elemental energy

HIGGINS MOUNTAIN WIND FARM

Environmental Assessment Registration Document

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Environmental Assessment Registration Document

Prepared By:	*Prepared For:*
Strum Consulting	**Higgins Mountain Wind Farm General Partner Inc.**

March 2023

March 8, 2023

Mr. Jeremy Higgins, Environmental Assessment Officer
Nova Scotia Department of Environment & Climate Change
Environmental Assessment Branch
#2085 - 1903 Barrington Street
PO Box 442
Halifax, NS B3J 2P8

Dear Mr. Higgins,

Re: Environmental Assessment Registration Document
Higgins Mountain Wind Farm

Please find enclosed the Environmental Assessment Registration Document for the Higgins Mountain Wind Farm Project.

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

Sincerely,

James Houssian, Director
Higgins Mountain Wind Farm General Partner Inc.

EXECUTIVE SUMMARY

Higgins Mountain Wind Farm General Partner Inc., Sipekne'katik First Nation, Elemental Energy Renewables Inc., and Stevens Wind Ltd. (carrying on business as the Higgins Mountain Wind Farm Limited Partnership) is proposing to construct and operate the Higgins Mountain Wind Farm (the Project) near the community of Wentworth in Cumberland County, Nova Scotia. The Project is an onshore wind farm with up to 17 wind turbines, along with associated infrastructure, including access roads, substation, and interconnection lines. The Project turbines will have a nominal nameplate capacity of between 5.9 to 7 megawatts which represents the range of turbine models being considered for the Project. The development of this Project will support Nova Scotia in its target of producing 80% renewable energy by 2030, reducing the province's dependency on coal generated electricity.

The Project is considered a Class I Undertaking under Schedule A of the Nova Scotia Environmental Assessment Regulations, NS 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, and will not act cumulatively with nearby developments. 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.

Higgins Mountain Wind Farm Limited Partnership is a partnership between Sipekne'katik First Nation, Elemental Energy Renewables Inc., and Stevens Wind Ltd. The Higgins Mountain Wind Farm Limited Partnership 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
AQHI	Air Quality Health Index
ARIA	Archaeological Resource Impact Assessment
ARS	Avian Radar System
ATSC	Advanced Television Systems Committee
ATV	All-terrain Vehicle
ARD	Acid Rock Drainage
BMPs	Best Management Practices
BTs	Biological Targets
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
CEPA	Canadian Environmental Protection Act
CH_4	Methane
CLC	Community Liaison Committee
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWS	Canadian Wildlife Service
dBA	Decibels (A-weighted)
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
FAC	Facultative
FACU	Facultative Upland
FACW	Facultative Wetland
FM	Frequency modulation
FWI	Fire Weather Index
GHGs	Greenhouse Gases
GIS	Geographic Information System
GPS	Global Positioning System
HPAs	High Potential Areas

KMKNO	Kwilmu'kw Maw-klusuaqn
HRM	Halifax Regional Municipality
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
kWh/year	Kilowatts per hour per year
kV	kilovolt
LAA	Local Assessment Area
LABO	Eastern red bat
LACI	Hoary bat
LANO	Silver-haired bat
Lpm	Litres per minute
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
mg/L	Milligrams per litre
mS/cm	MilliSiemens per centimetre
MW	Megawatt
MYOT	Myotis Species
NFCs	Night Flight Calls
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	Nova Scotia
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 Inc.
NSPW	Nova Scotia Public Works
NSSU	Nova Scotia Southern Upland (Atlantic salmon population)
NTSC	National Television Standards Committee
O_3	Ozone
OBL	Obligate

POI	Point of Interconnection
PESU	Tri-colored Bat
PID	Property Identification
PM	Particulate Matter
PPE	Personal Protective Equipment
Q_{20}	Long term safe yield
RAA	Regional Assessment Area
RABC	Radio Advisory Board of Canada
RBP	Rate-based Procurement
RFP	Request for Proposal
ROW	Right of way
SAR	Species at Risk
SARA	Species at Risk Act
SGEM	Silvicultural Guide for the Ecological Matrix
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
SOCI	Species of Conservation Interest
SUV	Sports Utility Vehicle
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
TIANS	Tourism Industry Association of Nova Scotia
TRS	Total Reduced Sulfur
TSP	Total Suspended Particulate
µm	Microns or micrometres
µg/m3	micrograms per cubic metre
UNKW	Unknown
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
WMA	Wskijnu'k Mtmo'taqnuow Agency Ltd
WSS	Wetlands of Special Significance

LIST OF DRAWINGS

LIST OF APPENDICES

1.0 PROPONENT DESCRIPTION

Higgins Mountain Wind Farm General Partner Inc., Sipekne'katik First Nation, Elemental Energy Renewables Inc., and Stevens Wind Ltd., carrying on business as the Higgins Mountain Wind Farm Limited Partnership (Higgins Wind, the Proponent), is proposing to construct and operate the Higgins Mountain Wind Farm (the Project), an onshore wind farm with up to 17 wind turbines. Higgins Wind is a partnership between Sipekne'katik First Nation, Elemental Energy Renewables Inc. (Elemental), and Stevens Wind Ltd. (Stevens Wind).

Higgins Wind includes experienced Canadian wind farm developers who have designed, constructed, and operated wind and solar energy projects in Atlantic Canada, Western Canada, and across North America over the past 20 years. Higgins Wind combines Indigenous values, local knowledge, and responsible resource stewardship with industry leading experience developing, constructing, and operating renewable energy projects, including five Community Feed-In Tariff wind energy projects in Nova Scotia and two utility scale wind energy projects in Newfoundland and Labrador.

Higgins Wind 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 Registration Document. Strum Consulting is an independent multi-disciplinary team of consultants with extensive experience in undertaking Environmental Assessments (EAs) throughout Atlantic Canada. Government engagement that has informed the scope of EA technical studies is described in Section 6.

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

Table 1.1: Proponent and Consultant Contact Information

Proponent Information	
Project Name	Higgins Mountain Wind Farm
Proponent Name	Higgins Mountain Wind Farm General Partner Inc., Sipekne'katik First Nation, Elemental Energy Renewables Inc., and Stevens Wind Ltd. carrying on business as the Higgins Mountain Wind Farm General Partner Inc.
Chief Executive Officer(s) / Principal(s)	James Houssian Director, Higgins Mountain Wind Farm General Partner Inc. Director, Higgins Mountain Wind Farm Limited Partnership
Mailing and Street Address	Elemental Energy 2150-745 Thurlow Street Vancouver, BC V6E 0C5

Proponent Information	
Proponent Contact Information for the EA Registration	Dan Eaton Director of Project Development, Elemental Energy Phone: 604.648.6609 Email: deaton@elementalenergy.ca
Consultant Information	
Name of Consultant	Strum Consulting
Mailing and Street Address	1355 Bedford Highway Bedford, NS B4A 1C5
EA Contact	Melanie Smith, VP Environmental Assessment and Approvals Phone: 902-835-5560 Email: msmith@strum.com

2.0 PROJECT INFORMATION

2.1 Project Introduction

Higgins Wind proposes to construct and operate an onshore wind energy project with up to 17 wind turbines on Higgins and Steven Mountains between the communities of Westchester Station, Wentworth Station, and Londonderry, Nova Scotia (Drawing 2.1). The approximate center of the Project is located at 45° 32' 43.9764'' N, 63° 35' 54.6576'' W (or 45.545549, -63.598516).

The Project turbines will have a nominal nameplate capacity of between 5.9 to 7 megawatts (MW), which represents the range of turbine models being considered for the Project. For the purposes of this EA, the Siemens Gamesa SG-6.6 170 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, interconnecting transmission lines, a substation, and a connection to the Nova Scotia Power (NS Power) grid.

The Project lies primarily within the Philip River / Wallace River Watershed (1DN), which reaches into the Economy River Watershed (IDJ) and Salmon River / Debert River Watershed (1DH) along the Project's southern extent and is located near the community of Folly Lake in Colchester County, Nova Scotia (Drawing 2.1). The Study Area consists primarily of private land, with one parcel of Crown Land. The Crown land is currently utilized for forestry and recreational use. Options for easements and land lease agreements are in place with the private landowners. Higgins Wind will be applying for a road use agreement and easements from Nova Scotia Natural Resources and Renewables (NSNRR) where an existing access road and a proposed collector transmission line cross through a Crown land parcel.

Upon approval of the EA, construction activities are proposed to begin in the fall of 2023 and once constructed, the Project is expected to be operational for a minimum of 35 years.

2.2 Purpose & Need for the Undertaking

Nova Scotia has set a new target of producing 80% renewable energy by 2030 and the development of wind energy is expected to be a significant part of achieving that goal. The Project has been proposed in support of this renewable energy target. Dependence on fossil fuels increases the vulnerability of Nova Scotians to rising international energy prices, weakens energy security, and takes valuable revenue out of the province, further leading Nova Scotia towards a preference for renewable energy (Province of NS, 2015). 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 (IPCC 2022). 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 (IPCC 2022). 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 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.

As part of this overall strategy, the Project will contribute to meeting Nova Scotia's renewable energy goals by providing Nova Scotian homes with stable, locally-produced renewable energy.

Need for the Project
The government of Nova Scotia announced a Rate Base Procurement (RBP) aiming to supply the province with ~350 MW of renewable energy. The RBP is designed to assist the province in getting closer to the 80% target of renewable energy and support the province's goal of achieving a 53% reduction in greenhouse gas emissions by 2030 and net-zero by 2050.

"The Rate Base Procurement (RBP) portfolio was chosen through an independent, objective, and open procurement process. The portfolio is comprised of 5 projects, totaling 372 megawatts or 1,373 gigawatt hours per year of renewable low-impact electricity production. This represents approximately 12% of Nova Scotia's total electricity consumption." (NSRBP 2022).

In August 2022, the Project was officially selected as one of five successful projects under the RBP process.

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, and ongoing energy literacy/education. The Project Team has created a Community Liaison Committee (CLC), which will help to identify Project-related opportunities and benefits for the local community.

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* 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	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*, Higgins Wind 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-2020-25)
Migratory Bird Convention Act (*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 under the Nova Scotia *Environment Act*. 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 following EA approval. Locations requiring alteration are described in Sections 7.3.1-7.3.3
Endangered Species Act (*ESA*)	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, NS 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 approval.
Elevator lift license	NS Labour Skills and Immigration	Future approval.
Archaeology Field Research Permit	NS Communities, Culture, Tourism and Heritage (NSCCTH)	Permit A2022NS134 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
Municipal Development Agreement – Cumberland County	Municipality of Cumberland	Have introduced the Project to Mayor, Council, and senior administrative and planning staff.
License from a Development Officer – Colchester County	Municipality of Colchester	Have introduced the Project to Mayor, Council, and senior administrative and planning staff.

2.4 Funding

Higgins Wind has applied for funding under Natural Resource Canada's Smart Renewables and Electrification Pathways Program under the Established Renewables Stream. If successful, a contribution agreement will be signed prior to the Project's construction start.

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 both Cumberland County and Colchester County, between the communities of Wentworth, Londonderry, and Westchester, NS (Drawing 2.1). The Project is situated on Higgins Mountain and Steven Mountain on primarily privately owned, managed forestry land. The Project is centered at approximately 45° 32' 43.9764'' N, 63° 35' 54.6576'' W (or 45.545549, -63.598516).

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 100 m radius from each turbine, a 25 m buffer on either side of the centreline for the road layout, and a 20 m corridor for the collector and interconnection 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
20131264	Crown Land
20318416	Northern Pulp
25267428	Northern Pulp
25267410	Northern Pulp
20448288	Northern Pulp
25088733	Private Landowner
20129722	Private Landowner
25088725	Private Landowner
25360041*	Private Landowner

*Though this PID is a participating land parcel, no infrastructure is located on the property and no field assessments were completed on the property. Therefore, this parcel is not included in the "Study Area" boundaries for related component studies or "Study Area" area calculations.

Table 3.2: Areas of Study

Area of Study	Area (ha)
Study Area	7,950
Assessment Area	235
Project Area*	69

*Area is a conservative estimate of the permanent footprint of the Project Area. Temporary Project Area components are shown in Drawing 3.2 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. A drawing illustrating the Project development constraints is provided in (Drawing 3.1).

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 turbines (from tip of blade)	NSECC
Wetlands	30 m from turbines (from tip of blade)	NSECC, NSNRR
Wetlands of Special Significance	At least 30 m, to be determined in consultation with NSECC	NSECC, NSNRR
Protected Areas and Public Resources	300 m	NSECC, NSNRR
Rare Plants and Lichens	Species-specific (Section 7.4.2)	NSNRR
Residences	1,000 m from habitable buildings external to the Project (Cumberland County) 244 m from habitable buildings internal to the Project (Cumberland County) 2,000 m from civic address points (Colchester County)	Cumberland and Colchester Counties
External Property Boundaries	215 m (Cumberland) 195.5 m (Colchester)	Cumberland and Colchester Counties
Public Roads	293.25 m *(1.5 x Turbine Height)*	Health Canada
Powerlines	293.25 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, Cumberland County
Restricted Overlay	3.2 km from centerline of Highway 4	Cumberland 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 privately owned land which has been subject to previous and ongoing disturbance from forestry activities, 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.

3.2 Physical Components

3.2.1 Turbine Specifications

Higgins Wind is proposing the construction of up to 17 turbines. Each turbine will have an individual generating capacity of 5.9 to 7 MW. There are a variety of turbine makes and models being considered. For the purposes of the EA, Higgins Wind has selected the Siemens Gamesa wind turbine generator (SG 6.6-170) as it represents the general range of turbine options that are being considered. Refer to Table 3.4 for both the range of turbine characteristic that are being considered as well as the specific characteristics of the Siemens Gamesa wind turbine generator (SG 6.6-170).

Table 3.4: Turbine Technical Specifications

Turbine Component	Range of Turbines Being Considered	Turbine Specifications for SG6.6-170
Rated capacity	5.9 – 7.0	6.6 MW
Rotor diameter	162 -170 m	170 m
Hub height	110 – 118 m	110.5 m
Cut – out wind speed	22.0 - 30.0 m/s	25.0 m/s
Number of blades	3	3
Swept area	20,612 – 22,698 m^2	22,698 m^2
Rotor speed (variable)	Variable	5 – 16 rpm
Generator	Various	DFIG Asynchronous
Brake system	Various	Three independent pitch control systems with emergency power supply, rotor brake, rotor lock
Yaw control	Various	Active via adjustment gears, load-dependent damping
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 Stevens Wind 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.

Higgins Mountain Road (running between Westchester Road near Mines Bass River Road and Valley Road) and Tower Road (running between Highway 4 in Folly Mountain and Higgins Mountain Road near the center of the Project Area) are the two largest arterial roads that grant access to the majority of the Project Area. A vast network of smaller spur roads and trails suited for ATV and/or snowmobile use are present throughout much of the Study Area and may require upgrades to facilitate the transportation of turbine components.

3.2.3 Substation and Power Collection Systems

The Study Area has existing transmission line infrastructure to transport generated energy to the NS Power grid along Highway 4 in the Wentworth Valley. There is no dedicated substation to handle the existing energy capacity being produced, as the voltage being generated by the pre-existing turbines was compatible with the nearby grid access. A new point of interconnection to the grid will be established to the 138 kilovolt (kV) transmission line running between Onslow and Springhill, across the southern portion of the Project. To facilitate this grid-connection, a substation will need to be installed. The Project turbines will generate power that will flow via its 34.5 kV collection circuit (that primarily follows the proposed Project roads) to the 34.5 kV to 138 kV Project substation. Power will be transmitted via a dedicated overhead 138 kV transmission interconnection line to the NS Power transmission system to the Point of Interconnection (POI). Two POI options are under consideration.

Drawing 3.2 shows the location of Project infrastructure.

3.3 Project Phases

The Project will include three phases:

- Site preparation and construction
- Operations and maintenance
- Decommissioning

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 works
- Geotechnical investigations
- Placement of erosion and sedimentation control measures
- Clearing of trees and grubbing areas for construction

General construction activities include:

- Access road upgrading and construction
- Laydown area and turbine pad construction
- Transportation of turbine components
- Turbine assembly
- Construction of collection system and substation
- Grid connection
- Removal of temporary works and site restoration
- Commissioning

Access Road Construction

Approximately 26.6 km of the existing road network will be re-used as part of the Project. Approximately 7.50 km of new road construction is required to provide direct access to the turbines. Access roads will have a 6 to 12 m wide road surface and including ditching and grading will be 17 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.

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 approximately 30 m diameter (typical for a 6.6 MW wind turbine) and extend to a depth of 5 to 7 m below grade. Foundations will be backfilled (underground) with the exception of the concrete pedestal which will extend up to 0.5 m above ground to support the wind turbine tower structure.

Each turbine pad and laydown area is expected to be approximately 100 m x 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 proposed. Construction of a typical turbine pad (from clearing to final preparation for erecting of the turbine) can take between 1 to 4 months, depending on weather, soil, and construction vehicle access. The following equipment may be used for the laydown area 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 pieces 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 rotors. Rotors are usually attached to the hub on the ground prior to lifting. This assembly will occur with the use of cranes. Erection will depend on weather, specifically wind and lighting conditions. Typical assembly duration per turbine is expected to be between two and five days. The following equipment is expected to be used for turbine assembly:

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

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 138 kV Project substation. Power will be transmitted via a dedicated overhead 138 kV transmission interconnection line to the NS Power transmission system to the POI. Two POI options are under consideration (Drawing 3.2).

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.

3.3.2 Operations & Maintenance

Maintenance will conform to manufacturer equipment 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 Higgins Wind 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 operations and maintenance building will be constructed between Turbine 8 and Turbine 9, at the location of the temporary laydown area (Drawing 3.2). Detailed design will determine the size of the building; however, it will be contained within the Assessment Area.

3.3.3 Decommissioning

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 collection system, conductor, and poles with NS Power's permission/cooperation.
- Removal of all other equipment and reinstatement and stabilization of land.

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	March 2023
Post-EA Environmental Monitoring Programs	2023 onward (as required by the EA Approval)
Geotechnical Assessment	Summer / Fall 2023
Engineering Design	Spring / Summer 2023
Municipal Decision on Development Agreement	Spring 2023
Clearing	Fall 2023
Construction	2024-2025
Commissioning	Fall 2025
Operation	Fall / Winter 2025-26 onward
Decommissioning	2050 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 Nova Scotia *Environment Act*. 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)

The Project Team contacted the following regulatory bodies to provide input and advice into the EA scope and planning:

- Canadian Wildlife Service (CWS)
- NSCCTH
- NSECC
- 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". 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 that the Project may interact with (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 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., 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 100 m radius from each turbine, a 25 m buffer on either side of the centreline for the road layout, and a 20 m corridor for the collector and interconnection 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	18-24 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

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

5.2 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 was developed by Membertou Geomatics Solutions and was 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" in the MEKS report). A copy of the MEKS is provided in Appendix B.

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.

A total of 26 interviews were undertaken by the MEKS Team with Mi'kmaq knowledge holders from the First Nation communities of Pictou Landing, Millbrook, Sipekne'katik. The interviews took place between October 2022 to February 2023. A summary of the MEKS findings is provided below. Detailed results and mapping are supplied in Appendix B.

Traditional Use in the Project Area
Documented activities within the Project Area include:

- Moose, rabbit, and deer hunting
- Salmon, trout, and bass fishing
- Sweetgrass, berry, and wood harvesting

The majority of these activities are categorized as Historic Past (69%, >25 years ago); however, there is some Recent Past (18%, 11 to 25 years ago) and Current Use (13%, within the last 10 years) documented.

Traditional Use in the Study Area
Deer hunting, salmon and trout fishing, along with berry and sweetgrass harvesting were the activities reported by interviewees in the highest frequency. There was other fishing, hunting, and gathering activities reported as well. The majority of these activities are categorized as Historic Past (78%), however, there is some Recent Past (13%) and Current Use (9%) documented.

Historic Review
The Project Area and Study Area straddle the Traditional Political Districts of Sipekni'katik (Wild Potato Area) of the central area of NS and Siknikt (Drainage Area) of NS and New Brunswick; centered on the isthmus between the two Provinces of today. Millbrook First Nation is the nearest large Mi'kmaq community to the Study Area, located south of Truro, referenced as Millbrook No. 27. Franklin Manor No, 22 Reserve is located west of the River Herbert and south of Amherst, approximate half distance to Parrsboro.

There are potential natural resources within the Cobequid Hills in exposed bedrock containing rhyolite stone of suitable properties for tools and weapons for early peoples. There are reported sources of black ash on the north slopes of the Cobequid Hills which are a valuable resource to early peoples and Mi'kmaq today, for tool handles and basket making.

Within the Study Area specifically, there are few known archaeological finds/sites found. Most archaeological finds/sites in that area were found close to rivers and also among present-day development, whether that be building or road construction, including agricultural land use. Most are likely accidental finds and the site locations give indication of where to tread lightly at river and brook crossings.

Lastly, a review of Specific Claims shows no current and active First Nation Claims within the Study Area.

5.3 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. The Proponent developed an Indigenous Engagement Plan with Consultant Jay Hartling (Appendix C) and focused preliminary engagement efforts with the communities closest to the Project. Over the past five years, the Proponent has had numerous discussions with Wskijnu'k Mtmo'taqnuow Agency Ltd. (WMA), the Kwilmu'kw Maw-klusuaqn Negotiation Office (KMKNO), and individual First Nation communities to provide information, updates, and discuss partnership opportunities.

The Proponent notified the Mi'kmaq early in the development process, provided as much information as possible, met with Mi'kmaq communities, completed a MEKS with Membertou Geomatics, invited KMKNO to participate in the Project's CLC meetings, and documented the engagement process per steps one through six of the Proponents' Guide: The Role of Proponents in Crown Consultation with the Mi'kmaq of Nova Scotia (Office of L'Nu Affairs, 2012).

Engagement with the Mi'kmaq of Nova Scotia is summarized in Table 5.1.

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

First Nation / Organization	Role(s)/Representatives	Contact Details
KMKNO	Derek Peters, Board Director and Energy Advisor Jennifer McGillvary, Benefits Officer	October 26, 2017 – Meeting with Jennifer McGillvary at KMKNO to give a detailed explanation about the Project, a future provincial renewable energy procurement process, and potential partnerships. January 17, 2019 – Conference call with Derek Peters (KMKNO Energy Advisor) to discuss the history of the Project, potential partnership opportunities, community engagement and the CLC, and the MEKS. September 13, 2019 – In person presentation to the KMKNO Benefits Committee by the Proponent to introduce the Project, the companies behind it, Project history and current activities. Also discussed community feedback. November 2019 – Project status update letter to Jennifer McGillivary, KMKNO December 2019 – copied on introductory email letters to KMKNO (Derek Peters), Millbrook First Nation (Alex Cope), Pictou Landing First Nation (Heather Hughes) and Sipekne'katik First Nation (Jennifer Copage). February 22, 2023 – provided a Project

First Nation / Organization	Role(s)/Representatives	Contact Details
		information package to provide notification of the following: • intent to submit an EA • invitation to meet with Higgins Wind if they are interested in learning about the Project / have any questions or concerns about the Project, including during the EA review period. The information package included an environmental overview document with a description of the Project, engagement efforts, and an overview of VCs.
Millbrook First Nation	Chief Gloade	December 2019 – Introductory email letter May 20, 2021 – Introduction letters were sent to provide Project details and contact information and seek follow up meetings for further information and possible partnership opportunities. February 2022 – Discussion with Chief Gloade about partnership opportunities, as well as a follow up email overview of the Project. February 22, 2023 – provided a Project information packaged to provide notification of the following: • intent to submit an EA • invitation to meet with Higgins Wind if they are interested in learning about the Project / have any questions or concerns about the Project, including during the EA review period. The information package included an environmental overview document with a description of the Project, engagement efforts, and an overview of VCs.
Sipekne'katik First Nation	Sosep Hatfield, Economic Development Officer Brian Dorey, Director of Operations Stuart Knockwood (Director of Administration)	December 2019 – Introductory email letter May 20, 2021 – Introduction letters were sent to provide Project details and contact information and seek follow up meetings for further information and possible partnership opportunities. February 11, 2022 - Phone call with Sosep Hatfield to discuss the Project and potential partnership opportunities. February 23, 2022 - Phone call with Sosep Hatfield and Brian Dorey about the Project and

First Nation / Organization	Role(s)/Representatives	Contact Details
		potential partnership opportunities. March 24, 2022 – Follow-up phone call with Sosep Hatfield and Brian Dorey to discuss the Project and potential partnership opportunities. March 28, 2022 – Follow-up phone call with Sosep Hatfield to discuss the Project and proposed Memorandum of Understanding. April 21, 2022 – In-person meeting with Brian Dorey, Sosep Hatfield, and Stuart Knockwood to discuss the partnership opportunity and tour Sipekne'katik's reserve lands.
	Chery Maloney, Consultation Consultant Charlotte Olson, Consultation Manager Brian Dorey, Director of Administration Samatha Watts, SFN Earth Keeper	August 8, 2022 – Introduced and discussed the Project. Higgins Wind gave a presentation about the Project, benefits, and schedule. Strum Consulting gave a presentation on environmental conditions, design considerations/constraints, and EA schedule and next steps. Sipekne'katik First Nation spoke on their interest areas around the MEKS and Mi'kmaq engagement.
	Rufus Copage, SFN Councilor Brian Dorey, Director of Operations Cheryl Maloney, consultation consultant	September 13, 2022 – Site visit to Higgins Wind. Discussion of Project and potential impacts through construction and operations phases. Sipekne'katik First Nation raised interests around jobs and employment opportunities, discussed Mainland moose and other environmental resources of importance
	Stewart Knockwood, SFN Director of Administration Brian Dorey, Director of Operations	September 13, 2022 – Introduce Elemental and NS wind projects to Sipekne'katik First Nation Chief and Council. Council meeting cancelled due to death in the community; however, the Elemental Team met with Stuart Knockwood and Brian Dorey in lieu of the Council meeting. Project update meeting followed by a tour of the community.
	Charlotte Connolly Samantha Watts Brian Dorey	September 29, 2022 – Follow-up from in person meeting on September 13. Discussed community engagement process moving forward. Review of field studies completed and follow up from August 8th meeting.
	Brian Dorey	October 8, 2022 – Discuss Sipekne'katik Governance Initiative process and Sipekne'katik First Nation engagement approach with Brian Dorey. Discussed how to engage with other Mi'kmaq Nations.

First Nation / Organization	Role(s)/Representatives	Contact Details
	Charlotte Connolly Samantha Watts Brian Dorey	October 11, 2022 – Provided ENV overview document for Higgins Wind which included the following items: Project Description, summary of engagement activities, summary of Mi'kmaq engagement activities, Project design philosophy and approach, summary of potential environmental impacts and risk assessment, potential mitigation measures, list of permits required for the Project.
	Charlotte Connolly Samantha Watts Brian Dorey	October 28, 2022 – Provided project update, discussed the ENV overview document for Higgins Wind and discussed community engagement format and timing of future community meetings.
	Charlotte Connolly Samantha Watts Brian Dorey	November 18, 2022 – Provided Sipekne'katik First Nation engagement plan for Sipekne'katik First Nation review.
	Charlotte Connolly Samantha Watts Brian Dorey	November 23, 2022 – Project update, solicited comments on the ENV overview documents provided. Solicited comments on the Sipekne'katik First Nation engagement plan.
	Sipekne'katik elected Council, Chief was unable to attend due to a family matter	December 7, 2022 – Meeting with Sipekne'katik First Nation Council in Ottawa. The focus was relationship building between the Project Team and Sipekne'katik First Nation. Provided an introduction to the Project and the development approach. Discussions were around partnership agreements and capacity building.
	Charlotte Connolly	December 16, 2022 – Reporting out on the meeting with Sipekne'katik First Nation Council. Discussed community engagement event for 2023.
	Sipekne'katik Chief and Council Brian Dorey Stuart Knockwood	January 10, 2023 – Discussed visit to the Sipekne'katik First Nation community and scope of community Project update meeting. Discussed partnership agreements implementation timing. Discussed Project concerns that Sipekne'katik First Nation Chief and Council have and concerns that are being raised in the community.
	Sipekne'katik Chief and Council Brian Dorey Stuart Knockwood	January 19, 2022 – Reviewed Project materials that will be presented in the community meeting. Answered questions about the Project and potential effects of the Project. Answered questions about the EA review process. Discussed implementation of the community engagement plan with Sipekne'katik First Nation support as a Project partner.

First Nation / Organization	Role(s)/Representatives	Contact Details
	Sipekne'katik First Nation Members Sipekne'katik First Nation Chief and Councilors Community Open House	January 19, 2022 – Higgins Wind had Project representatives providing an overview of the Project and answering questions about potential environmental effects. Discussed potential employment and contracting opportunities. Provided an overview of the Project schedule and how / when future engagements with the community would be undertaken.
	Stephanie Doucette Brian Dorey	February 16, 2022 – meeting with the Sipekne'katik First Nation Employment and Training Center to discuss upcoming employment opportunities and hiring approach. Provided documentation on Project phased approach to capacity building within employment and training initiatives. Discussed hiring process and how Sipekne'katik First Nation and Higgins Wind can work together.
	Sipekne'katik First Nation Members Sipekne'katik First Nation Chief and Councilors Community Open House	February 16, 2022 - Higgins Wind had Project representatives providing an overview of the Project and answering questions about potential environmental effects. Discussed potential employment and contracting opportunities. Provided an overview of the Project schedule and how / when future engagements with the community would be undertaken. General interests were related to environmental, socio-economic, and employment and training opportunities. Higgins Wind committed to participate in an upcoming community career day.
	Sipekne'katik First Nation	Provided an update on the Project, the EA review, and timing of EA submission. Completed communications planning for community engagement during the EA review (e.g., notification mail out advertising the EA review period).
Pictou Landing First Nation	Barry Francis, Director of Lands and Economic Development Jeffery Slivocka, CEO Chief Andrea Paul	December 2019 – Introductory email letter May 20, 2021 – Introduction letters were sent to provide Project details and contact information and seek follow up meetings for further information and possible partnership opportunities. August 19, 2021 – Meeting with Barry Francis and Jeffery Slivocka to explore the possible ways that Pictou Landing First Nation might be involved in the Project. February 22, 2023 – provided a Project information packaged to provide notification of the following:

First Nation / Organization	Role(s)/Representatives	Contact Details
		• intent to submit an EA • invitation to meet with Higgins Wind if they are interested in learning about the Project / have any questions or concerns about the Project, including during the EA review period. The information package included an environmental overview document with a description of the Project, engagement efforts, and an overview of VCs.
WMA	Tracy Menge Terry French, Board Director	October 2020 – Calls and Emails with Tracy Menge from WMA to introduce the Project, discuss potential partnerships with WMA. Also discussed the engagement process, including the MEKS. December 7, 2020 – Presentation to Terry French and Tracy Menge. Introduced the Project to Terry and asked questions. February 15, 2021 – Call with Terry French to provide an update on the status of the Project. Discussed the upcoming provincial RFP process and potential partnership opportunities. November 5, 2021 – Call with Terry French to discuss an update on the status of the Project. Discussed the upcoming provincial RFP process. Discussed possible partnership structure. Discussed existing partnership between WMA and another developer. November 23, 2021 – Call with Terry French to discuss updates to the RFP process. Discussed possible partnership structure. December 7, 2021 – Discussion with Terry French who recommended we reach out to Acadia First Nation to discuss possible partnership opportunities.
Acadia First Nation	Chief Deborah Robinson Rachel Stevenson, Economic Development Officer Bruce Clarke, Legal Counsel Rachel Falls, Councillor Natteal Battiste, Councillor Michael Paul, Councillor Julian O'Connell, Acadia Band Manager Amanda Lloyd, Acadia Chief Financial Office Bruce Clarke	January 29, 2022 – Met with Rachel Stevenson and Bruce Clarke to discuss the Project and potential partnership opportunities. February 7, 2022 – Met with Chief Deborah Robinson, Heather Stevenson, Rachel Falls Tom Pictou, Natteal Battiste, Michael Paul, Julian O'Connell, Amanda Lloyd and Bruce Clarke to discuss the Project and potential partnership opportunities. February 10, 2022 – Met with Rachel Stevenson

First Nation / Organization	Role(s)/Representatives	Contact Details
		and Bruce Clarke to discuss the Project and potential partnership opportunities. March 28, 2022 – Sent Chief Robinson a Project information summary and an invitation to an open house scheduled for April 2022. February 22, 2023 – provided a Project information packaged to provide notification of the following: • intent to submit an EA • invitation to meet with Higgins Wind if they are interested in learning about the Project / have any questions or concerns about the Project, including during the EA review period. The information package included an environmental overview document with a description of the Project, engagement efforts, and an overview of VCs. February 22, 2023 – provided a Project information packaged to provide notification of the following: • intent to submit an EA • invitation to meet with Higgins Wind if they are interested in learning about the Project / have any questions or concerns about the Project, including during the EA review period. The information package included an environmental overview document with a description of the Project, engagement efforts, and an overview of VCs.
Glooscap Energy Limited Partnership	Glooscap Chief Sidney Peters Michael Peters, CEO, Glooscap Energy LP Karen Kluska, Financial Analyst Members of Glooscap's Finance, Audit, and Risk (FAR) Committee	February 9, 2022 – Call with Michael Peters to discuss the Project and potential partnership opportunities. February 24, 2022 – Follow-up call with Michael Peters to discuss the Project and partnership opportunities. February 25, 2022 – Follow-up call with Michael Peters to discuss the Project and partnership opportunities. March 8, 2022 – Call with Karen Kluska to discuss Project financial information. March 16, 2022 – Call with Michael Peters, Karen

First Nation / Organization	Role(s)/Representatives	Contact Details
		Kluska, Chief Sidney Peters, and members of Glooscap's Finance, Audit, and Risk Committee. March 18, 2022 – Call with Michael Peters, Karen Kluska, and Bruce Clarke (Burchells LLP) to discuss the Memorandum of Understanding. February 22, 2023 – Provided a Project information packaged to provide notification of the following: • intent to submit an EA • invitation to meet with Higgins Wind if they are interested in learning about the Project / have any questions or concerns about the Project, including during the EA review period. The information package included an environmental overview document with a description of the Project, engagement efforts, and an overview of VCs.
Annapolis Valley First Nation	Chief Gerald Toney	February 22, 2023 – Provided a Project information packaged to provide notification of the following: • intent to submit an EA • invitation to meet with Higgins Wind if they are interested in learning about the Project / have any questions or concerns about the Project, including during the EA review period. The information package included an environmental overview document with a description of the Project, engagement efforts, and an overview of VCs.
Eskasoni First Nation	Chief Leroy D.C. Denny	February 22, 2023 – Provided a Project information packaged to provide notification of the following: • intent to submit an EA • invitation to meet with Higgins Wind if they are interested in learning about the Project / have any questions or concerns about the Project, including during the EA review period. The information package included an environmental overview document with a description of the Project, engagement efforts, and an overview of VCs.

First Nation / Organization	Role(s)/Representatives	Contact Details
L'sitkuk (Bear River) First Nation	Chief Carol Dee Potter	February 22, 2023 – Provided a Project information packaged to provide notification of the following: • intent to submit an EA • invitation to meet with Higgins Wind if they are interested in learning about the Project / have any questions or concerns about the Project, including during the EA review period. The information package included an environmental overview document with a description of the Project, engagement efforts, and an overview of VCs.
Membertou First Nation	Chief Terrance J. Paul	February 22, 2023 – Provided a Project information packaged to provide notification of the following: • intent to submit an EA • invitation to meet with Higgins Wind if they are interested in learning about the Project / have any questions or concerns about the Project, including during the EA review period. The information package included an environmental overview document with a description of the Project, engagement efforts, and an overview of VCs.
Paqtnkek First Nation	Chief Corey Julian	February 22, 2023 – Provided a Project information packaged to provide notification of the following: • intent to submit an EA • invitation to meet with Higgins Wind if they are interested in learning about the Project / have any questions or concerns about the Project, including during the EA review period. The information package included an environmental overview document with a description of the Project, engagement efforts, and an overview of VCs.
Polotek First Nation	Chief Wilbert Marshall	February 22, 2023 – Provided a Project information packaged to provide notification of the following: • intent to submit an EA • invitation to meet with Higgins Wind if they are interested in learning about the

First Nation / Organization	Role(s)/Representatives	Contact Details
		Project / have any questions or concerns about the Project, including during the EA review period. The information package included an environmental overview document with a description of the Project, engagement efforts, and an overview of VCs.
Wagmatcook First Nation	Chief Norman Bernard	February 22, 2023 – Provided a Project information packaged to provide notification of the following: • intent to submit an EA • invitation to meet with Higgins Wind if they are interested in learning about the Project / have any questions or concerns about the Project, including during the EA review period. The information package included an environmental overview document with a description of the Project, engagement efforts, and an overview of VCs.
We'koqma'q First Nation	Chief Annie Bernard-Daisley	February 22, 2023 – Provided a Project information packaged to provide notification of the following: • intent to submit an EA • invitation to meet with Higgins Wind if they are interested in learning about the Project / have any questions or concerns about the Project, including during the EA review period. The information package included an environmental overview document with a description of the Project, engagement efforts, and an overview of VCs.

5.3.1 Review of Concerns

Key areas of interest identified through engagement were related to Mainland moose; environmental and socio-economic effects; and employment and training opportunities, as described in Table 5.1.

5.3.2 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.

5.4 Partnership with Sipekne'katik First Nation

Sipekne'katik First Nation is engaged as a partner in the Project. In addition to regularly occurring business discussions with Sipekne'katik First Nation representatives, Higgins Wind continues to engage with Sipekne'katik Chief and Council, Sipekne'katik 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.

6.0 GOVERNMENT AND PUBLIC ENGAGEMENT

Higgins Wind is committed to meaningful engagement with government, the public, stakeholders, and the Mi'kmaq of Nova Scotia. To date, the Project Team has participated in meetings, delivered presentations, hosted two Open House events, and established a CLC. Associated presentations, posters, and meeting agendas/minutes are provided in Appendix C.

6.1 Engagement with Government Departments, Agencies and Regulators

The Project Team has met 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	
MP of Cumberland-Colchester	Dr. Stephen Ellis	April 22, 2022 Project site tour. Began at Londonderry and drove the site on Higgins Mountain Road, showing the locations of where wind turbines were planned. Went over the various turbine locations, the rationale for siting (i.e., minimizing disturbance, capturing high winds, proximity to transmission lines). Discussed the significant changes made to the layout, which resulted in the wind turbines being set back over 2 km from Highway 4. Also visited one of the original Higgins turbines and discussed the technology, the wind industry, and the significant economic impact of projects. Discussed ecotourism opportunities (notably international visitors) who would expect clean energy as part of recreational industry.
Canadian Coast Guard	Wind Farm Coordinator	February 2022 EMI notification letter sent. February 2022 Letter of no objection received. Updated layout to be submitted March 2023.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
Department of National Defence (DND)	Military Air Defence and Air Traffic Control; Military Radio communication users	February 2022 EMI notification letter sent. February 2022 Request for NAV Canada Land Use number received February 2022. September 2022 Letter of no objection received. Updated layout to be submitted March 2023.
ECCC	Weather Radar Coordinator	February 2022 EMI notification letter sent. Updated layout to be submitted March 2023.
Innovation, Science, and Economic Development Canada	Nova Scotia District Office	February 2022 EMI notification letter sent.
NAV Canada	Land Use Specialist	February 2022 EMI notification letter sent. February 2022 Land Use number received February 2022. Updated layout to be submitted March 2023.
RCMP	Wind Farm Coordinator	February 2022 EMI notification letter sent. February 2022 Response received requesting coordination with Bell, who are acting on behalf of the RCMP in the province with leased towers.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
CWS	Wildlife Biologist EA Analyst	June 2019 Email correspondence regarding the review and feedback on the proposed Avian Assessment Plan. August/September 2020 Email correspondence regarding the review and feedback on the updated Avian Assessment Plan.
	Provincial Government	
Local MLAs	Local MLAs	January 2019 Letters to local MLAs
Office of L'nu Affairs	Consultation Advisor of the Mi'kmaq Relations Unit of the Department of Natural Resources and Renewables	May 2022 Higgins Wind initiated outreach to the Office of L'nu Affairs to introduce the Project and request a meeting. October 2022 Meeting with Consultation Advisor to discuss Higgins Wind's role in Crown consultation with the Mi'kmaq of Nova Scotia. February 2023 Meeting with Executive Director Negotiations to provide an overview of the Project, Higgins Wind, and engagement activities with Mi'kmaq of Nova Scotia.
NSCCTH	Director of Special Places Protection	October 2022 Email exchanges regarding the confidentiality of archaeological and cultural resources information and approach for incorporating results into the EA.
NSECC	EA Officer EA Supervisor Business Relations Manager Air Quality Protection Advisor	May 20, 2021 Project scoping meeting led by NSECC and included ECCC, CWS, and NSNRR.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
		June 2021 NSECC shared advice from ECCC/CWS on bird radar requirements. January 2022 Email correspondence regarding data sensitivity for Mainland moose and what data should be provided in the EA versus to NSNRR directly. October 2022 Email exchanges regarding the approach for incorporating the results of the Archaeological Resource Impact Assessment (ARIA) into the EA and to discuss the timing of the NSCCTH review of the ARIA. November 4, 2022 Meeting to present an update on the EA and preliminary results. Key discussion topics included Mainland moose, visual assessment, socio-economic assessment, and the Project scope. November 9, 2022 Meeting to discuss expectations for the assessment of low frequency noise. November 15, 2022 Meeting with EA Officers and Business Relations Manager to discuss the potential for using a real-case scenario for shadow flicker.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
NSNRR	Species at Risk Biologist Regional Biologist	July 2020 Email and call to introduce the Project. August 13, 2020 Meeting to discuss field assessments. August 2020 Email correspondence regarding initial field surveys for Wood turtles, birds, and bats. Also included location data for Mainland moose observations to date. May 13, 2021 Meeting to discuss field findings re: bats, Mainland moose, rare plants, lichens, Wood turtles and to discuss the approach for the avian radar assessment. January 2022 Email correspondence regarding data sensitivity for Mainland moose and what data should be provided in the EA versus to NSNRR directly. May 2022 Email correspondence regarding guidance for bat, bird, and Wood turtle surveys. Additional correspondence regarding the criteria for determining if a site is considered "coastal". June 2022 Email discussions about bat monitoring, followed by a call on June 22, 2022.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
Municipal Government		
Cumberland Council		December 16, 2020 Presentation regarding the Project, Proponents, timeline, schedule, development milestones, and engagement efforts.
Cumberland Municipal Staff	Planner	May 2022, June 2022, and February 2023 Project update and discussion about the Development Agreement.
Cumberland Wind Turbine Bylaw Review	Planners, CAO, Mayor and Council	April 2022 Letter submission. May 2022 Letter submission comments on the recommendations. June 2022 Presentation to Mayor and Council at public hearing.
Colchester Council		February 2, 2021 Presentation regarding the Project, Higgins Wind, timeline, schedule, development milestones, and engagement efforts. November 2, 2021 Presentation regarding the recent open house, Project updates, timeline, schedule, development milestones, and engagement efforts. Discussion around wind turbine bylaw.
Colchester Municipal Staff	Planner, Development Manager	September 2022 Project update, discussed upcoming scope of the Colchester Turbine Wind Turbine Bylaw review.

Government Departments, Agencies, & Regulators	Representative	Dates, Activities, Comments
Colchester Bylaw Review	Planner, Planning and Advisory Committee, Mayor and Council	October 2022 Presentation at the public hearing. October 2022 / November 2022 Participation in open house sessions related to presentation of survey findings. February 2023 Presentation at 2nd reading for the Colchester Turbine Wind Turbine Bylaw review.

6.1.1 Review of Government Concerns

Discussions with federal and provincial regulators primarily focused on ensuring component studies were scoped appropriately and identifying scenarios where additional study may be warranted (e.g., if wind turbines have tonal characteristics, additional modelling for low frequency sound is required).

The Project Team has had extensive engagements with municipal planners and other staff within both Cumberland and Colchester municipalities regarding their reviews and updates of their Wind Turbine Bylaws. While engagements and submissions made by Higgins Wind were focused industry norms and standards that occur in other jurisdictions, there was also discussion related to how the Project is being developed, how potential changes to the wind turbine bylaws might affect the Project, and what was being done by the Project to mitigated concerns that were being raised by community members and through the Project's CLC.

The Project Team has also undertaken discussions with both Cumberland and Colchester County officials regarding the municipal permitting processes (as-of-right permits and or Development Agreements, information requirements for the permit applications, and how this should be timed with the Project's EA review).

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

6.2 Public and Stakeholder Engagement

The Project Team has been involved in formal engagement activities with the public and stakeholders since January of 2019 to ensure the community was made aware of the Project and given ample opportunity to receive information, ask questions, and share local knowledge.

Higgins Wind has:

- Publicly posted its contact information and Project details in a way that is easily accessible to the public.
- Identified a lead contact for questions and feedback.
- Provided opportunities for comment and feedback prior to EA registration.
- Ensured information distributed to the public is accurate, current, and accessible in multiple channels (including a non-internet channel).
- Conducted a range of activities to facilitate effective and efficient dialogue with members of the public.
- Demonstrated examples of how the Project has evolved to address feedback received from the public.

A review of stakeholder meetings and events is included in Table 6.2.

Table 6.2: Stakeholder Meetings and Events

Community/Stakeholder Organization	Engagement
Tourism Industry Association of Nova Scotia (TIANS)	August 2021 Higgins Wind was introduced to President and Director of Professional Development and Industry Relations over email by a CLC member. TIANS was invited to September's CLC meeting. September 2021 Higgins Wind left voicemails with both contacts regarding September's CLC meeting. TIANS was later invited to the Open House on October 5. November 2021 Higgins Wind invited TIANS to Open House on December 4. TIANS was later invited to upcoming CLC meeting. TIANS was not able to attend but offered to consult one-on-one. Higgins Wind followed up to arrange a meeting time, but the request was not reciprocated.
Dr. Karen Beazley, Dalhousie's School of Resource and Environmental Studies	September 17, 2021 Higgins Wind consulted with biodiversity, moose, and connectivity expert, Dr. Beazley, an author of the Nova Scotia Mainland Moose Recovery Plan. Dr. Beazley emphasized using existing roads to minimize landscape fragmentation caused by constructing new roads, and to utilize (previously) clear-cut areas on site. Higgins Wind noted that the site has existing logging roads and discussed the Project plan to maximize the use of existing roads.
Protect Wentworth Valley	November 2021 Representatives called on a few occasions in late November asking questions about the upcoming open house in December, progress on the EA, construction impacts, wildlife impacts, and visual impacts of the Project to update the community group.
Individual residents	September 2021 to February 2022 Higgins Wind met individually with several residents to select photo locations for the visual simulations (provided in Section 10.4). Meetings included a tour of nearby communities and discussion about the methodology involved in completing the visual simulations, as requested.

Community/Stakeholder Organization	Engagement
	Several residents also reached out to the Project Team during this time period to express their support for the Project. One resident reached out to request the Project Team consider existing biking trails as a constraint.
CLIMAtlantic	February 16, 2022 In a virtual meeting, Project Team outlined the Project, Higgins Wind, environmental studies, and engagement efforts.
Ecology Action Centre	February 18, 2022 In a virtual meeting, Project Team outlined the Project, Higgins Wind, environmental studies, and engagement efforts.
NCS Managed Services	February 23, 2022 In a virtual meeting, Project Team consulted about telecommunication impacts from a telecommunications operator's perspective as well as Project-specific EA questions from a resident's perspective.
Cumberland Climate Hub	February 23, 2022 In a virtual meeting, Project Team presented on the Project, Higgins Wind, environmental benefits and studies, community benefits, and community engagement for the Project. Questions ensued about decommissioning, tax revenues, and visual impacts from some members of the group. Some members also expressed their support for the Project following the presentation.
Community Meeting	March 16, 2022 Project Team was invited to a virtual community meeting to discuss the Project from the community's perspective. The group received updates on the EMI study, visual simulations, the EA, socioeconomic study, and decommissioning.

6.2.1 Digital Communications

The Project has maintained a website since 2019 (https://higginswind.com). It includes information about the Project, Higgins Wind, and the CLC. This publicly accessible website continues to be updated regularly. The Project also has a Facebook page (Higgins Mountain Wind LP) where the open houses have been advertised, and emails can be received at info@higginswind.com or at development@elementalenergy.ca. Should individuals want to have their name added to a Project contact list, they are able to sign-up to receive digital announcements and updates, such as newsletters.

6.2.2 Public Open House Events

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

Open House #1

An Open House was held on Tuesday, October 5, 2021 at the Wentworth Recreation Centre (13752 NS-4, Wentworth, NS). Advertisements for this event were mailed to property owners within 5 km of the Project. Advertisements were also published in the Colchester Wire and Truro News local newspapers for two circulation weeks prior to the open house, and were also emailed to stakeholders and Council, and advertised on the Project's Facebook page (Appendix C).

The public was welcomed to drop by between 2 pm and 8 pm and there was a combination of presentations and a Q&A by representatives of Higgins Wind and information boards made available describing the Project. Over 100 people were estimated to be in attendance. Feedback forms with a questionnaire were provided and 18 attendees filled out the questionnaire (Appendix C).

Following the Open House, Higgins Wind responded via email to the Project's engagement list regarding concerns expressed about visual impacts, health and noise impacts, environmental impacts, tourism and recreation impacts, telecommunications impacts, decomissioning, and the timing of the Open House (summary of concerns provided in Section 6.2.4)

Open House #2

A second Open House was held on Saturday, December 4, 2021 at the Wentworth Recreation Centre (13752 NS-4, Wentworth, NS). Advertisements for this event were mailed to all mailboxes within 9 km of the Project (in response to community feedback of having a larger mailing radius). Advertisements were also published in the Colchester Wire, Cumberland Wire, and Truro News local newspapers for two circulation weeks prior to the open house, and were also emailed to stakeholders and Council, and advertised on the Project's Facebook page (Appendix C).

The public was welcomed to drop by between 3 pm and 6 pm and there was a combination of presentations and a Q&A by representatives of Higgins Wind and information boards made available describing the proposed Project. Feedback forms were provided at this event; however, none were filled out.

As part of the Project's municipal permitting processes there are requirements for future open house meetings in each of Cumberland and Colchester communities. Since there have been ongoing municipal wind turbine bylaw reviews in each municiaplity, further open houses have not been held the lead up to submission of the EA, as there has been uncertainty of how the ammended Wind Turbine Bylaws would impact the Project layout.

6.2.3 Community Liaison Committee

The purpose of the CLC is to allow a respectful and transparent exchange of information between Higgins Wind and the residents of local communities and those representing nearby Mi'kmaq communities to the Project. The Terms of Reference for the CLC can be found in Appendix C.

The objectives of the CLC are to:

- Provide avenues for community input to Higgins Wind by two-way sharing of information in a transparent forum on Project matters regarding approvals and permits or operations that have, or are perceived to have, environmental, social, or economic impacts.
- Support regular and detailed discussions regarding the updates to the Project, share the scope and results of the field studies, input to visual quality assessments from important community viewpoints, and support participation by regulators or other stakeholders of the Project who may have interests in the Project area or participation in the EA review. The meetings also provide a forum for residents / community members to share information with the Higgins Project Team.
- Provide a voice to those in the community who have concerns, suggestions, or questions.

Recruitment for the CLC began in January 2019. Letters were sent to community members within 20 km of Folly Lake, an advertisement was made on Wentworth Learning Centre's Facebook page, and notices were posted in the community (Appendix C). Membership was structured to provide a balance in terms of interests in the Project and location relative to the Project, as well as demographics and culture. The CLC includes six community members and two municipal councilors.

Meetings were held in-person prior to COVID-19, and then transitioned to a virtual format. A summary of meetings can be found in Table 6.3. A complete log including attendees, guests, members, topics discussed, action items, and materials shared can be found in Appendix C.

Table 6.3: CLC Meeting Summary

CLC Meeting Date	Agenda
March 13, 2019 – 6:00pm - 8:30pm	Introductions, presentation of Project history and status, Q&A, formation of CLC, and review of Terms of Reference.
May 6, 2019 – 6:00pm – 8:00pm Wentworth Recreation Centre, Wentworth (First official CLC meeting)	Project update, community update, formation of CLC, approval of members, formal adoption of the Terms of Reference, suggestions for future meetings.
November 19, 2019 – 6:00pm – 8:00pm Fundy Trail Snowmobile Club House, Folly Lake	Project update, community update, chair position for upcoming year.

CLC Meeting Date	Agenda
May 12, 2020 Zoom meeting	Project update, community update, CLC mission update, presentation from Manager of Planning Services - Municipality of Colchester and Planner - Municipality of Cumberland County regarding Cumberland and Colchester by-laws.
August 20, 2020 – 6:00pm – 8:45pm Zoom meeting	Project update, community update, CLC mission update.
December 1, 2020 – 6:00pm – 8:45pm	Project update, community update, CLC mission update, presentation from Strum Consulting regarding environmental studies and summary of work to date, review of potential community economic benefits.
March 30, 2021 – 6:00pm – 7:30pm Zoom meeting	Governance and functioning of the CLC, Project update, community update.
May 19, 2021 – 6:00pm – 7:30pm Zoom meeting	Presentation from EA Officer from NSECC regarding the EA process, Project update, procurement update, community update.
July 7, 2021 – 6:00pm – 8:00pm Zoom meeting	Project update, request for proposals (RFP) for NS Power RBP update, environmental update, layout.
August 26, 2021 – 6:00pm – 8:00pm Zoom meeting	Project update, RFP update and feedback, EA submission timeline, open house plans, presentation from Strum Consulting regarding the EA process and the environmental studies completed to date.
September 27, 2021 – 6:00pm – 8:00pm Zoom meeting	Review and feedback of draft visual impact assessment from Strum Consulting, status with Northern Pulp.
November 23, 2021 – 6:00pm – 8:00pm Microsoft Teams meeting	Open house #1, Council meeting, Project update, review updated layout and visual simulations.
January 31, 2022 – 6:00pm – 8:00pm Microsoft Teams meeting	Project update, community benefit fund, decommissioning security, Project commitments, environmental studies, EMI, annual CLC review.
April 22, 2022 – 6:00-800 PM	Project update, discussion on RFP, Higgins Wind will have a First Nations partner on the Project, this will be announced in the future. CLC also made a request for Strum Consulting to participate in future meetings
June 30, 2022	Project update, reviewed tabled items from previous meetings to ensure all follow up items were being addressed. CLC asked Higgins Wind to share the EA before submission. Higgins Wind responded that this was not possible, as the EA will not be finalized until it is ready for submission. Project layout updates will be ongoing until EA submission; however, they will be similar to what was shared in the November and December 2021 open houses.
July 2022	CLC survey was completed by all CLC members.

CLC Meeting Date	Agenda
November 1, 2022	Review of tabled items from previous meetings, Project update, and discussion of positive power purchase agreement award from the RBP competition, discussion of the Cumberland By-law review process and potential impacts to the Project, CLC requested that the EA not be submitted immediately before the holidays and Higgins Wind committed to this. Higgins Wind also committed to notifying the CLC of the EA submission in advance of registration and holding the next CLC meeting within the first two weeks of EA review period.

6.2.4 Review of Concerns

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 6.4)

Table 6.4: Comments Received from the Public

Key Issues	Proponent Response	Section of EA
Environmental Impacts		
Concerned about fragmentation and impacts to wildlife and connectivity.	The land where the Project is proposed consists primarily of disturbed forestry land that has existing power lines, gravel pits, and roads that the Project intends to use. Efforts have been made to site turbines in previously cleared areas and reuse existing roads where possible.	Section 7.4
Property Values		
Concerns related to property values (identified as a FAQ per engagement activities)	Canadian Renewable Energy Association's literature review of the impact of wind turbines on property value has been shared with concerned residents.	Section 8.2
Impacts on Tourism		
Concerns related to tourism (identified as a FAQ per engagement activities)	The Project Team is committed to working with local recreational groups to ensure continued access to the Project Area and associated trails, within the bounds of all safety considerations. The presence of turbines is highly compatible with most land-based recreation activities and should not pose a threat to the usability of the area. Proponent has also adjusted turbine locations to minimize visual effects from the highway, ski hill and popular trail viewpoints.	Section 8.4

Key Issues	Proponent Response	Section of EA
	Health Impacts	
What can be done to ensure no ill health effects will be cast on the residents of Folly Lake or Wentworth?	Studies have been uploaded on the Project website on wind farm health impacts at https://higginswind.com/. The evidence to date does not support a causal link between wind turbines and adverse health effects.	Section 10
	Electromagnetic Interference (EMI)	
I'm concerned about impacts to my TV/internet/cell/etc. services.	Consultation with stakeholders has been conducted by Strum Consulting based on the proposed wind farm layout in December 2021. Updates have been made to the EMI study and communicated to stakeholders based on new revisions in the layout and as part of the EA.	Section 10.2
	Shadow Flicker Impacts	
Will there be annoying visual impacts associated with shadow flicker from the wind turbine blades turning?	Shadow flicker is expected to be minimal and well within regulations due to the far distances from turbines to residences.	Section 10.3
	Visual Impacts	
A large-scale wind turbine development will negatively alter the sightlines in the area.	Taking community feedback into consideration, Higgins Wind removed wind turbines from "Zones of Visual Influence/Impact" as identified by a group of community members based on their independent visual simulation modelling. This siting increased the minimum distance from occupied residences, increased the average distance from residences to over 6 km (previously approximately 5.5 km), and reduced the number of turbines from 28 to 18. This resulted in the relocation of turbines from ridges with high wind resources to respond to the community's concerns regarding visual impacts.	Section 10.4
	Noise Impacts	
Will wind turbines be noisy?	NSECC requires sound levels of no more than 40 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.	Section 10.5
	Decommissioning	
How will we get comfortable that these turbines won't be stranded?	Higgins Wind's land agreement contains a requirement for decommissioning equipment and reclaiming the lands at the end of the Project's life.	NA

Key Issues	Proponent Response	Section of EA
	Higgins Wind is required to provide a decommissioning security to be developed with Colchester County, Cumberland County, and the landowner. The security will ensure that the community will not be burdened with abandoned turbines.	
	Wind Farm Navigation Lighting	
Concerns related to light pollution (identified as a FAQ per engagement activities)	Typically, on wind farms the majority of turbines will need navigation lights in accordance with Transport Canada regulatory requirements. The industry is starting to see technology implemented to minimize visual impacts, notably at sites where turbine lighting could impact dark sky conditions. The industry has not seen any such installations in Canada, but Higgins Wind will continue tracking this new technology to see if the implementation would be suitable for a site like Higgins Mountain.	NA

6.2.5 Ongoing Engagement

The Project Team will continue to work to address any concerns raised by stakeholders and members of the public over the duration of the Project's development.

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*, SNS. 1994-95, c.1
- Air Quality Regulations, NS 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, 2022a)
- NSECC Ambient Air Quality Data (NSECC, 2022a)

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) of the Nova Scotia Uplands Ecoregion (Drawing 7.1). This ecodistrict is relatively cooler as it is exposed to prevailing winds, snow, and ice (Neily et al., 2017).

The local temperature and precipitation data were obtained from the Debert meteorological station (Climate ID 8201390) located approximately 18 km southeast 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													
Daily Avg (°C)	-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 (°C)	-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 (°C)	-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 (°C)	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 (°C)	-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 2022a

From 2012 to 2022, the mean annual temperature was 6.2°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, the meteorological station did not record mean annual snowfall and mean annual rainfall. However, data was recorded in terms of precipitation (monthly average), with most occurring in November and December (118.0 mm and 118.3 mm, respectively) (ECCC, 2022a).

Wind speed and direction data were also obtained from the Debert meteorological station (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 2022a

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, 2022a). A windrose plot provided for the Debert meteorological station (CZDB) demonstrates the wind directions from 2012 to 2022 (Figure 7.1).

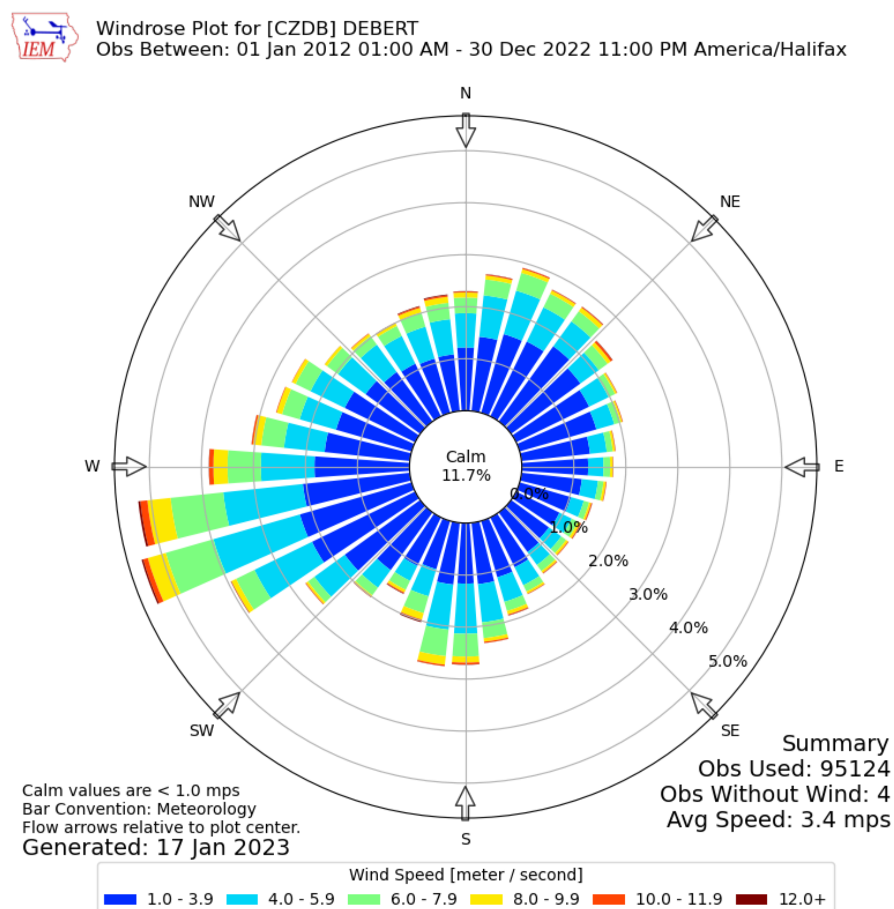

Figure 7.1: Windrose Plot for Debert Meteorological Station (CZDB) – January 1, 2012, through December 30, 2022 (Iowa State University, 2023)

Figure 7.1 demonstrates that between January 1, 2012, and December 30, 2022, wind speeds above 12 m per second (m/s) [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 [≤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 (NSAQR), NS Reg. 8/2020 under the *Environment Act,* SNS 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 included as an ambient air quality standard in the Proposed Ambient Air Quality Standards.

Nova Scotia monitors air quality at eight ambient air quality monitoring stations located throughout the province (NSECC, 2022a). Measured parameters at these locations may include the following:

- Carbon monoxide (CO)
- Ground-level ozone (O_3)
- Nitrogen oxides (NO_x)
- Nitric oxide (NO)
- Nitrogen dioxide (NO_2)
- Particulate matter ($PM_{2.5}$)
- Sulphur dioxide (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, 2022b; NSECC, 2022a). The AQHI is a scale from 1-10+, in which scores represent the following health risk categories: Low (1-3), Moderate (4-6), High (7-10), and Very High (10+) (ECCC, 2022b).

The air quality monitoring station closest to the Project is in Pictou, NS, approximately 73 km northeast of the Project at 45.682647 N, 62.69671 W.

Table 7.4 summarizes the current (baseline) maximum ambient air quality conditions observed at the Pictou air quality monitoring station from 2017 to 2021. 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	48.0	112.4	80.5	31.9	48.0	-	-	-
	24 hours	53.2	19.1	26.0	11.7	14.2	23.0	-	-	-
	Annual	28.2	0.4	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 2022a
*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 at 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, 2022b).

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. There are no air emissions associated with the operation of the wind turbines as the generation of wind power will offset power production that would have otherwise been generated from fossil fuels (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 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 particulate matter (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 microns (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, 2022a).

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, 2022a):

- 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 result in an increase of 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., wind storms, 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

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 Greenhouse Gases (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:

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

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:

- Carbon dioxide (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

Methane (CH_4) is produced when fossil fuels are burned with insufficient oxygen to complete combustion (Government of Canada, 2019b). Another source of methane is the decay of organic solid wastes and, indirectly, methane can also be released due to disturbance of wetlands (which act as methane sinks).

The Project's construction phase requires different heavy- and light-duty equipment, contributing to methane emissions. Alteration of wetlands for constructing access roads and wind turbine laydowns, and the decay of waste (i.e., decomposing cleared vegetation, workforce waste production) will also contribute 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, solvents, foam-blowing agents, and fumigants (Government of Canada, 2013). There are various industrial sources, but the main contributor is aluminum production (US EPA, 2021).

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. Air conditioning units will be used during the Project's construction phase. 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 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 17 turbines, each capable of generating 5.9 to 7 MW of renewable energy. Based on the wind turbine design capacity and a capacity rating of 31.86% (Hatch, 2008), the Project will be capable of producing approximately 313,143,019[1] kilo Watts per hour per year (kWh/year). The lifespan of the Project is estimated at a minimum of 35 years.

Quantifying GHGs in terms of 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).

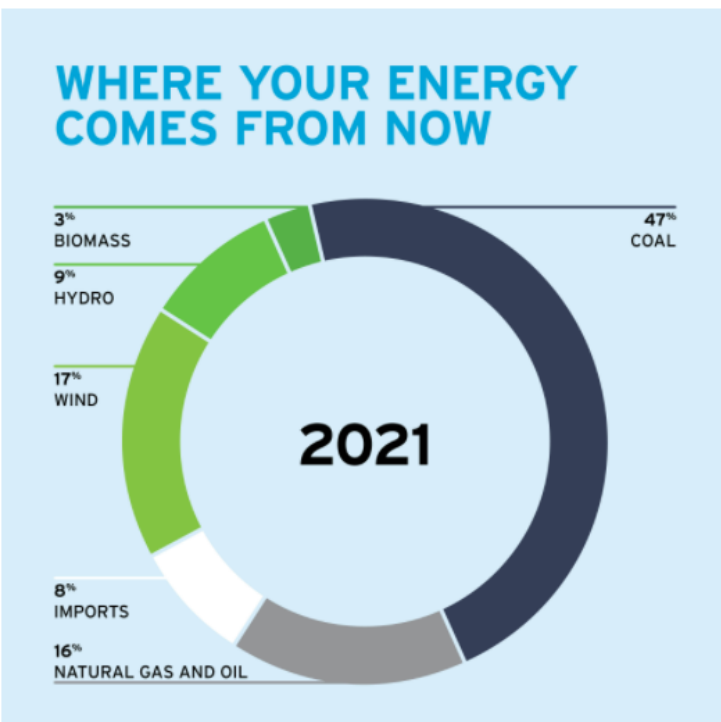

Figure 7.2: NS Power 2021 Energy Statistics

[1] $6.6 \frac{MW}{Turbine} \times 17\,Turbines \times 0.3186 \times 365 \frac{days}{year} \times 24 \frac{hours}{day} \times 1000 \frac{kW}{MW} = 313{,}143{,}019 \frac{kWh}{year}$

In 2021, electricity generated in Nova Scotia by NS Power (the leading producer) was produced from the following fuel sources (NS Power, 2022):

- Coal (47%)
- Wind (17%)
- Natural Gas and Oil (16%)
- Hydro and Tidal (9%)
- Imports (8%)
- Biomass (3%)

Most of the electricity generated is through coal, natural gas, and oil at 63%. Renewable sources account for 29% (Biomass, Wind, Hydro, and Tidal) and the remaining 8% consists of imports. For the purpose of this assessment, the energy imports are distributed amongst coal (+2%), natural gas (+3%), and oil (+3%). Therefore, the fractions used for this assessment were: coal at 49%, natural gas at 11%, and oil at 11%. As the majority of renewable energy is generated from wind, quantification considers wind at 29%.

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
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	153,440,079	157,294.34
Natural Gas	34,445,732	15,155.59
Oil	34,445,732	38,123.33
Wind	90,811,476	0
Total	**313,143,019**	**210,573.26**

The total annual GHG emissions generated in Nova Scotia for the same electrical capacity of the Project is **210,573.26 tCO_2e.**

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

7.1.2.6 Quantification of the Project-generated GHG Emissions

Construction Phase

Access Roads
Most turbines are located adjacent to existing roadways; 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 (Atmosphere and Air Quality).

Laydown Areas
Laydown areas (estimated area 100 m x 100 m = 10,000 m^2 each) are intended to store equipment temporarily, turbine pad foundation, and the crane pad. 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, NS. 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 the purposes of this assessment, transportation distances are based on the nearest known concrete supplier, which is located approximately 50 km from the Project Area. Given the turbine locations are scattered across the Project Area, transportation distances range from 47 km to 51 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	50.74
2	49.36
3	49.25
4	49.37
5	48.88
6	49.04
7	48.50
8	48.38
9	47.30
10	47.36
11	48.59
12	47.52
13	47.70
14	47.67
15	47.34
16	47.51
17	48.58
Total	**823.09**

Based on Table 7.8, the total distance between the wind turbines and the nearest concrete supplier is 823.09 km. Assuming 140 truckloads per wind turbine, the total one-way distance travelled is 115,232.60 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[2] 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.

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} $tCO_2e/tonne \cdot km$
Concrete Truck (Diesel) without Freight	1.106×10^{-3} tCO_2e/km

Source: GHGenius v5.0d (Squared Consultants Inc., 2022)

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

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 **13,155.24 tCO_2e** for constructing all the tower foundation and pedestal.

Detailed CO_2e calculations are provided in Appendix D.

Turbine

The Project will require wind turbines to be manufactured and delivered to the Project Area. The Siemens Gamesa 6.6-170, which has a rotor diameter of 170 m and can generate up to 6.6 MW of power, is used for the purposes of this assessment.

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: Old Fort Madison, Iowa, USA
- Nearest US Shipping Port: Norfolk, Virginia, USA
- Nearest NS Shipping Port: Sheet Harbour, NS, CA

Siemens Gamesa Product Design Detailed Documentation (Siemens Gamesa Renewable Energy, 2020) provides weights for wind turbine components (Table 7.10).

Table 7.10: Wind Turbine Weights

Component	Type	Approximate Weight (kg)
Nacelle	GLOBAL_MY21	69,194
Drive Train	SG5X-155/170	79,970
Low Speed Shaft	SG5X-155/170	26,775
Gear Box	SG5X-155/170	50,000
Hub	SG5X-170	54,540
Spinner	SG5X-170	800
TU Container	SG5X-155/170	18,620
Blade	SG5X-155*	21,141 (x3)
Tower		585,279
Total		**948,601**

* SG5X-170 dimensions and weights pending; therefore, the SG5X-155 model was used.

Based on Table 7.10, the total weight of a wind turbine is approximately 948,601 kg.

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

Table 7.11: Wind Turbine Manufacturing Emission Factor

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).

Given the steel required to produce the wind turbines for the Project and the emission factor (Table 7.11), the CO_2e emissions from the manufacturing of all the wind turbines are expected to be approximately **24,189.33 tCO_2e**.

Siemens Gamesa Renewable Energy occupies an onshore turbine manufacturing plant in Old Fort Madison, IA (Siemens Gamesa Renewable Energy, 2022). For the purposes of this assessment, Project turbines are assumed to be manufactured at this location, then will travel to Norfolk, Virginia, by heavy diesel hauler (transport), where they will be shipped via diesel cargo vessel to the Port of Sheet Harbour, NS. Table 7.12 summarizes the transportation distances from the manufacturer to the Project.

Table 7.12: Wind Turbine Transportation Distances

Originating Destination	Final Destination	Distance (km)
Fort Madison, Iowa	Norfolk, Virginia	2,500 (Land)
Norfolk, Virginia	Sheet Harbour, NS	1,500 (Marine)
Sheet Harbour, NS	Higgins Mountain (Project)	145 (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 Fort Madison, Iowa to Norfolk, Virginia (total of 30,000 km per turbine).
  - 12 components per turbine to travel from Sheet Harbour, NS 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 7.13.

Table 7.13: Land Distance from the Manufacturer to Individual Wind Turbine Locations

Wind Turbine	Approximate Distance (km)
1	31,782.47
2	31,765.92
3	31,764.59
4	31,766.06
5	31,760.14
6	31,762.06
7	31,755.61

Wind Turbine	Approximate Distance (km)
8	31,754.14
9	31,741.22
10	31,741.92
11	31,756.72
12	31,743.86
13	31,746.04
14	31,745.61
15	31,741.67
16	31,743.73
17	31,756.57
Total	**539,828.31**

*Note: Estimated distances from the Port of Sheet Harbour to the individual turbines one way.

Based on Table 7.13, the total land transportation distance between the wind turbine manufacturer and the wind turbine laydowns (not including marine transportation) is **539,828.31 km**. The total marine transportation distance associated with getting the wind turbines from Norfolk, Virginia, to Sheet Harbour, NS, is **25,500 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 7.14.

Table 7.14: 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: GHGenius v5.0d (Squared Consultants Inc., 2022)

Given the land transportation distances required to deliver the wind turbines to the Project and the emission factors (Table 7.14), the CO_2e emissions from land transportation of the wind turbines are expected to be approximately **5,760.92 tCO_2e**. In addition, the marine transportation distances required to deliver the wind turbines from the United States to Canada will contribute **365.26 tCO_2e**.

Detailed CO_2e calculations are provided in Appendix D.

7.1.2.7 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 and a capacity rating of 31.86% (Hatch, 2008), the Project will be capable of producing approximately 313,143,019 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., maintenance activities are the only contributor of 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. This replacement rate is equivalent to approximately 10,379 kg of nacelle material and 21,141 kg for a blade replacement throughout the wind turbine lifetime. The total emission from the replacement material for all the Project's wind turbines is **803.76 tCO_2e** (Table 3, Appendix D).

7.1.2.8 Effects Assessment

Project-GHG Interactions
Project activities will emit GHGs during all phases of the Project (Table 7.15).

Table 7.15: 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
Assessment criteria provided in Section 4.6 apply for Project-related GHG contributions. The VC-specific definition for magnitude is as follows:

- Positive – Project is expected to have a positive effect on GHG emissions.
- Negative – 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 7.16).

Table 7.16: Project GHG Emission Summary

Component	Emissions (tCO_2e)
Baseline	
Electricity Generated from Coal	157,294.34
Electricity Generated from Natural Gas	15,155.59
Electricity Generated from Oil	38,123.33
Electricity Generated from Wind	0
Total	**210,573.26**
Construction Phase	
Concrete Production and Transportation	13,155.24
Wind Turbine Manufacturing	24,189.33
Wind Turbine Transportation	6,126.18
Total	**43,470.74**
Operations Phase	
Electricity Generated from Wind	0
Wind Turbine Maintenance	803.76*
Total	**803.76**

Note: The values in this table may differ from the values presented in Appendix D, 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 Nova Scotia Power's conventional generation methods contribute to **210,573.26 tCO_2e**.

The Project's construction phase will generate the most GHGs from the manufacturing and transportation of the wind turbine, as well as the production and transport of the concrete for the tower foundation and pedestal. The total GHG emission contributions from the construction phase are **43,470.74 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 **803.76 tCO_2e**.

Following the commissioning of the Project, the annual Project GHG emission reduction is expected to be **210,573.26 tCO_2e**. A one-time **803.76 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 0.2-year[3] payback period to offset the construction-related GHG emissions. Following this period, the Project will positively offset GHG emissions that would typically be emitted from conventional production methods employed by NS Power.

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.

[3] $\frac{Construction\ Emissions}{Offset\ Emissions} = \frac{43{,}470.74 tCO2e}{210{,}573.26 tCO2e/year} = 0.2 years$

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 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 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.
- 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, NS Reg. 57/95
- *Environment Act,* SNS 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 three counties – Cumberland, Colchester, and Pictou – from the Parrsboro area in the west to the Pictou area in the east. The Cobequid Hills spans a total area of 1,866 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 mainland Nova Scotia's highest peak at approximately 360 meters 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).

Surficial Geology

Surficial geology within the Study Area is complex, but primarily consists of glacially scoured basins and knobs dating back to the Pre-Quaternary Period (NSNRR, 2021a). The basins and knobs are composed of various bedrock types and ages which are overlain by a thin, discontinuous veneer of till (Drawing 7.4). Other surficial geology units within the Study Area include:

- Colluvial deposits
- Kame fields and esker systems
- Ground moraines and streamlined drifts

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 (NSNRR, 2021a).

The Study Area contains ground moraines and streamlined drifts which are accumulations of unconsolidated sediment ranging between 2 m and 20 m in thickness. These features were formed through the deposition of stony/sandy sediment (derived from local bedrock) at the base of melting ice sheets. Ground moraines and streamlined drifts are usually rapidly draining based on their stony/sandy composition (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 (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 specifically, bedrock geology varies significantly and overlaps with seven bedrock zones/types (Drawing 7.5). The northern portion is primarily comprised of Devonian-Carboniferous igneous rock composed of diorite, gabbro, and granite. The southern portion is a combination of Great Village Gneiss, metamorphic rocks of the Gamble Brook Formation, and the Mabou Group. Great Village Gneiss comprises Neoproterozoic hornblende quartzo-feldspathic gneiss, amphibolite, and granite gneiss. The Gamble Brook Formation comprises Cryogenian-neoproterozoic aged quartzite and garnet-mica schist. The Mabou Group consists of early to late Carboniferous fine-grained red and gray fluvial and lacustrine strata (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 one area 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 lakes are small and generally shallow; however, Folly Lake (located adjacent to the eastern boundary of the Study Area) has depths of over 30 m as a result of glacial activity depositing gravel on either end of the river valley. 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 Stewiacke – St. Andrews River Watershed located over 40 km south of the Study Area (across the Cobequid Bay) (Province of NS, 2009). This protected water area provides water to Stewiacke/area and is designated/delineated under the *Environment Act*, SNS 1994-95, c. 1, specifically the Stewiacke Watershed Protected Water Area Regulations, NS Reg. 262/2007.

Groundwater Quality and Quantity

The northern regions of the Study Area are underlain by plutonic bedrock while the southern stretches are underlain by either 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 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, are more often associated with plutonic and metamorphic groundwater regions.

According to groundwater risk mapping, the Study Area is primarily located in a “High Risk” zone for arsenic and “Low Risk” zone for uranium. There are also isolated pockets of “Medium Risk” for uranium containing bedrock throughout the Study Area (NSNRR, 2021b).

Groundwater Wells

Water supplies near the Study Area are generally derived from individually drilled or dug wells. A total of 258 water wells were identified within 2 km of the Study Area using the NSECC Well Logs Database (2022c) (Appendix E). 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	1965	3.04	0.61	-0.03	0	46.67
Maximum	2018	122.41	33.5	30.45	340.50	329.37
Average	n/a	36.85	6.68	5.83	45.64	154.23

Source: Well Logs Database (NSECC, 2022c).

Based on short term driller's estimates for the wells located within 2 km of the Study Area (Appendix E), well depth varied between 3.04 m and 122.41 m, with an average depth of approximately 36.85 m. Static water levels were found on average at 5.83 m below the surface, with well yields averaging 45.64 Lpm (litres per minute). These measurements represent very short-term yields estimated by the driller at the completion of well construction (NSECC, 2022c).

Four of the 258 water wells are located within the Study Area (none of which are within the Assessment Area) and are summarized in Table 7.18 (Drawing 7.6).

Table 7.18: Summary of Water Well Records within the Study Area

Well ID	Community	Use	Depth (m)	Casing (m)	Bedrock (m)	Static (m)	Yield (Lpm)	Easting	Northing	Distance to AA*
790309	Londonderry	Domestic	36.54	10.35	n/a	15.53	18.16	456862	5037873	0.9 km
840202	Folly Lake	Domestic	18.27	5.48	4.57	10.35	36.32	456500	5042500	3.1 km
921822	Great Village	Domestic	18.27	6.39	6.09	11.27	136.20	452500	5049500	0.5 km
981646	Folly Lake	Domestic	54.81	2.44	2.44	7.31	2.27	450500	5050500	2.7 km

*Distance (km) to the nearest point of the Assessment Area

The NSNRR Pumping Test Database (2022a) provides longer term yields for select wells throughout the province. There are several pumping test wells located near the Study Area including two at Folly Lake. The pumping test well that has the most recent data available is in the community of Londonderry, located within the southwestern corner of the Study Area. Conducted in 2005, this test indicates a long-term safe yield (Q20) of 49.7 Lpm and an apparent transmissivity of 1.3 m^2/day.

NSECC maintains the Nova Scotia Groundwater Observation Well Network (2015a). The nearest provincial observation well to the Study Area is Debert Station (#68) located approximately 20 km southeast, near Debert, NS. This well was drilled to a depth of 46.6 m through conglomerate bedrock of the Wolfville Formation. Monitoring at this well location began in 1993 and is on-going. In 2020, the average annual water elevation was 24.97 masl and the annual water level fluctuation was approximately 2.7 m. The average depth to water in this well was 3.38 m below top of casing in 2020.

7.2.5 Effects Assessment

Project-Geophysical Interactions
Project activities will primarily interact with the geophysical environment during earth moving activities (Table 7.19).

Table 7.19: 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) identified one area of “Medium Risk” in the most southern extent of the Study Area. A section of the Assessment Area does travel within this “Medium Risk” zone, and therefore, these areas will be assessed and confirmed for karst topography during geotechnical investigations (NSNRR, 2019).

Colluvial slopes (also known as talas slopes) were identified sporadically across 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 slopes were highlighted as construction hazards and were subsequently avoided. No known colluvial slopes are located within the Assessment Area; however, this will be confirmed during geotechnical investigations.

Radon potential mapping (Drawing 7.8) shows the Project in a ‘Low-Risk” area for radon in indoor air (NSNRR, 2009). In addition, there is no indoor air pathway for radon gas associated with the Project. 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 region that has a "High Risk" of arsenic (Drawing 7.9) and "Low – Medium Risk" of uranium containing bedrock (Drawing 7.8) (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). Seven wells were identified within 800 m of the Assessment Area, none of which are located within the Assessment Area: IDs 013226, 071749, 120730, 881401, 903152, 920265, and 921822. Details regarding the characteristics of water wells within 800 m of the Assessment Area can be found in Appendix E. The closest water well to the Assessment Area is located approximately 550 m south of where Tower Road intersects Highway 4. 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 feature/hazard identified and were subsequently avoided during Project siting. 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, NS 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 (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 moderate 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 7.11O).
- Use the information collected to inform mitigation and management practices and further refine the Project Area.

7.3.1.2 Regulatory Context
Under the *Environment Act,* SNS 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, NS 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 Carter Lake and four unnamed waterbody features within the Study Area, along with 62 named and unnamed features within 5 km. Carter Lake is the largest open body of water within the Study Area, approximately 3.2 ha in size, located within the central east extent of the Study Area. Evidence of recreational fishing was observed at Carter Lake during field surveys. A complete list of named waterbodies located within 5 km of the Study Area is provided in Table 7.20.

Table 7.20: Named Waterbodies Within 5 km of Study Area

Name of Waterbody	Distance (km)
Waterbodies Within the Study Area	
Carter Lake	--
Waterbodies Within 5 km of Study Area*	
Slack Lake	0.05
Folly Lake	0.09
Sutherland Lake	0.29
Barber Lake	0.43
Little Dead Lake	0.66
Purdy Pond	1.70
Dead Lake	2.26
Long Lake	2.45
Stevens Lake	2.52
Newfound Lake	2.53
Hart Lake	2.73
Webbs Lake	2.79
Dominic Lake	3.02
Little Long Lake	3.45
Isaac Lake	3.52
Bear Lake	3.53
Trout Pond	3.86

Name of Waterbody	Distance (km)
Pine Lake	4.08
Lily Ponds	4.70
Indian Lake	4.94
Trout Lake	4.94

*Measurement from the nearest point of the Study Area.

According to the Significant Species and Habitats Database (2018a), Folly Lake is recorded to contain talus slopes. 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 will not be further discussed 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 277 watercourse feature segments within the Study Area and 1,203 feature segments within 5 km of the Study Area. Several named watercourses were identified within the Study Area including:

- Rockland Brook
- Smith Brook
- Great Village River
- Emery Brook
- Tunnel Brook
- Higgins Brook
- Wallace River
- Village Brook
- Roaring River
- Spencer Brook
- West McElmon Brook
- Harty Brook
- Martin Brook
- Whetstone Brook
- Saltspring Brook
- Caldwell Brook

The largest watercourse flowing through the Study Area is Rockland Brook, located within the southern portion of the Study Area. This watercourse is a major tributary to the Great Village River, which drains into the Bay of Fundy, and represents the largest watershed source within the Study Area. Rockland Brook has several smaller tributaries, including Village Brook, which originates from a large wetland complex known as Dicks Meadows east of the Study Area. Dicks Meadows also feeds Higgins, Smith, and Harty Brooks which are small tributaries of the Wallace River, which drains north into the Northumberland Strait. Other identified watercourses that intersect the Study Area include the Roaring River, a tributary to the Wallace River; Caldwell, Emery, and Snider Brooks in the north; and Tunnel Brook in the southeast.

According to the Significant Species and Habitats Database (2018a), Smith Brook and Wallace River are recorded as areas containing significant species and/or their habitat. Smith Brook is recorded to contain talus slopes, and Wallace River is recorded to contain Wood turtle (*Glyptemys insculpta*). As both records are related to the terrestrial environment, refer to Section 7.4.3 for further details.

Watercourses within the Study Area drain through three primary watersheds referred to as the Phillip/Wallace Watershed (1DN), the Economy Watershed (1DJ), and the Salmon/Debert Watershed (1DH) (Drawing 7.12).

The Phillip/Wallace Watershed drains a large portion of the Study Area northward through a secondary watershed known as the Wallace River Watershed (1DN-3), and ultimately into the Northumberland Strait. This watershed is separated from the lower portion of the Study Area via the topographic influence of Higgins Mountain and Stevens Mountain, and its notable watercourses include Emery Brook, Roaring River, Smith Brook, Higgins Brook, Harty Brook, and the Wallace River.

The Economy Watershed occupies most of the Study Area’s southern half and comprises the majority of the Study Area’s drainage regime. The drainage for this portion of the Study Area flows through a secondary watershed known as the Great Village River Watershed (1DJ-8) and into the Cobequid Bay near the community of Great Village, NS. The notable watercourses include Rockland Brook and the east branch of the Great Village River.

The third primary watershed is the Salmon/Debert Watershed which drains a small portion of the Study Area’s eastern extent southward, through a secondary watershed known as the Folly River Watershed (1DH-1). Drainage from this area ultimately discharges into the Cobequid Bay near the community of Little Dyke, NS. Notable watercourses include Tunnel Brook and Folly River.

Throughout the Study Area, WAM data indicates that groundwater ranges from 0 m to >10 m of the surface, with the majority being within >10 m of the surface on account of the area being rapidly to 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 were focused on potential Project-watercourse interactions.

Watercourse assessments were completed during the summer months of 2021 and 2022. 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. Field crews assessed the entire footprint of 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 incidental observations of species of conservation interest (SOCI) were also recorded during the surveys (Section 7.3.2). Information collected included:

- Date and time
- Weather
- Watercourse type
- Flow characteristics (direction, velocity, etc.)
- Physical characteristics (width, length, etc.)
- Substrate composition
- Instream cover
- Riparian habitat
- Bank stability and siltation presence
- Fish presence/habitat potential (Section 7.3.2)
- Photos, global positioning system (GPS) location, 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).

An additional survey was created for drainage features which are characterized as a natural landscape feature such as a gully, depression, or other water-channeling feature that impacts the directionality of overland flow during and immediately after rainfall events (as per the Queensland *Survey and Mapping Infrastructure Act,* 2003). Recordings were made by making note of the observed topography, type of drainage feature, and presumed direction of flow, and also included a representative GPS-recorded polyline. The inclusion of this additional survey was intended to better the understanding of the localized hydrology as a means of facilitating hydrologically-informed decision making.

7.3.1.5 Field Assessment Results

A total of 18 watercourses were identified within the Assessment Area (Appendix F and Drawing 7.11A to 7.11O) including small permanent (11) and large permanent (seven) features ranging in bankfull width from 0.52 m to 6.91 m. There were no incidental observations of aquatic SAR identified during the watercourse assessment. However, several areas of potential turtle habitat were noted and are described further in Section 7.4.3.

Permanent watercourse features 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).

The majority (11 of 18) of the identified watercourses within the Assessment Area showed evidence of alteration resulting from anthropogenic development activities throughout the last century. For example, many watercourses have been disrupted through the installation of culverts or bridges to facilitate forestry activities and/or from previous wind developments in the area. 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.

In addition to the 18 identified watercourses, 83 drainage features were identified within the Assessment Area. Despite a confined overland flow similar to ephemeral features, these topographical drainage features lack a hydroperiod sufficient for the creation of a riverine environment. The data for these features was provided to Higgins Wind to facilitate Project Area refinement during the detailed design phase, providing a better understanding of the hydrological forms and features of the area to maintain existing patterns of overland flow throughout Project development.

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, transmission lines, a substation, and a laydown area. 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. As previously mentioned, there are no identified Project-waterbody interactions.

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 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
Many 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

Watercourse	Existing Alteration Present?	Forecasted Alteration
WC1	Yes, clear span wooden bridge allows water to pass under road.	Bridge to be assessed and potentially replaced during road upgrades.
WC2	Yes, metal culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC3	Yes, metal culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC4	Yes, decaying wooden structure allows water to pass under road.	Structure to be assessed and potentially replaced during road upgrades.
WC5	None observed.	Transmission line corridor – no alteration expected.
WC6	None observed.	Transmission line corridor – no alteration expected.
WC7	Yes, decaying wooden structure allows water to pass under road.	Structure to be assessed and potentially replaced during road upgrades.
WC8	Yes, decaying wooden structure allows water to pass under road.	Structure to be assessed and potentially replaced during road upgrades.
WC9	Yes, metal culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC10	None observed.	Transmission line corridor – no alteration expected.
WC11	Yes, metal culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC12	Yes, metal culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC13	Yes, plastic culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC14	Yes, metal culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.

Watercourse	Existing Alteration Present?	Forecasted Alteration
WC15	None observed.	Transmission line corridor – no alteration expected.
WC16	None observed.	Transmission line corridor – no alteration expected.
WC17	None observed.	Transmission line corridor – no alteration expected.
WC18	None observed.	Transmission line corridor – no alteration expected.

Road Upgrades
If determined to be required, all forecasted alterations (11) will be upgrades to existing watercourse crossings during road upgrades. Many of the current watercourse crossings see flow being directed through decaying infrastructure such as rusted metal culverts (six), a deteriorating plastic culvert (one), and collapsing wooden structures (three).

The final alteration may arise from upgrades to a clear span bridge that crosses WC1. However, given that the bridge provides safe crossing for logging machinery and logging trucks, it is expected that the bridge will be sufficient for the Project as it exists in its current state. Should the bridge need to be replaced, another open-bottom structure 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.

No new watercourse crossings are required for this Project.

Transmission Line
Of the identified watercourses within the Assessment Area, seven are along proposed transmission line routes. 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
The following specific mitigative measures will be implemented to avoid and mitigate any potential effects on watercourses. In addition, a site-specific EPP will be developed to further inform mitigation measures. This EPP will act as a “living document” that incorporates an adaptive management approach to environmental protection and mitigation. Further, the EPP will incorporate proven BMPs that have demonstrated success in mitigating such effects.

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.
- 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
	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 low magnitude such that there will be no loss of aquatic habitat, with minimal potential for altered hydrology. 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, be 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.

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 NS *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, 2022).
- Species listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as "Endangered", "Threatened", or "Special Concern" (Government of Canada, 2022).
- Species listed under NS *ESA* as "Endangered", "Threatened" or "Vulnerable" (Government of NS, 2022).
- Species having a subnational (provincial) rank (S-Rank) of "S1", "S2", or "S3" (ACCDC, 2022a).

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)
- NS 10K Topographic Database – Hydrographic Network (Open Data NS, 2022)
- WAM (NSNRR, 2021d)
- Aquatic Species at Risk Map (DFO, 2022)
- NS Significant Species and Habitats Database (NSNRR, 2018a)
- Atlantic Canada Conservation Data Centre (ACCDC) Data Report (ACCDC, 2022b)

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, 2022) is a federal database showing the distribution of SAR and their associated critical habitat within Canadian waters. A review of this database determined that the southern half of the Study Area is located within critical habitat for Atlantic salmon IBoF pop. (*Salmo salar pop. 1*) and there are documented observances of IBoF Atlantic salmon and Brook floater (*Alasmidonta varicosa*) within the Study Area.

The Nova Scotia Significant Species and Habitat Database (NSNRR, 2018a) contains 28 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 13 "Species of Concern" records relating to the Delicate lamp mussel (*Lampsilis cariosa*) (three), Triangle floater (*Alasmidonta undulata*) (five), Brook floater (*Alasmidonta varicosa)* (one), Creeper (*Strophitus undulatus*) (two), and unknown molluscs (*Mollusca spp.*) (two).
- A total of 16 "Species at Risk" records relating to Triangle floater (10), Brook floater (three), and Delicate lamp mussel (three).

The ACCDC database identified 16 fish and aquatic invertebrate SOCI within a 100 km of the Study Area (Table 7.24).

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

Common Name	Scientific Name	COSEWIC Status[1]	SARA Status[2]	NS ESA Status[3]	NS S-Rank[4]
Fish					
Alewife / Gaspereau	*Alosa pseudoharengus*	---	---	---	S3B
American eel	*Anguilla rostrata*	Threatened	---	---	S3N
Atlantic salmon - Gaspe-Southern Gulf of St Lawrence pop.	*Salmo salar pop. 12*	Special Concern	---	---	S1

Common Name	Scientific Name	COSEWIC Status[1]	SARA Status[2]	NS ESA Status[3]	NS S-Rank[4]
Atlantic salmon - Inner Bay of Fundy pop.	*Salmo salar pop. 1*	Endangered	Endangered	---	S1
Atlantic salmon- NS Southern Upland pop.	*Salmo salar pop. 6*	Endangered	---	---	S1
Atlantic sturgeon	*Acipenser oxyrinchus*	Threatened	---	---	S2S3N
Atlantic whitefish	*Coregonus huntsmani*	Endangered	Endangered	Endangered	S1
Brook trout	*Salvelinus fontinalis*	---	---	---	S3
Lake trout	*Salvelinus namaycush*	---	---	---	S3
Striped bass	*Morone saxatilis*	Endangered / Special Concern	---	---	S2S3B, S2S3N
Striped bass - Bay of Fundy pop	*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 ochraea*	---	---	---	S1
Triangle floater	*Alasmidonta undulata*	---	---	---	S2S3

Source: ACCDC 2022b; [1] Government of Canada 2022; [2] Government of Canada 2022; [3] Government of NS 2022; [4]ACCDC 2022a

The ACCDC Data Report (2022b) also identified six observations of aquatic mammals within 100 km of the Study Area (Appendix G). These species are not discussed further as the Study Area is contained inland and will not impact the marine environment.

No fish or aquatic invertebrate SOCI have ACCDC-documented observations within 5 km of the Study Area (ACCDC, 2022b).

7.3.2.4 Field Assessment Methodology

Fish presence and existing habitat were documented as part of the watercourse surveys (Section 7.3.1). 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, was then used to select ideal watercourses for detailed fish habitat assessments and qualitative electrofishing (Drawing 7.14). 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.

Fish Habitat Assessment

The fish and fish habitat assessments were completed during summer 2021 and included several components: an analysis of in-situ water chemistry, a physical analysis of the watercourse including bank characteristics and substrate composition, and an assessment of fish habitat potential across various life stages (i.e., spawning, rearing, and overwintering). 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 evidence of siltation, erosion, stability, and undercutting. Conditions were ranked as being present in either trace, moderate, or abundant amounts.

  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 (DO)
  DO fluctuates in response factors such as plant biomass, substrate, velocity, and temperature. Optimal DO concentrations should be >6.5-8 mg/L, with a subsequent saturation of around 80-120% (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 (0-0.2 mS/cm) is used as an indicator of pristine conditions.
- Medium conductivity (0.2-1 mS/cm) is the typical range of most major rivers.
- High conductivity (1-10 mS/cm) indicates saline conditions (Government of Northwest Territories, 2013).

pH

pH is a measure of acidity based on a 0-14 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.

Electrofishing was done in tandem with fish habitat assessments and was conducted over 200 m stretches along each target watercourse. For the targeted watercourses, electrofishing assessments were completed at the 0 m, 100 m, and 200 m points (i.e., the downstream, crossing, and upstream locations, respectively), with notes, photos, and measurements taken for any fish caught during the completed surveys. As part of the assessment, field staff made note of any fish observed but not caught, along with any points of concern such as obstructions to fish passage (e.g., elevated culverts, waterfalls, etc.).

7.3.2.5 Field Assessment Results

Fish Habitat Assessment

Fish presence and existing habitat were documented as part of the watercourse surveys (Section 7.3.1). 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). Detailed descriptions and characterization parameters for each watercourse are found in Appendix F.

Habitat assessments were also conducted during electrofishing surveys. Detailed results are in Appendix H, with a summary shown in Table 7.25.

Table 7.25: Fish and Fish Habitat Assessment Results

Watercourse	Surveyed Reach	Possible Barriers to Passage	Fish Seen	Habitat Characteristics			Ranking of Fish Presence
				Spawning [1]	Rearing [2]	Overwintering [3]	
Higgins Brook	Downstream	Yes	Yes	Moderate	Moderate	Moderate	High
	Crossing	Yes	Yes	Moderate	Moderate	Moderate	High
	Upstream	Yes	Yes	High	High	Moderate	High
Smith Brook	Downstream	No	Yes	High	High	High	High
	Crossing	No	Yes	High	High	High	High
	Upstream	No	Yes	High	High	High	High
Tributary to east branch of Great Village River	Downstream	No	Yes	Moderate	Moderate	Moderate	High
	Crossing	No	Yes	Moderate	Moderate	Moderate	High
	Upstream	No	Yes	Poor	Moderate	Moderate	High
Tributary to Rockland Brook 2	Downstream	No	No	Poor	Poor	Poor	Low
	Crossing	No	No	Moderate	Moderate	Poor	Low
	Upstream	No	No	Poor	Poor	Poor	Low
Tributary to Village Brook 1	Downstream	Yes	No	Moderate	Moderate	Moderate	Moderate
	Crossing	Yes	No	Moderate	Moderate	Moderate	Moderate
	Upstream	Yes	No	Poor	Poor	Poor	Moderate
Tributary to Village Brook 2	Downstream	No	No	High	High	High	Moderate
	Crossing	No	No	Moderate	Moderate	Poor	Moderate
	Upstream	No	No	High	High	Poor	Moderate
Tunnel Brook	Downstream	No	Yes	Moderate	Moderate	Poor	High
	Crossing	No	Yes	Moderate	Moderate	Poor	High
	Upstream	No	Yes	Moderate	Moderate	High	High
Near Carter Lake	Downstream	No	Yes	Moderate	Moderate	Poor	High
	Crossing	No	Yes	Moderate	Moderate	Poor	High
	Upstream	No	Yes	Moderate	Moderate	Poor	High

[1] Spawning Habitat = gravel to cobble dominant substrates
[2] Rearing Habitat = riffle-pool sequences
[3] Overwintering Habitat = contains deep pools

Electrofishing Surveys

Electrofishing was conducted during summer 2021. Given the confirmed presence of the Atlantic salmon IBoF subspecies, a *SARA* permit was obtained prior to any electrofishing proceeding (*SARA* Permit No: DFO-MAR-2020-25). Qualitative electrofishing was conducted along Higgins Brook, Smith Brook, Tunnel Brook, a tributary of the east branch of the Great Village River, a tributary of Rockland Brook, two tributaries of Village Brook, and an unnamed watercourse near Carter Lake (Drawing 7.14). Results are provided in Table 7.26.

Table 7.26: Electrofishing Survey Results

Watercourse	Count	Common Name	Scientific Name	COSEWIC[1]	*SARA*[2]	NS *ESA*[3]	S-Rank[4]
Higgins Brook	19	Brook trout	*Salvelinus fontinalis*	---	---	---	S3
Smith Brook	24	Brook trout	*Salvelinus fontinalis*	---	---	---	S3
Tunnel Brook	19	Brook trout	*Salvelinus fontinalis*	---	---	---	S3
Tributary of east branch Great Village River	13	Brook trout	*Salvelinus fontinalis*	---	---	---	S3
Tributary #2 of Rockland Brook*	0	---	---	---	---	---	---
Tributary #1 of Village Brook	0	---	---	---	---	---	---
Tributary #2 of Village Brook	0	---	---	---	---	---	---
Unnamed watercourse - near Carter Lake	7	Brook trout	*Salvelinus fontinalis*	---	---	---	S3

[1] Government of Canada 2022; [2] Government of Canada 2022; [3] Government of NS, 2021; [4] ACCDC 2022a

*The water temperature in Tributary #1 of Rockland Brook was too high (>22°C) to electrofish.

The electrofishing surveys resulted in 82 Brook trout (both juvenile and adult) being caught across five of the eight surveyed watercourses. These results aligned with observations made during the watercourse characterizations (Appendix F) and fish and fish habitat assessments (Appendix H, Table 7.25), demonstrating the high availability of brook trout habitat throughout the Study Area.

Due to environmental circumstances and permitting limitations, one of the targeted watercourses was unable to be electrofished. This is because electrofishing is restricted to waters below 22°C, as temperatures that exceed this threshold can put stress on the fish, and any electrofishing efforts would only further exasperate this stress, as such, the Tributary #1 of Rockland Brook was not assessed.

Priority Species

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

Atlantic Salmon (*Salmo salar*)

The Atlantic salmon – IBoF subspecies is listed as 'Endangered' by *SARA* and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and as "S1" by ACCDC (2022a). IBoF Atlantic salmon are a genetically distinct population of Atlantic salmon that encompass 48 rivers, including the Minas Basin and Chignecto Bay (COSEWIC, 2011). For freshwater habitat, Atlantic salmon prefer clear, well-oxygenated waters in streams with bottoms of gravel, cobble, and boulder. Atlantic salmon prefer cool waters, with spawning typically observed in the 4.4 to 10° C range, and growth typically observed in the 5 to 19° C range (US Fish and Wildlife Service, 2021). 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 to 40 cm range (US Fish and Wildlife Service, 2021). Furthermore, Atlantic salmon prefer a circumneutral pH ranging from 6.5-7.5 (Maine Department of Environmental Protection, 2022).

Atlantic salmon species undertake long feeding migrations to the ocean as older juveniles and adult and return to freshwater streams to reproduce. 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-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 9.0 ± 1.0 km from the Study Area (ACCDC, 2022b).

Atlantic salmon – Nova Scotia southern upland (NSSU) subspecies is listed as ‘Endangered’ by COSEWIC and as “S1” by ACCDC (2022a). NSSU Atlantic salmon are a genetically distinct population of Atlantic salmon that occupy rivers in both the Eastern Shore and South Shore, draining into the Atlantic, as well as Bay of Fundy Rivers south of Cape Split (DFO, 2013). The exact number of rivers that contain NSSU Atlantic salmon is unknown; however, they have been historically considered present in 72 of the regions 585 watersheds. They are managed under Salmon Fishing Area 20, 21, and part of 22 (DFO, 2013). As the Bay of Fundy rivers interacting with the Project are located to the northeast of Cape Split, it is unlikely that the population would interact with the Project.

The closest observation of Atlantic salmon NSSU subspecies is 74.9 ± 0.0 km from the Study Area (ACCDC, 2022b).

Brook Trout (*Salvelinus fontinalis*)
Brook trout are not listed under federal (*SARA*) or provincial (NS *ESA*) legislation as a SAR; however, they are listed as ‘S3’ by ACCDC (2022a). This species of trout is typically found in cold, clear, and well oxygenated rivers and lakes with plenty of shade and gravel substrate (US Fish and Wildlife Service, 2021). 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, they do best 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).

The closest observation of Brook trout is within the Assessment Area, where field staff recorded 82 individuals during electrofishing surveys.

American Eel (*Anguilla rostrata*)
The American eel is listed as 'Threatened' under COSEWIC and 'S3N' by ACCDC (2022a). 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).

The closest ACCDC observation of American eel is 10.2 ± 1.0 km from the Study Area (ACCDC, 2022b).

Brook Floater (*Alasmidonta varicosa*)
The Brook floater is listed as 'Special Concern' under *SARA* and COSEWIC, 'Threatened' under NS *ESA*, and as 'S3' by ACCDC (2022a). Brook floaters are medium sized freshwater mussels that are confined to only 15 watersheds in Nova Scotia and New Brunswick, including the Salmon/Debert watershed and the Phillip/Wallace watershed (COSEWIC, 2009), both watersheds which are located within the Study Area (further details supplied in Section 7.3.1). This species of mussel is typically found in shallow rivers or streams with moderate to high water flow, and substrate consisting of a rocky bottom with cobble and sand or fine gravel (DFO, 2016). Furthermore, Brook floaters prefer environments with dissolved oxygen levels above 6 mg/L, and a pH greater than 5.4 (DFO, 2016).

Brook floaters are considered long-term brooders, known to hold onto their larvae (called glochidia) for almost a year (US Fish and Wildlife Service, 2021). From there, larvae are released into the water column when temperatures rise above 14° C, where they attach to the body, gills or fins of fish, remaining there through fall and winter until being released in the following spring (US Fish and Wildlife Service, 2018). After development on the host fish, juveniles burrow into the substrate of rivers where they grow into adults. As sessile organisms, Brook floaters require areas of flow refuge with stable substrate (US Fish and Wildlife Service, 2018) and in this life stage, like other mussels, Brook floaters feed on algae, bacteria, and other particles filtered from the water column (COSEWIC, 2009).

The closest ACCDC observation of Brook floater is 11.7 ± 0.0 km from the Study Area (ACCDC, 2022b).

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 11 watercourse alterations for the Project. These alterations are all associated with upgrades to existing roads and associated crossings, including one clear span bridge (Table 7.28). Many of the current watercourse crossings have flow being directed through decaying infrastructure such as rusted culverts and collapsing wooden structures. Furthermore, when paired with the current buildup of sediment, organic material, and both natural and artificial debris, many of the observed crossings may be seen as a barrier to fish passage in their current state. Therefore, for many 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 four of the 19 wetlands within the Assessment Area may offer some form of fish habitat. 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. All of these wetland alterations are associated with pre-existing road crossings and are contiguous with identified and delineated watercourses. As such, any 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.

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

Feature ID	Existing Alteration Present?	Forecasted Alteration
Watercourses		
WC1	Yes, open-bottom wooden bridge allows water to pass under road.	Bridge to be assessed and potentially replaced during road upgrades.
WC2	Yes, metal culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC3	Yes, metal culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.

Feature ID	Existing Alteration Present?	Forecasted Alteration
Watercourses		
WC4	Yes, decaying wooden structure allows water to pass under road.	Structure to be assessed and potentially replaced during road upgrades.
WC5	None observed.	Transmission line corridor – no alteration expected.
WC6	None observed.	Transmission line corridor – no alteration expected.
WC7	Yes, decaying wooden structure allows water to pass under road.	Structure to be assessed and potentially replaced during road upgrades.
WC8	Yes, decaying wooden structure allows water to pass under road.	Structure to be assessed and potentially replaced during road upgrades.
WC9	Yes, metal culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC10	None observed.	Transmission line corridor – no alteration expected.
WC11	Yes, metal culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC12	Yes, metal culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC13	Yes, plastic culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC14	Yes, metal culvert installation for road crossing.	Culvert to be assessed and potentially replaced during road upgrades.
WC15	None observed.	Transmission line corridor – no alteration expected.
WC16	None observed.	Transmission line corridor – no alteration expected.
WC17	None observed.	Transmission line corridor – no alteration expected.
WC18	None observed.	Transmission line corridor – no alteration expected.
Wetlands		
WL1	Yes, gravel road cuts through WL1 and WC1.	Partial infill for road upgrades.
WL3	Yes, gravel road cuts through WL3 and WC4.	Partial infill for road upgrades.
WL14	Yes, gravel road cuts through WL14 and WC13.	Partial infill for road upgrades.
WL15	Yes, gravel road cuts through WL15 and WC13.	Partial infill for road upgrades.

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., 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 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 no expected new crossings. In addition, a site-specific EPP will be developed to further inform mitigation measures. This EPP will act as a “living document” that incorporates an adaptive management approach to environmental protection and mitigation. Further, the EPP will incorporate proven BMPs that have demonstrated success in mitigating such effects.

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.

Changes in Surface Water Quantity

- Integrate water management systems into the design, where appropriate, including diversion and collection ditches, roadside drainage channels, and vegetated swales.
- 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.
- Fit any watercourse crossings with appropriately sized infrastructure, as prescribed by a certified Watercourse Alteration Installer/Sizer.
- Avoid impacts to wetlands to the extent possible.
    - Where unavoidable, design wetland crossings to occur at the narrow part of the wetland or the wetland's edges, to the extent possible.

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 7.29).

Table 7.29: 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

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
	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 NS *ESA*.
- Wetlands in designated protected water areas as described within Section 106 of the *Environment Act,* SNS 1994-95, c. 1.

As per Section 5 of the *Environment Act*, SNS 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, 2022)
- NS 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 53 wetlands within the Study Area, which are classified as: swamp (44), marsh (6), bog or fen (2), and fen (1). The wetlands ranged in size from 0.44 to 5.45 ha (Drawing 7.15).

According to the WSS database (2014), there are no WSS located within the Study Area. However, outside the Study Area, there are several WSS associated with provincially protected areas including the Portapique River Wilderness Area to the west and Wentworth Provincial Park to the north. In addition, there are two WSS (determined to contain SAR) located 2 km west of the Study Area associated with Sutherland Lake.

The NS Hydrographic Network (Open Data NS, 2022) 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 rapidly to 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 a Mainland moose (*Alces alces americana*) concentration area (discussed further 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.

7.3.3.4 Field Assessment Methodology

General
Wetland field assessments were completed across the entirety of the Assessment Area. This included high-level assessments for hydrology, complimented by in-depth wetland delineations and functional assessments. Wetland surveys were 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 and road placement. This approach resulted in several layout modifications as the Project Area was optimized to minimize interactions with wetlands. Although extensive wetland field assessments were completed throughout the entire Study Area, only wetlands within the current Assessment Area are discussed in the EA.

To accompany wetland field surveys, a list of SOCI known to occur within the general area of the Project was compiled to help with incidental identification. Throughout the wetland surveys all incidental 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
Field 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 outside of the Assessment Area, the extent of its boundary was 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 7.30). 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 7.30: Classification of Wetland-Associated Plant Species

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

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

Table 7.31: 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

All field delineated wetlands 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

General

Field surveys completed during summer 2022 identified 19 wetlands either partially or fully within the Assessment Area (Drawings 7.11A to 7.11O). Detailed results are found in Appendix I.

Of the 19 identified wetlands, the most prominent wetland type was treed swamps (10). Treed swamps are characterized by an environment that is not as waterlogged as other wetland types, such as shrub swamps or marshes, and 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 and yellow birch) and coniferous trees (e.g., black spruce and balsam fir) the opportunity to establish themselves and adapt to the inconsistent inundation periods (Province of NS, 2018).

Most treed swamps identified were situated in either a basin landscape position that showed signs of historic forestry activity (i.e., moss covered tree stumps), or along sloped river valleys. Typical species composition consisted of cinnamon fern (*Oundastrum cinnamomeum*), creeping snowberry (*Gaultheria hispidula*), black spruce (*Picea mariana*), and balsam fir (*Abies balsamea*). Surface water was typically not observed, though saturation was often present as identified through the excavation of small soil pits.

Shrub swamps (two) were also identified within the Assessment Area. Shrub swamps tend to form in permanently or seasonally flooded areas where the surface is moist from ground saturation. 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 common woolly bullrush (*Scirpus cyperinus*), Canada goldenrod (*Solidago canadensis*), speckled alder (*Alnus incana*)*,* 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.

Bogs (three) were also observed throughout 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). Typical species composition observed included tawny cottongrass (*Eriophorum virginicum*), speckled alder, balsam fir, and black spruce. The majority of the observed bogs were in a basin landform that had been intersected by a roadway, as could be observed by the continuation of bog habitat extending laterally from the adjacent side of the roadway, and the pooling of water near roadway shoulders. Trees, when present, were often stunted and scattered throughout.

Fens (three) 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 common woolly bullrush, Canada goldenrod, and steeplebush (*Spiraea tomentosa*).

One vernal pool was observed within the Assessment Area. These wetland features often lack a clear inlet or outlet and appear as an ephemeral pool that is typically less than 0.5 ha (Province of NS, 2018). Vernal pools serve as important habitat for herpetofauna such as the Red-spotted newt (*Notophthalmus viridescens viridescens*) and the Northern green frog (*Lithobates clamitans*). Flora species composition included crested woodfern (*Dryopteris cristata*), sweet gale (*Myrica gale*), red maple (*Acer rebrum*), and yellow birch (*Betula alleghaniensis*).

A minor layout modification was made to the Project following the 2022 field season, which included the following:

- The relocation of turbines 15 and 16 and the associated connection road to areas that have experienced previous (i.e., historic) anthropogenic disturbance.
- The realignment of connection roads leading to turbines 1 and 2 to accommodate the turning radius needed for materials transport.
- The relocation of the western substation to an area that had been previously altered.

These minor layout modifications served to limit disturbance in previously unaltered areas by relocating infrastructure to areas where anthropogenic disturbance had already taken place.

A high-level, out-of-season, assessment was completed in these areas to identify the potential for wetlands in December 2022. Results indicated six locations noted as “possible wet areas” on Drawing 7.11A to 7.11O. A seasonally-appropriate wetland survey will be completed in these “possible wet areas” during the 2023 field season to confirm the presence and extent of any wetlands.

Functional Assessments
Functional assessments were completed during summer 2022 for each of the 19 wetlands located within the Assessment Area. Detailed WESP-AC results are found in Appendix I, and a summary is provided in Table 7.32.

None of the wetlands were determined to be WSS, as dictated by the Functional WSS Interpretation Results within the WESP-AC spreadsheet calculator. These results aligned with the desktop review results. Furthermore, these scores aligned with the results of other field surveys, including no at-risk lichen or plant species within field-delineated wetlands within the Assessment Area. The results of the wetland field assessments were also cross-referenced with breeding bird survey results, specifically for avian SAR with wetland habitat requirements, with no at-risk bird species observed within field delineated wetlands within the Assessment Area.

The majority of wetlands were determined to be in moderate ecological condition, with 11 of 19 wetlands receiving this result. However, 16 of 19 were determined to be at a higher wetland risk, based on an average of their respective sensitivity and stressors. This is likely due to many of the wetlands being previously impacted by anthropogenic disturbance (i.e., road construction, forestry activities, etc.) both directly and within the greater catchment area, resulting in a potential lack of intrinsic resistance and resilience to future stressors.

Note that one WSS was identified 2 km to the east of the Assessment Area in an area known as Dicks Meadow. This area is known to support significant species habitat including confirmed presence of moose, beaver, nesting waterfowl, and an assemblage of flora SOCI including the large purple fringed orchid (*Platanthera grandiflora*). This information was taken into consideration when designing the Project Area, and a buffer will be maintained between the area and any Project infrastructure.

Table 7.32: Summary of WESP-AC Assessments for Wetlands within the Assessment Area

Wetland ID	Tertiary Watershed	Wetland Type(s)	WSS[1] (Yes/No)	Condition[2]	Risk[3]
WL1	1DJ-8-D	Fen	No	Moderate	Higher
WL2	1DJ-8-F	Bog	No	Higher	Higher
WL3	1DJ-8-F	Treed swamp	No	Lower	Higher
WL4	1DJ-8-F	Treed swamp	No	Moderate	Higher
WL5	1DJ-8-F	Treed swamp	No	Moderate	Higher
WL6	1DJ-8-F	Treed swamp	No	Lower	Higher
WL7	1DJ-8-F	Treed swamp	No	Moderate	Moderate
WL8	1DJ-8-F	Treed swamp	No	Moderate	Moderate
WL9	1DJ-8-F	Treed swamp	No	Moderate	Higher
WL10	1DN-3-G	Treed swamp	No	Moderate	Moderate
WL11	1DN-3-G	Treed swamp	No	Higher	Higher
WL12	1DJ-8-F	Shrub swamp	No	Moderate	Higher
WL13	1DJ-8-F	Treed swamp	No	Higher	Higher
WL14	1DN-3-F	Fen	No	Lower	Higher
WL15	1DN-3-F	Fen / Shrub swamp	No	Moderate	Higher
WL16	1DJ-8-F	Bog	No	Moderate	Higher
WL17	1DJ-8-G	Vernal pool	No	Higher	Higher
WL18	1DJ-8-F	Bog	No	Moderate	Higher
WL19	1DJ-8-F	Shrub swamp	No	Higher	Higher

[1] Wetlands of Special Significance
[2] Wetland ecological condition, as compared to representative selection of calibration wetlands.
[3] Wetland risk is calculated as an average of the wetland sensitivity and stressors.

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 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 7.33).

Table 7.33: 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 are not part of a WSS.
- 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 are part of a WSS.

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 7.34 and shown on Drawing 7.11A to 7.11O.

Table 7.34: Habitat Alteration for Wetlands within the Assessment Area

ID	Wetland Type	Delineation Extent	Delineated Area (m^2)	Area Of Potential Alteration[1] (m^2)	Activity
WL1	Fen	Full	19,810	5,068.37	Road upgrade
WL2	Bog	Full	8,106.23	2,812.45	Road upgrade
WL3	Treed swamp	Partial	2,121.97	2,026.77	Road upgrade
WL4	Treed swamp	Partial	3,547	0	Road upgrade - wetland can be avoided
WL5	Treed swamp	Partial	3,324.53	2,917.74	Road upgrade
WL6	Treed swamp	Full	562.61	0	New road construction - wetland can be avoided
WL7	Treed swamp	Partial	1,489.97	1,308.12	New road construction
WL8	Treed swamp	Full	2,654.24	0	New road construction and turbine pad placement – wetland can be avoided
WL9	Treed swamp	Partial	660.22	0	Road upgrade – wetland can be avoided

ID	Wetland Type	Delineation Extent	Delineated Area (m^2)	Area Of Potential Alteration[1] (m^2)	Activity
WL10	Treed swamp	Full	5,029.38	3,930.95	New road construction
WL11	Treed swamp	Partial	1,812.44	0	Road upgrade – wetland can be avoided
WL12	Shrub swamp	Partial	2,414.03	454.74	Road upgrade
WL13	Treed swamp	Partial	739.89	651.97	Road upgrade
WL14	Fen	Partial	3,539.88	2,135.49	Road upgrade
WL15	Fen / Shrub swamp	Partial	484.99	434.48	Road upgrade
WL16	Bog	Full	4,004.13	1,761.43	New road construction
WL17	Vernal pool	Full	734.31	0	Transmission line – wetland can be avoided
WL18	Bog	Full	6,368.76	0	Transmission line – wetland can be avoided
WL19	Shrub swamp	Partial	3,708.85	0	Transmission line – wetland can be avoided

[1]The area of potential alteration was calculated via GIS by assuming a conservative road disturbance width of 25 m. As the detailed design is completed, the actual area of alteration required to upgrade or construct a new road 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 2.35 ha of delineated wetland habitat may be directly altered by the Project. Significant effort was made to maximize existing disturbed areas, with only 7.5 km of new road being constructed, and 26.2 km of previously existing road being utilized. As such, only 11 of the 19 delineated wetlands may require alteration, with eight of these alterations being associated with upgrades to existing roads (if determined to be required during the detailed design phase). No alterations are required for the construction of turbines, and installation of the transmission line will avoid all wetland habitat.

Provincial wetland data (NSNRR, 2021e) was used to estimate the total amount of wetland habitat within the 7,950.38 ha Study Area. An estimated 87.96 ha of wetland habitat was identified, which equates to approximately 1.12% of the total Study Area. Field delineated wetland habitat that may be directly impacted comprises approximately 0.03% of the total area within the Study Area, approximately 2.67% of the potential wetland habitat within the Study Area, and approximately 1% of the total area within the 235.19 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. In addition, a site-specific EPP will be developed to further inform mitigation measures. This EPP will act as a "living document" that incorporates an adaptive management approach to environmental protection and mitigation. Further, the EPP will incorporate proven BMPs that have demonstrated success in mitigating such effects.

Habitat Loss

- Ensure wetlands are clearly marked to avoid interference with wetland habitat to the extent possible.
- Complete in-season wetland surveys for areas subject to minor layout modifications (refer to Section 7.3.3.5).
- 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.

Hydrology

- Ensure 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

- 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.
- 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 7.35).

Table 7.35: 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
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

Monitoring Parameter	Tasks	Method of Assessment	
		General Monitoring	Detailed Monitoring
	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 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. 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 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 Higgins 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*, SNS 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,* SNS 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 Crown Land, however, most of the Assessment Area is on private land, and 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 NS *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)
- Significant Species and Habitat Database (NSNRR, 2018a)
- Old-Growth Policy Layer (Province of NS, 2022)
- Nova Scotia Parks and Protected Areas Map (NSECC, 2022d)

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 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 was reviewed to identify the land cover within the Study Area (Table 7.36; Drawing 7.16). Land cover within the Study Area is varied, including built infrastructure and forested area. 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 (81% 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 likely much lower.

Table 7.36: 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	37.70
Hardwood	32.11
Mixed Wood	26.70
Bog or Wetland	1.39
Harvests	1.39
Utility Corridor	0.39
Water	0.15
Urban, Landfill, Quarry, or Transport Corridor	0.15
Agriculture	0.013
Old Field	0.0025

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 3 km of the Project, and the closest protected stand is within the Wentworth Valley Wilderness 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 within the Assessment Area and intersecting with the location of proposed electricity collector lines. These areas were assessed visually during fall field surveys.

A review of the NSNRR Significant Species and Habitat Database (2018a) within 100 km of the Study Area identified 44 feature records:

- 38 records classified as ‘Other Habitat’ which relate to a brook (1), cave (1), cliffs (4), estuaries (15), islands (4), karst (4), lakes (6), a National Wildlife Area (1), and talus slopes (2).
- Two records classified as ‘Species at Risk’ which relate to caves.
- Four records classified as ‘Species of Concern’ which relate to a cave (1), an island (1), karst (1), and a valley (1).

Only two of these features (talus slopes), are located within the Study Area. These habitats were targeted during field surveys and do not overlap with the Assessment Area.

The Nova Scotia Parks and Protected Areas Map (NSECC, 2022d) was screened to identify any protected areas in/near the Study Area (Drawing 7.17), which include:

- Portapique River Wilderness Area
- Wentworth Valley Wilderness Area
- Wentworth Provincial Park

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

7.4.1.4 Field Assessment Methodology

Terrestrial habitats investigated through field studies included those associated with watercourses, wetlands, mature/old-growth forests, caves/mine shafts, and habitat types known to support rare plants, lichens, and important lifecycle functions/stages for moose, birds, and bats.

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 has resulted in extensive modification to the natural habitat conditions. Current habitat conditions included forests that have been subject to clearcutting, selective cutting of hardwood stands, reforestation using single species seedlings, and the occasional stand of naturally regenerating mixed wood forests. Many of the softwood tree stands encountered within the Study Area, particularly in the northern, Cumberland portion, are plantations. 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.

The native vegetation in and around the Assessment Area includes a variety of mixed wood stands, along with hardwood dominated slopes. Primary native tree species include sugar maple (*Acer saccharum*), red maple, red spruce, American beech (*Fagus grandifolia*), black spruce (*Picea mariana)*, and white birch (*Betula papyrifera*). Balsam fir and black spruce dominate the poorly drained slopes, while black spruce, yellow birch (*Betula alleghaniensis*), and red maple dominate the treed swamps and riparian zones around watercourses and wetlands. Understory species in the hardwood stands include hobble bush (*Viburnum lantanoides*) and mountain maple (*Acer spicatum*). Speckled alder (*Alnus incana*) is present in many of the areas of the site where higher levels of beaver activity have been observed, including under the L-8001 NS Power transmission lines running north-south through the Study Area. Through-flow wetlands dominated by alders are also present in many areas near the headwaters of the brooks and streams that flow in all directions from ridges and high points throughout the Assessment Area.

Hurricane Fiona, a category four hurricane that made landfall in Nova Scotia on September 24, 2022, caused significant disturbance to forested habitat at varying levels across the province. Within the Study Area, it was noted that most of the already sparse large softwood trees had fallen, particularly in wet and riparian area. Limited damage to hardwood trees was observed. No stand-level disturbance occurred as a result of the hurricane; however, loss of mature softwoods in hardwood-dominant stands may create openings in the canopy necessary for secondary succession to begin.

The province defines old-growth forest as “an area where 20% or more of the basal area is in trees greater than or equal to the reference age for that forest (ecosystem classification vegetation) type” (NSNRR, 2022b). As the Project occurs primarily on private land, the Old-Growth Forest Policy (NSNRR, 2022b) is not enforceable within most of the Assessment Area and associated old-growth scoring was not undertaken. However, to support best management practices, potential locations for old-growth forest were noted during field surveys. Late successional forests such as the Rocklands Brook Valley exhibited old-growth features characteristic of the Cobequid Valley Ecodistrict and the Project design avoided these areas. A segment of proposed transmission line crosses one high-ranking forest stand on Crown land, as identified through desktop review; however, signs of old-growth characteristics were not noted by field biologists during fall surveys.

Areas supporting flora and fauna SOCI, such as mature forests, wetlands, or talus slopes were surveyed to determine the capacity for these areas to support SOCI and whether any SOCI were present. No mature forests or talus slopes were identified through field studies within the Assessment Area (wetlands are addressed separately in Section 7.3.3). Since the Assessment Area makes use of pre-existing roads and vegetation areas subject to historic and ongoing forestry activities, the interaction between Project infrastructure components and undisturbed/mature stands of naturally occurring vegetation is minimal.

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 7.37). These activities could result in habitat removal or alteration.

Table 7.37: 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 habitat for flora SOCI was identified within the Assessment Area through the NSNRR Significant Species and Habitat Database (2018a) and field surveys; however, talus slopes, a priority habitat feature, are found in the Study Area. This habitat is not expected to be impacted due to its distance from the Project Area and proximity to pre-existing roads. No confirmed old-growth forest will be impacted by the Project. 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. In addition, a large amount of forested habitat exists within 25 m of a pre-existing road or otherwise cleared area. The Project Area will consist of 7.5 km of new roads and utilize 26.2 km of pre-existing roads. 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., karsts) 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 NS *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 (2022b)
- Boreal Felt Lichen Habitat Layer (NSNRR, 2012a)

ACCDC records (2022b) identified 449 flora species within 100 km of the Study Area (Appendix G). Of the 449 species, 281 are vascular plants and 168 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 7.38 (Drawings 7.18A-7.18C).

Table 7.38: ACCDC Plant and Lichen SAR/SOCI Identified within the Study Area

Common Name	Scientific Name	COSEWIC[1]	*SARA*[2]	NS *ESA*[3]	S-Rank[4]
Plants (Vascular)					
Large round-leaved orchid	*Platanthera macrophylla*	---	---	---	S2
Large purple fringed orchid	*Platanthera grandiflora*	---	---	---	S3
Loesel's twayblade	*Liparis loeselii*	---	---	---	S3S4
Small round-leaved orchid	*Platanthera orbiculata*	---	---	---	S3S4
Lichens (Non-vascular)					
Eastern waterfan	*Peltigera hydrothyria*	Threatened	Threatened	Threatened	S1
Valley oakmoss lichen	*Evernia prunastri*	---	---	---	S3S4

Source: ACCDC 2022b; [1]Government of Canada 2022; [2]Government of Canada 2022; [3]Government of NS, 2022; [4]ACCDC 2022a

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, 2012a). Boreal felt lichen – Atlantic population (*Erioderma pedicellatum*) is a rare species listed as “Endangered” under Schedule 1 of *SARA* and NS *ESA* and is also listed as “S1” by ACCDC. The Boreal Felt Lichen Layer identified no suitable habitat across the Assessment Area.

An additional desktop review was conducted using habitat mapping layers, and potential lichen habitat was assessed. Important habitats include mature hardwood stands, where a wide variety of lichen can be found, including blue felt lichen (*Pectenia plumbea)* (ECCC, 2022c). Watercourses are also prominent throughout the Assessment Area and are a known habitat for eastern waterfan (*Peltigera hydrothyria*).

7.4.2.4 Field Assessment Methodology

Plant and lichen surveys were completed across the Assessment Area on July 22, 23, and 24, 2020. Targeted transects were conducted by an expert botanist with extensive experience in Nova Scotia botany. The transects were spaced out through different habitats and positioned evenly throughout the Assessment Area to ensure survey coverage of all representative habitats was obtained. Habitat types surveyed included vernal pools, clear-cuts, river valleys, mature hardwood stands, regenerating softwood stands, and treed swamps. If important habitat types such as wetlands or fringe habitat were identified adjacent to transects, these areas were investigated (Drawing 7.19).

Field staff conducting wetland and watercourse surveys were briefed on a short list of plant SOCI prior to conducting surveys and used a plant guide to aid in incidental SOCI observations.

Concurrent with the plant surveys, lichen surveys were conducted by an expert lichenologist, as recognized by NSNRR. The presence of lichen species is dependent upon the vegetation in the area; therefore, vegetative cover was a criterion used to design lichen SOCI survey transects. Survey methods included predetermined transects in suitable vegetation habitats and investigating proposed road and turbine locations (the Assessment Area) that interacted with vegetation conditions known to support lichen SOCI.

7.4.2.5 Field Assessment Results

During the plant and lichen surveys, 183 flora species were identified, which included four plant SOCI and three lichen SOCI (Drawings 7.11A to 7.11O). A complete list of plant species identified during targeted surveys and incidental observations is provided in Appendix J. Additional species were added to this list were primarily spring ephemeral species observed in May 2021 during migratory bird surveys and wildlife surveys, as well as wetland plants observed in late summer 2022 during wetland surveys. All SOCI plants and lichens identified during field assessments are summarized in Table 7.39. A total of 21 non-native plants were also encountered during field surveys (Table 7.40). Because some of the Assessment Area was surveyed out of flowering season (October to December) due to a minor layout modification (see Section 7.3.3), additional plant and lichen SOCI surveys are recommended during flowering season before construction activities, including land clearing, are initiated.

Table 7.39: Flora SOCI Encountered during Flora Surveys

Common Name	Scientific Name	COSEWIC Status[1]	SARA Status[2]	NS *ESA* Status[3]	NS S-Rank[4]	Habitat
American beech	*Fagus grandifolia*	---	---	---	S3S4	Understory of hardwood and mixed-wood stands throughout the Assessment Area
Acadian jellyskin lichen	*Leptogium acadiense*	---	---	---	S3S4	Mature hardwood trees, stands with no recent harvesting
Blue felt lichen	*Pectenia plumbea*	Threatened	Special Concern	Special Concern	S3	Mature hardwood tree along edge of brook
Eastern waterfan	*Peltigera hydrothyria*	Threatened	Threatened	Threatened	S1	Rocks in shaded streams
Large purple fringed orchid	*Platanthera grandiflora*	---	---	---	S3	Wet meadows in areas of relatively high elevation
Tender sedge	*Carex tenera*	---	---	---	S3	Mature hardwood forest in close proximity to wetland habitat
Tuckerman's sedge	*Carex tuckermanii*	---	---	---	S3	Generally wet areas

[1]Government of Canada 2022; [2]Government of Canada, 2022; [3]Government of NS, 2022; [4]ACCDC 2022a

Table 7.40: Non-Native Flora Encountered during Flora Surveys

Common Name	Scientific Name	Exotic Status[1]	S-Rank[2]
Black knapweed	*Centaurea nigra*	Widespread	SNA
Coltsfoot	*Tussilago farfara*	Widespread	SNA
Common buttercup	*Ranunculus acris*	Widespread	SNA
Common eyebright	*Euphrasia nemorosa*	---	SNA
Common plantain	*Plantago major*	Widespread	SNA
Common speedwell	*Veronica officinalis*	Widespread	SNA
Common St John's-wort	*Hypericum perforatum*	Widespread	SNA
Common timothy	*Phleum pratense*	Widespread	SNA
Common yarrow	*Achillea millefolium*	Widespread	SNA
Deptford-pink	*Dianthus armeria*	Fairly Common	SNA
English cinquefoil	*Potentilla anglica*	Rare	SNA
English plantain	*Plantago lanceolata*	Fairly Common	SNA
Garden bird's-foot trefoil	*Lotus corniculatus*	Widespread	SNA
Helleborine orchid	*Epipactis helleborine*	Fairly Common	SNA
Marsh cudweed	*Gnaphalium uliginosum*	Widespread	SNA
Mouse-ear hawkweed	*Pilosella officinarum*	Fairly Common	SNA
Narrow-leaved spring beauty	*Claytonia virginica*	---	SNA
Oxeye daisy	*Leucanthemum vulgare*	Widespread	SNA
Purple joe pye weed	*Eutrochium purpureum*	---	SNA
Queen Anne's lace	*Daucus carota*	Widespread	SNA
Tufted vetch	*Vicia cracca*	Widespread	SNA
White sweet- clover	*Melilotus albus*	Widespread	SNA

[1]NSECC 2012; [2]ACCDC 2022a

Four plant SOCI were observed during field surveys (Table 7.38, Drawings 7.11A-7.11O). American beech was observed throughout the Assessment Area; however, since this species was not listed as a SOCI by ACCDC until March 2022, observed locations were not documented during 2021 surveys.

Tender sedge (*Carex tenera*) was found in one location near the west boundary of the Study Area, in a mature hardwood forest with a largely open forest floor.

Tuckerman's sedge (*Carex tuckermanii*) was found in two locations throughout the Assessment Area, and in both instances, it was found near wet areas.

The large purple fringed orchid (*Platanthera grandiflora*) was commonly encountered during wetland and watercourse surveys, which is consistent with its known preference for high elevation wet meadow habitats.

Three lichen SOCI were observed during field surveys (Table 7.39, Drawings 7.11A-7.11O). Many common species of lichen were observed throughout the Study Area but were not recorded due to their abundance.

The eastern waterfan was one of the most commonly recorded lichen SOCI, as it was recorded at 10 sites throughout the Study Area. Eastern waterfan grows on rocks in streams that are partially-to-well shaded, with high moisture requirements and partial or full submersion for the majority of the year, aside from winter (if/when frozen) and peak summer (when water levels are too low). This lichen is listed in the At-Risk Lichens–Special Management Practices (NSNRR, 2018b) as a ‘Very rare, and highly sensitive lichen’, and is granted a ‘Protected zone’ buffer. This buffer restricts forest harvest, new construction, and road upgrades within 200 m of the lichen.

Other observed lichen SOCI include the Acadian jellyskin lichen (*Leptogium acadiense*) and blue felt lichen (*Pectenia plumbea*), both found on mature hardwood trees. The Acadia jelly skin lichen was also found at 10 sites throughout the Study Area, with the majority of the observations in dense hardwood stands with no recent selective harvesting of timber. The single site where blue felt lichen was observed is in the southeastern part of the Study Area, along the edge of a brook that flows downstream into the Folly River, over 250 m from the Study Area. Blue felt 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 results of flora studies have been incorporated into the design phase of the Project. 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 7.41). 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 7.41: 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 plant 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 7.5 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 that may host rare flora. For example, eastern waterfan requires partially-to-well shaded areas with high moisture levels and partial or full submersion for the majority of the year. Numerous samples of this species were identified by targeting this habitat during surveys. The Project design has avoided habitat that is known to support plant and lichen SOCI within the Study Area to the extent possible, and the design has also incorporated relevant buffers for known locations of individual species. 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
- Complete in-season rare plant and lichen surveys for areas subject to minor layout modifications (further discussed in Section 7.3.3).
- 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 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.

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, 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 will be necessary.

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 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*
- NS *ESA*
- *Canada Wildlife Act*
- *Wildlife Act,* RSNS. 1989, c. 504

- NS *Biodiversity Act*
- *Canadian Environmental Protection Act (CEPA)*
- *Environment Act,* SNS 1994-95, c. 1

The NS *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,* RSNS. 1989, c. 504 provides policies and programs for wildlife to maintain diversity of species at levels of abundance to meet specific management objectives. The Nova Scotia *Wildlife Act,* RSNS. 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 Nova Scotia *Environment Act,* SNS 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 (2022b) for mammal, herpetofauna, butterfly, and Odonates species recorded within a 100 km radius of the Study Area. 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 34 unique species and/or habitat records pertaining to terrestrial mammals within a 100 km radius of the Study Area. These records include:

- 30 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 the Long-tailed shrew (*Sorex dispar*).
- One record of “Species at Risk” relating to Southern flying squirrel.
- One record of “Other Habitat” relating to an American black bear (*Ursus americanus*).

There is one deer wintering area found within the Study Area, south of the Project Area. The next closest record is of one Long-tailed shrew, captured 3.9 km from the Study Area in 1996 under rocks and talus. This record occurs across the Portapique River Wilderness Area, extending into an adjacent area proposed as an addition to this Wilderness Area.

The ACCDC Data Report (2022b) 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 7.42). None of the identified SOCI have records within the Study Area.

Table 7.42: Mammal Species Recorded within a 100 km Radius of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
American water shrew	*Sorex palustris*	---	---	---	S3S4
Canada lynx	*Lynx canadensis*	Not at Risk	---	Endangered	S2S3
Fisher	*Martes pennanti*	---	---	---	S3
Long-tailed shrew	*Sorex dispar*	Not at Risk	---	---	S2
Maritime shrew	*Sorex maritimensis*	---	---	---	S3
Mainland moose*	*Alces alces americanus*	---	---	Endangered	S1
Southern bog lemming	*Synaptomys cooperi*	---	---	---	S3
Southern flying squirrel	*Glaucomys volans*	Not at Risk	---	---	S2S3

Source: ACCDC 2022b; [1]Government of Canada 2022; [2]Government of Canada 2022; [3]Government of NS 2022; [4]ACCDC 2022a
*Reported by ACCDC as 'Moose – *Alces americanus*', 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 26-74% 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 7.43), in 5 ha hexagons spanning the RAA (as defined in Section 7.4.3.6).

Table 7.43: Moose Habitat Suitability Model Weighting Scheme

Score	Distance between wetland and mixed wood 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 center of the Study Area, between the two main roads and parallel with Folly Lake, features a large patch of habitat deemed unsuitable. 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. Because Mainland moose are a “location-sensitive” species, the results of this model have not been provided within this EA but will be submitted under separate cover to the appropriate regulators. The exact location for records of species deemed “location-sensitive” are not provided by species databases such as ACCDC, as mandated by NSNRR to reduce the risk of exploitation of these species (ACCDC, 2022c

Herpetofauna

The Nova Scotia Significant Species and Habitat Database (NSNNR, 2018a) contains 92 unique species and/or habitat records pertaining to reptiles and amphibians within a 100 km radius of the

Study Area. These records include:

- 90 records of "Species at Risk" relating to Wood turtle (*Glyptemys insculpta*) (88) and Snapping turtle (*Chelydra serpentine*) (two).
- Two records of "Species of Concern" relating to Painted turtle (*Chrysemys picta*).

Of the 88 Wood turtle records with 100 km of the Study Area, 10 occur within the Study Area, all within the Wallace River. Extensive searches were done across the Study Area, with focus on the Project Area, to identify signs of Wood turtle (Section 7.4.3.4 – Herpetofauna). The other two turtle species (Snapping turtle and Painted turtle) were recorded over 20 km from the Study Area and were not considered further.

Data from the ACCDC (2022b) report indicate that four herpetofauna SOCI have been recorded within a 100 km radius of the Study Area (Table 7.44).

Table 7.44: Herpetofauna Species Recorded by ACCDC within a 100 km Radius of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Eastern painted turtle	*Chrysemys picta picta*	Special Concern	Special Concern	---	S4
Four-toed salamander	*Hemidactylium scutatum*	Not at Risk	---	---	S3
Snapping surtle	*Chelydra serpentina*	Special Concern	Special Concern	Vulnerable	S3
Wood turtle	*Glyptemys insculpta*	Threatened	Threatened	Threatened	S2

Source: ACCDC 2022b; [1]Government of Canada 2022; [2]Government of Canada 2022; [3]Government of NS 2022; [4]ACCDC 2022a

The Wood turtle, a location-sensitive species, is known to occur within the Study Area according to ACCDC records (2022b). It is likely that the ACCDC records overlap with those in the NSNRR Significant Species and Habitats database (2018a).

Butterflies and Odonates

The NSNRR Significant Species and Habitats (2018a) database identifies 10 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*).
- One record classified as "Other Habitat" related to Hoary elfin (*Callophrys polios*).

The database contains no records of butterflies or Odonates within a 40 km radius of the Study Area.

The ACCDC report (2022b) contains records of 51 unique butterfly and Odonate SOCI within a 100 km radius of the Study Area (Table 7.45). Only one, the Pepper and salt skipper (*Amblyscirtes hegon*), has been recorded within the Study Area.

Table 7.45: Unique Butterfly and Odonate Species Recorded within a 100 km Radius of the Study Area

Common Name	*Scientific Name*	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Acadian hairstreak	*Satyrium acadica*	---	---	---	S2
Aphrodite fritillary	*Speyeria aphrodite*	---	---	---	S3S4
Arctic fritillary	*Boloria chariclea*	---	---	---	S1S2
Baltimore checkerspot	*Euphydryas phaeton*	---	---	---	S2S3
Banded hairstreak	*Satyrium calanus*	---	---	---	S3
Black meadowhawk	*Sympetrum danae*	---	---	---	S3S4
Blue dasher	*Pachydiplax longipennis*	---	---	---	S1
Bog elfin	*Callophrys lanoraieensis*	---	---	---	S3
Broadtailed shadowdragon	*Neurocordulia michaeli*	---	---	---	S2
Brook snaketail	*Ophiogomphus aspersus*	---	---	---	S3
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*	---	---	---	S3
Greenish blue	*Icaricia saepiolus*	---	---	---	SH
Harlequin darner	*Gomphaeschna furcillata*	---	---	---	S3S4
Harpoon clubtail	*Gomphus 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	S2B, S3M

Common Name	*Scientific Name*	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Monarch	*Danaus plexippus plexippus*	Endangered	Special Concern	Not Listed	S2B, S3M
Mottled darner	*Aeshna clepsydra*	---	---	---	S3S4
Northern cloudywing	*Thorybes 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?
Skillet clubtail	*Gomphus ventricosus*	Endangered	Endangered	---	SH
Southern pygmy clubtail	*Lanthus vernalis*	---	---	---	S2S3
Spot-winged glider	*Pantala hymenaea*	---	---	---	S2?B
Taiga bluet	*Coenagrion resolutum*	---	---	---	S2
Two-spotted skipper	*Euphyes bimacula*	---	---	---	S1S2
Vernal bluet	*Enallagma vernale*	---	---	---	S3
Williamson's emerald	*Somatochlora williamsoni*	---	---	---	S2S3
Zebra clubtail	*Enallagma vesperum*	---	---	---	S2S3

Source: ACCDC 2022b; [1]Government of Canada 2022; [2] Government of Canada 2022; [3]Government of NS 2022; [4]ACCDC 2022a

7.4.3.4 Field Assessment Methodology

Mammals

Winter tracking and pellet surveys were conducted to assess the presence and distribution of mammals across the Study Area, and trail cameras were also placed across the Study Area to capture the presence of wildlife without any interference from human disturbance (Drawing 7.19 and Drawing 7.20). The goal of the surveys was to cover all 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).

Methods were adapted from those recommended by the Wildlife Division of NSNRR (2012b). Updated procedural recommendations were provided by the department in 2022 after wildlife tracking was completed for this Project, however, the methods used for wildlife tracking remain in alignment with the most up-to-date guidance. Winter wildlife tracking surveys were completed January 25-29, March 8, and March 16-17 of 2021. Survey dates were all within seven days of the most recent snowfall of 10 cm or more, and when possible, within two to three days of the most recent snowfall. 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. Pellet surveys were completed on April 13, 15, 16, and May 3 of 2021 after the snow had melted completely, revealing animal droppings that had been preserved in the snow over the winter.

Surveys were conducted with the intention to cover a range of representative habitat types within the Study Area, with priority given to habitat where Mainland moose were expected to be active, or where animal sign had been observed previously. Transects were established after completing the first round of tracking (January 25-29) and were revisited in March for round two of tracking. Transect lengths and locations were slightly altered between winter tracking and pellet surveys to account for information gained during winter tracking and ensure as many habitat types as possible could be covered across surveys. Winter tracking transects ranged in length from 0.64 km to 4.31 km with a total of 22.93 km travelled in round one and 17.58 km travelled in round two. Transects walked during pellet surveys ranged from 0.67 km to 3.61 km in length, with over 14 km travelled across all pellet survey transects. Sections of trail and road were also surveyed opportunistically and any incidental observations were recorded. All survey tracks were recorded using GPS devices, and any changes to transects were made such that the new course was similar in length to the planned transect and covered similar or improved habitat types.

Transects were travelled either by all-terrain vehicles (ATVs) (along roads/trails) or by foot. While slowly travelling along a transect, a 4 m area centred on the transect line was scanned for any sign of animal activity, including tracks, pellets/scat, browse, dens, or animal sightings. When suspected Mainland moose activity was observed, detailed notes and photos were recorded. If activity from other, non-SOCI animals was observed, the observation was also recorded. All observations were recorded and georeferenced in the field using GPS waypoints and field notes. Additional notes relating to habitat, weather, and animal activity were recorded in a wildlife tracking spreadsheet. If incidental observations of mammalian activity were made during other survey types, these observations were also recorded.

Concurrently, and in addition to wildlife surveys, trail cameras were deployed at various locations across the Study Area from July 2020 to November 2021. Locations were selected to include various habitat types, and to capture more information from locations previously found to have signs of wildlife (Drawing 7.20). Trail cameras were targeted to areas that provide natural corridors for wildlife movement throughout the landscape. Many large mammals commonly use old roads, trails, or natural corridors such as riparian zones to travel throughout a landscape, and thus cameras were placed in these areas to capture their movements. Riparian areas are often preferred by these mammals as this habitat represents some of the only remaining intact forest within the Assessment Area. Trail cameras were visited regularly to replace storage cards and batteries, and occasionally the trail camera itself was removed from one location and relocated to increase site coverage. All photos/videos were then assessed for signs of wildlife.

Herpetofauna

Targeted Wood turtle surveys were conducted on June 24 and 25, 2021. A desktop review of the Study Area was undertaken before conducting field surveys to identify areas of preferred turtle habitat. All standing open water across the Assessment Area, including in wetlands, ponds, and lakes was surveyed. Additional habitat targeted included clear, meandering watercourses with a moderate flow; sandy or sand-gravel areas; and artificial nesting sites which may include gravel pits, road shoulders, and residential sites (Flanagan et al., 2013; McLean, 2018). Also considered was the habitat surrounding watercourses, which may be riparian or forested areas, or open areas such as flood plains, meadows, agricultural fields, river oxbows, and beaver ponds (McLean, 2018).

In addition to desktop data, previously collected wetland and watercourse survey information was used to support selecting Wood turtle survey locations. Areas 200 m upstream and downstream of any proposed upgraded infrastructure on watercourses were prioritized during surveys to best understand the impacts of this development on turtle activity.

Transect lines were walked at a width of 10 m along both sides of a watercourse and surveyed simultaneously by two field biologists. The transect line served as a center point, and surveyors scanned 10 m on either side for a total search area of 20 m on both sides of the watercourse. Search efforts focused 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 were searched with greater intensity as they may be more inconspicuous. Basking platforms were created from tar shingles and deployed along watercourses and open-water wetlands from June 24 to 30, 2021 to promote turtle basking. These basking platforms were visited regularly to observe any turtles using the created habitat.

Surveys occurred in early summer with an ambient air temperature 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 were recorded and georeferenced in the field using a GPS and field notes. Any additional incidental observations of herpetofauna made during wetland or watercourse surveys, as well as observations of suitable turtle habitat, were also recorded.

Butterfly and Odonates
Targeted surveys for butterfly and Odonates species were not conducted; however, any incidental observations of butterfly and Odonates SOCI during other field surveys were documented.

7.4.3.5 Field Assessment Results

Mammals
A total of 11 species were identified during field assessments (including incidental observations) conducted within the Study Area (Table 7.46). Of these species, six were captured by trail cameras (Table 7.47; Drawing 7.11A to 7.11O (photo log provided in Appendix K).

Table 7.46: Summary Results of the Mammal Field Assessments

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
American black bear	*Ursus americanus*	Not at Risk	---	---	S5
American porcupine	*Erethizon dorsatum*	---	---	---	S5
Bobcat	*Lynx rufus*	---	---	---	S5

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Eastern coyote	*Canis latrans*	---	---	---	S5
Fisher	*Pekania pennanti*	---	---	---	S3
Mainland moose	*Alces alces americana*	---	---	Endangered	S1
Raccoon	*Procyon lotor*	---	---	---	S5
Red fox	*Vulpes vulpes*	---	---	---	S5
Red squirrel	*Tamiasciurus hudsonicus*	---	---	---	S5
Snowshoe hare	*Lepus americanus*	---	---	---	S5
White-tailed deer	*Odocoileus virginianus*	---	---	---	S5

[1]Government of Canada 2022; [2]Government of Canada 2022; [3]Government of NS 2022; [4]ACCDC 2022a

Table 7.47: Summary of Trail Camera Results

Trail Camera Location	Dates Employed	Animals Observed	Number of Observations*
West Side Dead End	July 29, 2020 to October 28, 2020	White-tailed deer	37
		Eastern coyote	1
Northeast Dicks Meadows	August 9, 2020	---	---
Central Dicks Meadows, Road Forks	July 30, 2020 to October 28, 2020	American black bear	1
Central Dicks Meadows, in Wetland	December 16, 2020 to January 26, 2021	---	---
Central Dicks Meadows, Off Road	August 11, 2021 to September 8, 2021	White-tailed deer	3
		Eastern coyote	1
		Bobcat	1
Downhill from Carcass	February 11, 2021 to March 8, 20201	---	---
Moose Carcass	January 29, 2021 to July 5 2021	White-tailed deer	17
		American black bear	4
		Raccoon	1
Salt Lick in Dicks Meadows	March 18, 2021 to June 1, 2021	White-tailed deer	10
		American black bear	3
	March 17, 2021 to June 30, 2021	American black bear	1
		Mainland moose	3
Dicks Meadows Game Trail	June 1, 2021 to June 30, 2021	White-tailed deer	5
Dicks Meadows Southern Outflow	June 1, 2021 to June 19, 2021; August 11, 2021 to November 12, 2021	White-tailed deer	3

Trail Camera Location	Dates Employed	Animals Observed	Number of Observations*
	June 1, 2021 to June 26, 2021	White-tailed deer	2
		Mainland moose	1
	June 2, 2021 to June 30, 2021	White-tailed deer	13
		Mainland moose	1
Wetland, Dicks Meadows Rd.	June 1, 2021 to June 10, 2021	---	---
Wetland, Centre of Site	June 24, 2021 to June 30, 2021	White-tailed deer	2
West Side Bridge	August 11, 2021 to November 12, 2021	White-tailed deer	1
		American black bear	4
		Eastern coyote	12
		Bobcat	7
		Raccoon	1
Mature Hardwoods	August 11, 2021 to November 12, 2021	White-tailed deer	5
	August 12, 2021 to November 12, 2021	White-tailed deer	7
		Mainland moose	3
		Eastern coyote	1
Carter Lake Inflow	August 11, 2021 to November 12, 2021	White-tailed deer	5

*Number of observations adjusted based on likelihood of photos belonging to the same animal; a general rule of one hour between photos was applied to consider photos of the same species to be separate observations.

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 a list of priority species. These priority species include:

- Mainland moose (*Alces alces americanus*) – Endangered (NS *ESA),* S1 (S-Rank)
- Fisher (*Pekania pennanti*) – S3 (S-Rank)

Mainland moose are a SOCI listed as “Endangered” under the NS *ESA* with a subnational ranking of S1 (highest priority) (ACCDC, 2022a). 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 in the Study Area during targeted pellet surveys conducted in April and May 2021, as well as incidentally during several other field programs and on trail cameras. The majority of the signs of Mainland moose were incidental observations made during watercourse and wetland delineation surveys in the summer of 2020 and fall of 2022, along with the frequent site visits from the fall of 2020 through the fall of 2021 for maintenance of field equipment. The signs observed included lays, tracks, pellets, and browsing of shrubs and trees at heights not likely to have been reached by deer. Notably, no moose observations were made during the winter snow tracking surveys conducted in January and March 2021. As Mainland moose are a location-sensitive species, the location and type of observations made are not provided in this EA but will be provided to NSNRR under separate cover.

Five instances of Mainland moose sightings were recorded during field surveys, three occurring in July and August 2020. A mature bull and a mature cow were both observed near wetlands in close proximity to one another. A bull carcass was discovered in a wetland elsewhere within the Study Area, having died of what appeared to be natural causes. The other direct observations occurred during field surveys in summer 2021. Two bulls were encountered in June and August 2021, though they are not thought to be the same animal given varying body and antler sizes at each relative observation. Further to these sightings during field studies, anecdotal reports from trail users in the winter months indicated that private trail cameras have also recorded Mainland moose in the immediate area, as well as a report of a “young moose” being seen in fall 2020 within the boundaries of the Study Area. Hunters encountered on the site also reported finding shed moose antlers during the 2020 and 2021 deer hunting seasons.

Eight Mainland moose were photographed with the trail cameras within the Study Area, including having bulls and cows in the same areas at different times, as well as different bulls in the same location at different times. Upon returning for field surveys in fall 2022, additional Mainland moose evidence was observed in areas that had not previously been surveyed, including browse, scat, and tracks. Many of the moose observations recorded between 2020 and 2022 were in Dicks Meadows wetland complex, an area east of the Assessment Area.

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. Mid-aged forest stands in the Assessment Area’s interior may provide escape cover and relief from deep snows and hot summer temperatures, especially along south facing slopes, while regenerating cutovers provides suitable forage. Through winter wildlife tracking surveys conducted in January and March 2021, there was no sign of Mainland moose presence within the Assessment Area in comparison to incidental observations during the summer and fall months. This may indicate that moose do not use the Study Area during the winter, possibly owing to the deep snow cover that accumulates during winter at this high elevation terrain.

The nature of the Study Area being at relatively high altitude and featuring abundant mixed wood forest and wetland habitat makes the majority of the Study Area ideal habitat for Mainland moose. The cooler summer temperatures in this area are also better suited to Mainland moose, and an observed lack of White-tailed deer and ticks limit the risk of disease spreading to moose using the

Study Area. The deep snow in winter seems to drive the Mainland moose off the mountain; however, evidence of their return was clear in April 2021 and October 2022.

The Fisher 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 327 Fishers have been harvested from Cumberland County since 2010, representing 20.89% of the provincial total during that time (NSNRR, 2021h). Several indications of Fishers were observed during field surveys, including tracks in the snow during the winter and suspected scat in the summer near Rockland Brook. Mid-aged mixed wood stands in the interior of the Study Area may provide suitable canopy closure and coarse woody debris of sufficient diameter for Fishers, especially in those areas where the slopes are too steep for forestry activities to take place.

Herpetofauna

Table 7.48 lists the herpetofauna species identified in the Study Area during the 2020 and 2021 field studies.

Table 7.48: Summary of the Herpetofauna Field Assessments

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Green frog	*Lithobates clamitans*	---	---	---	S5
Spring peeper	*Pseudacris crucifer*	---	---	---	S5
Leopard frog	*Lithobates pipiens*	---	---	---	S5
Wood frog	*Lithobates sylvaticus*	---	---	---	S5
Maritime garter snake	*Thamnophis sirtalis*	---	---	---	S5

[1]Government of Canada 2022; [2]Government of Canada 2022; [3]Government of NS 2022; [4]ACCDC 2022a

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*), “Threatened” (NS *ESA*), “Threatened” (COSEWIC), “Sensitive” (NSNNR), “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 Assessment Area was 3.3 ± 1.0 km.

The Wallace River, located north of the Assessment Area, likely provides that best habitat for Wood turtles. However, the elevation and slope of the Assessment Area renders it to be poor turtle habitat with limited connectivity. Small areas containing potentially suitable habitat were observed along watercourses or at washed-out roadsides during 2020/2021 field studies, but no indication of Wood turtle was observed. It is possible that dispersing Wood turtles may travel from nearby known habitats through the Study Area in search of territories in surrounding lands, but due to a lack of signs or sightings in the Assessment Area, the likelihood that this species breeds or nests in the Assessment Area is low.

Butterflies and Odonates
There were no incidental observances of butterfly and Odonates SOCI during the field assessments within the Study Area. Based on the results of the field and desktop assessments, the following species was identified as priority species and is discussed in further detail below:

- Pepper and Salt Skipper – “S3S4” (S-Rank)

This grass skipper can be found from central to southeastern Canada, and generally prefers wooded areas, forest edge habitat, and occasionally roadside puddles. Larvae feed on a variety of grasses, and adults on the nectar of plants such as viburnum, blackberry, honeysuckle, and lilac. Adult flight occurs from April to July (McLeod & Nanz, 2017). This species is considered secure in most of its range; however, it may be rare at the periphery of its range (Nature Serve Explorer, 2022). ACCDC data indicate that the closest observation of this species to the Project was 3.5 ± 0.0 km (2022b).

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 7.49). 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 7.49: 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

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 7.19).

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 ~5,300 km^2 of Core Habitat to meet recovery objectives. This area overlaps with the Study Area and is ~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. As Mainland moose are considered a ‘location-sensitive’ species, the specific results of this analysis will be provided directly to NSNRR for review. Of the 4,403 ha of habitat determined to be suitable for Mainland moose within the RAA, only 184 ha lie within the Assessment Area (3.4%). Furthermore, approximately 26.2 km of existing roads have been incorporated into the Project design. Only 7.5 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 85.1% 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 66.29, while the average score within the LAA is 64.55. The Project Area will therefore be located in areas of statistically average quality for moose habitat, as the Project design has maximized the use of pre-existing roads, thereby avoiding areas of particularly high-quality habitat. Of note, the Dicks Meadows wetland complex was determined to be particularly high-quality habitat able to support the local Mainland moose population, and this area was avoided completely to minimize impacts to Mainland moose using this habitat. Additionally, 12 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 only 7.5 km of new roads needing to be constructed (while the remaining 26.2 km of roadways will utilize existing road). The length of roads will increase slightly in the Project Area (from 26.2 km to 33.7 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 200 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 all pre-existing roads. During field surveys, Mainland moose were observed on the eastern, western, and southern sides of the pre-existing main roadways, as well as between them. 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 both age and sex diversity have been noted within the Study Area. 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 age and sex diversity, and male and female connectivity still exists across 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.

The steep elevation gradients and high levels of snowfall across the Study Area are currently keeping deer presence to a minimum. 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 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. Evidence of fisher activity was found in these habitat types within the Study Area. Deep snow atop the slopes may, however, be excluding fishers from using the extent of the Study Area. The preferred valley-slope habitat found at the interior of the Study Area will be largely unaffected by the Project, with the majority of infrastructure flanking this region to utilize pre-existing roads. Transmission lines will cross these interior areas; however, the relatively small areas of vegetation removal required to install transmission lines is unlikely to result in habitat loss for Fishers. Furthermore, of the approximately 100 ha of hardwood forest that may be impacted by the Project, a large percentage of this area is within 25 m of pre-existing roads and is unlikely to be providing habitat to Fishers.

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 (10-20 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 mainly use pre-existing roads, and infrastructure to be constructed in intact habitats will be smaller than 5 km in length, 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 within the LAA. Both small and large terrestrial mammals are known to use the roadways within the Study Area, as evidenced by trail camera footage and 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 NS Power technicians to access pre-existing transmission lines; 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 7.5 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 and trail camera photos 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, 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. With 7.5 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 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, the majority of aquatic habitats currently supporting herpetofauna are downslope of the Assessment Area and no herpetofauna SOCI were observed within the Study Area during field surveys. It is believed that the steep hills present within the Study Area will continue to exclude herpetofauna, particularly turtles, from the nearest Project-related infrastructure. 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.

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.
- 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.
- Augment connectivity by creating semi-artificial pathways such as wildlife corridors, greenbelts, and 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 in consultation with NSECC, NSNRR, the Mi'kmaq of Nova Scotia (including the First Nations development partner, Sipekne'katik First Nation), and all other relevant parties. The management plan will inform monitoring activities that will take place to ensure continued protection of known SOCI in the LAA and RAA.

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 animals 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. 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 six species of bats in Nova Scotia, of which three are resident species that reside in the province year-round and three migratory species that overwinter in the southern United States. Resident species include the Little brown myotis (*Myotis lucif*ugus), Northern myotis (*Myotis septentrionalis*), and Tri-colored bat (*Perimyotis subflavus*). Migratory species include the Eastern red bat (*Lasiurus borealis*), Hoary bat (*Lasiurus cinereus*), and Silver-haired bat (*Lasionycteris noctivagans*).

All three resident species are protected at both the federal and provincial level under *SARA* and the NS *ESA*. The Little brown myotis, Northern myotis, and Tri-colored bat were added to the NS *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).

All three migratory bat species are currently undergoing a status assessment by COSEWIC, which is scheduled to be released in April 2023 (COSEWIC, 2022).

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, 2022b)

Terrestrial Habitat Mapping
Terrestrial habitat mapping from Section 7.4.1 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 (ECCC, 2015a; NSNRR, 2020). As a result, information on potential maternity roosts near the Project was supplemented through field studies.

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 18 known hibernacula within a 100 km radius of the Study Area (Table 7.50).

Table 7.50: Known Bat Hibernacula within 100 km of the Study Area

Hibernaculum	Approximate Distance to Study Area (km)*	Direction
	7	
	34	
	34	
	40	
	47	
	52	
	56	
	60	
	61	
	62	
	62	
	62	
	63	

Hibernaculum	Approximate Distance to Study Area (km)*	Direction
	68	
	73	
	73	
	78	
	96	

*Distance measured to the centre point of the Study Area.
Source: Moseley (2007)

As per the recommended buffer of 25 km, provided in the Guide to Preparing an EA Registration Document for Wind Power Projects in Nova Scotia (NSECC, 2021), only one hibernaculum, known as the is located within 25 km of the Study Area (Drawing 7.21). The 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).

The next closest hibernaculum is located approximately 33 km to the south in . 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 no recorded abandoned mine openings located in the Study Area; however, there are several mine openings documented immediately south of the Study Area (Drawing 7.21) (NSNRR, 2021a).

Significant Species and Habitat Records
The NSNRR Significant Species and Habitats database (2018a) indicates 19 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 (13), Northern myotis (one), or bat hibernacula (five). One of these records is within 10 km of the Study Area, relating to the Little brown myotis (Drawing 7.21).

ACCDC Records
A search of the ACCDC Data Report (2022b) indicated four bat species of concern recorded within 100 km of the Study Area (Table 7.51).

Table 7.51: Bat Species Recorded within a 100 km Radius of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Little brown myotis	*Myotis lucifugus*	Endangered	Endangered	Endangered	S1
Northern myotis	*Myotis septentrionalis*	Endangered	Endangered	Endangered	S1
Tri-colored bat (Eastern pipistrelle)	*Perimyotis subflavus*	Endangered	Endangered	Endangered	S1
Bat species	*Vespertilionidae sp.*	Not Listed	Not Listed	Not Listed	S1S2

Source: ACCDC 2022b.
[1]Government of Canada 2022; [2]Government of Canada 2022; [3]Government of NS 2022; [4]ACCDC 2022a

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, congregating in tight spaces to roost at night (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 8.7 ± 0.0 km from the centre of the Study Area (ACCDC, 2022b).

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 8.7 ± 0.0 km from the centre of the Study Area (ACCDC, 2022b).

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 32.5 ± 1.0 km from the centre of the Study Area (ACCDC, 2022b).

7.4.4.4 Field Assessment Methodology

Field surveys and monitoring conducted within the Study Area include the following:

- Passive Bat Assessment (2020-2021)
    - Fall Acoustic Survey (2020)
    - Spring Acoustic Survey (2021)
- Active Bat Assessment (2021)
    - Bat Search (2021)
    - Active Acoustic Monitoring (2021)
    - Bat Habitat Survey (2021)

Passive Bat Assessment

Passive acoustic monitoring was conducted at the Study Area across various representative habitats such as clear cuts, riparian river valleys, forest edges, and nearby hibernacula (Drawing 7.21). 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 the bat species present in Nova Scotia. The passive acoustic bat monitoring program was conducted using Anabat SD2 Detectors from Titley Electronics. The detectors were programmed to monitor between 6:00 pm and 7:00 am to correspond with peak bat activity between sunset and sunrise. Photos, GPS points, and supplementary information (i.e., habitat descriptions) of each monitor location and set up were recorded.

During consultation with NSNRR, it was determined that Strum would monitor a nearby hibernaculum ( ) as a data sharing exercise with the province. A NSNRR biologist directed field staff to the hibernacula location where an acoustic monitor was placed for the duration of the fall (2020) and spring (2021) acoustic surveys.

Acoustic monitoring data (i.e., sonograms) was processed using Analook Software from Titley Electronics, complementary to the Anabat SD2 Detectors. Sonograms were manually processed for potential bat generated ultrasonic vocalizations and speciated where possible. Identification codes for Nova Scotia bat species are listed below:

- MYOT Myotis (Little brown myotis and Northern myotis)
- PESU Tri-colored bat
- LACI Hoary bat
- LABO Eastern red bat
- LANO Silver-haired bat
- UNKW Unknown

Due to their similarity, calls of Nova Scotia's two resident Myotis species (Little brown myotis and Northern myotis) can be difficult to reliably distinguish from one another (O'Farrell et al., 1999), so these calls are typically not identified to species. Bat generated calls were identified as Unknown (UNKW) if the recording was within the correct frequency range for bats (20-40 kHz for low frequency bats and 40-120 kHz for high frequency bats) but was unable to be speciated based on the quality or length of the recording.

Fall Acoustic Survey

A fall acoustic survey was carried out between August 18 and November 24, 2020 using four Anabat SD2 Detectors; see Table 7.52 for monitoring 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 (i.e., edges and wetlands).

Detector 001 was deployed off-site at the entrance of a nearby hibernaculum ( ) as part of the data sharing exercise with NSNRR. Detector 002 was deployed along a hardwood dominated forested edge. Detector 003 was initially set up within the riparian zone of a watercourse known as Rocklands Brook, and later moved to the Project's Radar Trailer for ease of access. Detector 004 was deployed next to a large wetland complex located in the eastern section of the Study Area known as Dicks Meadows (Drawing 7.21). The acoustic detectors were programmed to monitor between 6:00 pm and 7:00 am, corresponding to durations of peak bat activity seen a few hours after sunset and just prior to sunrise.

Table 7.52: Fall Monitoring Periods at Bat Detector Locations

Detector Location	Monitoring Duration	# Of Consecutive Days	# Of Recordings
Detector 001:	August 18 to November 24, 2020	99	4,897
Detector 002: Forested Edge	August 18 to October 27, 2020	71	890
Detector 003: Rocklands Brook	August 18 to September 23, 2020	35	3,086
Detector 003: Radar Trailer*	September 23 to November 4, 2020	43	3,634
Detector 004: Dicks Meadows	August 18 to October 27, 2020	71	78

*On September 23, 2020 Detector 3 was relocated from Rocklands Brook to the location of the radar trailer for ease of access.

Spring Acoustic Survey

The spring acoustic survey was conducted for 57 consecutive nights between May 18 and July 13, 2021 using five Anabat detectors deployed across the Study Area in the same general areas as the fall acoustic survey (Table 7.53 and Drawing 7.21).

Table 7.53: Spring Monitoring Periods at Bat Detector Locations

Detector Location	Monitoring Duration	# Of Consecutive Days	# Of Recordings
001 Dicks Meadows	May 18 to June 30, 2021	44	66
002 Hardwood Edge	May 18 to June 30, 2021	44	3,474
003 *	May 18 to June 30, 2021	44	24,368
004 Radar Site**	May 18 to July 13, 2021	57	1,844
005 Rocklands Brook	May 18 to June 30, 2021	44	4,034

*A large number of files were recorded because the detector was accidently programed to monitor audio continuously.
**A bear was encountered while initially trying to retrieve the detector and thus it was left in place until the next field visit.

Active Bat Assessment

Bat Search

As part of the data sharing exercise with the NSNRR (i.e., passive acoustic monitoring at nearby hibernacula) an active bat search was completed at the in November 2020. An observer was positioned outside the hibernacula entrance for 1 hour between 4:45 pm to 5:45 pm ADT corresponding with peak bat activity approximately 30 minutes after sunset, which was at 4:38 pm ADT. All bat activity or potential evidence of bats (i.e., sighting, noise, heat, etc.) was recorded.

Active Acoustic Monitoring

Active acoustic monitoring was conducted in June 2021 at various locations across the Study Area including Tower Road, Higgins Mountain Road, and Dicks Meadow (Drawing 7.21). An Echo Meter Touch II Pro by Wildlife Acoustics was used to survey point and transect locations between the hours of 8:45 pm and 11:45 pm ADT on a clear low wind night, corresponding with peak bat activity seen a few hours after dusk/sunset on nights with favorable weather conditions (seasonal temperatures, low wind, and no precipitation). The Echo Meter Touch II Pro and corresponding app is a portable acoustic monitor that plugs directly into a phone or tablet to actively listen for bat calls. This device can actively listen, record, and save bat generated ultrasound. It also provides information regarding speciation and GPS location. Each point location was monitored for approximately 10 minutes before moving on and each transect was monitored throughout (approximately 20 minutes in length). During the active acoustic monitoring, the field team was watching for visible bats flying nearby.

Bat Habitat Survey

A bat habitat survey was conducted over two consecutive days in August 2021 within the Assessment Area 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. Other features that were considered as identifiable habitat include cliffs, rock outcrops, caves, abandoned mines, and anthropogenic structures such as buildings or bridges. For each habitat feature identified, the habitat type and GPS location was recorded along with a series of photographs (Appendix L) and general descriptions. Wetlands were not included as recordable bat habitat features during this survey as the significance, location, and assessment of these habitat features is captured in Section 7.3.3.

7.4.4.5 Field Assessment Results

Passive Bat Assessment

Fall Acoustic Survey
In total, 12,585 files were recorded by the Anabat detectors, of which only 18 were determined to be bat generated ultrasound using Analook software. The remaining files were determined to be caused by extraneous noise from sources such as vegetation, wind, or precipitation. Of the 18 echolocation calls recorded during the survey, there was one Eastern red bat, two Hoary bats, 11 Myotis species, and four unknown calls identified (Table 7.54).

Table 7.54: Fall Bat Survey Results

Detector	ID Code	Date	Time (*hour : minute : second*)
001	---	---	---
002 Forest Edge	MYOT	2020-08-19	23:50:42
	LACI	2020-08-23	00:18:40
	MYOT	2020-08-23	03:30:26
	UNKW	2020-08-25	22:24:02
	LACI	2020-09-04	22:58:13
	MYOT	2020-09-07	05:46:54
	LABO	2020-09-09	04:35:49
003 Rockland's Brook	MYOT	2020-08-21	04:00:06
	MYOT	2020-08-26	23.39:48
	MYOT	2020-08-26	23:41:28
	MYOT	2020-09-12	20:00:36
	MYOT	2020-09-15	00:11:22
	UNKW	2020-09-15	03:11:56
	MYOT	2020-09-15	03:42:45
	MYOT	2020-09-18	04:03:34
003 Radar Site*	---	---	---
004 Dicks Meadows	UNKW	2020-08-19	21:14:42
	MYOT	2020-08-20	02:25:54
	UNKW	2020-10-08	00:01:24

*On September 23, 2020 Detector 3 was relocated from Rocklands Brook to the location of the radar trailer for ease of access.

Calls persisted throughout the monitoring period, until October 8, 2020, after which no calls were detected. No bat generated ultrasound was detected at the and radar site locations. The first set of data collected from the detector was corrupted upon retrieval; therefore, no data is available between August 18 and September 3, 2020 for this location.

Spring Acoustic Survey
A total of 33,786 files were recorded (9,418 excluding the) during the monitoring period, of which four were identified as bat calls. The remaining files were determined to be background noise likely caused by vegetation, wind, or precipitation. Three of the species recorded were of the Myotis genus (i.e., Little brown myotis and Northern myotis). One recording was listed as 'Unknown' because the recording is in the correct range for high frequency bats (40-120 kHz) but could not be

identified to the species level. Two detectors, located at the Hardwood Edge and Rockland's Brook sites, did not record any bat calls during the entire spring survey period (Table 7.55).

Table 7.55: Spring Bat Survey Results

Detector	ID Code	Date	Time (h:m:s)
001 Dicks Meadows	MYOT	2021-06-13	21:53:23
	MYOT	2021-06-20	22:10:00
002 Hardwood Edge	---	---	---
003	MYOT	2021-06-16	20:06:06
004 Radar Site	UKWN	2021-06-07	05.19.37
005 Rocklands Brook	---	---	---

All recorded bat calls were detected during the month of June, with three of the four calls occurring within a seven-day period between June 13 and 20, 2021.

Active Bat Assessment

Bat Search
During the active bat search at the , a significant and consistent amount of heat was recorded as coming from the opening of the mine shaft, which could be an indication of bats or possible geothermal activity. No bats were observed at the hibernaculum's entrance during the survey, but this was expected given the low temperature (-2°C) and time of year (November).

Active Acoustic Monitoring
No bats were recorded or observed during the active acoustic monitoring survey.

Bat Habitat Survey
A total of 26 habitat features were recorded during the two-day survey within the Assessment Area. Habitat features identified primarily consist of snags and downed trees in the early to mid-stages of decay with ideal conditions for roosting such as peeling bark, center rot, and crevices. The bat habitat features identified do not meet the OMNR (2022) criteria for potential maternity roost habitat, and therefore, these features are not considered significant or critical habitat for bats. These features may serve as potential resting/over-day roosting sites only.

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 7.56). 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 7.56: 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 duration of the fall (2020) and spring (2021) 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. The Study Area is in a high elevation area that experiences high winds and cooler temperatures than the surrounding lowland areas, which may contribute to the lack of bat activity recorded as bats prefer warm seasonal temperatures and low winds (Barclay, 1991). The highest number of bat detections within the Study Area was between the months of August and September (with no bats recorded after October 10 and before June 7). This could be explained by the August peak in temperatures along with the higher elevation areas (i.e., Study Area) experiencing declining temperatures earlier than surrounding lowlands during fall, and subsequently, increasing temperatures later in the spring than surrounding lowlands. The Study Area is also significantly disturbed from previous and active forestry, agriculture, recreation, and an existing wind farm, leaving 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 extremely 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 power lines, a wind project, active and previous forestry, agriculture, and recreational activity. There were no identified areas of mature hardwood forests with the necessary density or clusters of snags (at ≥10 snags per hectare) required to support maternity colonies (OMNR, 2022). It is unlikely that the bat habitat observed during the survey supports maternity colonies; however, the identified snags may provide adequate day-roosting habitat for a variety of bat species. Other significant habitat features, including caves and abandoned mines, that could serve as hibernacula or over-wintering sites were not observed during the survey.

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 7.5 km in length). Areas where new roads are proposed do not contain important bat habitat.

Injury/Morality
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). In addition, 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 and fall migratory seasons. Bat species identified during field studies include Myotis species, Hoary bat, and Eastern red bat. Myotis resident bats were the most frequently recorded species within the Study Area representing 61% of species recorded; and are at a lower risk for turbine related injuries and mortalities due to lower flight patterns. Only three Hoary bats and Eastern red bats, which are at a higher risk due to higher flight patterns and longer migration routes, were recorded 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.
- Minimize fragmentation and habitat isolation during the design phase.
- Revegetate roadsides and cleared areas to minimize lost habitat as much as possible.

Injury/Morality

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 detailed Post Construction Bat Monitoring Plan will be developed and submitted to NSECC and NSNRR for review. Monitoring activities may include:

- Passive acoustic monitoring.
- Revisiting the to assess multi-year changes in use.
- 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:

- *MBCA*
- NS *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 NS *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, 2022)
- Maritimes Breeding Bird Atlas (MBBA) (Bird Studies Canada, 2016)
- Nova Scotia Significant Species and Habitats Database (NSNRR, 2018a)
- ACCDC Data Report (ACCDC, 2022b)

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. 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, 2022) is the Cobequid Bay, Bay of Fundy, approximately 12 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, 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 Assessment Area is contained within the map square 20MR54 of the MBBA. The Study Area also intersects squares 20MR53, 20MR44, and 20MR55 (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 20MR54, including 24 SOCI:

- Bank Swallow (*Riparia riparia*) – “Threatened” (*SARA* and COSEWIC), “Endangered” (NS *ESA*), “S2S3B” (ACCDC)
- Bay-breasted Warbler (*Setophaga castanea*) – “S3S4B” (ACCDC)
- Black-billed Cuckoo (*Coccyzus erythropthalmus*) – “S3B” (ACCDC)
- Black-backed Woodpecker (*Picoides arcticus*) – “S3S4” (ACCDC)
- Boreal Chickadee (*Poecile hudsonicus*) – “S3” (ACCDC)
- Canada Warbler (*Cardellina canadensis*) – “Threatened” (*SARA*), “Special Concern” (COSEWIC), “Endangered” (NS *ESA*), “S3B” (ACCDC)
- Cape May Warbler (*Setophaga tigrine*) – “S2B” (ACCDC)
- Eastern Wood-pewee (*Contopus virens*) – “Special Concern” (*SARA* and COSEWIC), “Vulnerable” (NS *ESA*), “S3S4B” (ACCDC)
- Evening Grosbeak (Coccothraustes vespertinus) – “Special Concern” (*SARA* and COSEWIC), “Vulnerable” (NS *ESA*), “S3S4B, S3N” (ACCDC)
- Killdeer (*Charadrius vociferus*) – “S3B” (ACCDC)
- Northern Goshawk (*Accipiter gentilis*) – “S3S4” (ACCDC)
- Olive-sided Flycatcher (*Contopus cooperi*) – “Threatened” (*SARA*), “Special Concern” (COSEWIC), “Threatened” (NS *ESA*), “S2B” (ACCDC)
- Pine Siskin (*Spinus pinus*) – “S2S3” (ACCDC)
- Red-breasted Nuthatch (*Sitta canadensis*) – “S3” (ACCDC)
- Rose-breasted Goshawk (*Pheucticus ludovicianus*) – “S2S3B” (ACCDC)
- Ruby-crowned Kinglet (*Regulus calendula*) – “S3S4B” (ACCDC)
- Scarlet Tanager (*Piranga olivacea*) – “S2B” (ACCDC)
- Spotted Sandpiper (*Actitis macularius*) – “S3S4B” (ACCDC)
- Swainson’s Thrush (*Catharus ustulatus*) – “S3S4B” (ACCDC)
- Tennessee Warbler (*Oreothlypis peregrina*) – “S3S4B” (ACCDC)
- Veery (*Catharus fuscescens*) – “S3S4B” (ACCDC)
- Vesper Sparrow (*Pooecetes gramineus*) – “S2B” (ACCDC)
- Wilson’s Warbler (*Cardellina pusilla*) – “S3B” (ACCDC)
- Yellow-bellied Flycatcher (*Empidonax flaviventris*) – “S3S4B” (ACCDC)

The NS Significant Species and Habitats database contains 1356 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:

- 496 records classified in the database as "Other Habitat", most of which relate to Bald Eagle (*Haliaeetus leucocephalus*) (482).
- 123 records classified as "Species of Concern" most of which relate to Common Loon (*Gavia immer*) (39), Bald Eagle (*Haliaeetus leucocephalus*) (six), and unclassified Tern (25).
- 129 records classified as "Migratory Bird" most of which relate to American Black Duck (*Anas rubripes*) (7), unclassified shorebirds (25), unclassified Cormorant (9), unclassified waterfowl (4), Great Blue Heron (*Ardea herodias*) (15), Canada Goose (*Branta canadensis*) (7), Double-crested Cormorant (*Phalacrocorax auritus*) (34), and unclassified Tern (4).
- 608 records classified as "Species at Risk" most of which relate to Bay-breasted Warbler (*Dendroica castanea*) (4), Piping Plover (*Charadrius melodus*) (67), Peregrine Falcon (*Falco peregrinus*) (27), Eastern Wood-Pewee (*Contopus virens*) (34), Canada Warbler (*Cardellina canadensis*) (46), Blackpoll Warbler (*Dendroica striata*) (24), Boreal Chickadee (*Poecile hudsonicus*) (36), Olive-sided Flycatcher (*Contopus cooperi*) (23), Pine Siskin (*Pinus spinus*) (19), Ruby-crowned Kinglet (*Regulus calendula*) (61) and Yellow-bellied Flycatcher (*Empidonax flaviventris*) (28).

The NS Significant Species and Habitats database contains 15 unique records pertaining to birds and/or bird habitat within a 10 km radius of the Project. All these records are classified as "Other Habitat", referencing Bald Eagles (*Haliaeetus leucocephalus*).

The ACCDC database contains records of 120 bird species within a 100 km radius of the Study Area (Table 7.57).

Table 7.57: Bird Species Recorded within a 100 km Radius of the Study Area

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
American Bittern	*Botaurus lentiginosus*	---	---	---	S3S4B
American Coot	*Fulica americana*	Not At Risk	---	---	S1B
American Golden-Plover	*Pluvialis dominica*	---	---	---	S1S2M
American Kestrel	*Falco sparverius*	---	---	---	S3B
American Three-toed Woodpecker	*Picoides dorsalis*	---	---	---	S1?
Arctic Tern	*Sterna paradisaea*	---	---	---	S3B
Atlantic Puffin	*Fratercula arctica*	---	---	---	S3B,S5N
Baltimore Oriole	*Icterus galbula*	---	---	---	S2S3B
Bank Swallow	*Riparia riparia*	Threatened	Threatened	Endangered	S2S3B
Barn Swallow	*Hirundo rustica*	Threatened	Threatened	Endangered	S2S3B
Barrow's Goldeneye – Eastern pop.	*Bucephala islandica (Eastern pop.)*	Special Concern	Special Concern	---	S1N
Bay-breasted Warbler	*Dendroica castanea*	---	---	---	S3S4B
Bicknell's Thrush	*Catharus bicknelli*	Threatened	Threatened	Endangered	S1S2B
Black Tern	*Chlidonias niger*	Not At Risk	---	---	S1B
Black-backed Woodpecker	*Picoides arcticus*	---	---	---	S3S4

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
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*	---	---	---	S3B,S5N
Blackpoll Warbler	*Dendroica striata*	---	---	---	S3S4B
Blue-winged Teal	*Anas discors*	---	---	---	S3S4B
Bobolink	*Dolichonyx oryzivorus*	Threatened	Threatened	Vulnerable	S3S4B
Boreal Chickadee	*Poecile hudsonica*	---	---	---	S3
Boreal Owl	*Aegolius funereus*	Not At Risk	---	---	S2?B
Brant	*Branta bernicla*	---	---	---	S2M
Brown Thrasher	*Toxostoma rufum*	---	---	---	S1B
Brown-headed Cowbird	*Molothrus ater*	---	---	---	S2B
Bufflehead	*Bucephala albeola*	---	---	---	S3S4N
Canada Jay	*Perisoreus canadensis*	---	---	---	S3
Canada Warbler	*Wilsonia canadensis*	Threatened	Threatened	Endangered	S3B
Cape May Warbler	*Dendroica tigrina*	---	---	---	S2B
Chimney Swift	*Chaetura pelagica*	Threatened	Threatened	Endangered	S2B,S1M
Cliff Swallow	*Petrochelidon pyrrhonota*	---	---	---	S2S3B
Common Eider	*Somateria mollissima*	---	---	---	S3S4
Common Gallinule	*Gallinula galeata*	---	---	---	S1B
Common Goldeneye	*Bucephala clangula*	---	---	---	S2B,S5N
Common Nighthawk	*Chordeiles minor*	Special Concern	Threatened	Threatened	S2B
Common Tern	*Sterna hirundo*	Not At Risk	Not Listed	---	S3B
Cooper's Hawk	*Accipiter cooperii*	Not At Risk	Not Listed	---	S1?B
Eastern Bluebird	*Sialia sialis*	Not At Risk	Not Listed	---	S3B
Eastern Kingbird	*Tyrannus tyrannus*	---	---	---	S3B
Eastern Meadowlark	*Sturnella magna*	Threatened	Threatened	Not Listed	SHB
Eastern Whip-poor-will	*Antrostomus vociferus*	Threatened	Threatened	Threatened	S1B
Eastern Wood-pewee	*Contopus virens*	Special Concern	Special Concern	Vulnerable	S3S4B
Evening Grosbeak	*Coccothraustes vespertinus*	Special Concern	Special Concern	Vulnerable	S3S4B,S3N
Fox Sparrow	*Passerella iliaca*	---	---	---	S3S4B
Gadwall	*Anas strepera*	---	---	---	S2B
Gray Catbird	*Dumetella carolinensis*	---	---	---	S3B
Great Cormorant	*Phalacrocorax carbo*	---	---	---	S2S3

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Great Crested Flycatcher	*Myiarchus crinitus*	---	---	---	S1B
Greater Yellowlegs	*Tringa melanoleuca*	---	---	---	S3B,S3S4M
Harlequin Duck – Eastern pop.	*Histrionicus histrionicus pop. 1*	Special Concern	Special Concern	Endangered	S2N
Horned Grebe	*Podiceps auritus*	Special Concern	Special Concern	---	S4N
Horned Lark	*Eremophila alpestris*	---	---	---	SHB,S4S5N
Hudsonian Godwit	*Limosa haemastica*	Threatened	---	---	S1S2M
Hudsonian Whimbrel	*Numenius phaeopus hudsonicus*	---	---	---	S2S3M
Indigo Bunting	*Passerina cyanea*	---	---	---	S1?B
Killdeer	*Charadrius vociferus*	---	---	---	S3B
Lapland Longspur	*Calcarius lapponicus*	---	---	---	S3?N
Laughing Gull	*Leucophaeus atricilla*	---	---	---	SHB
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	---	---	---	S3B,S5M
Least Bittern	*Ixobrychus exilis*	Threatened	Threatened	---	SUB
Least Sandpiper	*Calidris minutilla*	---	---	---	S1B,S3M
Lesser Yellowlegs	*Tringa flavipes*	---	---	---	S3M
Long-eared Owl	*Asio otus*	---	---	---	S2S3
Marsh Wren	*Cistothorus palustris*	---	---	---	S1B
Nelson's Sparrow	*Ammodramus nelsoni*	Not At Risk	---	---	S3S4B
Northern Gannet	*Morus bassanus*	---	---	---	SHB,S5M
Northern Goshawk	*Accipiter gentilis*	Not At Risk	---	---	S3S4
Northern Harrier	*Circus cyaneus*	Not At Risk	---	---	S3S4B
Northern Mockingbird	*Mimus polyglottos*	---	---	---	S1B
Northern Pintail	*Anas acuta*	---	---	---	S1B
Northern Shoveler	*Anas clypeata*	---	---	---	S2B
Northern Shrike	*Lanius borealis*	---	---	---	S3S4N
Olive-sided Flycatcher	*Contopus cooperi*	Special Concern	Threatened	Threatened	S2B
Pectoral Sandpiper	*Calidris melanotos*	---	---	---	S2S3M
Peregrine Falcon - anatum/tundrius	*Falco peregrinus pop. 1*	Not At Risk	Special Concern	Vulnerable	S1B,SNAM
Philadelphia Vireo	*Vireo philadelphicus*	---	---	---	S2?B
Pine Grosbeak	*Pinicola enucleator*	---	---	---	S2S3B,S5N
Pine Siskin	*Carduelis pinus*	---	---	---	S2S3

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Pine Warbler	*Dendroica pinus*	---	---	---	S1B
Piping Plover melodus ssp	*Charadrius melodus melodus*	Endangered	Endangered	Endangered	S1B
Purple Martin	*Progne subis*	---	---	---	SHB
Purple Sandpiper	*Calidris maritima*	---	---	---	S3?N
Red Crossbill	*Loxia curvirostra*	---	---	---	S3S4
Red Knot rufa ssp	*Calidris canutus rufa*	Endangered	Endangered	Endangered	S2M
Red Phalarope	*Phalaropus fulicarius*	---	---	---	S2S3M
Red-breasted Merganser	*Mergus serrator*	---	---	---	S3S4B,S5N
Red-breasted Nuthatch	*Sitta canadensis*	---	---	---	S3
Redhead	*Aythya americana*	---	---	---	SHB,SNAM
Red-necked Phalarope	*Phalaropus lobatus*	Special Concern	Special Concern	---	S2S3M
Roseate Tern	*Sterna dougallii*	Endangered	Endangered	Endangered	S1B
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	---	---	---	S2S3B
Rough-legged Hawk	*Buteo lagopus*	Not At Risk	---	---	S3N
Ruby-crowned Kinglet	*Regulus calendula*	---	---	---	S3S4B
Ruddy Duck	*Oxyura jamaicensis*	---	---	---	S1B
Ruddy Turnstone	*Arenaria interpres*	---	---	---	S3M
Rusty Blackbird	*Euphagus carolinus*	Special Concern	Special Concern	Endangered	S2B
Sanderling	*Calidris alba*	---	---	---	S3M,S2N
Scarlet Tanager	*Piranga olivacea*	---	---	---	S2B
Semipalmated Plover	*Charadrius semipalmatus*	---	---	---	S1B,S3S4M
Semipalmated Sandpiper	*Calidris pusilla*	---	---	---	S3M
Short-billed Dowitcher	*Limnodromus griseus*	---	---	---	S3M
Short-eared Owl	*Asio flammeus*	Special Concern	Special Concern	---	S1S2B
Spotted Sandpiper	*Actitis macularius*	---	---	---	S3S4B
Swainson's Thrush	*Catharus ustulatus*	---	---	---	S3S4B
Tennessee Warbler	*Vermivora peregrina*	---	---	---	S3S4B
Turkey Vulture	*Cathartes aura*	---	---	---	S2S3B
Veery	*Catharus fuscescens*	---	---	---	S3S4B
Vesper Sparrow	*Pooecetes gramineus*	---	---	---	S2B
Virginia Rail	*Rallus limicola*	---	---	---	S2S3B
Warbling Vireo	*Vireo gilvus*	---	---	---	S1B
White-rumped Sandpiper	*Calidris fuscicollis*	---	---	---	S3M

Common Name	Scientific Name	COSEWIC Status[1]	*SARA* Status[2]	NS *ESA* Status[3]	NS S-Rank[4]
Willet	*Tringa semipalmata*	---	---	---	S2S3B
Willow Flycatcher	*Empidonax traillii*	---	---	---	S2B
Wilson's Snipe	*Gallinago delicata*	---	---	---	S3B
Wilson's Warbler	*Wilsonia pusilla*	---	---	---	S3B
Wood Thrush	*Hylocichla mustelina*	Threatened	Threatened	---	SUB
Yellow-bellied Flycatcher	*Empidonax flaviventris*	---	---	---	S3S4B

Source: ACCDC 2022b
[1]Government of Canada 2022; [2]Government of Canada 2022; [3]Government of NS 2022; [4]ACCDC 2022a

7.4.5.4 Field Survey Methodology

Several types of survey methods were employed 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, 2007), unless otherwise stated.

Point Counts

Point count surveys were used as the primary means of identifying species in the Study Area through all seasons. 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 behavioural information (such as breeding evidence). Point count locations were determined using terrestrial habitat resources (Section 7.4.1) and in consultation with an expert birder, with the objective of representing the diversity of habitat within the Study Area. The estimated distance to target, direction, and number of species is recorded, while the observer remains still and silent for the duration of the survey interval. Surveys were completed from 30 minutes before, through four hours after dawn in any given season 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 Counts

Nocturnal counts were 10 minutes in duration and completed at predetermined locations throughout the Study Area. As the target species, all nightjars (nighthawks, etc.) and owls heard or observed were recorded with information on direction, behavior (if applicable) and distance from the observer. Surveys were conducted from dusk until two hours after dusk on clear nights with minimal wind and no precipitation.

Standardized Area Searches

Standardized area searches were completed to assess the use of specific habitat features as migratory stopover locations for migratory birds. Standardized area searches were 20 minutes and conducted at predetermined locations (usually targeting waterbodies for use by waterfowl). All visual and auditory observations of birds were recorded, along with relevant behaviour information.

Diurnal Watch Surveys
Watch surveys were completed to assess the movement of birds within the Study Area during the day. These surveys were completed for 120 minutes, usually in the late morning. 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.

Breeding Bird Surveys (2020 and 2021)
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 2020, with a follow-up survey conducted in 2021 to highlight habitats that were not well represented during 2020 surveys.

Nocturnal Bird Surveys (2020)
Nocturnal bird surveys were completed during both the breeding season and the spring migration period to gain an understanding of resident and migratory species.

Fall Migration Season Bird Surveys (2020)
Fall migration surveys were used in tandem with spring migration surveys to determine the migratory species that are moving through the Study Area, though at a different time of year. In Nova Scotia, the fall migration period lasts from late August through late October for most species. These surveys included point counts, diurnal watches, and area searches.

Winter Bird Surveys (2020-2021)
Winter bird surveys were completed to establish the species and distribution of resident birds through the winter season. These surveys were conducted from mid-December through March and included point counts.

Spring Migration Season Bird Surveys (2021)
Spring migration surveys were completed to inventory species migrating through or over the Study Area. The spring migratory period runs from early April through mid-June, and surveys included point counts, diurnal watch surveys, and nocturnal surveys (owling).

7.4.5.5 Habitat Modelling Methodology
Habitat modelling for SAR observed during the 2020 and 2021 breeding bird surveys (i.e., priority species that may be breeding within the Study Area) was completed. 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.

Cerulean Warbler (Setophaga cerulea)
Although Cerulean Warblers were observed during 2020 breeding bird surveys, they are not a known migrant, breeding, or resident species in Nova Scotia. It is expected that the Cerulean Warblers observed were vagrants, as their breeding range in Canada is restricted to Southern Ontario and Quebec (ECCC, 2021). No breeding evidence was observed, and no breeding is expected. Therefore, this species is not assessed further.

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.

Rusty Blackbird
Forestry inventory data was filtered to include all spruce or fir forests near wetlands or waterbodies and buffered by 200 m to include areas of wet softwood forest.

7.4.5.6 Remote Sensing Methodology

Avian Radar Assessment
Avian radar assessments were undertaken during the fall 2020 and spring 2021 migratory periods. The objective of the avian radar assessment was to assess migratory bird activity in the airspace above the Study Area. Avian radar systems (ARS) were deployed from August 30 to October 31, 2020, and from April 15 to June 28, 2021. The ARS can be configured with different radar orientations. During fall 2020, the ARS consisted of one Simrad Halo 6 pulse compression marine surveillance radar mounted on a horizontal, as well as one Simrad Halo 20+ pulse compression marine surveillance radar at 90° to scan vertically. The vertical orientation allowed for a 180° scan of the airspace above the radar, while the 180° below the radar is blanked.

An off grid 12V system was designed for optimal active monitoring and specificity in deployment. It was designed to charge and store energy using solar panels and a battery bank, while also powering the radar and associated equipment for data collection and remote communications. The system in its entirety was designed to be mobile, so the movement of the radar throughout the Study Area was possible, if desired.

A central location within the Study Area was chosen, which also provided a good line of site (relatively few trees in the immediate area) into the airspace above the Study Area, a southern exposure for solar charging, sufficient cellular and satellite coverage for remote communications, and accessibility for spot checks. The radar was mounted off the ground (approximately 3 m) to minimize ground noise interference and lessen the impacts of local microtopography on data collection and clarity.

Avian radar assessment results were processed using the radR platform (Taylor et al, 2010) – an open-source platform designed for the processing of radar data for biological applications – and outputs were analyzed using Microsoft Excel. Standard settings for the identification of biological targets (BT), such as birds, and bats were used. Targets reflected by the radar generate blips in the image of the radar scan. radR helps filter sequential images of radar scans to identify blips that occur in the same area over at least four out of five scans. Should these constraints be met, a target is generated. BTs are most likely generated by birds, but could also be bats and insects, or even drones and planes. Fog, rain, low cloud cover, and snow are detectable by the radar (similarly to weather radar), which lowers the effectiveness of the system, and may cause false positive- BT identifications. As such, any data collected when the nearest weather station (in this case, ECCC's Debert, NS Weather Station) indicates a minimum hourly rainfall of 0.5 mm were excluded from the analysis.

Avian Acoustic Assessment

Wildlife Acoustics SM3 Acoustic monitors were deployed within the Study Area in tandem with the radar system from August 30 to October 31, 2020 for the fall 2020 monitoring campaign, and April 15 to June 28, 2021 for the spring 2021 monitoring campaign. The monitors were programmed to record during the night with the intention of recording the acoustic activity of migratory songbirds for analysis.

The acoustic data was initially processed using Wildlife Acoustics' Kaleidoscope's cluster analysis capabilities. The dataset was restricted to only assess data between 7:30 pm and 4:00 am with the goal of finding night flight calls (NFCs). The cluster analysis was done using bait files in conjunction with the raw acoustic data. The bait files included sample audio from 91 bird SOCI (Table 7.58) for Kaleidoscope to create clusters around avian acoustics.

Table 7.58: Species Used as Bait Files for NFC Recognition Using Kaleidoscope

Common Name	Scientific Name
American Coot	*Fulica americana*
American Kestrel	*Falco sparverius*
American Robin	*Turdus migratorius*
American Three-toed Woodpecker	*Picoides dorsalis*
Arctic Tern	*Sterna paradisaea*
Atlantic Puffin	*Fratercula arctica*
Bank Swallow	*Riparia riparia*
Barn Swallow	*Hirundo rustica*
Bay-breasted Warbler	*Setophaga castanea*
Bicknell's Thrush	*Catharus bicknelli*
Black-backed Woodpecker	*Picoides arcticus*
Black-billed Cuckoo	*Coccyzus erythropthalmus*
Black-crowned Night-heron	*Nycticorax nycticorax*
Black-headed Gull	*Chroicocephalus ridibundus*
Blacklegged Kittiwake	*Rissa tridactyla*
Blackpoll Warbler	*Setophaga striata*
Black Tern	*Chlidonias niger*
Blue-winged Teal	*Spatula discors*
Bobolink	*Dolichonyx oryzivorus*

Common Name	Scientific Name
Boreal Chickadee	*Poecile hudsonicus*
Boreal Owl	*Aegolius funereus*
Brown-headed Cowbird	*Molothrus ater*
Brown Thrasher	*Toxostoma rufum*
Canada Jay	*Perisoreus canadensis*
Canada Warbler	*Wilsonia canadensis*
Cape May Warbler	*Setophaga tigrina*
Chimney Swift	*Chaetura pelagica*
Cliff Swallow	*Petrochelidon pyrrhonota*
Common Eider	*Somateria mollissima*
Common Gallinule	*Gallinula galeata*
Common Goldeneye	*Bucephala clangula*
Common Murre	*Uria aalge*
Common Nighthawk	*Chordeiles minor*
Common Tern	*Sterna hirundo*
Cooper's Hawk	*Accipiter cooperii*
Eastern Bluebird	*Sialia sialis*
Eastern Kingbird	*Tyrannus tyrannus*
Eastern Whip-poor-will	*Antrostomus vociferus*
Eastern Wood-pewee	*Contopus virens*
Evening Grosbeak	*Coccothraustes vespertinus*
Fox Sparrow	*Passerella iliaca*
Gadwall	*Mareca strepera*
Great Cormorant	*Phalacrocorax carbo*
Great Crested Flycatcher	*Myiarchus crinitus*
Greater Yellowlegs	*Tringa melanoleuca*
Harlequin Duck	*Histrionicus histrionicus*
Indigo Bunting	*Passerina cyanea*
Killdeer	*Charadrius vociferus*
Lapland Longspur	*Calcarius lapponicus*
Leach's Storm-petrel	*Hydrobates leucorhous*
Least Sandpiper	*Calidris minutilla*
Lesser Yellowlegs	*Tringa flavipes*
Long-eared Owl	*Asio otus*
Manx Shearwater	*Puffinus puffinus*
Marsh Wren	*Cistothorus palustris*
Nelson's Sparrow	*Ammospiza nelson*
Northern Goshawk	*Accipiter gentilis*
Northern Mockingbird	*Mimus polyglottos*
Northern Pintail	*Anas acuta*
Northern Shoveler	*Spatula clypeata*
Olive-sided Flycatcher	*Contopus cooperi*

Common Name	Scientific Name
Peregrine Falcon	*Falco peregrinus*
Philadelphia Vireo	*Vireo philadelphicus*
Pine Grosbeak	*Pinicola enucleator*
Pine Siskin	*Spinus pinus*
Pine Warbler	*Setophaga pinus*
Piping Plover	*Charadrius melodus*
Purple Finch	*Haemorhous purpureus*
Razorbill	*Alca torda*
Red-breasted Merganser	*Mergus serrator*
Red Crossbill	*Loxia curvirostra*
Roseate Tern	*Sterna dougallii*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Rough-legged Hawk	*Buteo lagopus*
Ruddy Duck	*Oxyura jamaicensis*
Rusty Blackbird	*Euphagus carolinus*
Scarlet Tanager	*Piranga olivacea*
Semipalmated Plover	*Charadrius semipalmatus*
Semipalmated Sandpiper	*Calidris pusilla*
Short-eared Owl	*Asio flammeus*
Solitary Sandpiper	*Tringa solitari*
Spotted Sandpiper	*Actitis macularius*
Tennessee Warbler	*Leiothlypis peregrina*
Turkey Vulture	*Cathartes aura*
Vesper Sparrow	*Pooecetes gramineus*
Virginia Rail	*Rallus limicola*
Warbling Vireo	*Vireo gilvus*
Willet	*Tringa semipalmata*
Willow Flycatcher	*Empidonax traillii*
Wilson's Snipe	*Gallinago delicata*
Wilson's Warbler	*Cardellina pusilla*

The signal parameters used for this analysis included:

- 250 – 22000 Hz frequency range
- 0.1 – 7.5 s length of detection
- 0.35 s maximum inter-syllable gap

The cluster analysis parameters for this analysis included:

- 2.0 maximum distance from cluster center to include outputs in cluster.csv
- 10.67 ms FFT window
- 12 maximum states

- 0.5 maximum distance to cluster center for building clusters
- 500 maximum clusters

Once the clusters were generated by Kaleidoscope, the output was vetted for the presence of avian acoustics. Every cluster was manually scanned to a minimum of 5% of its contents to determine whether it contained avian calls or singing, or noise including any non-avian sounds. If the cluster was found to be 90% noise, the entire cluster was considered noise. If the cluster scan achieved less than 90% noise, the entire cluster was investigated for avian acoustics. Any avian acoustics recorded during these scans were included in the analysis regardless of whether the cluster itself was considered noise.

7.4.5.7 Field Survey Results

2020 Breeding Bird Surveys

Two breeding bird surveys were conducted within the Study Area in 2020 (June 16 and 17; July 6 and 7). In total, 65 10-minute point counts were completed across the Study Area covering a wide range of habitat types and spatial distribution (Drawing 7.23). A total of 1,985 individual birds, representing 50 species, were observed (Table 7.59; Tables 1/2, Appendix M). The most abundant and frequently observed species were the White-throated Sparrow (*Zonotrichia albicollis*), Hermit Thrush (*Catharus guttatus*), Red-eyed Vireo (*Vireo olivaceus*), and American Robin. Migrant passerines accounted for 78% of the species and 98.4% of the individual birds observed.

Table 7.59: Total Observations by Bird Group – 2020 Breeding Bird Point Count Surveys

Bird Group	# Individuals	# Species
Waterfowl	0	0
Shorebirds	3	2
Other Waterbirds	0	0
Diurnal Raptors	3	2
Nocturnal Raptors	2	2
Passerines	1953	39
Other Landbirds	24	5
Total	**1985**	**50**

SOCI observed during the 2020 breeding surveys include Boreal Chickadee, Cerulean Warbler, Common Nighthawk, Northern Waterthrush (*Parkesia noveboracensis*), Red-breasted Nuthatch, Ruby-crowned Kinglet, Swainson’s Thrush, and Rusty Blackbird.

2020 Nocturnal Survey

A nocturnal survey for nightjars and owls survey was completed on July 22, 2020. Eight 10-minute point counts were completed throughout the Study Area (Drawing 7.24), with 13 individual birds representing three species observed (Table 7.60; Tables 3/4, Appendix M). Barred Owl (*Strix varia*) was the most common species observed.

Table 7.60: Total Observations by Bird Group – 2020 Nightjar and Owl Survey

Bird Group	# Individuals	# Species
Waterfowl	0	0
Shorebirds	0	0
Other Waterbirds	0	0
Diurnal Raptors	0	0
Nocturnal Raptors	11	2
Passerines	2	1
Other Landbirds	0	0
Total	**13**	**3**

Common Nighthawk was the only SOCI observed during the nocturnal surveys.

2020 Fall Migration Surveys
Fall migration surveys were completed on September 2, 3,16, and 28 and October 13, 26, and 29, 2020. The surveys included 88 10-minute point counts and eight 60-minute diurnal watches. Additional surveys were conducted at Dicks Meadows and Carter Lake, including four 20-minute point counts and four 20-minute area searches.

A total of 61 species, comprising 1,134 individual birds, were observed during the fall migration point count surveys (Table 7.61; Tables 5/6, Appendix M). A total of 53 10-minute and four 20-minute point counts were completed. Surveys were completed across a wide range of habitats, spatially distributed throughout the Study Area (including at Dicks Meadows and Carter Lake) on September 2, 3, 16, and 28, and October 13, 26, and 29, 2020 (Drawing 7.25). Dark-eyed Junco (*Junco hyemalis*), American Robin, Blue Jay (*Cyanocitta cristata*), Song Sparrow (*Melospiza melodia*), and Black-capped Chickadee (*Poecile atricapillus*) were the most abundant and frequently observed species. Migrant passerines accounted for 88.6% of the individual birds, and 70.5% of the species observed.

Table 7.61: Total Observations by Bird Group – 2020 Fall Migration Point Count Surveys

Bird Group	# Individuals	# Species
Waterfowl	13*	2*
Shorebirds	55	2
Other Waterbirds	0	0
Diurnal Raptors	11	6
Nocturnal Raptors	1	1
Passerines	1031**	43**
Other Landbirds	53	7
Total	**1164**	**61**

*Three unidentified waterfowl observations could not be identified to the species level
**53 unidentified passerine observations could not be identified to the species level

SOCI observed during the fall migratory point count surveys include Boreal Chickadee, Canada Jay, Evening Grosbeak, and Turkey Vulture.

A total of 22 species, comprising 67 individual birds, were observed during fall migration diurnal watch surveys (Table 7.62; Tables 7/8, Appendix M). The eight 60-minute diurnal watch surveys were conducted on September 16 and 28; and October 13 and 26, 2020, from elevated locations covering a wide range of habitats within the Study Area (Drawing 7.26). Cedar Waxwing (*Bombycilla cedrorum*) and Common Grackle (*Quiscalus quiscula*) were the most abundantly observed species. Migrant passerines accounted for 73.1% of the individual birds, and 59.1% of the species observed.

Table 7.62: Total Observations by Bird Group – 2020 Fall Migration Diurnal Watch Surveys

Bird Group	# Individuals	# Species
Waterfowl	3*	1*
Shorebirds	0	0
Other Waterbirds	0	0
Diurnal Raptors	11	4
Nocturnal Raptors	1	1
Passerines	49**	13**
Other Landbirds	3	3
Total	**67**	**22**

*Three waterfowl observations could not be identified to the species level
**One unidentified passerine specimen was observed

SOCI observed during the fall migratory diurnal watch surveys include American Kestrel, American Robin, Downy Woodpecker (*Picoides pubescens*), Hairy Woodpecker (*Picoides villosus*), Pine Grosbeak, and Turkey Vulture.

No large migratory flocks were observed during diurnal watch surveys. Most observations consisted of passerine species flying in small groups just above the tree line. Observations of raptors and waterfowl mostly consisted of individual birds.

A total of 19 species, comprising 51 individual birds were observed during fall migration area search surveys (Table 7.63; Tables 9/10, Appendix M). Four 20-minute area search surveys were conducted on October 13 and 26, 2020, at Dicks Meadows and Carter's Lake (Drawing 7.25). Pine Siskin and Common Raven were the most abundantly observed species. Migrant passerines accounted for 82.4% of individual birds, and 78.9% of species observed.

Table 7.63: Total Observations by Bird Group – 2020 Fall Migration Area Search Surveys

Bird Group	# Individuals	# Species
Waterfowl	7	2
Shorebirds	0	0
Other Waterbirds	0	0
Diurnal Raptors	1	1
Nocturnal Raptors	0	0
Passerines	42	15
Other Landbirds	1	1
Total	**51**	**19**

SOCI observed during the fall migratory area search surveys include Boreal Chickadee, Gray Jay (*Perisoreus canadensis*), Hairy Woodpecker, and Pine Grosbeak.

2020 – 2021 Winter Surveys

Winter surveys were completed on December 16, 2020; January 28 and 29, 2021; and March 5 and 8, 2021. The surveys included 70 10-minute point counts across 42 locations (Drawing 7.27A to 7.27C). A total of 19 species, comprising 131 individual birds, were observed (Table 7.64; Tables 11/12/13/14, Appendix M). Snow Blunting (*Plectrophenax nivalis*), Black-capped Chickadee, Common Raven, and Golden-crowned Kinglet (*Regulus satrapa*) were the most abundant and commonly observed species. Resident passerines accounted for 84.0% of the individual birds, and 63.2% of species observed.

Table 7.64: Total Observations by Bird Group – 2021 Winter Bird Surveys

Bird Group	# Individuals	# Species
Waterfowl	0	0
Shorebirds	0	0
Other Waterbirds	0	0
Diurnal Raptors	3	2
Nocturnal Raptors	0	0
Passerines	111*	12*
Other Landbirds	16**	4*
Total	**130**	**18**

*One unidentified passerine was observed
**Nine unidentified woodpeckers were observed (Other Landbirds)

Four SOCI were observed during the 2020/2021 winter surveys: Boreal Chickadee, Canada Jay (*Perisoreus canadensis*), Evening Grosbeak, and Pine Grosbeak.

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.

2021 Spring Migration Surveys
Spring surveys were completed within the Study Area on April 13, 15, 16; and May 2, 3, 6, 8, 15, 30, 31, 2021. The surveys included 110 10-minute point counts, ten rounds of owling, and 33 60-minute diurnal watches. Additional surveys (three 20-minute area searches) were conducted at Dicks Meadows and Carters Lake.

A total of 65 species, comprising 942 individual birds were observed in the Study Area during spring migration point count surveys (Table 7.65; Tables 15/16, Appendix M) completed on April 13 and 15; May 6, 8, and 30; and June 14, 2021 (Drawing 7.28). American Robin and Dark-eyed Junco were the most frequently and abundantly observed species. Migrant passerines accounted for 92.6% of the individual birds and 70.8% of the species observed.

Table 7.65: Total Observations by Bird Group – 2021 Spring Migration Point Count Surveys

Bird Group	# Individuals	# Species
Waterfowl	10	4
Shorebirds	10	4
Other Waterbirds	1	1
Diurnal Raptors	6	4
Nocturnal Raptors	0	0
Passerines	856*	46*
Other Landbirds	41**	6**
Total	**924**	**65**

*Two unidentified passerines were observed
**Seven unidentified woodpeckers were observed (Other Landbirds)

SOCI encountered throughout the 2021 spring migration point counts included American Kestrel (*Falco sparverius*), American Robin, Boreal Chickadee, Canada Goose, Canada Warbler, Evening Grosbeak, Greater Yellowlegs, Hairy Woodpecker, Mourning Warbler (*Oporornis philadelphia*), Nashville Warbler (Vermivora ruficapilla), Northern Harrier, Northern Parula, Northern Waterthrush, Pine Grosbeak, Spruce Grouse (*Falcipennis canadensis*), and Winter Wren.

A total of 27 species comprising 361 individual birds were observed in the Study Area during spring migration diurnal watch surveys (Table 7.66; Tables 17/18, Appendix M) completed on April 15, 16, and 20; and May 2, 3, and 15, 2021 (Drawing 7.29A to 7.29C). American Robin was the most frequently and abundantly observed species. Several soaring species were observed, including eight diurnal raptor species, though no large flocks of migrating waterfowl were observed. Migrant passerines accounted for 67.9% of individual birds, and 48.1% of species observed. One large flock of 40 Herring Gulls (*Larus argentatus*) was observed flying low in a northerly direction.

Table 7.66: Total Observations by Bird Group – 2021 Spring Migration Diurnal Watch Surveys

Bird Group	# Individuals	# Species
Waterfowl	8	2
Shorebirds	40	1
Other Waterbirds	1	1
Diurnal Raptors	55	8
Nocturnal Raptors	0	0
Passerines	245**	13**
Other Landbirds	5	2
Total	**361***	**27***

*Nine unidentified medium and large birds were observed
**Four unidentified passerine specimens were observed

SOCI observed during the 2021 spring migration watch surveys included American Kestrel, Canada Goose, Evening Grosbeak, and Turkey Vulture.

Four species, comprising 18 individual birds were observed during 2021 spring migration area search surveys (Table 7.67; Tables 19/20, Appendix M) completed on April 12, 2021, at Dicks Meadows and Carter's Lake (Drawing 7.28). Ring-necked Duck (*Aythya collaris*) was the most abundantly observed species, while Boreal Chickadee was the lone SOCI observed. Waterfowl accounted for 83.3% of individual birds, and 50% of the species observed.

Table 7.67: Total Observations by Bird Group – 2021 Spring Migration Area Search Surveys

Bird Group	# Individuals	# Species
Waterfowl	15	2
Shorebirds	0	0
Other Waterbirds	0	0
Diurnal Raptors	0	0
Nocturnal Raptors	0	0
Passerines	3	2
Other Landbirds	0	0
Total	**18**	**4**

Three species, comprising four individual birds were recorded in the Study Area during 2021 spring migration nocturnal surveys (Table 7.68; Tables 21/22, Appendix M) completed on May 15, 2021 (Drawing 7.29). Despite nighttime survey efforts, only one nocturnal raptor, a Northern Saw-whet Owl (*Aegolius acadicus*), was observed. American Woodcock (*Scolopax minor*) was the most abundantly observed species, while no SOCI were observed.

Table 7.68: Total Observations by Bird Group – 2021 Spring Migration Nocturnal Surveys

Bird Group	# Individuals	# Species
Waterfowl	0	0
Shorebirds	2	1
Other Waterbirds	0	0
Diurnal Raptors	0	0
Nocturnal Raptors	1	1
Passerines	1	1
Other Landbirds	0	0
Total	**4**	**3**

Throughout 2021 spring migration surveys, very few large flocks of migratory waterfowl or shorebirds were observed.

2021 Breeding Bird Survey

The 2021 breeding bird surveys was conducted on June 14, 2021. Ten 10-minute point count surveys were conducted within the Study Area, with 130 individual birds, representing 32 species observed (Table 7.69; Tables 23/24, Appendix M; Drawing 7.30). Mourning Warbler, White-throated Sparrow, and Black-throated Green Warbler (*Setophaga virens*) were the most abundant and frequently observed species. Migrant passerines accounted for 93.4% of the species and 98.2% of the individual birds observed.

Table 7.69: Total Observations by Bird Group – 2021 Breeding Bird Surveys

Bird Group	# Individuals	# Species
Waterfowl	0	0
Shorebirds	1	1
Other Waterbirds	0	0
Diurnal Raptors	0	0
Nocturnal Raptors	0	0
Passerines	127	30
Other Landbirds	2	1
Total	**130**	**32**

Three SOCI were observed during the 2021 breeding bird surveys: Mourning Warbler, Northern Parula, and Winter Wren.

Table 25 (Appendix M) includes all SAR observed throughout field surveys. SAR abundance was observed to be low, while distribution was observed to be stochastic (Drawing 7.31).

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.

- Common Nighthawk
- Rusty Blackbird

The results of the modelling are shown in Drawings 7.32A and 7.32B.

7.4.5.9 Remote Sensing Results

Avian Radar Assessment
Data collected by the horizontal and vertical radar modes for fall 2020 and spring 2021 radar monitoring campaigns (Drawing 7.33) were analyzed to provide the number of BT by date, and by height bin (for the vertical radar modes) or range bin (for the horizontal radar modes) (Tables 26 to 29, Appendix M).

The horizontal radar mode identified 2,073 BTs during the fall 2020 monitoring campaign. Most of these BTs (nBTs = 1,587) were detected on September 17 (nBTs = 338) and September 18 (nBTs = 338). No BTs were detected prior to September 16, and smaller numbers of BTs were detected until the end of the fall 2020 monitoring program on October 31, 2020 (Table 26, Appendix M).

The vertical radar mode detected 225 BTs during the fall 2020 monitoring campaign, with the highest numbers detected on September 24, 25 and October 1, 2 and 29. Most BTs were detected in the 500 m to 1000 m height bin (nBTs = 79) and the 1000 m to 1500 m height bin (nBTs = 131) (Table 27, Appendix M).

The data indicates that avian migration activity was highest in mid-September 2020, and dropped later in the season, though persists into at-least late-October.

The horizontal radar mode identified 106,551 BTs in the spring 2021 monitoring campaign. The highest number of BTs were detected on May 11 (nBTs = 95870) and May 12 (nBTs = 6380). Small and moderate numbers of BTs were detected from the beginning of the monitoring period until May 11. No BTs were detected after May 13 (Table 28, Appendix M).

The vertical radar mode identified 51,543 BTs during the spring 2021 monitoring campaign. The highest number of BTs were detected May 11 (nBTs = 42,798), May 6 (nBTs = 5,137), and on April 22 (nBTs = 1,995). Small to moderate numbers of BTs were detected on several nights between those dates. No BTs were detected after May 11 (Table 29, Appendix M).

Similar to the 2020 fall monitoring campaign, most targets were detected between heights of 500 m to 1500 m (Table 29, Appendix M). Spring 2021 results suggest that avian migration activity occurred stochastically from the beginning of (and possibly before) the monitoring period on April 15, until the large migration event on May 11. After this, no BTs were detected through the end of the monitoring period on June 28.

Both radar modes detected significantly more BTs in spring 2021 than fall 2020. This was due in part to weather, and in part to a refinement in the ARS settings. There was consistent fog and low clouds in the northern portion of the Study Area during fall 2020, which likely obscured the radar's ability to track small BTs. When these files were processed using radR, targets with stronger signal strengths (e.g., greater radar cross section, or higher electromagnetic reflectivity), such as large bodied birds, were able to be tracked, while weaker signals could not be distinguished from the background noise. The BTs detected by the ARS in fall 2020 are likely attributable to larger birds, such as waterfowl (e.g., ducks and geese), shorebirds (e.g., Double-crested Cormorants), or larger bodied passerine and raptor species (e.g., crows, hawks, or eagles). Strong target signals can also come from flocks of birds, so it is possible that flocks of smaller birds are represented in the fall 2020 dataset.

Overall, the daily total of BTs detected were highly variable, indicating that migratory bird activity is somewhat stochastic during both the spring and fall migration seasons. 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).

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.

Figure 7.3 shows that the majority (57.3%) of BTs in fall 2020 (horizontal radar) were detected when the winds were from the northwest, followed by winds from the northeast (29.9%). This may indicate that winds with a northerly bias are associated with migratory bird movements to the south during fall migration.

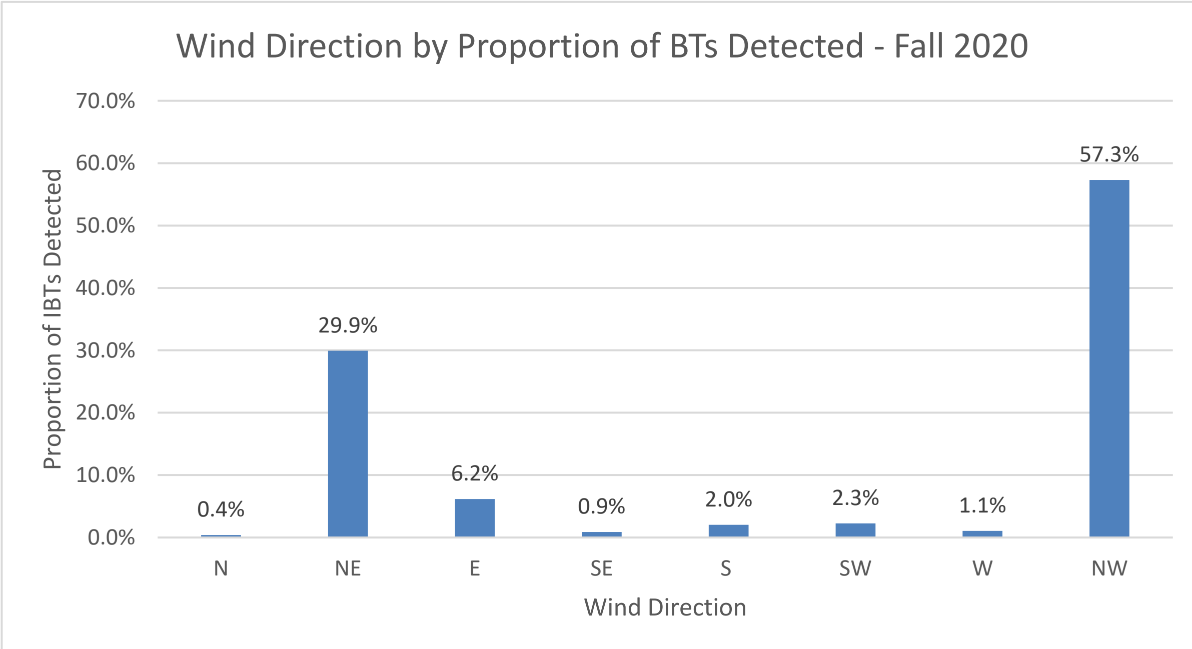

Figure 7.3: Wind Direction by Proportion of BTs Detected, Horizontal Radar More, Fall 2020

By contrast, the largest proportion of BT detections in spring 2021 were associated with winds from the south (48.4%) and southeast (16.3%) (Figure 7.4). This aligns with the expectation that winds from a southerly direction would support birds migrating to the north and northwest to breeding grounds.

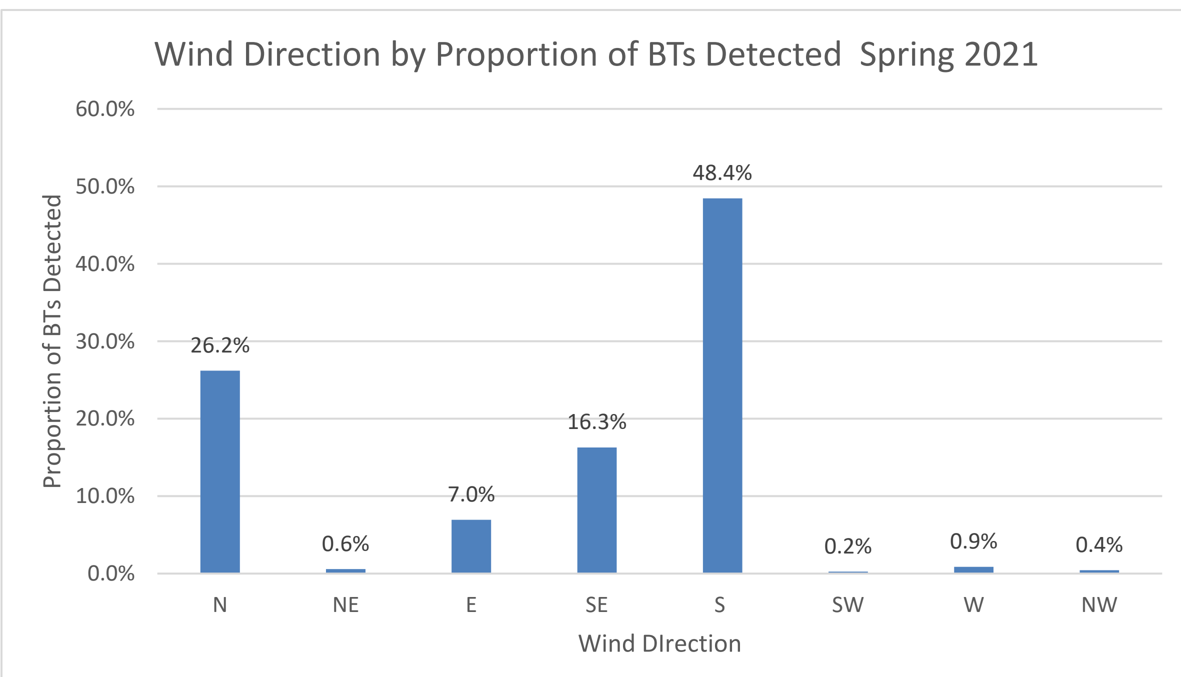

Figure 7.4: Wind Direction by Proportion of BTs Detected, Horizontal Radar More, Spring 2021

These findings are consistent with the findings of other studies that examined the effects of weather and atmospheric conditions on bird migration (Richardson, 1990; Liechti & Bruderer, 1998).

The weather and tide records for the area during the monitoring campaigns are appended (Tables 30 and 31, Appendix M).

Determining Migratory Bird Density
Both the Halo 6 radar (used for the horizontal radar mode) and the Halo 20+ radar (used for the vertical radar mode) emit a beam that is angled 12.5° upward and downward from the radar's antenna. As the radar beam extends outwards, the volume of airspace that the radar scans increases with range. Therefore, the number of BTs detected by the ARS generally increases with range, until such a point that the radar becomes limited by range and the number of BTs detected drops (this is true for both the horizontal and vertical radar modes).

To correct for the distortions in BT detection counts at different ranges, it is necessary to correct for the airspace volume scanned by the radar at each range bin (or height bin in the case of the horizontal radar mode). Based on the geometry of the radar's beam angle, the volume of airspace scanned in each of the range and height bins for the horizontal and vertical radar modes was determined using CAD software. These volumes are shown for each height bin in Table 7.70 and Table 7.71 along with the number of BTs detected in each height bin, and the target density (i.e., the number of targets detected per cubic kilometer of airspace) for the spring 2021 monitoring period (the fall 2020 dataset was too small). Birds per km^3 has been used as a metric of bird migration in avifauna for in other studies (Farnsworth, 2013). Target density is representative of, and likely proportional to, the migratory bird activity in the airspace above the Study Area for the cumulative monitoring period (in this case, for the spring 2021 avian radar monitoring campaign).

Table 7.70: Target Density - Horizontal Radar Mode – Spring 2021

Range bin	Number of Targets Detected	Airspace Scanned (km^3)	Target Density (BT/km^3)
0-250	0	0.0071	0
250-500	0	0.0496	0
500-750	268	0.1346	1991
750-1000	1099	0.2621	4193
1000-1250	72	0.4321	166
1250-1500	137	0.6446	212
1500-1750	822	0.8995	913
1750-2000	12354	1.1970	10320
2000-2500	80627	3.4560	23329
2500-3000	11169	5.1560	2166
3000-3500	0	7.1960	0
3500-5000	1	37.2300	0
5000-10000	2	396.6000	0
Total	**106551**	**453.2646**	**235**

Table 7.71: Target Density - Vertical Radar Mode – Spring 2021

Range bin	Number of Targets Detected	Airspace Scanned (km^3)	Target Density (BT/km^3)
0-25	865	0.1015	8522
25-50	2228	0.1016	21929
50-100	1891	0.2036	9288
100-150	2170	0.2043	10622
150-200	2367	0.2052	11535
200-250	2229	0.2063	10805
250-500	7768	1.052	7384
500-1000	12251	2.226	5504
1000-1500	10850	2.337	4643
1500-2000	6447	2.426	2657
2000-3000	2477	3.774	656
Total	**51543**	**12.8375**	**4015**

The number of BTs detected by both the horizontal and vertical radar modes was generally higher at higher ranges, where the radar scans a greater volume of airspace, before dropping to ranges where radar signal decay becomes limiting.

The horizontal radar mode detected the most targets in the 2000 m to 2500 m range bin. This is associated with a large migration event on May 11, where 95,870 BTs were detected. Approximately 78% of BTs (nBTs = 74352, Table 28, Appendix M) were in this range bin. By contrast, the target density for this range bin shows less variation than target counts (Figure 7.5).

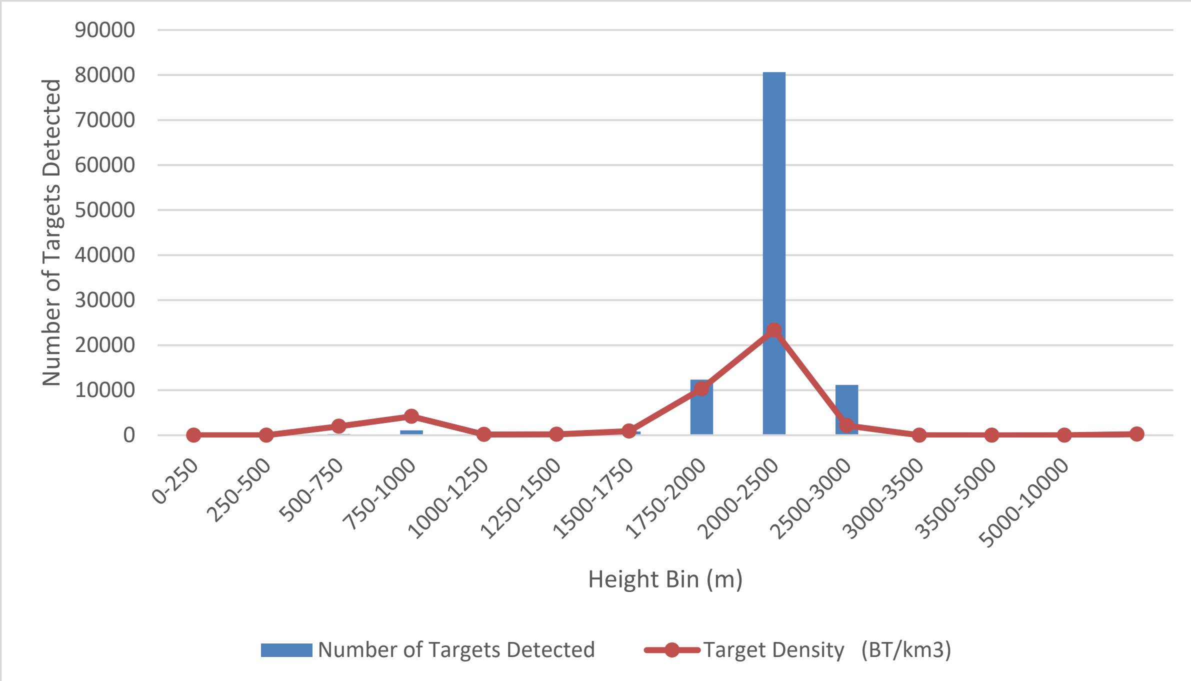

Figure 7.5: Targets Detected and Target Density – Horizontal Radar Mode – Spring 2021

The vertical radar mode provided high resolution on the height at which BTs were detected during the monitoring campaigns. The number of targets detected by this radar increases with height (or range from the radar), until the radar signal decay becomes limiting (Figure 7.9).

However, target density in the height bins between 0 m and 250 m show less variation (except for the outlier in the 20 m to 50 m height bin), and target density begins to drop above 250 m (Figure 7.6). This indicates that migratory bird activity is somewhat even in the height bins that the proposed wind turbines would occupy and may decrease with height above 250 m.

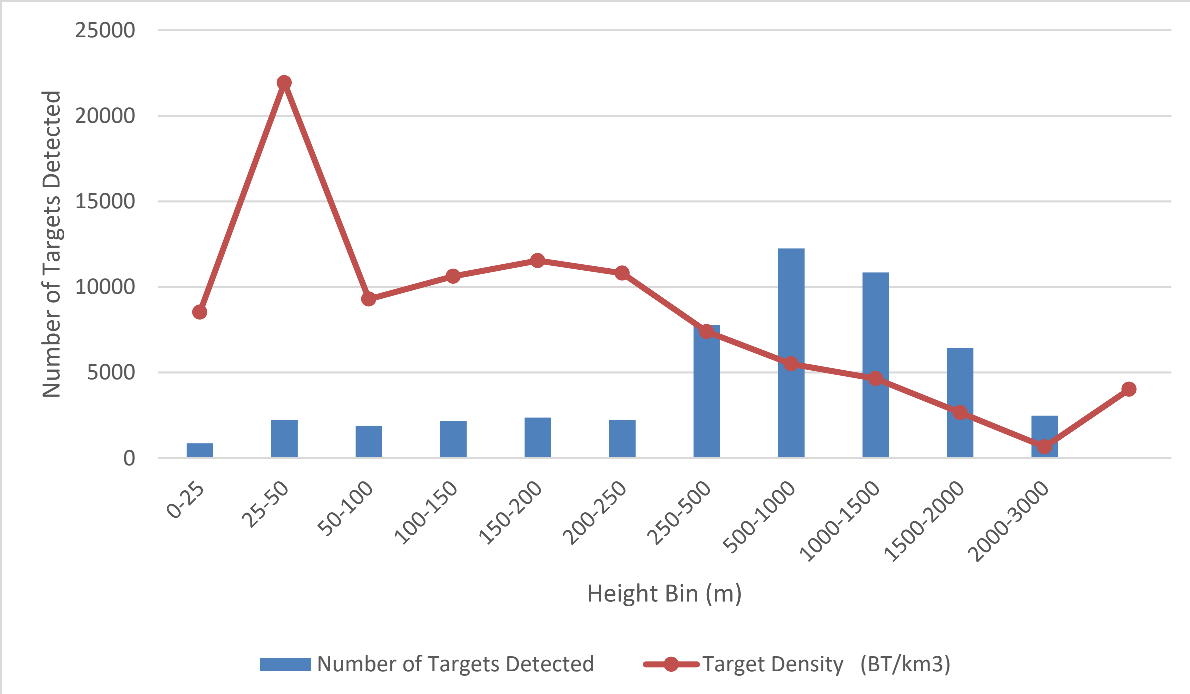

Figure 7.6: Targets Detected and Target Density - Vertical Radar Mode - Spring 2021

Avian interaction model

The level of interaction between migratory birds and the Project turbines can be estimated using data collected from the radar monitoring in fall 2020 and spring 2021. Interactions may include sensory disturbance to birds passing near the turbines, a requirement for birds to maneuver around the turbines (thus forcing migratory birds to expend energy), bird collisions with the turbine components, or blade strikes (for operating turbines).

The Migratory Bird Interaction Index (MBII, $\boldsymbol{M}$) is an estimate of the level of risk that aerial infrastructure for a Project poses to migratory birds. This index is calculated using the following expression.

Equation 1:

$$\boldsymbol{M} = \boldsymbol{D} \div \boldsymbol{I}$$

Where $\boldsymbol{D}$ is the migratory bird density, and $\boldsymbol{I}$ is the volume of airspace that the infrastructure being assessed would occupy.

To represent the volume of airspace occupied by the infrastructure (I), the volume of airspace where avifauna would interact with the turbines was estimated using CAD software that is based on morphology of the proposed turbines. An over-estimate of the volume of the turbine's physical components was used to represent the larger volume of airspace where the turbines would influence avifauna. Table 7.72 shows the turbine dimensions for this Project and the parameters used to calculate the interaction airspace volume for the turbine model.

Table 7.72: Turbine – Avifauna Interaction Volume Calculation Information

Turbine Model Information		
Component	**Description**	
Turbine Model	Siemens Gamesa 6.6-170	
Number of Turbines	17	
Hub Height	110.5 m	
Total Height	195.5 m	
Rotor Diameter	170 m	
Blade Length	85 m	
Rotor Sweep Area	22,698 m^2	
Turbine – Avifauna Interaction Volume Calculations		
Interaction Airspace Model Component	**Dimensions**	**Airspace Interaction Volume**
Tower	15 m diameter cylinder, 103 m tall	4,416 m^3
Nacelle	7.5*7.5*24M cuboid	1,483 m^3
Rotor (Operational)	180m diameter cylinder, 7.5 m thick	190,847 m^3
Rotor (Curtailed)	three 7.5*7.5*90 m cuboids (triangular)	15,000 m^3
Total airspace volume (Operational Turbine)		**196,746 m^3**

The horizontal radar mode data was used to determine target density for each day of the monitoring program (calculated from values in Tables 26 and 28, Appendix M) and the interaction airspace volume (determined in Table 7.72) was used to calculate and project the MBII (Figure 7.7) over the spring 2021 monitoring period. This is because it scanned significantly more airspace and detected more BTs than the horizontal radar mode, largely owing to its orientation and the increased power (resulting in increased detection range) of the Halo 6 radar. While this radar configuration does not provide resolution in target height, it is useful for quantifying migratory bird movements over a large sample area.

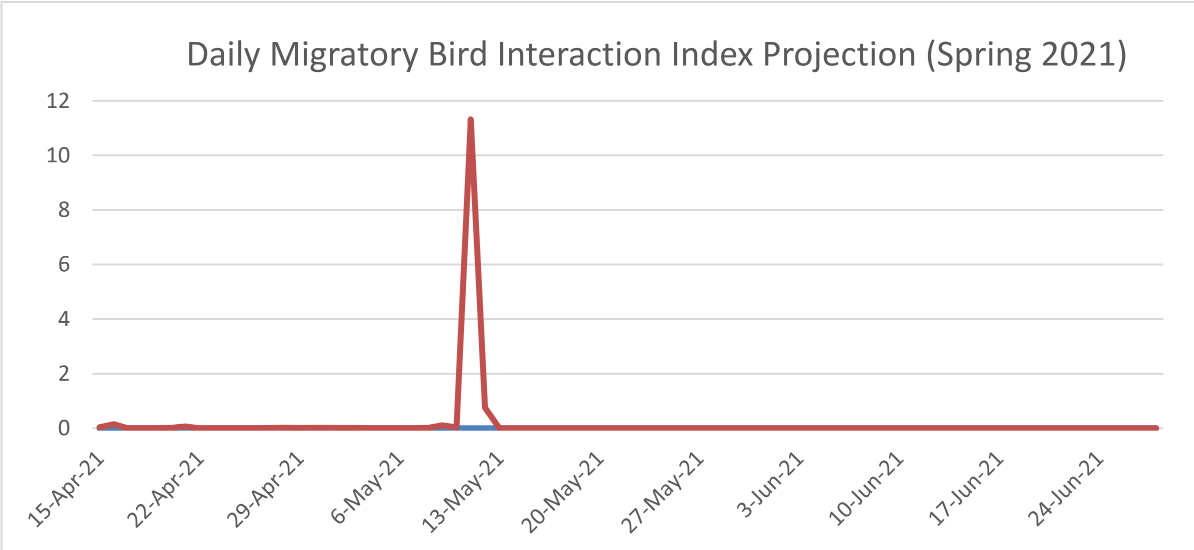

Figure 7.7: Migratory Bird Interaction Index – Projected Daily for the Spring 2021 Monitoring Period

Figure 7.7 shows the MBII value spiked for May 11, 2021, corresponding to the large migratory movement on that date. The MBII model represents a basic estimate of the level of interaction between migratory birds and the wind turbines infrastructure. The MBII value calculated for May 11, 2021 (11.32) is not representative of the number of interactions that would have occurred had the proposed Project been built and operating on that date. Rather, this MBII value is useful in comparing anticipated interaction levels between dates, to expose the frequency and intensity of migratory bird interaction events.

Acoustic Monitoring Results

Acoustic monitoring results indicate a peak in bird sounds on and around May 10 (Figure 7.8). Most avian acoustics identified were calls or songs rather than NFCs, which would indicate that migration was likely occurring shortly prior to, or after the increased acoustic activity. This is supported by the radar data (Tables 28 and 29, Appendix M), which shows a spike in bird migration on May 11, 2021.

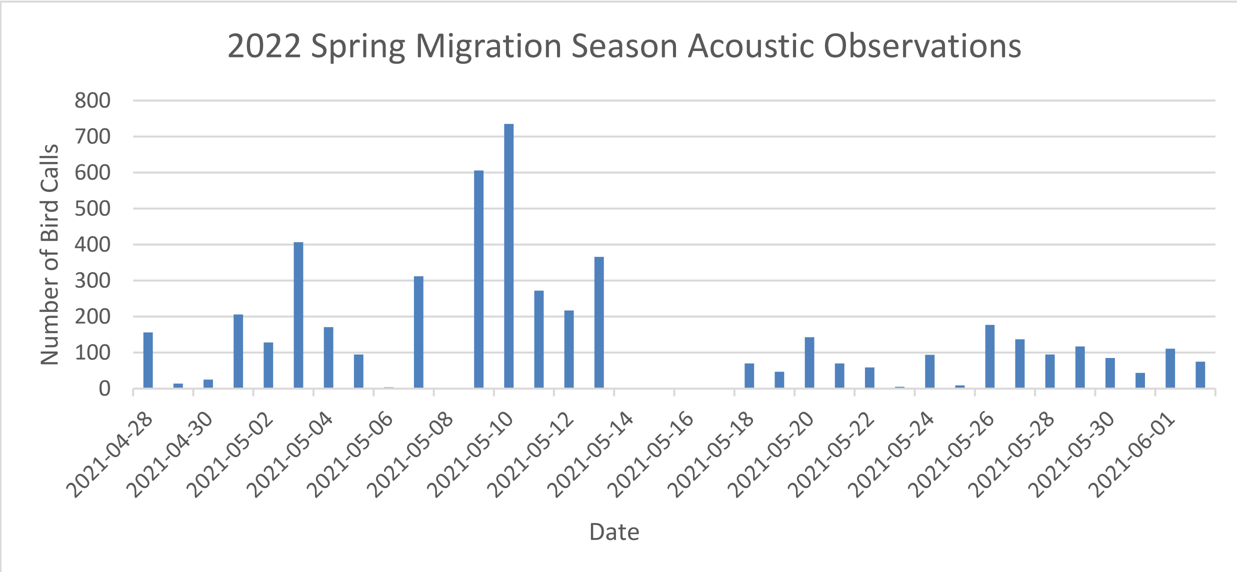

Figure 7.8: Avian Acoustic Activity by Date During the 2021 Spring Migration Season

This analysis does not meaningfully aid the radar assessment in identifying species composition, or in determining the number of migratory birds passing over the Study Area. This is due in part to the detection range of the acoustic monitor being significantly lower than that of the ARS. The presence of Spring Peepers (*Pseudacris crucifer*) during the spring migration season also made the results difficult to parse given that these amphibians are loud, vocalize prolifically, and share a similar frequency to many avian NFCs.

The fall data did not yield any avian acoustic detections.

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 7.73). 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 7.73: 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, as described above in the MBII. The RAA for avifauna includes the surrounding landscape, including the Folly Gap and Wentworth Valley, and the airspace above these areas, up to approximately 3000 m (Drawing 7.19).

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 7.5 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, 12 of the 17 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.

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 7.32A). In addition, the construction of turbine pads and new spur road may create additional suitable habitat for Common Nighthawks.

One Rusty Blackbird was observed during the 2020 breeding season, near a clearcut on the eastern side of the Assessment Area, though no breeding evidence was observed. As Rusty Blackbirds prefer swamp areas (ECCC, 2015b), the well drained, high-elevation Project Area is not expected to provide an abundance of preferred habitat, though habitat modelling suggests there is some suitable habitat withing the Study Area (Drawing 7.32B). The Project design has prioritized the use of existing roads and minimized alterations to wetlands, with no wetland alterations required for the construction of turbine pads (Section 7.3.3).

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 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.

The vertical radar mode data from the spring 2021 monitoring campaign indicates that the density of migratory avifauna was largely even throughout the lower height bins that the proposed turbines would occupy, and dropped with height beyond 250 m. This indicates that there would be some level of interaction between migratory avifauna and the Project during operation.

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). Interactions with the turbine infrastructure would vary over time, with variations in migratory bird density. Bird strikes and avian mortalities are likely to be proportional to migratory bird activity. MBII values (Figure 7.10) cannot be used as a predictor of avian mortality rates, as not every interaction would result in mortality.

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 Consulting at operating wind power projects in Nova Scotia within the past decade (i.e., >1 detectable bird mortality[4] per wind turbine per year on average). The MBII model projection (Figure 7.10) indicates that interactions would have occurred on just two nights in spring 2021 (May 11 and 12), indicating that the level of avian mortality caused by the Project would be low for the vast majority of the Project's operation, and mortality events (if any) would be limited to a few events during the migration periods.

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).

The MBII model shows that interactions between birds and the turbines would be low, with infrequent spikes during migration events. 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:

[4] 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 post-construction Wildlife Management Plan will be developed in consultation with NSECC, NSNRR, and all other relevant parties. The management plan will 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.
- Conduct the second year of avian radar monitoring and provide results to CWS.
- Monitor changes to habitat within the Study Area and greater RAA that may occur as an indirect result of the Project.
- 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 (2022)
- Taxation legislation
- Public mapping resources
- Economic data from Higgins Wind

8.1.2 Existing Environment

The Project is located along the boundary of Cumberland and Colchester Counties, near the communities of Westchester Station (7.2 km), Wentworth Valley (5.5 km), Folly Lake (5.5 km), and Londonderry (7.9 km). The largest community in Cumberland County is Amherst (population 9,413) and in Colchester County is Truro (population 22,954).

Population statistics for the 2016 and 2021 Census Subdivisions of Colchester A and Cumberland D are summarized in Table 8.1.

Table 8.1: Local Population

Population Statistics	Colchester Subdivision A	Cumberland Subdivision D
Population in 2021	3,762	4,283
Population in 2016	3,459	4,155
Population change from 2016-2021 (%)	+8.8	+3.1
Total private dwellings in 2021	2,262	3,322
Land area (km^2)	877.35	1,052.90
Population density (per km^2)	4.3	4.1

Source: Statistics Canada 2022

The age distribution in Colchester Subdivision A reveals a median age of 51.2 years, which is higher than the provincial median age (45.6) and the Halifax Regional Municipality (HRM) (40.4). The age distribution in Cumberland Subdivision D reveals a median age of 58.4 years, which is significantly higher than the provincial median age (45.6), and the HRM median age (40.4) (Statistics Canada 2022). An overview of age distribution for 2022 in both subdivisions is outlined in Table 8.2.

Table 8.2: Age Distribution in Colchester Subdivision A and Cumberland Subdivision D

Age Statistics	Colchester Subdivision A	Cumberland Subdivision D
0 – 14 years	510 (13.6%)	410 (9.6%)
15 – 64 years	2,285 (60.8%)	2,355 (55.0%)
65+ years	970 (25.8%)	1,515 (35.4%)
Total Population	**3,760 (100%)**	**4,285 (100%)**

Source: Statistics Canada 2022; note that due to rounding, total percentage may be ± 100%.

Average housing costs and average individual incomes for Colchester Subdivision A and Cumberland Subdivision D are compared to the provincial and federal averages, as shown in Table 8.3.

Table 8.3: Housing Costs and Average Individual Income

Jurisdictions	Average Dwelling Value in 2020	Average Total Income in 2020
Colchester Subdivision A	$207,000	$41,320
Cumberland Subdivision D	$242,200	$44,960
Province of Nova Scotia	$295,600	$47,480
Canada	$618,500	$54,450

Source: Statistics Canada 2022

Most residents in both Colchester Subdivision A and Cumberland Subdivision D (99%+ each) speak English (Statistics Canada, 2022). 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 Wentworth Volunteer Fire Department is located approximately 10 km north of the Study Area on Highway 4. The Westchester Volunteer Fire Department is also located nearby, approximately 7 km northwest of the Study Area, on Valley Road running between Westchester Station and Wentworth Station.

Health and emergency services exist in the area and are accessible to Project workers if the need should arise at both the Lillian Fraser (28 km northeast) and at the All-Saints Springhill Hospital (35 km west). Limited health services are also available at the Wentworth Learning Centre (15 km northeast).

Statistics for Colchester Subdivision A indicate that the unemployment rate in 2021 was 12.4% and 13.8% for Cumberland Subdivision D, both being near the provincial rate of 12.7% (Statistics Canada, 2022). The Colchester Subdivision A employment rate was 47.8% and 42.6% for Cumberland Subdivision D employment rate, which are both slightly lower than the provincial employment rate of 51.9% (Statistics Canada, 2022).

A breakdown of the labour force within both subdivisions is provided in Table 8.4. The highest proportions of workers in Colchester Subdivision A fall into the “retail trade” category (16.4%) and in Cumberland Subdivision D the highest percentage fall into the “health care and social assistance” category (18.2%). Other significant industries include retail trade, manufacturing, and agriculture, forestry, fishing, and hunting (Statistics Canada, 2022).

Table 8.4: Top Industries for the Employed Labour Force, Colchester Subdivision A and Cumberland Subdivision D

Industry	Colchester Subdivision A %	Cumberland Subdivision D %
Total Employed Labour Force 15 years +	1,735	1,845
Construction	175 (10.1%)	105 (5.7%)
Retail Trade	285 (16.4%)	115 (6.2%)
Health Care and Social Assistance	220 (12.7%)	335 (18.2%)
Manufacturing	175 (10.1%)	185 (10.0%)
Agriculture, Forestry, Fishing, Hunting	160 (9.2%)	220 (11.9%)

Source: Statistics Canada 2022

In the immediate vicinity of the Assessment Area there is ongoing forestry operations, as well as the wind turbines associated with the original Stevens Wind Project. All other uses of the Study Area could be considered recreational, whether economically driven or not.

The Town of Debert is considered the closest economic centre, located approximately 17 km southeast 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 the Town of Debert) are provided below in Table 8.5.

Table 8.5: Local Businesses and Proximity to Study Area

Business	Distance and Direction to the Study Area*
Ski Wentworth	6 km northeast, on Highway 4
Wentworth Market	11 km northeast, on Highway 4
Masstown Market	15 km southeast, on Highway 4
Quality Concrete	5 km east, on Highway 4
Bentley's Blueberries	7 km northwest, on Wentworth-Collingwood Road
Emily's Tattie's Take Out	10 km northeast, on Highway 4
Flanagan's Take Out	11 km northeast, on Highway 4
Hidden Hilltop Family Campground	14 km southeast, on Highway 4
Nova Tree	15 km southeast, on Highway 4
Debert Golf Course	15 km southeast, on Reid Road
Breathing Green Solutions	5 km east, on Highway 4
Superline Fuels	11 km northwest, on Greenville Road

*All distances measured from center of the Study Area, using the most direct route.

Aside from the immediate area and associated businesses, the communities of the Wentworth Valley, Londonderry, and others are all highly dependent on the greater municipal centers of Truro and Amherst for many of their regular shops and services, including indoor recreation, big-box stores, and health care facilities including emergency services and inpatient care. Another key factor in the workforce is that many residents of the communities surrounding the Project Area commute daily to either Truro or Amherst.

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 A and Cumberland Subdivision D. The RAA for 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 $115 million in investments into the province of Nova Scotia over the first 25 years. The Partnership 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. The Project Team hosted a CLC since 2019, which has helped to characterize potential Project-related opportunities and benefits for the local community.

Higgins Wind understands the importance of supporting local 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, 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 Nova Scotia 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 100 jobs for varying scope and duration throughout the two-year construction period. The largest construction scopes of work are anticipated to be:
    - Civil installation, responsible for land clearing, grubbing, road building, and foundation installation.
    - Electrical installation, responsible for transmission line, collector line and substation infrastructure installation, and connection to the NS Power grid.
    - Turbine installation, responsible for offloading of turbine components, stacking of the wind turbine generators, and commissioning.
- 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 a team of five operations and maintenance technicians can maintain regular operations and maintenance service for the proposed up to 17 turbines associated with the Project. 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 high-paying jobs.

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 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,* SNS 2006, c 22, the Municipalities of the County of Colchester and the County of Cumberland 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 $800,000 annually to the Municipalities, escalating in each year of operation. As the Project is spread across both Cumberland and Colchester Counties, the distribution of the tax revenue will be spread out based on the distribution of the turbines.

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, and be continuous.

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 is primarily "Commercial Forest" private land owned by Northern Timber Nova Scotia Corporation. There are also a collection of smaller parcels including Crown land and private land that are included in the Study Area. Land use around the Study Area is varied and includes several blueberry fields to the north and northwest, and a mix of "Resource Forest", residential, and farmlands to the east, south, and northeast along Highway 4 and the surrounding roads. Ski Wentworth is located northeast of the Study Area on Highway 4 and is a central attraction for many landowners in the immediate area. 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 the Wentworth Provincial Park and Wentworth Valley Wilderness Area. There are also Nova Scotia Nature Trust private conservation properties east of Highway 4 (for PIDs see Section 3.1) which, despite their private status, are used in similar ways to protected areas; and points of interest, including the Horse Pasture Brook Falls, Wentworth Falls, and Smith Brook Falls are located nearby.

There are no First Nations 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 First Nations resources and the results of the MEKS are included in Section 5.0.

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 is Colchester Subdivision A and Cumberland Subdivision D. 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 blueberry fields on and near the Study Area will not be disrupted by the Project, nor will the forestry activities that are ongoing in the area. As existing users of the private land parcels are primarily industrial 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, there is reason to believe that 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 (as reviewed in 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., 2010).

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 the 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 the 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).

Another recent review based on housing and property values within specific radii of wind farms and other energy infrastructure by Brinkley & 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).

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 Higgins Wind and gathered during stakeholder engagement to understand how the Project may interact with existing traffic volume and patterns.

8.3.2 Existing Environment

The center of the Project is located approximately 4 km west of Highway 4 and 8 km east of the Cobequid Pass toll section of Highway 104. The primary road running along the southern border of the Study Area is Back Road, which is approximately 8 km south of the center of the Study Area. Valley Road runs from Wentworth Station to Westchester Station approximately 4 km to the north, while intersecting Higgins Mountain Road. Higgins Mountain Road runs from the north boundary through the center of the Project and down the mountain to the southwest, while intersecting Tower Road, which runs from the southeast corner of the Study Area to the center at Higgins Mountain Road. Tower Road also runs directly under the NS Power transmission line LH-8001. Also branching off Higgins Mountain Road is Stephen Mountain Road, which runs parallel to Higgins Mountain Road to the west, ultimately reaching Webb Road near Westchester Station.

Throughout the Study Area, the roads are accessible by truck/SUV 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. In late summer the blueberry fields to the north end of the Study Area are harvested, though very few, if any, of those users travel south (i.e., further into the Study Area). 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. During the winter, Higgins Mountain Road, Stephen Mountain Road, Tower Road, and the roads that connect them are groomed snowmobile trails that are used exclusively for snowmobiles and other snow sports. This limits access in the winter to users with that specific equipment, or who are travelling on foot. The Fundy Trail Snowmobile Club and Sutherland's Lake Trail Groomer Association maintain the trails in the area and charge membership fees associated with the Snowmobile Association of Nova Scotia. Despite the inclusion of Tower Road into the grooming route of the trails, it is also the primary access road for NS Power and their associates, providing access to the L8001 and L8004 transmission line ROWs that cross the northeast portion of the Assessment Area.

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

Project activities primarily have the potential to interact with transportation during construction (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 A and Cumberland Subdivision D. The RAA extends from the LAA to the Port of Sheet Harbour. 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 requiring 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.

Mitigation Measures
- 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., 7 to 9 am and 3 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 Cumberland and Colchester County planning amendments

8.4.2 Existing Environment

The Project is located along the border of Colchester and Cumberland Counties, situated between Masstown in the Fundy Region and Tatamagouche/Wallace in the Northumberland Shore region.

The communities of Folly Lake, Wentworth Valley, Wentworth, Westchester Station, and Londonderry are home to a variety of primarily outdoor recreational activities. Approximately 6.5 km northeast 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 outdoor recreational activities such as hiking and sight-seeing that can be enjoyed in the spring, summer, and fall seasons.

The ski hill recently undertook mountain upgrades to increase capacity and lower wait times for visitors, through the addition of a new chairlift. Ski Wentworth has also shared that they are working on a master plan for an all-seasons retreat that will include a Nordic Spa, a new lodge, and accommodations for visitors. Current accommodations in the area are limited to private rentals (e.g., Airbnb or similar), as well as HI Wentworth, a member of Hostelling International Canada.

Skiers and other visitors travel to Wentworth throughout the winter for the ski hill, cross-country skiing, snowshoeing, and snowmobiling activities. In the summer, the draws include mountain biking with the Wentworth Mountain Bike Association, ATV use on the various trails (that are used for snowmobiling in the winter), and the use of other outdoor facilities. Wentworth Provincial Park is located approximately 8 km northeast of the Project and is often frequented by hikers and picnickers in the summer. Debert Golf Course, a nine-hole, par 36 course that is open to the public, is located 15 km southeast of the Study Area. Further to Ski Wentworth's existing property, it is understood that Ski Wentworth has plans for an expansion to the west side of Highway 4 near the Higgins Brook Falls. According to Ski Wentworth, development of this property as described in its conceptual master plan, would increase tourism amenities in the area and enhance recreation opportunities by connecting to existing trail networks in the area, increasing access and land usability.

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. During field surveys, several deer hunters were encountered on the site, along with blinds and tree stands that appear to have been used for hunting. Other mammalian hunting or trapping may occur on the site, though no signs were observed during field surveys.

Trout are confirmed to be present in Carter's Lake and several avian species were also observed. There is a small partially overgrown ATV trail that leads to the edge of the lake, providing access to the lakeshore and indicating possible fishing and/or waterfowl hunting in this area.

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. In the fall of 2021, the inaugural Higgins Mountain Rambler Gravel Bike Race occurred, making use of the road network throughout the Study Area, as well as some surrounding public roads and Wentworth Provincial Park. The race was held in 2022 as well, under a different name, "The Ramble before the Gamble", though it used many of the same roads and pathways. As mentioned in Section 8.3, the Sutherland's Lake Trail Groomers Association and the Fundy Trail Snowmobile Club are the local associations that care for and regulate the use of snowmobile trails in the region. Both clubs have clubhouses and associated facilities to support trail user access and enjoyment of the trail systems.

The only attraction of note within the Study Area, beyond wildlife and bird watching, is a memorial placed at the location of a plane crash from 1944. An RCAF Mosquito crashed during a training exercise and the memorial was erected in 2013, including the story and names of the victims.

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 A and Cumberland Subdivision D. 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 2017 Nova Scotia Visitor Exit survey, administered by Tourism Nova Scotia in 2015 and 2017 combined with results published in 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 HRM, 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.

The Wentworth Valley is a scenic area, being one of the most colourful drives in the province during the fall due to the abundance of hardwood trees and their colour-changing leaves. There is already visual evidence of the industrial activity in the area with the quarry at the north end of Folly Lake. Although the Project is generally well-hidden from surrounding vantage points, some of the wind turbines proposed would be visible from several locations along the highway, as well as by skiers at the ski hill. The proposed turbines would be in addition to those that are pre-existing on and near Higgins Mountain Road; the pre-existing turbines are presently visible from the ski hill and other local hiking trails. 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, skiing, 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". 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). Locally, Cumberland County is home to the Amherst Wind Farm and research was recently (2018) conducted on the public perception of wind energy by residents in Sackville, NB and Amherst, NS. Respondents to the survey largely supported an increase in wind energy infrastructure, both in a general context, as well as on the regional scale (Chappel et al., 2020; Chappel et al., 2021). Professor Kate Sherren, from Dalhousie's School for Resource and Environmental Studies, co-authored this research and provided a letter to the Cumberland County Planning Department during their by-law review in 2022 to summarize the findings (Sherren, 2022).

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). 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).

More recent studies have indicated that the first offshore wind farm in the United States generated an increase in tourism revenue in the nearby coastal region. The Block Island Offshore Wind Farm Project, the first of its kind in the United States, coincided with a direct increase in Airbnb reservations and occupancy rates for Block Island during the period directly after construction in the height of the tourist season (July and August) (Carr-Harris & Lang, 2019). Given the existing infrastructure in Wentworth, including the ski hill and all associated operations, there is capacity for local businesses to take advantage of a potential influx of tourism.

A number of ski resorts and similar businesses worldwide advertise the use of renewables to power their facilities, as the use of renewables can be seen as compatible with their outdoor recreation activities, especially when considering the potential impacts of climate change on their businesses (i.e., snow presence) (SNO Group Limited, 2023).

Snowmobile trails are present throughout the Study Area, including several of the roads that are maintained primarily as groomed trails in the winter months. To ensure continued and safe access to trails, a site-specific safety and shared use agreement/plan/memorandum will be developed through engagement with users. The plan will address snow clearing, access, signage, and communication.

The turbines will consist of a small footprint on privately owned land. 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 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.

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

As the Project will be one of the largest in Nova Scotia, other projects of similar scale, as well as those that are nearby are described below.

Stevens Wind, a 3.5 MW, three turbine wind energy project was constructed in 2006 and operated from 2007 to 2019. In the fall of 2022, one of the turbines was removed from the site, and it is anticipated that the additional turbines will either be removed or restored.

Nearby operational wind projects include Nuttby in Colchester County, with 22 turbines and a capacity of 50.6 MW, and Amherst in Cumberland County, with 15 turbines and a capacity of 30 MW.

Another proposed project in the area includes the Westchester Wind Project being developed by Natural Forces, which recently received EA approval from NSECC (NSECC, 2023), as well as the proposed Windy Ridge project being developed by RES, northwest of Debert, NS (RES, 2023).

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. Boreas Heritage Consulting Inc. (Boreas Heritage) was contracted to conduct the ARIA, which was directed by Sara Beanlands.

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 A2022NS134, issued by the NSCCTH – Special Places Program.

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 report itself provided directly to NSCCTH for review. It is understood that the findings and recommendations of the ARIA are considered “draft” until the report is 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, 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 model, developed by Boreas Heritage.

The field component involved an on-site visual examination of the Assessment Area. Parallel pedestrian transects were completed, at intervals of 20 m to 30 m (maximum of 50 m), across the Assessment Area to visually assess archaeological potential. These transects assist in maintaining effective coverage. Structured pedestrian transects assist 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).

The field study included visiting areas of high archeological potential and undertaking a preliminary shovel testing program to investigate these areas. The objective of the subsurface survey was to determine whether buried archaeological resources were present within areas ascribed high potential for encountering archaeological resources.

A baseline was established across each testing area to standardize and document the location of shovel tests and to facilitate detailed recording of any resources encountered. Shovel test pits, averaging 40 cm by 40 cm, were dug through the topsoil into subsoil at 5 m intervals. All soil removed from the test pits was screened through 6 mm wire mesh to facilitate the recovery of artifacts within the excavated soil. If archaeological resources were identified and appeared to extend beyond the previously defined high potential area, additional testing would be conducted to delineate archaeological site margins.

Details of the testing program and archaeological recording of identified features were documented in field notes, site plans, stratigraphic drawings, and photographs. A hand-held GPS unit was used to record UTM coordinates. All coordinates are UTM projection with NAD 83 as datum. Any archaeological resources encountered during the shovel testing program would be evaluated and sufficiently documented for registration within the MARI database. All artifacts recovered would be processed and catalogued in accordance with standards set by the Special Places Program of NSCCTH.

Upon completion of field activities, analysis and interpretation, the results of the assessment were summarized in the report (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

The field component of the ARIA was carried out between August and November 2022 and resulted in the identification of four areas (HPA-01, HPA-02, HPA-03 and HPA-04) considered to exhibit high potential for encountering archaeological resources, including the remains of a Second World War plane crash site. Preliminary shovel testing was undertaken at HPA-01 and a total of 42 shovel tests were manually excavated at 5 m intervals. No shovel tests within HPA-01 were recorded as positive for cultural material. Following the results of the ARIA, the Project Area was modified to ensure avoidance of HPA-02, HPA-03 and HPA-04.

Note that a minor layout modification was made to the Project following the completion of the ARIA, as further described in Section 7.3.3. As a result of this modification, an additional Heritage Research Permit has been obtained to assess this area and the associated ARIA will be completed as soon as snow conditions allow.

Ground disturbance associated with the transmission interconnection line is expected to be minimal and specific to the placement of power poles. Once the detailed design phase identifies the areas of disturbance, these areas will be investigated under a separate Heritage Research Permit from NSCCTH, prior to the construction of the transmission interconnection line. Should archaeological resources be identified, the design will be modified to ensure avoidance is achieved. The EA Branch and NSCCTH will be engaged throughout this process. No ground disturbance associated with the transmission interconnection line will occur until a separate ARIA is completed and accepted by NSCCTH.

With the exception of HPA-01 – HPA-04, all remaining portions of the Assessment Area are considered to exhibit low archaeological potential for encountering archaeological resources. As a result, Boreas Heritage recommends 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. Areas exhibiting high potential for archaeology resources have either been avoided (HPA-02, HPA-03, and HPA-04) or were subject to a preliminary shovel testing program (HPA-01), with no tests showing as positive for cultural material. As referenced above, an additional assessment will be

completed to address areas associated with the minor layout modifications, prior to any ground disturbance proceeding at these locations. Higgins Wind is committed to following any forthcoming recommendations from the archaeologist and NSCCTH related to this work.

Mitigation
The following mitigation measures are recommended:

- Ensure an archaeological monitor is present for any initial ground disturbance within the remainder of HPA-01, to prevent accidental impacts to areas ascribed high archaeological potential.
- Maintain avoidance of HPA-02, HPA-03, and HPA-04 throughout site activities.
- Complete an archaeological assessment to address the minor layout modifications (as described above). The EA Branch will be provided with the acceptance letter from NSCCTH prior to completion of any disturbance in those areas.
- 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 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 (170 m rotor diameter and 110.5 m hub height), the maximum throwing distance associated with the Project's turbines is 420.75 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 4, which is approximately 2.6 km northeast 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 110.5 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. 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**
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 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 N.

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 February 2022. Request for NAV Canada Land Use number received February 2022. Project Team responded with this information. No objection confirmation received September 2022. Updated layout to be submitted March 2023.
Maritime vessel traffic system radars	Canadian Coast Guard	Notification letter sent February 2022. No objection confirmation received February 2022. Updated layout to be submitted March 2023.
VHF omnidirectional range Primary air traffic control surveillance radar	NAV Canada	Notification letter sent February 2022. Land Use number received February 2022. Request for Transmission Line info received November 2022. Updated layout to be submitted March 2023.

Signal Source	Operator	Consultation Results
Weather radar	ECCC	Notification letter sent February 2022. No objection confirmation received September 2022. Updated layout to be submitted March 2023.
Radiocommunication Systems	Amherst Police New Glasgow Police RCMP Truro Police Stellarton Police Westville Police	Notification letter sent February 2022 Response received from the RCMP in February 2022 requesting coordination with Bell (see below), who are acting on behalf of the RCMP in the province with leased towers. Confirmation of receipt received from Westville Police February 2022. No objection confirmation received from Truro Police February 2022. Updated layout to be submitted March 2023.
Regulator	Innovation, Science and Economic Development Canada (ISED formerly Industry Canada)	Notification letter sent February 2022. Acknowledgement email received February 2022. Updated layout to be submitted March 2023.
Telecom	Bell Eastlink NCS Managed Services Inc. Rogers Communications Seaside Communications	Notification letter sent February – March 2022. Acknowledgement email received from Bell in March 2022. Acknowledgment email received from Eastlink in March 2022. Request for meeting received from NCS Managed Services Inc. in February 2022. Meeting with the Project Team took place on February 23, 2022. A follow-up email was sent by the Project Team on March 18, 2022 requesting a field visit to better understand concerns. Field visit completed

Signal Source	Operator	Consultation Results
		with NCS representative on April 20, 2022. Towers of concern identified during site visit were taken into consideration during subsequent Project iterations. Updated layout to be submitted March 2023.
Emergency Services	Wentworth Volunteer Fire Department Westchester Volunteer Fire Department	Notification letter sent February 2022. Updated layout to be submitted March 2023.

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, 17 notifications were submitted in total.

Correspondence received from DND, CCG, Nav Canada, ISED, ECCC, RCMP, Truro Police, Westville Police, Bell, and Eastlink confirmed receipt and (if relevant), indicated no objections.

NCS Managed confirmed receipt, requested and was granted, a meeting with the Project Team and subsequent field visit to identify concerns. The concerns identified were considered in subsequent Project iterations (post-field visit).

No response was received from Amherst Police, New Glasgow Police, Stellarton Police, Wentworth Volunteer Fire Department, Westchester Volunteer Fire Department, Seaside Communications, or Rogers Communications.

Mitigation
The following general mitigation measures regarding EMI will be implemented:

- Ensure 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.

Should additional layout modifications be required, the above agencies will be provided with the updated information, as appropriate.

Monitoring
No monitoring programs are recommended.

Conclusion
Results are characterized as low magnitude, 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, or 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 Assessment Area 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. Any structures located on "Project lands" were not included in the assessment.

The initial analysis was conducted using the WindPRO version 3.5.552 software package under worst-case scenario conditions (i.e., maximum amount of shadow) which assumes that all the criteria listed in Section 10.3.1 are always met.

As the worst-case scenario uses highly conservative assumptions, resulting in modelled conditions that are not possible to occur in practice, a real-case scenario was developed to better represent site characteristics. The real-case scenario incorporated the average daily sunshine hours from the Kentville weather station (Table 10.4) instead of the assumption of continuous sunshine used in the worst-case scenario.

The real-case scenario 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) were considered and the model assumed that the turbines were always in operation, which is not the case.

Table 10.4: Sunshine Data Used for the Real-Case Scenario

Month	Average Daily Sunshine Hours*
January	2.53
February	3.50
March	4.28
April	4.96
May	6.33
June	7.24
July	7.51
August	7.27
September	5.85
October	4.44
November	2.81
December	1.86

*Source: Kentville Weather Station (Available WindPRO Weather station closest to Project Area)

10.3.4 Assessment Results

A total of 322 potential receptors were identified within 2 km of the Study Area. Under worst-case scenario conditions (meeting criteria described in Section 10.3.1 above), three potential receptors exceed 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 Study Area are provided in Appendix O.

Table 10.5: Potential Receptors Impacted by Shadow Flicker – Worst-case Scenario

Receptor ID*	Hours of Shadow Flicker per Year	Minutes of Shadow Flicker per Day (on the worst day)
ER	39:51:00	37
EM	34:07:00	31
EL	29:54:00	35

* 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 real-case scenario 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 O.

Table 10.6: Potential Receptors Impacted by Shadow Flicker – Real-case Scenario

Receptor ID*	Hours of Shadow Flicker per Year**
ER	10:03:00
EM	8:51:00
EL	7:11:00

*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 Study Area (Drawings 10.1A – 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

Modelling for the real-case scenario 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 real-case scenario still assumes the wind turbines are always in operation (i.e., rotors always spinning) and does not account for screening by trees, outbuildings, or other local structures.

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. 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 viewscape, however, the Municipality of Cumberland recently underwent a planning review regarding wind turbine development. Following public hearings and comments, Council approved a wind turbine restrictive overlay in response to the community's desire to protect the visual landscape in the area. The restrictive overlay extends 3.2 km east and west of the centreline of Highway 4, from the Colchester border northwards to Highway 246 on the east and Highway 448 on the west.

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. The following locations were selected (Drawings 10.2A-10.2N):

- Folly Lake from Lafarge Lane (coordinates provided in Drawing 10.2B)
- Highway 4 from Wentworth Valley (coordinates provided in Drawing 10.2C)
- Folly Mountain (coordinates provided in Drawing 10.2D)
- Highway 4 along the Wallace River (coordinates provided in Drawing 10.2E)
- The lodge patio at Ski Wentworth (coordinates provided in Drawing 10.2F)
- Sutherland Lake from Westchester Road (coordinates provided in Drawing 10.2G)
- Isaac Lake from Webb Road (coordinates provided in Drawing 10.2H)
- Westchester Station from Valley Road (coordinates provided in Drawing 10.2I)
- The top of Ski Wentworth (coordinates provided in Drawing 10.2J)
- Londonderry from Baseline Road (coordinates provided in Drawing 10.2K)
- Folly Lake from Peninsula Drive (2 locations, coordinates provided in Drawing 10.2L to 10.2M)
- Folly Lake from Stevens Road (coordinates provided in Drawing 10.2N)

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-10.2N.

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:

- Westchester Station from Valley Road
- Isaac Lake from Webb Road
- Highway 4 along the Wallace River
- Folly Mountain

Turbines were not visible from the other observer locations.

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.

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 both construction and operational generated noise 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 to be used for the Project's construction were used to calculate noise levels at set distances from the Assessment Area in consideration of nearby receptors.

During the operational phase of the Project, 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. To quantify potential impacts of turbine generated noise on nearby receptors, detailed sound modeling was completed.

10.5.2 Regulatory Context

Changes to the acoustic environment during construction and operational activities could result in displacement, annoyance, and interference of 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			
Nova Scotia Department of Environment and Labour (now NSECC)	Guidelines for Environmental Noise Measurement and Assessment (NSECC, 1990)*	≤ 65	0700 to 1900
		≤ 60	1900 to 2300
		≤ 55	2300 to 0700
NSECC	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	Municipality of the County of Colchester Chapter 56 - Wind Turbine Development By-law	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
Municipality of Cumberland	Municipal Planning Strategy	Proponent to ensure that all turbines operate within the noise requirements established by the Provincial EA process	During the operation of wind turbines
Municipality of the County of Colchester	Neighbourhood Nuisance By-Law***	Defined as: "activity that by frequency or intensity unreasonably interferes with the enjoyment of the neighbourhood"	All hours
Municipality of Cumberland	Municipality of Cumberland Noise By-Law 09-01****	Defined as: "noise or sound that unreasonably disturbs the peace and tranquility of a neighborhood"	All hours
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, 2022)	85	8-hour maximum

*Note: NSECC is in the process of updating these guidelines (NSECC, 2022e) which are currently in consultation phase. Any changes to the guidelines as a result of 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.
***Noise emission caused by lawful construction activities (with a valid building permit) are exempt from this By-Law.
****This By-Law does not apply to lawfully operating businesses and their activities.

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 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.

Potential receptors (including sensitive receptors such as schools, daycares, and senior residences) located within 2 km of the Assessment Area were identified using GIS data from the Nova Scotia Geomatics Centre and aerial imagery.

Sound levels and impacts from blasting activities have not been included in this assessment as these activities are not anticipated. If blasting is determined to be required during construction, Higgins Wind 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 Assessment Area. 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. Any structures located on "Project lands" were not included in the assessment.

A review of EAs for wind projects was conducted to identify any existing operational turbines within 3 km of the Project.

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, either provided by the manufacturer or calculated by WindPRO, for the wind turbines.
- UTM coordinates for receptors (all non-Project participant structures within a 2 km radius of the Assessment Area were evaluated).
- A wind speed of 10 m/s, the speed at which the highest sound power level output is achieved (based on test data from the manufacturer).
- Topographic data for the surrounding area.

The ISO 9613-2 calculation method assumes meteorological conditions that are ideal for noise propagation, including a ground temperature of 10°C and 70% relative atmospheric humidity. A ground factor of 0.7 was applied to the model, representing predominantly 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 that has established and ongoing agriculture (primarily blueberry fields), 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 is most active. Surrounding the Study Area, there are a number of privately owned parcels which contain permanent and/or seasonal residences. Primary and secondary roadways within the Study Area include Highway 104, Highway 4, and Wentworth Collingwood Road. These roadways are travelled daily by vehicular traffic emitting different levels of sound, including transport trucks and motorcycles. Several developments in/near the Study Area also contribute to ambient sound levels including:

- Ski Wentworth (2 km northeast)
- Concrete quarry (north end of Folly Lake)
- Railway (bordering southern, eastern, and northern extent of the Study Area)

Stevens Wind, a 3.5 MW, three turbine wind energy project was constructed in 2006 and operated within the Study Area from 2007 to 2019. In fall 2022, one of the turbines was removed from the site, and it is anticipated that the additional turbines will either be removed or restored. Although these turbines are not currently operational, they historically contributed to the ambient sound levels within and surrounding the Study Area.

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

During construction activities, sound will predominantly be generated through the operation of construction equipment and heavy machinery such as cranes, backhoes, excavators, dump trucks, graders and transportation vehicles. 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]
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 (undated)
[2]Government of Ontario (2021)
[3]Transport Scotland (undated)
[4]Government of Oregon (undated)
[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 to 115 dBA (from a single piece of equipment within 15 m from the source). Construction activities are anticipated to occur between fall 2023 into 2025.

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 10.11 above. Combined sound levels produced by multiple pieces of equipment operating simultaneously has not been included in the assessment.

Operational Sound

A total of 322 potential receptors were identified within 2 km of the Study Area. Results of the sound modelling (presented as a heat map) are shown on Drawing 10.3 and detailed results are provided in Appendix P. No operational turbines exist within 3 km of the Project; therefore, only the Project turbines were modelled. No non-participating potential receptors exceed the recommended guideline of 40 dBA. The highest predicted sound level at a receptor is 36 dBA.

Information regarding turbine tonality will be confirmed 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. A literature review related to infrasound/low frequency sound is provided in Appendix P.

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
Assessment criteria provided in Section 4.6 apply for 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 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 have the potential to exceed these thresholds at some 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 to

be a temporary source of noise generated by the Project. Based on the desktop review, a total of:

- 44 potential receptors located within 0.5 km of construction activities which may result in median sound levels above 65 dBA during daytime hours.
- 322 potential receptors located within 2.0 km of construction activities which may result in median 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, which also contribute to baseline sound levels as a result of moving air and vegetation. Furthermore, the median sound level from construction is similar to 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 sound 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.

All potential non-participating receptors comply with the NSECC and the Municipality of the County of Colchester guidance for operational sound.

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.

Information regarding turbine tonality will be confirmed 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.

The Project will develop a complaint response protocol, which will 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	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 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	Low – 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	Low – 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 habitat, but overall habitat	Within the Assessment Area	Seasonal aspects not applicable;	Single event	Reversible	Not significant	Mitigation required; no

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?
	functions remain intact		long-term duration				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
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

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?
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 A and Cumberland Subdivision D extending to the Port of Sheet Harbour.	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 A and Cumberland Subdivision D	Seasonal aspects not applicable; medium-term duration	Intermittent	Reversible	Not significant	Mitigation required; no monitoring required
Archaeological Resources	Moderate to low – 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 Study Area	Seasonal aspects applicable; medium-term duration	Intermittent	Reversible	Not significant	No mitigation or monitoring required
Visual Impacts	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)	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 Study 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 Study 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, NS 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, 2015).
- 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, 2015).
- 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, 2015).
- 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, 2015).
- 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., 7-9 am and 3- 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
- Ensure an archaeological monitor is present for any initial ground disturbance within the remainder of HPA-01, to prevent accidental impacts to areas ascribed high archaeological potential.
- Maintain avoidance of HPA-02, HPA-03, and HPA-04 throughout site activities.
- Complete an archaeological assessment to address the minor layout modifications. The EA Branch will be provided with the acceptance letter from NSCCTH prior to completion of any disturbance in those areas.
- 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 notified in advance and 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 Project Area is over 10 km north of the Cobequid Bay, and over 30 km south of the Northumberland Strait. The access point leading to the Project Area from Valley Road is 127 masl, while the access point leading to the Project Area from Highway 4 is 198 masl. The majority of the Assessment Area, however, is between approximately 275-320 masl. The proposed turbine locations are between 270 masl and 355 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, although they have the lowest elevation, these roads are still a minimum of 127 masl and at least 10 km from the nearest tidal waters and are 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, Higgins Wind 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, 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, NS Reg. 135/2019 outline restrictions for burning and operating power saws during the fire season (March 15 to October 15). Burning restrictions are determine 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. 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 (0-5) to high (10-20) (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). Although most days (63 out of 122 days in June to September) in the wildfire season had a low FWI score, 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, BC 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.
- Ensure 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 turbines 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.

- Ensure all fuels, lubricants, and chemicals are stored in designated containers and areas.
- Provide secondary containment in storage areas (where possible).
- Ensure the equipment used is inspected and free of fluid leaks.
- Ensure 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).
- Ensure refueling of machinery and equipment is conducted on an impervious surface.
- Ensure any equipment servicing is completed off-site. If this is not possible, ensure the work is completed on an impervious surface.
- Ensure the storage of all dangerous goods comply with the Workplace Hazardous Material Information System (WHMIS).
- Ensure 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.
- Ensure 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

Stevens Wind, a 3.5 MW, three turbine wind energy project was constructed in 2006 and operated from 2007 to 2019. In the fall of 2022, one of the turbines was removed from the site, and it is anticipated that the additional turbines will either be removed or restored.

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	Throughout Study Area	Within AA
Agriculture	Agricultural fields (planting, harvesting, spraying, etc.).	Active	Throughout Study Area	Within AA (access roads)
Ski Wentworth	Ski resort	Active	14595 NS-4, Wentworth, NS	2.0 km NE
Quality Concrete Quarry	Concrete quarry	Active	Northern end of Folly Lake	3.5 km E
Railway	Railway	Active	Bordering the southern, eastern, and northern extent of Study Area	0.08 km N

*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	There are no new watercourse crossings associated with this Project.
Fish & Fish Habitat	No	There are no new watercourse crossings associated with this Project.

VC	Cumulative Effects Assessed	Reasoning
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	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	No	The Project Area is maximizing the use of existing roads, clearings, and infrastructure to minimize potential impacts to fauna SOCI and associated habitat. In addition, high quality habitat identified through modelling and field observations will be avoided and minimized by the Project Area. Further, in the absence of the Project, it is likely that the Project Area would still be subject to future clearing/disturbance from forestry activities.
Bats	No	No nearby operational wind developments. The nearest wind development is located approximately 24 km south near Truro, NS.
Avifauna	No	No nearby operational wind developments. The nearest wind development is located approximately 24 km south near Truro, NS.
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 24 km away and will not act cumulatively with the Project.
Visual Aesthetics	No	Residual impacts considered not significant.

VC	Cumulative Effects Assessed	Reasoning
Sound	No	Sound levels from the operation of wind turbines are below guidance thresholds. The nearest operational wind development is 24 km away and will not act cumulatively with the Project.

None of the identified VCs have been considered or assessed at a cumulative level based on no existing wind developments within 3 km of the Study Area and the nature of nearby industrial activities. Industrial activities identified (i.e., forestry, quarry, agriculture) are not anticipated to interact with the Project in a way that results in adverse cumulative impacts on the surrounding biophysical, archeological/ cultural, or socioeconomic environment. Active forestry activities have already resulted in wide-spread habitat removal and an existing road network throughout the Study Area, which the Project is utilizing to minimize requirements for clearing. In addition, it is also likely that a large portion of the remaining required tree removal for the Project would have been subject to future harvesting in the absence of the Project.

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 Q. A list of the Project Team and their associated roles is provided below.

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