ENVIRONMENTAL ASSESSMENT
REGISTRATION DOCUMENT

Walden Quarry Expansion Project
Walden, Nova Scotia

PREPARED FOR

Dexter Construction Company Ltd
927 Rocky Lake Dr.
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PREPARED BY

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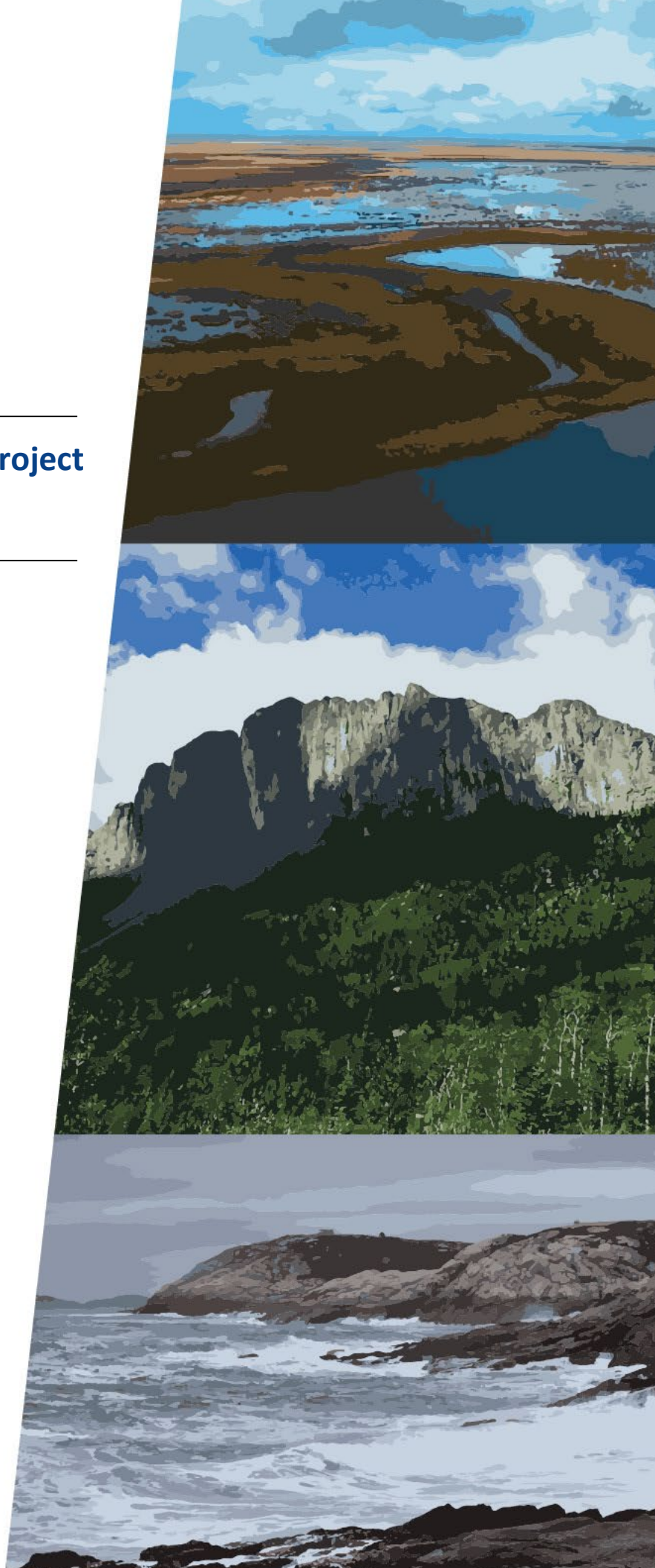
October 25, 2023



McCallum Environmental Ltd.

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EXECUTIVE SUMMARY

Municipal Enterprises Limited (MEL), an affiliated company of Dexter Construction Company Limited (Dexter), operates an existing <4 ha aggregate quarry under a Nova Scotia Environment and Climate Change (NSECC) Industrial Approval (2015-092380) at 2995 Woodstock Road, Walden, Lunenberg County, Nova Scotia. The Walden Quarry has been an NSECC approved quarry since 2015 and serves as an important source of construction aggregate for local and Nova Scotia Department of Public Works (NSDPW) projects in the area.

Dexter is proposing to expand the quarry operating footprint to increase available aggregate material and ensure that a long-term aggregate supply is available to support local Project and infrastructure needs in the future. The Nova Scotia Environment Act, Environmental Regulations require that the proponent of "a pit or quarry in excess of 4 hectares in area, primarily engaged in the extraction of ordinary stone, building or construction stone, sand, gravel or ordinary soil" must register it for an Environmental Assessment (EA) as a Class I undertaking.

The proposed quarry expansion (the Project) would see the existing <4 ha quarry expanded an additional 23.8 ha. Other than an increase in the total footprint of the site and the increase in the Project's life, site activities are not planned to increase in scope or frequency from past use. The predicted timeline of the Project is expected to be over a 40+ year period. The Quarry Expansion Area (QEA) will be developed progressively, expanding from the existing quarry area westward.

Project activities include clearing and grubbing, drilling and blasting, stockpiling, crushing, and hauling. Final reclamation of the Project will be completed at the conclusion of extraction when aggregate reserves have been fully exhausted within the QEA and in line with the *Pit and Quarry Guidelines*. A progressive reclamation approach will focus on rehabilitation strategies within the quarry footprint throughout the development and operations phases of the site.

<u>Mi'kmaq and Public Engagement</u>

Early engagement was initiated through provision of the Project description and an invitation to discuss the Project. In October 2022, a letter containing the Project overview, location map, anticipated EA timeline, and an offer to meet to discuss the Project was emailed to seven First Nation communities/organizations. A follow up email was sent to the same First Nation communities/organizations in October 2023 providing an updated Project overview and registration timing.

Dexter sent requests via email to meet with various political stakeholders in June and August 2023. No responses have been received to date. Further public engagement on the Project will be completed through published notices and comment periods through the EA process.

Dexter is committed to maintaining open lines of communication with interested Mi'kmaq communities and the public through the life of the EARD process and the construction, operational and decommissioning phases of the Project.

Study Areas

Spatial boundaries of the EA are defined by the Study Area, Fish Study Area, QEA and IA Permit Area. The IA Permit Area is the existing <4 ha Walden Quarry under a NSECC Industrial Approval (2015-092380). The QEA (23.8 ha) extends northwestward from the IA Permit Area and encompasses the proposed Project footprint to include the maximum extent of ground disturbance associated with quarry expansion area . The QEA boundary was microsited to the southwest and east to avoid sensitive environmental features. The Study Area comprises the QEA and was designed to include the maximum extent of expected terrestrial impacts, in consideration of property ownership and compliance boundaries. Evaluation of watercourses, fish and fish habitat was completed within the Fish Study Area (67.5 ha), which serves as an extension of the Study Area. The Fish Study Area was defined to consider the maximum extent of potential direct and indirect impacts to fish and fish habitat.

Environmental Effects Assessment

The Environmental Assessment Registration Document (EARD) has been prepared to evaluate the effect of the Project on Valued Environmental Components (VEC). A summary of each VEC and Project interactions are outlined below.

Air Quality

Air quality (dust) has the potential to adversely affect human health at adjacent residential receptors and the health of flora. Air quality at the Project will be regulated under the Site Industrial Approval and *Pit and Quarry Guidelines*, where particulate emission limits are required to be met at the Project property boundaries. Quarry expansion is not expected to decrease air quality compared to current baseline conditions, as the existing quarry has been in operation since 2015 and there is no proposed increase to the magnitude and frequency of activities likely to generate dust. Quarry expansion will increase the life of the Project; therefore, the duration of these activities is proposed to be increased. Air quality is expected to return to baseline conditions during periods of site inactivity and post-reclamation. After mitigation measures are implemented, and the *Pit and Quarry Guidelines* are adhered to, the predicted residual environmental effects for air quality are assessed not to be significant.

Noise

Noise has the potential to adversely affect residential receptors adjacent to the Project as well as fauna and avifauna. Noise at the Project will be regulated by the Site Industrial Approval, the *Occupational Health and Safety Act*, and *Pit and Quarry Guidelines*. One existing permanent residential receptor (Receptor 1) was identified within 800 m of the QEA. Dexter has authorization to conduct blasting at the existing quarry and within the QEA. Relatively intact forest lands separate local residences from Project infrastructure, therefore, Project generated noise from blasting is not expected to be transmitted at a significant degree to adjacent receptors. All municipal by-laws will be followed to ensure that allowable noise levels are not exceeded. Proposed Project activities are in line with the current magnitude of operations and no increased frequency of activities is anticipated. Quarry expansion will extend the life of the Project; therefore, the duration of these activities is proposed to be increased. Noise is expected to return to baseline conditions

during periods of inactivity and post-reclamation. After commitments and mitigation measures are implemented, and the *Pit and Quarry Guidelines* are adhered to, the predicted residual environmental effects for noise are assessed not to be significant.

Geology and Topography

Quarry expansion will alter the immediate surficial and bedrock geology as well as local topography. Exposed soils have the potential to affect surface water quality through erosion and sedimentation and changes in surface water volume discharged downstream and potentially Acid Rock Drainage (ARD) in certain types of bedrock. The bedrock underlying the Study Area is part of the Goldenville Formation, the NSDNRR ARD Potential Map identifies that the Study Area falls within an area of low ARD potential and ARD testing indicated sulphur concentrations in the sample is below the requirement (0.4 Wt.%) for handling under the Sulphide Bearing Materials Disposal Regulations and does not have significant acid producing potential. No sulphide-bearing rock has been encountered during current quarry operations. A surface water monitoring program will be implemented to ensure that Total Suspended Solids (TSS) and pH levels remain within acceptable parameters. The predicted residual effects are assessed not to be significant.

Groundwater

Quarrying has the potential to affect groundwater quantity by altering recharge/discharge functions and quantity and groundwater flow paths. Groundwater quality could also be affected from blasting or rock-water interaction. Effects to groundwater quantity and quality (and surrounding wells) from quarry expansion is unlikely because the quarry floor is permeable, allowing for infiltration. No additional hard landscaped areas are proposed in the QEA (i.e., impermeable, compacted areas such as paved roads or other constructed infrastructure). A drilled well is present within 800 m of the QEA, at Receptor 1, and Dexter has authorization to conduct blasting at the existing quarry and within the QEA. Overall groundwater recharge is expected to remain unchanged from existing conditions, but groundwater flow paths may be locally disrupted.

Site operations and existing aggregate excavation has not encountered the deep bedrock water table as evidenced by the lack of water ponding on the quarry floor or intrusion of groundwater through the highwall. It is the intention of Dexter to not excavate or blast below the water table in the QEA. If future quarry operations are planned to extend below the groundwater table, a hydrological study will be completed, and approval from NSECC prior to excavation below the groundwater table.

No significant residual environmental effects to groundwater quality and quantity anticipated, however, a groundwater monitoring program will be implemented to validate predictions.

Habitat, Vascular Plants, and Lichens

Direct loss to wetland and upland habitats is expected to occur primarily during the construction phase of the Project (i.e., clearing and grubbing). No Species at Risk (SAR) vascular plant species were identified. The two occurrences of a Species of Conservation Interest (SOCI) vascular plant, southern twayblade, will be avoided by the Project. One SAR lichen, frosted glass-whiskers, was identified at one location within

the Study Area and will be avoided by the Project. Three occurrences of two SOCI lichen, corrugated shingles lichen and blistered tarpaper lichen, are proposed to be directly impacted from the Project.

The predicted residual environmental effects are assessed to be not significant because no permanent, unmitigated alteration to habitat that supports flora/lichen species distribution, where similar habitat is not currently available at the local/regional level, is expected. No SAR vascular plants or lichen will be lost as a result of the Project.

Fauna

Quarry activities have the potential to have an effect on the fauna from potential mortality, sensory disturbance, and the loss or alteration of habitat and habitat fragmentation. No priority mammal species were observed within the Study Area during the wildlife surveys or incidentally, including during dedicated mainland moose surveys. Two SAR turtle species, Eastern painted turtle and snapping turtles, were observed incidentally in wetland 1 (WL1) and Bagpipe Lake. Nests and tracks were observed within the IA permit Area and adjacent road.

Habitat will be lost as a result of the Project, but the habitat present in the Study Area is common to the regional area and available in the surrounding landscape. The geographic extent of the QEA is relatively small (23.8 ha). The activities likely to create the greatest indirect impact to fauna are sensory disturbances from blasting and crushing. These activities will only occur as required (e.g., anticipated one blast per year during years in which the quarry is active). Turtle exclusion fencing has already been erected at the existing quarry. Exclusion fencing or other deterrence strategies will be maintained through the operational life of the proposed Project. During inactive periods, sensory disturbance will reverse to baseline conditions as it will be post-reclamation. After mitigation measures are implemented (including a wildlife management plan), no significant residual effects of the Project on fauna are anticipated.

Avifauna

Quarry activities have the potential to have an effect on the avifauna from potential mortality, sensory disturbance, and the loss or alteration of habitat and habitat fragmentation. Avifauna surveys included migration (spring and fall), breeding, nocturnal owl, and common nighthawk. Four avifauna SAR were observed: Canada warbler, olive-sided flycatcher, eastern wood-pewee, and peregrine falcon.

Physical loss of bird habitat within the QEA, and the likely displacement of birds as a result of quarrying will occur but is expected to be small in scale and not impact regional populations and patterns. The activities likely to create the greatest indirect impact to avifauna are sensory disturbances from blasting and crushing. These activities will only occur as required (e.g., anticipated one blast per year during years In which the quarry is active). During inactive periods, sensory disturbance will reverse to baseline conditions as it will be post-reclamation. After mitigation measures have been implemented, the predicted residual environmental effects are assessed to be not significant.

Wetlands

Ten wetlands were identified within the Study Area and total approximately 4.1 ha. Swamps make up the majority of these wetlands (90%). Five wetlands (WL1, 2, 4, 5 and 9) are noted as potential Wetlands of Special Significance (WSS) based on the presence of SAR and suitable habitat. Seven wetlands are proposed for direct alteration. The QEA was microsited to avoid direct and indirect impacts to two WSS (WL1 and 2). WL4, 5 and 9 could not be avoided by the Project. None of the wetlands within the Study Area are classified as a functional WSS.

Wetland alteration approvals will be obtained for wetlands proposed for alteration, wetlands altered will be appropriately compensated for, and a wetland monitoring program will be implemented for wetlands partially altered or with potential to be indirectly affected by the Project (i.e., WL2, 5, and 10). As a result, the predicted residual environmental effects to wetlands are assessed to be not significant.

Surface Water, Fish and Fish Habitat

Two field identified watercourses, WC1 (Big North Brook) and WC2 (Little North Brook), and two waterbodies, Pond 1 and Bagpipe Lake, were delineated and characterized within the Fish Study Area.

- Big North Brook (WC1) is a provincially mapped watercourse that originates to the north of the Fish Study Area, flows through Pond 1 and continues south beyond the Fish Study Area before draining into Little Mushamush Lake;
- WC2 originates along the edge of an access road, traveling southwest through a provincially mapped wetland and acts as the main inflow to Bagpipe Lake;
- Pond 1 is a waterbody that is present within WC1/WL1 and situated along the northeastern boundary of the Fish Study Area;
- Bagpipe Lake is a waterbody that is located in the Fish Study Area, receives inflow of surface water from WC2 and has an outflow (Little North Brook; not assessed) that drains into Little Mushamush Lake.

Seven fish species (105 individuals) were captured (i.e., electrofishing and trapping surveys) within the Fish Study Area, including one SAR, American eel.

No surface water features or fisheries resources were identified within the QEA. The closest watercourse, WC1, will be avoided by Project activities and a 30 m buffer will be maintained around this watercourse during quarry expansion. As such, no direct impacts to fish or fish habitat are expected to occur because of the Project.

Indirect effects associated with quarry development include changes to surface water quantity and quality to downstream aquatic receivers. A WBA found that all assessed POIs were expected to have less than a 10% reduction in flow as a result of Project changes to the contributing drainage areas. Little North Brook-3 (WC2) is predicted to experience a decrease in annual streamflow of 9.46% during Operating and

Reclamation conditions. All other POIs are predicted to see minimal impacts and require no further analysis (-3.23% to 1.19% change in drainage area). The predicted decreases in runoff to WC2 is not expected result in changes to the morphological characteristics (i.e., bed or bank) of the watercourse, or in detectable changes to the existing fish community and the fish habitat provided by the watercourse.

Surface water discharge from the quarry site will be sampled as per requirements listed in the IA to meet the *Pit and Quarry Guidelines.*

After mitigation measures have been implemented, the predicted residual environmental effects on surface water, fish and fish habitat are assessed to be not significant.

Economy

The Project will benefit the economy as an important part of Nova Scotia's natural resource sector. The Project will also benefit the people of Nova Scotia via the continued construction and maintenance of the Provincial highway system and support the local community via a source of aggregate for local infrastructure needs. During periods of site operation, activity at the quarry will provide a stimulus to local businesses (e.g., restaurants and hotels). A positive effect on the economy is anticipated from the Project.

Land Use and Value

The Project is located on private land owned by Dexter. Reclamation of the quarry will return the site to pre-quarrying conditions, to the extent practicable. The Project is anticipated to have minimal impact upon the use of the lands when compared to existing baseline conditions and once reclamation is completed. As the Project is an expansion of an existing quarry operation, it is unlikely that there will be a change in property value. The Project is predicted to not have a significant effect on land use and value.

Recreation and Tourism

There are no provincial parks or known sensitive heritage or cultural attractions near the Study Area nor are there any designated public recreational trails or public recreational lands present inside the Study Area. While Mahone Bay and associated tourist attractions are located ~15 km southeast of the Project, tourism in the immediate area surrounding the Project is relatively low, therefore, the impacts of the Project on tourism are anticipated to be negligible. The Project is predicted to not have a significant effect on recreation or tourism.

Human Health

Potential impacts to human health from the Project development and operations include effects from air quality, noise, and accidents or malfunctions. The Project will generate noise and dust and has the potential to result in a spill or release, however, after mitigation measures are implemented and the Industrial Approval conditions and *Pit and Quarry Guidelines* are adhered to, no adverse effects to human health are predicted.

Cultural and Heritage Resources

No significant archaeological features were identified within the Study Area during field reconnaissance. The portions of the Study Area ascribed elevated potential for encountering Mi'kmaw archaeological resources through desktop review are beyond the boundaries of the proposed QEA. The remainder of the Study Area has been ascribed low archaeological potential. Due to a low potential for archaeological resources, of either Mi'kmaq or European-descended origin within the Study Area, no direct or indirect impacts to Cultural and Heritage Resources are expected as a result of the Project.

Conclusions

The findings of this EARD indicate that residual environmental effects will not be significant for identified VECs. Monitoring will be completed to confirm the predicted effects and determine if additional mitigation measures need to be implemented utilizing an adaptive management approach.

Monitoring

Dexter commits to developing the following monitoring plans or programs:

- Surface Water Monitoring Plan
- Groundwater Monitoring Plan
- Wetland Monitoring Plan
- A qualified blasting professional will monitor all blasts.
- Sedimentation, erosion control and monitoring will be implemented using industry best-practices.

Monitoring of Air and/or Noise will be completed at the request of NSECC and in accordance with IA terms and conditions.

Additional Commitments

Dexter commits to the following additional commitments:

- Ongoing engagement with Mi'kmaq communities and organizations and the public throughout the life of the Project.
- Development of a Surface Water Management Plan
- Development of a Reclamation Plan
- Development of a Wildlife Management Plan
- Development of a Contingency Plan

The plans noted above will be developed to meet EARD and/or IA approval terms and conditions. Plans will be submitted as part of the IA amendment process, or as necessary based on Project and approval timelines.

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LIST OF TABLES

LIST OF ACRONYMS

ACCDC	Atlantic Canadian Conservation Data Centre
ACPF	Atlantic Coastal Plain Flora
AMO	Abandoned Mine Opening
AQHI	Air Quality Health Index
ARD	Acid Rock Drainage
ARIA	Archaeological Resource Impact Assessment
ASL	Above Sea Level
ATV	All-Terrain Vehicle
BSC	Bird Studies Canada
CCME	Canadian Council of Ministers of the Environment
CCTH	Coordinator of Special Places
CM	Centimeters
CONI	Common nighthawk
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	Catch Per Unit Effort
CWS	Canadian Wildlife Services
dBA	*Decibels*
DFO	Fisheries and Oceans Canada
DO	Dissolved Oxygen
EA	Environmental Assessment
EARD	Environmental Assessment Registration Document
EC	Environment Canada
ECCC	Environment and Climate Change Canada
ELC	Ecological Land Classification
ESC	Erosion and Sediment Control
FBP	Functional Benefit Product
FEC	Forest Ecosystem Classification for Nova Scotia
FACW	Facultative Wetland
FAC	Facultative
FN	First Nations
FWAL	Protection of Aquatic Life for Freshwater Guidelines
GIS	Geographic Information System
GPS	Global Positioning System
HA	Hectares
IA	Industrial Approval
IBA	Important Bird Area
IH	Intolerant Hardwood Forest Group
Kg	Kilogram
KM	Kilometer
KMKNO	Kwilmu'kw Maw-klusuaqn Negotiation Office
KMKNO-ARD	Archaeology Research Division of Kwilmu'kw Maw-klusuaqn
L	Litres

LiDAR	Light Detection and Ranging
M	Meters
MA	Marsh Group
MBBA	Maritime Breeding Bird Atlas
MBS	Migratory Bird Sanctuary
MEKS	Mi'kmaq Ecological Knowledge Study
MTRI	Mersey Tobeatic Research Institute
NAPS	National Air Pollution Surveillance
NS	Nova Scotia
NSDNRR	Nova Scotia Department of Natural Resources and Renewables
NSE	Nova Scotia Environment
NSCCH	Nova Scotia Communities, Culture and Heritage
NSECC	Nova Scotia Environment and Climate Change
NSDPW	Nova Scotia Department of Public Works
NSESA	Nova Scotia Endangered Species Act
NSGWN	Nova Scotia Groundwater Well Network
NSTDB	Nova Scotia Topographic Database
OBL	Obligate
OLA	Nova Scotia Office of L'nu Affairs
PC	Point Count
PGI	Pellet Group Inventory
PI	Prevalence Index
PID	Property Identification Number
PM	Particulate Matter
POI	Point of Interest
QEA	Quarry Expansion Area
RGWD	Relative Groundwater Depth
SAR	Species at Risk
SARA	Species at Risk Act
SH	Spruce Hemlock Forest Group
SMP	Special Management Practices
SOCI	Species of Conservation Interest
SOP	Standard Operating Procedure
SP	Spruce Pine Forest Group
SRank	Status rank
SS	Shrub Swamp Group
TDS	Total Dissolved Solids
TH	Tolerant Hardwood Forest Group
TSS	Total Suspended Solids
UTM	Universal Transform Mercator
VEC	Valued Ecosystem Components
WBA	Water Balance Assessment
WESP-AC	Wetland Ecosystem Services Protocol – Atlantic Canada

WSS	Wetland of Special Significance
WC	Watercourse
WC	Wet Coniferous Forest Group
WL	Wetland
WQ	Water Quality

AUTHORIZATION OF APPLICATION FOR APPROVAL

The following authorizes McCallum Environmental Ltd. to submit this registration document on our behalf:

Municipal Enterprises Limited, an affiliated company of Dexter Construction Company Ltd.
Name of Proponent

Gary Rudolph, P.Eng
Name of Proponent Applicant

Director of Aggregates and Pavement Rehabilitation
Title

October 10, 2023
Date


Signature

1 GENERAL INFORMATION

The Project summary is provided below.

Table 1-1 Project Summary

General Project Information	Dexter Construction Company Limited intends to expand a facility that recovers and processes construction aggregate within Property Identification Numbers (PID) 60690302 and 60696549 at 2995 Woodstock Road, Walden, Nova Scotia.
Project Name	Walden Quarry Expansion (the Project)
Proponent Name	Municipal Enterprises Limited (MEL) An affiliated company of Dexter Construction Company Ltd (Dexter)
Proponent Contact Information	927 Rocky Lake Dr. Bedford, Nova Scotia B4A 3Z2 Business: (902) 835-3381
Proponent Project Directors	Gary Rudolph, P.Eng Director of Aggregates and Pavement Rehabilitation
Project Location	• The Study Area is located at 2995 Woodstock Road, Walden, Lunenberg County, Nova Scotia. • The Study Area is located within PIDs 60690302 and 60696549. • The approximate centre of the Study Area is located at 20T 388049 m E 4932912 m N. • The Study Area encompasses a larger footprint than that of the proposed Quarry Expansion Area (QEA).
Landowner(s)	The Study Area is located on private land, wholly owned by Dexter.
Closest distance from the proposed quarry to a residence	The closest residential receptor is located approximately 350 m west of the Study Area (and 380 m from the QEA).
Federal Involvement, Permits and Authorizations	No federal Environmental Assessment is required with the Impact Assessment Act of Canada (IAAC) based on a review of the Physical Activities Regulations. The following federal legislation apply during the lifetime of the Project. 1. *Species at Risk Act* 2. *Migratory Bird Conventions Act* 3. *Fisheries Act*
Provincial Authorities issuing Approvals	Nova Scotia Environment and Climate Change (NSECC)

Required Provincial Permits & Authorizations	The following permits, authorizations and/or approvals may be required which will allow for the construction and operation of the Project: 1. *Environmental Assessment Approval.* Approved pursuant to Section 40 of the *Environment Act* and Section 13 (1)(b) of the *Environmental Assessment Regulations* in Nova Scotia, Canada. 2. *Industrial Approval* (IA) pursuant to Activities Designation Regulations, Division V, Section 13(f) 3. *Watercourse Alteration Approval* Pursuant to Activities Designation Regulations, Division I, Section 5A (2) 4. *Wetland Alteration Approval* Pursuant to Activities Designation Regulations, Division I, Section 5A (2)	
Provincial Regulatory Authorities Consulted during EA and Project Development Process	NSECC Environmental Assessment Branch: • Mark McInnis, Environmental Assessment Officer Nova Scotia Department of Natural Resources and Renewables (NSDNRR): • Dr. Donna Hurlburt, Manager Biodiversity • Peter Kydd, Regional Biologist • Mark McGarrigle, Species at Risk Biologist Nova Scotia Office of L'nu Affairs (OLA): • Salima Medouar, Consultation Advisor	
Municipal Authorities	Municipality of the District of Lunenburg	
Required Municipal Permits & Authorizations	None for the proposed quarry.	
Funding	All Project related costs are proposed to come from Dexter. No public or government funding has been obtained to support this Project.	
Environmental Assessment Document Completed By:	**McCallum Environmental Ltd.** Suite 115, 2 Bluewater Road Bedford, Nova Scotia B4B 1G7	Meghan Milloy, MES Jeff Bonazza, M.Env.Sci. Sarah Scarlett, M.Sc. Hannah Machat, MREM Katrina Ferrari, B.Sc. Melissa Dube, B.Sc.

2 PROJECT INFORMATION

The following sections outline the proponent profile, the environmental assessment team, a description of the Project and location, and proposed future operations.

2.1 Project Overview

Municipal Enterprises Limited (MEL), an affiliated company of Dexter Construction Company Limited (Dexter), operates an existing <4 ha aggregate quarry under a Nova Scotia Environment and Climate Change (NSECC) Industrial Approval (2015-092380) at 2995 Woodstock Road, Walden, Lunenberg County, Nova Scotia (PID 60690302 and 60696549; Figure 1, Appendix A). The Walden Quarry has been an NSECC approved quarry since 2015 and serves as an important source of construction aggregate for local and Nova Scotia Department of Public Works (NSDPW) projects in the area.

Dexter is proposing to expand the quarry operating footprint to increase available aggregate material and ensure that a long-term aggregate supply is available to support local Project and infrastructure needs in the future. The Nova Scotia Environment Act, Environmental Regulations require that the proponent of "a pit or quarry in excess of 4 hectares in area, primarily engaged in the extraction of ordinary stone, building or construction stone, sand, gravel or ordinary soil" must register it for an Environmental Assessment (EA) as a Class I undertaking.

McCallum Environmental Ltd. (McCallum) was retained by Dexter to complete the Environmental Assessment Registration Document (EARD) for the Project.

2.2 Proponent Profile

The construction arm of the Municipal Group of Companies, Dexter originated in New Brunswick in 1961. Since then, Dexter has expanded its operations throughout Atlantic Canada and beyond, while remaining a locally owned and privately held company. Based on local contracts, Dexter typically mobilizes a fleet of modern equipment and a knowledgeable workforce comprised of thousands of qualified professionals and tradespeople — enabling them to successfully compete in any area of heavy civil construction.

Dexter Construction Company Limited Aggregate Management Team consists of:

- Gary Rudolph, P.Eng.
- Rhett Thompson, P.Eng.
- Gavin Isenor, P.Geo.

The Environmental Assessment Project Team consists of:

- Meghan Milloy, MES, McCallum Environmental Ltd;
- Jeff Bonazza, M. Env. Sci., McCallum Environmental Ltd;
- Sarah Scarlett, M.Sc., McCallum Environmental Ltd;
- Mark MacDonald, M.ScF., McCallum Environmental Ltd;
- John Gallop, B.Sc., McCallum Environmental Ltd (former);

- Emma Halupka, M.Sc., McCallum Environmental Ltd;
- Jessica Lohnes, B.Sc., McCallum Environmental Ltd;
- Katrina Ferrari, B.Sc., McCallum Environmental Ltd;
- Chris Muirhead, M.A.Sc, P.Eng, GHD;
- Kyle Cigolotti, BA, Cultural Resource Management Group Limited
- Logan Robertson, BA, Cultural Resource Management Group Limited
- Robert Shears, MA, RPA, Cultural Resource Management Group Limited
- Shawn MacSween, BA, Cultural Resource Management Group Limited

CVs are provided in Appendix B.

2.3 Project Location and Characteristics

The proposed Project is located in a rural setting and is bounded by the communities of Middle New Cornwall to the south (4 km), Upper New Cornwall to the west (5 km), Mahone Bay to the southeast (15 km; Figure 1, Appendix A). The quarry entrance is situated at 2995 Woodstock Road and the approximate centre of the Study Area is located at UTM 20T 388049 m E 4932912 m N. The Study Area includes the entirety of PIDs 60696549 and 60690302 owned by Dexter. All Project PIDs are privately owned.

Two Study Areas were defined for the project, the general Study Area and the Fish Study Area (Section 6.2). The Study Area and Fish Study Area are 44.4 ha and 67.5 ha, respectively. The Fish Study Area encompasses the Study Area as well as Bagpipe Lake, Little North Brook and a portion of Big North Brook and associated wetland area (Figure 2, Appendix A). Little North Brook flows towards Bagpipe Lake, whereas Big North Brook drains south into Little Mushamush Lake which flows southeast for approximately 9 km before emptying into the Atlantic Ocean (Figure 1, Appendix A).

Aerial imagery and the completion of ground-truthing surveys were used to determine site characteristics and surrounding land-use. Overall, the majority of the Study Area exhibits forested land. Evidence of disturbance is present in smaller areas of the Study Area including the existing <4 ha quarry and an access road that bisects the Study Area.

Based on a review of aerial imagery and ground truthing, the closest residential receptor (Receptor 1) within 800 m of the Study Area and the Quarry Expansion Area (QEA) is a permanent residence located on the north shore of Bagpipe Lake (Table 2-1; Figure 3, Appendix A). A seasonal camp with no well present is also situated within 800 m of the QEA, 370 m northeast of the Study Area on Whale Lake. Dexter has authorization to conduct blasting at the existing quarry and within the QEA.

Table 2-1. Receptors within 800 m of the Walden Quarry Expansion Area

Structure ID	Receptor 1
Structure Location Description	Situated on the northern extent of Bagpipe Lake
PID	60698115
Distance from Study Area (m)	350
Distance from the QEA (m)	380
Direction from the QEA	W
Seasonal/Permanent Residence	Permanent
Potable Well	Confirmed
Well type	Drilled

2.4 Purpose and Need for the Undertaking

Dexter is proposing to expand the quarry's operating footprint to increase available aggregate reserves and ensure that a long-term aggregate supply is available to support local projects and infrastructure needs in the future. The proposed quarry expansion would see the existing <4 ha quarry expanded an additional 23.8 ha. Other than an increase in the total footprint of the site and the increase in the Project's life, site activities are not planned to increase in scope or frequency from past use.

The primary benefit of the Project will be to the people of Nova Scotia via the continued construction and maintenance of the Provincial highway system. The Project will also support the local community with source of aggregate for local infrastructure needs and continued employment opportunities.

2.5 Consideration of Alternatives

Quarries are established where quality aggregate reserves are identified, and applicable environmental and logistical considerations are satisfied. Dexter maintains a strategic network of NSECC approved aggregate quarries around the province to support local infrastructure projects.

Alternative sites were considered but the proposed location represents the best option because it is an established quarry operation with proven aggregate quality and no known environmental impacts. This site has high quality and large amounts of aggregate material. An alternative to the proposed quarry expansion is to develop a new quarry nearby. Considering quality, environmental, and logistical constraints, it is preferred to proceed with an expansion of the existing quarry rather than the development of a new quarry nearby.

Dexter operates rock quarries throughout Nova Scotia and Atlantic Canada and uses modern industry standard methodologies in all phases of the extraction, processing, and delivery processes. Alternative processes are always being considered in terms of their efficiency, cost effectiveness and environmental mitigation advantages, by few alternatives exist for the methods related to aggregate quarrying. The rock type found within the proposed QEA requires drilling and blasting to make it available for crushing. Operations at the current Walden Quarry will be assessed on an on-going basis to ensure that the best available techniques are being utilized in all phases of day-to-day operations.

2.6 Quarry Design and Operations

The Project is proposed to expand the existing <4 ha existing Walden Quarry and development will occur within the QEA (Figure 2 Appendix A). The Project will adhere to all setbacks and other requirements of the Nova Scotia Department of Environment and Labour (NSDEL) *Pit and Quarry Guidelines* (NSDEL, 1999) and the Occupational Safety General Regulations (Province of Nova Scotia, 2013).

The following items were considered when determining the extent and location of the QEA:

- QEA not encroaching within 30 m of a public road;
- QEA not encroaching within 30 m of an adjacent property boundary;
    - *Note: Authorization has been granted by the adjacent property owner to encroach within this setback along the eastern extent of the QEA*
- QEA not encroaching within 30 m of a watercourse (unless approval provided to do so from NSECC);
- QEA not encroaching (i.e., blasting) within 800 m of an offsite structure (without consent of the structure owner).
    - *Note: Dexter has authorization to conduct blasting at the existing quarry and within the QEA.*

The following sections provide additional information related to the operations and best management practices proposed for the Project.

2.6.1 Development Plan

The quarry will continue to be operated periodically during the construction season to meet demand within the local construction industry. The quantity of aggregate produced at the site each year is dependent on demand and activity within the construction industry, the amount of provincial highway work to be completed each year, and Dexter successfully bidding work in the area. It is anticipated that future quarry operations will continue on an as needed basis to support local projects. For years in which the quarry is operational, it is estimated that approximately 25,000 - 50,000 tonnes of aggregate will be produced. The rate of quarry expansion will progress slowly, gradually increasing at a rate consistent with aggregate demand in the area.

The predicted timeline of the Project has been proposed over a 40+ year time period. The QEA will be developed progressively, expanding from the existing quarry area westward.

Final reclamation will be completed following the exhaustion of aggregate reserves and is anticipated to be completed within one year following closure of the quarry. Refer to Section 2.7 for additional details on reclamation.

The QEA is proposed to be 23.8 ha in size and extends ~540 m southwest from the existing quarry face. Quarry activities within the QEA will include the use of portable quarrying infrastructure (e.g., crusher, heavy equipment, scale etc.).

2.6.2 Quarry Activities

Quarry activities include a recurring operational cycle, typically consisting of clearing of vegetation, grubbing of overburden, drilling and blasting of bedrock, production of aggregate via a portable crushing spread, stockpiling of various aggregate products, and loading, weighing, and hauling of aggregate products from the site. Advancement of the quarry highwall will be slow and progressive throughout the life of the quarry. As previously stated, quarrying is dependent on demand and activity within the local construction industry.

A typical Project (often a NSDPW contract) will require crushing activities at the quarry for a period of 2-3 weeks at a time. During crushing activities, the site may be operated 24 hours per day, possibly 7 days per week. Following crushing activities, aggregate products would be loaded and hauled from the quarry for several weeks, or as required by a Project. During load and haul activities the site would typically be operated during daylight hours (approximately 12 hours per day), possibly 7 days per week.

All quarry activities will adhere to applicable time of day limits (e.g., noise) in applicable legislation and Municipal bylaws.

Additional details pertaining to these activities are outlined in the following subsections.

2.6.2.1 *Clearing and Grubbing*

Clearing of vegetation and grubbing of overburden will take place in advance of scheduled work at the site and may include harvesting trees and grubbing of overburden from areas anticipated for short-term (<5 years) progression of the site. When possible, overburden is strategically stockpiled onsite to reduce double handling of material and may be used to construct berms adjacent the quarry for safety purposes or be stockpiled onsite for future use in reclamation.

2.6.2.2 *Drilling and Blasting*

Drilling and blasting will occur once the site is prepared. Blasting is conducted on an as required basis but is anticipated to occur once per year for years in which the quarry is operational. Blasting events are always undertaken by a fully certified and licensed blasting company with expertise in the field. A rock drill is used to drill boreholes into the exposed bedrock according to a specific blast design pattern. Boreholes are then loaded with explosives and blasted to generate manageable sized rock that can be further crushed and screened into specific aggregate products. For the establishment of a relatively level quarry floor, it is

common practice for blasting to occur 1 to 1.5 m below the intended extraction elevation. This allows for a relatively flat, graveled working area with a fractured quarry sub-floor.

One permanent residential structure (Receptor 1) is located within 800 m of the QEA. Dexter has authorization to conduct blasting at the existing quarry and within the QEA.

The certified and licensed blasting company will be responsible for blast design, methods, monitoring and will undertake the blasting operations in accordance with the *General Blasting Regulations* contained in the *Nova Scotia Occupational Health and Safety Act* (1996). Dexter will also meet the appropriate blasting setbacks outlined in the *Guidelines for the use of explosives in or near Canadian fisheries waters* (Wright and Hopky, 1998). All blasts will be monitored for concussion and ground vibration at the nearest structure (NSDEL, 1999) to ensure levels do not exceed the limits stated within the Industrial Approval (IA), which will be amended after EA approval. To date, there have been no exceedances of the limits within the current IA during any past blasts.

No explosives will be stored on site. Explosives are delivered before the scheduled blasts.

Weather conditions, including high humidity or cloud cover, can cause the levels of overpressure and noise to appear more severe for surrounding residents than on a day when the humidity is low and there is lack of cloud cover. When possible, Dexter and its sub-contractors will avoid blasting when weather conditions include significant temperature inversions, strong winds, foggy, hazy, or smoky conditions with little or no wind, or still, cloudy days with a low cloud ceiling.

2.6.2.3 *Crushing Activities*

A portable crushing spread is used for aggregate production. A typical crushing spread consists of a series of chassis mounted crushers and screeners, mobile conveyors, and stackers, along with loaders for feeding and stockpiling materials. Blasted material is fed into the portable crusher by a front-end loader. The blasted rock is initially broken down by a primary crusher, and then conveyed to a secondary crusher and screening deck to be crushed and sized into finished aggregate products. Trailer enclosed generators supply power for the portable crushing spread. A portable lab trailer is used to maintain quality control. A portable scale house and truck scale is set up along the site access road during periods of site activity.

2.6.2.3.1 Washing

No aggregate washing process are anticipated to take place on the site, however, if washing is required Dexter will construct a closed loop of ponds in the quarry floor. Water will be imported via a water truck and emptied into one of the ponds. Water will be drawn from this pond to wash the aggregate material before being discharged to a separate pond and reused within the closed loop washing system. No water used in the closed loop for washing will be discharged from site.

2.6.2.4 *Stockpiling*

Aggregate products are stockpiled in designated areas on the quarry floor and in the laydown area by a front-end loader or portable conveyor stacker. Aggregate products that may be produced and stockpiled

onsite include crusher run, crusher dust, clear stone, and other specialty products. Aggregate stockpiles are stable and stored uncovered. Given the dynamic nature of quarry operations, stockpile locations and volumes may vary throughout the year.

2.6.2.4.1 Asphalt Plant

If required by a local contract, a portable asphalt plant may be mobilized to the site. When in operation a front-end loader will feed aggregate products from stockpiles into a portable asphalt plant. Portable asphalt plants have separate permits specific to their operation, therefore, are not being discussed in more detail within the EARD.

2.6.2.5 *Hauling*

Prior to leaving the quarry, trucks report to a scale house to be weighed. Trucks will follow the existing site haul road northeast to Woodstock Road (Figure 2, Appendix A; see Section 2.6.4.3.). Trucks are routed to required Project locations either north or south on Woodstock Road and will use the local and provincial road network to reach their destination.

There is no planned increase in truck traffic from quarry expansion compared to current conditions and it is anticipated that future quarry operations will continue on an as needed basis to support local projects.

2.6.3 Quarry Components

The primary components associated with the Project include the following;

1. Working quarry highwall
2. Storage and loading areas
3. Portable crushing plants
4. Site haul road
5. Water management system
6. Ancillary buildings

These components are described in greater detail within the following subsections.

2.6.4 Working Quarry Highwall

The working quarry highwall currently exists along the southern extent of the existing quarry. The current height of the quarry face is ~15 m.

2.6.4.1 *Storage and Loading Areas*

The quarry floor will be used for crusher set-up, storage, and loading of aggregate. Aggregate material (e.g., Type 1 gravel) is stockpiled in this area and is dependent on the Project needs of the local contract. Topsoil

and organic stockpiles (grubbings) will typically be stockpiled around selected areas of the site for future use in reclamation.

2.6.4.2 *Portable Crushing Plants*

Refer to Section 2.6.2.3.

2.6.4.3 *Site Haul Road*

A 1.5 km site haul road (~12 m wide) runs northeast from the existing quarry to Woodstock Road. The entirety of this road is gravel.

The site haul road is pre-existing and does not require any upgrades to support the Project, therefore, it has not been included in the Project description and Study Area.

2.6.4.4 *Water Management System*

Refer to Section 2.6.7.

2.6.4.5 *Ancillary Buildings*

Currently, there are no structures on site. During active quarrying in the proposed QEA, a portable scale and scale house will be transported to site.

2.6.5 Quarry Personnel

During routine active periods of operation, approximately five Dexter employees will be on site. These personnel typically include an excavator operator, two front end loader operators, crusher foreman, and scale house operator. Additionally, company and third-party trucks will cycle through the site.

More specialized personnel including the blasting subcontractor, or a site superintendent will be on site intermittently and as needed during required periods.

2.6.6 Quarry Equipment

The portable equipment fleet will be mobilized to site by Dexter during active periods of operation. The potential mobile equipment fleet will fluctuate depending on awarded projects and demand for aggregate. Table 2-2 outlines the potential fleet to support quarry expansion.

Table 2-2. Potential Mobile Equipment to Support Quarrying Activities

Mobile Equipment	# of Units	Example Model	Description of Equipment Use
Excavator	1	240 Komatsu Excavator	Handling material (stockpiling, crushing, loading haul trucks, grubbing)
Front end loader	2	988 CAT Loader, 980 CAT Loader	Handling material (stockpiling, crushing, loading haul trucks)
Dozer	1	D8 CAT Dozer	Levelling material (grading, grubbing)
Haul truck	2-20	Single axel, double axel, and tri-axel trucks	To haul aggregate from the Project site to its destination.
Portable crusher	1	Various Components	Crushing and screening blast rock to desired size.

The qualified blasting subcontractor will provide the equipment for drilling and blasting.

2.6.7 Water Management

The Study Area is primarily forested and includes gently sloped hills, wetlands, and a watercourse, excluding the existing quarry footprint and access roads. The QEA is located within the 1EG-4-C Tertiary Watershed (part of the Mushamush River Secondary Watershed [1EG-4]) which drains to the southeast into Mushamush River (Figure 1, Appendix A).

The following subsections describe site water management during operations and reclamation.

2.6.7.1 *Operations*

The majority of surface water runoff and drainage occurring within the QEA will infiltrate the fractured quarry floor. Small amounts of runoff may flow over the graded quarry floor and discharge towards the east to a vegetated settling area prior to flowing into Big North Brook. If necessary, a settling pond will be constructed in the future.

Additional erosion and sediment control (ESC) measures, including rock check dams and sediment fence will be implemented on site to manage erosion and sedimentation, as required. Environmental controls will be repaired and replaced as needed and will be implemented throughout the life of the quarry.

As part of the IA amendment process, a Surface Water Management plan and Surface Water Monitoring plan will be developed. The Surface Water Management plan will be modified as needed during quarry expansion to ensure water discharge meets water quality and water volume discharge criteria, prior to release into the receiving environment.

2.6.7.2 *Reclamation*

As the site reaches the end of its life, the quarry will be decommissioned and reclaimed. The site will be revegetated and contoured so that surface water runoff from the QEA will slowly be directed towards Big North Brook, to maintain appropriate water quantities within the system.

2.6.8 Waste Management

Quarry operations are not expected to result in large quantities of waste material. Prior to blasting, tree clearing activities will be completed and merchantable timber will be removed from the site. Overburden and topsoil will be stored within the boundary of the quarry permit area and will be re-used during reclamation at the end of the Project's operational phase.

Other typical small-scale waste will be disposed of off-site via local waste handling facilities operated by the local municipalities. As appropriate, materials suitable for recycling will be separated, reused and/or recycled. Washroom facilities will be provided for employees.

2.6.9 Hazardous Waste Management

There will be no long-term storage of fuel onsite. Fuel will be temporarily stored onsite in a trailer enclosed generator as part of the portable crushing spread when crushing activity occurs.

During active quarrying, re-fuelling of equipment will be completed regularly by a third-party fuel truck. Refuelling will occur in designated areas >30 m from a watercourse or a wetland. The operators will always remain with the equipment when re-fueling activities are taking place.

A spill kit housing appropriate spill response gear (e.g., spill pads, absorbent, booms etc.) will remain on site during active quarrying. Equipment will be routinely inspected for leaks and general condition.

Regular, small-scale maintenance of the equipment (loaders, excavators, and crushing equipment) may be conducted at the site. Waste fuel, used spill kit materials, and oil filters will be securely stored in a spill-proof container and discarded at an approved facility when removed from site.

Disposal of hazardous material and refuelling procedures will be conducted in accordance with best management practices and regulatory requirements. All larger scale maintenance will be completed off-site. A quarry contingency plan will be prepared and submitted with the IA Amendment Application and will include procedures for responding to and reporting spills.

2.6.10 Noise Management

Sound levels within the quarry will be monitored as requested by NSECC at the property boundaries of the quarry, in accordance with the *Pit and Quarry Guidelines* (NSDEL, 1999). Blasting will account for the predominant source of noise from the quarry. As previously discussed, blasting is expected to occur once per year during active years. Blasting will be monitored and planned to occur on days where weather

conditions are less likely to cause excessive sound levels, and blasting will not occur on Saturdays, Sundays, or holidays.

Noise from heavy equipment (e.g., haul trucks, excavator, loader etc.) and the crusher will occur during active quarrying. Applicable best practices for noise mitigation will be applied where appropriate.

2.6.11 Dust Control

Dust emission and particulate matter will be monitored at property boundaries adjacent to the quarry, at the request of NSECC, in accordance with the *Pit and Quarry Guidelines* (NSDEL, 1999). Should it be required, dust emissions from the quarry will be controlled with the application of water. Water will be sourced onsite from retained surface water within the fractured quarry floor, or will be acquired from a water truck, therefore, no water withdrawal permits are required. The volume of water used for dust control will not require a Water Withdrawal Approval.

2.6.12 Viewscape

The Project is located in a rural location. The nearest road to the Project is Woodstock Road, ~1.2 km northeast of the existing quarry. At this location, Woodstock Road has an elevation 10 m lower than the maximum elevation of the QEA but due to forest cover and distance between Woodstock Road and the QEA, it is not expected that the Project will be identifiable from this location. It is also not expected that the Project will be visible from topographically higher ground, farther from the quarry.

2.6.13 Risk Management

A contingency plan for the Project will cover identification of key individuals and regulatory contacts, spill prevention, spill procedures, sediment and erosion control, fire management, and incident reporting procedures. This plan will be provided to NSECC as part of the IA amendment process.

Barriers (e.g., berms) and appropriate signage will be located throughout the quarry to identify potential safety risks.

2.7 **Reclamation**

Reclamation of the Project will be completed in line with the *Pit and Quarry Guidelines* (NSDEL, 1999), the Terms and Conditions of the sites amended IA, and rehabilitation strategies that are consistent with industry standards and best practices. A progressive reclamation approach will be used throughout the development and operation phases of the Project, and a final reclamation plan will be developed and implemented at the conclusion of extraction and site related activities when aggregate reserves have been fully exhausted within the QEA.

As per the existing IA for the Walden Quarry, the site Reclamation Plan is updated every three years and submitted to NSECC for review. Additionally, a reclamation bond is maintained to ensure funds are available to rehabilitate the quarry. The value of the reclamation bond is reviewed and updated in line with the updated reclamation plans to ensure sufficient security is maintained throughout the life of the Project.

The progressive reclamation approach will focus on rehabilitation strategies within the quarry footprint throughout the development and operations phases of the site. The following rehabilitation strategies will be progressively implemented to help facilitate final reclamation of the site in the future:

- As the site is developed and aggregate reserves are depleted, disturbed areas no longer required for aggregate production or site related activities (e.g., storage of stockpiles) will be progressively rehabilitated.
- Overburden will be strategically stockpiled to reduce handling and facilitate reuse and will be temporarily stockpiled on site for future use in site grading, slope construction, and re-vegetation efforts. Some overburden may also be used on an ongoing basis to construct more permanent berms adjacent to the quarry for safety and/or environmental considerations.
- Where a quarry highwall advances to the furthest extent possible within the QEA, and future expansion of the highwall is not practical, efforts to rehabilitate / slope the highwall may be initiated with nearby overburden and excess rock that is unusable on site (i.e., oversize).
- Stabilized areas will be maintained as gravel staging areas for site related activities or for other potential site activities conducive to the area.
- Occasional site visits will be conducted to identify progressive reclamation opportunities and assess progressive reclamation outcomes.

Final quarry reclamation will focus on rehabilitation of the site footprint at the conclusion of extraction and related activities when aggregate reserves have been fully exhausted within the QEA. The end land use objectives are based on pre-development site conditions, to the extent possible, and the reclaimed site will plan to support the land uses that were present prior to quarrying occurring (i.e., undeveloped, forested land). Prior to fully rehabilitating the site, and when actual conditions representing final extraction limits and site features are known, Dexter will confirm a Final Reclamation Plan for the site. The following rehabilitation strategies will be considered to facilitate final reclamation of the site:

- Removal of facility infrastructure and machinery;
- Control erosion and sedimentation;
- Surface contouring and drainage patterns;
- Site stabilization & revegetation (including considerations to manage invasive plant species) objectives for final land use, and;
- Other reclamation activities.

2.8 Anticipated Schedule of Activities

The following milestone schedule (Table 2-3) outlines the Project schedule.

Table 2-3. Schedule of Project Activities

Task	Anticipated Completion Date
Environmental Studies	Spring, Summer, Fall, and Winter of 2022 and Spring of 2023
Public and First Nations Engagement	Ongoing throughout Project.
Environmental Assessment Registration	Fall 2023
Expected EA Decision	Winter 2023
Provincial Permitting (Industrial Approval and wetland/watercourse alteration approval)	Following EA Approval
Quarry Expansion Window	40+ Years
Reclamation	Progressive reclamation ongoing during operations. Final reclamation to occur when aggregate reserves have been fully exhausted.

3 MI'KMAQ OF NOVA SCOTIA

The Mi'kmaq are the founding people of Nova Scotia and currently live throughout the province in and beyond the 13 Mi'kmaq communities (OLA 2015). The Study Area is part of the greater Mi'kmaw territory, Sipekne'katik, which means 'area of wild potato and turnip' (CRM Group, 2022). Within the Southwestern region of the province, where the Study Area is located, the Acadia First Nation encompasses six reserves – Yarmouth, Ponhook, Medway, Wildcat, Gold River and Hammonds Plains (Acadia First Nation, 2023a).

The Mi'kmaq in the provinces of Nova Scotia, New Brunswick, Prince Edward Island, and the Gaspé Peninsula in Quebec are founded on land historically occupied by the ancestors of the Mi'kmaq. The earliest evidence of the Mi'kmaq of Nova Scotia in the Maritimes Region indicates that the ancestors of the Mi'kmaq have existed on the land for more than 10,000 years (CBU, 2023).

The Mi'kmaq of Nova Scotia have established Aboriginal and Treaty rights, including the right to fish for a "moderate livelihood" which flows from the Peace and Friendship Treaties, and Aboriginal rights to hunt, fish and gather for food, social and ceremonial purposes – more broadly referred to as "traditional" purposes. Mi'kmaq rights are communal rights and therefore shared amongst all members of the Mi'kmaq Nation in Nova Scotia.

The Crown has a duty to consult with the Mi'kmaq of Nova Scotia, which is achieved in accordance with the Mi'kmaq- Canada-Nova Scotia Consultation Terms of Reference. As per Supreme Court of Canada instruction and subsequent guidance from governments, such as the Updated Guidelines for Federal Officials to Fulfill the Duty to Consult (Government of Canada 2011) and the Proponents' Guide:

Engagement with the Mi'kmaq of Nova Scotia (Province of Nova Scotia 2012), the Crown may delegate procedural aspects of consultation to proponents. However, the duty to consult, and ultimate decision-making authority remains with the Crown. The results of the Proponent's Mi'kmaq of Nova Scotia engagement program to support the EARD are expected to be considered by the provincial government in the EA decision-making process.

For the purposes of consultation, 10 of the 13 Mi'kmaq communities are represented in consultation by the Kwilmu'kw Maw-klusuaqn Negotiation Office (KMKNO), which reports to the Assembly of Nova Scotia Mi'kmaq Chiefs (ANSMC). Sipekne'katik, Millbrook and Membertou First Nations represent their own communities in consultation through their elected Chiefs and Councils.

The most proximate First Nation community to the Study Area is Amapapskegek, or the Gold River Indian Reserve No.21, which is located ~12 km east of the Study Area (Figure 4; Appendix A). The Gold River Reserve is positioned near the Gold River, which has long been used by the Mi'kmaq people, along with resources in the surrounding area of Mahone Bay (Acadia First Nation, 2023b). The Gold River Reserve had a registered population of 81 individuals based on the 2021, National Census of population (Statistics Canada, 2021).

Businesses owned and operated by the Acadia First Nation, located on the Gold River Reserve, include the Gold Nugget, a multi functioning facility that includes a gas bar, electric vehicle charging station, convenience store, gaming entertainment and a meeting room; as well as the Gold Bean Café restaurant (Acadia First Nation, 2023c).

3.1 Mi'kmaq Engagement

Early engagement was initiated through provision of the Project description and an invitation to discuss the Project. On October 19, 2022, a letter containing the Project overview, location map, anticipated EA timeline, and an offer to meet to discuss the Project was emailed to the following First Nation communities/organizations:

- Chief Bob Gloade, Millbrook First Nation;
- Chief Michael Sack, Sipekne'katik First Nation;
- Chief Augustine, Native Council of Nova Scotia;
- Chief Deborah Robinson, Acadia First Nation;
- Twila Gaudet, KMKNO; and,
- Shawn Taylor, KMKNO.

On October 10, 2023, a follow up email was distributed to the above noted First Nation communities/organizations. Within this email Dexter included a Project summary, the EA notice, and photo of the existing quarry, and offered to meet to discuss typical quarry operations and to learn about potential concerns with the Project. Dexter also informed the First Nation communities/organizations of

their intent to register the EA on October 25, 2023, and provided information on how to submit comments to the EA branch during the review period (i.e., prior to November 24, 2023).

Refer to Appendix C for the First Nations Engagement Log.

3.2 Office of L'nu Affairs and Nova Scotia Department of Natural Resources and Renewables

The Project was presented to Janel Hayward (NSDNRR) during an EA Branch meeting on June 22, 2022. The Project introduction and a copy of the presentation from the EA Branch meeting was shared with Salima Medouar, Consultation Advisor (OLA) on June 28, 2022, via email, as they were unable to attend the June 22, 2022, meeting.

Additional consultation between Dexter/McCallum and OLA occurred in 2022 and 2023. Refer to Table 5-1 for specific details on these communications.

3.3 Summary of Issues

Recommendations were provided by OLA during early engagement described above. Following review of the provided Project description and presentation (June 28, 2022), OLA recommended an Archaeological Resource Impact Assessment (ARIA) be completed and a Mi'kmaq Ecological Knowledge Study (MEKS) be considered to support the Project.

Dexter retained CRM Group to complete an ARIA. Results of the ARIA are detailed in Section 8.5.4 and Appendix D provides the executive summary of the ARIA, the Heritage Research Permit, and the CCTH Heritage Research Permit Report. Please note that the full ARIA report has been excluded from the EARD as requested by NSECC. An MEKS was not completed based on the findings and recommendations of the ARIA. No additional concerns have been communicated by Mi'kmaq communities at this time.

3.4 Ongoing Engagement

The results of OLA engagement have been considered and incorporated in the environmental effects assessment.

With the exception of recommendations provided by OLA, Dexter has yet to receive any feedback from interested Mi'kmaq communities or organizations but is committed to maintaining open lines of communication with interested Mi'kmaq communities through the life of the EARD process and the construction, operational and decommissioning phases of the Project.

Dexter will continue to support adjustments in proposed mitigation measures and monitoring plans relating to Project impacts based on on-going feedback and input received from communities. Dexter's commitment to involve the Mi'kmaq in the development and implementation of mitigation and monitoring measures and proposed compliance and effects monitoring programs.

3.5 Effects of the Undertaking on the Mi'kmaq of Nova Scotia

Early engagement has been initiated with Mi'kmaq communities and organizations through the EARD process. Feedback heard from OLA through this process has been considered and addressed in the EARD as is possible (see Section 9.5.4). Ongoing engagement aims to result in constructive dialogue relating to the Project and its potential impact on the surrounding environment and the Mi'kmaq of Nova Scotia.

The ARIA (refer to Appendix D for the ARIA executive summary) concluded that the terrain within 50 m of the watercourse adjacent to the Study Area, the bank of Big North Brook, is ascribed high archaeological potential. The area between 50 m and 80 m of the Big North Brook's banks is ascribed as moderate archaeological potential. The remainder of the Study Area was ascribed as low archaeological potential for Mi'kmaq archaeological resources. The QEA is avoiding the areas ascribed as high and moderate potential.

Based on the results of the ARIA, the QEA does not interact with the areas of moderate or high potential. As a result, no Project-related impacts to Mi'kmaq archaeological resources are expected. If development plans and areas change, the mitigations outlined in Section 9.5.4 will be followed to ensure further areas are cleared of archaeological potential before ground disturbance commences.

4 PUBLIC ENGAGEMENT

Dexter sent requests via email to meet with various political stakeholders in June 2023. No responses were received at the time. Dexter followed-up with all political stakeholders in August 2023 and no responses have been received to date. Further public engagement on the Project will be completed through published notices and comment periods through the EA process.

Dexter will document any concerns received during the public consultation portion of the EA process and provide a copy to NSECC.

Dexter is committed to maintaining open lines of communication with interested members of the general public through the EA process and for the life of the Project. On the date of Registration, the public will be notified of the EA Registration by an advertisement in the Chronicle Herald and the South Shore Breaker.

5 REGULATORY CONSULTATION

To support the EARD, the Project team consulted with the following regulatory agencies:

1. Nova Scotia Environment and Climate Change (NSECC)
2. Nova Scotia Department of Natural Resources and Renewables (NSDNRR)
3. Nova Scotia Office of L'nu Affairs (OLA)

A meeting was held with Bridget Tutty and Mark McInnis of the NSECC EA Branch and Mark McGarrigle (NSDNRR SAR Biologist) and Janel Hayward (NSDNRR Consultation Advisor) on June 22, 2022, to introduce NSECC and NSDNRR to the Project, review site sensitivities, Valued Environmental Components (VECs), proposed field methods for the biophysical surveys, and proposed plans for First Nations and public engagement. NSDNRR recommended two surveys for common nighthawk and requested additional details related to the mainland moose survey transects.

On September 6, 2023, several members of NSECC and NSDNRR attended a site visit. Dexter and McCallum provided a tour of the site during the regulatory visit and provided details on the history of the site, the quarrying process, surface water management, key EA findings, and the status of EA registration. NSECC and NSDNRR asked questions related to site operations, the life of the quarry, reclamation process, type of rock on site, and surface water management.

Refer to Table 5-1 for the regulatory consultation log of communications.

Table 5-1. Regulatory Consultation Log of Communications

Department	Individual	Method	Date	Details
Nova Scotia Environment and Climate Change (NSECC)	Helen MacPhail	Email	June 14, 2022	McCallum introduced the NSECC EA Branch to the Project and requested a scoping session to discuss the Project in greater detail.
	Bridget Tutty	Email	June 20, 2022	McCallum provided NSECC EA Branch with presentation in advance of scoping session.
	Bridget Tutty Mark McInnis	Video Call	June 22, 2022	Project introduction meeting to the NSECC EA Branch. Provided a review site sensitivities, Valued Environmental Components (VECs), proposed field methods for the biophysical surveys, and proposed plans for First Nations and public engagement
	Bridget Tutty	Email	June 28, 2022	McCallum provided the NSECC EA Branch with the methods proposed to model surface water quantity at the Project and requested the methods be forwarded to the surface water team for comment.
	Bridget Tutty	Email	June 30, 2022	NSECC EA Branch confirmed receipt of the surface water modelling methods.
	Bridget Tutty	Email	July 4, 2022	The EA Branch was included on an email exchange with OLA. McCallum confirmed that Dexter has retained CRM to complete an ARIA. McCallum noted that at this time a MEKS is not proposed to be completed but pending the results of the ARIA and any First Nations concerns from early engagement, the Project Team will revisit the MEKS recommendation.
	Bridget Tutty	Email	August 18, 2023	Dexter invited NSECC and NSDNRR to a site visit at the Project site.

Department	Individual	Method	Date	Details
	Allison Fitzpatrick Joe Xie Tessa Bermarija Gordon Check Adam McKechnie John Gallop	In Person	September 6, 2023	Dexter and McCallum provided a tour of the site during the regulatory visit and provided details on the history of the site, the quarrying process, surface water management, key EA findings, and the status of EA registration. NSECC and NSDNRR asked questions related to the life of the quarry, reclamation process, type of rock on site, and surface water management.
	Mark McInnis	Email	September 11, 2023	The EA Branch notified McCallum and Dexter of the EA Officer (Mark McInnis) assigned to the Project.
	Mark McInnis	Email	October 2, 2023	Dexter provided the EA Branch with the draft notice of assessment and the EA branch provided comments on October 4, 2023.
Nova Scotia Department of Natural Resources and Renewables (NSDNRR)	Mark McGarrigle Janel Hayward	Video Call	June 22, 2022	Project introduction meeting to NSDNRR. Provided a review site sensitivities, Valued Environmental Components (VECs), and proposed field methods for the biophysical surveys. Confirmed the project is within Mainland moose core habitat.
	Mark McGarrigle	Email	June 28, 2022	McCallum provided NSDNRR with the proposed mainland moose survey transects and methods.
	Mark McGarrigle	Email	July 18, 2022	NSDNRR commented on the proposed mainland moose survey transects and methods and noted to ensure that survey effort informs project mitigations and to ensure there is sufficient coverage of the different cover types used by mainland moose in the area.

Department	Individual	Method	Date	Details
	Mark McGarrigle	Email	September 16, 2022	McCallum modified the proposed mainland moose transects based on NSDNRR comments. Transects that were originally proposed on Crown land 6-8 km from the Study Area were removed.
	Dr. Donna Hurlburt	Email	September 16, 2022	McCallum inquired with NSDNRR if the Study Area is located within core habitat for wood turtle, black ash, bats or any other SAR. McCallum acknowledged that the Study Area is within core habitat for mainland moose and targeted surveys are proposed. No location sensitive species were documented in the ACCDC report.
	Mark McGarrigle Peter Kydd	Email	October 3, 2022	NSDNRR indicated that the Study Area does not overlap with core or critical habitat layers for black ash, bat species, wood turtle, or bank swallow. The closest location of core habitat is for black ash, located 13 km southeast of the Study Area.
	Janel Hayward	Email	October 19, 2022	Dexter provided the NSDNRR with a project summary and indicated that a similar notice was sent to the KMKNO, Acadia First Nation, Millbrook First Nation, Sipekne'katik First Nation and the Native Council of Nova Scotia. Dexter extended an offer to meet and discuss the Project in more detail.
	Peter Kydd Stephen Freeman	In Person	September 6, 2023	Dexter and McCallum provided a tour of the site during the regulatory visit and provided details on the history of the site, the quarrying process, surface water management, key EA findings, and the status of EA registration. NSECC and NSDNRR asked questions related to the life of the quarry, reclamation process, type of rock on site, and surface water management.
Office of L'nu Affairs (OLA)	Salima Medouar	Email	June 28, 2022	McCallum informed OLA of the Project and provided the presentation provided to NSECC/NSDNRR during the scoping session. McCallum indicated that an early engagement letter and offer to meet will be distributed to Sipekne'katik First Nation, Millbrook First Nation, KMKNO, Office of L'nu Affairs, and the Native Council of Nova Scotia. McCallum will provide project updates as information is gathered and provide an invitation to an information session (should one be hosted).

Department	Individual	Method	Date	Details
	Salima Medouar	Email	June 30, 2022	OLA recommends that an ARIA be completed and recommended considering a MEKS.
	Salima Medouar	Email	July 4, 2022	McCallum confirmed that Dexter has retained CRM to complete an ARIA. McCallum noted that at this time a MEKS is not proposed to be completed but pending the results of the ARIA and any First Nations concerns from early engagement, the Project Team will revisit the MEKS recommendation.
	Salima Medouar	Email	October 19, 2022	Dexter provided the OLA with a project summary and indicated that a similar notice was sent to the KMKNO, Acadia First Nation, Millbrook First Nation, Sipekne'katik First Nation and the Native Council of Nova Scotia. Dexter extended an offer to meet and discuss the Project in more detail.
	Krista McLarty	Email	October 19, 2022	OLA confirmed receipt of Project information and stated that OLA would be pleased to receive any further information but is unable to meet until the early spring of 2023 ahead of EA registration.
	Beata Dera	Email	May 29, 2023	Dexter updated OLA on the status of the project and timeline for registration of the EA. Dexter extended an invitation to meet with OLA.
	Beata Dera	Email	May 29, 2023	OLA responded and indicated they are happy to meet if Dexter has any questions for OLA with respect to engaging with the Mi'kmaq and the duty to consult.
	Beata Dera Kendra Gorveatt	Email	October 10, 2023	Dexter informed OLA of the Project's proposed registration timing, provided OLA with the EA notice, and noted that the KMKNO, Acadia First Nation, Millbrook First Nation, Sipekne'katik First Nation, and the Native Council of Nova Scotia were also provided a similar update. OLA confirmed receipt of this information.

6 ENVIRONMENTAL ASSESSMENT METHODS

The EA methods for the Project followed general guidance provided in the *Guide to Preparing an Environmental Assessment Registration Document for Pit and Quarry Developments in Nova Scotia* (NSE 2009). Assessments were also completed in accordance with acceptable practices in EA.

The EA evaluates specific environmental components called Valued Environmental Components (VECs), which include the atmospheric, geophysical, biophysical, and socioeconomic, environments. VECs are not only important to a local human population but can have a national or even international profile.

6.1 Scope

The scope of the assessment for this Project included: the selection and assessment of potential VECs; evaluation of the potential Project activities interactions with VECs (both positive and negative), identification of environmental effects from Project activities, if any, for each VEC; determination of appropriate mitigation measures to reduce effects; quantification of residual effects (those that are left over once mitigation measures are applied); and identification of VEC thresholds to determine the significance of residual environmental effects, if any.

The EA process allows for the prediction of environmental effects of the proposed Project. The proponent and technical experts identify measures that can be used to mitigate, and subsequently minimize, potential adverse environmental effects. The EA attempts to predict if significant residual adverse environmental effects will occur once mitigation measures are implemented.

The methods and baseline environmental conditions for the Project are described in detail in Section 7 and Section 7.4 in this EARD, respectively. Each potential VEC, as identified in Section 6.3, has been described and an evaluation on the effects of the undertaking on each VEC is presented in Section 8.4.

6.2 Boundaries of the Assessment

Boundaries for the assessment of the Project include both spatial boundaries and temporal boundaries. Boundaries were designed to include potential Project interactions with VECs.

6.2.1 Spatial Boundaries

Spatial boundaries of the EA are defined by the Study Area, Fish Study Area, QEA and IA Permit Area (Table 6-1; Figure 2, Appendix A).

6.2.1.1 *IA Permit Area*

The IA Permit Area is the existing <4 ha Walden Quarry under a NSECC Industrial Approval (2015-092380).

6.2.1.2 *Quarry Expansion Area*

The QEA extends northwestward from the IA Permit Area and encompasses the proposed Project footprint to include the maximum extent of ground disturbance associated with quarry expansion infrastructure. The QEA boundary was microsited to the southwest and east to avoid sensitive environmental features (see VEC Sections for details). The QEA is 23.8 ha.

6.2.1.3 *Study Area*

The Study Area comprises the QEA and includes a minimum 30 m buffer between the QEA and adjacent property boundaries. Note that authorization from the landowner has been obtained to encroach within this setback along the eastern extent of the QEA, where the QEA and Study Area boundaries align. The Study Area is 44.4 ha and has an approximate centre located at 20T 380033 m E, 4932958 m N.

The Study Area was designed to include the maximum extent of expected terrestrial impacts, in consideration of property ownership and compliance boundaries.

6.2.1.4 *Fish Study Area*

Evaluation of watercourses, fish and fish habitat was completed within the Fish Study Area, which serves as an extension of the Study Area. The Fish Study Area is 67.5ha and includes the entirety of the Study Area and additional aquatic features to the northwest – Bagpipe Lake and an inflow watercourse (Little North Brook) – and to the east – the NSECC mapped wetland complex, associated pond (Pond 1) and outflow watercourse (Big North Brook). The Fish Study Area was defined to consider the maximum extent of potential direct and indirect impacts to fish and fish habitat.

6.2.1.5 *Additional Spatial Boundaries*

Expanded spatial boundaries were considered for discrete aspects of the EA. Lunenberg County and, more broadly, Nova Scotia, were used for the purpose of data collection, evaluation of existing conditions and effects assessment relating to certain VECs (e.g., Geophysical, Air Quality) that naturally extend beyond the Study Area.

Local watersheds were used as the spatial boundaries in support of the Water Balance Assessment (WBA) and include points of interest that may sustain indirect hydrological effects as a result of the proposed Project (Appendix E, and Section 9.4.2).

6.2.1.6 *Assessments Per Spatial Boundary*

VECS were assessed in the Study Area, Fish Study Area, or Additional Spatial Boundaries as outlined in Table 6-1.

Table 6-1. Assessments Completed per Spatial Boundary

Spatial Boundary		Assessment
Study Area		Geology
		Habitat
		Vascular Plants
		Lichens
		Fauna
		Avifauna[1]
		Wetlands
Fish Study Area		Surface Water, Fish and fish habitat
Additional Spatial Boundaries	Within 800 m of QEA	Noise Groundwater
	Lunenberg County	Socioeconomic
	Nova Scotia	Weather and Climate Air quality
[1]**Note**: Several avian surveys (e.g., owl, common nighthawk) occurred within and beyond the Study Area but are not carried into the Additional Spatial Boundaries.		

6.2.2 Temporal Boundaries

The temporal boundaries of the EA include the expansion (40+ years) and reclamation (1 year) phases of the Project, and associated activities.

6.3 Valued Environmental Component (VEC) Selection

The selection of VECs were based on the following:

- Technical aspects of the Project and known interactions based upon similar projects;
- Regulatory policies and guidelines1, including regulatory consultation recommendations;
- Information received during engagement with First Nations and/or the public;

[1] As part of VEC selection, McCallum also reviewed the NSECC *Guide to Preparing an Environmental Assessment Registration Document for Pit and Quarry Developments in Nova Scotia* (NSE 2009).

- Scientific knowledge of the area from existing public data sources; and,
- Professional judgement based upon expertise in EA completion across Canada.

Refer to Table 6-2 for the VECs selected for evaluation.

Table 6-2. VECs Selected for Evaluation

Group	VEC	Rationale for Inclusion
Atmospheric	Air Quality	Dust will be emitted during all Project phases.
	Noise	The Project will generate noise during all phases which may adversely affect fauna or avifauna.
Geophysical	Geology and Topography	Surficial and bedrock geology will be altered by the expansion of the Project. Soil erosion from Project expansion may increase the potential for sedimentation in adjacent water features.
	Groundwater	Project expansion may alter local groundwater quality and flow patterns.
Terrestrial[1]	Habitat, Vascular Plants, and Lichens	The Project will directly impact habitat, flora, and lichens, via clearing and grubbing associated with Project expansion.
	Fauna	Fauna may be directly impacted from loss of habitat or indirectly impacted by Project activities.
	Avifauna	Avifauna may be directly impacted from loss of habitat or indirectly impacted by Project activities.
Aquatic[1]	Wetlands	Wetlands may be directly and indirectly impacted from Project expansion.
	Surface Water, Fish and fish habitat	Water quality and quantity may be impacted from Project expansion, and as a results Fish and fish habitat may be directly or indirectly impacted.
Socioeconomic	Local Economy	The local economy may be affected by Project expansion.
	Land Use and Value	Land use will be altered from Project expansion. Land value may be altered from Project expansion.
	Recreation and Tourism	Recreation and tourism may be affected by Project expansion.
	Human Health	Human health may be affected by Project expansion.

Group	VEC	Rationale for Inclusion
	Cultural and Heritage Resources	The Project may impact cultural and heritage resources.
[1] Priority species were assessed in their respective VECs.		

6.4 Characterization of Environmental Effects

To determine the level of residual effects to each VEC that remains after mitigations are implemented, the Project team considered the magnitude, likelihood, duration, and frequency of the Projects impact. As the Project is proposed for a finite time and will be fully reclaimed, all VECs have been considered reversible (partially to fully). Table 6-3 provides a description of each characterization criteria and the degrees in which they can contribute to an effect. These criteria were defined in relation to assessing the significance of the residual adverse effects for the VECs.

Table 6-3. Characterization Criteria for Environmental Effects

Characterization	Description	Category Definitions
Magnitude	Refers to the expected size or degree of the effects compared against baseline conditions. If no average values or threshold values are identified, the magnitude determination is subjective based on literature and/or reasonable inference.	**Negligible (N)** – Differing from known average values for the existing environment/baseline conditions to a small degree, but within the range of natural variation and below a threshold value **Low (L)** – Differing from the average value for the existing environment/baseline conditions, outside the range of natural variation, and less than or equal to appropriate guideline or threshold value **Moderate (M)** – Differing from the existing environment/ baseline conditions and natural variation, and marginally exceeding a guideline or threshold value **High (H)** – Differing from the existing environment/ baseline conditions and natural variation, and exceeding a guideline or threshold value
Likelihood	Refers to the probability of the impact occurring.	**Unlikely (UL)** – expected to occur with a low degree of certainty **Possible (P)** - expected to occur with a low to medium degree of certainty **Likely (L)** - expected to occur with a medium to high degree of certainty

Characterization	Description	Category Definitions
		Almost Certain (AC) - expected to occur with a high degree of certainty
Duration	Refers to the time period over which the effects are likely to persist.	**Short-Term (ST)** –As little as 1 day to 1 year (e.g., reclamation) **Long-Term (LT)** – >1 year to +4- years (e.g., operations) **Permanent (P)** – VEC unlikely to recover to baseline conditions
Frequency	Refers to the rate of recurrence of the effects (or conditions causing the effect).	**Once (O)** – effects occur once **Sporadic (S)** – effects occur at irregular intervals throughout the Project **Regular (R)** – effects occur at regular intervals throughout the Project **Continuous (C)** – effects occur continuously throughout the Project

6.5 Determination of Significance

Table 6-4 outlines the approach to determine the significance of effects from the Project on VECs. Significance is based on the category (e.g., high, moderate, low, or negligible) for each characterization (e.g., magnitude) per VEC. Certain combinations of categories will result in a determination of a significant adverse effect, while other combinations will not. For example, a VEC with a high magnitude, almost certain likelihood, permanent duration, continuous frequency, and irreversible impact will result in a significant adverse effect. Conversely, a VEC with negligible magnitude, unlikely likelihood, short-term duration, and a frequency of once will result in a not adverse effect.

Table 6-4. Evaluation of Significance for Adverse Effects

Magnitude	Likelihood	Duration	Frequency	Significance
Negligible	All	All	All	Not significant
Low	All	All	All	Not significant
Moderate	Unlikely Possible Likely	Short term Long term	Once Sporadic	Not significant

Magnitude	Likelihood	Duration	Frequency	Significance
	Unlikely Possible Likely	Short term Long term	Regular Continuous	Significant
	Almost certain	All	All	Significant
	Unlikely Possible Likely Almost certain	Permanent	All	Significant
High	Unlikely	Short term	Once Sporadic	Not significant
	Unlikely	Short term	Regular Continuous	Significant
	Unlikely	Long term Permanent	All	Significant
	Possible Likely Almost certain	All	All	Significant

An evaluation has been completed to determine the significance of residual effects (based upon significance criteria) for each VEC resulting in the interaction from Project activities once appropriate mitigation has been completed. Potential effects, mitigation, monitoring, and residual effect for each VEC is provided in Section 8.4.

7 BASELINE SURVEY METHODS

This section details the following key aspects of the EA methodologies:

- Atmospheric: weather and climate, air quality, and noise.
- Geophysical: topography, geology, and groundwater.

- Terrestrial: habitat, vascular plants, lichens, wildlife, and avifauna.
- Aquatic: wetlands, surface water, fish habitat.
- Socioeconomic: economy, land use and value, recreation and tourism, and cultural and heritage resources.

7.1 Atmospheric Assessments

The following subsections outline the methods undertaken to assess for baseline weather and climate, air quality, and noise.

7.1.1 Weather and Climate

Weather conditions in Nova Scotia are monitored by a network of ECCC weather stations. Data collected from these stations includes temperature (°C), precipitation (mm), relative humidity (%), pressure (kPA) wind direction and wind speed (km/hr). Recent data from the Emergency Weather Station #2 located in New Ross, Nova Scotia (Climate ID 8202195) was used to summarize weather conditions in proximity to the Study Area (NSDNR 2023). The Emergency Weather Station is situated roughly 21 kilometers northeast of the Study Area. Both sites fall within the same Ecodistrict (Lahave Drumlins 740), and both are located inland, approximately 20 to 25 kilometers west of the Atlantic Ocean.

The Lunenburg (Climate ID 8203210) weather station is situated 25 kilometers southeast of the Study Area; however, it is in a different ecoregion and Ecodistrict (South Shore, 830). Due to the location of this weather station being adjacent to the Atlantic Ocean, weather conditions are not anticipated to correspond to the Study Area, and thus, this weather station was not chosen to reflect conditions within the Study Area.

Additionally, a literature review of climate conditions within the Western Ecoregion, specifically the Lahave Drumlins Ecodistrict, was completed.

7.1.2 Air Quality

Air Quality Health Index (AQHI) was assessed in Greenwood, Nova Scotia, 57 km northwest of the Study Area. The Greenwood station is the nearest AQHI station to the Project. AQHI is calculated based on values for ground-level ozone (O_3), particulate matter ($PM_{2.5}$/PM_{10}), and nitrogen dioxide (NO_2). The AQHI is a scale from 1-10+, representing the following health risk categories: Low (1-3), Moderate (4-6), High (7-10), and Very High (10+) (ECCC, 2023).

As recommended by Health Canada (2016), available data from air quality monitoring stations, provided by National Air Pollution Surveillance (NAPS) Network, was reviewed to describe the existing environment. Average air quality data was assessed from the nearest station (ID # 030113), with available data, situated 75 kilometers east of the Study Area in Halifax, Nova Scotia.

No baseline particulate monitoring or air quality modelling was completed for the Project.

7.1.3 Noise

Health Canada defines noise as any unwanted sound (Health Canada, 2017). Health Canada provides qualitative descriptions of community types and estimated baseline sound levels per community type. The community type in the vicinity of the Study Area was determined and based on the Health Canada guidance document, estimated baseline sound levels were determined.

No baseline noise monitoring or modelling was completed for the Project.

7.2 Geophysical Assessments

The following subsections outline the methods undertaken to assess for baseline topography, geology, and groundwater.

7.2.1 Geology and Topography

7.2.1.1 *Topography*

Topography within and adjacent to the Study Area was assessed via a review of the Nova Scotia Topographic Database (NSTDB) landform contour (i.e., 5 m contour) data and provincially available LiDAR.

7.2.1.2 *Surficial Geology*

A review of geologic units provided by NSDNR (2012) was completed for the Study Area.

7.2.1.3 *Bedrock Geology*

A literature review of NSDNRR regional mapping information (NSDNR 2012), and Neily et al., 2017, was completed to determine bedrock geology within the Study Area.

7.2.1.3.1 Acid Rock Drainage

Exposing and physically disturbing sulphide-bearing rocks can cause acid rock drainage (ARD) to develop which can negatively impact the environment and human health (NSDNR 2021). In Nova Scotia, bedrock groups such as the Goldenville Formation and Halifax Formation of the Cambro-Ordovician Meguma Group are more likely to comprise acid producing rock. NSDNRR has developed an ARD Potential Map for this area based on a higher probability of acid producing bedrock to occur in Southwestern Nova Scotia. This map was reviewed to determine its proximity and/or interaction with the Study Area.

One sample was collected within the existing quarry area in 2023 and ARD testing was completed by the Minerals Engineering Centre at Dalhousie University. The sample was analyzed using an Eltra CS2000 to measure total sulphur. Acid Producing Potential was calculated assuming a conservative estimation that all sulphur measured was sulphide sulphur.

7.2.2 Groundwater

The existing quarry operations and groundwater interactions were considered along with the following to support predicted groundwater levels:

- Adjacent surface water feature elevations at presumed groundwater discharge locations;
- Underlying rock type;
- Hydrologic characterization (Kennedy, Drage, and Fisher, 2008);
- Information sourced from the Nova Scotia Groundwater Well Network (NSGWN);
    - The Nova Scotia Groundwater Observation Well Network was established in 1965 and includes 40 active well observations across the province.
- Information sourced from the NS Well Logs Database (2022);
    - The NS Well Logs Database provides information on more than 100,000 water wells in the province, including information on well locations, geology and well construction, well depth and yield. General conclusions relating to the groundwater resource in the Study Area were derived from this information.
    - To determine a more precise location for adjacent residential wells, the NSTDB and aerial imagery was reviewed to identify buildings within 5 km of the Study Area.

Groundwater modeling and/or monitoring was not completed for the Project.

7.3 Terrestrial Assessments

Biophysical field studies for the Project began in April 2022 and continued until March 2023, complying with the requirements for a *Class I* undertaking under Section 9(1) of the *Nova Scotia Environmental Assessment Regulations*. The field studies were focused on highlighting the ecological linkages within the Study Area, as well as with the surrounding habitats. The biophysical field assessments, timing, and surveyors that completed the assessments are outlined in Table 7-1.

Table 7-1. Biophysical Assessment Components, Timing, and Surveyors

Survey		Date	Surveyor(s)
Vegetation Community and Classification (i.e., habitat)		May 20, September 9, 2022	John Gallop, P.Biol Emma Halupka
Vascular Plant Surveys	Early botany	June 15, 2022	John Gallop, P.Biol
	Late botany	September 9, 2022	Mark MacDonald
Lichen Survey		June 15, 2022	John Gallop, P.Biol

Survey		Date	Surveyor(s)
Wildlife Surveys	Incidental observations	Opportunistically throughout all biophysical surveys	All surveyors
	Mainland Moose	February 2, 27 (Tracks) April 11, 2023 (PGI)	Lucas Bonner Katrina Ferrari
Avifauna Surveys	Spring migration	April 25, May 18, 2022	Jessica Lohnes Nick Doane Emma Halupka Mark MacDonald
	Breeding bird	June 16, July 7, 2022	
	Common nighthawk	June 15, July 9, 2022	
	Fall migration	September 9, 19, October 13, 2022	
	Owl Surveys	April 21, 2022	
Wetland and Watercourse Delineations and Assessments		June 16-17, 23-24, July 26, 2022	Jessica Lohnes Katrina Ferrari Reilly Cameron
Fish and Fish Habitat Assessments		July 14 – 16, 2021 and November 24 and 25, 2022	

The mainland moose assessment methods were shared with Mark McGarrigle (NSDNRR SAR Biologist) on June 28th, 2022, for review and comment. Mr. McGarrigle was aligned with McCallum's approach for transect placement within the Study Area and outside of the Project footprint but recommended that transect placement be further refined to ensure the transects will inform the Project team of mainland moose habitat and use of the species. Recommendations were implemented by the Project team through communications with NSDNRR.

7.3.1 Priority Species

Assessment of wildlife, vegetation, and habitat was completed based on the requirements outlined in the NSECC *Guide to Addressing Wildlife Species and Habitat in an EA Registration Document* (NSE, 2009). The priority species list was created in accordance with this guide and outlined below; and it is used for the following purposes:

1. To identify which targeted surveys were required based on species and habitats available within the Study Area;
2. To identify key detection times for targeted surveys; and,
3. To inform field staff of priority species which may be encountered during biophysical surveys.

7.3.1.1 *Development of a Priority Species List*

In support of the assessment of priority species occurrence and use of the Study Area, a priority species list was created prior to commencing field assessments. The purpose of the priority species list is to identify a broad list of species that have the potential to be present within the Study Area. Priority species include Species of Conservation Interest (SOCI) that are not listed species under provincial or federal legislation (i.e., Committee on the Status of Endangered Wildlife in Canada [COSEWIC] species and/or Atlantic Canada Conservation Data Center [ACCDC] S1, S2 and S3 species or any combination thereof (i.e., S3S4 is considered a SOCI)), and Species at Risk (SAR) which are listed under the Species at Risk Act (SARA) and/or the Nova Scotia Endangered Species Act (NSESA).

Development of a priority species list for lichen, vascular plants, avifauna, and wildlife was completed based on a compilation of listed species from the following sources:

1. COSEWIC and SARA – All species listed as Endangered, Threatened, or of Special Concern;
2. NSESA – All species listed as Endangered, Threatened, or Vulnerable; and,
3. ACCDC Conservation Rank – All Species designated as S1, S2, or S3.

Additionally, invertebrates listed under NSESA, COSEWIC and SARA as described above, were included in the development of the priority species list.

The priority species list was first narrowed by broad geographic area and then further narrowed by identifying specific habitat requirements for each species. For example, if a listed species on the NSESA required open water habitat and no open water habitat is present inside the Study Area, this species was not carried forward to the final list.

The compilation of a priority species list is habitat driven, rather than observation driven (e.g., ACCDC report of Maritime Breeding Bird Atlas [MBBA]). This is based on the recognition that observation-based datasets are not comprehensive lists of species in any given area. As such, the information provided by observation driven sources are supplementary to the priority species list, rather than forming the basis of the list.

A single desktop priority species list was developed for all seasons for the Project using the methodology provided above. The seasonality of mobile species is not used to screen species into, or out of, the priority species list. All field staff reviewed the desktop evaluation for priority species prior to commencing field work to ensure they were familiar with the priority species identification and their status ranks. The priority species list is referenced across the various biophysical assessments and is provided in Appendix F. See Table 7-2 for status rank definitions across multiple regulatory levels.

Table 7-2. Status Ranks Definitions

Protection	Status	Definition
COSEWIC	**Extinct**	A wildlife species that no longer exists.
COSEWIC	**Extirpated**	A wildlife species that no longer exists in the wild in Canada, but exists elsewhere
COSEWIC	**Endangered**	A wildlife species facing imminent extirpation or extinction
COSEWIC	**Threatened**	A wildlife species that is likely to become endangered if nothing is done to reverse the factors leading to its extirpation or extinction
COSEWIC	**Special Concern**	A wildlife species that may become threated or endangered because of a combination of biological characteristics and identified threats.
COSEWIC	**Data Deficient**	A category that applies when the available information is insufficient (a) to resolve a wildlife species' eligibility for assessment or (b) to permit an assessment of the wildlife species' risk of extinction.
COSEWIC	**Not at Risk**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
SARA	**Extirpated**	Species which no longer exist in the wild in Canada but exist elsewhere in the wild.
SARA	**Endangered**	Species facing imminent extirpation of extinction.
SARA	**Threatened**	Species which are likely to become endangered if nothing is done to reverse the factors leading to their extirpation or extinction.
SARA	**Special Concern**	Species which may become threatened or endangered because of a combination of biological characteristics and identified threats.
NSESA	**Endangered**	A species facing imminent extirpation or extinction.
NSESA	**Threatened**	A species likely to become endangered if limiting factors are not reversed.
NSESA	**Vulnerable**	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
NSESA	**Extirpated**	A species that no longer exists in the wild in the Province but exists in the wild outside of the Province.
NSESA	**Extinct**	A species that no longer exists.
ACCDC	**SX**	**Presumed Extirpated** - Species or community is believed to be extirpated from the province. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

Protection	Status	Definition
ACCDC	**S1**	**Critically Imperiled** - Critically imperiled in the province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.
ACCDC	**S2**	**Imperiled** - Imperiled in the province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
ACCDC	**S3**	**Vulnerable** - Vulnerable in the province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
ACCDC	**S4**	**Apparently Secure** - Uncommon but not rare; some cause for long-term concern due to declines or other factors.
ACCDC	**S5**	**Secure** - Common, widespread, and abundant in the province.
ACCDC	**SNR**	**Unranked** - Nation or state/province conservation status not yet assessed.
ACCDC	**SU**	**Unrankable** - Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
ACCDC	**SNA**	**Not Applicable** - A conservation status rank is not applicable because the species is not a suitable target for conservation activities.
ACCDC	**S#S#**	**Range Rank** - A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).
ACCDC	**Not Provided**	Species is not known to occur in the province.
ACCDC	**Breeding Status Qualifiers**	
ACCDC	**Qualifier**	**Definition**
ACCDC	**B**	Breeding - Conservation status refers to the breeding population of the species in the province.
ACCDC	**N**	Nonbreeding - Conservation status refers to the non-breeding population of the species in the province.
ACCDC	**M**	Migrant - Migrant species occurring regularly on migration at particular staging areas or concentration spots where the species might warrant conservation attention. Conservation status refers to the aggregating transient population of the species in the province.

7.3.1.2 *Additional Desktop Priority Species Review*

Several sources were used to supplement the desktop priority species list. These sources are described herein and include observations-based datasets (i.e., ACCDC report) and proximal datasets (e.g., provincial abandoned mine openings [AMO] database, boreal felt lichen predictive habitat; Figure 5, Appendix A). Proximal datasets are those that provide information that may support the understanding of priority species in proximity to an area. For example, AMO's may support bat hibernacula, but this dataset does not represent known bat hibernacula or observations of the species.

The ACCDC houses a comprehensive biodiversity database for Atlantic Canada, including conservation status ranks, which is updated regularly. ACCDC reports provide important supplementary, observation-driven data sources including sightings of priority species recorded within 5 km and 100 km. An ACCDC report was prepared for the Study Area on May 5, 2022 (Appendix G).

NSDNRR has classified several species as 'location sensitive', meaning that ACCDC is not permitted to provide specific location data for these species in their reports. Location sensitive species in Nova Scotia include black ash (*Fraxinus nigra*), Blanding's turtle (*Emydoidea blandingii*), wood turtle (*Glyptemys insculpta*), peregrine falcon populations (*Falco peregrinus, pop.1*), and any bat hibernaculum. If any of these species are present within 5 km of the Study Area, the ACCDC report will simply identify that they are present. If noted in the ACCDC report, McCallum will consult with NSDNRR to obtain additional information on the observation.

Additional datasets reviewed during the desktop review for priority species included:

- Lichen databases, included those provided by the Mersey Tobeatic Research Institute (MTRI), that were assessed to identify potential for priority lichen species including vole ears (*Erioderma mollissimum*) and boreal felt lichen (BFL);
- Provincial government records of AMOs were reviewed as AMOs that are uncapped and unflooded may provide bat hibernacula;
- The NSNDRR significant species and habitats database;
- Maritime Breeding Bird Atlas (MBBA)
- Canada Wildlife Service Migratory Bird Sanctuary (MBS)
- Canada Important Bird Area (IBA)
- SARA critical habitat layers
- SARA recovery strategies
- DFO critical habitat mapping
- Atlantic salmon atlas

- Freshwater fish species distribution records
- Provincial Landscape Viewer – Atlantic Coastal Plain Flora (ACPF) Buffer, Lynx Buffer, Marten Range Patches 2019, Marten Range Patches 2030, Marten Habitat Management Zones, Mainland Moose Concentration Areas
- Provincial Special Management Practice layers – wood turtle, vole ears, mainland moose, etc.

7.3.2 Habitat

The following are the desktop and field methodologies used during the vegetation community identification and classification program. The purpose of defining the vegetation communities within the Study Area is to determine what communities are present, what habitats and species they can support, and if unique or rare habitats are present (i.e., areas to target during other biophysical surveys).

7.3.2.1 *Desktop Review*

Prior to completing field assessments, several geospatial datasets were reviewed to inform the vegetation community surveys:

- Study Area spatial boundary
- Nova Scotia forestry inventory
- Nova Scotia Environment and Climate Change (NSECC) wetland and watercourse inventory
- Nova Scotia Topographic Database (NSTDB)
- Ecological Land Classification (ELC)
- Nova Scotia old forestry policy polygons
- Aerial imagery

These datasets allowed the surveyor to, at a high-level, identify potential areas of interest, particularly wetland features which often reflect changes in vegetation community structures.

7.3.2.2 *Field Survey*

Vegetation community surveys were completed in in May 2022 throughout the Study Area. This timing was selected as it facilitates proper detection and characterization of the vegetation communities and allows the findings to guide other surveys (i.e., targeted locations for vascular plant surveys). Surveys were completed by a qualified biologist walking meandering transects. Figure 6 (Appendix A) outlines forest types within the Study Area and targeted habitats as part of the vegetation community surveys. The Nova

Scotia Forest Ecosystem Classification System (FEC) was used (e.g., Neily et al., 2010) to classify vegetation communities found within the Study Area.

All vegetation community types encountered within the Study Area were georeferenced using a handheld Garmin GPSMAP 64s unit, and the following information was recorded:

1. Dominant tree, shrub, and herbaceous species
2. Presence of disturbance
    a) Anthropogenic (e.g., cut block)
    b) Natural (e.g., windthrow)
    c) None
3. Representative photographs
4. Vegetation community and classification

Both wetland and upland vegetation communities were assessed, acknowledging that additional wetland information will be recorded during detailed wetland evaluations.

7.3.3 Vascular Plants

Desktop and field survey methodologies were implemented during the vascular plant survey program and these survey methodologies are discussed below.

7.3.3.1 *Desktop Review*

Prior to undertaking the field assessment, a detailed desktop review of known vascular plant observations and potential habitat for rare plants within the Study Area was conducted. The desktop review process involved a review of the ACCDC database results (Appendix G), mapped wetland habitat, results of the vegetation community identification and classification (Section 8.3.1.2), and the priority species list (Appendix F).

Additional geospatial databases were reviewed for information pertaining to vascular plant community assemblages. These databases include ACPF Group Buffers (Nova Scotia Department of Natural Resources, 2019) and the ecological land classifications of Nova Scotia (Neily, Basquill, Quigley, & Keys, 2017). The desktop review process informs field surveyors if there is an increased likelihood of priority vascular plant species and where they may be expected (e.g., landscape characteristics).

7.3.3.2 *Field Survey*

Dedicated vascular plant surveys were completed early (June 15th, 2022) and late (September 9th, 2022) in the growing season (~June 1 to September 30) to capture plant species with different flowering periods.

Early botany surveys were completed within the Study Area by former McCallum biologist, John Gallop and McCallum Senior Ecologist Mark MacDonald. Late botany surveys were completed by Mark MacDonald. All suitable habitats, as identified within the field, were surveyed. Additionally, incidental vascular plant observations, particularly priority species, were recorded throughout the suite of other biophysical surveys conducted in 2022.

Meandering transects were completed on foot, and all major habitat types were assessed to create a species list of vascular species and community assemblages observed within the Study Area, along with georeferenced locations of priority vascular flora species. All encountered vascular plant species were identified. If a species could not be identified in the field, detailed photographs were taken to capture diagnostic features, and, if required, specimens were collected and preserved for identification out of the field. Specimens were only collected if they were abundant on site and were not collected if only one or two individuals were observed. All priority species observed were georeferenced, counted (when possible), photographed, and a description of their habitat was recorded. If specimens were present in tufts or in large numbers (e.g., counting was not reasonable), the areas that contained large numbers of that species were measured (e.g., 10 m x 10 m). The following literature were the primary references used during the field surveys and identification process:

- Roland's Flora of Nova Scotia (Zinck, 1998);
- Nova Scotia Plants (Munro, Newell, & Hill, 2014);
- Flora of New Brunswick (Hinds, 2000);
- Go Botany (Native Plant Trust, 2020);
- Field Manual of Michigan Flora (Voss & Reznicek, 2012);
- Sedges of Maine (Arsenault, et al., 2013); and,
- Grasses and Rushes of Maine (Mittelhauser, Arsenault, Cameron, & Doucette, 2019).

All plant species were reviewed to determine if they are a member of the ACPF group or invasive.

7.3.4 Lichens

The following are the desktop and field survey methodologies implemented during the lichen survey program.

7.3.4.1 *Desktop Review*

Prior to the field assessment, a detailed desktop review of known lichen observations and potential habitat for rare lichens within the Study Area was conducted. The desktop review process involved a review of the following:

- ACCDC database results (Appendix G);

- NSDNR predictive habitat mapping for boreal felt lichen (*Erioderma pedicellatum*) (2010);
- MTRI Vole Ears and extant Blue Felt Lichen (BFL) GIS databases (Mersey Tobeatic Research Institute, 2019);
- NSDNR forest inventory GIS database (NSL&F, 2021); and,
- The Priority Species List (Appendix F).

The desktop review process informs field surveyors if there is an increased likelihood of priority lichen species and where they may be expected. The forest inventory GIS database helps predict forest characteristics, including age, which are more suitable for lichens. While the specific habitat requirements for each priority lichen species varies, many require mature to over-mature forests; stand age is one of the greatest determinants of the presence of many rare epiphytic lichens (McMullin R. , Duinker, Cameron, Richardson, & Brodo, 2008).

7.3.4.2 *Field Survey*

All suitable lichen habitats within the Study Area, as identified within the field (guided by the desktop review), were surveyed by qualified lichenologist John Gallop on June 15th, 2022. Lichens, unlike vascular plants, can be surveyed all year-round if their hosts (tree trunks, the forest floor, and rocky outcrops) are not snow covered. Meandering transects were completed on foot and targeted mature trees appropriate for hosting priority lichen species, supported by the preliminary habitat assessment and points (Figure 7, Appendix A). These trees were visually inspected, focusing on tree trunks, branches, and twigs. Any identified priority species lichens were clearly marked with flagging tape.

The following information was collected for any priority lichen species identified during field surveys, along with photographs, and any other relevant information:

- Surveyor name
- Weather condition
- Survey condition
- General site location
- Date
- Scientific name
- Count (# of thalli)
- Size of thallus or thalli
- Habitat (host tree and general habitat – including within a wetland or upland)

- Location (waypoint in UTM NAD83)
- Height of the specimen
- Direction that the specimen is facing
- Any relevant comments

If a lichen specimen could not be readily identified in the field, photos and/or specimens were collected and identified later. Specimens were only collected if they were abundant on site and were not collected if only one or two individuals were observed. If necessary, collected samples were inspected via microscope and standard chemical spot tests in accordance with Brodo *et al.* (2001), to determine the species. The following literature was referenced during the surveys and identification process:

- The Macrolichens of New England (Hinds & Hinds, 2007);
- Lichens of North America (Brodo, Sharnoff, & Sharnoff, 2001);
- Keys to Lichens of North American – Revised and Expanded (Brodo, Sharnoff, & Sharnoff, Keys to Lichens of North America - Revised and Expanded, 2016);
- Microlichens of the Pacific Northwest – Volume 1 – Key to The Genera (McCune, 2009);
- Microlichens of the Pacific Northwest – Volume 2 – Key to the Species (McCune, 2009); and
- Common Lichens of Northeastern North America (McMullin & Anderson, 2014).

Through the lichen survey, a list of common lichens was recorded with focus on macrolichens (i.e., foliose, fruticose, and squamulose), along with georeferenced locations of priority lichen species.

7.3.5 Fauna

Desktop and field survey methodologies were implemented during the wildlife survey program and these methodologies are discussed below.

7.3.5.1 *Desktop Review*

Prior to undertaking the terrestrial field assessments, a detailed desktop review of known fauna observations and potential habitat was undertaken within the Study Area and to support survey design. The following databases were reviewed:

- ACCDC report (Appendix G);
- NSDNRR Significant Habitat layers;

- SARA Critical Habitat layers;
- Government records of AMOs (NSDNRR 2017)
- SARA Recovery strategies;
- SMPs layers; and,
- Priority species list (Appendix F).

Additionally, NSDNRR is consulted regarding location sensitive species if recorded in the ACCDC report, as well as the presence of species' core habitat in relation to the Study Area. The ACCDC report (Appendix G) did not contain records of location sensitive species.

7.3.5.2 *Field Surveys*

Data collection on various terrestrial fauna species, such as mammals, reptiles, amphibians, and invertebrates, occurred through targeted surveys, as well as incidental observations. Particular attention was paid to SAR and SOCI species. Additionally, incidental observations during other surveys were recorded and provided a holistic and overarching understanding of wildlife on the landscape. These surveys help to understand which species are present within the Study Area and how they could potentially interact with the Project. All observations were identified and recorded by biologists experienced in recognition of wildlife tracks, scat, and browse, resulting in a comprehensive fauna species list. Wildlife habitat availability was assessed concurrently with other biophysical surveys, within wetland and upland habitat. The following literature was referenced during the surveys and identification process:

- Mammal Tracks & Signs: A Guide to North American Species (Elbroch, 2003);
- A Field Guide to Animal Tracks (Murie, 1974);
- Dragonflies and Damselflies of the East (Paulson, 2011); and
- Tracking & the Art of Seeing (Rezendes, 1999).

Based on the desktop review, specialized surveys were deemed necessary to target specific priority species known, or having the potential, to exist within the Study Area and surrounding area (e.g., priority species list, ACCDC report and/or the presence of suitable habitat). Specialized surveys were designed for these species, as they are not reliably detected during the previously described field programs. Where a priority species was identified during surveys, additional effort was made in the field to understand the habitat at the sighting location and evaluate its suitability to support the species' survival and life cycle requirements. Refer to the following subsections for additional details on specialized surveys.

7.3.5.2.1 Species at Risk Bats

The little brown myotis (*Myotis lucifugus*), the northern long-eared myotis (*Myotis septentrionalis*) and the tricolored bat (*Perimyotis subflavus*) have been observed within 11.2 km, 11.4 km and 11.4 km from the Study Area, respectively (ACCDC, 2022; Appendix G). The little brown myotis, northern long-eared myotis, and the tricolored bat are listed as S1 by the ACCDC, Endangered by COSEWIC, SARA, and NSESA. AMOs can provide bat habitat, especially if they are open and unflooded. No AMOs are located within the Study Area; the closest location is 5.1 km southeast (NSDNR, 2017). During all biophysical surveys, McCallum biologists recorded any evidence of caves, open wells, cavities in mature trees, rock outcrops or other potential hibernacula or maternity roosting habitats, or any incidental observations of bats themselves. If a hibernaculum was observed, additional surveys (e.g., acoustical monitoring) would be completed.

7.3.5.2.2 Mainland Moose

Mainland moose (*Alces alces americana*) is listed as Endangered by the NSESA and considered critically imperiled (S1) by the ACCDC. The ACCDC report presents that the nearest mainland moose observation is 24.9 km away from the Study Area (ACCDC, 2022; Appendix G). The Study Area was confirmed to be located on the margins of mainland moose core habitat (pers. coms. Mark McGarrigle, NSDNRR SAR Biologist, June 22, 2022) identified in the *Recovery Plan for the Moose (Alces alces americana*) in Mainland Nova Scotia (NSDNRR, 2021; Figure 5, Appendix A). Core habitat has been identified as areas that currently provide life cycle requirements of mainland moose and/or are expected to contain biophysical attributes for life cycle requirements over the next 30 years (NSDNRR, 2021). Mainland moose forage in habitats that are dominated by regenerative forests and cutovers. Mature forested stands can provide areas for winter and summer cover, and areas of open water features provide calving and aquatic feeding areas in the summer months (NSDNRR, 2021). The *Provincial Landscape Viewer* shows the forest within the Study Area is comprised of all stages (NSDNRR, 2022), dominated by mixedwood and softwood forests.

As the Study Area is conservatively within the mainland moose core habitat, and there is potential habitat for mainland moose in parts of the Study Area, dedicated mainland moose surveys were conducted. Dedicated surveys better inform the presence/absence of mainland moose and how mainland moose may be using the Study Area. NSDNRR confirmed they are aligned with McCallum's approach to establish transects both within the Study Area and on a nearby crown land parcel (Marl McGarrigle, NSDNRR SAR Biologist, September 16, 2022).

Transects were distributed throughout suitable habitat to better understand the broader distribution of mainland moose within the Study Area and surrounding areas. The transect layout was driven by habitat suitability, including undisturbed habitat and wetlands, trails, and accessibility from roads. Track surveys were completed on foot by observers experienced in recognition of moose, deer and other wildlife tracks, scat and browse. Once the first round of surveys was complete, the same set of transect was used for any future rounds, unless safety and access dictated a change in transects. Winter track surveys were completed within 3-7 days following a 10 cm snowfall if there were no additional precipitation events in the intervening days. Surveys were not conducted during periods of rain, snowfall, or blowing snow. Pellet Group Inventory (PGI) survey was completed in post snow melt conditions, which allows for

moose pellets that were undetected during the winter months due to snow cover, which were identified by the survey team. Survey types and dates are presented in Biophysical field studies for the Project began in April 2022 and continued until March 2023, complying with the requirements for a *Class I* undertaking under Section 9(1) of the *Nova Scotia Environmental Assessment Regulations*. The field studies were focused on highlighting the ecological linkages within the Study Area, as well as with the surrounding habitats. The biophysical field assessments, timing, and surveyors that completed the assessments are outlined in Table 7-1.

The surveyors used a handheld GPS device, pre-loaded with the transects to complete the surveys. If mainland moose signs were observed, UTM coordinates and photographs were recorded, and microhabitat assessments completed. A microhabitat assessment includes observations on forest type and age, dominant vegetation species, distance to the closest watercourse and road.

7.3.5.2.3 Herpetofauna

Snapping turtle (*Chelydra serpentina,* COSEWIC, SARA Special Concern, NSESA Vulnerable, ACCDC S3) has been documented 3.7 km from the Study Area (ACCDC, 2022; Appendix G). The Eastern painted turtle (*Chrysemys picta picta,* SARA and COSEWIC Special Concern, ACCDC S4) has been observed 9.3 km from the Study Area (ACCDC, 2022; Appendix G).

Snapping turtles use a variety of habitats; however, they are the most aquatic of the turtle species present in Nova Scotia and preferred habitat is slow-moving water with a soft mud bottom and dense aquatic vegetation. Nesting typically occurs in sand or gravel banks in proximity to water with sparse vegetation cover (ECCC, 2020). Hibernation sites are aquatic environments (e.g., lentic, lotic, and mud) where water will not freeze to the bottom, the substrate is a thick layer of mud, and other cover (e.g., large woody debris) is present (ECCC, 2020).

Eastern painted turtles are primarily found throughout the southwestern and central parts of Nova Scotia. Eastern painted turtles typically inhabit areas with shallower, and slower moving waters and a soft bottom (NCC, 2023). In addition, they are known to be found basking in habitats with abundant rocks and logs (COSEWIC, 2018). Nesting typically occurs in habitats with sand or gravel, forest clearings, meadows and fields with areas of high sun exposure (COSEWIC, 2018).

Female turtles are attracted to soft gravel areas to dig and lay their eggs. Suitable habitat may be available for these species within the Study Area based on desktop review (i.e., roadside clearings, quarries and gravel pits). In addition, based on the desktop review, there is a watercourse system in the northern part of the Study Area; that has the potential to support hibernation sites for both snapping and Eastern painted turtles. During all biophysical surveys, McCallum biologists recorded any incidental observations of turtles using the Study Area. Specifically, during wetland and watercourse delineation, surveyors were looking for turtles and assessing habitat potential.

7.3.6 Avifauna

The following desktop and field survey methodologies were implemented during the avifauna survey program and are discussed below.

7.3.6.1 *Desktop Review*

The following databases were reviewed prior to undertaking the avifauna field assessments to assess known avifauna observations and potential habitat within the Study Area and support survey design:

- ACCDC report (Appendix G);
- Canada Important Bird Areas database;
- Maritime Breeding Bird Atlas (MBBA) squares 20LQ73 and 20LQ83 (Appendix H), and;
- Canada Wildlife Service Maritime Breeding Bird Sanctuaries.

7.3.6.2 *Field Surveys*

As per to the *Guide to Addressing Wildlife Species and Habitat in an EA Registration Document,* activities that have the potential to impact migratory avifauna species require field surveys (NSE, 2009). Avifauna surveys, including migratory surveys, were completed given the potential impact to avifauna species through habitat alteration, direct mortality, and sensory disturbance. The avifauna field programs were designed following specific guidance from *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds* (EC CWS, 2007). Although this document is specific to wind turbine projects, these protocols provide a variety of survey methods that can be considered applicable to other developments such as quarries and is an appropriate guidance document for avifauna surveys in general.

Avifauna surveys were conducted using point count (PC) methodology, a commonly used survey technique for determining avian species composition (FAO, 2007). These methods were based on Canada Wildlife Services (CWS) protocols as they relate to survey site selection, survey duration, and season selection. Pont count locations were chosen to survey representative habitat types within the Study Area. Additionally, common nighthawk (*Chordeiles minor*) and nocturnal owl surveys were conducted due to their inclusion within the ACCDC report and potential for their habitat within the Study Area, based on desktop review. Priority species observations were documented and mapped during dedicated survey periods and incidentally.

Avian survey locations are provided in Figure 8 (Appendix A). Survey types, dates, and surveyors are presented in Biophysical field studies for the Project began in April 2022 and continued until March 2023, complying with the requirements for a *Class I* undertaking under Section 9(1) of the *Nova Scotia Environmental Assessment Regulations*. The field studies were focused on highlighting the ecological linkages within the Study Area, as well as with the surrounding habitats. The biophysical field assessments, timing, and surveyors that completed the assessments are outlined in Table 7-1. Detailed methods, provided in the sections below, were completed for the following surveys:

- Breeding bird
- Spring migration
- Fall migration
- Common nighthawk
- Nocturnal owl
- Winter

Avifauna species were identified based on functional bird groups to understand how each group is using the Study Area. These functional groups include waterfowl, shorebirds, other water birds (i.e., that are not waterfowl or shorebirds), diurnal raptors, nocturnal raptors, passerines (excluding dippers), and other landbirds.

The following literature were referenced during the surveys and identification process:

- Birds of Nova Scotia (Tufts, 1986);
- Field Guide to the Birds of North America (National Geographic, 2002);
- Peterson Field Guide to Birds of Eastern & Central North America (Peterson, 2020); and
- The Sibley Field Guide to Birds of Eastern North America (Sibley, 2016).

Additionally, applications such as iBird Pro, eBird, and iNaturalist, were used in the field in a supplementary manner to aid in species identification. These apps, however, were not relied on to generate species lists or in lieu of a qualified biologist. The goal of the suite of avifauna surveys is to develop a robust species list, document breeding evidence, and map observed priority species occurrences.

7.3.6.2.1 Spring Migration, Fall Migration, and Breeding Surveys

PCs were selected as the preferred method for avian usage surveys as they allow identification of a broad range of species. The same suite of PC locations were used for spring migration, breeding bird, and fall migration surveys (Figure 8, Appendix A). PC locations were selected using available aerial imagery and habitat type information and were spread throughout the Study Area. PC locations cover various representative habitats, in and immediately surrounding the Study Area, including mixedwood forests, wetlands, trails, disturbed and undisturbed habitats as outlined in Table 7-3. PCs were spaced at least 250 m apart to avoid double counting species observations (Howe, Wolf, & Rinaldi, 1997), as recommended in *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds* (EC CWS, 2007). PCs allow for a 360-degree survey arc around a fixed point and are especially useful for detecting shy birds that would otherwise hide during transect surveys (FAO, 2007).

Nine point counts were selected for avian surveys within the relatively small size of the Study Area while maintaining a distance of 250 m between points to ensure point independence. In addition to covering a variety of habitats, the selected PC locations provide safe access for surveyors, good visibility/vantage points, and detectability of species drawn to edge habitats.

Table 7-3: Avifauna Point Count Habitat Descriptions

PC	PC Habitat Description
1	Predominantly softwood forest by pond and wetland
2	On the edge of water of the pond. Mixedwood forest behind the survey location
3	Edge of open treed swamp (mixedwood), closed canopy around the edges.
4	On a road/trail, with mixedwood forest around trail.
5	In existing quarry, surrounded by mixedwood forest
6	Mixedwood forest, a shrubby area that is close to a treed swamp.
7	Edge trail for a clear-cut area. Some tall softwood dominant forest around/on either side of the trail.
8	Mixedwood forest close to disturbed clearcut area. Edge habitat.
9	Mixedwood forest close to a treed swamp.

Following guidance provided by EC CWS (2007), surveys commenced within half an hour of sunrise and were completed by 10:00 a.m. Ten-minute PCs were completed at each survey location. Bird observations were recorded at four distance regimes: within a 50 m radius, 50 to 100 m radius, outside the 100 m radius, and flyovers. At each PC, a handheld Garmin GPSMAP 64s unit was used to geo-reference the location.

General observations including the temperature, visibility, wind speed, date, start time, and end time were recorded. Surveys were terminated if windy, noisy, or rainy conditions arose. Surveys were not conducted in wind speeds over 3 on the Beaufort scale (12-19 km/hr), when noise levels make it difficult to hear or distinguish bird calls, or when it rains more than a light drizzle (EC CWS, 2007).

Incidental observations are those that occur outside of the allotted survey time, while walking to/from PC locations, or during other biophysical surveys. Incidental observations made while conducting avian surveys were recorded and included in field data collection, however, these observations were analyzed separately from non-incidental observations. Incidental avian observations that occur during other biophysical surveys (i.e., wetland delineation, botany survey, etc.) were noted, but only priority species observations were carried forward into analysis.

7.3.6.2.1.1 *Spring Migration, Fall Migration*

Two rounds of spring migration surveys (April 25 and May 18, 2022) and three rounds of fall migration surveys (September 9, 19, and October 13, 2022) were completed at the nine PC locations. Survey dates were selected to provide representative coverage of important stages of avifauna ecology; by spreading out survey dates, the widest variety of migrating birds were able to be observed. An extra survey round is conducted in fall as this migration season is slightly longer than the spring (CWS, 2007).

7.3.6.2.1.2 *Breeding*

The goal of breeding bird surveys is to determine which species are nesting, raising young, and foraging during the breeding season with the Study Area to better understand the potential impacts of the proposed Project on these species and breeding life stages (EC CWS, 2007). The methodology for breeding bird surveys is the same as those described for spring and fall migration (Section 7.3.6.2.1, Figure 8 Appendix A)), with the addition of area searches. Area searches are recommended by CWS during the breeding season to visit more habitat types and/or search habitats more thoroughly for species use during the breeding season (EC CWS, 2007). Area searches were conducted by qualified surveyors (see Biophysical field studies for the Project began in April 2022 and continued until March 2023, complying with the requirements for a *Class I* undertaking under Section 9(1) of the *Nova Scotia Environmental Assessment Regulations*. The field studies were focused on highlighting the ecological linkages within the Study Area, as well as with the surrounding habitats. The biophysical field assessments, timing, and surveyors that completed the assessments are outlined in Table 7-1), following meandering transects for 45 mins after PC surveys were completed. Area searches targeted areas not covered by PC locations.

During area searches, avian observations were recorded at the same four distance regimes as PC protocol, and a handheld Garmin GPSMAP 64s unit was used to geo-reference the location of any priority species. General observations were similar to those recorded at PCs. Area searches may result in the observation of the same individual multiple times from different transects.

As with migratory surveys, breeding bird surveys were conducted at the previously described nine PC locations. In addition to the methods described above, the breeding status of the bird species observed during breeding bird surveys were also recorded. Table 7-4 outlines the types of breeding evidence and status that were recorded (MBBA, n.d.).

Table 7-4: Breeding Evidence Descriptions (MBBA, n.d.)

Breeding Status	Code	Breeding Evidence
Observed	X	Species observed in its breeding season (no breeding evidence).
Possible	H	Species observed in its breeding season in suitable nesting habitat.
	S	Singing male(s) present, or breeding calls hard, in suitable nesting habitat in breeding season.
Probable	P	Pair observed in suitable nesting habitat in nesting season.
	T	Permanent territory presumed through registration of territorial song, or the occurrence of an adult bird, at the same place, in breeding habitat, on at least two days a week or more apart, during its breeding season.
	D	Courtship or display, including interaction between a male and a female or two males, including courtship feeding or copulation.
	V	Visiting probable nest site.
	A	Agitated behaviour or anxiety calls of an adult.
	B	Brood patch on adult female or cloacal protuberance on adult male.
	N	Nest-building or excavation of nest hole by wrens and woodpeckers.

Breeding Status	Code	Breeding Evidence
Confirmed	NB	Nest building or carrying nest materials, for all species except wrens and woodpeckers.
	DD	Distraction display or injury feigning.
	NU	Used nest or eggshells found (occupied or laid within the period of the survey).
	FY	Recently fledged young or downy young including incapable of sustained flight.
	AE	Adult leaving or entering nest sites in circumstances indicating occupied nest.
	FS	Adult carrying fecal sac.
	CF	Adult carrying food for young.
	NE	Nest containing eggs
	NY	Nest with young seen or heard.

Two breeding bird surveys were conducted, June 16 and July 7, 2022, to capture representative early and late breeders, while minimizing disturbance to nesting birds. It should be noted that during migration surveys, breeding behavior is also noted when observed as some individuals may breed earlier or later in the year. Surveys were spaced apart by 10 days to avoid/limit disturbance to nesting birds (EC CWS, 2007).

7.3.6.2.2 Common Nighthawk

Common nighthawk (*Chordeiles minor*) are listed as Special Concern by COSEWIC and SARA and Threatened by NSESA. Common nighthawks prefer to nest in gravelly substrates and are best detected while foraging for insects shortly after sunset (MBBA, 2008). Common nighthawks are documented by the ACCDC and the MBBA as present in the vicinity of the Study Area, and suitable habitat may be available for this species within the Study Area based on desktop review (i.e., harvested areas, roadside clearings, quarries and gravel pits). The ACCDC report states this species has been identified within 1.8 ± 0.0 km of the Study Area (Appendix G). In addition, the MBBA notes common nighthawk has been observed within the region displaying probable breeding evidence.

Two dedicated evening surveys for the common nighthawk were conducted during their breeding season on June 15 and July 9, 2022. Targeted surveys were selected as common nighthawk are not reliably detected during the seasonal PC surveys due to their crepuscular nature (Saskatchewan Ministry of Environment, 2015). The survey dates coincide with breeding season for common nighthawk and were limited to two evening surveys to reduce rick of disturbance to breeding species. Four common nighthawk PCs (CONI PC), CONI1, CONI2, and CONI3, CONI4, were surveyed by a qualified surveyor (see Biophysical field studies for the Project began in April 2022 and continued until March 2023, complying with the requirements for a *Class I* undertaking under Section 9(1) of the *Nova Scotia Environmental Assessment Regulations*. The field studies were focused on highlighting the ecological linkages within the Study Area, as well as with the surrounding habitats. The biophysical field assessments, timing, and surveyors that completed the assessments are outlined in Table 7-1). Surveys were conducted one hour before sunset and ended 30 minutes after sunset (Saskatchewan Ministry of Environment, 2015; MBBA, 2008).

CONI1 is situated within the Study Area, in the existing IA Permit Area, CONI2 is located on Woodstock Road (approximately 1 km northeast of the Study Area), CONI3 is also located on Woodstock Road (2.7 km southeast to the Study Area), and CONI4 is located on Hallamore Lane (2 km southwest of the Study Area; Figure 8 Appendix A). CONI PC locations were selected based on suitable nesting habitat (e.g., gravel roads, clearings) and safe access from a vehicle during nocturnal surveys (MBBA, 2008). CONI PCs were separated by 800 m to provide coverage, while avoiding overlapping observations (i.e., hearing the same individual at multiple locations) (Saskatchewan Ministry of Environment, 2015).

At each CONI PC location, surveys consisted of a seven-minute passive surveying period, as per survey protocol by Saskatchewan Ministry of Environment (2015). Any observations of common nighthawk were recorded, including the number of individuals heard, sex, distance, bearing, dominant habitat that the bird is observed within, bird behaviour, and whether the bird is observed during the allotted survey time or not. Any other birds observed during the survey time were recorded.

7.3.6.2.3 Nocturnal Owl Surveys

Two owl species were reported by the ACCDC to have been observed within 100 km of the Study Area (Appendix G): the short-eared owl (*Asio flammeus,* 32.0km), and the long-eared owl (*Asio otus,* 2.1 km). The short-eared owl is mainly found in open fields and grasslands (Cornell University, 2021). The long-eared owl is mainly found roosting in dense vegetation and foraging in open grass or shrublands consisting of coniferous or deciduous forests; they typically use stick nests that have been abandoned by other bird species such as American crows, common ravens, and various hawk species (Cornell University, 2019). The short-eared owl and the long-eared owl were also observed within the MBBA for the region; and the long-eared owl was observed to have possible breeding evidence. Habitat for the short-eared owl is unlikely to exist within the Study Area which, based on aerial imagery and field surveys, does not have large areas of open fields or grasslands, and is not in boreal forest (Neily, Basquill, Quigley and Keys, 2017). Habitat is present within the Study Area for long-eared owl, therefore dedicated nocturnal surveys were completed.

The methods for monitoring nocturnal owls followed the Guidelines for Nocturnal Owl Monitoring in North America (Takats et al., 2001). Nocturnal owl surveys take place once per year when vocal activity of most owl species is greatest, as identified by Takats and colleagues (2001), typically between April and May. A nocturnal owl survey was completed on April 21, 2022. Nocturnal owl PC stations are spaced at least 1.6 km apart to reduce the chances of detecting the same owl at multiple stations. Some of the louder owls, such as the barred owl, can be heard at distances of two kilometers or more (Takats et al., 2001). However, most of the smaller owls cannot be heard as far or as clearly. Surveys were conducted between half an hour after sunset and midnight (Takats et al., 2001).

Four PC stations were surveyed: one within the Study Area (Owl 1) and the other three (Owl 2, Owl 3, and Owl 4) adjacent to the Study Area (Figure 8, Appendix A). Owl 2 is located on Woodstock Road (~2.9 km southeast of the Study Area), Owl 3 is located on Woodstock Road (~1.5 km east of the Study Area) and Owl 4 is located on Hallamore Lane (~2 km south of the Study Area). The four locations were selected for their ease of access and suitable habitat. Prior to commencing the survey, the selected broadcaster was tested to ensure that owl calls are audible and recognizable at 400 m. Ensuring that the broadcast cannot be

heard beyond 400 m will minimize bias at an adjacent survey station (Takats et al., 2001). The broadcaster test was carried out under weather and noise conditions similar to those that are likely to be encountered during the survey.

The Bird Studies Canada (BSC) Nova Scotia Nocturnal Owl Survey program broadcast was used, which consists of a 9.5-minute track that follows the following format and owl data recording method (Bird Studies Canada - Atlantic Region, 2019):

- Initiates with a beep to indicate the start of the first silent listening period, which lasts one minute. All owls heard or seen are recorded. Only if an owl is calling during this period, estimate a distance and bearing, then immediately proceed ~300 m along the road (toward the owl if possible) and record a second distance and bearing to permit triangulation of the owl and facilitate habitat association. Another beep marks the end of the first silent listening minute.
- A second silent listening minute will follow. All new owls seen or heard in the second minute are recorded, as well as any owls that continue to call from the first silent listening minute. As described above, if a new owl is heard during the second silent listening minute record a second distance and bearing will be taken to permit triangulation of the owl and facilitate habitat association.
- During each of the following 20-second broadcasts, rotate the speakers fully.
- A 20-second boreal owl broadcast begins, which is followed by a one-minute silent listening period. All owls heard or seen during this period are to be recorded separately and it is important to keep track of whether the owls heard in the first two-minutes continue to call as well as any new owls.
- The boreal owl broadcast is repeated, which is again followed by a one-minute silent listening period. All owls heard or seen during this period continue to be recorded separately.
- A 20-second barred owl broadcast begins, which is followed by a two-minute silent listening period. All owls heard or seen during this period continue to be recorded separately.
- The barred owl broadcast is repeated, which is again followed by another two-minute silent listening period. All owls heard or seen during this period continue to be recorded separately.
- A beep marks the end of the broadcast track.

7.3.6.2.4 Incidental Observations

Incidental observations include individuals observed outside of dedicated PC surveys or survey times (i.e., when walking between point count locations) and individuals observed during non-avian surveys (e.g., wetland and watercourse assessments).

Avifauna recorded incidentally include novel species (i.e., those not yet recorded in standardized point counts) and priority species.

7.4 Aquatic Assessments

The following subsections outline the methods undertaken to assess for wetlands, surface water, and fish and fish habitat.

7.4.1 Wetlands

The Nova Scotia Environment Act (2006) defines wetlands as:

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

Wetlands perform a broad range of functions including, but not limited to; water storage, pollutant removal, sediment retention and provision of nesting/breeding habitat. Wetlands may also have values and benefits associated with aesthetics/recreation, cultural values, and subsistence production (NBDELG, 2008). The discussions of wetlands presented herein primarily aligns with the Canadian Wetlands Classification System (Warner and Rubec, 1997) and/or with the methodologies adapted by Nova Scotia for wetland delineation and functional assessment.

The Nova Scotia *Environment Act* requires that an approval from NSECC be obtained before any wetlands can be altered (Environment Act c.1, s.1, 1994-95). Wetland delineation and assessment is necessary to provide a holistic understanding of what wetlands are present, where they are located, and what functions they perform within the Study Area.

A desktop review and field survey were implemented during the wetland survey program and these methods are discussed below.

7.4.1.1 *Desktop Review*

A desktop review of available topographic maps, appropriate provincial databases and aerial photography was completed to support the identification of anticipated potential wetland areas in the Study Area and guide field surveys (Figure 9, Appendix A). These datasets include, but are not limited to:

- Wet Areas database;
- Flow Accumulation database;
- NSECC Wetland Inventory; and,
- NSECC Wetlands of Special Significance (WSS).

7.4.1.2 *Wetlands of Special Significance*

The *Wetland Conservation Policy* was developed by NSECC (NSE, 2019). Its mandate is to provide a framework for the conservation of wetlands. Furthermore, it provides a framework for the identification of WSS. According to NSECC (NSE, 2019; p.11-12), the following criteria define 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 Areas 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 Easter Habitat Joint Venture (NS-EHJV);
- Wetlands known to support at-risk species as designated under the federal *Species at Risk Act* or the *Nova Scotia Endangered Species Act*; and,
- Wetlands in designated protected water areas as described within Section 106 of the *Environment Act*.

To date NSECC Wetland Specialists have provided guidance that the presence of a sessile or mobile SAR within a delineated wetland triggers the determination of that wetland as a WSS. These may be field observed or from the ACCDC database. For observations of mobile SAR in wetlands, habitat requirements for critical life functions (e.g., breeding, overwintering) are considered in relation to the habitat the wetland provides. The wetland may be assessed to not provide suitable habitat for critical life function and there not recommended as a WSS. All habitat assessment rationale is provided for NSECC review and consideration. During WSS determination assessments McCallum considers species-specific and site-specific conditions, including the following factors:

- whether the species was observed during field surveys within the wetland;
- whether the species was observed historically (e.g., ACCDC) within the wetland and the temporal and spatial accuracy of the observation point; and,
- whether suitable habitat is present within the wetland, in consideration of:
    - what the wetland habitat is used for (i.e., does the habitat provided within the wetland provide necessary life functions (i.e., nesting, or overwintering habitat)); and,

- the discreteness or specificity of habitat use by the mobile species (i.e., wood turtles have specific and discrete nest beach requirements, compared with the in-discrete and non-specific foraging habitat usage by mainland moose, for example).

A framework for determination of WSS designation based on functional benefit using the Wetland Ecosystem Services Protocol – Atlantic Canada (WESP-AC) has recently been developed and implemented by NSECC in August 2021. A Functional WSS Interpretation Tool automatically assesses the subject wetland based on the WESP-AC functional results. The grouped functions in Section 8.4.1.2.1.1 are used to calculate a "Functional Benefit Product" (FBP). The FBP is categorized into scores of "low", "moderate" and "high". The thresholds for these categories are calibrated by WESP-AC assessments across Nova Scotia. These categories are used to create WSS determination rules. The grouped functions are further combined into "supergroups" for habitat (Aquatic Habitat and Transition Habitat) and support (Hydrologic Support, Water Quality Support and Aquatic Support) functions. The wetland is determined to be a WSS if certain 'high' or combination of 'moderate and 'high' scores are satisfied within these supergroups.

NSECC has also developed a WSS predictive GIS layer (September 2020, pers. comm., NSECC Wetland Specialist), which was consulted during the desktop evaluation for wetlands prior to field delineations by McCallum. The layer overlies mapped wetlands with protected areas layers, and rare species observations from ACCDC, among other attributes. According to NSECC, this WSS GIS layer is intended to be used as a planning tool and should be interpreted as potential WSS, as it incorporates all ACCDC priority species observations which fall within NSECC mapped wetlands, regardless of the species' ranking or status, positional accuracy of the data points, observation date, etc.

Final WSS designation will be determined by NSECC with guidance from data collected through Project field surveys and wetland assessment presented herein. The Project team will engage with NSECC to discuss WSS designation on a site-specific basis through the permitting process.

7.4.1.3 *Field survey*

Meandering transects were completed within the Study Area to identify wetland habitat on June 16, 17, 23-24, 2022 and July 26-28, 2022. Desktop review results showing topographic trends and habitat types guided survey routes.

Wetland delineation was conducted in accordance with the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory, 1987) and the Regional Supplement to the United States Army Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (United States Army Corps of Engineers 2011). In each wetland, vegetation, hydrology, and soils data were recorded at both wetland and upland data points on either side of the wetland boundary in accordance with the Army Corps of Engineers Wetland Delineation Manual (Environmental Laboratory, 1987). Wetland classes were determined using the Canadian Wetland Classification System (Warner and Rubec 1997).

In keeping with the Army Corps of Engineers methodologies for wetland delineation, three criteria are required for a wetland determination to be made:

- Presence of hydrophytic vegetation;
- Presence of hydrologic conditions that result in periods of flooding, ponding, or saturation during the growing season; and
- Presence of hydric soils.

Wetland boundaries were recorded on a Garmin GPSMAP 64s (capable of sub-5m accuracy). The delineated wetlands were flagged with pink flagging tape. Wetland Data Determination Forms were completed in and adjacent to wetlands identified within the Study Area to confirm wetland/upland conditions, confirm boundaries, and demonstrate that delineated wetlands met all three criteria. Wetland functional assessment were completed for each wetland identified within the Study Area using the WESP-AC wetland evaluation technique within the growing season. The WESP-AC process involves the completion of three forms; a desktop review portion that examines the landscape level aerial conditions in which the wetland is situated, and two field forms identifying biophysical characteristics of the wetland (field form) and stressors within the wetland (stressors form).

Additionally, a McCallum -designed rapid functional assessment field form was completed, which contained information on wetland type, dominant vegetation types, landform, water flow, and landscape position. The form also contains information on saturation, groundwater, and the presence of ponded water; notes will be made on the level of ground irregularity, water movement, vegetation patterns, fish presence, priority species and/or habitat presence, vegetated buffer, and canopy cover. This assessment is completed in addition to the WESP-AC functional assessment (see Section 7.4.1.3.4).

7.4.1.3.1 Hydrophytic Vegetation Methodology

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

Dominant plant species observed at each data point location were classified according to their indicator status (probability of occurrence in wetlands), in accordance with the Nova Scotia Wetland Indicator Plant List. Further relevant information was reviewed in Flora of Nova Scotia (Zinck, 1998; Munro, Newell, and Hill, 2014).

If the majority (>50%) of the dominant vegetation at a data point is classified as obligate (OBL), facultative wetland (FACW), or facultative (FAC) (excluding FAC-), then the location of the data point is considered to be dominated by hydrophytic vegetation. The prevalence index (PI) was used to calculate and determine positive hydrophytic vegetation indicators.

7.4.1.3.2 Wetland Hydrology Methodology

Wetland habitat, by definition, has a water table at, near, or above the land surface or that is saturated with water either periodically or permanently. To be classified as a wetland, a site should have at least one primary indicator or two secondary indicators of wetland hydrology. Examples of primary indicators of wetland hydrology include water marks, drift lines, sediment deposition, and water-stained leaves. Examples of secondary indicators of wetland hydrology include oxidized root channels, dry season water table, and stunted or stressed plants.

Each area of expected wetland habitat was assessed for signs of hydrology through observations across the area and assessment of soil pits at each data point.

7.4.1.3.3 Hydric Soils Methodology

A hydric soil is defined as a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (USDA-NRCS, 2003). Indicators that a hydric soil is present include the following: soil colour (gleyed soils and soils with bright mottles and/or low matrix chroma), aquic or preaquic moisture regime, reducing soil conditions, sulfidic material (odour), soils listed on the hydric soils list, iron and manganese concretions, organic soils (histosols), histic epipedon, high organic content in surface layer in sandy soils, and organic streaking in sandy soils.

A soil pit was completed at each data point location. These pits were excavated to a maximum depth of 50 cm or refusal. The soil in each was then examined for hydric soil indicators. The matrix colour and mottle colour (if present) of the soil were determined using Munsell Soil Colour Charts.

7.4.1.3.4 Wetland Functional Assessment

Wetland functional assessment was completed for all wetlands identified within the Study Area using the WESP-AC evaluation technique. WESP-AC assessments were completed on June 17th-24th and July 25th, 2022.

The WESP-AC process involves the completion of three forms; a desktop review portion (Office Form) that examines the landscape level aerial conditions in which the wetland is situated, and two field forms identifying biophysical characteristics of the wetland (Field Form) and stressors within the wetland (Stressors Form), if any. The process serves as a rapid method for assessing individual wetland functions and values. WESP-AC addresses 17 specific functions that wetlands may provide (Table 7-5).

The specific wetland functions are individually allocated into grouped wetland functions and measured for “function” and “benefit” scores. Wetland function relates to what a wetland does naturally (i.e., water storage), whereas wetland benefits are benefits of the function, whether it is ecological, social, or economic. The highest functioning wetlands are those that have both high function and benefit scores for a given function. WESP-AC enables a comparison to be made between individual wetlands within the province to gain a sense of the importance each has in providing ecosystem services.

Table 7-5: WESP-AC Wetland Function Parameters

Grouped Wetland Function	Specific Wetland Functions
Hydrologic Function	Surface Water Storage
Aquatic Support	Aquatic Invertebrate Habitat
	Stream Flow Support
	Organic Nutrient Export
	Water Cooling
Water Quality	Sediment Retention & Stabilization
	Phosphorus Retention
	Nitrate Removal & Retention
	Carbon Sequestration
Aquatic Habitat	Anadromous Fish Habitat
	Resident Fish Habitat
	Waterbird Feeding Habitat
	Waterbird Nesting Habitat
	Amphibian and Turtle Habitat
Terrestrial Habitat	Songbird, Raptor, & Mammal Habitat
	Pollinator Habitat
	Native Plant Habitat

In addition to the grouped wetland functions above, WESP-AC also measures the following grouped functions, however these are only evaluated by their benefit scores:

- Wetland Condition; and
- Wetland Risk.

The following individual functions are assessed to determine the benefit scores associated with each wetland:

- Public Use & Recognition;
- Wetland Sensitivity;
- Wetland Ecological Condition; and
- Wetland Stressors.

For each wetland evaluated, WESP-AC process calculates the overall score for the seven grouped wetland functions and the 17 specific wetland functions listed in Table 7-5 above. One score each is provided for function and benefit. Scores are ranked as ‘Lower’, ‘Moderate’, or ‘Higher’, allowing for analysis of the wetland as compared to baseline wetland scores in Nova Scotia. A ‘Higher’ WESP-AC score means that

wetland has a greater capacity to support those processes as compared to other wetlands in the province. A 'Higher' WESP-AC score in both the function and benefits category means the wetland supports the natural ecosystem functions and provides services potentially societal importance.

The WESP-AC Functional WSS Interpretation Tool is discussed in Section 7.4.1.2

The WESP-AC functional evaluation technique recognizes that, in many cases, delineation of entire wetlands where they extend beyond the Study Area is not always feasible (e.g., property ownership) or necessary to complete an appropriate assessment (Adamus 2016). Instead, WESP-AC permits the delimitation of an Assessment Area (AA), defined as the wetland or portion of wetland physically assessed in the field, while the Office Form considers the broader landscape characteristics and functions that extend beyond the AA and/or Study Area.

7.4.2 Surface Water, Fish and Fish Habitat

The Nova Scotia *Environment Act* requires that an approval from NSECC be obtained before any watercourses or water resource can be altered, including the flow of water (Environment Act c.1, s.1, 1994-95). Therefore, it is necessary to understand what watercourses and water resources are present within the Fish Study Area prior to the quarry development.

The Nova Scotia Environment Act (2006) defines a watercourse as:

> "the bed and shore of every river, stream, lake, creek, pond, spring, lagoon or other natural body of water, and the water therein, within the jurisdiction of the Province, whether it contains water or not, and all groundwater".

Using this guidance, watercourses have been identified and described throughout the Fish Study Area to support the description of fish habitat, and effects to regulated watercourses which may require provincial approval.

The federal Fisheries Act defines fish as "(a) parts of fish, (b) shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and (c) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals;", and fish habitat as "waters frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply and migration areas".

Within the Fisheries Act, activities which result in the harmful alteration, disruption or destruction (HADD) of fish habitat are prohibited. Under Section 35(2) of the Act, authorization may be granted for a proposed work, undertaking or activity that may, respectively, result in the death of fish or the harmful alteration, disruption or destruction of fish habitat.

Throughout this EARD, fish habitat is described in the context of watercourses as defined above. While groundwater is included in the regulatory definition of a watercourse under the Environment Act, this

section focuses on surface water features in the context of fish habitat provision. In addition to the above-mentioned definition and in accordance with the Guide to Altering Watercourses (NSE 2015), the watercourse parameters listed in this document were used to aid in determining the presence of a watercourse. Refer to Section 7.2.2 for groundwater assessment methods.

The following desktop and field survey methodologies were implemented during the surface water, fish and fish habitat survey programs and are discussed below.

7.4.2.1 *Desktop Review*

The goal of the surface water desktop evaluation was to identify the location of watercourses and waterbodies within, or in proximity to, the Fish Study Area based on mapped systems, topography, and satellite imagery. An assessment of where the Fish Study Area lies within primary and secondary watersheds was also conducted (Figures 1 and 10, Appendix A). Prior to completing the field evaluation, McCallum reviewed all NSTDB mapped watercourses and waterbodies, provincial flow accumulation data, and depth to water table mapping to identify potential surface water features within the Fish Study Area.

The priority species list, as defined in Section 7.3.1, was used to identify priority fish species that may occur in the Fish Study Area (Appendix F). Information on confirmed and potential fish presence within the Fish Study Area and surrounding surface water features was collected from the following sources:

- ACCDC Report (as presented in Appendix G);
- NSDNRR Significant Species and Habitats database;
- Aquatic Species at Risk Map (Fisheries and Oceans Canada, 2019);
- Fisheries and Oceans Stock Status Reports (Gibson, Amiro, and Robichaud-LeBlanc, 2003);
- Description of Selected Lake Characteristics and Occurrence of Fish Species in 781 Nova Scotia Lakes (Alexander, Kerekes, and Sabean, 1986);
- Nova Scotia Salmon Atlas (2021);
- Freshwater Fish Species Distribution Records (NSDFA, 2019); and
- Nova Scotia Department of Fisheries and Aquaculture (NSDFA) Lake Inventory Maps.

7.4.2.2 *Field Surveys*

The Fish Study Area (Figure 2, Appendix A) was established to identify watercourses (i.e., fish habitat) that may be directly or indirectly affected by the Project. The following surveys were completed in these watercourses:

- Watercourse delineation (Section 7.4.2.2.1);
- Fish habitat characterization (Section 7.4.2.2.4);

- Electrofishing surveys (Section 7.4.2.2.2);
- Trapping surveys (Section 7.4.2.2.3); and,
- In-situ water quality measurements (Section 7.4.2.2.5).

7.4.2.2.1 Watercourse Delineation

Watercourse delineation and site drainage characterizations were completed throughout the Fish Study Area in conjunction with wetland delineation and evaluation.

During the field evaluations, McCallum used NSECC guidance on watercourse determinations to identify watercourses (NSE, 2015a). The following parameters were used to define watercourses:

- Presence of a mineral soil channel;
- Presence of sand, gravel and/or cobbles evident in a continuous pattern over a continuous length with little to no vegetation;
- Indication that water has flowed in a path or channel for a length of time and rate sufficient to erode a channel or pathway;
- Presence of pools, riffles or rapids;
- Presence of aquatic animals, insects or fish; and,
- Presence of aquatic plants.

According to guidance provided by NSECC, any surface feature that meets two of the criteria above meets the definition of a provincially regulated watercourse. The source and sink of each system were verified in field. Any identified watercourses were flagged in the field with blue flagging tape and mapped using a Garmin GPSMAP 64s unit (capable of sub-5m accuracy).

Watercourses identified within the Fish Study Area were characterized and data such as weather, watercourse identification information, stream order, flow type, entrenchment, gradient, and water quality parameters were recorded. Measurement of substrate types, cover, description of riparian habitat, and physical channel measurements (depth, wetted, and bankfull widths) were also recorded. Detailed fish habitat assessments are described in Section 7.4.2.2.4.

7.4.2.2.2 Fish Surveys: Electrofishing

Electrofishing was conducted within one perennial watercourse in the Fish Study Area (WC1) and one of the intermittent watercourses (WC2) (Figures 11 and 12, Appendix A). Sampling reaches of approximately 100 m, if possible and not restricted by watercourse length, were selected as representative habitats with potential to support fish along a section of a watercourse. The goal of these single pass open site electrofishing surveys was to determine fish species presence and to estimate relative abundance within the

Fish Study Area. Fish collection was completed under Fisheries and Oceans Canada Fishing License # 341208.

Electrofishing was completed using guidance from a McCallum Standard Operating Procedure (SOP) for Fish Collection (Appendix I). The methods and data collection forms outlined in the SOP were developed using the following sources:

- A review of fish sampling methods commonly used in Canadian freshwater habitats (Portt et al., 2006)
- New Brunswick (NB) Aquatic Resources Data Warehouse, the NB Department of Natural Resources and Energy, and the NB Wildlife Council (2002, updated 2006)
- Fisheries and Oceans Canada's Interim Policy for the Use of Backpack Electrofishing Units (2003)

Fisheries and Oceans Canada's Interim Policy for the Use of Backpack Electrofishing Units (2003) was reviewed and followed by all members of the electrofishing crew. This document provides a detailed list of standard equipment, safety, training, and emergency response procedure requirements for electrofishing. Each electrofishing crew consisted of two individuals, one of which (the crew lead) was a qualified person as defined under the DFO Interim Electrofishing Policy.

Fish were sampled within open sites (i.e., without the use of barrier nets) using a Halltech Battery Backpack Electrofisher (HT-2000) with unpulsed direct current (DC) and a single pass – an open site was employed to ensure the greatest likelihood of capturing any fish present and estimate relative abundance. The operator waded upstream to eliminate the effects of turbidity caused by bottom sediment and probed the anode into fish habitat within the site. A second crew member walked behind the operator to net any stunned fish using a D-frame landing net (1/8" mesh). If fish were captured, they were held in a live well containing ambient stream water and an aerator (i.e., bubbler), and the live well was kept out of the sun. Captured fish were checked regularly for signs of stress, in addition, water temperatures were monitored during electrofishing surveys to prevent fishing in water greater than 22˚C (as per Section 1.5 of the fish license). At the conclusion of the pass, fish in the live well were identified to species and measured for length and weight. After recuperating, all fish were released back into the sampled reach.

Details of the electrofishing locations and survey dates are provided in Table 7-6. Electrofishing locations are shown on Figures 11 and 12 (Appendix A), and representative photographs of each electrofishing reach are provided in Appendix J.

Table 7-6. Electrofishing Survey Details

Electrofishing Location	Stream Order	Survey Dates	Upstream Coordinates (UTM)		Downstream Coordinates (UTM)		Reach Length (m)
			Easting	Northing	Easting	Northing	
WC1 (Big North Brook)	2	September 27, 2022	380619	4932995	380722	4932994	97
WC2 (Little North Brook)	1	September 27, 2022	379627	4933133	379527	4933133	100

7.4.2.2.3 Fish Surveys: Trapping

Trapping was conducted in conjunction with electrofishing surveys to capture and record fish presence within Pond 1 and Bagpipe Lake in July 2022. Minnow traps have an effective catch range of body depths approximately 6 - 50 mm. Eel pots were used to determine presence of larger bodied fish approximately 10 – 90 mm in body depth. Fyke nets were also used at each trapping location, either perpendicular to the shore or at the outflow (Pond 1). These traps allow fish to swim inside through the funnels that guide them from the large opening near the outside of the trap to the narrow opening close to the center of the trap. Both minnow traps and eel pots were baited with cat food and were set in Pond 1 and Bagpipe Lake in sufficient water depths to cover to the traps, left overnight, and collected the following day.

Details of fish collection locations, survey dates, and traps deployed are provided in Table 7-7. Trap locations are shown on Figure 11 and 12, Appendix A.

Table 7-7: Trapping Locations

Water-body ID	Site	UTM		Survey Dates	Traps Deployed	
		Easting	Northing		Trap Type	Number of Traps
Pond 1	Site 1	380609	4933052	July 26-27, 2022	Minnow Trap	2
	Site 2	380619	4933048	July 26-27, 2022	Minnow Trap	4
					Eel Pot	2
	Site 3	380611	4933016	July 26-27, 2022	Fyke Net	1
	Site 4	380561	4933097	July 26-27, 2022	Minnow Trap	2
	Site 5	380568	4933093	July 26-27, 2022	Minnow Trap	2
	Site 6	380574	4933082	July 26-27, 2022	Minnow Trap	2
	Site 7	380562	4933096	July 26-27, 2022	Eel Pot	1
Bagpipe Lake	Site 1	379338	4933166	July 27-28, 2022	Minnow Trap	6
					Eel Pot	1
	Site 2	379428	4933032	July 27-28, 2022	Minnow Trap	6
					Eel Pot	1
					Fyke Net	1

7.4.2.2.4 Fish Habitat Characterization

7.4.2.2.4.1 *Lotic Habitat Assessment*

Initial fish habitat characterization was completed by McCallum biologists in July of 2022. Additional data collection was completed in targeted watercourses in April of 2023 to support the analysis of the WBA and potential indirect effects to fish and fish habitat associated with the management of surface water across the proposed quarry development. Detailed fish habitat surveys were completed by McCallum for watercourses providing fish habitat predicted that will be directly or indirectly affected by Project development. Fish habitat characterization was completed using guidance from the McCallum Standard Operating Procedure for Fish Habitat Assessments in the lotic environment (Appendix I). The methods outlined in the SOP were derived from the following sources:

- The Nova Scotia Fish Habitat Assessment Protocol: A Field Methods Manual for the Assessment of Freshwater Fish Habitat (NSLC, 2018);
- DNR / DFO – New Brunswick Stream Habitat Inventory Datasheets;
- Standard Methods Guide for the Classification and Quantification of Fish Habitat in Rivers of Newfoundland and Labrador for the Determination of Harmful Alteration, Disruption and Destruction of Fish Habitat (DFO, 2012a);
- Reconnaissance (1:20,000) Fish and Fish Habitat Inventory (RIC, 2001);
- The US EPA Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish (Barbour et al., 1999); and,
- The Canadian Aquatic Biomonitoring Network Field Manual, Wadeable Streams (EC, 2012).

To support fish habitat assessments, each surveyed watercourse was delineated into individual reaches defined by discrete homogeneous units (e.g., riffle, run, pool, flat, etc.) as determined in the field in an upstream to downstream direction. Each habitat type contains discrete gradient, substrate types, water depth, and velocity ranges which have been determined using the described biological 'preferences' outlined in Grant and Lee (2004), whenever possible. In smaller, first-order streams, habitat types were often found to be extremely short and variable. For efficiency in the field, when individual habitat types were less than five meters in overall length, they were be grouped together into one reach containing multiple smaller habitat units. The upstream and downstream ends of each reach were recorded with handheld GPS device. Watercourses selected for detailed habitat evaluations are shown on Figures 11 and 12, (Appendix A).

For each reach (i.e., homogenous section of watercourse), a detailed fish habitat survey was completed which included water quality measurements, designation of substrate and cover types, riparian habitat descriptions, and barrier assessments. Cross-sectional measurements (transects) were established to describe morphological (e.g., channel and wetted widths, bank heights) and flow characteristics (e.g., velocities and depths) within the reach. Transect measurements were recorded at every 50 m length of reach

– for example, if a reach was 150 m in total length, three transects were established within the reach. If multiple habitat types (<5 m in length) were grouped together to form a reach, transects were established within each habitat type represented within the reach. The number of transects and transect locations were selected and modified as needed in the field based on specific habitat features observed, or limitations related to access, wadeability, and safety concerns.

7.4.2.2.4.2 *Lentic Habitat Assessment*

Detailed fish habitat surveys were completed by McCallum for waterbodies providing fish habitat predicted to be directly and indirectly affected by Project development. Fish habitat characterization was completed using guidance from the Standard Methods Guide for the Classification/Quantification of Lacustrine Habitat in Newfoundland and Labrador. (Fisheries and Oceans, 2001).

A detailed habitat assessments was completed in Bagpipe Lake and Pond 1 in July 2022. The assessment comprised a series of five to six transects separated approximately 50 - 125 m apart. The selection of transects was guided by aerial imagery to assess the range of depths present within the waterbodies.

Measurements were recorded along each transect in Bagpipe Lake (Figure 12, Appendix A) at seven to thirteen separate locations, evenly spaced along the transect to ensure collection of data through a range of representative depths. Pond 1 had measurements taken every one to six points per transect (Figure 11, Appendix A). This was due to unsafe boating and wading conditions brought on by shallow water and deep muck substrates. At each measurement location on the transect, depth, vegetation cover, and substrate type were recorded. Substrate was described using a variety of methods depending on the depth and clarity of the water, including visual assessments or probing with a paddle. In the central point of each transect, water quality was collected in the middle of the water column using a YSI multi-parameter probe. Secchi depth was recorded once along each transect, and a description of the shoreline substrate was recorded.

7.4.2.2.5 Water Quality Measurements

In-situ water quality measurements were recorded at all 2022 electrofishing and trapping sites prior to each sampling event and for each watercourse reach delineated through detailed habitat assessments. These water quality measurements were collected using a calibrated YSI Multi-Probe water quality instrument (or equivalent) or a combination of a Myron Ultrapen DO Pen Probe and Hannah Combo pH/Conductivity/TDS Probe at the time of the sampling event/survey. Locations of water quality measurements coincide with fish collection locations (Section 7.4.2.2; Figures 11 and 12, Appendix A).

7.5 Socioeconomic Assessment

The socioeconomic environment was evaluated by reviewing background literature. Dexter sent out requests by email to meet with various political stakeholders in June and August 2023 to discuss the Project, but no responses have been received to date.

The following subsections describe the baseline survey methods for economy, land use and value, transportation, recreation and tourism, cultural and heritage resources, and other undertakings in the area.

7.5.1 Economy

To understand the economy in proximity to the Project, statistical information was obtained from the most recently available National Census data from Statistics Canada. The 2021 National Census (Statistics Canada, 2021) provided economic data including labour force information on Lunenburg County, where the proposed Project is located. Additionally, GIS software and aerial photos were used to determine existing businesses and industries within and beyond a 5-kilometer buffer around the Study Area. Search results from the Nova Scotia Property Online website were used to verify land use on properties near the Study Area. Additionally, the Lunenburg Region website was used to understand the businesses, land uses and economic drivers in proximity to the Project.

7.5.2 Land Use and Value

GIS software, datasets, and aerial photos were used to determine present day land use in and around the Study Area. This desktop review complemented land use as determined by field biologists during the field assessment. Additionally, the approved ARIA (refer to Appendix D for CCTH approval) for the Project provides information on historical land uses and archaeological potential. Search results from the Nova Scotia Property Online website were used to verify land use on the PIDs associated within the Study Area (Nova Scotia Property Online, 2023).

7.5.3 Recreation and Tourism

Recreation and tourism data for Lunenburg County was sourced from the Nova Scotia tourism website (Nova Scotia, 2023), Lunenburg Region website (Lunenburg Region, 2023), and aerial imagery via Google Earth Pro and Google Maps.

7.5.4 Cultural and Heritage Resources

Cultural Resource Management Group Limited (CRM Group) completed an ARIA for the Project in 2022. The ARIA consisted of the three following components: Mi'kmaw engagement, background study and archaeological fieldwork. Refer to Appendix D for the executive summary of the ARIA, the Heritage Research Permit, and the CCTH Heritage Research Permit Report. Please note that the full ARIA report has been excluded from the EARD as requested by NSECC.

The Maritime Archaeological Resource inventory was searched, and the resources of various institutions were used to assess cultural resources potential in the Study Area, including Nova Scotia Archives, the Nova Scotia Museum, the Department of Natural Resources Library, the Nova Scotia Registry of Deeds, and the Nova Scotia Crown Land Information Management Centre. Additionally, CRM Group engaged with the Archaeology research division at Kwilmu'kw Maw-klusuaqn (Mi'kmaq Rights Initiative KMKNO).

CRM Group conducted site reconnaissance and an exploratory subsurface test within the planned QEA of the Study Area on May 20, 2022. GPS tracklogs of all reconnaissance areas were retained for records, and any sites determined to have potential for archaeological resources were recorded with photographs and GPS coordinates. The terrain and vegetation were noted in the interest of recording negative evidence for

historic cultural activity. A model of archaeological potential within the Study Area was developed based on desktop and field evaluations.

8 EXISTING CONDITIONS

8.1 Atmospheric Environment

The following subsections outline the baseline results of the assessments undertaken for weather and climate, air quality, and noise.

8.1.1 Weather and Climate

The Study Area is within the Western Nova Scotia Ecoregion (700) and the Lahave Drumlins Ecodistrict (740). The Western Ecoregion is characterized by a milder climate than the rest of Nova Scotia (Neily et al., 2017). This ecoregion has a mean annual precipitation of between 1,300 and 1,500 mm, with early springs, warm summers and milder winters than other regions within Nova Scotia (Neily et al., 2017). The Lahave Drumlins Ecodistrict is primarily southeasterly sloping, toward the Atlantic Ocean with early, warm springs, and a long growing season, combined with a relatively mild winter. Annual precipitation within this Ecodistrict is on the high-end of average for the Western Ecoregion, ranging between 1,400 and 1,500 millimeters annually (Neily et al., 2017, Webb and Marshall, 1999).

Weather records for the past 3 years (2020, 2021 and 2022) were obtained from Emergency Weather Station #2 (Climate ID 8202195). The average low temperature range was between 1.57°C and 1.88°C, and the average high temperature range was 13.86°C to 14.06°C (ECCC 2023). The lowest recorded temperature was -25.4°C with a highest record of 36.1°C. Total recorded precipitation at this weather station was 1,270.3 mm in 2020, 1,406 mm in 2021 and 1,587.7 mm in 2022 (ECCC 2023).

8.1.2 Air Quality

The Study Area is located approximately 57 km south of Greenwood, Nova Scotia, where the nearest station monitoring AQHI is located. The AQHI in Greenwood was considered low (i.e., 1-3 health risk category) when assessed in May 2023 (ECCC, 2023).

As recommended by Health Canada (2016), available data from air quality monitoring stations were used to describe the existing environment. Average air quality data from the nearest station in Kentville (60 km north of the Study Area) is provided by the NAPS Network and is presented in Table 8-1.

Table 8-1: Air Quality Data

Station	NOX (ppb)	NO (ppb)	NO_2 (ppb)	PM2.5 (ug/m^3)	O3 (ppb)
Kentville	1.3	0.4	1.0	5.7	28.2

8.1.3 Noise

The community type in the vicinity of the Study Area meets the Health Canada (2016b) qualitative description of a "quiet rural area". A quiet rural community has an estimated baseline sound level of ≤45 dBA (Health Canada, 2017).

While situated in a "quiet rural area", one permanent residential receptor (Receptor 1) is located within 800 m of the Study Area (Table 2-1; Figure 3, Appendix A). No noise modeling has been performed in relation to existing quarry or proposed expansion Project.

8.2 Geophysical Environment

The following subsections outline the baseline results of the assessments undertaken for geology and topography and groundwater.

8.2.1 Geology and Topography

8.2.1.1 *Topography*

Topography within the Study Area is highest along the western edge (115 m ASL) and slopes downward to the center of the Study Area (90 m ASL). There is another topographic rise (105 m ASL) running north-south within the eastern portion of the Study Area. The lowest elevation is 80 m ASL along the eastern edge at Little North Brook (in-text Figure 1 below). The range of elevations observed along this profile is ~80 m ASL – 115 m ASL within the boundaries of the Study Area. In-text Figure 1 below illustrates a west-east elevation profile across the Study Area

From the western high point, topography slopes northwest toward Bagpipe Lake and to Little Mushamush Lake to the south via northwestern tributaries (Figure 9, Appendix A).

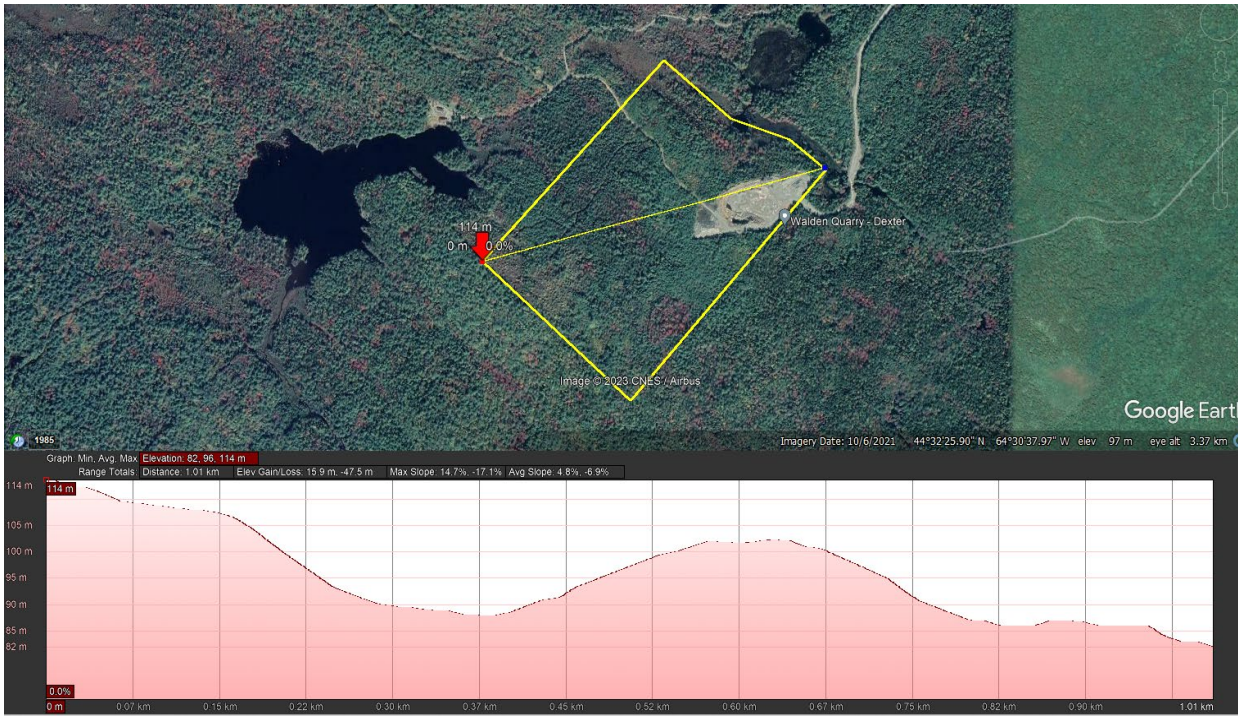

Figure 1. West-East Elevation Profile through the Study Area

The elevation profile in in-text Figure 2 below illustrates a north-south elevation profile across the Study Area, which depicts a topographic high point in the central portion of the Study Area at 105 m ASL.

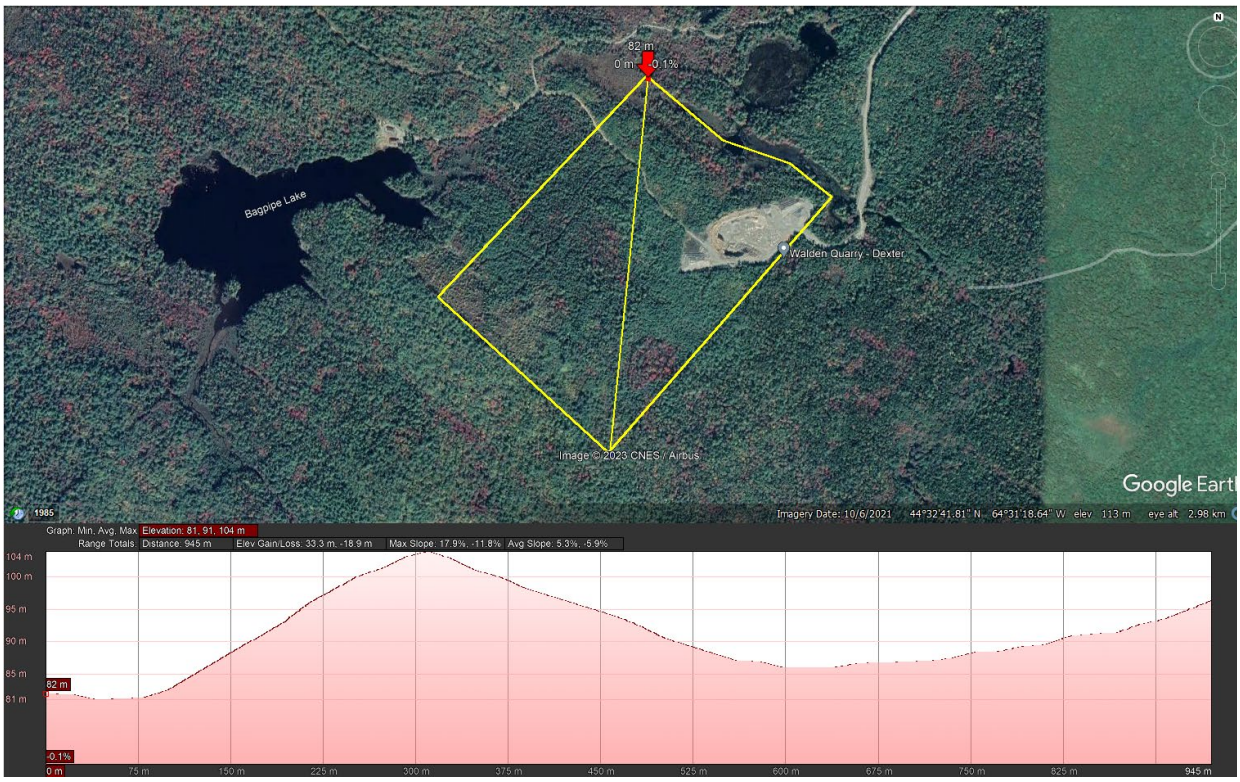

Figure 2. North-South Elevation Profile through the Study Area

8.2.1.2 *Surficial Geology*

The Study Area is situated on two zones within this section of the Lahave Drumlins (740) Ecodistrict, one of exposed bedrock to the north, comprised primarily of Goldenville Formation material, and the southern zone of the Study Area which is comprised of stony till plain and drumlins. Soil classifications include stony, sandy matrix, with material derived from local bedrock sources. Drumlin facies, where present, are comprised of siltier till due to erosion and incorporation of older till units by glaciers (NSDNR, 2012).

The Study Area is located within the stony till plain geologic unit (NSDNR, 2012). This unit was deposited during the last Wisconsinan period. The topography of this geologic unit is described as flat to rolling, with many surface boulders and a thickness of 2-20 m. Surficial geology within the Study Area is shown on Figure 13 (Appendix A).

8.2.1.3 *Bedrock Geology*

The geology of this section of the Lahave Drumlins (740) Ecodistrict, in which the Study Area is within, is comprised of Meguma Group sedimentary deposits of the Goldenville Formation (Neily et al., 2017). Sandstone turbidites and slate are common in these areas, with continental rise prism (in places metamorphosed to schist and gneiss), (Neily et al., 2017). Within the Lahave Drumlins Ecodistrict,

bedrock drumlin deposits typically contain less stony and fine-grained till with source material comprised primarily of slate from nearby bedrock deposits (Neily et al., 2017).

Bedrock geology within the Study Area is shown on Figure 14 (Appendix A).

8.2.1.3.1 Acid Rock Drainage

The bedrock underlying the Study Area is part of the Goldenville Formation, and therefore the potential exists for ARD. According to the NSDNRR ARD Potential Map, the Study Area falls within an area of low ARD potential. Typical deposits in the Walden area include slates, shales, sandstones, siltstone and igneous intrusions (NSDNR, 2012). As with other metamorphic deposits in the region, there is a low potential for sulphides or other potentially acid generating materials present within the Study Area.

To fully understand the potential for ARD to occur, ARD testing was completed in October 2023 by the Minerals Engineering Centre at Dalhousie University. One sample was collected within the Study Area. The total sulfur weight proportion was <0.001% and the acid producing potential was <0.03 kg/t for this sample. The sulphur concentration in the sample is below the requirement (0.4 Wt.%) for handling under the Sulphide Bearing Materials Disposal Regulations (Province of Nova Scotia, 2017) and does not have significant acid producing potential.

8.2.2 Groundwater

Groundwater flow is anticipated to follow the general north-south topographic trend, towards Bagpipe Lake and southward, ultimately flowing towards Little Mushamush Lake, roughly 1,600 m to the south. Flows are channelized through Big North Brook, along the eastern extent of the Study Area, flowing south to Little Mushamush Lake (Figure 9, Appendix A). See Section 8.2.1.1 for detailed illustrations of Study Area topography.

Hydrogeologic characterization of Nova Scotia's Groundwater Regions indicates that the Study Area is located on an area of metamorphic bedrock material (Kennedy, Drage, and Fisher, 2008). Wells located within this groundwater region tend to have higher water yields than other bedrock groundwater regions (NSDNR 2009).

The nearest Nova Scotia Groundwater Observation Well Network observation sites to the Study Area are: #077 - West Northfield (11.8 km southwest), #088 - Maitland (13.2 km southeast), and Simms Settlement (32.8 km northeast). The West Northfield (077) well southwest of the Study Area is within the same metamorphic groundwater region as the Study Area, is the closest to the Study Area, and therefore, is most likely representative of the Project. Groundwater at this site has been monitored since 2008, in that time groundwater level elevations have been relatively stable (NSECC 2022). The trend for this well is to have the highest groundwater level elevations from February to March (~50.80 m ASL historic high) with a decline in groundwater elevations from June to September (~48.45 m ASL historic low), increasing again in October (NSECC 2022). In late-December 2022, the most recently recorded water level, groundwater levels were approximately 50.05 m ASL.

According to the NS Well Logs Database (NSECC 2022), eight wells were identified within 3 km of the Study Area, with roughly 49 wells located within 5 km of the Study Area. The nearest of which exists within 1.88 km to the south, adjacent to Little Mushamush Lake (Figure 3, Appendix A). According to the user's manual of the NS Well Logs Database, wells were based off the NS Map Book, the well UTM Well Log, the well UTM – CBWRDB, the Gazeteer, and the map reference (NTS) (NSECC, 2022).

The wells identified within 3 km and 5 km of the Study Area by the Nova Scotia Well Logs Database are presented in Table 8-2 in further detail. This information includes records of geological conditions with distances from the Study Area for the eight sites within 3 km. Average well composition information is also tabulated for a total of 71 wells within 5 km of the Study Area.

With the exception of one location to the north, all of the wells within 5 km of the Study Area are located within the Metamorphic groundwater region, the northernmost well is located in the Plutonic groundwater region. Identified wells were a combination of drilled and dug construction methods. The wells presented in Table 8-2 average in depth of 47.52 m (ranges from 2.44 m to 126.37 m) with an average depth to bedrock of 14.12 m (ranges from 0 m to 56.94 m). These wells have an average static groundwater level of 7.03 m (ranges from 0.61 m to 30.45 m) and an average yield of 51.667 L/min (ranges from 2.27 L/min to 1044.2 L/min). This information provides details on background conditions that can be reviewed in the context of groundwater within the Study Area.

Per Table 2-1, the nearest permanent residential receptor to the Project, as identified via a review of aerial imagery and ground truthing, is 380 m west of the Study Area (Receptor 1). This receptor, as well as others within 5 km of the Study Area, are not included in the Nova Scotia Wells Logs Database, however, Mccallum confirmed that Receptor 1 does have a drilled well. McCallum also field verified that the seasonal camp northeast of the Study Area (and within 800 m of the QEA) does not have a well.

Table 8-2. Characteristics of Groundwater Wells within 3 and 5 km of the Study Area

Well #	Distance from Study Area (km)	Direction from Study Area	Date	Depth (m)	Casing (m)	Depth to Bedrock (m)	Static Level (m)	Yield (L/m)	Elevation (m ASL)	Type	Groundwater Region
Wells Within 3 km of Study Area											
60876	1.8	South	2006-10-16	66.99	12.18	7.61	-	6.81	63	Drilled	Metamorphic
960284	2.0	South	1996-07-10	36.54	6.7	1.83	-	18.16	63	Drilled	Metamorphic
141171	2.1	South	2014-06-30	36.54	6.09	3.04	2.44	36.32	66	Drilled	Metamorphic
140098	2.4	South	2014-04-29	60.9	12.18	10.35	-	4.54	68	Drilled	Metamorphic
101062	2.4	North	2010-04-30	47.2	6.09	1.83	6.09	9.08	135	Drilled	Plutonic
200877	2.65	South	2020-09-04	73.08	12.18	3.65	-	6.81	63	Drilled	Metamorphic
200610	2.85	South	2020-07-27	30.45	14.92	13.09	-	90.8	64	Drilled	Metamorphic
31490	3.0	South	2003-11-19	65.47	6.09	4.57	-	18.16	63	Drilled	Metamorphic
Wells Within 5 km of Study Area											
961453	-	-	1996-05-15	120.28	-	-	30.45	2.27	81	Drilled	Metamorphic
731261	-	-	1973-05-08	85.26	-	-	9.14	4.54	95	Drilled	Metamorphic
850630	-	-	1985-09-05	89.83	14.62	13.4	4.87	2.27	97	Drilled	Metamorphic
890180	-	-	1989-05-09	37.45	9.74	8.53	-	40.86	97	Drilled	Metamorphic
911138	-	-	1991-12-10	5.48	-	-	1.52	-	136	Dug	Metamorphic
972751	-	-	1997-09-28	4.26	4.57	-	3.35	1044.2	79	Dug	Metamorphic
20274	-	-	2002-11-22	5.48	5.48	-	-	-	97	Dug	Metamorphic
51475	-	-	2005-05-26	65.47	11.88	10.35	3.04	9.08	65	Drilled	Metamorphic
10076	-	-	2001-09-22	5.48	5.48	-	-	-	68	Dug	Metamorphic
101030	-	-	2010-03-11	65.47	20.4	16.75	3.04	22.7	85	Drilled	Metamorphic
981588	-	-	1998-12-01	53.29	17.66	15.53	1.52	18.16	68	Drilled	Metamorphic
71533	-	-	2007-05-22	89.83	35.63	31.97	-	54.48	83	Drilled	Metamorphic

Well #	Distance from Study Area (km)	Direction from Study Area	Date	Depth (m)	Casing (m)	Depth to Bedrock (m)	Static Level (m)	Yield (L/m)	Elevation (m ASL)	Type	Groundwater Region
781865	-	-	1978-12-31	65.47	24.66	22.84	6.09	13.62	95	Drilled	Metamorphic
650861	-	-	1965-05-27	21.92	8.53	21.92	4.57	15.89	95	Drilled	Metamorphic
140116	-	-	2014-06-30	6.09	-	-	1.83	113.5	66	Dug	Metamorphic
51535	-	-	2005-07-27	65.47	6.09	3.04	3.04	27.24	77	Drilled	Metamorphic
41206	-	-	2004-07-05	89.83	25.58	23.14	12.18	6.81	88	Drilled	Metamorphic
10077	-	-	2001-09-22	3.96	4.57	-	-	-	68	Dug	Metamorphic
921315	-	-	1992-06-23	108.1	34.1	30.75	30.45	4.54	81	Drilled	Metamorphic
922417	-	-	1992-12-31	5.48	5.48	-	-	-	79	Dug	Metamorphic
790949	-	-	1979-06-06	59.38	42.02	41.11	-	18.16	76	Drilled	Metamorphic
130025	-	-	2012-02-15	2.74	-	-	1.52	90.8	108	Dug	Metamorphic
970914	-	-	1997-10-01	6.7	7.31	-	3.65	54.48	79	Dug	Metamorphic
71869	-	-	2007-12-05	45.68	6.09	1.07	4.87	45.4	70	Drilled	Metamorphic
901653	-	-	1990-06-11	89.83	-	-	-	4.54	97	Drilled	Metamorphic
761210	-	-	1976-05-03	83.74	3.65	0	-	9.08	95	Drilled	Metamorphic
741130	-	-	1974-07-30	38.06	27.71	26.49	3.04	18.16	76	Drilled	Metamorphic
1350	-	-	2000-10-31	89.83	25.27	24.36	12.18	3.4	81	Drilled	Metamorphic
890181	-	-	1989-05-16	27.4	10.96	9.44	-	22.7	97	Drilled	Metamorphic
920114	-	-	1992-05-20	91.35	18.27	16.75	3.04	2.27	79	Drilled	Metamorphic
12451	-	-	2001-07-05	12.79	12.79	-	5.79	227	83	Drilled	Metamorphic
670797	-	-	1967-04-18	14.31	8.22	6.09	-	13.62	95	Drilled	Metamorphic
161097	-	-	2016-08-09	4.26	-	-	0.91	113.5	77.08	Dug	Metamorphic
951408	-	-	1995-08-09	77.65	6.09	2.13	6.09	6.81	76	Drilled	Metamorphic

Well #	Distance from Study Area (km)	Direction from Study Area	Date	Depth (m)	Casing (m)	Depth to Bedrock (m)	Static Level (m)	Yield (L/m)	Elevation (m ASL)	Type	Groundwater Region
41262	-	-	2004-07-15	47.2	12.18	1.67	-	38.59	67	Drilled	Metamorphic
871160	-	-	1987-06-26	53.29	43.24	42.33	18.27	18.16	79	Drilled	Metamorphic
20053	-	-	2002-05-09	48.72	10.96	9.14	-	81.72	76	Drilled	Metamorphic
110005	-	-	2011-02-04	5.33	-	-	0.61	113.5	75	Dug	Metamorphic
911192	-	-	1991-06-20	41.11	12.79	9.44	9.14	9.08	97	Drilled	Metamorphic
850663	-	-	1985-06-07	83.74	19.79	18.88	6.09	9.99	84	Drilled	Metamorphic
942476	-	-	1994-11-08	4.87	4.87	-	-	-	63	Dug	Metamorphic
991391	-	-	1999-06-21	85.26	58.46	56.94	21.32	113.5	79	Drilled	Metamorphic
961529	-	-	1996-05-10	126.37	37.45	35.93	21.92	2.27	76	Drilled	Metamorphic
930234	-	-	1993-05-28	5.48	5.48	-	-	-	79	Dug	Metamorphic
890179	-	-	1989-05-01	31.97	10.35	9.44	-	13.62	97	Drilled	Metamorphic
961454	-	-	1996-05-16	53.29	-	-	-	54.48	80	Drilled	Metamorphic
12500	-	-	2001-10-10	35.32	35.32	-	13.7	45.4	136	Drilled	Metamorphic
792182	-	-	1979-09-25	66.99	33.19	30.45	-	4.54	95	Drilled	Metamorphic
891718	-	-	1989-12-14	80.69	6.09	1.22	-	-	81	Drilled	Metamorphic
31444	-	-	2003-12-23	77.65	15.83	14.62	5.48	11.35	64	Drilled	Metamorphic
950279	-	-	1995-05-15	24.36	24.36	-	-	27.24	136	Drilled	Metamorphic
110438	-	-	2011-12-12	5.48	-	-	4.87	90.8	84	Dug	Metamorphic
981553	-	-	1998-07-10	59.38	13.4	9.14	3.04	18.16	63	Drilled	Metamorphic
930235	-	-	1993-05-28	2.44	2.44	-	-	-	79	Dug	Metamorphic
992314	-	-	1999-08-04	77.65	6.09	3.04	2.44	18.16	97	Drilled	Metamorphic
20276	-	-	2002-11-22	5.48	5.48	-	-	-	64	Dug	Metamorphic

Well #	Distance from Study Area (km)	Direction from Study Area	Date	Depth (m)	Casing (m)	Depth to Bedrock (m)	Static Level (m)	Yield (L/m)	Elevation (m ASL)	Type	Groundwater Region
891896	-	-	1989-02-16	59.38	6.09	0.61	2.44	13.62	64	Drilled	Metamorphic
150404	-	-	2015-12-08	2.74	2.5	-	1.34	-	108	Dug	Metamorphic
922416	-	-	1992-12-31	2.44	2.44	-	-	-	79	Dug	Metamorphic
200879	-	-	2020-09-03	66.99	-	3.96	-	40.86	63.76	Drilled	Metamorphic
21624	-	-	2002-09-12	89.83	-	-	4.57	36.32	97	Drilled	Metamorphic
51537	-	-	2005-07-28	53.29	-	-	1.52	68.1	80	Drilled	Metamorphic
770880	-	-	1977-01-01	22.84	6.39	3.04	-	18.16	95	Drilled	Metamorphic
AVERAGE	**-**	**-**	**-**	**47.52**	**14.73**	**14.12**	**7.03**	**51.66**	**83.26**	**-**	**-**

To add context to the general local groundwater discussion, a comparison was made between the elevation of the Study Area, surface water features, and adjacent receptor. Bagpipe Lake, Whale Lake and Little Mushamush Lake have approximate elevations of 90 m ASL, 84 m ASL and 61 m ASL, respectively. The elevation within the Study Area ranges from 82 to 105 m ASL.

The elevation profiles provided in in-text Figure 1 and Figure 2 in Section 8.2.1.1 illustrates the elevation change across the Study Area. Groundwater flow is anticipated to follow the general drainage trend to the south, toward Little Mushamush Lake.

8.3 Terrestrial Environment

Habitat and vegetation community assessments and surveys for vascular plants and lichens were completed to determine potential impacts to species or their specific habitat which may be protected under legislation.

8.3.1 Habitat

The desktop review and field results for the vegetation community assessment completed within the Study Area are provided in the following sections. Vegetation community assessments were completed to address key topics regarding species habitat as discussed in *The Guide to Addressing Wildlife Species and Habitat in an EA Registration Document* (NSECC, 2005).

8.3.1.1 *Desktop Results*

The Study Area is in the Western ecoregion (700) and LaHave Drumlins (740) ecodistrict (NSDNRR, 2016). The Western ecoregion has significant temperature and precipitation fluctuations, as no part of the ecoregion is less than 60 km from influence of either the Bay of Fundy or the Atlantic Ocean (Neily et al., 2016). The total area of this ecoregion is 16,870 km^2 or approximately 30.5% of the province (Neily et al., 2016). The LaHave drumlins ecodistrict extends from Mahone Bay north to parts of Kings County, extending to the interior boundary of Kejimkujik National Park (Neily et al., 2017). This ecodistrict is dominated by one landscape element: drumlin landscapes, creating unique ecosystems with a surrounding matrix forest. The forests within this ecodistrict are dominated by coniferous trees, however in areas with drumlin slopes, it is common to find tolerant hardwood forests (Neily et al., 2017).

No Old Forest polygons (NSDNRR, 2022) are present within the Study Area. NSDNRR forestry polygons (2022) identified the Study Area is composed of softwood, hardwood and mixedwood forestry stands (Figure 6, Appendix A). The closest Nova Scotia Old Forestry Policy polygon is 10.5 km east of the Study Area.

Table 8-3 and Figure 6 (Appendix A) displays the desktop identified landcover classifications using the FEC (i.e., habitat types) within the Study Area. These estimations are based on the forest inventory GIS database (NSDNRR, 2022).

Table 8-3. Desktop Calculations of Habitat within the Study Area.

Habitat Type	Area (ha)	Approximate Percentage of Study Area (%)
Hardwood Forests	2.6	6
Mixedwood Forests	16.2	37
Softwood Forests	19.7	45
Urban/Developed	4.1	9
Wetland[1]	1.4	3
Total Study Area	44	100
[1]Includes wetlands from provincial forestry layer (NSDNRR 2021) and does not include field delineated wetlands.		

Habitat in the Study Area consists mainly of softwood stands (19.7 ha, 45% of the Study Area) and mixedwood stands (16.2 ha, 37% of the Study Area). The rest of the Study Area is comprised of industrial/ developed areas (4.1 ha, 9% of the Study Area), hardwood stands (2.6 ha, 6% of the Study Area) and wetlands (1.4 ha and 3% of the Study Area). The majority of the Study Area is intact forest.

Softwood stands are mainly in the central and western portion of the Study Area. Smaller pockets of hardwood stands are mapped in the southern portion of the Study Area. The mixedwood stands are more dominant in the eastern and southern portion of the Study Area. The industrial/developed areas include the existing quarry and forestry road. Mapped wetland habitat in the Project Area includes 1.5 ha. Mapped wetlands are present in the northern part of the Study Area. Refer to Section 8.4.1 for additional details on wetlands.

8.3.1.2 *Field Results*

The Study Area is comprised of a mosaic of softwood dominated stands, hardwood dominated stands, mixedwood dominated stands, forested wetlands, and disturbed areas. Disturbed portions of the Study Area include a road in the central part of the Study Area and the existing quarry footprint. Within the Study Area, four vegetation community groups and five vegetation types were present. The upland vegetation types belong to the Intolerant Hardwood Forest Group (IH), and the Spruce Pine Forest Group (SP). The wetland vegetation types belong to the Wet Coniferous Forest Group (WC) and the Wet Deciduous Forest Group (WD). See Table 8-4 and Figure 6 (Appendix A) for upland vegetation communities and corresponding habitat points. Section 8.4.1 and Figure 17 (Appendix A) details wetlands communities.

Table 8-4. Vegetation Community Groups and Vegetation Types within the Study Area

Community Type	Vegetation Group	Vegetation Type (VTs)	Habitat Point	Classification Source
Upland Communities	Intolerant Hardwood Forest Group	IH3 – Large-tooth aspen / Christmas fern – New York fern	HP8	FEC
		IH7 – Red maple / hay-scented fern – wood sorrel	HP4	
	Spruce Pine Forest Group	SP4 – White pine / Blueberry / Bracken	HP5, HP6	FEC
Wetland Communities	Wet Coniferous Forest Group	WC7 – Tamarack – Black spruce / Lambkill / Sphagnum	HP3	FEC
	Wet Deciduous Forest Group	WD2 – Red maple / Cinnamon fern / Sphagnum	HP1, HP7	FEC

The vegetation groups and vegetation types identified within the Study Area are described in detail within the following subsections.

8.3.1.3 *Vegetation Community and Classification – Upland Communities*

The following subsections outline the upland vegetation communities.

8.3.1.3.1 Intolerant Hardwoods Group (IH)

This vegetation group represents early to mid-successional hardwood vegetation types, with red maple (*Acer rubrum*), white birch (*Betula papyrifera*), grey birch (*Betula populifolia*), and aspen (*Populus sp*.) dominating. This group covers a range of soil moisture and nutrient regimes, and well-developed shrub and herb layers with reduced bryophyte and lichen cove are typical (Neily et al. 2010). The IH group can provide browse for deer and snowshoe hare (regenerating trees). Two VTs belonging to this group, IH3 and IH7, were observed within the Study Area.

IH3 – Large-tooth aspen / Christmas fern – New York fern

The IH3 – Large-tooth aspen/Christmas fern – New York fern VT is an early successional vegetation type that is dominated by large-tooth aspen (*Populus grandidentata*). It generally has a well-developed shrub layer, but a less abundant herb layer and poorly developed bryophyte layer. IH3 is typically found on dry, nutrient poor soils. The shrub layer typically consists of wild raisin (*Viburnum nudum*), serviceberry (*Amelanchier* sp.), velvet-leaf blueberry (*Vaccinium myrtilloides*) and witch-hazel (*Hamamelis virginiana*) (Neily et al., 2010). This VT was observed in the northeast portion of the Study Area at HP8.

IH7 – Red Maple / Hay-scented Fern – Wood Sorrel

The IH7 – Red maple/ Hay-scented fern – wood sorrel VT is an early to mid-successional vegetation type, where the overstory is dominated by red maple (*Acer rubrum*), and has a diverse herbaceous layer dominated by several species of ferns, as well as wood aster (*Oclemna acuminata*), wood sorrel (*Oxalis corniculate*), rose twisted stalk (*Streptopus lanceolatus*), cucumber root (*Modeola virginiana*), club moss (*Lycopodium* sp.), and violet species (*Viola sp*.). The shrub layer is generally moderately developed, and includes regenerating trees, fly-honeysuckle (*Lonicera canadensis*), and striped maple (*Acer pensylvanicum*). IH7 is typically associated with fresh to moist, medium to rich soils. It is quite common in the Nova Scotia Uplands ecoregion (Neily et al. 2010). This VT was observed in the northern portion of the Study Area at HP4.

8.3.1.3.2 Spruce Pine Forest Group (SP)

The Spruce-Pine forest group consists of vegetation types that are associated with nutrient poor soils which are often associated with forest disturbances (Neily et al., 2010). Within this group conifer species, primarily spruce and pine are often dominant. Within this forest group and a result of the nutrient poor acidic soils, ericaceous species are often present within this group (Neily et al. 2010). One vegetation types within this group were observed within the Study Area, SP4.

SP4 – White pine / Blueberry / Bracken

The SP4 – White pine / Blueberry / Bracken vegetation type can be an early to mid-successional VT that typically occurs on dry to moist, nutrient poor sites. White pine (*Pinus* strobus) is the dominant overstory tree, and the deep roots of this species can allow it to access moisture during drier periods of time (Neily et al., 2010. This vegetation type is typical following a stand-replacing distrubance such as fire disturbance. A dense shrub layer is usually present with species such as lambkill (*Kalmia angustofilia*), velvet-leaf blueberry, and lowbush blueberry (*Vaccinium angustofolium*). A herbaceous layer is present with a low diversity of species, and ann extensive bryophyte cover is typical. The SP4 vegetation type was observed at two different locations within the Study Area, HP5 and HP6.

8.3.1.4 *Vegetation Community and Classification – Wetland Communities*

The following subsections outline the wetland vegetation communities.

8.3.1.4.1 Wet Coniferous and Deciduous Forest Group (WC and WD)

The wet coniferous and wet deciduous forest groups are wet forested ecosystems. This vegetation group is classified by having water at or near the surface for most of the year (Neily et al., 2010). These forested vegetation groups are typically found within swamps in Nova Scotia. This vegetation group is mainly dominated by a canopy of black spruce that varies from dense to sparse. Shrub layers are typically comprised of ericaceous species and the herbaceous layer is typically dominated by cinnamon fern (*Osmundastrum cinnamomeum*), creeping snowberry (*Gultheria hispidula*), or sedges (*Carex sp*.) over sphagnum moss (Neily et al., 2010). The WC Forest group can provide suitable habitat for rare cyanolichens, including blue felt lichen. WC forest groups with a well-defined shrub layer can also provide habitat for Canada warbler (*Cardellina canadensis*) and olive-sided flycatcher (*Contopus cooperi*). Two vegetation types were found in this forest group (WC7 and WD2).

WC7 – Tamarack – Black spruce / Lambkill / Sphagnum

The WC7 – Tamarack – Black spruce / Lambkill / Sphagnum vegetation type is relatively common in Nova Scotia but represents one of the only wet vegetation types that is dominated by tamarack (*Larix laricina*). This is an early to mid-successional forest that typically has a well-developed shrub or herbaceous layer. Common shrub species include lambkill and wild raisin, the most common herbaceous species is three-seeded sedge (*Carex trisperma*). A dense bryophyte layer is typical of this vegetation type (Neily et al., 2010). Rare plants like black ash (*Fraxinus nigra*) and showy lady's slipper (*Cyprpedium reginae*) have been found in WC7 habitats. This vegetation type was found at one point in the Study Area, HP3.

WD2 – Red Maple / Cinnamon fern / Sphagnum

The WD2 – Red Maple / Cinnamon fern / Sphagnum vegetation type is common throughout coastal and inland Nova Scotia and found within treed swamps. Red maple is the dominant hardwood treed species with scattered balsam fir and black spruce. Cinnamon fern cover is extensive and often form dense clumps which cover the forest floor completely (Neily et al. 2010). In this vegetation type, sphagnum cover is extensive and species such as mountain holly (*Ilex mucronata*), three-seeded sedge, wild raisin, speckled alder (*Alnus incana*), and bunchberry (*Cornus canadensis*) are commonly found. This vegetation type, like

many within this forest group, provide suitable habitat for many rare lichen species when mature red maple stands are present. This vegetation type was found at two points, HP1 and HP7.

8.3.1.5 *Vegetation Community and Classification Summary*

The Study Area is comprised of VTs within the Spruce Pine Forest Group (SP), the Intolerant Hardwood Forest group (IH), the Wet Coniferous Forest Group (WC), and the Wet Deciduous Group (WD). The VTs informed field surveys for rare vascular and nonvascular species. The vegetative communities identified within the Study Area are common in the surrounding landscape and the province.

8.3.2 Vascular Plants

The following sections outline the results from the desktop review and the field surveys completed within the Study Area.

8.3.2.1 *Desktop Results*

The ACCDC report states that there are observations of black ash (*Fraxinus nigra*) within 5 km of the Study Area. The NSDNRR considers black ash to be a "location sensitive" species, therefore precise coordinates were not provided. Communication with NSDNRR in October 2022 confirmed that there are no records of black ash within the Study Area (M. McGarrigle, NSDNRR SAR Biologist, Personal Communications, October 3, 2022). In addition, Mr. McGarrigle stated that the closest location of core habitat for black ash to the Study Area is 13 km southeast of the Study Area.

There are no ACPF buffers within the Study Area, with the closest buffer located 11 km southwest of the Study Area along LaHave River.

8.3.2.2 *Field Results*

A total of 99 vascular plant species were observed within the Study Area during botany surveys (early and late), wetland delineation, and incidentally. None of the vascular plants identified are classified as SAR, however, one is SOCI. The one SOCI identified is Southern twayblade (*Neottia bifolia,* ACCDC S3). Refer to Section 8.3.2.3 for additional information on priority vascular plant species.

Within the Study Area, 2.1% of the observed vascular plant species (n=2) comprised of exotics, 97.9% (n=97) were native. A list of all plants observed can be found in Appendix K.

As discussed in Section 8.3.1, the Study Area consists primarily of intact and regenerating softwood, mixedwood and hardwood forested communities and wetlands with disturbed sites consisting of the gravel road and existing quarry. Hydrophytic vegetation was present in wetlands (Section 8.4.1). The disturbed habitats (e.g., gravel roads) consisted primarily of herbaceous pioneer species, with the majority of the exotic species being confined to the edges of the gravel roads.

8.3.2.3 *Priority Vascular Plants*

Observation details of the one priority vascular plant species identified within the Study Area, southern twayblade, are outlined in Table 8-5 (Figure 7, Appendix A).

Table 8-5: Summary of Priority Vascular Plant Observations within the Study Area

Scientific Name	Common Name	COSEWIC	SARA	NSESA	SRank	No. of Observation Locations within the Study Area	No. of Individuals Within the Study Area
Neottia bifolia	Southern Twayblade	-	-	-	S3	2	11

The habitat suitability within the Study Area for these species are described below:

Southern Twayblade

Southern twayblade is a small and slender (15-30cm) flowering plant that grows in shaded bogs and swamps in Eastern Canada (MTRI, 2011). Southern twayblade if part of the ACPF group. Typical habitats for southern twayblade include moist forests that are dominated by mosses and trees. Two observations of southern twayblade occurred in WL2 (treed swamp), which is on eastern side of the Study Area (Figure 7, Appendix A). WL2 is a treed swamp and is a moist habitat, with a well-developed bryophyte layer.

8.3.3 Lichens

The following sections outline the results from the lichen desktop review and the field surveys completed within the Study Area.

8.3.3.1 *Desktop Results*

The ACCDC report (Appendix G) documented three priority lichen species within 5 km of the Study Area. One of the species identified are SAR and two are SOCI:

- Wrinkled shingle lichen (*Pannaria lurida*, SARA/COSEWIC/NSESA Threatened, ACCDC S2S3)
- Blistered jellyskin lichen (*Leptogium corticola*, ACCDC S3S4)
- Salted shell lichen (*Coccocarpia palmicola,* ACCDC S3S4)

No predicted blue felt lichen polygons are present within the Study Area, with the closest predicted polygon 950m to the southeast of the Study Area. According to the MTRI databases, no extant BFL populations are within 25 km and the closest vole ears lichen population is located over 30 km away.

8.3.3.2 *Field Results*

During the field surveys, 18 lichen species were observed within the Study Area. One SAR, frosted glass-whiskers lichen (*Sclerophora peronalla,* SARA and COSEWIC Special Concern ACCDC S3S4; Figure 7, Appendix A), was identified in the Study Area in WL2. There were five podetia (stalks) observed on the heartwood of a dead red maple. Two SOCI lichen were also observed within the Study Area, blistered tarpaper lichen (*Collema nigrescens,* ACCDC S3) and corrugated shingles lichen (*Fuscoppanaria ahlneri*, ACCDC S3; Figure 7, Appendix A). Additional information regarding the priority lichen species is provided in Section 8.3.3.3.

As mentioned previously, the Study Area consists of both disturbed and intact habitat. Intact habitat is dominated by softwood, mixedwood and hardwood stands and wetlands. Many of the priority lichens in Nova Scotia have an association with mature forested communities, often associated with wetlands, lakes, and watercourses. The habitat that provided the greatest potential to support priority lichen species was WL1 and WL2. Wetland and adjacent upland habitat provided mature forested communities consisting of softwood and hardwood species, in addition to the watercourse system that goes through the northern part of the Study Area. The appropriate tree maturity, bark texture, and pH provided habitat for a suite of priority cyanolichens and calicioids including blue felt lichen (*Pectenia plumbea*), frosted glass-whiskers (*Sclerophora peronella*), and fringe lichen (*Heterodermia neglecta*). However, only frosted glass-whiskers was observed within the Study Area. Refer to Table 8-6 for a list of lichen species observed within the Study Area.

Table 8-6: Observed Lichen Species in the Study Area

Scientific Name	Common Name	SARA	COSEWIC	NSESA	SRank
Sclerophora peronalla (Atlantic pop.)	**Frosted glass-whiskers**	**Special Concern**	**Special Concern**	-	**S3S4**
Collema nigrescens	**Blistered tarpaper lichen**	-	-	-	**S3**
Fuscopannaria ahlneri	**Corrugated shingles lichen**	-	-	-	**S3**
Lobaria pulmonaria	Lungwort lichen	-	-	-	S5
Lobaria scrobiculata	Textured lungwort lichen	-	-	-	S5
Leptogium cyanescens	Lungwort lichen	-	-	-	S5
Recasolia quercizans	Smooth lung lichen	-	-	-	S5
Menegazzia terebrata	Magic flute lichen	-	-	-	S4S5
Pannaria rubiginosa	Brown-eyed shingle lichen	-	-	-	S4
Pannaria conoplea	Mealy-rimmed shingle lichen	-	-	-	S4S5
Pseudocucyphellaria hawaiiensis	Gilded specklebelly lichen	-	-	-	SNA
Parmelia sulcata	Hammered shield lichen	-	-	-	S5
Plastismatia tuckermanii	Crumpled rag lichen	-	-	-	S5
Cladonia crispata	Organpipe lichen	-	-	-	S5

Scientific Name	Common Name	SARA	COSEWIC	NSESA	SRank
Cladonia arbuscula	Reindeer lichen	-	-	-	S5
Hypogymnia physodes	Monk's hood Lichen	-	-	-	S5
Dolichousnea longissima	Methuselah's beard lichen	-	-	-	S4
Bryoria sp.	-	-	-	-	-
Note: Scientific names used are in accordance with the latest ACCDC species list retrieved in March 2023. Scientific names may no longer be in use, however, for consistency in this report, species names in the ACCDC species list are used. "-" indicates no common name and/or ranking currently available.					

8.3.3.3 *Priority Lichens*

Three priority species was observed within the Study Area during the field surveys: frosted glass-whiskers, corrugated shingles lichen, blistered tarpaper lichen (Table 8-7; Figure 7, Appendix A). The *At-Risk Lichens – Special Management Practices* requires a 100 m buffer around the observation of frosted glass-whiskers (NSDNR, 2018). This species was observed in one location within the Study Area, WL2. Five podetia were observed on the heartwood of a dead red maple. Two SOCI lichens were observed within the Study Area, corrugated shingles lichen and blistered tarpaper lichen.

Table 8-7: Summary of Priority Species Lichens Observations within the Study Area

Common Name	Scientific Name	COSEWIC	SARA	NSESA	SRank	No. of Observation Locations Within the Study Area	Total number of Thalli
Frosted glass-whiskers	*Sclerophora peronella* (Atlantic pop.)	Special Concern	Special Concern	-	S3S4	1	5 Podetia
Corrugated shingles lichen	*Fuscopannaria ahlneri*	-	-	-	S3	1	1
Blistered tarpaper lichen	*Collema nigrescens*	-	-	-	S3	2	2

Frosted Glass-Whiskers

Frosted glass whiskers belong to a group known as calicioids or "stubble" lichen, due to their tiny, stalked structures, which are imbedded into substrates. They generally occur on hardwoods, usually on the exposed heartwood or living trunks, particularly red maple. It is mostly often found in mature and old-growth coniferous and deciduous forests (EC, 2011). There was one observation of frosted glass-whiskers in WL2, with five podetia observed in the heartwood of a red maple.

Environment and Climate Change Canada considers frosted glass-whiskers a rare and sensitive lichen (EC, 2011). The Nova Scotia *At-Risk Lichens – Special Management Practices (*NSDNR, 2018) recommends a 100 m buffer with no forest harvesting or road construction to occur within the buffer area.

Corrugated Shingles Lichen

Corrugated shingles lichen is a grey/brown foliose shingle lichen. It is typically found on hardwoods but can be found on rocks in moist environments (McMullin and Anderson, 2014). It has a small thallus, with convex lobes and a rough upper surface. One observation of corrugated shingles lichen was in the central portion of the Study Area in WL 4 on a red maple in a cinnamon fern swamp. Corrugated shingles lichen is not included in the *At-Risk Lichens – Special Management Practices* (NSDNRR 2018), therefore, no buffer is recommended.

Blistered Tarpaper Lichen

Blistered tarpaper lichen is a foliose medium sized lichen. Its upper surface is dark olive-green to brown. It is typically found in riparian or coastal environments, where it is on nutrient-rich bark (Nash et al., 2004). There were two observations of blistered tarpaper lichen throughout the Study Area. Both observations were found on red maples in treed swamps, WL 4 and WL 1. Blistered tarpaper lichen is not included in the *At-Risk Lichens – Special Management Practices* (NSDNRR 2018), therefore, no buffer is recommended.

8.3.3.4 *Bryophytes*

No priority bryophytes were identified by the ACCDC report within five km of the Study Area. Sixteen bryophyte species were observed within the Study Area throughout vascular plant surveys, lichen surveys, and incidentally during other biophysical surveys. No priority bryophyte species were identified in the Study Area. Refer to Table 8-8 for a full list of bryophyte species within the Study Area.

Table 8-8. Observed Bryophyte Species

Scientific Name	Common Name	SARA	COSEWIC	NSESA	SRank
Sphagnum central	Central peat moss	-	-	-	S4
Sphagnum austinii	Austin's peat moss	-	-	-	S5
Sphagnum rubellum	Red peat moss	-	-	-	S5
Pleurozium schreberi (Schreber's moss)	Red-stemmed feather moss	-	-	-	S5
Hylocomium splendens (stairstep moss)	Stairstep moss	-	-	-	S5
Sphagnum capillifolium	Northern peatmoss	-	-	-	S5
Neckera pennata	Feathery neckera moss	-	-	-	S5
Sphagnum angustifolium	Narrowleaf peatmoss	-	-	-	S5
Sphagnum girgensohnii	Green peat moss	-	-	-	S5
Ulota crispa	Crisped pincushion moss	-	-	-	S5
Polytrichum commune	Common haircap moss	-	-	-	S5

Scientific Name	Common Name	SARA	COSEWIC	NSESA	SRank
Dicranum viride	Green broom moss	-	-	-	S5
Dicranum montanum	Mountain broom moss	-	-	-	S5
Bazzania tribolata	Three-lobed whipwort	-	-	-	S5
Hedwigia ciliata	Ciliata hedwigia moss	-	-	-	S5
Dicranim undulatum	Dicranum moss	-	-	-	S5
Note: Scientific names used are in accordance with the latest ACCDC species list retrieved in March 2023. Scientific names may no longer be in use, however, for consistency in this report, species names in the ACCDC species list are used. "-" indicates no common name and/or ranking currently available.					

8.3.4 Habitat, Vascular Plants and Lichens Summary

The Study Area consists of wetlands, watercourses, mature and regenerative forest stands. During the plant and lichen surveys, 99 vascular plants, 18 lichens, and 16 bryophyte species were identified within the Study Area. One SOCI vascular plant was observed and one SAR, and two SOCI lichen were observed. No SAR vascular plants were identified. No priority bryophytes were observed.

8.3.5 Fauna

The following sections outline the results from the desktop review and the field surveys completed within the Study Area.

8.3.5.1 *Desktop Results*

There are no documented NSDNRR significant habitats within the Study Area; the closest significant habitat is located approximately 1.6 km south of the Study Area (Figure 5; Appendix A). The closest abandoned mine opening (AMO; ID# SPO-1-002, and SPO-1-001) are located 4.8 km southeast of the Study Area (Figure 5; Appendix A).

No priority mammal species were listed within 5 km of the Study Area by the ACCDC (Appendix G). The Study Area falls within mainland moose core habitat. NSDNRR confirmed that the Project does not overlap with any other core or critical habitat layers including bat species, and wood turtle (M. McGarrigle, SAR Biologist, NSDNRR, October 3rd, 2022).

According to the ACCDC, snapping turtle (*Chelydra serpentina*) have been observed 3.7 km from the Study Area, and the Eastern painted turtle has been observed 9.3 km from the Study Area (Appendix G). Wood turtle SMP buffers are not present within 5 km of the Study Area. The Study Area is outside of the range of Blanding's turtle critical habitat (ECCC, 2019); therefore, this species is not discussed within this document.

8.3.5.2 *Field Results*

8.3.5.2.1 Mammals

Wildlife species, including mammals, were assessed through incidental wildlife observations and recorded within the Study Area during all biophysical surveys. Refer to Table 8-9 for all incidental mammal observations confirmed either visually or by sign (scat, tracks, etc.).

Table 8-9. Confirmed Mammalian Species within the Study Area

Common Name	Scientific Name	COSEWIC	SARA	NSESA	SRank
Snowshoe hare	*Lepus americanus*	-	-	-	S5
White tailed deer	*Odocoileus virginianus*	-	-	-	S5
American red squirrel	*Tamiasciursus hudsonicus*	-	-	-	S5
Eastern coyote	*Canis latrans*	-	-	-	S5
American beaver	*Castor canadensis*	-	-	-	S5
Red fox	*Vulpes vulpes*	-	-	-	S5
North American deer mouse	*Peromyscus maniculatus*	-	-	-	S5
Meadow vole	*Microtus pennsylvanicus*	-	-	-	S5

8.3.5.2.2 Mainland Moose

Winter mainland moose surveys occurred on February 2nd, and 27th, 2023. Pellet group inventory surveys occurred on April 11th, 2023. No moose were observed during the dedicated surveys or incidentally. Refer to Table 8-10 for survey conditions and Figure 7B (Appendix A) for transect locations.

Table 8-10. Mainland Moose Survey Transect Information

Survey Dates	Transects Surveyed	Survey Type	Snow Conditions	General Weather Conditions	Moose Observations
February 2	1, 2, 3, 4, 5, 6	Winter track	Good, 30cm snow	Sunny	No
February 27	1, 2, 3, 4, 5, 6	Winter track	Good, 20 cm snow	Sunny	No
April 11	1, 2, 3, 4, 5, 6	Pellet group inventory	-	Sunny	No

Several different habitats suitable for mainland moose were observed within and surrounding the Study Area. These habitats include regenerative forests and small portions of cutovers that provide suitable habitat in the winter and summer months. It also includes forested stands that can provide winter and summer cover. Open water features are present in the northern portion of the Study Area (WL1) that can provide calving and aquatic feeding areas in the summer months.

The 2021 Recovery Plan provides a definition of Core Habitat for Mainland moose and provides additional guidance for survey methods and habitat suitability modelling. The Recovery Plan suggests that core habitat has been identified as areas that currently provide life cycle requirements of mainland moose and/or are expected to contain biophysical attributes for life cycle requirements over the next 30 years (NSDNRR, 2021). While no signs of mainland moose were observed during the dedicated surveys, the Study Area supports the habitat for mainland moose and falls within the core habitat for mainland moose, suggesting that mainland moose have the potential to utilize the Study Area.

8.3.5.2.3 Bats

No location sensitive bat hibernaculum or bat species occurrence was identified by the ACCDC within 5 km of the Study Area. Additionally, no bat observations or identification of potential hibernacula were identified within the Study Area during the field survey program. All bat species found within Nova Scotia have a provincial SRank of S1 or SUB, S1M with little brown bat (*Myotix lucifugus*), northern myotis (*Myotis septentrionalis*) and tricolored bat (*Perimyotis subflavus*) all listed as Endangered under SARA and NSESA (ECCC, 2018). Mature forested stands do exist within the Study Area and could provide roosting habitat. However, no evidence of roosting was observed during the biophysical surveys in 2022 and 2023. Mature forested stands are targeted by many bat species for roosting as older forests tend to provide a higher density of snags, and foraging habitat in a closed canopy (ECCC, 2018). Little Brown Myotis, Northern Myotis and Tri-colored Bat forage for insects. The foraging needs of each species is dependent on sex and species. Little Brown Myotis and Tri-colored bat tend to forage more frequently in open habitats, such as ponds and roads or forests with open canopy, which are present in the northern portion of the Study Area.

8.3.5.2.4 Priority Herpetofauna

Eastern painted turtle and snapping turtles were observed incidentally during field surveys. There were three observations of basking eastern painted turtle, two locations within WL1 (5 individuals) and one in Bagpipe Lake (2 individuals), and one observation of snapping turtle at the outflow of WL1 near the access road leading north to Woodstock Road (beyond the field delineated extent; Figure 15, Appendix A). During the biophysical surveys, a turtle nest and tracks were observed within the northern extent of the existing quarry (Figure 15, Appendix A), on a gravel stockpile with evidence of approximately 22 predated eggs. Based on clutch size and tracks, the nest was assessed to be snapping turtle. Three other turtle nests were observed along the roadside at the outflow of WL1, adjacent to the snapping turtle observation location. McCallum was unable to definitely confirm which species these three nests belonged to.

Suitable habitat is present for overwintering in WL1, Pond 1 and WC1 (Big North Brook) and suitable nesting habitat was identified in anthropogenically disturbed areas (i.e., stockpiles within the IA Permit Area and gravel shoulders of adjacent roadsides) for the observed turtle species. The rest of the Study Area does not contain suitable habitat for critical turtle life functions. While wood turtle was not observed, the Study Area is within their range and the identified habitat is suitable for this species as well. The preferred habitat for snapping turtle, eastern painted turtle, and wood turtle are described below (not observed during biophysical surveys). As a result, it can be expected that these species may continue to use these habitats and the Study Area.

Snapping Turtle

Snapping turtles are listed as Vulnerable under the NSESA and Special Concern under SARA and COSEWIC. Snapping turtles use a variety of habitats; however, the preferred habitat is slow-moving water with a soft mud bottom and dense aquatic vegetation. Nesting typically occurs in sand or gravel banks in proximity to water with sparse vegetative cover (ECCC, 2020). Hibernation sites are aquatic environments (e.g., lentic, lotic, and mud) where water will not freeze to the bottom, the substrate is a thick layer of mud, and other cover (e.g., large woody debris) is present (ECCC, 2020).

Eastern Painted Turtle

Eastern painted turtles are most common in the southwestern region of Nova Scotia (Natural History Museum, 2023). They occupy slow moving, relatively shallow, and well-vegetated wetlands and water bodies with organic substrate, which provide suitable overwintering sites (COSEWIC, 2018). Preferred nesting substrate is sand, loam, clay, and/or gravel (COSEWIC, 2018).

Wood Turtle

Wood turtles are listed as Threatened under SARA, COSEWIC and NSESA. The species live along permanent streams but may roam overland during summer and can be found in a variety of terrestrial habitats. Wood turtles nest on sand or gravel-sand beaches and banks (ECCC, 2020). This species prefers clear rivers, streams or creeks with moderate current and sandy or gravelly substrate (Environment Canada, 2016). They overwinter in numerous microhabitat types, which include burrowing in mud, under overhanging banks, or in the bottoms of stream pools (ECCC, 2020).

8.3.6 Avifauna

The following sections outline the results from the desktop review and the field surveys completed within and adjacent to the Study Area.

8.3.6.1 *Desktop Results*

There are no IBAs within 5 km of the Study Area (Bird Studies Canada, 2012). The closest IBA, Grassy Island Complex (NS026), is approximately 17 km southeast of the Study Area. The Grassy Island Complex includes three islands off the south coast of Nova Scotia. All three islands are 10 ha or less in size. Two of the islands (Westhaver and Grassy Island) are treeless and wedge island has a rocky shore with low spruce cover. The Study Area habitat is not representative of those found within the Grassy Island Complex.

There are two MBBA squares that cover the Study Area; 20LQ73 and 20LQ83. MBBA square 20LQ73 has 100 species observed in the first atlas, and in the second atlas 82 species were observed. In the second MBBA square, 20LQ83, 71 species were observed in the second atlas. The ACCDC (Appendix G) identified 14 priority avifauna species (six SAR and eight SOCI) within 5 km of the Study Area. These are discussed further in Section 8.3.6.3. The provincial landscape viewer identified significant habitat for common loon 1.1 km south of the Study Area and 1.7 km west of the Study Area.

8.3.6.2 *Avian Survey Results*

The following subsections outline the survey results of the point count surveys (spring migration, breeding season, fall migration, common nighthawk, and nocturnal owl surveys), and all incidental observations.

8.3.6.2.1 Spring Migration

Nine point count locations (Figure 16, Appendix A) were surveyed on two separate dates during the spring migration period for a total of 180 mins of effort (April 25 and May 18, 2022). Refer to Table 8-11 for a summary of survey conditions.

Table 8-11: Spring Migration Survey Conditions Table

Survey Round	Date	Survey Effort (mins)	Survey Start			Survey End		
			Temp. (°C)	Wind[1]	Precip.[2]	Temp. (°C)	Wind[1]	Precip.[2]
1	April 25, 2022	90	3	1	0	6	1	0
2	May 18, 2022	90	10	1	0	15	3	0

[1]Beaufort scale – 0 (<1km/hr; calm); 1 (1-5 km/hr; light air); 2 (6-11 km/hr; light breeze); 3 (12-19 km/hr; gentle breeze).

[2]Precipitation – 0 (none); 1 (haze of fog); 2 (drizzle); 3 (rain); 4 (thunderstorm); 5 (snow); 6 (wind driven dust, sand, or snow).

During spring migration surveys, a total of 108 individuals representing 27 species were observed (Table 5-13). There were no incidental observations (i.e., those outside of PC locations or survey times).

Table 8-12: Spring Migration: Species and Abundance of Birds

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	#	Observation Location	Bird Group
American crow	*Corvus brachyrhynchos*	-	-	-	S5	4	1, 5, 7, 8	6
American redstart	*Setophaga ruticilla*	-	-	-	S5B	1	1	6
American robin	*Turdus migratorius*	-	-	-	S5B, S3N	8	1, 2, 3, 4, 6, 8, 9	6
Bald eagle	*Haliaeetus leucocephalis*	-	-	-	S5	1	5	4
Belted kingfishers	*Megaceryle alcyon*	-	-	-	S4S5B	1	2	3
Black-and-white warbler	*Mniotilta varia*	-	-	-	S5B	1	4	6
Black-capped chickadee	*Poecile atricapillus*	-	-	-	S5	3	3, 6, 7	6
Blue jay	*Cyanocitta cristata*	-	-	-	S5	6	1, 3, 5, 7, 9	6
Canada goose	*Branta canadensis*	-	-	-	SUB, S4N, S5M	14	1, 4, 7	1
Dark-eyed junco	*Junco hyemalis*	-	-	-	S4S5	3	1, 4	6
Golden-crowned kinglet	*Regulus satrapa*	-	-	-	S5	1	7	6
Hairy woodpecker	*Dryobates villosus*	-	-	-	S5	1	5	7
Hermit thrush	*Catharus guttatus*	-	-	-	S5B	5	1, 2, 6, 7	6
Mallard	*Anas platyrhynchos*	-	-	-	S5B, S5N	2	1, 3	1
Mourning dove	*Zenaida macroura*	-	-	-	S5	2	3, 7	7
Nashville warbler	*Leiothlypis ruficapilla*	-	-	-	S4B, S5M	7	2, 7	6
Northern flicker	*Colaptes auratus*	-	-	-	S5B	7	3, 4, 5, 9	7
Ovenbird	*Seiurus aurocapilla*	-	-	-	S5B	4	3, 7, 8, 9	6
Palm warbler	*Setophaga palmarum*	-	-	-	S5B	19	1, 2, 3, 4, 5, 6, 7, 8, 9	6
Purple finch	*Haemorhous purpureus*	-	-	-	S4S5B, S3S4N,	2	2, 8	6

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	#	Observation Location	Bird Group
					S5M			
Red-breasted nuthatch	*Sitta canadensis*	-	-	-	S4S5	3	7, 8, 9	6
Red-eyed vireo	*Vireo olivaceus*	-	-	-	S5B	1	1	6
Ruffed grouse	*Bonasa umbellus*	-	-	-	S5	2	1, 8	7
Song sparrow	*Melospiza melodia*	-	-	-	S5B	5	1, 2, 9	6
Swamp sparrow	*Melospiza georgiana*	-	-	-	S5B	4	2, 3	6
White-throated sparrow	*Zonotrichia albicollis*	-	-	-	S4S5B, S5M	2	3, 7	6
Yellow-rumped warbler	*Setophaga coronata*	-	-	-	S5B	4	1, 5, 6	6
Total Species: 27					**Total Individuals: 108**			

Notes: Unknown birds and incidental observations are not included (those observed outside of point count locations). Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e., that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers), and 7 = other landbirds. Bolded species are priority species. ACCDC rankings retrieved from: http://accdc.com/webranks/NSall.htm (April 2023).

No priority species were observed during the dedicated spring migration surveys.

The majority of species observed during dedicated spring migration surveys were of the order Passeriformes (70.3%). The second most abundant group were other landbirds (14.8%), followed by waterfowl (7.4%), diurnal raptors (3.75%), and other waterbirds (3.75%). Palm warbler (n=19) was the most abundant species observed, followed by Canada goose (n=14), and American robin (n=8). A large flock of Canada geese were observed at PC7.

8.3.6.2.2 Breeding Season

The breeding bird survey consisted of nine point count stations that were surveyed on June 16 and July 7, 2022, for a total of 285 mins (180 mins at PCs and 105 mins conducting area searches) of effort (Figure 16, Appendix A). Refer to Table 8-13 for a summary of survey conditions.

Table 8-13: Breeding Season Survey Conditions Table

Survey Round	Date	Survey Effort (mins)	Survey Start			Survey End		
			Temp. (°C)	Wind[1]	Precip.[2]	Temp. (°C)	Wind[1]	Precip.[2]
1	June 16, 2022	150	12	1	0	18	2	0
2	July 7, 2022	135	12	2	0	22	2	0

[1]Beaufort scale – 0 (<1km/hr; calm); 1 (1-5 km/hr; light air); 2 (6-11 km/hr; light breeze); 3 (12-19 km/hr; gentle breeze).
[2]Precipitation – 0 (none); 1 (haze of fog); 2 (drizzle); 3 (rain); 4 (thunderstorm); 5 (snow); 6 (wind driven dust, sand, or snow).

A total of 49 individuals representing 17 species were observed (Table 5-14). The species observed during dedicated surveys are included in the summary below. No priority avifauna species were observed during the breeding bird surveys.

Table 8-14: Breeding Season Surveys: Species and Abundance of Birds

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	#	Observation Location	Breeding Status	Group
American crow	*Corvus brachyrhynchos*	-	-	-	S5	1	6	X	6
American robin	*Turdus migratorius*	-	-	-	S5B, S3N	4	2, 3, 5	H, X	6
Black-capped chickadee	*Poecile atricapillus*	-	-	-	S5	4	1, 7, 9	S, H	6
Black-throated blue warbler	*Setophaga caerulescens*	-	-	-	S5B	1	7	S	6
Blue jay	*Cyanocitta cristata*	-	-	-	S5	4	2, 3, 5, 6	X, H	6
Common raven	*Corvus corax*	-	-	-	S5	1	3	X	6
Common yellowthroat	*Geothlypis trichas*	-	-	-	S5B	2	1, 4	H	6
Dark-eyed junco	*Junco hyemalis*	-	-	-	S4S5	2	3, 6	H	6
Hairy woodpecker	*Dryobates villosus*	-	-	-	S5	1	6	X	7
Hermit thrush	*Catharus guttatus*	-	-	-	S5B	3	2, 3, 7	H	6
Mourning Dove	*Zenaida macroura*	-	-	-	S5	3	3, 4, 5	X	7
Northern flicker	*Colaptes auratus*	-	-	-	S5B	2	3, 5	H, X	7
Northern parula	*Setophaga americana*	-	-	-	S5B	2	1, 4	H	6
Ovenbird	*Seiurus aurocapilla*	-	-	-	S5B	6	4, 6, 8, 9	H, S	6
Palm warbler	*Setophaga palmarun*	-	-	-	S5B	4	1, 3, 6, 7	H, S	6
Ruffed grouse	*Bonasa umbellus*	-	-	-	S5	4	8	FY	7
Swamp sparrow	*Melospiza georgiana*	-	-	-	S5B	1	2	H	6
Yellow-rumped warbler	*Setophaga coronata*	-	-	-	S5B	3	1, 2, 3	X, H	6
Total Species: 18				**Total # Individuals: 48**					

Notes: Unknown birds and incidental observations are not included (those observed outside of point count locations). Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e., that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers), and 7 = other landbirds. Bolded species are priority species. Underlined species are SAR. E = Endangered, T = Threatened, V = Vulnerable, SC = Special Concern. ACCDC rankings retrieved from: http://accdc.com/webranks/NSall.htm (April 2023). Breeding evidence codes: A = agitated behaviour or anxiety calls of an adult (probable); H = species observed in its breeding season in suitable nesting habitat (possible); P = pair observed in suitable nesting habitat in nesting season (probable); S = singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season (possible); T = permanent territory presumed through registration of territorial song, or the occurrence of an adult bird, at the same place, in breeding habitat, on at least two days a week or more apart, during its breeding season (probable); X = species observed in its breeding season (no breeding evidence; observed); NB = Nest building or carrying nest materials, for all species except wrens and woodpeckers (confirmed); NY = Nest with young seen or heard (confirmed); NU = Used nest or egg shells found.

The majority of species observed during dedicated breeding bird surveys were of the order Passeriformes (77.7%). The second most abundant group of species were other landbirds (22.3 %). The most common species observed during breeding bird surveys were the ovenbird (n=6), ruffed grouse (n=4), American robin (n=4), black-capped chickadee (n=4), blue jay (n=4), and palm warbler (n=4).

Breeding evidence (e.g., nest, adult with chicks, or adult with nesting material) was confirmed for one species; ruffed grouse, where one female was observed with young. The 13 species identified as possible or probable breeders were observed in suitable nesting habitat. It should be noted that it was not possible to confirm that all species identified as displaying breeding behaviour were breeding within the boundaries of the Study Area. For instance, an adult bird observed singing in suitable nesting habitat (possible breeding evidence) may be nesting on an adjacent parcel of land, outside of the Study Area.

The remaining four species, American crow, common raven, hairy woodpecker, and mourning dove were identified as observed in breeding season with no breeding evidence.

All the species identified are native species to Nova Scotia and were observed within the typical and common habitat associated with the Study Area and surrounding landscape.

8.3.6.2.3 Fall Migration

Nine point count locations were surveyed on three separate dates during the fall migration period for a total of 270 hours of effort (September 9, September 19 and October 13, 2022; Figure 16, Appendix A). Refer to Table 8-13 for a summary of survey conditions.

Table 8-15: Fall Migration Survey Conditions Table

Survey Round	Date	Survey Effort (mins)	Survey Start			Survey End		
			Temp. (°C)	Wind[1]	Precip.[2]	Temp. (°C)	Wind[1]	Precip.[2]
1	September 9, 2022	90	13	0	0	20	1	0
2	September 19, 2022	90	10	0	0	14	2	0
3	October 13, 2022	90	7	0	0	8	1	0

[1]Beaufort scale – 0 (<1km/hr; calm); 1 (1-5 km/hr; light air); 2 (6-11 km/hr; light breeze); 3 (12-19 km/hr; gentle breeze).

[2]Precipitation – 0 (none); 1 (haze of fog); 2 (drizzle); 3 (rain); 4 (thunderstorm); 5 (snow); 6 (wind driven dust, sand, or snow).

During fall migration, a total of 325 individuals representing 35 species were observed (Table 8-16). One SOCI were observed during the dedicated fall bird migration point count surveys; Canada jay (ACCDC S3; Figure 16, Appendix A). All avian priority species are discussed in Section 8.3.6.3.

Table 8-16: Fall Migration Surveys: Species and Abundance of Birds

Common Name	Scientific Name	SARA	COSEWIC	NSESA	Srank	#	Observation Location	Bird Group
Canada Jay	***Perisoreus canadensis***	**-**	**-**	**-**	**S3**	**4**	**3, 6, 7, 8**	**6**
Alder flycatcher	*Empidonax alnorum*	-	-	-	S5B	1	5	**6**
American crow	*Corvus brachyrhynchos*	-	-	-	S5	8	1, 3, 4, 5, 6, 7, 8, 9	**6**
American goldfinch	*Spinus tristis*	-	-	-	S5	29	All PCs	6
American robin	*Turdus migratorius*	-	-	-	S5B, S3N	36	All PCs	6
Barred owl	*Strix varia*	-	-	-	S5	1	3	5
Belted kingfisher	*Megaceryle alcyon*	-	-	-	S4S5B	1	2	3
Black-and-white warbler	*Mniotilta varia*	-	-	-	S5B	3	1, 2, 3	6
Black-capped chickadee	*Poecile atricapillus*	-	-	-	S5	64	All PCs	6
Blackpoll warbler	*Setophaga striata*	-	-	-	S3B, S5M	1	5	6
Black-throated blue warbler	*Setophaga caerulescens*	-	-	-	S5B	1	2	6
Blue jay	*Cyanocitta cristata*	-	-	-	S5	41	All PCs	6
Blue-headed vireo	*Vireo solitarius*	-	-	-	S5B	1	3	6
Canada goose	*Branta canadensis*	-	-	-	SUB, S4N, S5M	9	5, 9	1
Common grackle	*Quiscalua quiscula*	-	-	-	S5B	1	7	6
Common loon	*Gavia immer*	-	-	-	S4B	1	1	3
Common raven	*Corvus corax*	-	-	-	S5	5	5, 9	6
Common yellowthroat	*Geothlypis trichas*	-	-	-	S5B	11	2, 3, 4, 6, 7	6
Dark-eyed junco	*Junco hyemalis*	-	-	-	S4S5	5	1, 3, 7	6
Downy woodpecker	*Dryobates pubescens*	-	-	-	S5	1	3	7
Golden-crowned	*Regulus satrapa*	-	-	-	S5	15	5, 6, 8, 9	6

Common Name	Scientific Name	SARA	COSEWIC	NSESA	Srank	#	Observation Location	Bird Group
kinglet								
Hermit thrush	*Catharus guttatus*	-	-	-	S5B	7	1, 2, 7, 8, 9	6
Mourning Dove	*Zenaida macroura*	-	-	-	S5	3	2, 5, 9	7
Northern flicker	*Colaptes auratus*	-	-	-	S5B	14	2, 3, 5, 6, 7, 8	7
Ovenbird	*Seiurus aurocapilla*	-	-	-	S5B	1	9	6
Red-breasted nuthatch	*Sitta canadensis*	-	-	-	S4S5	40	All PCs	6
Red-eyed vireo	*Vireo olivaceus*	-	-	-	S5B	2	8	6
Ruby-crowned kinglet	*Corthylio calendula*	-	-	-	S4B, S5M	2	3, 9	6
Ruby-throated hummingbird	*Archilochus colubris*	-	-	-	S5B	1	4	6
Ruffed grouse	*Bonasa umbellus*	-	-	-	S5	1	8	7
Song sparrow	*Melospiza melodia*	-	-	-	S5B	5	1, 3, 4, 5, 7	6
Spruce grouse	*Canachites canadensis*	-	-	-	S4	1	9	7
Swamp sparrow	*Melospiza georgiana*	-	-	-	S5B	5	2, 3	6
White-throated sparrow	*Zonotrichia albicollis*	-	-	-	S4S5B, S5M	2	3, 8	6
Yellow-rumped warbler	*Setophaga coronata*	-	-	-	S5B	2	1, 3	6
Total Species: 35				**Total # Individuals: 325**				

Notes: Unknown birds and incidental observations are not included (those observed outside of point count locations). Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e., that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers), and 7 = other landbirds. Bolded species are priority species. ACCDC rankings retrieved from: http://accdc.com/webranks/NSall.htm (April 2023).

The majority of species observed during dedicated fall bird migration surveys were of the order Passeriformes (74.3%), which was to be expected based on forest habitat coverage. The second most abundant group of species was other landbirds (14.3%). The next most abundant groups were other water birds (5.7%), followed by nocturnal raptors (2.85%), and waterfowl (2.85%). The most common species observed during fall migration were the black-capped chickadee (n=64), blue jay (n=41), and red-breasted nuthatch (n=40).

8.3.6.2.4 Common Nighthawk Surveys

Common nighthawk surveys took place at four CONI PC locations on June 15 and July 9, 2022, for a total of 56 minutes of effort (Table 8-20; Figure 16, Appendix A).

Table 8-17: Common Nighthawk Survey Conditions Table

Survey Round	Date	Survey Effort (mins)	Survey Start			Survey End		
			Temp. (°C)	Wind[1]	Precip.[2]	Temp. (°C)	Wind[1]	Precip.[2]
1	June 15, 2022	28	16	1	0	15	0	0
2	July 9, 2022	28	18	0	0	18	1	0

[1]Beaufort scale – 0 (<1km/hr; calm); 1 (1-5 km/hr; light air); 2 (6-11 km/hr; light breeze); 3 (12-19 km/hr; gentle breeze).
[2]Precipitation – 0 (none); 1 (haze of fog); 2 (drizzle); 3 (rain); 4 (thunderstorm); 5 (snow); 6 (wind driven dust, sand, or snow).

A total of four common nighthawks were observed during surveys, all of which were adults (Table 8-18). The primary behaviour observed for the common nighthawk sightings was flushing and calling. During the second round, the common nighthawk flushed at CONI1 upon arrival of the surveyor.

Table 8-18: Common Nighthawk Surveys: Species and Abundance

Common Name	Scientific Name	SARA	COSEWIC	NSESA	Srank	#	CONI PC Location	Bird Group
Common nighthawk	*Chordeiles minor*	SC	SC	T	S3B	4	1, and 3	5
Total Species: 1					**Total Individuals: 4**			

Notes: Unknown birds and incidental observations are not included (those observed outside of point count locations). Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e., that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers), and 7 = other landbirds. ACCDC rankings retrieved from: http://accdc.com/webranks/NSall.htm (April 2023).

8.3.6.2.5 Nocturnal Owl Survey

One nocturnal owl survey was conducted on April 22, 2022, at four point count locations for a total of 28.5 minutes of effort (Table 8-19; Figure 16, Appendix A).

Table 8-19: Nocturnal Owl Survey Conditions Table

Survey Round	Date	Survey Effort (mins)	Survey Start			Survey End		
			Temp. (°C)	Wind[1]	Precip.[2]	Temp. (°C)	Wind[1]	Precip.[2]
1	April 22, 2022	28.5	3	1	0	2	1	0

[1]Beaufort scale – 0 (<1km/hr; calm); 1 (1-5 km/hr; light air); 2 (6-11 km/hr; light breeze); 3 (12-19 km/hr; gentle breeze).
[2]Precipitation – 0 (none); 1 (haze of fog); 2 (drizzle); 3 (rain); 4 (thunderstorm); 5 (snow); 6 (wind driven dust, sand, or snow).

Two barred owls (*Strix varia,* ACCDC S5) were detected during this survey, one at Owl 4, and the other at Owl 2.

8.3.6.2.6 Incidentals

Incidental observations include those made during dedicated bird surveys (i.e., observation outside of point count time or survey location) and those made during non-bird related surveys (e.g., wetland delineation). Incidental observations were recorded for novel species (i.e., those not yet recorded in standardized point counts) and priority species. Sixty-seven individuals representing 39 species were identified incidentally. Four of the species were SAR: Canada warbler (*Cardellina canadensis,* SARA Threatened, NSESA Endangered, ACCDC S3B), olive-sided flycatcher (*Contopus cooperi,* SARA Special Concern, NSESA Threatened, ACCDC S3B), eastern wood-pewee (*Contopus virens,* SARA Special Concern, NSESA Vulnerable, ACCDC S3S4B), and peregrine falcon (*Falco peregrinus,* NSESA Vulnerable, ACCDC S1B, SUM). One observed species was SOCI: Canada jay (*Periosoreus canadensis*, ACCDC S3).

Incidental observations are shown in Table 8-20 (SAR are **bolded**).

Table 8-20: Avian Incidentals Recorded During All Surveys (Targeted and Non-Targeted Avifauna Surveys)

Common Name	Scientific Name	SARA	COSEWIC	NSESA	Srank	#	Survey Type	Bird Group
Olive-sided flycatcher	***Contopus cooperi***	**Special Concern**	**Special Concern**	**Threatened**	**S3B**	**2**	**WL and WC delineation, early botany**	**6**
Canada warbler	***Cardellina canadensis***	**Threatened**	**Special Concern**	**Endangered**	**S3B**	**5**	**Lichen surveys, WL and WC delineation**	**6**
Eastern-wood pewee	***Contopus virens***	**Special Concern**	**Special Concern**	**Vulnerable**	**S3S4B**	**2**	**Early botany, WL and WC delineation**	**6**
Peregrine falcon	***Falco peregrinus***	**-**	**-**	**Vulnerable**	**S1B, SUM**	**1**	**WL and WC delineation**	**4**
Canada jay	*Periosoreus canadensis*	-	-	-	S3	3	WL and WC delineation, early botany	6
Alder flycatcher	*Empidonax alnorum*	-	-	-	S5B	1	CONI	6
American goldfinch	*Spinus tristis*	-	-	-	S5	1	CONI	6
American robin	*Turdus migratorius*	-	-	-	S5B, S3N	3	CONI, WL and WC delineation, PGI surveys	6
American woodcock	*Scolopax minor*	-	-	-	S5B	2	CONI, WL and WC delineation	2
Bald eagle	*Haliaeetus leucocephalus*	-	-	-	S5	2	CONI, WL and WC delineation	4
Barred Owl	*Strix varia*	-	-	-	S5	2	Owl surveys	5
Black-capped chickadee	*Poecile atricapillus*	-	-	-	S5	3	PGI surveys	6
Black-and-white warbler	*Mniotilta varia*	-	-	-	S5B	2	CONI	6
Black-throated blue warbler	*Setophaga caerulescens*	-	-	-	S5B	3	WL and WC delineation	6
Black-throated green warbler	*Setophaga virens*	-	-	-	S5B	1	WL and WC delineation	6
Canada goose	*Branta canadensis*	-	-	-	SUB, S4N, S5M	1	WL and WC delineation	1
Common loon	*Gavia immer*	-	-	-	S4B	1	WL and WC delineation	3

Common Name	Scientific Name	SARA	COSEWIC	NSESA	Srank	#	Survey Type	Bird Group
Common yellowthroat	*Geothlypis trichas*	-	-	-	S5B	2	CONI, WL and WC delineation	6
Dark-eyed junco	*Junco hyemalis*	-	-	-	S4S5	4	CONI, WL and WC delineation, PGI Surveys	6
Downy woodpecker	*Dryobates pubescens*	-	-	-	S5	1	CONI	7
Golden-crowned kinglet	*Regulus satrapa*	-	-	-	S5	1	CONI	6
Hermit thrush	*Catharus guttatus*	-	-	-	S5B	1	CONI	6
Magnolia warbler	*Setophaga magnolia*	-	-	-	S5B	1	CONI	6
Mourning dove	*Zenaida macroura*	-	-	-	S5	1	WL and WC delineation	7
Nashville warbler	*Leiothlypis ruficapilla*	-	-	-	S4B, S5M	1	WL and WC delineation	6
Northern waterthrush	*Parkesia noveboracensis*	-	-	-	S4B, S5M	1	CONI	6
Palm warbler	*Setophaga palmarun*	-	-	-	S5B	1	WL and WC delineation	6
Purple finch	*Haemorhous purpureus*	-	-	-	S4S5B, S3S4N, S5M	1	CONI	6
Red-breasted nuthatch	*Sitta canadensis*	-	-	-	S4S5	4	CONI, WL and WC delineation, PGI surveys	6
Red-eyed vireo	*Vireo olivaceus*	-	-	-	S5B	2	CONI, WL and WC delineation	6
Ruby-throated hummingbird	*Archilochus colubris*	-	-	-	S5B	1	CONI	6
Ruffed grouse	*Bonasa umbellus*	-	-	-	S5	1	WL and WC delineation	7
White-breasted nuthatch	*Sitta carolinensis*	-	-	-	S4	1	CONI	6
White-throated sparrow	*Zonotrichia albicollis*	-	-	-	S4S5B, S5M	1	CONI	6
Yellow warbler	*Setophaga petechia*	-	-	-	S5B	1	CONI	6
Yellow-bellied sapsucker	*Sphyrapicus varisu*	-	-	-	S5B	1	CONI	7

Common Name	Scientific Name	SARA	COSEWIC	NSESA	Srank	#	Survey Type	Bird Group
Yellow-rumped warbler	*Setophaga coronata*	-	-	-	S5B	1	CONI	6
Unknown Grouse	-	-	-	-	-	3	Winter Moose Surveys, PGI surveys	7
Unidentified sandpiper	-	-	-	-	-	1	Late Botany	2
Total Species: 39				**Total Individuals: 67**				

Notes: Bird group is coded as: 1 = waterfowl; 2 = shorebirds; 3 = other waterbirds (i.e., that are not waterfowl or shorebirds); 4 = diurnal raptors; 5 = nocturnal raptors; 6 = passerines (excluding dippers), and 7 = other landbirds. Bolded species are priority species. Underlined species are SAR. E = Endangered, T = Threatened, V = Vulnerable, SC = Special Concern. ACCDC rankings retrieved from: http://accdc.com/webranks/NSall.htm (April 2023). CONI = common nighthawk survey.

The majority of species observed incidentally during biophysical surveys were of the order Passeriformes (69.2%). The second most abundant was other landbirds (12.8%). The next most abundant groups were shorebirds (5.1%), diurnal raptors (5.1%), waterfowl (2.6%), other waterbirds (2.6%), and nocturnal raptors (2.6%). The most common species observed incidentally were Canada warbler (n=5), dark-eyed junco (n=4), and red-breasted nuthatch (n=4).

A male and female pair of black-and-white warbler were observed incidentally during July 9, 2022, CONI surveys and is considered a confirmed breeder within the Study Area.

8.3.6.3 *Priority Avifauna*

A total of 21 individuals representing six priority avifauna species were observed within the Study Area during all field surveys, including incidentals (Table 8-21; Figure 16, Appendix A). Five species are listed as SAR (olive-sided flycatcher, common nighthawk, Canada warbler, peregrine falcon and Eastern wood-pewee). One SOCI was observed (Canada jay).

Table 8-21. SAR and SOCI observed during all survey periods and incidentally

Common Name	Scientific Name	SARA	COSEWIC	NSESA	Srank	Survey Type	Frequency / Observation Location	#
Canada warbler	***Wilsonia canadensis***	**T**	**SC**	**E**	**S3B**	**Lichen surveys**	**1 / lichen area search**	**1**
						WL and WC delineation	**2/ WL and WC delineation**	**4**
Common nighthawk	***Chordeiles minor***	**SC**	**SC**	**T**	**S3B**	**CONI**	**3/ CONI 1, 3**	**4**
Eastern wood-pewee	***Contopus virens***	**SC**	**SC**	**V**	**S3S4B**	**Early botany**	**1/ botany area searches**	**1**
						WL and WC delineation	**1/ WL and WC delineation**	**1**
Olive-sided flycatcher	***Contopus cooperi***	**SC**	**SC**	**T**	**S3B**	**WL and WC delineation**	**1/ WL and WC delineation**	**1**
						Early botany	**1/ Botany area search**	**1**
Peregrine falcon	***Falco peregrinus***	**-**	**-**	**V**	**S1B, SUM**	**WL and WC delineation**	**1/ WL and WC delineation**	**1**
Canada jay	*Perisoreus canadensis*	-	-	-	S3	FM	4/ PC 3, 6, 7, 8	4
						WL and WC delineation	2/ WL and WC delineation	2
						Early botany	1/ botany area searches	1
Total Individuals								**21**

Notes: **Bold denotes SAR designation.** ACCDC rankings retrieved from: http://accdc.com/webranks/NSall.htm (January 2023). Survey Type: SM = spring migration survey; BB = breeding bird survey; FM = fall migration survey; CONI = common nighthawk survey. "-" = incidental observations away from PC locations.

The observation location and preferred habitat of the priority avifauna species identified are described in the following paragraphs:

Canada Jay

Canada jay is a boreal and subalpine forest species (Cornell University, 2021) often found nesting and foraging with a forested community consisting of spruce, pine, and hardwood tree species. Suitable habitat is present within the Study Area. Canada jay was identified during the fall migration surveys, and incidentally during WL and WC delineation, and early botany surveys. Canada jay was identified in WL1 (foraging in swamp/fen) at PC3, PC7, PC8, PC6. It was also identified in an upland habitat within the Study Area (Figure 16, Appendix A).

Canada Warbler

Canada warblers are often found in forest undergrowth and shady thickets. They breed in mature mixed hardwoods of extensive forests and streamside thickets and prefer to nest in moist habitats (Environment Canada 2016a). Five Canada warblers were observed incidentally throughout the Study Area. Three were observed in WL5, one observed in WL4, and another observed singing in WL9 (Figure 16, Appendix A). Refer to Section 8.4.1.2.2 for more information.

Common Nighthawk

Common nighthawks breed in a range of open and partially open habitats, including forest openings, bogs, sandy or sandy natural habitats, and disturbed areas. Settled areas can also provide habitat needs (COSEWIC 2018a). Suitable habitat is found scattered throughout the Study Area. Common nighthawks were identified during the common nighthawk survey at two points (CONI1, 3). CONI1 is centered inside the existing quarry and CONI 3 is on the side of the road. Refer to Figure 16 (Appendix A).

Eastern Wood-Pewee

Eastern wood-pewees are mostly associated with mid-canopy layer of forest clearings and edges of deciduous and mixed forests. They are most abundant in intermediate age and mature forest stands (COSEWIC 2012). Eastern wood-pewee were observed incidentally during early botany surveys in WL 2 (Figure 16; Appendix A).

Olive-sided Flycatcher

This species inhabits open coniferous or mixed coniferous forests, often near water or wetlands that contain tall snags or trees (COSEWIC 2016b). Suitable habitat is present in and around the Study Area. This species was observed twice, both using WL1 (Figure 16, Appendix A).

Peregrine Falcon

The peregrine falcon can exist in a range of habitats however, they typically use cliffs for nesting as it provides viewing for hunting and territorial defence. Suitable breeding habitat is typically found in areas where there is sufficient prey and prey habitat (COSEWIC, 2017). The peregrine falcon was heard in the existing quarry (Figure 16, Appendix A).

8.3.6.4 *Summary of Avifauna Surveys*

Baseline point count surveys for birds (spring migration, breeding season, fall migration, common nighthawk surveys, and nocturnal owl surveys) and meandering transects (breeding season area searches) were completed from April 2022 to September 2022, by McCallum biologists. A total of 819.5 minutes (13.6 hours) of surveys were completed over three seasons including time spent completing common nighthawk surveys and nocturnal owl surveys. These surveys resulted in the observation of 552 individuals, representing 56 species, which includes all individuals recorded incidentally. Incidental observations include those individuals observed outside of dedicated point count survey locations or survey times (i.e., when walking between point count locations) or during non-bird related surveys. Novel species (i.e., those not yet recorded in standardized point counts) and priority species were recorded, if observed incidentally.

The most abundant bird group observed was Group 6 (passerines) accounting for 67.9% of total individuals, followed by Group 7 (other landbirds, 14.6%), Group 2 (shorebirds; 3.5%), Group 1 (waterfowl; 3.5%), Group 3 (other waterbirds, 3.5%) Group 4 (diurnal raptors, 3.5%), and Group 5 (nocturnal raptors, 3.5%).

Six priority avifauna species were observed within the Study Area during all field surveys, including incidentals. The species and the survey where they were observed are as follows (SAR are **bolded**):

- Canada jay (*Perisoreus canadensis*; breeding);
- **Canada warbler** (*Wilsonia canadensis,* vegetation/lichen);
- **Common nighthawk** (*Chordeiles minor,* CONI, vegetation/lichen);
- **Eastern wood-pewee** (*Contopus virens,* breeding, CONI, vegetation/lichen);
- **Olive-sided flycatcher** (*Contopus cooperi*; breeding);
- **Peregrine falcon** (*Falco peregrinus*, WL and WC delineation)

All species observed are native species in this region; they are typical species commonly found within the Study Area habitat and its surroundings. No obvious concentrations of one particular bird group were identified, nor was an identifiable migratory pathway noted.

8.4 Aquatic Environment

Wetland and watercourse surveys, including fish and fish habitat assessments, were completed to determine potential impacts to these features and species, which may be protected under legislation.

8.4.1 Wetlands

The following sections outline the wetland findings from the desktop review and field survey.

8.4.1.1 *Desktop Review*

A review of the NSECC Wetlands Inventory Database identified one mapped wetland, classified as a swamp, within the Study Area, which extends along the watercourse along the northeastern boundary of the Study Area (Figure 9, Appendix A). The wetland and boundary were field verified during wetland surveys (see Section 8.4.1.2). No other NSECC wetlands are located within the Study Area.

The Wet Areas Mapping database identifies areas within the Study Area that have saturation ranges varying from 0 to 10.0 m below the ground surface. Areas immediately surrounding the mapped watercourses to the north, and the central portion of the Study Area are characterized by saturation depth ranges from 0 (surface) to 2.0 m below surface. Saturation closer to the surface coincides with lower elevations and water features. Deeper sub-surface saturation (>10.0 m) occurs within areas of higher elevation, such as along the southwest Study Area boundary and the existing IA Permit Area.

No NSECC predicted WSS are located within the Study Area. The closest predicted WSS (ID# 15544) is a riparian wetland along Martins River, located approximately 3.0 km east of the Study Area.

8.4.1.2 *Field Surveys*

Field surveys completed across the Study Area identified and delineated 10 wetlands (Figure 17, Appendix A). Wetland habitat was confirmed at the locations of the one NSECC mapped wetland identified within the Study Area as part of the desktop review. The boundaries of WL1 were adjusted in the field as necessary.

Refer to Table 8-22 for characteristics of the wetlands identified within the Study Area. See Appendix L for the wetland photolog.

Table 8-22: Wetland Characteristics

Wetland	Wetland Type	Wetland Size (m^2)	Water Flow Path	Landform	Landscape Position	Hydric Soil Indicator	Hydrological Conditions	Dominant Vegetation
1[1]	Riparian complex: fen and mixed-wood treed swamp	18,639	Contiguous Throughflow	Flat	Lentic	Histosol	Surface water, high water table, saturation, inundation visible on aerial imagery, hydrogen sulfide odor, drainage patterns, stunted or stressed plants, microtopographic relief.	**Herbs**: *Carex stipata, Chamaedaphne calyculata* **Shrubs**: *Larix laricina, Acer rubrum* **Trees**: *Acer rubrum, Larix laricina, Pinus strobus*
2	Mixed-wood treed swamp	12,547	Inlet	Flat	Terrene	Histosol	High water table, saturation, inundation visible on aerial imagery, water-stained leaved, drainage patterns, stunted or stressed plants.	**Herbs**: *Carex trsiperma, Osmundastrum cinnamomeum,* **Shrubs**: *Osmundastrum cinnamomeum, Gaylussacia baccata* **Trees**: *Acer rubrum, Larix laricina, Picea mariana*
3	Mixed-wood treed swamp	677	Discontinuous Throughflow	Flat	Terrene	Histosol	Surface water, high water table, saturation, inundation visible on aerial imagery, water-stained leaved, aquatic fauna. Stunted or stressed plants.	**Herbs**: *Carex stipata, Osmundastrum cinnamomeum* **Shrubs**: *Gaylussacia baccata, Picea mariana* **Trees**: *Acer rubrum, Picea mariana*
4	Mixed-wood treed swamp	4403	Discontinuous Throughflow	Flat	Terrene	Histosol	Surface water, high water table, saturation, inundation visible on aerial imagery, water-stained leaves, hydrogen sulfide odor, drainage patterns, stunted or stressed plants, microtopographic relief.	**Herbs**: *Sarraacenia purpurea, Osmundastrum cinnamomeum, Carex trisperma* **Shrubs**: *Gaylussacia baccata, Alnus incana, Osmundastrum cinnamomeum* **Trees**: *Acer rubrum, Picea mariana*

Wetland	Wetland Type	Wetland Size (m^2)	Water Flow Path	Landform	Landscape Position	Hydric Soil Indicator	Hydrological Conditions	Dominant Vegetation
5[1]	Mixed-wood treed swamp	868	Discontinuous Throughflow	Flat	Terrene	Histosol	Surface water, high water table, saturation, inundation visible on aerial imagery, water-stained leaves, hydrogen sulfide odor, drainage patterns, stunted or stressed plants.	**Herbs**: *Osmundastrum cinnamomeum, Carex trisperma, Cornus canadensis* **Shrubs**: *Gaylussacia baccata, Alnus incana, Picea mariana* **Trees**: *Acer rubrum, Picea mariana*
6	Mixed-wood treed swamp	134	Isolated	Basin	Terrene	Histosol	High water table, saturation.	**Herbs:** *Scirpus cyperinus. Rhynochospora alba, Osmundastrum cinnamomeum* **Shrubs:** *Abies balsamea, Picea mariana* **Trees:** *Abies balsamea*
7	Mixed-wood treed swamp	279	Isolated	Flat	Terrene	Histic Epipedon	Saturation.	**Herbs:** *Lysimachia nummularia, Osmundastrum cinnamomeum* **Shrubs:** *Larix laricina, Picea mariana, Pinus strobus* **Trees:** *Picea mariana, Acer rubrum,*
8	Mixed-wood treed swamp	1561	Isolated	Flat	Terrene	Histosol	High water table, saturation.	**Herbs:** *Osmundastrum Cinnamomeum, Gaylussacia baccata* **Shrubs:** *Picea mariana, Gaylussacia baccata* **Trees:** *Abies balsamea, Picea mariana, Acer rubrum*
9	Mixed-wood treed swamp	1724	Isolated	Flat	Terrene	Histosol	High water table, saturation.	**Herbs:** *Osmundastrum cinnamomeum* **Shrubs:** *Picea mariana, Alnus incana, Larix laricina* **Trees:** *Picea mariana, Larix laricina, Acer rubrum*
10	Mixed-wood treed swamp	582	Isolated	Basin	Terrene	Histosol	High water table, saturation.	**Herbs:** *Gaylussacia baccata, Osmundastrum cinnamomeum* **Shrubs:** *Picea mariana, Acer rubrum, Gaylussacia baccata* **Trees:** *Acer rubrum, Picea mariana*

[1] Field delineated wetlands extend beyond the Study Area boundary

In total, the 10 wetlands account for approximately 4.1 ha within the Study Area. Of the wetlands identified within the Study Area, 9 were classified as swamps, and one riparian complex. See Table 8-23 for a summary of area and abundance by wetland type.

Table 8-23: Summary of Wetland Classes

Wetland Type	Area				Abundance		
	Average (ha)	Minimum (ha)	Maximum (ha)	Total (ha)	# of wetlands	% of all wetlands	% of all wetland area
Swamp	0.25	0.013	1.25	2.269	9	90%	55
Riparian Complex	-	-	-	1.86	1	10%	45

Wetland type classifications are guided by The Canadian Wetland Classification System (1997). The majority of the swamps delineated within the Study Area are under one hectare in size (80%). WL1, a swamp-fen complex, is 1.86 ha and accounts for 45.04% of the total wetland area in the Study Area.

Within the Study Area, 90% of wetlands encountered were swamps, with the exception of WL1, a riparian shrub/softwood tree swamp-fen complex. Swamps identified in the Study Area are predominantly mixedwood or coniferous dominant. Common tree species include red maple (*Acer rubrum*), black spruce (*Picea mariana*), balsam fir (*Abies balsamea*), and tamarack (*Larix laricina*). Five had a notable shrub layer (WL1, 4, 5, 6, 7, 10).

Swamps are wetlands that are characterized by the dominance of tall woody perennial vegetation that often exceeds 30% cover (National Wetlands Working Group, 1997). These wetland types are often forested (dominated by trees with a high canopy cover) and/or have extensive shrub cover and consist of soils which can either be mineral or organic (National Wetlands Working Group, 1997). This wetland type is common within Nova Scotia and can either be stand-alone or found within wetland complexes (often along the outer edges).

Wetland soils were characterized by histosols in all wetlands except WL7, which was a histic epipedon.

8.4.1.2.1 Wetland Functional Analysis

The following subsections outline the results of the WESP-AC grouped wetland functions (Section 8.4.1.2.1.1) and the WESP-AC WSS Interpretation Tool (Section 8.4.1.2.1.2). Refer to Appendix M for WESP results.

8.4.1.2.1.1 *WESP-AC Grouped Wetland Function Results*

The following sections provides a summary of results by grouped function for all wetlands present within the Study Area. Tables 1 and 2 of Appendix M show grouped and specific function scores.

Hydrologic Group

The hydrological wetland service group evaluates the effectiveness of a wetland to store or delay the downslope movement of surface water. The model does not account for wetland size, and in turn, does not account for larger wetlands having the ability to store more water than smaller wetlands. See Table 8-24 for each wetland's function and benefit score.

Table 8-24: Hydrologic Group Score Category

Function	Benefit		
	Lower	Moderate	Higher
Lower	WL1,	None	None
Moderate	WL3, WL4, WL5	None	None
Higher	WL2, WL6, WL7, WL8, WL9, WL10	None	None

The wetlands that scored moderate and high in this function are those wetlands that are isolated or do not have watercourse connectivity; thus they are able to store water on the landscape more effectively. WL1 is a riparian system with a throughflow watercourse, resulting in a lower score. All wetlands assessed scored lower in benefit (n=10).

Water Quality Group

This wetland function group is compiled from four different functions: sediment retention and stabilization; phosphorus retention; nitrate removal; carbon sequestration. The main function of this group is to evaluate the wetland's potential to intercept, retain, and filter sediments, particulates, and organic matter. Like the hydrologic group, the wetlands that have the highest functions in this regard include those that do not have a surface water outlet, and instead are isolated from flowing surface water. This model also does not account for wetland size and as such, larger wetlands do not necessarily score higher for water purification than small wetlands, although in reality, size may factor into this function (Table 8-25).

Table 8-25: Water Quality Group WESP-AC Results

Function	Benefit		
	Lower	Moderate	Higher
Lower	None	None	None
Moderate	None	None	WL1
Higher	WL2, WL3, WL4, WL5, WL6, WL7, WL8, WL9, WL10	None	None

Most of the wetlands (90%) scored lower in benefit and higher in function. As with the hydrologic group, high scoring wetlands (function) did not have watercourse connectivity. WL1 scored moderate for function as it contains a throughflow watercourses. However, WL1 is the only wetland to score higher for benefit due to its sediment, phosphorus and nitrate retention or removal properties, as well as its fish and waterfowl habitat provisions.

Aquatic Support Group

The aquatic support group comprises four individual functions: stream flow support; aquatic invertebrate habitat; organic nutrient export; and water cooling. The main function of this group is to determine the wetland's ability to support ecological stream functions that promote habitat health, therefore wetlands lying adjacent to or containing flowing water score higher than those that do not (i.e., isolated wetlands). In addition, however, headwater wetlands are crucial for supporting stream flow during the dry season by contributing to water flow via groundwater input and storage capacity (Table 8-26).

Table 8-26: Aquatic Support Group WESP-AC Results

Function	Benefit		
	Lower	Moderate	Higher
Lower	WL4	None	None
Moderate	WL2, WL3, WL5, WL6, WL7, WL8, WL9, WL10	None	None
Higher	None	WL1	None

Eighty percent of the wetlands within the Study Area scored lower or moderate in function (n=8), whereas WL1 scored higher. The highest function scores within the Aquatic Support Group included wetlands that either have evidence of surface water for periods of the year or have direct watercourse connectivity. Similar to the Water Quality Grouped function, all wetlands scored lower in benefit with the exception of WL, which scored moderate as a result of its riparian nature.

Aquatic Habitat Group

The aquatic habitat group is compiled from five different functions: anadromous fish habitat, resident fish habitat, amphibian and turtle habitat, waterbird feeding habitat, and waterbird nesting habitat. Wetlands that have the highest functions within this group include those that are adjacent to or contain flowing water (Table 8-27).

Table 8-27: Aquatic Habitat Group

Function	Benefit		
	Lower	Moderate	Higher
Lower	WL2, WL6, WL7, WL8, WL9, WL10	None	None
Moderate	None	WL3, WL4, WL5	None
Higher	None	None	WL1

Six of the wetlands scored lower for function, three wetlands (WL3, 4, 5) have moderate function, and The wetlands that scored lower for function (WL2, 6, 7, 8, 9, 10) do not have suitable conditions to support fish, herpetofauna, or waterbirds. The other wetlands in the Study Area have moderate/high function (WL1, 3, 4, 5) due to higher amounts or evidence of standing or flowing water that could provide habitat for fish, herpetofauna, or waterbirds. For the same reasons, these wetlands also scored moderate/higher in benefit.

Transition Habitat Group

The transition habitat group comprises three different functions: songbird, raptor, and mammal habitat, native plant habitat and pollinator habitat. The main function of the collective group is to evaluate the wetland's ability to support healthy habitat for birds, mammals, and native plants (Table 8-28).

Table 8-28: Transition Habitat Group WESP-AC Results

Function	Benefit		
	Lower	Moderate	Higher
Lower	None	None	None
Moderate	WL7	None	None
Higher	WL1, WL2, WL3, WL6, WL8, WL10	WL4, WL5, WL9	None

All wetlands scored either moderate (n=1) or higher (n=9) for function and all either scored low (n=7) or moderate (n=3) for benefit in the Transition Habitat Group. In general, wetlands within the Study Area provide habitat that supports a variety of flora and fauna, which includes downed wood, prevalent ground cover, varied microtopography, tree and shrub cover in and around the wetlands, and naturally vegetated buffer zones. The wetlands have a variety of woody heights and diverse forms, which allows for nesting habitat, perches, and feeding grounds. In addition, the wetlands provide a diverse range of herbaceous vegetation. As such, wetlands within the Study Area generally provide habitat for songbirds, mammals, pollinators, and potentially rare plants. Wetlands that scored lower/moderate for the benefit score suggests that these wetlands perform these benefits at the same or lower rate to others in the landscape.

Wetland Condition

Wetland Condition refers to the integrity or health of a wetland as defined by its vegetative composition and richness of native species. Scores are derived from the similarity between the wetland being evaluated and reference wetlands of the same type and landscape setting (Adamus, 1996).

Wetland condition within the Study Area included lower (WL1, 3, 5, 6, 7), moderate (WL4, 8, 9, 10), and higher (WL2), indicating that the moderate to higher wetlands carry a relatively good range of vegetative community health levels. High scoring wetlands may have greater ecological integrity, microhabitats, species diversity, etc., while lower scoring wetlands may indicate that they have lost their function and integrity due to historical natural or anthropogenic impacts. While WL6 appears to have been historically harvested, it doesn't appear that WL1, 3, 5, or 7 have been subject to anthropogenic disturbance. These wetlands may exhibit natural traits, like dominance of a few herbaceous species, minimal microtopography and bare soil/depressions, that are also indicators of human impact.

Wetland Risk

Wetland Risk takes sensitivity and stressors into account by averaging the two. Sensitivity is the lack of intrinsic resistance and resilience of the wetland to human or naturally caused stress (Niemi et al., 1990).

The functional assessment tool uses five metrics to measure sensitivity: abiotic resistance, biotic resistance, site fertility, availability of colonizers, and growth rate. Stress relates to the degree to which the wetland is or has recently been anthropogenically altered in a way that degrades natural condition and/or function. The model applies four stress groups: hydrologic stress, water quality stress, fragmentation stress, and general disturbance stress. Wetlands that are highly resilient may have lower risk scores despite their exposure to multiple stressors. Additionally, wetlands exposed to fewer threats, but with low resilience may have high risk scores. Wetland resilience is tied to multiple factors, such as size, proximity to natural land cover, and presence of invasive species.

Most of the analyzed wetlands (n=6) scored high (WL2, 3, 4, 7, 8, 9) for wetland risk, meaning they are generally exposed to pre-existing stressors (e.g., road development) and/or may be less resilient and susceptible to change. WL5, WL6, and WL10 scored moderate and WL1, scored low for wetland risk, indicating a higher resilience, and/or fewer preexisting stressors.

Functional Assessment Summary

WESP-AC is a quantitative decision-making tool, but its results must be used qualitatively to form conclusions around wetland functions. As stated in Section 7.4.1.3.4, the highest functioning wetlands are those that have both higher function and higher benefit scores. It is also necessary to evaluate the wetlands that scored higher (function and benefit) across function groups. While higher benefit or function scores were calculated for various wetlands, no wetlands scored higher in both benefit and function.

WL1 scored higher in function and benefit, on average. WL1 is the only wetland with watercourse connectivity and thus provides a unique range of function and benefits compared to other wetlands in the Study Area. Generally, the wetlands within the Study Area also scored higher in the Hydrologic, Water Quality and Transition Habitat groups compared to the other wetlands across Nova Scotia.

8.4.1.2.1.2 *WESP-AC WSS Interpretation Tool*

The results generated from the WESP-AC Interpretation tool are presented Table 8-29 and Table 8-30. None of the wetlands within the Study Area are classified as a functional WSS.

Table 8-29: WESP-AC WSS Interpretation Tool Results

Wetland	Function-Benefit Product (FBP)									
	Support Supergroup - Hydrologic		Support Supergroup – Water Quality Support		Support Supergroup – Aquatic Support		Habitat Supergroup – Aquatic Habitat		Habitat Supergroup – Transition Habitat	
	Score	Category	Score	Category	Score	Category	Score	Category	Score	Category
1	4.56	Low	44.09	Low	34.18	Low	37.45	Low	30.83	Low
2	24.62	Low	16.96	Low	3.06	Low	0.90	Low	33.37	Low
3	18.25	Low	15.67	Low	11.41	Low	16.64	Low	33.40	Low
4	17.84	Low	18.24	Low	11.73	Low	11.94	Low	65.07	Low
5	17.88	Low	24.41	Low	14.17	Low	12.81	Low	57.63	Low
6	27.03	Low	21.01	Low	1.98	Low	0.40	Low	21.48	Low
7	23.17	Low	14.98	Low	2.34	Low	0.57	Low	17.49	Low
8	24.76	Low	16.72	Low	3.17	Low	0.71	Low	20.50	Low
9	24.76	Low	16.6	Low	3.09	Low	0.67	Low	52.94	Low
10	29.87	Low	21.83	Low	2.83	Low	0.64	Low	22.44	Low

Table 8-30: Functional Wetland Determination Results

Wetland	Habitat Rule Satisfied?	Support Rule Satisfied	Habitat/Support Rule Hybrid Satisfied?	Conclusion
1	No	No	No	Not a WSS
2	No	No	No	Not a WSS
3	No	No	No	Not a WSS
4	No	No	No	Not a WSS
5	No	No	No	Not a WSS
6	No	No	No	Not a WSS
7	No	No	No	Not a WSS
8	No	No	No	Not a WSS
9	No	No	No	Not a WSS
10	No	No	No	Not a WSS

8.4.1.2.2 Wetlands of Special Significance

As part of a qualitative wetland assessment, along with a review of the current NSECC GIS predictive WSS layer, each wetland was reviewed to determine if it meets the threshold for a WSS. No NSECC predictive WSS are identified within the Study Area.

No wetlands within the Study Area are present within any of the following special habitats: Ramsar Sites; Provincial Wildlife Management Areas; Provincial Parks; Nature Reserves; Wilderness Areas; Lands owned or legally protected by non-governmental charitable conservation land trusts; intact or restored wetlands under the North American Waterfowl Management Plan; and protected water areas, which would result in the designation of a WSS.

No functional WSS were identified through the WESP-AC WSS Interpretation Tool (see Section 8.4.1.2.1.2).

Five wetlands within the Study Area had observations of SAR within wetland boundaries during field surveys completed by McCallum. The wetlands-associated SAR species sightings are indicated in Table 8-31 below. Preferred habitat for the noted SAR is described below. Species in **bold** have legal protection under SARA or the NSESA (status: Endangered or Threatened), while others do not have legal protection (status: Special Concern or Vulnerable).

Table 8-31: Wetlands with Observed SAR

Wetland ID	Wetland Habitat	Direct Wetland Alteration Proposed?	Observed SAR	Suitable Habitat Present (Y/N)[1]
1	Complex: riparian treed swamp/fen	None	**Olive-sided flycatcher**[2] (SARA/COSEWIC Special Concern, NSESA Threatened)	Y
			Eastern painted turtle (SARA/COSEWIC Special Concern)	Y
			Snapping turtle (SARA/COSEWIC Special Concern, (NSESA Vulnerable)	Y
2	Mixedwood treed swamp	None	Eastern wood-pewee (SARA/COSEWIC Special Concern, NSESA Vulnerable)	Y
			Frosted glass-whiskers (Atlantic population) (SARA/COSEWIC Special Concern)	Y
4	Mixedwood treed swamp	Complete	**Canada warbler** (SARA, Threatened,	Y

Wetland ID	Wetland Habitat	Direct Wetland Alteration Proposed?	Observed SAR	Suitable Habitat Present (Y/N)[1]
			COSEWIC Special Concern, NSESA Endangered)	
5	Mixedwood treed swamp	Partial	**Canada warbler** (SARA, Threatened, COSEWIC Special Concern, NSESA Endangered)	Y
9	Mixedwood treed swamp	Complete	**Canada warbler** (SARA, Threatened, COSEWIC Special Concern, NSESA Endangered)	Y

[1] In consideration of preferred habitat for critical life functions or necessary biological requirement (e.g., nesting, overwintering).

[2] Observed beyond the Study Area.

The three SAR birds identified in wetlands (Figure 16, Appendix A), olive-sided flycatcher, Canada warbler, and eastern wood-pewee, were all observed incidentally (e.g., during wetland and vegetation surveys) during the breeding season. These species are known to breed in wetland habitat. Olive-sided flycatchers prefer conifer forests and often edge habitats near meadows and ponds (Environment Canada 2016b). Eastern Wood-Pewee is known to breed in a variety of wooded habitats but prefers deciduous or mixedwood stands generally associated with forest edges/clearings and/or wetlands for feedings. (COSEWIC 2012).

Canada Warbler breeds in a variety of habitats that differ across its range but are almost always associated with moist forests with a dense, mixed wood or deciduous shrub layer, complex understory, and available perch trees. Within Nova Scotia, breeding preference appears to be in moist sites with cinnamon fern, speckled alder, or other deciduous shrubs with sphagnum and uneven ground (Environment Canada 2016a). McCallum assessed the suitability of breeding habitat based on this definition at points evenly distributed throughout WL4 (n=11), WL5 (n=3), and WL9 (n=6). Sixty four percent (7/11), 67% (2/3), and 83% (5/6) of the points assessed within WL4, 5, and 9, respectively, contained suitable breeding habitat for this species. While these three wetlands contain characterises of Canada warbler preferred breeding habitat (e.g., mixedwood tree swamp with understory of cinnamon fern, speckled alder and hummocky, moss dominated ground cover), this wetland type and habitat characteristics have been observed extensively across Nova Scotia, including other Project wetlands not proposed for direct alteration (i.e., WL1, 2 and 10). While all avifauna SAR observations within the Study Area wetlands occurred in the respective species' preferred breeding habitat the uniqueness of the habitat characteristics in the local and broader area, discreetness of the species' breeding requirements and species' home ranges should be considered. While nest fidelity is common, avifauna are less likely rely on a specific wetland compared to less mobile species with discreet nesting sites (e.g., turtles). Avifauna have large home ranges and may only spend a portions of their life history in Nova Scotia.

Historically, frosted glass-whiskers in Nova Scotia has been found on the exposed heartwood of mature hardwood trees in old-growth hardwood stands (COSEWIC, 2005). More recently, the species has also been found on the heartwood of red maples in mixedwood or deciduous dominated wetlands (COSEWIC,

2014). Within the Study Area, one observation of frosted glass-whiskers was found within a mixedwood swamp, WL2.

Eastern painted turtles were observed basking in WL1 (5 total) between May-July 2023. A snapping turtle was observed in July 2022 near the outflow of WL1, beyond the field delineated extent. Both species occupy slow moving, relatively shallow, and well-vegetated wetlands and water bodies with organic substrate, which provide suitable overwintering sites (ECCC, 2016, COSEWIC, 2018). Preferred nesting substrate is sand, loam, clay, and/or gravel (ECCC, 2016, COSEWIC, 2018). While WL1 does not meet the Eastern painted turtle or snapping turtle nesting site requirements, it does provide soft, depth organic substrate and shallow water depths (<50 cm) for overwintering.

WL1, 2, 4, 5 and 9 are presented as potential WSS due to observations of SAR and supporting habitat for critical life functions[2] (Figure 17, Appendix A). Final WSS designation will be made by NSECC.

8.4.1.2.3 Wetland Hydrology

Wetland hydrology is largely dependent on wetland type and its position on the landscape. Within the Study Area, there were two classes of wetland observed, swamp (n=9) and a riparian swamp-fen complex (n=1).

Water table fluctuations in swamps are often greater than that of other wetlands, particularly if there is a watercourse connection. Isolated swamps are on average drier than most other wetland types, with a water table below the surface for the majority of the year (Warner & Rubec, 1997). Swamps may function as groundwater recharge or discharge systems depending on their position in the landscape and association with other hydrologic features (e.g., watercourses).

Generally, the topographic and hydrologic gradient in the Study Area is to the north and southeast, with the exception of the northwest corner which drains toward Bagpipe Lake (see the WBA, Appendix E, for detailed catchment areas). While the primary flow path is through the delineated watercourse associated with WL1, there is passive groundwater flow or drainage features, supported by other wetlands on the landscape. WL1, is a swamp-fen complex associated with a throughflow watercourse, however, most wetlands in the Study Area are hydrologically isolated, in the context of surface water.

Wetlands in the central portion of the Study Area are located at a lower topographic position (WL2, 3, 4, 5, 7, 8 and 9), and generally at the same elevation, with a slight southward gradient (Figure 9, Appendix A). As a result, these wetlands may be functioning as discharge and/or throughflow wetlands, received groundwater inputs from the adjacent hillslopes to the east and west and shuttling it through the Study Area to the south or north. Typically, groundwater discharge areas maintain higher local water tables, whereas recharge systems replenish local aquifers (Siegel and Glaser, 1987). Wetlands at higher

[2] Note: NSECC is currently amending the triggers for WSS designation which may change the number of wetlands proposed as WSS within this report. McCallum will continue to consult with NSECC on the matter and WSS designation will be confirmed by NSECC during the wetland permitting process.

elevations (WL6 and 10) are likely functioning as recharge wetlands, where hydrologic gradients are dominated by downward flows in the underlying mineral soils and aquifer, due to their local headwater (higher) topographic position. The assessed discharge/recharge functions of these wetlands is supported by the near surface saturation shown in the Wet Area mapping databased examined during the desktop review (Figure 9, Appendix A), where the modeled local water table is closer to the surface in those areas expected to be discharge/throughflow locations.

8.4.2 Surface Water, Fish and Fish Habitat

The following sections outline the surface water, fish and fish habitat findings from the desktop review and field surveys.

8.4.2.1 *Desktop Review*

The Fish Study Area is situated entirely within the Gold River primary watershed (1EG) and the Mushamush River secondary watershed (1EG-4) (Figure 1, Appendix A). Within the secondary watershed, prominent aquatic features such as Whale, Caribou, Little Mushamush and Big Mushamush Lakes are fed by smaller headwater lakes situated along the north and northwest boundaries of the watershed. The watershed generally drains southeast, eventually collecting within the Mushamush River which empties into the Atlantic Ocean at Mahone Harbour.

The topographical high within the Study Area generates a division of flow, with surface water on the northwestern side of the Study Area draining southwest, and surface water on the northeastern side draining southeast. All surface water originating from the Fish Study Area is eventually directed south towards Little Mushamush Lake.

A review of aerial imagery and NSTDB mapping identified two waterbodies within the Fish Study Area. There is an unnamed waterbody of approximately 2 ha situated within the northeastern extent of the Fish Study Area. This waterbody lies to the west of the existing access road to the existing quarry and is herein referred to as Pond 1. Another named waterbody (Bagpipe Lake) was identified in the most western extent of the Fish study Area and is approximately 14 ha in size.

One named watercourse, North Big Brook (field verified and subsequently referred to as WC1), was identified within the Fish Study Area. This watercourse begins upstream of Pond 1, flowing through the pond and re-channelizing just upstream of the bridge to the existing quarry. WC1 continues for approximately 2.5 km before draining into Little Mushamush Lake (Figure 1, Appendix A). A second identified watercourse, Little North Brook, (field verified and referred to as WC2) is a first order stream that originates within the Fish Study Area upstream of a provincially mapped wetland and flows southwest through the wetland before draining into Bagpipe Lake (Figure 17, Appendix A).

The Canadian Rivers Institute (CRI) inland fish distribution maps show the following species as potentially present within the Gold River primary watershed: American eel (*Anguilla rostrata;* COSEWIC threatened); white sucker (*Castostomus commersoni;* S5); smallmouth bass (*Micropterus dolomieu*: SNA); alewife (*Alosa pseudoharengus*; S3B); common shiner (*Luxilus cornutus*; S5); creek chub (*Semotilus atromaculatus;* S5); golden shiner (*Notemigonus crysoleucas*; S4); lake chub (*Couesius plumbeus*; S5);

northern redbelly dace (*Phoxinus eos;* S5); banded killifish (*Fundulus disphanus*; S5); mummichog (*Fundulus heteroclitus*; S5); Atlantic tomcod (*Microgadus tomcod;* S5); fourspine stickleback (*Apeltes quadracus*; S5); threespine stickleback (*Gasterosteus aculeatus;* S5); ninespine stickleback (*Pungitius pungitius;* S5); brown bullhead (*Ameirus nebulosus;* S5); white perch (*Morone americana*; S5); brook trout (*Salvelinus fontinalus;* S3); brown trout (*Salmo trutta*; SNA); rainbow trout (*Oncorhynchus mykiss*; SNA); and southern upland population of Atlantic salmon (*Salmo salar;* COSEWIC Endangered).

The ACCDC report (Appendix G) did not identify any priority fish species within 5 km of the Study Area. Atlantic salmon (southern upland population) were identified within 10 km of the Study Area. The Aquatic Species at Risk Map (DFO, 2023) was reviewed, and no critical habitat or species listed under the SARA were identified within the Mushamush River secondary watershed.

Details relating to habitat requirements for priority species identified through the desktop review are discussed in Appendix F. Fish habitat characterization provided herein is focused on habitat requirements for native fish species.

8.4.2.2 *Field Results*

Two field identified watercourses (Big North Brook [WC1] and Little North Brook [WC2]) and two waterbodies (Pond 1 and Bagpipe Lake) were delineated and characterized within the Fish Study Area (Figure 17, Appendix A);

- WC1 (Big North Brook) is a provincially mapped watercourse that originates to the north of the Fish Study Area, flows through Pond 1 and continues south beyond the Fish Study Area before draining into Little Mushamush Lake;
- WC2 (Little North Brook) originates along the edge of an access road, traveling southwest through a provincially mapped wetland and acts as an inflow to Bagpipe Lake;
- Pond 1 is a waterbody that is present within WC1/WL1 and situated along the northeastern boundary of the Fish Study Area;
- Bagpipe Lake is a waterbody that is located in the Fish Study Area, receives inflow of surface water from WC2 (Little North Brook) and has an outflow that drains into Little Mushamush Lake (not assessed).

Refer to Section 8.4.2.2.3 Resources for physical descriptions of the water features identified within the Fish Study Area. No additional watercourses or waterbodies were delineated within the Fish Study Area. Representative photographs of each water feature are provided in Appendix J.

8.4.2.2.1 Fish Surveys

The following sections outline the results of electrofishing and fish trapping efforts within the Fish Study Area.

8.4.2.2.1.1 *Electrofishing*

The results of electrofishing surveys are presented in Table 8-32. Relative abundance has been expressed through Catch Per Unit Effort (CPUE) calculated as the number of fish captured per 300 seconds of electrofishing effort.

Table 8-32: Summary of Electrofishing Efforts within the Fish Study Area

Site	Survey Date	Fish Species Collected		Catch Per Species	Total Catch	Total Effort (seconds)	CPUE (fish/300 seconds)
		Common Name	Scientific Name				
WC1	September 27, 2022	American eel	*Anguilla rostrata*	19	23	1444.5	4.78
		Brown bullhead	*Ictalurus nebulosus*	1			
		Smallmouth Bass	*Micropterus dolomieui*	3			
WC2	September 27, 2022	Banded killifish	*Fundulus diaphanus*	1	2*	943.5	0.64
		Yellow perch	*Perca flavescens*	1			

*One American eel was observed but not caught, not included in CPUE.

During electrofishing surveys in the two watercourses, WC1 had the highest abundancy and diversity of fish. Twenty-three fish representing three species (American eel, brown bullhead and smallmouth bass) were caught within the one pass of electrofishing. This reach also had the highest CPUE between the two watercourses (4.78 fish per 300 electrofishing seconds). Over the 943 seconds of electrofishing, only two fish representing two species (banded killifish and yellow perch) were caught within WC2 resulting in a total CPUE of 0.64. Additionally, one American eel was observed but not caught.

8.4.2.2.1.2 *Fish Trapping*

The results of trapping efforts in Pond 1 and Bagpipe Lake are presented in Table 8-33. Relative abundance has been expressed through CPUE per trap type and per species.

Table 8-33. Summary of Trapping Efforts within the Fish Study Area.

Water-body ID	Survey Date	Fish Species Collected		Total Catch (per species)	Total Catch	Total Catch Per Trap Type[1]	Total Effort Per Trap Type (hours)	CPUE (per trap)	CPUE (per species)
		Common Name	*Scientific Name*						
Pond 1	July 26-27, 2022	American eel	*Anguilla rostrata*	1	3*	MT- 2 EP- 0 FN- 1	MT – 281.00 hrs EP – 45.83 hrs FN- 23.50 hrs	MT- 0.007 EP- N/A FN- 0.043	American eel – 0.003
		Banded killifish	*Fundulus diaphanus*	1					Banded killifish – 0.003
		Brown bullhead	*Ictalurus nebulosus*	1					Brown bullhead – 0.003
Bagpipe Lake	July 27-28, 2022	American eel	*Anguilla rostrata*	2	77	MT- 69 EP- 8 FN- 0	MT – 283.00 hrs EP – 46.83 hrs FN- 24.00 hrs	MT- 0.244 EP- 0.171 FN- N/A	American eel – 0.006
		Banded killifish	*Fundulus diaphanus*	39					Banded killifish – 0.110
		Golden Shiner	*Notemigonus crysoleucas*	12					Golden Shiner – 0.034
		Yellow Perch	*Perca flavescens*	24					Yellow Perch – 0.068

[1]MT = minnow trap, EP = eel pot, FN = fyke net

*One white sucker was caught but escaped before measured were obtained, not included in CPUE.

Between the seven groups of traps deployed within Pond 1, three individual fish were caught after approximately 350 hours of trapping. American eel, banded killifish and brown bullhead were all caught and measured during trapping within Pond 1. In addition, one white sucker was caught but escaped before it could be measured. No fish were caught in the eel pots after more than 45 hours of trapping.

Abundance and diversity were higher in Bagpipe Lake, with 77 fish representing four species being caught over the 353 hours of trapping. In Bagpipe Lake, banded killifish had the highest CPUE of all trapped fish (CPUE – 0.110) and American eel was the lowest with a CPUE of 0.006. Minnow traps were the most effective with a CPUE of 0.244, then eel pots with a CPUE of 0.171. No fish were caught in the fyke net after 24 hours of trapping.

Refer to Figures 11 and 12 (Appendix A) for site locations.

8.4.2.2.1.3 *Fish Species Observed*

Table 8-34 presents a summary of fish species captured through all electrofishing and trapping surveys within the Fish Study Area, listed in order of abundance (SAR are **bolded**). Individual data for fish captured at each sampling site within the Fish Study Area are presented in Appendix N, and representative photographs of each species captured are presented in Appendix J.

Table 8-34. Fish Species Captured within the Fish Study Area

Common Name	Scientific Name	COSEWIC	SARA	NSESA	SRank	Total Catch		Length range (mm)	System			
						Total #	% Catch		WC1	WC2	Pond 1	Bagpipe Lake
Banded killifish	*Fundulus diaphanus*	Not at Risk	-	-	S5	41	39.0	55-85	-	X	X	X
Yellow Perch	*Perca flavescens*	-	-	-	S5	25	23.8	90-170	-	X	-	X
American eel	***Anguilla rostrata***	**Threatened**	**-**	**-**	**S3N**	**22**	**21.0**	180 - 440	X	X	X	X
Golden Shiner	*Notemigonus crysoleucas*	-	-	-	S4	12	11.4	85-115	-	-	-	X
Smallmouth bass	*Micropterus dolomieui*	-	-	-	SNA	3	2.9	90-180	X	-	-	-
Brown bullhead	*Ictalurus nebulosus*	-	-	-	S5	2	1.9	70-140	X	-	X	-
White sucker	*Catosomus commersonii*	-	-	-	S5	1	0.9	-*	-	-	X	-
Total Individuals						106	Total Species		3	3	4	4

* One adult white sucker was caught in the fyke net at the outflow of Pond 1. Upon removal from the wing net the white sucker escaped - no measurements were recorded for the individual.

As a result of fishing efforts (i.e., all electrofishing and trapping surveys) completed within the Fish Study Area, a total of seven species were captured:

- American eel (COSEWIC: threatened; S3N);
- banded killifish (S5);
- brown bullhead (S5);
- golden shiner (S4);
- smallmouth bass (SNA);
- white sucker (S5); and
- yellow perch (S5).

In total, 105 individual fish were captured across four survey locations. Banded killifish was the most commonly captured and one of the most widely distributed species, accounting for 39% of the total catch for all fishing efforts. Yellow perch and American eel were the caught less frequently, comprising 45% of all fish caught throughout the Fish Study Area combined. Twelve golden shiners were caught in Bagpipe Lake, making up 11.4% of all fish caught in the Fish Study Area. Smallmouth bass and brown bullhead were the lowest represented fish, accounting for less then 10% between the two species. One white sucker was observed during trapping in Pond 1 but was not caught. American eel, ranked as S3N by the ACCDC, was the only priority fish species captured.

It is noted that smallmouth bass are an invasive species to Nova Scotia – the species was introduced in 1942 to 10 lakes in hopes of supporting recreational fishing (Nova Scotia, 2022). Since 1942, more than 300 lakes throughout the province have confirmed presence of smallmouth bass. Smallmouth bass have been known to reduce or eliminate native fish populations, such as Atlantic salmon, brook trout and Atlantic whitefish, by predating on juveniles and out competing adults. The use of a biological pesticide, such as rotenone, in select lakes (i.e., Dobsons Lake) have been taken to eliminate smallmouth bass populations from select ecosystems.

8.4.2.2.2 Water Quality

Water quality results are reported and discussed as they relate to the chemical characteristics required for suitable fish habitat. Where applicable, water quality sampling results are evaluated against the CCME Guidelines for the Protection of Freshwater Aquatic Life (FWALs). In-situ water quality measurements recorded during detailed habitat surveys in July 2022 and during fish surveys in July and September of 2022 provided in Table 8-35 and Table 8-36.

Table 8-35: Summary of In-situ Water Quality Measurements during Detailed Habitat Surveys

Site	Reach #	Sampling Date	Water Temp (ºC)	pH	DO (mg/L)	Conductivity (µS/cm)
WC1	2	July 28, 2022	29.6	**4.64**	**5.13**	22.5
	3	July 28, 2022	22.8	**4.51**	**3.15**	21.3
	4	July 28, 2022	22.9	**4.55**	**4.84**	19.8
WC2	1	July 28, 2022	25.6	**3.84**	**3.47**	19.1
Pond 1	N/A	July 28, 2022	26.6	**4.44**	**5.15**	21.5
	N/A	July 28, 2022	27.5	**4.56**	**3.44**	23.3
	N/A	July 28, 2022	27.7	**4.42**	**4.53**	22.1
	N/A	July 28, 2022	27.8	**4.64**	**4.56**	22.1
	N/A	July 28, 2022	28.9	**4.51**	**4.76**	22.4
Bagpipe Lake	N/A	July 27, 2022	27.2	**4.42**	6.13	16.2
	N/A	July 27, 2022	27.2	**4.42**	6.13	16.9
	N/A	July 27, 2022	27.0	**4.37**	**5.29**	16.6
	N/A	July 27, 2022	27.1	**4.48**	6.50	16.8
	N/A	July 27, 2022	26.7	**4.51**	6.02	16.6
	N/A	July 27, 2022	26.5	**4.53**	6.67	16.6

Note**:** Values in bold indicate parameters recorded as below CCME guidelines for the protection of aquatic life, including: DO levels not suitable for any life stage of warm or cold-water fish species (<5.5 mg/L) (1999), and pH levels below 5.0 (CCREM, 1987).

Table 8-36: Summary of In-situ Water Quality Measurements During Fish Surveys

Site	Sampling Date	Water Temp (ºC)	pH	DO (mg/L)	Conductivity (µS/cm)
WC1	September 28, 2022	16.2	**4.30**	7.96	19.5
WC2	September 28, 2022	13.5	**3.68**	**3.38**	48.0
Pond 1	July 26, 2022	27.3	**4.69**	**4.90**	22.1
	July 27, 2022	16.7	**4.34**	5.74	24.6
Bagpipe Lake	July 28, 2022	16.6	**4.06**	8.95	16.4

Note**:** Values in bold indicate parameters recorded as below CCME guidelines for the protection of aquatic life, including: DO levels not suitable for any life stage of warm or cold-water fish species (<5.5 mg/L) (1999), and pH levels below 5.0 (CCREM, 1987).

These results are discussed as they relate to fish habitat quality in the following sections.

8.4.2.2.2.1 *Temperature*

Water temperature affects the metabolic rates and biological activity of aquatic organisms, thus influencing the use of habitat by aquatic biota. There are no CCME guidelines related to temperature and aquatic biota. Temperature preferences of fish vary between species, as well as with size, age, and season.

Species documented within the Fish Study Area have generally prefer cool-warm thermal regimes. The lethal temperature for yellow perch is 26.5˚C (Scott and Crossman, 1973). American eel can tolerate a range from 3 to 25ºC (Baensch and Riehl 1995). Golden shiners have an unusually high tolerance for North American minnows, having been recorded to tolerate temperatures up to 40 ˚C (Coad et al., 1995). Keast stated that brown bullhead had the best growth rate in waters with a temperature between 20-30 ˚C (2011).

The results shown in Table 8-35 and Table 8-36 provide a snapshot of temperatures from early (July 2022) and late summer (September 2022) for the two watercourses and waterbodies present within the Fish Study Area. Throughout the Fish Study Area, recorded summer temperatures in 2022 ranged from 13.5°C in WC2 to 29.6°C in WC1 (note: the warmest temperatures were not recorded during the warmest months of the year [August/September]). The average temperature recorded throughout the Fish Study Area was 24.6°C. Summer temperatures recorded within the Fish Study Area are considered suitable for the documented fish community.

8.4.2.2.2.2 *pH*

CCME FWALs establish that a range of pH from 6.5 to 9.0 is suitable for supporting fish populations within freshwater habitat. Kalff (2002) indicates that the loss of fish populations is gradual and depends on fish species, but decline is evident when pH is <6.5. Kalff (2002) further states that a 10-20% species loss is apparent when pH <5.5.

The pH range for aquatic features sampled within the Fish Study Area was 3.68 (WC2) to 4.69 (Pond 1), with an average pH of 4.40. Out of the 20 pH measurements (Table 8-35 and Table 8-36), all exhibited pH levels so low (<5.0) as to expect to cause harm to the eggs and fry of salmonid species (CCREM, 1987); however, no salmonid species were documented through fish collection efforts within the Fish Study Area. The fish community documented with the Fish Study Area is generally considered acid-tolerant (Smith et al., 1986; Lacroix, 1987).

8.4.2.2.2.3 *Dissolved Oxygen (DO)*

The atmosphere and photosynthesis by aquatic vegetation are the major sources of DO in water (CCME 1999). However, the amount of oxygen available for aquatic life (i.e., the concentration of oxygen in water) is affected by several independent variables including water temperature, atmospheric and hydrostatic pressure, microbial respiration, and growth of aquatic vegetation; DO can vary daily and seasonally (CCME, 1999). The CCME guidelines for the Protection of Aquatic Life establish a minimum recommended concentration of DO of 9.5 mg/L for early life stages of cold-water biota and 6.5 mg/L for other life stages. For warm-water biota, the CCME guidelines recommend 6.0 mg/L for early life stages, and 5.5 mg/L for all other life stages.

DO levels recorded in July 2022 throughout all watercourses and waterbodies ranged between 3.15 mg/L in WC1 Reach 3 to 8.95 mg/L in Bagpipe Lake, the average DO was 5.30 mg/L. DO levels recorded in September 2022 were 3.38 mg/L in WC2 and 7.96 mg/L in WC1. No recorded DO measurements were within the CCME guidelines for early life stages of cold-water biota (>9.5 mg/L), and only four were within the CCME guidelines for other life stages for cold-water biota (>6.5 mg/L). Seven recorded DO measurements were within the CCME guideline for early life stages of warm-water biota (>6.0 mg/L) and 16 were lower then the CCME guidelines for all other life stages of warm-water biota (>5.5 mg/L).

8.4.2.2.2.4 *Conductivity and Turbidity*

Conductivity is a measure of water's capacity to conduct an electrical current. Toxicity in fish can be achieved through large increases in salinity, changes in the ionic composition of the water and toxicity of individual ions. Environment Canada has established a freshwater conductivity target of 500 µS/cm (conductivity must not exceed target) as part of its Environmental Performance Water Quality Index (EC, 2011).

Conductivity is often used as baseline for comparison with background measurements. Major changes in this parameter could indicate that a discharge or some other source of pollution has entered the aquatic resource. Conductivity levels measured within the Fish Study Area (16.4-48.0 µS/cm) are considered acceptable for aquatic life.

8.4.2.2.3 Assessment of Fisheries Resources

A summary of key fish habitat characteristics within each linear watercourse surveyed, and the fish species and life stages they support, is presented in Table 8-37. These summary tables have been prepared using data collected during watercourse delineation, detailed habitat surveys, fishing surveys and water quality surveys. Detailed fish habitat measurements are presented in Appendix O. Fish habitat characteristics of waterbodies are provided in Table 8-38. Delineated linear watercourse reaches and waterbodies are presented on Figure 17, (Appendix A), and representative photos are presented in Appendix J.

The subsections following these tables describe fish habitat within each freshwater feature identified in the Fish Study Area and provide an assessment of the baseline habitat quality in relation to fish species and their life stages. The results of fish habitat characterizations and fish surveys have been used to define which water features provide habitat for fish (i.e., "Fisheries Resources"), and which do not. All delineated surface water features within the Fish Study Area (watercourses and waterbodies) are considered fisheries resources.

Table 8-37: Physical Characteristics of Watercourses within the Aquatic Study Area

Watercourse	Reach	Stream Order	Flow Type[1]	Reach Characteristics										Fish Support[6]					
				Channel Width (m)[2]	Wetted Width (m)[2]	Reach Length (m)	Dominant Habitat Type	Other Habitats Present	Slope (%)[3]	Velocity Range (m/s)	Average Depth (m)	Dominant Substrate	Cover (%)[4]	Confirmed Species	Probable Species[5]	Suitable Habitat			
																Spawning	YOY	Juvenile	Adult
1	1[7]	1	P	1.21-3.9	0.86-2.9	277	Flat	-	<1	<0.05	0.83	Muck/Detritus	84	EEL, BBH, SMB	BKF, WHS	BKF, BBH	BKF, BBH	BKF, EEL, BBH	BKF, EEL, BBH
	2	1	P	4.9-6.0	3.9-5.5	97	Riffle	-	2	0.207-0.901	0.18	Boulder and Rubble	20			SMB, WHS	SMB, WHS	SMB, WHS	EEL, SMB, WHS
	3	1	P	20.7	19.0	57	Run	-	1	<0.05	0.60	Muck/Detritus	25			-	-	-	EEL
	4	1	P	10.4-11.8	8.1-10.2	87	Riffle	-	3	<0.05-0.492	0.14	Boulder	35			SMB, WHS	SMB, WHS	SMB, WHS	EEL, SMB, WHS
2	1	1	I	1.4-1.8	0.85-1.4	333	Flat	-	<1	<0.05	0.30	Muck/Detritus	20	BKF, YLP, EEL	-	BKF	BKF, YLP	BKF, YLP, EEL	BKF, YLP, EEL

[1]Perennial (P) – A stream that flows continuously throughout the year, Intermittent (I) – Streams that go dry during protracted rainless periods when percolation depletes all flow, Ephemeral € – A watercourse that flows during snowmelt and rainfall runoff periods only (AT, 2009).
[2]Ranges are provided for reaches measured through multiple transects.
[3]Slopes were estimated based on overall habitat type (DFO, 2012a).
[4]Cover is calculated as a sum of all available cover types present (large woody debris, boulders, undercut banks, deep pools, overhanging vegetation, emergent vegetation, and submergent vegetation).
[5]Probable species presence determined for watercourses based on direct aquatic connectivity with another fisheries resource with confirmed species presence and habitat suitability
[6]Species codes: American eel (EEL), banded killifish (BKF), brown bullhead (BBH), golden shiner (GSH), smallmouth bass (SMB), white sucker (WHS), and yellow perch (YLP).
[7]Transect 4 and 5 within WC1 Reach 1 could not be waded across due to depth and substrate posing safety concern to assessor.

Table 8-38: Physical Characteristics Waterbodies within the Aquatic Study Area

Waterbody ID	Waterbody area (m²)	Waterbody length (m)	Waterbody width (m)	Transect	Depth Range (m)	Dominant Substrate[1]	Vegetation	Cover (%)[2]	Fish Support[3]					
									Confirmed Species[4]	Probable Species	Suitable Habitat			
											Spawning	YOY	Juvenile	Adult
Pond 1	19,287	360	70	1	0.14 – 5.8	Muck/Detritus	*Utricularia* spp. and *Nymphaeaceae* spp.	34	EEL, BKF, BBH, WHS	-	BKF, GSH, BBH	BKF, GSH, BBH	BKF, EEL, GSH, BBH	BKF, EEL, GSH, BBH
				2	0.24 – 0.7	Muck/Detritus	*Utricularia* spp. and *Nymphaeaceae* spp.							
				3	0.71 – 0.73	Muck/Detritus	*Utricularia* spp. and *Nymphaeaceae* spp.							
				4	0.32 – 0.66	Muck/Detritus	*Utricularia* spp. and *Nymphaeaceae* spp.							
				5	0.08 – 2.1	Muck/Detritus	*Utricularia* spp. and *Nymphaeaceae* spp.							
Bagpipe Lake	142,533	420	680	1	0.23 – 1.47	Muck/Detritus	*Utricularia* spp. and *Nymphaeaceae* spp.	82	EEL, BKF, GSH, YLP	-	BKF, YLP, GSH	BKF, YLP, GSH	BKF, YLP, EEL, GSH	BKF, YLP, EEL, GSH
				2	0.22 – 3.6	Muck/Detritus	*Utricularia* spp. and *Nymphaeaceae* spp.							
				3	0.29 – 3.4	Muck/Detritus	*Utricularia* spp. and *Nymphaeaceae* spp.							
				4	0.18 – 5.5	Muck/Detritus	*Utricularia* spp. and *Nymphaeaceae* spp.							
				5	0.23 – 7.6	Muck/Detritus	*Utricularia* spp. and *Nymphaeaceae* spp.							
				6	0.20 – 6.5	Muck/Detritus	*Utricularia* spp. and *Nymphaeaceae* spp.							

[1]Dominant substrate was visually estimated or was estimated by touching bottom with the canoe paddle. .
[2]Cover is calculated as a sum of all available cover types present (large woody debris, boulders, overhanging vegetation, emergent vegetation, and submergent vegetation
[3]Probable species presence determined for watercourses based on direct aquatic connectivity with another fisheries resource with confirmed species presence and habitat suitability
[4]Species codes: American eel (EEL), banded killifish (BKF), brown bullhead (BBH), golden shiner (GSH), smallmouth bass (SMB), white sucker (WHS), and yellow perch (YLP).

8.4.2.2.3.1 *Watercourse 1 and Pond 1*

WC1 (Big North Brook) is a first order stream originates within a provincially mapped swamp outside of the Fish Study Area (Figure 17, Appendix A) Within the Fish Study Area, WC1 flows through Pond 1 before re-channelizing for 240 m prior to exiting the eastern side of the Fish Study Area where it eventually drains into Little Mushamush Lake (Figure 17, Appendix A).

Reach 1 is a slightly to moderately entrenched 277 m flat with a gradient of around 1%. Channel and wetted width ranged between 0.86-2.9 m and 1.21-3.9 m, with an average depth of 83 cm. Large woody debris, large woody debris and undercut banks provide high coverage throughout the watercourse for fish. Muck/detritus was the only substrate observed within WC1. Depth and substrate within this reach prevented complete transects from being done due to safety concerns for the assessor. The mucky substrate and slow-moving water observed throughout this reach provides suitable habitat for all life stages of banded killifish and brown bullhead.

Two out of the four reaches were characterized as riffle habitat (Reach 2 and 4). Reach 2 begins downstream of Pond 1 and is dominated by boulder and rubble with a channel and wetted width of 4.9-6.0 m and 3.9-5.5 m, respectively, and had an average depth of 18 cm. Reach 4 was wider and had a channel and wetted width of 10.4-11.8 m and 8.1-10.2 m, respectively. The dominant substrate within this reach was boulders with an average depth of 14 cm. These slightly entrenched reaches had a low to moderate cover provided mainly by large woody debris, unembedded boulder, submergent and emergent vegetation. Within these reaches, suitable habitat is found for all stages of life for smallmouth bass, white sucker and adult American eel, all of which prefer fast-moving water over boulder to rubble substrates.

Reach 3 is a 57 m long run dominated by muck and detritus. This reach was the widest recorded reach with a channel width of 20.7 m and a wetted width of 19.0 m. Heavy downed trees within the watercourse have jammed the water creating the wide and deep reach. Average depth within the reach is 60 cm, and velocity was never recorded above 0.05 m/s. Light coverage was observed in the reach, in the form of large woody debris, unembedded boulders, deep pools, emergent and submergent vegetation. Little suitable habitat is found within this reach. Boulder substrate, moderate velocity water and light coverage only provide suitable habitat for adult American eel who seek cover under boulders during the day.

Pond 1 is characterized as highly vegetated. Bladderwort was documented along all transects assessed, and attached floating vegetation was observed in 18 of the 21 measurements (86%). Moderate cover was observed throughout the entire pond. The average depth in Pond 1 was 1.17 m, with a maximum depth observed at 2.1 m. Suitable habitat within Pond 1 is abundant to most species known within the Fish Study Area, except smallmouth bass and white sucker that prefer fast moving waters or clear lakes.

8.4.2.2.3.2 *Watercourse 2*

WC2 (Little North Brook) is an intermittent slightly entrenched, first order inlet to Bagpipe Lake. During the detailed habitat assessment, the watercourse was delineated into one homogenous fish habitat reach.

Reach 1 is a 333 m slightly entrenched channel comprising of only flat habitat. Substrate within this reach is dominated by muck and detritus. Large woody debris, undercut banks, and overhanging vegetation provide little cover throughout the watercourse (20%). Wetted and channel width ranged between 0.85-1.4 and 1.4-1.8 m, respectively, with an average depth of 30 cm. The first 30 m that runs parallel with the access road, was dry at the time of assessment, the watercourse then transitions into a flat for 20 m. Eventually the watercourse has no defined channel for approximately 140 m, before re-channelizing for 25 m. The last 60 m before WC2 connects into Bagpipe Lake has a defined channel and remains as a flat habitat. Direct connectivity to Bagpipe Lake was observed with no barriers preventing fish access throughout this reach. Low water velocities and muck/detritus substrate within the watercourse provides suitable habitat for all stages of life for banded killifish, yellow perch and both freshwater life stages of American eel (juvenile and adult).

8.4.2.2.3.3 *Bagpipe Lake*

Bagpipe lake is approximately 420 m wide and 680 m long, with a rough area of 142,000 m^2. Substrates are dominated by organic muck and detritus, while the shoreline is slightly rockier (boulder, rubble, cobble, gravel, and sand composition).

The average depth recorded within the lake was 2.36 m, with a maximum depth observed at 8.60 m along the western side of the lake. Submerged bladderwort was observed throughout most of the lake, while attached floating vegetation (lily pads) and emergent vegetation was observed but less abundant. Moderate cover was observed throughout the lake (34%), primarily in the form of submergent vegetation and unembedded boulders. The extensive cover provided by submergent vegetation and attached floating vegetation, along with the muck/detritus substrate provide suitable habitat for all freshwater life stages for American eel, banded killifish, golden shiner and yellow perch.

8.4.2.3 *Priority Fish*

One priority fish species, American eel (COSEWIC Threatened), was captured during fish surveys within the Fish Study Area. The preferred habitat for American eel is outlined below:

<u>American Eel</u>

American eel are found in the Atlantic Ocean from Iceland to the Caribbean Sea. They spawn in the Sargasso Sea, situated on the west side of the Atlantic Ocean, south of Nova Scotia (COSEWIC, 2012). American eel can be found in all waters that are connected to the Atlantic Ocean, including both lotic and lentic environments (DFO, 2016). American eel are frequently found in watercourses that offer structural complexity and shade in the form of coarse woody debris, rocks, in-stream vegetation for daytime cover, and an available food source of forage fish, invertebrates, molluscs and vegetation.

Migrating elvers are bottom dwellers and spend most of their time burrowed or hidden, including directly into soft bottom sediments (Tomie, 2011). In freshwater, yellow eel continue their migration upstream into rivers, streams, and muddy or silt bottomed lakes (Scott and Crossman, 1998). Like elvers, yellow eel are primarily nocturnal, spending most of the day under cover or buried in soft substrates. These soft substrates are particularly important for overwintering, where the eel hibernate by burying themselves into the bottoms

of lakes and rivers (Smith and Saunders, 1995; Scott and Scott, 1998). Trautman (1981) also reported that eel partially or completely bury themselves in mud, sand, and gravel during the day, emerging at dusk to begin feeding.

American eel has been assessed as threatened by COSEWIC (2012) and are ranked as S3N by the ACCDC (S3N). American eel are not currently protected under SARA or NSESA. Twenty-two American eels were captured or observed in every aquatic habitat within the Fish Study Area during the 2022 field program (WC1, WC2, Pond 1 and Bagpipe Lake). The slow-moving waters and the muck/detritus or boulder substrates found within all watercourses throughout the Fish Study Area provide suitable habitat for all freshwater life stages of American eel (juvenile and adult). Habitat provisions within the Fish Study Area for American eel are limited to juvenile and adult life stages, as American eel spawn at sea (COSEWIC, 2012).

8.5 Socioeconomic Conditions

Refer to the following subsections for baseline details related to the local economy, land use and value, transportation, recreation and tourism, and cultural and heritage resources.

8.5.1 Economy

The Project Area is located in Walden, Lunenburg County, Nova Scotia. According to the 2021 National Census, the population of Lunenburg County was 48,599, which was approximately 5% of the population of Nova Scotia. From 2016 to 2021, the population within Lunenburg County increased by 3.1%, from 47,126 to 48,599. Table 8-39 below presents population and demographics statistics for Lunenburg County (Statistics Canada, 2021)

Table 8-39. Population and Demographics for Lunenburg County (Statistics Canada, 2021)

Information	Lunenburg County	Nova Scotia
Population in 2021	48,599	969,383
Population in 2016	47,126	923,598
2011-2016 Population Change (%)	3.1%	5.0
Total private dwellings (2021)	27,092	476,007
Population density per square km (2021)	16.7	18.4
Land area (square km) (2021)	2,906.47	52,824.71

Today, the economy of Lunenburg County is driven by health care and social assistance (14%), followed by manufacturing (12.2%), and construction (8.9%). Table 8-40 outlines the percentages of industries which make up the labour force of Lunenburg County, based on the Statistics Canada Census Profile of Lunenburg County in the 2021 Census.

Table 8-40: Labour Force by Industry, Lunenburg County (Statistics Canada, 2021)

Industry	Total	Percentage
Industry - NAICS2017 - not applicable	405	1.8
Agriculture; forestry; fishing and hunting	1,145	5.2
Mining; quarrying; and oil and gas extraction	70	0.3
Utilities	90	0.4
Construction	1,975	8.9
Manufacturing	2,705	12.2
Wholesale trade	430	1.9
Retail trade	2,885	13
Transportation and warehousing	690	3.1
Information and cultural industries	310	1.4
Finance and insurance	415	1.9
Real estate and rental and leasing	270	1.2
Professional; scientific and technical services	1,190	5.4
Management of companies and enterprises	10	0.04
Administrative and support; waste management and remediation services	1,120	5
Educational services	1,395	6.3
Health care and social assistance	3,285	14
Arts; entertainment and recreation	560	2.5
Accommodation and food services	1,125	5.1
Other services (except public administration)	1,150	5.2
Public administration	1,125	5.1
Total	**22,230**	**100.0**

According to the Statistics Canada 2021 Census, the labour force in Lunenburg County has a greater percentage of men (52.8%) than women (47.2%). The participation rate in the county's labour force is 53.7%, compared to a provincial average of 59.5%. Lunenburg County's unemployment rate is 10.9%, compared to 12.7 % in the province of Nova Scotia.

Resource industries within 1 km of the Project Area only includes the existing quarry.

Economic activity within 5 km of the Project Area is made up of a number of small businesses including a bed and breakfast ~1.86 km southwest (Backwoods Hideaway), a Soap Business ~1.89 km north (Soap by Natures Art), a sustainable forest management organization with outdoor recreation ~2.7 km southeast (T-Ernst Forestry Products), a children's camp ~3.5 km southwest (Lutheran Camp Mushamush), a small food business ~ 3.4 km southwest (Ma Bell's Country Condiments), a construction support service business ~ 3.6km south (Lawrence Veinotte Enterprises), an air conditioning repair service ~3.6 km south (South Shore Reefer Services), a web design business (Techspertise Inc.), a lumber store ~3.6 km south (Bruhm Maurice Ltd – Sawmill), a church ~3.7km south (New Cornwall Baptist Church), a gift shop ~3.8

km southwest (Van Fancy Oars & Paddles), an outdoor products and service company ~4 km south (Nature's Point of View), a massage therapy clinic ~4 km southwest (Free Flow Massage & Pain Relief), a computer store ~4.2 km southwest (K D Micro Computers) and an upholstery business ~4.3 km northwest (Dis-N-Dat Upholstery & Canvas).

T-Ernst Forestry Products located ~2.7 km southeast of the Study Area is a sustainable forest management organization coupled with outdoor recreation, which includes a 23 km region of trails for hiking, walking and cross-country skiing (Lunenburg Region, 2023).

Community services within 5 km of the Project Area include the Cornwall Fire Hall ~3.4 km to the southwest and the Walden Fire Hall ~5km to the northwest.

Additional businesses/facilities further from the Study Area include:

- Lunenburg County Winery ~ 7.4 km northwest;
- E.I.E.I.O farm and greenhouse ~ 10 km southeast;
- DeLong Farms, Christmas tree farm ~15 km west;
- Little Tree Farm ~12 km southwest;
- Kevin's U-Cut ~9.5 km southwest;
- JK Christmas Trees ~12.2 km southwest;
- Crossroad Farm ~5.2 km southwest;
- Upper Cornwall Community Hall ~5 km southwest;
- Abby's Retreat ~5.2 km south;
- Parkdale-Maplewood Community Museum;
- Close Maplewood Maple Syrup & Christmas Tree Farm; and
- Various other vacation rental properties and small businesses.

The closest community to the Project is Middle New Cornwall, located approximately 3.5 km south of the Project (Figure 1; Appendix A). There is no census data to confirm the population.

The schools in closest proximity to the Study Area include West Northfield Elementary School ~11 km southwest in West Northfield, the South Shore Waldorf School ~12 km southeast in Blockhouse, Bayview Community School ~13.6 km southeast in Mahone Bay, South Shore Alternate School ~14 km southeast in Mahone Bay, Centre Scolaire da la Rive Sud ~15 km southeast in Cookville, Forest Heights Community School ~15.8 km northeast in Chester Basin, and New Germany Elementary School and New Germany Rural High School, which are both located ~16.5 km west of the Study Area in New Germany.

Quarrying in Nova Scotia is important for the province's economy and quarries provide required raw materials for the construction of buildings and infrastructure. (Nova Scotia 2021a).

The QEA operations are expected to increase the longevity of current employment associated with the current quarry operations. Additionally, the Project will allow Dexter to continue to utilize a local source of rock materials rather than relying on a source from further afield.

8.5.2 Land Use and Value

The area surrounding the Study Area is largely undeveloped, aside from the existing quarry, and consists of waterbodies, wetlands, forested areas, as well as historically logged areas. The Study Area is situated on Dexter owned land (PIDs 60696549 and 60690302; Figure 2, Appendix A). These PIDs are rural and are not zoned.

The Study Area can be accessed by an existing gravel access road northeast of the Study Area, via Woodstock Road. The nearest permanent residence is Receptor 1 on a privately owned lot located 350 m northwest of the Study Area, on the edge of Bagpipe Lake (Figure 3, Appendix A). A seasonal camp 370 m northeast of the Study Area (and within 800 m of the QEA) also exists.

Based on a review of historic air photos as part of the ARIA (refer to Appendix D for the executive summary of the ARIA), CRM Group identified that around 1965 two properties northeast of the Study Area had been previously clearcut and were then regenerating. The most recent harvesting near the Study Area began in 1985. No known historical quarrying or mining has occurred in the Study Area, with the exception of the existing quarry.

The ARIA study (CRM Group, 2022) lists the following known cemeteries or burial plots:

- A cemetery located on the east side of Woodstock Road, approximately 1.8 kilometers to the north of the Study Area;
- New Cornwall Memorial Gardens, approximately 3.6 km to the south;
- Upper Cornwall Cemetery, approximately 5.3 km to the west;

Potential contamination resulting from past land use is unknown but based on the activities the risk of encountering historical contamination would be considered low.

Other undertakings in the area include the South Canoe Wind Farm, a 34-turbine wind farm located approximately 30 km northeast of the Study Area (South Canoe Wind, 2023).

8.5.3 Recreation and Tourism

Residents of Lunenburg County have access to a wide variety of recreational facilities which include parks, beaches, sports fields, playgrounds, splash pads, and hiking and biking trails (Lunenburg Region, 2023). Since many parts of Lunenburg County are rural, residents may also participate in hunting and driving ATVs. The many lakes in the region are ideal for boating, swimming and fishing.

There are several trail systems within 15 km of the Study Area, including the Mush-a-mush trail (~4 km southwest of the Study Area), the Bay to Bay Trail (~13 km southeast), the Bridgewater Centennial Trail (~15 km south of the Study Area) and the LaHave River Trail (14.5 km southwest of the Study Area). Additionally, there are mapped river routes between Texas Lake and Indian Lake, along the North Branch

of the LaHave River. There are several waterfalls within the 15 km radius as well, including the Indian Falls, Lantz Falls, Wentzells Falls, Keddy Falls, Darrs Falls, Frideaux Falls, Mosher Falls Burned Potato Falls and Myra Falls. The nearest ATV Association of Nova Scotia trial system is 9 km southwest of the Study Area, near Clearland (Shore Riders ATV Club).

Mahone Bay is located ~ 15 km south of the Study Area and contains the Mahone Bay Community Sports Field, Mahone Bay Tennis Club, Mahone Bay Community Centre, and the Mahone Bay Visitors Information Centre. The nearest largescale community recreation facility is the Lunenburg County Lifestyle Centre in Bridgewater.

The nearest park is Church Lake Park, which is located approximately 6 km west of the Study Area. Church Lake Park has a launching area for small recreational fishing boats, canoes and kayaks (Municipality of the District of Lunenburg, 2023). The nearest provincial park is Wentzells Lake Provincial Park located approximately 11.7 km southwest of the Study Area. Also nearby is Cookville Provincial Park located ~12.5 km south of the Study Area and along the LaHave River and LaHave River trail (Nova Scotia Provincial Parks, 2023).

Additional nearby parks include:

- Mushamush Beach Park (~7 km south);
- Sucker Lake Park (~ 8.8 km southwest);
- Pine Grove Outdoor Play Park in Pine Grove (~13.5 km south);
- the Tiny tots Playground in Mahone Bay (~14km southeast); and
- River Ridge Common Park (~15km west).

Other recreational pursuits within ~20 km of the Project which were observed from aerial imagery include the LaHave River Campground (~9.8 km northwest), the Mahone Bay Swimming Pool (~14 km southeast), the Mahone Bay Museum (~14 km southeast), Osprey Ridge Golf Course, (~15km south) and the Chester Grant DNR Shooting Range (~17 km northeast).

The province of Nova Scotia relies on tourism as an important industry. According to a news release from Tourism Nova Scotia, there was a 28% increase in tourism revenues between 2010 and 2016, reaching an estimated $2.61 billion in 2018 (Tourism Nova Scotia, 2019). In 2020 and 2021, tourism revenues reached an estimated $1 billion each year (Tourism Nova Scotia, 2022). Within Lunenburg County and within Nova Scotia as a whole, Lunenburg and Mahone Bay are a large draw to tourists. Other tourist attractions in the region include Blue Rocks, Hirtles Beach, Chester, LaHave and the famous Lighthouse Route road, popular for viewing the coast and its many lighthouses.

Additionally, Lunenburg County is home to many festivals, the famous Bluenose Schooner - one of Nova Scotia's top tourist attractions and the UNESCO World Heritage Site of Old Town Lunenburg, which all draw tourists to the region (Nova Scotia, 2023). In Mahone Bay, located ~14 km southeast of the Study Area you will find many restaurants, shops and businesses as well as the famous Three Churches tourist site.

There are no known ATV or walking trails on the property. No fishing or hunting is known to occur within the Study Area.

8.5.4 Cultural and Heritage Resources

The ARIA was completed by CRM Group for the Project in 2022, which included screening and reconnaissance phases. Appendix D provides the executive summary of the ARIA, the Heritage Research Permit, and the CCTH Heritage Research Permit Report. Please note that the full ARIA report has been excluded from the EARD as requested by NSECC.

8.5.4.1 *Screening*

A historic background study was conducted in April 2022 which included consultation of historic maps and manuscripts and published literature. The Maritime Archaeological Resource Inventory, a provincial database of known archaeological resources, was searched to better understand prior archaeological research and known archaeological resources neighbouring the Study Area. The background research indicated that the Study Area and surrounding landscape were likely used and occupied by the Mi'kmaq from at least the Archaic Period (9,000 BP). Despite there being no registered archaeological sites with Mi'kmaq components within the Study Area, it is believed that may be due to lack of research in the area and does not necessarily reflect a true absence of archaeological sites.

Staff at the Archaeology Research Division of Kwilmu'kw Maw-klusuaqn (KMKNO-ARD) were contacted to inquire whether their records contained any information regarding past or traditional land use in or near the Study Area. The traditional use information is confidential, but was considered in background research, assessment and field methodology done by CRM Group.

8.5.4.2 *Reconnaissance*

An archaeological field reconnaissance was conducted on May 20, 2022, within the Study Area. The assessment was directed by CRM Group Archaeologist Logan Robertson, with the assistance of CRM Group Partner and Archaeologist Kyle Cigolotti.

The field reconnaissance portion of the Study Area revealed the Study Area to be predominantly wet, sloping and hummocky terrain. The terrain has been disturbed by development of the existing quarry. The forested area consists of relatively open, immature mixed woods, low vegetation and areas of denser immature softwoods. Topography along the southwestern shoreline of Big North Brook was assessed as a suitable location for temporary encampment and landing. With the exception of the activities associated

with the maintenance of the road leading away from the quarry, no areas of historic interest were identified in the Study Area.

As evidenced by the background study and engagement, the study area and vicinity have likely been utilized and occupied at some point by the Mi'kmaq. Therefore, as part of the archaeological potential model, portions of the study area are ascribed elevated potential for encountering Mi'kmaw archaeological resources. Given the location of the Study Area, along a minor watercourse (Big North Brook [WC1]), and the modeled results of the ARIA, the terrain within 50 meters of the bank of the brook has been ascribed high archaeological potential. The land between 50 to 80 meters from the shore of Big North Brook has been ascribed moderate archaeological potential. The remainder of the Study Area has been ascribed low archaeological potential.

The AIRA was provided to and approved by Nova Scotia Communities, Culture and Heritage (NSCCH), as documented in Appendix D.

8.5.5 Human Health

Potential impacts to human health from quarry expansion include effects to noise, air quality and accidents or malfunctions.

Access to site is gated to restrict public access to the site. Signage is posted at the quarry entrance and includes the civic address, quarry approval number, and emergency contact numbers. Additional signage is posted around the quarry highwall advising of the rock face, and berms/boulders have been constructed surrounding the existing quarry face as a barrier to the highwall.

9 EFFECTS OF THE UNDERTAKING ON THE ENVIRONMENT

The detailed effects assessment involves the following steps:

- Identification of potential Project interactions on selected VEC;
- Identification of potential effects;
- Description of recommended mitigation and monitoring;
- Identification of expected residual effects (post mitigation); and,
- Identification of the significance of residual effects.

Results of the detailed effects assessment process listed above is presented for each identified VEC in the following sections. Refer to Table 9-1 for potential Project interactions with all VECs.

Table 9-1 provides a summary of the potential Project interactions and environmental effects resulting from the Project. The table is divided according to each of the Project phases assessed (construction,

operation and maintenance, decommissioning and reclamation) as well as accidents, malfunctions, and unplanned events.

Table 9-1. Potential Project Interactions with Valued Environmental Components

Group	Values Environmental Components	Site Preparation and Construction	Operations and Maintenance				Decommissioning and Reclamation		Accidents and Malfunctions
		Clearing and Grubbing	Drilling and Blasting	Crushing	Handling and Stockpiling Material	Surface Water Management	Re-Grading of Rock Face	Reclamation and Revegetation	
Atmospheric	Air quality	X	X	X	X		X	X	X
	Noise	X	X	X	X		X	X	X
Geophysical	Geology and Topography	X	X				X		X
	Groundwater	X	X			X		X	X

Group	Values Environmental Components	Site Preparation and Construction	Operations and Maintenance				Decommissioning and Reclamation		Accidents and Malfunctions
		Clearing and Grubbing	Drilling and Blasting	Crushing	Handling and Stockpiling Material	Surface Water Management	Re-Grading of Rock Face	Reclamation and Revegetation	
Terrestrial	Habitat, vascular plants and lichens	X	X	X	X	X		X	X
	Fauna	X	X	X	X	X	X	X	X
	Avifauna	X	X	X		X	X	X	X
Aquatic	Wetlands	X	X			X	X	X	X
	Surface water, fish and fish habitat	X	X			X	X	X	X
Socioeconomic	Economy	X	X	X			X		X

Group	Values Environmental Components	Site Preparation and Construction	Operations and Maintenance				Decommissioning and Reclamation		Accidents and Malfunctions
		Clearing and Grubbing	Drilling and Blasting	Crushing	Handling and Stockpiling Material	Surface Water Management	Re-Grading of Rock Face	Reclamation and Revegetation	
	Land use and value	X	X				X		X
	Recreation and tourism	X	X	X			X		
	Human health		X	X		X	X		X
	Cultural and heritage resources		X						X

9.1 Atmospheric Environment

The following subsections outline the effects of the undertaking on air quality and noise.

9.1.1 Air Quality

Quarry activities are not expected to change from the existing quarry operations. There is a potential interaction with air quality during all Project phases (Table 9-1). Dust and particulate levels (known as Total Particulate Suspended Matter) can be emitted from quarrying activities such as blasting, rock drilling, crushing, stockpiling material, truck travel on unpaved roads. as well as onsite routine operations.

An increase in particulate levels can act as a cause of nuisance to local residents or people in proximity of the quarry. Project activities may result in dust deposition on vegetation within proximity of the Study Area, especially when conditions are dry. Refer to Section 9.3.1 for more details.

For the purposes of this assessment, potential effects to air quality are compared to the Air Quality Regulations, which provides regulations for maximum permissible ground level concentrations of total suspended particulates. As per the *Pit and Quarry Guidelines* (NSEDL, 1999), particulate levels at a receptor will be met by Dexter. Air quality from the QEA is expected to be similar to that already produced at the site, since there is no anticipated change in the operational scope of quarry activities, aside from timeline. Based on evidence from current quarry operations, dust emissions are expected to be localized and short term and are expected to be minimal. Exhaust emissions will occasionally be generated by the operation of vehicles and equipment. Given the scope of the QEA, emissions will be minimal (i.e., restricted to several pieces of heavy equipment, earth movers, trucks etc. as well as operation of portable crushers) and will be localized and similar in type and amount to those produced during existing quarry operations.

Air quality is expected to return to baseline conditions during inactive periods and post-reclamation.

9.1.1.1 *Mitigation*

Industry standards and best practices will be followed during all phases of operations. The following mitigation measures will be included in the design of the Project to minimize effects to air quality:

- During periods of heavy activity and/or dry or windy periods, water spray or an approved dust suppressant may be used to reduce the re-suspension of dust during quarrying activities, or on unpaved roads, where necessary.
    - Water will be sourced from the Project (e.g., retained surface water from the fractured quarry floor) or imported via a water truck.
- A vegetated buffer will be maintained between the quarry and the property boundary (with the exception of the southeastern boundary as previously discussed).

- Appropriate truck loading and hauling procedures will be followed to reduce the generation of dust during trucking activities. Trucks will abide by posted speed limits.
- When not in use, machinery and light vehicles will not be left idling to reduce emissions.
- All vehicles and machinery will be maintained in proper working order to reduce emissions generated from worn parts.
- If dust emissions become an issue at the site, then the issue will be investigated, and additional mitigation strategies will be considered.

9.1.1.2 *Monitoring*

Dust emission and particulate matter will be monitored at a receptor at the request of NSECC and in accordance with IA terms and conditions.

9.1.1.3 *Residual Effects and Significance*

Magnitude
The Project is predicted to have a **low** magnitude of impact as air quality anticipated to remain less than or equal to the maximum permissible ground level concentrations as defined by NSECC within the Air Quality Regulations made under Section 25 and 112 of the *Environment Act* at a receptor.

Likelihood
The probability of impact to air quality is **likely** as activities during all Project phases may generate dust and emissions.

Duration
The duration of the effects on air quality are considered to be **long-term** as they are likely to occur during all Project phases.

Frequency
Potential impacts on air quality will occur at **regular** frequencies during the construction, operations, and decommissioning/reclamation phases of the Project. Impacts are only anticipated during active periods of quarrying.

Significance
The Project is predicted to have a **not significant** effect on air quality (Table 6-4).

9.1.2 Noise

Quarry activities are not expected to change from the existing quarry operations. As outlined in Table 9-1, noise can be generated as a result of multiple quarry activities, such as blasting, the use of heavy equipment, crushing, and hauling of material by truck. Blasting and use of explosives is a primary source of noise and vibration and can act as a nuisance for adjacent residents. Potential impacts to humans associated with noise could include noise-induced hearing loss, noise-induced sleep disturbance, and interference with speech

comprehension (Health Canada, 2017). Changes to ambient noise levels and the presence of periodic vibrations also have the potential to adversely affect fauna and birds by potentially influencing migration and behavioural patterns. Details related to effects of noise on wildlife is provided in Section 9.3.2.

Forested lands separating local residences and the Study Area are expected to aid in muffling noise production. Wind direction will also play a role in dominant sound propagation directions surrounding the Study Area. Physically blocking the line of sight between the noise source and the receiver can result in a 5 dB reduction (California Department of Transportation, 2016) and dense vegetation can reduce noise levels by as much as 10 dB over 200 feet (61 m) (California Department of Transportation 2016). It has been documented that noise from point sources (i.e., construction equipment) traveling through a soft site (e.g., a forest or meadow), are typically reduced by attenuation rates of 7.5 dBA for each doubling of distance (based on 50 feet (15 m)) (California Department of Transportation, 2016). Table 9-2 shows how average noise levels from Project-related equipment/activities is expected to attenuate.

Table 9-2: Sound attenuation from construction through forested habitats (California Department of Transportation, 2016)

Construction Sound Source	Avg dBA at 0 m	15 m	30 m	45 m	60 m	75 m	90 m	105 m	120 m	135 m	150 m	165 m
Rock Blast	112	105	97	90	82	75	67	60	52	45	37	30
Track Hoe	99	91	84	76	69	61	54	46	39	31		
Truck Horn	104	97	89	82	74	67	59	52	44	37	29	
Rock Drill	92	84	77	69	62	54	47	39	32			
Dump Truck	90	83	75	68	60	53	45	38	30			
Rock Drills and Jackhammers	90	82	75	67	60	52	45	37	30			
Diesel Truck	91	83	76	68	61	53	46	38	31			
Pneumatic Chipper	93	86	78	71	63	56	48	41	33			
Hydromulcher	91	83	76	68	61	53	46	38	31			
Grader	87	80	72	65	57	50	42	35				
Dozer	86	79	71	64	56	49	41	34				
Crane	87	79	72	64	57	49	42	34				
Pumps, Generators, Compressors	84	77	69	62	54	47	39	32				
Front-end Loader	84	76	69	61	54	46	39	31				
Pump	81	74	66	59	51	44	36	29				
Auger Drill Rig	85	78	70	63	55	48	40	33				
Flat Bed Truck	84	77	69	62	54	47	39	32				
Backhoe	82	75	67	60	52	45	37	30				

Construction Sound Source	Avg dBA at 0 m	15 m	30 m	45 m	60 m	75 m	90 m	105 m	120 m	135 m	150 m	165 m
Generator	68	61	53	46	38	31	23	16				
Ground Compactor	81	74	66	59	51	44	36	29				
Cat Skidder	81	74	66	59	51	44	36	29				
Roller	77	70	62	55	47	40	32	25				
Welder	73	66	58	51	43	36	28	21				
Pickup Truck	63	56	48	41	33	26	18	11				
Background Sound Level— quiet rural area dBA (average)	45											

Notes: Green cell indicates distance at which sound attenuates to background conditions of a quiet rural area (45 dBA)

Per Table 2-1, the nearest permanent residential receptor to the Project is 380 m northwest of the QEA (Receptor 1), within the 800 m separation distance required within the *Pit and Quarry Guidelines* (NSEDL, 1999). Based on the assessment provided in Table 9-2 and the landcover surrounding the Study Area, Project generated noise is predicted to attenuate to background conditions prior to reaching residential dwellings. Dexter has authorization to conduct blasting at the existing quarry and within the QEA.

Noise and vibration are provincially regulated via the *Occupational Health and Safety Act (*OSHA, 1996) and the *Pit and Quarry Guidelines* (NSEDL, 1999), which protect the health of site workers and the general public (i.e., nearby residential receptors) at the property boundaries of the Project. As per the *Pit and Quarry Guidelines* (NSEDL, 1999), noise levels at the property boundaries of the Project will be met by Dexter. Noise from the proposed expansion of the quarry is expected to be similar to that already produced at the site, since there is no anticipated change in the operational scope of quarry activities, aside from timeline. Blasting is expected to occur infrequently (once per year during years in which the site is active). Occasional night-time operations may be required.

9.1.2.1 *Mitigation*

Industry standards and best practices will be followed during all phases of operations. The following mitigation measures will be included in the design of the Project to minimize the effects of noise:

- Blasting will only be undertaken by qualified blasting professionals.
- Blasting will be monitored and will be planned to occur on days where weather conditions are less likely to cause excessive sound levels;
- Blasting will not occur on Sundays or holidays;
- A vegetated buffer will be maintained between the quarry and the property boundary;

- Attention will be given to traffic patterns around the site to reduce the need for vehicles to back up (i.e., reduce the frequency of backup alarms);
- Regular maintenance of site vehicles will be completed to ensure they are in working order and not a source of excessive noise;
- If noise becomes an issue at the site, then the issue will be investigated, and additional mitigation strategies will be considered.

9.1.2.2 *Monitoring*

Noise monitoring will be conducted at the request of NSECC, in accordance with the terms and conditions of the IA and in line with the Guidelines for Environmental Noise Measurement and Assessment (NSECC 2023). All blasts will be monitored by a qualified blasting professional at the nearest off-site structure.

9.1.2.3 *Residual Effects and Significance*

Magnitude
The Project is predicted to have a **low** magnitude of impact as noise is predicted to remain less than maximum allowable noise limits at a receptor. Dexter has authorization to conduct blasting at the existing quarry and within the QEA.

Likelihood
It is **almost certain** that the Project will generate noise.

Duration
The Project will generate noise for a **long-term** as noise is produced from activities associated with all Project phases. Noise will return to baseline conditions during periods of inactivity.

Frequency
The frequency of noise generated from the Project will be generated at a **regular** frequency.

Significance
The Project is predicted to have a **not significant** effect on noise (Table 6-4) as all regulatory thresholds and requirements will be met during construction, operations, and decommissioning/reclamation. If exceedances are detected, a procedure for mitigating effects will be implemented.

9.2 Geophysical Environment

The following subsections outline the effects of the undertaking on geology and topography and groundwater.

9.2.1 Geology and Topography

Alterations to surficial geology, bedrock geology, and topography will occur during all Project phases (Table 9-1). Quarrying has the potential to have an effect on the following variables:

- Topography: Topography (land elevations) will be altered by quarry development.
- Soil Destabilization: Clearing and disturbance of lands has the potential to cause soil erosion. Refer to Section 9.4.2..
- Rock Mineralization: Upon exposure to oxygen and water, blasted or otherwise disturbed rock has potential to mineralize and leach soluble metals into surface and groundwater systems. The production of ARD is a possibility in areas which comprise rock containing iron-sulphides. As discussed in Section 8.2.1.3.1 the potential for ARD is considered low and ARD testing indicated sulphur concentrations in the sample is below the requirement (0.4 Wt.%) for handling under the Sulphide Bearing Materials Disposal Regulations (Province of Nova Scotia, 2017) and does not have significant acid producing potential.

Potential minor impacts to receiving surface water systems (e.g., watercourses and wetlands) are possible from ground disturbances associated with earthwork related to Project construction, operation, and reclamation. Ground disturbances may cause a temporary increase in sediment loads that can degrade water quality conditions. Effects and associated mitigation measures related to wetlands are assessed in Section 9.4.1, potential effects on surface water, fish and fish habitat and associated mitigation measures are assessed in Section 9.4.2.

Project development will alter site topography as material is extracted. The topography within the Study Area will continue to be altered throughout the life of the Project (40+ years). The Project is located in a rural setting and the Study Area is located approximately 350 m southeast of the Project's nearest permanent residential receptor (Receptor 1). Although visual modelling was not completed, based on a review of local topography and site visits, it is not expected that the Project will be visible from Cornwall Road or other areas of higher elevation. Forested land surrounding the Study Area and Receptor 1 is expected to block sight lines to proposed disturbance areas. Reclamation will be employed to stabilize and revegetate slopes and exposed surfaces.

9.2.1.1 *Mitigation*

The following mitigation measures will be included in the design of the Project to minimize effects to surficial and bedrock geology and topography and resulting potential effects to surface water and wetlands:

- Construction of sediment control measures (e.g., sediment fencing) and erosion control (e.g., mulching/revegetation) will be implemented.
- Topsoil and organic soil material removed during construction will be saved and used during reclamation in order to use the local seed bank.
- Soil material will be replaced during reclamation when weather is optimal (i.e., minimal precipitation).
- Areas of soil that do become compacted may be aerated to aid in reclamation of soil quality.
- Implement progressive reclamation as the quarry expands, where possible, to stabilize and revegetate side slopes and exposed surfaces.
- A Surface Water Management Plan will be developed and will include site specific measures to prevent sedimentation and erosion.

9.2.1.2 *Monitoring*

As part of the IA amendment process, a Surface Water Management Plan and Surface Water Monitoring plan will be developed.

Monitoring for sedimentation and erosion will be implemented using best practices and as described in the existing quarry's IA conditions, and any changes thereto, as well as Section 9.4.1. and Section 9.4.2.

9.2.1.3 *Residual Effects and Significance*

Magnitude
There is no regulatory threshold for impacts to geology. Since disturbance to site geology can impact water quality (i.e., total suspended solids, metals, ARD, and sediments etc.) the magnitude is defined as it is for surface water, a regular exceedance (i.e., >2 per year) of the standard parameters for total suspended solids[3]. These parameters are defined in the *Nova Scotia Watercourse Alteration Standard* (NSECC 2015).

The Project is predicted to have a **low** magnitude of impact as total suspended solids levels are anticipated to remain within acceptable limits with appropriate mitigation measures in place.

Likelihood
It is **almost certain** that the Project will disturb site geology as groundwork is required to support the construction and during operations, blasting of the quarry will occur within the bedrock geology.

[3] The turbidity and total suspended solid levels of runoff from a construction area must not exceed the levels immediately upstream by 25 mg/l unless levels immediately upstream are greater than 250 mg/l, in which case construction area runoff turbidity and total suspended solid levels must not exceed levels immediately upstream by more than 10% (NSECC 2015).

Duration
The time period over which the effects are likely to persist are predicted to be **long-term**, as they will occur for the duration of the Project.

Frequency
Effects to site geology will occur at a **regular** interval during the life of the Project.

Significance
The Project is predicted to have a **not significant** effect on geology (Table 6-4).

9.2.2 Groundwater

Groundwater impacts as a result of quarry development can be variable and depend on conditions such as underlying geological conditions, natural groundwater characteristics and the activities taking place. Project activities that have the potential to interact with groundwater are outlined in Table 9-1. These interactions are based upon a potential change in groundwater quantity and quality from baseline conditions as outlined below.

9.2.2.1 *Quantity*

Groundwater Baseflow (i.e., Recharge and Discharge)
Changes to the natural surface conditions within the Study Area has the potential to alter groundwater flow paths and recharge/discharge functions and rates. This could potentially cause temporary lowering or rising of the water table relative to baseline conditions and changes in groundwater interaction within adjacent water features (e.g., wetlands). Hardened surfaces (i.e., new roads, compacted surfaces) will likely reduce recharge, whereas clearing of vegetation and exposure to fractured bedrock could increase recharge and local groundwater levels. The type and integrity of the underlying bedrock will influence the infiltration rates (and subsequent recharge) that can be expected. Localized groundwater flow paths may be disrupted from surface water management infrastructure (e.g., ditching).

Blasting
Blasting can increase bedrock fracture frequency and change the direction of groundwater interflow, potentially impacting flow to wells or surface water features. Groundwater flow may be irreversibly altered from blasting; however, the effect is expected to be localized to the immediate quarry area and is not anticipated to affect groundwater flow in a regional area related to surrounding receptors. The nearest well identified on the Nova Scotia Well Logs Database is 1.8 km to the south of the Study Area (2.0 km east of the proposed QEA; Figure 3 Appendix A). Per Table 2-1, the nearest permanent residential receptor to the Project is Receptor 1, 350 m northwest of the QEA (Figure 3 Appendix A). McCallum confirmed that Receptor 1 has a drilled well. Dexter has authorization to conduct blasting at the existing quarry and within the QEA.With the exception of Receptor 1, all other permanent residential receptors are beyond the 800 m separation distance for blasting required within the *Pit and Quarry Guidelines* (NSEDL, 1999).

9.2.2.2 *Quality*

There is potential for groundwater quality issues to arise from blasting and rock-water interactions, as described below.

Blasting: Use of ammonium nitrate in the blasting process has the potential to leave residual nitrogen that can leach into groundwater which could potentially make its way to water wells or surface water features.

Rock-Water Interaction: Precipitation or surface water that comes into contact with rock could affect surface water runoff quality or leach into the groundwater. There is low potential for ARD to occur on site based on the local geology (see Section 8.2.1.3.1) and ARD testing indicated sulphur concentrations in the sample is below the requirement (0.4 Wt.%) for handling under the Sulphide Bearing Materials Disposal Regulations (Province of Nova Scotia, 2017) and does not have significant acid producing potential.

Potential impacts on groundwater quality may be associated with contamination from hazardous material spills during all activity phases. It is expected, however, that potential spills will be mitigated during construction.

Effects to groundwater quantity and quality (and surrounding wells) from quarry expansion is unlikely because the quarry floor will be permeable, allowing for infiltration. No additional hard landscaped areas are proposed in the QEA (i.e., impermeable, compacted areas such as paved roads or other constructed infrastructure). It is possible that the infiltration characteristics at the surface will change post reclamation to allow for more groundwater recharge. Future reclamation of the Project will be completed as per a Final Reclamation Plan developed for the site. The Final Reclamation Plan may include removal of some of the surface water drainage features (i.e., ditches), regrading and revegetation of the quarry surface will occur where feasible. Post-reclamation localized groundwater levels may resemble active quarry conditions.

The quarry has been in operation since 2015 with no known impacts to groundwater. As discussed in the WBA (Appendix E), minimal Project-related impacts to the local water balance are predicted.

Site operations and existing aggregate excavation has not encountered the deep bedrock water table as evidenced by the lack of water ponding on the quarry floor, no observed seepage from the quarry highwall, and no upwelling of water through the quarry floor. It is the intention of Dexter to not excavate or blast below the water table in the QEA. In addition, there will be no pumping of groundwater and therefore no dewatering of the associated bedrock aquifer. If future quarry operations are planned to extend below the groundwater table, a hydrological study will be completed, and approval from NSECC obtained prior to excavation below the groundwater table.

9.2.2.3 *Mitigation*

The following mitigation measures will be included in the design of the Project:

- The quarry floor will be sloped and designed (i.e., graded and ditched) within the QEA in order to control runoff.

- The quarry floor will be constructed of blast rock (i.e., permeable) to increase infiltration rates.
- Dexter will monitor neighboring residential receptors during blasting events. Any damage that occurs to these receptors because of blasting will be repaired at the expense of the Proponent.
- Blasting will only be undertaken by qualified blasting professionals.
- Potential effects to groundwater quality as a result of blasting will be mitigated by using an emulsion compound that is insoluble in water. This will prevent contaminants such as Ammonium Nitrate Fuel Oil entering surface water bodies and groundwater during blasting activities.
- There will be no long-term storage of fuel onsite. Fuel will be temporarily stored onsite in a trailer enclosed generator as part of the portable crushing spread when crushing activity occurs.
    - Refueling will be completed by a third party.
    - Refueling will occur in designated areas, >30 m from a watercourse/wetland.
    - The operator will remain with the equipment during refueling.
    - Spill response equipment will be readily available.
- A Contingency Plan will be developed for the Project to outline the prevention and response methods regarding spills and/or substance loss.

9.2.2.4 *Monitoring*

Upon EA Approval, Dexter will develop and implement a groundwater monitoring program in line with NSECC standards and IA Amendment commitments. As part of the groundwater monitoring program, Dexter will drill groundwater wells between the QEA and any nearby receptors. Monitoring will be completed to ensure the Project is not causing adverse effects to groundwater quantity and quality conditions (as a result of dissolved solids and metals or other deleterious substances).

Dexter will follow the *Pit and Quarry Guidelines* and conduct pre-blast surveys for all receptors within 800 m.

Refer to Section 9.4.1.4 for wetland monitoring, as groundwater drawdown may have a drying effect on wetlands adjacent the QEA.

9.2.2.5 *Residual Effects and Significance*

Magnitude
The Project is predicted to have a **low** magnitude of impact on groundwater. No regulatory threshold is available; therefore, the Project team has considered a change in the groundwater quantity such that it has a negative effect on a groundwater receptor such as drinking water wells as the threshold. With the exception of Receptor 1 (Dexter has authorization to conduct blasting at the existing quarry and within the QEA), all other existing permanent residential receptors and mapped wells exist >800 m from the QEA.

Likelihood
The likelihood of an effect to groundwater was deemed as being **possible** as a result of blasting.

Duration
Potential impacts to groundwater are anticipated to be **permanent**. Impacts are likely to occur during operations (40+ years) and post-reclamation groundwater patterns may not return to pre-quarry conditions.

Frequency
Potential impacts to groundwater are predicted to be **continuous**, as they are expected to occur consistently from operations through to reclamation.

Significance
The Project is predicted to have a **not significant** effect on groundwater (Table 6-4).

9.3 Terrestrial Environment

The following subsections outline the effects of the undertaking on habitat, vascular plants, and lichens, fauna, and avifauna.

9.3.1 Habitat, Flora, and Lichens

The proposed Project will result in both indirect and direct impacts to both vascular and non-vascular individuals, lichens, and vegetation community types associated with wetland and upland habitats. These impacts are described in the following subsections. Table 9-1 provides a summary of the potential Project interactions and environmental effects resulting from the Project on habitat, vascular plants, and lichens.

Direct Effects
Direct loss to wetland and upland vegetation, vegetation communities, and habitat are expected to occur primarily during the construction phase of the Project (i.e., clearing and grubbing) in the QEA. This is a localized impact that is anticipated to have a negligible impact to habitat or changes to wildlife movement. The Project is located in a rural area with similar, expansive intact habitat immediately surrounding the Study Area.

It is expected that there will be a total loss of 23.8 ha of habitat, which will be directly impacted by the quarry expansion. Table 9-3 displays the habitat types and areas overlapped by the QEA. These estimations were derived by the same tools used to estimate land types in the Study Area (Section 8.3.1).

Table 9-3. Habitat Types Directly Impacted by the Project.

Habitat Type	Total Area of Habitat Type in QEA (ha)	Approximate Percentage of QEA (%)
Hardwood forests	2.2	9.2
Mixedwood forests	7.1	30
Softwood forests	14.3	60
Urban/Developed	0.2	0.8
Total QEA	**23.8**	**100**
Does not include field delineated wetlands.		

Four habitat types are present within the QEA and include softwood forests (14.3 ha, 60% of the QEA), hardwood forests (2.2 ha, 9.2% of the QEA), mixedwood forests (7.1 ha, 30% of the QEA), and urban/developed areas (0.2 ha, 0.8% of the QEA). The urban/developed area in the QEA is an existing forestry road.

No SAR vascular plant species were identified within the Study Area, however, one SOCI plant species, southern twayblade (n=2), was documented throughout the Study Area via field surveys (Figure 7; Appendix A). All observations of southern twayblade will be avoided by the QEA (i.e., no direct impacts).

One SAR lichen, frosted glass-whiskers, was identified at one location within the Study Area (WL2; Figure 7, Appendix A). A 100 m buffer was implemented, aligning with the *At-Risk Lichen Special Management Practices* and ECCC Management Plan (Environment Canada, 2011). The QEA was modified to avoid the frosted glass-whiskers occurrence and buffer. Impacts to the two SOCI lichen, corrugated shingles lichen and blistered tarpaper lichen, which were identified within the Study Area, are outlined in Table 9-5 and Figure 7, Appendix A.

Table 9-4 Direct Impacts to Priority Lichens and Vascular Plants

Taxa	Common Name	Scientific Name	No. of Observation Locations within the QEA	No. of Individuals (or thalli) Within the Study Area	No. of Individuals Impacted
Vascular plant	Southern twayblade	*Neottia bifolia*	2	2	0
Lichen	Frosted glass-whiskers	*Sclerophora peronella (Atlantic pop.)*	1	5	0

Taxa	Common Name	Scientific Name	No. of Observation Locations within the QEA	No. of Individuals (or thalli) Within the Study Area	No. of Individuals Impacted
Lichen	Blistered tarpaper lichen	*Collema nigrescens*	2	2	1
Lichen	Corrugated shingles lichen	*Fuscopannaria ahlneri*	1	1	1

Although Project activities will cause a direct loss of flora, lichens, and the habitats that support them, the QEA has a small footprint of impact (23.8 ha), relative to the surrounding environment. The site will be restored during the reclamation phase of the Project.

Indirect Effects

Removal of vegetation and habitat loss during the construction phase of the Project can result in indirect effects to vascular plants and lichens through edge effects. The effects include changes in microclimate, increased light availability and changes in vegetation communities. Clearing of habitats could also result in the potential of invasive plant species to establish an area.

Lichens and nonvascular plants are notably sensitive to edge effects and air quality due to being poikilohydric organisms with an inability to regulate and maintain their water content (Nash III 2008). Forested communities adjacent to clearings often have a microclimate which varies from interior forests, which is a result of increased solar radiation, high wind velocity and lower humidity (Rheult et al. 2003). Edge effects can result in the desiccation and death of lichen species and is one of the biggest threats to SAR and SOCI lichens. The extent in which lichens and plants are impacted by edge effects (referred as depth of influence) have been well documented, however, the depth of influence is context-dependent (e.g., dependent on size of the clearings, substrate, type of climate etc.). For simplicity, and consideration that not all lichens, vascular and nonvascular plants respond the same to edge effects, a depth of influence of 100 m was selected for the frosted glass-whiskers, as this is the buffer identified in the At-Risk Lichens SMP (Figure 7; Appendix A). Observed priority lichen and plant species within the depth of influence by edge effects, has potential for adverse effects from the Project.

All observations of southern twayblade are located outside the 100 m depth of influence (Figure 7, Appendix A). The other observation of blistered tarpaper lichen that is not within the QEA, does not fall within the 100 m depth influence from the QEA.

Regarding lichens, one observation of frosted glass-whiskers (*Sclerophora peronella*) is located outside of the QEA and the 100 m depth of influence. The *At-Risk Lichens – Special Management Practices* (NSDNRR 2018) considers frosted glass-whiskers a rare and sensitive lichen and requires a 100 m buffer

with no forest harvesting or road construction to occur within the buffer area. Dexter was able to microsite the QEA to ensure the 100 m buffer stays intact.

As discussed in Section 9.2.2, groundwater drawdown has the potential to alter groundwater flow and direction that could potentially lead to groundwater change within adjacent wetlands, resulting in a drying effect to the wetlands. This change in moisture regime could ultimately affect flora community structure and composition, and in particular, could negatively affect lichen species that require humid conditions wetlands provide. Similarly, should wetlands be affected by altered surface water flows (as discussed in Section 9.4.1.2), it could lead to a plant community shift which could negatively affect flora individuals.

Potential introduction of invasive species could occur surrounding the Study Area. Seeds and roots of invasive plants can be transferred from construction equipment, transportation vehicles, or workers (footwear and clothing) into adjacent habitat during construction and operational activities. Cleared areas surrounding the active quarry site have an increased risk of establishment of invasive and exotic species.

Blasting, crushing, and hauling aggregate may result in deposition of dust on vegetation (including lichens) within close proximity of the Study Area, especially when conditions are dry. Dust on the leaves of flora can block stomata and cellular respiration and reduce the overall efficiency of photosynthesis (Farmer, 1993). Dust can be absorbed through the soil resulting in overall decline in plant health and even lead to necrosis (Hosker & Lindberg, 1982). Dust deposition would largely be associated with activities during the operations phases of the Project. It is expected that the conditions will be similar to the current conditions of the active quarry production.

9.3.1.1 *Mitigation*

The following mitigation measures will be included in the design of the Project to minimize effects to Habitat, Vascular Plants, and Lichens:

- Maintain a 100 m buffer between the frosted glass-whiskers and the QEA;
- Maintain surface water flow via cross drainage culverts on access roads;
- Grubbings and topsoil will be salvaged and stored for use in site restoration;
- Monitor wetlands as directed in regulatory approvals;
- Develop and implement erosion and sediment control plan;
- Regularly inspect and repair erosion and sediment control devices;
- Avoid travel across erosion prone areas;
- Manage vegetation by cutting rather than the use of herbicides;
- Dust suppressants (e.g., water trucks) will be used, as required, to control dust;

- Equipment will be stocked with spill kits and site personnel will be instructed on their use;
- Employ measures to reduce the spread of invasive species (such as cleaning and inspecting vehicles);
- Implement reclamation program to re-establish native vegetation communities; and,
- A Contingency Plan will be developed and will include site-specific measures related to sedimentation and erosion control, dust management, and spill response.

9.3.1.2 *Monitoring*

No specific monitoring is proposed for this VEC, although monitoring for wetlands will ensure that plant communities are not affected by indirect impacts.

No monitoring is proposed for the observation of frosted glass-whiskers as the 100 m buffer will be maintained and/or the Quarry Expansion Area will not encroach on the location of the host wetland.

9.3.1.3 *Residual Effects and Significance*

Magnitude
The Project is predicted to have a **low** magnitude of impact on habitat, flora, and lichens. No regulatory threshold is available; therefore, the Project team has considered an effect that is likely to cause a permanent, unmitigated, alteration to habitat that supports flora/lichen as the threshold, where similar habitat is not currently available at the local/regional level as the threshold.

Likelihood
It is **almost certain** that the Project will impact habitat, flora, and lichens as clearing and grubbing associated with the construction phase of the Project will directly impact this VEC.

Duration
The time over which the effects are likely to persist are predicted to be **long-term**, over the progressive construction phases of the Project.

Frequency
Direct effects to habitat, flora, and lichens will occur **once** during the construction phase of the Project. Indirect effects have the potential to occur **sporadically** during the life of the Project.

Significance
The Project is predicted to have a **not significant** effect on habitat, flora, and lichen (Table 6-4).

9.3.2 Fauna

Quarry activities have the potential to have an affect on the fauna from mortality, sensory disturbance, and the loss or alteration of habitat and habitat fragmentation. These effects may occur during all Project phases (Table 9-1).

Direct Mortality

Direct mortality of fauna species could result from Project activities, particularly from wildlife vehicle collisions. The Project phase with the highest levels of truck traffic, and therefore the highest risk of wildlife vehicle collisions, is operations, however, the transportation route is not included within this effects assessment. There is no proposed increase in expected truck traffic as a result of quarry expansion, therefore, wildlife vehicle collisions are unlikely to increase. During construction and decommissioning/reclamation, trucks and other equipment will be accessing and working at the site but at a much lower frequency, lessening the potential interaction with wildlife.

According to Fahrig and Rytwinski (2009), road construction can have greater impacts on amphibians and reptiles, and large mammals, compared with small mammals and birds. Road infrastructure and traffic have a negative impact on those species that are attracted to roads but lack the speed or reaction time to avoid traffic (e.g., turtles attracted to gravel roadsides for nesting). Ruts, caused by equipment and vehicles, may fill with water in the spring and attract breeding amphibians. Since these ruts would likely dry up in the summer, this presents a potential risk to species that hatch. Small mammals and birds are generally able to avoid collisions with vehicles. Amphibians can benefit from culvert installation where wetlands and watercourses intersect roads, as an alternative to crossing the roads, because this group can experience high mortality (Bouchard et al. 2009).

The risk of collisions with wildlife will vary depending on the season and the species. For instance, during winters with deep snow conditions, white-tailed deer are more likely to use roads and trails, putting them at an elevated risk of collisions. Turtles are drawn to the roadside to nest in the gravelly shoulders in June. During spring and summer, porcupine and skunk forage on roadside vegetation at dawn and dusk, increasing the risk of collisions with those species. As such, the risk of wildlife collisions is present at any time of year.

Additionally, accidents such as fuel spills have the potential to cause indirect mortality to fauna due to exposure of contaminants.

Direct mortality to fauna from Project activities is possible but unlikely to occur and only infrequently if at all. The potential for direct mortality will only occur during active work and there is no risk during inactive periods of the quarry or post-reclamation.

Sensory Disturbance

Sensory disturbance to fauna is expected to occur throughout all Project phases and would result from activities such as rock blasting, clearing and grubbing, and the sorting and crushing of aggregate. This will likely result in the localized wildlife avoidance of the Study Area. Some species may tend to avoid the area,

while others may be attracted to the increased activity, including opportunistic species such as eastern coyote, northern racoon, striped skunk or American black bear.

Noise is the type of sensory disturbance that is most likely to affect fauna within the Study Area. Although the auditory capabilities of fauna species vary (Shannon et al., 2016) and fauna behavior in response to noise is largely related to perceived threats, not noise intensity (Bowles, 1995), changes to ambient noise levels and the presence of periodic vibrations from blasting have the potential to adversely affect fauna. Noise can affect behavioral patterns (Patthey et al., 2008), stress fauna (Knight and Swaddle, 2011), cause avoidance behavior (Ware et al., 2015), and reduce the ability for communication and hunting success (Barber et al., 2009). Combined, these effects can negatively impact the overall population health of a particular species (Ware et al., 2015).

Drolet et al. (2016) report no changes to density of white-tailed deer when a simulated drilling noise was played at 55 to 65 dBA. A literature review conducted by Shannon et al. (2016) found that an increase in stress and decrease in reproductive success in terrestrial mammals has the potential to occur at noise levels ranging from 52 to 68 dBA.

Blasting and heavy equipment use during all phases of the Project will generate noise. According to Suter (2002); bulldozers, graders, and excavators generate noise of the following ranges 91-107 dBA, 88-91 dBA, and 70-108 dBA, respectively. Blasting is expected to exceed these ranges. The levels of noise will exceed the levels cited by Drolet et al. (2016) and Shannon et al. (2016) for indirect impacts to wildlife. As indicated in Table 9-2, sound attenuation for all construction related equipment is expected to be at conditions representative of a quiet rural area (45 dBA) at 135 m from the source of the sound meeting the levels cited by Drolet et al. (2016) and Shannon et al. (2016) much closer to the source.

Light is another source of sensory disturbance that can impact fauna by potentially causing disorientation or by causing attraction or avoidance behaviour (Longcore and Rich, 2004). In turn, these behavioral changes can affect the success of foraging, reproduction, and communication of wildlife (Longcore and Rich, 2004) and can disrupt habitat connectivity (Bliss-Ketchum et al., 2016).

Sensory disturbance to avifauna is expected to occur throughout all Project phases and would result from activities such as site preparation, clearing, grubbing, removal of overburden, construction of storage areas, rock blasting, transfer and the sorting and crushing of aggregate. During reclamation, sensory disturbance may come from re-grading of the rock face. Overall, Project activities will likely cause a change in usage of the QEA by fauna, with some species tending to avoid the area, while others may be attracted to the increased activity. This disturbance is temporary and will return to baseline during periods of inactivity, and not persist beyond project completion. The activities likely to create the greatest sensory disturbance (drilling/blasting, crushing, and hauling/transportation) will only occur while the quarry is active. The primary noise disturbance will be during periods of drilling and blasting. Frequency of blasts to be approximately once per year during years in which the quarry is active.

It is not anticipated that the impacts from sensory disturbance will increase from the current conditions of the operating quarry.

Habitat Alteration

The Project will result in direct and indirect impacts to habitat used by terrestrial fauna within the QEA. Vegetation clearing of the proposed QEA footprint will account for the loss of 23.8 ha of habitat. Most effects to fauna are expected during the construction and operations phase. During construction, clearing and grubbing will alter habitat. During operations, which will occur gradually as quarry progresses, blasting and stockpiling of materials will also alter habitat. Habitat alteration will increase progressively over the QEA, as the quarry expands. Quarry activities also have the potential to decrease the habitat quality for fauna in the Study Area.

Habitat alteration will impact different species in different ways. Some species will find new opportunities in fragmented habitats (e.g., foraging), while others are likely to avoid areas with new construction in favor of undisturbed habitats. Mainland moose, for example, are particularly sensitive to habitat fragmentation, which constrains their habitat use, increases pressures from predators and human interaction (Snaith et al., 2002). The Study Area is on the edge of mainland moose core habitat; however no moose or sign of moose were observed during any field surveys within or in the vicinity of the Study Area. Suitable habitat for mainland moose was observed through the QEA include regenerative and mature forest stands. Some of this habitat will be lost during the construction phase of the Project. However, during reclamation forested habitat will regenerate, eventually creating suitable habitat for foraging for mainland moose.

Wetlands that are located within the Study Area and are proposed for alteration offer suitable habitat to common amphibian species (e.g., green frog). Eastern painted turtles were observed in bagpipe lake and in the watercourse adjacent to the northern portion of the Study Area. Suitable habitat for priority herpetofauna was only observed in the northern section of the Study Area and in the bagpipe lake, no suitable habitat was observed in the QEA. All suitable habitat observed in the Study Area will be avoided from direct impacts from the QEA.

Linear features such as roads, trails and transmission corridors have the potential to influence wildlife movement patterns. They create a barrier to movement for certain species, may act as a conduit to movement for other species and the types of human activity can influence wildlife movement. Bears are tolerant of some human activity but will avoid features when human frequency is high (Jalkotzky et al. 1997).

Studies completed by Buckmaster et al. (1999) indicate that wildlife populations may be expected to disperse from the area during periods of construction. Based upon the vegetation characteristics in adjacent areas, and the conclusions of Buckmaster et al. (1999), it is expected that displacement of wildlife will be temporary.

Overall effects to fauna habitat as a result of the Project are limited due to the relatively small geographic extent of alteration (23.8 ha) when compared to the vast expanse of available habitat in the vicinity. The habitat present in the QEA footprint is common to the regional area and alternate habitat for wildlife exists on adjacent undeveloped lands, therefore, changes in abundance and distribution could be expected, but overall fauna population changes are not expected as a result of the Project.

Decommissioning and reclamation of the quarry will result in a positive effect on the Project, involving the reclamation of land and re-establishment of vegetation across disturbed portions of the Study Area. Reclamation will aim to restore the site as best as possible to baseline conditions.

9.3.2.1 *Mitigation*

The following mitigation measures will be included in the design of the Project to minimize effects to Fauna:

- Wildlife awareness training will be provided to site personnel;
- Quarry staff will be made aware of wildlife potential in the QEA and on roads especially for Project traffic/transportation. Specifically, signage will be posted to indicate turtle presence where previously identified and at any future observation locations.
- Turtle exclusion fencing was erected in summer 2022 following turtle observations between WL1 and stockpiles. Fencing or other appropriate barriers and will be maintained on-site during nesting season (April to late-July) and kept in effective working condition. During the nesting season quarry personnel will conduct a visual inspection of stockpiles before handling to ensure no nests are present;
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- Follow Pit and Quarry Guidelines (NSEDL, 1999) to reduce impact of noise and vibration on wildlife;
- Grubbings and topsoil will be salvaged and stored for use in site restoration;
- Implement erosion and sediment control plan;
- Regularly inspect and repair erosion and sediment control devices;
- Dust suppressants (e.g., water trucks) will be used when normal precipitation levels are not effective in controlling dust, as needed;
- Equipment will be stocked with spill kits and site personnel will be instructed on their use;
- Implement reclamation program to re-establish habitat to support fauna;
- Waste management to reduce attractants to opportunistic wildlife species (e.g., American black bear);
- Blasting will be completed by a qualified blasting professional and is anticipated to occur approximately once per year;

- Blasting will be monitored and will be planned to occur on days and where weather conditions are less likely to cause excessive sound levels;
- The quarry will typically operate during daylight hours to prevent nighttime disturbance. If nighttime activities are required, temporary, downward directional lighting will be used;
- Conduct regular road maintenance in the form of grading to prevent water pooling and to minimize deep ruts to prevent amphibians from laying eggs in pools;
- Vegetation management will be conducted by cutting (i.e., no use of herbicides); and,
- A Wildlife Management Plan will be developed with methods by which the Project can take place while minimizing interactions with wildlife.

9.3.2.2 *Monitoring*

No dedicated monitoring is proposed for this VEC. During the nesting season quarry personnel will conduct a visual inspection of stockpiles before handling to ensure no nests are present.

9.3.2.3 *Residual Effect and Significance*

Magnitude

The Project is predicted to have a **low** magnitude of impact on fauna. No regulatory threshold is available; therefore, the Project team has considered an effect that is likely to cause a permanent, unmitigated, alteration to habitat that supports fauna as the threshold.

Likelihood

It is **almost certain** that the Project will impact fauna as clearing and grubbing associated with the construction phase of the Project will directly impact habitat and activities associated with all Project phases will generate noise that may adversely affect fauna. The likelihood for the Project to cause direct mortality to fauna is less likely but still possible. The quarry will only be operational sporadically when Dexter is awarded projects in the area or there is demand for aggregate material.

Duration

The time over which the effects are likely to persist are predicted to be **long-term**, as they there is potential for interaction during all Project phases.

Frequency

Potential effects to fauna will occur at varying frequencies. For example, loss of habitat will occur once construction phase of the Project, sensory disturbance will occur regularly during all Project phases. During inactive periods of the quarry, sensory disturbance is returned to baseline conditions as it will be post-reclamation.

Overall, effects to fauna are anticipated to occur at **regular** intervals during the Project.

Significance

The Project is predicted to not have a significant effect on fauna (Table 6-4). It is anticipated that the effects from the QEA will not increase from the current quarry operations.

9.3.3 Avifauna

Quarry activities has the potential to have an affect on birds from direct mortality, sensory disturbance, and the loss or alteration of habitat. These effects have the potential to occur during all Project phases (Table 9-1).

Direct Mortality

Direct mortality of birds is possible at the proposed Walden Quarry Expansion as a result of quarrying activities. There is the potential for direct mortality, including direct mortality of eggs/unfledged nestlings, during site preparation when clearing and grubbing vegetation and when removing overburden. Rock blasting and material hauling are two activities where birds could be struck or accidentally killed. Direct and indirect mortality could result from short and long-term exposure to varying levels of contaminants or spills from incidents and accidents.

Direct mortality to birds from Project activities is possible but unlikely to occur and infrequently if it does. The potential for direct mortality will only occur during active work and there is no risk during inactive periods (January to March) of operations or post-reclamation. Dexter will not conduct clearing activities during the breeding bird window (April 15 to August 30).

Sensory Disturbance

Sensory disturbance refers to the changes in ambient noise levels and the periodic vibrations caused by quarry activities. Sensory disturbance has the potential to impact avifauna, either negatively through disruption to migration and behavioral patterns or positively by attracting some species with the increased activity levels. Noise and vibrations are provincially regulated under the *Workplace Health and Safety Regulations, Guidelines for Environmental Noise Measurements and Assessment* (NSDEL, 2005), and the *Pit and Quarry Guidelines* (NSEDL, 1999) to protect the health and safety of site workers and the general public, which will help mitigate any negative impacts to bird species. Noise levels will be monitored in accordance with NSECC IA Conditions.

Noise has the potential to impact birds in a number of ways. Birds can exhibit greater susceptibility to noise impacts as many species rely on vocal communication (Bickley and Patricelli 2010). Birds have the potential to show changes in song characteristics, reproduction, abundance, stress levels, and species richness at noise levels over 45 dBA (Shannon et al., 2016). Studies have shown that biological responses commenced at 40-45 dBA, with a decline in species diversity (i.e., avoidance by sensitive species) and reproductive success at 43-58 dBA. Changes in song frequency and length were observed at 45 dBA. Francis et al. (2009) notes noise pollution can lead to changes in avian communities and altered species interactions.

Impacts can also differ between acute and chronic noise sources. Chronic exposure may degrade auditory cues, feedback, and vocal development over time; which is important for predator/prey detection, communication, and orientation (Shannon et al, 2016; Bickley and Patricelli, 2010; Marler et al, 1973). A direct physiological impact causing a temporary decrease in auditory sensitivity can occur at acute noise levels above 93 dBA, while permanent damage to avian auditory systems is not recorded until 125-140 dBA (Bickley and Patricelli, 2010).

Some bird species may not be impacted by sensory disturbances. A study of the impact of logging truck traffic on birds reports no observed effects on nesting at noise levels of 53 dBA (Grubb et al., 1998). It was also found that noise tolerant species had increased nest success through decreasing nest predation (Francis et al., 2009).

Sensory disturbance to avifauna is expected to occur throughout all Project phases and would result from activities such as site preparation, clearing, grubbing, removal of overburden, construction of storage areas, rock blasting, transfer and the sorting and crushing of aggregate. During reclamation, sensory disturbance may come from re-grading of the rock face. Overall, Project activities will likely cause a change in usage of the QEA by birds, with some species tending to avoid the area, while others may be attracted to the increased activity. This disturbance is temporary and will not persist beyond project completion. The activities likely to create the greatest sensory disturbance (drilling/blasting, crushing, and hauling/transportation) will only occur temporarily when Dexter has work in the area, and would occur for several weeks within the seasonal construction window. While the quarry is active, the primary noise disturbance will be during periods of drilling and blasting. Frequency of blasts to be approximately once per year during years in which the quarry is active.

Light is a source of sensory disturbance that can impact birds by potentially causing disorientation, avoidance, or attraction (Longcore and Rich, 2004). In turn, these behavioral changes can affect the success of foraging, reproduction, and communication of wildlife (Longcore and Rich, 2004) and can disrupt habitat connectivity (Bliss-Ketchum et al., 2016). The proposed quarry area does not comprise any permanent quarry lighting. Temporary lighting associated with a portable scalehouse may remain on during the night for safety purposes. The scalehouse is portable and will only be on site at times when quarrying is active. In the unlikely event that nighttime work is required, temporary, downward directional lighting will be used. Therefore, no effects to avifauna are expected related to light pollution.

It is not anticipated that the impacts from sensory disturbance will increase from the current conditions of the operating quarry.

Habitat Alteration

The Project will cause direct impacts to bird habitat within the QEA including both upland forested habitat and wetlands. Habitat will be eliminated progressively over the quarry expansion. During site preparation, clearing and grubbing will remove vegetation, reducing the quantity and quality of avifauna habitat that currently exists in and around the QEA and potentially cause nest abandonment and/or the disturbance to nest contents. The habitat altered will include upland forested habitat and wetlands. Overall effects to

avifauna habitat as a result of the Project is limited due to the relatively small geographic extent of alteration (~23.8 ha), when compared to the vast expanse of available habitat in the vicinity.

Additional edge habitat will be created as a result of Project activities, which is favorable to some species. Blasting will also alter habitat and may make new types of avifauna habitat available, especially to those species that nest in cliff faces (e.g., bank swallows). Stockpiling of gravel and overburden may attract ground-nesting birds, that may often remain in the area until chicks are fledged, once a nest is established. The management of surface water may also create new habitat for waterfowl; however, any settling ponds constructed will be relatively small and will be reclaimed upon reclamation of the quarry if they do not align with reclamation objectives. During the reclamation phase, the re-grading of rock face may remove cliff habitat while at the same time providing opportunities for birds requiring less sloped terrain. Reclamation and re-vegetation will also support avian use of the area birds. Accidents and malfunctions also have the potential to alter habitats used by birds.

WL1, WL2, WL4, WL5, and WL9 are potential WSS based on observations of SAR birds and suitable habitat. While direct impacts proposed for WL4, 5 and 9 will remove this habitat availability the SAR identified within them, Canada warbler, these wetlands are common mixedwood treed swamps which are locally abundant beyond the Study Area. Conversely, quarry activities are anticipated to generate habitat for other SAR birds identified in the Study Area which includes common nighthawk. No direct impacts are proposed for WL1 or WL2.

Bird species that currently use the habitat within the QEA will be displaced during the initial stages of the Project from changes in habitat availability and associated sensory disturbances. This could potentially cause direct mortality of species if individuals are unable to relocate to alternate suitable habitat. However, there are areas of suitable nesting habitat in adjacent lands and the regional area in general. The proposed quarry is located in a rural, relatively untouched setting, surrounded by forested landscape that may provide alternative suitable habitat.

The Project is likely to result in a small increase in habitat fragmentation and an increased amount of forest edges. This may lead to decreased forest quality for species that rely on interior forest conditions (i.e., areas within a forest sheltered from edge effects). These effects have both positive and negative outcomes depending on the bird species using the habitat. Habitat fragmentation and increased edge areas may lead to increased predation on birds. A study by Manolis, Andersen, and Cuthbert (2002) found that distance to nearest clear-cut was the best predictor of nest predation in multiple ground laying birds. However, some bird species benefit from forest edge habitat and have shown to return in subsequent years after an area is cleared due to the availability of foraging opportunities and other niche habitats. A study in Alberta showed that the abundance of alder flycatchers increased in a previously cut area (Tittler et al., 2001). Additionally, rusty blackbirds can also tolerate forestry activities as long has their habitat of coniferous dominant trees of varied heights near waterbodies is maintained (C. Stacier, Personal Communications, 2018).

The Project will alter habitat within the QEA; alterations will have both negative and positive effects depending on the bird species. Not all alteration will be permanent, a relatively small area is being lost and

furthermore, alterations will not have a significantly negative impact on local habitat as similar habitat for avifauna is present in the surrounding landscape.

9.3.3.1 *Mitigation*

The following mitigation measures will be included in the design of the Project to minimize effects to avifauna:

- Adherence to the Migratory Birds Convention Act;
- Avoid construction/disturbances on native vegetation during the breeding bird season (April 15 to August 30), where practicable. If avoidance is not possible, nest sweeps will be conducted by qualified professionals prior to clearing;
- Where possible, clearing of vegetation associated with quarrying will be limited to areas where quarry activities are imminent (i.e., within the next two years) to maintain intact habitat elsewhere across undisturbed portions of the QEA;
- Discourage ground-nesting species (e.g., common nighthawk) by limiting large piles or patches of bare soil during the breeding season, where practicable;
- Should any ground- or burrow-nesting species initiate breeding activities within stockpiles, the quarry, or other exposed areas, the Proponent will avoid disturbance to these areas until the chicks have fledged and the nesting areas is no longer being utilized or consult with NSDNRR;
- Implement dust suppressants (e.g., water trucks) when normal precipitation levels are not effective in controlling dust;
- Limit the use of lighting on site to the office and maintenance buildings;
- Install downward-facing lights on site infrastructure to reduce attraction to birds;
- Implement wildlife best management plans;
- Provide wildlife awareness training to site personnel;
- Vehicles will yield to wildlife on roads;
- Install signage where specific wildlife concerns have been identified;
- Adhere to the *Guidelines for Environmental Noise Measurements and Assessment* (NSDEL, 2005) to reduce the impact of noise and vibration on birds;
- Grubbings and topsoil will be salvaged and stored for use in site restoration;
- Implement erosion and sediment control plan;

- Regularly inspect and repair erosion and sediment control devices;
- Equipment will be equipped with spill kits and site personnel will be instructed on their use;
- Implement reclamation program to re-establish habitat to support reintroduction of birds post quarry life;
- Blasting will be monitored by a qualified blasting professional and will be planned to occur on days where weather conditions are less likely to cause excessive sound levels;
- The quarry will typically operate during daylight hours to prevent nighttime disturbance; and,
- Should site activities during active nesting periods be unavoidable, additional mitigative measures such as pre-disturbance nest searches and avoidance and setbacks from active nests will be applied. These will be developed in consultation with Environment and Climate Change Canada (ECCC) and NSDNRR.
- A Wildlife Management Plan will be developed with methods by which the Project can take place while minimizing interactions with wildlife.

9.3.3.2 *Monitoring*

No dedicated monitoring is proposed for this VEC.

9.3.3.3 *Residual Effect and Significance*

Magnitude

The Project is predicted to have a **low** magnitude of impact on avifauna. No regulatory threshold is available; therefore, the Project team has considered an effect that is likely to cause a permanent, unmitigated, alteration to habitat that supports avifauna as the threshold.

Likelihood

It is **almost certain** that the Project will impact avifauna as clearing and grubbing associated with the construction phase of the Project will directly impact habitat and activities associated with all Project phases will generate noise that may adversely affect avifauna. The likelihood for the Project to cause direct mortality to avifauna is less likely but still possible.

Duration

The time over which the effects are likely to persist are predicted to be **long-term**, as they there is potential for interaction during all Project phases.

Frequency

Potential effects to avifauna will occur at varying frequencies. For example, loss of habitat will occur once construction phase of the Project, sensory disturbance will occur regularly during all Project phases.

Overall, effects to avifauna are anticipated to occur at **regular** intervals during the Project. Alterations to habitat will be made gradually over the lifetime of the quarry giving avifauna time to adapt. Reclamation will allow the Project to be partially reversible as habitat will be restored progressively.

Significance

The Project is predicted to not have a significant effect on avifauna (Table 6-4).

9.4 Aquatic Environment

The following subsections outline the effects of the undertaking on wetlands, surface water, and fish and fish habitat.

9.4.1 Wetlands

Quarry development can affect wetland habitat through direct and indirect pathways associated with quarrying practices. Wetlands will be altered through the direct removal of wetland area within the QEA. Activities associated with the Project also have the potential to indirectly alter wetlands through changes in wetland function, such as hydrology (e.g., flooding, drying), sedimentation and erosion, water quality and habitat and vegetation integrity (e.g., introduction of invasive species). These interactions are outlined in Table 9-1 and described in the following sections.

9.4.1.1 *Direct Effects*

A total of 10 wetlands were identified within the Study Area. Seven wetlands are located within the QEA and will be directly impacted by the Project (either completely or partially; Table 9-5). Direct impacts are defined as the physical alteration (e.g., soil and/or hydrological disturbance) of wetland area as a result of Project development. No direct impacts are proposed for three wetlands: WL1, WL2 and WL10 (Figure 17; Appendix A).

Table 9-5: Estimated Direct Impact to Wetland Area

Wetland ID	Wetland Size (m^2)	Estimated Direct Impact Area (m^2)	% Area Proposed for Alteration
WL1[1]	18,631	0	0%
WL2	12,537	0	0%
WL3	678	678	100%
WL4	4,402	4,402	100%
WL5	869	57	7%
WL6[2]	134	134	100%
WL7	280	280	100%
WL8	1,561	1,561	100%
WL9	1,724	1,724	100%
WL10	582	0	0%
Total Wetland Area = 41,398 m^2 (4.140 ha) Total Direct Impact Area = 8,836 m^2 (0.884 ha)			**Total Complete Wetlands Altered = 6**
			Total Partial Wetlands Altered = 1

[1] Wetland continues beyond the Study Area

[2] WL6 is predicted to be completely altered. The 41 m^2 beyond the QEA is not expected to maintain natural wetland functions and conditions following direct alteration.

In total, over the lifetime of the quarry, seven wetlands are proposed for direct alteration. The proposed alteration area is 0.884 ha, representing 21% of the wetland area in the Study Area and 1% of the total area within the Study Area. Five wetlands are proposed for complete alteration and two are proposed for partial alteration. Alteration areas were assessed based on the proposed maximum footprint of the QEA.

9.4.1.1.1 Direct Impacts to Wetlands of Special Significance

Of the five potential WSS (see Section 8.4.1.2.2), two are proposed for complete alterations (WL4 and WL9) and one is proposed for partial alteration (WL5) by the QEA (Figure 17; Appendix A). WL4, WL5 and WL9 were identified as a potential WSS due to observations of Canada warbler in the wetland and the presence of suitable wetland breeding habitat.

No direct impacts are proposed for the other two potential WSS, WL1 and WL2. The QEA was adjusted to avoid the 100 m SMP setback for the observation of frosted glass-whiskers in WL2. See Section 9.4.1.3 for a discussion of wetland avoidance and mitigation.

9.4.1.2 *Indirect Effects*

Indirect impacts are described as changes to wetland condition where wetland habitat is not directly lost but may be indirectly altered as the result of Project activities. Project-related potential indirect impacts to wetlands may occur as a result of:

- Changes to the local hydrology (groundwater and surface water) resulting in wetting or drying of wetlands.
- Potential sedimentation within wetlands as a result of up-gradient activities resulting in soil erosion (e.g., earth moving, removal of vegetation).
- The spread or introduction of invasive species into wetlands through construction equipment, vehicles, or runoff from adjacent development. Increased traffic during the construction and operational phases can elevate this risk.

Changes to wetland hydrology are common drivers for change to wetland function and habitat integrity. Indirect impacts may occur through Project alteration of hydrological conditions within the QEA (i.e., quarrying activities, implementation of water management features, upgradient alterations), impacting the quantity and timing of water inputs and outputs of adjacent wetlands (i.e., the hydroperiod). While changes to water quality may result in indirect impacts, they are not expected based on the Project description and activities.

The following sections describe potential Project-related indirect hydrological effects to wetlands.

9.4.1.2.1 Local Catchment Areas

Potential for downgradient, indirect wetland impacts can occur as a result of upgradient hydrological alteration and changes to catchment area size and/or land use. Upgradient development in catchment areas can impact wetlands by altering natural surface water runoff and groundwater contributions, and thus the amount of water supplied to downgradient systems. Changes to catchment areas typically result in a reduction of water inputs, however, an increase can also occur if catchments are enlarged or receive managed drainage. Change to catchment surface conditions, such as ditching, vegetation clearing, soil compaction or paving, can alter the timing of water inputs by increasing the amplitude and shortening the hydroperiod (e.g., flashier inputs).

Quarrying has the ability to alter changes to surface water runoff through each phase of quarry expansion. The WBA (Appendix E) provides an assessment of changes to contributing catchment areas from quarry expansion and subsequent hydrological modeling for downgradient aquatic receptors. The majority of surface water runoff captured within the IA Permit Area infiltrates into the fractured quarry floor. Any additional surface water runoff is passively directed to Big North Brook. During quarry expansion, surface water will continue to infiltrate into the quarry floor and excess water will drain towards Big North Brook, the outflow of WL1. As a result, the headwater catchment area for Little North Brook will be reduced (Appendix E).

The WBA presents that the Little North Brook-3 catchment is the only catchment area with predicted Project-related impacts due to catchment size and the proportionally impacted area. The proportionally small increase in the Big North Brook catchment is not expected to result in a change in flow. No other POIs were carried forward into the WBA due to the minimal impacts to the contributing drainage areas for these catchments.

Little North Brook-3 will experience an annual reduction in flow of 9.46% during the Operating and Reclamation phases of development. The maximum monthly change will be 9.53% from December to February. WL5 is the only wetland in this catchment that will remain partially unaltered. Monthly changes in runoff do not vary greatly from existing conditions and maximum changes are predicted outside the growing season in months where wetlands typically have a surplus of water (e.g., winter) and are not hydrologically stressed (e.g., summer). However, as WL5 is located in the upper portions of this catchment, the impact of the quarry development will be to its immediate upgradient, within WL5's local contributing area. Similarity, while broader flow reductions in WL2's catchment area (Big North Brook) are not expected, the Project will divert flow in the immediate upgradient contributing area. As a result, WL2 and WL5 are not currently predicted to be indirectly impacted but are proposed for monitoring to assess potential changes to wetland hydrology based on the proportional impacts to their respective catchments and potential WSS (WL2) status (see Section 9.4.1.4).

No other potential indirect hydrological impacts to wetlands are expected as a result of catchment area changes. Potential impacts to fish and fish habitat are described in Section 9.4.2.2.

9.4.1.2.2 Groundwater Interactions

Quarrying has the ability to potentially alter groundwater-wetland interactions as a result of localized groundwater drawdown. Isolated discharge wetlands which are predominantly reliant on groundwater inputs, may be more vulnerable to this change (Mortellaro et al., 1995). The downward hydrological gradients of recharge wetlands (e.g., WL10) may also be amplified by local groundwater drawdown, resulting in water outputs exceeding inputs.

Impacts of groundwater drawdown to WL1, a riparian complex, would be muted due to its supply of water from WC1 (Big North Brook). The wetland's riparian qualities (i.e., high water level fluctuations and prolonged periods of surface water presence) combined with its expansive, unimpacted catchment area are expected to regulate potential impacts from localized groundwater drawdown. As such, effects to groundwater in WL1 are unlikely to results to results in changes to wetland function beyond natural variability.

Due to the proximity of WL5 and WL10 to the QEA, there's potential that these wetlands may be indirectly impacted by changes to local groundwater contributions, at such a time that development expands to the western portion of the QEA. As a result, WL5 and 10 are proposed for hydrological monitoring to capture potential impacts from groundwater drawdown (see Section 9.4.1.4).

9.4.1.3 *Mitigation*

Avoidance is the first step in the hierarchical process for wetland conservation, as described in the Wetland Conservation Policy (NSE, 2019). Avoidance of wetland alteration was achieved, where possible, during the initial design of the QEA, where micro-siting was used to minimize wetland impacts whenever possible and feasible. Dexter was able to reduce the QEA to avoid direct impacts to potential

WSS WL1 and WL2, including the occurrence of frosted glass-whiskers and 100 m SMP setback (Figure 7, Appendix A).

Avoidance was limited by the location of the quarriable aggregate material and access in relation to the existing quarry. Generally, an expansion to the existing quarry will result in less disturbance and fewer wetland and environmental impacts than a new quarry. Where wetland avoidance is not possible, mitigation measures will be implemented to reduce risk to wetlands. Mitigations will also include wetland compensation for altered wetland area, and wetland monitoring where appropriate/necessary to verify predicted effects.

The following mitigation measures will be included in the design, construction and operation of the QEA to reduce overall loss of function of wetland habitat in impacted areas:

- Acquire and adhere to wetland alteration permits;
- Implement wetland monitoring as described in permits;
- Engage in wetland compensation activities for the wetland loss associated with the QEA as required by the provincial wetland alteration process;
- Wetland compensation to be completed in a nearby watershed whenever possible and feasible;
- Complete pre-construction site meetings for all relevant staff/contractors related to working around wetlands and watercourses to minimize unauthorized disturbance;
- Refueling and equipment maintenance will not occur within 30 m of wetlands;
- Ensure all wetlands are visually delineated (i.e., flagged);
- Implement water management methods to reduce the potential for draining or flooding of surrounding wetlands;
- Direct site runoff through natural upland vegetation;
- Implement erosion and sediment control measures and best practices;
- Re-vegetate and progressively reclaim the quarry using native vegetation to reduce erosion and risk of invasive species establishment.

9.4.1.4 *Monitoring*

Wetlands are protected under the provincial *Environment Act* and Wetland Conservation Policy (NSE 2019) to mitigate net loss of habitat and function. As is required through the wetland alteration permitting process, wetland monitoring will be completed to verify the accuracy of the predicted environmental effects, the effectiveness of the mitigation measures and signal the potential need for additional mitigation

measures or compensation. A detailed wetland monitoring plan will be prepared through the wetland permitting process in consultation with NSECC.

Wetland monitoring methods will include hydrological and vegetative assessments to evaluate potential shifts in wetland characteristics and function over time. A hierarchy of monitoring approaches will be applied in consideration of the magnitude and type of individual wetland impacts (e.g., direct vs. potential indirect), and potential WSS status. Generally, wetland monitoring is proposed for the unaltered portions of WL2, WL5, and WL10 based on the potential for hydrologic changes as described in the indirect effects assessment.

Pre-construction baseline monitoring will take place before wetland alterations commences to acquire baseline conditions from which to compare post-construction monitoring results. Comparison methods and indicators of change will be detailed in the final wetland monitoring plan. Should post-construction wetland monitoring indicate a potential shift above natural variation, Dexter will consult with NSECC to identify whether corrective actions or compensation will be required.

Annual monitoring results, as well as any changes to the program, will be provided to NSECC, as per wetland alteration permit conditions. NSECC will be contacted and consulted in the instance of an unintended direct and/or indirect impact to a wetland.

9.4.1.5 *Residual Effects and Significance*

Magnitude

No magnitude significance threshold is defined for wetlands; therefore, McCallum defined the threshold as an effect that results in an unmitigated or uncompensated net loss of wetland habitat as defined under the NSECC Wetland Conservation Policy, and its associated no-net loss goals. Expected Project wetland impacts are predicted for seven wetlands (WL3, 4, 5, 6, 7, 8, 9). The direct wetland impact area totals 0.884 ha. No indirect impacts are expected at this time. Wetland alteration will be monitored and compensated through the alteration approval process and therefore no net-loss of wetlands is predicted as a result of the Project. The Project is predicted to have a **low** magnitude of impact on wetlands.

Likelihood

It is **almost certain** that the Project will impact wetlands as Project development is proposed to directly impact seven wetlands.

Duration

The time over which the effects are likely to persist are predicted to be **long-term**, over the progressive construction phase of the Project.

Frequency

Effects to wetlands will occur **once** during the construction phase of the Project.

Significance

The Project is predicted to have a **not significant** effect on wetlands (Table 6-4).

9.4.2 Surface Water, Fish and Fish Habitat

Quarry development can affect surface, fish, and fish habitat through quarry development activities and pathways of effects. Activities such as clearing, grubbing, and blasting can lead to a direct loss of watercourses during infrastructure placement. Site access and movement of equipment across watercourses may necessitate the installation of drainage structures such as culverts or bridges. Indirect effects to surface water and fish and fish habitat include potential changes in water quality conditions draining from the quarry footprint into aquatic receivers, water quantity changes due to quarry development, associated potential loss of drainage area, re-direction of surface water flows, and groundwater drawdown.

9.4.2.1 *Direct Effects*

No surface water features or fisheries resources were identified within the QEA. The closest watercourse, WC1, will be avoided by Project activities and a 30 m buffer will be maintained around this watercourse during quarry expansion. As such, no direct impacts to fish or fish habitat are expected to occur as a result of the Project.

9.4.2.2 *Indirect Effects*

Indirect effects associated with quarry development include changes to surface water quantity, surface water quality, and blasting effects to downstream aquatic receivers and associated fish and fish habitat.

9.4.2.2.1 Water Quantity

Utilizing the methodology discussed in the WBA (Appendix E), the following section outlines the predicted changes that can be expected to surface water runoff and the resulting impacts to surface water features and fish habitat within or downgradient of the Fish Study Area.

A preliminary assessment of changes to contributing drainage areas to each Point of Interest (POI; Appendix E) were assessed across the two Project phases and compared to baseline (i.e., operating and reclamation conditions versus existing contributing drainage areas). The results of this quantitative assessment are provided in Appendix E. WC2 was selected for additional hydrologic modeling, despite having less than a 10% reduction in the contributing drainage area, due the potential for changes in land use within the contributing drainage area. All other POIs are predicted to see minimal impacts and require no further analysis (-3.23% to 1.19% change in drainage area).

A summary of the predicted annual runoff volumes, average annual change in runoff, and maximum average monthly change in runoff at POI Little North Brook-3 (which lies at the outflow of WC2) under both operating and reclamation conditions is presented in Table 9-6 and the WBA (Appendix E).

Table 9-6. Annual Runoff Volumes at Little North Brook-3 POIs (WC2 results)

Scenario	Annual Runoff (m^3)	% Change in Annual Flow	Max. Monthly % Change	Month of Max. Change
Little North Brook-3				
Existing Conditions	225,866	--	--	--
Operating Conditions	204,509	-9.46%	-9.53%	January, February, December
Reclamation Conditions	204,509	-9.46%	-9.53%	January, February, December

Little North Brook-3 (WC2) is predicted to experience a decrease in annual streamflow of 9.46% during Operating and Reclamation conditions. The maximum monthly change in flow of a 9.53% decrease occurs in January, February and December. These changes will remain relatively consistent through Reclamation conditions as the size of the contributing drainage area remains the same.

The predicted changes in water being sourced to each aquatic feature can have implications to the viability of fish or habitat conditions. The Pathways of Effects diagram developed by DFO outlines potential impacts to fish and fish habitat as a result of changes to timing, duration, and frequency of flow (DFO, 2010). Effects may include:

- Changes to water quality including increases in temperature and changes to contaminant, sediment, and nutrient concentrations;
- Fish passage issues including changes to migration patterns or displacement or stranding of fish; and,
- Changes to habitat structure, cover, and food supply (DFO, 2010).

The probability of these impacts to fish and fish habitat increases with increasing alteration to the natural flow regime. When applicable, changes in surface water runoff have been compared to thresholds outlined in the DFO Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada (DFO, 2013):

- Cumulative flow alterations <10% in amplitude of the actual (instantaneous) flow in the river relative to a "natural flow regime" have a low probability of detectable impacts to ecosystems that support fisheries.
- Cumulative flow alterations that result in instantaneous flows <30% of the mean annual discharge (MAD) have a heightened risk of impacts to fisheries.

As stated in the Framework, "for Canadian rivers and streams, the expert consensus is that cumulative flow alterations of less than +/- 10% of the magnitude of actual (instantaneous) flow in the river relative to a "natural flow regime" have a low probability of detectable negative impacts to ecosystems… In addition, there was consensus amongst workshop participants that cumulative flow alterations that result in

instantaneous flows less than 30% of the MAD have a heightened risk of impacts to ecosystems that support fisheries" (DFO, 2013).

As part of the effects assessment, a review of the predicted changes in monthly runoff was completed to determine if quarrying would likely result in an alteration of flow in exceedance of the thresholds outlined by DFO (2013). If flows fall below 30% MAD naturally and is then exacerbated by Project flow reductions, or if the flow is increased or reduced by more than 10% based on Project activities, the resulting alteration can be considered to have a heightened risk of impacts to fisheries and therefore could have a significant negative effect on fish and fish habitat. Alterations that do not exceed these thresholds are considered to have a low probability of detectable impacts to ecosystems that support fisheries.

One key limitation identified by DFO (2013) is that the determinations of effects to fish and fish habitat are not well understood in intermittent, seasonal, or ephemeral watercourses. The in-stream flow needs for watercourses which naturally lack flow at certain times of the year (i.e., WC2) are not well understood, and guidance is lacking to determine effects to fish habitat in these systems.

As demonstrated in the WBA (Appendix E) and discussed in Section 9.4.1.2, WC1 and Pond 1 (POIs Big North Brook 1-4) and Bagpipe Lake (POI Little North Brook 1-2) are expected to experience minimal to no changes in water quantity from Project development. No detectable changes to flow from existing conditions within these systems are anticipated, therefore they are not discussed further in the effects assessment of water quantity on fish and fish habitat.

A discussion of potential effects to fish and fish habitat as a result of changes to streamflow are provided in the following paragraphs for WC2. When discussing the results of the WBA it should be noted that the quarry will be developed over the course of approximately 20 years, with the maximum extent of the QEA to be reached during year 16.

As an annual average, WC2 is predicted to experience a permanent reduction in flow of -9.46% during both Operations and Reclamation. The intermittent and discontinuous channel observed throughout WC2 naturally restricts fish movement throughout the reach in baseline conditions. As an intermittent system, the stream is expected to exhibit variability in streamflow and seasonal dryness throughout the year. As a first order stream, the watercourse does not provide passage to any upgradient, potentially fish-bearing aquatic features. The results of the WBA indicate that during the winter months (December, January, and February), WC2 will have the maximum decrease in runoff from the project (9.53%). However, the WBA also notes that these months have some of the highest runoff recorded throughout the year (excluding the months of March and November), negating the decrease in runoff. Furthermore, reductions in runoff are expected to be gradual as the quarry is developed (16 years).

Though the watercourse is considered to provide suitable habitat for banded killifish, American eel, and yellow perch, overall habitat quality is considered low. Water quality parameters measured within the system (pH and DO) are generally considered suboptimal for fish (pH range of 3.38-3.47 and DO range of 3.36-3.84). These findings are supported by the results of fish collection efforts, which resulted in only 2 individuals captured (one yellow perch and banded killifish) captured and one individual (American eel)

observed. Suitable habitat for these species is provided within Bagpipe Lake, which based on the results of fish collection efforts supports greater numbers of these species.

According to Harmal et al. (2006) and Di Baldassarre and Montanari (2009), a 10% error in streamflow measurements and discharge calculations is considered reasonable. A change in streamflow of <10% is considered low in magnitude as it is within natural variability. The annual average and maximum monthly change in runoff predicted for WC2 fall below this threshold.

Overall, the indirect effects associated with the predicted decreases in runoff to WC2 will are not expected result in changes to the morphological characteristics (i.e., bed or bank) of the watercourse, or in detectable changes to the existing fish community and the fish habitat provided by the watercourse.

9.4.2.2.2 Water Quality

Similar to some of the effects discussed for groundwater, the Project has the potential to impact surface water quality through the following pathways:

- Rock-Water Interaction: The physical processing of aggregate and rock and contact with surface water and oxygen has the potential to create dissolved solids and metals which could flow to downstream surface water receivers. This includes ARD, but as discussed in Section 8.2.1.3.1, the potential for ARD is considered low and ARD testing indicated sulphur concentrations in the sample is below the requirement (0.4 Wt.%) for handling under the Sulphide Bearing Materials Disposal Regulations (Province of Nova Scotia, 2017) and does not have significant acid producing potential.
- Erosion and Sedimentation: earth moving, excavation, vegetation clearing, and blasting are activities that can lead to increased erosion and sedimentation and turbidity issues in surface water.
- Malfunctions and Accidents: Oil spills or loss of a hazardous or deleterious substance within the quarry has the potential to release into surface water systems.

During Operations, the primary sources of potential water quality issues stem from the following quarry components; stockpiles (waste rock, topsoil, and overburden) and the internal haul road.

Elevated TSS in surface water systems is a primary concern associated with mining and quarrying activities. However, TSS can be mitigated through use of best management practices around the quarry (e.g., check dams, straw waddles and site fence as needed). Details on specific mitigation measures for water quality are provided in Section 9.4.2.3.

Aluminum and iron are commonly found to be elevated across Nova Scotia and, as such, are not unexpected constituents to see in background water quality data. Additionally, arsenic is found to be elevated within the watershed, however, this is common within Halifax County and Lunenburg County. A background search was performed for existing groundwater wells surrounding the Site via the Nova Scotia Groundwater Atlas (Nova Scotia Groundwater Atlas, last accessed April 14, 2023). The surrounding well records indicate

elevated iron in some locations but not all locations. All other constituents are below regulatory limits in these wells.

Overall, the data available indicates that there are no major sources of water quality concerns outside of TSS, arsenic, aluminum, and iron. All surface water discharges from the quarry site will be sampled as per requirements listed in the IA to ensure water quality conforms with CCME FWAL criteria or confirmed background concentrations for TSS, pH and metals to meet the *Pit and Quarry Guidelines* (NSEDL, 1999).

Water quality issues associated with the blasting and quarrying practices (i.e., chemical composition of water, increase in dissolved metals, changes in temperature, etc.) are also a threat to fish and fish habitats. As the primary receiver of quarry discharge, water quality in WC1 will be a key focus of mitigation and monitoring measures.

Discharge water temperatures will be monitored by Dexter as part of the overall water quality monitoring program to ensure water temperatures entering WC1 is appropriate. Should temperatures be so warm as to expect impacts to WC1, additional mitigation measures (i.e., cooling trenches) may be applied.

Mitigation and monitoring, as described further below, will ensure discharge is within permitted parameters, and thus, no residual impact to fish and fish habitat is expected from changed water quality, with appropriate mitigation measures and a comprehensive water quality monitoring program implemented.

9.4.2.2.3 Blasting

Indirect impacts to fish and fish behaviour, spawning grounds, and migration patterns are possible from blasting activities associated with quarry development. The detonation of explosives near watercourses can produce post-detonation shock waves which involves a rise to a high peak pressure and then a subsequent fall to below ambient hydrostatic pressure. This pressure deficit can cause impacts in fish (Wright and Hopky, 1998). An overpressure in excess of 100 kPa can result in effects to fish including damage to the swim bladder in finfish, and potential rupture and hemorrhage to the kidney, liver, spleen and sinus venous. It is also possible that fish eggs and larvae can be damaged (Wright and Hopky, 1998). The degree of damage is related to the type of explosive, size and pattern of the charges and the distance to the watercourse, depth of water within the watercourse, and species, size and life stage of the fish.

Blasting at the Project is anticipated to occur once per year during years in which the site is active. The *Guidelines for the use of explosives in or near Canadian fisheries waters* (Wright and Hopky, 1998) indicate a setback distance of 50.3 m is required for a 100 kg explosive charge (20 kg greater than the proposed charge) in rock to achieve 100 kPa in adjacent fish habitat. Setback recommendations to minimize impact to fish and fish habitat from blasting activities outlined in Wright and Hopky (1998) will be adhered to during Project development. The closest the QEA is to a field identified watercourse is 55 m (from Pond 1), beyond the 50.3 m setback distance. Future blasting will advance the quarry highwall further away from WC1.

9.4.2.2.4 Summary of Indirect Effects

As demonstrated in the WBA, all POIs are expected to experience minimal to no change in water quantity from Project development. No detectable change to flow from existing conditions within any watercourse or waterbody within the Fish Study Area is anticipated (<10%). WC2 is predicted to experience a reduction in annual runoff volume of 9.46% during both operation and reclamation conditions while experiencing maximum changes in monthly runoff (9.53%) during January, February, and December. However, these months naturally experience the highest amount of runoff throughout the year through snowmelt and the decrease is considered negligible.

No residual impacts to fish and fish habitat is expected from changed water quality. Mitigation and monitoring, as described further below, will ensure discharge is within permitted parameters.

Potential impacts from blasting activities will be mitigated through setback recommendations to minimize impact to fish and fish habitat.

9.4.2.3 *Mitigation*

The following mitigation measures will be included in the design of the Project:

- Dexter will implement erosion and sediment control structures (e.g., sediment fence, rip rap, check dams etc.) as needed to minimize the potential for sediment release into surface water. All erosion and sediment control structures will be regularly inspected and repaired.
- Stockpiles of material with a potential to cause sedimentation issues will be set back from surface water systems and will be stabilized to reduce the likelihood of erosion and sedimentation.
- Perimeter ditching will be constructed where necessary.
- Natural riparian buffers will be maintained on all watercourses and waterbodies not directly impacted by quarry development, where practical.
- Potential effects to water quality as a result of blasting will be reduced by using an emulsion compound which is insoluble in water. This will prevent contaminants such as Ammonium Nitrate Fuel Oil entering surface water bodies and groundwater during blasting activities.
- Blasting is expected to occur once per year during years in which the site is active.
- Setback recommendations and other mitigation strategies to minimize impact to fish and fish habitat from blasting activities outlined in Wright and Hopky (1998) will be adhered to during Project development.
- Blasting will follow best management practices and will be completed by a qualified blasting professional.

- Blasting will be monitored per EA and Industrial Approval terms and conditions (i.e., at the nearest offsite structure).
- Explosive charges will be reduced if there is potential to impact fish and fish habitat;
- There will be no long-term storage of fuel onsite. Fuel will be temporarily stored onsite in a trailer enclosed generator as part of the portable crushing spread when crushing activity occurs. A Project Contingency Plan will be developed for the Project to outline the prevention and response methods regarding spills and/or substance loss.

9.4.2.4 *Monitoring*

Dexter will design and implement a Surface Water Monitoring Plan to ensure water quality entering the downstream environment meets regulatory requirements and that potential impacts to aquatic life does not occur. Details of the water quality program will be outlined in a Surface Water Monitoring Program as part of the IA Application process.

The Surface Water Monitoring Program will also include monitoring locations for water quantity. Data collected on actual conditions will be compared to the predicted stream flow reductions. Monitoring will verify the predictions made and ensure potential adverse impacts to fish and fish habitat outside of the predicted effects does not occur. Baseline water quality samples will be collected prior to quarry expansion for comparison against samples collected during quarry development.

9.4.2.5 *Residual Effects and Significance*

Magnitude
No impacts to downgradient, off-site watercourses are expected, nor are any impacts to the overall fish community. The Project will have a **low** magnitude of impact on fish and fish habitat.

Likelihood
It is **almost certain** that the Project will impact fish habitat as Project development is proposed to indirectly impact one watercourse through changes in flow.

Duration
The time over which the effects are likely to persist are predicted to be **permanent.** WC2 is predicted to experience a reduction in annual runoff volume of 9.46% during both operation and reclamation conditions**.**

Frequency
Overall, effects to fish habitat are anticipated to occur at **regular** intervals during the Project.

Significance
The Project is predicted to have a **not significant** effect on fish or fish habitat (Table 6-4).

9.5 Socioeconomic

This section outlines the effects of the undertaking on the following socioeconomic VECs; economy, land use and value, recreation and tourism, human health, and cultural and heritage resources.

Refer to Table 9-1 for potential Project interactions with each socioeconomic VEC.

9.5.1 Economy

The existing quarry (IA Permit Area) and proposed QEA are an important part of Nova Scotia's construction sector and will benefit the local and provincial economy. The Project expected to prolong the benefits to other local businesses (e.g., restaurants and hotels).

9.5.1.1 *Mitigation*

Dexter will employ local contractors and members of First Nations communities/organizations to complete or assist with Project tasks, whenever possible.

9.5.1.2 *Monitoring*

No monitoring is proposed for this VEC.

9.5.1.3 *Residual Effects and Significance*

Magnitude
No regulatory threshold is available; therefore, the magnitude was determined based on the Project altering (increasing or decreasing) revenue to the local economy. The Project is anticipated to have a **moderate** magnitude of effect on the local economy as the existing quarry is expanding and is predicted to continue to contribute revenue to the local economy and be an important part of Nova Scotia's construction sector.

Likelihood
It is **almost certain** that the Project will interact with the local economy.

Duration
The duration of the Projects potential interaction with the local economy is **long-term** as it will occur during all Project phases.

Frequency
The effects of Project on the local economy will occur **regularly** throughout the life of the Project.

Significance
The Project will have a **significant** positive effect on economy (Table 6-4).

9.5.2 Land Use and Value

9.5.2.1 *Land Use*

The Study Area is located on private lands (Figure 2; Appendix A). Access to the Project will continue to be gated to restrict public access. Access is required to be restricted due site infrastructure that could pose a safety risk to the public (e.g., quarry highwall). During reclamation the site will be returned the to pre-development conditions, to the extent practicable.

9.5.2.2 *Property Value*

Ford and Seals (2018) found that quarry operation or anticipation of quarry development in the United States did not negatively impact house prices. In Wellington County, Ontario, it was found that aggregate sites do not have a strong negative effect on rural residential property values (Grant 2017). Conversely, Erickcek (2006) found that property value diminished in proximity to quarries in Ohio and Michigan, respectively.

The Project is an expansion of the existing quarry which has been in operations since 2015. While the impacts of the Project on the value of properties in proximity to the QEA is unknown, the expansion of the existing development is not expected to negatively impact value.

9.5.2.3 *Mitigation*

Local political stakeholders were notified of the Project and offered meetings in June 2023 and August 2023. No response was received at the time. Local residents will be notified through the published notifications through the EARD process. Residents will have the opportunity to comment and provide feedback on the Project through the EARD comment period. Ongoing engagement will occur throughout the life of the Project. Dexter will also develop a Complaints Resolution Plan to appropriately respond to Project related complaints.

9.5.2.4 *Monitoring*

No monitoring is proposed for this VEC.

9.5.2.5 *Residual Effects and Significance*

Magnitude

The Project is anticipated to have a **low** magnitude of effect on the land use and value. The QEA is an expansion of an existing quarry development. While land use will be altered and there is potential for the Project to cause a decrease in property values, based on a literature review and current land use, the effects of property values in proximity to quarries are expected to be negligible.

Likelihood

It is **almost certain** that the Project will interact with land use. The Projects interaction with land value is **possible**.

Duration
The duration of the Projects potential interaction with land use and value is **long-term** as it may occur during all Project phases.

Frequency
The effects of Project on land use and value may occur **continuously** throughout the life of the Project.

Significance
The Project will have a **not significant** effect on land use and value (Table 6-4).

9.5.3 Recreation and Tourism

9.5.3.1 *Recreation*

There are no provincial parks or known sensitive heritage or cultural attractions near the Study Area nor are there any designated public recreational trails or public recreational lands present inside the Study Area. One seasonal camp is located within 800 m of the QEA. Dexter has authorization to conduct blasting at the existing quarry and within the QEA.

9.5.3.2 *Tourism*

The effects of the Project on local tourism and tourist perceptions cannot definitively be known until the Project is implemented, however, since tourism in the immediate area surrounding the Project is relatively low, the impacts of the Project on tourism are anticipated to be negligible. The Project is also an expansion of an existing quarry operation.

Reclamation of quarries and mines can be beneficial to tourism and the economy (Gandah and Atiyat, 2016). This is shown by tourism at the Gypsum Mine Trail, a trail to the reclaimed Cheticamp Gypsum Quarry, in Cheticamp, Nova Scotia.

9.5.3.3 *Mitigation*
No mitigations are proposed for this VEC.

9.5.3.4 *Monitoring*
No monitoring is proposed for this VEC.

9.5.3.5 *Residual Effects and Significance*

Magnitude
The Project is anticipated to have a **low** magnitude of effect on recreation or tourism.

Likelihood
It is **unlikely** that the Project will have an effect on recreation and tourism based on current operations.

Duration
The duration of the Projects potential interaction with recreation or tourism is **long-term** as there is potential for it to occur for the life of the Project.

Frequency
The effects of Project on recreation or tourism will occur **sporadically**, if they occur at all.

Significance
The Project will have a **not significant** effect on recreation or tourism (Table 6-4).

9.5.4 Cultural and Heritage Resources

The portions of the Study Area ascribed elevated potential for encountering Mi'kmaw archaeological resources are beyond the boundaries of the proposed QEA. The remainder of the Study Area has been ascribed low archaeological potential. As a result, Project-related impacts to cultural and heritage resources are not expected.

9.5.4.1 *Mitigation*

The ARIA (refer to Appendix D for the executive summary of the ARIA) recommends that the portion of the Study Area ascribed as low potential be cleared of the requirement for further archaeological investigation. No operational buffer is recommended for the areas of high and moderate archaeological potential.

If any changes are made to the layout of the Study Area beyond the area assessed in the ARIA, it is recommended that those proposed areas be subjected to an Archaeological Resource Impact Assessment.

In the event that archaeological deposits or human remains are encountered during construction activities associated with the study area, all work in the associated area(s) will be halted and immediate contact made with the Special Places Program.

Should ground disturbance be required within the areas assessed as moderate and high archaeological potential, Dexter will follow recommendations within the ARIA including:

- It is recommended that any worksite activity or ground disturbance within the areas of high archaeological potential, as depicted on the archaeological potential model of the study area be preceded by a program of shovel testing undertaken at 5- meter intervals to search for archaeological resources and assess requirements for further archaeological testing or archaeological mitigation.
- It is recommended that any worksite activity or ground disturbance within the areas of moderate archaeological potential, as depicted on the archaeological potential model of the study area be preceded by a program of shovel testing undertaken at 10-metre intervals to search for archaeological resources and assess requirements for further archaeological testing or archaeological mitigation.

9.5.4.2 *Monitoring*

No monitoring is proposed for this VEC.

9.5.4.3 *Residual Effects and Significance*

Magnitude
The Project is anticipated to have a **low** magnitude of effect on cultural and heritage resources. No regulatory threshold is available; therefore, the magnitude was determined based on the conclusions of the ARIA, where the QEA is beyond areas ascribed moderate and high archaeological potential.

Likelihood
It is **unlikely** that the Project will have an effect on cultural and heritage resources due to the moderately low potential for their presence within the Study Area.

Duration
The duration of the Projects potential interaction with cultural and heritage resources is **short-term** as it only has potential to occur during the construction phase of the Project.

Frequency
The effects of Project on cultural and heritage resources will occur **once** during construction, if it occurs at all.

Significance
The Project will have a **not significant** effect on cultural and heritage resources (Table 6-4).

9.5.5 Human Health

Potential impacts to human health from the Project development and operations include effects from air quality, noise, and accidents or malfunctions. Dexter will monitor all blasts and will monitor for air quality at the request of NSECC to ensure Project activities do not result in impacts to human health. Dexter will also develop a contingency plan to mitigate for accidents and malfunctions (e.g., spills or fires) and a complaint resolution plan, should any members of the public have concerns regarding quarry operations.

The Project will generate noise and dust and has the potential to result in a spill or release, however, after mitigation measures are implemented and the Industrial Approval conditions and *Pit and Quarry Guidelines* are adhered to, no adverse effects to human health are predicted. Refer to Section 9.1.1 and Section 9.1.2 for additional details related to noise and air quality and associated monitoring and mitigations.

9.5.5.1 *Residual Effects and Significance*

Magnitude

The Project is anticipated to have a **negligible** magnitude of effect on human health. No regulatory threshold is available; therefore, the Project team has considered a proven adverse effect on human health as the threshold.

Likelihood

It is **unlikely** that the Project will have an effect on human health due to the mitigations proposed and the setback distance to existing residential receptors.

Duration

The duration of the Projects potential interaction with human health is **long-term** as it may occur during all Project phases.

Frequency

The effects of Project on human health will occur **sporadically,** if it occurs at all.

Significance

The Project will have a **not significant** effect on human health (Table 6-4).

9.6 Summary of the Effects of the Undertaking on the Environment

Refer to Table 9-7 for an effects assessment summary for all VECs.

Table 9-7. Effects Assessment Summary

Group	VEC	Project Phase Interactions	Characterization[1]				Significance
			Magnitude	Likelihood	Duration	Frequency	
Atmospheric	Air Quality	All	L	L	LT	R	Not Significant
	Noise	All	L	AC	LT	R	Not Significant
Geophysical	Geology and Topography	All	L	AC	LT	R	Not Significant
	Groundwater	All	L	P	P	C	Not Significant
Terrestrial	Habitat, Vascular Plants and Lichens	All	L	AC	LT	O/S	Not Significant
	Fauna	All	L	AC	LT	R	Not Significant
	Avifauna	All	L	AC	LT	R	Not Significant
Aquatic	Wetlands	All	L	AC	LT	O	Not Significant
	Surface Water, Fish and Fish Habitat	All	L	AC	P	R	Not Significant
Socioeconomic	Economy	All	M	AC	LT	R	Significant (positive)
	Land Use and Value	All	L	AC/P	LT	C	Not Significant
	Recreation and Tourism	All	L	U	LT	S	Not Significant
	Cultural and Heritage Resources	Construction	L	U	ST	O	Not Significant
	Human Health	All	N	U	LT	S	Not Significant

Magnitude – Negligible (N), Low (L), Moderate (M), High (H)
Likelihood – Unlikely (UL), Possible (P), Likely (L), Almost Certain (AC)
Duration – Short-Term (ST), Long-Term (LT), Permanent (P)
Frequency – Once (O), Sporadic (S), Regular (R), Continuous (C)

10 EFFECTS OF THE ENVIRONMENT ON THE UNDERTAKING

Effects of the environment on the undertaking considers local conditions or natural hazards that can affect the Project's operations and may contribute to further environmental impacts. Extreme storms and forest fires are natural hazards that have the potential to affect the Project. These hazards are described in more detail in the following subsections.

10.1 Extreme Storms

Climate change is increasing the frequency, strength, and intensity of storms (USEPA 2022) and extreme storms have the potential to affect Project infrastructure. In recent years Nova Scotia specifically has been impacted by extreme storms (e.g., Hurricane Fiona) and weather events (e.g., July 2023 flash flood event).

10.1.1 Heavy Precipitation and Flooding

Heavy precipitation and flooding have the potential to impact Project haul roads, encourage sediment and erosion control issues, and flood the quarry floor. Due to Study Area topography, it is unlikely that the flooding associated with the adjacent watercourses and waterbodies would result in flooding in the QEA. No flooding has occurred in the current quarry operation (IA Permit Area). The Study Area is >13 km from the nearest tidal waterbody, Mahone Harbour, therefore, storm surges are not anticipated to be a risk to the Project.

If required, settling ponds will be engineered to appropriately maintain surface water runoff during storm events. Settling ponds will be monitored regularly during high precipitation events.

10.1.2 Lightning

Lightning strikes have the potential to damage Project infrastructure and are a risk to human health and safety. Fire extinguishers will be located on site in case of fire. The Project will assess working conditions and cease work as necessary when there are risks of lightning strikes at the Project site.

10.2 Drought

Drier than normal conditions can cause an increase in dust. Dust will be managed via application of water and dust suppression mitigations (see Section 9.1.1.1), as necessary.

10.3 Forest Fires

Forest fires have the potential to damage Project infrastructure and are a risk to human health and safety. Nova Scotia was recently impacted by expansive forest fires in spring 2023, with concern that these events may occur more frequently as a result of climate change.

The risk of a forest fire is dependent on several weather conditions such as extended periods without precipitation and high temperatures. Forest fire risk is also dependent on potential ignition sources such as lightening or human-caused fires (campfires, cigarettes etc.). Climate change is causing an increase in the frequency and strength of heatwaves (USEPA 2022). Forest fires are near impossible to predict, however, the Study Area is situated in an area with the lowest likelihood (0-5) according to the fire weather index[4] (Natural Resources Canada 2022). The Project will employ best-practices to mitigate fire risk and ensure preparedness (e.g., emergency planning, fire extinguishers, equipment and vehicle maintenance, employee training).

11 OTHER APPROVALS REQUIRED

In addition to approval of the EARD, the Project requires additional provincial permits/approvals (Table 11-1). No federal or municipal approvals are anticipated.

Table 11-1. Other Approvals Required

Approval / Permit Required	Responsible Department	Timeline to Obtain Approval	Description	Anticipated Submission
Provincial Approvals				
IA Amendment	Nova Scotia Environment and Climate Change (NSECC)	Prior to quarry expansion	Amendment to current Walden Quarry IA for QEA.	Application to be submitted after EA approval.
Wetland Alteration Permit	Nova Scotia Environment and Climate Change (NSECC)	Prior to encroachment within 30m of wetlands	Nova Scotia Wetland Alteration Application is required for alterations to wetlands.	Application to be submitted after EA approval.

12 FUNDING

The Project is being funded by Dexter.

13 ADDITIONAL INFORMATION

All applicable information has been included above.

[4] Fire weather index is based on means measured from April to September from 1981 to 2010

14 CONCLUSIONS

The EARD has been prepared to evaluate the effect of the Project on selected VECs, as presented in Table 6-2 in Section 6.4, which includes a detailed assessment of existing baseline conditions and predicted impacts to each VEC.

A summary of each VEC and Project interactions are outlined below.

Air Quality

Air quality (dust) has the potential to adversely affect human health at adjacent residential receptors and the health of flora. Air quality at the Project will be regulated under the Site Industrial Approval and *Pit and Quarry Guidelines*, where particulate emission limits are required to be met at the Project property boundaries. Quarry expansion is not expected to decrease air quality compared to current baseline conditions, as the existing quarry has been in operation since 2015 and there is no proposed increase to the magnitude and frequency of activities likely to generate dust. Quarry expansion will increase the life of the Project; therefore, the duration of these activities is proposed to be increased. Air quality is expected to return to baseline conditions during periods of site inactivity and post-reclamation. After mitigation measures are implemented, and the *Pit and Quarry Guidelines* are adhered to, the predicted residual environmental effects for air quality are assessed not to be significant.

Noise

Noise has the potential to adversely affect residential receptors adjacent the Project as well as fauna and avifauna. Noise at the Project will be regulated by the Site Industrial Approval, the *Occupational Health and Safety Act*, and *Pit and Quarry Guidelines*. One existing permanent residential receptor (Receptor 1) was identified within 800 m of the QEA. Dexter has authorization to conduct blasting at the existing quarry and within the QEA. Relatively intact forest lands separate local residences from Project infrastructure, therefore, Project generated noise from blasting is not expected to be transmitted at a significant degree to adjacent receptors. All municipal by-laws will be followed to ensure that allowable noise levels are not exceeded. Proposed Project activities are in line with the current magnitude of operations and no increased frequency of activities is anticipated. Quarry expansion will extend the life of the Project; therefore, the duration of these activities is proposed to be increased. Noise is expected to return to baseline conditions during periods of site inactivity and post-reclamation. After commitments and mitigation measures are implemented, and the *Pit and Quarry Guidelines* are adhered to, the predicted residual environmental effects for noise are assessed not to be significant.

Geology and Topography

Quarry expansion will alter the surficial and bedrock geology as well as local topography. Exposed soils have the potential to affect surface water quality through erosion and sedimentation, mineralisation of rock (including ARD) and changes in surface water volume discharged downstream. The bedrock underlying the Study Area is part of the Goldenville Formation, the NSDNRR ARD Potential Map identifies that the Study Area falls within an area of low ARD potential and ARD testing indicated sulphur concentrations in the sample is below the requirement (0.4 Wt.%) for handling under the Sulphide Bearing Materials Disposal Regulations and does not have significant acid producing potential. A surface

water monitoring program will be implemented to ensure that Total Suspended Solids (TSS) and pH levels remain within acceptable parameters. The predicted residual effects are assessed not to be significant.

Groundwater

Quarrying has the potential to affect groundwater quantity by altering recharge/discharge functions and quantity and groundwater flow paths. Groundwater quality could also be affected from blasting or rock-water interaction. Effects to groundwater quantity and quality (and surrounding wells) from quarry expansion is unlikely because the quarry floor will be fractured, allowing for infiltration. No additional hard landscaped areas are proposed in the QEA (i.e., impermeable, compacted areas such as paved roads or other constructed infrastructure). One active well was identified within 800 m of the QEA (Receptor 1), and Dexter has authorization to conduct blasting within the existing quarry and QEA. Overall groundwater recharge is expected to remain unchanged from existing conditions, but groundwater flow paths may be locally disrupted.

Site operations and existing aggregate excavation has not encountered the deep bedrock water table. It is the intention of Dexter to not excavate or blast below the water table in the QEA. If future quarry operations are planned to extend below the groundwater table, a hydrological study will be completed, including and approval from NSECC obtained prior to excavation below the groundwater table.

No significant residual environmental effects to groundwater quality and quantity anticipated, however, a groundwater monitoring program will be implemented to validate predictions.

Habitat, Vascular Plants, and Lichens

Direct loss to wetland and upland habitats is expected to occur primarily during the construction phase of the Project (i.e., clearing and grubbing). No SAR vascular plant species were identified. The two occurrences of a SOCI vascular plant, southern twayblade, will be avoided by the Project. One SAR lichen, frosted glass-whiskers, was identified at one location within the Study Area and will be avoided by the Project. All observations of southern twayblade will be avoided by the Project. Three occurrences of two SOCI lichen, corrugated shingles lichen and blistered tarpaper lichen, are proposed to be directly impacted from the Project.

The predicted residual environmental effects are assessed to be not significant because no permanent, unmitigated alteration to habitat that supports flora/lichen species distribution, where similar habitat is not currently available at the local/regional level, is expected. No SAR vascular plants or lichen will be lost as a result of the Project.

Fauna

Quarry activities have the potential to have an effect on the fauna from potential mortality, sensory disturbance, and the loss or alteration of habitat and habitat fragmentation. No priority mammal species were observed within the Study Area during the wildlife surveys or incidentally, including during dedicated Mainland moose surveys. Two SAR turtle species, Eastern painted turtle and snapping turtles, were

observed incidentally in WL1 and Bagpipe Lake. Nests and tracks were observed within the IA permit Area and adjacent road.

Habitat will be lost as a result of the Project, but the habitat present in the Study Area is common to the regional area and available in the surrounding landscape. The geographic extent of the QEA is relatively small (23.8 ha). The activities likely to create the greatest indirect impact to fauna are sensory disturbances from blasting and crushing. These activities will only occur as required (e.g., anticipated one blast per year during years in which the site is active). Turtle signage and exclusion fencing has already been erected at the existing quarry and will be maintained through the operational life of the proposed Project. During inactive periods, sensory disturbance will reverse to baseline conditions as it will be post-reclamation. After mitigation measures are implemented (including a wildlife management plan), no significant residual effects of the Project on fauna are anticipated.

Avifauna

Avifauna surveys included migration (spring and fall), breeding, winter, nocturnal owl, and common nighthawk. Four avifauna SAR were observed: Canada warbler, olive-sided flycatcher, eastern wood-pewee, and peregrine falcon.

Physical loss of bird habitat within the QEA, and the likely displacement of birds as a result of quarrying will occur but is expected to be small in scale and not impact regional populations and patterns. Therefore, after mitigation measures have been implemented, the predicted residual environmental effects are assessed to be not significant.

Wetlands

Ten wetlands were identified within the Study Area and total approximately 4.1 ha. Swamps make up the majority of these wetlands (90%). Five wetlands (WL1, 2, 4, 5 and 9) are noted as potential WSS based on the presence of SAR and suitable habitat. Seven wetlands are proposed for direct alteration. The QEA was microsited to avoid direct and indirect impacts to two WSS (WL1 and 2). WL4, 5 and 9 could not be avoided by the Project. None of the wetlands within the Study Area are classified as a functional WSS.

Wetland alteration approvals will be obtained for wetlands proposed for alteration, wetlands altered will be appropriately compensated for, and a wetland monitoring program will be implemented for wetlands partially altered or with potential to be indirectly affected by the Project (i.e., WL2, 5, and 10). As a result, the predicted residual environmental effects to wetlands are assessed to be not significant.

Surface Water, Fish and Fish Habitat

Two field identified watercourses, WC1 (Big North Brook) and WC2 (Little North Brook), and two waterbodies, Pond 1 and Bagpipe Lake, were delineated and characterized within the Fish Study Area.

- Big North Brook (WC1) is a provincially mapped watercourse that originates to the north of the Fish Study Area, flows through Pond 1 and continues south beyond the Fish Study Area before draining into Little Mushamush Lake;

- WC2 originates along the edge of an access road, traveling southwest through a provincially mapped wetland and acts as the main inflow to Bagpipe Lake;
- Pond 1 is a waterbody that is present within WC1/WL1 and situated along the northeastern boundary of the Fish Study Area;
- Bagpipe Lake is a waterbody that is located in the Fish Study Area, receives inflow of surface water from WC2 and has an outflow (Little North Brook; not assessed) that drains into Little Mushamush Lake.

Seven fish species (105 individuals) were captured (i.e., electrofishing and trapping surveys) within the Fish Study Area, including one SAR, American eel.

No surface water features or fisheries resources were identified within the QEA. The closest watercourse, WC1, will be avoided by Project activities and a 30 m buffer will be maintained around this watercourse during quarry expansion. As such, no direct impacts to fish or fish habitat are expected to occur because of the Project.

Indirect effects associated with quarry development include changes to surface water quantity and quality to downstream aquatic receivers. A WBA found that all assessed POIs were expected to have less than a 10% reduction in flow as a result of Project changes to the contributing drainage areas. Little North Brook-3 (WC2) is predicted to experience a decrease in annual streamflow of 9.46% during Operating and Reclamation conditions. All other POIs are predicted to see minimal impacts (<<10% reduction in monthly flows) and require no further analysis (-3.23% to 1.19% change in drainage area). The predicted decreases in runoff to WC2 is not expected result in changes to the morphological characteristics (i.e., bed or bank) of the watercourse, or in detectable changes to the existing fish community and the fish habitat provided by the watercourse.

All surface water discharges from the quarry site will be sampled as per requirements listed in the IA to meet the *Pit and Quarry Guidelines.*

After mitigation measures have been implemented, the predicted residual environmental effects on surface water, fish and fish habitat are assessed to be not significant.

Economy

The Project will benefit the economy as an important part of Nova Scotia's natural resource sector. The Project will also benefit the people of Nova Scotia via the continued construction and maintenance of the Provincial highway system and support the local community via a source of aggregate for local infrastructure needs. The Project will increase the longevity of current employment associated with the current quarry operations, as well as provide a stimulus to other local businesses (e.g., restaurants and hotels). A positive effect on the economy is anticipated from the Project.

Land Use and Value

The Project is located on private land owned wholly by Dexter. Reclamation of the quarry will return the site to pre-quarrying conditions, to the extent practicable. The Project is anticipated to have minimal impact upon the use of the lands when compared to existing baseline conditions and once reclamation is completed. As the Project is an expansion of an existing quarry operations, therefore it is unlikely that it will have additional impacts on property value. The Project is predicted to not have a significant effect on land use and value.

Recreation and Tourism

There are no provincial parks or known sensitive heritage or cultural attractions near the Study Area nor are there any designated public recreational trails or public recreational lands present inside the Study Area. While Mahone Bay and associated tourist attractions are located ~15 km southeast of the Project, tourism in the immediate area surrounding the Project is relatively low, therefore, the impacts of the Project on tourism are anticipated to be negligible. The Project is predicted to not have a significant effect on recreation or tourism.

Human Health

Potential impacts to human health from the Project development and operations include effects from air quality, noise, and accidents or malfunctions. The Project will generate noise and dust and has the potential to result in a spill or release, however, after mitigation measures are implemented and the Industrial Approval conditions and *Pit and Quarry Guidelines* are adhered to, no adverse effects to human health are predicted.

Cultural and Heritage Resources

No significant archaeological features were identified within the Study Area during field reconnaissance. The portions of the Study Area ascribed elevated potential for encountering Mi'kmaw archaeological resources through desktop review are beyond the boundaries of the proposed QEA. The remainder of the Study Area has been ascribed low archaeological potential. Due to a low potential for archaeological resources, of either Mi'kmaq or European-descended origin within the Study Area, no direct or indirect impacts to Cultural and Heritage Resources are expected as a result of the Project.

14.1 Summary of Conclusions

The findings of this EARD indicate that residual environmental effects will not be significant for identified VECs. Monitoring will be completed to confirm the predicted effects and determine if additional mitigation measures need to be implemented utilizing an adaptive management approach.

Monitoring

Dexter commits to developing the following monitoring plans or programs:

- Surface Water Monitoring Plan
- Groundwater Monitoring Plan

- Wetland Monitoring Plan
- All blasts will be monitored by a qualified blasting professional.
- Sedimentation, erosion control and monitoring will be implemented using industry best-practices.

Monitoring of Air and/or Noise will be completed at the request of NSECC and in accordance with IA terms and conditions.

Additional Commitments

Dexter commits to the following additional commitments:

- Ongoing engagement with Mi'kmaq communities and organizations and the public throughout the life of the Project.
- Development of a Surface Water Management Plan
- Development of a Reclamation Plan
- Development of a Wildlife Management Plan
- Development of a Contingency Plan

The plans noted above will be developed to meet EARD and/or IA approval terms and conditions. Plans will be submitted as part of the IA amendment process, or as necessary based on Project and approval timelines.

15 LIMITATIONS

Constraints Analyses:

- Many databases used for desktop review and constraints analysis for all VECs are provincially owned and shared. While the latest data sources were used to support this EA, these databases are limited by their age, update frequency, open-source restrictions, metadata, etc., particularly spatial data files.
- Conflicts may exist between and within a database, including topological inconsistencies, duplicate identifiers, errors caused by spatial resolution or projections, etc. McCallum attempts to identify and rationalize potential inconsistencies. In map generalization, the vast majority of conflicts are consequences of varying map and spatial data scales.

VEC Assessment Limitations:

- McCallum has relied in good faith upon the evaluation and conclusions in all third-party assessments. McCallum relies upon these representations and information provided but can make no warranty as to the accuracy of information provided.
- There are a potentially infinite number of methods in which human activity and natural factors can influence wildlife behaviors and populations and merely demonstrating that one factor is not operative does not negate the influence of the remainder of possible factors.
- The EA provides an inventory based on acceptable industry methodologies. A single assessment may not define the absolute status of site conditions.
- Effects of impacts separated in time and space that may affect the spatial assessment areas presented in this EA, have not been included in this assessment.

General Limitations:

- Classification and identification of soils, vegetation, wildlife, and general environmental characteristics (i.e., vegetation concentrations, wildlife habitat and usage) have been based upon commonly accepted practices in environmental consulting. Classification and identification of these factors are judgmental and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may not identify all factors and may be subjective between observers.
- All reasonable assessment programs will involve an inherent risk that some conditions will not be detected and all reports summarizing such investigations will be based on assumptions of what characteristics may exist between the sample points.

16 CERTIFICATION

This Report has considered relevant factors and influences pertinent within the scope of the assessment and has completed and provided relevant information in accordance with the methodologies described.

The undersigned has considered relevant factors and influences pertinent within the scope of the assessment and written, combined, and referenced the report accordingly.

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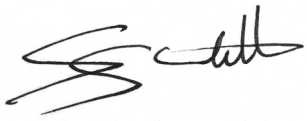

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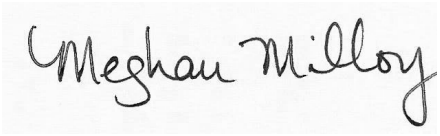

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17 REFERENCES

Adamus, P. 1996. Bioindicators for Assessing Ecological Integrity of Prairie Wetlands. EPA/600/R-96/082, US EPA Environmental Research Laboratory, Corvallis. http://www.epa.gov/owow/wetlands/wqual/ppaindex.html

Adamus, P., K. Verble, and M. Rudenko. 2016. Manual for the Oregon Rapid Wetland Assessment Protocol (ORWAP, revised). Version 3.1. Oregon Dept. of State Lands, Salem, OR.

Acadia First Nation. 2023a. About Us: Communities. Retrieved from: https://www.acadiafirstnation.ca/communities.html

Acadia First Nation. 2023b. About Us: Gold River. Retrieved from: https://www.acadiafirstnation.ca/gold-river.html

Acadia First Nation. 2023c. Business. Retrieved from: https://www.acadiafirstnation.ca/business.html

Alexander, D.R., J.J. Kerekes, and B.C. Sabean. 1986. Description of selected lake characteristics and occurrence of fish species in 781 Nova Scotia lakes. Proceedings of the Nova Scotia Institute of Science 36:63-106.

Baensch, H.A., and R. Riehl. 1995. Aquarien Atlas. Band 4. Mergus Verlag GmbH, Verlag für Natur- und Heimtierkunde, Melle, Germany. 864 p.

Barber, J.R., Fristrup, K.M., Brown, C.L., Hardy, A.R., Angeloni, L.M., and Crooks, K.R. 2009. Conserving the wild life therein- Protecting park fauna from anthropogenic noise. Parks Science. 26(3).

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Bickley, J. L. and Patricelli, G. 2010. Impacts of Anthropogenic Noise on Wildlife: Research Priorities for the Development of Standards and Mitigation. Journal of International Wildlife Law and Policy. 13(4): 274-292. DOI:10.1080/13880292.2010.524564.

Bird Studies Canada - Atlantic Region. 2019. *Nova Scotia Nocturnal Owl Survey: Guide for Volunteers.* Sackville, NB: Bird Studies Canada.

Bird Studies Canada. 2012. Important Bird Areas of the Maritimes. Retrieved from: http://www.ibacanada.org/maps/regions/Maritimes.pdf.

Bliss-Ketchum, Leslie L., et al. 2019. The Effect of Artificial Light on Wildlife Use of a Passage Structure. Biological Conservation, vol. 199, 2016, pp. 25–28., doi:10.1016/j.biocon.2016.04.025.

Bouchard, J., Ford, A. T., Eigenbrod, F. E., and Fahrig, L. 2009. Behavioral responses of northern leopard frogs (Rana pipiens) to roads and traffic: implications for population persistence. Ecology and Society, 14(2), 23.

Bowles, A.E. 1995. Responses of Wildlife to Noise. In Wildlife and Recreationists: Coexistence through Management and Research (Knight, R.L. and Gutzwiller, J., eds), pp. 109–156, Island Press.

Bradbury, C., A.S. Power and M.M. Roberge. 2001. Standard Methods Guide for the Classification/Quantification of Lacustrine Habitat in Newfoundland and Labrador. Fisheries and Oceans, St. John's, NF. 60 p

Brett, J.R. 1944. Some lethal temperature relations of Algonquin Park fishes. Univ. Toronto Stud. Biol. Ser. No. 52. 49 pp

Brodo, I.M., S.D. Sharnoff and S. Sharnoff. 2016. Keys to Lichens of North America – Revised and Expanded. Yale University Press, New Haven, Connecticut.

Brodo, I.M., Sharnoff, S.D., Sharnoff, S. 2001. Lichens of North America. Ottawa: Canadian Museum of Nature.

Buckmaster, Glenn, Todd, Melissa, Smith, Kirby, Bonar, Beck, Barbara, Beck, James, and Richard Quinlan. 1999. Elk Winter Foraging Habitat Suitability Index Model, Version 5. http://www.fmf.ab.ca/pdf/h_elk.pdf

California Department of Transportation. 2016. Technical Guidance for the Assessment and Mitigation of the Effects of Traffic Noise and Road Construction Noise on Bats. Division of Environmental Analysis. Sacramento, CA.

Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines (CCME). 1999. Water Quality Guidelines for the Protection of Freshwater Aquatic Life. Retrieved from: http://ceqg-rcqe.ccme.ca/en/index.html#void.

Canadian Rivers Institute (CRI). N.d. Alewife (Gaspereau), Alosa pseudopharengus. University of New Brunswick. Accessed online Alewife- Gaspereau | UNB

Carlson, R.E. and J. Simpson. 1996.*A Coordinator's Guide to Volunteer Lake Monitoring Methods*. North American Lake Management Society. 96 pp. Retrieved from: Trophic State Equations – North American Lake Management Society (NALMS)

Cape Breton University (CBU). 2023. Indigenous Affairs, The Mi'kmaq Resource Centre. The Mi'kmaq. Retrieved from: https://www.cbu.ca/indigenous-affairs/mikmaq-resource-centre/the-mikmaq/

Carter, V. 1996. National Water Summary - Wetland Resources. Technical Aspects of Wetlands: Wetland Hydrology, Water Quality and Associated Functions. U.S. Geological Survey Water- Supply Paper, 2425.

Coad, B.W., Waszczuk, H., and Labignan, I., 1995, Encyclopedia of Canadian fishes, Canadian Museum of Nature

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2012. COSEWIC assessment and status report on the American Eel Anguilla rostrata in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 109 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2012. COSEWIC assessment and status report on the Eastern Wood-pewee in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 39 pp. (Species at Risk Public Registry).

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2018. COSEWIC assessment and status report on the Midland Painted Turtle Chrysemys picta marginata and the Eastern Painted Turtle Chrysemys picta picta in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2018a. COSEWIC assessment and status report on the Common Nighthawk (Chordeiles minor) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 50 pp. (Species at Risk Public Registry).

Cornell University. 2021. *All About Birds*. Retrieved from https://www.allaboutbirds.org/guide/

Cultural Resource Management Group Limited (CRM Group), 2022. Walden Quarry Expansion Archaeological Resource Impact Assessment Screening & Reconnaissance 2022 Walden, Nova Scotia. Final Report.

Department of Fisheries and Oceans Canada (DFO). 2001. Bradbury, C., A.S. Power and M.M. Roberge. Standard Methods Guide for the Classification/Quantification of Lacustrine Habitat in Newfoundland and Labrador. Fisheries and Oceans, St. John's, NF. 60 p

Department of Fisheries and Oceans Canada (DFO). 2003. Interim Policy for the Use of Backpack Electrofishing Units. Retrieved from: http://www.dfo-mpo.gc.ca/library/273626.pdf.

Department of Fisheries and Oceans Canada (DFO). 2010. Pathways of Effects – Change in timing, duration and frequency of flow. Retrieved from: https://www.dfo-mpo.gc.ca/pnw-ppe/pathways-sequences/frequency-frequence-eng.html.

Department of Fisheries and Oceans Canada (DFO). 2012. Standard Methods Guide for the Classification and Quantification of Fish Habitat in Rivers of Newfoundland and Labrador for the Determination of Harmful Alteration, Disruption and Destruction of Fish Habitat. Retrieved from https://waves-vagues.dfo-mpo.gc.ca/library-bibliotheque/242052.pdf

Department of Fisheries and Oceans Canada (DFO). 2013. Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/017.

Department of Fisheries and Oceans Canada (DFO). 2016. American Eel. Retrieved from: http://dfo-mpo.gc.ca/species-especes/profiles-profils/eel-anguille-eng.html.

Department of Fisheries and Oceans Canada (DFO). 2019. Policy for Applying Measures to Offset Adverse Effects on Fish and Fish Habitat Under the Fisheries Act. Fish and Fish Habitat Protection Program. Fisheries and Oceans Canada. https://www.dfo-mpo.gc.ca/pnw-ppe/reviews-revues/forms-formes/apply-policy-politiqueapplique-eng.pdf.

Department of Fisheries and Oceans Canada (DFO). 2019a. Action Plan for the Atlantic Salmon (Salmo salar), inner Bay of Fundy population in Canada. Species at Risk Act action plan series. Fisheries and Oceans Canada, Ottawa. vii + 61pp.

Department of Fisheries and Oceans Canada (DFO). 2019b. Aquatic Species at Risk. Online interactive map tool. Retrieved from: https://www.dfo-mpo.gc.ca/species-especes/sara-lep/map-carte/index-eng.html.

Di Baldassarre, G. and Montanari, A. 2009. Uncertainty in River Discharge Observations: A Quantitative Analysis. Hydrology and Earth System Sciences, 13, 913-921. DOI: 10.5194/hessd-6-39-2009.

Drolet, A., Dussault, C. and Côté, S.D., 2016. Simulated drilling noise affects the space use of a large terrestrial mammal. Wildlife Biology, 22(6), pp.284-293.

Elbroch, M. (2003). *Mammal Tracks & Signs: A Guide to North American Species.* Mechanicsburg, PA, USA: Stackpole Books.

Erickcek 2006. An Assessment of the Economic Impact of the Proposed Stoneco Gravel Mine Operation on Richland Township. Retrieved from: https://research.upjohn.org/cgi/viewcontent.cgi?article=1225&context=reports

Environment and Climate Change Canada (ECCC). 2019. Canadian Environmental Protection Act, 1999 - Federal Environmental Quality Guidelines – Iron. Retrieved from:

https://www.canada.ca/en/environment-climate-change/services/evaluating-existing-substances/federal-environmental-quality-guidelines-iron.html
Environment and Climate Change Canada (ECCC). 2020. Recovery Strategy for the Wood Turtle (Glyptemys insculpta) in Canada. Ottawa.
Environment and Climate Change Canada (ECCC). 2022. Emergency Weather Station #2 - Air Quality Health Index. Accessed July 31, 2023, https://weather.gc.ca/airquality/pages/nsaq-005_e.html
Environment Canada – Canadian Wildlife Service (EC CWS). 2007. Recommended Protocols for Monitoring Impacts of Wind turbines on Birds.
Environment and Climate Change Canada Canadian Wildlife Service (ECCC CWS). 2019. Kentville Migratory Bird Sanctuary. Retrieved online: https://www.canada.ca/en/environment-climate-change/services/migratory-bird-sanctuaries/locations/kentville.html
Environment Canada. 2011. Management Plan for the Frosted Glass-whiskers (Sclerophora peronella), Nova Scotia Population, in Canada. Species at Risk Act Management Plan Series. Environment Canada, Ottawa. iii + 11 pp.
Environment Canada. 2012. The Canadian Aquatic Biomonitoring Network Field Manual, Wadeable Streams
Environment Canada. 2016. Recovery Strategy for the Wood Turtle (Glyptemys insculpta) in Canada [Proposed]. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. v + 48 pp
Environment Canada. 2016a. Recovery Strategy for the Canada Warbler (Cardellina canadensis) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vii + 56 pp.
Environment Canada. 2016b. Recovery Strategy for the Olive-sided Flycatcher (Contopus cooperi) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vii + 52 pp.
Environment and Climate Change Canada (ECCC). 2019. Action Plan for the Blanding's Turtle (*Emydoidea blandingii*), Nova Scotia Population, in Canada [Proposed]. *Species at Risk Act* Action Plan Series. Environment and Climate Change Canada and Parks Canada Agency, Ottawa. v + 24 pp
Environment and Climate Change Canada. 2020. Management Plan for the Snapping Turtle (Chelydra serpentina) in Canada. Species at Risk Act Management Plan Series. Environment and Climate Change Canada, Ottawa
Environmental Laboratory. 1987. "Corps of Engineers Wetlands Delineation Manual," Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
Erickcek, G. 2006. An assessment of the economic impact of the proposed Stoneco Gravel Mine operation on Richland Township. Michigan.
Fahrig, L. and Rytwinski, T., 2009. Effects of roads on animal abundance: an empirical review and synthesis. Ecology and society, 14(1).
Farmer, A.M. 1993. The effects if dust on vegetation – A review. Environmental Pollution. 79: 63-75.
Ford, George S. and Seals, Richard A. 2018. Quarry Operations and Property Values: Revisiting Old and Investigating New Empirical Evidence. Available at SSRN: https://ssrn.com/abstract=3138712 or http://dx.doi.org/10.2139/ssrn.3138712
Francis, C. D., Ortega, C. P., and Cruz, A. 2009. Noise Pollution Changes Avian Communities and Species Interactions. Current Biology 19(16): 1415-1419. DOI: 10.1016/j.cub.2009.06.052.

Grant, A. 2017. Estimating the Marginal Effect of Pits and Quarries on Rural Residential Property Values in Wellington County, Ontario: A Hedonic Approach. Retrieved from: https://dam-oclc.bac-lac.gc.ca/download?is_thesis=1&oclc_number=1252218919&id=7c8f3a94-76d7-443f-8f18-436383738f35&fileName=Grant_Alison_201706_MSc.pdf

Gandah, F. and Atiyat, D., 2016. Re-Use of Abandoned Quarries; Case Study of Eco-Tourism and Rangers Academy Ajloun–Jordan. *Journal of Civil and Environmental Engineering*, *6*, pp.1-238.

Gibson, A.J.F., P.G. Amiro, and K.A. Robichaud-LeBlanc. 2003. Densities of juvenile Atlantic salmon (Salmo salar) in inner Bay of Fundy rivers during 2000 and 2002 with reference to past abundance inferred from catch statistics and electrofishing surveys. Can Stock Assess. Sec. Res. Doc. 2003/121. ii + 61p.

Gilhen, J. 1974. The fishes of Nova Scotia's lakes and streams. Nova Scotia Museum, Halifax, Nova Scotia. v + 49 p.

Government of Canada. 2011. Aboriginal Consultation and Accommodation. Updated Guidelines for Federal Officials to Fulfill the Duty to Consult. Retrieved from: https://www.aadnc-aandc.gc.ca/DAM/DAM-INTER-HQ/STAGING/textetext/intgui_1100100014665_eng.pdf

Government of Canada. 2012. First Nation Profiles Interactive Map. Retrieved from: https://geo.aadnc-aandc.gc.ca/cippn-fnpim/index-eng.html

Government of Canada. 2021b. Census Profile, 2021 Census of Population. Retrieved from: https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/details/page.cfm?Lang=E&SearchText=Malagawatch%204&DGUIDlist=2021A00051215005&GENDERlist=1,2,3&STATISTIClist=1&HEADERlist=0

Government of Nova Scotia. 1998. Endangered Species Act. Bill No. 65. 1st Session, 57th General Assembly Nova Scotia 47 Elizabeth II, 1998.

Government of Nova Scotia. 2006. Environment Act. SNS 1994-95, c 1.

Grant, A., 2017. *Estimating the Marginal Effect of Pits and Quarries on Rural Residential Property Values in Wellington County, Ontario: A Hedonic Approach* (Doctoral dissertation, University of Guelph).

Grubb, T.G., Pater, L.L., and Delaney, D.K. 1998. Logging Truck Noise Near Nesting Northern Goshawks. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. https://doi.org/10.2737/RMRS-RN-3.

Harmel, R., Cooper, R., Slade, R., Haney, R. and Arnold, J. 2006. Cumulative Uncertainty in Measured Streamflow and Water Quality Data for Small Watersheds. Transactions of the ASABE Vol. 49(3): 689-701. DOI: 10.13031/2013.20488.

Health Canada. 2016. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Air Quality. Retrieved from: https://publications.gc.ca/collections/collection_2017/sc-hc/H129-54-1-2017-eng.pdf

Health Canada. 2017. Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise. Retrieved from: https://www.ceaa.gc.ca/050/documents/p80054/119378E.pdf

Hinds, H.R. 2000. Flora of New Brunswick. 2nd Edition. University of New Brunswick, Fredericton, NB.

Hinds, J.H., and Hinds, P.L. 2007. The Macrolichens of New England. The New York Botanical Garden Press.

Hite, D. 2006. Summary Analysis: Impact of Operational Gravel Pit on House Values, Delaware County,

Ohio, Auburn University.
Hosker Jr, R.P. and Lindberg, S.E., 1982. Atmospheric deposition and plant assimilation of gases and particles. Atmospheric Environment (1967), 16(5), pp.889-910.
Howe, R., Wolf, A., & Rinaldi, T. 1997. Monitoring Birds in a Regional Landscape: Lessons from the Nicolet National Forest Bird Survey. *Monitoring Bird Populations by Point Counts.* Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture. https://invernesscounty.ca/residents/recreational-resources/
Jalkotzy MG, Ross PI, Nasserden MD. 1997. The effects of linear developments on wildlife: a review of selected scientific literature. Arc Wildlife Services Ltd, prepared for Canadian Association of Petroleum Producers, Calgary
Kalff, J. 2002. Limnology: Inland Water Ecosystems. San Francisco, United States: Pearson Education.
Keddy, P. A. 2010. Wetland Ecology: Principles and Conservation. New York, New York. Cambridge University Press.
Kennedy, G.W., Drage, J., and Fisher, B.E. 2008. Groundwater Regions Map of Nova Scotia, scale 1:500 000 Digital version of Nova Scotia Department of Natural Resources Open File Map ME 2008-3.
Keys, K.; Neily, P.; Quigley, E.; Stewart, B. 2010. Part 3: Ecosites Forest Ecosystem Classification for Nova Scotia. Nova Scotia Department of Natural Resources.
Knight, R., Swaddle, J. 2011. How and Why Environmental Noise Impacts Animals: An Integrative, Mechanistic Review. Ecology Letters. doi: 10.1111/j.1461-0248.2011.01664.x
Lacroix, G. L. 1987. *F*ish community structure in relation to acidity in three Nova Scotia rivers. *Canadian Journal of Zoology, 65(12), 2908–2915.* doi:10.1139/z87-441
Lunenburg Region. 2023. Things to Do: Christmas Trees. T-Ernst Forestry Products. Retrieved from: https://www.lunenburgregion.ca/entries/thing-to-do/t-ernst-forestry-products.
Maritime Breeding Bird Atlas (MBBA). 2008. Atlassing for Species at Risk in the Maritime Provinces: A supplement to the Maritimes Breeding Bird Atlas Guide for Atlassers. 2nd Edition. Government of Canada. Habitat Stewardship Program for Species at Risk.
Marler, P., Konish, M., Lutjen, A. and Wasre, M.S., 1973. Effects of Continuous Noise on Avian Hearing and Vocal Development. Proc. Nat. Acad. Sci. USA. 70(5): 1393-1396. https://dx.doi.org/10.1073%2Fpnas.70.5.1393
McCune, B. 2009a. Microlichens of the Pacific Northwest. Volume 1: Key to The Genera. Wild Blueberry Media. Corvallis, Oregon, USA.
McCune, B. 2009b. Microlichens of the Pacific Northwest. Volume 2: Key to The Species. Wild Blueberry Media. Corvallis, Oregon, USA.
McMullin, R., Duinker, P., Cameron, R., Richardson, D., & Brodo, I. 2008. Lichens of Coniferous Old-Growth Forests of Southwestern Nova Scotia, Canada: Diversity and Present Status. *The Bryologist, 11*(4), 620-637.
McMullin, T. and Anderson, F. 2014. Common Lichens of Northeastern North America. MEM 112.
Mersey Tobeatic Research Institute. 2019. Vole Ears GIS Database.
Mortellaro, S., Krupa, S., Fink, L., and VanArman, J. 1995. Literature Review on the Effects of Groundwater Drawdowns on Isolated Wetlands. South Florida Water Management District: West Palm Beach, FL, USA.

Municipality of the District of Lunenburg. Recreation, Parks and Tourism: Municipal Parks and Trails: Church Lake Park. Retrieved from: https://www.modl.ca/church-lake-park.html

Munro, M.C., Newell, R.E., and Hill, N.M. 2014. Nova Scotia Plants. Retrieved from: https://ojs.library.dal.ca/NSM/pages/view/Plants.

Murie, O. (1974). *A Field Guide to Animal Tracks* (2 ed.). New York, New York, USA: The Peterson Field Guide Series.

Nash III, T. 2008. Lichen Biology. Cambridge: Cambridge University Press.

Native Plant Trust. 2020. Go Botany. Retrieved from: https://gobotany.nativeplanttrust.org/full/.

Natural Resources Canada. 2022. Fire Weather Normals. Retrieved from: https://cwfis.cfs.nrcan.gc.ca/ha/fwnormals?type=fwi&month=7

Neily P., Basquill S., Quigley E., and Keys K. 2017. Ecological Land Classification for Nova Scotia. Retrieved from: https://novascotia.ca/natr/forestry/ecological/pdf/Ecological-Land-Classification-guide.pdf.

Neily, P, Basquill, S., Quigley, E., Stewart, B., and Keys, K. 2010. Part 1: Vegetation Types. Forest Ecosystem Classification for Nova Scotia. Prepared by Nova Scotia Department of Natural Resources.

New Brunswick Department of Environment and Local Government (NBDELG). 2008. Manual for Wetland Ecosystem Services Protocol Atlantic Canada (WESP-AC): Non-tidal Wetlands. Fredericton, NB.

Niemi, G. J., P. DeVore, N. Detenbeck, D. Taylor, A. Lima, J. Pastor, J. D. Yount, and R. J. Naiman. 1990. Overview of case studies on recovery of aquatic systems from disturbance. Environmental Management 14(5): 571-587.

Nature Conservancy of Canada. 2023. Painted Turtle . Retrieved from: https://www.natureconservancy.ca/en/what-we-do/resource-centre/featured-species/reptiles-and-amphibians/painted-turtle.html

Nova Scotia. 2012. Proponents' Guide: The Role of Proponents in Crown Consultation with the Mi'kmaq of Nova Scotia. Second Revision November 2012.

Nova Scotia. 2021a. Mining. Natural Resources and Renewables. Retrieved from: https://novascotia.ca/natr/meb/mineral-resources/mining.asp

Nova Scotia. 2021b. Mining Highlights. Natural Resources and Renewables. Retrieved from: https://novascotia.ca/natr/meb/mineral-resources/mining-highlights.asp

Nova Scotia. 2023. Protecting Native Species of Fish in Nova Scotia. News Release. Retrieved from: https://novascotia.ca/news/release/?id=20220908002#:~:text=smallmouth%20bass%20were%20brought%20to,in%20more%20than%20300%20lakes

Nova Scotia Department of Environment and Labour (NSDEL). 2005. Guidelines for Environmental Noise Measurement and Assessment. First approved April 1990. Retrieved from https://noise-ordinances.com/wp-content/uploads/2021/01/EnvironmentalNoiseMeasurement.pdf

Nova Scotia Department of Fisheries and Aquaculture (NSDFA). Updated July 5, 2019. Nova Scotia Freshwater Fish Species Distribution Records. Retrieved from: https://data.novascotia.ca/Fishing-and-Aquaculture/Nova-Scotia-Freshwater-Fish-Species-Distribution-R/jgyj-d4fh.

Nova Scotia Department of Natural Resources (NSDNR). 2007. Ecological Land Classification 1:500,000. Retrieved online https://novascotia.ca/natr/forestry/ecological/pdf/ELC_Map.pdf

Nova Scotia Department of Natural Resources (NSDNR). 2009. The Drop on Water Online Interactive Groundwater Map. Retrieved online https://nsefp.ca/wp-content/uploads/2014/07/droponwaterFAQ_InteractiveGroundwaterMap.pdf

Nova Scotia Department of Natural Resources (NSDNR). 2010. Boreal Felt Lichen Predictive GIS Layer.

Nova Scotia Department of Natural Resources (NSDNR). 2012. Surficial Geologic Unit Polygons. GIS Spatial Data.

Nova Scotia Department of Natural Resources (NSDNR). 2015. Ecological Land Classification. GIS spatial data. Retrieved from https://nsgi.novascotia.ca/gdd/.

Nova Scotia Department of Natural Resources (NSDNR). 2017. Nova Scotia Abandoned Mine Openings Database. Retrieved from: https://novascotia.ca/natr/meb/download/dp010.asp.

Nova Scotia Department of Natural Resources (NSDNR). 2018. *At-Risk Lichens – Special Management Practices.*

Nova Scotia Department of Natural Resources (NSDNR). 2019. Ecodistrict Profile, Ecological Landscape Analysis Summary Ecodistrict 740: Lahave Drumlins.

Nova Scotia Department of Natural Resources (NSDNR). 2020. Provincial Landscape Viewer. Retrieved from: https://nsgi.novascotia.ca/plv/.

Nova Scotia Department of Natural Resources and Renewables (NSDNR). 2021. Acid Rock Drainage. Retrieved from: https://novascotia.ca/natr/meb/hazard-assessment/acid-rock-drainage.asp

Nova Scotia Department of Natural Resources and Renewables (NSDNRR). 2019. Atlantic Coastal Plain Flora Buffer GIS Database.

Nova Scotia Department of Natural Resources and Renewables (NSDNR). 2021. Recovery Plan for the Moose (Alces alces Americana) in Mainland Nova Scotia. Nova Scotia Endangered Species Act Recovery Plan Series.

Nova Scotia Department of Natural Resources and Renewables (NSDNRR). 2022. Forest Inventory Database: GIS Spatial Data. Retrieved from https://nsgi.novascotia.ca/gdd/

Nova Scotia Department of Natural Resources and Renewables (NSDNR). 2022. Old Growth Policy. Retrieved from: https://novascotia.ca/natr/forestry/programs/ecosystems/oldgrowth.asp

Nova Scotia Department of Public Works (NSDPW), 2022. Primary Roads Traffic Volume Data. Retrieved from: https://novascotia.ca/tran/publications/Primary_Roads_-_Traffic_Volume_Data.pdf

Nova Scotia Environment (NSE). 2009. Guide to Addressing Wildlife Species and Habitat in an EA Registration Document. Policy and Corporate Services Division. Environmental Assessment Branch. Retrieved from: https://www.novascotia.ca/nse/ea/docs/EA.Guide-AddressingWildSpecies.pdf.

Nova Scotia Environment (NSE). 2015a. Guide to Altering Watercourses. Retrieved from: https://www.novascotia.ca/nse/watercourse-alteration/. Last modified: 2015-06-10.

Nova Scotia Environment (NSE). 2017. Wetland Inventory Database. GIS spatial data. Provided by NSE (Charles Sangster).

Nova Scotia Environment (NSE). 2019. Nova Scotia Wetland Conservation Policy. Revision Date October 2019. Retrieved from: https://www.novascotia.ca/nse/wetland/conservation.policy.asp.

Nova Scotia Environment and Climate Change (NSECC). 2022. Well Logs Database. Retrieved from: https://novascotia.ca/natr/meb/download/dp430.asp.

Nova Scotia Environment and Climate Change (NSECC). 2022. West Northfield (088) - Groundwater Level Elevations (2008 to present). Retrieved from: https://novascotia.ca/nse/groundwater/docs/historical/082LongPointHistoricalGraph.pdf

Nova Scotia Environment and Climate Change (NSECC). 2023. Guidelines for Environmental Noise Measurement and Assessment. Retrieved from: https://novascotia.ca/nse/air/docs/guidelines-environmental-noise-measurement-and-assessment.pdf

Nova Scotia Environment and Labour (NSDEL). 1999. *Pit and Quarry Guidelines*, NSDEL, May 1999.

Nova Scotia Property Online. 2022. Retrieved from: https://novascotia.ca/sns/access/land/property-online.asp

Nova Scotia Provincial Parks. 2023. South Shore Region Parks. Retrieved from: https://parks.novascotia.ca/region/south-shore

Nova Scotia Sportfish Association. 2018. Nova Scotia Fish Habitat Assessment Protocol: A Field Methods Manual for the Assessment of Freshwater Fish Habitat.

Nova Scotia Tourism. 2023. Places to Go: South Shore. Retrieved from: https://www.novascotia.com/places-to-go/regions/south-shore.

Occupational Health and Safety Act (OHSA). 1996. Province of Nova Scotia. Retrieved from: https://nslegislature.ca/sites/default/files/legc/statutes/occupational%20health%20and%20safety.pdf

Office of L'nu Affairs (OLA). 2015. Aboriginal People in Nova Scotia. Retrieved from: https://novascotia.ca/abor/aboriginal-people/

Patthey, P., S. Wirthner, N, Signorell, R. Arlettaz et al. 2008. Impact of Outdoor Winter Sports on the Abundance of a Key Indicator Species of Alpine Ecosystems. J. Appl. Ecol. 10, 2–8.

Paulson, D. (2011). Dragonflies and Damselflies of the East. Woodstock, Oxforshire, UK: Princeton University Press.

Peterson, R. (2020). Peterson Field Guide to Birds of Eastern & Central North America. Houghton Mifflin Harcourt.

Portt, C.B., G.A. Coker, D.L. Ming, and R.G. Randall. 2006. A review of fish sampling methods commonly used in Canadian freshwater habitats. Can. Tech. Rep. Fish. Aquat. Sci. 2604 p.

Province of Nova Scotia. 2012. Proponents' Guide: The Role of Proponents in Crown Consultation with the Mi'kmaq of Nova Scotia. Second Revision November 2012.

Province of Nova Scotia. 2013. Occupational Safety General Regulations made under Section 82 of the Occupational Health and Safety Act S.N.S. 1996, c.7.

Province of Nova Scotia. 2017. Sulphide Bearing Material Disposal Regulations. Environment Act, Section 66. S.N.S. 1994-95, c.1.

Raleigh, R. F. 1982. Habitat suitability index models: Brook trout. U.S. Dept. Int., Fish Wildl. Servo FWS/OBS-82/10.24. 42 pp.

Rezendes, P. (1999). Tracking & the Art of Seeing: How to Read Animal Tracks & Sign (2 ed.). New York, New York, USA: Harper Collins.

Saskatchewan Ministry of Environment. 2015. Common Nighthawk Survey Protocol. Fish and Wildlife Branch Technical Report No. 2015-15.0. 3211 Albert Street, Regina Saskatchewan. 7 pp.

Scott W.B. and Crossman, E.J. 1973. Freshwater Fishes of Canada. Ottawa. 515 – 517 pp

Shannon, G., McKenna, F., Angeloni, L., Crooks, K., Fistrup, K., Brown, E., Warner, K., Nelson, M., White, C., Briggs, J., McFarland, S., Wittemyer, G. 2016. A Synthesis of Two Decades of Research Documenting the Effects of Noise on Wildlife. Biological Reviews, 91(4). https://doi.org/10.1111/brv.12207.

Sibley, D. 2016. *The Sibley Field Guide to Birds of Eastern North America.* Knopf.

Sibson, R. 1981. A Brief Description of Natural Neighbor Interpolation, chapter 2 in Interpolating Multivariate Data. New York: John Wiley & Sons. 21–36.

Siegel, D. I., and P. H. Glaser. 1987. Groundwater flow in a bog-fen complex, Lost River Peatland, northern Minnesota. The Journal of Ecology, 75, 743-754. Simonson, T. D., and J. Lyons. 1995.

SMITH, D. L., UNDERWOOD, J. K., OGDEN, J. G., 111, and SABEAN, B. C. 1986. Fish species distribution and water chemistry in Nova Scotia lakes. Water Air Soil Pollut. 30: 489-496.

South Canoe Wind. 2023. South Canoe Wind Farm website. Retrieved from: https://southcanoewind.com/

Statistics Canada. 2016. Gold River 21, IRI [Census subdivision], Census Profile. 2016 Census. Retrieved from: https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E (accessed May 11, 2023).

Statistics Canada. 2023. Lunenburg County, Census Profile. 2021 Census of Population. Retrieved from: https://www12.statcan.gc.ca/census-recensement/2021/dp-pd/prof/index.cfm?Lang=E (accessed June 5, 2023).

Stewart, R.L.M, K.A., Bredin, A.R. Couturier, A.G. Horn, D. Lepage, S. Makepeace, P.D. Taylor, M.A. Villard, and R.M. Whittam (eds). 2015. Second Atlas of Breeding Birds of the Maritime Provinces. Bird Studies Canada, Environment Canada.

Stone, Nathan & Kelly, Anita & Roy, Luke. 2016. A Fish of Weedy Waters: Golden Shiner Biology and Culture. Journal of the World Aquaculture Society. 47. 152-200. 10.1111/jwas.12269.

Suter, A.H., 2002. Construction noise: exposure, effects, and the potential for remediation; a review and analysis. AIHA journal, 63(6), pp.768-789.

Takats, D., Francis, C., Holroyd, G., Duncan, J., Mazur, K., Holt, D. 2001. *Guidelines for Nocturnal Owl Monitoring in North America.* Edmonton, Alberta: Beaverhill Bird Observatory and Bird Studies Canada.

The Salmon Atlas. 2021. The Atlantic Salmon Rivers of Nova Scotia, Canada. Retrieved online: http://www.salmonatlas.com/atlanticsalmon/canada-east/nova-scotia/mapnovascotia.html

Tiner, R. 2005. In Search of Swampland, A Wetland Sourcebook and Field Guide. Second Ed. Rutgers University Press, New Brunswick.

Tourism Nova Scotia. 2022. Tourism Performance. Retrieved from: https://tourismns.ca/historic-tourism-statistics

Tufts, R. (1986). *Birds of Nova Scotia* (3 ed.). Halifax, Nova Scotia: Nimbus Publishing Limited & The Nova Scotia Museum.

United States Army Corps of Engineers. 2012. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region. Retrieved from http://www.usace.army.mil/Portals/2/docs/civilworks/regulatory/reg_supp/NCNE_suppv2.pdf

United States Department of Agriculture & Natural Resources Conservation Service (USDA-NRCS). 2003. Soil Survey Staff. *Keys to Soil Taxonomy* (9th Ed.). Retrieved from: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051544.pdf.

United States Environmental Protection Agency (USEPA). 2022. Climate Change Indicators: Weather and Climate. August 1, 2022. Retrieved from: https://www.epa.gov/climate-indicators/weather-climate#:~:text=Scientific%20studies%20indicate%20that%20extreme,with%20human%2Dinduced%20climate%20change.

Ware, H., McClure, C., Carlisle, J., Barber., J. 2015. A Phantom Road Experiment Reveals Traffic Noise Is an Invisible Source of Habitat Degradation. PNAS. 112 (39). 12105-12109. https://doi.org/10.1073/pnas.1504710112

Warner B.G., and Rubec C.D.A. 1997. The Canadian Wetland Classification System. Second Edition.

Webb and Marshall, 1999. Ecoregions and Ecodistricts of Nova Scotia. Retrieved from: http://sis.agr.gc.ca/cansis/publications/surveys/ns/nsee/nsee_report.pdf

Webb, K.T. and Marshall, LB. 1999. Ecoregions and ecodistricts of Nova Scotia. Crops and Livestock Research Centre, Research Branch, Agriculture and Agri-Food Canada, Truro, Nova Scotia; Indicators and Assessment Office, Environmental Quality Branch, Environment Canada, Hull, Quebec. 39 pp. and 1 map. https://sis.agr.gc.ca/cansis/publications/surveys/ns/nsee/nsee_report.pdf

Weber-Scannell, P. K., & Duffy, L. K. 2007. Effects of Total Dissolved Solids on Aquatic Organisms: A Review of Literature and Recommendation for Salmonid Species. American Journal of Environmental Sciences, 3(1), 1-6.

Wright, D.G. and G.E. Hopky. 1998. Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters. Canadian Technical Report of Fisheries and Aquatic Sciences 2107. Iv + 34p.

Zinck, M. 1998. Roland's Flora of Nova Scotia. Nimbus Publishing, Halifax, NS.