipated to be low to negligible, or positive.
Archeology, Culture, & Heritage	No	Avoidance of archaeological, historical, or culturally significant areas.
Human Health	No	Residual impacts to human health are not anticipated.
EMI	No	No potential to interact with nearby industrial activities.
Shadow Flicker	No	Shadow flicker produced by the Project is within guidelines. The nearest operational wind development is approximately 3 km away and will not act cumulatively with the Project.
Visual Aesthetics	No	Residual impacts considered not significant.
Sound	No	Sound levels from the operation of wind turbines are below guidance thresholds. The nearest operational wind development is approximately 3 km away and will not act cumulatively with the Project.

The following VCs are assessed for cumulative effects:

- Bats
- Avifauna
- Wildlife (mainland moose)

Bats & Avifauna

Bats and avifauna are discussed in terms of cumulative effects based on the Project's proximity to other wind developments along with the cumulative potential for injury/mortality of SAR.

The Nuttby Mountain Wind Farm is a moderately sized wind farm development consisting of 22 wind turbines (~78 m hub height) in total. As part of the EA, pre-construction bat and avian surveys were completed, and the EA determined that impacts to avifauna would not be significant. In addition, the proponent was required to complete post-construction bat and bird monitoring (results are not publicly available but were required to be submitted to NSECC) (CBCL Limited, 2008). Based on the moderate scale, the Project's shared use of existing infrastructure, and the respective EA conclusions of the Nuttby Mountain Wind Farm, the anticipated cumulative effects on bats and avifauna from the operation of the combined wind developments are anticipated to be not significant.

Wildlife (Mainland Moose)

While the Project is not expected to have a significant impact on terrestrial wildlife, including the regional Mainland moose population, due to the minimal anticipated loss of forest habitat and road network expansion, the combined impact of several wind power projects and other activities in the region, including forestry, should be considered carefully. The Proponent recognizes the importance of robust wildlife monitoring and management initiatives to ensure the continued health of wildlife in the region, namely the Mainland moose population. To do this effectively requires a landscape-level approach and the collaboration between key stakeholders, including government departments (e.g., NSECC and NSNRR), subject-matter experts, project developers, landowners and managers, land users, and the Mi'kmaq of Nova Scotia. The Proponent is fully committed to taking a leadership role and allocating resources to support wildlife monitoring and management measures, in partnership with other stakeholders, to ensure the continued health and conservation of wildlife, especially Mainland moose. As a first step, the Proponent will initiate discussions with government and key stakeholders on how the wind industry can support and mitigate the cumulative impacts of multiple land uses on Mainland moose habitat in the Cobequid Mountains, with the goal of helping to protect and restore this important habitat.

15.0 CONCLUSION

In accordance with A Proponent's Guide to Environmental Assessment (NSECC, 2017), the studies, regulatory assessments and VC evaluations described within this EA Report have been considered both singularly and cumulatively, for all phases of the Project.

The results of this assessment indicate that in consideration of the Project's mitigative and protection measures, adverse residual effects are not anticipated to be significant.

16.0 CLOSURE

This EA Report was completed by Strum Consulting, an independent, multi-disciplinary team of consultants with extensive experience with submission of EA Registration documents for undertakings within Atlantic Canada. Curriculum vitae for EA Report contributors and Project Team members are provided in Appendix T. A list of the Project team and their associated roles is provided below.

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17.0 REFERENCES

Activities Designation Regulations, N.S. Reg 47/95

Allen, A.W. (1983). *Habitat suitability index models: fisher*. Retreived from https://pubs.usgs.gov/publication/fwsobs82_10_45

Adamus, P.R. (2021). *Wetland Ecosystem Services Protocol – Atlantic Canada (WESP-AC).* Retrieved from MCFT Training Course.

Air Quality Regulations, N.S. Reg. 8/2020

Atlantic Canada Conservation Data Centre (ACCDC). (2023a). *Species ranks*. Retrieved from http://accdc.com/en/ranks.html

Atlantic Canada Conservation Data Centre (ACCDC). (2023b). *Data Report 7738: Nuttby, NS.* Retrieved from ACCDC.

Bennett Jones LLP. (2023*). Key Takeaways from the 2023 Canadian Hydrogen Convention: Part 1.* Retrieved from https://www.bennettjones.com/Blogs-Section/Key-Takeaways-from-the-2023-Canadian-Hydrogen-Convention-Part-1

Bird Studies Canada. (2016). *Maritimes Breeding Bird Atlas*. Retrieved from https://www.mba-aom.ca/

Birds Canada. (2019). *Nova Scotia Nocturnal Owl Survey – Guide for Volunteers.* Retrieved from https://birdscanada.org/wp-content/uploads/2022/03/NS_owl_instructions_2022.pdf

Bird Studies Canada & Nature Canada. (2023). *Canada important bird areas interactive map*. Retrieved from https://www.ibacanada.com/mapviewer.jsp?lang=EN

Blakeslee, C.J., Galbraith, H.S., & Deems, R.M. (2018). The Effects of Rearing Temperature on American Glass Eels. *Agricultural Sciences, 2018*(9), 1070-1084.

Brinkley, C & Leach, A. (2019). Energy next door: a meta-analysis of energy infrastructure impact on housing value. *Energy Research & Social Science, 50*, 51-65.

British Columbia Fisheries Information Services Branch (BC Ministry of Environment). (2001). Reconnaissance (1:20 000) Fish and Fish Habitat Inventory: Standards and Procedures. Retrieved from https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/recce2c.pdf

British Columbia Ministry of Environment and Climate Change (BCECC). (2018). *Inventory and Survey Methods for Rare Plants and Lichens. Standards for Components of British Columbia's Biodiversity No. 43.* Retrieved from https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/inventory_and_survey_methods_for_rare_plants_and_lichens.pdf

Broders, H., Quinn, G. M., & Forbes, G.J. (2003). Special Status, and the Spatial and Temporal Patterns of Activity of Bats in Southwest Nova Scotia, Canada. *Northeastern Naturalist, 10*(4), 383-398.

Broders, H., & Forbes, G. (2004). Interspecific and intersexual variation in roost-site selection of northern long-eared and little brown bats in the Greater Fundy National Park Ecosystem. *Journal of Wildlife Management, 68,* 602-610.

BMWK. (2023). *Canada-Germany Energy Partnership*. Retrieved from https://www.canada-germany-energy-partnership.org/about-the-energy-partnership/?L=0

Caceres, C. & Barclay, R. (2000). Myotis septentrionalis. *Mammalian Specie, 634,* 1-3.

Canada Wildlife Act, R.S.C. 1985, c. W-9

Canadian Centre for Occupational Health & Safety (CCOHS). (2023). *Noise – Occupational Exposure Limits in Canada*. Retrieved from https://www.ccohs.ca/oshanswers/phys_agents/noise/exposure_can.html

Canadian Council of Ministers of the Environment (CCME). (undated). *CAAQS*. Retrieved from https://ccme.ca/en/air-quality-report#slide-7

Canadian Environmental Protection Act, S.C. 1999, c. 33

Canadian Navigable Waters Act, R.S.C. 1985, c. N-22

Canadian Renewable Energy Association (CanWEA). (2006a). *Community Benefits, Why Wind is Right – Right Now.* Retrieved from http://www.CanWEA.ca/images/uploads/File/12_community.pdf

Canadian Renewable Energy Association (CanWEA). (2006b). *North Cape Wind Farm*. Retrieved from http://www.canwea.ca/images/uploads/File/Case_studies/North_Cape_e.pdf

Canadian Wildlife Service (CWS). (2007a). *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds.* Retrieved from https://publications.gc.ca/collections/collection_2013/ec/CW66-364-2007-eng.pdf

Canadian Wildlife Service (CWS). (2007b). *Wind turbines and birds : a guidance document for environmental assessment.* Retrieved from https://publications.gc.ca/site/eng/458437/publication.html

Canadian Wildlife Service (CWS). (2020). *Canadian Nightjar Protocol*. Retrieved from http://wildresearch.ca/wp-content/uploads/2019/05/National-Nightjar-Survey-Protocol-WildResearch-2019.pdf

Carter, J. (2011). *The Effect of Wind Farms on Residential Property Values in Lee County, Illinois*. [Master's Thesis, Illinois State University].

CBCL. (2023a). *Proposed Nuttby Ridge Wind Farm Technical Summary Report Fish and Fish Habitat, Water Quality, Aquatics, and Turtle Habitat Assessments FINAL Report*. Retrieved from CBCL.

CBCL. (2023b). *Proposed Nuttby Ridge Wind Farm Technical Summary Report Flora & Vegetation Inventories, Project Ecological Land Classification and Wetland Assessments*. Retrieved from CBCL.

Centre for Plant Conservation (CPC). (2020). *What Makes a Plant Rare?* Retrieved from https://saveplants.org/rarity-mini-article/

Chemical & Engineering News. (2019). *Industrial ammonia production emits more CO2 than any other chemical-making reaction. Chemists want to change that*. Retrieved from https://cen.acs.org/environment/green-chemistry/Industrial-ammonia-production-emits-CO2/97/i24

Chief Medical Officer of Health (CMOH). (2010). *The Potential Health Impact of Wind Turbines.* Retrieved from https://health.gov.on.ca/en/common/ministry/publications/reports/wind_turbine/wind_turbine.pdf

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). (2011). *COSEWIC Assessment and Status Report on the Atlantic salmon Salmo salar.* Retrieved from https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/cosewic/sr_Atlantic_Salmon_2011a_e.pdf

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). (2012). *American eel (Anguilla rostrata) COSEWIC assessment and status report 2012.* Retrieved from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/american-eel-2012.html

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). (2013). *COSEWIC assessment and status report on the Little Brown Myotis Myotis lucifugus, Northern Myotis Myotis septentrionalis and Tri-colored Bat Perimyotis subflavus in Canada*. Retrieved from https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/cosewic/sr_Little%20Brown%20Myotis%26Northern%20Myotis%26Tri-colored%20Bat_2013_e.pdf

Canadian Renewable Energy Association (CREA). (2020). *Best Practices for Wind Farm Icing and Cold Climate Health & Safety.* Retrieved from https://renewablesassociation.ca/wp-content/uploads/2021/01/Best-Practices-for-Wind-Farm-Icing-and-Cold-Climate_June2020.pdf

Cooper, B.A., R.H. Day, R.J. Ritchie, and C.L. Cranor. 1991. An improved marine radar system for studies of bird migration. Journal of Field Ornithology 62:367–377.

DataStream Initiative. (2021). *Dissolved Oxygen A Water Monitor's Guide to Water Quality*. Retrieved from https://datastream.cdn.prismic.io/datastream/a7aeae1b-a092-43d2-877a-acfbffa75c92_Dissolved_Oxygen.pdf

Davis, D., & Browne, S. (1996). *The Natural History of Nova Scotia*. Nova Scotia Museum, Halifax, NS. p. 304.

d'Entremont, M.V., Hartley, M.I., & Otter, K.A. (2017). Comparing pre- versus postoperational movement of nocturnal migrants around a wind energy facility in northeast British Columbia, Canada*. Avian Conservation and Ecology* 12(2):3.

Duiker, S. W. (2005). *Effects of Soil Compaction*. Retrieved from https://extension.psu.edu/effects-of-soil-compaction

Electrical Academia. (undated). *Wind turbine parts and functions*. Retrieved from https://electricalacademia.com/renewable-energy/wind-turbine-parts-functions/#:~:text=A%20wind%20turbine%20consists%20of,a%20wind%20turbine%20cannot%20function.&text=The%20foundation%20is%20under%20the,it%20is%20covered%20by%20soil

Endangered Species Act, S.N.S. 1998, c. 11

Environment Act, S.N.S. 1994-95, c. 1

Environmental Assessment Regulations, N.S. Reg. 221/2018

Environmental Protection Act, R.S.O. 1990, c. E.19

Environment Canada and Climate Change (ECCC). (2016). *Recovery Strategy for the Common Nighthawk (Chordeiles minor) in Canada.* Retrieved from https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/plans/rs_common%20nighthawk_e_final.pdf

Environment Canada and Climate Change (ECCC). (2018). Wind Turbines and Birds – Updated Guidance for Environmental Assessment and Monitoring Canadian Wildlife Service – Atlantic Region May 2018. Retrieved from ECCC.

Environment and Climate Change Canada (ECCC). (2020). *Criteria for public weather events*. Retrieved from https://www.canada.ca/en/environment-climate-change/services/types-weather-forecasts-use/public/criteria-alerts.html#rainfall

Environment Canada and Climate Change (ECCC). (2023a). *Weather and Climate Historical Data*. Retrieved from https://climate.weather.gc.ca/historical_data/search_historic_data_e.html

Environment and Climate Change Canada (ECCC). (2023b). *Nova Scotia – Air quality health index – Provincial summary*. Retrieved from https://weather.gc.ca/airquality/pages/provincial_summary/ns_e.html

Environmental Goals and Sustainable Prosperity Act, S.N.S. 2007, c 7

Environmental Laboratory. (1987). *Corps of Engineers Wetlands Delineation Manual, US Army Corp of Engineers, 1987.* Retrieved from https://www.lrh.usace.army.mil/Portals/38/docs/USACE%2087%20Wetland%20Delineation%20Manual.pdf

Erisman, J. W., Sutton, M. A., Galloway, J., Klimont, Z., & Winiwarter, W. (2008). How a century of ammonia synthesis changed the world. *Natural Geoscience, 1*: 636-639.

ERM Worldwide Group Limited (ERM). (2023). Carbon footprinting and evaluation of RED II conformance at design phase report. ERM Worldwide Group Limited.

European Wind Energy Association. (u.d.). *Rotor and nacelle mass*. Retrieved from https://www.wind-energy-the-facts.org/rotor-and-nacelle-mass.html

Farmer, A. M. (2003). *The effects of Dust on Vegetation – A Review. Environmental Pollution*. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/026974919390179R

Federal Ministry for Economic Affairs and Climate Action. (2023). *The National Hydrogen Strategy.* Retrieved from https://www.bmwk.de/Redaktion/EN/Hydrogen/Dossiers/national-hydrogen-strategy.html

Fenton, M. B. & Barclay, R. (1980). Myotis lucifugus. *Mammalian Species, 42*, 1-8.

Fisheries Act, R.S.C. 1985, c. F-14

Fisheries and Oceans Canada (DFO). (1996). *Trout in Canada's Atlantic Provinces.* Retrieved from https://waves-vagues.dfo-mpo.gc.ca/Library/40628887.pdf

Fisheries and Oceans Canada (DFO). (2022). *Best Management Practices for the Protection of Freshwater Fish Habitat in Newfoundland and Labrador.* Retrieved from https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/41030217.pdf

Fisheries and Oceans Canada (DFO). (2023). *Aquatic species at risk map*. Retrieved from https://www.dfo-mpo.gc.ca/species-especes/sara-lep/map-carte/index-eng.html

Forest Fire Protection Regulations, N.S. Reg. 135/2019

Garroway, C. & Broders, H. (2008). Day roost characteristics of northern long-eared bats (Myotis septentrionalis) in relation to female reproductive status. *Ecoscience 15,* 89-93.

GE Renewable Energy. (2018). *Technical documentation wind turbine generator systems 2MW platform - 60 Hz*. Retrieved from https://www.cerrogordoauditor.gov/home/showpublisheddocument/10677/637039654110230000

Ghavam, S., Vahdati, M., Wilson, G., & Styring, P. (2021). Sustainable Ammonia Production Processes. *Frontiers in Energy Research, 9*.

GeoNOVA. (2020). *DataLocator – Elevation Explorer.* Retrieved from https://nsgi.novascotia.ca/datalocator/elevation/

GeoNOVA. (2022). *Nova Scotia topographic database - Water features (line layer).* Retrieved from https://data.novascotia.ca/Lands-Forests-and-Wildlife/Nova-Scotia-Topographic-DataBase-Water-Features-Li/fpca-jrmt

Government of British Columbia. (undated). *Cumulative effects framework.* Retrieved from https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/cumulative-effects-framework

Government of Canada. (2015). *Proposed Recovery Strategy for Little Brown Myotis (Myotis lucifugus), Northern Myotis (Myotis septentrionalis), and Tri-colored Bat (Perimyotis subflavus) in Canada.* Retrieved from https://www.registrelep-sararegistry.gc.ca/virtual_sara/files/plans/rs_LittleBrownMyotisNorthernMyotisTricoloredBat_e_proposed.pdf

Government of Canada. (2018). *Regional Hazards: Nova Scotia*. Retrieved from https://www.getprepared.gc.ca/cnt/hzd/rgnl/ns-en.aspx

Government of Canada. (2019a). *Causes of climate change*. Retrieved from https://www.canada.ca/en/environment-climate-change/services/climate-change/causes.html

Government of Canada. (2019b). *Canada's changing climate report*. Retrieved from https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/Climate-change/pdf/CCCR_FULLREPORT-EN-FINAL.pdf

Government of Canada. (2019c). *Changes in temperature*. Retrieved from https://www.canada.ca/en/environment-climate-change/services/climate-change/canadian-centre-climate-services/basics/trends-projections/changes-temperature.html

Government of Canada. (2020). *Canada Gazette, Part I, Volume 154, Number 46: Federal Halocarbon Regulations, 2020*. Retrieved from https://canadagazette.gc.ca/rp-pr/p1/2020/2020-11-14/html/reg2-eng.html

Government of Canada. (2022). *Government of Canada makes significant investment in Alberta's clean hydrogen sector and outlines next steps to help Canadian industry sectors cut pollution.* Retrieved from https://www.canada.ca/en/innovation-science-economic-development/news/2022/11/government-of-canada-makes-significant-investment-in-albertas-clean-hydrogen-sector-and-outlines-next-steps-to-help-canadian-industry-sectors-cut-p.html

Government of Canada. (2023). *Species at Risk Public Registry*. Retrieved from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

Government of Ontario. (2022). *A guide to the Noise Regulation under the Occupational Health and Safety Act Appendix D: Noise in construction, mining, farming and firefighting operations.* Retrieved from https://www.ontario.ca/document/guide-noise-regulation-under-occupational-health-and-safety-act/appendix-d-noise-construction-mining-farming-and-firefighting-operations

Government of Oregon. (undated). *ATV sound.* Retrieved from https://www.oregon.gov/oprd/ATV/Pages/ATV-Sound.aspx
Government of the Northwest Territories. (2013). *Conductivity Environment and Natural Resources.* Retrieved from https://www.enr.gov.nt.ca/en

Government of Nova Scotia. (2023). *Species At Risk – Recovery Update.* Retrieved from https://novascotia.ca/natr/wildlife/species-at-risk/

Gulden, W. E. (2011). A Review of the Current Evidence Regarding Industrial Wind Turbines and Property Values from a Homeowner's Perspective. *Bulletin of Science, Technology & Society*, *31*(5), 363-368.

Health Canada. (2020). *Radiofrequency electromagnetic fields (EMF).* Retrieved from https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/types-sources/radiofrequency-fields.html

Heavy-duty Vehicle and Engine Greenhouse Gas Emission Regulations, S.O.R./2013-24

Hegmann, G., Cocklin, C., Creasey, R., Dupuis, S., Kennedy, A., Kingsley, L., Ross, W., Spaling, H., & D. Stalker. (1999). *Cumulative effects assessment practitioners' guide.* Retrieved from https://www.canada.ca/content/dam/iaac-acei/documents/policyguidance/cumulative-effects-assessment-practitionersguide/cumulative_effects_assessment_practitioners_guide.pdf

Henry, M., Thomas, D., Vaudry, R., & Carrier, M. (2002). Foraging Distances and the Home Range of Pregnant and Lactating Little Brown Bats (Myotis Lucifugus). *Journal of Mammalogy, 83*(3), 767-774.

Hinman, J. L. (2010). *Wind Farm Proximity and Property Values: A Pooled Hedonic Regression Analysis of Property Values in Central Illinois*. [Thesis, Illinois State University]. Retrieved from https://puc.sd.gov/commission/dockets/electric/2017/el17-055/exhibit4.pdf

Hoen, B., Wiser, R., Cappers, P., Thayer, M., & Sethi, G. (2009). *The Impact of Wind Power Projects on Residential Property Values in the United States: A Multi-Site Hedonic Analysis*. Retrieved from https://www.osti.gov/servlets/purl/978870

Hoen, B., Wiser, R., Cappers, P., Thayer, M., & Sethi, G. (2011). Wind energy facilities and residential properties: the effect of proximity and view on sales prices. *Journal of Real Estate Research, 33.*

Hoen, B., Brown, J. P., Jackson, T., Wiser, R., Thayer, M., & Cappers, P. (2013). *A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States.* Retrieved from https://www.energy.gov/eere/wind/articles/spatial-hedonic-analysis-effects-wind-energy-facilities-surrounding-property

Horn, J., Arnett, E., & Kunz, T. (2008). Behavioral Responses of Bats to Operating Wind Turbines. *Journal of Wildlife Management, 72*(1), 123-132.

Horton, K.G., Van Doren, B.M., Albers, H.J., Farnsworth, A. & Sheldon, D. (2021). Near-term ecological forecasting for dynamic aeroconservation of migratory birds. *Conservation Biology, 35*(6), pp.1777-1786.

Intergovernmental Panel on Climate Change (IPCC). (2018). Annex I: Glossary. In *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 541-562. https://doi.org/10.1017/9781009157940.008

Intergovernmental Panel on Climate Change (IPCC). (2022). *Climate Change 2022 - Impacts, Adaptation and Vulnerability.* Retrieved from https://www.ipcc.ch/report/ar6/wg2/

International Energy Agency (IEA). (2021). *Ammonia Technology Roadmap*. Retrieved from https://www.iea.org/reports/ammonia-technology-roadmap

Iowa State University. (2023). *Station data and met data: Debert*. Retrieved from https://mesonet.agron.iastate.edu/sites/dyn_windrose.phtml?station=CZDB&network=CA_NS_ASOS&bin0=2&bin1=5&bin2=7&bin3=10&bin4=15&bin5=20&conv=from&units=mps&nsector=36&fmt=png&dpi=100&year1=2012&month1=1&day1=1&hour1=0&minute1=0&year2=2022&month2=12&day2=31&hour2=0&minute2=0

ISO 9613-2, International Organization for Standardization, Geneva, Switzerland, 2017

ISO 14064, International Organization for Standardization, Geneva, Switzerland, 2019

Jansson, S., Malmqvist, E., Brydegaard, M., Akesson, S., & Rydell, J. (2020). A Scheimpflug Lidar used to observe insect swarming at a wind turbine. *Ecological Indicators*, 117, 106578.

Kenter, P. (2017). *Nova Scotia contractor completes massive single-day wind turbine pour*. Retrieved from https://canada.constructconnect.com/dcn/news/projects/2017/02/nova-scotia-contractor-completes-massive-single-day-wind-turbine-pour-1021503w

Kingsley, A. & Whittam, B. (2005). *Wind Turbines and Birds: A Background Review for Environmental Assessment.* Draft report for Environment Canada, Canadian Wildlife Service, Quebec. 81 pp. Retrieved from https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.172.1664&rep=rep1&type=pdf

Knopper, L.D., Ollson, C.A, McCallum, L. C., Aslund, M. L., Berger, R. G., Souweine, K., & McDaniel, M. (2014). Wind turbines and human health. *Public Health*, 19.

Laposa, S. & Mueller, A. (2010). Wind Farm Announcements and Rural Home Prices: Maxwell Ranch and Rural Northern Colorado. *Journal of Sustainable Real Estate, 2*(1), 383-402.

LeBlanc, M.P. (2007). *Recommendations for risk assessments of ice throw and blade failure in Ontario*. Retrieved from https://d3n8a8pro7vhmx.cloudfront.net/uplandprairiewind/pages/64/attachments/original/1492703881/ice_throw_document_%28002%29.pdf?1492703881

Liechti, F., & Bruderer, B. (1998). The Relevance of Wind for Optimal Migration Theory. *Journal of Avian Biology, 29*(4), 561–568.

Long, C.V., Flint, J.A., Lepper, & P.A. (2011). Insect attraction to wind turbines: does colour play a role? *European Journal of Wildlife Research,* 57, 323-331.

Lovich, J.E. & Ennen, J.R. (2013). Assessing the state of knowledge of utility-scale wind energy development and operation on non-volant terrestrial and marine wildlife. *Applied Energy,* 103, 52–60.

Lucas, Z., & Hebda, A. (2011). Lasiurine bats in Nova Scotia. Proceedings of the Nova Scotian Institute of Science.

MacGregor, M.K. & Elderkin, M.F. (2003). Protecting and Conserving Wood Turtles: A Stewardship Plan for Nova Scotia. Retrieved from https://novascotia.ca/natr/wildlife/biodiversity/pdf/recoveryplans/finalwoodturtleplan.pdf

Maine Department of Environmental Protection. (2022). *Reducing Acidification in Endangered Atlantic Salmon Habitat.* Retrieved from https://www.maine.gov/dep/water/monitoring/rivers_and_streams/salmon/Third%20year%20of%20clam%20shells%20(003).pdf

Market and Opinion Research International. (2002). *Tourist Attitudes Toward Windfarms*. Retrieved from http://www.bwea.com/pdf/MORI.pdf

Maryland Department of Natural Resources. (2012). *Brook Trout.* Retrieved from https://dnr.maryland.gov/education/Documents/BrookTrout.pdf

McCallum, L. C., Aslund, M. L., Knopper, L.D., Ferguson, G. M., & Ollson, C.A. (2014). Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern? *Environmental Health*, 13(9).

McGuire, L.P., Guglielmo, C. G., Mackenzie, S.A., & Taylor, P. D. (2011). Migratory stopover in the long-distance migrant silver-haired bat, *Lasionycteris noctivagans*. *Journal of Animal Ecology*, 81(2), 377-385.

McGrath, T., Pulsifer, M., Seymour, R., Doucette, L., Forbes, G., McIntyre, R., Milton, R., Cogan, L., Retallack, M., & Crewe, T. (2021). *Nova Scotia Silvicultural Guide for the Ecological Matrix.* Retrieved from https://novascotia.ca/ecological-forestry/docs/silvicultural-guide.pdf

Merida, W. (2023, July 21). Green not grey: How Canada can tap into the $2.5-trillion hydrogen market. *Financial Post*.

Meyer, R. (2007). *Pekania pennanti*. Retrieved from https://www.fs.usda.gov/database/feis/animals/mammal/pepe/all.html

Migratory Birds Convention Act, S.C. 1994, c. 22

Ministry of Transportation of Ontario (MTO). (2009). *Environmental Guide for Fish and Fish Habitat, Section 5: Impact Assessment and Mitigation.* Retrieved from: https://longpointbiosphere.com/download/fish__water/MTO-Fish-Guide-June-2009-Final.pdf

Mitsch, W. J., & Gosselink, J. G. (2001). Wetlands (third edition). *Regulated Rivers Research and Management, 17*(3), 295–295.

Moseley, M. (2007). *Records of bats (Chiroptera) at caves and mines in Nova Scotia.* Retrieved from the Nova Scotia Museum.

Municipality of Argyle. (2014). *Pubnico: Nova Scotia's First Wind Farm* (video). Retrieved from https://www.youtube.com/watch?v=-eBZKBA4_AU

Municipality of the County of Colchester. (2023). *Wind Turbine Development By-law*. Retrieved from https://www.colchester.ca/4034-wind-turbine-development-by-law-september-2023/file

National Geographic. (2022). *Invasive Species.* Retrieved from https://education.nationalgeographic.org/resource/invasive-species

National Renewable Energy Laboratory. (2017). *2015 cost of wind energy review*. Retrieved from https://www.nrel.gov/docs/fy17osti/66861.pdf

National Wetlands Working Group. (1997). *The Canadian Wetland Classification System*. Retrieved from https://nawcc.wetlandnetwork.ca/Wetland%20Classification%201997.pdf

National Wildlife Federation (NWF). (undated). *Moose.* Retrieved from https://www.nwf.org/Educational-Resources/Wildlife-Guide/Mammals/Moose

Natural Resources Canada (NRCan). (2017). *About Renewable Energy*. Retrieved from https://www.nrcan.gc.ca/our-natural-resources/energy-sources-distribution/renewable-energy/about-renewable-energy/7295

Natural Resources Canada (NRCan). (2020). *Hydrogen Strategy for Canada Seizing the Opportunities for Hydrogen a Call to Action.* Retrieved from https://natural-resources.canada.ca/sites/nrcan/files/environment/hydrogen/NRCan_Hydrogen-Strategy-Canada-na-en-v3.pdf

Natural Resources Canada (NRCan). (2022a). *CanVec Database – Hydrographic Features*. Retrieved from https://open.canada.ca/data/en/dataset/8ba2aa2a-7bb9-4448-b4d7-f164409fe056

Natural Resources Canada (NRCan). (2022b). *CWFIS: Interactive Map.* Retrieved from https://cwfis.cfs.nrcan.gc.ca/interactive-map?zoom=8&center=2292290.966344817%2C10933.87960105588&month=7&day=9&year=2022#iMap

Neily, P., Basquil, S., Quigley, E., & Keys, K. (2017). *Ecological Land Classification for Nova Scotia.* Retrieved from https://novascotia.ca/natr/forestry/ecological/pdf/Ecological-Land-Classification-guide.pdf

Nova Scotia Department of Agriculture and Fisheries. (2005). *Nova Scotia Trout Management Plan.* Retrieved from https://novascotia.ca/fish/documents/special-managementareas-reports/NSTroutManplandraft05.pdf

Nova Scotia Environment and Climate Change (NSECC). (1990). *Guidelines for Environmental Noise Measurement and Assessment.* Retrieved from https://novascotia.ca/environmental-noise-measurement-assessment-engagement/

Nova Scotia Environment and Climate Change (NSECC). (1993). *Procedure for conducting a pre-blast survey*. Retrieved from NSECC.

Nova Scotia Environment and Climate Change (NSECC). (2009). *Guide to Addressing Wildlife Species and Habitat in an EA Registration Document*. Retrieved from https://novascotia.ca/nse/ea/docs/EA.Guide-AddressingWildSpecies.pdf

Nova Scotia Environment and Climate Change (NSECC). (2011). *Nova Scotia 1:10,000 Primary Watersheds*. Retrieved from https://www.novascotia.ca/nse/watercourse-alteration/docs/Watercourse-Alterations-Standard.pdf

Nova Scotia Environment and Climate Change (NSECC). (2015a). *Nova Scotia Groundwater Observation Well Network*. Retrieved from https://novascotia.ca/nse/groundwater/groundwaternetwork.asp

Nova Scotia Environment and Climate Change (NSECC). (2015b). *Nova Scotia Watercourse Alterations Standard*. Retrieved from https://www.novascotia.ca/nse/watercourse-alteration/docs/Watercourse-Alterations-Standard.pdf

Nova Scotia Environment and Climate Change (NSECC). (2015c). *Guide to Altering Watercourses*. Retrieved from https://novascotia.ca/nse/watercourse-alteration/docs/NSE-Watercourse-Alteration-Program-May29.pdf

Nova Scotia Environment and Climate Change (NSECC). (2017). *A Proponent's Guide to Environmental Assessment.* Retrieved from https://novascotia.ca/nse/ea/docs/EA.Guide-Proponents.pdf

Nova Scotia Environment and Climate Change (NSECC). (2019). *Nova Scotia wetland conservation policy*. Retrieved from https://novascotia.ca/nse/wetland/docs/Nova.Scotia.Wetland.Conservation.Policy.pdf

Nova Scotia Environment and Climate Change (NSECC). (2020). *Standards for Quantification, Reporting, and Verification of Greenhouse Gas Emissions*. Retrieved from https://climatechange.novascotia.ca/sites/default/files/uploads/QRV_Standards.pdf

Nova Scotia Environment and Climate Change (NSECC). (2021). *Guide to preparing an EA registration document for wind power projects in Nova Scotia*. Retrieved from https://novascotia.ca/nse/ea/docs/EA.Guide-Proponents-WindPowerProjects.pdf

Nova Scotia Environment and Climate Change (NSECC). (2022b). *Ambient air quality standards: Public engagement*. Retrieved from https://novascotia.ca/ambient-air-quality-standards-public-engagement/

Nova Scotia Environment and Climate Change (NSECC). (2022c). *Nova Scotia Well Logs Database*. Retrieved from https://novascotia.ca/nse/groundwater/welldatabase.asp

Nova Scotia Environment and Climate Change (NSECC). (2022d). *Guidelines for environmental noise measurement and assessment*. Retrieved from https://novascotia.ca/environmental-noise-measurement-assessment-engagement/

Nova Scotia Environment and Climate Change (NSECC). (2023a). *Nova Scotia environment ambient air quality data*. Retrieved from https://novascotia.ca/nse/airdata/

Nova Scotia Environment and Climate Change (NSECC). (2023b). *Our Climate, Our Future* Retrieved from https://climatechange.novascotia.ca/sites/default/files/uploads/ns-climate-change-plan.pdf

Nova Scotia Environment and Climate Change (NSECC). (2023d). *Parks and protected areas interactive map*. Retrieved from https://novascotia.ca/parksandprotectedareas/plan/interactive-map/

Nova Scotia Environment and Climate Change (NSECC) & Nova Scotia Natural Resources and Renewables (NSNRR). (2009). *Online interactive groundwater map*. Retrieved from https://nsefp.ca/wp-content/uploads/2014/07/droponwaterFAQ_InteractiveGroundwaterMap.pdf

Nova Scotia Environment and Labour (NSEL). (2002). *Focus on the Tobeatic: Tobeatic Management Planning Exercise Background Information & Worksheet*. Retrieved from https://novascotia.ca/nse/protectedareas/docs/tobeaticplanning.pdf

Nova Scotia Natural Resources and Renewables (NSNRR). (undated). Wind Energy In Nova Scotia. Retrieved from https://energy.novascotia.ca/renewables/wind-energy

Nova Scotia Natural Resources and Renewables (NSNRR). (2002*). Mineral Resource Land Use Atlas*. Retrieved from https://novascotia.ca/natr/meb/geoscience-online/interactive-nts-map.asp

Nova Scotia Natural Resources and Renewables (NSNRR). (2009). *Potential for Radon in Indoor Air.* Retrieved from https://fletcher.novascotia.ca/DNRViewer/?viewer=Radon

Nova Scotia Natural Resources and Renewables (NSNRR). (2012). *Potential Boreal Felt Lichen habitat layer.* Retrieved from NSNRR.

Nova Scotia Natural Resources and Renewables (NSNRR). (2014). *Wetlands of special significance database.* Retrieved from NSNRR.

Nova Scotia Natural Resources and Renewables (NSNRR). (2016). Forest Seral Stages and Development Classes. GIS files provided [to Stantec] by B. James via email on June 29, 2016.

Nova Scotia Natural Resources and Renewables. (NSNRR). (2017). *Provincial landscape viewer.* Retrieved from https://nsgi.novascotia.ca/plv/

Nova Scotia Natural Resources and Renewables (NSNRR). (2018a). *Significant species and habitats database*. Retrieved from NSNRR.

Nova Scotia Natural Resources and Renewables (NSNRR). (2018b). *At-Risk Lichens– Special Management Practices.* Retrieved from https://novascotia.ca/natr/wildlife/habitats/terrestrial/pdf/SMP_BFL_At-Risk-Lichens.pdf
Nova Scotia Natural Resources and Renewables (NSNRR). (2019). *Karst risk map.* Retrieved from https://fletcher.novascotia.ca/DNRViewer/?viewer=Karst

Nova Scotia Natural Resources and Renewables (NSNRR). (2020). *Recovery Plan for Tri-colored bat (Perimyotis subflavus) in Nova Scotia [Final].* Retrieved from https://novascotia.ca/natr/wildlife/species-at-risk/docs/RECOVERY_PLAN_Tri_colored_Bat_27Sept20.pdf

Nova Scotia Natural Resources and Renewables (NSNRR). (2021a). *Nova Scotia Geoscience Atlas*. Retrieved from https://novascotia.ca/natr/meb/geoscience-online/geoscience_about.asp

Nova Scotia Natural Resources and Renewables (NSNRR). (2021b). *Nova Scotia Groundwater Atlas*. Retrieved from https://fletcher.novascotia.ca/DNRViewer/?viewer=Groundwater

Nova Scotia Natural Resources and Renewables (NSNRR). (2021c). *Acid Rock Drainage*. Retrieved from https://novascotia.ca/natr/meb/hazard-assessment/acid-rock-drainage.asp

Nova Scotia Natural Resources and Renewables (NSNRR). (2021d). *Wet Areas Mapping (WAM).* Retrieved from NSNRR.

Nova Scotia Natural Resources and Renewables (NSNRR). (2021e). *Wetlands inventory*. Retrieved from NSNRR.

Nova Scotia Natural Resources and Renewables (NSNRR). (2021f). *Recovery Plan for the Moose (Alces alces Americana) in Mainland Nova Scotia*. Retrieved from https://novascotia.ca/natr/wildlife/biodiversity/pdf/recoveryplans/mainlandmooserecoveryplan.pdf

Nova Scotia Natural Resources and Renewables (NSNRR). (2021g). *Mainland Moose Frequently Asked Question.* Retrieved from https://novascotia.ca/natr/wildlife/sustainable/mmoosefaq.asp#mm1

Nova Scotia Natural Resources and Renewables (NSNRR). (2021h). *Hunter and Trapper Harvest Statistics Index*. Retrieved from http://novascotia.ca/natr/hunt/furbearer-harvests.asp#bycounty

Nova Scotia Natural Resources and Renewables (NSNRR). (2021i). *Fire Weather Forecast Maps and Indices.* Retrieved from https://novascotia.ca/natr/forestprotection/wildfire/forecasts.asp

Nova Scotia Natural Resources and Renewables (NSNRR). (2022a). *Nova Scotia Pumping Test Database***.** Retrieved from https://novascotia.ca/natr/meb/download/dp498.asp

Nova Scotia Natural Resources and Renewables (NSNRR). (2022b). *An Old-Growth Forest Policy for Nova Scotia.* Retrieved from https://novascotia.ca/ecological-forestry/docs/old-growth-forest-policy.pdf

Nova Scotia Natural Resources and Renewables (NSNRR). (2022c). Pellet Group Inventory Data Collection Protocol March 2022. Provided to Stantec via email on April 5, 2022.

Nova Scotia Power. (undated). *Nova Scotia's 2030 Clean Power Plan*. Retrieved from https://beta.novascotia.ca/sites/default/files/documents/1-3582/nova-scotia-clean-power-plan-presentation-en.pdf

Nova Scotia Power. (2023). *Clean energy*. Retrieved from https://www.nspower.ca/cleanandgreen/clean-energy#how

Nova Scotia Salmon Association Adopt a Stream (NSSA Adopt a Stream). (2018). *The Nova Scotia Fish Habitat Suitability Assessment.* Retrieved from http://adoptastream.ca

Occupational Health and Safety Act, S.N.S. 1996, c. 7

Ontario Ministry of Natural Resources (OMNR). (2000). *Conserving the forest interior: a threatened wildlife habitat*. 12 pp

Open Data Nova Scotia (NS). (2023). *Nova Scotia Hydrographic Network*. Retrieved from https://data.novascotia.ca/Environment-and-Energy/Nova-Scotia-Hydrographic-Network/dk27-q8k2/data

Ozone-depleting Substances and Halocarbon Alternatives Regulations, S.O.R./2016-137

Padey, P., Blanc, I., Le Boulch, D., & Xiusheng, Z. (2012). A simplified life cycle approach for assessing greenhouse gas emissions of wind electricity. *Journal Of Industrial Ecology*, 16, S28-S38. Doi: 10.1111/j.1530-9290.2012.00466.x

Parisé, J., & Walker, T. (2017). Industrial wind turbine post-construction bird and bat monitoring: A policy framework for Canada. *Journal of Environmental Management, 201*, 252-259.

Passenger Automobile and Light Truck Greenhouse Gas Emission Regulations, S.O.R. 2010-201

Physical Activities Regulations, S.O.R./2019-285

Province of Nova Scotia (NS). (2009). *Protected Water Areas of Nova Scotia*. Retrieved from https://www.novascotia.ca/nse/water/docs/protected.water.areas.map.pdf

Province of Nova Scotia (NS). (2018). *Nova Scotia Wet Places*. Retrieved from https://novascotia.ca/natr/wildlife/habitats/nswetlands/

Province of Nova Scotia (NS). (2021). *Geographic Data Directory: Forest Inventory*. Retrieved from https://nsgi.novascotia.ca/gdd/

Province of Nova Scotia (NS). (2022). *Geographic Data Directory: Old Growth Forest Policy*. Retrieved from https://nsgi.novascotia.ca/gdd/

Radio Advisory Board of Canada (RABC) & Canadian Renewable Energy Association (CanWEA). (2020). *Technical Information and Coordination Process Between Wind Turbines and Radiocommunication and Radar Systems.* Retrieved from https://www.rabc-cccr.ca/about/publications/wind-turbines-radio-radar/

Rabin, L., Coss, R., & Owings, D. (2006). The effects of wind turbines on antipredator behavior in California ground squirrels (*Spermophilus beecheyi*). *Biological Conservation*, 131(3), 410–420.

Reed, P.B. (1988). *National List of Plant Species that Occur in Wetlands: NE Region (Region 1) U.S. Fish and Wildlife Service, Washington, DC.* Retrieved from https://digitalmedia.fws.gov/digital/api/collection/document/id/1348/download

Regulations Respecting Greenhouse Gas Emissions, N.S. Reg. 260/2009

Richardson, W.J. (1990). Timing of Bird Migration in Relation to Weather: Updated Review. *Bird Migration,* 78-101. https://doi.org/10.1007/978-3-642-74542-3_6

Rydell, J., Bach, L., Dubourg-Savage, M.-J., Green, M., Rodrigues, L., & Hedenstrom, A. (2010). Mortality of bats at wind turbines links to nocturnal insect migration? *European Journal of Wildlife Research,* 56, 823-827.

Segers, J., & Broders, H. (2014). Interspecific effects of forest fragmentation on bats. Canadian *Journal of Zoology, 92*(8), 665-673.

Seifert, H., Westerhellweg, A., & Kroning, J. (2003). *Risk Analysis of Ice Throw from Wind Turbines.* Retrieved from http://www.mi-group.ca/files/boreas_vi_seifert_02.pdf

Siemens Energy. (2022). Executive summary and technical information for the Silyzer 300 system and the hydrogen production island, a customizable, scalable, & modular solution. Siemens Energy.

Southern California Edison (SCE). (2016). *Final environmental impact report*. Retrieved from https://ia.cpuc.ca.gov/environment/info/ene/mesa/attachment/A1503003%20ED-SCE-01%20Q.PD-01%20Attachment%20(Revised%20Noise%20Levels%20Construction%20Equipment).pdf

Special Places Protection Act, R.S.N.S. 1989, c 438

Species at Risk Act, S.C. 2002, c. 29

Squared Consultants Inc. (2022). *GHGenius*. Retrieved from https://ghgenius.ca/

Stantec. (2022). *Mainland Moose Snow Tracking and Pellet Group Inventory Surveys for Proposed Wind Project (2022).* Retrieved from Stantec.

Stantec. (2023a). *Avian Migration Survey Program for Proposed Wind Project near Nuttby, Nova Scotia.* Retrieved from Stantec.

Stantec. (2023b). *Bat Monitoring Program for Proposed Wind Project Near Nuttby, Nova Scotia.* Retrieved from Stantec.

Stantec. (2023c). *Breeding Bird Survey Program for Proposed Wind Project near Nuttby, Nova Scotia.* Retrieved from Stantec.

Stantec. (2023d). *Nocturnal Migration Radar and Avian Acoustic Survey for Proposed Wind Site Near Nuttby, Nova Scotia.* Retrieved from Stantec.

Stantec. (2023e). *Overwintering Bird and Nocturnal Owl Survey Programs for Proposed Wind Project near Nuttby, Nova Scotia.* Retrieved from Stantec.

Statistics Canada. (2023). *Census Profile, 2021 Census of Population*. Retrieved from https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=E

Strum. (2022). *Lichen Assessment Nuttby II, Bear Lake, and Loganville Wind Energy Sites.* Retrieved from Strum.

Sulphide Bearing Material Disposal Regulations, N.S. Reg. 57/95

Survey and Mapping Infrastructure Act, 2003

The Canadian Press Staff. (2023, March 6). EU head says Canada should focus on exporting clean hydrogen ahead of Ontario visit. *Global News*.

The Driller. (2005). *Hearing protection and air-rotary drilling – Part 1.* Retrieved from https://www.thedriller.com/articles/86218-hearing-protection-and-air-rotary-drilling-part-1#:~:text=The%20sound%20level%20measurements%20around,to%20107%20dB(A)

Tilman, D., Siemann, E., Wedin, D., Knops, J., Reich, P., & Ritchie, M. (1997). Influence of Functional Diversity and Composition on Ecosystem Processes. *Science, 277* (5330): 1300-02.

Timmerberg, S., Kaltschmitt, M., and Finkbeiner, M. (2020). *Hydrogen and hydrogen-derived fuels through methane decomposition of natural gas – GHG emissions and costs*. Retrieved from https://www.sciencedirect.com/science/article/pii/S2590174520300155#:~:text=Hydrogen%20can%20be%20produced%20from,carbon%20and%20no%20CO2

Tourism Nova Scotia (NS). (2019). *2019 Nova Scotia Visitor Exit Survey*. Retrieved from https://tourismns.ca/sites/default/files/2021-01/2019%20VES%20Full%20Year%20Report.pdf

Transport Scotland. (undated). *Appendix A17.1 Typical construction plant and noise levels*. Retrieved from https://www.transport.gov.scot/media/42094/appendix-a171-typical-construction-plant-and-noise-levels.pdf

Trombulak, S. C., & Frissell, C. A. (2000). Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. *Conservation Biology, 14*(1), 18–30.

Uadiale, S., Urban, E., Carvel, R., Lange, D., & Rein, G. (2014). Overview of Problems and Solutions in Fire Protection Engineering of Wind Turbines. *Fire Safety Science,* 11, 983-995.

United States Department of Agriculture - Natural Resources Conservation Service (USDA-NRCS). (2010). *Field Indicators of Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils.* Retrieved from http://fwf.ag.utk.edu/mgray/wfs340/PDF/NRCSHydricSoils_FieldIndicators.pdf

United States Department of Energy (USDE). (2008). *20% Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply*. Retrieved from: http://www.nrel.gov/docs/fy08osti/41869.pdf

United States Environmental Protection Agency (US EPA). (2013). *Streams, Types of Streams.* Retrieved from https://archive.epa.gov/water/archive/web/html/streams.html

United States Environmental Protection Agency (US EPA). (2022b). *pH*. Retrieved from https://www.epa.gov/caddis-vol2/ph

United States Environmental Protection Agency (US EPA). (2022c). *Climate Adaptation and Storms & Flooding*. Retrieved from https://www.epa.gov/arc-x/climate-adaptation-and-storms-flooding

United States Environmental Protection Agency (US EPA). (2023a). *Health and Environmental Effects of Particulate Matter (PM).* Retrieved from https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm

United States Environmental Protection Agency (US EPA). (2023b). *Overview of greenhouse gases*. Retrieved from https://www.epa.gov/ghgemissions/overview-greenhouse-gases#f-gases

US Fish and Wildlife Service. (2023a). *Atlantic salmon (Salmo salar)*. Retrieved from https://www.fws.gov/species/atlantic-salmon-salmo-salar

US Fish and Wildlife Service. (2023b). *Brook Trout*. Retrieved from https://www.fws.gov/species/brook-trout-salvelinus-fontinalis

United States Energy Information Administration (US EIA). (2022). *How much carbon dioxide is produced per kilowatthour of U.S. electricity generation?*. Retrieved from https://www.eia.gov/tools/faqs/faq.php?id=74&t=11

University of Bath. (2011). *Inventory of Carbon & Energy (ICE) v.2.0*. Retrieved from https://perigordvacance.typepad.com/files/inventoryofcarbonandenergy.pdf

Vyn, R.J. and McCullough, R.M. (2014). The effect of wind turbines on property values in Ontario: Does public percepon match empirical evidence? Canadian Journal of Agricultural Economics. Volume 62, Issue 3, pages 365-392.

Voigt, C. (2021). Insect fatalities at wind turbines as biodiversity sinks. *Conservation Science and Practice,* 3, e366.

Volkoff, H., & Rønnestad, I. (2020). Effects of temperature on feeding and digestive processes in fish. *Temperature, 7*(4), 307–320. https://doi.org/10.1080/23328940.2020.1765950

Wellig, S., Nusslé, S., Miltner, D., Kohle, O., Glaizot, O., Braunisch, V., Obrist, M.K., & Arlettaz, R. (2018). Mitigating the negative impacts of tall wind turbines on bats: Vertical activity profiles and relationships to wind speed. *PloS One,* 13(3), 1-16.

Whitlock, R. (2015). Windmill Aflame: Why Wind Turbine Fires Happen, How Often and What Can be Done About It. *Interesting Engineering.* Retrieved from https://interestingengineering.com/science/windmill-aflame-why-wind-turbine-fires-happen-how-often-and-what-can-be-done-about-it

Wildfire Regulation, B.C. Reg. 38/2005

Wildlife Act, R.S.N.S. 1989, c. 504

Wills, M. (2021, June 26). Road Density Threatens Turtle Populations. *JSTOR Daily.* Retrieved from https://daily.jstor.org/road-density-threatens-turtle-populations/

Wind Europe. (2017). *Mainstreaming energy and climate policies into nature conservation*. Retrieved from https://windeurope.org/wp-content/uploads/files/policy/topics/sustainability/WindEurope-Paper-on-the-role-of-wind-energy-in-wildlife-conservation.pdf

Wind Turbine Facilities Municipal Taxation Act, SNS 2006, c 22

Workplace Health and Safety Regulations, N.S. Reg. 52/2013, Part 2, s. 2.1-2.3

WorkSafe BC. (undated). *How loud is it? – Construction.* Retrieved from https://www.worksafebc.com/resources/health-safety/hazard-alerts/how-loud-is-it-construction?lang=en

WorkSafe BC. (2016). *How loud is it? – Forestry.* Retrieved from https://www2.bcforestsafe.org/files/Safety_Alert_WSBC-How_Loud_Is_It-Forestry.pdf

Zedler, J. B., & Kercher, S. (2004). Causes and Consequences of Invasive Plants in Wetlands: Opportunities, Opportunists, and Outcomes. *Critical Reviews in Plant Sciences, 23*(5), 431–452.

Zimmerling, R.J., Pomeroy, A.C., d'Entremont, M.V., & Francis, C.M. (2013). Canadian Estimate of Bird Mortality Due to Collisions and Direct Habitat Loss Associated with Wind Turbine Developments. *Avian Conservation and Ecology, 8*(2).

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