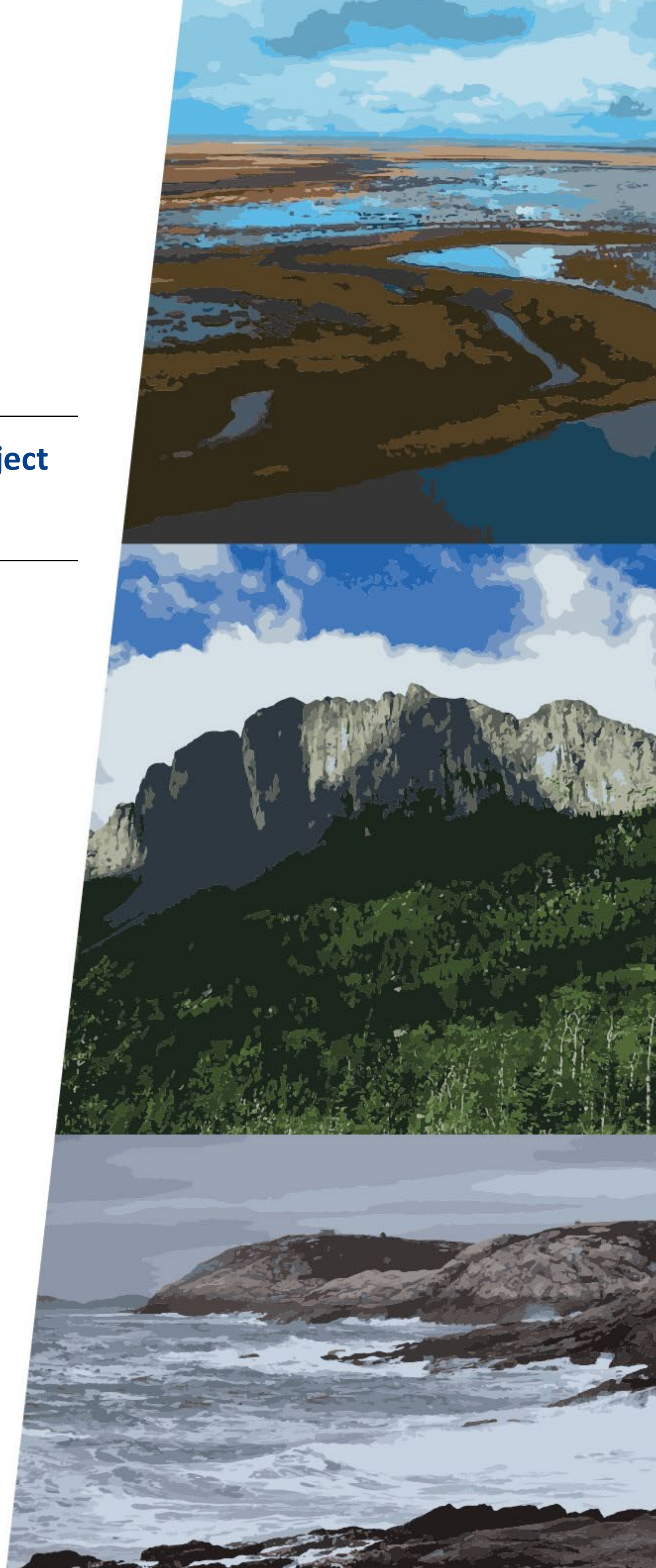
ENVIRONMENTAL ASSESSMENT
REGISTRATION DOCUMENT

Lantz Quarry Expansion Project

Lantz, Nova Scotia



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November 2, 2022

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EXECUTIVE SUMMARY

2514869 Nova Scotia Limited, an affiliated company of Dexter Construction Company Limited (Dexter), operates an existing <4 ha rock quarry under a Nova Scotia Environment and Climate Change (NSECC) Industrial Approval (2007-060446-03) at 48 Dutch Settlement Road, Lantz, Halifax County, Nova Scotia (PID 00524298). The Lantz Quarry has been an NSECC approved quarry for approximately 15 years 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 increased an additional 5.9 ha within the Quarry Expansion Area (QEA). In addition to the QEA, a 2.8 ha laydown area will also be constructed (laydown area will not be quarried). The Project has been proposed over a 40-year time period and the QEA has been divided into three phases: Phase 1 (1.9 ha, 10 years), Phase 2 (1.9 ha, 10 years), and Phase 3 (2.2 ha, 10 years). Other than an increase in the total footprint of the site, site activities are not planned to increase in scope or frequency from past use.

Mi'kmaq and Public Engagement

The Project team has engaged with the Kwilmu'kw Maw-klusuaqn Office (KMKNO) throughout the EA process and this engagement resulted in constructive dialogue relating to the Project and its potential impact on the surrounding environment and the Mi'kmaq of Nova Scotia. Dexter has also initiated engagement activities with Sipekne'katik First Nation and Millbrook First Nation. Dexter is committed to engaging with First Nation communities and organizations throughout the life of the Project.

Public engagement activities have occurred to support the EA process for the Project and include a Project description letter and a public information session held at the existing quarry on October 26, 2021. Members of the public inquired about truck traffic, potential impacts to road quality, and impacts to house foundations and wells from blasting. Dexter is committed to continuing to engage with the public throughout the life of the Project.

Study Area

Spatial boundaries of the EA are defined by the Study Area and the Aquatic Study Area. The Study Area was designed to include the maximum potential extent of the QEA for the Project and the maximum extent of potential terrestrial impacts (and in consideration of property ownership) and is defined by the southern extent of PID 00524298. The Aquatic Study Area includes the Study Area and an unmapped watercourse to its connection with Keys Brook to the northeast of the Study Area. This study area was defined to consider the maximum extent of potential aquatic impacts. All assessments used the Study Area as the spatial boundary for assessment with the exception of Fish and fish habitat assessments, which occurred within the Aquatic Study Area. The Study Area and Aquatic Study Area are 25.8 ha and 26.1 ha, respectively.

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.

Noise

Noise has the potential to affect residential receptors adjacent the Project as well as fauna and avifauna. Noise at the Project will be regulated by the Site Industrial Approval and *Pit and Quarry Guidelines*. No residential receptors were identified within 800 m of the QEA and there have been no known exceedances of blasting parameters at the existing quarry, 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 nor any change in timing expected. After these 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.

Air Quality

Air quality (dust) has the potential to adversely affect human health 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 baseline conditions, as the existing quarry has been in operation for 15 years 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. 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.

Surficial Geology, Bedrock 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 Acid Rock Drainage) and changes in surface water volume discharged downstream. Acid Rock Drainage (ARD) testing was completed and it was determined that there is negligible potential for ARD based on low sulphur concentrations. 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 and groundwater flow. Groundwater quality could also be affected from blasting or rock-water interaction (e.g., Acid Rock Drainage).

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) and no active wells were identified within 800 m of the QEA. Overall groundwater recharge is expected to remain unchanged from existing conditions, but groundwater flow paths may be locally disrupted. No significant residual environmental effects to groundwater quality and quantity anticipated, however, a groundwater monitoring program will be implemented to ensure predictions are accurate.

Surface Water
One unnamed watercourse was delineated and characterized within the Study Area (WC1). WC1 originates outside of the western Aquatic Study Area boundary, flowing northeast under the Projects existing quarry access road via a culvert and continues to flow northeast to its connection with Keys Brook (818 m linear length). WC1 is a first order, low to moderate gradient watercourse that transitions from being ephemeral to intermittent and then perennial before dispersing into Keys Brook.

No direct effects to surface water features are expected and a 30 m buffer will be maintained around WC1. The mapped, upstream extent of WC1, as well as downstream in Keys Brook, are not expected to sustain a change in water quantity as there is minimal anticipated changes to their contributing drainage areas. Changes to water quantity within WC1 are predicted to occur downstream of the settling pond discharge location (maximum monthly average of 49.44%). Impacts to the morphological characteristics of this section of watercourse are possible, however, mitigation measures (e.g., infiltration trenches and/or soakaway pits) will be employed and a surface water monitoring program will be initiated to validate and manage potential increases in flow.

Fish and Fish Habitat
During fish surveys, brook trout (*Salvelinus fontinalis*; S3) were captured in the downstream reaches of WC1. Keys Brook has been documented by Fisheries and Oceans Canada (DFO) to support Atlantic salmon – inner Bay of Fundy population (*Salmo salar* pop.1; SARA Endangered), however, no Atlantic salmon were identified during fishing surveys.

No fisheries resources were identified within the QEA. WC1, the sole watercourse identified within the Study Area, will be avoided by Project activities and a 30 m buffer will be maintained around this watercourse during quarry expansion. Unmitigated, WC1 may experience a permanent increase in streamflow to approximately 482 m^2 of brook trout and American eel habitat, which is the length of the delineated watercourse downstream of WC-1D multiplied by the average channel widths of Reaches 4 and 5, as measured during detailed habitat assessments. The increase in flow to the downstream extent of

WC1 is not anticipated to have measurable impacts on Keys Brook, whose contributing drainage area remains relatively unchanged through quarry expansion. Mitigation measures (e.g., infiltration trenches and/or soakaway pits) will be employed to manage flow releases into WC1.

The predicted residual environmental effects of the Project on fish and fish habitat are assessed to be not significant. A Surface Water Monitoring Program will be designed to evaluate the potential changes in surface water runoff and water quality to fish and fish habitat. The protective mitigation measures and monitoring commitments will ensure impacts to fish and fish habitat do not occur as a result of quarry expansion.

Wetlands

Seventeen wetlands were identified within the Study Area, of which seven are located within or partially within the QEA. Treed swamps make up the majority of these wetlands (n=12) and the remaining five wetlands are bogs. Due to the observation of Canada warbler (*Wilsonia canadensis*, SARA Threatened, NSESA Endangered, S3B) and the availability of suitable breeding habitat within wetland 1 (WL1), it is expected that NSECC will classify WL1 as a wetland of special significance (WSS). No direct or indirect impacts are anticipated to WL1 from the Project.

Over the 40-year lifespan of the quarry, seven wetlands will be completely or partially altered. Indirect effects to downgradient wetlands have the potential to occur, however, the use of mitigation practices will greatly reduce this potential. 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. As a result, the predicted residual environmental effects to wetlands are assessed to be adverse but not significant.

Vegetative Community, Vascular Plants, and Lichens

The Study Area is comprised of a mosaic of mixedwood stands, softwood dominated stands, forested wetlands, and disturbed areas. Disturbed portions of the Study Area include the existing quarry footprint, access roads, and historic forestry activities. One Species of Conservation Interest (SOCI) vascular plant was identified, Bicknell's crane's-bill (*Geranium bicknellii*, S3). This plant is located 10 m southeast of the existing quarry face and will be lost due from Project expansion. No lichen priority species were identified within the Study Area.

The predicted residual environmental effects are assessed to be adverse, but 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 Species at Risk (SAR) vascular plants or lichen will be lost as a result of quarry development.

Fauna

Wildlife surveys found signs of snowshoe hare (*Lepus americanus;* S5), white-tailed deer (*Odocoileus virginianus;* S5), American red squirrel (*Tamiasciursus hudsonicus;* S5), North American porcupine (*Erethizon dorsatum;* S5), and red fox (*Vulpes vulpes;* S5). No priority fauna species were observed within the Study Area during the wildlife survey or incidentally.

Habitat will be lost as a result of the Project but the habitat present in the QEA is common to the regional area and available in the surrounding landscape. The geographic extent of disturbance footprint is small (8.75 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 and is it anticipated that the expansion will only require one blast per year. During inactive periods sensory disturbance is reversed 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. Three Species at Risk (SAR), Canada warbler, common nighthawk (*Chordeiles minor*; SARA and NSESA Threatened, S3B), and eastern wood-pewee (*Contopus virens*; SARA Special Concern, NSESA Vulnerable, S3S4B), and one SOCI, killdeer (*Charadrius vociferus*; S3B) were identified during targeted surveys or incidentally.

Physical loss of bird habitat within the QEA, and the likely displacement of birds as a result of quarry expansion will occur but will be small in scale and is not expected to impact birds at a regional scale. Therefore, after mitigation measures have been implemented, the predicted residual environmental effects are assessed to be not significant.

Priority Species

Surveys were completed in WC1 for wood turtle (*Glyptemys insculpta*; SARA and NSESA Threatened, S2) because the wood turtle Special Management Plan (SMP) buffer exists on Keys Brook, ~200 m east of the Study Area. No wood turtle or other turtle species were identified during targeted surveys or incidentally.

The Atlantic Canada Conservation Data Center (ACCDC) identified a bat hibernaculum within 5 km of the Study Area. The Nova Scotia Department of Natural Resources and Renewables (NSDNRR) confirmed that the hibernaculum is <4km northeast of the Study Area. No potential hibernacula were identified within the Study Area and no bat species were observed, however, suitable maternity roosting habitat is present in snags within wetlands and in portions of the Study Area with more mature intact stands.

The Study Area is outside of mainland moose (*Alces alces americana;* NSESA Endangered, S1) concentration areas and core habitat for the species, therefore, no targeted surveys for mainland moose were completed.

In alignment with the residual effects and significance determination for fauna, avifauna, and vascular plants, the residual effects of this Project to priority species are expected to not be significant.

Socioeconomic
Quarry expansion has the potential to result in adverse effects on the following socioeconomic conditions; population and economy, land use and value, transportation, recreation and tourism, and human health:

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. A positive effect on the economy is anticipated from the Project.

The Project is located on private land owned by Dexter and the existing Lantz Quarry is present within this property. 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.

There is no proposed increase in truck traffic from the Project compared to existing baseline conditions, therefore, no additional adverse effects on transportation are anticipated as a result of the proposed Project.

The Project is not anticipated to have an adverse effect on recreation or tourism as no known tourist sites are located within or in proximity to the Project.

The Project will generate noise and dust, 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.

Archaeological and Heritage Resources
No significant archaeological features were identified within the Study Area during the field reconnaissance study. The Study Area was determined to be of low potential for archeological resources of either First Nations or European-descended origin and therefore, no direct or indirect impacts to archaeological or heritage resources are expected as a result of the Project.

Conclusion
The findings of this EARD indicate that residual environmental effects have been determined to be not significant for all identified VECs. Monitoring will be completed to confirm the predicted effects and determine if additional mitigation measures need to be implemented.

Monitoring
Dexter commits to developing the following monitoring plans:

- Surface Water Monitoring Plan
- Groundwater Monitoring Plan
- Wetland Compensation and Monitoring Plan
- Blast monitoring

These plans will be developed to meet EA approval terms and conditions or as part of the IA amendment process.

Additional Commitments

Dexter commits to the following additional commitments:

- Ongoing engagement with First Nation 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 EA approval terms and conditions, and will be submitted as part of the IA amendment process.

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LIST OF ACRONYMS

AA	Assessment Area
ACCDC	Atlantic Canadian Conservation Data Centre
ACPF	Atlantic Coastal Plain Flora
AGAT	Agricultural Analysis Ultra-trace & Toxicology
AMO	Abandoned Mine Opening
AQHI	Air Quality Health Index
ARD	Acid Rock Drainage
ARIA	Archaeological Resource Impact Assessment
BFL	Boreal Felt Lichen
BMP	Best Management Practices
BOF	Bay of Fundy
BSC	Bird Studies Canada
CCME	Canadian Council of Ministers of the Environment
CM	Centimeters
CoC	Chain of Custody
CONI	Common nighthawk
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPUE	Catch Per Unit Effort
CRM	Cultural Resource Management
CWS	Canadian Wildlife Services
DBA	A-Weighted Decibel
DC	Direct Current
DFO	Fisheries and Oceans Canada
DNR	Department of Natural Resources
DO	Dissolved Oxygen
DS	Downstream
E	Endangered
EA	Environmental Assessment
EARD	Environmental Assessment Registration Document
EC	Environment Canada
ECCC	Environment and Climate Change Canada
ELC	Ecological Land Classification
EQS	Environmental Quality Standards
ESC	Erosion and Sediment Control
FBP	Functional Benefit Product
FEC	Forest Ecosystem Classification for Nova Scotia
FACW	Facultative Wetland
FAC	Facultative
FAO	Food and Agriculture Organization
FHAA	Fish Habitat Assessment Area
FWAL	Protection of Aquatic Life for Freshwater Guidelines

G	Gram
GIS	Geographic Information System
GPS	Global Positioning System
HA	Hectares
HR	Hour
IA	Industrial Approval
IAAC	Impact Assessment Act of Canada
IBA	Important Bird Area
IBOF	Inner Bay of Fundy
IH	Intolerant Hardwoods Group
KM	Kilometer
KMKNO	Kwilmu’kw Maw-klusuaqn Negotiation Office
KMKNO-ARD	Kwilmu’kw Maw-klusuaqn Negotiation Office - Archaeology Research Division
KPA	Kilopascal
L	Litre
LiDAR	Light Detection and Ranging
Ltd	Limited
M	Meters
MAD	Mean Annual Discharge
MARI	Maritime Archaeological Resource Inventory
MASL	Meters Above Sea Level
MBBA	Maritime Breeding Bird Atlas
MBS	Migratory Bird Sanctuary
MEKS	Mi’kmaq Ecological Knowledge Study
MEL	McCallum Environmental Ltd.
MES	Master in Environmental Studies
MLA	Member of the Legislative Assembly
MM	Millimetre
MREM	Master of Resource and Environmental Management
MTRI	Mersey Tobeatic Research Institute
N	Number
NAD	North American Datum
NAPS	National Air Pollution Surveillance
NAR	Not At Risk
NB	New Brunswick
NLM	Natural Landscape of Maine
NS	Nova Scotia
NSCCH	Nova Scotia Communities, Culture and Heritage
NSDEL/EDL	Nova Scotia Department of Environment and Labour
NSDNRR	Nova Scotia Department of Natural Resources and Renewables
NSDPW	Nova Scotia Department of Public Works
NSE	Nova Scotia Environment

NSECC	Nova Scotia Environment and Climate Change
NS-EHJV	Nova Scotia Eastern Habitat Joint Venture
NSESA	Nova Scotia Endangered Species Act
NSDFA/AF	Nova Scotia Department of Fisheries and Aquaculture
NSL&F	Nova Scotia Department of Lands and Forestry
NSNRR	Nova Scotia Natural Resources and Renewables
NSPRD	Nova Scotia Property Records Database
NSPW	Nova Scotia Department of Public Works
NSTDB	Nova Scotia Topographic Database
NTS	National Topographic System
OBL	Obligate
OLA	Nova Scotia Office of L'nu Affairs
PC	Point Count(s)
PG	Peatland Group
PGI	Pellet Group Inventory
PH	Potential of Hydrogen
PID	Property Identification Number
PM	Particulate Matter
POI	Point of Interest
QEA	Quarry Expansion Area
QGIS	Quantum Geographic Information System
RCAp-MS	Rapid Chemical Analysis Package – Metals
RPA	Register of Professional Archaeologists
RS	Regenerating Swamp
SAR	Species at Risk
SARA	Species at Risk Act
SC	Special Concern
SH	Spruce Hemlock Forest Group
SMP	Special Management Plan/Practices
SOCI	Species of Conservation Interest
SOP	Standard Operating Procedure
SP	Spruce Pine Forest Group
SRank	Status rank
T	Threatened
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
US	Upstream
US EPA	United States Environmental Protection Agency
UTM	Universal Transform Mercator
V	Vulnerable
VC	Valued Component
VEC	Valued Environmental Component

VT	Vegetation Type
WBA	Water Balance Assessment
WESP-AC	Wetland Ecosystem Services Protocol – Atlantic Canada
WSS	Wetland of Special Significance
WC	Watercourse
WC	Wet Coniferous Forest Group
WD	Wet Deciduous Forest Group
WL	Wetland
WQ	Water Quality
YOY	Young-of-Year

DEFINITIONS

Study Area – the spatial boundary for surveys related to the terrestrial environment to support the Environmental Assessment. The Study Area is defined by the southern extent of PID 00524298.

Aquatic Study Area – the spatial boundary for fish and fish habitat surveys to support the Environmental Assessment. The Aquatic Study Area includes the Study Area and an unmapped watercourse to its connection with Keys Brook to the northeast.

Quarry Expansion Area – the area proposed for quarry development, expanding from the existing permit area.

Laydown Area – area proposed to house stockpiles of aggregate products. No quarry activities are proposed to occur within the laydown area.

1 GENERAL INFORMATION

The Project summary is provided below.

Table 1-1 Project Summary

General Project Information	Dexter Construction Company Limited intends to develop a facility that recovers and processes construction aggregate within Property Identification Number (PID) 00524298.
Project Name	Lantz Quarry Expansion (the "Project")
Proponent Name	2514869 Nova Scotia Limited 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 email: rthompson@dexter.com
Proponent Project Directors	Ken MacLean Vice President Date: Oct 26, 2022
Project Location	• The Study Area is located within PID 00524298. • The Study Area is located in Lantz, Halifax County, Nova Scotia. • The approximate centre of the Study Area is located at 20T 463119 m E 4979242 m N • The Study Area shown 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 803 m northwest of the Study Area (and 1,120 m from the quarry expansion area) along Old Trunk Road.
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	Nova Scotia Environment and Climate Change (NSECC)

Approvals	
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* 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 • Shavonne Meyer, Regional Biologist • Mark McGarrigle, Species at Risk Biologist • Janel Hayward, Senior Policy Analyst, Aboriginal Consultation and Engagement Nova Scotia Office of L'nu Affairs (OLA): • Salima Medouar, Consultation Advisor
Municipal Authorities	Halifax County
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 Registration Document Completed By:	**McCallum Environmental Ltd.** Suite 115, 2 Bluewater Road Bedford, Nova Scotia B4B 1G7 Meghan Milloy, MES Jeff Bonazza, M.Env.Sci. Mark MacDonald, M.Sc.F Sarah Scarlett, M.Sc. Amber Stoffer, MREM Katrina Ferrari, B.Sc. Jessica Lohnes, B.Sc.

2 PROJECT INFORMATION

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

2.1 Project Overview

2514869 Nova Scotia Limited, an affiliated company of Dexter Construction Company Limited (Dexter), operates an existing <4 ha rock quarry under a Nova Scotia Environment and Climate Change (NSECC) Industrial Approval (2007-060446-03) at 48 Dutch Settlement Road, Lantz, Halifax County, Nova Scotia (PID 00524298; Figure 1, Appendix A). The Lantz Quarry has been an NSECC approved quarry for approximately 15 years 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.

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.
- Mark MacDonald, M.Sc.F., McCallum Environmental Ltd.
- Melanie MacDonald, MREM, McCallum Environmental Ltd.
- Sarah Scarlett, M.Sc., McCallum Environmental Ltd.
- Amber Stoffer, MREM, McCallum Environmental Ltd.
- Emma Halupka, M.Sc., McCallum Environmental Ltd.

- Katrina Ferrari, B.Sc., McCallum Environmental Ltd.
- Jessica Lohnes, B.Sc., McCallum Environmental Ltd.
- Jose Mulino-Devoe, B.Env.Sci., McCallum Environmental Ltd.
- Nick Doane, B.Sc., McCallum Environmental Ltd.
- Lucas Bonner, B.Sc., McCallum Environmental Ltd.
- Chris Muirhead, M.A.Sc., P.Eng., GHD
- Andrew Betts, M.A.Sc., P.Eng., GHD
- Sarah Ingram, MA, RPA, Cultural Resource Management Group Ltd.
- Kyle Cigolotti, BA, Cultural Resource Management Group Ltd.
- Shawn MacSween, BA, Cultural Resource Management Group Ltd.

CVs are provided in Appendix B.

2.3 Project Location and Characteristics

The proposed Project is located within the rural community of Lantz, Nova Scotia, and bounded by the communities of Dutch Settlement to the east (~2 km) and Elmsdale to the west (~3 km; Figure 1, Appendix A). The current quarry entrance is situated on 48 Dutch Settlement Road and the approximate centre of the Study Area is located at 20T 463119 m E 4979242 m N.

Aerial imagery and the completion of ground-truthing surveys were used to determine site characteristics and surrounding land-use. The Study Area includes access roads, the existing <4 ha quarry, forested land mainly comprising regenerating softwood and hardwood, and field identified wetlands and a watercourse.

Based on a review of aerial imagery and ground truthing, there are no structures within 800 m of the proposed quarry expansion area (QEA; i.e., from the nearest blast location). The two nearest structures are located at 362 Highway 277 and 390 Highway 277 (Table 2-1).

Table 2-1. Nearest Structures to the Study Area and Quarry Expansion Area

Structure ID	Structure Description	PID	Distance from Study Area (m)	Distance from the QEA[1] (m)	Direction from the Study Area/QEA	Residence Type	Potable Well
Receptor1	362 Highway 277	525733	803	1,120	N	Permanent	Unconfirmed[2]
Receptor2	390 Highway 277	525360	860	1,150	N	Permanent	Unconfirmed[2]
[1]QEA = Quarry Expansion Area [2]Well assumed but not confirmed via ground truthing							

2.4 Study Areas

Two Study Areas were defined for the Project, the General Study Area ("Study Area") and the Aquatic Study Area (Figure 2A and 2B, Appendix A). The Study Area is located within the southern portion of PID 00524298 and is 25.8 ha. The Aquatic Study Area includes the entirety of the Study Area and an unnamed field identified watercourse that flows northeast (335 m) to its connection with Keys Brook (26.1 ha).

2.5 Purpose and Need for the Undertaking

Dexter is proposing to expand the quarry 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 less than 4-hectare quarry expanded an additional 8.8 ha (includes a 2.8 ha laydown area). Other than an increase in the total footprint of the site, site activities are not planned to increase in scope or frequency from past use.

The Project will be an important part of Nova Scotia's natural resource sector and will 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.

2.6 Consideration of Alternatives

The consideration of alternatives analyzes different ways construction projects can be supported. These include alternate sites and alternate extraction methods.

Alternative sites were considered but the proposed location represents the best option because it is an existing quarry operation that has been active for 15 years with no known environmental impacts. This site has high quality and large amounts of aggregate material.

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. Future operations of the Project will be assessed on an on-going basis to ensure that the best available techniques are being utilized in all phases of operations.

2.7 Quarry Design and Operations

The Project is proposed to expand the existing <4 ha Lantz Quarry and development will occur within the QEA (Figure 3, 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;
- QEA not encroaching within 30 m of a watercourse (unless approval provided to do so from NSECC);
- QEA not encroaching within 800 m of an offsite structure (without consent of the structure owner).

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

2.7.1 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 per year. 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 which includes three phases of development (Table 2-2).

Table 2-2. Project Phases and Timeline

Phase	Area (ha)	Timeline (years)	Tentative Dates
1	1.9	10	2023-2033
2	1.9	10	2033-2043
3	2.2	20	2043-2063
TOTAL	**6.0**	**40**	**NA**

In addition to the three phases of quarry expansion, final reclamation will be completed following Phase 3 and is anticipated to be completed in one year following closure of the quarry.

Components of the Project that are situated within the Study Area include the proposed QEA, a laydown area, and portable quarrying infrastructure (e.g., crusher, heavy equipment, scale etc.). The QEA is proposed to be 5.9 ha in size and extend ~240 m south from the existing quarry face. The laydown area is proposed to be 2.8 ha and is situated north of the existing quarry footprint. The total area of the Project footprint (QEA and laydown area) is 8.7 ha. The laydown area and the existing quarry footprint are separated by a field identified watercourse and its 30 m buffer.

2.7.2 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 NSPW 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 (approx. 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.

2.7.2.1 *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.

2.7.2.2 *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 or twice 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.

No residential structures are located within 800 m of 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.

2.7.2.3 *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 scalehouse and truck scale is set up along the site access road during periods of site activity.

2.7.2.3.1 Washing

No 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.

2.7.2.4 *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, clearstone, 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.

2.7.2.4.1 Asphalt Plant

An asphalt plant is not anticipated to be used on the site, however, if the local market requires a plant to be mobilized, 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.

2.7.2.5 *Hauling*

Prior to leaving the quarry, trucks report to a scalehouse to be weighed. Trucks will follow the site haul road north to Dutch Settlement Road. Trucks are routed to required Project locations either east or west on Dutch Settlement Road and will use the local and provincial road network to reach their destination. Trucks use tarpaulins to cover loads and minimize dust.

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.

2.7.3 Quarry Components

The primary components associated with the Project include the following;

- Working quarry highwall
- Storage and loading areas
- Portable crushing plants
- Site haul road
- Water management system
- Ancillary buildings

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

2.7.3.1 *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 to 20 m.

2.7.3.2 *Storage and Loading Areas*

The quarry floor and laydown area will be used for crusher set-up, storage and loading of aggregate. Aggregate material (e.g., Type 1 gravel) is stockpiled in these areas and is dependent 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.

2.7.3.3 *Portable Crushing Plants*

Refer to Section 2.7.2.3.

2.7.3.4 *Site Haul Road*

A 1.2 km site haul road (~12 m wide) runs northwest from the existing quarry to Dutch Settlement Road. The majority of this road is gravel, however, Dexter has paved the initial ~75 m of this access road immediately off Dutch Settlement Road. This portion was paved to reduce the potential generation of dust in proximity to residences along Dutch Settlement Road and reduce the potential for gravel to accumulate on Dutch Settlement Road.

The site haul road does not require any upgrades to support the Project, therefore, the majority of this road is situated beyond the extent of the Study Area.

2.7.3.5 *Water Management System*

Refer to Section 2.7.6.

2.7.3.6 *Ancillary Buildings*

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

2.7.4 Quarry Personnel

During 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 scalehouse operator. Additionally, company and broker 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 active periods.

2.7.5 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 2-3 outlines the potential fleet to support quarry expansion.

Table 2-3. 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.

2.7.6 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 1DG-1-UU Tertiary Watershed (part of the Shubenacadie River Secondary Watershed [1DG-1]). which drains to the northeast into Keys Brook.

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

2.7.6.1 *Operations*

All surface water runoff and drainage occurring within the QEA will be directed (by gravity) via rock-lined ditches, swales, or through the fractured quarry floor to the existing settling pond, located in the northeastern extent of the existing quarry footprint (Figure 3, Appendix A). These environmental controls will be repaired and replaced as needed and will be implemented throughout the life of the quarry.

Settled water will be released from the settling pond (Figure 3, Appendix A) via a culvert and water will be passively discharged to a vegetated settling area prior to flowing into a field identified watercourse (WC1), a tributary to Keys Brook. The settling pond will be increased in size, as required, during quarry expansion to ensure downstream effects do not occur (e.g., scour, sedimentation, erosion).

Perimeter ditching surrounding the laydown area will collect runoff and passively discharge it into a vegetated area at a topographical low point prior to entering WC1, upstream of the settling pond discharge. No settling pond is proposed to be associated with this discharge location.

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.

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.

2.7.6.2 *Reclamation*

As the site reaches the end of its life, site ditches and the settling pond 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 WC1, to maintain appropriate water quantities within the system.

2.7.7 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 rehabilitation and reclamation at the end of its 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.

2.7.8 Hazardous Waste Management

No hazardous material will be kept on site.

During active quarrying, re-fuelling 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 remain with the equipment at all times 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.

2.7.9 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 will be 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.

2.7.10 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). Haul truck loads will be covered to minimize dust. Should it be required, dust emissions from the quarry will be controlled with the application of water. Water will be sourced from the onsite settling pond or will be acquired from a water truck, therefore, no water withdrawal permits are required. Dexter has paved the initial ~75 m of the quarry access road immediately off Dutch Settlement Road. This portion was paved to reduce the potential generation of dust in proximity to residences along Dutch Settlement Road and reduce the potential for gravel to accumulate on Dutch Settlement Road.

2.7.11 Viewscape

The Project is located in a rural location. The nearest road to the Project is Dutch Settlement Road, ~1.2 km northwest of the existing quarry. At this location, Dutch Settlement Road has an elevation 35 m lower than the QEA but due to forest cover and distance between Dutch Settlement 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.

2.7.12 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 issues.

2.8 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 Industrial Approval, 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 Lantz 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
- Other reclamation activities

2.9 Anticipated Schedule of Activities

The following milestone schedule (Table 2-4) outlines the Project schedule.

Table 2-4. Schedule of Project Activities

Task	Anticipated Completion Date
Environmental Studies	Winter, Spring, Summer, and Fall of 2021
Public Engagement	Ongoing throughout Project. Public information session held in October 2021.
Environmental Assessment Registration	November 2022

Task	Anticipated Completion Date
Expected EA Decision	Late fall 2022
Provincial Permitting (Industrial Approval and wetland/watercourse alteration approval)	Following EA Approval
Quarry Expansion Window	2023 - 2063 (40 years)
Reclamation	Progressive reclamation ongoing during operations. Final reclamation to occur when aggregate reserves have been fully exhausted.

3 ENVIRONMENTAL ASSESSMENT SCOPE

The Nova Scotia *Environment Act* and Environmental Assessment Regulations regulate provincial EAs. The proposed Project requires a provincial EA registration as it is considered a *Class I* undertaking under Schedule A of the Nova Scotia Environmental Assessment Regulations.

3.1 Site Sensitivity

The Study Area is not located in any protected or conservation areas within federal, provincial, or municipal jurisdiction. Figure 4 (Appendix A) shows the Study Area and surrounding significant habitats and conservation areas. The Nova Scotia Provincial Landscape Viewer (NSDNR, 2022) and desktop review identified the following:

- Wood turtle Special Management Plan (SMP) buffer exists on Keys Brook, ~200 m east of the Study Area;
- The closest NSECC predicted Wetland of Special Significance (WSS; ID# 36288) is located 600 m north of the Study Area;
- The closest abandoned mine opening (AMO; ID# ELM-1-001) is located approximately 330m northeast of the Study Area;
- The closest protected area is the Bennery Lake Nature Reserve, located approximately 10 km southwest of the Study Area;
- The Study Area is not located within mainland moose core habitat or black ash core habitat;
- The closest Atlantic Coastal Plain Flora (ACPF) buffer is 2.8 km north east of the Study Area;
- The closest Nova Scotia Old Forestry Policy polygon is 10 km south east of the Study Area;
- The DFO SAR interactive map identifies Atlantic salmon (inner Bay of Fundy population), within Keys Brook, ~200 m east of the Study Area

3.2 Priority Species

Assessment of wildlife, vegetation, and habitat was completed based on the requirements outlined in the *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 as outlined below; and it is used for the following purposes:

1. To identify which targeted surveys were recommended 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.

3.2.1 Development of a Priority Species List

In support of the assessment of priority species occurrences and use of the Study Area, a priority species list was created. 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 on the Species at Risk Act (SARA) and/or the Nova Scotia Endangered Species Act (NSESA).

Development of a priority list of species for lichen, vascular plants, mammals, birds, herpetofauna, and fish was completed based on a compilation of listed species from the following sources:

1. COSEWIC and the SARA. All species listed as Endangered, Threatened, or of Special Concern;
2. NSESA. All species listed as Endangered, Threatened, or Vulnerable; and,
3. Conservation Rank: All Species designated as S1, S2, or S3 as defined by the ACCDC (rankings as of July 2021)

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

The priority list of species 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 of priority species.

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 identified 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 priority species list.

A single desktop priority species list is 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 desktop priority species list. All field staff reviewed the desktop evaluation for priority species prior to commencing field work to ensure they were familiar with priority species identification and their status ranks. The priority species list is referenced across the various biophysical assessments and is provided in Appendix C. See Table 3-1 for status rank definitions across multiple regulatory levels. More information on the priority species list is provided in Section 4.3.9.

Table 3-1. 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.

Protection	Status	Definition
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.
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

Protection	Status	Definition
		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.

3.2.2 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 data) and proximal datasets (e.g., abandoned mine openings database). Proximal datasets are those that provide information that may support the understanding of priority species in proximity to an area. For example, AMOs may support bat hibernacula, but this dataset does not represent known bat hibernacula or observations of the species.

The ACCDC houses the most comprehensive biodiversity database available in Atlantic Canada. The centre compiles and distributes georeferenced data on species occurrences to governments, private industry, and academia. Additionally, the ACCDC data include conservation status ranks that are assessed in collaboration with experts. ACCDC reports provide important supplementary, observation-driven data sources including sightings of priority species recorded within 5 km and 100 km. An ACCDC report (Appendix D) was prepared for the Study Area on April 25, 2022.

When the ACCDC prepares a rare species report, they provide the user with georeferenced shapefile points of rare species records within 5 km of the center of the Study Area. However, 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. Concern about exploitation of location-sensitive species precludes inclusion of coordinates in the rare species 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 or bat species occurrence. If any of these species are present within 5 km of the center of the Study Area, the ACCDC report will simply identify that they are present but will not provide specific location data. Location sensitive species were noted in the ACCDC report, therefore, MEL consulted with NSDNRR to obtain additional information on the observation.

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

- 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;
- 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 (NSDNRR, 2022) – Atlantic Coastal Plain Flora (ACPF) Buffer, Lynx Buffer, Marten Range Patches 2019, Marten Habitat Management Zones, Mainland Moose Concentration Areas, Mainland Moose Core Habitat, Black Ash Core Habitat
- Provincial Special Management Practice layers – wood turtle, vole ears, mainland moose, etc.

3.3 Boundaries of the Assessment- Spatial and Temporal

Spatial boundaries of the EA are defined by the Study Area and the Aquatic Study Area (Figure 2A and 2B, Appendix A). The Study Area was designed to include the maximum potential extent of the QEA for the Project and the maximum extent of expected terrestrial impacts (and in consideration of property ownership), and is defined by the southern extent of PID 00524298. The Aquatic Study Area includes the Study Area and an unmapped watercourse to its connection with Keys Brook to the northeast. This study area was defined to consider the maximum extent of expected aquatic impacts. All assessments used the Study Area as the spatial boundary for assessment. Fish and fish habitat surveys occurred within the Aquatic Study Area. The Study Area and Aquatic Study Area are 25.8 ha and 26.1 ha, respectively. Additionally, expanded spatial boundaries were considered for discrete aspects of the EA including:

1. Local watersheds: These spatial boundaries were developed in support of the Water Balance Assessment and include points of interest that may sustain indirect hydrological effects as a result of the proposed Project (Appendix E, and Section 7.2.5); and
2. Halifax County was considered for the purpose of data collection relating to existing socioeconomic conditions and evaluation.

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

3.4 Assessment Scope

The EA planning process allows for the prediction of environmental effects of a proposed Project and identifies measures to minimize and then mitigate potential adverse environmental effects. The EA predicts significant residual adverse environmental effects once mitigation measures are implemented.

The EA focusses on specific environmental components called valued environmental components (VECs). VECs are specific components of the biophysical, socioeconomic, human health, and cultural environments. VECs are important to a local human population and can have a national or even international profile. VECs are important for the evaluation of environmental impacts of a proposed undertaking. The scope of the assessment for this Project included: the selection and assessment of potential VECs; evaluation of the potential VEC interactions with Project activities, identification of environmental effects, if any, for each VEC; and identification of thresholds to determine the significance of residual environmental effects.

3.4.1 Standards or Thresholds for Characterizing and Determining Significance of Effects

Criteria or established thresholds for determining the significance of residual effects from Project activities are described for each VEC in their corresponding subsection within Section 7.2. These criteria or thresholds were developed though using available information on the status and characteristic of each VEC, using applicable regulatory documents, environmental standards, guidelines, and/or objectives (i.e., IA approval requirements, and using professional judgement of the EA Study Team) wherever possible.

These criteria or thresholds establish a level beyond which a residual effect would be considered significant. Thresholds may be based on regulations, standards, resource management objectives, scientific literature, and/or ecological processes. Significance criteria has been defined quantitatively where possible and are measurable, and qualitatively with supporting justifications where no quantified standards exist.

3.5 Regulatory Consultation

To support the EARD, the Project team consulted with NSECC, NSDNRR, The Office of L'nu Affairs (OLA) and the Nova Scotia Department of Communities, Culture, Tourism and Heritage. A Project introduction meeting was held on June 16, 2021, to inform the regulators on the quarry location, typical quarry operations, EA Study Area, scope of proposed expansion, site sensitivities, selection of VECs, proposed biophysical survey program, proposed archaeology survey program, and a review of the approach to Mi'kmaq and Community Engagement. This presentation was attended by Gillian Fielding (OLA), Rachel Bower (NSECC), Mark McInnis (NSECC), Samuel Donaldson (NSECC), Bernard Matlock (NSECC), and Mark McGarrigle (NSDNRR). On August 10, 2022, a site visit was completed with regulators at the existing Lantz Quarry to see the Project lands, discuss the quarrying process, and EA findings. The site visit was attended by Renata Mageste da Silva (NSECC), Lynda Weatherby (NSECC) Salima Medouar (OLA), Janel Hayward (NSDNRR), Matthew McFetridge (NSDNRR), John Cormier (Communities, Culture, Tourism, and Heritage).

Refer to Table 3-2 for a complete log of all regulatory communications.

Table 3-2. Regulatory Consultation Communication Log

Department	Individual	Method	Date	Details
NSECC	Helen MacPhail Bridget Tutty	Email	May 31, 2021	Informed the EA branch of the Project and requested a meeting to formally introduce the Project to NSECC and other regulators.
	Rachel Bower Mark McInnis Samuel Donaldson Bernard Matlock	Video conference	June 16, 2021	Presentation provided on the Project. Presentation included quarry location, typical quarry operations, EA Study Area, scope of proposed expansion, site sensitivities, VECs, biophysical survey program, Archaeology, Mi'kmaq and Community Engagement. Copy of presentation provided.
	Renata Mageste da Silva Rachel Bower	Email	October 14, 2021	Invited EA branch to public information session.
	Renata Mageste da Silva Rachel Bower	Email	January 21, 2022	Provided EA branch with Project update (shared a presentation provided to OLA) and anticipated registration timing.
	Renata Mageste da Silva	Email	March 16, 2022	Provided EA branch with update on proposed registration timing.
	Renata Mageste da Silva Lynda Weatherby	In person	August 10, 2022	Site visit at existing Lantz Quarry to see the Project lands, discuss the quarrying process and EA findings to date. NSECC inquired about registration timing, quarrying rates, plan for reclamation, washing, and asphalt plant.
	Renata Mageste da Silva Mark McInnis	Email	August 17, 2022	Renata informed Dexter that Mark McInnis will be leading the EA process for this Project.
Office of L'nu Affairs	Gillian Fielding	Email	May 25, 2021	Early engagement letter notifying the Office of L'nu Affairs of the Project, including Project overview, location map, anticipated timeline, and an offer to meet to discuss the Project.
		Video conference	June 16, 2021	Presentation provided on the Project. Presentation included quarry location, typical quarry operations, EA Study Area, scope of proposed expansion, site sensitivities, VECs, biophysical survey program, Archaeology, Mi'kmaq and Community Engagement. Copy of presentation provided. No questions or concerns brought forward by OLA.
		Email	October 12, 2021	Follow up on previous conversations and offer to meet for a second time extended.
		Email	January 5, 2022	Request meeting to provide update on Project and First Nations engagement.
	Gillian Fielding and	Video conference	January 19, 2022	Presentation provided on Project update, registration timing, field findings,

Department	Individual	Method	Date	Details
	Salima Medouar			public engagement, First Nations engagement to date and plans for future engagement. OLA recommended mailing hardcopies of documents to First Nation communities as part of early engagement.
		Email	January 21, 2022	Copy of slide deck presented during January 19, 2022, meeting sent to OLA.
	Salima Medouar	Email	March 14, 2022	Provided the OLA with a copy of the Project update letter that will be sent to the KMKNO, Millbrook First Nation, Sipekne'katik First Nation, and the Native Council of Nova Scotia.
		In Person	August 10, 2022	Site visit at existing Lantz Quarry to see the Project lands, discuss the quarrying process and EA findings to date. OLA indicated that just because no communities have responded does not mean they do not have any concerns regarding the Project.
		Email	August 24, 2022	Informed OLA of registration timing and recent outreach to communities/KMKNO related to the Project.
NSDNRR	Dr. Donna Hurlburt	Email	March 31, 2021	Request for NSDNRR to check data base for core habitat. April 7, 2021 – NSDNRR indicated that no wood turtle or bats are located directly on the Project area, but wood turtle core habitat is within close proximity (<1 km). Wood turtle surveys should be performed during optimal weather.
	Dr. Donna Hurlburt	Email	June 3, 2021	Requested distance and direction from the Project of bat hibernaculum identified within the ACCDC report. June 8, 2021 – NSDNRR indicated the bat hibernaculum is located <4 km to the northeast. This hibernaculum is not at the location of an AMO identified in the same general distance/direction (3.5 km NE)
	Mark McGarrigle	Video conference	June 16, 2021	Presentation provided on the Project. Presentation included quarry location, typical quarry operations, EA Study Area, scope of proposed expansion, site sensitivities, VECs, biophysical survey program, Archaeology, Mi'kmaq and

Department	Individual	Method	Date	Details
				Community Engagement. Copy of presentation provided.
	Mark McGarrigle Dr. Donna Hurlburt	Email	August 13, 2021	MEL informed NSDNRR that there is no intention to acoustically monitor the AMO (3.5 km NE) or the bat hibernaculum and no hibernacula were identified within the Study Area. August 18, 2021 – NSDNRR requested information to support MELs determination that no hibernacula is within the Study Area. August 26, 2021 – MEL provided NSDNRR with map of all survey tracks walked through the Study Area. September 3, 2021 – NSDNRR asked if any surveys were conducted near dusk/dawn. September 3, 2021 – MEL informed NSDNRR that dawn surveys were complete spring migration (x2 in May), breeding (x2 in June), and fall migration (x3 Sept/Oct). Nocturnal owl surveys (x1 in April) and common nighthawk surveys (x2 in June) around dusk. No bats were observed incidentally during these surveys.
	Dr. Donna Hurlburt Mark McGarrigle Shavonne Meyer	Email	December 21, 2021	Inquired if mainland moose core habitat is present within the Study Area. January 10, 2022 – follow up with NSDNRR regarding mainland moose core habitat. August 30, 2022 – follow up with NSDNRR regarding mainland moose core habitat. September 6, 2022 – NSDNRR confirmed core habitat is not present within the Study Area
	Janel Hayward	Email	January 5, 2022	Request meeting to provide introduction to the Project and update on First Nations engagement to date. Janel Hayward indicated that NSDNRR Aboriginal Consultation and

Department	Individual	Method	Date	Details
				Engagement office is not required for quarry related projects.
	Janel Hayward Matthew McFetridge	In Person	August 10, 2022	Site visit at existing Lantz Quarry to see the Project lands, discuss the quarrying process and EA findings to date.
	Janel Hayward	Email	August 24, 2022.	Informed OLA of registration timing and recent outreach to communities/KMKNO related to the Project.
Communities, Culture, Tourism, and Heritage	John Cormier	In Person	August 10, 2022	Site visit at existing Lantz Quarry to see the Project lands, discuss the quarrying process and EA findings to date.

Refer to Table 6-2 for all communications with the Office of L'nu Affairs and NSDNRR Aboriginal Consultation and Engagement Office.

4 ENVIRONMENTAL ASSESSMENT METHODS

The EARD for the Project describes the biophysical, social, and economic environment. All VECs were identified, and the potential for interaction between individual VECs and Project activities were determined. Methods to minimize and mitigate environmental effects resulting from the Project are provided in this document.

The Project team, through an evaluation of the VECs, identified Project environmental effects that, post-mitigation, have the potential for a residual effect on the environment. The significance of these residual effects was then determined and evaluated (Section 7.2).

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

1. Atmospheric: weather and climate, air quality, and noise.
2. Geophysical: topography, surficial geology, bedrock geology, and groundwater.
3. Biophysical: vegetation community classification, vascular plants, lichens, wildlife, avifauna, wetlands, surface water, fish habitat, and priority species.
4. Archaeological Resource Assessment.

The social and economic environment was evaluated by reviewing background literature as well as communicating with local residents via a mail-out and an in-person information session which took place on October 26, 2021.

4.1 Atmospheric Assessments

4.1.1 Weather and Climate

Weather conditions in Nova Scotia are monitored by 55 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 Halifax Stanfield International Airport (Climate ID 8202251) weather station was obtained to summarize weather conditions in proximity to the Study Area. The Halifax Stanfield International Airport weather station is 12 km southwest of the Study Area, in the same ecoregion (Eastern Interior) and is similar to the Study Area as both are situated within the interior of the province.

Additionally, a literature review of climate conditions within the Eastern Interior ecoregion was completed.

4.1.2 Air Quality

Air Quality Health Index (AQHI) was assessed in Lake Major, Nova Scotia, the nearest AQHI station to the Project (~27 km south of the Study Area). 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 2021).

As recommended by Health Canada (2016), available data from air quality monitoring stations was assessed to describe the existing environment. Average air quality data from the Lake Major station, provided by National Air Pollution Surveillance (NAPS) Network, was reviewed.

No particulate monitoring or air quality modelling was completed within the Study Area.

4.1.3 Noise

Health Canada defines noise as any unwanted sound (Health Canada, 2017). Health Canada (2017) 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 noise monitoring or modelling was completed within the Study Area.

4.2 Geophysical Assessments

4.2.1 Topography

Topography within and adjacent to the Study Area was assessed via a review of the NSTDB landform line (i.e., 5 m contour) spatial files and provincially available LiDAR.

4.2.2 Surficial Geology

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

4.2.3 Bedrock Geology

A review of the Geological Map of the Province of Nova Scotia (NSDNR, 2006) was completed to determine bedrock geology within the Study Area.

Additionally, rock samples were collected and tested for acid rock drainage (ARD) potential. Exposing and physically disturbing sulphide-bearing rocks can cause ARD to develop which can negatively impact the environment and human health. Acidic runoff, with pH levels as low as 3, can be harmful for aquatic habitats and can cause fish kills. ARD can contaminate drinking water supplies with increased concentrations of toxic and carcinogenic heavy metals (The Province of Nova Scotia, 2017).

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 Risk Map (Trudell and White, 2013) which was reviewed. One sample was collected within the existing pit area in 2020 and ARD testing was completed by the Minerals Engineering Centre at Dalhousie University. These samples were 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.

4.2.4 Groundwater

While depth to groundwater is challenging to predict prior to the implementation of a groundwater monitoring program, a number of variables can be considered to predict groundwater levels. These variables include a review of:

- 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;
    - The Nova Scotia Groundwater Observation Well Network was established in 1965 and includes 40 active well observations across the province. The closest observation site to the Study Area is located in Fall River, approximately 20 km to the southwest, and is named Fall River (076).
- Information sourced from the NS Well Logs Database;
    - 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 Nova Scotia Topographic Database (NSTDB) and aerial imagery was reviewed to identify buildings within 1 km of the Study Area.

4.3 Biophysical Assessments

Biophysical field components of the EA were initiated in March of 2021. These field components continued through until July 2022, 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 habitats surrounding the Study Area. The field components included, survey timing, and surveyors that completed the assessments are outlined in Table 4-1.

Table 4-1. Biophysical Assessment Components, Timing, and Surveyors

Survey		Date	Surveyor(s)
Vegetation Community and Classification		May 13, 2021	Melanie MacDonald Emma Posluns
Vascular Plant Surveys	Early botany	June 29 - 30, 2021	Melanie MacDonald
	Late botany	August 31, 2021	John Gallop
Lichen Survey		August 31, 2021	John Gallop
Wildlife Survey		March 23, 2021	Jeff Bonazza
		Opportunistically throughout all biophysical surveys	All surveyors
Avian Surveys	Winter	March 23, 2021	Jeff Bonazza
	Nocturnal Owl	April 29, 2021	Jose Mulino-Devoe
	Spring migration	May 13 and 28, 2021	Melanie MacDonald Emma Posluns Jessica Lohnes
	Breeding bird	June 13 and 25, 2021	Jessica Lohnes
	Common nighthawk	June 26 and 29, 2021	Jessica Lohnes
	Fall migration	August 25, September 21, and October 8, 2021	Jessica Lohnes
Wetland and watercourse evaluations		April 21, July 7, August 9, 2021, and July 5, 2022	Jeff Bonazza Chris Pepper Emma Halupka Lucas Bonner Nick Doane
Fish and fish habitat assessment		July 21 and July 28, 2021, and April 12, 2022	Katrina Ferrari
Species at Risk	Wood turtle	May 13, 18, and 28, 2021	Melanie MacDonald Emma Posluns Jessica Lohnes
	Incidental	All seasons	All surveyors

The biophysical assessment methods were shared with NSDNRR and NSECC during a Project introduction meeting on June 16, 2021, for review and comment. NSDNRR did not request any additional surveys.

4.3.1 <u>Vegetation Community and Classification</u>

The following are the desktop and field survey methodologies used during the vegetation community and classification survey program. The purpose of defining the vegetation communities within the Study Area is to determine what vegetation communities are present, what habitats and species they can support and if unique or rare habitats are present within the Study Area (i.e., areas to target during other biophysical surveys). The methods below describe MEL's approach to vegetation community and classification both from a desktop and field perspective.

4.3.1.1 *Desktop Review*

Prior to completing field assessments, several geospatial datasets were reviewed to inform the surveyors of the landscape within the Study Area. These datasets include:

1. Nova Scotia forestry inventory
2. NSECC wetland and watercourse inventory
3. Nova Scotia Topographic Database (NSTDB)
4. Ecological Land Classification (ELC)
5. Nova Scotia old forestry policy polygons
6. Aerial imagery

Aerial imagery and spatial files of wetland features were invaluable in the desktop review as indicators of different soil regimes often reflect changes in vegetation community structures. The aerial imagery allowed the surveyor to, at a high-level, identify areas of interest.

4.3.1.2 *Desktop Vegetation Community Delineation*

The data collected in the field during wetland delineations and habitat classification (described in Section 4.3.1.3 and 4.3.6.3), as well as review of aerial imagery and the Nova Scotia forestry inventory were used to delineate the approximate boundary of the vegetation communities at a coarse level (i.e. mixedwood, softwood, cutover, etc.). Quantum Geographic Information System (QGIS) software was used to delineate the boundaries into discrete polygons. Once all the polygons were created per vegetation community, a vegetation group was assigned. Wetlands were further classified into vegetation types using the in-field data points.

4.3.1.3 *Field Survey*

Upland vegetation community surveys took place on May 13, 2021, throughout the Study Area. This timing was selected as it facilitates proper detection and characterization of the vegetation communities and allows the findings to dictate other surveys (i.e., targeted locations for vascular plant surveys and lichen surveys). Surveys were completed by MEL biologists, Emma Posluns and Melanie MacDonald, who are qualified to identify vegetation species and habitats. Vegetation community surveys were completed in the field by walking meandering transects, and broad vegetation types were identified. Four habitat survey points were established based on these preliminary surveys to further examine community types represented in the Study Area. The upland communities identified were not delineated on the ground at a finer scale as the purpose of information gleaned from this effort was primarily used to inform other surveys (e.g., vascular plant surveys and lichen surveys). Figure 5 (Appendix A) outlines identified forest types within the Study Area. Wetlands were visited during the growing season in August 2021 by MEL biologist, Emma Halupka, to create vegetation lists per wetland. The vegetation lists were then used to identify vegetation types present in each wetland.

To identify vegetation community types found within the Study Area, several resources were referenced. Although Nova Scotia has forested and barren communities, literature is lacking for many of the non-forested communities (e.g., shrub bogs, marshes, fens etc.). Several classification systems (Table 4-2) were used when specific community types were observed. By using several different classification systems, communities which were not defined in the available Nova Scotia guides were able to be classified. By merging these classifications, the communities within the Study Area can be accurately described. If Nova Scotia guides were only used, then there would be a bias towards forested and barren communities and many non-forested wetlands communities and their abundance and frequency within the Study Area would not be accurately documented. Table 4-2 summarizes the classification systems used during the field program and the community types that they describe.

Table 4-2. Classification System Guides Used in the Surveys

Classification System	Author(s)	Vegetation Community Types Defined
Forest Ecosystem Classification System (FEC)	Neily et al., 2010	Forested uplands, forested wetlands and woodlands.
Natural Landscapes of Maine (NLM)	Gawler, S & Cutko, A. 2018	Defines forested and non-forested communities. This was used to define non-forested wetland communities within the PA.
Classification of Heathlands and Related Plant Communities on Barrens Ecosystem in Nova Scotia	Porter, Basquill, & Lundholm, 2020	Described barrens, heathlands and shrublands.

The Natural Landscape of Maine (NLM) classification was referenced and used as a guideline because Nova Scotia does not have any published non-forested wetland classification systems. Due to the geographical location of Maine and its proximity to Nova Scotia, many parallels exist between the two locations. Nova Scotia and Maine are both within the Acadian Forest region which is characterized by temperate broadleaf and mixedwood forests which are subject to coastal influences. Many of the community types described in the NLM are found in Nova Scotia and attributed to the climatic and geographic similarities between these two provinces/states. Therefore, the use of NLM to describe communities in Nova Scotia is a suitable classification system to use for these surveys.

When vegetation community types were observed that did not meet the definitions outlined in the above-mentioned classification systems, MEL biologists applied a name that best describes the community type. For example, if an upland vegetation community dominated by the shrub species mountain ash (*Sorbus americana*) and wild raisin (*Viburnum nudum*) were encountered, the name Mountain Ash - Wild Raisin Shrubland would be applied. The classification name cites the dominant species that are characteristic of the community type. In the event two species were dominant within the same strata, a dash (-) is applied, while a slash (/) is applied to dominant species of different strata. This naming convention is then followed by a descriptor of the community such as shrubland, barren, forest etc. In certain circumstances, particularly in the case of a recent disturbance (e.g., a clear cut within five years) vegetation types may be in early successional stages. This applies to both uplands and wetlands. In this instance, the habitat type "cut-over" would be applied and dominant species in that community type would be recorded.

All vegetation community types encountered within the Study Area were georeferenced using a handheld Garmin GPS 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. Approximate stand age
    a. Regenerative
    b. Mature
4. Representative photographs
5. Vegetation community and classification

4.3.2 Vascular and Nonvascular Plants

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

4.3.2.1 *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 four components: a review of the ACCDC database results (Appendix D), a review of mapped wetland habitat, a review of the vegetation communities and classification (Section 4.3.1), and a review of the Priority Species List (Appendix C).

4.3.2.2 *Field Survey*

Dedicated vascular plant surveys were completed early (June 29 - 30, 2021) and late (August 31, 2021) in the growing season (June 1 to September 30) to capture plant species with different flowering periods. These surveys were completed within the Study Area by MEL biologists, Melanie MacDonald and John Gallop. Additionally, incidental vascular plant observations, particularly priority species, were recorded throughout the suite of the biophysical surveys conducted in 2021.

The available GIS databases were checked for information pertaining to vascular plant community assemblages. GIS databases include the ACCDC report, ACPF Buffers (Nova Scotia Department of Natural Resources, 2019), the ecological land classifications of Nova Scotia (Neily, Basquill, Quigley, & Keys, 2017), and others listed in Section 3.2. This background research helped inform field surveys by notifying surveyors if there is an increased likelihood of priority vascular plant species. The ecological land classifications helped inform surveyors of landscape characteristics that may shape the prevalence of priority vascular plant species. All suitable habitats, as identified within the field, were surveyed.

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. 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 later. 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 and counting individuals became a challenge, the areas of these assemblages 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).

Through the vascular plant survey, the MEL biologists developed a list of species observed, along with a figure identifying locations of priority vascular flora species. All plant species were reviewed to determine if they are a member of the ACPF group, according to the NS wetland indicator plant list. Plant species were also reviewed to determine if they are native or invasive.

In addition to vascular plants, a species list of nonvascular plants (i.e., bryophytes) was also collected during the field survey. The following literature were the primary references used during the field surveys and identification process:

- Mosses of Eastern North America Vol. 1 & 2 (Crum & Anderson, 1981);
- Mosses and Liverworts of Britain and Ireland ‑ a Field Guide (British Bryological Society, 2010); and,
- Common Mosses of the Northeast and Appalachians (McKnight., Rohrer, Ward, & Perdrizet, 2013).

4.3.3 Lichens

The following sections outline the desktop and field survey methodologies implemented during the lichen and nonvascular plant survey program.

4.3.3.1 *Desktop Review*

Prior to undertaking 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 D);
- NSDNR predictive habitat mapping for boreal felt lichen (*Erioderma pedicellatum*) (2010);
- MTRI Vole Ears (*Erioderma mollissimum*) and extant boreal felt lichen (BFL) GIS databases (Mersey Tobeatic Research Institute, 2019);
- NSDNRR forest inventory GIS database (Nova Scotia Department of Natural Resources, 2016); and,
- The Priority Species List (Appendix C).

This background research informs field surveys by notifying surveyors if there is an increased likelihood of priority lichen species present. The forest inventory GIS database will help inform surveyors of forest characteristics, including age. 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).

4.3.3.2 *Field Survey*

All suitable lichen habitats within the Study Area, were surveyed by qualified lichenologist John Gallop on August 31, 2021. Lichens, unlike vascular plants, can be surveyed all year-round if their hosts (tree trunks, the forest floor, and rocky outcrops) are not covered by snow. Meandering transects were completed on foot and targeted mature trees appropriate for hosting priority lichen species. 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 a photograph, and any other relevant comments:

- 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

A general list of common lichens was recorded with focus on macrolichens (i.e., foliose, fruticose, and squamulose).

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, 2009a);
- Microlichens of the Pacific Northwest – Volume 2 – Key to the Species (McCune, 2009b); and
- Common Lichens of Northeastern North America (McMullin & Anderson, 2014).

4.3.4 Wildlife

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

4.3.4.1 *Desktop Review*

A desktop review was conducted using the available GIS forestry database (NSDNR, 2016a) to determine the forest cover types within and surrounding the Study Area. The significant habitat database was reviewed to determine presence of SAR/SOCI wildlife (NSDNR, 2016b). Government records of Abandoned Mine Openings (AMOs; NSDNR, 2017) were reviewed as AMOs can provide bat habitat. The wood turtle (*Glyptemys insculpta*) Special Management Practices (SMP) spatial file provided by NSDNRR was reviewed as was the ACCDC report (Appendix D) with its accompanying GIS files. These databases were reviewed to determine what wildlife or habitat is potentially within the Study Area and to support wildlife survey design.

4.3.4.2 *Field Surveys*

Wildlife surveys were completed as part of the winter bird surveys on March 23, 2021, by Jeff Bonazza as well as opportunistically throughout the suite of biophysical surveys in 2021. All observations were identified and recorded by biologists experienced in recognition of wildlife tracks, scat and browse, resulting in an overall 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).

Incidental observations have been chosen in addition to dedicated wildlife surveys as they provide the broadest coverage of the Study Area, both spatially and temporally. Instead of limiting wildlife surveys to transects, incidental observations during other survey types provide a holistic and overarching understanding of wildlife on the landscape.

Specific field methods to identify priority fauna species are provided in Section 4.3.9.

4.3.5 Avifauna

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

4.3.5.1 *Desktop Review*

A review of the Canada Important Bird Areas database, ACCDC report (Appendix D), MBBA square 20MQ67 (Appendix F), and Canada Wildlife Service MBS was completed to support bird survey design and methodology. This desktop review was completed to identify avifauna species found in the general area, prior to conducting field surveys.

4.3.5.2 *Field Surveys*

According to the *Guide to Addressing Wildlife Species and Habitat in an EA Registration Document,* activities that have the potential to impact migratory avifauna species will 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), *Atlassing for Species at Risk in the Maritime Provinces* (MBBA, 2008), and a selection of peer-reviewed literature.

Avifauna surveys were conducted using point count (PC) methodology as they are a commonly used survey technique for determining avian species composition (FAO, 2007). Methodology was based on Canada Wildlife Services (CWS) protocols as they relate to survey site selection, survey duration, and season selection. PC locations were chosen to represent major habitat types and are spaced, at minimum, 250 m apart to avoid double counting species observations (Howe, Wolf, & Rinaldi, 1997; 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). PCs were placed both within and outside of the Study Area, allowing reference points for pre- and post-construction monitoring. Additionally, common nighthawk (*Chordeiles minor*) and nocturnal owl surveys were conducted due to their inclusion within the ACCDC report (Appendix D) and the potential for their habitat within the Study Area, based on desktop review. Refer to the following subsections for additional details.

Avian field surveys were conducted by qualified MEL ornithologists (listed below). Avian survey locations are provided in Figure 6 (Appendix A). Detailed methods, provided in the sections below, were completed for the following surveys:

- Spring migration (1 survey round conducted by Melanie MacDonald and Emma Posluns, 1 round conducted by Jessica Lohnes)
- Breeding bird (2 survey rounds conducted by Jessica Lohnes)
- Fall migration (3 survey rounds conducted by Jessica Lohnes)
- Common nighthawk (2 survey rounds conducted by Jessica Lohnes)
- Nocturnal owl (1 survey round conducted by Jose Mulino-Devoe)
- Winter (1 survey round conducted by Jeff Bonazza)

Bird species were identified based on functional bird groups to understand how each group of birds 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, smartphone applications such as Merlin, eBird, and iNaturalist, were used in the field to support identification clarification. The goal of all avifauna surveys is to develop a robust species list, document breeding evidence, and map observed priority species occurrences.

4.3.5.2.1 Spring Migration, Fall Migration, and Breeding Surveys

PC locations were used for spring migration, breeding bird, and fall migration surveys. PCs are in a variety of habitats as outlined in Table 4-3 (Figure 6, Appendix A). The same suite of PC locations were used for each set of seasonal surveys conducted in spring, breeding season, and fall.

PC locations were chosen prior to the finalization of the quarry expansion area; all attempts were made to cover a wide variety of habitat types without knowing the exact quarry footprint. PC locations are distanced by a minimum of 250 m, to prevent the risk of double-counting individuals, as recommended in *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds* (EC CWS, 2007). PC were selected as the preferred method for avian usage surveys as they allow identification of a broad range of species.

PC locations were selected using available aerial imagery and habitat type information and were spread throughout and surrounding the Study Area to provide representative coverage of the largest area possible. PC locations cover various habitats that are representative of those within the Study Area, including hardwood/mixedwood forests, a watercourse, wetlands, trails, disturbed and undisturbed habitats. It is MEL's understanding that PC locations provided representative sampling of avifauna habitats. All attempts were made to establish PCs within and surrounding the Study Area, should post-construction monitoring of avifauna be necessary.

Given the relatively small size of the Study Area, only six PCs were placed within it without encroaching on the 250 m separation distance. An additional two PCs were established outside of the Study Area to help provide more regional information on avian usage.

Table 4-3. Avifauna Point Count (PC) Habitat Descriptions (for Spring Migration, Breeding Bird, and Fall Migration Surveys)

PC	Within or Outside Study Area	Habitat Description
1	Within	Southern extent of Study Area within a treed swamp (WL1).
2	Within	Southeastern boundary of Study Area within WL4, regenerative forest.
3	Within	Southwestern boundary of the Study Area within moderate age mixed wood forest (softwood dominant) in upland habitat.
4	Within	Central Study Area, south of existing quarry footprint. Surrounded by regenerative mixed wood forest.
5	Within	Northeast extent of Study Area, north of existing quarry footprint in mixed wood forest, adjacent a field identified watercourse (WC1).
6	Within	Northwestern extent of Study Area in mixed wood forest, mixed age (softwood dominant).
7	Outside	North of Study Area along roadside surrounded by hardwood dominant forest.
8	Outside	North of Study Area along roadside surrounded by hardwood dominant forest.

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.

Following guidance provided by 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 GPS 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). Bearings were taken for priority species observed during dedicated survey periods and incidentally.

Incidental observations are those that occur outside of the allotted survey time (e.g., 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. Avian observations that occur during other biophysical surveys (i.e., wetland delineation, botany survey, etc.) were noted, but only priority and novel species observations were carried forward into analysis (novel species include any avian species not observed during targeted avian surveys – spring migration, breeding bird, and fall migration surveys).

4.3.5.2.1.1 *Spring Migration, Fall Migration*

Two rounds of spring migration surveys (May 13, and 28, 2021) and three rounds of fall migration surveys (August 25, September 21, and October 8, 2021) were completed. 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).

4.3.5.2.1.2 *Breeding*

The goal of breeding bird surveys is to determine which species are using the area for nesting, raising young, and foraging during the breeding season to better understand the impact of the proposed quarry expansion on these species (EC CWS, 2007). The methodology for breeding bird surveys is identical to those described for spring and fall migration (Section 4.3.5.2.1), except for 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 (CWS, 2007). Area searches were conducted by qualified personnel, following meandering transects for 60 mins after PC surveys were completed. Area searches targeted areas not covered by PC locations or any high activity areas noted during the morning PC survey. Approximate locations of meandering transects are shown in Figure 6 (Appendix A).

During area searches, bird observations were recorded in a similar manner to PC location protocol. Bird observations were recorded at the same four distance regimes, and a handheld Garmin GPS 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. In particular, the data that was recorded included priority species, novel species or species showing breeding evidence/noteworthy behaviour.

As with migratory surveys, breeding bird surveys were conducted at the previously described eight PC locations. In addition to the methods described above, the breeding status of the bird species observed during breeding bird surveys were also recorded. The surveyor recorded bird behaviour observed, including distraction display, carrying food, and carrying nesting material. Table 4-4 outlines the types of breeding evidence and status that were recorded during the breeding bird surveys (MBBA, n.d.).

Table 4-4. 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.
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 surveys during the breeding season were conducted to obtain a representative snapshot of early and late breeders within and immediately adjacent the Study Area, while minimizing disturbance to nesting birds. Breeding bird surveys occurred on June 13 and 25, 2021. It should be noted that during migration surveys, breeding behavior will also be noted when observed as some individuals may breed earlier or later in the year. Surveys were spaced apart by, at minimum, ten days to avoid/limit disturbance to nesting birds (CWS, 2007).

4.3.5.2.2 Common Nighthawk

Common nighthawk (*Chordeiles minor*) are listed as Special Concern by COSEWIC and Threatened by the SARA and NSESA. Common nighthawk prefer to nest in gravelly substrates and are best detected while foraging for insects shortly after sunset (MBBA, 2008). Common nighthawk are documented by 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). The ACCDC report states this species has been identified within 4 km of the Study Area (Appendix D).

Two dedicated evening surveys for the common nighthawk were conducted during their breeding season on June 26 and 29, 2021. The survey dates coincide with breeding season for common nighthawk and were limited to two evening surveys to limit disturbance to breeding species. Targeted surveys for this species were selected because they are not reliably detected during the seasonal PC surveys due to their crepuscular nature (Saskatchewan Ministry of Environment, 2015). Four common nighthawk PCs (CONI PC), CONI1, CONI2, CONI3, and CONI4 were surveyed by a qualified ornithologist (Figure 6, Appendix A). 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 existing quarry of the Study Area. The three other CONI PCs are situated outside of the Study Area. CONI2 is located approximately 800 m northeast of CONI1 on along the gravel road (and adjacent a disturbed area) that leads to the Study Area from Dutch Settlement Road. CONI3 is located approximately 1.37 km east from CONI1 on a dirt logging road that branches off Logan Road. CONI3 is situated adjacent clearcut habitat. CONI4 is located approximately 1.48 km southeast from CONI1 adjacent disturbed habitat and on a dirt logging road that branches south from CONI3 (Figure 6, Appendix A). CONI PC locations were selected prior to the placement of the quarry expansion layout. A central location (the existing quarry) was chosen within the Study Area in order to provide coverage of the entire Study Area as common nighthawk can be heard from 800 m away (Saskatchewan Ministry of Environment, 2015). From this central location there is a maximum distance of 639 m to the Study Area boundary. CONI PC locations were selected because they are on gravel roads, with roadside gravel clearings suitable for nesting habitat, and can safely be accessed from a vehicle during nocturnal surveys (MBBA, 2008). CONI PCs are distanced 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 three-minute passive surveying period, followed by three minutes of alternating 30-seconds call-playback of the conspecific common nighthawk call and 30-seconds of silence (passive surveying) as per survey protocol by Saskatchewan Ministry of Environment (2015). The MBBA *Species at Risk Atlassing Guide* states that common nighthawk are territorial, therefore using call-playback methods may increase the probability of observations (MBBA, 2008). 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.

In June 2022 (i.e., after the completion of these surveys) CWS informed MEL that they do not recommend the use of playback recordings when monitoring SAR.

4.3.5.2.3 Nocturnal Owl Surveys

Three owl species were reported by the ACCDC to have been observed within 100 km of the Study Area: the short-eared owl (*Asio flammeus*), the boreal owl (*Aegolius funereus*), and the long-eared owl (*Asio otus*). The short-eared owl is mainly found in open fields and grasslands (Cornell University, 2021). The boreal owl is mainly found in northern Nova Scotia, in boreal-like forests or along the coast (Stewart, et al., 2015). 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). Only the short-eared owl was observed within the MBBA for the region; no breeding evidence was observed for this species within the MBBA (Appendix F; Summary Square 20MQ67; MBBA, 2021). Habitat for the short-eared and boreal owl is unlikely to exist within the Study Area which, based on aerial imagery, does not have large areas of open fields or grasslands, and is in the Acadian Ecosite Group and not in boreal forest (Neily, Basquill, Quigley and Keys, 2017). Habitat may exist for long-eared owl within the Study Area, therefore nocturnal owl surveys were completed.

The methods for monitoring nocturnal owls followed the *Guideline for Nocturnal Owl Monitoring in North America* (Takats *et al*., 2001). Nocturnal owl surveys took place once 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 29, 2021. Point count survey stations are spaced a minimum of 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).

Three owl point count stations (OwlPC) were surveyed: one is within the Study Area (Owl1) and the other two (Owl2 and Owl3) are outside the Study Area. Owl1 is situated within the existing quarry of the Study Area. Owl2 is located approximately 1.6 km southeast from Owl1 on a dirt logging road. Owl 3 is located approximately 1.9 km east from Owl1 on a dirt logging road that branches off Logan Road. The three locations are distanced by >1.6 km and were selected for their safe access and suitable habitat (Figure 6, Appendix A). As the quarry expansion layout had not been finalized at the time of designing this survey program, the PC within the Study Area was placed in a central location (the existing quarry site), allowing the surveyor to hear owls calling within the entire Study Area. From this central location, there is a maximum distance of 640 m to the Study Area boundary.

Prior to starting 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 the next survey station due to owls hearing the recording from the previous 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 1 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.

4.3.5.2.4 Winter

One avifauna survey was conducted on March 23, 2021, by Jeff Bonazza. This survey was a non-standardized area search throughout the Study Area and all opportunistic observations of avifauna were recorded.

No staging grounds for species such as large water bodies and open field exist within the Study Area, therefore, low overwintering abundance and detection rates are assumed and no dedicated point count or watch count surveys were completed in the winter season.

4.3.5.2.5 Incidental Observations

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

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

4.3.6 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.*

Wetland functions are the natural processes associated with wetlands and include, but are not limited to; water storage, pollutant removal, sediment retention and provision of nesting/breeding habitat. Functions may also include values and benefits associated with these natural processes such as aesthetics/recreation, cultural values, and subsistence production (NBDELG, 2008). The discussions of wetlands presented herein primarily uses terminology associated with the Canadian Wetlands Classification System (Warner and Rubec, 1997) or in line with the methodologies adapted by Nova Scotia for wetland delineation and functional assessment.

The Nova Scotia *Environment Act* requires that an approval from Nova Scotia Environment and Climate Change (NSECC) be obtained before any wetlands can be altered (Environment Act c.1, s.1, 1994-95). Wetland delineation and functional assessment of wetlands are necessary to understand the number, location, extent and type of wetland within the Study Area.

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

4.3.6.1 *Desktop Review*

A background desktop review of available topographic maps, appropriate provincial databases and aerial photography was completed to aid in determination and assessment of wetland habitat in the Aquatic Study Area. The Wet Areas database, the NSECC Wetlands Inventory database, and the NSECC Wetlands of Special Significance (WSS) database were all reviewed. Desktop reviews were completed in order to identify anticipated potential wetland areas and prepare for field surveys.

4.3.6.2 *Wetlands of Special Significance*

The *Wetland Conservation Policy* was developed by NSECC in 2011 and amended in 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 (2011, 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 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*.

In addition to the policy, NSECC Wetland Specialists have provided guidance on the designation of a WSS. Wetlands with observed provincially or federally designated SAR, mobile or sessile, will be classified a as WSS, unless it is determined through field assessments that the wetland does not contain habitat necessary for critical life functions (e.g., breeding or dwelling) to support the observed species. This assessment may be reviewed by NSECC and NSDNRR prior to final WSS designation. A WSS designation assessment based on the observation a mobile SAR considers species-specific and site-specific conditions, considering the following factors:

- whether the species was observed within the wetland;
- whether suitable habitat is present within the wetland;
- what is the wetland habitat 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 provincial Wetland Ecosystem Services Protocol – Atlantic Canada (WESP-AC) assessment tool has recently been developed and implemented by NSECC in August 2021 (see Section 5.4.1.2.1 for results). A Functional WSS Interpretation Tool automatically assesses the subject wetland based on the WESP-AC functional results. The grouped functions in 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 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., Ian Bryson, NSECC Wetland Specialist), which 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 its contents should be interpreted as potential WSS. The actual determination of WSS status is based on field verification of the parameters or considerations listed above. This predictive layer, or a previous version, was consulted during the desktop evaluation for wetlands prior to delineations by MEL in 2021. It incorporates all rare species observations, regardless of the species' ranking, accuracy of the data points, observation date, and mobility of species. As such, it is used as a predictive tool only to support WSS determination.

MEL will engage with NSECC and NSDNRR on WSS designation if confirmed or potential identified through desktop or field assessments. Final WSS designation will be determined by NSECC at the permitting phase with guidance from data collected through Project field surveys.

4.3.6.3 *Field survey*

Meandering transects were completed within the Study Area to identify and assess wetland habitat on April 21, 2021, by MEL biologist Jeff Bonazza and subcontractor Chris Pepper. In season assessments occurred between July 7 and August 9, 2021, and on July 5, 2022, by qualified MEL biologists Emma Halupka, Nick Doane, and Lucas Bonner. Desktop analysis results showing topographic trends and habitat types helped to guide these transect locations. Wetland assessments were completed within the appropriate growing season (Section 4.3.6.3.4).

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 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 in order 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 Aquatic Study Area to confirm wetland/upland conditions to 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 (~June to September). 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 MEL-designed rapid functional assessment tool was completed to qualitatively describe wetland features and functions, and to support the effects assessment.

The goal of the wetland program is to provide a holistic understanding of what wetlands are present, where they are located, and what functions they perform.

4.3.6.3.1 Hydrophytic Vegetation Methodology

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

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 (greater than 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 was used to calculate and support determination of positive hydrophytic vegetation indicators.

4.3.6.3.2 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.

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

4.3.6.3.4 Wetland Functional Assessment

Wetland functional assessment was completed for each wetland identified within the Aquatic Study Area using the WESP-AC wetland evaluation technique. WESP-AC was completed during the 2021 and 2022 wetland field assessments described above.

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 quantitatively assessing individual wetland functions and values. WESP-AC addresses 17 specific functions that wetlands may provide (see Table 4-4).

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 4-5. 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

Grouped Wetland Function	Specific Wetland Functions
	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 4-5 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 important to society.

The WESP-AC results and Functional WSS Interpretation Tool is discussed in Section 4.3.6.2.

The WESP-AC functional evaluation technique recognizes that, in many cases, delineation of entire wetlands where they extend beyond a Study Area is not always feasible (e.g., property ownership) or necessary (Adamus, 2018). Instead, WESP-AC permits the delimitation of an Assessment Area (AA), defined as the wetland or portion of wetland physically assessed in the field.

4.3.7 Surface Water

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). Therefor, it is necessary to understand what watercourses and water resources are present within the Aquatic Study Area prior to quarry expansion.

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

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

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

4.3.7.1 *Desktop Review*

The goal of the surface water desktop evaluation was to identify where watercourses, waterbodies, and drainage features are located within or in proximity to the Aquatic Study Area based on mapped systems, topography, and satellite imagery, while also identifying where the Aquatic Study Area lies within primary and secondary watersheds. Prior to completing the field evaluation, MEL reviewed all Nova Scotia Topographic Database (NSTDB) mapped watercourses and waterbodies, provincial flow accumulation data, and depth to water table mapping to identify potential surface water features within the Study Area.

4.3.7.2 *Field Surveys*

Watercourse delineation and site drainage characterizations were completed throughout the Study Area in conjunction with wetland delineation and evaluation, on April 21, 2021 by Jeff Bonazza.

During the field evaluations, MEL 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. General reconnaissance was conducted via meandering transects within the Study Area by qualified MEL biologists (April 21, 2021). 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 Aquatic Study Area were characterized using a MEL field form. The field form included general survey data such as Project name, date, crew member names, weather, watercourse identification information, and stream order. Flow type, entrenchment, gradient, and water quality parameters were also be recorded. Measurement of substrate types, cover, description of riparian habitat, and physical channel measurements (depth, wetted, and bankfull widths) were recorded. Detailed fish habitat assessments are described in Section 4.3.8.2.1.

4.3.7.2.1 Surface Water Quality Measurements

Surface water samples were collected by Dexter's third party Environmental Technician on a quarterly schedule (March 23, May 20, none within the third quarter, and November 24, 2021). Within the third quarter, insufficient water, and lack of flow within the selected watercourse prevented collection of surface water samples. Samples were not collected during periods of heavy rain when precipitation would impact the collection of surface water. Samples were collected when there were sufficient water levels to allow for collection. The locations were selected via desktop prior to the field delineation of wetlands and watercourses (and prior to the QEA being finalized).

Three water quality sampling locations were selected (SW-1, SW-2, and SW-3; Table 4-6, Figure 7 [Appendix A]) within the Aquatic Study Area. These locations were selected as they best capture baseline information. SW-1 is located in WC1, along the southern Aquatic Study Area boundary and upstream of the existing quarry. SW-2 is also located in WC1, downstream of the existing quarry and along the northern Study Area boundary. SW-3 is located within the northern extent of the Study Area at the settling pond discharge location.

Table 4-6. Surface Water Samples Locations

Sample ID	Sample Location Description	Sample Location (UTM NAD83)
SW-1	Southern boundary of the Aquatic Study Area, upstream of existing quarry, within WC1	463148 m E, 4979111 m N
SW-2	Northern boundary of the Aquatic Study Area, downstream of the existing quarry, within WC1	463334 m E, 4979422 m N
SW-3	Northern portion of the Aquatic Study Area, at the settling pond discharge location	463312 m E, 4979359 m N

At each sample location, surface flow is captured in a sample bottle (pre-rinsed 3 times) by submerging the sample bottle neck entirely so water from the surface fills the bottle. Water was poured from a pre-rinsed bottle into sample bottles that contain a preservative. Care is taken to ensure there is no increase in water turbidity from disturbance to the benthic layer of the watercourse. The sample bottles are labelled with the sample location, date, Project name, and a chain of custody (CoC) is filled out for each sample event. Sample bottles are maintained at a temperature <10°C and transported to Agricultural Analysis Ultra-trace & Toxicology (AGAT) Laboratories in Bedford, Nova Scotia for processing. They were analysed for RCAp-MS total metals and total suspended solids (TSS) in surface water. These samples are considered representative of baseline water quality conditions in water features within the Aquatic Study Area. Continued sampling at these locations may occur if needed as part of on-going surface water monitoring programs for the Project during construction and operation. Surface water sample results were compared to the Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life for Freshwater (FWAL).

4.3.8 Fish and Fish Habitat

4.3.8.1 *Desktop Review*

The priority species list, as defined in Section 4.3.9, was used to identify priority fish species that may occur in the Aquatic Study Area (Appendix C). Information on confirmed and potential fish presence within the Aquatic Study Area and surrounding surface water features was collected from the following sources:

- ACCDC Report (as presented in Appendix D);
- NSL&F 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.

4.3.8.2 *Field Surveys*

The following subsections describe the components of the fish and fish habitat field surveys.

4.3.8.2.1 Fish Habitat Characterization

Fish habitat characterization was completed by MEL biologist Katrina Ferrari, for all delineated watercourses in the Aquatic Study Area on July 28, 2021, and April 12, 2022. Detailed fish habitat characterization was completed using guidance from the MEL Standard Operating Procedure (SOP) for Fish Habitat Assessments in the lotic environment (Appendix G). 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 grouped together into one reach containing multiple smaller habitat units. The upstream and downstream ends of each reach were recorded with a handheld GPS device. Watercourses selected for detailed habitat evaluations are shown on Figure 8 (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 (i.e., channel and wetted widths, bank heights) and flow characteristics (i.e., 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 amount 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.

During the fish habitat characterisation, a determination of limitations for fish movement and access was also completed in part to evaluate each watercourse to determine whether it is considered a fisheries resource. According to Bourne et al. (2011), and Fullerton et al. (2010), the ability of fish to pass barriers can be difficult to define and measure, as it combines the physical characteristics of a barrier with fish physiology in a dynamic environment. Parameters such as the species of interest and their swimming capability, the variability in stream flow, length of the barrier, slope, drop height, and outflow pool are all to be taken into consideration when determining the potential for fish to pass a barrier. Throughout baseline watercourse mapping and fish habitat surveys, an assessment of potential limitations for fish movement and access was completed. If a potential limitation is encountered, biologists recorded the type of limitation, height and length of the limitation, depth of water, along with an estimate of slope where relevant. The contiguity and spatial relationships of discontinuous pools are also described, when present, with the intent of understanding a fish's ability to move from one step-pool or isolated pool to another.

If a potential limitation for fish movement and access is anthropogenic in nature (i.e., improperly installed culverts), it was noted as such, but not considered a permanent due to its potential for being removed and reinstating fish passage.

4.3.8.2.2 *Fish Surveys: Electrofishing*

Electrofishing was conducted within WC1 on July 21, 2021 (Figure 8, Appendix A). A sampling reach of approximately 100 m in length was selected as representative fish habitat to survey. The goal of the electrofishing survey was to determine fish species presence within the Aquatic Study Area. Fish collection was completed under Fisheries and Oceans Canada Fishing License # 341208.

Electrofishing was completed using guidance from a MEL SOP for Fish Collection (Appendix G). 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. The crew lead is responsible for operating the backpack electrofisher according to their training and the Policy, and for communicating safety policies and electrofishing procedures to the second crew member.

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. 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. 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.

The electrofishing location is shown on Figure 8 (Appendix A) and representative photos of the electrofishing reach are provided in Appendix H.

Table 4-7. Electrofishing Survey Details

Electrofishing Location	Stream Order	Survey Date	Upstream Coordinates (UTM)		Downstream Coordinates (UTM)		Reach Length (m)
			Easting	Northing	Easting	Northing	
WC1	1	July 29, 2021	463355	4979429	463450	4979476	100

4.3.9 Priority Species

Based on the desktop review, specialized surveys were deemed necessary to target specific priority species known or having the potential to exist within the general area surrounding the Study Area due to being listed in the ACCDC report, MBBA breeding bird square, and/or the presence of suitable habitat. These specialized surveys were completed as these species are not reliably detected during the previously described field programs.

4.3.9.1 *Desktop Review*

A desktop priority species list was created in accordance with the *Guide to Addressing Wildlife Species and Habitat in an EA Registration Document* (NSE, 2009). This broad priority species list (provided in Appendix C) informed the biophysical field programs by identifying species that have the potential to be present within the Study Area. The desktop priority list was based on general species habitat requirements and the broad geographic area in which individual species are known to occur. See Section 3.2.1 for a definition of the following terms: priority species, SOCI, and SAR.

A review of site sensitivities (Section 3.1) was completed as part of the desktop review.

- Wood turtle Special Management Plan (SMP) buffer exists on Keys Brook, ~200 m east of the Study Area;
- The DFO SAR interactive map identifies Atlantic salmon (inner Bay of Fundy population), within Keys Brook, ~200 m east of the Study Area

Databases provided by MTRI were assessed to identify the potential for priority lichen species including vole ears and boreal felt lichen. To determine the presence of any mapped SAR habitat, the NSNDRR significant species and habitats database was reviewed. This included a review of wood turtle SMP areas and locations of mainland moose concentration areas/mainland moose core habitat.

A desktop review for known bat hibernaculum nearby and within the Study Area was completed. The NSDNRR records of AMOs (NSDNR, 2017) were reviewed for the Study Area and within 5 km of the Study Area, as AMOs potentially provide bat hibernacula. The ACCDC report and the Recovery Strategy for the Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), and Tri-colored Bat (*Perimyotis subflavus*) in Canada (Environment Canada, 2015) were consulted.

Lastly, the DFO SAR interactive map was also reviewed to determine if watercourses within or adjacent to the Study Area were recorded to have aquatic SAR or critical habitat.

4.3.9.2 *Field Surveys*

Species specific field methods for priority species are discussed in the following sections: Section 4.3.9.2.1 (bat species), Section 4.3.9.2.2 (wood turtle) and Section 4.3.9.2.3 (common nighthawk). Where a SAR or SOCI was identified during surveys, additional effort was made in the field to understand the habitat at the sighting location and evaluate whether it was critical to the species' survival or life cycle requirements.

4.3.9.2.1 Species at Risk Bats

The ACCDC report (Appendix D) identified bat hibernaculum or bat species occurrence within 5 km of the Study Area (location sensitive). The ACCDC report also indicates that little brown myotis (*Myotis lucifugus*), northern long-eared myotis (*Myotis septentrionalis*), and tri-colored bat (*Perimyotis subflavus*) have been observed within 4.2 km of the Study Area. These three SAR bats are listed as Endangered by COSEWIC, SARA, and NSESA. Other bat species listed by the ACCDC report were a bat species (*Vespertillionidae* sp.) eastern red bat (*Lasiurus borealis*) and the hoary bat (*Lasiuruus cinereus*), observed 4.0 km, 83.5 km, and 18.6 km from the Study Area, respectively. AMOs can provide bat habitat, especially if they are open and unflooded. No AMOs are located within the Study Area, however, an AMO was identified 3.5 km northeast of the Study Area (shaft ID: ELM-1-001). Metadata for this AMO indicated that it is plugged with rock and vegetation. MEL consulted with the landowner but were denied access to their property, therefore, could not field verify that the AMO is filled and offers no suitable overwintering habitat for bats. NSDNRR confirmed that a bat hibernaculum exists <4 km northeast of the Study Area (Dr. D. Hurlburt, NSDNRR Manager of Biodiversity, Personal Communications, June 3, 2021) and that the hibernaculum is not situated in the location of the AMO (Dr. D. Hurlburt, NSDNRR Manager of Biodiversity, Personal Communications, June 8, 2021).

During all biophysical surveys, MEL biologists searched for 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 have been completed. Biophysical surveys occurred within and surrounding the Study Area at dawn (e.g., bird spring migration, bird fall migration, and breeding bird surveys) and dusk (e.g., nocturnal owl surveys and common nighthawk surveys).

4.3.9.2.2 Wood Turtle

The wood turtle (*Glyptemys insculpta*) is listed as Threatened under SARA and the NSESA. Their presence has been documented within 5 km of the Study Area by the ACCDC report (location sensitive; Appendix D). Communication with NSDNRR in April 2021 confirmed that there is no identified core habitat within the Study Area, but wood turtle core habitat is within close proximity, and observations of the species were documented less than 1 km from the Study Area (Dr. D. Hurlburt, NSDNRR Manager of Biodiversity, Personal Communications, April 7, 2021).

The Study Area is located near a wood turtle SMP (Nova Scotia Department of Natural Resources, 2012). The SMP buffer surrounds Keys Brook. Within the Study Area, an unnamed tributary (WC1) is present that flows northeast into Keys Brook. A review of aerial imagery does not reveal any large areas of open water suitable for wood turtle overwintering habtiat within the Study Area. Species-specific field surveys were completed following the methodology outlined herein.

Wood turtle surveys were completed on May 13, 18 and 28, 2021, by MEL biologists to survey for foraging and nesting turtles. Surveys occurred within the Study Area along WC1 and within riparian wetlands (WL15 and 17; Figure 9, Appendix A). This watercourses was identified within the Study Area in accordance with the *Wood Turtle (Glyptemys insculpta) Standardaized Water-Based Survey Protocol* (Ikanawtiket Environmental Inc., 2018). The goal of these surveys was to better understand if wood turtles are using the Study Area and to identify any potential suitable nesting and overwintering habitat for this species within the Study Area. Spring surveys were completed before "green-up" when visibility was optimal.

MEL biologists searched for physical evidence of wood turtle, as well as suitable habitat (i.e., nesting, overwintering) or depredated nests. Searches included surveying for turtles at the base of woody shrubs, under or near deadfall, and amongst grasses or leaf litter, as wood turtles are typically associated with some form of vegetative structure. Additionally, searches focused on bank areas with high solar exposure. The ground and undergrowth were searched from the waters' edge inland to 20 m along one side of a watercourse at a time.

Wood turtles are active in temperatures over 9˚C, but best results are found when temperatures range from 15-20˚C. Observations drop off significantly when temperatures exceed 25˚C, at which point turtles are not moving or are hidden under protective cover (Flanagan, Roy-McDougall, Forbes, & Forbes, 2013). Ambient temperature appears to be as good an indicator of the probability of detection as sunlight, so surveys can occur on cloudy days. If air temperature is warmer than water temperature, there is a thermal advantage to basking on land (Flanagan, Roy-McDougall, Forbes, & Forebes, 2013). All surveys were conducted when daytime temperatures were ≥ 9 °C, and optimally between 15 °C and 25 °C. Searchers wore polarized sunglasses and searched the area in a sweeping motion, while walking with their backs to the sun to aid in detection (Ikanawtiket Environmental Inc., 2018).

Wood turtle survey cards were completed and if turtles were observed, a Nova Scotia turtle observation card was also completed, which includes the species, number of notches, turtle sex, date and time, note-worthy observations, habitat description, location, and weather.

During all surveys within the Study Area, MEL personnel looked for signs of habitat that could support turtle nesting and overwintering. Usage of the area by wood turtle (*Glyptemys insculpta*), snapping turtle (*Chelydra serpentina*), and eastern painted turtle (*Chrysemys picta picta*) was also considered, and MEL searched for incidental or opportunistic evidence of these species concurrently with watercourse and wetland surveys. Roadside surveys (e.g., avian surveys) were also completed at dawn and dusk during the turtle nesting season, suitable timing to detect nesting turtles along roadsides.

4.3.9.2.3 Common Nighthawk

Refer to Section 4.3.5.2.2.

4.4 Archaeological Resource Assessment

Cultural Resource Management Group Limited (CRM Group) completed an Archaeological Resource Impact Assessment (ARIA) for the proposed Project in 2020. This assessment consisted of three components:

- Background Study
- Mi'kmaw Engagement
- Archeological Reconnaissance

The methodologies of these components are described below. Refer to Appendix I for the ARIA report and additional details related to assessment methods.

4.4.1 Background Study

As part of this assessment, a historic background study was conducted. Historical maps, manuscripts and published literature were consulted. The Maritime Archaeological Resource inventory was searched. Topographic maps and aerial photographs were used in conjunction with LiDAR Digital Elevation Models to evaluate the study area.

4.4.2 Mi'kmaw Engagement

As part of Mi'kmaw engagement, CRM Group contacted the Kwilmu'kw Maw-klusuaqn Negotiation Office's Archaeological Research Division (KMKNO-ARD) requesting information pertaining to historic or traditional Mi'kmaw use of the land. A similar request was made to the Sipekne'katik First Nation. This information provided CRM Group with a better understanding of the cultural and archeological importance of the Study Area.

4.4.3 Archeological reconnaissance

Sarah Ingram and Kyle Cigolotti conducted a field reconnaissance of the Study Area on November 10, 2020.

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.

Refer to Appendix I for the ARIA.

5 EXISTING CONDITIONS

5.1 General Spatial Setting for Project

The proposed Project is in the Eastern Ecoregion (400), as defined by the NSDNRR (Neily et al., 2017). The Eastern Ecoregion is characterized by softwood forests of red spruce and hemlock, waterbodies, large wetlands, and watercourses (Neily et al., 2017).

5.1.1 Natural Subregion

The Eastern Ecoregion is further subdivided into ecodistricts. The proposed Project is in the Eastern Interior Ecodistrict (440), as defined by the NSDNRR (Neily et al., 2017). The Eastern Interior Ecodistrict comprises the mainland hardwood and softwood forests from Halifax in the west to Guysborough in the east (Neily et al., 2017). The total area of this ecodistrict is 4,575 km^2, making it one of the largest in the province (Neily et al., 2017).

5.1.2 Land Use and Habitat

Table 5-1 below displays the land use types and area within the Study Area. These estimations are based on aerial imagery, the forest inventory GIS database (NSL&F, 2021), and field ground truthing (including field delineated wetlands).

Table 5-1. Calculations of Land Use within the Study Area

Land Use/Land Type	Area (ha)	% of Study Area
Access Road	0.7	2.7
Existing Quarry	3.8	14.7
Clearcut	3.1	12.0
Mixed wood	7.5	29.1
Softwood	8.5	32.9
Wetland	2.2	8.5
TOTAL STUDY AREA	**25.8**	**100**

Land use within the Study Area is dominated by softwood stands (32.9%), followed by mixed wood stands (29.1%), the existing quarry footprint (14.7%), clearcut (12.0%) and wetlands (8.5%). Access roads makes up the remaining 2.7% of the Study Area.

5.1 Atmospheric Environment

5.1.1 Weather and Climate

The Study Area is within the Eastern ecoregion (400) and the Eastern Interior ecodistrict (440). Climate in the Eastern ecoregion is characterized by a warmer summers and colder winters (Neily et al., 2017).

The Eastern ecoregion is sheltered from direct marine influences and tends to be colder than western areas (Neily et al., 2017).

Records from the Halifax Stanfield International Airport (Climate ID 8202251), located 12 km southwest of the Study Area, indicates the average low temperature based on records from 2017-2021 was 2.93°C and the average high temperature was 12.12°C (ECCC, 2021). The total precipitation in 2021 at this weather station was 1539.6 mm (ECCC, 2021). The Halifax Stanfield International Airport weather station is located in the same Ecoregion, the Eastern Ecoregion, and is also located in the interior of the province.

5.1.2 Air Quality

The Study Area is located approximately 27 km north of Lake Major, Nova Scotia, where the nearest station monitoring AQHI is located. The AQHI in Lake Major was considered low when assessed in April 2022 (Government of Canada, 2022).

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 Lake Major (2021) is provided by NAPS Network and is presented in Table 5-2.

Table 5-2. Air Quality Data

Station	SO_2 (ppb)	NOX (ppb)	NO (ppb)	NO_2 (ppb)	PM2.5 (ug/m^3)	O3 (ppb)
Lake Major	0.58	3.57	0.65	2.90	4.97	26.5

The Project is situated 500 m east of the existing competitor quarry which would generate dust from quarrying activities.

5.1.3 Noise

The community type in the vicinity of the Study Area meets the Health Canada (2017) qualitative description of a quiet rural area. A quiet rural area is based on dwellings being >500 m from heavily travelled roads and not subject to frequent aircraft flyovers. A quiet rural area has an estimated baseline sound level of ≤45 dBA (Health Canada, 2017).

The Study Area is located in a rural setting with no residential receptors located within 800 m (Figure 10, Appendix A).

The Project is situated 500 m east of the existing competitor quarry which would generate noise from quarrying activities.

5.2 Geophysical Environment

5.2.1 Topography

Topography within the Study Area includes an incline from the lowest elevation along the northeast boundary (31 masl) to the south of the Study Area, where the highest elevation of 65 masl is located (Figure 11, Appendix A). From this high point, topography slopes downwards to the northeast, towards Keys Brook. The elevation within the existing quarry floor is ~39 masl.

5.2.2 Surficial Geology

Within the Eastern ecoregion, where the Study Area is situated, soil classifications include Gleyed supergroups in imperfectly drained areas, Orthic-Humo-ferric and Ferro-Humi Podzols in well drained areas and Ortstein subgroups in coarse, granitic soils (Neily et al., 2017). The Study Area is located in silty till plain unit. Within this unit, topography is flat to rolling with few surface boulders and the till is generally thick enough to mask bedrock undulations (NSDNR, 2006).

Surficial geology within the Study Area is shown on Figure 11 (Appendix A).

5.2.3 Bedrock Geology

The geology of the Eastern ecoregion, where the Study Area is located, is comprised of Paleozoic slates and quartzites intruded with granites (Neily et al., 2017). Faults and underlying quartzite strata in the ecoregion are folded and covered with varying thickness of glacial till (Neily et al., 2017). The Study Area is located within the Goldenville Formation Unit (NSDNR, 2012c). This unit was deposited during the Cambrian – Ordovician age. The stony, sandy matrix is derived from local bedrock sources. The topography of this geologic unit is described as being folded into numerous, upright folds trending northeast to east, with a maximum measured thickness of 5400 m (Williams et al, 2018).

Bedrock geology within the Study Area is shown on Figure 12 (Appendix A).

5.2.3.1 *Acid Rock Drainage*

The bedrock underlying the Study Area is part of the Goldenville Formation, and therefore has potential for ARD. NSDNRR has developed an ARD Risk Map (Trudell and White, 2013) which was reviewed, however, the map is focused on southwestern Nova Scotia, as this area has a higher probability of acid producing bedrock to occur. Therefore, mapping does not exist where the Study Area is located.

To fully understand the potential for ARD to occur, ARD testing was completed in August 2020 by the Minerals Engineering Centre at Dalhousie University (

Table 5-3 below, and Appendix J). One sample was collected within the Study Area. The total sulfur weight proportion was less than 0.021% and the acid producing potential was less than 0.65 kg/t for this sample (Table 5-4).

Table 5-3. Acid Rock Drainage Testing

Sample ID	Location (UTM, NAD 83)		Total Sulfur (Wt. %)	Acid Producing Potential (kg/t)
	Easting	Northing		
Lantz Quarry – Blast Rock	463301	4979178	0.021	0.65

The sulphur concentration in the sample is below the requirement (0.4 Wt. %) for handling under the *Sulphide Bearing Material Disposal Regulations* (Province of Nova Scotia, 2017) and do not have significant acid producing potential (G. Fraser, Dalhousie University Minerals Engineering Centre Technician, Personal Communications, August 23, 2022).

5.2.4 Groundwater

The Study Area records its lowest elevation of ~31 masl along the northeast boundary and its peak elevation of 65 masl along the southern boundary resulting in a descending slope from the south to north. Within the Study Area there are no NSECC mapped watercourse systems (Figure 7, Appendix A). One field identified watercourse (WC1) bisects the Study Area and flows northeast, eventually tying into Keys Brook. Groundwater flow within the Study Area is anticipated to follow the general drainage trend from the southwest to the northeast towards Keys Brook.

Hydrogeologic characterization of Nova Scotia's Groundwater Regions indicates that the Study Area is located on an area of metamorphic rock (Kennedy, Drage, and Fisher, 2008). One of the four residential wells within 1 km of the Study Area (

Table 5-4) falls within the metamorphic groundwater region, the other three are within the Carbonate/evaporite groundwater region. Hydraulic conductivity for the bedrock type underlying the Study Area (i.e., metamorphic rock) is low (Heath, 1983). Low hydraulic conductivity is also evident by the relatively low yields from the closest known wells, both within and outside the metamorphic groundwater region (Table 5-5).

The closest Nova Scotia Groundwater Observation Well Network observation site to the Study Area is located in Fall River, approximately 21 km to the southwest, and is named Fall River (076). This well is located within the same groundwater region as the Study Area, the metamorphic groundwater region. Groundwater at this site has been monitored since 2008, in that time groundwater level elevations have been relatively stable (NSECC, 2022). In mid-July 2022, groundwater levels were approximately 103.7 masl, near their historic high of approximately 104.6 masl for that time period and after recovering from a historic low of 101.8 masl in early June.

According to the NS Well Logs Database, four wells were identified within 1 km of the Study Area (Figure 10, Appendix A). According to the user's manual of the NS Well Logs Database, wells were based off the NS Map Book, the NSPRD, the Atlas, the well UTM Well Log and the map reference (NTS), (NSE, 2016).

Table 5-4. Surrounding Groundwater Wells Identified from the Well Logs Database (NSE, 2016)

Identification	Well Number	Civic Address	Number of Structures	Distance (m) and Direction from Study Area	Distance (m) and Direction from QEA	Type
NS Wells Logs Database	932428	Hescott Drive	1	195 E	330 N	Drilled domestic
NS Wells Logs Database	111001	92 Dutch Settlement Rd	1	825 N	1,230 NW	Drilled domestic
NS Wells Logs Database	111000	92 Dutch Settlement Rd	1	825 N	1,230 NW	Drilled domestic
NS Wells Logs Database	100627	369 Highway #277	1	860 N	1,150 N	Drilled domestic

As indicated in Table 5-4, one well (932428) was identified within 800 m of the QEA, however, a review of aerial imagery did not identify any structures at this location and location accuracy was indicated to be ± 707 m. the metadata of the well point states it belongs to a civic address on Hescott Drive, Elmsdale, which is approximately 3 km southwest of the Study Area. The apparent location of this well is almost certainly an artefact of data management rather than a true reflection of on the ground conditions. This was not confirmed in the field because it is present on private land that is not owned by Dexter.

Per Table 2-1, the nearest residential receptors to the Project, as identified via a review of aerial imagery, are 362 Highway 277 (Receptor1) and 390 Highway 277 (Receptor2). Receptor1 and Receptor2 sit 1,120 m and 1,150 m north of the QEA, respectively. These receptors are not included in the Nova Scotia Wells Logs Database, however, well number 100627 (
Table 5-4) appears to be located at 390 Highway 277 although it is listed at 369 Highway 277.

The wells identified within 1 km of the Study Area by the Nova Scotia Well Logs Database are presented in Table 5-5 in further detail. This information includes records of geological conditions.

Table 5-5. Characteristics of Groundwater Wells within 1 km of the QEA

Well Number	932428	111001	111000	100627
Distance from QEA (m)	195	860	825	825
Date	02-06-1993	25-02-2011	25-02-2011	22-11-2010
Depth (m)	43.54	79.78	17.97	18.27
Casing (m)	18.27	23.14	12.18	12.18
Depth to Bedrock (m)	17.05	10.05	10.05	10.35
Static Level (m)	-9999	-9999	4.26	-9999
Yield (L/min)	9.08	0	68.1	36.32
Elevation (masl)	27	15	15	16
Easting	463500	462748	462748	463162
Northing	4979500	4980178	4980177	4980285
Accuracy ± (m)	707	15	15	15
Groundwater Region	Metamorphic	Carbonate/evaporite	Carbonate/evaporite	Carbonate/evaporite

The four wells presented in Table 5-5 are drilled to varied depths but are otherwise relatively similar in their attributes. The yields presented in this table, including that of the inaccurately spatially defined well (± 707 m location accuracy), provide information on background conditions that can be reviewed in the context of groundwater within the Study Area. These wells are drilled from depths of 17.97 m to 79.78 m. Depth to bedrock ranges from 10.05 m to 17.05 m and yield ranged from 0 L/min to 68.1 L/min.

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 water wells. The three drilled wells along Dutch Settlement Road to the north of the Study Area, have approximate elevations of 15 m and 16 m. The elevation profiles provided in Table 5-6 and Table 5-7 (below) illustrates the elevation change across the Study Area.

The elevation profile indicated in Table 5-6 (below) depicts topography that remains relatively unchanged within the Study Area across an east-west transect but begins to drop far to the west and rises in the east outside of the boundary, before descending to Keys Brook. This east-west profile suggests groundwater movement within the QEA does not occur primarily along this aspect. The range of elevations observed along this profile is 52 masl – 58 masl within the boundaries of the Study Area.

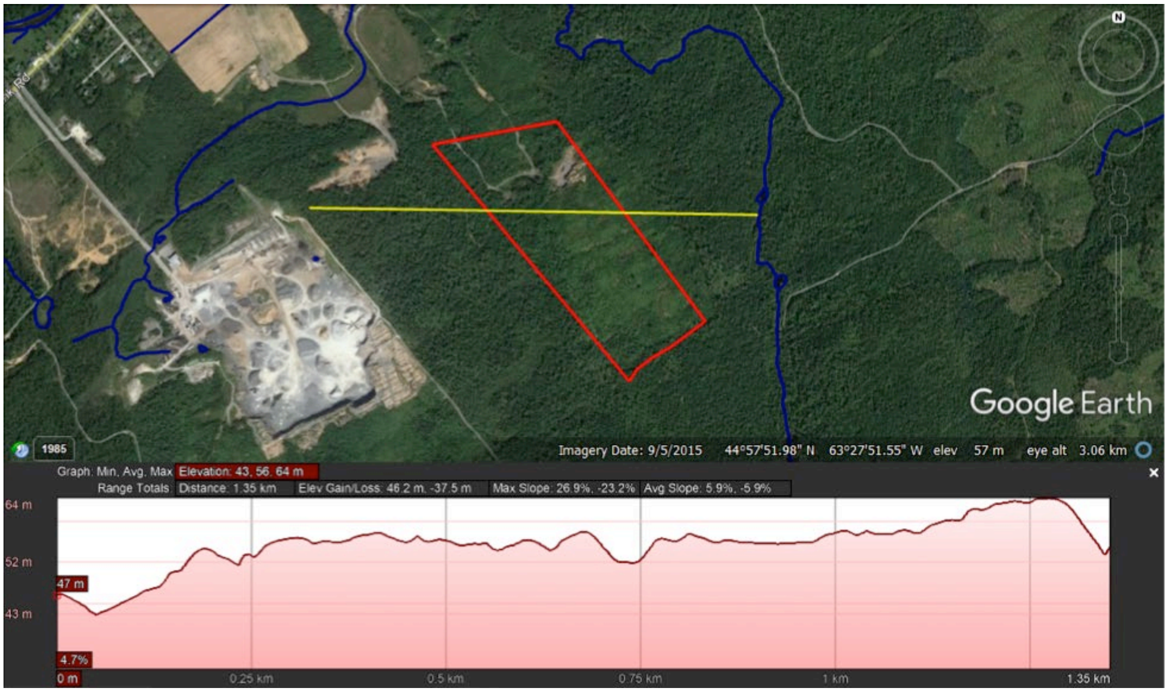

Table 5-6. East-West Elevation Profile through the Quarry Expansion Area

The elevation profile indicated in Table 5-7 (below) depicts a significant decline in slope to the northeast of the Study Area boundary. The majority of groundwater discharge sourced from the Study Area is expected to drain this direction towards Keys Brook in the east. Keys Brook is located at an elevation of 23 masl which is ~9 m lower than the current extent of blasting at site (32 masl at the settling pond).

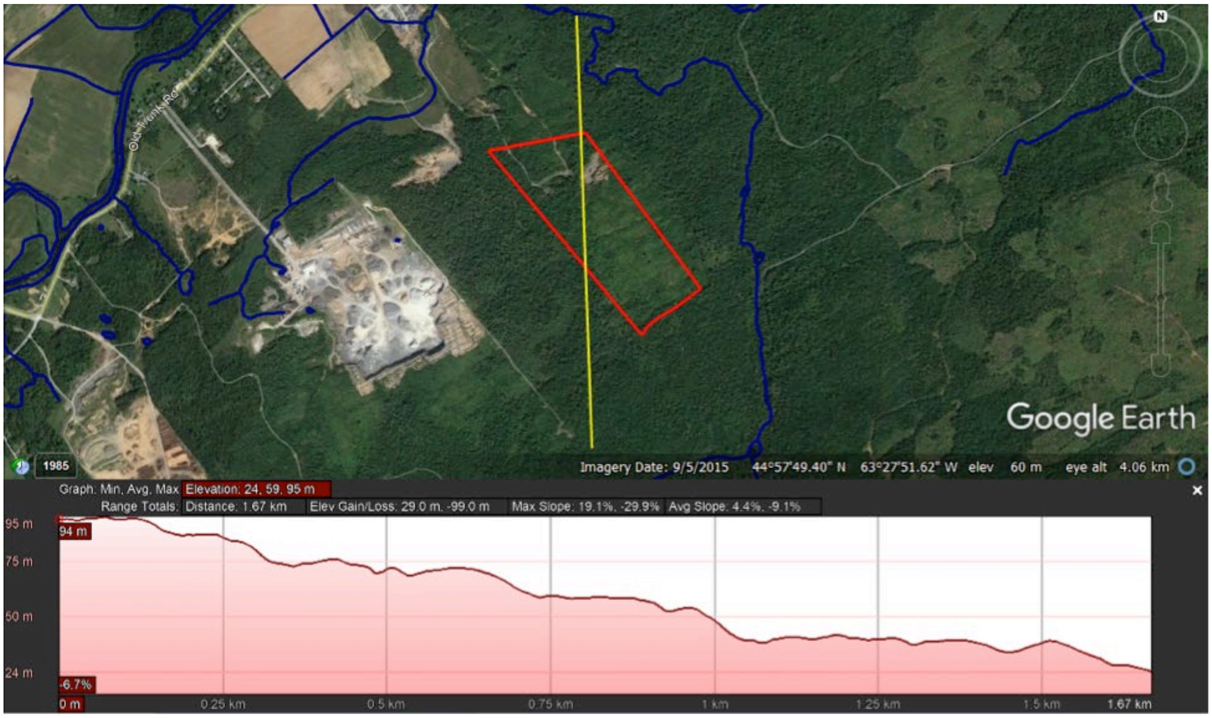

Table 5-7. South-North Elevation Profile through the Quarry Expansion Area

5.3 Terrestrial Environment

This section describes the vegetation community, vascular plants, lichen, wildlife, and birds found within the Study Area.

5.3.1 Vegetation Community and Classification

The desktop review and field results for the vegetation community assessment completed within the Study Area are provided in the following sections.

5.3.1.1 *Desktop Results*

The Study Area is in the Eastern Ecoregion (400) and the Eastern Interior (440) Ecodistrict (Neily et al., 2017). The Eastern Interior Ecodistrict covers 4,575 km^2 and is one of the largest ecodistricts in Nova Scotia. It is dominated by one matrix element (spruce pine hummocks) and seven patch elements (tolerant mixedwood hills, red and black spruce hummocks, tolerant hardwood drumlins and hummocks, spruce hemlock pine hummocks and hills, wetlands, spruce pine flats, and salt marsh) (NSDL&F, 2019). The spruce pine hummocks element is characterized by imperfectly drained soils on hummocky terrain with black spruce, white pine and occasionally red spruce (NSDL&F, 2019). No Old Forest polygons (NSDNRR, 2020) are present within the Study Area. NSDNRR forestry polygons (2021) identified the Study Area is composed of softwood and mixedwood forestry stands (Figure 5, Appendix A).

Refer to Section 5.3.1.3 for details on the vegetation associated with the aforementioned ecodistricts and ecoregions.

5.3.1.2 *Field Results*

The Study Area is comprised of a mosaic of mixedwood stands, softwood dominated stands, forested wetlands, industrial and disturbed areas. Disturbed portions of the Study Area include roads and cutblocks in the southern and eastern portion. In May 2021, MEL biologists identified three points of specific vegetation types: Intolerant Hardwood (IH4) and two types of Mixedwood Forest groups (MW2 and MW5). The wetland vegetation types belong to the Wet Coniferous Forest Group (WC), Wet Deciduous Forest Group (WD), Peatland Group (PG) as well as MEL defined Regenerating Swamp Group. See Table 5-8, 5-8 and Figure 13 (Appendix A) for upland vegetation communities and section 5.4.1 for details on wetlands.

Table 5-8. Upland Vegetation Community Groups and Vegetation Types

Community Type	Habitat Point	Vegetation Group	Vegetation Type (VTs)	Classification Source
Upland Communities	HP2	Mixedwood Forest	MW2	FEC
	HP3, HP4	Mixedwood Forest	MW5	FEC
	HP1	Intolerant Hardwood Forest	IH4	FEC
	NA	Cutover	-	MEL
	NA	Disturbed	-	MEL

Table 5-9. Wetland Vegetation Community Groups and Vegetation Types

Community Type	Vegetation Group	Wetland ID	Vegetation Type (VTs)	% of total Study Area	Classification Source
Wetland Communities	Wet Coniferous Forest	WL2, WL10, WL13	WC1	0.78	FEC
		WL5	WC2	0.17	FEC
		WL15	WC6	0.27	FEC
		WL9	WC7	0.14	FEC
	Wet Deciduous Forest	WL1, WL3, WL11	WD2	1.27	FEC
		WL17	WD5	0.34	FEC
		WL12, WL14, W16	WD6	0.25	FEC
	Peatland Group	WL4, WL7	PG4	2.33	NLM adapted
	Regenerating Swamp	WL6, WL8	Grey-birch/Carex lurida/sphagnum regenerative swamp	2.44	MEL[1]

[1]Neither the FEC or NLM systems accurately describe these vegetation community types, therefore, MEL biologists characterized the vegetation community by dominant species observed

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

5.3.1.3 **Vegetation Community and Classification – Upland Vegetation Types**

The following subsections outline the upland vegetation types identified within the Study Area.

5.3.1.3.1 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 her layers with reduced bryophyte and lichen cove are typical (Neily et al. 2010). One VT belonging to this group, IH4, was observed within the Study Area at habitat point 1.

IH4 – Trembling Aspen/ Wild Raisin,/ Bunchberry
The IH4 – Trembling aspen/ wild raisin / bunchberry VT is an early successional vegetation type that is dominated by trembling aspen (*Populus tremuloides*). It generally has a well-developed understory of woody and herbaceous plants with reduced bryophyte cover. IH4 is typically found in fresh to moist soils. Trembling aspen dominated the overstory, with red maple (*Acer rubrum*) and balsam fir (*Abies balsamea*) present in lesser amounts. IH4 tends to have a well-developed shrub layer including regenerating red maple and balsam fir, wild raisin (*Viburnum nudum*), lambkill (*Kalmia angustifolia*) and blueberry species (*Vaccinium sp.*). Common species in the herbaceous layer include starflower (*Trientalis borealis*), Canada bunchberry (*Cornus canadense*), twinflower (*Linnaea borealis*) and bracken fern (*Ptreridium aquilum*). Although the bryophyte layer is poorly developed, Schreber's moss (*Pleurizium schreberi*) and broom moss (*Dicranum scoparium*) can be present (Neily et al. 2010).

This VT was observed at HP1, in the northern portion of the Study Area (Figure 13; Appendix A).

5.3.1.3.2 Mixedwood Forest Group (MW)

This forest group comprises of early to late successional vegetation types, and these vegetation types can be difficult to characterize due to variation of tree species composition. This forest group is dominated by a mixture of hardwood and softwood species and occur in an upland setting. Early successional stages often consist of red maple, white birch and balsam fir and late successional stages comprise of yellow birch (*Betula alleghaniensis*), red spruce (*Picea rubens*) and/or hemlock (*Tsuga canadensis*). Herb and bryophyte diversity is often high and extensive. Two VTs belonging to this group, MW2 and MW5, were observed within the Study Area.

MW2 – Red Spruce – Red Maple – White Birch / Goldthread
The MW2 – Red spruce - red maple – white birch / goldthread VT is a mid-successional vegetation type. The overstory is composed of red spruce and red maple with other species, such as trembling aspen,

occasionally present. The shrub layer is composed primarily of regenerating trees, and the herbaceous layer is typical of mixedwood forest flora. Bryophyte coverage is limited by the abundance of softwood tree species and presence of coarse woody debris and, therefore, varies greatly. This VT usually follows stand-replacing disturbance events such as windthrow or harvesting.

This VT was observed once in the Study Area at HP2 in a disturbed and regenerating area (Figure 13; Appendix A). Classification of this VT was subject to interpretation, as the area was recently cut.

MW5 – White Birch – Balsam Fir / Starflower

The MW5 – White birch – balsam fir / starflower VT is an early successional vegetation type. The overstory is composed of co-dominant white birch and balsam fir with other species occasionally present. The shrub layer is composed primarily of regenerating trees, and the herbaceous layer is typical of mixedwood forest flora. Bryophyte coverage is limited by the abundance of softwood tree species and presence of coarse woody debris and, therefore, varies greatly. This VT usually follows stand-replacing disturbance events such as windthrow or harvesting.

This VT was observed twice in the Study Area at HP3 and HP4 in disturbed and regenerating habitats (Figure 13; Appendix A). Classification of this VT was subject to interpretation, as the area was recently cut.

5.3.1.4 **Vegetation Community and Classification – Wetland Communities**

The following subsections outline the wetland vegetation communities.

5.3.1.4.1 Wet Coniferous Forest Group (WC)

This vegetation group is classified by having water at or near the surface for most of the year (Neily et al., 2010). 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). Four VT belonging to this group, WC1, WC2, WC6, WC7, were observed within the Study Area (Figure 13; Appendix A).

WC1 – Black Spruce / Cinnamon Fern / Sphagnum

WC1 – Black spruce / cinnamon fern / sphagnum is generally a mid-successional ecosystem associated with wet, nutrient poor soils and dominated by black spruce, moderate to high herbaceous cover, and sphagnum moss. Other important canopy trees hybrid black spruce-red spruce and balsam fir. The shrub layer typically contains low to moderate cover, and the herbaceous layer contains high cover of vascular plants and high bryophyte development. Nutrient availability is generally low (Neily et al. 2010).

This VT was observed in three wetlands (WL2, WL10, and WL13) throughout the Study Area and accounted for 0.78% of the total Study Area (Figure 13; Appendix A).

WC2 – Black Spruce / Lambkilll – Labrador Tea / Sphagnum, Huckleberry – Inkberry variant
WC2 – Black spruce / lambkill – Labrador tea / sphagnum is an edaphic climax ecosystem associated with poorly drained mineral or organic deposits. It is dominated by black spruce with a high shrub and sphagnum moss cover. The variant WC2A contains coastal plain species like inkberry (*Ilex glabra*) and/or huckleberry (*Ilex* sp.), and occasionally supports rare Atlantic Coastal Plain Flora (Neily et al. 2010).

This VT was observed in one wetland (WL5) in the eastern border of the Study Area and accounted for 0.17% of the total Study Area (Figure 13; Appendix A).

WC6 – Balsam Fir / Cinnamon Fern – Three seeded sedge / Sphagnum
WC6 – Balsam fir/ cinnamon fern – three seeded sedge / sphagnum is an early to mid-successional ecosystem that is typically associated with wet soils, and is dominated by balsam fir, moderate herbaceous cover, and sphagnum. The shrub layer is variably developed with low to moderate cover. Nutrient availability is low to moderate (Neily et al. 2010).

This VT was observed in one wetland (WL15) in the northeast portion of the Study Area and accounted for 0.27% of the total Study Area (Figure 13; Appendix A).

WC7 – Tamarack – Black Spruce / Lambkilll / Sphagnum
WC7- Tamarack – black spruce / lambkill / sphagnum is an early to mid- successional ecosystem that is associated with larch (*Larix laricina*) canopy and sphagnum cover. Many WC7 stands are co-dominated by black spruce. WC7 is common on poorly drained flats and depressions, and nutrient availability is low to moderate (Neily et al. 2010).

This VT was observed in one wetland (WL9) in the southwest portion of the Study Area and accounted for 0.17% of the total Study Area (Figure 13; Appendix A).

WD2 – Red Maple / Cinnamon Fern / Sphagnum
WD2 – Red maple / cinnamon fern / sphagnum is an early to mid-successional ecosystem that has a low tree and herbaceous species richness and is found in peat or poorly drained mineral soil. The canopy is generally dominated by red maple and the shrub layer is dominated by wild raisin, speckled alder and regenerating trees. Cinnamon fern and goldthread tend to dominate the herbaceous layer.

This VT was observed in three wetlands (WL1, WL3, WL11) in the Study Area, and accounted for 1.27% of the total Study Area (Figure 13; Appendix A).

WD5 – Trembling Aspen / Beaked Hazelnut / Interrupted Fern / Sphagnum
WD5 – Trembling aspen / beaked hazelnut / interrupted fern / sphagnum is an early successional forest with poorly drained flats and gentle slopes. Trembling aspen dominates the canopy, with red maple occasionally co-dominating. Balsam fir and spruce are occasionally present. This vegetation type has a

high sphagnum cover. This vegetation type generally originates from agricultural land clearing or clearcutting. This vegetation type is associated with low to moderate nutrient availability (Neily et al. 2010).

This VT was observed in one wetland (WL17) near the western boundary of the Study Area, and accounted for 0.34% of the total Study Area (Figure 13; Appendix A).

WD6 – Red Maple – Balsam Fir / Wood Aster / Sphagnum

WD6 – Red maple – balsam fir / wood aster / sphagnum stands are generally mid-successional, and are characterized by red maple and balsam fir in the canopy, moderate to high herbaceous cover and a well-developed bryophyte layer. It is typically found in poorly drained mineral soils and has low to medium nutrient availability.

This VT was observed in three wetlands (WL12, WL14, WL16 in the northern half of the Study Area, and accounted for 0.25% of the total Study Area (Figure 13; Appendix A).

Grey birch / Carex lurida / Sphagnum regenerative swamp

Grey birch / *Carex lurida* / sphagnum regenerative swamps are wet areas with a forest management disturbance history and, therefore, dominated by young pioneer tree species such as grey birch (*Betula populifolia*) and the early successional wetland sedge, *Carex lurida*.

This VT was observed in two wetlands (WL6, WL8) in the central portion of the Study Area (Figure 13; Appendix A).

5.3.1.5 Peatland Vegetation Group (PG)

This vegetation community group often consists of extensive sphagnum moss cover, graminoids (sedges and grasses), sparse tree cover and often with the presence of carnivorous plant species.

PG4 – Sheep Laurel Dwarf Shrub Bog

The PG4 – Sheep Laurel Dwarf Shrub Bog vegetation type is a prototypical bog community, dominated by sheep laurel and stunted black spruce and larch (Gawler & Cutko, 2018). Other dwarf shrubs include sweetgale (*Myrica gale*) and leather leaf (*Chamaedaphne calyculata*). The herbaceous layer consists of sedges and scattered bog golden rod (*Solidago ugilonosa*). Other trademark bog species such as purple pitcher plant (*Sarracvenia purpurea*) and round-leaved sundew (*Drosera rotundifolia*) were observed. This vegetation type is similar to the PG1 - Huckleberry – Crowberry bog community but differs primarily by the absence and/or trace amounts of huckleberry and increased cover of sheep laurel and sweetgale. Black spruce and larch cover were also more abundant in this vegetation type then compared to the PG1 vegetation type.

This VT was observed in two wetlands (WL4, WL7) in the southern portion of the Study Area (Figure 13; Appendix A).

5.3.1.6 *Cut-over*

Per Section 4.3.1.3, when MEL encounters a vegetative group that does not fit into a defined system (e.g., FEC), a new group is created with a VT based on dominant vegetation observed. The cut-over vegetative group was scattered throughout the Study Area and includes cut areas and roads. Cut areas, as its name implies, is characterized by historic clearing activities (~20 years ago). Cut areas were located throughout the Study Area.

5.3.1.7 *Vegetation Community and Classification Summary*

The Study Area is comprised of VTs within the Mixedwood Forest Group (MW), the Intolerant Hardwood Forest group (IH), the Wet Coniferous Forest Group (WC), the Peatland Group (PG), MEL-defined swamp group and the 'cut-over' group. The vegetative communities identified within the Study Area are common in the surrounding landscape and the province.

5.3.2 <u>Vascular and Nonvascular Plants</u>

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

5.3.2.1 *Desktop Results*

The ACCDC report (Appendix D) documented 11 priority vascular plant species within 5 km of the Study Area:

- Eastern leatherwood (*Dirca palustris,* S2),
- Small-spike false-nettle (*Boehmeria cylindrica,* S2S3),
- Canada lily (*Lilium canadense,* S2),
- Stalked bulrush (*Scirpus pedicellatus,* S2S3),
- Canada wood nettle (*Laportea canadensis,* S3),
- Deer-tongue panic grass (*Dichanthelium clandestinum,* S3S4),
- Long-root smartweed (*Persicaria amphibia var. emersa*, S3?),
- Woodland strawberry (*Fragaria vesca ssp. americana,* S3S4),
- Sharp-fruit rush (*Juncus acuminatus,* S3S4),
- White elm (*Ulmus americana*; S3S4), and
- Thyme-leaved speedwell (*Veroonica serpyllifolia*; S3S4).

There are no ACPF buffers within the Study Area, with the closest buffer located 2.6 km northeast of the Study Area.

Black ash (*Fraxinus nigra*) has been identified by ACCDC to have been recorded within 8.8 km of the Study Area (Appendix D). Vegetation community assessments, vascular flora surveys, and wetland assessments targeted potential habitat for this species within the Study Area.

No priority bryophytes were documented within 5 km of the Study Area in the ACCDC report (Appendix D).

5.3.2.2 *Field Results*

A total of 174 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 classified as a SOCI: Bicknell's crane's-bill (*Geranium bicknellii,* S3 [ACCDC April 2022]). The Bicknell's crane's-bill observation occurred in upland regenerating forested habitat, 10 m southeast of the existing quarry face (Figure 14, Appendix A). Refer to Section 5.5.2 for additional information on priority vascular plant species.

Photo 1. Photo of Bicknell's crane's-bill, observed within the Study Area

Within the Study Area, 4.0% of the observed vascular plant species (n=7) comprised of exotics, 96.0% (n=167) were native. A list of all plants observed can be found in Appendix K.

As discussed in Section 5.3.1, the Study Area consists primarily of intact and regenerating softwood and mixedwood forested communities with wetland habitats interspersed throughout. Disturbed areas, such as a gravel road and historic timber harvesting, are also present. Hydrophytic vegetation was present in wetlands (Section 5.4.1). The disturbed habitats (e.g., gravel roads, and historic timber harvesting) consisted primarily of herbaceous pioneer species.

Within the Study Area, a total of 22 bryophytes were identified, none of which are listed as a priority species (Table 5-10).

Table 5-10. Bryophtes Identified within the Study Area

Scientific Name	Common Name	SRank
Codriophorus acicularis	Black-tufted Rock Moss	S5
Dicranella schreberiana	Schreber's Forklet Moss	SU
Dicranum scoparium	Common Broom Moss	S5
Dicranum undulatum	a Dicranum Moss	S5
Dicranum viride	Green Broom Moss	S5

Scientific Name	Common Name	SRank
Hedwigia ciliata	Ciliate Hedwigia Moss	S5
Hylocomium splendens	Stairstep Moss	S5
Hypnum imponens	Pellucid Plait Moss	S5
Leucobryum glaucum	White Pincushion Moss	S5
Mnium hornum	Swan's-neck Leafy Moss	S5
Neckera pennata	Feathery Neckera Moss	S5
Pogonatum pensilvanicum	a Moss	S5
Pohlia bulbifera	Blunt-bud Nodding Moss	SU
Polytrichum commune	Common Haircap Moss	S5
Sphagnum capillifolium	Northern Peatmoss	S5
Sphagnum cuspidatum	Feathery Peat Moss	S5
Sphagnum girgensohnii	Green Peat Moss	S5
Sphagnum magellanicum	Magellan's Peat Moss	S5
Sphagnum palustre	Blunt-leaved Peat Moss	S5
Thuidium delicatulum	Delicate Fern Moss	S5
Ulota coarctata	a Moss	S5
Ulota crispa	Crisped Pincushion Moss	S5

Note: Scientific names used are in accordance to the latest ACCDC species list retrieved in March 2022. Scientific names may no longer be in use, however, for consistency in this report, species names in the ACCDC species list are used.

5.3.3 Lichens

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

5.3.3.1 *Desktop Results*

One priority lichen species was documented within 5 km of the Study Area in the ACCDC report (Eastern boreal pixie-cup lichen (*Cladonia coccifera,* S2S3; Appendix D)). No predicted BFL polygons are present within the Study Area, with the closest predicted polygon 3.7 km southeast of the Study Area. According to the MTRI databases, no extant BFL populations are within the Study Area, and the closest population is located 27 km southeast. The closest vole ears lichen population is located 27.1 km southeast from the Study Area.

5.3.3.2 *Field Results*

During the field surveys, 14 lichen species were observed within the Study Area, and none were determined to be SAR or SOCI species (Table 5-11).

Table 5-11. Lichen Species Identified within the Study Area

Scientific Name	Common Name	SRank
Cladonia coniocraea	Common Pixie Powderhorn	S5
Cladonia crispate	Organpipe Lichen	S5
Cladonia maxima	Giant Cladonia Lichen	S5
Cladonia rangiferina	Gray Reindeer Lichen	S5
Cladonia uncialis	Thorn Lichen	S5

Scientific Name	Common Name	SRank
Dibaeis baeomyces	Pink Earth Lichen	S5
Hypogymnia incurvoides	Lattice Tube Lichen	S4S5
Lobaria pulmonaria	Lungwort Lichen	S5
Lobaria scrobiculata	Textured Lungwort Lichen	S5
Pannaria conoplea	Mealy-rimmed Shingle Lichen	S4S5
Parmelia sulcate	Hammered Shield Lichen	S5
Platismatia glauca	Varied Rag Lichen	S5
Pseudocyphellaria hawaiiensis	Gilded Specklebelly Lichen	SNA
Ricasolia quercizans	Smooth Lung Lichen	S5

Note: Scientific names used are in accordance to the latest ACCDC species list retrieved in March 2022. Scientific names may no longer be in use, however, for consistency in this report, species names in the ACCDC species list are used.

As mentioned previously, the Study Area is disturbed and dominated by cutover and regenerating softwood and mixedwood stands, wetlands, and disturbed areas. Many of the rare lichens in Nova Scotia have an association with mature forested communities, often associated with wetlands, lakes, and watercourses. The appropriate tree maturity and bark texture that provide habitat for a suite of rare cyanolichens and calicioids including blue felt lichen (*Pectenia plumbea*), frosted glass-whiskers (*Sclerophora peronella*), and fringe lichen (*Heterodermia neglecta*) was not observed within the Study Area.

5.3.4 Wildlife

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

5.3.4.1 *Desktop Results*

There are no documented NSDNRR significant habitats within the Study Area; the closest significant habitat is for wood turtle (HX279), located approximately 200 m east of the Study Area in Keys Brook. Keys Brook is also designed as a wood turtle (*Glyptemys insculpta*) Special Management Practice (SMP) area (Nova Scotia Department of Natural Resources, 2012). Within the Study Area is an unnamed watercourse (WC1) which drains northeast into Keys Brook. Keys Brook flows north and is a tributary to the Shubenacadie River.

Snapping turtle, eastern painted turtle, and four-toed salamander were listed within 5 km of the Study Area by the ACCDC (Appendix D). Additionally, wood turtle and bat hibernacula or bat species occurrence, documented as "location sensitive", are listed in the ACCDC report as being found in proximity to the Study Area. Communication with NSDNRR in April 2021 confirmed that there is no identified core habitat within the Study Area but wood turtle core habitat is within close proximity, and observations of the species were documented less than 1 km from the Study Area (Dr. D. Hurlburt, NSDNRR Manager of Biodiversity, Personal Communications, April 7, 2021).

An AMO was identified 3.5 km northeast of the Study Area (shaft ID: ELM-1-001). Metadata for this AMO indicated that it is plugged with rock and vegetation. MEL consulted with the landowner but were denied access to their property, therefore, could not field verify that the AMO is filled and offers no suitable overwintering habitat for bats. The Study Area appears to exist within a national 10 km x 10 km standardized grid squares within which critical habitat (hibernacula) for little brown myotis, northern myotis, and tri-colored bat is found (Environment Canada, 2015). NSDNRR confirmed that a bat hibernaculum exists <4 km northeast of the Study Area (Dr. D. Hurlburt, NSDNRR Manager of Biodiversity, Personal Communications, June 3, 2021) and that the hibernaculum is not situated in the location of the AMO (Dr. D. Hurlburt, NSDNRR Manager of Biodiversity, Personal Communications, June 8, 2021).

The Study Area is not located within a moose concentration area or mainland moose core habitat (NSDNRR, 2021; M. McGarrigle, NSDNRR SAR Biologist, Personal Communications, September 6, 2022).

Refer to Section 5.5 for additional details on priority species within the Study Area.

5.3.4.2 *Field Results*

The following subsections outline the survey results of incidental wildlife observations and wood turtle surveys.

5.3.4.2.1 Mammals

Wildlife species, including mammals, were assessed as part of the winter wildlife and bird surveys, as well as incidentally during all biophysical surveys. Refer to Table 5-12 for all incidental mammal observations confirmed either visually or by sign (scat, tracks, etc.).

Table 5-12. 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
Red fox	*Vulpes vulpes*	-	-	-	S5
North American porcupine	*Erethizon dorsatum*	-	-	-	S5

Other species not encountered during field surveys that have the potential to use the Study Area habitat include those lists in Table 5-13.

Table 5-13. Mammalian Species with Potential Habitat within the Study Area

Common Name	Scientific Name	COSEWIC	SARA	NSESA	SRank
Star-nosed mole	*Condylura cristata*	-	-	-	S5
Eastern chipmunk	*Tamias striatus*	-	-	-	S5
American beaver	*Castor canadensis*	-	-	-	S5
Bobcat	*Lynx rufus*	-	-	-	S5
American black bear	*Ursus americanus*	-	-	-	S5

Common Name	Scientific Name	COSEWIC	SARA	NSESA	SRank
Deer mouse	*Peromyscus maniculatus*	-	-	-	S5
Raccoon	*Procyon lotor*	-	-	-	S5
Eastern coyote	*Canis latrans*	-	-	-	S5
Mainland moose	*Alces alces americana*	-	-	E	S1
Tricolored bat	*Perimyotis subflavus*	E	E	E	S1
Little brown myotis	*Myotis lucifugus*	E	E	E	S1
Northern myotis	*Myotis septentrionalis*	E	E	E	S1
Short-tailed weasel	*Mustela erminea*	-	-	-	S5
Common shrew	*Sorex cinereus*	-	-	-	S5
American mink	*Vison vison*	-	-	-	S5
Meadow vole	*Microtus pennsylvanicus*	-	-	-	S5
White-footed deer mouse	*Peromyscus leucopus*	-	-	-	S5

5.3.4.2.2 Herpetofauna

Wood turtle surveys occurred on May 13, 18 and 28, 2021. No wood turtles or other herpetofauna were observed. The results of the wood turtle survey are discussed in Section 5.5.5.

Within the Study Area, habitat for herpetofauna is present within wetlands and WC1. Northern leopard frog (*Lithobates pipiens*; S5) and spring peepers (*Pseudacris crucifer;* S5) were the only herpetofauna identified within the Study Area. The Northern leopard frog was observed within wetland habitat and spring peepers were heard calling within the Study Area during common nighthawk nocturnal surveys. An assemblage of herpetofauna species may inhabit the areas where suitable habitat was observed are listed in Table 5-14.

Table 5-14. Herpetofauna Species with Potential to Occupy the Study Area

Taxa	Common Name	Scientific Name	COSEWIC	SARA	NSESA	SRank
Reptiles	Wood turtle	*Glyptemys insculpta*	T	T	T	S2
	Snapping turtle	*Chelydra serpentina*	SC	SC	V	S3
	Eastern painted turtle	*Chrysemys picta picta*	SC	SC	-	S4
	Maritime garter snake	*Thamnophis sirtalis pallidulus*	-	-	-	S5
	Smooth green snake	*Opheodrys vernalis*	-	-	-	S4
Amphibians	Pickerel frog	*Lithobates palustris*	-	-	-	S5
	Green frog	*Lithobates clamitans*	-	-	-	S5
	American bullfrog	*Lithobates catesbeianus*	-	-	-	S5
	Mink frog	*Lithobates septentrionalis*	-	-	-	S5
	Eastern American toad	*Anaxyrus americanus*	-	-	-	S5

Taxa	Common Name	Scientific Name	COSEWIC	SARA	NSESA	SRank
		americanus				
	Spring peeper	*Pseudacris crucifer*	-	-	-	S5
	Wood frog	*Lithobates sylvatica*	-	-	-	S5
	Eastern red-back salamander	*Piethodon cinereus*	-	-	-	S5
	Yellow-spotted salamander	*Amystoma maculatum*	-	-	-	S5
	Four-toed salamander	*Hemidactylium scutatum*	-	-	-	S3
	Red-spotted newt	*Notophthalmus viridescens*	-	-	-	S5

Refer to Section 5.5.5 for information on suitable habitat within the Study Area for wood turtle.

5.3.5 Avifauna

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

5.3.5.1 *Desktop Results*

The Eastern Interior Ecodistrict, where the Study Area is situated, is the largest ecodistrict in the province and characterised by forested, wet ecosystems. These wet ecosystems include treed and unforested wetlands as well as other aquatic ecosystems such as rivers, lakes, and ponds (Neily et al. 2017). This ecodistrict exhibits a strong diversity of habitats to support, in turn, a high diversity of bird species.

There are no IBAs within 5 km of the Study Area (Bird Studies Canada, 2012). The closest IBA, Musquodoboit (NS014), is approximately 40 km southeast of the Study Area. The Musquodoboit IBA includes many wooded islands and a tidal inlet that is enclosed by a barrier sand beach. Sand and mud flats appear during low tide or periods with low water levels. Main habitat types include temperate coniferous forests, tidal wetlands/rivers, mud/sand flats, open sea, coastal shores, and rocky cliffs (IBA Canada, n.d.). The site is well known for its large gatherings of Canada geese (*Branta canadensis*) during migration periods. Piping plover (*Charadrius melodus*) and semipalmated plover (*Charadrius semipalmatus*) have been recorded within the Muquodoboit IBA (IBA Canada, n.d.). Habitats within the Study Area are not representative of those found within the Musquodoboit IBA.

The MBBA square 20MQ67 (Appendix F) encompasses the entirety of the Study Area. In the first MBBA Atlas, 68 species were observed within this square, in the second atlas 70 species were observed. The ACCDC (Appendix D) identified 21 avian priority species within 5 km of the Study Area.

5.3.5.2 *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), winter surveys, and all incidental observations.

5.3.5.2.1 Spring Migration

Eight point count locations (Figure 6, Appendix A) were surveyed on two separate dates during the spring migration period for a total of 160 minutes of effort (May 13 and May 28, 2021). Refer to Table 5-15 for a summary of survey conditions (Note: no end survey condition data was collected during both rounds of spring migration).

Table 5-15. Spring Migration Survey Conditions Table

Survey Round	Date	Surveyor(s)	Survey Effort (mins)	Survey Start			Survey End		
				Temp. (°C)	Wind[1]	Precip.[2]	Temp. (°C)	Wind[1]	Precip.[2]
1	May 13, 2021	Emma Posluns & Melanie MacDonald	80	10	0	0	-	-	-
2	May 28, 2021	Jessica Lohnes	80	7	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).

During spring migration surveys, a total of 176 individuals representing 32 species were observed (Table 5-16). One priority species was observed during the spring migration surveys, Canada warbler (*Wilsonia canadensis*, SARA Threatened, NSESA Endangered, S3B). The Canada warbler was identified at PC1 (Figure 15; Appendix A). Killdeer (*Charadrius vociferus*, S3B) was identified at PC8 but based on its SRank (S3B), is only considered a priority species during the breeding period. All avian priority species are discussed in detail in Section 5.5.6.

Table 5-16. Spring Migration: Species and Abundance of Birds

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	#	Observation Location	Bird Group
Canada warbler	***Wilsonia canadensis***	**T**	**T**	**E**	**S3B**	**2**	**PC1**	**6**
Killdeer	*Charadrius vociferus*	-	-	-	S3B	1	PC8	2
American crow	*Corvus brachyrhynchos*	-	-	-	S5	9	PC4, 5, 6, 8	6
American goldfinch	*Spinus tristis*	-	-	-	S5	5	PC1, 3, 4, 8	6
American redstart	*Setophaga ruticilla*	-	-	-	S5B	1	PC8	6
American robin	*Turdus migratorius*	-	-	-	S5B,S3N	18	PC1, 2, 3, 4, 5, 6, 7, 8	6
Black-and-white warbler	*Mniotilta varia*	-	-	-	S5B	15	PC1, 2, 3, 4, 5, 7, 8	6
Black-capped chickadee	*Poecile atricapillus*	-	-	-	S5	12	PC1, 3, 7, 8	6
Blue-headed vireo	*Vireo solitarius*	-	-	-	S5B	4	PC1, 4, 6	6
Blue jay	*Cyanocitta cristata*	-	-	-	S5	5	PC3, 4, 5, 7, 8	6
Black-throated green warbler	*Setophaga virens*	-	-	-	S5B	5	PC4, 5, 6	6
Common grackle	*Quiscalus quiscula*	-	-	-	S5B	4	PC7, 8	6
Common raven	*Corvus corax*	-	-	-	S5	2	PC2, 8	6
Common yellowthroat	*Geothlypis trichas*	-	-	-	S5B	9	PC1, 2, 3, 4, 7, 8	6
Dark-eyed junco	*Junco hyemalis*	-	-	-	S4S5	9	PC1, 2, 3, 4, 6, 7	6
European starling	*Sturnus vulgaris*	-	-	-	SNA	2	PC8	6
Golden-crowned kinglet	*Regulus satrapa*	-	-	-	S5	1	PC2	6
Hermit thrush	*Catharus guttatus*	-	-	-	S5B	13	PC2, 3, 4, 5, 6, 7, 8	6
Magnolia warbler	*Setophaga magnolia*	-	-	-	S5B	7	PC1, 2, 4, 5, 7, 8	6
Nashville warbler	*Oreothlypis ruficapilla*	-	-	-	S4B, S5M	2	PC3, 5	6
Northern flicker	*Colaptes auratus*	-	-	-	S5B	4	PC3, 6, 7, 8	7
Northern parula	*Parula americana*	-	-	-	S5B	4	PC1, 2, 6, 7	6
Ovenbird	*Seiurus aurocapilla*	-	-	-	S5B	5	PC1, 3, 4, 6, 7	6

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	#	Observation Location	Bird Group
Red-breasted nuthatch	*Sitta canadensis*	-	-	-	S4S5	2	PC1, 2	6
Red-eyed vireo	*Vireo olivaceus*	-	-	-	S5B	5	PC1, 2, 3, 6, 8	6
Red-winged blackbird	*Agelaius phoeniceus*	-	-	-	S4B	3	PC7, 8	6
Ring-necked pheasant	*Phasianus colchicus*	-	-	-	SNA	1	PC8	7
Song sparrow	*Melospiza melodia*	-	-	-	S5B	6	PC1, 7, 8	6
Spruce grouse	*Falcipennis canadensis*	-	-	-	S4	1	PC7	7
White-throated sparrow	*Zonotrichia albicollis*	-	-	-	S4S5B, S5M	17	PC2, 3, 4, 5, 6, 7, 8	6
Winter wren	*Troglodytes troglodytes*	-	-	-	S5B	1	PC5	6
Yellow-rumped warbler	*Setophaga coronata*	-	-	-	S5B	1	PC1	6
Total Number of Species Identified: 32		**Total Number of Individuals: 176**						

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 2022).

The majority of species observed were of the order Passeriformes (87.5%). The second most abundant group were other landbirds (9.4%), followed by shorebirds (3.1%). American robin (*Turdus migratorius*, n=18) was the most abundant species observed, followed by white-throated sparrow (*Zonotrichia albicollis*, n=17) and black-and-white warbler (*Mniotilta varia*, n=15). There was no evidence of migration groups or patterns observed during these surveys. A pair of Canada warblers were observed during a spring migration survey displaying territorial and agitated behaviour. This is a high level of breeding evidence and the observation location (PC1; Figure 15, Appendix A) is a treed swamp with suitable nesting habitat. Due to the observation of a SAR and suitable breeding habitat within WL1, it is expected that NSECC will classify WL1 as a wetland of special significance (WSS; Section 5.4.1.2.4).

5.3.5.2.2 Breeding Season

The breeding bird survey consisted of eight point count stations that were surveyed on June 13 and June 25, 2021 for a total of 280 mins of effort (including area searches) (Figure 6, Appendix A). Refer to Table 5-17 for a summary of survey conditions.

Table 5-17. Breeding Season Survey Conditions Table

Survey Round	Date	Surveyor(s)	Survey Effort (mins)	Survey Start			Survey End		
				Temp. (°C)	Wind[1]	Precip.[2]	Temp. (°C)	Wind[1]	Precip.[2]
1	June 13, 2021	Jessica Lohnes	80[3] 60[4]	8	0	0	17	1	0
2	June 25, 2021	Jessica Lohnes	80[3] 60[4]	11	0	0	19	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).
[3]Effort during point count survey
[4]Effort during area search

During breeding bird surveys, a total of 199 individuals representing 35 species were observed (Table 5-18). Two priority species were observed during the breeding bird surveys, Canada warbler (*Wilsonia canadensis*, S3B) and common nighthawk (*Chordeiles minor*, S3B). Both species are SAR and the Canada warbler is listed as threatened under SARA and COSEWIC and endangered under NSESA. The common nighthawk is listed as special concern under SARA and COSEWIC and threatened under NSESA (Figure 15; Appendix A). All avian priority species are discussed in detail in Section 5.5.6.

Table 5-18. Breeding Season Surveys: Species and Abundance of Birds

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	#	Observation Location	Breeding Status	Bird Group
Canada warbler	***Wilsonia canadensis***	**T**	**T**	**E**	**S3B**	**1**	**PC1**	**H, S, T, A, P**	**6**
Common nighthawk	***Chordeiles minor***	**T**	**SC**	**T**	**S3B**	**1**	**Area Search Transect (on edge of quarry)**	**H**	**6**
Alder flycatcher	*Empidonax alnorum*	-	-	-	S5B	6	PC1, 3, 4, 5, 7	H, S	6
American crow	*Corvus brachyrhynchos*	-	-	-	S5	5	PC2, 3, 6, 7, 8	H, S	6
American goldfinch	*Spinus tristis*	-	-	-	S5	2	Area Search Transect	H, S, P	6
American redstart	*Setophaga ruticilla*	-	-	-	S5B	4	PC2, 3, 4, 8	H, S	6
American robin	*Turdus migratorius*	-	-	-	S5B,S3N	19	PC1, 2, 3, 4, 5, 6, 7, 8	H, S	6
Black-and-white warbler	*Mniotilta varia*	-	-	-	S5B	13	PC1, 2, 3, 4, 5, 7, 8, Area Search Transect	H, S, P	6
Black-capped chickadee	*Poecile atricapillus*	-	-	-	S5	5	PC3, 4, 8	H, S	6
Blue-headed vireo	*Vireo solitarius*	-	-	-	S5B	17	PC1, 2, 3, 4, 5, 6, 7, 8	H, S	6
Blue jay	*Cyanocitta cristata*	-	-	-	S5	7	PC1, 2, 4, 6, 7, 8	H, S	6
Black-throated blue warbler	*Dendroica caerulescens*	-	-	-	S5B	1	Area Search Transect	H, S	6
Black-throated green warbler	*Setophaga virens*	-	-	-	S5B	10	PC1, 3, 4, 5, 6	H, S, CF	6
Broad-winged hawk	*Buteo platypterus*	-	-	-	S5B	1	Area Search Transect	X	4
Cedar waxwing	*Bombycilla cedrorum*	-	-	-	S5B	5	PC1, 3, Area Search Transect	H, S	6
Common yellowthroat	*Geothlypis trichas*	-	-	-	S5B	8	PC1, 2, 3, 4, 7, 8	H, S	6
Dark-eyed junco	*Junco hyemalis*	-	-	-	S4S5	12	PC2, 3, 4, 5, 6, 8	H, S	6
European starling	*Sturnus vulgaris*	-	-	-	SNA	7	PC7	H	6

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	#	Observation Location	Breeding Status	Bird Group
Golden-crowned kinglet	*Regulus satrapa*	-	-	-	S5	2	PC6	H, S	6
Hairy woodpecker	*Picoides villosus*	-	-	-	S5	1	PC5	H	7
Hermit thrush	*Catharus guttatus*	-	-	-	S5B	9	PC1, 2, 4, 5, 6, 8	H, S	6
Magnolia warbler	*Setophaga magnolia*	-	-	-	S5B	6	PC2, 3, 4	H, S	6
Mourning dove	*Zenaida macroura*	-	-	-	S5	2	PC3, 8	H, S	7
Nashville warbler	*Oreothlypis ruficapilla*	-	-	-	S4B, S5M	3	PC1, 2, 3	H, S, A	6
Northern flicker	*Colaptes auratus*	-	-	-	S5B	3	PC3, 7	H, X	7
Northern parula	*Parula americana*	-	-	-	S5B	6	PC2, 3, 4, 6, 7, 8	H, S	6
Ovenbird	*Seiurus aurocapilla*	-	-	-	S5B	7	PC1, 3, 6	H, S	6
Palm warbler	*Dendroica palmarum*	-	-	-	S5B	7	PC1, 2, 3, 4, Area Search Transect	H, S, P, A	6
Red-breasted nuthatch	*Sitta canadensis*	-	-	-	S4S5	3	PC1, 2, 3	H, S	6
Red-eyed vireo	*Vireo olivaceus*	-	-	-	S5B	1	Area Search Transect	H	6
Red-winged blackbird	*Agelaius phoeniceus*	-	-	-	S4B	4	PC7, 8	H, S	6
Ruffed grouse	*Bonasa umbellus*	-	-	-	S5	1	Area Search Transect	H, S	7
Song sparrow	*Melospiza melodia*	-	-	-	S5B	6	PC7, 8	H, S	6
White-throated sparrow	*Zonotrichia albicollis*	-	-	-	S4S5B, S5M	11	PC1, 2, 3, 4, 5, Area Search Transect	H, S, P, A	6
Yellow-rumped warbler	*Setophaga coronata*	-	-	-	S5B	3	PC3, 8, Area Search Transect	H, S	6
Total Number of Species Identified: 35			**Total Number of Individuals: 199**						

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 2022). Breeding evidence codes: X = species observed in its breeding season (no breeding evidence; observed); H = species observed in its breeding season in suitable nesting habitat (possible); S = singing male(s) present, or breeding calls heard, in suitable nesting habitat in breeding season (possible); P = pair observed in suitable nesting habitat in nesting season (probable); A = agitated behaviour or anxiety calls of an adult (probable); 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); 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 (occupied or laid within the period of the survey; confirmed); DD = Distraction display or injury feigning (confirmed); CF = adult carrying food for young (confirmed)

The majority of species observed were of the order Passeriformes (85.7%). The second most abundant group were other landbirds (11.4%), followed by diurnal raptors (2.9%). American robin (*Turdus migratorius*, n=19) was the most abundant species observed, followed by blue-headed vireo (*Vireo solitarius*, n=17).

A total of 29 species were observed in suitable nesting habitat during breeding season (observed and/or heard singing). Pairing, a high level of breeding evidence, was observed for the black-and-white warbler (*Mniotilta varia*), white-throated sparrow (*Zonotrichia albicollis*), palm warbler (*Dendroica palmarum*), American goldfinch (*Spinus tristis*) and the Canada warbler (*Wilsonia canadensis*). The black-throated green warbler (*Setophaga virens*) was also observed carrying food during a survey, a high level of breeding evidence. The Canada warbler also displayed territorial and agitated behaviour during the survey, which could indicate nesting activity. The Canada warbler was observed in suitable nesting habitat (WL1, a treed swamp) and a Canada warbler pair was also observed during a spring migration survey displaying similar behaviour. As previously mentioned, due to multiple observations of Canada warbler at PC1 during both spring migration and breeding bird survey, it is highly likely that there was nesting activity within WL1. Based on these observations and because suitable breeding habitat is available within this wetland, it is expected that NSECC will classify WL1 as a wetland of special significance (WSS; Section 5.4.1.2.4).

It should be noted that it was not possible to confirm that all species identified as displaying breeding behaviour were actually 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.

With the exception of European starling (*Sturnus vulgaris*), all the species identified during breeding bird surveys are native species to Nova Scotia and were observed within the typical and common habitat associated with the Study Area and surrounding landscape. European starling were observed outside of the Study Area (PC7; Figure 6, Appendix A) in closer proximity to Dutch Settlement Road.

5.3.5.2.3 Fall Migration

Eight point count locations were surveyed on three separate dates during the fall migration period for a total of 240 minutes of effort (August 25, September 21, and October 8, 2021; Figure 6, Appendix A). Refer to Table 5-19 for a summary of survey conditions.

Table 5-19. Fall Migration Survey Conditions Table

Survey Round	Date	Surveyor(s)	Survey Effort (mins)	Survey Start			Survey End		
				Temp. (°C)	Wind[1]	Precip.[2]	Temp. (°C)	Wind[1]	Precip.[2]
1	August 25, 2021	Jessica Lohnes	80	19	0	0	25	0	0

Survey Round	Date	Surveyor(s)	Survey Effort (mins)	Survey Start			Survey End		
				Temp. (°C)	Wind[1]	Precip.[2]	Temp. (°C)	Wind[1]	Precip.[2]
2	September 21, 2021	Jessica Lohnes	80	11	0	0	14	0	0
3	October 8, 2021	Jessica Lohnes	80	11	2	0	12	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).

During fall migration, a total of 241 individuals representing 26 species were observed (Table 5-20). One priority species was observed during the fall migration surveys, Eastern-wood pewee (*Contopus virens*, SARA SC, NSESA Vulnerable, S3S4B; Figure 15; Appendix A). All avian priority species are discussed in detail in Section 5.5.6.

Table 5-20. Fall Migration Surveys: Species and Abundance of Birds

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	#	Observation Location	Bird Group
Eastern wood-pewee	***Contopus virens***	**SC**	**SC**	**V**	**S3S4B**	**1**	**PC4**	**6**
Alder flycatcher	*Empidonax alnorum*	-	-	-	S5B	3	PC2, 4	6
American crow	*Corvus brachyrhynchos*	-	-	-	S5	9	PC 5, 7, 8	6
American goldfinch	*Spinus tristis*	-	-	-	S5	16	PC 2, 4, 5, 7, 8	6
American robin	*Turdus migratorius*	-	-	-	S5B,S3N	20	PC2, 4, 5, 6, 7	6
Bald eagle	*Haliaeetus leucocephalus*	-	-	-	S5	4	PC 5	4
Black-and-white warbler	*Mniotilta varia*	-	-	-	S5B	3	PC3, 5, 7	6
Black-capped chickadee	*Poecile atricapillus*	-	-	-	S5	55	PC1, 2, 3, 4, 5, 6, 8	6
Blue-headed vireo	*Vireo solitarius*	-	-	-	S5B	7	PC2, 3, 4, 5, 6, 7	6
Blue jay	*Cyanocitta cristata*	-	-	-	S5	48	PC1, 2, 3, 4, 5, 6, 7, 8	6
Black-throated green warbler	*Setophaga virens*	-	-	-	S5B	1	PC5	6
Canada goose	*Branta canadensis*	-	-	-	SUB, S4N, S5M	13	PC5 ,7*	1
Cedar waxwing	*Bombycilla cedrorum*	-	-	-	S5B	7	PC1, 2, 3, 4, 7	6
Common raven	*Corvus corax*	-	-	-	S5	2	PC4, 5	6
Common yellowthroat	*Geothlypis trichas*	-	-	-	S5B	1	PC4	6
Dark-eyed junco	*Junco hyemalis*	-	-	-	S4S5	4	PC5	6
Golden-crowned	*Regulus satrapa*	-	-	-	S5	7	PC3, 5, 6, 7	6

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	#	Observation Location	Bird Group
kinglet								
Hairy woodpecker	*Picoides villosus*	-	-	-	S5	2	PC2, 3	7
Hermit thrush	*Catharus guttatus*	-	-	-	S5B	3	PC2, 3, 5	6
Nashville warbler	*Oreothlypis ruficapilla*	-	-	-	S4B, S5M	2	PC5	6
Northern flicker	*Colaptes auratus*	-	-	-	S5B	12	PC1, 2, 3, 4, 5, 7	7
Pileated woodpecker	*Dryocopus pileatus*	-	-	-	S5	1	PC1	7
Red-breasted nuthatch	*Sitta canadensis*	-	-	-	S4S5	16	PC1, 2, 3, 4, 5, 6, 7	6
Ruby-crowned kinglet	*Regulus calendula*	-	-	-	S4B, S5M	1	PC3	6
Ruby-throated humming bird	*Archilochus colubris*	-	-	-	S5B	2	PC1, 5	6
Song sparrow	*Melospiza melodia*	-	-	-	S5B	1	PC5	6
Total Number of Species Identified: 26			**Total Number of Individuals: 241**					
*Migration behaviour observed for Canada geese. Flying in a group at PC5 and in flying in a group and a “v” pattern at PC7.								

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 2022).

The majority of species observed during fall migration were of the order Passeriformes (80.8%). The second most abundant group were other landbirds (11.5%), followed by waterfowl (3.8%) and diurnal raptors (3.8%). Black-capped chickadee (*Poecile atricapillus*; n=55) was the most abundant species observed, followed by blue jay (*Cyanocitta cristata*; n=48) and American robin (*Turdus migratorius*; n=20). Migration behaviour was observed at PC7 on September 21, 2021 (round 2 of 3), for Canada goose (*Branta canadensis*) when a group of 10 were sighted flying in a "v" pattern at a height of 200 m +.

5.3.5.2.4 Common Nighthawk Surveys

Common nighthawk surveys took place at four CONI PC locations on June 26 and 29, 2021, for a total of 48 minutes of effort (Table 5-21; Figure 6, Appendix A).

Table 5-21. Common Nighthawk Survey Conditions Table

Survey Round	Date	Surveyor(s)	Survey Effort (mins)	Survey Start			Survey End		
				Temp. (°C)	Wind[1]	Precip.[2]	Temp. (°C)	Wind[1]	Precip.[2]
1	June 26, 2021	Jessica Lohnes	24	21	1	0	22	1	0
2	June 29, 2021	Jessica Lohnes	24	21	1	0	21	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 common nighthawk adults (*Chordeiles minor*) were observed during targeted surveys (Table 5-22; Figure 15, Appendix A). Behavioural observations included foraging, calling/croaking, and breeding/territorial behaviour (courtship display – fluttering wings and diving/wing booming display). There was also response to call playback from a single common nighthawk at CONI3 during the second survey round indicating territorial behaviour.

A common nighthawk was also incidentally observed between point count locations during the first round of common nighthawk surveys. Common nighthawk were also incidentally observed during a breeding bird survey at the edge of the quarry footprint. These observations are not included in the table below but are discussed in Section 5.3.5.2.7.

Table 5-22. Common Nighthawk Surveys: Species and Abundance

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	#	Observation Location	Bird Group
Common nighthawk	***Chordeiles minor***	**T**	**SC**	**T**	**S3B**	**1**	**CONI1**	**6**
						1	**CONI3**	

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 2022).

5.3.5.2.5 Nocturnal Owl Survey

One nocturnal owl survey was conducted by MEL biologist Jose Mulino-Devoe on April 29, 2021, at three point count locations for a total of 28.5 minutes of effort (Table 5-23; Figure 6, Appendix A for point count locations). There was no moon present (a wanning gibbous moon at 88%).

Table 5-23. 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 29, 2021	28.5	9	2	0	11	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).

No owls were observed during the survey at the three owl point count locations.

5.3.5.2.6 Winter Survey

Bird observations were recorded by MEL biologist Jeff Bonazza during a winter wildlife survey conducted for approximately 180 mins on March 23, 2021. Weather conditions during the survey period were sunny with no cloud cover and with winds of 8 km/hr. A total of six observations of six different species were recorded (Table 5-24). No SAR or SOCI were observed.

Table 5-24. Winter Survey: Species and Abundance of Birds

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	#	Bird Group
American crow	*Corvus brachyrhynchos*	-	-	-	S5	1	6
Black-capped chickadee	*Poecile atricapillus*	-	-	-	S5	1	6
Blue jay	*Cyanocitta cristata*	-	-	-	S5	1	6
Dark-eyed junco	*Junco hyemalis*	-	-	-	S4S5	1	6
Downy woodpecker	*Dryobates pubescens*	-	-	-	S5	1	7
Red-breasted nuthatch	*Sitta canadensis*	-	-	-	S4S5	1	6

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 2022).

The majority of species observed during winter surveys were passerines (83.3%) followed by other landbirds (16.7%).

5.3.5.2.7 Incidental Observations

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. Sixteen individuals representing four species were identified incidentally (Table 5-25). Two of the four species are considered SAR: common nighthawk (*Chordeiles minor*, NSESA Threatened, SARA/COSEWIC Special Concern) and eastern wood-pewee (*Contopus virens*, NSESA Vulnerable, SARA/COSEWIC Special Concern). One of the observed species is considered a SOCI: killdeer (*Charadrius vociferus,* S3B).

Table 5-25. Incidental Avifauna Observations

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	#	Observation Location	Surveys Observed	Bird Group
Common nighthawk	***Chordeiles minor***	**T**	**SC**	**T**	**S3B**	**1**	**On road at edge of quarry (20T 0465665 m E 4979992 m N)**	**Common Nighthawk**	**6**
						1	**Identified foraging over existing quarry.**	**Early Botany***	
Eastern wood-pewee	***Contopus virens***	**SC**	**SC**	**V**	**S3S4B**	**1**	**South of the Study Area (20T 0463030 m E 4979196 m N)**	**Breeding Bird**	**6**
						1	**~100 m north of WL17**	**Early Botany***	
Killdeer	***Charadrius vociferus***	**-**	**-**	**-**	**S3B**	**3**	**On gravel road (20T 0462733 m E 4979803 m N)**	**Breeding Bird**	**2**
						6	**CONI2**	**Common Nighthawk**	
Tree swallow	*Tachycineta bicolor*	-	-	-	S4B	2	CONI2	Common Nighthawk	6
						1	Foraging over tall grass (20T 0462733 m E 4979803 m N)	Breeding Bird	
Total Number of Species Identified: 4				**Total Number of Individuals: 16**					

*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 2022). *Early botany survey was completed on June 29, 2021.*

Three of the incidental observations were of the order Passeriformes and one was a shorebird. The shorebird, killdeer, was the most common species observed incidentally (n=9).

Two common nighthawks were observed incidentally (Figure 15; Appendix A). One was foraging over the existing quarry during an early botany survey on June 29, 2021, and one was incidentally identified along a road during a common nighthawk survey (i.e., between CONI PCs).

Eastern wood-pewee were incidentally identified during early botany surveys and breeding bird surveys (n=2). The one individual identified during early botany surveys (June 29, 2021) was located ~100 m north of WL17 and the one individual identified during breeding bird surveys was located south of the Study Area (Figure 15; Appendix A).

Six killdeer were observed with breeding evidence during the common nighthawk surveys. An adult was observed foraging with three young fledglings in suitable nesting habitat. Two other adult killdeer were observed in the same area calling and foraging. Additionally, three killdeer were identified incidentally on a gravel road during breeding bird surveys (Figure 15; Appendix A).

Two tree swallows (*Tachycineta bicolor*) were observed with breeding evidence during the common nighthawk surveys. The tree swallows were incidentally observed calling and foraging in suitable nesting habitat. Another tree swallow observation was incidentally recorded during breeding bird surveys.

5.3.5.3 *Summary of Bird Surveys*

Baseline point count surveys for birds (spring migration, breeding season, fall migration, common nighthawk, and nocturnal owl) and meandering transects (breeding season area searches and winter survey) were completed from March 2021 to October 2021 by MEL biologists Jeff Bonazza, Jessica Lohnes, Emma Posluns and Melanie MacDonald (Figure 6; Appendix A). A total of 936.5 mins (15.6 hrs) of surveys were completed over four seasons including time spent on common nighthawk and nocturnal owl surveys. These surveys resulted in the observation of 624 individuals, representing 48 species. The most abundant bird group observed was Group 6 (passerines 85.0%), followed by Group 7 (other landbirds, 11.0%), Group 4 (diurnal raptors, 2.0%), Group 2 (shorebirds, 1.0%) and Group 1 (waterfowl, 1.0%).

Sixteen individuals representing four species were identified 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.

Four priority avifauna species were observed within the Study Area during all field surveys, including incidentals (Figure 15; Appendix A). Three SAR (Canada warbler, common nighthawk and eastern wood-pewee) and one SOCI (killdeer) were observed. The species and the survey where they were observed are as follows;

- Canada warbler (*Wilsonia canadensis,* spring, breeding);

- Common nighthawk (*Chordeiles minor,* breeding, common nighthawk, and incidentally [early botany and common nighthawk]);
- Eastern wood-pewee (*Contopus virens,* fall migration and incidentally [breeding and early botany]); and,
- Killdeer (*Charadrius vociferus*, spring [note: not Killdeer is not considered a priority species outside of the breeding period] and incidentally [breeding and common nighthawk]).

These priority species are discussed in Section 5.5.6.

With the exception of European starling, all the species identified during all surveys are native species to Nova Scotia typical species commonly found within habitat similar to that of the Study Area and its surroundings. European starling were observed outside of the Study Area (PC7; Figure 6, Appendix A) in closer proximity to Dutch Settlement Road. No obvious concentrations of one particular bird group were identified, nor was an identifiable migratory pathway noted.

5.4 Aquatic Environment

The Aquatic Study Area lies within two unnamed tertiary watersheds, 1DG-1UU and 1DG-1-TT, however, the majority of the Aquatic Study Area is within 1DG-1UU (99.1%; Figure 7, Appendix A). Both of these tertiary watersheds are part of the Shubenacadie River Secondary Watershed (1DG-1; Figure 1, Appendix A). The Shubenacadie River Secondary Watershed, which drains north to the Shubenacadie River is located in the Shubenacadie/Stewiacke River Primary Watershed (1DG) which empties in the Bay of Fundy. The sizes of the tertiary, secondary, and primary watersheds are 2130.3 ha (1DG-1-UU) and 523.8 ha (1DG-1-TT), 248,111.1 ha (1DG-1) and 270,630.9 ha (1DG), respectively.

The following sections provide details about the wetlands and surface water features identified, including the results from the wetland functional analysis and fish and fish habitat evaluations.

5.4.1 <u>Wetlands</u>

Wetlands provide important ecological functions, such as offering habitat for aquatic and terrestrial species (including priority species), supporting rare plants, managing water storage and flow, and improving downstream water quality. In addition to providing socio-economic value. The following sections outline the wetland findings from the desktop review and field surveys within the Project's Study Area. Desktop and field survey methodologies are provided in section 4.3.6.

5.4.1.1 *Desktop Review Results*

A review of the NSECC Wetlands Inventory Database identified no mapped wetlands within the Study Area (Figure 7, Appendix A).

The provincial Wet Areas Database identifies areas within the Study Area that have modelled water table depth ranges varying from 0 to 10.0 m below ground surface. In the central portion of the Study Area, depth to water table is greater than 2.0 m from the surface. The northwest section of the Study Area has a linear feature with water table depth ranges between 0 to 2.0 m from the surface. This feature connects directly into Keys Brook located to the east of the Study Area.

No predicted WSS are located within the Study Area (Figure 7, Appendix A), based on the NSECC predicted WSS database. The nearest predicted WSSs are a marsh located approximately 580 m north of the Study Area (ID# 36288), a swamp located along the Shubenacadie River (ID# 35897) 3.9 km west of the Study Area and a swamp (ID# 35539) located 5.1 km southwest of the Study Area.

5.4.1.2 *Field Surveys*

During field surveys completed across the Study Area, 17 wetlands were identified (Figure 16, Appendix A). In total, the 17 wetlands account for 2.26 ha (22,358 m^2), representing a land cover of 8.7% of the Study Area. Data determination forms describing vegetation cover, soil characteristics and hydrology indicators were collected for each wetland and adjacent upland habitat (Appendix L). This data is available to support alteration applications in the permitting phase of the Project. A photolog of all wetlands is presented in Appendix H. Table 5-26 summarizes the characteristics of delineated wetlands. Wetland type classifications are guided by The Canadian Wetland Classification System (1997).

Table 5-26: Wetland Characteristics

Wetland	Dominant Wetland Type	Wetland Size (m²)	Water Flow Path	Landform	Landscape Position	Hydric Soil Indicator	Hydrological Conditions	Dominant Vegetation
1[1]	Treed Swamp	2,015	Outflow Drainage	Basin	Terrene	Depleted Below Dark Matrix	Surface water, high water table, Saturation, water-stained leaves	**Herbs**: *Osmundastrum cinnamomeum* **Shrubs**: *Alnus incana, Ilex mucronate, Abies balsamea* **Trees**: *Acer rubrum, Picea mariana*
2[1]	Treed swamp	1,665	Isolated	Basin	Terrene	Histic epipedon	Surface water, high water table, saturation	**Herbs**: *Osmundastrum cinnamomeum, Carex crinita* **Shrubs**: *Alnus incarna, Picea mariana* **Trees**: *Acer rubrum, Picea mariana*
3[1]	Treed Swamp	539	Isolated	Basin	Terrene	Histic epipedon	Surface water, high water table, saturation, sparsely vegetated concave surface, water-stained leaves	**Herbs**: *Rubus hispidus* **Shrubs**: *Viburnum nudum, Picea mariana, Acer rubrum* **Trees**: *Betula papyrifera, Acer rubrum*
4[1]	Bog	5,902	Isolated	Basin	Terrene	Depleted matrix	Surface water, high water table, saturation	**Herbs**: *Carex crinita, Kalmia angustifolia, Carex trisperma* **Shrubs**: *Gaylussacia baccata, Viburnum nudum, Picea mariana* **Trees**: *Picea mariana, Betula populifolia*
5[1]	Treed Swamp	439	Isolated	Basin	Terrene	Depleted matrix	Saturation, sparsely vegetated concave surface, water-stained leaves	**Herbs**: *Rubus hispidus* **Shrubs**: *Gaylussacia baccata, Acer rubrum, Spirea alba* **Trees**: *Picea mariana, Pinus strobus, Betula alleghaniensis*

Wetland	Dominant Wetland Type	Wetland Size (m^2)	Water Flow Path	Landform	Landscape Position	Hydric Soil Indicator	Hydrological Conditions	Dominant Vegetation
6[1]	Bog	3,880	Isolated	Basin	Terrene	Histic epipedon	Surface water, high water table, saturation, sparsely vegetated concave surface	**Herbs**: *Rubus hispidus* **Shrubs**: *Gaylussucia baccata, alnus incana* **Trees**: *Betula populifolia, Larix laricina*
7	Bog	115	Isolated	Flat	Terrene	Histosol	High water table, saturation, water-stained leaves	**Herbs**: *Glyceria crinite, Rubus hispidus* **Shrubs**: *Gaylussacia baccata, Viburnum nudum* **Trees**: *Betula populifolia, Acer rubrum*
8[1]	Treed Swamp	2,404	Isolated	Flat	Terrene	Histosol	Saturation	**Herbs**: *Scripus atrocinctus, Rubus flagellaris, Carex lurida* **Shrubs**: Betula populifolia, Picea mariana, *Alnus incana* **Trees**: *Betula populifolia*
9	Bog	449	Isolated	Basin	Terrene	Histosol	High water table, saturation	**Herbs**: *Ledum graenlandicum, Poa palustris* **Shrubs**: Gaylussacia baccata, Larix laricana **Trees**: *Acer rubrum, Larix laricina*
10	Bog	975	Isolated	Flat	Terrene	Histosol	High water table, saturation	**Herbs**: *Gaylussacia baccata, Fragaria virginiana, Kalmia angustifolia* **Shrubs**: *Alnus incana* **Trees**: *Betula populifolia, Larix laricana*

Wetland	Dominant Wetland Type	Wetland Size (m^2)	Water Flow Path	Landform	Landscape Position	Hydric Soil Indicator	Hydrological Conditions	Dominant Vegetation
11[1]	Treed swamp	850	Isolated	Flat	Terrene	Histic epipedon	Saturation	**Herbs**: *Scirpus atrocinctus, Rubus flagellaris* **Shrubs**: *Picea rubens, Betula populifolia* **Trees**: *Betula populifolia, Acer rubrum, Picea rubens*
12	Treed swamp	384	Isolated	Flat	Terrene	Histic epipedon	Saturation	**Herbs**: *Thelypteris noveboracensis Trientalis borealis* **Shrubs**: *Abies balsamea, Hamamelis virginiana* **Trees**: *Acer rubrum*
13[1]	Treed swamp	924	Isolated	Flat	Terrene	Histic epipedon	Saturation, water-stained leaves	**Herbs**: *Osmunda claytoniana* **Shrubs**: *Abies balsamea, Alnus incana,* **Trees**: *Acer rubrum*
14	Treed swamp	155	Isolated	Terrace Flat	Terrene	Histosol	Saturation	**Herbs**: *Cornus canadensis, Solidago gigantea, Carex crinite* **Trees**: *Betula populifolia, Acer rubrum, Quercus rubra*
15	Treed swamp	696	Contiguous Throughflow WC	Flat	Terrene	Histosol	Surface water, saturation	**Herbs**: *Thelypteris noveboracensis, Cornus canadensis, Rubus pubescens* **Shrubs**: *Abies balsamea* **Trees**: *Acer rubrum, Tsuga canadensis*
16	Treed Swamp	100	Isolated	Flat	Terrene	Histic Epipedon	Saturation	**Herb:** *Osmunda cinnamomea, Trentalis borealis* **Shrubs:** *Abies balsamea* **Trees:** *Acer rubrum, Abies balsamea*

Wetland	Dominant Wetland Type	Wetland Size (m^2)	Water Flow Path	Landform	Landscape Position	Hydric Soil Indicator	Hydrological Conditions	Dominant Vegetation
17	Treed Swamp	866	Contiguous Throughflow WC	Flat	Terrene	Histic Epipedon	Saturation	**Herb:** *Osmunda cinnamomea, Onoclea sensibilis* **Shrubs:** *Alnus incana, Abies balsamea* **Trees:** *Alnus incana, Acer rubrum, Abies balsamea*

[1] Field delineated wetlands extend beyond the Study Area boundary. All field results are based on surveys completed within the Study Area and no assessment was completed beyond the Study Area boundaries in the field or via desktop review.

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). Within the Study Area, 12 of the wetlands encountered were swamps (70.6%). Of the swamps encountered, 100% contained a prominent treed layer (WL1, 2, 3, 5, 8, 11-17). WL3, 8, and 12 are treed swamps dominated by hardwood trees, including red maple (*Acer rubrum*) and paper birch (*Betula papyrifera*). The remaining nine swamps (WL1, 2, 5, 11, 13-17) were dominated by both softwood and hardwood trees, including black spruce (*Picea mariana*), balsam fir (*Abies balsamea*), speckled alder (*Alnus incana*) and red maple. Soils within the swamps observed in the Study Area were histosols (WL8, 14 and 15), histic epipedon (WL2, 3, 11. 12. 13, 16 and 17), depleted below dark matrix (WL1) and depleted matrix (WL5). All swamps delineated within the Study Area are under one hectare in size, and collectively account for 49.6% of the total wetland area (Table 5-27).

Within the Study Area, five of the wetlands encountered were bogs (WL4, 6, 7, 9, and 10) which account for 29.4% of all wetlands within the Study Area and 50.4% of the total wetland area (Table 5-27). Though tamaracks (*Larix laricina*) were present, these wetlands were not dominated by tree cover. The herbaceous layer was characterized by ericaceous species such as sheep laurel (*Kalmia angustifolia*), and Labrador tea (*Rhododendron groenlandicum*), which are adapted to the acidic and nutrient poor soils indicative of bogs. Herbaceous layer diversity within bogs is greatly lower than that of swamps. The hydric soil within the bogs observed in the Study Area were histosols (WL7, 9 and 10), histic epipedon (WL6) and depleted matrix (WL4).

No fens, marshes or shallow open water wetland classes were distinctly observed within the Study Area.

Table 5-27. 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	0.09	0.01	0.24	1.12	12	70.6	49.6
Bog	0.23	0.01	0.59	1.14	5	29.4	50.4

5.4.1.2.1 *Wetland Functional Analysis*

The following sections summarize the results of the WESP-AC functional assessments for the 17 wetlands within the Study Area, broken into the Grouped Functions. The results are further detailed in the summary tables provided in Appendix M. No functional WSS were identified through the WESP-AC WSS Interpretation Tool. The raw WESP-AC Excel files can be provided to the NSECC Wetland Specialist(s) upon request.

5.4.1.2.2 WESP-AC Grouped Wetland Function Results

Analysis was completed on the individual wetland functional groups being provided by the wetlands present within the Study Area. The following sections provide results of this analysis on a per wetland functional group basis (Appendix M).

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 5-28 for each wetland's function and benefit score.

Table 5-28. Hydrologic Group

Function	**Benefit**		
	Lower	**Moderate**	**Higher**
Lower	None	WL15, WL17	None
Moderate	WL1[1], WL2[1], WL3[1], WL4[1], WL5[1], WL6[1], WL7, WL8[1], WL9	None	None
Higher	WL10, WL11[1], WL12, WL13[1], WL14, WL16	None	None
[1] Wetland extends outside of the Study Area.			

A majority of the analyzed wetlands scored low in benefit. 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. Wetland 15 and 17 scored low for this function, as they are connected to a throughflow watercourse (WC1).

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. Similar to 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 5-29).

Table 5-29. Water Quality Group

Function	Benefit		
	Lower	Moderate	Higher
Lower	None	None	None
Moderate	WL17	WL15	None
Higher	WL3[1], WL4[1], WL5[1], WL7, WL8[1], WL9, WL10, WL11[1], WL12, WL13[1], WL14, WL16	WL1[1], WL2[1], WL6[1],	None
[1] Wetland extends outside of the Study Area.			

The majority of the analyzed wetlands scored high in water purification group function. As with the hydrologic group, high scoring wetlands did not have watercourse connectivity. Wetland 15 and 17 scored Moderate in function as a result of the throughflow watercourse (WC1).

Most of the wetlands scored lower in benefit, largely because of the isolation of the Project from developed areas and the small size of the wetlands compared to their catchment areas, which limits the potential benefits of the water purification function.

<u>Aquatic Support Group</u>

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 5-30).

Table 5-30. Aquatic Support Group

Function	Benefit		
	Lower	Moderate	Higher
Lower	WL1[1], WL8[1]	None	None
Moderate	WL2[1], WL3[1], WL4[1], WL5[1], WL6[1], WL7, WL9, WL11[1], WL12, WL13[1], WL16	None	None
Higher	WL10, WL14, WL15, WL17	None	None
[1] Wetland extends outside of the Study Area.			

The highest function scores within the aquatic support group included WL10, 14, 15 and 17. These wetlands all have either have evidence of surface water for periods of the year or a throughflow watercourse within their boundaries. All wetlands scored lower in benefit, likely for the same reasons described for the water quality group.

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 5-31).

Table 5-31. Aquatic Habitat Group

Function	**Benefit**		
	Lower	**Moderate**	**Higher**
Lower	WL11[1], WL12, WL13[1], WL14, WL16	WL6	None
Moderate	WL7, WL10	WL1[1], WL2[1], WL3[1], WL4[1], WL5[1], WL8[1], WL9, WL15, WL17	None
Higher	None	None	None
[1] Wetland extends outside of the Study Area.			

The six wetlands (WL6, 11, 12, 13, 14, and 16) that scored lower for function do not have suitable conditions to support fish, herpetofauna, or waterbirds. The other wetlands in the Study Area have moderate function due to higher amounts or evidence of standing or flowing water that could provide habitat for fish, herpetofauna, or waterbirds.

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 5-32).

Table 5-32. Transition Habitat Group

Function	**Benefit**		
	Lower	**Moderate**	**Higher**
Lower	None	None	None
Moderate	WL5[1], WL8[1], WL10, WL11[1], WL13[1], WL14	None	None
Higher	WL1[1], WL2[1], WL3[1], WL4[1], WL6[1], WL7, WL9, WL12, WL15, WL16, WL17	None	None
[1] Wetland extends outside of the Study Area.			

All wetlands scored moderate to high for function 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. All wetlands scored lower for the benefit score, indicating 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 ranged from Lower (WL2, 5, and 7), Moderate (WL3 and 8), to Higher (WL1, 4, 6, 9, 10, 11, 12, 13, 14, 15, 16, and 17), indicating that the moderate to higher wetlands carry a relatively good range of vegetative community health and natural functions. High scoring wetlands may have greater ecological integrity, microhabitats, species diversity, etc., while lower scoring wetlands may have lost their function and integrity due to historical natural or anthropogenic impacts.

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 its 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 wetlands in the Study Area scored moderate to high for wetland risk, meaning they have a low resilience and/or have been exposed to historical impacts and may be more susceptible to change. One wetland, WL8, scored lower for risk, indicating a higher resilience.

Functional Assessment Summary

WESP-AC is a quantitative decision-making tool, but its results must be used qualitatively to form conclusions around wetland functions. 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 functional groups. While higher benefit or function scores were calculated for various wetlands, no wetlands scored higher in both benefit and function. Generally, the wetlands within the Study Area have similar function and benefit scores within WESP-AC groups compared to the wetlands beyond the Study Area, across the Nova Scotia landscape.

5.4.1.2.3 WESP-AC WSS Interpretation Tool

All assessed wetlands received low Function-Benefit Product (FBP) scores for each support supergroup. As a result, no WSS was designated based on the WESP-AC WSS Interpretation Tool. The results generated from the tool are presented Table 5-33 and Table 5-34 below.

Table 5-33. 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	
	FBP Score	FBP Score Category	FBP Score	FBP Score Category	FBP Score	FBP Score Category	FBP Score	FBP Score Category	FBP Score	FBP Score Category
1	12.65	Low	33.48	Low	18.80	Low	13.90	Low	21.78	Low
2	11.70	Low	33.43	Low	15.30	Low	13.40	Low	24.15	Low
3	10.25	Low	27.67	Low	12.15	Low	12.38	Low	28.93	Low
4	11.70	Low	28.31	Low	15.35	Low	13.76	Low	32.61	Low
5	9.80	Low	16.20	Low	5.57	Low	7.01	Low	19.55	Low
6	9.67	Low	33.22	Low	7.78	Low	6.51	Low	30.08	Low
7	9.28	Low	17.84	Low	5.05	Low	5.79	Low	23.15	Low
8	8.14	Low	27.24	Low	6.53	Low	17.72	Low	23.16	Low
9	9.73	Low	27.62	Low	9.11	Low	8.35	Low	27.85	Low
10	15.16	Low	16.49	Low	5.98	Low	2.42	Low	18.94	Low
11	13.75	Low	14.49	Low	3.43	Low	1.35	Low	18.70	Low
12	13.63	Low	17.01	Low	2.80	Low	2.25	Low	28.19	Low
13	12.08	Low	19.80	Low	2.31	Low	1.94	Low	26.17	Low
14	12.08	Low	14.18	Low	3.50	Low	2.36	Low	26.58	Low
15	4.20	Low	18.10	Low	24.84	Low	18.14	Low	36.18	Low
16	14.43	Low	17.44	Low	2.98	Low	2.24	Low	29.62	Low
17	2.57	Low	6.39	Low	26.11	Low	19.62	Low	32.38	Low

Table 5-34. WSS 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
11	No	No	No	Not a WSS
12	No	No	No	Not a WSS
13	No	No	No	Not a WSS
14	No	No	No	Not a WSS
15	No	No	No	Not a WSS
16	No	No	No	Not a WSS
17	No	No	No	Not a WSS

5.4.1.2.4 Wetlands of Special Significance

As part of a qualitative wetland assessment, along with a review of the most current NSECC predictive WSS layer (pers. Comm., Ian Bryson, NSECC Wetland Specialist, September 2020 [Figure 7; Appendix A]), each wetland was reviewed to determine if it meets the threshold for a WSS.

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.

A review of the NSECC predictive WSS layer did not identified any of the wetlands within the Study Area as a potential WSS, with the closest WSS located approximately 580 m to the north.

One wetland within the Study Area, WL1, had observations of avifauna SAR, Canada warbler (SAR T, NSESA E, S3B), within the wetland boundaries during field surveys completed by MEL (Table 5-35, Figure 16; Appendix A). The species was observed during spring migration and breeding bird surveys at PC1 in WL1 (see Section 5.3.5.2 for survey details). Canada warbler are known to use wetland habitat for breeding purposes and prefer wet forests and riparian shrub forests, which are abundant within and surrounding the Study Area. WL1 was noted to contain suitable breeding habitat for Canada warbler (e.g., well developed shrub layer). Based on guidance from NSECC, WL1 has been proposed for designation herein as a WSS due to the presence of Canada warbler and supporting habitat, with final determination to be made by NSECC.

Table 5-35. Wetlands with Observed SAR

Wetland ID	Wetland & Habitat Available	Observed SAR	Suitable Breeding or Dwelling Habitat Present (Y/N)
1	Treed swamp	Canada Warbler	Y

5.4.1.2.5 Wetland Hydrology

Generally, the topographic and hydrologic gradient in the Study Area is south to north. The primary flow path is through the one delineated watercourse, WC1, and associated WL15 and WL17. Flow within the rest of the Study Area is dominated by passive groundwater flow or drainage features, supported by the wetlands on the landscape. The primary hydrological outlet of the Study Area is WC1 at the outflow of WL15.

Wetland hydrology is dependent on wetland type and its position on the landscape. The Study Area is dominated by swamps and bogs. Water table fluctuations in swamps are often greater than those of bogs (commonly resulting in low to no peat acclamation) and they 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). Whereas, bogs are ombrotrophic wetlands, meaning they are fed by precipitation, and typically do not receive surface water or groundwater inputs. As a result, they are commonly found in headwater positions and function as groundwater recharge systems. Bogs form through the accumulation of undecomposed organic soils (peat), which can be elevated above the surrounding landscape. As a result, the water table in bogs is often mounded, following the bog's convex surface topography, and isolated from local groundwater regimes (Warner & Rubec, 1997).

WL15 and 17 are both riparian swamps associated with WC1. However, most wetlands in the Study Area are hydrologically isolated, in the context of surface water. With respect to groundwater interactions, wetlands in the southern portion of the Study Area are likely functioning as recharge wetlands, where hydrologic gradients are dominated by downward flows in the underlying mineral soils and aquifer, due to their headwater (higher) topographic position (e.g., all bog are found in this area). Whereas wetlands to the north of the Study Area are located at a lower topographic position and are associated with watercourse features (i.e., WL15 and 17). As a result, these may be functioning as discharge wetlands, where groundwater moves upwards from underlying soils towards the wetland surface. Typically, groundwater discharge maintains higher water tables, whereas recharge systems replenish local aquifers (Siegel and Glaser, 1987).

5.4.2 Surface Water

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

5.4.2.1 *Desktop Review*

Through a review of aerial imagery and NSTDB mapping, no mapped waterbodies or watercourses were identified within the Aquatic Study Area. Multiple first order watercourses, however, are mapped in in proximity to and surrounding the Study Area. Keys Brook is a named second order watercourse that originates south of the Aquatic Study Area and flows to the north, along the east side of the Aquatic Study Area, before transitioning into a third order stream and draining into the Shubenacadie River. Flow accumulation lines are present within the Aquatic Study Area. The flow accumulation lines bisect the Aquatic Study Area, north of the existing quarry footprint (Figure 7; Appendix A).

Refer to Section 5.4.1 for details related to mapped wetlands and wet areas mapping identified within the Study Area.

5.4.2.2 *Field Results*

One field identified watercourse, WC1, was delineated and characterized within the Aquatic Study Area. WC1 originates outside of the southern Aquatic Study Area boundary and flows northeast across the Aquatic Study Area. WC1 flows under the Projects existing quarry access road via a culvert and continues to flow northeast to its connection with Keys Brook (Figure 16, Appendix A). The total linear length of the watercourse within the Aquatic Study Area is 818 m.

WC1 is a first order, low to moderate gradient watercourse that originates west of the Study Area, from the location of a mapped wetland (Figure 7 and 16, Appendix A). The upstream reaches of the watercourse are ephemeral, with flows dictated by runoff from rainfall or snowmelt. As the watercourse continues downstream and east of the Study Area, flows within the watercourse transition to intermittent and then perennial characteristics before dispersing into Keys Brook. Channel width ranges from 0.9-2.7 m, and substrates are dominated by larger rocks (cobbles, rubble, and boulder) and muck. The watercourse primarily comprises riffles, runs, and flat, with shorter sections of less frequent pools and rapids.

The physical characteristics of this watercourse are summarized in Section 5.4.3.2.3. Refer to Appendix H for the wetland and watercourse photolog. During the 2021-2022 field program WC1 was surveyed for water quality (Section 5.4.2.2.1). Additionally, WC1 was surveyed for fish and fish habitat (Section 5.4.2.2).

5.4.2.2.1 *Surface Water Sampling*

Surface water samples were collected at three locations (SW-1, SW-2, and SW-3) on March 23 (high flow), May 20 (high flow), and November 24, 2021 (average flow). Samples could not be collected during the summer low flow due to insufficient water depths at all sample locations. Samples were collected and analyzed for RCAP-MS Total Metals and TSS to understand background conditions and establish a baseline for future surface water quality comparison. Comprehensive laboratory results are presented in Appendix N. Unless included in the table below, all other sample results were low to undetectable levels (with the exception of colour exceedances).

Sample results recorded at all water quality sample locations meet all but three applicable CCME FWAL water quality guidelines and Nova Scotia Environmental Quality Standards (Tier 1 EQS) (Table 5-36). Exceedances for pH, total aluminum (ug/L), and total iron (ug/L) are indicated by bolded and/or underlined cells in Table 5-36. Unless included in the tables below, all other sample results were below CCME FWAL or Tier 1 EQS guidelines.

Table 5-36. CCME FWAL and Tier 1 EQS Guideline Exceedances

Guideline			**pH**	**Total Aluminum** (ug/L)	**Total Iron** (ug/L)
CCME FWAL Guideline			6.5 to 9.0	5 ug/L if pH <6.5 100 ug/L if pH >6.5	300
Tier 1 EQS Guideline			6.5 to 9.0	5	300
Location	**Watercourse ID**	**Date**	**pH**	**Total Aluminum** (ug/L)	**Total Iron** (ug/L)
SW-1	WC1	March 23, 2021	6.83	**213**	135
		May 20, 2021	7.99	**175**	161
		November 24, 2021	**6.48**	**331**	297
SW-2	WC1	March 23, 2021	6.93	**210**	162
		May 20, 2021	7.47	**88**	202
		November 24, 2021	6.67	**364**	**343**
SW-3	Settling Pond discharge	March 23, 2021	7.70	17	76
		May 20, 2021	7.88	14	144
		November 24, 2021	7.95	11	53

Bold indicate exceedances of CCME FWAL guidelines.

Underline indicate exceedance of Tier 1 EQS guidelines.

Baseline conditions indicate that pH levels were within the acceptable range of CCME FWAL guideline and Tier 1 EQS criteria (6.5 – 9.0) at both SW-2 and SW-3 during all sampling events. SW-1 was below the acceptable pH range for during the November sampling period (6.48).

Aluminum exceeds the CCME FWAL guidelines (5 ug/L if pH <6.5, 100 ug/L if pH >6.5) for all samples collected from SW-1 and SW-2. Exceedances in Tier 1 EQS criteria (5 ug/L) were noted for all samples at all sampling locations. Varying amounts of aluminum are present naturally in groundwater and surface water, with the amount of aluminum in surface water across Nova Scotia varying from below detection limits (<0.04 ug/L) to 2900 ug/L (ECCC, 2022). CCME FWAL guidelines and Tier 1 EQS criteria for total iron (300 ug/L) is only exceeded during the November sampling period at SW-2 (343), both SW-1 and SW-3 are within the guidelines.

TSS was collected at the same sample locations. The results of TSS sampling are presented in Table 5-37.

Table 5-37. Baseline TSS Results

Location	Watercourse ID	Date	TSS (mg/L)
SW-1	WC1	March 23, 2021	1
		May 20, 2021	1
		November 24, 2021	<1
SW-2	WC1	March 23, 2021	1
		May 20, 2021	<1
		November 24, 2021	<1
SW-3	Settling Pond Discharge	March 23, 2021	2
		May 20, 2021	12
		November 24, 2021	<1

At sampling locations SW-1 and SW-2, TSS ranged from <1 to 1 mg/L. TSS at sampling location SW-3 ranged from <1 mg/L to 12 mg/L.

5.4.3 Fish and Fish Habitat

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

5.4.3.1 *Desktop Review*

No mapped watercourses or waterbodies were identified within the Aquatic Study Area, however, the northern branch of the Aquatic Study Area ends immediately south of Keys Brook, a mapped watercourse and a tributary to the Shubenacadie River.

The priority species list, as defined in Section 4.3.9, was used to identify seven priority fish species that may occur within the Study Area (Appendix C); American eel (*Anguilla rostrata;* COSEWIC threatened), alewife (*Alosa pseudoharengus*; S3B), Atlantic salmon – inner Bay of Fundy population (*Salmo salar* pop.1; SARA endangered), brook trout (*Salvelinus fontinalis*; S3), pearl dace (*Margariscus nachtriebi;* S3), brook stickleback (*Culaea inconstans;* S3), and striped bass – Bay of Fundy population (*Morone saxatilis* pop. 2; COSEWIC endangered).

The ACCDC report identified six species located within 5 km of the Study Area; Atlantic salmon – inner Bay of Fundy pop. (hereinafter referred to as Atlantic salmon iBoF), striped bass – Bay of Fundy pop. (hereinafter referred to as striped bass BoF), Atlantic sturgeon, American eel, alewife, and brook trout.

Atlantic salmon iBoF were identified within the ACCDC report as being found within 2.4 km of the Study Area. Atlantic salmon are divided into unique populations based on genetic distinction and range. For the purposes of this discussion, we are considering only the Atlantic salmon iBoF population, as outlined by DFO in the *Recovery Potential Assessment for the inner Bay of Fundy population of Atlantic salmon* (DFO, 2008). Atlantic salmon iBoF population is ranked as S1 by the ACCDC and has been assessed by COSEWIC and SARA as endangered.

The iBoF population of Atlantic salmon has experienced significant reduction over the last few decades to critically low levels (DFO, 2008). Over the last 30 years, iBoF populations of Atlantic salmon have been predicted to have declined by almost 95% (DFO, 2021). Current adult and juvenile abundance has been assessed as critically low in most rivers, and there is strong evidence for river-specific extirpation (Jamie et al., 2011). The main historical threats to this sub population of salmon are loss and degradation of habitat. Other threats are interbreeding with escaped farm fish, barriers to fish passage and environmental changes, such as contaminants and warmer water (DFO, 2021). The Shubenacadie River has been identified as an important river for long-term population self-sustainability for the iBoF population of Atlantic salmon (DFO, 2021). The Study Area does not fall within critical habitat for the iBoF population of Atlantic salmon as identified in the Recovery Strategy (DFO, 2010); however, Atlantic salmon are expected to inhabit major tributaries to the Shubenacadie River, including Keys Brook. The DFO aquatic SAR interactive map identifies Atlantic salmon iBoF population, within Keys Brook (Fisheries and Oceans Canada, 2019).

Striped bass BoF were identified within the ACCDC report as being found within 4.9 km of the Study Area. This population of Striped Bass has been found within the Shubenacadie River, which is the only confirmed spawning location in the province (COSEWIC 2004). They are also known in the Saint John River and Annapolis River (COSEWIC 2004)). Within the Shubenacadie River, there was a decline in abundance between 1950 and 1975. This decline was manly due to changes in flow regime, poor water quality and the introduction of chain pickerel into overwintering areas (COSEWIC, 2004). However, population numbers have seemed to remain relatively stable since this decline was documented (COSEWIC, 2004). Striped bass BoF population is ranked as S1B by the ACCDC and is listed as endangered by COSEWIC, they are not currently listed under SARA or NSESA.

Atlantic sturgeon (*Acipenser oxyrinchus*) were identified within the ACCDC report within 4.9 km of the Study Area. Atlantic sturgeon are known to be present within the Shubenacadie River and other rivers that have direct access to the sea preferably with deep channels (COSEWIC, 2011). Commercial and recreational fishing paired with small breeding populations have been the main threats to Atlantic Sturgeon populations, however, little monitoring has been done, making its viability highly uncertain

(COSEWIC, 2011). Atlantic sturgeon are ranked as S1B by the ACCDC and are listed as threatened by COSEWIC. They are not currently listed under SARA or NSESA.

American eel were identified within the ACCDC report within 2.4 km of the Study Area. As a catadromous species, eel spend the majority of their lives in freshwater, moving to the Sargasso Sea to spawn (Scott and Crossman, 1973). American eel distribution encompasses all freshwater watercourses that has connectivity to the Atlantic Ocean (COSEWIC, 2012). The abundance and distribution of American eel has diminished over the last century due to human impacts within freshwater habitat (COSEWIC, 2021). American eel populations are ranked as S2 by the ACCDC and are listed as threatened by COSEWIC. They are not currently listed under SARA or NSESA.

Alewife were identified within the ACCDC report within 4.9 km of the Study Area. Alewife are known to inhabit this secondary watershed (Shubenacadie River secondary watershed) and six of the nine adjacent watersheds. It is mainly a marine species only returning to spawn in freshwaters (CRI, n.d.). Alewife populations are ranked as S3 by the ACCDC and has not been assessed by COSEWIC, nor are they listed under SARA or NSESA.

Brook trout were identified within the ACCDC report within 2.4 km of the Study Area. They are also known to inhabit every secondary watershed within Nova Scotia (CRI, n.d.). Trout populations in general are affected by habitat loss, over exploitation (brook trout are the number one sport fish within Nova Scotia), and competition and illegal introductions (NSDAF, 2005). Brook trout populations are ranked as S3 by the ACCDC and have not been assessed by COSEWIC, nor are they listed under SARA or NSESA.

The Nova Scotia freshwater fish species distribution records (NSDFA, 2019) and Description of Selected Lake Characteristics and Occurrence of Fish Species in 781 Nova Scotia Lakes (Alexander. Kerekes, and Sabean, 1986) were reviewed, and additionally banded killifish (*Fundulus diaphanus*; S5), brown bullhead (*Ameiurus nebulosus*; S5), common shiner (*Luxilus cornutus*; S5), creek chub (*Semotilus atromaculatus*; S5), fourspine stickleback (*Apeltes quadracus*; S5), golden shiner (*Notemigonus crysoleucas*; S4), lake chub (*Couesius plumbeus*; S5), ninespine stickleback (*Pungitius pungitius*; S5), white perch (*Morone americana*; S5), white sucker (*Catostomus commersonii*; S5), and yellow perch (*Perca flavescens*; S5) were all identified within waterbodies within the Shubenacadie River watershed. Fishbrain, a fishing app through which anglers can record catch data, documents smallmouth bass (*Micropterus dolomieu*; SNA), chain pickerel (*Esox niger*; SNA), and striped bass in Keys Brook, near its confluence with the Shubenacadie River. No additional fish species were identified through the review of Fisheries and Oceans Stock Status Reports (Gibson, Amiro, and Robichaud-LeBlanc, 2003) or NSDNRR Significant Species and Habitats database.

Details relating to habitat requirements for priority species identified through the desktop review are discussed in Section 5.5.7. Fish habitat characterization provided herein is focused on habitat requirements for native fish species.

5.4.3.2 *Field Results*

Per Section 4.3.8.2.1, field surveys confirmed the presence of one watercourse (WC1) within the Aquatic Study Area (Figure 16, Appendix A). Representative photos of water features are provided in Appendix H.

5.4.3.2.1 Fish Surveys

The following sections outline the results of electrofishing efforts within the Aquatic Study Area.

5.4.3.2.1.1 *Electrofishing*

The results of electrofishing surveys are presented in Table 5-38. Relative abundance has been expressed through Catch Per Unit Effort (CPUE) calculated as the number of fish captured per 300 seconds of electrofishing effort. Electrofishing surveys within the Aquatic Study Area are presented on Figure 8 (Appendix A).

Table 5-38. Summary of Electrofishing Efforts within the 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	July 16, 2021	Brook trout	*Salvelinus fontinalis*	3	3	558.9	0.01

During electrofishing survey within WC1, three brook trout were caught and recorded. This resulted in a low CPUE of 0.01 fish per 300 electrofishing seconds. No other species of fish were observed or caught during fish and fish habitat surveys.

5.4.3.2.1.2 *Fish Species Observed*

Table 5-39 presents a summary of fish species captured through electrofishing within the Aquatic Study Area.

Table 5-39. Fish Species Captured within the Study Area

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	Total Catch	
						Total #	% Catch
Brook trout	*Salvelinus fontinalis*	-	-	-	S3	3	100%
TOTAL						**3**	

Individual data for fish captured within the Study Area are presented in Table 5-40, and representative photos captured species are presented in Appendix H.

Table 5-40. Individual Fish Measurements within the Study Area

Fish ID	Common Name	Scientific Name	Fork Length (mm)	Total Length (mm)	Weight (g)	Age Class	Mark Observed
1	Brook trout	*Salvelinus fontinalis*	115	120	19.95	Adult	None
2	Brook trout	*Salvelinus fontinalis*	165	168	50.03	Adult	None
3	Brook trout	*Salvelinus fontinalis*	149	155	42.47	Adult	None

As a result of fishing efforts (i.e., all electrofishing) completed within the Aquatic Study Area, three individual adult brook trout were captured in WC1.

Life stage and freshwater habitat descriptions for brook trout are provided in the following paragraphs. Description of habitats available within the Aquatic Study Area are provided in Section 5.4.3.2.4.

Brook trout

Brook trout are known to inhabit a wide range of cool, freshwater environments, from small headwater streams to large lakes. Water temperature is a critical factor influencing brook trout distribution and production. Though typically not anadromous, brook trout require free passage along streams to move between areas of use, including spawning grounds, overwintering areas, and summer rearing areas.

In Nova Scotia, mature brook trout migrate to spawn in lakes or streams in the fall of the year. Brook trout spawning sites are usually near groundwater upwelling or spring seeps and within a lake or stream with gravel substrate (NSDFA, 2005). Optimal spawning conditions for brook trout include clear substrate 3-8 mm in size in shallow water with limited fines (<5%), and velocities of 25-75 cm/s (Raleigh, 1982).

Young of the year brook trout require cold water, stable, low velocities, and an abundance of in-stream cover. Optimal temperature for juvenile growth is 10-16°C, while cover in the form rubble, vegetation, undercut banks, and woody debris should account for a minimum of 15% of total stream area (Raleigh, 1982). In winter, brook trout aggregate in pools beneath silt-free rocky substrate and close to point sources of groundwater discharge (Raleigh, 1982; Cunjak and Power, 1986). Adults use both pools and riffles, with more than 25% in-stream cover being optimal (Raleigh, 1982). Brook trout respond negatively to flashy or hydrologically dynamic systems and require stable flow for all life stages (Raleigh, 1982).

Brook trout are considered provincially vulnerable by the ACCDC (S3) but have not been assessed by COSEWIC nor are they currently listed under SARA or NSESA. During the field program, brook trout made up for 100% of all fish caught within the Aquatic Study Area. Three individual adult brook trout were captured within WC1 during electrofishing efforts.

5.4.3.2.2 *Water Quality*

Water quality results are reported and discussed as it relates to the chemical characteristics required for suitable fish habitat. Where applicable, water quality sampling results are measured against the CCME Guidelines for the Protection of Aquatic Life (FWALs). In-situ water quality measurements recorded during detailed habitat surveys and fish surveys in July 2021 and in detailed habitat surveys in April 2022, are provided in Table 5-41.

Table 5-41. Summary of In-situ Water Quality Measurements recorded during field studies.

Site[1]	Reach #	Sampling Date	Water Temp (ºC)	pH	DO (%)	Conductivity (µS/cm)	Turbidity[1]
WC1	1	April 12, 2022	5.3	6.82	102.4	53.8	35.1
	2	April 12, 2022	5.5	6.99	96.3	34.4	35.75
	3	April 12, 2022	5.5	7.26	111.6	34.1	35.1
	3	July 21, 2021	13.0	7.64	-	-	-
	4A	April 12, 2022	6.8	7.30	99.7	83.7	83.2
	4B	July 28, 2021	14.2	7.56	-	-	-
	5	July 28, 2021	15.1	7.62	-	-	-

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). Missing measurements reflect equipment malfunctions in the field.

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

5.4.3.2.2.1 *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 for aquatic biota. Temperature preferences of fish vary between species (as well as with size and age) and season.

Salmonids are cold-water fish species, meaning they require cold water to live and reproduce (Bowlby et al., 2014). The optimal temperature range for these species (growth of juvenile) is 10-20˚C (The Stream Steward n.d.) to 16-20˚C (DFO, 2012b) (brook trout and Atlantic salmon, respectively). The Nova Scotia Trout Management Plan (NSDFA, 2005) identifies three classes of streams based on water quality and pH for trout species. Class A streams (cool) require the average summer temperature to be <16.5˚C. Class B streams (intermediate) temperature (average summer) ranges from 16.5-19˚C. Finally, Class C streams (warm) require temperatures above 19˚ or pH of <4.7 (NSDFA, 2005). The identification, maintenance, protection, and enhancement of instream habitats of Class A and Class B waters can benefit the brook trout fishery.

The results shown in the tables above generally provide a snapshot of temperatures from early (April) spring and mid (July) summer for WC1. Throughout WC1, recorded spring temperatures ranged, from 5.3°C to 6.8°C. Whereas in the summer, temperatures ranged from 13.0°C to 15.1°C within WC1. These temperatures are considered suitable for cold-water fish species like brook trout.

5.4.3.2.2.2 *pH*

CCME FWALs establish that a range of pH from 6.5 to 9.0 is suitable 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.

Brook Trout can tolerate acidic conditions particularly well, compared with other species. They have been known to survive at pH 3.5 in laboratory settings (Daye and Garside, 1975). Raleigh (1982) proposed an optimal pH range for brook trout as 6.5-8.0, with a tolerance range of 4.0-9.5.

The pH range for aquatic features sampled within the Study Area was 6.48 to 7.95, with an average pH of 7.32. Out of the 16 pH measurements presented (Table 5-36 and Table 5-41), 15 exhibited pH levels within CCME recommended range for freshwater aquatic life (6.5-9). No measurements recorded in-situ during fishing surveys, habitat assessment or surface water sampling exhibited pH levels so low (<5.0) as to expect to cause harm to the eggs and fry of salmonid species (CCREM, 1987).

5.4.3.2.2.3 *Dissolved Oxygen*

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).

DO levels recorded during the spring sampling period ranged between 96.3% - 111.6% (average = 102.5%). No DO measurements were recorded during the summer sampling period due to equipment malfunction. DO levels recorded are considered suitable for aquatic life; though each species and life stage of fish has its own range of suitable dissolved oxygen levels, water that supports a range of fish will generally have dissolved oxygen concentrations of 80-120% (ENR, 2014). This range includes brook trout, which are considered sensitive in dissolved oxygen tolerance with sublethal negative effects observed below 6.8 mg/L for juvenile and adult life stages (Tang et al., 2020).

5.4.3.2.2.4 *Conductivity, Total Dissolved Solids, and Turbidity*

Total Dissolved Solids (TDS) is a measurement of inorganic salts, organic matter, and other dissolved materials in water. Conductivity, which is a measure of water's capacity to conduct an electrical current, is correlated to TDS as increases in the mineral and salt content of water will increase its capacity to carry a charge. Toxicity in fish can be achieved through large increases in salinity, changes in the ionic composition of the water and toxicity of individual ions. A literature review by Weber-Scannell and Duffy (2007) reported a variety of studies that evaluated the effect of elevated TDS on freshwater aquatic invertebrates. These studies reported the commencement of negative effect at 499 mg/L, with most effects not observed until >1,000 mg/L. With fish, research is limited, but preliminary studies reported in Weber-Scannell and Duffy (2007) demonstrated survival rates of salmonid embryos to elevated TDS (38% survival when exposed to 2,229 mg/L for brook trout, and 35% survival when exposed to 1,395 mg/L). 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).

Turbidity is the measure of light clarity. High turbidity levels can negatively affect fish in a number of ways, including decreases in food sources and DO levels, reduction in foraging and predation success, egg suffocation, and direct mortality (ENR, 2013)

Conductivity, TDS, and turbidity are often used as baseline for comparison with background measurements. Significant changes in these three parameters could indicate that a discharge or some other source of pollution has entered the aquatic resource. Conductivity, TDS and turbidity levels measured within the Aquatic Study Area are considered acceptable for aquatic life.

5.4.3.2.3 Detailed Fish Habitat Surveys

For detailed fish habitat assessments, each habitat type has been characterized via surveys using standard methodologies to gather key measurements such as reach length (m), reach wetted and channel widths (m), reach slope (%), stream substrate composition (% composition), water depths (m), water velocities (m/s), cover (%), and riparian habitat. The data was used to determine the overall habitat area within each reach as well as the habitat suitability based on measured stream substrate, water depths, and water velocities (habitat parameters) for each fish species identified or potentially residing within the Aquatic Study Area.

A summary of key fish habitat characteristics within each reach of linear watercourse surveyed, and the fish species and life stages they support, are presented in Table 5-42. Delineated watercourse reaches are presented on Figure 8 (Appendix A) and representative photos are presented in Appendix H.

Table 5-42. Summary of Key Diagnostic Features of Fish Habitat within Linear Watercourses in 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]	Average Velocity (m/s)	Average Depth (m)	Dominant Substrate	Cover (%)[4]	Confirmed Species	Probable Species[5]	Spawning	YOY	Juvenile	Adult
1	1	1	E	1.6	0.9	44	Riffle	-	4	<0.05	0.06	Boulder, Rubble, Cobble	26	BKT	BKT, ATS, EEL, SMB, STB, CHP, ATC**	-	EEL, BKT	EEL, BKT	EEL, BKT
	2	1	E	1.3-1.95	1.0-1.2	213	Run	-	1-2	<0.05	0.17	Muck/Detritus	25			BKT	EEL, BKT	EEL	EEL, BKT
	3	1	I	1.15-2.3	0.75-1.5	166	Riffle	Rapid	3-7	0.54	0.09	Rubble	24			-	EEL, BKT	EEL, BKT	EEL, BKT
	4A*	1	I	1.3	1.2	57	Flat	-	1	<0.05	0.16	Muck/Detritus	22			BKT	EEL, BKT	EEL	EEL, BKT
	4B*	1	P	0.9-2.7	0.4-2.25	283	Flat	Run, Pool	1	<0.05	0.07	Muck/Detritus	60			BKT	EEL, BKT	EEL	EEL, BKT
	5	1	P	1.55	1.5	55	Run	Pool	2	<0.05	0.01	Boulder	75			-	EEL, BKT	EEL, BKT	EEL, BKT

[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 (E) – 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: Atlantic Salmon (ATS), Atlantic Sturgeon (ATC), American Eel (EEL), Brook Trout (BKT), Chain Pickerel (CHP), Smallmouth Bass (SMB), Striped Bass (STB)
*One homogeneous reach assessed at different times of the year.
** Cascade at confluence with Keys Brook may restrict passage of fish upstream

5.4.3.2.4 Assessment of Fisheries Resources

The following paragraphs describe the fish habitat characterized through detailed habitat assessments of WC1 and provides an assessment of the quality of the habitat in relation to fish species identified within the Aquatic Study Area and their life stages.

Watercourse 1

WC1 is a first order, low to moderate gradient watercourse that originates west of the Aquatic Study Area (Figure 16, Appendix A). Within the Study Area, WC1 flows northeast for approximately 400 m prior to exiting the Study Area, then continues northeast within the Aquatic Study Area for approximately 340 m before draining into Keys Brook. The watercourse begins as an ephemeral feature which extends through Reaches 1 and 2, with flows becoming intermittent through Reaches 3 and 4a within the Study Area, and then permanent towards its downstream extent in Reaches 4b and 5 within the Aquatic Study Area. During the 2021-2022 field program, fish collection, detailed habitat assessment, and water quality surveys were conducted within this watercourse. Detailed habitat assessments were completed across two field visits. In 2021, reaches 1-4A were dry and only reaches 4B-5 were assessed. During high flow of 2022, reaches 1-4A were assessed and the watercourse was delineated into five homogenous reaches.

Reach 1 begins at the western edge of the Study Area and is a slightly entrenched 44 m riffle. Average channel width is 1.6 m with an average depth of 6 cm. Large woody debris, boulders, and seasonally deep pools (maximum depth of 30 cm observed) provide some cover throughout the reach for fish. Boulder, rubble, and cobble are the dominant substrates found within this reach. Reach 2 is a 213 m run starting at WL17. Channel width ranged between 1.3-1.95 m with an average depth of 17 cm. Large woody debris, boulders and seasonally deep pools (maximum depth of 30 cm observed) provide some cover throughout the reach for fish, and muck is the dominant substrate. These reaches are considered ephemeral as they run dry during rainless periods.

Reach 3 is a moderately entrenched 166 m riffle, with a section (under five meters) of rapid habitat. This reach begins within WL15 and has a channel width that ranges between 1.15-2.3 m, with an average depth of 0.09 cm. Boulders, undercut banks, and seasonally deep pools (maximum depth of 30 cm observed) provide some coverage throughout the watercourse for fish. Rubble is the dominant substrate found within this reach. Observed within this reach was a possible obstacle to fish passage. Woody debris created a dam holding back water and a small, 1 m falls, had formed (Photo 41, Appendix H). The permanency of this obstacle was undetermined but could restrict the passage of fish species with limited jumping capabilities. Additionally, there is a 12.5 m long, 762 mm (30 inch) diameter concrete culvert that directs water north under the existing quarry access road (Photo 44 and 45, Appendix H). A build-up of riprap was observed at the culvert outflow. This, combined with low water levels through the culvert, likely impede upstream fish passage during low-flow periods.

Reach 4 begins at the northeastern extent of the Study Area then flows northeast within the extension of the Aquatic Study Area. This reach was assessed at two different times of the year; Reach 4A was assessed during high flow of 2022, whereas Reach 4B was assessed during low flow of 2021. Reach 4 is a

340 m, intermittent-perennial flat that ranges between 0.9-2.7 m in width and has water depths ranging between 7-16 cm. Large woody debris, boulders and undercut banks provides moderate coverage for fish throughout the reach. Muck/detritus was the dominant substrate observed.

Reach 5 is the final reach of WC1 before it drains into Keys Brook. This highly entrenched 55 m perennial reach is dominated by run habitat with small sections (under 5 m) of pool habitat. Channel width was measured as 1.55 m with an average depth of 1 cm (during low flow). Boulder is the dominant substrate and provides heavy instream coverage for fish. At the confluence with Keys Brook a potential obstacle to fish passage was observed. This permanent, 1 m cascade over bedrock was determined a potential barrier for fish species with limited jumping capabilities.

One single pass of electrofishing was conducted within WC1 (downstream of the culvert and upstream of the cascade), resulting in the capture of three adult brook trout. Direct connectivity to Keys Brook provides the possibility of access to other fish species noted in Section 5.4.3.1; however, the high-gradient cascade at the confluence with Keys Brook (Photo 41, Appendix H) likely restricts passage of most fish species into WC1. Suitable habitat within WC1 was identified for YOY and adult brook trout throughout with suitable habitat types, water depths, velocities, and cover types noted present at least seasonally (high flow events), while spawning (clean gravels) and juvenile habitat (deeper pools or flats with a variety of cover types) for brook trout is sparser. Though not captured during electrofishing surveys, suitable habitat was identified for all freshwater life stages of American eel; WC1 has moderate-heavy instream cover through variety of cover types, and provides soft-bottom sediments (muck/detritus) in which to burrow. American eel are adept climbers and are expected to be able to navigate the cascade at the downstream end of WC1. The ephemeral flow regimes of Reaches 1 and 2 provide temporary, seasonal restrictions to passage into the upper reaches of WC1.

5.5 **Priority Species**

5.5.1 Desktop Review

A review of ACCDC report (Appendix D) confirms the presence of several priority species in proximity to the Study Area (Figure 4, Appendix A). The ACCDC identified the following records of SAR and SOCI within 5 km of the Study Area including:

- 19 records of 11 vascular flora;
- One record of one nonvascular flora;
- 51 records of 30 vertebrates;
- 4 records of 3 invertebrates; and
- Location sensitive occurrences of a bat hibernacula or bat species occurrence and wood turtle.

The NSDNRR considers a number of species “location sensitive”. Concern about exploitation of location-sensitive species excludes the precise coordinates in an ACCDC report. Although the ACCDC report identifies wood turtle within 5 km of the Study Area, communication with NSDNRR in April 2021 confirmed that there is no identified core habitat within the Study Area but wood turtle core habitat is within close proximity, and observations of the species were documented less than 1 km from the Study Area (Dr. D. Hurlburt, NSDNRR Manager of Biodiversity, Personal Communications, April 7, 2021). NSDNRR also confirmed that a bat hibernaculum exists <4 km northeast of the Study Area (Dr. D. Hurlburt, NSDNRR Manager of Biodiversity, Personal Communications, June 3, 2021)

The following fifteen SAR have been identified within 5 km of the Study Area by the ACCDC:

- Atlantic Salmon – Inner Bay of Fundy population (SARA Endangered)
- Bank Swallow (NSESA Endangered, SARA Threatened)
- Barn Swallow (NSESA Endangered, SARA Threatened)
- Canada Warbler (NSESA Endangered, SARA Threatened)
- Rusty Blackbird (NSESA Endangered, SARA Special Concern)
- Common Nighthawk (NSESA & SARA Threatened)
- Snapping Turtle (NSESA Vulnerable, SARA Special Concern)
- Eastern Wood-Pewee (NSESA Vulnerable, SARA Special Concern)
- Evening Grosbeak (NSESA Vulnerable, SARA Special Concern)
- Eastern Painted Turtle (SARA Special Concern)
- Monarch (NSESA Endangered, SARA Special Concern)
- Wood turtle (NSESA & SARA Threatened)
- Bat hibernacula or bat species occurrence – little brown myotis, long-eared myotis, and tri-colored bat (all three species are NSESA & SARA Endangered)

A summary of priority species identified by ACCDC within 5 km of the Study Area is provided below (Table 5-43). Priority species identified within 5 km of the Study Area provide a good representation of what species may occur in the Study Area. For avifaunal priority species, breeding status as documented for the second atlas in the Maritime Breeding Bird Atlas square summary (20MQ67) is also included. If the species was observed during atlas surveys, with no breeding evidence noted in the second atlas, this is indicated below as well (see Table 4-4 for breeding evidence codes).

Table 5-43. Summary of ACCDC observations of priority species within 5 km of the Study Area.

Scientific Name	Common Name	COSEWIC	SARA	NSESA	SRank	Distance	MBBA
Vascular Plants							
Dirca palustris	Eastern Leatherwood	-	-	-	S2	3.7 ± 1.0	-
Lilium canadense	Canada Lily	-	-	-	S2	3.7 ± 0.0	-
Dichanthelium clandestinum	Deer-tongue Panic Grass	-	-	-	S3S4	1.9 ± 0.0	-
Veronica serpyllifolia	Thyme-leaved Speedwell	-	-	-	S3S4	4.3± 0.0	-
Ulmus americana	White Elm	-	-	-	S3S4	3.1± 0.0	-
Juncus acuminatus	Sharp-Fruit Rush	-	-	-	S3S4	3.4 ± 0.0	-
Laportea canadensis	Canada Wood Nettle	-	-	-	S3	3.4 ± 0.0	-
Boehmeria cylindrica	Small-spike False-nettle	-	-	-	S2S3	4.0 ± 0.0	-
Scirpus pedicellatus	Stalked Bulrush	-	-	-	S2S3	4.7 ± 0.0	-
Persicaria amphibia var. emersa	Long-root Smartweed	-	-	-	S3?	4.8 ± 0.0	-
Fragaria vesca ssp. americana	Woodland Strawberry	-	-	-	S3S4	4.4 ± 0.0	-
Lichens							
Cladonia coccifera	Eastern Boreal Pixie-cup Lichen	-	-	-	S2S3	3.1 ± 4.0	-
Mammals							
Myotis lucifugus	Little Brown Myotis	E	E	E	S1	4.2 ± 0.0	-
Myotis septentrionalis	Northern Myotis	E	E	E	S1	4.2 ± 0.0	-
Perimyotis subflavus	Tri-colored Bat	E	E	E	S1	4.2 ± 0.0	-
Avifauna							
Falco sparverius	American Kestrel	-	-	-	S3B, S4S5M	4.3 ± 7.0	-
Charadrius vociferus	Killdeer	-	-	-	S3B	4.3 ± 7.0	-
Actitis macularius	Spotted Sandpiper	-	-	-	S3S4B, S5M	4.3 ± 7.0	-
Gallinago delicata	Wilson's Snipe	-	-	-	S3B, S5M	4.3 ± 7.0	-
Eremophila alpestris	Horned Lark	-	-	-	SHB,	4.3 ± 7.0	-

Scientific Name	Common Name	COSEWIC	SARA	NSESA	SRank	Distance	MBBA
					S4S5N, S5M		
Hirundo rustica	Barn Swallow	SC	T	E	S3B	4.3 ± 7.0	AE
Setophaga castanea	Bay-breasted Warbler	-	-	-	S3S4B, S4S5M	4.3 ± 7.0	-
Cardellina canadensis	Canada Warbler	SC	T	E	S3B	4.3 ± 7.0	P
Euphagus carolinus	Rusty Blackbird	SC	SC	E	S2B	4.3 ± 7.0	-
Pinicola enucleator	Pine Grosbeak	-	-	-	S3B, S5N, S5M	4.3 ± 7.0	-
Loxia curvirostra	Red Crossbill	-	-	-	S3S4	4.3 ± 7.0	-
Spinus pinus	Pine Siskin	-	-	-	S3	4.3 ± 7.0	H
Contopus virens	Eastern Wood-Pewee	SC	SC	V	S3S4B	4.3 ± 7.0	S
Poecile hudsonicus	Boreal Chickadee	-	-	-	S3	4.3 ± 7.0	P
Coccothraustes vespertinus	Evening Grosbeak	SC	SC	V	S3B, S3N, S3M	2.0 ± 0.0	H
Perisoreus canadensis	Canada Jay	-	-	-	S3	4.3 ± 7.0	FY
Pheucticus ludovicianus	Rose-breasted Grosbeak	-	-	-	S3B	4.3 ± 7.0	H
Chordeiles minor	Common Nighthawk	SC	T	T	S3B	4.3 ± 7.0	D
Oreothlypis peregrina	Tennessee Warbler	-	-	-	S3S4B, S5M	4.3 ± 7.0	S
Cardellina pusilla	Wilson's Warbler	-	-	-	S3B, S5M	4.3 ± 7.0	S
Riparia riparia	Bank Swallow	T	T	E	S2B	4.9 ± 0.0	-
Fish							
Acipenser oxyrinchus	Atlantic Sturgeon	T	-	-	S2S3N	4.9 ± 0.0	-
Anguilla rostrata	American Eel	T	-	-	S3N	2.4 ± 0.0	-
Alosa pseudoharengus	Alewife	-	-	-	S3B	4.9 ± 0.0	-
Salmo salar pop. 1	Atlantic Salmon - Inner Bay of Fundy pop.	E	E	-	S1	2.4 ± 0.0	-
Salvelinus fontinalis	Brook Trout	-	-	-	S3B	2.4 ± 0.0	-

Scientific Name	Common Name	COSEWIC	SARA	NSESA	SRank	Distance	MBBA
Morone saxatilis pop. 2	Striped Bass - Bay of Fundy pop.	E	-	-	S2S3B, S2S3N	4.9 ± 0.0	-
Herpetofauna							
Hemidactylium scutatum	Four-toed Salamander	NAR	-	-	S3	2.9 ± 0.0	-
Chrysemys picta picta	Eastern Painted Turtle	SC	-	-	S4	3.6 ± 1.0	-
Chelydra serpentina	Snapping Turtle	SC	SC	V	S3	2.5 ± 0.0	-
Glyptemys insculpta	Wood Turtle	T	T	T	S2	1.2± 0.0	-
Invertebrates							
Stylurus scudderi	Zebra Clubtail	-	-	-	S2S3	2.9 ± 1.0	-
Danaus plexippus	Monarch	E	SC	E	S2?B, S3M	3.4 ± 0.0	-
Margaritifera margaritifera	Eastern Pearlshell	-	-	-	S2	3.2± 1.0	-

5.5.2 Vascular Plants

Eleven vascular priority plant species were documented within 5 km of the Study Area in the ACCDC report (Table 5-43). None of the priority vascular plant species identified within 5 km by the ACCDC were observed in the Study Area, however, one other priority vascular plant species was identified during targeted plant surveys: Bicknell's crane's-bill (S3 [ACCDC April 2022]). The Bicknell's crane's-bill observation occurred in upland regenerating forested habitat, 10 m southeast of the existing quarry face in the center of the Study Area (Figure 14, Appendix A).

The habitat suitability within the Study Area for Bicknell's crane's-bill is described below:

Bicknell's Crane's-Bill

Typical habitats for Bicknell's crane's-bill are recently burned or cleared land, as well as exposed lakeshores (Munro, Newell & Hill, 2014). Bicknell's crane's-bill can also be found on ridges, ledges and talus or rocky slopes (Native Plant Trust, 2022). Although only one observation of Bicknell's crane's-bill was identified, suitable habitat for the species occurs in other locations within the Study Area as the Study Area is primarily regenerating forest.

5.5.3 Lichens

One priority lichen species was identified within 5 km of the Study Area by the ACCDC, eastern boreal pixie-cup lichen (*Cladionia coccifera*). No priority lichen species were observed within the Study Area during the targeted lichen surveys.

Overall, the lichen community within the Study Area consisted of a community structure often associated with regenerating forested stands, such as the SH8 group. It is unlikely for the SH8 group to support SAR lichens as the majority of these species require more mature trees. This forest type is common throughout the Study Area, the surrounding landscape, and throughout Nova Scotia.

5.5.4 Mammals

No priority mammal species were observed during field surveys.

No potential bat hibernaculum or bat species were identified in the Study Area during the biophysical surveys. Northern myotis, little brown myotis, and tri-colored bat were identified within 5 km of the Study Area by the ACCDC report. The Study Area appears to exist within a national 10 km x 10 km standardized grid squares within which critical habitat (hibernacula) for little brown myotis, northern myotis, and tri-colored bat is found (Environment Canada, 2015). NSDNRR confirmed that a bat hibernaculum exists <4 km northeast of the Study Area (Dr. D. Hurlburt, NSDNRR Manager of Biodiversity, Personal Communications, June 3, 2021) Potential maternity roosting habitat is present within the Study Area. Maternity roosting habitat for each species is described below:

Northern myotis

Northern myotis prefer tree roosts and maternity roost sites that are typically associated with forest cover (Broders and Forbes 2004; Broders et al. 2006; Carter and Feldhamer 2005). Silvis et al. (2015) found that larger trees in a later state of decay were favored by female northern myotis. Northern myotis will also roost in anthropogenic structures, but not as frequently as little brown myotis (Environment Canada 2015).

Little brown myotis
Little brown myotis are less of a forest specialist than northern myotis. Little brown myotis use buildings or other anthropogenic structures to roost but will also use tree cavities, foliage, and tree bark (COSEWIC 2013; Randall et al. 2014).

Tri-colored Bat
Tri-colored bat have been documented in roosting within forested areas under dead foliage or arboreal lichens on coniferous or deciduous trees, in proximity to water (Environment Canada 2015). The species has also been documented using barns or other anthropogenic structures as maternity roost sites (Fujita and Kunz, 1984).

The majority of the Study Area is comprised of regenerating forests and there are no permanent anthropogenic structures associated with the existing quarry, therefore, suitable maternity roosting habitat within the Study Area is limited. Potential maternity roosting habitat is available in WL2, 3, 4, 6, and 10, in snags and in areas with intact stands of more mature trees (eastern and northern extent of the Study Area).

5.5.5 Herpetofauna

According to the ACCDC (Appendix D), wood turtles were observed within 5 km of the Study Area and the wood turtle SMP layer is present in proximity to the Study Area, along Keys Brook. Additionally, the ACCDC report identified snapping turtles and eastern painted turtles within 2.0 km and 3.6 km of the Study Area, respectively.

The preferred habitat for wood turtle, snapping turtle, and eastern painted turtle is outlined below:

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. This species prefers clear rivers, streams or creeks with moderate current and sandy or gravelly substrate. They overwinter in numerous microhabitat types, which include burrowing in mud, under overhanging banks, or in the bottoms of stream pools (Environment Canada, 2016).

According to the Recovery Strategy, wood turtles require water with sufficient flow and sufficient depth to provide them with ice-free, well-oxygenated water throughout the winter (Environment and Climate Change Canada, 2020). In Ontario, wood turtles hibernate in water with an average depth of 91 ± 34.8 cm, approximately 123.3 cm from the shore (Environment and Climate Change Canada, 2020). Wood turtles tend to hibernate wherever instream structures such as boulders or root-wads provide some cover, and rarely hibernate outside of the main channel of a watercourse, as they require well oxygenated water throughout the winter (pers. comm., M. Pulsifer).

Wood turtles nest in well-drained gravelly soil on the banks of inhabited watercourses. While some may be attracted to gravelly roadsides for nesting, this habitat is considered unsuitable due to the danger presented to emerging hatchlings. To support egg incubation, soils need to be well-drained, with a southern aspect, and free of vegetation. This habitat is typically present as sand or gravel bars in depositional areas of dynamic, natural watercourses (Environment and Climate Change Canada, 2020).

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, 2016). 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, 2016).

Eastern Painted Turtle

Eastern painted turtles can often be found in slow moving, relatively shallow watercourses, waterbodies, or wetlands. They require abundant basking sites and organic substrate with submergent aquatic plants that provide cover and food sources (COSEWIC, 2018). Their nesting habitats are open areas with south facing slopes that have a sandy loamy and/or gravel substrate; these habitats must be near (within 1.2 km) their preferred aquatic habitats. Overwintering habitats include areas with shallow water and deep substrate.

Field surveys were completed on May 13, May 18, May 28, 2021, along the full extent of WC1 (385 m linear length) within the Study Area. WC1 was identified within the Study Area as potential suitability for wood turtle, as it is a tributary to Keys Brook, a mapped watercourse known to support the species. Although wood turtle was the intended species targeted during these assessments, surveyors were also searching for snapping turtle and eastern painted turtle. Surveys were completed >48 hours apart within the early spring season when turtles are often identified near water and prior to "green-up" (Ikanawtiket Environmental Inc., 2018). All surveys were completed on days with air temperatures >9 °C and the total search effort of the three surveys was 260 mins (Table 5-44). It should be noted that during other surveys (e.g., wetland and watercourse delineation, fish and fish habitat surveys) MEL biologists searched for incidental or opportunistic evidence of wood turtle, snapping turtle, and eastern painted turtle and also recorded suitable nesting/overwintering habitat, if observed.

Table 5-44. Wood Turtle Survey Conditions

Date	Effort (Mins)	Precipitation[1]	Cloud Cover (%)	Wind Speed[2]	Air Temperature (°C)	Water Temperature (°C)
May 13, 2021	70	N	10	C	10.0	8.0
May 18, 2021	120	N	50	C	19.0	11.4
May 28, 2021	70	N	0	L	10.0	8.0

[1] Precipitation: N=none, D=drizzle/mist, L=light rain, M=moderate-heavy rain, F=snow flurries, O=other

[2] Wind Speeds: C=calm, L=light, M=moderate, S=strong

The upstream reach of the WC1 surveyed for turtles is ephemeral, with flows dictated by runoff from rainfall or snowmelt (Figure 9, Appendix A). At the northern boundary of the Study Area, the watercourse becomes intermittent.

Along the reach surveyed, channel width ranges from 1.15-2.3 m, and substrates are dominated by larger rocks (cobbles, rubble, and boulder) with muck present within WL15 and 17. The watercourse primarily comprises riffles, runs with some seasonally deep pools (maximum depth of 30 cm observed). The physical characteristics of this watercourse are summarized in more detail in Section 5.4.3.2.3 (Reach 1-3 surveyed for turtles).

No wood turtle, snapping turtle, eastern painted turtle or evidence of these three species was observed during the surveys or incidentally during other surveys to support the EA. Pools are present within the surveyed reach of WC1, however, due to the watercourse's ephemeral/intermittent flow within the Study Area, none of the pools provide suitable overwintering habitat (i.e., if water is present during the winter it will likely freeze to the bottom). No gravel or sand beaches were identified along the surveyed reaches, therefore, no potential nesting areas were identified within WC1. Gravel is present along the quarry access road and at stockpiles on the existing quarry floor, both of which may offer suitable nesting habitat for wood turtle and snapping turtle. No nesting activity was identified at these locations in 2021 or 2022 by MEL biologists.

Suitable habitats for mating, foraging, thermoregulation, and movement are present in WC1 for wood turtle. Wood turtles are known to travel between overwintering and nesting sites and when foraging (i.e., in upland habitat, >200 m from a watercourse). Although not identified during surveys, since wood turtles have been recorded within 1.2 km of the Study Area by the ACCDC, it is possible that wood turtles (as well as snapping turtle and eastern painted turtle) may access and utilize areas within the Study Area seasonally.

5.5.6 Avian

The ACCDC (Appendix D) identified 21 avian priority species within 5 km of the Study Area (Table 5-43).

Twenty individuals, representing four avifauna priority species were observed within the Study Area during all field surveys, including incidentals (Table 5-42; Figure 15, Appendix A). Three SAR (Canada warbler, common nighthawk, and eastern wood-pewee) and one SOCI (killdeer) were observed. Three species were of the bird group passerines (group 6) and the other was of the bird group shorebirds (group 2). See below for observations of all bird species broken down by survey type and PC location.

Table 5-42. SAR and SOCI observed during all survey periods and incidentally

Common Name	Scientific Name	SARA	COSEWIC	NSESA	SRank	#	Observation Location	Survey Type	Bird Group
Eastern wood-pewee	***Contopus virens***	**SC**	**SC**	**V**	**S3S4B**	**1**	**PC4**	**Fall migration**	**6**
						1	**South of the Study Area (20T 0463030 m E 4979196 m N)**	**Incidental (BBS)**	
						1	**~100 m north of WL17**	**Incidental (early botany)**	
Canada warbler	***Wilsonia canadensis***	**T**	**T**	**E**	**S3B**	**2**	**PC1**	**Spring Migration**	**6**
						1	**PC1**	**Breeding Bird**	
Common nighthawk	***Chordeiles minor***	**SC**	**T**	**T**	**S3B**	**1**	**Area search (on edge of existing quarry)**	**Breeding Bird**	**6**
						1	**CONI1**	**Common Nighthawk**	
						1	**CONI3**		
						1	**On road at edge of existing quarry (20T 0465665 m E 4979992 m N)**	**Incidental (common nighthawk)**	
						1	**Identified foraging over existing quarry.**	**Incidental (early botany)**	
Killdeer	***Charadrius vociferus***	**-**	**-**	**-**	**S3B**	**3**	**On gravel road (20T 0462733 m E 4979803 m N)**	**Incidental (breeding bird)**	**2**
						6	**CONI2**	**Incidental (common nighthawk)**	
Total Number of Species Identified: 4						**Total Number of Individuals: 20**			

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 2022). Incidental observations are away from designated point count locations (waypoints or description of location).

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

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 (NSDL&F, 2021). A Canada warbler pair was found at PC1 during spring migration and a single Canada warbler was identified at the same point count during breeding bird surveys. PC1 is located at the southern extent of the Study Area within WL1 (a treed swamp with shrub growth; Figure 15, Appendix A). Due to the Canada warbler observations and availability of suitable habitat within WL1, it is believed that NSECC will classify this wetland as a WSS.

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 (COSEWIC, 2018). Settled areas can also provide habitat needs (COSEWIC, 2018). Suitable habitat is found scattered throughout the Study Area but is concentrated to the northern extent, surrounding the existing quarry footprint, gravel access roads, and clearings. In total, five common nighthawks were identified during the survey program in 2021 (incidentally and during breeding bird and targeted common nighthawk surveys). Four of the five observations occurred in proximity to the existing quarry footprint. The other observation occurred at outside of the Study Area at CONI3, approximately 1.37 km east from CONI1 on a dirt logging road that branches off Logan Road (Figure 15, 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 (COSEWIC, 2012). They are most abundant in intermediate age and mature forest stands (COSEWIC, 2012). Three eastern wood-pewee were identified during the field survey program. Eastern wood-pewees were identified during a fall migration survey (PC4), as well as incidentally ~100 m north of WL17, and south of the Study Area (Figure 15, Appendix A).

Killdeer

Killdeer are known to frequent fields, airports, lawns, mudflats, coastal estuaries, river-banks, and coastline (National Audubon Society, 2022). Killdeer do well in disturbed areas such as pastures, plowed fields and gravel lots. Nesting areas tend to be flat and close to shallow water or other feeding habitat for chicks. Although it is included in the shorebirds group, it can be found far from water (National Audubon Society, 2022). Killdeer were identified incidentally on a gravel access road during a breeding bird survey and beyond the Study Area during a common nighthawk survey (CONI2) (Figure 15, Appendix A). Killdeer were also identified during a spring migration survey (PC8), however, based on their SRank (S3B), they are not considered a priority species outside of the breeding period.

5.5.7 Fish

One priority fish species (brook trout) was captured during fish surveys within the Study Area. Brook trout are known to inhabit a range of freshwaters environments across Nova Scotia. Not typically an anadromous species, the brook trout require free range passage along watercourses to use various habitat types for spawning grounds, overwintering, and summer rearing areas. Brook trout spawning typically require gravel substrate with ground upwelling or spring seeps. YOY life stages require low velocity watercourses with a rubble substrate, whereas adult brook trout prefer pools with silt-free rocky substrates. All life stages of brook trout require stable water flow.

Brook trout are considered provincially vulnerable by the ACCDC (S3) but have not been assessed by COSEWIC nor are they currently listed under SARA or NSESA. During the field program, three individual adult brook trout were captured within WC1. There is suitable habitat found within WC1 for all life stages of brook trout.

The ACCDC report identified Atlantic Salmon iBoF, striped bass, Atlantic sturgeon, American eel, alewife and brook trout within 5 km of the Study Area (Section 5.4.3.1; Table 5-43). Descriptions of these species preferred habitat and potential to be found in the Study Area is described in the following paragraphs:

Alewife

Alewife are an anadromous fish that return to freshwater watercourses in the early spring to spawn (Scott and Crossman, 1973). Some alewife populations are landlocked and live their entire lives in freshwater environments, the largest landlocked populations occur within the Great Lakes (Grant and Lee, 2004). Alewife spawning tends to occur within open waters and quiet streams just beyond the influence of tides, however, alewife can navigate rapid waters to go further upstream if needed (Scott and Crossman, 1973). Eggs are typically scattered over a sandy, gravel, detritus or submerged vegetation (Grant and Lee, 2004). Most juveniles will move out to sea within their first year of life, where they will follow a seasonal migration along the Atlantic coast (CRI, n.d.).

Alewife are considered provincially vulnerable by the ACCDC (S3) but have not been assessed by COSEWIC nor are they currently listed under SARA or NSESA. During the 2021-2022 field programs no alewife were caught or observed within the Study Area. The slow waters, sandy/detritus substrate and direct connectivity to the Shubenacadie River makes it possible but unlikely to have Alewife present within WC1.

American Eel

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, southeast 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, 1973). 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, 1955; 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 have been assessed as threatened by COSEWIC (2012) and are considered provincially imperiled by the ACCDC (S2). American eel are not currently protected under SARA or NSESA.
No American eel were captured or observed during fish surveys in throughout the Study Area. The slow moving and soft substrates within WC1 provide suitable habitat for all life stages, excluding spawning, of American eel.

Atlantic Salmon – inner Bay of Fundy Pop

Within the freshwater environment, Atlantic salmon are found in cool, clear, well-oxygenated waters that support a reliable food source of aquatic invertebrates. Gravel and cobble are the preferred substrates for spawning (Bowlby et al., 2013), with redd sites typically located in well aerated areas - a riffle above a pool, or at the tail of pools on the upstream edge of riffles with depths of 10-70 cm (Grant and Lee, 2004). Young of year (YOY) will remain near the redd for a few months, after which they disperse downstream, occupying areas of faster velocities as they increase in size (Grant and Lee, 2004). Juveniles can be found occupying a variety of habitats. In summer and fall, they are typically found in moderate velocity runs with clean, rocky substrate free of sand, silt, and detritus (Rimmer et al., 1983). Older parr are usually found in riffles, whereas deeper pools are the preferred habitat during low water levels, high temperatures, and winter freeze (Grant and Lee, 2004).

The iBoF Population of Atlantic salmon has been assessed as endangered by COSEWIC (2010) and SARA and is considered provincially critically imperiled by the ACCDC (S1). This population is not currently protected under NSESA. No Atlantic salmon were caught or observed within the 2021 field program. WC1 does not provide the substrate or habitat needed for any life stage of Atlantic salmon, this is mainly due to the lack of gravel/sandy substrates and riffle habitat.

Atlantic Sturgeon

Little is known about the habitat preference of the northern range of Atlantic sturgeon. However, it appears that rivers with deep channels and access to the sea and continental shelf are preferred (COSEWIC, 2011). They are an anadromous species that typically chooses to lay their eggs over gravel substrates with a strong current, that have a depth between 1-3 m (COSEWIC, 2011). This species typically resides and matures out at sea before returning to freshwater-brackish environments to spawn (COSEWIC, 2011).

Atlantic sturgeon have been assessed as threatened by COSEWIC and is considered provincially imperiled by ACCDC (S1B). This population is not currently protected under NSESA. No Atlantic sturgeon were caught or observed during fish collection. WC1 does not have suitable habitat for any life stage of Atlantic sturgeon, this is mainly due to WC1 having shallow water, gravel substrate, and a lack of marine influence.

Striped Bass

Striped Bass are usually associated with estuaries and coastal waters. They can be found on the east coast of North America, from the St. Lawrence Estuary to the northeast of Florida. They spawn in freshwater and brackish water and following hatching will undergo a slow migration downstream to saltwater. The Canadian population is known to overwinter in freshwater. The Striped Bass - Bay of Fundy population is currently limited to spawning in the Shubenacadie River, other residence occurring in the Saint John and the Annapolis River (COSEWIC, 2004)). Spawning within the Shubenacadie River takes place within the major tributary, Stewiacke River. Juveniles and adult striped bass use coastal and estuarine habitats predominantly.

Striped bass have been assessed as endangered by COSEWIC and is considered provincially imperiled by ACCDC (S1B). This population is not currently protected under NSESA. No striped bass were caught or observed during fish collection. WC1 does not have suitable habitat for any life stage of striped bass, this is mainly due to the lack of marine influence.

5.6 Socioeconomic Conditions

The Project is located in the community of Lantz, approximately 40 km northeast of Halifax, Nova Scotia (Figure 1, Appendix A). Information on the region including nearby centres is summarized below.

5.6.1 Mi’kmaq of Nova Scotia

The Study Area is located within the Mi’kmaq district of Sipekne’katik, meaning “where the groundnuts grow” (Rand, 1875). The nearest known Mi’kmaw placename to the Study Area is Waqmiaq which means “clean flowing river”, the name for Elmsdale (Ta’n Weji-sqalia’tiek, 2020). Water sources (for drinking and transportation) are important for historic Mi’kmaq use and archeological potential (CRM Group, 2021) and the Shubenacadie River is located ~1.4 km northwest of the Study Area. The Shubenacadie River is a known canoe route used by the Mi’kmaq prior to the arrival of Europeans to Nova Scotia (CRM Group, 2021). There are no recorded Mi’kmaw archaeological sites within 5 km of the Study Area (CRM Group, 2021 [KMKNO-ARD, pers. comm., 2020]). The Archaeological Resource Impact Assessment (Appendix I) concluded that the Study Area was of low potential for archeological resources related to the Mi’kmaq or their ancestors, and nothing was observed during field reconnaissance (CRM Group, 2021).

Current First Nations communities located near the Study Area include Sipekne’katik (~13 km north) and Millbrook (~42 km north). Sipekne’katik First Nation is the second largest Mi’kmaq band in Nova Scotia and includes the communities of Indian Brook IR #14, New Ross, Pennal, Dodd’s Lot, Wallace Hills, and

Grand Lake (Sipikne'katik First Nation, 2022), the closest of which is Indian Brook IR #14 (Figure 17; Appendix A). Sipekne'katik First Nation is a community of 2,588 band members, with just under half of its members (1,244) residing in the community (Sipikne'katik First Nation, 2022).

Millbrook First Nation is a Mi'kmaq community located in the town of Truro. Millbrook First Nation has reserve lands in Beaver Dam, Sheet Harbour, and Cole Harbour (Millbrook First Nation, 2022). The reserve lands in Cole Harbour are the closest to the Study Area, ~35 km to the south, and the Millbrook community is located approximately 42 km north of the Study Area (Figure 17; Appendix A). There are 2,123 band members with Millbrook First Nation, 971 of which live on reserve (Millbrook First Nation, 2022).

No Mi'kmaq Ecological Knowledge Study (MEKS) was completed for the Project.

5.6.2 Population and Economy

The Study Area is located in Lantz, Halifax County, Nova Scotia. According to the 2021 census, the population of Halifax County was 440,072 which was approximately 45.4% of the population of Nova Scotia (Statistics Canada, 2021). From 2011 to 2016, the population within Halifax County increased by 9.1%, from 403,390 to 440,072. Table 5-45 presents population and demographics statistics for Halifax County (Statistics Canada, 2021).

Table 5-45. Population and Demographics for Halifax County and Nova Scotia (Statistics Canada, 2021)

	Halifax County	Nova Scotia
Population in 2021	440,072	969,383
Population in 2016	403,390	923,598
2011-2016 Population Change (%)	9.1	5.0
Total private dwellings (2021)	200,619	476,007
Population density per square km (2021)	80.3	18.4
Land area (square km) (2021)	5,477.53	52,804.71

According to the 2016 Statistics Canada census, the economy of Halifax County is driven by health care and social assistance (12.8%), followed by retail (11.8%), and public administration (10.3%). Table 5-46 outlines the percentages of industries which makes up the labour force of Halifax County, based on the Statistics Canada Census Profile of Halifax County in the 2016[1] Census (Statistics Canada, 2016).

[1] 2021 Statistics Canada Census labour data was not available at the time of writing the EARD and is scheduled to be released on November 30, 2022.

Table 5-46. Labour Force by Industry, Halifax County (Statistics Canada, 2016)

Industry	Total	Percentage
Agriculture; forestry; fishing and hunting	1,445	0.7
Mining; quarrying; and oil and gas extraction	1,115	0.5
Utilities	1,595	0.7
Construction	13,815	6.2
Manufacturing	10,005	4.5
Wholesale trade	7,065	3.2
Retail trade	26,560	12.0
Transportation and warehousing	10,025	4.5
Information and cultural industries	6,320	2.8
Finance and insurance	10,365	4.7
Real estate and rental and leasing	4,390	2.0
Professional; scientific and technical services	17,540	7.9
Management of companies and enterprises	230	0.1
Administrative and support; waste management and remediation services	11,680	5.3
Educational services	17,535	7.9
Health care and social assistance	28,990	13.1
Arts; entertainment and recreation	4,835	2.2
Accommodation and food services	16,120	7.3
Other services (except public administration)	8,850	4.0
Public administration	23,370	10.5
Total	**221,850**	**100**

According to the Statistics Canada 2016 Census, the labour force in Halifax County has a greater percentage of men (50.9%) than women (49.1%). The participation rate in the county's labour force is 67.0%, compared to a provincial average of 61.3%. Halifax County's unemployment rate is 7.3%, compared to 10.0 % in the province of Nova Scotia (Statistics Canada, 2016).

Economic activity within 1 km of the Study Area includes an auto recycling centre ~600 m north (Kenny U-Pull), mechanic shop ~900 m to the north (Molnar Welding and Machine Shop Ltd), and a quarry ~500 m west (Gallant Aggregates Limited). Farming and forestry activity in the vicinity of the Project is visible on satellite imagery of the area.

Additional businesses/facilities further from the Study Area include:

- Versaillles Holding Limited (~1.8 km north)
- The Shaw Group Limited (~2.0 km north)
- East Hants Sportsplex (~2.1 km north)
- Elmsdale Medical Centre (~2.6 km northwest)

- Elmsdale Landscaping (~2.6 km northwest)
- Elmsdale Service Centre (~2.5 km northwest)

5.6.3 Land Use and Value

Land in proximity to the Study Area consists of both private and crown land. Land use south of the Study Area is generally less developed but does include historical forestry activity. Land use to the east, west, and north of the Study Area include undeveloped areas, farmland, clear-cuts, and industrial development (e.g., quarry).

The Study Area is accessed by a private road (gated) that is only used to access the quarry. The existing quarry is an NSECC approved quarry (<4 ha) operating under Industrial Approval (2007-060446-03) for approximately 15 years. Aggregate deposits exist within the entirety of the QEA. In addition to the footprint of the existing quarry and the gravel quarry access road, a secondary access road has been cut to the southern Study Area boundary. The majority of the intact portions of the Study Area have regenerating forest, indicating that forestry activities have occurred on site within the last ~20 years. There are no residential developments within the Study Area and Dexter is unaware of any historical activities that have resulted in potential contamination within site.

5.6.4 Transportation

The Nova Scotia Department of Department of Public Works (NSDPW, 2022) most recent traffic counts for the area surrounding the Project indicate the following:

- Along Highway 2 from Route 214 (Elmsdale) to Route 277 (Lantz; Figure 18, Appendix A) the average daily traffic count in 2021 was 7,066 vehicles. The annual average daily traffic count was 6,640 vehicles. The difference between the two numbers is likely the result of increased seasonal traffic. The traffic counts for 2021 are generally consistent with traffic counts in the same location from previous years, dating back to 2007.

- On Highway 2 from Route 227 (Lantz) to Trunk 14 (Milford Station; Figure 18, Appendix A) the traffic counts prepared by NSTIR in 2021 show an average daily traffic count of 3,324 vehicles and an annual average daily traffic count of 3,320 vehicles. The traffic counts for 2021 are consistent with previous years counts prepared by NSTIR dating back to 2005.

A private access road (gated) off Dutch Settlement Road is the only access to the Study Area. Dexter has paved. the initial ~75 m of this access road immediately off Dutch Settlement Road. This portion was paved to reduce the potential generation of dust in proximity to residences along Dutch Settlement Road and reduce the potential for gravel to accumulate on Dutch Settlement Road. Trucks are routed to required Project locations either east or west on Dutch Settlement Road and will use the local and provincial road network to reach their destination. Trucks use tarpaulins to cover loads and minimize dust.

The existing quarry has been in operations seasonally for 15 years and there is no anticipated increase in truck traffic volume from the Project. Truck traffic is dictated by Dexter being awarded local projects and demand for aggregate.

5.6.5 Recreation and Tourism

Residents of Halifax County have access to a wide variety of recreational facilities which include baseball fields, multi purpose fields, playgrounds, and hiking trails (Regional Municipality of Halifax, 2022). Residential areas have access to recreation centres, including swimming pools and skating rinks.
Since many areas of the county are rural, residents may also participate in hunting and driving in all-terrain vehicles (ATVs).

There are several trail systems within 15 km of the Study Area, including the Beaver Lake Trail (~3 km west of the Study Area) and the Dot Buchanan Park trail (~5.7 km west of the Study Area).

The nearest provincial park is the Dollar Lake Provincial Park which is located approximately 10.0 km southeast of the Study Area. Dollar Lake Provincial Park is approximately 1,414 ha and includes serviced, unserviced, and walk-in campsites (Nova Scotia Provincial Parks, 2021).

The province of Nova Scotia relies on tourism as an industry. According to a news release from Tourism Nova Scotia, tourism revenues increased 28% between 2010 and 2016, and reached an estimated $2.61 billion in 2018 (Tourism Nova Scotia, 2019). Within Halifax County, downtown Halifax is a large draw to tourists. Downtown Halifax is located ~36 km south of the Study Area.

The Study Area does not include any known recreational uses; however, an existing ATV trail runs along the western boundary of the Study Area, located on private land owned by Dexter (Figure 15; Appendix A). The quarry access road from Dutch Settlement Road is gated, to restrict public access to the Study Area. No fishing or hunting is known to occur within the Study Area.

5.6.6 Human Health

Potential impacts to human health from quarry expansion include effects to noise, air quality and accidents or malfunctions (Section 7.2.2). 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.

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. Equipment ramps to the highwall are blocked when the site is inactive to prevent vehicle access to the highwall.

Members from the Dutch Settlement & Area Fire Department attended the public information session (Section 6.1) held at the existing quarry to become familiar with site access and quarry operations.

5.7 Archaeological Resources

Three phases of the archaeological resource impact assessment were completed for the Project. The first, was a historical assessment of the potential for archaeological resources to be present within the Study Area (i.e., Background Study). The second, was Mi'kmaw Engagement and the third was the field reconnaissance program within the Study Area. The results described below are taken directly from the assessment completed by CRM Group (Appendix I).

5.7.1 Background Study

No archaeological sites were identified within the Study Area through a historic background study. The nearest registered historical archaeological site is 8 km west of the Study Area and is identified as a mixed Mi'kmaq and early nineteenth century general activity site.

A review of the Maritime Archaeological Resource inventory (MARI) identified that there are no registered sites within the Study Area, but eight registered Mi'kmaq archeological sites within three kilometers of the Study Area.

There is little evidence of settlement in the area surrounding the Study Area prior to the nineteenth century. Historic maps from that period do not indicate any settlement near the Study Area. Aerial photography from 1945 and 1974 identify the Study Area was undeveloped.

5.7.2 Mi'kmaw Engagement

Staff at the Archaeology Research Division of Kwilmu'kw Maw-klusuaqn (KMKNO-ARD) were contacted on November 5, 2020, 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 completed by CRM Group.

5.7.3 Archeological Reconnaissance

An archaeological field reconnaissance was conducted on November 10, 2020, within the Study Area. The assessment was directed by Sarah Ingram and Kyle Cigolotti of CRM Group.

The field reconnaissance of the Study Area has revealed recently cleared areas as part of the active quarry, sloped landscapes, exposed bedrock, wetlands, forested areas, and historic logging areas. Historic domestic cultural material was identified west of the Study Area boundary but no cultural material or resources were observed within the Study Area. In general, the Study Area was sloped with shallow, rocky soils and far from significant watercourses. Based on these observations, and a lack of evidence of historic activity, the Study Area is described as having low potential for precontact and historic period archaeological resources. There were no recommendations for further mitigation.

The 2020 report is provided in Appendix I. On April 29, 2021, the Nova Scotia Communities, Culture and Heritage (NSCCH), provided CRM Group with a letter indicating NSCCH staff agree with the recommendations and finds the ARIA report acceptable as submitted.

6 ENGAGEMENT SUMMARY

In support of this EARD, the Project Team have engaged with the public, with various stakeholders and with the Mi'kmaq of Nova Scotia, since late 2021. Engagement efforts for the Project have focused on individual meetings, written correspondence (emails and letters), in person conversations, and a public information session.

6.1 Public Engagement

6.1.1 Public Information Session

Public information sessions allow Dexter to inform the general public about a proposed Project and allow interested members of the public the opportunity to view information and speak directly with Dexter representatives and the EA Project Team. This allows one-on-one discussions to answer questions and allow for deeper, more detailed questions to be answered.

MEL prepared a Project description letter and invitation to the public information session that was scheduled to be held at the existing quarry site on October 26, 2021. The letters included an introduction to the proposed Project, information relating to the EA process, information related to the public information session (date, time, location etc.) and included methods by which the public can contact Dexter to ask questions or voice concerns (Appendix O). On October 13, 2021, the Project description and invitation letter were distributed by MEL to 196 residential properties located within 2.5 km of the Study Area. Letters were distributed to residences along the following routes:

- Route 277 between Elmsdale Road bridge over Shubenacadie River (2.4 km west of Project) and Logan Road (2.5 km northeast of Project)
- Logan Road, Skyridge Drive, and Mitchell Logan Road (1.4 km NE of the Project)
- Iseley Lane (1.3 km NE of the Project)
- Bomont Drive and Hillcrest Street (1.5 km west of Project)
- Old Trunk Road to the bridge over Shubenacadie River (1.3 km NW of Project)

During the distribution of these letters, MEL employees had conversations with two homeowners on Dutch Settlement Road and one on Logan Court. Two of the members of the public stated that they either had no concerns with the quarry expansion or supported the Project. The third member of the public voiced concerns regarding rocks on Dutch Settlement Road from haul trucks which can cause tire punctures (Table 6-1).

The Project description letter and invitation to attend the information session was also distributed via email to MLA John MacDonald (Hants East), Councilor Norval Mitchell (Municipality of East Hants, District 2), and Warden Eleanor Roulston (Municipality of East Hants). The letter and invitation to attend the information session was also distributed to the NSECC EA Branch (Renata Mageste da Silva and Rachel Bower).

A public information session for the Project was held on Tuesday, October 26, 2021, at Dexter Construction's Lantz Quarry, 48 Dutch Settlement Road, Lantz Nova Scotia. The information session involved information boards and displays showing the location of the proposed Project in relation to nearby communities, a Project description, reclamation, and details about each Valued Environmental Component (VEC) listed below:

- Noise;
- Air Quality;
- Topography, Surficial, and Bedrock Geology;
- Groundwater;
- Surface Water, Fish and Fish Habitat;
- Wetlands;
- Habitat, Flora and Lichens;
- Avifauna;
- Wildlife and Species at Risk;
- Cultural and Heritage Resources; and
- Socio-economic Conditions.

Information from the poster boards displayed during the information session is presented in Appendix O.

The public information session was attended by 11 members of the public. One attendee, who resides along Dutch Settlement Road, provided feedback via a comment card which stated "no complaints" (Appendix O). Refer to Table 6-1 for a summary of all issues/concerns raised during communications between members of the public and the Project team at the public information session.

6.1.2 Additional Public Engagement

MLA John MacDonald and Councilor Norval Mitchell met Dexter Representative Gavin Isenor at the quarry site on October 15, 2021. Mr. Isenor provided Mr. MacDonald and Councilor Mitchell an overview of the quarrying process, life of the quarry, required monitoring, and the EA/IA process. Both Mr. MacDonald and Councilor Mitchell were aware of the quarry and did not have any immediate feedback from their constituents. Mr. MacDonald indicated he would give the Project description letter and invitation to the open house to MLA Larry Harrison.

Dexter Representative Rhett Thompson spoke to a member of the public over the phone on October 19, 2021. The member of the public was concerned about potential blasting impacts to his foundation and well and referenced a blast the previous week. Mr. Thompson confirmed that no blasting events have occurred at the existing Lantz Quarry in 2021 and the blast was likely from an unrelated Project. Mr. Thompson informed the member of the public of the pre-blast survey and blast monitoring process, and future groundwater monitoring program.

6.1.3 Public Engagement - Summary of Issues

The following table provides a summary of all issues raised during public engagement related to the Project. For each key issue identified, a summary of the Project team's response is provided along with references to sections within the EARD which more fully address the issue.

Table 6-1. Summary of Issues Raised During Public Engagement

Key Issue	Summary of Proponent Response	Primary EARD Reference
Concern regarding rocks on Dutch Settlement Road for Haul Trucks causing tire punctures.	All trucks will use tarpaulins to cover loads and minimize dust. Dexter has paved the initial ~75 m of the quarry access road immediately off Dutch Settlement Road. This portion was paved to reduce the potential generation of dust in proximity to residences along Dutch Settlement Road and reduce the potential for gravel to accumulate on Dutch Settlement Road.	2.7.10
Concern about potential impacts to house foundation and well from blasting	Pre-blast surveys will be conducted and all blasts will be monitored by a qualified blasting company to ensure compliance with the Pit and Quarry guidelines and approval terms and conditions. Groundwater monitoring program to be established upon Project approval.	2.7.2.2
Public notification of blasting events	Dexter is not proposing to distribute notifications related to blasting events at this time.	NA
Potential impacts to groundwater and drilled well water	Pre-blast surveys will be conducted and all blasts will be monitored by a qualified blasting company to ensure compliance with the Pit and Quarry guidelines and approval terms and conditions. Groundwater monitoring program to be established upon Project approval.	2.7.2.2 & 7.2.4
Concern regarding the road quality of Highway 277	No increase in traffic volumes from baseline conditions are expected. Traffic is dependent on the local contracts that are of benefit to the community.	2.7.2.5 & 2.7.3.4
Inquiry about the status of the bridge on Highway 277	This individual was directed towards the Councillor for more information on this bridge as it is unrelated to	NA

Key Issue	Summary of Proponent Response	Primary EARD Reference
	the Project.	
Concern about truck traffic	Truck traffic is not anticipated to increase from current rates. Quarry expansion will increase the life of the Project and truck traffic is dictated by projects awarded to Dexter and demand for aggregate material.	2.7.2.5
Inquiry about Dexter's plans to sell materials to local contractors	Dexter does not typically to sell materials to local contractors. Aggregate material produced from the Project will be used by Dexter on projects they are awarded.	NA

6.1.4 Ongoing Public Engagement

Dexter intends to continue to engage with the public and will continue to address and respond to additional stakeholders identified or issues noted as they move forward throughout the life of the Project.

6.2 Mi'kmaq Engagement

Early engagement was initiated through provision of the Project description and an invitation to discuss the Project. On May 25, 2021, 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:

- Sipekne'katik First Nation;
- Millbrook First Nation;
- KMKNO; and
- Native Council of Nova Scotia.

An invitation to meet to discuss the Project and an invitation to the public information session (scheduled to be held on October 26, 2021), was sent via email on October 12, 2021, to the First Nation communities/organizations listed above. To the Project team's knowledge, no First Nation community members or representatives attended the information session.

On January 28, 2022, the Project team provided a presentation on the Project to Shawn Taylor (KMKNO). The presentation included a Project update, timeline for registration, field findings, public engagement, as well as Mi'kmaq engagement to date and plans for future engagement. This engagement resulted in constructive dialogue relating to the Project and its potential impact on the surrounding environment and the Mi'kmaq of Nova Scotia.

A Project update letter and invitation to meet was sent via mail and email on March 15, 2022, to the same four First Nation communities/organizations originally engaged.

August 24, 2022, an email was sent to the four First Nation communities/organizations indicating that Dexter is planning on registering the EARD in the fall of 2022. Another offer to meet to discuss potential concerns with the Project was extended.

In summary, Project related meetings were held between the Project team and the KMKNO. Please refer to Table 6-2 for a complete First Nations engagement log of communications and Table 6-3 for a summary of issues raised during First Nations engagement.

6.2.1 Office of L'nu Affairs

On June 16, 2021, the Project team met via video conference with Gillian Fielding (Office of L'nu Affairs [OLA]) among other regulators. In this meeting an introduction to the Project was provided which included a review of the Project location, typical quarry operations, the Projects Study Area, a scope of the proposed Project expansion, site sensitivities, Valued Environmental Components, surveys, Archaeology, and Mi'kmaq and Community Engagement. A copy of the presentation was provided to all attendees.

On January 19, 2022, the Project team provided a presentation to the OLA which included a Project update, timeline for registration, field findings, public engagement, as well as Mi'kmaq engagement to date and plans for future engagement. During this meeting, Gillian Fielding (OLA) recommended that the Project team distribute hard copies of the Project update letter to Mi'kmaq communities via mail.

A site visit to the existing Lantz Quarry on August 10, 2022, was attended by Janel Hayward (NSDNRR) and Salima Medouar (OLA). The site visit was completed to show regulators that will be reviewing the EARD the Project lands, discuss the quarrying process and EA findings to date. During this visit, the Project team discussed the Mi'kmaq engagement completed to date and informed OLA and NSDNRR that meetings have occurred with the KMKNO.

6.2.2 Mi'kmaq Engagement Communication Log

Refer to the following table for the First Nations engagement communication log.

Table 6-2. First Nations Engagement Communication Log

Community or Organization	Individual	Method	Date	Details
KMKNO	Twila Gaudet	Email	May 25, 2021	Early engagement letter notifying the KMKNO of the Project, including Project overview, location map, anticipated timeline, and an offer to meet to discuss the Project.
		Email	October 12, 2021	Follow up to early engagement letter and invitation to Information Session. Invite to meet and discuss the Project.
	Shawn Taylor	Phone	January 21, 2022	Left voicemail with Mr. Taylor requesting a call to discuss the Project.
	Shawn Taylor and Twila Gaudet	Email	January 21, 2022	Follow up to voicemail. Offer to meet to discuss the Project, First Nations engagement to date, and plans for future engagement.
	Shawn Taylor, Twila Gaudet and Patrick Butler	Email	January 24, 2022	KMKNO requested to meet and discuss the Project on January 28, 2022.
	Shawn Taylor	Video Conference	January 28, 2022	Presentation provided on Project update, registration timing, field findings, public engagement, First Nations engagement to date and plans for future engagement. KMKNO stated that they do not have any concerns regarding the Project.
		Email	January 28, 2022	Provided a copy of the slide deck presentation to the KMKNO.
	Twila Gaudet	Mail	March 15, 2022	Hard copy of the Project update letter sent via mail.
		Email	March 15, 2022	Project update letter sent via email.
	Shawn Taylor and Twila Gaudet	Email	August 24, 2022	Informed the KMKNO that the Project is planned for EA registration in September/October. Extended another offer to meet to discuss the Project.
Millbrook First Nation	Chief Gloade, Shelly Martin, Gerald Gloade	Email	May 25, 2021	Early engagement letter notifying Millbrook First Nation of the Project, including Project overview, location map, anticipated timeline, and an offer to meet to discuss the Project.
		Email	October 12, 2021	Follow up to early engagement letter and invitation to Information Session. Invite to meet and discuss the Project.
	Chief Gloade	Mail	March 15, 2022	Hard copy of Project update letter sent via mail.
	Chief Gloade,	Email	March 15, 2022	Project update letter sent via email.

Community or Organization	Individual	Method	Date	Details
	Shelly Martin, Gerald Gloade	Email	August 24, 2022	Informed the community that the Project is planned for EA registration in September/October. Extended another offer to meet to discuss the Project.
Sipekne'katik First Nation	Chief Sack, S. Francis, J. Michael	Email	May 25, 2021	Early engagement letter notifying Sipekne'katik First Nation of the Project, including Project overview, location map, anticipated timeline, and an offer to meet to discuss the Project.
		Email	October 12, 2021	Follow up to early engagement letter and invitation to Information Session. Invite to meet and discuss the Project.
	Chief Sack	Mail	March 15, 2022	Hard copy of Project update letter sent via mail.
	Chief Sack, S. Francis, J. Michael	Email	March 15, 2022	Project update letter sent via email.
		Email	August 24, 2022	Informed the community that the Project is planned for EA registration in September/October. Extended another offer to meet to discuss the Project.
Native Council of Nova Scotia	Chief Lorraine Augustine	Email	May 25, 2021	Early engagement letter notifying the Native Council of Nova Scotia of the Project, including Project overview, location map, anticipated timeline, and an offer to meet to discuss the Project.
		Email	October 12, 2021	Follow up to early engagement letter and invitation to Information Session. Invite to meet and discuss the Project.
		Mail	March 15, 2022	Hard copy of Project update letter sent via mail.
		Email	March 15, 2022	Project update letter sent via email.
		Email	August 24, 2022	Informed the Native Council of Nova Scotia that the Project is planned for EA registration in September/October. Extended another offer to meet to discuss the Project.
Office of L'nu Affairs	Gillian Fielding	Email	May 25, 2021	Early engagement letter notifying the Office of L'nu Affairs of the Project, including Project overview, location map, anticipated timeline, and an offer to meet to discuss the Project.
		Video conference	June 16, 2021	Presentation provided on the Project. Presentation included quarry location, typical quarry operations, EA Study Area, scope of proposed expansion, site sensitivities, VECs, biophysical survey program, Archaeology, Mi'kmaq and Community Engagement. Copy of presentation provided. No questions or concerns brought forward by OLA.

Community or Organization	Individual	Method	Date	Details
		Email	October 12, 2021	Follow up on previous conversations and offer to meet for a second time extended.
		Email	January 5, 2022	Request meeting to provide update on Project and First Nations engagement.
	Gillian Fielding and Salima Medouar	Video conference	January 19, 2022	Presentation provided on Project update, registration timing, field findings, public engagement, First Nations engagement to date and plans for future engagement. OLA recommended mailing hardcopies of documents to First Nation communities as part of early engagement.
		Email	January 21, 2022	Copy of slide deck presented during January 19, 2022, meeting sent to OLA.
	Salima Medouar	Email	March 14, 2022	Provided the OLA with a copy of the Project update letter that will be sent to the KMKNO, Millbrook First Nation, Sipekne'katik First Nation, and the Native Council of Nova Scotia.
		In Person	August 10, 2022	Site visit at existing Lantz Quarry to see the Project lands, discuss the quarrying process and EA findings to date. OLA indicated that just because no communities have responded does not mean they do not have any concerns regarding the Project.
		Email	August 24, 2022	Informed OLA of registration timing and recent outreach to communities/KMKNO related to the Project.
NSDNRR	Janel Hayward	Email	January 5, 2022	Request meeting to provide introduction to the Project and update on First Nations engagement to date. Janel Hayward indicated that NSDNRR Aboriginal Consultation and Engagement office is not required for quarry related projects.
		In Person	August 10, 2022	Site visit at existing Lantz Quarry to see the Project lands, discuss the quarrying process and EA findings to date.
		Email	August 24, 2022.	Informed OLA of registration timing and recent outreach to communities/KMKNO related to the Project.

6.2.3 Mi'kmaq Engagement – Summary of Issues

The following table outlines the issues brought to the Project teams' attention during Mi'kmaq engagement.

Table 6-3. Summary of Issues Raised During Mi'kmaq Engagement

Key Issue	Summary of Proponent Response	Primary EA Reference
No issues have been brought to the attention of the Project team from Mi'kmaq engagement.	Dexter is committed to maintaining open lines of communication with interested Mi'kmaq communities through the life of the Project.	Section 6.2.4

6.2.4 Ongoing Mi'kmaq Engagement

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

7 DISCUSSION OF IMPACTS

7.1 Valued Environmental Component (VEC) Selection

The scope, methods, and baseline environmental conditions for the Project have been described in detail in Sections 3 through 5 in this EARD. Each potential VEC, as identified and defined in the NSECC *Guide to Preparing an Environmental Assessment Registration Document for Pit and Quarry Developments in Nova Scotia*, revised September 2009, has been described and baseline environmental work has been completed to evaluate each VEC based on the site-specific conditions relating to the Project.

Based on the environmental baseline work completed for each VEC over the course of a four-season survey period, and the expertise of the various members of the EA Project Team, an evaluation has been completed to determine the significance of residual effects for each VEC from Project activities once planned mitigation has been completed. Potential effects, mitigation, monitoring, and residual effect for each VEC is provided in Section 7.2.

The thresholds for determination of significant of adverse residual environmental effects for each VEC are defined in Table 7-1. Where they apply, regulatory guidelines and limits associated with anticipated IA approval requirements have been used as the threshold. Where anticipated IA guidelines or limits are not applicable to the VEC being addressed, appropriate thresholds have been identified based on quantifiable environmental standards wherever possible, and professional opinion of the Project Team.

Table 7-1. VECs Threshold for Determination of Significance

<table>
<tr><th>Valued Environmental Components (VECs)</th><th colspan="3">Threshold for Determination of Significance</th></tr>
<tr><td rowspan="6">Noise</td><td colspan="3">A significant adverse effect from the Project includes an exceedance of the maximum allowable noise limits as described under the Guidelines for Environmental Noise Measurement and Assessment (NSEDL, 2005) and the Pit and Quarry Guidelines (NSEDL, 1999) that remains after mitigation is put into place as indicated below:</td></tr>
<tr><td>Spatial Boundary</td><td>Temporal Boundary</td><td>Leq Threshold (dBA)</td></tr>
<tr><td>Property Boundary</td><td>Daytime (0700 to 1900)</td><td>65</td></tr>
<tr><td>Property Boundary</td><td>Evening (1900 to 2300)</td><td>60</td></tr>
<tr><td>Property Boundary</td><td>Nighttime (2300 to 0700) and
All day Sunday and statutory holidays</td><td>55</td></tr>
<tr><td>7 m from the nearest structure not located in the property boundary</td><td>During blasting events</td><td>128</td></tr>
<tr><td>Air Quality</td><td colspan="3">A significant adverse effect from the Project includes an exceedance of the standard parameters defined by NSECC in IAs for quarry projects in Nova Scotia at the Project property boundary after mitigations are put into place. Standard parameters include:
Particulate emissions shall not exceed the following limits at or beyond the Site property boundaries: Annual Geometric Mean 70 µg/m3 Daily Average (24 hr.) 120 µg/m3.</td></tr>
<tr><td>Topography, Surficial Geology and Bedrock Geology</td><td colspan="3">A significant adverse effect from the Project includes an unmitigated change in topography, where reclamation efforts are not completed.

The processing of aggregate and disturbance to surficial geology can impact water quality (i.e., total suspended solids [TSS], metals, ARD, and sediments). Refer to the threshold for determination of significance for surface water.</td></tr>
<tr><td>Groundwater</td><td colspan="3">GROUNDWATER QUALITY
A significant adverse effect from the Project includes a change (as defined below) in the groundwater quality due to the Project activity.

As demonstrated by a proven pathway from the Project and two or more exceedances of the following parameters at the nearest receptors to the QEA, compared to guidelines and/or confirmed baseline conditions:

• Standard water quality variables and trace metals as determined by the RCAp MS water sample analysis method.
• Benzene, Toluene, Ethylbenzene and Xylene (BTEX) as well as Total Petroleum Hydrocarbons (TPH).</td></tr>
</table>

Valued Environmental Components (VECs)	Threshold for Determination of Significance
	GROUNDWATER QUANTITY A significant adverse effect from the Project includes a change in the groundwater quantity such that it has a negative effect on a groundwater receptor such as drinking water wells after mitigation has been put into place. A negative effect has been defined as a reduction in water yield of >20%.
Surface Water	WATER QUALITY A significant adverse effect from the Project includes regular exceedance (i.e. more than two per year) of the standard parameters defined by NSECC in the IA after mitigation has been put into place as indicated below: *<u>Total Suspended Solids</u>* *Clear Flows (Normal Background Conditions):* *1) Maximum increase of 25 mg/l from background levels for any short term exposure (24 hour or less)* *2) Maximum average increase of 5 mg/l from background levels for longer term exposure (inputs lasting between 24 hours and 30 days)* *High Flow (Spring Freshets and Storm Events):* *1) Maximum increase of 25 mg/l from background levels at any time when background levels are between 25 mg/l and 250 mg/l* *2) Shall not increase more than 10% over background levels when background is > 250 mg/l* *<u>pH</u>* *1) Maximum 5 to 9 in grab sample* *2) Maximum 6 to 9 as a Monthly Arithmetic Mean*
	WATER QUANTITY Predicted surface water discharge flows that are beyond the existing natural variability in the studied watersheds were considered at greater risk for changes to the physical properties of the waterways, primarily through changes in the potential for erosion, sedimentation or water feature morphological changes. Additionally, the changes to the quantity of surface water can affect the corresponding aquatic habitat and water quality. A significant adverse effect from the Project on surface water quantity is defined as an effect that results from unmitigated and irreversible hydrological and geomorphological changes to watercourses resulting in an unmitigated loss of fish habitat.
Fish and Fish Habitat	A significant adverse effect from the Project to fish is an effect that is likely to cause harmful alteration, disruption, or destruction of fish habitat (HADD) or the death of fish, as defined by the *Fisheries Act* after mitigation has been put into place without consideration of appropriate offsetting measures.

Valued Environmental Components (VECs)	Threshold for Determination of Significance
Wetlands	A significant adverse effect from the Project on wetland habitat is defined 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 policy.
Habitat, Vascular Plants and Lichens	A significant adverse effect from the Project includes an effect that is likely to cause a permanent, unmitigated, alteration to habitat that supports flora/lichen species distribution, where similar habitat is not currently available at the local/regional level.
Fauna (Herpetofauna Species and Mammals)	A significant adverse effect from the Project includes an effect that is likely to cause a permanent, unmitigated, alteration to habitat that supports fauna species distribution.
Birds (Avifauna)	A significant adverse effect from the Project includes an effect that is likely to cause a permanent, unmitigated, alteration to habitat that supports avian species distribution.
Priority Species	A significant adverse effect from the Project includes an effect that is likely to cause a permanent, unmitigated, alteration to habitat that supports a priority species' distribution, or alteration of core habitat[1]. Sedentary species such as flora and lichens do not have the opportunity to move to avoid direct or indirect impact. For these species, the loss of an individual or individuals of a SAR that is important in the context of the province, or that species' overall abundance or distribution, may be considered significant, if appropriate mitigation measures are not implemented.
Socioeconomic	A significant adverse effect from the Project includes the permanent loss of lands and resources used by other industry sectors or community users and/or long term adverse health or safety conditions for relevant communities.
Archaeological and Heritage Resources	A significant adverse effect from the Project includes any disturbance to or destruction of any archaeological or heritage resource of importance in context of the *Special Places Act* after mitigation has been put into place.
[1] Core habitat is defined as "*specific areas of habitat essential for the long-term survival and recovery of endangered or threatened species*" (Government of Nova Scotia, 1998).	

7.2 Effects Assessment

The detailed effects assessment involves the following steps:

1. Identification of potential Project interactions on selected VEC;

2. Identification of potential effects;
3. Description of recommended mitigation and monitoring;
4. Identification of expected residual effects (post mitigation); and,
5. Identification of the significance of residual effects.

Results of the detailed effects assessment process listed above is presented for each identified VEC where residual effects are expected in the following sections.

7.2.1 Noise

Table 7-2 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC Noise. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Reclamation, and also Accidents, Malfunctions, and Unplanned Events). The discussion following the table provides an analysis of key Project-VEC interactions. Interaction and potential effects to noise levels as a result of quarrying on residential receptors surrounding the QEA have been analysed as part of the review.

Table 7-2. Project- VEC Interactions by Project Phase on Noise

Project Activities and Physical Works	Potential Project Interactions with Noise Levels[1]
Construction	
Site preparation/clearing	Y
Grubbing	Y
Watercourse/wetland alteration	Y
Waste management	Y
Storage areas for grubbings and overburden soils	Y
Operation and Maintenance	
Rock blasting	Y
Handling and stockpiling material	Y
Crushing and screening	Y
Management of surface water	N
Trucking/transport of product	Y
Reclamation	
Re-grading of rock face	Y
Reclamation/re-vegetation	Y
Accidents, Malfunctions and Unplanned Events	
Erosion and sediment control failure	N
Fuel spill from machinery/trucks	Y
Fire	N
[1]Y - interaction / N - no interaction	

As outlined above, noise can be created as a result of multiple quarry activities. The use of heavy equipment, hauling of material by trucks, quarry processing equipment and disposal of quarry rock are examples of activities that result in noise. Blasting using 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).

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 at the property boundaries of the Project. The existing quarry has been in operation for 15 years with monitoring of all blasting activities and no incidents of exceedance. The proposed activities are a continuation of current operations and will not increase in magnitude or frequency. Quarry expansion is also proposed to advance southeast and away from the nearest residential receptors.

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. Additional details related to effects of noise on wildlife is provided in Section 7.2.9.

Forested lands separating local residences and the QEA are expected to aid in muffling noise being produced. Additionally, the quarry expansion is proposed to occur to the south and away from the nearest residential receptors. The Project will not be active continuously throughout its 40-year life and activities will be confined to certain time periods dependant on Dexter being awarded projects and local demand for aggregate.

7.2.1.1 *Mitigation*

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 Saturdays, Sundays or holidays;
- The quarry is advancing southeast and away from the nearest residential receptors;
- Sound barriers such as the quarry highwall, overburden and aggregate stockpiles, and vegetative buffer may be strategically used to mitigate the travel of operational noise to nearby receptors;
- 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;
- A Project Contingency Plan will be developed and will include site specific measures to reduce and mitigate noise levels during operations if and as required, in consideration of on-going engagement with closest residents to understand their concerns.

7.2.1.2 *Monitoring*

- All blasts will be monitored by a qualified blasting professional at the nearest off-site structure.

- Noise levels will be monitored in accordance with NSECC IA Conditions.

7.2.1.3 *Residual Effects and Significance*

Residual environmental effects of the Project related to noise production are likely (i.e., audible blasting at residential receptors, site crushing, or truck traffic leaving the quarry site) but there is no expected increase in noise from baseline conditions. No residential receptors were identified within 800 m of the QEA and there have been no known exceedances of blasting parameters at the existing quarry, therefore, Project generated noise from blasting is not expected to be transmitted at a significant degree to adjacent receptors. Proposed Project activities are in line with the current magnitude of operations and no increased frequency of activities is anticipated nor any change in timing expected. The Project will increase the duration of noise being generated as the operations period is proposed to be 40 years. All noise is temporary and will return to baseline conditions seasonally (i.e., when no active quarrying is occurring) and post-reclamation. After mitigation measures have been implemented and the *Pit and Quarry Guidelines* (NSEDL, 1999) adhered to, the predicted residual environmental effects are assessed to be not significant.

7.2.2 Air Quality

Table 7-3 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC on Air Quality. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Reclamation, and also Accidents, Malfunctions, and Unplanned Events). The discussion following the table provides an analysis of key Project-VEC interactions. Interaction and potential effects to air quality levels as a result of quarrying on residential receptors surrounding the QEA have been analysed as part of the review.

Table 7-3. Project- VEC Interactions by Project Phase on Air Quality

Project Activities and Physical Works	Potential Project Interactions with Air Quality Levels[1]
Construction	
Site preparation/clearing	Y
Grubbing	Y
Watercourse/wetland alteration	Y
Waste management	Y
Storage areas for grubbings and overburden soils	Y
Operation and Maintenance	
Rock blasting	Y
Handling and stockpiling material	Y
Crushing and screening	Y
Management of surface water	N
Trucking/transport of product	Y
Reclamation	
Re-grading of rock face	Y

Project Activities and Physical Works	Potential Project Interactions with Air Quality Levels[1]
Reclamation/re-vegetation	Y
Accidents, Malfunctions and Unplanned Events	
Erosion and sediment control failure	N
Fuel spill from machinery/trucks	N
Fire	Y
[1]Y - interaction / N - no interaction	

Quarrying has the potential to have an effect to air quality by changing particulate levels. Dust and particulate levels (known as Total Particulate Suspended Matter), can be emitted from quarrying activities such as blasting, crushing, stockpiling material and travel of trucks on unpaved roads. An increase in particulate levels can act as a cause of nuisance to local residents or people in proximity to the quarry.

For the purposes of this effects assessment, potential effects to air quality are compared to the regulatory requirements set out in the *Pit and Quarry Guidelines* (NSEDL, 1999), which regulates particulate levels at the property boundaries of the Project. To date, Dexter has not received any concerns from the public in relation to air quality from the proposed quarry expansion.

7.2.2.1 *Mitigation*

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 will be used to reduce the re-suspension of dust during crushing activities, or on unpaved roads and work areas.
    - Water will be sourced from the quarry site (settling pond) or imported via a water truck.
- Portable crushing spreads have been retrofitted with a water spray system to reduce the generation of dust during crushing activities.
- Consideration will be given to strategically placing overburden and aggregate stockpiles to act as wind barriers for crushing activities.
- Appropriate truck loading and hauling procedures will be followed to reduce the generation of dust during trucking activities.
    - Trucks will use tarpaulins to cover loads and minimize dust.
    - Trucks will abide by posted speed limits.
- When not in use, machinery and light vehicles will not be left to idle so as to reduce emissions.
- All vehicles and machinery will be maintained in proper working order to reduce emissions generated from worn parts.
- Dexter has paved the initial 75 m of access road to the quarry to reduce dust and limit impacts on air quality to receptors along Dutch Settlement Road.

- A Project Contingency Plan will be developed and will include site specific measures to reduce and mitigate dust levels during operations, in consideration of on-going engagement with closest residents to understand their concerns.

7.2.2.2 *Monitoring*

- Dust emission and particulate matter will be monitored at the property boundary of the quarry at the request of NSECC as per IA regulations.

7.2.2.3 *Residual Effects and Significance*

Residual environmental effects of the Project related to air quality are likely as Project activities have the potential to contribute to climate change, increase air pollutant levels, and generate dust.

Dust and exhaust emissions will be generated during the construction, operation and maintenance, and reclamation phases of the Project. The activities that generate dust and exhaust emissions occur sporadically and are temporary.

Activities such as blasting and rock transfer are restricted to the QEA. Hauling will occur outside of the QEA and generation of dust on unpaved access road in this section may occur. Dexter will ensure that haul trucks use tarpaulins to cover loads and minimize dust and that speed limit signage is installed at the quarry, and that an open line of communication with residents is maintained so that public concerns can be considered.

Quarry expansion is not expected to decrease air quality compared to baseline conditions, as the existing quarry has been in operation for 15 years 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 inactive periods and post-reclamation. Should dust be generated from quarry operations within the property, standard mitigation (discussed above) can be applied to ensure compliance with potential IA conditions. No adverse effects to human health from changes in air quality are anticipated from the Project and the predicted residual environmental effects are assessed to be not significant.

7.2.3 Surficial Geology, Bedrock Geology, and Topography

Table 7-4 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC on Surficial and Bedrock Geology and Topography. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Reclamation, and also Accidents, Malfunctions, and Unplanned Events). The discussion following the table provides an analysis of key Project-VEC interactions. Interaction and potential effects to Surficial and Bedrock Geology and Topography have been analysed as part of the review.

Table 7-4. Project- VEC Interactions by Project Phase on Surficial and Bedrock Geology and Topography

Project Activities and Physical Works	Potential Project Interactions with Surficial and Bedrock Geology and Topography[1]
Construction	
Site preparation/clearing	Y
Grubbing	Y
Watercourse/wetland alteration	Y
Waste management	N
Storage areas for grubbings and overburden soils	Y
Operation and Maintenance	
Rock blasting	Y
Handling and stockpiling material	N
Crushing and screening	N
Management of surface water	N
Trucking/transport of product	N
Reclamation	
Re-grading of rock face	Y
Reclamation/re-vegetation	Y
Accidents, Malfunctions and Unplanned Events	
Erosion and sediment control failure	N
Fuel spill from machinery/trucks	Y
Fire	N
[1]Y - interaction / N - no interaction	

Quarrying has the potential to have an effect on the following surficial and bedrock geology and topography variables:

- Soil Destabilization: Clearing and disturbance of lands has the potential to cause soil erosion. Refer to Section 7.2.4.
- 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 also a possibility in areas which comprise rock containing high levels of iron-sulphides. As discussed in Section 5.2.3.1, the potential for ARD at the Project is considered low.
- Topography: Topography (land elevations) will be altered by quarry expansion.

Potential impacts to receiving surface water systems (e.g., watercourses and wetlands) are possible from ground disturbances (i.e., effects to surficial and bedrock geology and topography) associated with quarry expansion. Ground disturbances may cause an increase in sediment loads that can degrade water quality conditions. These effects have been evaluated in Section 7.2.4.

Project development will alter site topography as material is extracted. The topography within the QEA will continue to be altered throughout the life of the Project (estimated to be 40 years). The Project is located in a rural setting and the QEA is located approximately 880 m south of Dutch Settlement Road. Based on a review of local topography and site visits it is not expected that the QEA will be visible from Dutch Settlement Road or other areas of higher elevation. Forested land surrounding the QEA will remain intact throughout its development and is expected to block sight lines to proposed disturbance areas.

As described in the following section, progressive reclamation will be employed to stabilize and revegetate slopes and exposed surfaces.

7.2.3.1 *Mitigation*

The following mitigation measures will be included in the design of the Project to minimize effects to this VEC and resulting potential effects to surface water:

- Construction of sediment control measures (e.g., engineered settling ponds, sediment fencing) and erosion control (e.g., mulching/revegetation) will be implemented, where appropriate.
- Topsoil and organic soil material removed during construction will be saved and used during reclamation in order to restore 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, where possible, as the quarry expands to stabilize and revegetate side slopes and exposed surfaces.
- A Project Contingency Plan will be developed and will include site specific measures to prevent sedimentation and erosion and respond to spills.

7.2.3.2 *Monitoring*

Monitoring will be implemented as described in Section 7.2.4.

7.2.3.3 *Residual Effects and Significance*

Dexter will be required to meet future IA requirements associated with reclamation commitments ensuring that changes to topography and surficial characteristics are mitigated through remediation to a safe, stable, vegetated landscape. No residual adverse effect on site topography is anticipated.

Predicted residual environmental effects from soil destabilization and rock mineralization are assessed in Section 7.2.5.5.

7.2.4 Groundwater

Table 7-5 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC interactions with groundwater. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Reclamation, and also Accidents, Malfunctions, and Unplanned Events). The discussion following the table provides an analysis of key Project-VEC interactions. Interaction and potential effects to groundwater as a result of quarrying on potable wells surrounding the QEA have been analysed as part of the review.

Table 7-5. Project- VEC Interactions by Project Phase on Groundwater

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect[1]	
	Interaction with Localized Groundwater	Adjacent Potable Water Resources
Construction		
Site preparation/clearing	Y	N
Grubbing	Y	N
Watercourse/wetland alteration	Y	N
Waste management	N	N
Storage areas for grubbings and overburden soils	N	N
Operation and Maintenance		
Rock blasting	Y	Y
Handling and stockpiling material	N	N
Crushing and screening	N	N
Management of surface water	Y	N
Trucking/transport of product	N	N
Reclamation		
Re-grading of rock face	N	N
Reclamation/re-vegetation	Y	N
Accidents, Malfunctions and Unplanned Events		
Erosion and sediment control failure	N	N
Fuel spill from machinery/trucks	Y	Y
Fire	N	N
[1]Y - interaction / N - no interaction		

Groundwater impacts as a result of quarrying can be variable and depend on conditions such as underlying geological conditions, natural groundwater characteristics and the quarrying activities taking place. These interactions are based upon a potential change in groundwater quantity and quality from baseline conditions as outlined below.

7.2.4.1 *Quantity*

Recharge Capacity: Changes to the natural surface conditions within the QEA have the potential to alter groundwater recharge and could cause temporary lowering or rising of the water table relative to baseline conditions. Hardened surfaces (i.e., new roads, compacted surfaces) will likely reduce recharge, whereas clearing of vegetation and exposure to fractured bedrock on the quarry floor could increase local groundwater levels. The quarry floor will be permeable (blast rock) to allow surface water to infiltrate and recharge local groundwater. The type and integrity of the underlying bedrock will influence the infiltration rates (and subsequent recharge) that can be expected.

Changes in natural surface conditions are only expected within the QEA through the conversion of natural forest to a quarry floor. As discussed in Section 7.2.5, the WBA completed for the Project (Appendix E) suggests that some surface water collected within the quarry footprint will infiltrate into the bedrock through the permeable quarry floor. Water management infrastructure (e.g., ditches and settling ponds), will collect surface water from the quarry that does not infiltrate quickly.

Future reclamation of the Project could include removal of some of the surface water drainage features (i.e., ditches), and revegetation of the quarry surface will occur. It is possible that the infiltration characteristics at the surface will change post reclamation to allow for more groundwater recharge but ditching and settling ponds will remain to some degree. As such, localized groundwater levels are likely to resemble active quarry conditions on a permanent basis.

Discharge Capacity: Changes to the natural surface conditions within the QEA have the potential to alter groundwater discharge rates. The permeable quarry floor will allow for infiltration to occur, therefore, groundwater discharge to surrounding aquatic features is predicted to still occur. The QEA is relatively small (5.9 ha) in relation to the extent of surrounding lands that also provide groundwater discharge to adjacent aquatic features.

Groundwater Flow: Localized groundwater flow paths may be disrupted from quarry expansion. Quarry expansion may also cause an effect to shallow groundwater resources, which results in the local alteration of groundwater flow and direction. This could potentially lead to changes in groundwater interaction within adjacent wetlands.

Blasting: Blasting can increase bedrock fracture frequency and change the direction of groundwater interflow, potentially impacting flow to wells or surface water features. It is the intention of Dexter to not excavate or blast below the water table. If future quarry operations are planned to extend below the groundwater table, a hydrological study will be completed and an IA Amendment received from NSECC prior to excavation below the groundwater table Upon EA Approval, Dexter will develop and implement a groundwater monitoring program to determine groundwater elevations across the QEA and evaluate potential interaction with localized groundwater levels.

7.2.4.2 *Quality*

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. Processing of aggregate and rock at a quarry (notably crushing and exposure of rock to water and oxygen), can create dissolved solids and metals which could potentially make its way to water wells or surface water features. Refer to Section 7.2.5 for Project effects on surface water.

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). Overall groundwater recharge is expected to remain unchanged from existing conditions, but groundwater flow paths may be locally disrupted.

7.2.4.3 *Mitigation*

The following mitigation measures will be included in the design of the Project:

- The quarry floor will be sloped 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 the nearest residential structures during blasting events. Any damage that occurs to these structures because of blasting will be repaired at the expense of the Dexter.
- Blasting will only be undertaken by qualified blasting professionals.
- Potential effects to groundwater quality as a result of blasting will be reduced 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.
- No fuel will be stored on site.
    - Refueling will be completed by a third party
    - Refueling will occur in designated areas, >30 m from a watercourse
    - The operator will remain with the equipment during refueling
    - Spill response equipment will be readily available
- A Project Contingency Plan will be developed for the Project to outline the prevention and response methods regarding spills and/or substance loss.

7.2.4.4 *Monitoring*

- A groundwater monitoring program in line with NSECC standards will be implemented to assess the water table location and groundwater flow conditions for comparison to future conditions.
- As part of the groundwater monitoring program, Dexter will drill groudnwater wells between the QEA and nearby residential wells. Monitoring will be completed to ensure the quarry is not causing adverse effects to groundwater quantity and quality conditions (as a result of dissolved solids and metals or other deleterious substances).
- Refer to Section 7.2.7.4 for wetland monitoring, as groundwater drawdown may have a drying effect on wetlands adjacent the QEA.

7.2.4.5 *Residual Effects and Significance*

Due to the permeable quarry floor allowing infiltration, local groundwater quantity is not expected to be significantly impacted. It is also not expected that Project expansion will adversely affect the supply of water via groundwater discharge to surrounding aquatic features. Groundwater flow may be irreversibly altered from blasting, however, the effect is localized to the immediate quarry area and is not anticipated to effect groundwater flow in a regional area related to surrounding receptors.

Therefore, no significant residual environmental effects to groundwater quality and quantity anticipated.

Dexter will follow the Pit and Quarry Guidelines and conduct pre-blast surveys for all structures within 800 m. Dexter will drill groundwater wells and develop a groundwater monitor plan.

7.2.5 Surface Water

Table 7-6 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC interactions with surface water. Potential effects to surface water have been evaluated to the extent of the Aquatic Study Area, which includes the entire downstream extent of WC1 and one off-site watercourse, Keys Brook. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Reclamation as well as Accidents, Malfunctions, and Unplanned Events). Interaction and potential effects to water quantity and water quality as a result of quarry expansion are presented. The discussion following the table provides an analysis of key Project-VEC interactions.

Table 7-6. Project- VEC Interactions by Project Phase on Surface Water

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect[1]	
	Changes in Water Quality	Changes in Water Quantity
Construction		
Site preparation/clearing	Y	N
Grubbing	Y	N
Wetland alteration	Y	Y
Waste management	N	N
Storage areas for grubbings and overburden soils	Y	N
Operation and Maintenance		
Rock blasting	Y	Y
Handling and stockpiling material	N	N
Crushing and screening	N	N
Management of surface water	Y	Y
Trucking/transport of product	N	N
Reclamation		
Re-grading of rock face	Y	N
Reclamation/re-vegetation	Y	Y
Accidents, Malfunctions and Unplanned Events		
Erosion and sediment control failure	Y	N

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect[1]	
	Changes in Water Quality	Changes in Water Quantity
Fuel spill from machinery/trucks	Y	N
Fire	N	N
[1]Y - interaction / N - no interaction		

Potential surface water effects can be divided into direct impacts and indirect impacts. Indirect impacts can be further divided into two components (i) water quantity effects and (ii) water quality effects. These effects are discussed below. It should be noted that the Project interactions described relate to the physical effects that could occur to a surface water feature as a result of direct Project development and/or indirect changes in water quantity or water quality conditions. **Subsequent effects to fish and fish habitat as a result of indirect effects to surface water features are discussed separately in Section 7.2.6.**

7.2.5.1 *Direct Effects*

No direct alteration to surface water features is expected as a result of the Project. A 30 m buffer will be maintained around WC1 identified within the Aquatic Study Area during quarry expansion. An evaluation of potential water quantity and quality effects to this watercourse as a result of indirect impacts to surface water features is provided in Section 7.2.5.2.

7.2.5.2 *Indirect Effects*

Indirect effects associated with quarry development include changes to surface water quantity and quality to downstream aquatic receivers, as discussed below.

7.2.5.2.1 Water Quantity

Based on the methods and results discussed in Section 5.4.2 and in the Water Balance Assessment Report (WBA; Appendix E), the following sections outline and evaluate the predicted changes in water quantity within each aquatic receiving feature from the Lantz QEA.

7.2.5.2.1.1 *Contributing Drainage Area Assessment*

Changes in contributing drainage areas were assessed for the three quarry expansion phases (Phases 1-3) and the reclamation phase, which were compared to existing conditions. Reclamation is included with Phase 3 because the contributing drainage area under reclamation conditions is expected to remain unchanged from the Phase 3 contributing drainage area. Six Points of Interest (POIs) were established within WC1 (WC-1A, WC-1B, WC-1C, and WC-1D) and Keys Brook (Keys Brook-DS and Keys Brook-US; refer to Appendix E for figures). The results of the contributing drainage area assessment are presented in Table 7-7.

Table 7-7. Contributing Drainage Area Assessment

Point of Interest (POI)	Existing Area (ha)	Phase 1 Area (ha)	Phase 2 Area (ha)	Phase 3 + Reclamation Area (ha)	Phase 1 Difference	Phase 2 Difference	Phase 3 + Reclamation Difference
WC-1A	39	38.4	38.3	38.3	-1.60%	-1.81%	-1.81%
WC-1B	39.4	39.7	39.7	39.7	0.78%	0.57%	0.57%
WC-1C	43.1	42.4	42.3	42.3	-1.47%	-1.66%	-1.66%
WC-1D	49.9	51.1	52.8	55.3	2.45%	5.85%	10.71%
Keys Brook-DS	1,759	1,758	1,756	1,754	-0.04%	-0.13%	-0.27%
Keys Brook-US	1,819	1,819	1,819	1,819	0.00%	0.00%	0.00%

Five POIs (WC-1A, WC-1B, WC-1C, Keys Brook-DS and Keys Brook-US) experience minimal changes to contributing drainage area through quarry expansion (-1.81 to 0.57%). WC-1D experiences an increase in drainage area of 10.71% from baseline through quarry expansion. Based on this increase, POI WC-1D was selected to require additional hydrologic modelling to evaluate potential indirect impacts to surface water due to quarry expansion. POI WC-1C was also selected for additional modelling despite minimal change in total catchment area due to the potential for changes in land use within the contributing drainage area itself.

The results of additional hydrologic modelling for WC-1C and WC-1D are discussed in Section 7.2.5.2.1.2. All other POIs are predicted to see minimal impacts due to quarry expansion; therefore, no further modelling was completed for these POIs.

7.2.5.2.1.2 *Hydrologic Water Balance Model*

The following subsections outline the results of the WBA on the POIs that were carried forward from the contributing drainage area assessment: WC-1C and WC-1D. Refer to the attachment in the WBA (Appendix E) for a breakdown of predicted monthly runoff volumes.

7.2.5.2.1.2.1 WC-1C

Table 7-8 presents a summary of the predicted annual runoff volumes, average annual change in runoff and maximum average monthly change in runoff at WC-1C through each quarry expansion phase and the reclamation phase.

Table 7-8. Annual Runoff Volumes at WC-1C

Scenario	Annual Runoff (m^3)	% Change in Annual Flow	Max. Monthly % Change	Month of Max. Change
Existing Conditions	363,014	--	--	--
Phase 1 Conditions	357,654	-1.48%	-1.49%	January

Scenario	Annual Runoff (m^3)	% Change in Annual Flow	Max. Monthly % Change	Month of Max. Change
Phase 2 Conditions	356,962	-1.67%	-1.68%	January
Phase 3 Conditions	356,962	-1.67%	-1.68%	January
Reclamation Conditions	357,582	-1.50%	-1.70%	January

Percent change of annual runoff remains relatively consistent from Phase 1 through Reclamation conditions, varying from -1.47% to -1.67%. Maximum monthly changes in runoff do not vary greatly from the predicted annual change in flow as only a small portion of the contributing drainage area experiences a change in land use during quarry expansion and reclamation. Reduction in flow rates is largely due to a reduction in contributing drainage area.

7.2.5.2.1.2.2 <u>*WC-1D*</u>

A summary of the predicted annual runoff volumes, average annual change in runoff and maximum average monthly change in runoff at WC-1D through each quarry expansion phase and reclamation phase is presented in Table 7-9.

Table 7-9. Annual Runoff Volumes at WC-1D

Scenario	Annual Runoff (m^3)	% Change in Annual Flow	Max. Monthly % Change	Month of Max. Change
Existing Conditions	410,638	--	--	--
Phase 1 Conditions	415,542	1.19%	14.95%	August
Phase 2 Conditions	424,479	3.37%	30.48%	August
Phase 3 Conditions	438,592	6.81%	49.44%	August
Reclamation Conditions	464,107	13.02%	14.84%	January

WC1-D experiences an increase in average annual runoff through all phases of quarry expansion, up to 13.02% during reclamation conditions. The increase in runoff is largely due to increased contributing drainage area (up to 10.71% during Phase 3 and Reclamation conditions).

Through each phase of quarry expansion, the range of percent changes to average monthly runoff fluctuates more widely from the annual average. For Phases 1, 2, and 3, the range in average monthly changes in runoff are -0.93% to 14.95%, -0.81% to 30.48%, and 0.24% to 49.44%, respectively. This is due to the increasing change of land use from natural conditions to total extent of quarry expansion. As noted in Table 7-9, the maximum average monthly change in runoff occurs in August for all phases of quarry expansion (excluding reclamation). As the quarry expands, the QEA will experience more runoff and lower evaporation rates as compared to natural areas. Runoff is exacerbated in months where there is less rainfall, higher temperatures, and more daytime hours, reflecting in a predicted maximum change in flow in August. It is important to note, however, that WC1 currently exhibits no to minimal flow during the summer months, resulting in extensive drying and low residual water depths in its downstream reaches (average depths range from 1 – 7 cm in Reach 4 and 5).

During reclamation conditions it is anticipated that nearly all the less pervious area in the QEA will be restored back natural conditions (i.e., more pervious) leading to a maximum monthly percent change in runoff of 14.84% in January, comparable to the average annual predicted change in flow of 13.02%.

7.2.5.2.1.3 *Water Quantity Summary*

Throughout the expansion of the Project, water will continue to be drained to WC1 which eventually drains northeast to Keys Brook. The mapped, upstream extent of WC1 (comprising POIs WC-1A and WC-1B), as well as Keys Brook, are not expected to sustain a change in water quantity as there is minimal anticipated changes to their contributing drainage areas.

Changes to water quantity within WC1 are predicted to occur downstream of WC-1D. Any changes in flow to WC1 upstream of this point are expected to be minor (maximum average monthly decrease of 1.70% at WC-1C). As a result of the expected increase in surface water volume to the downstream reaches of WC1 (maximum monthly average of 49.44%), impacts to the morphological characteristics of this section of watercourse are possible. Excessive flow can increase erosion and deteriorate water quality (ECCC, 2017), and in turn affect the fish and fish habitat it supports. An effects assessment of changes in water quantity on fish and fish habitat is provided in Section 7.2.6. Mitigation measures to address the predicted increase in flow to WC1 are discussed in Section 7.2.5.3.

7.2.5.2.2 Water Quality

Similar to some of the effects discussed for groundwater, quarrying has the ability to impact surface water quality as follows:

- 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 the potential for ARD.

- 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 substances within the quarry has the potential to be released into surface water systems.

Potential effects to this VEC are compared to the regulatory requirements set out for surface water quality (i.e., no exceedance of CCME FWAL criteria or confirmed background concentrations for TSS, pH and metals to meet the *Pit and Quarry Guidelines* (NSEDL, 1999)). As discussed in Section 5.4.2, baseline water quality samples for total metals in water and TSS were collected at three locations across three sampling events within the Study Area (Figure 7; Appendix A). Water quality analysis indicates that the majority of CCME FWAL are met; however, all three sample locations indicated exceedances for Total Aluminum through all sample events. Additionally, the November 2021 sample from SW-1 fell just below the CCME FWAL guideline and Tier 1 EQS criteria for pH (6.48) and the November 2021 sample from SW-2 had an exceedance in Total Iron.

A rock sample from the Study Area was determined to have low sulphur content and does not present a potential for ARD (Section 5.2.3.1). Therefore, water quality is not expected to be impacted by ARD.

No 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 either be sourced from water retained on site, or 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.

7.2.5.2.3 Predicted Water Discharge

As described in Section 2.7.6, all surface water runoff and drainage occurring within the QEA will be directed (by gravity) via rock-lined ditches, swales, or through the fractured quarry floor to the existing settling pond, located in the northeastern extent of the existing quarry footprint (Figure 3, Appendix A). In addition, perimeter ditching surrounding the laydown area will collect runoff and passively discharge it into a vegetated area at a topographical low prior to entering WC1, upstream of the settling pond discharge.

Settled water will be released from the settling pond (Figure 3; Appendix A) via a culvert and water will be passively discharged to a vegetated settling area prior to flowing into WC1. The settling pond will be increased in size, as required, during quarry expansion to ensure downstream effects do not occur (e.g., scour, sedimentation, erosion). All water management environmental controls will be repaired and replaced as needed and will be implemented throughout the life of the quarry.

7.2.5.3 *Mitigation*

The following mitigation measures will be included in the design of the Project for surface water:

- Design and implementation of a surface water management strategy. This will include:
  - Redirection of surface water within the QEA to the settling pond or vegetated settling areas to i) reduce discharge flow into the active quarry and WC1 and ii) maintain connectivity of surface water to WC1/Keys Brook.
  - Specific mitigation measures to control increased runoff to WC1 such as infiltration trenches or soakaway pits to allow for infiltration or evaporation of stormwater runoff.
- Design and implementation of a sediment and erosion control plan. This will include:
  - Implementation 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 a minimum of 30 m from surface water systems and will be sloped appropriately to reduce the likelihood of erosion and sedimentation, where practicable.
- 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.
- Future blasts to support quarry expansion will continue to occur further from WC1 (i.e., quarry is expanding to the southeast and away form WC1).
- If washing of aggregate is required, a closed loop system will be constructed with water imported via a water truck. No water used in the closed loop for washing will be discharged from site.
- No fuel will be stored on site.
    - Refueling will be completed by a third party
    - Refueling will occur in designated areas, >30 m from a watercourse
    - The operator will remain with the equipment during refueling
    - Spill response equipment will be readily available
- A Project Contingency Plan will be developed for the Project to outline the prevention and response methods regarding spills and/or substance loss.

Additional mitigation measures related to water quantity and quality effects associated with fish habitat are provided in Section 7.2.6.

7.2.5.4 *Monitoring*

- A surface water monitoring program will be designed and implemented to ensure water quality entering the downstream environment meets regulatory requirements and that potential impacts to aquatic life is not occurring. 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 be designed to evaluate the effects of predicted increases in flow to WC1.

If visual signs of ARD (i.e., amorphous yellow, orange, or red deposit [USEPA, 1994]) are identified after blasting has occurred, additional ARD testing will be completed, and additional mitigations will be implemented.

7.2.5.5 *Residual Effects and Significance*

Quarry expansion will result in the increase of a contributing drainage area to the most downstream reaches of WC1, which in turn increases the water quantity supplied to this part of the system. The water balance predicts an average annual increase in runoff to WC-1D of 1.19% during Phase 1 of development and up to 13.02% during reclamation conditions. Increases in flow during expansion phases are more pronounced during low flow conditions (August) due to the change in land use from natural conditions to quarry floor. WC1 is a confirmed fisheries resource. Effects to fish and fish habitat are discussed in Section 7.2.6.

These changes in water quantity to WC1 are considered permanent because the size of the catchment area through Phase 3 conditions will remain unchanged through reclamation and after the life of the Project. However, changes to surface water quantity are local and are predicted to have negligible impacts on Keys Brook. In addition, mitigation measures will be implemented during quarry expansion and reclamation to attenuate increased runoff, including settling pond design, infiltration trenches, and/or soakaway pits. The effectiveness of these mitigation measures will be monitored through quarry expansion, the details of which will be outlined in the surface water monitoring as part of the IA Application process. Infiltration of surface water through the permeable quarry floor (constructed of blast rock) will also aid in controlling peak flows. With mitigation measures in place, geomorphological changes to the watercourse are not anticipated.

The removal of vegetation and the ground disturbance increases the potential for erosion and transport of suspended solids into the adjacent surface water features. The implementation of best management practices (BMPs) for control of erosion and sediment transport during construction will consist of contingency planning, monitoring, erosion control measures, runoff management, sediment control measures, and maintenance. BMPs for erosion and sediment control are therefore expected to mitigate releases of suspended solids to downgradient aquatic receptors and to limit potential changes to the concentrations of suspended solids. BMPs for sediment control will continue to be used during operation and reclamation, as required. By appropriately implementing BMPs for sediment control, the surface water quality of the surface water receivers is expected to remain within the range of concentrations observed under existing conditions. Additionally, based on testing of on-site rock samples, the potential for ARD is low.

Therefore, although residual effects associated with surface water quantity are predicted to occur at the site-level, no geomorphological changes are anticipated WC1 once mitigation measures are implemented. Effects to surface water quality are possible, however, after mitigation measures have been implemented and monitoring performed during quarry expansion, the predicted residual environmental effects of the Project on surface water are assessed to be not significant.

7.2.6 Fish and Fish Habitat

Quarry development can affect fish and fish habitat through direct and indirect impacts associated with quarrying practices. Activities such as clearing, grubbing, and blasting can lead to a direct loss of watercourses from the landscape, or access of equipment across watercourses would require installation of drainage structures such as culverts or bridges. Indirect effects to fish and fish habitat include potential changes in water quality conditions draining from the QEA into aquatic receivers, and water quantity changes due to quarry expansion, and associated potential loss of drainage area and re-direction of surface water flows.

Table 7-10 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC interactions with fish and fish habitat. As discussed in Section 7.2.4, potential effects to surface water have been evaluated within the Study Area as well as within off-site aquatic receivers, referred to collectively as the Aquatic Study Area. The table below is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Reclamation as well as Accidents, Malfunctions, and Unplanned Events). Potential effects to fish and fish habitat have been divided into direct and indirect impacts. The discussion following the table provides an analysis of key Project-VEC interactions.

Table 7-10. Project- VEC Interactions by Project Phase on Fish and Fish Habitat

Project Activities and Physical Works[1]	**Potential Project Interactions and Environmental Effect**[2]	
	Direct Impact	**Indirect Impact**
Construction		
Site preparation/clearing	N	Y
Grubbing	N	Y
Watercourse/Wetland Alteration	N[3]	Y[3]
Waste management	N	N
Storage areas for grubbings and overburden soils	N	Y
Operation and Maintenance		
Rock blasting	N	Y
Handling and stockpiling material	N	N
Crushing and screening	N	N
Management of surface water	N	Y
Trucking/transport of product	N	N
Reclamation		
Re-grading of rock face	N	Y
Reclamation/re-vegetation	N	Y
Accidents, Malfunctions and Unplanned Events		
Erosion and sediment control failure	N	Y
Fuel spill from machinery/trucks	N	Y
Fire	N	N

[1] All activities are assumed to be occurring outside of watercourses.

[2] Y - interaction / N - no interaction

[3] No watercourse alterations are proposed, however, wetland alterations are required to allow for quarry development within the QEA.

Potential effects to fish and fish habitat can be divided into direct impacts and indirect impacts. Indirect impacts have been further divided into three components (i) water quantity effects, (ii) water quality effects, and (iii) blasting. These effects are discussed below. It should be noted that the Project interactions described relate to the potential effects to fish and fish habitat as a result of direct Project development and/or indirect changes to fish habitat quality. **Physical effects to watercourses (including morphological characteristics, direct alteration, and water quality) are discussed separately in Sectio**n 7.2.4. **Any morphological or water quality changes which result in direct or indirect effects to fish habitat have been carried forward to this section.**

7.2.6.1 *Direct Impacts*

No fisheries resources were identified within the QEA. WC1, the sole watercourse identified within the Study Area, will be avoided by Project activities and a 30 m buffer will be maintained around this watercourse during quarry expansion. As discussed in Section 7.2.7, none of the wetlands proposed for alteration as part of quarry expansion directly support fish habitat and none are considered fisheries resources. As such, no direct impacts to fish or fish habitat are expected to occur because of the Project.

7.2.6.2 *Indirect Effects*

Indirect effects associated with quarry expansion include surface water quantity, surface water quality, and blasting effects to downstream aquatic receivers and associated fish and fish habitat. Each potential indirect effect is described in detail below.

Water Quantity

In support of the discussion below, the reader is referred to the WBA (Appendix E) and results presented in Surface Water Effects Assessment (Section 7.2.4).

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 quarry expansion 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 are not well understood, and guidance is lacking to determine effects to fish habitat in these systems. WC1 is considered mostly intermittent, having been observed to dry up for most of its length during summer low-flow periods. As a result, the determination of effects to this system have been informed by known physical parameters of the watercourse, known or expected fish usage, and predicted alterations in the natural flow regime.

As demonstrated in the WBA (Appendix E) and discussed in Section 7.2.4, contributing drainage areas to Keys Brook and the upstream reaches of WC1 (WC-1A, WC-1B, and WC-1C) are expected to experience minimal to no changes in water quantity (-1.81 to 0.57%) from quarry expansion. 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. WC-1D, located downstream of the settling pond discharge toward WC1, experiences an increase in drainage area of 10.71% from baseline through quarry expansion. Based on this increase, POI WC-1D was selected to require additional hydrologic modelling to evaluate potential indirect impacts to surface water due to quarry expansion. POI WC-1C was also selected for additional modelling despite minimal change in total catchment area due to the potential for changes in land use within the contributing drainage area itself.

WC1 was confirmed to support fish, with brook trout identified in the watercourse through baseline fish collection surveys. The watercourse may also provide habitat for American eel - this species was not confirmed through electrofishing surveys but may access the watercourse from Keys Brook.

A summary of the WBA (Appendix E) and a discussion of potential effects to fish and fish habitat are provided in the following paragraphs. When discussing the results of this water balance it should be noted that this quarry will be developed over the course of approximately 40 years (Phase 1 = 10 years; Phase 2 = 10 years; and Phase 3=20 years). As noted in the Water Balance Assessment, it is recommended that the water balance model be revisited upon the completion of Phase 2 to calibrate the model and allow for more accurate predictions of potential impacts to the downstream receiving waterbodies during Phase 3 and Reclamation.

Watercourse 1

- WC-1C: A reduction in mean annual streamflow of 1.48% in Phase 1 expansion (monthly range from -1.48% to -1.40%), followed by a mean annual reduction of 1.67% during Phase 2 and 3 (monthly range from -1.68% to -1.58% for both phases), and a mean annual reduction of 1.50% during reclamation conditions (monthly range from -1.70% to -0.25%).
- WC-1D: An increase in mean annual streamflow of 1.19% during Phase 1 expansion (monthly range from -0.93% to 14.95%), followed by a mean annual increase of 3.37% (monthly range from -0.81% to 30.48%) and 6.81% (monthly range from 0.24% to 49.44%) during Phase 2 and Phase 3, then a 13.02% increase in mean annual streamflow (monthly range from 1.53% to 14.84%) during reclamation conditions.

As an annual average, WC1 at assessment point WC-1C is expected to experience a minor, permanent reduction in streamflow due to a small reduction in catchment area. Predicted decreases calculated for this POI remain relatively consistent from Phase 1 conditions (reduction of 1.48%) through reclamation (reduction of 1.50%), with a maximum average annual reduction of 1.67% during Phase 2 and 3.

Monthly changes in streamflow, as presented in the WBA (Appendix E), were reviewed to assess potential impacts of a reduction in flow, specifically during low flow conditions. Reductions during seasonal low flow periods have the potential to result in more exaggerated impacts, compounded by lower water levels and higher water temperatures. Maximum monthly changes in runoff are comparable to annual averages, with a maximum monthly reduction in runoff of 1.70% during reclamation. This is due to the minimal change in land use within the contributing drainage area during quarry expansion and reclamation.

Overall, the predicted reduction in streamflow at WC-1C is considered a negligible to low magnitude of impact to fish and fish habitat, unlikely to result in detectable changes to fish habitat or the ability of fish to use the habitat to carry out one or more life processes.

WC1 at assessment point WC-1D captures runoff from the entire QEA. In Phase 1 conditions, there is a 1.19% mean annual increase in streamflow expected at the WC-1D assessment point, with predicted average annual flows increasing through each phase of quarry expansion up to 13.02% during reclamation conditions. This increase in streamflow through quarry expansion is primarily due to an increasing contributing drainage area.

An evaluation of the percent change in monthly streamflow for WC-1D shows the range of change widens with each subsequent phase of quarry expansion. For Phases 1, 2, and 3, the range in monthly runoff are -0.93% to 14.95%, -0.81% to 30.48%, and 0.24% to 49.44%, respectively. This is due to the increasing change of land use to less pervious conditions from natural conditions. For all phases of quarry expansion, maximum increases in flow are expected in August. During reclamation conditions, percent change in monthly streamflows more closely resemble the percent change in mean annual streamflow (range of 1.53% to 14.84%) due to the restoration of less pervious area within the QEA back to natural conditions (more pervious).

Unmitigated, WC1 may experience a permanent increase in streamflow to approximately 482 m^2 of brook trout and American eel habitat, which is the length of the delineated watercourse downstream of WC-1D multiplied by the average channel widths of Reaches 4 and 5, as measured during detailed habitat assessments. The increase in flow to the downstream extent of WC1 is not anticipated to have measurable impacts on Keys Brook, whose contributing drainage area remains relatively unchanged through quarry expansion.

These permanent increases in streamflow within Reaches 4 and 5 of WC1 exceed the DFO (2013) thresholds in July-August in Phase 1, July-September in Phase 2, March and June-September for Phase 3, and October through June during Reclamation. It is anticipated that these increases could have detectable, negative effects on fish and fish habitat within WC1. For example, increased streamflow may cause changes in channel morphology and deposition of eroded material, which may reduce the availability of suitable habitats. However, erosion or changes in channel morphology would not be expected during summer low-flow conditions as the watercourse currently exhibits minimal flow and very low water depths during this time period. Any percent increase in flow during summer low-flows would likely be significantly lower than flows currently experienced during wetter seasons (e.g., spring melt). It should also be noted that an increase in streamflow may improve fish habitat in this predominantly intermittent watercourse by improving passage and access to habitat within the watercourse. Accessibility and water levels during low flow has been documented as a limiting factor to fish habitat within the watercourse; therefore, greater streamflows, particularly during the summer low-flow period, may be beneficial to fish provided mitigations are in place to ensure the stability of the channel. Overall, predicted increases in streamflow at WC-1C, left unmitigated, is considered a moderate magnitude of impact to fish and fish habitat.

Impacts to the downstream extent of WC1 resulting from increases in streamflow will be mitigated through use of the settling pond. Instantaneous peak flows will be attenuated as water is held and then discharged more gradually through the pond outlet. The settling pond will be sized to ensure that these predicted flow increases are mitigated. Impacts will be further reduced by incorporating additional infiltration trenches and/or soakaways with the intention of allowing for infiltration or evaporation of stormwater runoff. Additional information such as groundwater table elevations is required to determine which option is the most feasible to mitigate increases in runoff. These measures would be particularly applicable during the summer months (July and August) when the water balance is governed by short, high intensity rainfall events. These rainfall events would be captured by the prescribed mitigation measure, allowing for an increase in infiltration and evaporation of stormwater runoff and a reduction of total runoff back to a value closer to existing conditions. A monitoring plan will be implemented to ensure that these mitigation strategies are effective.

Water Quality

Indirect impacts to fish and fish habitat are also possible as a result of water quality changes sourced from upgradient quarrying activities. These effects are the same as those described in Surface Water Effects (Section 7.2.4) and include unplanned events and release of deleterious substances, oil spills and erosion and sediment control failure (and associated siltation). In addition, water quality issues associated with the blasting and quarrying practices (i.e., chemical composition of water, increase in dissolved metals etc.) is also a threat to fish and fish habitats. Regarding ARD, samples were collected, and it was determined that they had no potential for ARD (Section 5.2.3.1). Mitigation and monitoring, as described below, will ensure discharge is within permitted parameters. No residual impact to fish and fish habitat is expected from changes in water quality with appropriate mitigation measures applied and the implementation of a water quality monitoring program.

Blasting

Indirect impacts to fish and indirect impacts to fish behavior, 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.

Sublethal effects have also been observed including changes in fish behavior as a result of noise produced during blasting (Wright and Hopky, 1998). 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.

Blasting is expected to occur once per year during operations. Future blasts to support quarry expansion will continue to occur further from WC1 (i.e., quarry is expanding to the southeast and away form WC1).

7.2.6.3 *Mitigation*

The following mitigation measures will be included in the design of the Project:

- Design and implementation of a surface water management strategy will be completed for the Project. This will include:

    - Redirection of surface water within the QEA to the settling pond or vegetated settling areas to i) reduce discharge flow into the active quarry and downstream aquatic receivers and ii) maintain connectivity of surface water to WC1/Keys Brook.
    - Design of new surface water management features (e.g., trenches, soakaway pits) to capture excess runoff and ensure appropriate discharge rates from the quarry site to WC1.
- Implementation of 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.
- 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 conducted on an as-required basis, but is expected to occur once per year.
- 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.
- Future blasts to support quarry expansion will continue to occur further from WC1 (i.e., quarry is expanding to the southeast and away form WC1).
- No fuel will be stored on site.
    - Refueling will be completed by a third party
    - Refueling will occur in designated areas, >30 m from a watercourse
    - The operator will remain with the equipment during refueling
    - Spill response equipment will be readily available
- A Project Contingency Plan will be developed for the Project to outline the prevention and response methods regarding spills and/or substance loss.

7.2.6.4 *Monitoring*

- Dexter will design and implement a Surface Water Monitoring Program (including water sample locations from the outflow/downstream environment of the settling pond), 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 include monitoring locations for water quantity to identify any potential effects associated with predicted changes in streamflow and fish habitat provisions. Monitoring will ensure that mitigation measures are effective and that potential adverse impacts to fish and fish habitat does not occur.

7.2.6.5 *Residual Effects and Significance*

Potential effects to fish and fish habitat as a result of direct and indirect impacts to fish will occur over a long duration concurrent with quarry expansion (40 years; i.e., water quality and blasting) or remain permanent after the life of the quarry (i.e., water quantity).

Based on the worst-case scenario, approximately 482 m^2 of brook trout and American eel habitat in WC1 could experience a permanent, detectable increase in streamflow. Unmitigated, this increase in streamflow is predicted to exceed the thresholds outlined by DFO (2013), which may result in adverse effects to fish and fish habitat. As such, the predicted increases in surface water runoff to WC1 are considered a moderate magnitude impact to fish habitat. However, after mitigation and monitoring measures have been implemented, there are no predicted adverse environmental effects of the Project on fish and fish habitat due to changes in streamflow.

To support the predictions made in this document and evaluate potential effects to fish and fish habitat as the quarry expands, it is proposed that monitoring of WC1 be initiated prior to quarry activities occurring within the contributing drainage area and continue concurrent with future quarrying. The goals of the monitoring program will be to further refine potential effects before quarry expansion commences, to verify that any observed changes to fish habitat during and/or after the quarry expansion is consistent with refined predictions, and to modify mitigation methods where necessary.

Effects to fish and fish habitat are possible, however, after mitigation measures have been implemented and monitoring is performed during quarry expansion, the predicted residual environmental effects of the Project on fish and fish habitat are assessed to be not significant. This is based on the following factors:

- Wetlands expected to be directly impacted by Project development do not provide habitat for fish.
- No watercourses will be directly impacted by the Project.
- Changes to contributing drainage areas to Keys Brook and the upstream reaches of WC1 are considered negligible to low in magnitude and detectable changes in water quantity as a result of quarry expansion within these systems are not expected.
- Any potential change in surface water runoff would be gradual with quarry expansion.
- The settling pond and infiltration structures will be designed to hold and manage flows into WC1, mitigating the predicted increases as presented in the WBA.
- A Surface Water Monitoring Program will be designed to evaluate the potential changes in surface water runoff and water quality to fish and fish habitat. The monitoring program will refine potential effects to fish and fish habitat before quarry expansion occurs and will verify whether mitigation measures are effective.
- The protective mitigation measures and monitoring commitments will ensure impacts to fish and fish habitat do not occur as a result of quarry expansion. Monitoring and mitigation will employ an adaptive management approach. If required, existing mitigation measures will be adjusted or additional measures will be implemented in response to the findings of the monitoring program.

7.2.7 Wetlands

Quarry development can affect wetland habitat through direct and indirect activities associated with quarrying practices. Wetland vegetation and habitat will be lost through the direct removal of wetlands within the QEA. Activities associated with the Project also have the potential to indirectly alter wetland hydrology by elevating or reducing water levels, resulting in flooding or drying of the wetland. Water quality entering a wetland may also change due to runoff from the quarry or quarrying activities. These Project interactions are outlined in Table 7-11 and described in the following sections.

Table 7-11. Project- VEC Interactions by Project Phase on Wetlands

Project Activities and Physical Works[1]	Potential Project Interactions and Environmental Effect[2]	
	Direct wetland impact	Indirect wetland impact
Construction		
Site preparation/clearing	N	Y
Grubbing	N	Y
Watercourse/Wetland Alteration	Y	Y
Waste management	N	N
Storage areas for grubbings and overburden soils	N	Y
Operation and Maintenance		
Rock blasting	N	Y
Handling and stockpiling material	N	N
Crushing and screening	N	N
Management of surface water	N	Y
Trucking/transport of product	N	N
Reclamation		
Re-grading of rock face	N	Y
Reclamation/re-vegetation	N	Y
Accidents, Malfunctions and Unplanned Events		
Erosion and sediment control failure	Y	Y
Fuel spill from machinery/trucks	Y	Y
Fire	Y	Y

[1] All activities, excluding watercourse/wetland alteration, are assumed to be occurring outside of wetland habitat.
[2] Y - interaction / N - no interaction

7.2.7.1 *Direct Effects*

Direct effects of the Project are anticipated from both the laydown area and QEAs (Figure 16, Appendix A). The laydown will directly impact the entirety WL12. Phase 1 of quarry expansion will directly impact a portion of WL8 and WL11. Phase 2 will directly impact a portion of WL6, 8 and 9, and completely alter WL10. An additional portion of WL6 and 9 and a new portion of WL5 will be directly impacted during Phase 3. There will be no direct impact to the 10 remaining wetlands (Wetlands 1-4, 7, 13-17) within the Study Area. Table 7-12 provides the estimated total direct impacts (all phases) to each wetland, and associated infrastructure, as a result of quarry expansion.

Table 7-12: Estimated Direct Impact to Wetland Area

Wetland #	Wetland Size (m^2)	Estimated Direct Impact Area (m^2)	Quarry Phase	% of Alteration Area
WL5	439[1]	89	Phase 3	20.3%

Wetland #	Wetland Size (m^2)	Estimated Direct Impact Area (m^2)	Quarry Phase	% of Alteration Area
WL6	3,880[1]	2,965	Phase 2/3	76.4%
WL8	2,404[1]	1,986	Phase 1/2	82.6%
WL9	449	449	Phase 2/3	100%
WL10	975	975	Phase 2	100%
WL11	850[1]	574	Phase 1	67.5%
WL12	384	384	Laydown	100%
Total Impact Area = 7,422 m^2 (0.74 ha)			**Total Partial Wetland Alterations = 4**	
			Total Complete Wetland Alterations = 3	
[1]Wetland continues beyond the Study Area boundary.				

Over the lifetime of the quarry, seven wetlands are proposed for alteration: three of these are complete alterations, and four are partial alterations. Each of the wetlands proposed for partial alteration continue beyond the Study Area boundaries and as such the impact percentages above are conservative. As the area is forested and provincial databases do not show mapped wetlands or water table depths between 0-10 m in these areas, the extent of the wetlands beyond the Study Area could not be accurately determined using desktop resources. Nevertheless, it is expected that the actual percent alteration areas of these wetlands are smaller than the numbers presented in Table 7-12. All wetland alterations will be gradual through the phased expansions and will take place over the expected 40-year lifespan of the quarry.

There are no direct Project effects expected to potential WSS, WL1. See Section 7.2.7.3 for a discussion on avoidance mitigations.

7.2.7.2 *Indirect Effects*

Indirect impacts are described as changes to wetland condition where wetland habitat is not directly lost but may be altered as the result of Project activities. Project-related indirect impacts to wetlands may occur as a result of:

- Changes to 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. Increased traffic during the construction and operational phases can elevate this risk.

Changes to wetland hydrology is a common driver for further change to wetland function and habitat integrity. Indirect impacts may occur through Project alteration of hydrological conditions within the QEA (i.e., through implementation of water management: settling pond and associated infrastructure), impacting water movement and timing in adjacent wetlands. Change in catchment area size and/or land use may also impact wetlands by altering surface water runoff and groundwater contributions, and thus the amount of water supplied, to downgradient systems.

There are no indirect Project effects expected to potential WSS, WL1.

Surface Water Changes

As described in Section 7.2.5, quarry expansion is expected to result in changes to surface water runoff through each phase of quarry expansion to downgradient aquatic features. Surface water runoff and drainage occurring within the QEA will be directed (by gravity) via rock-lined ditches, swales, to the existing settling pond (located in the northeastern extent of the existing quarry footprint) or through the fractured quarry floor. Settled water will be released from the settling pond (Figure 3; Appendix A) via a culvert and will be passively discharged to a vegetated settling area before draining towards WL15 and WC1. Surface water runoff and drainage within the laydown area will be collected by perimeter ditching and be passively discharged into a vegetated area at a topographical low, before draining into WC1 upgradient of the settling pond discharge and downgradient of WL17. Mitigation and monitoring of settling pond discharge are discussed in Section 7.2.5.

The Water Balance Assessment (Appendix E) provides an assessment of changes to contributing drainage areas from quarry expansion and subsequent hydrological modeling for downgradient aquatic receptors. As described in Section 7.2.5, most receptors (i.e., POIs) are expected to experience minimal impacts due to quarry expansion with catchment area changes ranging from a reduction of 1.81% to an increase of 0.57%. One POI, WC-1D, is anticipated to experience a permanent increase in surface water runoff. The catchment area is predicted to increase up to 10.71% in size, with the POI expected to experience an annual average increase in runoff of up to 13.02% during reclamation conditions. The catchment area for WC-1D includes all site surface water from the quarry, through each phase of expansion. WL15, which is located immediately upstream of the POI along WC1, is also expected to experience an increase in flow, predicted at WC-1D.

Enlarged catchment areas resulting in increased surface water runoff can lead to increased water levels in associated riparian wetlands. These effects may be exacerbated in groundwater discharge wetlands, such as WL15, where high water levels may already be maintained by groundwater inputs. It is expected that the mitigation measures outlined in Section 7.2.5.3 and 7.2.6.3 to retain excess runoff, including the use of water management strategies (i.e., settling pond and other infiltration features), will attenuate excess runoff, particularly during the summer months when increases in runoff are exaggerated by short, high intensity rainfall events. Swamps, particularly riparian wetlands (e.g., WL15), are also characterized by water level fluctuations and prolonged periods where water levels are above the ground surface. Keddy (2010) found that wetlands associated with lakes and watercourses were found to have seasonal variability as high as ± 1.5 m. As a result, WL15 is not expected to experience hydrological impacts beyond natural variability. WL15 is proposed to be monitored as the quarry develops (Section 7.2.7.4).

WL16 is also located within the catchment area of POI WC-1D but is upgradient (northwestern extent of the catchment area) and is assessed to be beyond the influence of the catchment area increase. Similarly, WL17, located within the catchment area of WC-1B, is not expected to be impacted based on the negligible increase in total catchment area demonstrated by the WBA (Appendix E) through all phases of quarry development (0.57-0.48%).

None of the wetlands occurring south and upgradient of the QEA (WL1-4 and WL7) are expected to be impacted by the changes to surface water runoff as their large, contributing catchment area extending to the south will remain undisturbed by the Project. Similarly, wetlands north of the laydown area (WL13 and WL14) occur outside of the predicted catchment areas for the quarry and are therefore not expected to be impacted by changes in surface water runoff. The local catchment area for WL1, the potential WSS, was delineated using provincial LiDAR data to confirm no Project related developments fall within its catchment, thus resulting in no predicted surface water impacts to the WSS. The WL1 local catchment area in relation to Project development is shown in Figure 19 (Appendix A).

Groundwater Interactions

As discussed in Section 7.2.4, quarrying has the ability to alter localized groundwater conditions. A change in groundwater interactions and contributions into aquatic features located in proximity to the QEA is possible as a result of groundwater drawdown. Isolated discharge wetlands which are reliant on groundwater inputs, such as isolated swamps, may be more vulnerable to this change. However, the potential discharge wetlands in the northern portion of the Study Area, which will not be directly impacted by Project infrastructure, are over 400 m from the proposed QEA (i.e., WL13, 14, and 16) and as a result are expected to be beyond the influence of groundwater drawdown.

Any effects that may occur as a result of a groundwater drawdown to WL17, a riparian swamp, would be muted due to its supply of water from WC1 and its undeveloped catchment area. The wetland’s riparian qualities (i.e., high water level fluctuations and prolonged periods of surface water presence) combined with its expansive, unimpacted drainage area from the southwest are expected to negate potential impacts from localized groundwater drawdown. As such, effects to groundwater in WL17 are unlikely to result in changes to wetland function beyond natural variability. WL15 is expected to behave similarly as a riparian swamp; however, given the predicted increase in surface water runoff sourced to WL15 during the life of the quarry, any effect to WL15 will be captured through monitoring (see Section 7.2.7.4).

Most recharge wetlands, including the potential WSS (WL1), lie beyond the predicted groundwater influence of the QEA. The nearest recharge wetlands located south of the QEA, WL4 and 7, are bogs. Bogs have deep organic deposits and self-regulating mechanisms (e.g., water retention) that make them more resilient to hydrological changes. These wetlands also have large contributing, unimpacted catchment areas to the south, beyond the Study Area (e.g., Figure 19; Appendix A). As such, it is not expected that the QEA will have an indirect hydrological impact on the wetlands south of the quarry. The nearest wetland to the QEA, WL7, lies approximately 30 m southeast of the Phase 3 expansion, and as such any potential impacts are not likely to result until 20 years into quarry development. Monitoring will be progressive throughout quarry expansion and reassessed as necessary during the expansion phases.

Local changes to groundwater quantity as a result of the direct impacts to recharge wetlands within the QEA are unlikely as 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 roads or other constructed infrastructure). Overall groundwater recharge is expected to remain unchanged from existing conditions, but groundwater flow paths may be locally altered.

Quarry expansion may result in groundwater impacts through drawdown within the unaltered portions of partially impacted wetlands (i.e., WL5, WL6, WL8, and WL11). Hydrological impacts within these wetlands would be captured through progressive monitoring program throughout the life of the quarry (Section 7.2.7.4).

Water Quality

Similar to potential indirect surface water quantity impacts to wetlands discussed above, water quality may be impacted due to quarry activity. These indirect effects may include siltation, dissolved solids, metals, and ARD. Additionally, accidents, malfunctions, and unplanned events have the potential to impact water quality that will indirectly impact wetlands. Project effects on water quality, mitigation and monitoring are further discussed in Section 7.2.5.

7.2.7.3 *Mitigation*

Avoidance is the first step in the hierarchical process for wetland conservation, as described in the Wetland Conservation Policy. 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 WL1 (designated a potential WSS due to the presence of Canada warbler and supporting habitat) and four additional wetlands (WL2, 3, 4, and 7) within the southern portion of the Study Area. Where wetland avoidance is not possible, a proponent must implement mitigation measures and a wetland compensation plan, along with wetland monitoring where appropriate/necessary. A detailed wetland compensation and monitoring plan will be prepared through the IA application process.

The following mitigation measures will be included in the design of the Project in order to reduce overall loss of function of wetland habitat in impacted areas:

- Acquire and adhere to wetland alteration permits;
- Implement wetland monitoring as described herein and within permits;
- Engage in wetland compensation activities for the wetland loss associated with the Project 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;
- Ensure all wetlands are visually delineated (i.e., flagged);

- Implement water management methods to reduce the potential to drain or flood surrounding wetlands by directing drainage either away from wetlands or towards them if a drying affect has been observed;
- Direct site runoff through natural vegetation, wherever possible;
- Implement erosion and sediment control measures and best-practices; and,
- Re-vegetate and progressively reclaim the quarry using native vegetation.

7.2.7.4 *Monitoring*

- Dexter will design and implement a Wetland Monitoring Program to ensure that unpermitted wetland areas are not directly or indirectly altered by the development of the Project. The program will include methods and a progressive implementation schedule to monitor the health of adjacent wetlands during the various quarry development phases. Details will be outlined within the Wetland Monitoring Program developed as part of the wetland alteration application and IA amendment process.
- Monitoring will be progressive as expansion occurs (i.e., by expansion phase) and reassessed as necessary during the expansion phases. Monitoring is expected to occur in all four wetlands proposed for partial direct alteration (WL5, WL6, WL8, and WL11), as well as WL15 to ensure mitigation measures to attenuate excess surface water runoff are effective. Monitoring will be conducted as directed in regulatory approvals.

7.2.7.5 *Residual Effects and Significance*

Direct impacts to wetlands are confined to the QEA and will occur gradually over the life of the Project as quarry development progresses (40 years). The loss of wetland habitat is permanent and irreversible; however, this loss is offset via compensation through the permitting process. No WSS will be impacted by the Project.

Indirect impacts to wetlands may occur through the life of the Project as a result of changes to localized groundwater and surface water interactions, potential changes to habitat integrity (e.g., invasive species) and potential water quality impacts (i.e., sedimentation and accidents). Water quality issues, should they occur, are expected to be sporadic, short in duration, and are likely reversible. Protective mitigation measures will be implemented to address these potential effects, which will be monitored and adapted as required based on the results of monitoring. Indirect effects associated with changes in wetland hydrology have been assessed and will be further determined through wetland monitoring during quarry expansion. Should these indirect effects result in a loss of wetland habitat or alteration to wetland characteristics or function, the impact would be considered permanent and irreversible. Overall wetland habitat integrity will be assessed through the routine monitoring program. Loss of wetland functions identified through monitoring will be offset via compensation through the permitting process.

After mitigation measures have been implemented, the predicted residual environmental effects of the Project on wetlands are assessed to be adverse, but not significant.

7.2.8 Vegetative Community, Vascular Plants, and Lichens

Table 7-13 provides a summary of the potential Project interactions and environmental effects resulting from the Project on the Vegetative Community, Vascular Plants and Lichens VECs. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Reclamation as well as Accidents, Malfunctions, and Unplanned Events). The discussion following the table provides an analysis of key Project-VEC interactions. Interaction and potential effects to Habitat, Vascular Plants and Lichens has been analysed as part of the review.

Table 7-13. Project – VEC Interactions by Project Phase on Habitat, Flora and Lichens

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect[1]	
	Direct Impact	**Indirect Impact**
Construction		
Site preparation/clearing	Y	Y
Grubbing	N	Y
Watercourse/Wetland Alteration	N	Y
Waste management	N	N
Storage areas for grubbings and overburden soils	Y	Y
Operation and Maintenance		
Rock blasting	N	Y
Handling and stockpiling material	N	Y
Crushing and screening	N	Y
Management of surface water	N	Y
Trucking/transport of product	N	Y
Reclamation		
Re-grading of rock face	N	N
Reclamation/re-vegetation	Y	N
Accidents, Malfunctions and Unplanned Events		
Erosion and sediment control failure	Y	N
Fuel spill from machinery/trucks	Y	N
Fire	Y	N
[1]Y - interaction / N - no interaction		

The proposed Project will result in both indirect and direct impacts to both vascular and non-vascular plants and vegetation community types associated with wetland and upland habitats. Both direct and indirect impacts are described below.

7.2.8.1 *Direct Effects*

The proposed Project will have direct impacts to vegetation community structure and to flora and lichen individuals. Clearing and grubbing account for the most notable impact and will occur throughout the operational life of the Project (40 years). Table 7-14 displays the land use types and areas overlapped by the Project footprint (QEA and laydown area). These estimations were derived by the same tools used to estimate land use in the Study Area (5.1.2).

Table 7-14. Land Use Overlapped by the Project Footprint

Land Use/Land Type	QEA Phase 1	QEA Phase 2	QEA Phase 3	Laydown	Total		
	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	% of Expansion	% of Study Area
Access Road	0	0	0	0.5	0.5	6	2
Existing Quarry	0	0	0	0.00	0	0	0
Clearcut	0.53	0.14	0.2	0.80	1.67	19	6
Mixed wood	0.50	0.50	0.60	0.76	2.36	27	9
Softwood	0.62	0.83	1.32	0.72	3.49	40	14
Wetland	0.22	0.37	0.11	0.03	0.73	8	3
TOTAL	**1.87**	**1.84**	**2.23**	**2.81**	**8.75**	**100**	**34**

The majority of the land overlapped by the Project footprint (QEA and laydown area) is softwood (40%) followed by mixed wood (27%), and clearcut (19%). Wetland habitat makes up the fourth most prominent land type (8%). The remaining area of the Project footprint consists of access roads (6%).

Although quarrying activities will cause a direct loss of vascular and non-vascular flora and the habitats that support them, habitats can be created by the quarry that could support habitat for herbaceous pioneer species and will be restored during the reclamation process when Project activities cease.

No SAR or SOCI lichens were observed throughout the biophysical surveys. No SAR vascular plants were observed during biophysical surveys. One SOCI species, Bicknell's crane's-bill (*Geranium bicknellii,* S3 [ACCDC April 2022]) was observed and has been detailed in Section 5.3.2.2. This species was found immediately south (< 10 m) of the current quarry face and is proposed to be removed from the proposed quarry expansion.

Reclamation of the quarry will result in a positive effect on the Project, involving the reclamation of land, regrading of the quarry face, and re-establishment of vegetation across the Study Area.

Accidents and malfunctions such as contamination from spills have the potential to directly impact this VEC by migrating into naturally vegetated areas, and negatively impacting habitat and vegetation through growth inhibition or cessation.

No direct impacts are expected to occur outside the footprint of the QEA and laydown area.

7.2.8.2 *Indirect Effects*

Vascular plants and lichens outside the QEA but within 100 m of the disturbance have a greater chance of being indirectly affected by edge effects (Rheult et al. 2003). 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). Adjacent clearing activities can alter forested microclimates and ultimately affect lichen and vascular plant health and abundance.

As discussed in Section 7.2.4, groundwater draw down has the potential to alter groundwater flow and direction that could potentially lead to groundwater within adjacent wetlands to be drawn toward the quarry, 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 7.2.4), 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 quarrying 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 temporarily reduce evapotranspiration and photosynthesis and over time this may reduce overall growth rates.

7.2.8.3 *Mitigation*

The following mitigation measures will be included in the design of the Project to minimize effects to vegetative community, vascular plants, and lichens:

- 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 equipped 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 Project Contingency Plan will be developed and will include site-specific measures to prevent sedimentation and erosion, dust level management, and vegetation management during operations.

7.2.8.4 *Monitoring*
No SAR lichens or vascular plants were observed within the Study Area, and therefore no monitoring is proposed.

Refer to Section 7.2.7.4for proposed monitoring of wetlands.

7.2.8.5 *Residual Effects and Significance*
Residual environmental effects of the Project related to vegetative community, vascular plants and lichens are expected from activities that directly impact the VEC. This includes the direct loss of habitat that will occur gradually over the 40-year life of the Project. Additionally, the lichens, vascular plants and habitat directly lost from Project development are also found outside the Study Area and are widespread throughout Nova Scotia. No SAR lichen or vascular plants are directly lost but one SOCI plant, Bicknell's crane's-bill could not be avoided. At a regional level, the losses described are small scale (8.75 ha). These losses are long-term but are partially reversible as reclamation will re-introduce habitat in the future.

After mitigations are implemented, indirect impacts are not expected to occur to this VEC. Monitoring of wetlands will be conducted to confirm this.

Overall, the predicted residual environmental effects are assessed to be adverse, but 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.

7.2.9 Fauna

Table 7-15 provides a summary of the potential Project interactions and environmental effects resulting from the Project-VEC interactions with fauna. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Reclamation as well as Accidents, Malfunctions, and Unplanned Events). Interaction and potential effects have been divided into direct mortality to fauna, habitat alteration, and sensory disturbance. The discussion following the table provides an analysis of key Project-VEC interactions.

Table 7-15. Project- VEC Interactions by Project Phase on Fauna

Project Activities and Physical Works	**Potential Project Interactions and Environmental Effect**[1]		
	Direct Mortality	**Habitat Alteration**	**Sensory Disturbance**
Construction			
Site preparation/clearing	Y	Y	Y
Grubbing	Y	Y	Y
Watercourse/Wetland Alteration	Y	Y	Y
Waste management	Y	N	Y

Project Activities and Physical Works	Potential Project Interactions and Environmental Effect[1]		
	Direct Mortality	Habitat Alteration	Sensory Disturbance
Storage areas for grubbings and overburden soils	Y	Y	Y
Operation and Maintenance			
Rock blasting	Y	Y	Y
Handling and stockpiling material	Y	N	Y
Crushing and screening	N	N	Y
Management of surface water	N	Y	N
Trucking/transport of product	Y	N	Y
Reclamation			
Re-grading of rock face	Y	Y	Y
Reclamation/re-vegetation	Y	Y	Y
Accidents, Malfunctions and Unplanned Events			
Erosion and sediment control failure	N	Y	N
Fuel spill from machinery/trucks	Y	Y	N
Fire	Y	Y	Y
Y - interaction / N - no interaction			

Quarrying has the potential to have an effect on fauna in the following ways:

<u>Direct Mortality</u>

Direct mortality of fauna species could result from Project activities, particularly from wildlife vehicle collisions.

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 which are attracted to roads but lack the speed or reaction time to avoid traffic (e.g., turtles attracted to gravel roadsides for nesting). 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. During spring and summer, porcupine and skunk forage on roadside vegetation at dawn and dusk, increasing the risk of collisions with those species, and turtles are drawn to the roadside to nest in the gravelly shoulders in June. As such, the risk of wildlife collisions is present at any time of year.

There is no proposed increase in expected truck traffic as a result of quarry expansion, therefore, wildlife vehicle collisions are unlikely to increase.

Accidents such as fuel spills have the potential to cause indirect mortality to fauna due to exposure of contaminants.

Habitat Alteration

The Project development will cause direct and indirect impacts to habitat used by terrestrial fauna within the Study Area.

Most direct effects to habitat that supports fauna are expected during clearing and grubbing, which will occur gradually as the quarry expands (40 years).

Habitat alteration will impact different species in different ways. Some species will find new opportunities in fragmented habitats (i.e., 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 outside of mainland moose concentration areas and core habitat (M. McGarrigle, NSDNRR SAR Biologist, Personal Communications, September 6, 2022) and no moose nor sign of moose were observed during any field surveys within or in the vicinity of the Study Area.

Wetlands within the Study Area offer suitable habitat to common amphibian species (e.g., green frog) but no priority herpetofauna species (e.g., wood turtle), nor their suitable habitat were observed within the Study Area.

Habitat loss can result in several indirect impacts including edge effects, fragmented habitats, and loss of connectivity. Connectivity can be defined as the basic ecological requirement to be able to move freely within areas that provide critical functions for a species, and habitat fragmentation is the disturbance of this movement. Connectivity is critical for maintaining biodiversity and healthy species populations and interior forests are often an important feature that supports this movement (NSDNR, 2015). Quarry expansion will result in increased habitat fragmentation, which restricts animal movements and connectivity to additional habitats, and a decrease in habitat quality for fauna.

The habitat present in the Study Area 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 quarry expansion and the Project footprint is small at the regional level (8.75 ha).

Reclamation of the quarry will result in a positive effect on the Project, involving the reclamation of land, regrading of the quarry face, and re-establishment of vegetation across the Study Area.

Sensory Disturbances

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 raccoon, 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).

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).

All sensory disturbance is temporary and will not persist beyond Project completion. While the quarry is active, the primary noise disturbance will be during periods of drilling and blasting (approximately one blast per year).

7.2.9.1 *Mitigation*

The following mitigation measures will be included in the design of the Project to minimize effects to fauna:

- A Wildlife Management Plan will be developed as part of the IA amendment process.
- Provide wildlife awareness training to site personnel.
- Quarry staff will be made aware of wildlife potential on roads especially for Project traffic.
- Install signage where specific wildlife concerns have been identified.
- 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, as required, to control dust.
- 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 fauna habitat.
- Waste management to reduce attractants to opportunistic wildlife species.

- 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 where weather conditions are less likely to cause excessive sound levels.
- Blasting will not occur on Saturdays, Sundays or holidays.
- If nighttime activities are required, temporary, downward directional lighting will be used.
- Vegetation management will be conducted by cutting (i.e., no use of herbicides).
- A Project Contingency Plan will be developed and will include site specific best management practices and mitigation methods associated with vegetation removal, dust suppression, progressive reclamation and re-vegetation of the quarry and a Wildlife Management Plan. The Project Contingency Plan will include methods by which the Project can take place while minimizing interactions with wildlife.

7.2.9.2 *Monitoring*

No monitoring is proposed for this VEC.

7.2.9.3 *Residual Effect and Significance*

Direct mortality to fauna from Project activities is possible but unlikely to occur and infrequent if it does. The potential for direct mortality will only occur during active work and the quarry will be operational sporadically when Dexter is awarded projects in the area or there is a demand for aggregate material.

Effects to fauna habitat as a result of the Project is limited because the habitat present in the Study Area is common to the regional area and available in the surrounding landscape. The geographic extent of alteration is small (8.75 ha) when compared to the vast expanse of available habitat in the vicinity. Furthermore, alterations will be made gradually over the lifetime of the quarry (~40 years) giving fauna the opportunity to adapt. Reclamation will allow the Project to be partially reversible as habitat will be restored progressively.

The activities likely to create the greatest sensory disturbance are blasting and crushing. These activities will only occur as required and is it anticipated that the expansion will only require one blast per year. During inactive periods sensory disturbance is reversed to baseline conditions as it will be post-reclamation.

The above-described mitigation measures will be implemented to reduce potential effects, therefore, no permanent alteration to habitat that supports fauna species distribution is expected as a result of quarry expansion. Due to this, no significant residual effects of the Project on fauna are anticipated.

7.2.10 Avifauna

Table 7-16 provides a summary of the potential environmental effects resulting from the Project-VEC interactions with birds. The table is divided according to each of the Project phases assessed (Construction, Operation and Maintenance, Reclamation as well as Accidents, Malfunctions, and

Unplanned Events). Interaction and potential effects have been divided into direct mortality of birds, alteration to habitat, and sensory disturbance. The discussion following the table provides an analysis of key Project-VEC interactions.

Table 7-16. Project- VEC Interactions by Project Phase on Birds

Project Activities and Physical Works	**Potential Project Interactions and Environmental Effect[1]**		
	Direct Mortality	**Habitat Alteration**	**Sensory Disturbance**
Construction			
Site preparation/clearing	Y	Y	Y
Grubbing	Y	Y	Y
Watercourse/Wetland Alteration	Y	Y	Y
Waste management	Y	N	N
Storage areas for grubbings and overburden soils	Y	Y	Y
Operation and Maintenance			
Rock blasting	Y	Y	Y
Handling and stockpiling material	Y	Y	Y
Crushing and screening	N	N	Y
Management of surface water	N	Y	N
Trucking/transport of product	Y	N	Y
Reclamation			
Re-grading of rock face	N	Y	Y
Reclamation/re-vegetation	Y	Y	Y
Accidents, Malfunctions and Unplanned Events			
Erosion and sediment control failure	N	Y	N
Fuel spill from machinery/trucks	Y	Y	N
Fire	Y	Y	Y
[1] Y - interaction / N - no interaction			

Potential quarrying effects on the VEC Avifauna are discussed in more detail below.

7.2.10.1 *Effects to Avifauna*

<u>Direct Mortality</u>

Direct mortality of birds is possible at the Project 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 hauling are two activities where birds could be struck or accidentally killed. There is no anticipated increase in either activity from quarry expansion. Direct and indirect mortality could result from short and long-term exposure to varying levels of contaminants or spills from incidents and accidents.

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 timeframe. Site preparation activities (clearing and grubbing) will remove vegetation that, in turn, will reduce the quantity and quality of avifauna habitat that currently exists in and around the QEA. This can result in the loss of nests, potentially cause nest abandonment, and/or disturbance to nest contents at sensitive times of the year. Rock 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 rock and overburden may attract ground-nesting birds, which 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 and ducks; however, the newly created settling ponds will be relatively small and reclaimed upon reclamation of the quarry. 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 help birds move back into the area. Lastly, incidents and accidents also have the potential to alter habitats used by birds.

Canada warbler were identified in WL1, where suitable breeding habitat is available. This wetland is being avoided by quarry expansion.

Bird species that currently use the habitat within the QEA will be displaced during the initial stages of construction, changes in habitat availability, and associated sensory disturbances. This could potentially cause direct mortality 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 edge. This could lead to decreased forest quality for species that rely on interior forest conditions (i.e., areas within a forest sheltered from edge effects), although such habitat is already limited due to historical forest management. 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 alterations will be permanent, and these alterations will not have a significantly negative impact on core habitat and similar habitat for avifauna is present in the surrounding landscape.

Sensory Disturbances

Sensory disturbance refers to the changes in ambient noise levels and the periodic vibrations caused by quarry activity. It 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* 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.

Sensory disturbance from noise can 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, 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 bird 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. While the quarry is active, the disturbance will primarily be observed during drilling and blasting periods only. Blasting is anticipated to occur once per year during operations.

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 behavioural 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.

7.2.10.2 *Mitigation*

The following mitigation measures will be included in the design of the Project to minimize effects to Avifauna:

- A Wildlife Management Plan will be developed as part of the IA application process.
- Avoid clearing during the breeding bird season (April 15 to August 30), where practicable. If avoidance is not possible, conduct nest sweeps prior to clearing.
- Should any ground- or burrow-nesting species initiate breeding activities within stockpiles or exposed areas, Dexter will avoid disturbance to these areas until chicks can fly and the nesting areas are no longer being utilized.
- Implement dust suppressants (e.g., water trucks), as required, to control dust.
- 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.
- Follow Pit and Quarry Guidelines (NSEDL, 1999) to reduce 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 completed by a qualified blasting professionsl
- 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 Saturdays, Sundays or holidays.
- 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.

- Clearing of vegetation associated with quarrying will be limited to areas where quarrying is imminent (i.e., within the next two years) in order to maintain intact habitat elsewhere across the unquarried portions of the QEA.

7.2.10.3 *Monitoring*
No monitoring is proposed for this VEC.

7.2.10.4 *Residual Effect and Significance*
Direct mortality to birds from Project activities is possible but unlikely to occur and infrequent if it does. The potential for direct mortality will only occur during active work and the quarry will be operational sporadically when Dexter is awarded projects in the area or there is a demand for aggregate material. Dexter will not conduct clearing activities during the breeding bird window (April 15 to August 30).

Effects to birds from Project activities associated with the proposed quarry expansion is limited due to the relatively small area of the Project footprint (8.75 ha) in relation to the natural surrounding area that will provide birds with alternative habitats. Although there is a loss of habitat associated with the quarry expansion for some species, habitat will be created for others. Furthermore, alterations will be made gradually over the lifetime of the quarry (~40 years) giving fauna the opportunity to adapt. Reclamation will allow the Project to be partially reversible as habitat will be restored progressively.

The activities likely to create the greatest sensory disturbance are blasting and crushing, which are temporary and short-term impacts. These activities will only occur as required and is it anticipated that the expansion will typically only require one blast per year. During inactive periods sensory disturbance is reversed to baseline conditions as it will be post-reclamation.

The mitigation measures described above will also be implemented to reduce potential effects that are likely to cause permanent alteration to habitat that supports avian species distribution. This includes adherence to the *Migratory Birds Convention Act*. Therefore, residual environmental effects of the Project related to birds are predicted to be not significant.

7.2.11 Priority Species

The following sections outline the priority species (and/or their habitat) that were identified within the Study Area. In total, three SAR and three SOCI were identified within the Study Area throughout the field survey program. The SAR include three bird species: Canada warbler, eastern wood pe-wee, and common nighthawk. The SOCI include a vascular plant, bird, and fish species: Bicknell's crane's-bill, killdeer, and brook trout, respectively.

Potential effects to SAR and SOCI are similar to those discussed for fish (Section 7.2.6), flora and lichens (Section 7.2.8), fauna (Section 7.2.9), and birds (Section 7.2.10). Refer to these sections for the VEC Interactions by Project Phase tables.

Priority Species Fish and Fish Habitat
Brook trout were captured in the one watercourse within the Study Area (WC1). Although not captured, this watercourse also contained suitable habitat for American eel. This watercourse is not within the QEA, a 30 m buffer is being maintained and quarry expansion is advancing southeast and away from the watercourse. Therefore, no direct impacts to priority species fish and fish habitat are expected from the Project.

Potential indirect impacts to priority species fish include reductions to water quantity, water quality and impacts from blasting (Refer to Section 7.2.6.2). A surface water monitoring plan will be developed to ensure there are no adverse effects to fish and fish habitat from quarry expansion.

Refer to Section 7.2.6 for additional details on potential impacts to fish and fish habitat.

Flora and Lichens Priority Species
No priority lichen species were observed within the Study Area.

Bicknell's crane's-bill was observed within the Study Area in cutover habitat. This plant is located within the QEA and will be lost during quarry expansion. No other priority vascular plant species were identified within the Study Area.

Refer to Section 7.2.8 for additional details on potential impacts to flora.

Fauna Priority Species
No priority herpetofauna species, nor their suitable habitat were observed within the Study Area and no priority mammals were observed within the Study Area. No unique habitat was identified within the Study Area for mammalian and herpetofauna SAR and SOCI that have been observed in the local region, and alternate habitat resource for these species is available during the construction and operational phase of this Project in surrounding areas.

NSDNRR confirmed that a bat hibernaculum exists <4 km northeast of the Study Area (Dr. D. Hurlburt, NSDNRR Manager of Biodiversity, Personal Communications, June 3, 2021). Vibrations from blasting has potential to result in disturbance of hibernating species such as bats. The vibrations, if strong enough, could result in the collapse of hibernaculum or cause changes to the microclimate of the hibernaculum. Vibrations from blasting could also result in the disruption of the hibernation of these species during the winter months and burning limited fat reserves (West Virginia Department of Environmental Protection, 2006). Blasting within 800 m of a hibernaculum may disturb hibernating bats (US Fish and Wildlife Service, 2014). The Project's Study Area is <4 km from the documented hibernaculum and the quarry is proposed to advance to the southeast and away from the hibernaculum, therefore, impacts from blasting to this feature are not expected. Additionally, there is no proposed increase in the number or frequency of blasts from current operations.

A wood turtle SMP exists on Keys Brook (WC1 is a tributary to this watercourse) and the ACCDC reported an observation of the species within 1.2 km of the Study Area. Within the Study Area, no suitable nesting or overwintering habitat was identified in WC1 nor were any wood turtle observations made during targeted wood turtle surveys or incidentally. Additionally, no snapping turtle or eastern painted turtle were identified, however, all three species may access and utilize areas within the Study Area seasonally.

Refer to Section 7.2.9 for additional details on potential impacts to fauna.

Avifauna Priority Species

One SOCI, killdeer, was identified within the QEA during the field evaluations. Development of the QEA will create more suitable nesting habitat for the species, therefore, no negative impact on this species is Projected.

Three SAR, Canada warbler, common nighthawk, and eastern wood-pewee were also identified within the Study Area.

Canada warbler observations were limited to WL1, in the southwestern extent of the Study Area, where suitable nesting habitat was also identified. Based on guidance from NSECC, WL1 has been designated herein as a WSS due to the presence of Canada warbler and supporting habitat, with final determination to be made by NSECC. The QEA will avoid this wetland and maintain a setback >125 m, therefore, no impact on this species is Projected.

Common nighthawk exhibit a degree of plasticity in nesting requirements including forest openings, bogs, and disturbed areas (COSEWIC, 2018). Like killdeer, development of the QEA will create more suitable nesting habitat for the species, therefore, no negative impact on this species is Projected.

Eastern wood-pewee were observed within the Study Area but not in association with suitable breeding habitat. Their preferred breeding habitat includes forest clearings and edges of deciduous and mixed forests (COSEWIC, 2012). There will be a loss of mixedwood forest within the QEA and laydown area of approximately 0.60 and 0.76 ha, respectively. This habitat is also found outside the QEA, within the Study Area and appears to be abundant in adjacent land (inferred based on aerial imagery). No significant impact on this species is Projected.

Refer to Section 7.2.10 for additional details on potential impacts to avifauna.

Progressive reclamation of the quarried areas will result in a positive effect on the habitat available for priority avifauna, involving the re-grading of the rock face, reclamation of land and vegetation across the Study Area, and reduction in overall habitat fragmentation associated with the Project.

7.2.11.1 *Mitigation*

Mitigation of effects to priority species are consistent with fish and fish habitat (Section 7.2.6.3), vegetative community, flora, and lichens (Section 7.2.8.3), fauna (Section 7.2.9.1), and avifauna (Section 7.2.10.2). The Project Contingency Plan (and associated Wildlife Management Plan) which will be created as part of the IA amendment process will raise awareness of the specific priority species identified and potential SAR that could be present to site personnel and provide recommendations for protective measures to be in place.

7.2.11.2 *Monitoring*

Proposed monitoring is consistent with fish and fish habitat (Section 7.2.6.3), vegetative community, flora, and lichens (Section 7.2.8.3), fauna (Section 7.2.9.1), and avifauna (Section 7.2.10.2).

7.2.11.3 *Residual Effects and Significance*

Due to the loss of Bicknell's crane's-bill as well as habitat to support the eastern wood-pewee, residual effects are anticipated. Although habitat for priority bird species will be lost within the QEA and the laydown area (8.75 ha total), this represents an small extent of the habitat that supports these species surrounding the QEA and in the greater landscape. The loss of habitat from the Project footprint will be temporary as the lifespan of the quarry is approximately 40 years. This site will be reclaimed and through natural succession, forestation of this area will likely occur.

The indirect impacts to all priority species (e.g., sensory disturbance on fauna) are temporary and reversible.

Overall, and in alignment with the residual effects and significance determination for each of the related VECs, the residual effects of this Project to priority species are expected to not be significant.

7.2.12 <u>Socioeconomic</u>

Quarry expansion has the potential to result in adverse effects on Socioeconomic conditions. Potential adverse effects on population and economy, land use and value, transportation, recreation and tourism, and human health are discussed below.

<u>Population and Economy</u>

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.

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 and the existing Lantz Quarry is present within this property. Reclamation of the quarry will return the site to pre-quarrying conditions, to the extent practicable (Section 2.8). 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.

Transportation
There is no proposed increase in truck traffic from the Project compared to existing baseline conditions, therefore, no additional adverse effects on transportation are anticipated as a result of the proposed Project.

Recreation and Tourism
The Project is not anticipated to have an adverse effect on recreation or tourism as no known tourist sites are located within or in proximity to the Project.

Human Health
The Project will generate noise and dust, 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 7.2.1 and Section 7.2.2 for additional details related to noise and air quality. Refer to Section 5.6.6 for quarry related mitigations for human health (e.g., gates, signage, and berms surrounding the quarry highwall).

7.2.13 Archaeological and Heritage Resources

Due to a low potential for archaeological resources, of either First Nations or European-descended origin within the Study Area, no direct or indirect impacts to Archaeological and Heritage Resources are expected as a result of the Project.

8 EFFECTS OF THE UNDERTAKING ON THE MI'KMAQ OF NOVA SCOTIA

Engagement has been completed with the KMKNO throughout the EA process and this engagement resulted in constructive dialogue relating to the Project and its potential impact on the surrounding environment and the Mi'kmaq of Nova Scotia. The ARIA concluded that there is low potential for First Nations archaeological resources on site. Dexter is committed to continued engagement with Mi'kmaq communities and organizations throughout the life of the Project. Dexter is also open to partnering with Mi'kmaq communities or organizations to assist with long term monitoring.

No Project related adverse effects on the Mi'kmaq of Nova Scotia are anticipated.

9 CONCLUSION

The EARD has been prepared to evaluate the effect of the Project on selected VECs, which includes a detailed assessment of baseline conditions and predicted impacts to each VEC. The VECs selected include:

- Noise
- Air Quality
- Surficial Geology, Bedrock Geology, and Topography
- Groundwater
- Surface Water
- Fish and Fish Habitat
- Wetlands
- Vegetative Community, Vascular Plants, and Lichens
- Fauna
- Avifauna
- Priority Species
- Socioeconomic
- Archeological and Heritage Resources

A summary of each VEC and Project interactions are outlined below.

Noise

Noise has the potential to affect residential receptors adjacent the Project as well as fauna and avifauna. Noise at the Project will be regulated by the Site Industrial Approval and *Pit and Quarry Guidelines*. No residential receptors were identified within 800 m of the QEA and there have been no known exceedances of blasting parameters at the existing quarry, 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 nor any change in timing expected. 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.

Air Quality
Air quality (dust) has the potential to adversely affect human health 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 for 15 years 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. 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.

Surficial Geology, Bedrock 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 Acid Rock Drainage (ARD)) and changes in surface water volume discharged downstream. Testing was completed and it was determined that there is negligible potential for ARD based on low sulphur concentrations. 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 and groundwater flow. 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 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) and no active wells were identified within 800 m of the QEA. Overall groundwater recharge is expected to remain unchanged from existing conditions, but groundwater flow paths may be locally disrupted. No significant residual environmental effects to groundwater quality and quantity anticipated, however, a groundwater monitoring program will be implemented to validate predictions.

Surface Water
One unnamed watercourse was delineated and characterized within the Study Area (WC1). WC1 originates outside of the western Aquatic Study Area boundary, flowing northeast under the Projects existing quarry access road via a culvert and continues to flow northeast to its connection with Keys Brook (818 m linear length). WC1 is a first order, low to moderate gradient watercourse that transitions from being ephemeral to intermittent and then perennial before dispersing into Keys Brook.

No direct effects to surface water features are expected and a 30 m buffer will be maintained around WC1. The mapped, upstream extent of WC1, as well as downstream in Keys Brook, are not expected to sustain a change in water quantity as there is minimal anticipated changes to their contributing drainage areas. Changes to water quantity within WC1 are predicted to occur downstream of the settling pond discharge location. Impacts to the morphological characteristics of this section of watercourse are possible, however, mitigation measures (e.g., infiltration trenches and/or soakaway pits) will be employed and a surface water monitoring program will be initiated to validate and manage potential increases in flow.

Fish and Fish Habitat

During fish surveys, brook trout (*Salvelinus fontinalis*; S3) were captured in the downstream reaches of WC1. Keys Brook has been documented by DFO to support Atlantic salmon – inner Bay of Fundy population (*Salmo salar* pop.1; SARA Endangered), however, no Atlantic salmon were identified during fishing surveys.

No fisheries resources were identified within the QEA. WC1, the sole watercourse identified within the Study Area, will be avoided by Project activities and a 30 m buffer will be maintained around this watercourse during quarry expansion. Unmitigated, WC1 may experience a permanent increase in streamflow to approximately 482 m^2 of brook trout and American eel habitat, which is the length of the delineated watercourse downstream of WC-1D multiplied by the average channel widths of Reaches 4 and 5, as measured during detailed habitat assessments. The increase in flow to the downstream extent of WC1 is not anticipated to have measurable impacts on Keys Brook, whose contributing drainage area remains relatively unchanged through quarry expansion. Mitigation measures (e.g., infiltration trenches and/or soakaway pits) will be employed to manage flow releases into WC1.

The predicted residual environmental effects of the Project on fish and fish habitat are assessed to be not significant. A Surface Water Monitoring Program will be designed to evaluate the potential changes in surface water runoff and water quality to fish and fish habitat. The protective mitigation measures and monitoring commitments will ensure impacts to fish and fish habitat do not occur as a result of quarry expansion.

Wetlands

Seventeen wetlands were identified within the Study Area, of which seven are located within or partially within the QEA. Treed swamps make up the majority of these wetlands (n=12) and the remaining five wetlands are bogs. Due to the observation of Canada warbler (*Wilsonia canadensis*, SARA Threatened, NSESA Endangered, S3B) and the availability of suitable breeding habitat within wetland 1 (WL1), it is expected that NSECC will classify WL1 as a wetland of special significance (WSS). No direct or indirect impacts are anticipated to WL1 from the Project.

Over the 40-year lifespan of the quarry, seven wetlands will be completely or partially altered. Indirect effects to downgradient wetlands have the potential to occur, however, the use of mitigation practices will greatly reduce this potential. 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. As a result, the predicted residual environmental effects to wetlands are assessed to be adverse but not significant.

Vegetative Community, Vascular Plants, and Lichens
The Study Area is comprised of a mosaic of mixedwood stands, softwood dominated stands, forested wetlands, and disturbed areas. Disturbed portions of the Study Area include the existing quarry footprint, access roads, and historic forestry activities. One Species of Conservation Interest (SOCI) vascular plant was identified, Bicknell's crane's-bill (*Geranium bicknellii*, S3). This plant is located 10 m southeast of the existing quarry face and will be lost due from Project expansion. No lichen priority species were identified within the Study Area.

The predicted residual environmental effects are assessed to be adverse, but 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 Species at Risk (SAR) vascular plants or lichen will be lost as a result of quarry development.

Fauna
Wildlife surveys found signs of snowshoe hare (*Lepus americanus;* S5), white-tailed deer (*Odocoileus virginianus;* S5), American red squirrel (*Tamiasciursus hudsonicus;* S5), North American porcupine (*Erethizon dorsatum;* S5), and red fox (*Vulpes vulpes;* S5). No priority fauna species were observed within the Study Area during the wildlife survey or incidentally.

Habitat will be lost as a result of the Project, but the habitat present in the QEA is common to the regional area and available in the surrounding landscape. The geographic extent of disturbance footprint is small (8.75 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 and is it anticipated that the expansion will only require one blast per year. During inactive periods sensory disturbance is reversed 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. Three Species at Risk (SAR), Canada warbler, common nighthawk (*Chordeiles minor*; SARA and NSESA Threatened, S3B), and eastern wood-pewee (*Contopus virens*; SARA Special Concern, NSESA Vulnerable, S3S4B), and one SOCI, killdeer (*Charadrius vociferus*; S3B) were identified during targeted surveys or incidentally.

Physical loss of bird habitat within the QEA, and the likely displacement of birds as a result of quarry expansion will occur but will be small in scale and is not expected to impact birds at a regional scale. Therefore, after mitigation measures have been implemented, the predicted residual environmental effects are assessed to be not significant.

Priority Species

Surveys were completed in WC1 for wood turtle (*Glyptemys insculpta*; SARA and NSESA Threatened, S2) because the wood turtle Special Management Plan (SMP) buffer exists on Keys Brook, ~200 m east of the Study Area. No wood turtle or other turtle species were identified during targeted surveys or incidentally.

The Atlantic Canada Conservation Data Center (ACCDC) identified a bat hibernaculum within 5 km of the Study Area. The Nova Scotia Department of Natural Resources and Renewables (NSDNRR) confirmed that the hibernaculum is <4km northeast of the Study Area. No potential hibernacula were identified within the Study Area and no bat species were observed, however, suitable maternity roosting habitat is present in snags within wetlands and in portions of the Study Area with more mature intact stands.

The Study Area is outside of mainland moose (*Alces alces americana;* NSESA Endangered, S1) concentration areas and core habitat for the species, therefore, no targeted surveys for mainland moose were completed.

In alignment with the residual effects and significance determination for fauna, avifauna, and vascular plants, the residual effects of this Project to priority species are expected to be not significant.

Socioeconomic

Quarry expansion has the potential to result in adverse effects on the following socioeconomic conditions; population and economy, land use and value, transportation, recreation and tourism, and human health:

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. A positive effect on the economy is anticipated from the Project.

The Project is located on private land owned by Dexter and the existing Lantz Quarry is present within this property. 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.

There is no proposed increase in truck traffic from the Project compared to existing baseline conditions, therefore, no additional adverse effects on transportation are anticipated as a result of the proposed Project.

The Project is not anticipated to have an adverse effect on recreation or tourism as no known tourist sites are located within or in proximity to the Project.

The Project will generate noise and dust, 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.

Archaeological and Heritage Resources

No significant archaeological features were identified within the Study Area during the field reconnaissance study. The Study Area was determined to be of low potential for archeological resources of either First Nations or European-descended origin and therefore, no direct or indirect impacts to archaeological or heritage resources are expected as a result of the Project.

Summary

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 utlizing an adaptive management approach.

Monitoring

Dexter commits to developing the following monitoring plans:

- Surface Water Monitoring Plan
- Groundwater Monitoring Plan
- Wetland Compensation and Monitoring Plan
- Blast monitoring

These plans will be developed to meet EA approval terms and conditions and will be submitted as part of the IA amendment process.

Additional Commitments

Dexter commits to the following additional commitments:

- Ongoing engagement with First Nation communities and organizations and the public throughout the life of the Project.
- Development of a Surface Water Management Plan
- Development of a Final Reclamation Plan
- Development of a Wildlife Management Plan
- Development of a Contingency Plan

The plans noted above will be developed to meet EA approval terms and conditions or as part of the IA amendment process.

10 LIMITATIONS

Constraints Analysis

- On some maps, land use or land cover is defined everywhere to form a complete mosaic of polygons. On topographic maps landuse/landcover is depicted only in certain areas. The source data in some cases may need to be conditioned to allow the second type of depiction if it is a mosaic, and certain constraints will operate differently in each case, and,

- Conflicts that might exist between objects in a database are typically of a logical nature, such as topological inconsistencies or duplicate identifiers. We attempted to ensure that our database has addressed any potential inconsistencies, however inconsistencies may still occur. In map generalization, the vast majority of conflicts are physical, spatial consequences of reducing map scale. The greater the degree of scale change, the more cluttered an un-generalized map will be, and this signals the extents of potential conflicts in presentation of the data.

<u>Limitations incurred at the time of the assessment include:</u>

- MEL has relied in good faith upon the evaluation and conclusions in all third-party assessments. MEL 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 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 areas in question, have not been included in this assessment; and

<u>General Limitations incurred include:</u>

- Classification and identification of soils, vegetation, wildlife, and general environmental characteristics (i.e. vegetation concentrations, and wildlife 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
- 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.

11 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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